COGNITIVE CURATION:
THE METU CAMPUS AS A DISPLAY OBJECT

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ABSTRACT

COGNITIVE CURATION
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The aim of this study is to present a contemporary approach to the process of archiving, preserving, and displaying the architecture of the campus of Middle East Technical University. Considering the process as a form of reproduction of architecture, the methodological term "cognitive curation" is introduced. As the term itself suggests, cognitive curation blends architecture with concepts borrowed from both cognitive and curatorial studies. While cognitive studies help to interpret the architectural ideas of campus architects, curatorial studies provide a narrative for this interpretation process. The application of cognitive curation in this study is undertaken within three phases: data collecting, model collection, and program display. Each cognitive-curatorial phase yields an evaluation of the campus as a display object and reproduces its architecture through comprehensive, collaborative, transdisciplinary, and computationally engaged architectural simulations.

Keywords: Architectural cognition, curating architecture, display, simulation, campus architecture

ÖZ

BİLİŞSEL KÜRATÖRLÜK: GÖSTERİM NESNESİ OLARAK ODTÜ KAMPÜSÜ

Erkoç, Damla Nur
Yüksek Lisans, Mimarlık
Tez Yöneticisi: Prof. Dr. Ayşen Savaş

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Çalışmanın amacı, Orta Doğu Teknik Üniversitesi yerleşke mimarisini arşivleme, koruma ve sergileme sürecine güncel bir yol sunmaktır. Çalışma, bu süreci mimarlığın bir yeniden üretim biçimi olarak düşünerek, metodolojik bir terim olan “bilişsel kuratörlüğü” tanıtıyor. Bilişsel kuratörlük adından anlaşılacağı üzere, mimarlığı bilişsel ve kuratoryal çalışmalardan öğrenilen kavramlarla işler ve harmanlar. Bilişsel çalışmalar kampüs mimarlarının mimarı fikirlerinin anlamlandırılmasına yardımcı olurken, kuratoryel çalışmalar bu anlamlandırma süreci için bir anlatı sağlayacaktır. Çalışma bilişsel kuratörlüğün uygulanması için üç faz tanımlanıyor: veri toplama, örnek koleksiyon ve yazılım gösterimi. Her bilişsel-kuratoryel faz, kampüsü bir görüntüleme nesnesi olarak değerlendirir ve mimarisini kapsamlı, katılımcı, disiplinler arası ve hesaplamalı mimarı simülasyonlarla yeniden üretir.

Anahtar Kelimeler: Mimarı biliş, mimarı kuratörlük, gösterim, simülasyon, yerleşke mimarisi

To all whom I consider as my family & to the memory of my uncle,

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TABLE OF CONTENTS

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

CTM: Computational Theory of Mind

RTM: Representational Theory of Mind

CRUM: Computational-Representational Understanding of Mind

NN: Neural Network

DNN: Deep Neural Network

GCN: Graph Convolutional Network

GAN: Generative Adversarial Neural Network

AI: Artificial Intelligence

ML: Machine Learning

DL: Deep Learning

SOFP: Self-organizing Floor Plans

CHAPTER 1

INTRODUCTION

This work is the outcome of an ongoing project initiated by the Getty Conservation Institute's "Keeping It Modern" project, focused on the building of the Faculty of Architecture of Middle East Technical University (METU) and interrelated graduate courses given via the Master of Architecture program at METU between 2016 and 2020.[1] It aims to reproduce the architecture of the METU campus by "cognitive curation," which is a methodological proposal for the process of archiving, preserving, and displaying architecture. In order to offer a contemporary approach to reproduction, this study refers to both cognitive and curatorial studies. Cognitive studies help to interpret campus architects' mental processes of thinking, representing, and practicing architecture, while curatorial studies offer a narrative to follow the traces of mental processes during the design process.

1.1 Background Information

The comprehensive design of the METU campus is one of the greatest symbols of modernism in Turkey. Its architects, Altuğ Çinici and Behruz Çinici, won the competition for the campus design held in 1960. The university, founded in 1956,

[1] These courses are Arch 524 Architecture and Different Modes of Representation, Arch 505 Advanced Architectural Design Research, and Arch 571 Directed Studies in Environmental Design. The study also benefited from international and national exhibitions organized within the main overarching "Conservation by Documentation" and "Conservation by Creating Awareness" policies of the project.

moved to its current location[2] when the first building, that of the Faculty of Architecture, was constructed there in 1963. Both the campus culture and the presence of the METU society are largely attributable to the architectural integrity of the campus. With a "tamed landscape" and modern architectural elements that impact society, the campus is a powerful symbol of modernism and its design is considered modern architectural heritage.[3]

The idea of displaying the architecture of the METU campus in this study was developed from the traveling exhibition "Representing Itself," which is also within the scope of the ongoing "Keeping It Modern" project initiated by the Getty Conservation Institute. Within the framework of the main overarching policies of the project,[4] many international and national exhibitions[5] were organized by Prof. Dr. Ayşen Savaş with the contributions of graduate students of the Faculty of Architecture at METU. In addition, in the context of graduate course ARCH 524 Different Modes of Representation, this study adopts the position that viewing modern architecture through the processes of archiving, preserving, and displaying is itself a form of reproducing architecture.

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[2] The METU campus is located in the southwest of Ankara and encompasses approximately 4500 hectares with an additional 3043 hectares of forest area. Lake Eymir and its natural habitat are also located in the area of the campus, 15 kilometers away from the center, providing students a location for water sports, scientific studies, and leisure.

[3] Güven Arif Sargın and Ayşen Savaş, "'A University Is a Society': An Environmental History of the Metu 'Campus,'" *The Journal of Architecture* 18, no. 1 (2013): pp. 79-106, https://doi.org/10.1080/13602365.2012.751806.

[4] "Conservation by Documentation" and "Conservation by Creating Awareness."

[5] Among these exhibitions, the following specifically form the basis of the present thesis: SALT-Commissioners' Exhibition (March 2018), Representing Itself | METU Faculty of Architecture (January 2019), and TU Delft Research Week Campus Exhibition (May 2019).

1.2 Problem statement

Referring to reproduction in general, there is a recognition that conventional resources are no longer the main medium for the collection, storage, retrieval, and use of information. Elementicularly in the process of information retrieval, the information environment has become remotely accessible from anywhere, not physically limited to archives and libraries. Reproduction in a technological space becomes more complex and crucial. Similarly, in architecture, the conventional media for archiving, preserving, and displaying architecture make its reproduction impossible. In the case of the METU campus as modern architectural heritage, it was documented specifically to the Faculty of Architecture Complex in the scope of the Keeping It Modern Project in 2020. Within that project, the medium of the research was proposed as heritage building information modeling (HBIM)[6] and the outcomes of the research included 3D HBIM as well as conventional media such as publications, exhibitions, and workshops.[7] Although HBIM achieves the transformation of architectural information in an accessible single model, it is not sufficient to convey the architectural relationships between architectural information.

[6] The premise of building information modeling (BIM) regarding data on architecture, engineering, and management provides the potential to import information directly from existing analytical models. BIM models go beyond the storage of relevant information and enable automated geometry and design, layout, and documentation of repeating elements and provide coordination across disciplines. In the Keeping It Modern Project, the scope of BIM has been expanded to support heritage information.

[7] A.Savaş, B.Derebaşı, İ.Gürsel Dino, S.Sarıca, S.İnan, Ş.Akın, "Research and Conservation Planning for the METU Faculty of Architecture Building Complex by Altuğ-Behruz Çinici, Ankara, Turkey", Keeping It Modern Project Report, Getty Foundation, 2018.

1.3 Research Objective

This study seeks a responsive and contemporary approach to displaying the architecture of the METU campus and thus making architectural reproduction possible. In other words, this work develops a contemporary medium for the collection, storage, retrieval, and usage of architectural information. As a continuation of the HBIM research method, in the context of the Keeping It Modern Project, the study expands the digital borders. It aims to provide a comprehensive method that activates individuals, guiding them to draw their own conclusions with accessible architectural information. The HBIM method provides a process of decoding architectural information digitally regarding the Faculty of Architecture, and this study accordingly proposes a process that accommodates both processes of coding the architectural information of the METU campus.

1.4 Research Scope

This study addresses the decoding and encoding of existing architecture as a form of "curating architecture." For this reason, the METU campus as the research object is referred to here as an architectural "display object."[8] As its name suggests, this study requires background in conventional curatorial studies and related terms such as "narrative," "exhibition," and "display" to be applied in contemporary curatorial practice. At the same time, the study requires a contemporary decoder and encoder for curating architecture. For this, it applies cognitive studies to understand architects' mental processes in the design process. Acknowledging such a need for

[8] Martin Beck, "The Exhibition and the Display," in *Exhibition*, ed. Lucy Steeds (Cambridge, MA: MIT Press, 2014). Martin Beck claims that exhibition was a static medium for mass communication, developed during the second half of the nineteenth century. In the early twentieth century, display was an active, representative, informative, and sometimes commercial strategy of exhibiting works of art. Even though both terms refer to the same interwoven environment today, it is more appropriate to address the object of the study, the METU campus, as "the display object."

the blending of studies from different disciplines enables a broad conceptual framework in the research. In order to narrow the focus, the reproduction of the architecture of the METU campus was considered in association with cognitive studies for a computable approach to decoding and encoding architects' underlying design approaches and curatorial studies for describing the way from decoding to encoding. Moreover, in order to construct a theoretical and methodological background, this study also refers to core disciplines linked to cognitive and curatorial studies such as philosophy, computer science, and neuroscience (Figure 1.1).

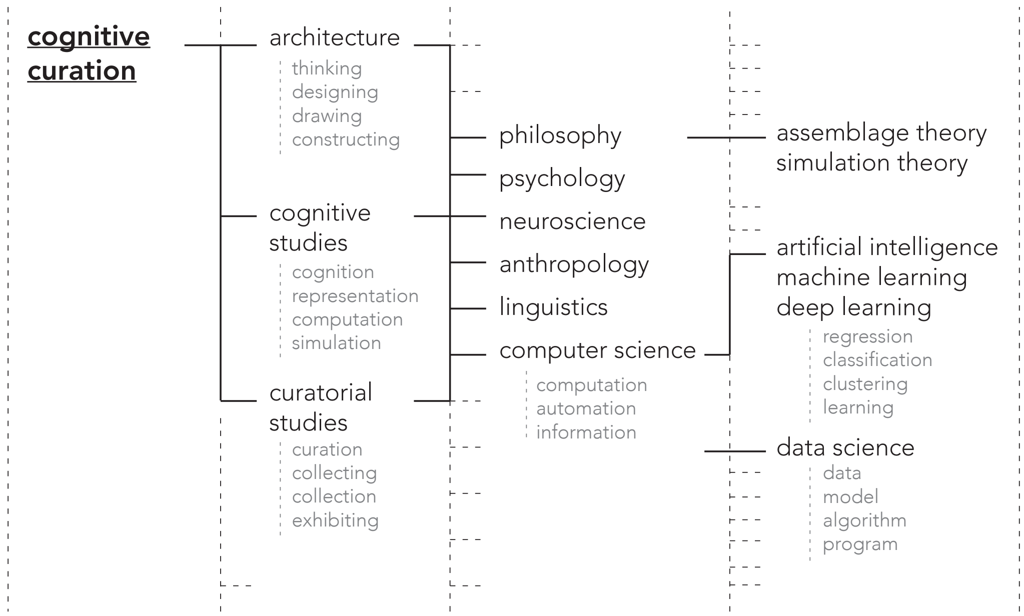

Figure 1.1. Transdiscipliner scope of the study[9]

[9] Produced by the author.

1.5 Interrelated Studies

While this study entails the expectation that cognitive studies will extract the campus architects' mental processes of thinking, representing, and practicing architecture, there is also a need to narrate those mental processes, and this need can be met by curatorial studies. In this context, the present study, which considers the process of reproduction of architecture as curation, utilizes the trilogy of curation: collecting, collection, and display. In the literature, collecting practices are cited as a starting point of curation.[10] According to Sharon Macdonald, a British anthropologist and museologist, curatorial collecting is intended to understand manifestations and flourishings in specific historical and cultural contexts. She extends this by describing the binary relationship between collecting and collection. A curatorial collection develops with the awareness that a collection will emerge in the end. Regarding the etymological root of "curation," Hans Ulrich Obrist, a Swiss curator, explains where both "curator" and "curation" came from in his book entitled *Ways of Curating*.[11] Obrist's explanation helps this study in conceptualizing curation as well. Finally, this study points to the spatialization of curation, namely exhibiting. Since the contemporary curating to be carried out in this study will not have a space, it must be understood what has been internalized with a space and not lost in the new method.

Looking at the extent of cognitive curation, there are several major disciplines – philosophy, psychology, neuroscience, anthropology, linguistics, and computer science– and four main terms –cognition, representation, computation, and simulation– that dominate the field. Cognitive science applies these disciplines and

[10] Sharon Macdonald, "Collecting Practices," in *A Companion to Museum Studies*, ed. Sharon Macdonald (Oxford, UK: Blackwell Publishing, 2006), pp. 81-90.

[11] Hans Ulrich Obrist and Raẓā Asad, "Curating, Exhibitions and the Gesamtkunstwerk," in *Ways of Curating* (New York: Farrar, Straus and Giroux, 2016), pp. 25-35.

terms to understand the human mind's processes between thinking and behaving. As this study aims to decode existing architecture and encode it, it is necessary to reinterpret the mental processes of the campus architects in thinking, representing, and producing architecture. In efforts to understand the human mind, cognitive studies first define cognition as the mental processes of the human mind in between human thought and behavior. They subsequently mimic cognition by "representation" and "computation" with "simulation."[12] The cognitive premise stated here has the potential to be applied to architecture with similar mental processes. Thus, akin to other cognitions, architectural cognition can be located in between architectural thought and behavior, and with architectural representation and computation, architectural cognition can be mimicked or reproduced through architectural simulations.

1.6 Research Method

The selection of the research area in terms of both cognition and curation provides the methodology as well as the method's name of "cognitive curation." The method applied in this study blends architecture with interrelated disciplines. It operates based on the transformation of architectural information into architectural data. In order to make the collected raw data meaningful, it structures the architectural data of the campus with the help of methodological data structure alternatives. The aim here is to decode the existing architecture with representational-computational models that include representations of and computations among the structured architectural data of the campus. Architectural unity is then encoded with computable models in a program to test the models with simulations. Thus, the three borrowed terms of "data," "model," and "program" are used to construct computable

[12] Paul Thagard, "Representation and Computation," in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), pp. 1-32.

"architectural simulations" as a form of the encoded modern architectural integrity of the METU campus.

1.7 Academic Relevance

There are few resources devoted to the relationship between curating architecture and cognitive science. For this reason, the present study is intended to contribute to the collaboration of architecture and other related disciplines in terms of decoding and encoding existing architecture. In this respect, this study addresses a significant gap in the literature. Simultaneously referring the academic publications about conservation and preservation of the METU campus, this study guides a new dimension to curating architecture of the METU campus.

1.8 Thesis Structure

The textual core of this study is presented in Chapter 2, which explains the scope of the method for curating the architecture of the METU campus and blended concepts. Building on those initial elements of the chapter, the final element defines cognitive curation, this study's method, together with its purpose, tools, phases, and interrelated concepts from curatorial-cognitive studies. The following chapters present the phases of the application of cognitive curation. The titles of the chapters, "Data Collection", "Model Collection", and "Program Display", come from the two interrelated concepts involved in the method of cognitive curation.

For the first phase of cognitive curation, data collecting, this study introduces data-driven terms[13] from the so-called emerging field of "data science" and transforms architectural information related to campus architecture into architectural data.

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[13] John D. Kelleher and Brendan Tierney, "What Are Data, and What Is a Data Set?," in *Data Science* (Cambridge, MA: MIT Press, 2018), p. 1-40.

However, collecting data from the architectural integrity of the campus necessitates a decoder to disassemble the architectural unity first. For this, the present study revisits the analysis of complexity in the unity through architectural elements and relationships. With the help of this division, this study approaches the architecture of the METU campus as an architectural unity that has strongly connected architectural elements and architectural relationships. Thus, it is understood that the data about the fixed architectural elements should be collected first so that the flexible relationships between elements can be extracted. In order to structure and organize the collected raw data about the architectural elements, this study proposes data classification. For this, it looks at the conventional practices in the process of curating architecture, such as conventional exhibitions, to find a contemporary approach. However, conventional classification in exhibitions produces separate raw data. To resolve that, this study applies a computable clustering method (k-means clustering). With this way, the existing similarities and contrasts between architectural elements and/or those that do not appear even though they exist may be acknowledged. After structuring the data of the architectural elements with classes, they are listed to see all possible architectural relationships between architectural elements. Therefore, Chapter 3 presents three acts for the data collection process in cognitive curation: disassembling, clustering, and listing.

The second phase of cognitive curation is portrayed in Chapter 4 as model collection. In this phase, the study benefits from a cognitive theory known as computational-representational understanding of the mind (CRUM),[14] which represents computable methods for imitating specific cognitive tasks of the human mind such as designing and problem-solving. CRUM provides different these kinds of representational-computational models to the study. For this reason, cognitive curation transforms all architectural elements (or elements) of the METU campus into "representational

[14] Paul Thagard, "Representation and Computation," in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), p. 6.

structures" in order to resolve the "computational procedures" of architectural relationships (or relationships) in the computable models so that the collected data can be processed in the computer environment.

The study then applies appropriate computable models for the selected areas of the METU campus, considering the campus educational zone for the campus scale, the Faculty of Architecture building complex for the building scale, and the METU lodging for the unit scale. The phase explored in Chapter 5, addressing program display, is closely connected to the previous phases. The representational structures of architectural elements and the computational procedures of architectural relationships, or, in other words, computable models, are simulated with software programs in virtual environments that resemble a kind of alternative campus architects' thinking. The programs by which the computational models are tested to determine whether they can actually produce the METU campus or not constitute the architectural simulation of the architectural cognition of the campus architects. For this, different programs are used to test the two different area on the METU campus, using magnetizing floor plan generator program[15] for the Faculty of the Architectural building complex, and wasp discrete aggregation[16] for the METU lodgings.

In Chapter 6, with the help of a literature review on curatorial and cognitive studies, a methodology is constructed for decoding and encoding the architectural unity of the METU campus. According to the methodological application, this study claims that the campus still generates theoretical, computational, and data-driven[17] architecture through cognitive curation.

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[15] Gavrilov Egor et al., "Computer-Aided Approach to Public Buildings Floor Plan Generation. Magnetizing Floor Plan Generator," *Procedia Manufacturing* 44 (2020): pp. 132-139, https://doi.org/10.1016/j.promfg.2020.02.214.

[16] Andrea Rossi, " WASP - A COMBINATORIAL TOOLKIT FOR DISCRETE DESIGN," Food4Rhino, 2019, https://www.food4rhino.com/en/app/wasp.

[17] This is a new scientific paradigm for the so-called discipline of data science.

CHAPTER 2

COGNITIVE CURATION

The aim of this chapter is to conceptualize the proposed method for curating architecture. For this, the act of curating will be examined from literature for the study's display object (2.1). Then, in order to propose a contemporary interpretation of curating architecture of the METU campus and to theorize the computable imitations of mental processes of the campus architects', cognitive theories about the human mind will be explored and rationalized for architecture (2.2). Lastly, the method's purpose, tools, phases, and interrelated concepts from curatorial-cognitive studies will be constructed (2.3).

2.1 Evolution of Curating Architecture

This element of the chapter extends the "curation" in line with etymological, theoretical, and curatorial studies. The review of conventional curatorial theories and practices is considered an essential condition to propose a new one. For this reason, the first focus is the overall processes of curation (2.1.1). And, the second focus is the meeting of the curation with a space, the process of exhibiting/displaying (2.1.2). As a result, the study, which describes the decoding and encoding of the campus's architecture as a form of curation, internalizes the conventional curatorial background.

2.1.1 Trilogy of Curation

In the twenty-first century, curation has cumulatively enriched its own ideas, purposes, tools, and networks among related fields such as art, architecture, and museology. At the same time, its definition had to be changed. The current dictionary definition is associated with the activities of collecting, selecting, and taking care of objects.[18] In order to comprehend the concept of curation, these activities must be evaluated. The chapter entitled "Collecting Practices" in the book "A Companion to Museum Studies" by Sharon Macdonald is helpful in understanding the curatorial activity of collecting.[19] According to Macdonald, British anthropologist and museologist, extends this activity by referring to the binary relationship between *collecting* and *collection* with the following words:

> "…Collecting, according to this perspective, should be seen as a practice in which the intention is to create a collection; and a collection in turn is a set of objects that forms some kind of meaningful though not necessarily (yet) complete "whole." Although delimiting "collecting" to activities intended to form "a collection" might at first seem tautologous, it serves to identify a distinctive type of object-oriented activity in which items are selected in order to become element of what is seen as a specific series of things, rather than for their elementicular use-values or individualized symbolic purposes."[20]

The intention of making a *collection* and the intention of *collecting* objects are relational and cannot be separated in the concept of curation. In addition, there is also the term *collector,* which etymologically derives from *collecting*. Before curating became a profession, curators were called as *collectors*. However, the

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[18] Cambridge online dictionary: https://dictionary.cambridge.org/dictionary/english/curation

[19] Sharon Macdonald, "Collecting Practices," in *A Companion to Museum Studies*, ed. Sharon Macdonald (Oxford, UK: Blackwell Publishing, 2006), pp. 81-90.

[20] Ibid, 81.

curator does not etymologically derive from the *collector* as the root of the word. About its root, Hans Ulrich Obrist, a Swiss curator, explains where the *curator* and curating came from in his book "Ways of Curating":

> "Being a curator is considered to be a fairly new profession. The activities it combines into one role, however, are still well expressed by the meaning of its Latin etymological root, *curare*: to take care of. In ancient Rome, *curatores* were civil servants who took care of some rather prosaic, if necessary, functions: they were responsible for overseeing public works, including the empire's aqueducts, bathhouses and sewers. In the medieval period, the focus shifted to a more metaphysical aspect of human life; the *curatus* was a priest who took care of the souls of a parish. By the late eighteenth century, curator came to signify the task of looking after a museum's collection. Different kinds of caretaking have sprung from this root word over the centuries, but the work of the contemporary curator remains surprisingly close to the sense in *curare* of cultivating, growing, pruning and trying to help people and their shared contexts to thrive."[21]

The etymological root and the history of the term *curator* thus add the activity of caring to the definition of *curation*. However, the associated activities of selecting, collecting, making a collection, and caring are not enough to provide the definition of curation. To define that word, this study unfolds how a *collection* forms a composition with a space. Therefore, another activity of curation may be curating an exhibition.

Exhibitions are narrative environments that mediate among collecting, collection, and space. With spatialization through narrative, an exhibition encourages engagement and evokes an experience. In addition to this, an insightful statement

[21] Hans Ulrich Obrist and Raẓā Asad, "Curating, Exhibitions and the Gesamtkunstwerk," in *Ways of Curating* (New York: Farrar, Straus and Giroux, 2016), pp. 25-35.

about the comprehensive role played by exhibition space is offered in "Reshaping Museum Space: Architecture, Design, Exhibitions" by Suzanne MacLeod:

> "The museum as a space with so much narrative potentials, so as to speak, inherently full of voids: temporal gaps between some other past and our own presents, geographical gaps between remote controls, cultural gaps between opposing world views, societal gaps between different group of visitors, professional gaps between various occupations involved in museum fabrication, physical gaps between the diverse media employed in museum. Narrative is so pervasive and promising as a mediating strategy precisely because it allows us to bridge these gaps."[22]

Bridging all these gaps requires much more than a sequential narrative among collecting, collection, and space. With the contributions of poststructuralist thinkers such as Lyotard and Foucault, space evolved to be more comprehensive in terms of its narrative potential. Sub-relationships or sub-narratives are established to enrich and bring *meta-narratives* to the exhibition space.[23] As MacLeod implies, textual, spatial, architectural, and societal forms of narrative anchor the content to the context.[24] For instance, to explore forms of narrative, Laura Hourston Hanks compares two display environments in her article entitled "Writing spatial stories: textual narratives in the museum": the Anne Frank House and Orhan Pamuk's Museum of Innocence.[25] The former is the space in which Anne Frank wrote her literal texts, and visitors experience those texts with the author's spatial narrative.

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[22] Suzanne MacLeod, "Introduction," in *Reshaping Museum Space: Architecture, Design, Exhibitions* (London: Routledge, 2006), pp. 16-17.

[23] The term "meta-narrative" is used here in the sense of poststructuralist philosopher Lyotard.

[24] Suzanne MacLeod, "Reshaping Museum Space: Architecture, Design, Exhibitions," in *Reshaping Museum Space: Architecture, Design, Exhibitions* (London: Routledge, 2006), pp. 16-17.

[25] Laura Hourston Hanks, "Writing Spatial Stories: Textual Narratives in the Museum," in *Museum Making: Narratives, Architectures, Exhibitions*, ed. Suzanne Macleod, Laura Hourston Hanks, and Jonathan Hale (Abingdon, Oxon: Routledge, 2012), pp. 22-23.

The latter is the spatialization of a textually narrated novel by Orhan Pamuk. The textual narrative in the Museum of Innocence now appears as a sub-narrative and it transformed into a spatial narrative.

Exhibitions and exhibition spaces now display the collecting, the collection, and even the space where an exhibition will occur. Hal Foster, who evaluates spatial practices of curation in museums after the 1980s, states that museums and their exhibition spaces in the twentieth century have turned into showrooms. They represent their magnificence and host artworks detached from their contexts, rather than curating with narrated architectural space. To illustrate, Foster refers to Richard Serra's site-specific artworks in the Guggenheim Museum Bilbao as having lost their own properties and calls them "imprisoned art."[26] Discussions of exhibition space as a tool in curating are also touched upon in the chapter entitled "Function of Architecture" in "Thinking About Exhibitions". According to author, Reesa Greenberg, the exhibited object rejects imprisonment in exhibition space and requires a dialectic implication with that exhibition space."[27]

As articulated with an order that begins with collecting, continues with making a collection, and ends with exhibiting, the present study evaluates curation according to this trilogy. It defines the curation of campus architecture with a contemporary form. For this reason, exhibition is not responsive to the process. According to the article "The Exhibition and the Display" by Martin Beck in an anthology book named "Exhibition",[28] exhibition was a static medium for mass communication that developed in the second half of the nineteenth century. In the early twentieth century,

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[26] Hal Foster, *Tasarım Ve Suç: Müze - Mimarlık - Tasarım*, trans. Gen Elçin (Fatih, İstanbul: İletişim Yayınları, 2015).

[27] Reesa Greenberg et al., "Function of Architecture," in *Thinking About Exhibitions* (London: Routledge, 2010), pp. 221-230.

[28] Martin Beck, "The Exhibition and the Display," in *Exhibition*, ed. Lucy Steeds (Cambridge, Massachuseets: The M.I.T. Press, 2014).

display was an active, representative, informative, and sometimes commercial strategy of exhibiting works of art.[29] With respect to this explanation, this study will use displays for exhibitions. Thus, this study requires a process that follows that triology of curation with collecting, collection, and display for curating architecture of the METU campus.

2.1.2 Architectural Display with/without a Space

Curatorial theories have been associated with many other disciplines such as art, architecture, and information science. Although other disciplines offer various approaches and give new dimensions to curation, they simultaneously imply some handicaps in the extension of curation. For instance, the artist-based curational group Raqs Media Collective explains the effects as follows: "Curating as an artist creates a conflict between the subjectiveness of art practice and the objectiveness of curation."[30] Curating artistically consumes the curation and the end product represents itself as an object of art. Elena Filipovic supports the same point of view in "When exhibitions become form: On the history of the artist as curator."[31] She states that despite the fact that curators had aims and responsibilities quite distinct from artists, the understanding of the term "curation" radically shifted with Duchamp. She strengthens this claim by giving the example of Duchamp's well-known work entitled "Fountain" (Figure 2.1):

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[29] Even though both terms refer to the same interwoven environment today, it would be more appropriate to address object of the study, METU Campus, as "the display object".

[30] Raqs Media Collective, "On Curatorial Responsibility," in *Exhibition*, ed. Lucy Steeds (Cambridge, MA: MIT Press, 2014), pp. 100-101.

[31] Elena Filipovic, "When Exhibitions Become Form: On the History of the Artist as Curator," in *Exhibition*, ed. Lucy Steeds (Cambridge, MA: MIT Press, 2014), pp. 156-157.

> "Many artist curated exhibitions -perhaps the most striking and influential of the genre- are the result of artist treating the exhibition as an artistic medium in its own right, an articulation of form although the profession of the curator was hardly very defined or prevalent when Duchamp first began to adopt curatorial operations as element of his artistic practice, the notion progressively became concretized in the half century during which he worked, solidifying into its present-day sense describing an art and its public exhibition."[32]

Figure 2.1. Fountain by Marcel Duchamp[33]

Similarly to the writings of the Raqs Media Collective and Elena Filipovic, Daniel Buren's article "Exhibiting exhibitions" manifests a focus shifted onto exhibition as

[32] Ibid, 157.

[33] Photographed by author, Tate Modern, 2020

well. Buren asserts that the subjects of exhibitions turned into exhibitions of exhibitions as works of art.[34]

Besides artist-based curators, curating by architects is another example. Akin to artists, architects do not hesitate to project their professional qualifications onto curation. Kayoko Ota refers to this in "Curating as architectural practice." Ota illustrates how OMA's architectural exhibitions could be evaluated as sites where architecture is seen and talked about and where architectural thinking is applied to non-architectural matters such as curation.[35] Likewise, in exhibitions organized with artist curation, architects address exhibitions as architectural objects. On the other hand, curation has become integrated with the humanities disciplines. Scientists exert immense efforts to improve their so-called digital curation. In "Digital Curation in Digital Humanities: Preserving Archival and Special Collections", Arjun Sabharwal semantically conceptualizes and differentiates curatorial activities in digitized environments by referring to an e-science report:

> "Curation: The activity of, managing and promoting the use of data, from its point of creation, to ensure it is fit for contemporary purpose, and available for discovery and re-use. For dynamic datasets this may mean continuous enrichment or updating to keep it fit for purpose.
>
> Archiving: A curation activity which ensures that data is properly selected, stored, can be accessed and that its logical and physical integrity is maintained over time, including security and authenticity.

