

Final report

WhySoSerious

June 23, 2016

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1 Introduction

The Tygron Engine is a program created by Tygron, designed for exploratory city planning using a virtual environment. This program makes it possible to plan areas of cities by allowing different stakeholders to log into the same session, and negotiate about plans and measures. Each stakeholder has its own goals, represented by indicators. One of the biggest problems with the usage of the program, is that it is not properly usable if not all parties are present. Tygron wants to overcome this problem by creating virtual humans that can replace specific stakeholders when not all parties are present. It is our job to design these virtual humans.

1.1 Problem description

The goal of the project is to create an example virtual human and a connector which the virtual human can use to communicate with the server. Five different virtual humans with different goals will be created, and will be pitted against each other to achieve their own goals, by negotiating with the other stakeholders. These virtual humans can then be used by Tygron as inspiration to create their own virtual humans.

The virtual human must be able to think ahead and use an adaptive strategy to reach its goals. Being able to negotiate with other agents would also make its goals a lot more achievable. For keeping track of goals, the Tygron Engine features indicators that automatically update according to what happens in the environment. The virtual human will have to be able to understand these indicators, as they are the internal representation of their goals.

1.2 End-user requirements

The end-user in this project is the company Tygron. Tygron wants a virtual human that is capable of replacing a real human that controls the stakeholder. To be able to achieve this, Tygron has a few requirements to specify how the virtual human should work.

The virtual human should be able to interact with other stakeholders; it should be able to request permissions for buildings and buy land from and sell land to other stakeholders.

The virtual human should also be able to act in a way that improves its indicators; it should know which action should be done at what moment to get closer to the completion of its goals.

Another requirement for the virtual human is that it should be able to negotiate with other stakeholders. Stakeholders will eventually need things from other stakeholders, like land or some money for building. The virtual human should not just accept any request for any price. It should look at what it needs and whether the price is reasonable before deciding to accept or decline the request. The virtual human should also make requests to other stakeholders and react when a stakeholder declines.

It is important to cooperate within the Tygron game. The outcome of the game should be a situation in which the combined goals of every stakeholder are optimized. The virtual human should try to help other stakeholders achieve their goals, while maintaining its own goals.

The virtual human should be able to operate in a challenging situation. The situation and environment should resemble a fairly realistic setting, instead of an overly simplified testing setting. The virtual human should have enough complexity to be able to be a part of such a setting.

2 Product overview

We were asked to build a virtual human that can run on the Tygron engine. To be able to connect the virtual human to the Tygron servers we had to extend the Tygron EIS-connector. This means that the project consists of both developing the virtual human and extending the functionality of the EIS-connector. This last part was in co-operation with the other groups of the context. This report won't cover any changes made by other groups.

2.1 Tygron EIS-connector

The first product that has been delivered is an extension of the Tygron EIS-connector. The Tygron EIS-connector links the Tygron game environment to software agents, in this case GOAL agents, so they can receive and send information from and to the environment. The virtual humans use this to connect with the Tygron server.

The connector receives updates from the server and keeps the virtual human up to date on the current state of the environment using percepts. The GOAL agent then uses actions to influence the game. The connector sends percepts that are useful for agents to be able to operate properly. A system has been added to add custom actions, which can be used to generate parameterized data about the game, like the possible places where a virtual human can build, or to perform more advanced actions.

2.2 Virtual human

The second delivered product is the virtual human itself. The virtual human uses the GOAL language to control a stakeholder (in our case the student housing cooperation DUWO) in the Tygron environment to maximize its indicators. Indicators are tools within the Tygron Engine that a stakeholder can be used to keep track of progress on predefined goals.

The virtual human receives percepts from the environment and processes them to construct a mental image of the current state of the environment. With this mental image the virtual human can deduce what is needed to increase its indicators and perform a suitable action to change the environment. The change is then verified by reading the updated percepts and this process repeats until the virtual human is no longer able to improve the scores of its indicators.

To maximize the DUWO stakeholder indicators the virtual human builds student housing that can accommodate at least two thousand students, whereby it will build an approximately equal amount of cheap, medium and luxury student houses. On top of that, the virtual human manages its money and ensures that there are ten million euros of the budget left as a reserve.

3 Reflection

In this section we will reflect both the created product and the problems we encountered during the project.

3.1 Reflection on product

At the beginning of the project there was documentation on what the current Tygron-EIS connector contained. The documentation stated that there were several percepts and actions that we could use for our implementation of the virtual human. This means that we thought that we could focus on the implementation of the virtual human and create an interesting strategy. Unfortunately the documentation was incorrect and changed after about two weeks. This meant that our initial planning was not valid anymore and we needed to shift our focus to the Tygron-EIS connector instead of the virtual human.

The virtual human does not contain functionality to negotiate with other virtual humans. Implementing such functionality proved to be very difficult and takes a lot of time as it requires a well-defined language that all teams agree on, as well as the ability to plan an action without it affecting the simulation. Since we needed to add a lot of functionality to the Tygron-EIS connector, we had insufficient time.

