

# Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences



## Graduation Plan: Architecture

Submit your Graduation Plan to the Board of Examiners ([Examencommissie-BK@tudelft.nl](mailto:Examencommissie-BK@tudelft.nl)), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Tarique Ali
Student number	5498198

Studio		
Name / Theme	Explore Lab 35	
Main mentor	George Vrachliotis Seyran Khademi	Architecture Research
Second mentor	Rufus van den Ban	Building Technology
Argumentation of choice of the studio	<ol style="list-style-type: none"><li>1. The Explore lab provided the freedom that my topic of choice required, in addition to assembling the best mentors that could assist me with their knowledge and background required to tackle the challenges and pose the right questions within the theme.</li><li>2. No other studio in the Architecture sub-track (or any other track for that matter) questions the lens of how technological advancements need to integrate with the study of architecture. The tools we use have inevitably played a role in shaping our forms and visions of what architecture is meant to be for us.</li><li>3. With the age of digital advancement and infusion of artificial intelligence in every single field of science, it was the right time and studio (Explore Lab) to pose these questions through a critical lens that one inevitably needs to within the faculty of Bouwkunde and still have it fit within the theme of scientific study, to see where exactly does technology fit in the large scheme of a mostly un-altered field of science (art?), architecture.</li></ol>	

Graduation project	
Title of the graduation project	Architectural Grayboxing using topological data [to design the extension of MAXXI museum in Rome]
Goal	
Location:	Rome, Italy
The posed problem,	<ol style="list-style-type: none"><li>1. The advent of diffusion models (for example, a text to image model, like Dall.E-2 and Midjourney that generates an image from the text you feed as a</li></ol>

	<p>'prompt') into mainstream utilization has led to abundant architectural designers to believe this being the future of architectural design where a machine generates an aesthetics of sorts for them to go after. This short sighted view of the complex science of architecture is detrimental, not only to the field of architecture but also happens to turn a blind-eye at effectiveness and efficient utilization of these machine learning advancements.</p> <ol style="list-style-type: none"> <li>2. And while I believe that diffusion models in their current form is not the future of architecture yet, it is also of prime importance to question the efficacy of AI in architecture and where might one benefit from its existence in the existing workflow of an architect.</li> <li>3. Looking through how architects often utilize bubble diagrams (also termed as functional or linkage diagrams) for their early design stages, we see the potential at utilizing large data already available, which comes from either archival drawings or online databases or even from one's previous projects (or competitions) that otherwise go un-used.</li> <li>4. These drawings hold large potential in informing architects of spatial organizations of a particular typology at an early stage of design, where it could be best used towards strategic level thinking or in analysis of latent design patterns. These linkages are understood through adjacency diagrams in the form of topological maps that are extracted from the architectural floorplans images.</li> <li>5. But no effective advancements have been made in creating not just datasets of various typologies, but also in looking at how to convert various raster drawings into their respective topological maps with minimum errors. We look into the current state of the art models, their advantages and limitations towards the posed question. These are best answered as a computer vision task, subsequently leading towards a more practical utilization of AI in architecture.</li> </ol>
research questions and	<p>How can architects effectively extract topological maps from archival drawings and learn from them, alongside their own knowledgeable analysis of spatial quality to aid early stages of design-decision making ?</p> <ol style="list-style-type: none"> <li>1. What are topological graphs ? How can they be useful to architects towards knowledge representation ?</li> </ol>