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[34] Daniel Buren, "Exhibiting Exhibition," in *Exhibition*, ed. Lucy Steeds (Cambridge, MA: MIT Press, 2014), p. 43.

[35] Kayoko Ota, "Curating as Architectural Practice," *Log*, no. 20 (2010): 141-149. Accessed July 6, 2021. http://www.jstor.org/stable/41765383.

> Preservation: An activity within archiving in which specific items of data are maintained over time so that they can still be accessed and understood through changes in technology."[36]

In light of curatorial definitions for the humanities, this study focuses on the twenty-first century's concerns of curation: discovery, re-use, and accessibility.

In the relevant literature, studies on curating architecture consist of critiques of the spatialization of curating architecture, or, in other words, of architectural exhibitions. To illustrate, in "Curating architecture with architecture," Eve Blau asserts that an architectural exhibition is not only an event for the consumption of something exhibited but also an event for the interactive reproduction of ideas, architecture, and human interactions. Curating an architectural exhibition, in this context, entails staging the conditions that make the production possible.[37] That production in the exhibition locates the museum, gallery, or any other location within this definition and it can thus be evaluated as "spatial praxis." With a similar approach, Tina di Carlo defines curating an architectural exhibition as a form of spatial praxis. She asks a question to emphasize curating architecture rather than exhibiting objects:

> "…if the exhibition entered as the primary and artistic spatial construct of our day; and if the curator's medium is now space and things, the perhaps the most pressing curatorial question of the day is not what can be exhibited but what can be done. In architectural terms: What does one purpose?"[38]

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[36] Arjun Sabharwal and Arjun Sabharwal, "Foundational Definitions for Curation," in *Digital Curation in the Digital Humanities Preserving and Promoting Archival and Special Collections* (Amsterdam (Holanda): Elsevier, 2015), pp. 12-15.

[37] Eve Blau, "Curating Architecture with Architecture", *Log*, no. 20 (2010): 141-149. Accessed March 12, 2020. www.jstor.org/stable/41765383.

[38] Tina Di Carlo, "Exhibitionism." *Log*, no. 20 (2010): 151-58. Accessed March 12, 2020. www.jstor.org/stable/41765385.

Di Carlo's article addresses exhibition as a discursive event, emerging from many different disciplines. She argues that an exhibition is no longer contained in space; rather, it is constitutive of and constituted by space. Exhibition is architecture; architecture is exhibition. It is a reflective mirror proposing what Foucault calls "heterotopic space." Exhibition space is now treated as a "discursive propositional event" that removes the boundaries between object and subject, content and context, art and architecture, exhibited and exhibiting, consumption and production, and idea and practice.[39]

Acknowledging that curating an architectural exhibition removes the boundaries, the curating of the architecture of the METU campus should internalize the trilogy of curation. However, as stated before, this study refers to display rather than exhibition because a display does not necessarily need a space for curating. Nevertheless, the displacement of the architecture of the METU campus cannot be placed in space as per the current proposal and care must be taken regarding the removal of boundaries by making that placement without a place.

2.2 Introduction to Architectural Cognition

In this element of this study, cognitive studies on understanding the human mind, especially by imitating cognition in-between thought and behavior with simulations through representation and computation, can guide the transformation process of architectural thinking into architecture in the case of the existing modern integrity of the METU campus (2.2.1). Then, this study approaches that process as a reproduction of architecture by decoding and encoding the campus architecture with cognitive methods. However, this approach cannot be applied to any architectural object. Architectural design, which can be described as cognitive, is considered in

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[39] Ibid.

the literature starting from modernism. The relationship between cognitive design and architecture is strongly connected to the technological developments. (2.2.2)

2.2.1 Transformation of Cognition into Architectural Cognition

In the 1950s, the emergence of studies containing complex mental representations and mental computations about the mind's functioning formed the scientific infrastructure of cognitive science. Yet, especially in the 70s, cognitive science expanded its research area with the proliferation of publications from different disciplines: philosophy, psychology, computer science, neuroscience, linguistics, and anthropology.[40] But attempts to understand the mind and its functioning date back to the Ancient Greeks. The cognitive history from Ancient Greeks to today can be examined in three time periods in order to understand the dominance of methods and disciplines in cognitive studies.[41] The first period begins when the philosophers, Plato, Descartes, Aristotle, Locke, Hume, and Kant, argued about how humans acquire knowledge.[42] In the second period, the study of the mind escaped the dominance of philosophy after the nineteenth century with the development of experimental psychology. Wilhelm Wundt and his students began to study mental processes in laboratories as an experimental psychology. Later, *behaviorism*, a view

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[40] Stanford Encyclopedia of Philosophy, s.v. "Cognitive Science," accessed September 15, 2021, https://plato.stanford.edu/entries/cognitive-science/

[41] Breaking points are demonstrated similar in the sources: "Stanford Encyclopaedia of Philosophy", "A Companion to Cognitive Science", "Mind Introduction to Cognitive Science", "Mind as Machine: History of Cognitive Science", and "Cognitive Science an Introduction to the Science of Mind"

[42] Plato supposed that knowledge is independent from people's sense experience. Unlike Plato, Descartes and Leibniz believed that knowledge could only be obtained by thinking and reasoning, which they called *rationalism*. On the other hand, Aristotle argued that knowledge can be learned from experience. This understanding, similarly adopted also by Locke, Hume, and others, is known as *empiricism*. Finally, Kant manage to overlay rationalism and empiricism, arguing that human knowledge depends on both sense experience and the innate capacities of the mind.

that virtually denied the existence of the mind, dominated throughout the 1950s.[43] At the end of the second period, the effect of neuroscientific experiments and technological developments became more observable in the study of understanding the mind. The third period is summarized in the book, "Mind: Introduction to Cognitive Science" by Paul Thagard, as follows:

> "Around 1956, the intellectual landscape began to change dramatically. George Miller (1956) summarized numerous studies that showed that the capacity of human thinking is limited, with short-term memory, for example, limited to around seven items. He proposed that memory limitations can be overcome by recoding information into chunks, mental representations that require mental procedures for encoding and decoding the information. At this time, primitive computers had been around for only a few years, but pioneers such as John McCarthy, Marvin Minsky, Allen Newell, and Herbert Simon were founding the field of artificial intelligence. In addition, Noam Chomsky (1957, 1959) rejected behaviorist assumptions about language as a learned habit and proposed instead to explain people's ability to understand language in terms of mental grammars consisting of rules."[44]

In light of technological developments and George Miller's structural analysis of the human mind, mental processes such as learning and using the information of the human mind have become both understandable and imitative in the third period, where the main focus is on producing artificial intelligence (AI)[45] through simulations.[46] This drive to simulate the mind artificially is explained as follows:

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[43] Paul Thagard, "Representation and Computation," in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), pp. 6.

[44] Ibid, 6.

[45] Written programs are a point of focus in the discipline of cognitive science regarding elementicular ideas about how the mind works.

[46] José Luis Bermúdez, "Historical Landmarks," in *Cognitive Science: An Introduction to the Science of the Mind* (New York: Cambridge University Press, 2020), p. 47.

> "In 1936-7 Alan Turing published an article in the Proceedings of the London Mathematical Society that introduced some of the basic ideas in the theory of computation. Computation is what computers do and, according to many cognitive scientists, it is what minds do. What Turing gave us was a theoretical model that many have thought to capture the essence of computation. Turing's model (the so-called Turing machine) is one of the most important and influential ideas in cognitive science, even though it initially seems to have little to do with the human mind."[47]

This study concentrates on the assumption that the human mind operates computationally, like a computer. In more detail, computational theory of mind (CTM), as proposed by Warren McCulloch and Walter Pitts in 1943, describes the physical neural activity of the brain as a computational system. Here, computation should be thought of as the manipulation of symbols according to rules. Because of the symbols, CTM requires mental representations for the input of the computational system. Cognitive studies combine these two assumptions together in the computational-representational understanding of the mind (CRUM) wih this statement:

> "Thinking can best be understood in terms of representational structures in the mind and computational procedures that operate on those structures."[48]

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[47] Ibid., 23.

[48] Paul Thagard, "Representation and Computation," in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), p. 10

Computational-Representational Understanding of Mind operates with the following kind of explanation schema:

Explanation target

Why do people have a particular kind of **intelligent behavior**?

Explanatory pattern

People have mental **representations**.

People have algorithmic **processes** that operate on those **representations**.

The **processes**, applied to the **representations**, produce the **behavior**.

Figure 2.2. Explanation schema of CRUM[49]

The human mind displays many examples of repetitive mental processes between "thought" and "behavior" in daily routine. These mental processes of learning, perception, reasoning, problem-solving, and producing are defined as "cognition."[50] CRUM holds that thinking is transformed into behavior with the collaboration of "representational structures" and "computational procedures" in simulations of the mind. Inspired by CRUM, scientists try to resolve and imitate cognition through *simulations* with artificial representational structures from thoughts of the human mind and computational procedures from behaviors of the human body (Figure 2.3).[51] However, the human mind is too complex to be resolved and it is impossible to track the exact representations and computations in the mind. For this reason, cognitive studies use sample data (information), computable models (representational structures and computational procedures/algorithms), and simulative programs (computer codes).[52]

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[49] Ibid.

[50] Ibid.

[51] Ibid, 3.

[52] This is explained technically as follows: "Vague ideas about representations can be supplemented by precise computational ideas about data structures, and mental processes can be defined

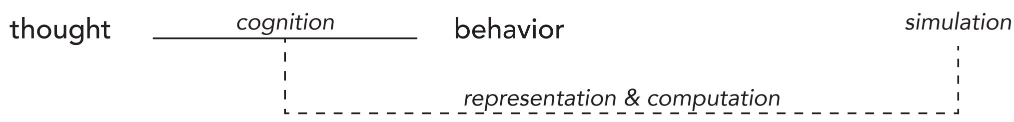

Figure 2.3. Diagram of cognitive premise[53]

The architect’s mind also displays similar repetitive mental processes between architectural thinking and architectural practicing. These mental processes of thinking, drawing, learning, problem solving, producing can be defined as “architectural cognition.” With a similar understanding, it can be claimed that architectural thinking (thought) is transformed into architecture (behavior) with the collaboration of representational structures and computational procedures in the mind. Again, architectural cognition can be resolved and imitated through architectural simulations with artificial representational structures and computational procedures (Figure 2.4). Cognitive studies can provide theoretical methods for and approaches to the reproduction of the architecture of the METU campus. In this paradigmatic shift, it can be said that there is “architectural cognition” between what Altuğ and Behruz Çinici imagined and what they produced in the architecture of the METU campus. With respect to this, architectural thinking and the architecture of the campus can be a tamed landscape with grids, algorithmically generated floor plans of faculties, or rule-based accumulations of lodging units. Therefore, the

algorithmically. To test the model, it must be implemented in a software program in a programming language such as LISP or Java.”

[53] Proposed by the author.

campus's architectural cognition, which includes thought and behavior, can be imitated by "architectural simulations" with cognitive representational-computational tools such as data, models, and programs. The present study will accordingly decode and encode the METU campus for its reproduction.

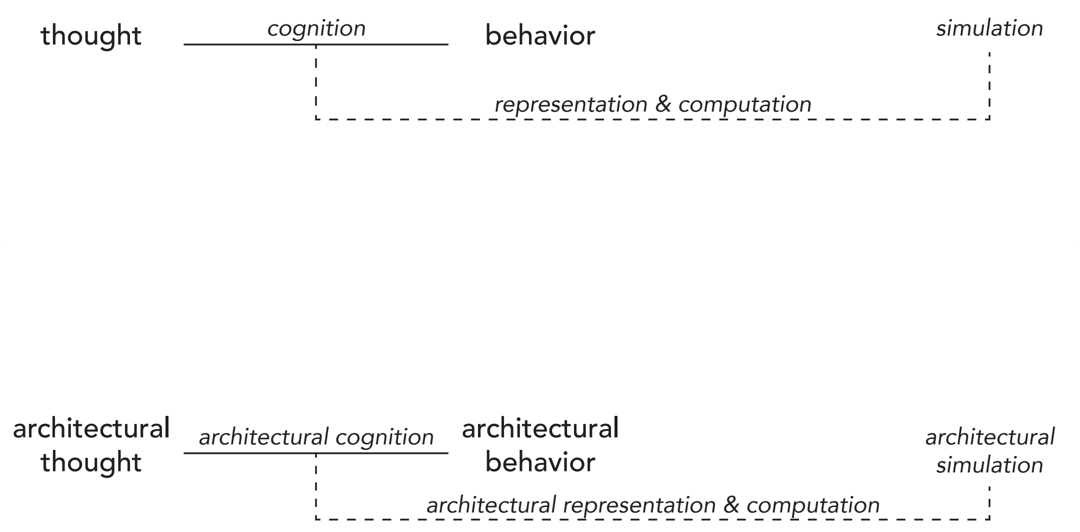

Figure 2.4. Reinterpretation of the diagram of cognitive premises for architecture[54]

2.2.2 History of Architectural Cognition

In the last century, architecture has evolved into a cognitive and computable form. Although the biggest factor in this evolution seems to be technological developments, technology has specifically developed to respond to complex design systems. This study evaluates the dramatic changes in architectural cognition with

[54] Proposed by the author.

technological developments (Figure 2.5). Solutions are specified and exist as collaborative intelligence, iterative intelligence, interactive intelligence, materializing intelligence, and so on. [55]

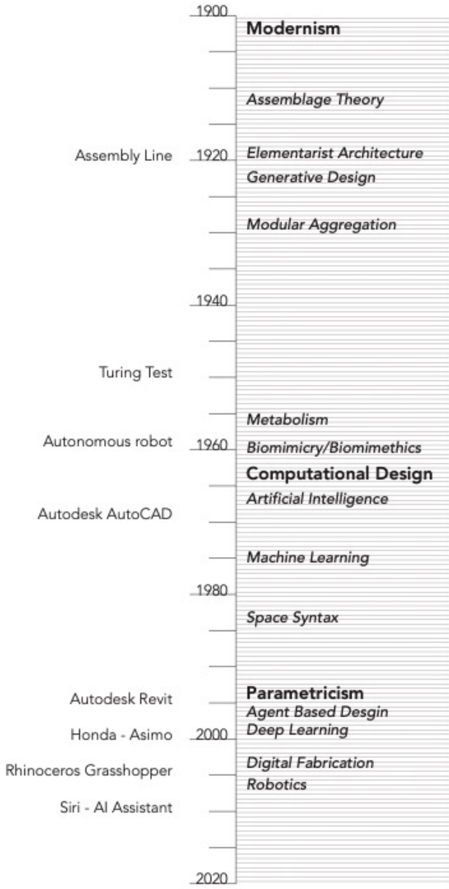

Figure 2.5. Timeline of technological developments and interrelated architectural periods and styles[56]

Modernism is the starting point of the last century as it contains traces of computable design understanding. According to Emmanuelle Chiappone-Piriou, an architect and

[55] Philip F. Yuan et al., eds., *Architectural Intelligence: Selected Papers from the 1st International Conference on Computational Design and Robotic Fabrication* (CDRF 2019) (Singapore: Springer Singapore, 2020), p. 4.

[56] Produced by author in accordance with the literature review.

curator based in Paris, "elementarist architecture" provides a system that can embed every process of design at that time:

> "The Bauhaus, De Stijl and Constructivist movements radically redefined architecture over the first three decades of the 20th century. All reworked its fundamental concepts in search of a universal dimension of art and architecture that would correspond to the normativity and perceptions proper to the industrial world. Parallel to Dutch artist and theoretician Piet Mondrian's spiritual explorations in abstract painting, the Dutch polymath and De Stijl founder Theo van Doesburg called for an exclusively universal method of representation and production that would contain all possible elementary expressions. (Figure 2.6)"[57]

Figure 2.6. Theo van Doesburg, Contra-constructie, 1923[58]

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[57] Emmanuelle Chiappone-Piriou, "Et Alia: A Projective History of the Architectural Discrete," ed. Neil Spiller and Gilles Retsin, *Architectural Design (Discrete: Reappraising the Digital in Architecture)* 258 (2019): pp. 78-81.

[58] Ibid, 80.

According to the thesis study of Nejat Emre Özen, the extraction elementarist attributes in the architecture of the METU Campus by the analysis Mondrian and Malevic paintings is possible[59] (Figure 2.7).

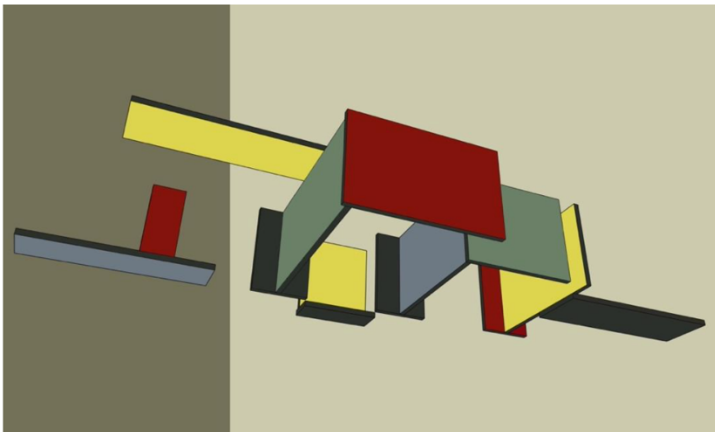

Figure 2.7. Campus elementarist drawings by Nejan Emre Özen[60]

After the 1920s, the scales of the spaces produced by the elementarist system had to grow. At this point, Walter Gropius advocated for the standardization of housing and the duplication of the basic cellular unit to form larger urban groups. This duplication, also referred to as "modular aggregation," provided some solutions for residential buildings as well as cities. For instance, Habitat 67 by Safdie Architects reflected two main ideas: one was to produce a housing complex in a dense urban environment and the other was related to the production method (prefabrication) of that complex. Focusing on the first idea, Habitat 67 revealed the potential of combining separate living units and their terraces with streets in a three-dimensional way. The fact that these units were arranged in various combinations provides a

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[59] Nejat Emre Özen (METU, 2021), p. 111.

[60] Ibid.

whole with a complex relationship between urban solid and void (Figure 2.8). From "elementarist architecture" to "modular aggregation," architecture was placed into a system more computational than before.

Figure 2.8. Habitat 67 by Safdie Architects[61]

The design of the lodgings for professors on the METU campus also shows an early example of modular aggregation (Figure 2.9). The living units are based on a generational idea able to adapt to the slope of the topography and the overall campus design (Figure 2.10).

[61] Image is retrieved from: https://www.archdaily.com/404803/ad-classics-habitat-67-moshe-safdie

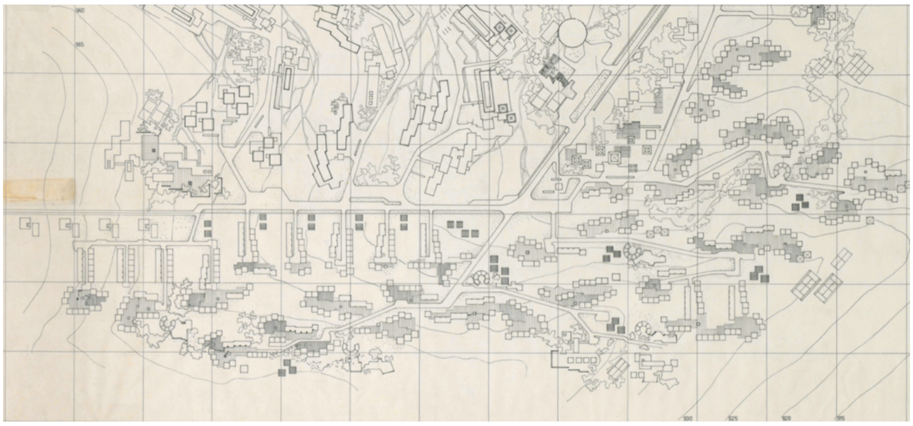

Figure 2.9. The generation idea of the METU lodgings[62]

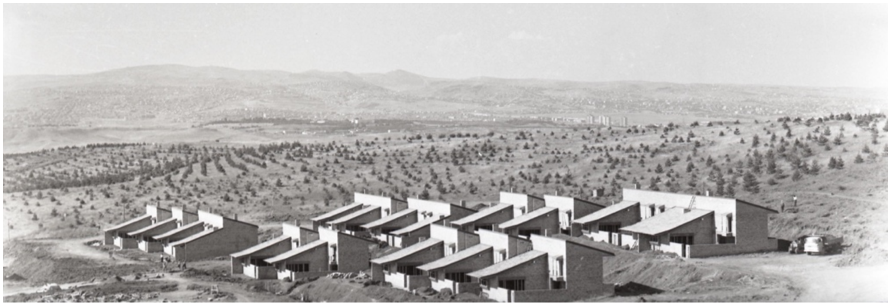

Figure 2.10. Construction site photograph of the METU lodgings[63]

In addition to examples of "modular aggregation," another important project is the Nakagin Capsule Tower by Kisho Kurokawa in Japan. It is a remaining example of Japanese "Metabolism," an architectural movement involving architectural megastructures with biological growth. As in the case of the Nakagin Capsule Tower, designers have always been inspired by nature. There are several analogies that arise from nature, such as structural systems, environmental adaptations, and the connections between different materials. The field of biomimetics, also known as

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62 "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

63 Ibid.

"biomimicry," emerged to solve human complex and computational problems. Its adaptation into architecture increased in the 1960s. In *Biomimetics in Architecture* by Petra Gruber, the overlaps of biology and architecture are explored, described as being of great importance in relation to translations from architectural thinking to architecture. According to Gruber, an examination of "natural constructions" was carried out in the 1960s in Germany by Frei Otto as his group took a more technical approach, stating that analogies between different fields should bring innovation. Objects can be similar as a result of form, gestalt, construction, structure, and material. They may have acquired this analogy through identical, similar, or completely different development processes, and development processes play a key role in the research of analogies.[64] Thus, the natural analogies applied to architectural systems require important development processes, but in the 1960s, it was very difficult to manually perform the necessary complex geometric calculations to transfer these analogical developments to architecture. The invention of computer-aided design (CAD) among computational design tools brought feasibility to modular design and complex geometries. The potential that was recognized when computational design programs first emerged was expressed as follows: "The ambition was for both design process and representation to radically merge traditional practices with the advantages afforded by computation."[65] In other words, it was hoped that computational tools would help transform architectural thinking into architecture. Later, new thoughts started to emerge with the opportunities provided by computation. In this way, the one-way relationship from architectural thinking to architecture was transformed into a new form of give-and-take, becoming intertwined in "architectural cognition." With computational design, programs have

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[64] Petra Gruber, "Classical Approaches to Investigate Overlaps between Biology and Architecture," in *Biomimetics in Architecture: Architecture of Life and Buildings* (Berlin: Springer, 2011), pp. 50-54.

[65] Roberto Bottazzi, "Introduction," *Digital Architecture beyond Computers: Fragments of a Cultural History of Computational Design* (London: Bloomsbury Visual Arts, 2020), pp. 1-12.

evolved to be able to perform multiple and repetitive tasks simultaneously, and designers began to connect those tasks to sets of rule chains. This understanding drove the advent of "parametricism." In the beginning of the twenty-first century, Grasshopper software was developed by David Rutten for such parametric design processes.[66] Early applications of computational design in architectural cognition can be seen in Zaha Hadid's works. Today, architectural cognition has new relationships with other fields such as artificial intelligence (AI), machine learning (ML), and deep learning (DL). Blending statistical principles with computation, AI is a new approach for parametric architecture to become more intelligent. For instance, research on the human mind is relevant in design for wayfinding in buildings. Humans have the ability to find their way in the environment, and with the help of AI, architects can now design simulations to mimic human navigational abilities.[67] Architecture that was already being achieved through cognitive methods, or those designed based on certain algorithms such as biomimetics, was cognitive in its nature. However, returning to the starting point of all these historical developments, it is possible to reveal both discovered theories of modernism and still undiscovered ones.

2.3 Development of Cognitive Curation

Looking at the existing curatorial practices on the METU campus, the architectural documents of Altuğ and Behruz Çinici and the campus itself are all still valid for curating architecture. In addition to academic work, Prof. Dr. Ayşen Savaş has

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[66] Stanislas Chaillou, "AI and Architecture," *Companion to Artificial Intelligence in Architecture,* 2021, pp. 420-441, https://doi.org/10.4324/9780367824259-27.

[67] Steffen Werner and Paul Long, "Cognition Meets Le Corbusier-Cognitive Principles of Architectural Design," ResearchGate. Accessed September 20, 2020. https://www.researchgate.net/publication/221104045_Cognition_Meets_Le_Corbusier-Cognitive_Principles_of_Architectural_Design.

elementicularly encouraged people to be aware of and curate the architecture of the METU campus through various projects with colleagues and graduates. She stresses that this process begins with the conservation of the existing physical documents of the campus. In this context, SALT Research, one of the well-known digital archiving organizations in Turkey, first compiled all available relevant documents (the drawings of Altuğ and Behruz Çinici and photographs, bills, and reports related to the METU campus) and presented them in an exhibition entitled "İşveren Sergisi" in 2017 at SALT Galata.[68] Among these documents, the most essential ones for curation are the architectural drawings of the METU campus. These architectural drawings by Altuğ and Behruz Çinici give us information about the architects' interpretations, or, in their words, their "sympathy" for the site, the university, and the community. These drawings depict architectural information to be transmitted and curated (Figure 2.11).

[68] The METU campus is a case where the relationships between all elementies can be monitored in every aspect. The METU Collection in the Altuğ-Behruz Çinici Archive, which was handed over to SALT Research in 2015, includes the construction site logbook and log reports, supervision contracts, and work completion documents, as well as the effective working principles of Altuğ and Behruz Çinici and the support of the rector, Kemal Kurdaş. The message of the exhibition was that these various records draw attention to the fact that successful architectural production needs an environment of healthy communication in which responsibilities are accurately and completely defined by the elementies. For further details of the exhibition, please see: https://saltonline.org/en/1668/isveren-sergisi.

Figure 2.11. Solid-void map of the METU campus by the Çinicis[69]

Referring back to the exhibition, "Representing Itself," one of the stops of the traveling exhibition was within the scope of the TU Delft Architecture research week. In this exhibition, the METU campus was represented in varied mediums such as academic publications, the Çinicis' drawings, reliefs, and photographs (Figure 2.12). Savaş explains how she interpreted the METU campus and turned it into a composition:

[69] "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

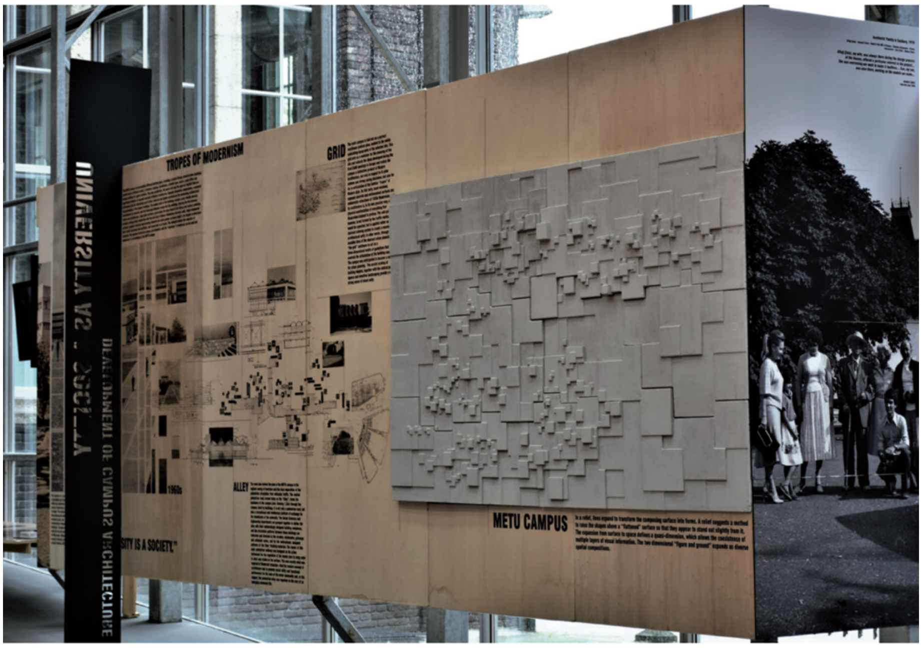

Figure 2.12. Travelling Exhibition at TU Delft by Serra Inan[70]

"A new method of preservation and representation is proposed here to generate awareness for architectural and social values with two statements: "conservation by documentation" and "conservation by international awareness". This method gained the invaluable support of the Getty Foundation with a grant awarded in 2017 through its "Keeping It Modern" initiative and further supported by the METU Faculty of Architecture, Goethe Institute, SALT Research, DO.CO.MO.MO Berlin and the TU Delft Faculty of Architecture. The METU campus exhibition is composed of three major elements: "University as a Society", "Transcoding the Bauhaus Paradigm" and "Diamonds in Sahara/Museum for one hour". Each element is divided into subtitles to represent a series of themes including the grid, alley, element

[70] Aysen Savaş, "The METU Campus Documented V: Representing Itself," *Journal of the Faculty of Architecture* 36, no. 1 (2019): pp. 285-295.

of the whole, distraction of a box, diagrams, house vs housing and "Keeping it Modern".[71]

Combining the existing documents (drawings, documents, photographs, and academic publications) was the central issue of the "Representing Itself" exhibition. The media of such documents create challenges because the medium is a key factor, and each different medium has the potential to emphasize different messages for a single object.[72] As Savaş notes, an effort was made to present the audience with three main scales while including similar media. Although each scale conveyed knowledge about itself, the array of three scales provided integrity with the presence of the same media on each scale. For instance, three Bauhaus reliefs were adapted to campus, faculty, and lodging unit scales.[73] In this way, it was emphasized that the campus could be read the same way on every scale. The conventional way of exhibiting the METU campus in the "Representing Itself" exhibition is very influential for this study in terms of reflecting the integrated modern architectural system.