For the students it is important to live close to Delft University of Technology, so we had the idea to implement a feature for the virtual human that will make it build student housing close to Delft University of Technology buildings. After an internal discussion we decided that this functionality is not important to have because the simulation takes place very close to Delft University of Technology.

Because we had to focus on adding functionality to the Tygron-EIS connector, we had to make some concessions regarding the virtual human. A more detailed description of the strategy we would have wanted can be found in appendix A.

3.2 Problems encountered during the project

At the start of the project we had no idea where we should look when we wanted to add or change the behavior of the Tygron-EIS connector. No one gave us a hint as to where to look or how to add things. Because of this we had to find it out by ourselves. This took us a lot of time. Next time we should ask the TA's or other people who know more about it. Another option is that the TA's could have pointed out where to start.

We were working with 4 other groups on the Tygron-EIS connector, every group consist of 5 people. This means that there were 23 people working on the Tygron-EIS connector. To be able to get a clear view on which groups are doing what on the connector, we had meetings at Tygron on Tuesday and in the Insyght-lab on Wednesday. These meetings took a lot of time for everybody. Next time we could send only two people instead of the whole team. These two people will inform the other team members about what was discussed. This will reduce the overhead of the team.

Another problem of working with so many people is that every pull request to the shared repository needed to be approved by at least two other teams (apart from the team that submitted the pull request). Sometimes confirmation of teams took a lot of time, while occasionally in the meantime other teams had to wait for this pull request.

In week three the teams decided on having a single repository where every team could create their branches and work on the Tygron-EIS connector. However, Sander did not like this at all. For him it was way too complex and time consuming to grade all teams.

Unfortunately Sander was informed of this only at the end of the week, so all our progress of this week had to be redone the next week. We agreed the following times we should ask the TA's first if they agree on such an organizational idea.

In week four we agreed with all teams that we should be working, on Wednesday morning, at the InsyghtLab. What we should have done is, make clear agreements on when all teams should be present at the InsyghtLab. These agreements should be made at the start of the project. If we did this, all teams could discuss their problems and features they wanted in the EIS-connector from the start of the project.

Only in week five we decided that our team should be working at Delft University of Technology instead of communicating through Skype. In future projects we should be working in a location where all team members are present.

In week seven Wouter decided we should use our own maven module. This module is an extension of Wouters environment. To achieve this we had to rewrite our code and add to the new module, which took a lot of time. We believe that this change should have been done in the first week of the project or even before the start of the project. If this had been done before the start of the project, a lot of merge conflict could have been avoided.

Next to these problems debugging the virtual human in eclipse is extremely difficult because the virtual human can not be resumed after it reaches a breakpoint. Besides this it is not possible to see the virtual humans beliefs, percepts and goals when it has been paused. Pausing and resuming the virtual human is also not possible. The only way to debug in eclipse is by reading the log of the virtual human.

When we talked about this problem with Wouter, he told us to use the simpleIDE. Unfortunately simpleIDE had some issues, we could not set breakpoints and we were not able to delete code. We communicated this to Wouter and a fix was online after a week. Unfortunately not all of us were able to use simpleIDE.

The services of Tygron also had quite a few issues. There was a long weekend (from Friday afternoon until Monday morning) in which we could not connect a virtual human to the Tygron Engine. On Friday afternoon of sprint seven, Tygron went down till Saturday afternoon. Next to these big issues there were some days where the Tygron Engine reacted very slow, which made testing of the virtual human quite hard.

In all of these cases we have send an email to Frank (from Tygron) directly, with a question if they can do something about our problems. We could also have asked Tygron when we could expect downtime of their services or when they wanted update the SDK. If we knew this beforehand we could plan better.

4 Description

In this section the developed functionality is described. It is split up in two different sections. In section 4.1 the added functionality of the Tygron-EIS connector is described and in section 4.2 all functionality of the virtual human.

4.1 Tygron EIS-connector

The following paragraphs describe what has been contributed to the connector.

First of all, a custom actions system was developed. Using an interface, `customAction` describing custom actions and a map containing all custom actions, this system made it very easy and straightforward to add new custom actions. A class implementing the interface would have to be added, containing a method that will be called by the virtual human, and a method returning the name the virtual human would have to call. This system did make it necessary to change the way incoming actions are verified, so all actions are approved now. These custom actions make it possible to, for example, get a lot more detailed information from the server that normally isn't possible, or at least isn't as usable.

A custom action has also been added, one for getting all areas a stakeholder can use for a specific goal, which we will call `relevantAreasAction`. The custom action uses a system similar to the custom actions; it makes it possible to add goals to the action. The interface for these goals extends the custom action interface, thus making it possible to call a goal directly if it is correctly added to the custom actions map.