	<ol style="list-style-type: none"> <li>2. How can these graphs be effectively extracted from existing architectural drawings ?</li> <li>3. Why does graphical understanding of design leading to comparative analyses subsequently help us create better architectural works ? in comparison to individual qualitative plan analysis that most designers tend to follow at this point ?</li> <li>4. Can the process of topological graphs be machine learnt in regards to its utilization in varying contexts of available architectural (open or private) drawing data ?</li> <li>5. In a globalized work setting, can graphs like these aid in an architect's understanding of culturally appropriate design and further help in better design decision making that are stemmed through a historical, social and cultural lens ?</li> <li>6. What do the topological maps of the existing museums of Italy tell us about their changes through time or other design features so seen through this lens.</li> </ol>
design assignment in which these result.	<p>The research will help understand the differences seen in the context of Italy where a large majority of museums are repurposed from Renaissance structures, keeping their original footprint intact in contrast to the designs from the recent past that fall under modernism.</p> <ol style="list-style-type: none"> <li>1. The methodology of data preparation of the museum typology in the context of Italy will provide a deep dive into how these buildings have always been designed and how it can be related back to the MAXXI extension in Rome, the topological understanding of the examples will aid in better spatial positioning of the programs when designing a building that holds cultural coherence to the society it exists in.</li> <li>2. And finally the extension of MAXXI will play host to a center for experimentation with AI in relationship to Art, architecture and urban regeneration, while the architectural quality of the space will be decrypted from the parent museum by ZHA from 2010, a larger deep dive into the 'needs' rather than the 'wants' of a museum will be explored to reach the final design pedagogy.</li> <li>3. Hence utilizing the design methodology that the research aids in (design by research), would help in early stage design decision making, a design</li> </ol>

	that uses the abundance of data, and designing for AI, with AI in the age of AI.
<p>[This should be formulated in such a way that the graduation project can answer these questions. The definition of the problem has to be significant to a clearly defined area of research and design.]</p> <p>This thesis thus follows a 'design by research' method and vice versa. It exists as a question defined in the problem statement which interrogates the queries of time and technology that drives design. It wishes to follow scientific methods to not just reach favorable outcomes, but to rather scrutinize these methods to find the extent to which they add value to the field of architecture, the design answer is beyond just a solution, but rather the heart of the research itself, without which no conclusions can be made.</p>	
<b>Process</b>	
<b>Method description</b>	
<p>The research takes into account the observational and derived data available through various reliable sources to conduct a mixed methodology, including but not limited to archival study, experiments and observations to arrive at a conclusion.</p> <ol style="list-style-type: none"> <li>1. The research will take into account the openly available clearly documented floor plans of Italian museums across different cities from varying online platforms as a means to data collection.</li> <li>2. The floorplans will then be tested for segmentation and where state of the art (SOTA) computer vision algorithms capable of vectorizing the images shall be utilized. Taking notes in their limitations, drawbacks and advantages.</li> <li>3. These vectorized drawings shall then be converted into their topological graphs that are able to convey the semantics from their forms and will then be analyzed for their use-cases in early design stages for decision making. The topological maps will also be drawn by hand to compare and looking for their limitations and attributes.</li> <li>4. The topological graphs/adjacency diagrams will convey the functional diagram for the MAXXI museum's extension design (the design assignment)</li> <li>5. The final design output shall then proceed with a design narration towards how AI could be spatialized in a museum to make it approachable and learnable from.</li> <li>6. Other prerequisites expected out of an architectural project, for example, sustainable measures, LCA and carbon capture shall be taken into consideration toward designing.</li> </ol>	

## Literature and general practical preference

### *Literature reading:*

1. Centre canadien d'architecture. The Museum is Not Enough: No. 1-9. Edited by Albert Ferré, et al., Canadian Centre for Architecture, 2019.
2. Corbusier, L. (1991). Precisions on the present state of architecture and city planning : with an American prologue, a Brazilian corollary followed by the temperature of Paris and the atmosphere of Moscow (E. Schreiber Ajame, Trans.). MIT Press.
3. Hanson, Julianne, and Bill Hillier. The Social Logic of Space. Cambridge University Press, 2009.
4. Hanson, Julianne. Decoding Homes and Houses. Cambridge University Press, 2009.
5. Hillier, Bill. Space is the Machine: A Configurational Theory of Architecture. Space Syntax, 2015.
6. Laseau, P. (2001). Graphic Thinking for Architects and Designers. Wile
7. Steadman, Philip. Architectural Morphology: An Introduction to the Geometry of Building Plans. Pion, 1983