In contrast to the existing curatorial practices for the architecture of the METU campus, the proposed curating of architecture will be more extensive than a conventional act of display or exhibition. Curating the campus architecture should be a more comprehensive application at every architectural scale and layer. Using the word "cultivation" metaphorically helps to clarify the intention of this study. According to the dictionary definition, "cultivation" is the act of preparing land and

[71] Aysen Savaş, "The METU Campus Documented V: Representing Itself," *Journal of the Faculty of Architecture* 36, no. 1 (2019): pp. 285-295.

[72] Marshall McLuhan, *The Medium Is the Message* (Corte Madera: Gingko Press, 2005).

[73] Bauhaus reliefs are among the representation methods used in the exhibition. The intention was to explain that modern architectural integrity in the built and natural environment is provided with arrangement in between grids, plates, and volumes.

growing crops on it, or the act of growing a elementicular crop.[74] Here, the cognitive curation – or cultivating – is not only intended to achieve an underlying design approach for the campus – or the growing of a elementicular crop – but also to provide a cognitive infrastructure for the literature – or preparing the land. Thus, this study proposes the "cultivation" of architectural knowledge by transforming the METU campus as a display object in a cognitive way rather than conventional ways such as documenting, archiving, and exhibiting.

This thesis, which articulates the cognitively curating of the METU campus architecture, concentrates on the related disciplines and their relevant terms (Figure 2.13). Although studies on curating architecture can benefit from a wide range of studies from other disciplines, they are primarily associated with architectural, cognitive, and curatorial studies in the first cycle of research. In the second cycle of research, it is possible to encounter infrastructural disciplines such as philosophy and computer science, which the present study heavily utilizes.

[74] Cambridge Dictionary: https://dictionary.cambridge.org/dictionary/english/cultivation.

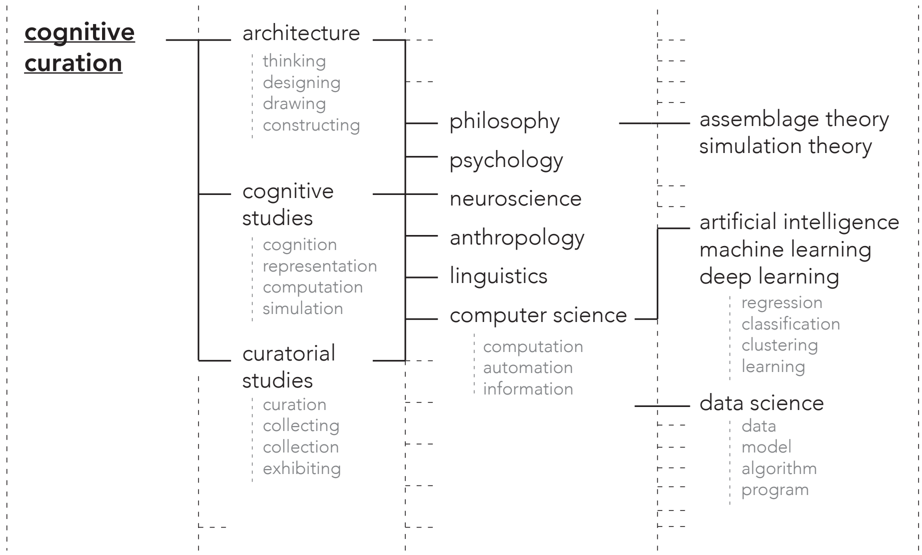

Figure 2.13. Interrelated studies for cognitive curation[75]

The main method developed for contemporary curating has emerged specifically from cognitive and curatorial studies. The cognitive concept was explored in the first element of this chapter and it allows for the decoding and encoding of the architectural integrity of the METU campus. The curatorial concept was also subsequently mentioned in this chapter and it provides crucial support to the method in terms of operating on this cognitive process of decoding and encoding. With the combination of these two concepts, the method applied here is referred to as "cognitive curation." Therefore, the final element of this chapter can be considered as both a synthesis of what has been explained so far and an explanation of what will be expanded upon in the next chapters. To facilitate this, the method is summarized below with a diagram (Figure 2.14).

[75] Produced by the author.

The first two stages shown in the diagram are related to cognitive studies. They represent a reinterpretation of the cognitive premise within architecture. In the cognitive premise, the reproduction of architecture can only take place by thought (original form) and behavior (translated version), and in the simulation of cognition (another translated version). Hence, the architectural cognition of the METU campus may also be present in the architects' thoughts (architectural thinking), in their behaviors (architecture itself), and in the simulation of architectural cognition. The third stage of the diagram recalls the processes of curating architecture with the three key steps of collecting, collection, and display as described in the second element of this chapter. This is associated with cognitive tools, data, models, and programs in the fourth stage of the diagram. The final stage of the diagram combines all these together for the method of cognitive curation for the reproduction of the architecture of the METU campus.

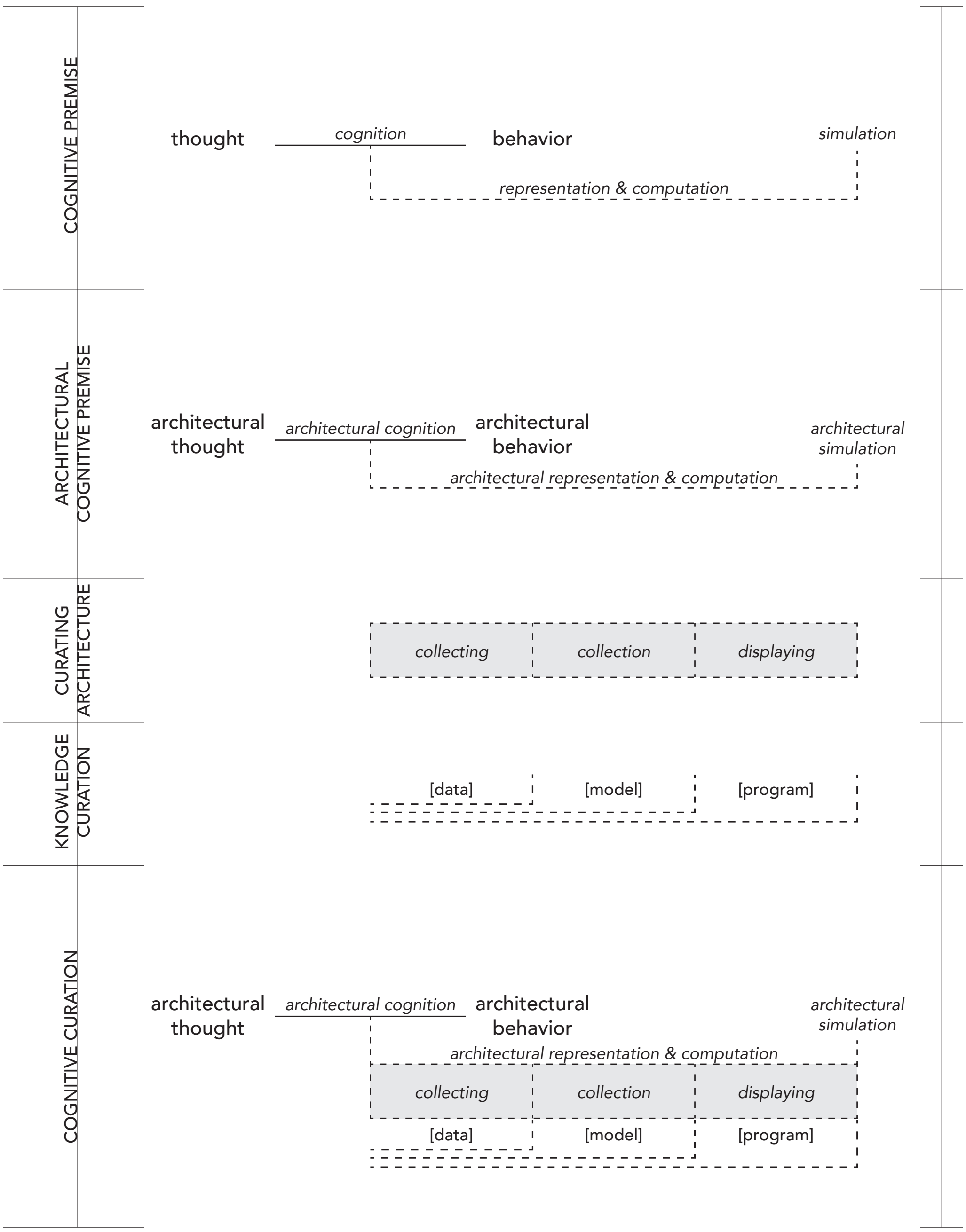

Figure 2.14. Evolution of the method of "cognitive curation"[76]

[76] Developed by the author.

The process of decoding the architectural cognition of the campus and encoding the campus by architectural simulation is divided into three main phases in terms of cognitive curation: data collection, model collection, and program display (Figure 2.15). The following chapters accordingly present the method, cognitive curation, and the curatorial narrative with cognitive tools. In the first phase of data collection, the method operates on the understanding of the data from campus architectural documents and clustering of the data. In the second phase, the method transforms the data into models by representational structures and computational procedures. In the final phase, the representational structures and computational processes obtained in the previous phase are used in architectural simulations with visual and textual programming and coding.

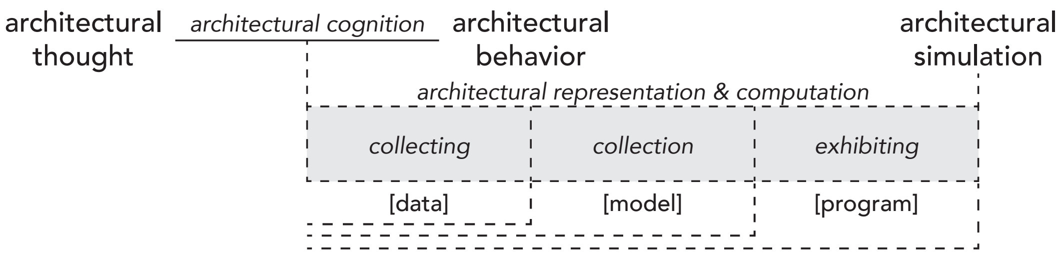

Figure 2.15. Translation of architectural cognition into architectural simulation[77]

[77] Developed by the author.

CHAPTER 3

DATA COLLECTING

In the process of curating campus architecture or, in other words, translating architects' design cognition into architectural campus simulations, the aim of the first phase of cognitive curation as well as this chapter is data collecting. In the name of this phase, the term "data" comes from other disciplines that cognitive science embodies for operations with computable[78] information in simulation processes. On the other hand, "collection" derives from the curatorial understanding of selective and structured collecting for a collection. Therefore, "data collecting" refers to the process of collecting architectural information by transforming, selecting, and organizing it for the production of computable architectural information without forgetting that it is all being done for the next phase of model collection. For the production of computable data, cognitive curation applies so-called data science and introduces data-driven terms.

Implementing computer solutions for real-world problems is one of the achievements of the twenty-first century. In the information age, decoding and encoding existing information with computers required the transformation of information into a form that computers could understand: namely data, a datum, or a piece of information, serving as abstractions of real-world entities.[79] Although studies on decoding and encoding problems with computers continue in computer

[78] In this study, "computable" is used in a different sense than "computational." Computable information or data may be in any format the computer can understand, not necessarily a number. "Computational," on the other hand, is more generally used for operations based on calculation with numbers.

[79] John D. Kelleher and Brendan Tierney, "What Are Data, and What Is a Data Set?," in *Data Science* (Cambridge, MA: MIT Press, 2018), p. 39.

science, they are also carried out in the field known as data science as a specialized branch of research. In the book entitled *Data Science*, John D. Kelleher and Brendan Tierney, the originators of the term, explain "data science" as follows:

> "The term data science came to prominence in the late 1990s in discussions relating to the need for statisticians to join with computer scientists to bring mathematical rigor to the computational analysis of large data sets. In 1997, C. F. Jeff Wu's public lecture "Statistics = Data Science?" highlighted a number of promising trends for statistics, including the availability of large/complex data sets in massive databases and the growing use of computational algorithms and models. He concluded the lecture by calling for statistics to be renamed "data science.""[80]

After the emergence of the term data science, which takes advantage of principles of computer science and statistics, "data science," "machine learning," and "data mining" began to be used interchangeably.[81] In a general sense, data science embodies all the other terms, and more specifically methods for the process of decoding and encoding[82] complex information.[83]

While implementing computer solutions for real-world problems, the transformation of information into data is not enough for meaningful data collecting by computers. In the process of transformation, there is another important term, "attribute," which

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[80] Ibid., 17. According to Kelleher and Tierney, the history of data science can be divided into the two main categories of history of data collection and history of data analysis if data science covers conventional data (information). However, data science operates with computers and this history goes back to the 1990s.

[81] Machine learning (ML) focuses on developing algorithms through experience with data, while data mining emphasizes the data structure analysis. Data science itself covers both of these.

[82] The process of decoding and encoding existing information follows these steps in data science: problem definition through data, extraction of non-obvious or obvious patterns from data, decision-making through the analysis of data, and problem-solving.

[83] Ibid., 66.

describes data. Moreover, for meaningful data collecting, the data are first collected in data sets. Secondly, the collected data, namely raw data,[84] are organized to construct a more meaningful state with data structures or, in other words, abstract data types, in accordance with their attributes:

> "Those patterns of use of the data organization and their properties form a kind of abstraction, which is independent of what the data actually is, what domain it comes form, what it is used for etc. These patterns of use represented as a bundle of certain operations is called Abstract Data Type, commonly abbreviated to ADT."[85]

Abstract data types, or data structures, can be organized as lists, sets, maps, graphs, and trees as common forms for decoding and encoding the information.[86] They help data become structured and meaningful.[87] However, some information may not have such concrete data expressions. For example, relationships established between data are expressed as "edges" in some data structures; in these cases, the data also become "nodes." Nodes and edges are specific to data structures such as graphs, trees, and lists.

In light of this background information about data, attributes, data collection, and data organization, raw data, data structures, nodes, and edges, another important term is "data source." In the case of the METU campus, data sources can be the physical

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[84] Ibid., 49.

[85] Göktürk Üçoluk and Sinan Kalkan, "Organizing Data," in *Introduction to Programming Concepts with Case Studies in Python* (Wien: Springer, 2012), p. 165.

[86] J. Glenn Brookshear and Dennis Brylow, "Data Abstractions," in *Computer Science: An Overview* (Harlow: Pearson, 2020), p. 438.

[87] John D. Kelleher and Brendan Tierney, "What Are Data, and What Is a Data Set?," in *Data Science* (Cambridge, MA: MIT Press, 2018), p. 48.

campus itself, academic records[88], and the architects' original drawings and documents[89]. In order to keep large amounts of information together as data, data science presents different forms of attributes: nominal (categories, classes, or states), ordinal (ranks), interval-based numeric (dates, times, temperatures), and ratio-based numeric (values that can have a true zero) attributes. For instance, in the concept competition poster of Altuğ and Behruz Çinici (Figure 3.1), many types of information are presented, such as texts, numbers, and drawings. Here, an effort was made to express the same information in different forms as a result of the desire to show more than one feature (attribute) of the same information (data) object together. This is also why data science defines different forms of attributes.

[88] This study cites mainly these for data collecting from academic sources: The Getty project report "Research and Conservation Planning for the METU Facult of Architecture Building Complex by Altu-Behruz Cinici, Ankara, Turkey", the article "Documentation as a Tool for the Preservation of the METU Faculty of Architecture", the book "Diamonds in the Sahara: METU Lodgings Documented", the article and exhibition "The Metu Campus Documented V: Representing Itself May 2019, TU Delft", the article "University is a Society: An Environmental History of the METU Campus", and the archival documents "Altuğ-Behruz Çinici Archive - Middle East Technical University."

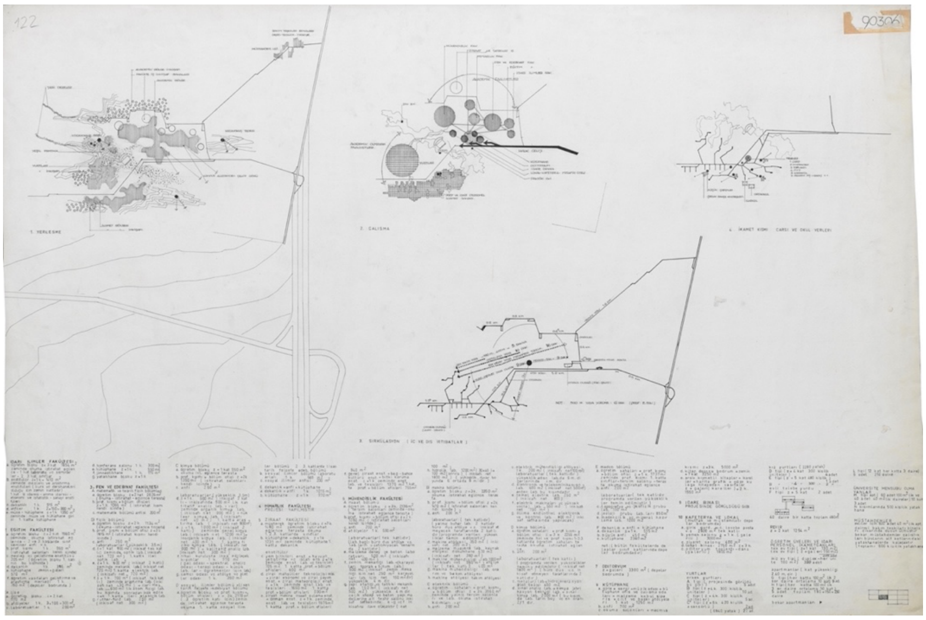

Figure 3.1. Poster from the competition project including conventional data, numeric-nominal-ordinal attributes, and data structures[90]

This chapter introduces the first phase of cognitive curation: data collection. Subsequently, this chapter answers the question of how to decode the architectural integrity of the campus with data collecting before encoding it in the further phases of cognitive curation. Three sub-sections accordingly follow, related to the acts of disassembling, classifying, and listing architectural data.

[90] Ibid.

3.1 Disassembling the Architectural Unity

Since the campus architecture creates a social, academic, and architectural unity,[91] it is impossible to extract architectural nodes or edges from that unity. An approach to reading, decoding, and disassembling is needed. Thus, this sub-section first aims to understand the existing architectural unity of the campus architecture and then proposing and element-relationship division for learning an approach to the architectural unity[92]. Finally, the campus is considered as an architectural unity in order to disassemble the architectural unity and transform its information into architectural data.

3.1.1 METU Campus's Architectural Unity

Looking at the campus today, it reflects not only architectural unity but also social and academic integrity brought about by the architecture (Figure 3.2). Although it was designed in the 1960s to serve many different purposes for different people, it still meets the needs of today. Its social, academic, and architectural integrity has been studied from many different angles and continues to be studied.

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[91] Güven Arif Sargın and Ayşen Savaş, "'A University Is a Society': An Environmental History of the Metu 'Campus,'" *The Journal of Architecture* 18, no. 1 (2013): pp. 79-106, https://doi.org/10.1080/13602365.2012.751806.

[92] Gilles Deleuze and Felix Guattari unpack the term "assemblage" in *A Thousand Plateaus: Capitalism and Schizophrenia*. Manuel DeLanda further explores the theory in his book, *Assemblage Theory*. Quotations are from DeLanda.

Figure 3.2. Aereal view of the METU campus[93]

In an article entitled "A university is a society," Prof. Dr. Ayşen Savaş and Prof. Dr. Güven Arif Sargın of the METU Faculty of Architecture explain that the design of the campus creates social unity by referring to the process of the campus design competition:

> "…The metaphor was very appropriate as the site was indeed 'virgin', devoid of any flora or structure, which is perhaps why the jury members asked for, in their own terms, 'sympathy to site'. This necessitated, besides 'architectural expression' and 'choice of materials', 'the treatment of spaces between buildings', meaning that priority was to be given to the design of the landscape rather than to the design of the buildings. The reason for this, indicated at the very outset, was that architectural tools such as core-walks,

[93] "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

arcades, pools, retaining walls, fountains, sculptures and terraces were going to transform the land to support the creation of a ‘community’.”[94]

As stated in this article, “taming” the landscape[95] with modern architectural elements to shape society is a powerful symbol of the societal agenda of modernism. Adapting modern architectural theory into both campus and society requires an integrated physical architectural system on different scales, as well. The fact that the METU campus contains many different types of facilities together also necessitates a comprehensive organization, similarly to cities. In light of the modern identity, positioning the buildings according to an open-plan “alley” (indicated as a “forum” in the diagram) rather than a hierarchical arrangement is the primary organizational idea of the campus’s architecture (Figure 3.3). Three zones, which are agricultural, non-academic (residential and social complexes), and academic, are connected to each other with many different architectural elements such as arcades, pools, and paths.

[94] Op.cit. Savaş and Sargın, p.94.

[95] The unique definition for the design of the METU campus is retrieved from this article.

Figure 3.3. Architectural zones of the campus[96]

As seen in diagrams (Figure 3.4) presenting the settlement of zones within the topography, the smooth transitions between zones and the flexibility of each zone offer a total unity of campus architecture. These zones melt into each other through architectural elements such as roads, pathways, and natural elements including rivers and topographical elevations. The gates and roads from the city are placed in

[96] “Altuğ-Behruz Çinici Archive - Middle East Technical University,” SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

harmony with the land. The main pedestrian line, which was called the "forum" or "alley," now reveals itself to be completely melted into all zones.

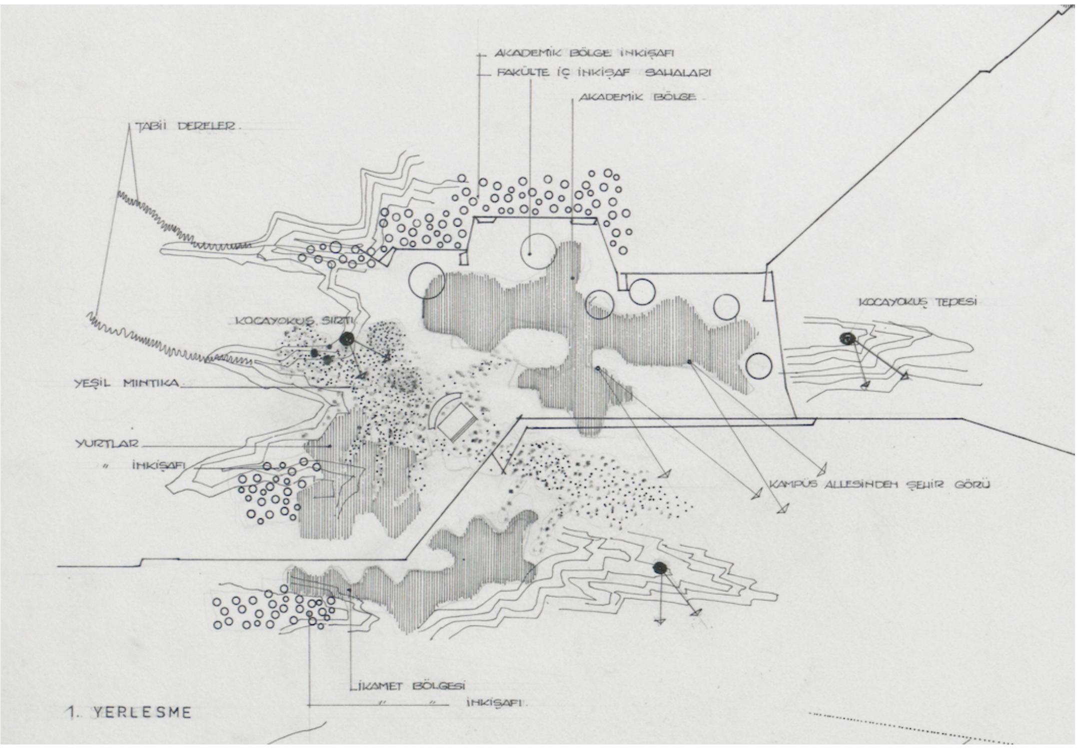

Figure 3.4. Settlement of the zones within the topography[97]

These zones then had to be spatialized in accordance with function (Figure 3.5). An invisible three-dimensional matrix regulates the articulation of the whole site consisting of building masses, alleys, landscapes, and even built-in furniture within the campus. Correspondingly, Savaş and Sargın demonstrate the modern architectural unity through grids and harmony of materials in "A university is a society" as follows:

[97] Ibid.

"The systematic and almost technical placement of first the infrastructure, that of the buildings, courtyards and arcades in the orderly layout of a very complex grid system; the memorable use of flat roofs, band windows and exposed concrete and brick surfaces; the flow of open and closed spaces into one another with the aid of the transparency provided through large glass surfaces and certain walls—were just some of the qualities where the familiar codes of Modern Architecture were manifested."[98]

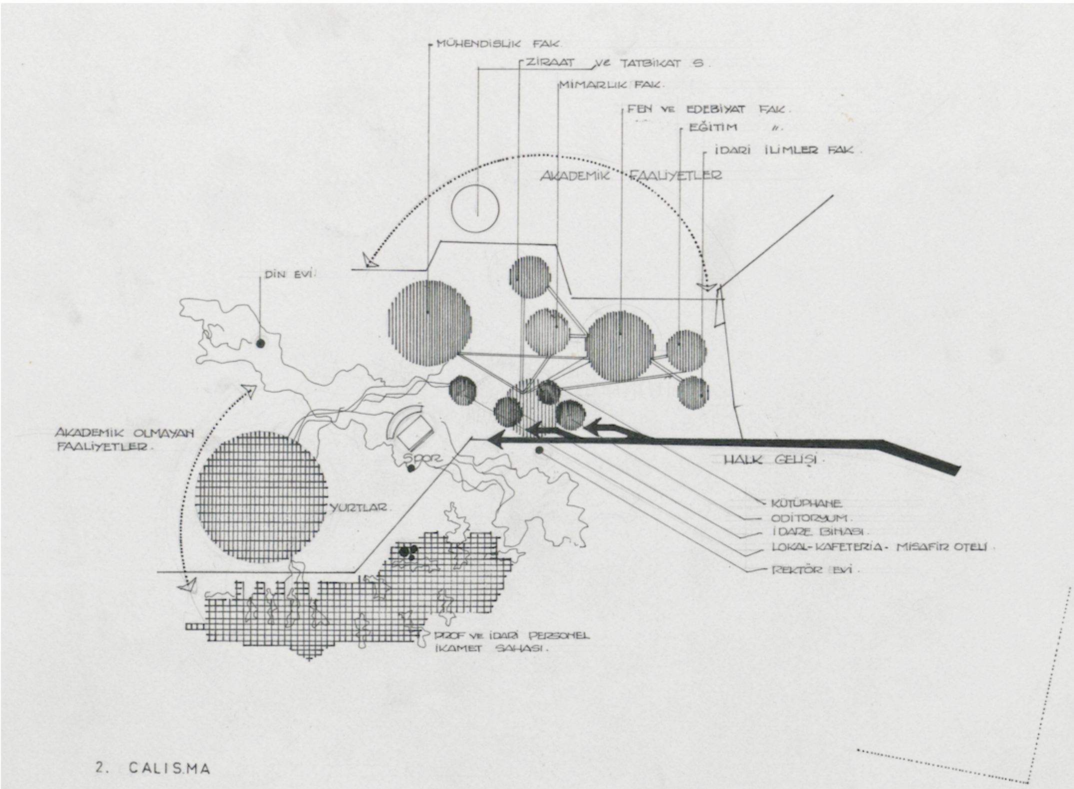

Figure 3.5. Replacement of the functions into campus design[99]

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[98] Güven Arif Sargın and Ayşen Savaş, "'A University Is a Society': An Environmental History of the Metu 'Campus,'" *The Journal of Architecture* 18, no. 1 (2013): pp. 79-106, https://doi.org/10.1080/13602365.2012.751806.

[99] "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

As stated in that article, although the METU campus, built in the 1960s, bears traces of the practices of modernism up until that time, the presence of local materials is also a message of geography. In this way, the harmony of brut architectural elements and local materials blended with nature can be seen as a unique attitude toward the land, rather than simply creating a built environment. The campus design with this blend of modern architectural elements and local materials generated a complex integrated architecture serving as a pioneer for urban models (Figure 3.6). This is supported in another article by Prof. Dr. Ayşen Savaş about the campus's architecture with the following words:

> "In the late 1950s, the project was anticipated to become a model for urban planning throughout the Middle East and today it remains as one of the most outstanding icons of modern architecture in the world."[100]

Figure 3.6. Final site plan and site sections by Altuğ and Behruz Çinici [101]

[100] Ayşen Savaş, "METU Campus," *Brownbook Magazine*, 2018, 71–85.

[101] "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

3.1.2 METU Campus's Architectural Elements and Relationships

If it is possible to see the object of this thesis, the METU campus, as an architectural unity, then the definition of "elements" and "relationships" gains significance. As stated, a unity is constituted of autonomous parts and flexible links. While the architectural unity of the campus creates a heterogeneous crowd with its own elements (parts), they can only be seen as a homogeneous unity through architectural relationships (links). Acknowledging the architectural elements and relationships in the architectural unity of the METU campus, this study seeks a way to transform the campus's architectural information into data. Akin to computer science, architectural elements can be nodes and architectural relationships can be edges in the data structure of campus architecture.

To illustrate, examples of data collection from existing architectural unity can be found in interdisciplinary studies involving architecture and computer science. This is exemplified in an article entitled "Artificial intelligence in architecture: Generating conceptual design via deep learning" in "International Journal of Architectural Computing."[102] According to the authors, an existing layout design can be transformed into a data structure. Since the authors focus on layout design, they consider each space as a node and each connecting path as an edge. They explain this process as follows:

> "(Right) Graph representation of the house: Nodes (yellow circles) denote rooms, and edges denote connections between rooms. Nodes have attributes such as type, area (indicated by size of the circle) and volume; and edges have attributes such as type: vertical (blue), open connection (pink) and door

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[102] *International Journal of Architectural Computing* (IJAC) is an exciting peer-reviewed journal founded by international organizations dedicated to promoting collaborative research and the development of computer-aided architectural design. IJAC is committed to deepening the understanding of the foundations of digital systems for architectural design and the technologies enabling their development and application.