One `relevantAreasAction` has been added as well, returning all areas a stakeholder can build in. This action takes all of the lands of a stakeholder and removes all land it cannot build in. Then it will apply some after-effects, converting the usable land to smaller, better looking shape.

A second custom action was added for disabling certain percepts. This would make it a lot easier to test the virtual human, as it is possible to fake percepts but if the virtual human immediately receives a new percept from the server, the fake data is overwritten, and the test would be inconclusive.

4.2 Virtual human

The following paragraphs describe the inner workings of the virtual human.

The virtual human uses different event modules to control and organize the control flow. The event module uses three modules; one to handle all percepts, then one to process goals and at the end it handles all requests the municipality needs.

When the virtual human does not have any space to build on, it will try to demolish buildings it doesn't need for its goals. It will only demolish gardens, as these are very cheap to demolish and the stakeholder owns a lot of gardens. This is needed to achieve its goals, as the agent needs more land to build student housing on.

When the virtual human does not have enough money to build anything, it will start selling land to other stakeholders. It will only sell land that doesn't contain anything it needs for achieving its goals. This includes gardens and nature (like forests). If a request gets denied, the virtual human will try to sell the land to another stakeholder, and when all stakeholders deny it will look for another piece of

land to sell. Without this feature the virtual human isn't able to earn any money, as all other actions only cost money.

As soon as the virtual human has enough space to build on and enough money, it will start building student housing. The virtual human can choose between three different types of student housing: cheap, medium and luxury. The goal of the DUWO stakeholder is defined in such a way that it needs the same amount of houses of each type of student housing. To achieve this the virtual human looks at its indicators and decides which type of student housing to build.

If the virtual human is almost out of budget, and it wants to build medium or luxury housing, it will try to sell land. This is because medium and luxury student housing can be very expensive.

This strategy makes it possible for the agent to both build equal amounts of all types of student housing, and to build extra houses for students.

5 Human Computer Interaction (Interaction design)

We have conducted a small study on the usability of the created product. The study will be explained in the following sections. An explanation of the project can be found in section 1.

5.1 Method

This section describes the method used to evaluate our human computer interaction.

5.1.1 User study

The user study is meant to evaluate the virtual human, based on test interactions with users. It will give insight into how users would act if they were in the same situation as the virtual human. It also makes clear what users think about the virtual human and what could be better. This information can be used to improve the virtual human in a way that it can be more user-friendly and simulate a real person better.

5.1.2 Interaction user with virtual human

Six people have been asked to cooperate in the user study. The people that have been chosen are a mix of student friends and family of the team members, which allowed for a diverse user group. There were male and female users, students and non-students, younger and older users.

Each user is given a short explanation of the Tygron Engine. After that they are permitted to play around with the municipality stakeholder for a minute to get them familiar. While they play around they get some information about the stakeholder and its goals.

Then the user will play two 5-minute sessions along with the stakeholder DUWO, which is once controlled by the virtual human and once by a real human. Within these sessions, the user interacts with DUWO and notices its behavior. In each session an user must at least once attempt to buy land from DUWO, attempt to sell land to DUWO and accept or decline a request com

5.1.3 Evaluation

After the user has finished a session with the virtual human and with the real human, they are asked to fill out a Google Docs form for either human interaction or virtual human interaction. The forms were copies of each other, so the questions are identical and they serve to keep the user evaluations separate. The user can't deduce from the form whether they have been interacting with a real human or a virtual human. The list of questions contained in these forms can be found in appendix B.1.

This form asked them firstly how much they understand of the Tygron Engine (developed by the company). The remaining questions are about our agent and ask the user to evaluate how logical the placing of buildings (our agents primary function) is, and how much our agent resembles the student housing cooperation DUWO. Lastly the user is asked how quickly the virtual human responds and how much it resembles an actual human.

5.2 Results

Results can be found in appendix B.

5.3 Conclusion

The results show that our agent reacts faster than the human. This result was already expected and holds for most implementations of artificial intelligence. What struck us as surprising was the fact that the participants found our agent to use better locations for its buildings. This is probably because our agent inherently tries to "cluster" its buildings creating a sort of district.

Another interesting observation is the fact that our agent simulates DUWO better than a human does. This isn't very surprising however since we spent good amount of time researching DUWO and discussing our role with the other stakeholders.

The final question asks the user to guess whether they were playing against a virtual human or an actual human, and surprisingly the answers were mixed. Here the people with technical knowledge seem to stand out, this is because the results show that technical students guess correctly more often than non-students. After questioning our participants about their choices in the form it showed that the non-students were "mislead" by the agent's tendency to create buildings with a smooth shape and its ability to decorate its buildings with gardens and trees. The technical students generally focused more on the response time (question 4) knowing that this is a more obvious tell-tale sign of artificial behavior.

So a thing we could improve is making the virtual human slower. We could choose between a random period of time the virtual human reacts. If we choose a fixed period, the user might recognize this.