### *Research papers:*

1. Cecilia, F., Dalmasso, N., Mai, J., & Llach, D. C. (2019). Architectural Distant Reading Using Machine Learning to Identify Typological Traits Across Multiple Buildings. Hello, Culture!, 18th International Conference, CAAD Futures 2019
2. C. Liu, J. Wu, P. Kohli and Y. Furukawa, "Raster-to-Vector: Revisiting Floorplan Transformation," 2017 IEEE International Conference on Computer Vision (ICCV), 2017, pp. 2214-2222, doi: 10.1109/ICCV.2017.241.
3. Z. Zeng, X. Li, Y. K. Yu and C. -W. Fu, "Deep Floor Plan Recognition Using a Multi-Task Network With Room-Boundary-Guided Attention," 2019 IEEE/CVF International Conference on Computer Vision (ICCV), 2019, pp. 9095-9103, doi: 10.1109/ICCV.2019.00919.
4. Kalervo, A., Ylioinas, J., Häikiö, M., Karhu, A., Kannala, J. (2019). CubiCasa5K: A Dataset and an Improved Multi-task Model for Floorplan Image Analysis. In: Felsberg, M., Forssén, PE., Sintorn, IM., Unger, J. (eds) Image Analysis. SCIA 2019. Lecture Notes in Computer Science(), vol 11482. Springer, Cham. [https://doi.org/10.1007/978-3-030-20205-7\\_3](https://doi.org/10.1007/978-3-030-20205-7_3)
5. Nourian, Pirouz & Rezvani, Samaneh & Sariyildiz, Sevil. (2013). A SYNTACTIC ARCHITECTURAL DESIGN METHODOLOGY: Integrating real-time Space Syntax analysis in a configurative architectural design process.
6. Lu, Y., Tian, R., Li, A., Wang, X., & del Castillo y López, J. L. G. (2021, March). CubiGraph5K: Organizational Graph Generation for Structured Architectural Floor Plan Dataset. <http://dx.doi.org/10.52842/conf.caadria.2021.1.081>
7. Liu, C., Wu, J., Kohli, P., & Furukawa, Y. (2017). Raster-to-Vector: Revisiting Floorplan Transformation (IEEE International Conference on Computer Vision (ICCV) ed.). 10.1109/ICCV.2017.241.

## Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

The prime relation between the graduation topic with regards to the master track of Architecture and MSc AUBS is with regards to how the right approach to technological advancements can help aid architecture become more data aware and also more approachable to open up avenues towards collaborations from various other fields, like computer and data sciences. It does not undermine the creativity of the science, but rather adds the accessibility for contributors.

The track of architecture at the moment seems to detach itself from technologies and somehow views itself to be far off from building technology and anything remotely computer based is pushed onto the track of BT, while in reality, architecture and BT needs to be interchangeable in the way they approach the field. Neither can be standalone and should not be treated that way. And while other universities concerning architectural master studies focus on these ever changing advancement, it becomes quintessential to at least look at these advancements critically and be open to question them, which would then lead to possibilities to contributing in making the right advancements rather than having to follow every new trend passing by.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

A wider architectural fraternity has blindly been claiming the diffusion, text to image model being the future of architecture, without looking at it critically. Architecture, while a creative field, still depends largely in the context it is set in, which have been overlooked in these kinds of AI models.

This has been the primary reason for the thesis to find its niche within the field where AI is being utilized in a form factor where it makes an actual impact, not necessarily in the most automated ground-breaking manner, but rather in acknowledging the abundance of existing architectural data around us and then making them utilitarian in a way that's usable and approachable to architects even if it means with a distant lens or for identification latent design patterns and analysis.