(beige). Numbers inside nodes are IDs and denote the floor levels (Figure 3.7).”[103]

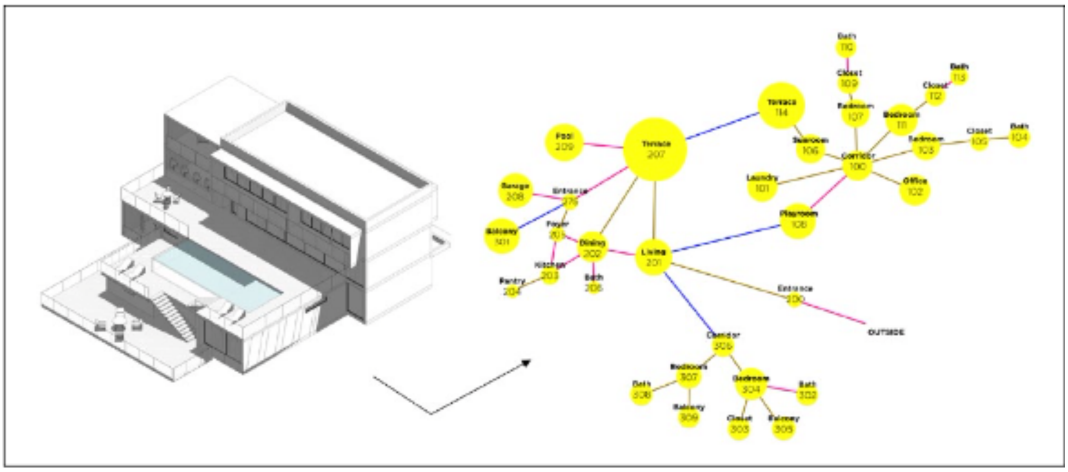

Figure 3.7. Attributed graph model for layout design[104]

If the intention in this article had been different, the function of the space could have been a type of relationship, and the architectural element would have been a element within the graph data structure. However, in the case of the METU campus, architectural elements such as windows, walls, floors, or railings will always be evaluated as architectural elements (nodes), not as architectural relationships (edges). Edges will only be located in between nodes if the nodes have a relationship that can be computationally explained. With this example, in order to collect data, it is necessary to determine precisely what are architectural elements of the campus as nodes (Chapter 3.2), what are architectural relationships of the campus as edges

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[103] Imdat As, Siddharth Pal, and Prithwish Basu, “Artificial Intelligence in Architecture: Generating Conceptual Design via Deep Learning,” *International Journal of Architectural Computing* 16 (2018): pp. 311-312, https://doi.org/10.1177/1478077118793180.

[104] Ibid, 311.

(Chapter 3.3), and which data structures are appropriate for the METU campus's architectural data.

3.2 Classifying the Types of the Architectural Elements

After finding a way to disassemble the architectural unity of the METU campus, the information can be transformed into computable data for further processes. This section will provide the exact definitions of the architectural elements of the METU campus as architectural data. The collected data of the architectural unity, i.e., of the METU campus, will then be divided into meaningful groups, namely clusters in the language of data science, in order to be able to understand the architectural relationships between them. Hence, this section of the study collects architectural data about architectural elements in a computable manner (Chapter 3.2.1), analyzes the conventional clustering in the exhibition "Representing Itself" (Chapter 3.2.2), and provides a contemporary clustering or organization of raw data with a graph data structure (Chapter 3.2.3).

3.2.1 Architectural Elements of the METU Campus

According to understanding of unity, the elements maintain their autonomy outside of the unity. This quality differentiates architectural elements from architectural relationships. In the architectural unity of the campus, these autonomous structures may be modern architectural elements as architectural elements because they have fixed, autonomous, and external expressions without any relationships. One can relationship them socially, academically, or architecturally in any composition. Without their relationships in any context, the architectural elements are converted to data and data attributes and collected in a data-driven version in data set matrix:

> "A data set consists of the data relating to a collection of entities, with each entity described in terms of a set of attributes. In its most basic form, a data set is organized in an n * m data matrix called the analytics record, where n

is the number of entities (rows) and m is the number of attributes (columns). So a data set contains a set of instances, and each instance is described by a set of attributes."[105]

For instance, in the data collection for the METU lodgings area, each architectural element was entered into the rows as data. Numeric (area, volume), nominal (material name), and ordinal (material type) attributes for each element were placed in columns (Figure 3.8).

Category	Type	Material: Name	Material: Area	Material: Volume
Floors	pavement	Concrete Masonry,	83 m^2	16.54 m^3
Floors	pavement	Concrete Masonry,	130 m^2	25.94 m^3
Floors	pavement	Concrete Masonry,	86 m^2	17.19 m^3
Floors	pavement	Concrete Masonry,	209 m^2	41.82 m^3
Floors	pavement	Concrete Masonry,	223 m^2	44.52 m^3
Floors	pavement	Concrete Masonry,	228 m^2	45.64 m^3
Floors	pavement	Concrete Masonry,	139 m^2	27.72 m^3
Floors	pavement	Concrete Masonry,	136 m^2	27.19 m^3
Walls	B-21	Brick, Common	64 m^2	13.51 m^3
Walls	B-21	Brick, Common	5 m^2	0.97 m^3
Walls	T-10	Structure, Timber Jo	6 m^2	0.60 m^3
Walls	T-10	Structure, Timber Jo	1 m^2	0.12 m^3
Walls	B-21	Brick, Common	7 m^2	1.57 m^3
Walls	B-21	Brick, Common	4 m^2	0.87 m^3
Walls	B-21	Brick, Common	7 m^2	1.42 m^3
Walls	T-10	Structure, Timber Jo	2 m^2	0.15 m^3
Walls	T-10	Structure, Timber Jo	1 m^2	0.15 m^3
Walls	T-10	Structure, Timber Jo	2 m^2	0.16 m^3
Walls	B-21	Brick, Common	2 m^2	0.34 m^3
Walls	C-32	Brick, Common	2 m^2	0.51 m^3
Walls	T-8	Structure, Timber Jo	3 m^2	0.22 m^3
Walls	B-21	Brick, Common	8 m^2	1.70 m^3
Walls	B-21	Brick, Common	7 m^2	1.39 m^3
Walls	B-21	Brick, Common	10 m^2	2.13 m^3
Walls	B-21	Brick, Common	16 m^2	3.36 m^3
Walls	T-10	Structure, Timber Jo	14 m^2	1.38 m^3
Walls	T-10	Structure, Timber Jo	6 m^2	0.61 m^3
Walls	T-10	Structure, Timber Jo	1 m^2	0.15 m^3
Walls	T-10	Structure, Timber Jo	2 m^2	0.24 m^3
Walls	B-21	Brick, Common	17 m^2	3.67 m^3
Walls	T-10	Structure, Timber Jo	8 m^2	0.77 m^3
Walls	T-10	Structure, Timber Jo	8 m^2	0.77 m^3
Doors	910x2110mm	Door - Panel	4 m^2	0.06 m^3
Doors	910x2110mm	Door - Handle	0 m^2	0.00 m^3
Doors	910x2110mm	Door - Frame/Mullio	2 m^2	0.02 m^3
Doors	910x2110mm	Door - Architrave	2 m^2	0.01 m^3
Doors	910x2110mm	Door - Panel	4 m^2	0.06 m^3

Figure 3.8. Sample raw data set of architectural elements in the campus[106]

[105] John D. Kelleher and Brendan Tierney, "What Are Data, and What Is Data Set?," in *Data Science* (MIT Press, 2018), p. 40

[106] Produced by author for METU lodgings which will be used in the study in further chapters.

However, as learned from curatorial studies, the process of collecting something cannot be arbitrary. There must be an awareness of a further process, which is the collection. Collecting architectural data within dozens of rows and columns does not inherently mean anything. As learned from data science, it is not enough to collect computable data (the architectural elements of the campus) and their attributes (physical characteristics of the architectural elements) without any structure. The collected raw data are meaningless and it will be impossible to define the architectural relationships between architectural elements. For this reason, the raw data of architectural elements should be organized and structured. Before introducing a computable version of that organization, this study evaluates the conventional organization of the METU campus's architectural elements.

3.2.2 Three Scales of the METU Campus

The METU campus has already been conventionally organized in a series of exhibitions where its architectural unity was curated. For example, in the "Representing Itself" exhibition at TU Delft,[107] information about campus architecture was divided into scale-based groups:

> "The METU campus exhibition is composed of three major elements: "University as a Society", "Transcoding the Bauhaus Paradigm" and "Diamonds in Sahara/Museum for one hour". Each element is divided into subtitles to represent a series of themes including the grid, alley, element of

[107] Ayşen Savaş et al., "Research and Conservation Planning for the METU Faculty of Architecture Building By Altuğ-Behruz Çinici" (Ankara, 2019), p. 407.

the whole, distraction of a box, diagrams, house vs housing and "Keeping it Modern""[108]

The first element of the exhibition, entitled "University as a Society," represents campus-scale design decisions. Original drawings, photographs, texts, and Bauhaus reliefs were combined in terms of themes such as grids, alleys, and campus buildings. In the second element, "Transcoding the Bauhaus Paradigm," the exhibition presented the faculty-scale modern architectural integrity with the examples of drawings, models, photographs, and reliefs of the building of the Faculty of Architecture. The selected themes for this second element were "element of a whole," "distraction of a box," and "grid" (Figure 3.9). In the final element, "Diamonds in Sahara/Museum for one hour," the book entitled *Diamonds in the Sahara: METU Lodgings Documented* and a previous exhibition, "A House Museum for One Hour,"[109] are linked to the unit-scale design solutions of Altuğ and Behruz Çinici. Akin to the campus design, the design of the exhibition and the media used in the exhibition repeat themselves on three scales: campus, faculty, and lodging units. For instance, the Bauhaus reliefs were produced for three scales in terms of three major architectural elements: grid, plates, and volumes (Figure 3.10).

[108] Aysen Savaş, "The METU Campus Documented V: Representing Itself," *Journal of the Faculty of Architecture* 36, no. 1 (2019): pp. 285-295.

[109] Prof. Dr. Ayşen Savaş explains the exhibition as follows: "The exhibition featured architectural representations of the selected house, which meant that Lodging#5, the home of the exhibition, was actually represented within itself."

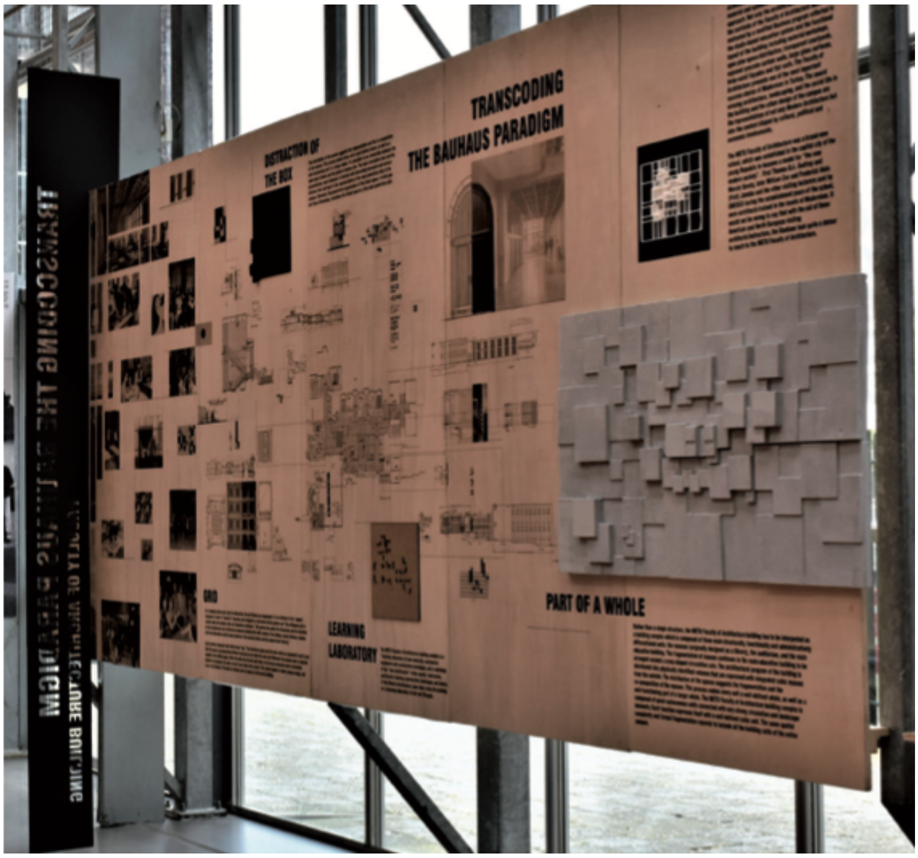

Figure 3.9. Second element of the "Representing Itself" exhibition[110]

[110] Ibid.

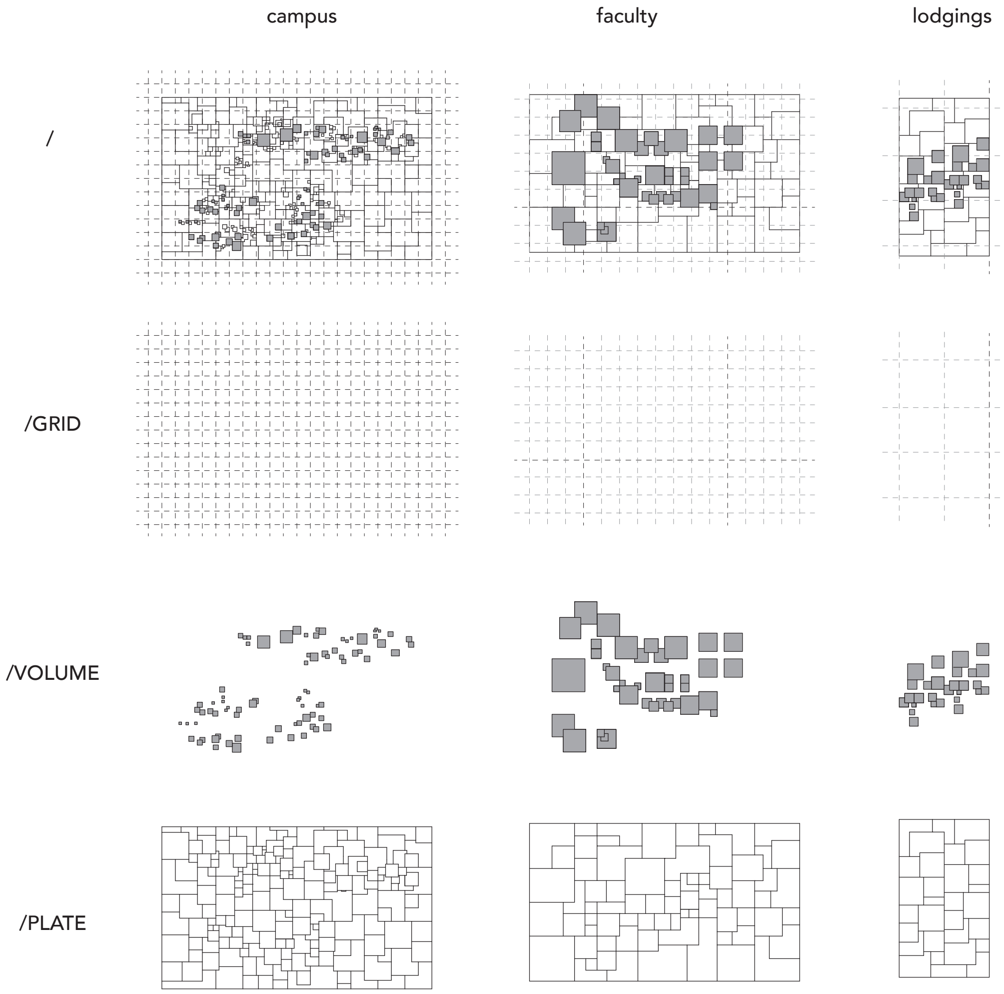

Figure 3.10. The production process of Bauhaus reliefs based on the “Representing Itself” exhibition[111]

[111] Produced by the author. The idea of seeing the campus with Bauhaus reliefs belongs to Prof. Dr. Ayşen Savaş

3.2.3 Architectural Classification

The conventional curating and exhibiting of architectural unity is limited to representing the relationships/relationships between the architectural elements/elements. Unlike conventional grouping, the present study needs to show all of them together. As learned from the conventional grouping of the architectural elements of the campus, architectural elements are understood to be present on three different scales. Thus, the raw data about the elements can be divided into three in terms of scales. Still, however, this is not enough to understand the relationships between them because now there are three separate raw data sets.[112] In order to group them properly for further representation processes, the raw data should be divided with respect to their similarities and differences considering their attributes.

Classification in accordance with architectural attributes gives a shape to the raw data and attributes of the campus architecture (Figure 3.11). It uses "graphs," also known as "networks," for the data structure. The final form of the data entails two numbers in the Cartesian coordinate system. These reductionist classes are defined with the location of data in the graph or Cartesian coordinate system in accordance with the numeric, ordinal, and nominal attributes of the data of architectural elements. That is, it assigns values of (x, y) to each data point (Figure 3.12). The data visualization of the final reductionist classes represents 11 types of architectural elements (Figure 3.14). The one-dimensional architectural elements of the campus are zone borders, topography contours, reference lines, and the grid. They are actually imaginary lines that do not exist physically and they are produced only for the campus design. When K-means clustering is applied, three types of architectural elements may be clustered: topographic lines, axial lines, and radial lines. The two-dimensional architectural elements are walls, roofs, railings, ramps, stair windows,

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[112] Raw data have the potential to become unstructured "information," but this format merely enables the data to become accessible for further processing.

and curtain walls. They show planar behavior in modern integrity and they are separated into clusters due to the characteristics of their angles. The three-dimensional architectural elements are alleys, forests, rooms, corridors, and pools. In naming the clusters, it is necessary to focus on the parameters that separate them. They can be divided into dynamic, static, and natural groups due to the ratio of human capacity to volume (Figure 3.16).

architectural part	base axis	function	material base	distance	width	height	radious	angle	area	volume
contour	x,y	reference	no material	272				0.01		
contour	x,y	reference	no material	274				0.01		
zoneline	x,y	reference	no material	392			0.01			
zoneline	x,y	reference	no material	282			0.01			
grid	x,y	reference	no material	340			0.05			
grid	x,y	reference	no material	341			0.05			
grid	x,y	reference	no material	342			0.05			
grid	x,y	reference	no material	143			0.05			
grid	x,y	reference	no material	143			0.05			
grid	x,y	reference	no material	143			0.05			
referance line	x,y	reference	no material	120			0.05			
referance line	x,y	reference	no material	320			0.05			
referance line	x,y	reference	no material	320			0.05			
referance line	x,y	reference	no material	320			0.05			
floor	x,y	move	concrete	5	9				49.34	
floor	x,y	move	concrete	2	5				10.65	
door	y,z	semi-stop	timber		0.9	2.1			1.89	
door	y,z	semi-stop	timber		0.9	2.1			1.89	
door	y,z	semi-stop	timber		0.9	2.1			1.89	
window	y,z	semi-stop	aluminium		1.5	1.8			2.7	
window	y,z	semi-stop	aluminium		1.5	1.8			2.7	
window	y,z	semi-stop	aluminium		2	1.8			3.6	
window	y,z	semi-stop	aluminium		3	1.8			5.4	
window	y,z	semi-stop	aluminium		4	2			8	
wall	y,z	stop	brick		5	9			45	
wall	y,z	stop	brick		5	7			35	
wall	y,z	stop	brick		7	3			21	
wall	y,z	stop	brick		7	5			35	
wall	y,z	stop	concrete		5	9			45	
wall	y,z	stop	concrete		2	3			6	
wall	y,z	stop	plaster		2	3			6	
stair	x,y	up-down	concrete	5	3			2		
roof	x,y	cover	concrete	13.7	6.3			3		
railing	y,z	stop	glass		3	1.5			4.5	
railing	y,z	stop	glass		5	1.5			7.5	
ramp	x,y	up-down	concrete	3	1.5			2		
greening	x,y,z	commutative	nature	6	4	1		1	24	24

Figure 3.11. Sample data and attributes file for architectural elements of the a selected area, the METU lodgings[113]

[113] Produced by the author.

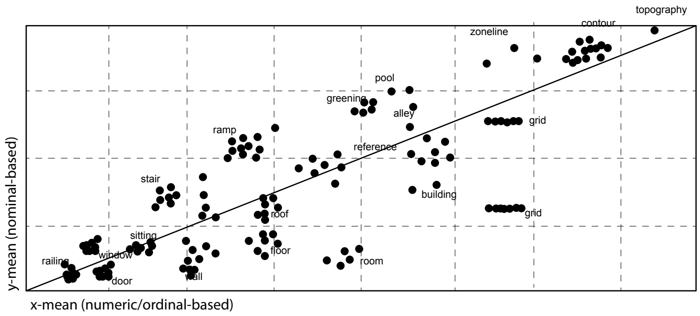

Figure 3.12. Putting data into the Cartesian coordinate system with new x and y values[114]

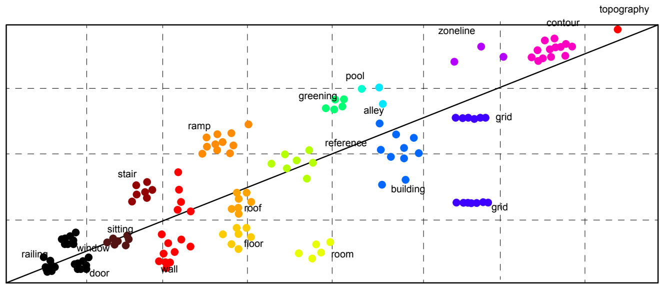

Figure 3.13. Classification visualization[115]

[114] Produced by the author.

[115] Produced by the author.

architectural part	base axis	function	material base	distance	width	height	radious	angle	area	volume	X	Y	ID
contour	x,y	reference	no material	x				x					1
zone line	x,y	reference	no material				x		x				2
grid	x,y	reference	no material	x									3
referance line	x,y,z	reference	no material	x									3
floor	x,y	move	variable	x	x				x				5
sitting plane	x,y	move	variable	x	x				x				5
door	y,z	semi-stop	variable		x	x			x				6
window	y,z	semi-stop	variable		x	x			x				6
wall	y,z	stop	variable		x	x			x				6
stair	x,y	up-down	variable	x	x			x					7
roof	x,y	cover	variable	x	x			x					5
railing	y,z	stop	variable		x	x			x				6
ramp	x,y	up-down	variable	x	x			x					7
pool	x,y,z	commutative	nature	x	x	x			x	x			8
alley	x,y,z	commutative	mixed	x	x	x			x	x			9
building	x,y,z	fixed	mixed	x	x	x			x	x			10
topography	x,y,z	commutative	nature	x	x	x		x	x	x			11
hall	x,y,z	commutative	mixed	x	x	x			x	x			9
classroom	x,y,z	fixed	mixed	x	x	x			x	x			10
greening	x,y,z	commutative	nature	x	x	x		x	x	x			11
corridor	x,y,z	commutative	mixed	x	x	x			x	x			9
room	x,y,z	fixed	mixed	x	x	x			x	x			10
vegetation	x,y,z	commutative	nature	x	x	x		x	x	x			11

Figure 3.14. Classifcation ID for each type of architectural element

dimension	geometry	type	initials	architectural part
1d	line	contour axial radial reference	l1 l2 l3 l4	contour grid zone line reference lines
2d	plane	horizontal vertical inclined	p1 p2 p3	floor, roof wall, railing stair, ramp
3d	volume	dynamic static green blue	v1 v2 v3 v4	alley, hall, corridor building, classroom, room earth/site, greening, vegetation river, pool, pond

Figure 3.15. Cognitive definition of architectural elements[116]

3.3 Listing the Types of Architectural Relationships

According to unities by their nature, the relationships of the them, or their relationships, cannot be autonomous and fixed elements. Rather, they can be placed between elements as well as displaced in another context. They are flexible. Because

[116] Produced by author in accordance with the outputs of the graph data structure by k-means clustering

of their characteristics, they cannot be data and they cannot be represented as nodes with attributes. For these reasons, in data science, relationships are represented as edges in some data structures such as trees and graphs. However, edges have two ends that can connect. Drawing an edge between two elements is not enough to identify all the relationships in the unity. In order to draw a relationship that has more than two ends, data science uses algorithms to define the relationship or the relationship. Before conceptualizing algorithms, it is necessary to ask which elements are being relationshiped to be defined. This section of the study elaborates on the architectural relationships for campus architecture (Chapter 3.3.1) and how they can be extracted from the architectural unity (Chapter 3.3.2).

3.3.1 Architectural Relationships of the METU Campus

In the case of campus architecture, architectural relationships are the relationships established between architectural elements in the unity. They can be the rules or reasons for combining two or more architectural elements together. For instance, considering the process of the design of the Faculty of Architecture building's ground floor (Figure 3.17), the questions to be asked include the underlying reason or rule for having a changeable circulation axis, how the circulation axis and classrooms come together, and how many architectural elements are present in the relationship.

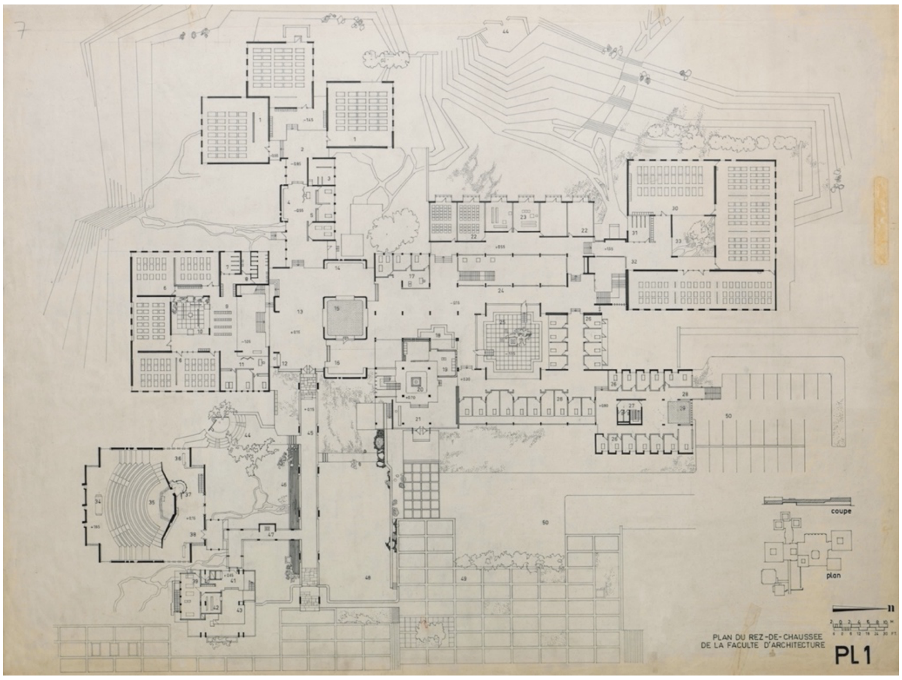

Figure 3.16. Ground floor plan of the Faculty of Architecture building complex[117]

While designing the Faculty of Architecture building, the architects first made an area calculation according to the function and the needs related to it. Architectural spaces that would meet that area calculation were created and positioned. After that positioning, they all had to be combined with circulation areas. At the stage of creating the spaces and circulation areas, the architectural elements began to shape the spaces, connected with the circulation areas, through a number of reasons and rules. In this design process, the needs and the architectural elements used to meet those needs can be clearly deduced from the plan drawing. However, it is not possible to manually determine the architectural relationships and the architectural elements

[117] "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

within these architectural relationships, because they are not visible like architectural elements.

3.3.2 Set Equations

In order to understand the architectural cognition in the METU campus design, it is necessary to calculate and identify all possible relationship probabilities. To make this calculation, this study benefits from sets and set calculations in the discipline of mathematics (Figure 3.15). A chosen architectural unity can be considered as a set, and the architectural elements inside it can be considered as the elements of the set. Accordingly, the sub-sets of the set present the set of elements that the relationship contains.

Furthermore, the number of sub-sets can give the total number of architectural relationships in the unity because sub-set lists show sets with specific numbers of elements. However, the number of sub-sets with no elements or with only one element must be subtracted from the total because there are no architectural relationships in sub-sets consisting of zero or one element. In addition, the number of sub-sets of relationship types is also useful in calculating lists. If three elements show the same characteristics in an architectural unity of five architectural elements, it can be said that there are a total of three architectural elements. In this case, the set has three elements, and when looking at the sub-sets of the three-element set, only the number of sets without any elements in them is subtracted at this time because sets containing one type of architectural element can still be defined (Figure 3.18).

X = { ■, ★, ●, ... }	X = set of ...
	n = number of elements in given set X
	S = number of subsets in given set X = $2^n = \sum_{k=0}^{n} \binom{n}{k} = \binom{n}{0} + \binom{n}{1} + \binom{n}{2} + \ldots + \binom{n}{n-1} + \binom{n}{n}$
	$\binom{n}{k}$ = number of subsets for the choice of k things from a set of n things
	X' = one of the subsets

- -

X^1 = {a1,a2,b1,b2,c,d}	X = set of architectural part in the architectural assemblage
	$2^n - \binom{n}{0} - \binom{n}{1}$ = number of architectural links
X^2 = {a,b,c,d}	X = set of types of architectural parts in the architectural assemblage
	$2^n - \binom{n}{0}$ = number of type of architectural links

Figure 3.17. Explanation of calculation of number of architectural relationships and number of types of architectural relationships[118]

Applying this calculation to the interior perspective drawing of the building of the Faculty of Architecture, there are six different types of architectural elements in the space: column (c), floor (f), staircase (s), railing (r), furniture (fu), and roof (ro). The total number of architectural elements is 17 (c1, c2, c3, c4, c5, c6, c7, c8, f1, f2, s1, r1, r2, fu1, fu2, ro1, ro2) (Figure 3.19).

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118 Produced by the author.

