# Thesis Pro Forma

## Title

**Using AI Agents in Unity to Improve Space Syntax Analysis**

## Research Problem

Space syntax helps designers understand how people move through spaces in buildings, cities, and games. Current tools like DepthmapX use very simple computer agents that move randomly to predict how spaces might be used. These basic agents can't account for real situations like emergency evacuations or people having specific destinations in mind.

The problem is clear: there's a big gap between how these simple computer agents move and how real people behave in specific situations. This leads to inaccurate predictions about how spaces will actually be used.

## Research Aims

This project will:

1. Create a Unity plugin using ML-Agents (a machine learning toolkit) to train smart agents that behave more like real people
2. Combine traditional space measurements with data from these smart agents to better evaluate spaces
3. Compare predictions from smart agents with traditional methods to show the improvements
4. Provide designers with pre-trained AI models for common scenarios and tools to create their own

## Current Research Gap

While some researchers have used space syntax in game design (Bıyık & Sürer, 2020) and others have used Unity for movement simulations (Gonzalez Rojas, 2021), no one has combined these approaches to create better space analysis tools. Current methods either use outdated agent models or don't connect with space syntax metrics. This research fills that gap.

## Expected Results

The main outcome will be a practical **Unity plugin** that helps designers analyze spaces using realistic AI agents. This will include:

1. A set of tools to combine traditional space measurements with AI agent data
2. Ready-to-use AI models for common scenarios
3. Evidence showing how much more accurate these new methods are
4. New ways to measure how spaces perform in specific situations

## Significance and Contribution

This research bridges the gap between abstract space analysis and realistic human behavior. By creating more accurate models of how people use spaces in specific situations, designers can make better decisions for spaces with specific scenario purposes (evacuation spaces, hospital spaces, game levels).

## References

*Bıyık, C., & Sürer, E. (2020). A space syntax-based method for evaluating procedurally generated game levels. Entertainment Computing, 33, 100346.*

*Choi, S.-K., Kim, D.-H. and Kim, Y.-O. (2012). A Study on the Placement of Game Objects using Space Syntax. Journal of Korea Game Society, 12(5), pp.43–56. doi:https://doi.org/10.7583/jkgs.2012.12.5.43.*

*Gonzalez Rojas, D. (2021). Machine learning simulation of pedestrian exploring architectural environments (Doctoral dissertation, Massachusetts Institute of Technology).*

*Kim, J.Y. and Kim, Y.O. (2023). Analysis of Pedestrian Behaviors in Subway Station Using Agent-Based Model: Case of Gangnam Station, Seoul, Korea. Buildings, 13(2), p.537. doi:https://doi.org/10.3390/buildings13020537.*

*Technologies, U. (n.d.). Unity - Scripting API: NavMesh. [online] docs.unity3d.com. Available at: https://docs.unity3d.com/ScriptReference/AI.NavMesh.html.*