6 Evaluation

This section contains an evaluation of the final delivered product, divided in a subsection for the connector and a subsection for our agent.

6.1 Evaluation of the connector

During the project all groups from the virtual humans context worked together to extend the functionality of the connector between the Tygron-API and the GOAL agent. The added code has been put in a separate modules so that the changes these groups made are easily identifiable. The changes that each individual group has made, can only be seen when you look at the pull requests made in the connector repository. Each pull request has been tagged so that it's easy to see which group made the changes. Furthermore, all changes needed to be tested. Travis was set up to automatically run both the tests and code coverage so that it was easy to see the quality of the changed code. The changes made by all groups to the connector have a code coverage of 81.6%. Our code coverage goal was 75%.

Below you will find a short overview of our contributions to the connector and the impact they have on the connector as a whole in order of importance to the connector. A detailed description of our contributions can be found in section 4 of this report.

- `CustomActions` system
The `CustomActions` system allows a developer to add actions to the environment. A few actions were already implemented but we found that these were not sufficient for working virtual human. We consider this to be our most important contribution to the connector.
- `GetRelevantAreas` action
This interface allows a developer to create an extension to the `GetRelevantAreas` action which could send areas owned by our agent which have a certain property (for example: a collection of areas on which the agent can build or which the agent is can sell). Without this action the agent has no sense of location.
- Build part of the `GetRelevantAreas` action
Giving the `GetRelevantAreas` action the `build` parameter allows an agent to receive all the areas on which it can build buildings. Without this it isn't possible to build a proper building.
- The `filterPercepts` action
The `filterPercepts` action allows an agent to temporally disable certain percepts to make goal testing possible.

6.2 Evaluation of the virtual agent

Unlike the connector every group created their own virtual human. As described in the reflection in section 3, this process depended heavily on the features of the connector. Despite these features being developed a bit slower than expected, we made sure to release a meaningful addition to our agent each week. Every change to the code had to be made in a different branch and pulled to the master using a pull request. This pull request would be automatically tested using Travis-CI configured for goal tests. After at least 2 team members approved the request the new features would be merged into the master branch.

The six features we consider to be the most important features added to the agent are:

- Building student housing with the `getRelevantAreas` action.
Building student housing is the most important goal of our virtual human. We accomplish using the `getRelevantAreas` action with `build` as parameter.
- Demolishing unnecessary parks in order from largest area to smallest when we don't have enough free space.
Since all space is filled with either buildings or parks, the agent will look for the largest and cheapest piece of land to demolish. The agent will do this every time it has insufficient land.
- The budget modules that change the agents behavior according to the current budget relative to the budget target.
The agent is at all times aware of it's budget relative to the target budget and reacts accordingly.
- Our agent's ability to handle the requests given for buying and selling land.
Instead of just denying every request, our agent listens to the requests from other stakeholders and handles them according to it's needs and the state of budget.
- The way our agent handles interaction with the municipality.
Since the municipality only accepts request from stakeholder that occasionally help their indicators, we have implemented a feature that allows our agent to build parks around its buildings to improve the overall environment indicator of the municipality.
- Maintaining variety between student buildings.
The virtual human has the option to build different kinds of student housing to accommodate students of all income types. It keeps track of the amount of student housing of each kind on the map and evens this out.

In the beginning of the project we made a high-level product backlog in our product planning. This backlog was ordered according to the MoSCoW method. The must haves from the backlog have all been completed. Except for trading land and inter-agent communication all should haves are also implemented. A more detailed description of how these could be implemented can be found in the outlook section 7.

7 Outlook

The virtual human simulates the student housing corporation DUWO. Several different strategies, that resemble the strategies of DUWO itself, have been created. In the end however, the virtual human is restricted by the capabilities of the Tygron-API and EIS-connector, and the amount of time that was available for the project.

Building student housing closer to the Delft University of Technology buildings would be a very interesting feature. Students generally want to live as close to their University as possible. It is currently not possible to create an indicator that rates on this. If this the indicator system was expanded to allow this a lot of interesting goals could be set for both Virtual humans and real humans using the Tygron engine. It would have been possible though to create an action that returns area as close to the TU campus as possible to build on.

It was decided not to implement it as it wouldn't count towards the indicators, and achieving those would be the ultimate goal of the project, but a function could have been made that calculates the distance between the possible building location and the campus, and returning only those withing a certain threshold. The indicator would also not offer that much of a practical difference, as the whole area of the game is approximately 2 by 2 kilometers around the university, so any building would be reasonably close to it.

Another feature that would make the simulation more interesting is the possibility of upgrading DUWO's buildings to be more environment-friendly. The Tygron engine allows this for several buildings, but unfortunately student housing is not included. With some more time it would have been possible to add this to the environment and incorporate it into the agent. If this had been implemented, the virtual human could have upgraded buildings as soon as the Municipality's feeling towards the stakeholder had gotten too low to build, to ensure it can build again in the future. The virtual human could first upgrade the more luxurious houses, before upgrading the modal and the cheap houses.