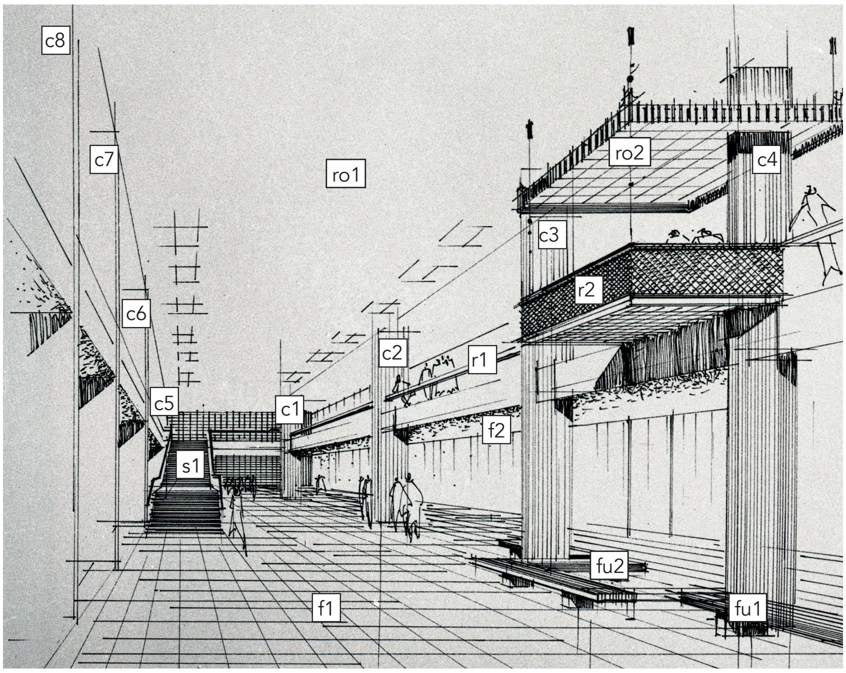

Figure 3.18. Number of architectural elements[119]

In this case, the set of the architectural unity, which contains 17 architectural elements, has 131054 architectural relationships. Likewise, 63 types of architectural relationships are observed in this architectural unity, which includes 6 types of architectural elements (Figure 3.20). For a more clear explanation, in data science, the possible sets of the elements that the relationship includes are expressed as listed data structures since the relationships cannot be displayed as data (Figure 3.21).

[119] Produced by the author.

$A^1 = \{c1,c2,c3,c4,c5,c6,c7,c8,s1, f1,f2,r,1,r2,ro1,ro2,fu1,fu2\}$

A^1 = set for architectural parts in the sample

$n = 17$

$$S = 2^{17} = \sum_{k=0}^{17} \binom{17}{k} = \binom{17}{0} + \binom{17}{1} + \binom{17}{2} + \ldots + \binom{17}{16} + \binom{17}{17} = 131072$$

$$2^{17} - \binom{17}{0} - \binom{17}{1} = \text{number of architectural links} = 131054$$

$A^2 = \{c,s,f,r,ro,fu\}$

A^1 = set of types of architectural parts in the architectural assemblage

$n = 6$

$$S = 2^{6} = \sum_{k=0}^{6} \binom{6}{k} = \binom{6}{0} + \binom{6}{1} + \binom{6}{2} + \ldots + \binom{6}{6} + \binom{6}{6} = 64$$

$$2^{6} - \binom{6}{0} = \text{number of type of architectural links} = 63$$

Figure 3.19. Application of the understanding of sets to a sample of architectural unity [120]

SUB SET W 1 ELEMENT	SUBSET WITH 2 ELEMENTS	SUBSET WITH 3 ELEMENTS
c1	c1,f1	c3,c1,f1
c2	c1,s1	c3,c1,s1
c3	c1,r1	c3,c1,r1
c4	c1,fu1	c3,c1,fu1
c5	c1,ro1	c3,c1,ro1
c6	f1,c2	c3,f1,c2
c7	f1,s1	c3,f1,s1
c8	f1,r1	c3,f1,r1
f1	f1,fu1	c3,f1,fu1
f2	f1,ro1	c3,f1,ro1
s1	s1,c2	c3,s1,c2
r1	s1,f2	c3,s1,f2
r2	s1,r1	c3,s1,r1
fu1	s1,fu1	c3,s1,fu1
fu2	s1,ro1	c3,s1,ro1
ro1	r1,c2	c3,r1,c2
ro1	r1,f2	c3,r1,f2
	r1,fu1	c3,r1,fu1
	r1,ro1	c3,r1,ro1

Figure 3.20. Lists of possible architectural relationships

[120] Produced by the author.

CHAPTER 4

MODEL COLLECTION

The second phase of cognitive curation is model collection. It progresses cumulatively based on the first phase of data collecting. Akin to data collecting, its name is derived from the concepts proposed by curatorial-cognitive studies to decode and encode architectural information. “Model” is borrowed here from cognitive science, which mimics the process applied in the translation of information from human thinking to behavior with a model consisting of representations and computations. “Collection,” on the other hand, refers to curation achieving unity with processes of collecting. This is why model collection can be considered as an intermediate translational phase to encode the decoded information.

Architectural collections can be found in libraries, archives, and exhibitions, as well as digitally on the internet. However, they can generally be described as sources containing information rather than collections as defined in this study because, in such architectural collections, information is encoded without being decoded. Although “collection” has many different meanings, it is described here as the phase in which information is decoded and prepared to be encoded again. For instance, SALT Research has created a web-based collection for the METU campus’s architectural documents. This collection separates everything that can be considered an architectural document about the architecture of the campus according to categories and presents them in their original forms. The present study, on the other hand, aims to reconstruct what the architectural documents together express as a meaningful whole (or collection) rather than organizing and presenting those existing documents as a collection. The collection that SALT Research presents is closer to the initial data collection phase of this study in terms of collecting, understanding, and organizing the existing information. In contrast, “model collection" as performed in the present study produces new expressions in order to present existing information.

In cognitive sciences, models are artificial mechanisms that use collected data to imitate the working of the mind. However, this imitation will not be exactly identical to the true situation in the mind. Today, the ways in which the mind works are still not fully understood. Imitations aim to achieve the same mental output by using the same mental inputs. And, cognitive studies claim that the working principles of models created in this way are close to those of the mind.[121] This theory, introduced by George Miller, continues to be a central point in the field of cognitive science as the computational-representational understanding of the mind (CRUM):

> "Thinking can best be understood in terms of representational structures in the mind and computational procedures that operate on those structures. Although there is much disagreement about the nature of the representations and computations that constitute thinking, the central hypothesis is general enough to encompass the current range of thinking in cognitive science, including connectionist theories."[122]

Although such a conclusion is not accepted by all cognitive scientists today, it is accepted as valid and for the methods that will be applied in this study. The most important terms utilized by CRUM here are "representational structures" and "computational procedures." According to CRUM, with these concepts, data structures can be converted into representational structures and computational procedures in computable models. CRUM proposes exemplary models that work together with these methods:

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[121] Stanford Encyclopedia of Philosophy: https://plato.stanford.edu/entries/cognitive-science/.

[122] Paul Thagard, "Representation and Computation," in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), pp. 10.

"Comprehension of cognitive science models requires noting the distinctions and the connections among four crucial elements: theory, model, program, and platform. A cognitive theory postulates a set of representational structures and a set of processes that operate on these structures. A computational model makes these structures and processes more precise by interpreting them by analogy with computer programs that consist of data structures and algorithms. Vague ideas about representations can be supplemented by precise computational ideas about data structures, and mental processes can be defined algorithmically. To test the model, it must be implemented in a software program in a programming language such as LISP or Java. "[123]

That is, models, express the rules hidden in the created data structures by computable representations and calculations. Such expression is necessary for model to be tested. Models play a transitional role between data and program, as well as between decoding and encoding.

In this chapter, the study advances to the second phase of cognitive curation: model collection. This chapter answers the question of how to encode the campus's architectural elements and relationships with representational structures and computational procedures after having decoded them in the previous phase of cognitive curation. With this aim, two sub-sections follow related to the acts of representing and computing data structures in model collection.

4.1 Representational Structures

A mental representation, or cognitive representation, is a mental form of information in the mind or elements that constitute thinking and behavior. Theories of mental representations have contributed to the understanding of the mind with the awareness

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[123] Ibid., 13.

that there is no exact single form of them.[124] This is because it is not exactly known what kinds of mental representations the human mind has. On the other hand, representational structures are artificial cognitive depictions of mental representations. Although some cognitive scientists claim that these structures are similar to mental representations, others argue that they are only tools produced to provide computable versions for computers and they cannot possibly be similar to mental representations. Likewise, the mental representations of an architect cannot be known, but architectural representational structures can be produced for computable environments. Thus, it is necessary to produce the representational structures of architectural elements, which are considered as fixed elements in architectural unity, in order to produce computational procedures in a computer environment. Architects have conventional as well as computer-based media to simulate (both to represent and to test) their own cognition: architectural drawings. The first element of this section will accordingly analyze architectural drawings for architects' mental representations (Chapter 4.1.1) and will then discuss computable representational structures for cognitive curation of campus architecture (Chapter 4.1.2).

4.1.1 Translation from Drawing to Building

Architectural drawing serves as a tool encompassing drawing in many different forms, such as sketches, diagrams, and technical drawings[125] (plans, sections, elevations, and axonometric drawings). These different forms have different capacities for depicting architectural mental representations or architectural thinking. In the literature, they are described as "translations" or "simulations" of architectural

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[124] Ibid., preface.

[125] Sometimes this is called application or construction drawing, as well.

thinking. According to the influential essay "Translations from drawing to building" by Robin Evans, an architect and historian, translation is defined as follows:

> "To translate is to convey. It is to move something without altering it. This is its original meaning and this is what happens in translatory motion. Such too, by analogy with translatory motion, the translation of languages. Yet the substratum across which the sense of words is translated from language to language does not appear to have the requisite evenness and continuity; things can get bent, broken or lost on the way."[126]

Evans further explains that an architect's thinking is not transformed into a drawing by pointing out the gaps or translations between architectural drawings and buildings, plans and occupancy, or projections and imagination, because the idea is bent, broken, or translated. In fact, Evans supposes that architectural drawings are responsible for allowing the architect to spill out his or her imagination, mostly referring to construction drawings in the cognitive process of design. On the other hand, according to Mark Alan Hewitt, an architect and architectural historian with close ties to the field of the history of architectural drawing (in his own words: the medium of thought), the images or concepts in the minds of designers need some kind of external symbol system in the cognitive process of design. While cognitive scientists focus on computational theory of mind (CTM), Hewitt declares that the process of designers does not have a strict physical representation similar to CTM's cognitive symbol system in his essay "Sketches as cognitive traces," in which he analyzes the connection between drawings, cognitive patterns, and memory in the work of Alvar Aalto.[127] Hewitt also refers to the art and design cognition studies of Vinod Goel:

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[126] Robin Evans, "Translation from Drawing to Building," in *Translation from Drawing to Building and Other Essays* (London: Architectural Association, 1997), pp. 150-160.

[127] Mark Alan Hewitt, "Sketches as Cognitive Traces: Alvar Aalto at Imatra," Research Gate, January 2019,

> "He argues persuasively that designers, confronting physical problems, must employ a wide range of symbolic representations in order to solve cognitive puzzles such as the design of buildings. Moreover, ―different symbol systems correlate with different cognitive phases which in turn are associated with different cognitive processes. If an architect is exploring alternative plan diagrams, he will employ plan sketches and draw on examples from his memory of previous plans. images. Later, during design development and construction drawing phases, architects are drawn to more conventional linguistic modes of thought, because the information that must be assimilated into designs is often coded in written language or mathematics."[128]

The conclusion that can be drawn from this quotation is that architects have different translation systems in different forms of drawings, such as sketches versus technical drawings. Hewitt points out that sketches can depict architects' mental processes more than technical plans, sections, or elevation drawings because sketches can give more references regarding previous architectural experiences or the thoughts of the architects. Similarly, Robin Evans supposes that architectural thinking should be inherited in the translation from technical drawings to buildings without losing this power. In addition, in the introduction of "Translations from Drawing to Building and Other Essays", it is stated that Evans evaluates drawings as a device for thinking and imagining, being fascinated by the difference between the architect's and the artist's use of drawings. According to him, the architect's use of drawings is a device for translation toward the act of building and exploration of architectural form.[129] Spyros Papapetros also expands on the significance of architectural drawings in her short essay entitled "Architects' drawings/artists' buildings" in the book, "Retracing

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researchgate.net/publication/334317952_SKETCHES_AS_COGNITIVE_TRACES_ALVAR_AALTO_AT_IMATRA.

[128] Ibid.

[129] Robin Evans, "Translations from Drawing to Building," in *Translations from Drawing to Building and Other Essays* (London: Architectural Association, 1997), pp. 150-160.

the Expanded Field: Encounters between Art and Architecture."[130] At the beginning of this essay is a drawing of the Fargo Moorhead Cultural Center Bridge by Michael Graves (Figure 4.1), which is self-descriptive of the essay's theme. After explaining the sculpture, Papapetros states the following:

> "Artists and architects somehow changed places, so that those who formerly concerned themselves with building, now draw, while those who formerly drew, now build."[131]

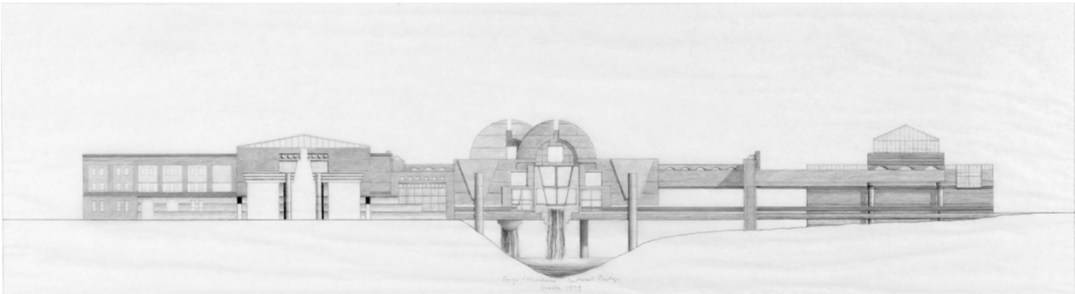

Figure 4.1. Fargo Moorhead Cultural Center Bridge by Michael Graves [132]

She further stresses that architects' drawings are now not only tools of translation from drawings to buildings. They are also tools for the expression of architectural thinking. Therefore, architects' drawings, sketches, and technical drawings can all depict mental representations, as Krauss, Evans, and Hewitt claim.

As a result, conventional representational structures, or architectural drawings, are among the depictions of mental representations of architects. They also bear traces of architectural thinking. However, this also shows that mental representations in the

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[130] Spyros Papapetros et al., "Architects' Drawings/Artists' Buildings," in *Retracing the Expanded Field: Encounters between Art and Architecture* (Cambridge, MA: MIT Press, 2014), pp. 107-120.

[131] Ibid, 112.

[132] Ibid, 107.

mind are not just numbers, texts, or images, but rather compositions of these. Architects' processes of design occur mostly through "mental pictures." Mark Alan Hewitt, who studies the cognitive history of architectural design, states the following:

> "Moreover, generating visual concepts engages the visual cortex in concert with other areas of the brain, but may not necessarily engage the language and number processing areas of the left hemisphere. Images captured in long-term memory are commonly seen as mental "pictures" that help to generate artistic compositions."[133]

According to Hewitt's neuroscientific and psychological research, architectural drawings prove that the minds of architects are not working just like mathematical computation; they work with mental representations:

> "He argues persuasively that designers, confronting physical problems, must employ a wide range of symbolic representations in order to solve cognitive puzzles such as the design of buildings. Moreover, "different symbol systems correlate with different cognitive phases which in turn are associated with different cognitive processes." If an architect is exploring alternative plan diagrams, he or she will employ plan sketches and draw on examples from memory of previous plans. It is unlikely that the designer will engage left cortical areas concerned with language processing while doing this. He or she won't need logical operators or subject-predicate pairs in this type of thinking." [134]

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[133] Mark Alan Hewitt, "Mimesis, Memory, and Enactment," in *Draw in Order to See a Cognitive History of Architectural Design* (San Francisco: ORO Editions, 2020), pp. 61-62.

[134] Mark Alan Hewitt, "Mimesis, Memory, and Enactment," in *Draw in Order to See a Cognitive History of Architectural Design* (San Francisco: ORO Editions, 2020), pp. 61-62.

4.1.2 Representational Structures for the METU Campus' Architectural Elements

Architectural drawings are influential for cognitive curation to produce its own computable representational structures. In the case of the METU campus, mental representations of campus architects can be extracted cognitive traces from sketches and technical drawings (Figure 4.2). In elementicular, technical drawings have the necessary information to produce computable representational structures. For example, the building of the METU Faculty of Architecture was documented in the scope of the "Keeping It Modern" Project in 2020. The outcomes of that research were presented as 3D BIM models with the help of Autodesk Revit software (Figure 4.3).

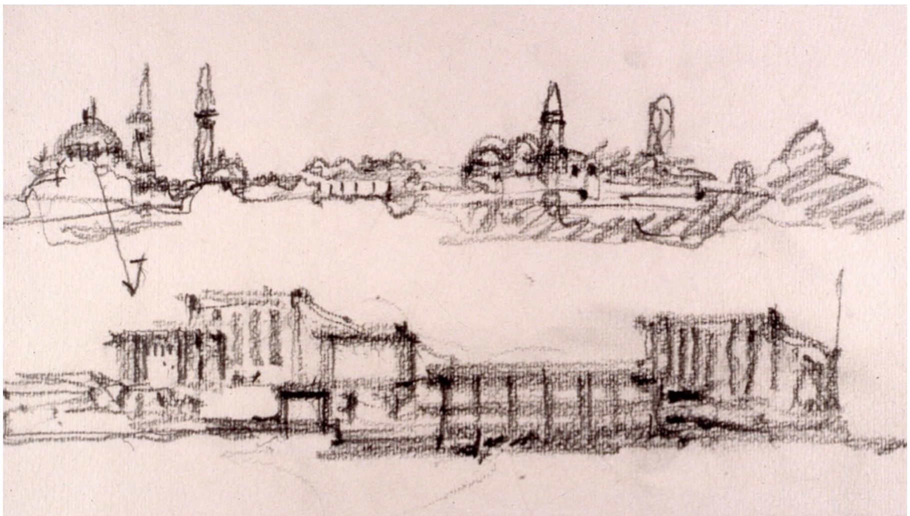

Figure 4.2. Sketches by Altuğ and Behruz Çinici[135]

[135] "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

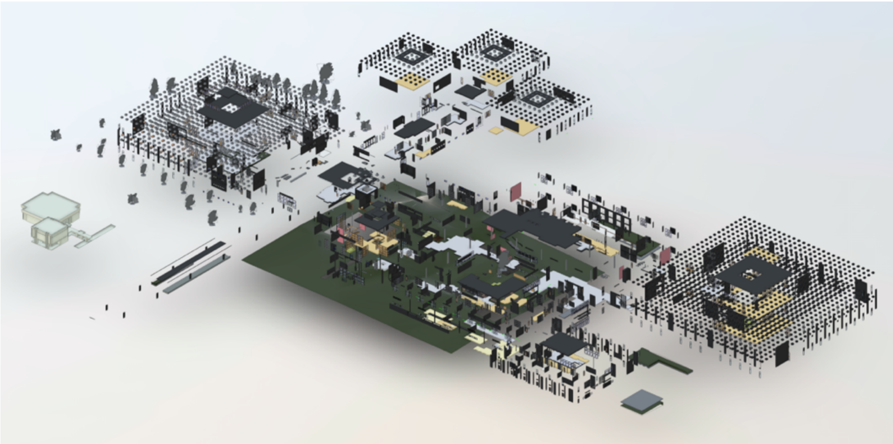

Figure 4.3. Exploded Revit model of the Faculty of Architecture building complex[136]

With the help of Revit, architectural elements of the METU campus and their properties, namely data and attributes, that were described in the first stage of cognitive curation can be encoded by generating a single geometry. In other words, decoded, collected, and organized data structures are encoded with computable representational structures for further processes of cognitive curation. This is applied

[136] The HBIM model and many informations are availbale in interact section of the project website http://kimproject.arch.metu.edu.tr/en/gallery/interact-0

to the entire campus and the lodging area in the same way as in the "Keeping it Modern" Project (Figures 4.4 and 4.5).

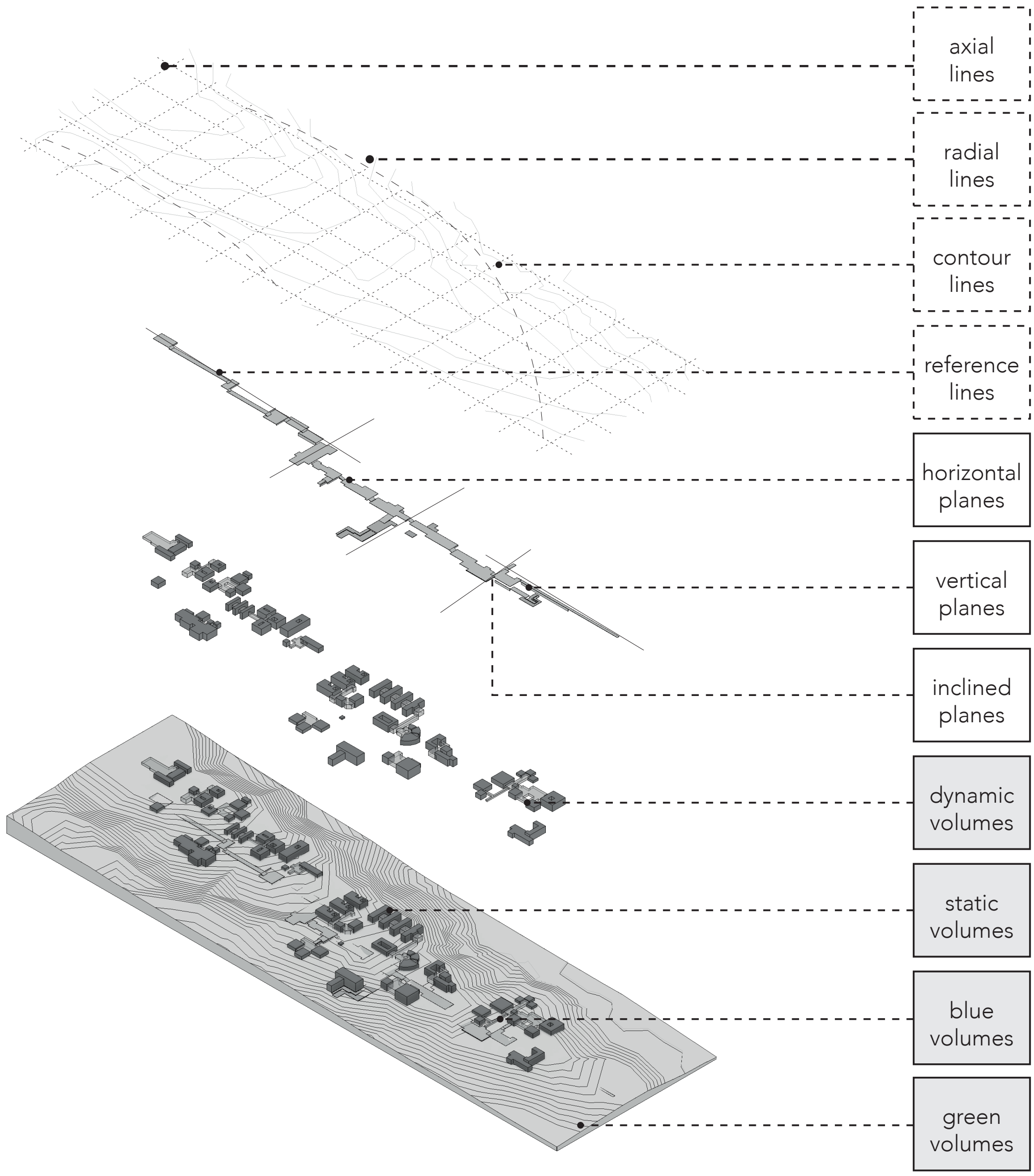

Figure 4.4. Representational structures of the educational zone of the METU campus for campus scale[137]

[137] Produced by the author with Autodesk Revit.

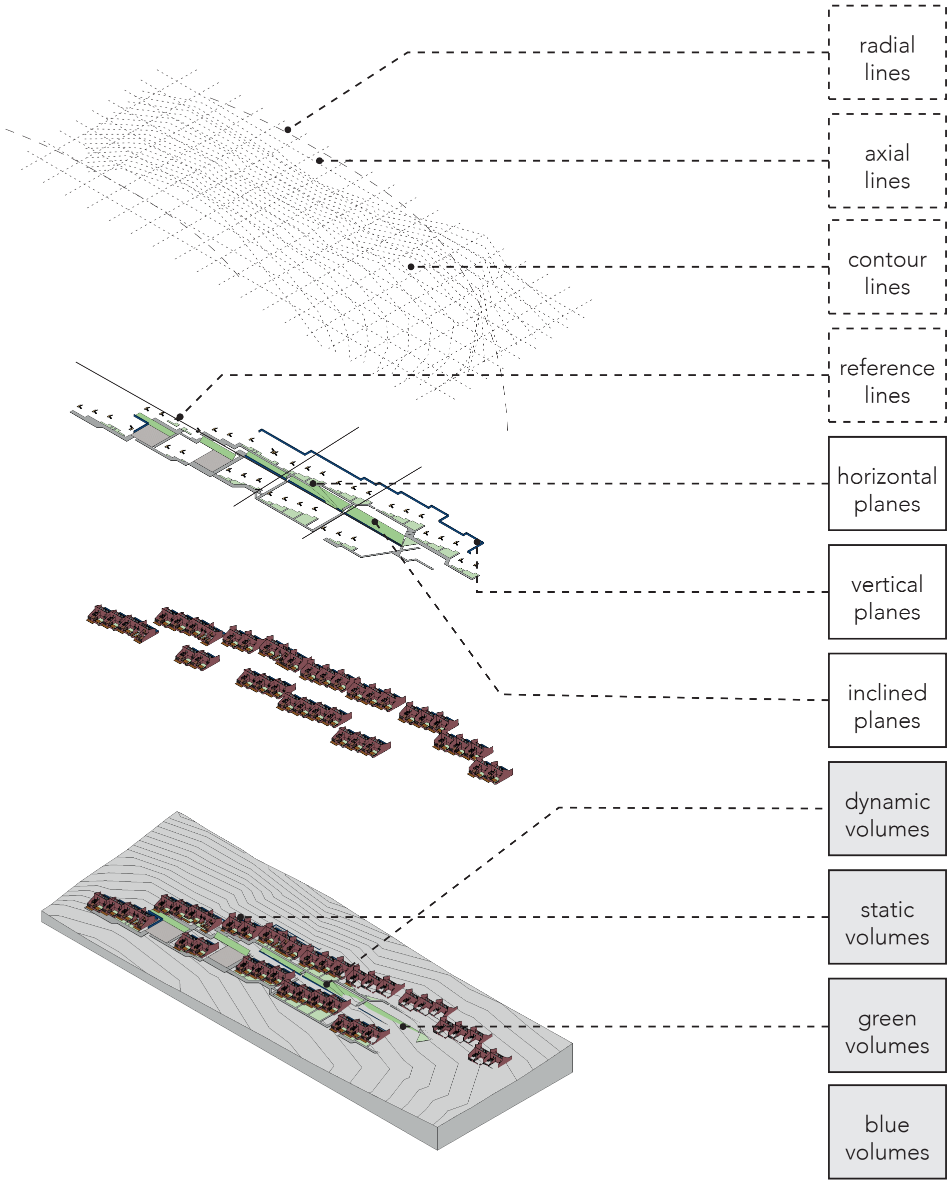

Figure 4.5. Representational structures of lodgings of the METU campus for unit scale[138]

However, these representational structures of the METU campus' are not sufficient to show both architectural elements and relationships together. They can only encode the architectural elements in the collected and decoded data structures (Figure 4.6).

[138] Produced by the author with Autodesk Revit.

The representations of the elements mentioned in this chapter can produce the computable models (or model collections) required for the program only if they are blended with the computational procedures of the architectural relationships of the METU campus. The representational structures here help to examine the combinations of different elements one by one (Figure 4.7).

