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Graduation Work Title

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Graduation Work 2023-2024

Digital Arts and Entertainment

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# Abstract & Key words

**An abstract explains the outline of the paper concisely (the methods, results, etc.). Maximum length of 250 words, preferably both in English and Dutch.**

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# Preface

***A preface is a statement of the author's reasons for undertaking the work and may include personal comments that are not directly relevant to other sections of the thesis or dissertation.* No word count limit.**

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# List of Figures

**The list of figures lists the figures in the order in which they appear throughout the thesis. They may be numbered sequentially, or be subdivided following the chapters in which they appear.**

Figure 1: A picture showing something

Figure 2: A graph showing another thing

Figure 3.1: A tabel showing yet another thing, that appears in chapter 3.

# Introduction

**In the introduction, you write the background of your topic and discuss the observation that spurred you on to do this research project. Explain the purpose of the paper and present your research question(s) and the hypothesis at the end of this section. This section is typically a couple of pages long.**

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# Literature Study / Theoretical Framework

**In the literature review, you present the secondary research you have conducted. You detail the background of your topics and write about the concepts that are relevant to the study. Assume that not every reader has the same skillset or -level as you do! This section typically requires a substantial amount of references and can be a lengthy section that requires a considerable amount of pages.**

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# Research

**In the research section, you detail the elements of your experiment(s), the tests, objects you will test upon and subjects you will test with, the data gathering, data cleaning or feature extraction, measurements, … and you present the results obtained in an objective manner for each of the tests you conducted.**

## Research Question:

What is the performance impact of switching from a **State Machine** to a **Goal Oriented Action Planning** (GOAP) in a simulation game, and how does it affect the agents performance?

## Hypothesises:

**H0**: After comparing the data graphs from both **State Machines** and **Goal Oriented Action Planning,** there is no real difference in performance. Both take the same amount of time per frame or there is less than a 5% difference in average script execution time.

**H1**: The data graph of the **Goal Oriented Action Planning** (GOAP) shows a longer average script execution time per frame of more than 5% compared to the average execution time per frame of **State Machines.**

**H3**: The time it takes for both agents in both systems to complete their tasks is the same, with a difference of less than a second.

**H4**: The Agents using the **State Machine** Complete their tasks faster than those using **Goal Oriented Action Planning** (GOAP) by at least a second.

## Methodology:

### Experiment Set-Up:

I will create two visually identical levels in Unity. The only difference between the levels will be the AI behaviour logic. In the first level agents will use **Goal Oriented Action Planning**. In The second level agents will use **State machines**. The implementation of the Goal Oriented Action Planning is done using the guide by Penny The Byll (<https://learn.unity.com/project/goal-driven-behaviour?uv=2021.3&courseId=5dd851beedbc2a1bf7b72be>). For the **State Machines** in the second level I will be recreating the agents behaviours of the **Goal Oriented Action Planning** making sure the behave in exactly the same way.

### Agent Behaviors

**Patient:**

* Go to Hospital.
* Register at the front desk.
* Go to the waiting room.
* Once a nurse is free go to the treatment room.
* Go home.

**Nurse:**

* Wait for patient
* Get patient from the waiting room
* Treat patient.
* Repeat.

### Hardware:

* Processor: AMD Ryzen 7 5800H with Radeon Graphics 3.20 GHz
* Ram: 16GB
* Type: system: x64-processor

### Data Collection:

To test the performance I will be creating **four builds**:

* A **Goal Oriented Action Planning** Build with **three agents**. ( one nurse, two patients )
* A **State Machine** build with **three agents**. ( one nurse, two patients )
* A **Goal Oriented Action Planning** Build with **eighteen agents**. ( six nurses, twelve patients )
* A **State Machine** build with **eighteen agents**. ( six nurses, twelve patients )

To test the performance of each build I will use the **Unity Profiler**. I will be running the **Unity Profiler** with the target set to **60FPS** on each build multiple times and take the **average of five runs**.

The metrics I will look at to formulate an answer:

* Average execution time spend on the scripts per frame.
* How many times he went over the given time of 60fps.

## Experiment:

The goal of the experiment is to compare **Goal Oriented Action Planning** against **State Machines** and answer the hypothesises.

### Testing the level for performance:

I will create 4 builds:

1. **Goal Oriented Action Planning** Build with **three agents**.
2. **State Machine** build with **three agents**.
3. **Goal Oriented Action Planning** Build with **eighteen agents**.
4. A **State Machine** build with **eighteen agents**.

I will use the **Unity Profiler** one each build to get the performance data from it.