Finally communication between virtual stakeholders through the Tygron Engine could be developed. This improvement is probably the hardest to realize since it requires a well-defined language that all agents agree on, as well as the ability to plan a action without it affecting the simulation. However this would allow the virtual human to do a lot of interesting things and make more complicated decisions that might not benefit the virtual human immediately, but help it in the long run.

One way to implement this would be to for all teams to develop a well-defined language together and use the messaging service provided by the Tygron API to communicate. This language could for example contain messages for requesting changes of zoning plans or for buying land, and reactions indicating the price for certain actions is too low.

A Ideal virtual human strategy for the DUWO stakeholder

This document describes what was the original plan regarding the virtual human strategy for the DUWO student housing stakeholder.

A.1 Goals

In the ideal strategy virtual human has five goals. These are:

- Build enough student housing to house two thousand more students.
- Build houses so each type of student housing is roughly equally represented.
- Build student housing close to the Delft University of Technology.
- Don't exceed the budget of twenty-five million euros and keep ten million euros as a reserve.
- Increase the livability in the zones with student housing.

Each of these goals are paired with an indicator that is visible within the Tygron game.

A.2 Situation

In the starting situation the DUWO stakeholder has some large patches of owned land and a few small ones. Some are very close to the university, but most of them are roughly a kilometer away. All of this land is occupied with buildings or gardens. The stakeholder owns buildings that house roughly two thousand students. Their housing types are not equally represented. Most of the houses are of the cheap and simple type and the luxury type, while the amount of medium type houses are roughly half the size of the amount of cheap type houses.

A.3 Strategy

The virtual human can be in any of the following mental states. Each mental state determines how the agent will act. The first state corresponds to making space by demolishing gardens. Since there is no free space left to build student housing the virtual human should demolish something first. Demolishing student housing can negatively affect the build and variety indicators, while demolishing gardens can not and is relatively cheap, so the virtual human will demolish gardens.

When there is space to build, the virtual human accesses the normal building state. While in this state, the virtual human builds houses on available land. This will increase the build indicator. To also increase the variety indicator, the virtual human builds student houses with the type of which there are the fewest. It selects the places closest to the university.

The third state is activated when the virtual human is close to reaching its reserve budget, this happens when its less than 20% above the budget target. When the building budget is low, the virtual human will build cheap student houses only and try to sell some of the land that does not have student houses on it.

When the virtual human has less than ten million euros, it has used up some of its reserve budget. It has to earn the money back. To accomplish this the virtual human will focus on selling land to other stakeholders, for five hundred euros per square meter, a price somewhat higher than the default price. If they decline it will try to sell it for four hundred euros, and if this is also declined it will try once more for three hundred euros.

The last state to be mentioned corresponds to the livability of zones. When the two thousand extra student houses are realized, the virtual human will look at some luxury houses in zones with the lowest livability and upgrade them to student houses with green roofs. The student containers are also upgraded to cheap student flats. Furthermore, the virtual human will try to sell land in the low livability zones to the municipality so gardens and forests can be built on it.

B Interaction Design

B.1 Questions

The following questions were asked after a session (either with the virtual human or a real person) with the user. The questions are in Dutch because all the users are Dutch and the form they filled in also was.

- Hoeveel begrijp je van de Tygron Engine?
With one being little and five being much.
- Hoe logisch is de plaatsing van gebouwen van de medespeler?
With one being illogical and five being logical
- In hoeverre associeer je het gedrag van de medespeler met die van DUWO?
With one being not DUWO and five being DUWO
- Hoe snel reageert de medespeler op verkoop/koop requests?
With one being slow and five being fast.
- Hoeveel lijkt de medespeler op een mens?
With one being a bot and five being a person.

B.2 Results

We had six persons do a session, this yielded the following graphs. In figure 1 the results of the user playing with another person is represented and in figure 2 the user playing with the virtual human. The score the graphs refers should be interpreted as the score given in the aforementioned list of asked questions.

Besides these results we have noticed a difference between students and non-students. The students were better at recognizing the virtual human than the non-students. This is can be seen in figure 3. The graph shows the result of the last question of the aforementioned list of asked questions.