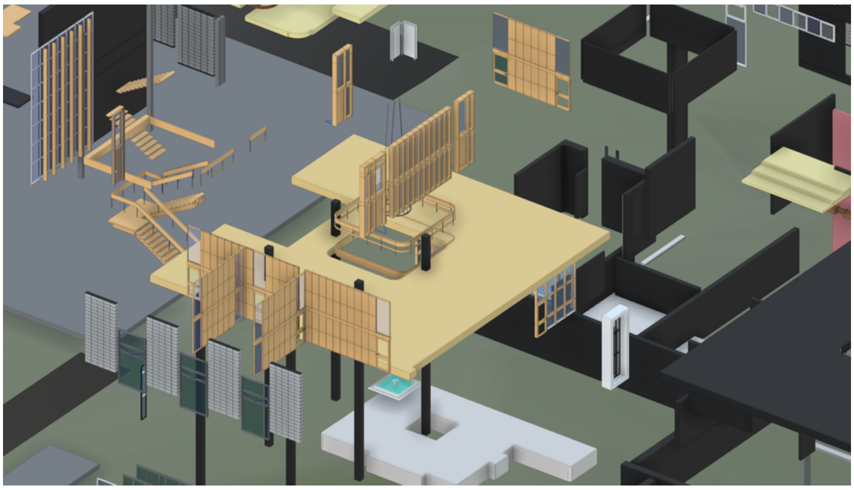

Figure 4.6. Representational structures of architectural elements of the Faculty of Architecture building complex[139]

[139] Retrieved from the HBIM model of the Faculty of Architecture building complex

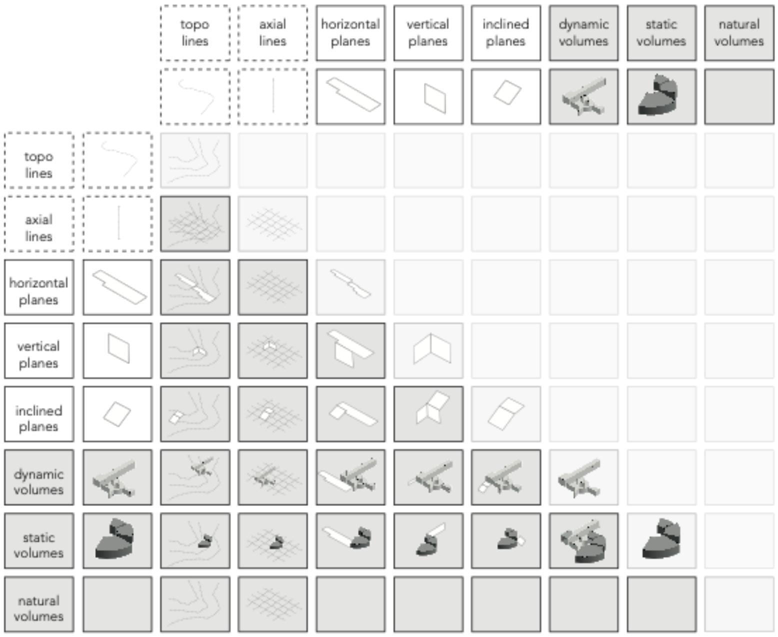

Figure 4.7. Representational structures of clusters having two architectural elements[140]

4.2 Computational Procedures

According to cognitive scientists, “People have mental procedures that operate on mental representations to produce thought and action”[141] and there are different kinds of mental procedures for different mental representations. For this reason, cognitive science produces “computational procedures” that can imitate mental ones with the help of computers. The aforementioned procedural processes are also defined as algorithms. They are reasons or rules for representational structures to come together. Thus, they are described as the second component of computable models. In architecture, as stated for the previous phase of cognitive curation, architectural

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[140] Produced by author.

[141] Paul Thagard, “Representation and Computation,” in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), p. 5.

relationships are the rules or reasons for architectural elements to come together. While representational structures prepare the architectural elements for a computable environment, the computational procedures enable the architectural relationships to be computable, too. Therefore, the blend of representational structures of campus architectural elements and computational procedures of campus architectural relationships constitutes the second phase of the cognitive curation of the METU campus: model collection. This section of the study will detail the relevant methods and algorithms of cognitive science (Chapter 4.2.1) and provide a sample computational procedure for selected elements of the campus (Chapter 4.2.2).

4.2.1 Algorithms and Cognitive Methods

Computational procedures are computable representations of algorithms. An algorithm is abstract and distinct from its representation.[142] It is a process or set of rules or well-defined instructions. They can be defined with mathematical/computational expressions or with computable models and programs that use computational procedures, or representations of algorithms (Figure 4.8). In cognitive science, there are specific methods and algorithms for the understanding of the mind: logic, rules, concepts, analogies, images, and neural connections.[143] These methods, and as well as this study, mainly use repetitive computational algorithms which can be expressed with computable iterative and recursive computational procedures for curating architecture of the METU campus.

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[142] J. Glenn Brookshear and Dennis Brylow, "Algorithms," in *Computer Science: An Overview* (Harlow: Pearson, 2020), p. 262.

[143] Ibid., 19.

computational expression of factorial:

$$\prod_{i=1}^{N} i = 1*2*3*...*N$$

iterative computable expression of factorial:

```
(defun factorial (n)
   (let ((f 1))
      (dotimes (i n)
         (setf f (* f (+ i 1))))
      f
   )
)
```

recursive computable expression of factorial:

```
(defun recursive-factorial (x)
   (if (<= x 1)
      1
      (* x (recursive-factorial (- x 1)))))
```

Figure 4.8. Sample algorihm with computational and computable iterative and resursice expressions[144]

4.2.2 Computational Procedures for the METU Campus' Architectural Relationships

Representational structures of architectural elements were previously produced with 3D software. Such 3D representational structures of the METU campus's architectural elements retain data about length, geometry, volume, area, and angle. In this section of this chapter, the computational procedures for the architectural relationships established between architectural elements will be explained. These computational procedures may not always correspond to mathematical operations because the human mind does not always work like a computational algorithm. In this regard, CRUM proposes different theoretical approaches, such as formal logic, rules, concepts, analogies, and connectionism. In accordance with theoretical approaches, two selected methods for the computational procedures for architectural relationships will be utilized for two selected areas of the METU campus, namely

[144] In order to improve computable skills for thesis, lessons were taken from METU, Graduate School of Informatics, Cognitive Science, COGS502 Symbols and Programming Course.

the building of the Faculty of Architecture and the lodgings area. These computational procedures for the architectural relationships and the representational structures of the architectural elements locate themselves as a model in the program, as will be elaborated upon in the next chapter.

The theoretical approach, which is called rules, is suitable for the lodgings area of the METU campus. Here the same unit repeats according to a set of rules. Therefore, in the rule-based theoretical approach suggested by CRUM, it can be tracked with the *IF-THEN* structure.[145] The explanatory scheme of this theoretical approach is as follows:

> "Explanation target: Why do people have a elementicular kind of intelligent behavior?
>
> Explanatory pattern: People have mental rules. People have procedures for using these rules to search a space of possible solutions, and procedures for generating new rules. Procedures for using and forming rules produce the behavior."[146]

In order to predict these kinds of rules, this study compares different scale drawings that the architects used to reflect their design decisions about the lodgings of the METU campus. By considering these 1/1000 scale drawings, it is seen that the architects generated modules in the direction of the decrease of the slope of the land. They clustered the modules in contiguous positions (Figure 4.9).

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[145] Paul Thagard, "Rules," in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), p. 44.

[146] https://plato.stanford.edu/entries/cognitive-science/#Rul

> "In the metu Lodgings there is actually a repetitive idea of the same unit, where the "public" takes place mainly in the patio/courtyard."[147]

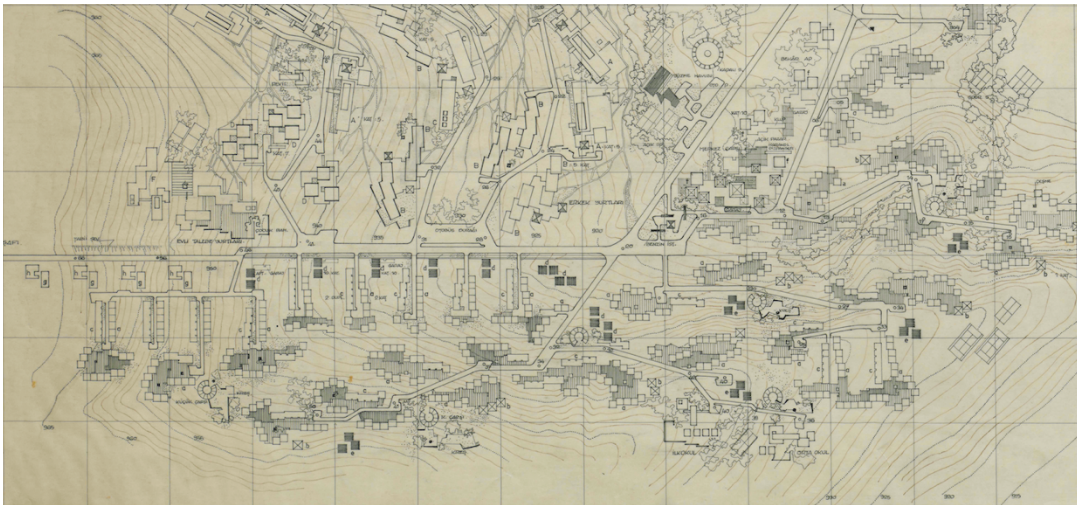

Figure 4.9. Initial design idea for campus lodgings at 1/1000 scale[148]

Later, when the architects detailed these drawings as needed, they created a 1/200 site plan for 18 units in the first phase (Figure 4.10). For the second phase, they added 21 more units, indicating this addition in the 1/500 site plan drawing (Figure 4.11). But, just 10 of them are constructed in the second phase.

[147] Max Risselada, "House vs Housing," in *Diamonds in Sahara: Metu Lodgings Documented,* ed. Ayşen Savaş (Ankara: Middle East Technical University, Faculty of Architecture, 2018) p. 86.

[148] "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

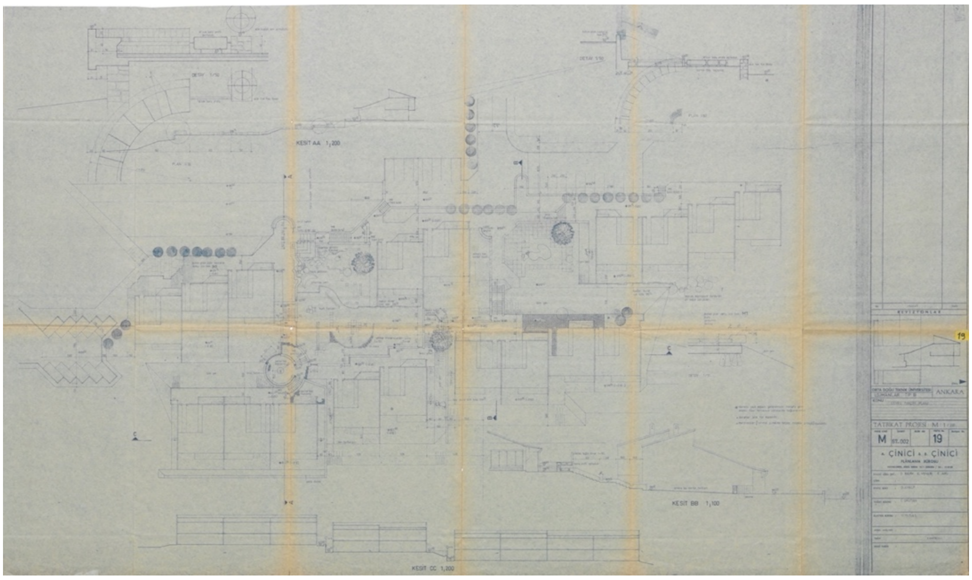

Figure 4.10. Site plan drawings for lodgings at 1/200 in the first phase[149]

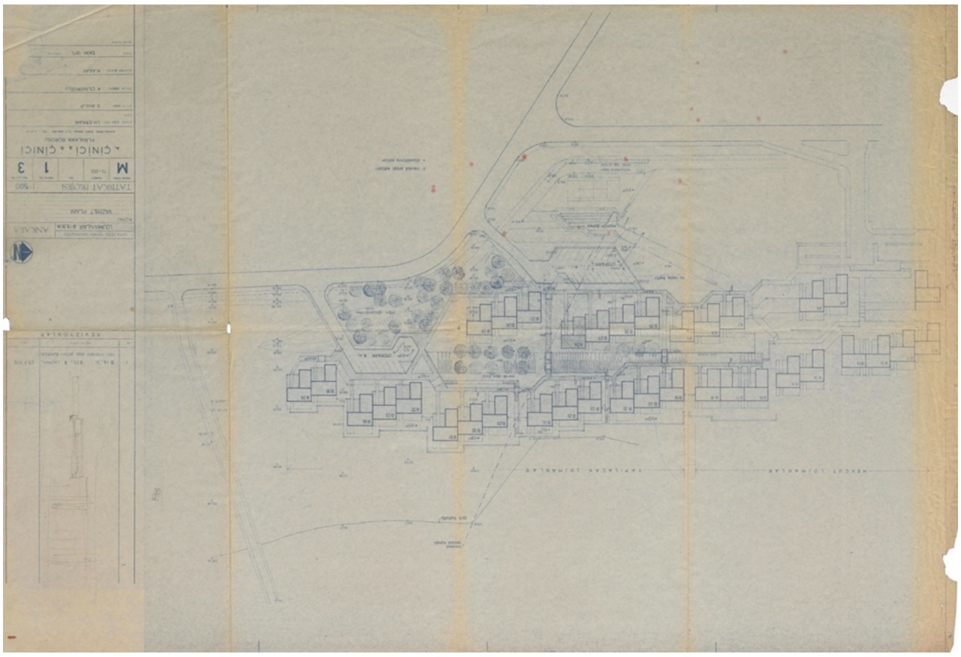

Figure 4.11. Site plan drawings for lodgings at 1/500 in the second phase[150]

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[149] Ibid.

[150] Ibid.

Based on these architectural drawings of the METU campus, the architectural relationship between architectural elements is not always constructed in the same sequence, but the units are articulated to each other with two prior algorithms. A new unit sticks to the previous unit by shifting 3 meters or reflecting itself without shifting. At this point, two functions are defined as “shift” and “mirror,” but the general articulation depends on a condition of the IF-THEN structure. According to the model created with representational structures, it is clarified that IF the slope of the land under the new unit is the same as that for the previous unit, THEN the new units stick with the “shift” function. Otherwise, IF the slope of the land under the new unit is lower than that for the previous unit, THEN the new units stick with the “mirror” function. These computational procedures can be illustrated with mathematical algorithms (Figure4.12):

```
f : n ---> n'
f(n) = f(n-1) + 1111

g: n ---> n'
g(n) = g(n-1) + 300

shift: n ---> (x,y)
shift(n) =  n = 0,  (0,0)
            n > 0, (f(n) , g(n))
```

```
f : n ---> n'
f(n) = f(n-1) + 2222

g: n ---> n'
g(n) = g(n)

mirror: n ---> (x,y)
mirror(n) =  n = 0,  (f(n) , 0)
             n > 0, (f(n) , g(n))
```

```
aggregate: n --> (x,y)

n = aggregation times
d = difference between contour
(x,y) = coordinate of points
shift(n) = conditional function
mirror(n) = conditional function

aggregate (n) =  d=0, shift(n)
                 d>1, mirror(n)
```

Figure 4.12. Computational procedures of IF, THEN structure for the METU lodgings[151]

In the book “Mind: Introduction to cognitive science” it is elaborated that the rules do not proceed in a linear fashion. Rather, they are both iterative, repetitive and simultaneous:

[151] Produced by the author.

> "Computational power: Computer scientists and psychologists make an important distinction between serial processing, in which thinking proceeds one step at a time, and parallel processing, in which many steps occur at once. Rule-based processing can be either serial, with one rule being applied at a time, or parallel, with many rules being applied simultaneously."[152]

Therefore, there is more than one lodging algorithm for this area. There are many, and they are running simultaneously. The second computational procedure method for the campus, that of combination of "connectionists" and "images," are applied for the building of the Faculty of Architecture. In this building's complex, the reasons or rules for coming together recall some pieces that are embedded in the cognition of the campus architecture. We see the repetition of image-based rules, which are seen many times on campus, in this scale in the plan sections. The architects inspected, found, zoomed, and transformed images in these complex many times (Figure 4.12)[153]. We seem to be able to alter and combine visual representations in powerful ways, including flipping and juxtaposing them, as well as rotating them. The explanatory scheme of the image-based method for computational procedures may be explained as follows:

> "Explanation target: Why do people have a elementicular kind of intelligent behavior?
>
> Explanatory pattern: People have visual images of situations. People have processes such as scanning and rotation that operate on those images. The

---

[152] Paul Thagard, "Rules," in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), p. 46.

[153] It is stated as: "Visual and other kinds of images play an important role in human thinking. Pictorial representations capture visual and spatial information in a much more usable form than lengthy verbal descriptions. Computational procedures well suited to visual representations include inspecting, finding, zooming, rotating, and transforming. Such operations can be very useful for generating plans and explanations in domains to which pictorial representations apply."

processes for constructing and manipulating images produce the intelligent behavior."[154]

In order to predict these kinds of image cognition, this study compares different scale drawings that the architects used to reflect their design decisions about plan of the Faculty of Architecture building complex. By considering these 1/1000 scale drawings, it is seen that the architects generated alley with different scales (Figures 4.13 and 4.14).[155]

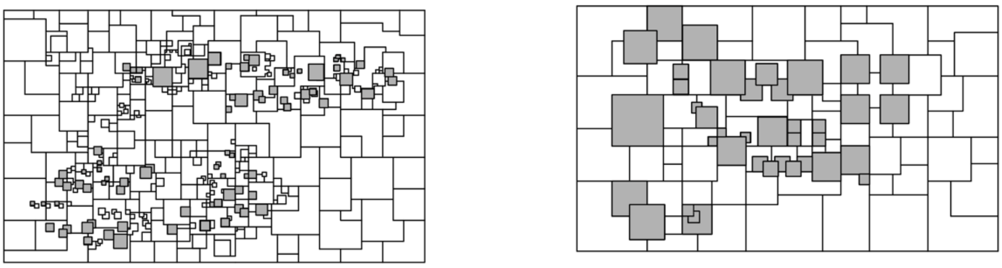

Figure 4.13. Similar image-based blocks cognition in the design process between campus and faculty

Figure 4.14. Similar image-based alley cognition in the design process between campus and faculty

[154] Paul Thagard, "Images," in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), p. 107.

[155] Will be detailed in the chapter 5

CHAPTER 5

PROGRAM DISPLAY

"Program display" is the third and final phase of cognitive curation. It progresses cumulatively based on the other phases of data collection and model collection. In the data collection phase, architectural information located conventionally in archives and libraries was transformed into a computer-based, data-driven format. For this transformation, campus integrity was examined together with the concept of unity, which is an ontological theory, in order to disassemble the architectural unity into data. The data of the architectural elements and relationships obtained according to that review were organized with data structures. In the model collection phase, the representational structures of the data for architectural elements and the computational procedures of the data for architectural relationships were created in computable models. Finally, in the program display phase, an architectural design process will be encoded due to these computable models and data structures. Thus, this study asserts that it is possible to progress from decoding to encoding the architectural unity of the METU campus through comprehensive, collaborative, transdisciplinary, and computationally engaged architectural simulations as tools of cognitive curation.

Referring back to the origin of simulation, the term "simulation" was expressed by the French theorist Jean Baudrillard in his influential book "Simulacra and Simulation" in 1981. According to him, simulation is what people call reality today. Because humans have recreated "new reality" (simulation) with symbols and signs. *Simulacra*, on the other hand, are for those who have no reality anymore, and whose only reality is *simulation*.[156] Knowing the philosophical meaning of simulations and considering the campus from this perspective, the architectural *reality* can be taken as physical campus, the *simulation* can be taken as architectural drawings of the architects, and *simulacra* can be taken as the things inside the document but not exist in the campus such as unbuilt buildings in the drawings from the competition. This study recreates the new contemporary "architectural reality" (simulation) of campus architecture with the computational tools of data, models, and programs (symbols and signs).

In cognitive science, "programming" is the phase that seems like the end but actually provides feedback to the previous phases in order to produce accurate predictions about the simulation in the transformation of human thinking into behavior. Programs can contribute to improving the models and data structures by showing that the process is representationally and computationally realizable with simulations.[157] At the same time, due to the computable context of the programs, they can be a element of display environments since the representational-computational "display" of cognitive curation can be an active, responsive, data-driven, appendable way of presenting this process.

Programs need software so that computable data and models can be tested and presented. Although there are many software options for operating programs, it is more appropriate to program the architectural data structures and architectural models in a three-dimensional environment, since the study object is architectural. For this reason, textual programming software choices such as Python, LISP, Java are not enough to model representational structures and computational procedures together. In response to this concern, there are many software options for three-

[156] Jean Baudrillard, "The Precession of Simulacra," in *Simulacra and Simulation*, trans. Sheila Faria Glaser, 1981, p. 3.

[157] Paul Thagard, "Representation and Computation," in *Mind: Introduction to Cognitive Science* (Cambridge, MA: MIT Press, 2005), p. 14.

dimensional visual programming.[158] For example, representational structures can be created in Autodesk Revit, and computational procedures can be processed in Dynamo, which is an extension of Revit. Similarly, Grasshopper provides a visual programming environment that runs within the Rhinoceros three-dimensional computer-aided design (CAD) application. (Figure 5.1.)

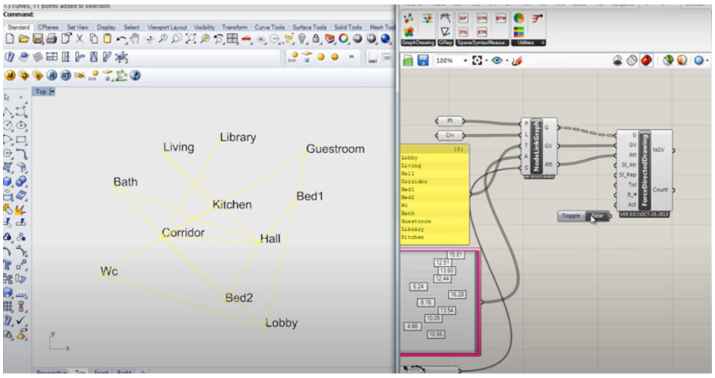

Figure 5.1. Rhinoceros-Grasshopper software interface shows representational structures(left) and computational procedures(right)

In this chapter, this study concludes with the final phase, program display, of the cognitive curation. This chapter answers the question of how to encode/program/simulate campus architecture with computable data structures and models. It illustrates this process for two selected areas of the campus: the METU lodgings (Chapter 5.1) and the the building complex of Faculty of Architecture (Chapter 5.2).

[158] Visual programming can consist textual programming as well.

5.1 METU Lodgings: Aggregating Units

The aggregation of units in architecture is an understanding that first appeared dominantly as a design idea in modernism. Today, it is not only a design idea but also a combination of design, production, and manufacturing ideas in architecture. Curator and author Emmanuelle Chiappone-Piriou tracks the projective history of architectural aggregation in a book entitled *Discrete: Reappraising the Digital in Architecture*. According to the precedents in history, aggregation is a modern quest for rationalization, the search for numerical objectification of the design process, and the result of moving away from the tradition of subjectivity.[159] In order to sustain that kind of query, modernism operates with ultimate rational tools such as grids, assemblies of autonomous architectural elements, and architectural rules. With this momentum in modernism, the aggregation of today covers design, production, and assembly with that kind of rationality.

The lodgings of the METU campus are among the examples of modern unit-based aggregation. The METU lodgings were designed by combining local materials and architectural styles with rational grids, autonomous architectural elements, and computational assembly rules, or, in other words, with architectural cognition. For this reason, the METU lodgings are an appropriate display object of cognitive curation in this study. This study applies all phases of cognitive curation to prove that the METU lodgings are one of the precedents in the history of architectural aggregation. For this, it collects architectural information from conventional sources, transforming the architectural information about the METU lodgings into architectural data. This study refers to conventional types of sources about the

[159] Emmanuelle Chiappone-Piriou, "Et Alia: A Projective History of the Architectural Discrete," in ed. Neil Spiller and Gilles Retsin, *Discrete: Reappraising the Digital in Architecture*, Architectural Design Series No. 258 (2019), p. 80.

lodgings as follows: academic publications[160], exhibitions (Figure 5.2)[161], and archival drawings (Figure 5.3) and photographs (Figure 5.4).[162] For instance, the book, entitled "Diamonds in Sahara: METU Lodgings Documented", is the main source for this study to internalize the architectural, social, and academic value of METU lodgings.[163] The book presents eight articles and many documents from a display entitled "METU Lodgings Documented." Savaş states that these units could not stand up to time any longer and their materials began to change. Therefore, she indicates the necessity of archival and curatorial activities for the METU campus in general and for the METU lodgings specifically:

> "The exhibition was planned to be open for only one hour, and lodging#5, in which the exhibition was held, to be transformed into a "house museum" for only one day. The ultimate goal of this exhibition was to protect these houses; a new method of preservation was proposed to generate an awareness for their architectural and social values."[164]

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[160] Especially, the book "Diamonds in Sahara: METU Lodging Documented" was cited.

[161] Especially, exhibitions "METU Lodging DOCUMENTED: Representing Itself" at METU Lodging 5 and "The METU Campus Documented V: Representing Itself" at TU Delft were indicated.

[162] "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

[163] Ayşen Savaş, "METU Lodging: Representing Itself," in *Diamonds in Sahara: METU Lodgings Documented* (Ankara: METU Press, 2018), pp. 11-27.

[164] Ayşen Savaş and Agnes van der Meij, "Diamonds in Sahara," in *Diamonds in Sahara: METU Lodgings Documented* (Ankara: METU Press, 2018), p. viii.

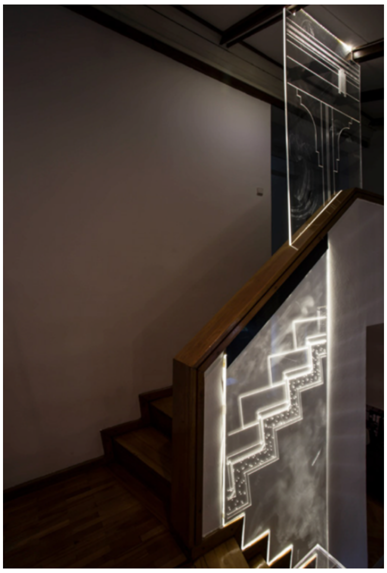

Figure 5.2. Museum for an hour[165]

Moreover, information from the exhibition and the book was supported by original archival documents such as architectural blueprints (Figure 5.3) and on-site construction photographs (Figure 5.4). Overall, the previous exhibitions help this study to contextualize one single unit in terms of architecture, and the previous publications and archival documents support this study in being able to decode and encode the architecture of the METU lodgings again. Finally, even if it is not built, the existing lodging aggregation in the drawings (see Figure 4.9 for architectural simulacra)[166], has a great contribution to the development of the architectural data, model, and program in the cognitive curation process.

[165] Ayşen Savaş, "Documents in Display II – Construction Photographs," in *Diamonds in Sahara: METU Lodgings Documented* (Ankara: METU Press, 2018), p. 98.

[166] Savaş states the condition as follows: "Only 28 houses in this original housing project were completed. The first 18 houses were in use in 1969 and the second stage was completed seven years later."

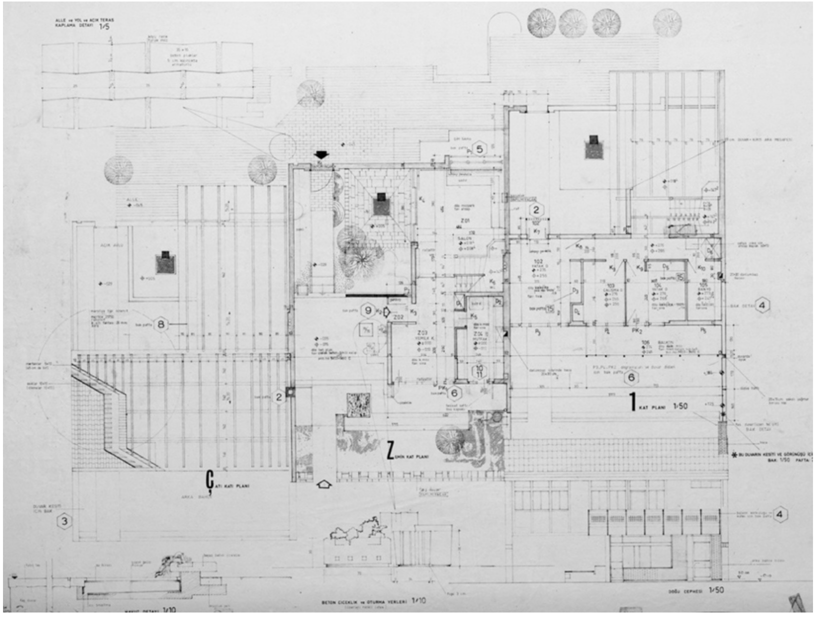

Figure 5.3. Original ground floor plan, first floor plan, and roof plan drawings of one lodging unit[167]

Figure 5.4. Construction photographs[168]

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[167] "Altuğ-Behruz Çinici Archive - Middle East Technical University," SALT Research, accessed November 1, 2021, https://archives.saltresearch.org/.

[168] Ayşen Savaş and Agnes Van der Meij, "Documents in Display II – Construction Photographs," in Diamonds in Sahara: Metu Lodgings Documented (Ankara: Middle East Technical University, Faculty of Architecture, 2018), p. 116.

With the help of conventional sources, the study begins to curate the architecture of the METU lodgings cognitively in a computable environment. Approaching the METU lodgings as an architectural unity, this study tries to determine the architectural elements and relationships of this assembly of lodgings. The data regarding the architectural elements and the attributes of these data are listed and clustered as described in Chapter 3 (Figure 5.5).