### Data Collection:

I will run each level for a **duration** of **5 minutes** while the **Unity Profiler** is collecting data. Once I have the data from a level I will only look at the **script execution time**, while the **target frame rate(FPS)** is set to **60 FPS**. After completing the test I will extract the **Unity Profiler** data and import it in the **Unity Profiler Analyzer** for a more detailed analysis. I will run the level with the **Unity Profiler** for **five times in total** and compare their data against themselves and take the **average of the five runs**.

### Data Comparison:

After taking the average of all the four builds I will compare the **State Machine** average with **3 agents** against the **Goal Oriented Action Planning** with also **3 agents**. After that I will compare the **State Machine** with **18 agents** against the **Goal Oriented Action Planning** with **18 agents**.

These are the variables I will Compare against each other:

* Average execution time per frame for scripts.
* How many time the target fps of 60 was missed.

These are the averages of **five runs** of **Goal Oriented Actions Planning** compared to the averages of five runs of **State Machines**. I will also a graph of every run.

### Prediction:

My prediction is that the State machine will better for the performance of the overall simulation. The graphs with less agents will be close but we will see a big difference in the graphs comparing 18 agents.

### Answer:

After I have compared all four builds, I can **answer Hypothesis 0 and 1**.

### Testing Agent Performance:

I create a build for both **State Machines** and **Goal Oriented Action Planning,** where I time how fast an agent is at completing his tasks. So I time patient from the moment he is spawned until I am about to destroy the patient. For the nurse I start counting at when the nurse goes to get the patient from the waiting room until the nurse is done treating the patient.

### Data Collection:

I will run the tests **ten times** collecting Data from one Behaviour System and taking the **average** of those **ten times** for patient and nurse. After that I will run the other behaviour system and get the timings for those. After I have the timing of both **State Machines** and **Goal Oriented Action Planning** I will compare them with each other.

### Data Comparison:

The patients average time in **State Machines** will be compared against the average time of the **Goal Oriented Action Planning** approach. I will do the exact same but then for the nurse. So I will compare **average task times** (in seconds) for patients and nurses across both AI systems.

### Prediction:

I predict that there will be no difference in the speed at which a sequence of tasks are completed.

### Answer:

After Comparing the timings of both **the state machine** patient and nurse versus the **Goal Oriented Action Planning** patient and nurse, I can **answer Hypothesises 2 and 3**.

## Topic 1

### Subtopic 1

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### Subtopic

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## Topic 2

### Subtopic 1

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# case study

**Alternatively, as opposed to research, you might have opted for a case study. Whichever you choose, you detail the elements of your experiment(s), the tests, objects you will test upon and subjects you will test with, the data gathering, data cleaning or feature extraction, measurements, … and you present the results obtained in an objective manner for each of the tests you conducted.**

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## introduction

**In the introduction, you write the background of your topic, explain the purpose of the paper more broadly, and explain the hypothesis, and the research question(s).**

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## Modelling

### Blockout

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Figure 1 : MAKING OF THE HOBBIT: THE DESOLATION OF SMAUG – LAKETOWN (WETA DIGITAL, 2014)

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### Zbrush

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## Texturing

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## Shading

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## Lighting

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# Discussion

**In this section, you offer an interpretation of the results you obtained and try to relate them to the theoretical framework you presented. This is typically not a very long section, but obviously one of the most important ones.**

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# Conclusion

**In this section, you ascertain the demonstrable outcomes of your study and outline the merits of the project for the academic field and the discourse community. This is typically not a very long section, but obviously also one of the more important ones.**

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# Future work

**This section is sometimes standalone, sometimes incorporated in the conclusion. It looks at the shortcomings of the study, alternative strategies, and what could be the next course of action in the research field. This is typically not a very long section.**

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# Critical Reflection

**This section is typically associated with a bachelor paper, not other forms of serious writing. It allows the student to reflect on the learning outcomes, both academically and in terms of personal growth.**

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# References

**In this section, you list all the references you made in alphabetical order; consequently adhere to the referencing style you have chosen.**

Casey Raes (2014), Processing (second edition).

Saccade. (n.d.). In Wikpedia. Retrieved November 6 2016 from <https://en.wikipedia.org/wiki/Saccade>

Sarah Northway (2016) A year in VR Northway [Powerpoint slides] from <https://www.gdcvault.com/play/1024631/A-Year-in-VR-A>

# Acknowledgements

**In this section, you can thank people who contributed to your work in a meaningful way.**

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# Appendices

**In many cases, there are items that were developed for a research paper that can’t go into the actual paper in full. Things suc as code, art pieces, output of statistical analysis, questionnaires, … In this section, you can present these elements; use the first page to list and number the items, then paste them sequentially. If some items are too large, you can store them online, and link to them. Common practice is to keep those links active at least one year after the publication of the thesis.**

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