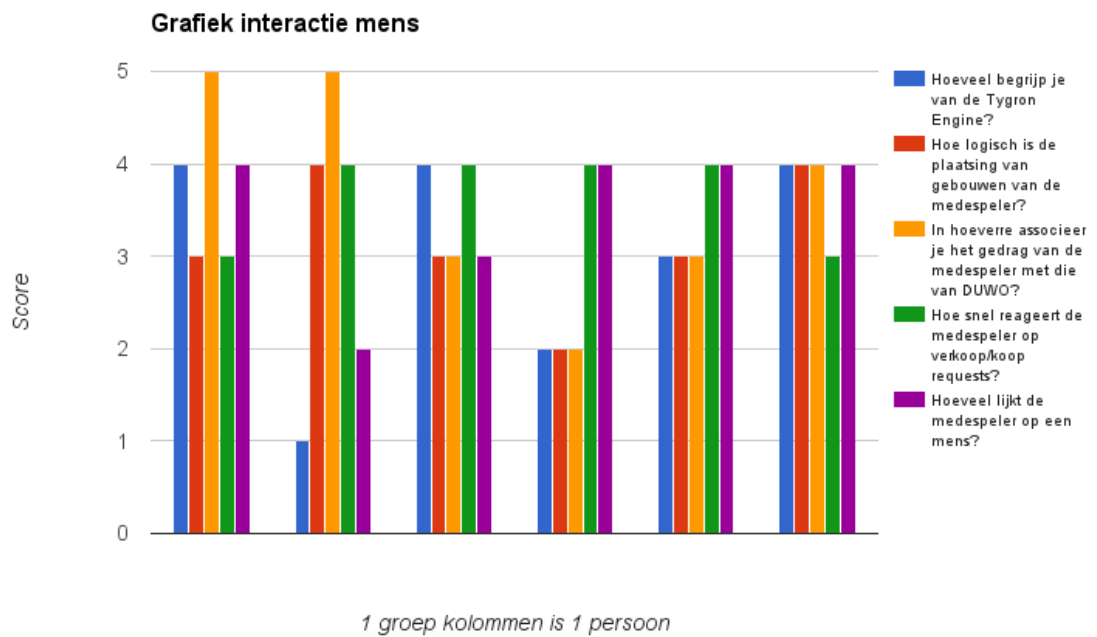


Figure 1: A graph displaying the results when testing with a human.

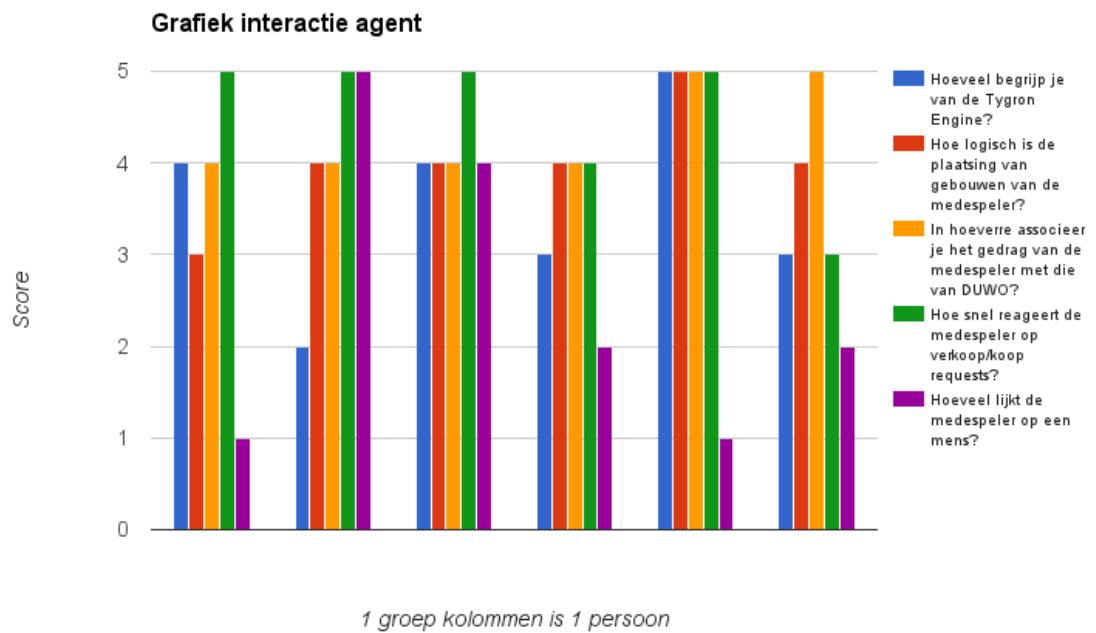


Figure 2: A graph displaying the results when testing with an agent.