Category	Type	Material: Name	Material: Area	Material: Volume
Floors	pavement	Concrete Masonry,	7 m²	1.49 m³
Walls	B-21	Brick, Common	64 m²	13.46 m³
Walls	B-21	Brick, Common	5 m²	0.97 m³
Walls	T-10	Structure, Timber Jo	6 m²	0.60 m³
Walls	T-10	Structure, Timber Jo	1 m²	0.12 m³
Walls	B-21	Brick, Common	7 m²	1.57 m³
Walls	B-21	Brick, Common	4 m²	0.87 m³
Walls	B-21	Brick, Common	7 m²	1.42 m³
Walls	T-10	Structure, Timber Jo	2 m²	0.15 m³
Walls	T-10	Structure, Timber Jo	1 m²	0.15 m³
Walls	T-10	Structure, Timber Jo	2 m²	0.16 m³
Walls	B-21	Brick, Common	2 m²	0.34 m³
Walls	C-32	Brick, Common	2 m²	0.51 m³
Walls	T-8	Structure, Timber Jo	3 m²	0.22 m³
Walls	B-21	Brick, Common	8 m²	1.70 m³
Walls	B-21	Brick, Common	6 m²	1.26 m³
Walls	B-21	Brick, Common	4 m²	0.85 m³
Walls	S-50	Stone	13 m²	6.60 m³
Floors	pavement	Concrete Masonry,	49 m²	9.87 m³
Walls	S-50	Stone	1 m²	0.65 m³
Walls	B-21	Brick, Common	7 m²	1.57 m³
Floors	ceramic	TRS_M_Şap	29 m²	1.44 m³
Floors	ceramic	TRS_M_DT_100X1	29 m²	1.44 m³
Floors	laminated	TRS_M_Şap	26 m²	1.32 m³
Floors	laminated	TRS_M_Lamine	26 m²	1.32 m³
Floors	green	green	23 m²	4.58 m³
Floors	gravel	gravel	20 m²	4.07 m³
Floors	green	green	13 m²	2.56 m³
Stairs	Private	Oak Flooring	13 m²	0.29 m³
Walls	B-21	Brick, Common	4 m²	0.88 m³
Walls	B-21	Brick, Common	66 m²	13.81 m³
Walls	Walls 1	Default Wall	10 m²	0.59 m³
Curtain Panels	Glazed	Glass	1 m²	0.02 m³
Curtain Panels	Glazed	Glass	1 m²	0.02 m³
Curtain Panels	Glazed	Glass	1 m²	0.02 m³
Curtain Panels	Glazed	Glass	2 m²	0.05 m³
Curtain Panels	Glazed	Glass	2 m²	0.05 m³
Curtain Panels	Glazed	Glass	2 m²	0.05 m³
Curtain Panels	Glazed	Glass	2 m²	0.05 m³
Curtain Panels	Glazed	Glass	1 m²	0.04 m³
Curtain Panels	Glazed	Glass	1 m²	0.03 m³
Curtain Panels	Glazed	Glass	1 m²	0.04 m³
Curtain Panels	Glazed	Glass	1 m²	0.04 m³
Curtain Panels	Glazed	Glass	1 m²	0.04 m³
Curtain Panels	Glazed	Glass	1 m²	0.03 m³

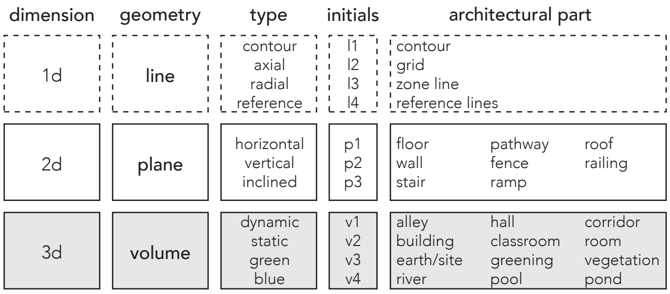
Figure 5.5. Sample of collected data regarding architectural elements for one lodging unit[169]

The architectural relationships between those architectural elements are listed to be evaluated (Figure 5.6). For example, in the sample list, architectural relationships with three architectural elements have started to be analyzed. In this way, every possible architectural relationship can be evaluated. Furthermore, the list produces many expressions about the inhomogeneity of the unity of the METU lodgings and it has been investigated what relations/architectural relationships will make this

[169] Produced by the author.

inhomogeneity homogeneous. Prof. Dr. Ayşen Savaş referred to these inhomogeneities as "binary oppositions" in "METU Lodging: Representing Itself":

> "The established demarcation between modern versus traditional, public versus private, transparent versus opaque, pitched versus flat was blurred in the competent juxtaposition of these "binary oppositions"."[170]



	geometry	type initials	description of the architectural link between architectural parts
1	line	l1,l2,l3	slope of the topography, grid and residential zone line
2	plane	p1,p2,p3	fence, entrance path, greening
3	plane	p1,p2,p2	entrance path, party wall, fence
4	volume	v1,v2,v3	green alley of the lodgings, livingroom, garden
5	volume	v1,v2,v1	garden, livingroom, alley
6	mix	l1,p2,v2	slope of the topography, fence, livingroom

Figure 5.6. Sample listing of the architectural relationships of the METU Lodgings

After the data of the architectural elements are collected computationally, or after the campus information is decoded, the data set must be put into a suitable computable format in order to be ready for encoding in programs in the phase of model collection. For this, architectural elements are transformed from the raw form in the Excel table into an informative form containing the data and all attributes in a 3D computer-aided environment (Figure 5.7).

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[170] Ibid., 13.

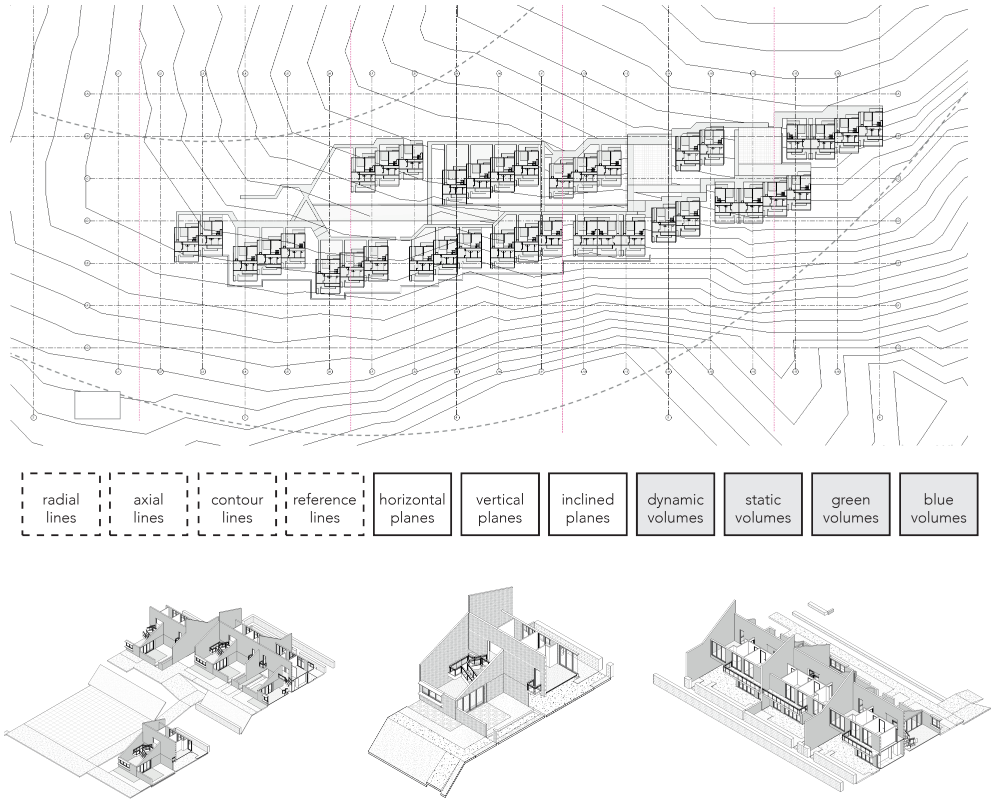

Figure 5.7. Representational structures of all types of architectural elements for METU lodgings by BIM

However, architectural computable models are not only limited to the representation of architectural elements; they also need computational procedures for architectural relationships in order for these elements to form a meaningful unity together. Since this study aims to understand how a unit is aggregated on another, first, the computational procedures of the architectural relationship between units can only be studied by bringing the elements of two units together (Figure 5.8).

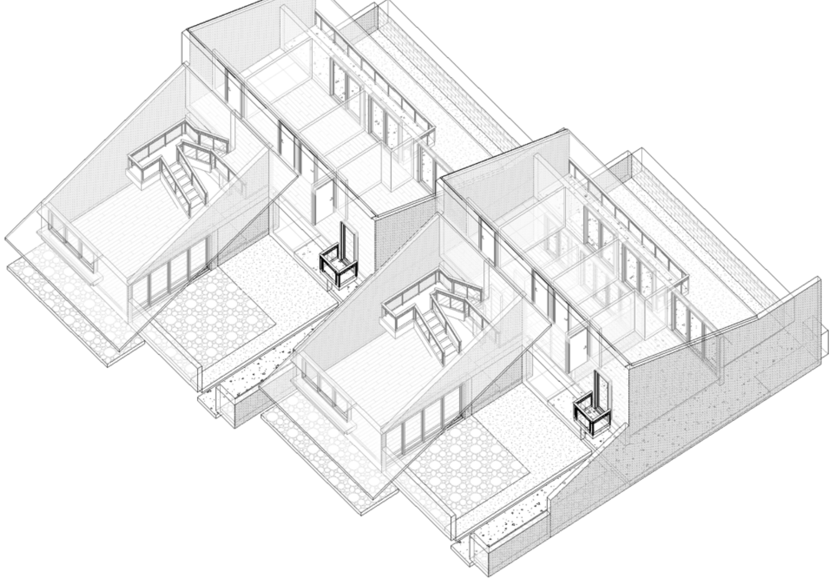

Figure 5.8. Representational structures of architectural elements of lodging unit by BIM

Two basic rules were determined for the two lodging units to come side by side: one of them was to be added by sliding it three meters and the second was to be added as a mirror reflection without sliding. These algorithms for aggregation models (Figure 5.9) were explained in Chapter 4, but models containing only these two basic rules or computations will not be enough to describe the whole design. In the list of architectural relationships, there are many possible relationships sets with different architectural elements.

```
f : n ---> n′
f(n) = f(n-1) + 1111

g: n ---> n′
g(n) = g(n-1) + 300

shift: n ---> (x,y)
shift(n) =  n = 0,  (0,0)
            n > 0, (f(n) , g(n))
```

```
f : n ---> n′
f(n) = f(n-1) + 2222

g: n ---> n′
g(n) = g(n)

mirror: n ---> (x,y)
mirror(n) =  n = 0,  (f(n) , 0)
             n > 0, (f(n) , g(n))
```

```
aggregate: n --> (x,y)

n = aggregation times
d = difference between contour
(x,y) = coordinate of points
shift(n) = conditional function
mirror(n) = conditional function

aggregate (n) =  d=0, shift(n)
                 d>1, mirror(n)
```

Figure 5.9. Sample algorithm models for aggregation programming

Although these algorithmic models run only one time, they give an idea about the need for aggregating by constantly looking at the previously aggregated units. Therefore, rule-based "recursive" algorithms are required, as also elaborated in Chapter 4. They perform each transaction by considering what has been produced so far. Thus, recursive models/rules can be run together at the same time in relation to the slope of the land, connection geometries of architectural elements, and the transitional alley. The computational procedures for the METU lodgings, which include many such models, cannot be described by just a few algorithms and they require high-level computational knowledge. For this reason, this study applies a programming script that contains ready-made aggregation models by Wasp:

> "Wasp is a Grasshopper plug-in, developed in Python, offering combinatorial tools to design with discrete elements. The description of each element includes all information necessary for the aggregation process (element geometry, connections location and orientation). The connections define the topological graph of the element, which is used to define the possibilities of aggregation with other elements. Wasp offers a series of aggregation procedures, allowing geometry- and data-driven generation of structures.

Additionally, it provides tools for constraining the resulting aggregation, both at the local and global level, as well as utilities to visualize and process it."[171]

Before the aggregation process is started, representational structures of the architectural elements (by geometry) and their connection attributes (by points and normal vectors) are defined as follows with model-I in a visual programming environment with the Wasp plug-in so that all unit data can be run with the algorithm (Figure 5.10). The possible locations where each defined lodging unit can be aggregated on the land are then determined, depending on the topographical slope (dark gray) and green alley positioning (light gray) by model-II (Figure 5.11). The final model, model-III, in which aggregation simulation can be done, runs with the previous models, model-I and model-II, with a rule generator (Figure 5.12).

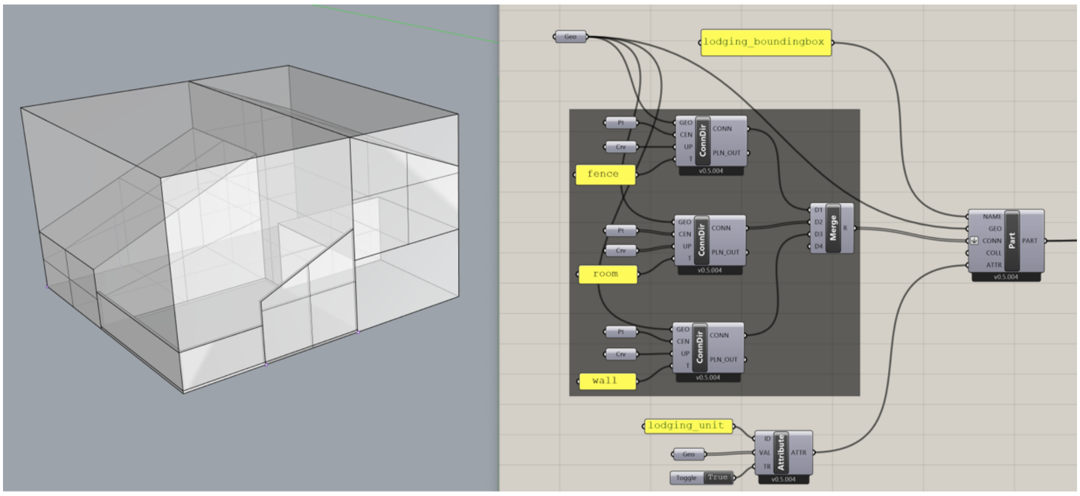

Figure 5.10. Representational-computational model-I (definition of architectural elements,attributes, bounding box of one unit) in a visual programming environment[172]

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[171] https://www.food4rhino.com/en/app/wasp

[172] Adoped from WASP open source aggregation programming.

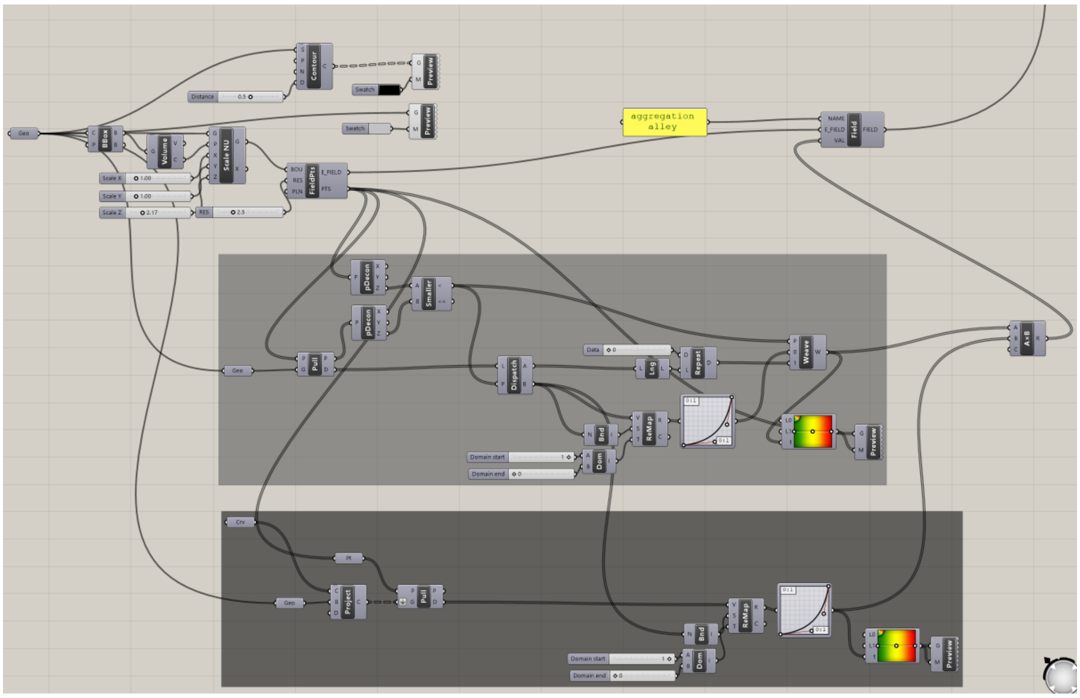

Figure 5.11. Representational-computational model-II (aggregation field definition with roads and slope) in a visual programming environment[173]

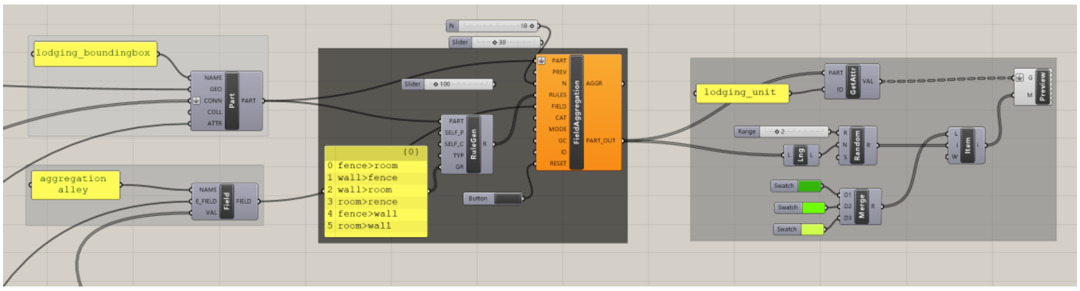

Figure 5.12. Representational-computational model-III (agreegation by elements and field) in a visual programming environment [174]

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[173] Adopted from WASP open-source aggregation programming.

[174] Adopted from WASP open-source aggregation programming.

Combining data, data structures, representational-computational models, and simulative programs gives the simulation results for feedback to previous phases of the cognitive curation. The simulation is good at checking the aggregation path for the slope and roads, but it only works if a starter unit is placed correctly. This situation brings with it the claim that design has a starting point, but as far as it is known, the METU lodgings do not have a starting point. The second challenging element is related to the rule generator model for Wasp. In the first phase of cognitive curation, the architectural relationships are established between two, three, or multiple architectural elements. In the computable model, however, the rule generator allows the relationships to be established between only two architectural elements.

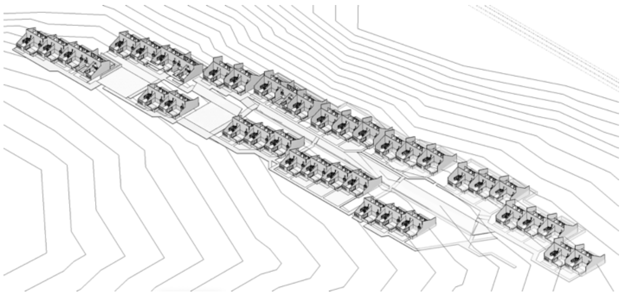

Figure 5.13. Expected result

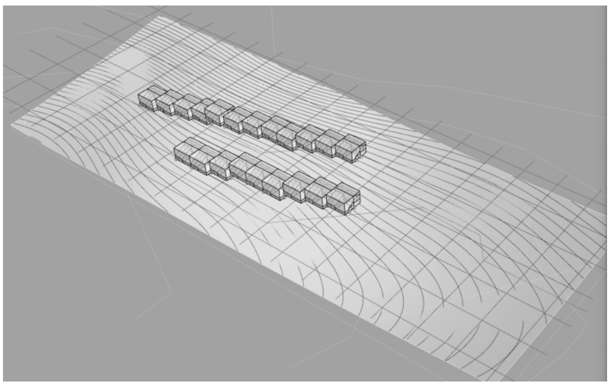

Figure 5.14. Final result of the simulation for 21 unit

5.2 Faculty of Architecture Building Complex: Magnetizing Floor Plans

The research field known as "self-organizing floor plans" (SOFP) serves to advance computers for simulations of architects' capabilities such as thinking, learning, and producing in order to solve problems such as planning complex volumes by calculating many parameters that the human mind cannot calculate all at once.[175] An article by Silvo Carta refers to examples of SOFP by machine learning (ML), generative adversarial neural network (GAN), and neural network (NN) models. One of the SOFP examples in that article is further explained in the graduate thesis of Stanislas Chaillou, who showed the correlation between technological innovation and the development of architecture. Chaillou later proposed that correlation can currently be found in the examples of implementations such as artificial intelligence in architecture:

> "The framework used here offers a springboard for discussion, inviting architects to start engaging with AI, and data scientists to consider Architecture as a field of investigation. In this article, we summarize a element of our thesis, submitted at Harvard in May 2019, where Generative Adversarial Neural Networks (or GANs) get leveraged to design floor plans and entire buildings. Rather than using machines to optimize a set of variables, relying on them to extract significant qualities and mimicking them all along the design process represents a paradigm shift. Beyond the mere development of a generation pipeline, this attempt aims at demonstrating the potential of GANs for any design process, whereby nesting GAN models, and allowing user input between them, we try to achieve a back and forth

[175] Silvio Carta, "Self-Organizing Floor Plans," Harvard Data Science Review (PubPub, July 23, 2021), https://hdsr.mitpress.mit.edu/pub/w1gujxim/release/2.

> between humans and machines, between disciplinarian intuition and technical innovation."[176]

According to Chaillou, after common interest in AI began arising at the beginning of the 1980s, the advent of networks and machine learning models enabled machines to grasp higher levels of complexity because such models can be trained to be intelligent. In elementicular, GANs were first theorized by Ian Goodfellow, a researcher at Google Brain, in 2014.[177] Chaillou described GANs as follows: "This model offers to use networks to generate images, while ensuring accuracy through a self-correcting feedback loop. Goodfellow's research turns upside down the definition of AI, from an analytical tool to a generative agent." Therefore, SOFP and GANs in elementicular provide an act of learning from existing tools with applications to new problems, such as generating new floor plans. This is as if someone – or something, namely a machine – who is not an architect is looking at the images, memorizing the plan diagram, and trying to produce the same diagram in similar situations. By doing so, the biggest result that we can observe for these diagrams is that GANs store the existing information and the proposed information in the form of diagrams or graphs as data structures. This is explained in more detail in an article entitled "Architecture as Graphs" by Chaillou as follows:[178]

> "The design of floorplans can leverage machine intuition to generate and qualify potential design options. In this article, we address a specific abstraction of space: adjacency. Any floorplan carries its own embedded logic; in clear, the relative placement of rooms and their connections is driven

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[176] Philip F Yuan et al., eds., "ArchiGAN: Artificial Intelligence x Architecture," in *Architectural Intelligence Selected Papers from the 1st International Conference on Computational Design and Robotic Fabrication* (CDRF 2019) (Singapore: Springer Singapore, 2020), p. 117.

[177] Ibid.

[178] Stanislas Chaillou, "Architecture as a Graph," Medium (Towards Data Science, February 23, 2020), https://towardsdatascience.com/architecture-as-a-graph-6a835d46f918.

> by a certain logic of interdependence, and yields varying qualities across space. For instance, the presence of a room will condition the existence of other rooms, as well as the position of openings between them. First, we attempt here to qualify adjacencies of existing floorplans, to assess the relevance of adjacencies among rooms. We later turn to Bayesian modeling to generate adjacency graphs, either freely or under set constraints. By qualifying and generating, our hope is to investigate both sides of the same problem: the understanding of relationships among neighbouring spaces."[179]

Although SOFP with graph data structures can produce computable planning schema in accordance with existing conventional schema, in this study, the focus is on understanding the adjacency by representing the process of generating the floor plan schema in architecture. Specifically, a conference paper[180] about generating floor plans can assist here in resolving the design idea of the planning schema of the METU campus buildings plan. That paper, entitled "Computer-aided Approach to Public Building Floor Plan Generation: Magnetizing Floor Plans," offers an algorithmic exploration of arrangements of all rooms as well as adjacencies and connections to the circulation area with the help of graph data structures.[181] In light of these concepts, the building of the Faculty of Architecture on the METU campus, which has an iconic and complex architectural plan, is examined here in the context of the generative planning scheme of this study.

Understanding the building plan is not possible while only examining the computable parameters within the building complex itself. The plan schemes of the Çinicis reflect an inter-scale cognition. On the largest scale, the campus scale, the

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[179] Ibid.

[180] 1st International Conference on Optimization-Driven Architectural Design (OPTARCH 2019)

[181] Gavrilov Egor et al., "Computer-Aided Approach to Public Buildings Floor Plan Generation. Magnetizing Floor Plan Generator," Procedia Manufacturing 44 (2020): pp. 132-139, https://doi.org/10.1016/j.promfg.2020.02.214.

placement of the building blocks and their integration with each other occurs as described by Ayşen Savaş:

> "The main idea behind the plan of METU campus is the vigilant division of functions and the clear separation of the pedestrian circulation from vehicular traffic. The central pedestrian road, known today as the 'Alley', forms the backbone of the campus plan. Running 1.5km through the campus, lined by buildings, it is not only a pedestrian road, but also a recreational and intellectual platform of exchange for the occupants of the university. The social sciences and engineering deelementments are grouped together to define the alley with their outstandingly designed building complexes. The circulation patterns between these buildings are indicated and directed by the colonnaded arcades, gateways and extended eaves, and by the meticulously designed patterns of the floor finishing materials."[182]

As is well known, architectural spaces with certain functions in the architecture of this faculty building complex plan and the pieces have an alley-like network that provides circulation among them (Figure 5.16). In order to understand this network, this study utilizes computable models and collects architectural information in graph form in terms of data structure[183].

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[182] Ayşen Savaş, "METU Campus," *Brownbook Magazine*, 2018, 71–85.

[183] Gavrilov Egor et al., "Computer-Aided Approach to Public Buildings Floor Plan Generation. Magnetizing Floor Plan Generator," Procedia Manufacturing 44 (2020): pp. 132-139, https://doi.org/10.1016/j.promfg.2020.02.214.

Figure 5.15. Circulation

For the first stage of cognitive curation, data collection occurs in this context for spaces, their measurements as attributes, and, most importantly, their relationships with the circulation area. The circulation area of the Faculty of Architecture includes static, dynamic, and even blue and green spaces from among the 3D data types specified in Chapter 3 (Figure 5.12). The plan and even the sections of the faculty building are resolved with similar cognition. In this dissolution, architectural elements are defined as rooms in the graph data structure and architectural relationships are established between the circulation area and rooms themselves. The data regarding the architectural elements of the faculty building were obtained using the HBIM 3-dimensional model.[184]

[184] The HBIM also has the potential to be used as a long-term digital medium that supports future activities regarding operations and maintenance, major renovation or analysis.

CLUSTER	NAME	AREA	HEIGHT	VOLUME
static	studio 1	225.4	5	1127
static	studio 2	309.4	5	1547
static	studio 3	269.5	5	1347.5
natural	courtyard 1	82.8	11.5	952.2
static	classroom 1	34.4	3.6	123.84
natural	entrance 1	64.7	12	776.4
static	classroom 2	46.6	3.6	167.76
static	classroom 3	46.6	3.6	167.76
static	classroom 4	40.8	3.6	146.88
static	classroom 5	40.8	3.6	146.88
static	classroom 6	48.1	3.6	173.16
static	classroom 7	48.1	3.6	173.16
natural	greening	269.5	11.5	3099.25
static	office 1	15.3	3.2	48.96
static	office 2	15.3	3.2	48.96
static	office 3	17.1	3.2	54.72
dynamic	gallery 1	182.1	8	1456.8
dynamic	balcony	4.8	3	14.4

Figure 5.16. Collected data regarding architectural elements of the Faculty of Architecture building complex[185]

After the first phase of cognitive curation, the collected data were expressed in representational structures and computational procedures in computable models. While the representative structures of the architectural elements of the faculty (in this case, rooms) can be easily obtained from the HBIM model that was already produced (Figure 5.18), many different algorithms need to be defined for computational procedures that can reflect architectural relationships (in this case, the relationship between rooms and circulation area). According to the analysis of the faculty building's plan, it may be said that the plan scheme was formed by the combination of more complex operations than a fixed chain of rules.

[185] Produced by the author.

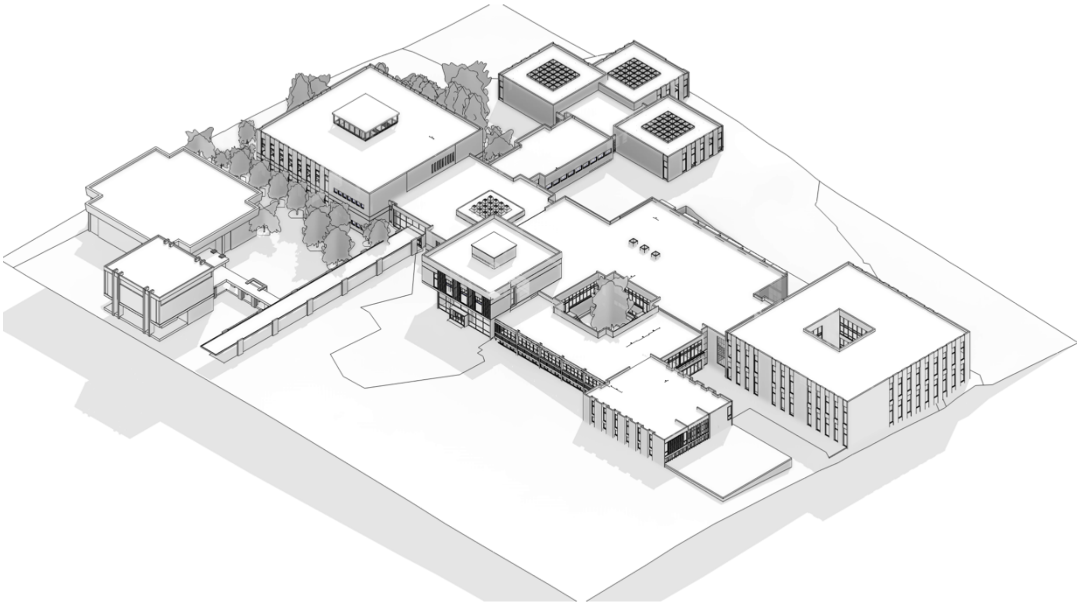

Figure 5.17. Representational structures of the architectural elements of the Faculty of Architecture building complex by HBIM[186]

Some common algorithms used by SOFP, GANs, or ML for computable models that will be applied to the representational structures of the architectural elements to be tested with the program can be examined among the categories of three main concepts: penalty and reward functions, offset algorithms, and network graphs. Starting with penalty and reward functions, the main idea entails calculating the needed square meters for defining a boundary within which all areas can fit. For example, in "Architectural Layout Design Through Simulated Annealing Algorithm," two specific penalties are defined as out-of-boundary penalties and overlapping penalties. In addition, four rewards are selected in terms of convenience,

[186] Retrieved from "Keeping It modern" project HBIM

attraction, orientation, and sunlight. These penalties and rewards depend on each project's necessities (Figure 5.19)

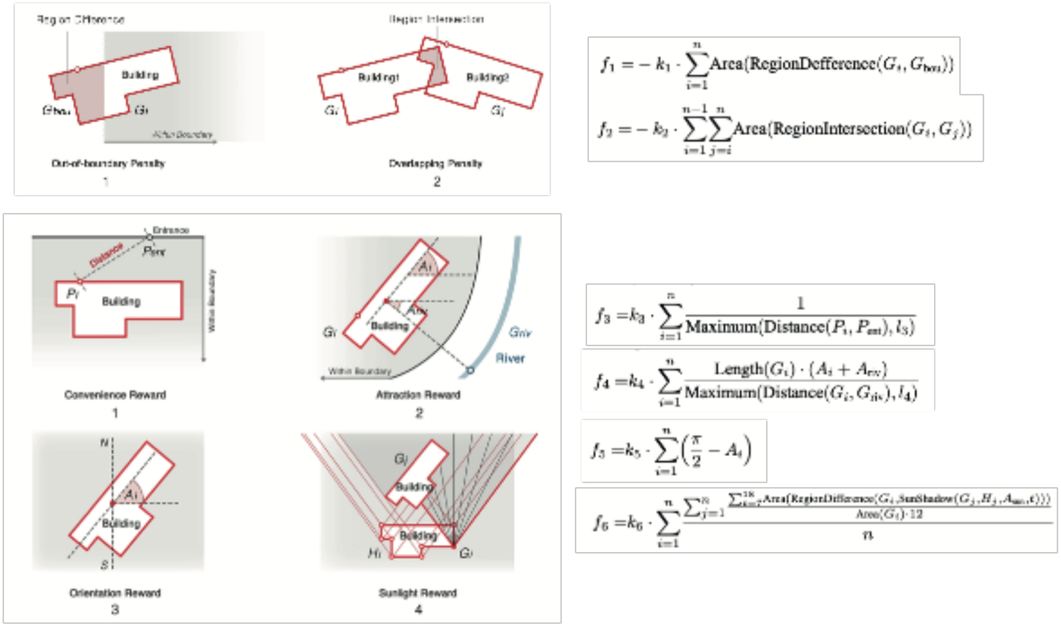

Figure 5.18. Sample penalty and reward algorithms[187]

Moreover, understandings of offset and network graph solutions can be seen in many SOFP architectural projects. In the conference paper entitled "Computer-aided Approach to Public Floor Plan Generation: Magnetizing Floor Plan Generator" by by Gavrilov, Schneider, Dennemark and Koenig[188], algorithms were created in accordance with the understanding that every room needs an offset space (transitional space) for bounding with other spaces. Thus, the architectural

[187] Ibid.