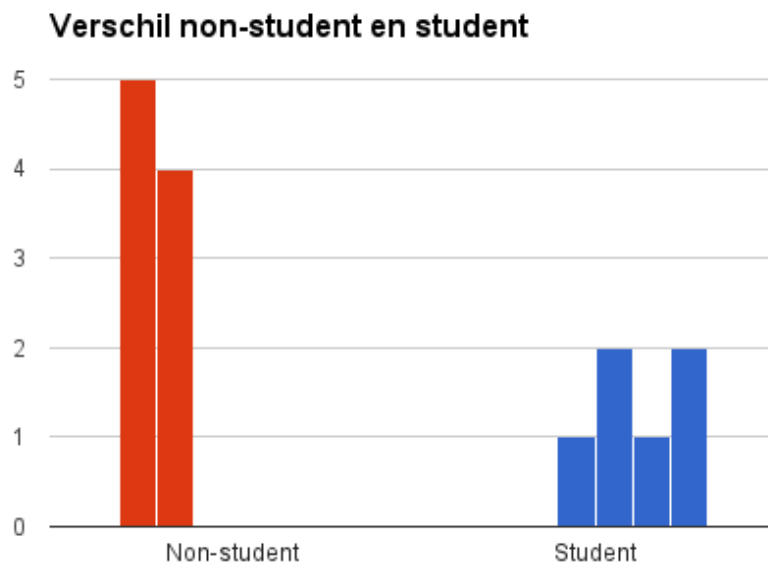


Figure 3: A graph displaying the difference in agent recognition between students and non-students.

C Sprint backlogs

Sprint backlog #1

Context project: Virtual Humans for Serious Gaming

Group: VH3

User Story	Task	Member responsible	Assigned to	Estimated Effort (hours)	Priority (A-E)
As a developer I need to have the latest version of GOAL installed.	Install or update GOAL. (http://ii.tudelft.nl/trac/goal/)	Individual	Everyone	Less than 1	A
As a developer I need to download the Tygron Engine.	Install the Tygron Engine. (https://preview.tygron.com)	Individual	Everyone	Less than 1	A
As a developer I need to know how the Tygron Engine works.	Try out the Tygron Engine.	Individual	Everyone	4	A
As a developer I need to know what kind of game we're planning to make.	Consult with other teams about the game.	Individual	Everyone	4	A
As a developer I need information on how the Tygron EIS Connector works.	Read through the source code of the Tygron EIS Connector. (https://github.com/eishub/tygron)	Individual	Everyone	2	B
As a developer I need information on how to program an agent in goal.	Read through the GOAL Programming Guide. (https://bintray.com/artifact/download/goalhub/GOAL/GOALProgrammingGuide.pdf)	Individual	Everyone	1	B

As a developer I need to know what kind of actions an agent can perform.	Read through the source code of the Tygron EIS Connector. (https://github.com/eishub/tygron)	Individual	Everyone	2	B
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Sprint backlog #2

Context project: Virtual Humans for Serious Gaming

Group: WhySoSerious

User Story	Task	Member responsible	Assigned to	Estimated Effort (hours)	Priority (A-E)
As a developer I want to complete the product vision, to ensure smooth development in the future.	Work on product vision conform the rubric.	Max & Marciano	Rico, Dennis, Max & Marciano	4	A
	Process the feedback of the TA.	Max & Marciano	Max & Marciano	2	A
As a developer I want to complete the product planning, to ensure smooth development in the future.	Process the feedback of the TA and finish the product planning.	Rico & Dennis	Rico & Dennis	2	A
As a developer I need to know what kind of indicators we are using.	Discuss with other teams about the indicators.	Marciano	Marciano	3	A
As a user I want an environment in which the virtual humans can be run.	Discuss and assign tasks with the other groups to make the environment ready.	Marciano	Marciano	Less than 1 hour	A
	Work on our group's assigned tasks for the environment.	Max	Everyone	7	A
As a developer I need information on how to program an agent in goal.	Read through the GOAL Programming Guide. (https://bintray.com/artifact/download/goalhub/GOAL/GOALProgrammingGuide.pdf)	Rico	Everyone	3	B

As a developer I need to have a working virtual human connected to the Tygron Engine.	When the EIS connector is working, setup github properly with continuous integration.	Rico	Everyone	1	B
	Try out the provided virtual human. (https://github.com/eishub/tygron/tree/master/environment/src/main/GOAL)	Dennis	Dennis	1	C
As a developer I need to have an up to date Architecture design paper.	Update the Architecture design paper if needed.	Dennis	Whoever made the change.	1	C

Sprint backlog #3

Context project: Virtual Humans for Serious Gaming

Group: WhySoSerious

User Story	Task	Member responsible	Assigned to	Estimated Effort (hours)	Priority (A-E)
As a user, I want a virtual human to run in the tygron game.	Create a prototype virtual agent in goal to run in the tygron game created last week.	Rico	Rico	4	A
			Dennis	4	
As a user, I want the virtual human to be able to build student housing on owned land so that it can fulfill its requirements.	Add building houses to the virtual human's functionality.	Dennis	Max	4	A
			Dennis	4	
As a user I want an environment in which the virtual humans can be run and rated.	Implement additional indicators for the virtual human.	Max	Max	3	A
			Marciano	3	
As a developer I need to have an up to date Architecture design paper.	Process the feedback of the TA.	Marciano	Rico	4	A
			Marciano	4	
	Update the Architecture design paper if needed.	Marciano	Whoever made the change	1	
As a developer I want more information on DUWO so that I can create a more accurate simulation.	Contact DUWO to see if they would like to meet with. us to give us more information on their vision.	Rico	Rico	1	B
	Meet with DUWO if they agree		Everyone	3	B