[188] Gavrilov Egor et al., "Computer-Aided Approach to Public Buildings Floor Plan Generation. Magnetizing Floor Plan Generator," Procedia Manufacturing 44 (2020): pp. 132-139, https://doi.org/10.1016/j.promfg.2020.02.214.

relationships between architectural elements should be indicated with a network-based data structure so that the relationships can be generated with the required offset spaces.[189] In the aforementioned research, this situation is summarized with the following statements:

> "Each of the rooms in a building is somehow accessible from any other room through a corridor." (see Figure 5.20)

> "Presented project can be considered as an exploration of various ways of generating floor plans for public buildings, which was followed by creating a new algorithm for solving that task. Public buildings were chosen as a main target of conducted research because of their complex and non-standardized structure."[190]

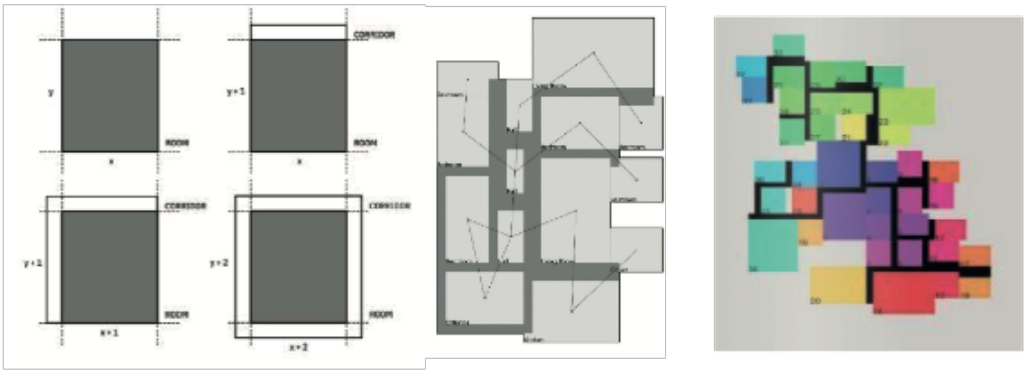

Figure 5.19. Magnetizing floor plan generator essentials: graph and offset[191]

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[189] Ibid.

[190] Indicated in the website of the plug-in https://www.food4rhino.com/en/app/magnetizing-floor-plan-generator

[191] Ibid.

Considering the penalty and reward functions, offset algorithms, and network graphs in the case of the building complex of the Faculty of Architecture, a plug-in for visual programming named "Magnetizing Floor Plans" by Egor Gavrilov will be used here for the simulation of the planning of the faculty. When the term "tamed landscape"[192] is considered for the faculty building, the Bauhaus relief implementation in the exhibition entitled "The METU Campus Documented V: Representing Itself" within the scope of the "Keeping It Modern" project should be remembered.[193] The campus and even the specific faculty plan are designed as a whole with the topography through rectangular spaces.

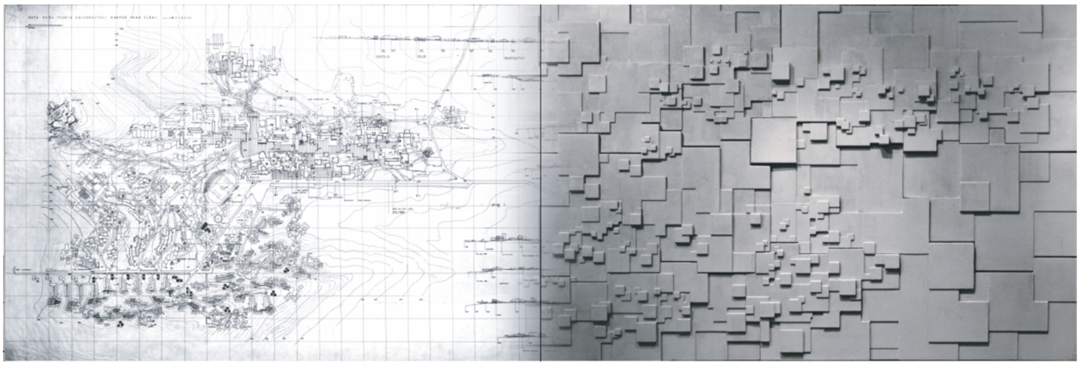

Figure 5.20. Bauhaus relief implementation for campus architecture

To simulate the continuous blended circulation area that connects all these rectangular spaces in the computable program, the applied penalty function states that the building is defined within certain square meters within a border. The first

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[192] Güven Arif Sargın and Ayşen Savaş, "'A University Is a Society': An Environmental History of the Metu 'Campus,'" *The Journal of Architecture* 18, no. 1 (2013): pp. 79-106, https://doi.org/10.1080/13602365.2012.751806.

[193] Aysen Savaş et al., Research and Conservation Planning for the METU Faculty of Architecture Buiilding Complex by Altuğ-Behruz Çinici Ankara, Turkey, 2018.

reward function, on the other hand, is that no defined area overlaps with each adjacency. Furthermore, the second reward function entails each space needing an offset distance to connect with another space. Finally, the program needs a graph data network for locating each space in the plan with the right relationships (Figure 5.21).

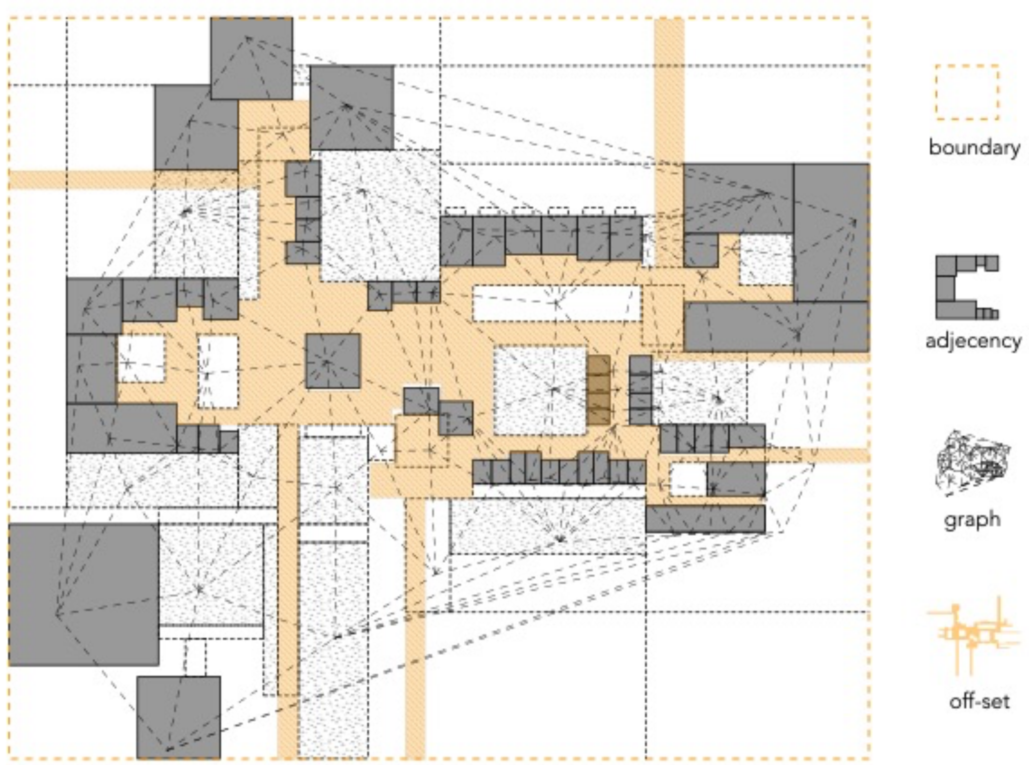

Figure 5.21. Combination of the penalty & reward functions, off-set algorithms, and network graphs of the Faculty of Architecture Building

The program consists of these four basis models. Akin to the repetitive algorithm of the aggregation of lodging units, the spaces are located one by one by evaluating the previous productions. However, the program uses an iterative algorithm this time, not a recursive algorithm, because when the program encounters any problems while placing spaces in order, it restarts to produce a better result. In recursive algorithms, when the next stage is begun, there is no reproduction of the previous stage.

In order for the simulation to imitate the planning strategy for the building complex of the Faculty of Architecture, the program needs to determine some spaces as entrances. Other fixed spaces within the transitional space itself, whose borders are not visible, must also be defined as fixed spaces in a rectangular way as halls, for example, as seen in the trial (Figure 5.23). The main reason why the expected was not obtained in the simulation was the lack of awareness of the fixed spaces in the wide corridors as well. In the trial of the selected area of the faculty building (Figure 5.22), there are big studios, classrooms, and offices for static spaces and inner courtyards and gallery spaces for dynamic spaces. Since the dynamic spaces are related to all static spaces, the simulation performed their offsets on four sides. However, in the real plan, this is not always the case.

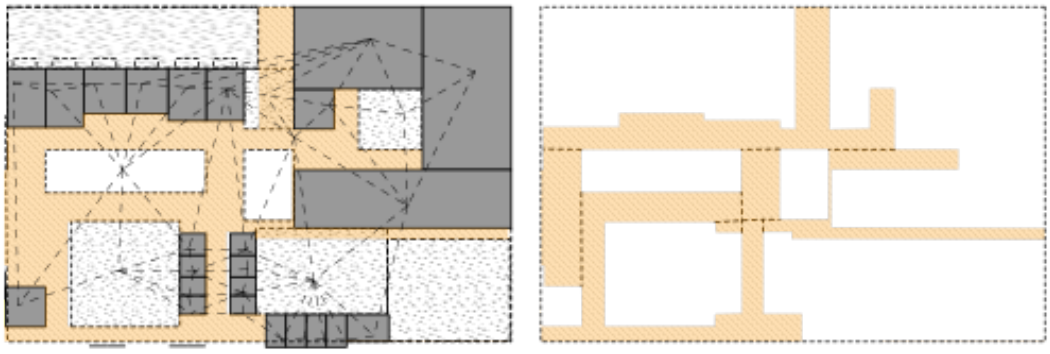

Figure 5.22. Expcted result

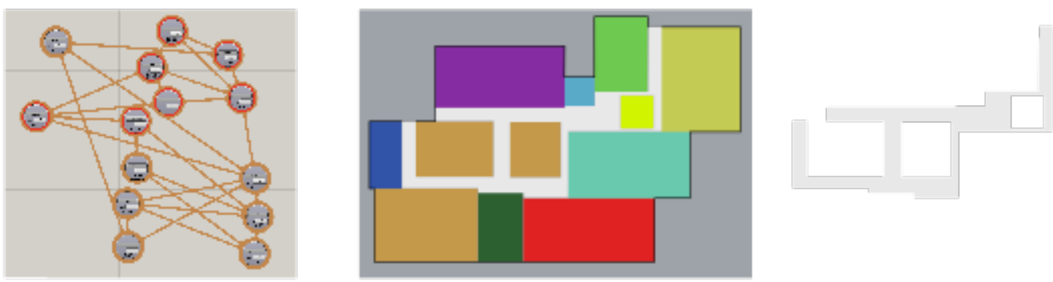

Figure 5.23. The result of the simulation

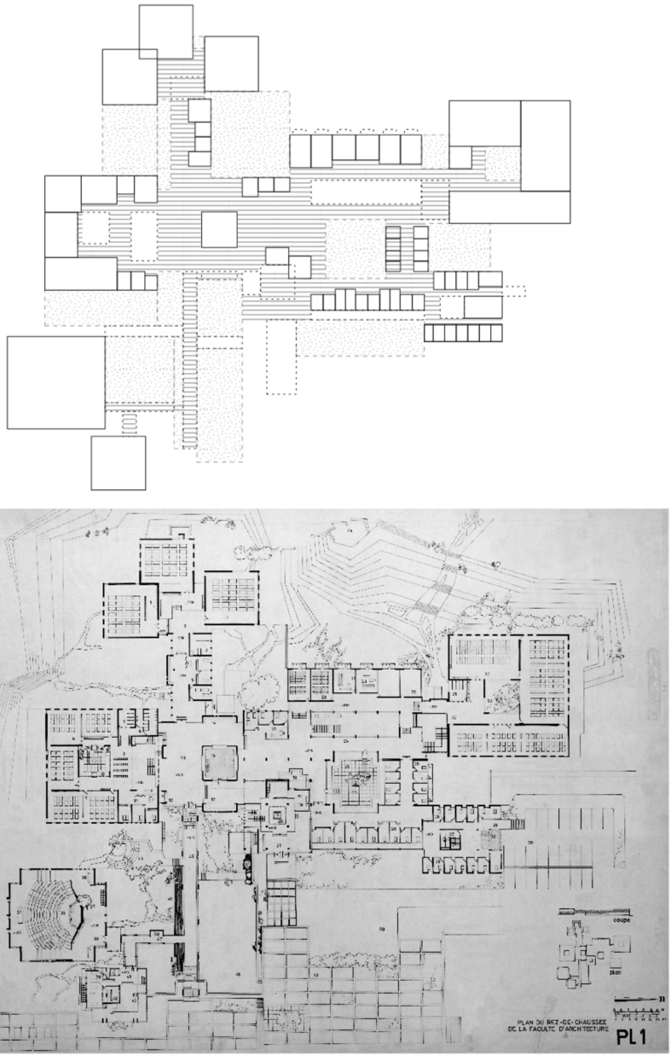

Figure 5.24. Ultimate expected result

CHAPTER 6

CONCLUSION

> "The purpose of the model is the documentation of the building, including the three-dimensional geometry, architectural significance, and the results of the assessment activities; data sharing between the work packages during the project; and data interoperability with the third elementy analysis tools, such as structural analysis tools and energy performance simulation tools. The HBIM also has the potential to be used as a long-term digital medium that supports future activities regarding operations and maintenance, major renovation or analysis."[194]

This study, which emerged as an extension of the HBIM model idea of the campus Getty Keeping It Modern project, discusses a contemporary method of archiving, preserving, and displaying the architecture of the METU campus. It evaluates this continuation as a reproduction of architecture, also a process of decoding and encoding the architectural information in the computable environment. For this, the present study adopts two concepts from cognitive and curatorial studies. In other words, it describes architectural reproduction as both curating architecture and mimicking an existing architectural cognition.

[194] Ayşen Savaş and Ipek Gursel Dino, "Documentation as a Tool for the Preservation of the METU Faculty of Architecture," in *100 Years Bauhaus. What Interest Do We Take in Modern Movement Today? Selected Papers from 16th Docomomo Germamy 3rd RMB Conference 1st March 2019, Berlin*, ed. U. Pottgiesser, Franz Jaschke, and Michel Melenhorst, TU Delft Research Portal (DOCOMOMO, December 14, 2020), https://research.tudelft.nl/en/publications/100-years-bauhaus-what-interest-do-we-take-in-modern-movement-tod.

Seeing this reproduction as a curation exists in the literature as a form that is not new or even a precedent for campus architecture. However, the curation needed to be reexamined before it could be recommended as a contemporary version. It was remembered that curation was characterized as a process, not just the end product of curating architecture, conventional exhibitions and displays. In order to present an contemporary curation of architecture, the exchanges between architecture and other disciplines had to be rationalized and theorized in the study. A curating approach that can be compatible with modern architectural examples bearing the first traces of architectural representational-computational cognition has been proposed as "cognitive curation".

The architectural characteristics of the study object is the most important element that shapes cognitive curation. Architectural cognition of campus design approach that is visible becomes a pioneer in order to reveal the invisible underliying design approach as well. For this, representational-computational cognition of the architecture of the METU campus is revealed with computable simulations. In order to be the object of the whole simulation process, the campus had to be based on a theoretical foundation. This basis should not only contain rational expressions, but should be open to flexibility and variability. Therefore, the understanding of unity, which tries to explain complex gatherings such as the study of a society living in a city or a musical composition created by an artist, was reconsidered for architecture. In this way, a decoder was introduced for the architectural unity of METU campus. For imitating the transformation of the architectural thought (design idea) into architectural behaviour (architecture of the campus), the architectural unity is basically divided into two: architectural elements and relationships. Therefore, the reproduction process of architectural unity with elements and relationships could be imitated with the data, model, and program through simulations. In other words, this study claims that the campus still generates theoretical, computational, and data-driven architectural knowledge through cognitive curation.

The study corresponds to the sample simulation process for the reproduction of the campus architecture with the word "cultivation". Here, the cognitive curation – or cultivating – is not only intended to achieve an underlying design approach for the campus – or the growing of a particular crop – but also to provide a cognitive infrastructure for the literature – or preparing the land. Thus, this study proposes the "cultivation" of architectural knowledge by transforming the METU campus as a display object in a cognitive way rather than conventional ways such as documenting, archiving, and exhibiting. Thus, the cognitive way of cultivation has no space and end product, it has a process.

REFERENCES

"Altuğ-Behruz Çinici Archive - Middle East Technical University." SALT Research. Accessed November 1, 2021. https://archives.saltresearch.org/.

Arrhenius, Thordis, Mari Lending, Wallis Miller, and McGowan Jérémie Michael. *Exhibiting Architecture: Place and Displacement*. Zürich: Lars Müller, 2014.

As, Imdat, Siddharth Pal, and Prithwish Basu. "Artificial Intelligence in Architecture: Generating Conceptual Design via Deep Learning." *International Journal of Architectural Computing* 16 (2018): 306–27. https://doi.org/10.1177/1478077118793180.

Baudrillard, Jean. "The Precission of Simulacra." Essay. In *Simularca and Simulation*, translated by Sheila Faria Glaser, 3, 1981.

Bechtel, William, and George Graham. Preface. In *A Companion to Cognitive Science*, i-xvi. Oxford: Blackwell, 1998.

Beck, Martin. "The Exhibition and the Display." Essay. In *Exhibition*, edited by Lucy Steeds. Documents of Conteporary Art. Cambridge, Massachuseets: The M.I.T. Press, 2014.

Bermúdez, José Luis. "Historical Landmarks." Essay. In *Cognitive Science: An Introduction to the Science of the Mind*, 47. New York, New York: Cambridge University Press, 2020.

Blau, Eve. "Curating Architecture With Architecture." Log, no. 20 (2010): 18-28. Accessed September 1, 2021. http://www.jstor.org/stable/41765362.

Bottazzi, Roberto. “Introduction.” Introduction. In *Digital Architecture beyond Computers: Fragments of a Cultural History of Computational Design*, 1–12. London: Bloomsbury Visual Arts, 2020.

Brookshear, J. Glenn, and Dennis Brylow. “Data Abstractions.” Essay. In *Computer Science: An Overview*, 438. Harlow: Pearson, 2020.

Buren, Daniel. “Exhibiting Exhibition.” Essay. In *Exhibition*, edited by Lucy Steeds, 43. Documents of Contemporary Art. Cambridge, Massachusetts: The M.I.T. Press, 2014.

Carta, Silvio. “Self-Organizing Floor Plans.” Harvard Data Science Review. PubPub, July 23, 2021. https://hdsr.mitpress.mit.edu/pub/w1gujxim/release/2.

Chaillou, Stanislas. “AI and Architecture.” *Companion to Artificial Intelligence in Architecture*, 2021, 420–41. https://doi.org/10.4324/9780367824259-27.

Chaillou, Stanislas. “Architecture as a Graph.” Medium. Towards Data Science, February 23, 2020. https://towardsdatascience.com/architecture-as-a-graph-6a835d46f918.

Chiappone-Piriou, Emmanuelle. “Et Alia: A Projective History of the Architectural Discrete.” Edited by Neil Spiller and Gilles Retsin. *Architectural Design (Discrete: Reappraising the Digital in Architecture)* 258 (2019): 78–81.

Di Carlo, Tina. "Exhibitionism." Log, no. 20 (2010): 151-58. Accessed September 1, 2021. http://www.jstor.org/stable/41765385.

Egor, Gavrilov, Schneider Sven, Dennemark Martin, and Koenig Reinhard. “Computer-Aided Approach to Public Buildings Floor Plan Generation.

Magnetizing Floor Plan Generator." *Procedia Manufacturing* 44 (2020): 132–39. https://doi.org/10.1016/j.promfg.2020.02.214.

Evans, Robin. "Translation from Drawing to Building." Essay. In *Translation from Drawing to Building and Other Essays*, 150–60. London: Architectural Association, 1997.

Filipovic, Elena. "When Exhibitions Come From: On the History of the Artist as Curators." Essay. In *Exhibition*, edited by Lucy Steeds, 156–57. Documents of Contemporary Art. Cambridge, Massachusetts: The M.I.T. Press, 2014.

Foster, Hal, and Hal Foster. Preface. In *The Art-Architecture Complex*. London: Verso, 2011.

Foster, Hal. *Tasarım Ve Suç: müze - Mimarlık - Tasarım*. Translated by Gen Elçin. Fatih, İstanbul: İletişim Yayınları, 2015.

Foucault, Michel, and Michel Foucault. "Archaeology and History of Ideas." Essay. In *The Archaeology of Knowledge*, 135–40. London: Tavistock Publications, 1972.

Greenberg, Reesa, Sandy Nairne, Bruce W. Ferguson, and Daniel Buren. "Function of Architecture." Essay. In *Thinking About Exhibitions*, 221–30. London: Routledge, 2010.

Gruber, Petra. "Classical Approaches to Investigate Overlaps between Biology and Architecture." Essay. In *Biomimetics in Architecture: Architecture of Life and Buildings*, 50–54. Berlin: Springer, 2011.

Hewitt, Mark Alan. “Mimesis, Memory, and Enactment.” Essay. In *Draw in Order to See a Cognitive History of Architectural Design*, 61–62. Place of publication unknown: ORO Editions, 2020.

Hewitt, Mark Alan. “Sketches as Cognitive Traces: Alvar Aalto at Imatra.” research gate, January 2019. researchgate.net/publication/334317952_SKETCHES_AS_COGNITIVE_TRACES_ALVAR_AALTO_AT_IMATRA.

Huygen, Peter. *Vorm Geven Aan De Campus: De Architectuur Van De Universiteitsiteit Twente*. Twente: Universiteit Twente de Stichting Over Ruimte en de Culturele Raad Overijssel, n.d.

Kelleher, John D., and Brendan Tierney. “What Are Data, and What Is Data Set?” Essay. In *Data Science*, 39. MIT Press, 2018.

Macdonald, Sharon. “Collecting Practices.” Essay. In *A Companion to Museum Studies*, edited by Sharon Macdonald, 81–90. Oxford, UK: Blackwell Publishing, 2006.

Macleod, Suzanne, Laura Hourston Hanks, Jonathan Hale, and Cristopher R Marshall. “ATHENS, LONDON OR BILBAO? Contested Narratives of Display in the Elementhenon Galleries of the British Museum.” Essay. In *Museum Making: Narratives, Architectures, Exhibitions*, 34–46. Abingdon: Routledge, 2012.

MacLeod, Suzanne. “Introduction.” Introduction. In *Reshaping Museum Space: Architecture, Design, Exhibitions*, 16–17. London: Routledge, 2006.

McLuhan, Marshall. *The Medium Is the Message*. Corte Madera: Gingko Press, 2005.

Obrist, Hans Ulrich, Raẓā Asad, and Hans Ulrich Obrist. "Curating, Exhibitions and the Gesamtkunstwerk." Essay. In *Ways of Curating*, 25–35. New York: Farrar, Straus and Giroux, 2016.

O'Doherty, Brian. *Inside the White Cube: the Ideology of the Gallery Space*. Berkeley: University of California Press, 2010.

Ota, Kayoko. "Curating as Architectural Practice." Log, no. 20 (2010): 141-49. Accessed September 1, 2021. http://www.jstor.org/stable/41765383.

Papapetros, Spyros, Julian Rose, Rosalind Krauss, Yve Alain Bois, Buchloh Benjamin H D., Hal Foster, Edward Eigen, et al. "Architect's Drawings / Artists' Buildings." Essay. In *Retracing the Expanded Field: Encounters between Art and Architecture*, 107–20. Cambridge (Mass.): The MIT Press, 2014.

Raqs Media Collective. "On Curatorial Responsibility." Essay. In *Exhibition*, edited by Lucy Steeds, 100–101. Documents of Contemporary Art. Cambridge, Massachusetts: The M.I.T. Press, 2014.

Rossi, Andrea. " WASP - A COMBINATORIAL TOOLKIT FOR DISCRETE DESIGN." Food4Rhino, 2019. https://www.food4rhino.com/en/app/wasp.

Sabharwal, Arjun, and Arjun Sabharwal. "Foundational Definitions for Curation." Essay. In *Digital Curation in the Digital Humanities Preserving and Promoting Archival and Special Collections*, 12–15. Amsterdam (Holanda): Elsevier, 2015.

Sargın, Güven Arif, and Ayşen Savaş. "'A University Is a Society': An Environmental History of the Metu 'Campus.'" *The Journal of Architecture* 18, no. 1 (2013): 79–106. https://doi.org/10.1080/13602365.2012.751806.

Savaş, Aysen, İpek Gürsel Dino, Sezin Sarıca, Bengisu Derebaşı, Fatma Serra İnan, and Şahin Akın. *Research and Conservation Planning for the METU Faculty of Architecture Buiilding Complex by Altuğ-Behruz Çinici Ankara, Turkey*, 2018. Retrieved from: https://www.getty.edu/foundation/pdfs/kim/metu_arch_res_cons_plan.pdf

Savaş, Ayşen, and Ipek Gursel Dino. Constituting an Archive: Documentation as a Tool for the Preservation of the METU Faculty of Architecture", in 100 Years Bauhaus. What Interest Do We Take in Modern Movement Today? ed. By Uta Pottgiesser, F. Jaschke, M. Melenhorst, Berlin: Lemgo, 2020. https://research.tudelft.nl/en/publications/100-years-bauhaus-what-interest-do-we-take-in-modern-movement-tod.

Savaş, Ayşen, and Agnes van der Meij. "METU Lodging: Diamonds in Sahara." Preface. In *Diamonds in Sahara: METU Lodgings Documented*, viii. Ankara: METU Press, 2018.

Savaş, Ayşen, Van der Meij Agnes, and Aysen Savaş. "METU Lodging: Representing Itself." Essay. In *Diamonds in Sahara: Metu Lodgings Documented*, 11–26. Ankara: Middle East Technical University, Faculty of Architecture, 2018.

Savaş, Ayşen. "The METU Campus Documented V: Representing Itself." *Journal of the Faculty of Architecture* 36, no. 1 (2019): 285–95.

Thagard, Paul. “Representation and Computation.” Essay. In *Mind: Introduction to Cognitive Science*, 2–23. Cambridge, MA: MIT Press, 2005.

Urbach, Henry. "Exhibition as Atmosphere." Log, no. 20 (2010): 11-17. Accessed September 1, 2021. http://www.jstor.org/stable/41765361.

Werner, Steffen, and Paul Long. “Cognition Meets Le Corbusier-Cognitive Principles of Architectural Design.” ResearchGate. Accessed September 20, 2020. https://www.researchgate.net/publication/221104045_Cognition_Meets_Le_Corbusier-Cognitive_Principles_of_Architectural_Design.

Yuan, Philip F, Mike Xie, Neil Leach, Jiawei Yao, and Xiang Wang, eds. “Introduction.” Introduction. In *Architectural Intelligence Selected Papers from the 1st International Conference on Computational Design and Robotic Fabrication (CDRF 2019)*, 4. Singapore: Springer Singapore, 2020.

Zheng, Hao. “Architectural Layout Design through Simulated Annealing Algorithm.” Proceedings of the 25th International Conference on Computer-Aided Architectural Design Research in Asia (CAADRIA), July 31, 2020. https://www.academia.edu/43756300/Architectural_Layout_Design_through_Simulated_Annealing_Algorithm.

Özen, Nejat Emre. “Elementary Architectural Formations and the METU Campus.” Thesis, METU, 2021.

Üçoluk, Göktürk, and Sinan Kalkan. “Organizing Data.” Essay. In *Introduction to Programming Concepts with Case Studies in Python*, 165. Wien: Springer, 2012.