As a user, I want the virtual human to make sure it doesn't exceed its allocated budget so that the simulation is more challenging.	Start implementing the functionality so the virtual humans takes its own budget in account.	Marciano	Max	4	B
			Dennis	4	
			Marciano	4	
			Rico	4	
As a developer I need to have a working virtual human connected to the Tygron Engine.	When the EIS connector is working, setup github properly with continuous integration.	Rico	Max	1	B
			Dennis	1	
			Marciano	1	
			Rico	1	
	Try out the provided virtual human. https://github.com/eishub/tygron/tree/master/environment/src/main/GOAL	Dennis	Dennis	1	C

Sprint backlog #4

Context project: Virtual Humans for Serious Gaming

Group: WhySoSerious

User Story	Task	Member responsible	Assigned to	Estimated Effort (hours)	Priority (A-E)
As a developer, I want to make proper use of github to ensure smooth development of the connector with all teams.	Update the old github connector fork and reconfigure it to work with travis CI.	Dennis	Dennis	4	A, needs to be done before we can work on the connector
As a user, I want the virtual human to differentiate between different types of student housing.	Change the building indicator to assign different weights to different kind of student housing.	Max	Max	8	B
	If the indicator percept is implemented, make sure our agent recognizes this indicator.		Marciano	8	
As a developer, I want the virtual humans to be able to communicate with each other.	Discuss with other groups about how to implement messages between virtual humans.	Marciano	Rico	6	B, important for negotiation, but the connector has a higher priority
			Dennis	6	
			Marciano	6	
			Max	6	
As a developer, I want to make sure that there is a working strategy before it is implemented into code.	Make a concept strategy for the DUWO stakeholder for achieving the goals as stated in the product vision.	Rico	Rico	5	B, the sooner this is clear, the more effective we can implement it (backed by Joost Broekens)
			Dennis	5	
			Marciano	5	
			Max	5	

As a developer I want more information on DUWO so that I can create a more accurate simulation.	Recontact DUWO.	Rico	Rico	1	C, can be beneficial to refine our stakeholder strategy, but it is not strictly necessary
As a developer, I want to have a connector between the tygron servers and our goal agents.	Meet with the other groups to discuss the features we want to have in the connector.	Dennis	Dennis	15*	A*, we need the connector to be able to work on our agents
	Divide the features into the groups (and maybe wouter) and prioritize them with a time estimate.		Max	10*	
			Rico	15*	
			Marciano	10*	

*Note: We expect to be working on issues regarding the connector, but we have to discuss with the other groups who is responsible for each issue. When we know which issues we are responsible we will create an extra sprint plan. We also expect new issues to resurface constantly and we can not know in advance what they will be. This means that we can not yet accurately describe and divide these tasks.

Sprint backlog #5

Context project: Virtual Humans for Serious Gaming

Group: WhySoSerious

User Story	Task	Member responsible	Assigned to	Estimated Effort (hours)	Priority (A-E)
As a developer, I want the virtual human to be able to see who it is, so that it can query information about itself, its indicators and its belongings.	Make sure the my_stakeholder_id percept is approved by the other teams and merged in the tygron/eishub context branch.	Rico	Rico	3	A, this was planned last week and should be finished at the beginning of the week.
As a developer, I want to see what the other team members are developing and be up to date with new code.	Review the code of other team members when a new pull request has been created.	Rico	Max Dennis Marciano Rico	2.5 2.5 2.5 2.5	A, code needs to be reviewed quickly so that groups can continue to work on the connector.
As a developer, I want to improve the code coverage, so that the code of the EIS-Tygron connector is well tested.	Install eCobertura in our IDEs.	Max	Max Marciano Rico Dennis	2 2 2 2	B
	Update the tygron connector tests so the code coverage (according to eCobertura) is above the 85%.	Marciano	Max Marciano	8 8	B
As a developer, I want the virtual human to make sure that it always has enough houses available to students so that students have enough houses.	Adopt a goal to build more student housing when there are not enough houses for students according to the indicator.	Rico	Dennis Rico	3 3	B, part of our agents must have's but not necessary for this week
	Let the virtual human build student housing on owned property when it has this as a goal.	Dennis	Rico Dennis	8 8	C
As a developer, I want the virtual human to make sure that it only builds when it has enough money., so the virtual human can meet its goals.	Create a module for the virtual human so it will build when it has the money required and not build if the budget is too low.	Dennis	Dennis	2	B
	Create a goal that the virtual human adopts when it has less than a threshold of money.	Max	Max	1	C
As a developer, I want the virtual human to clear land if more building space is needed, so that the virtual human is able to achieve its goals.	The virtual human should be able to demolish structures on patches of its own land.	Marciano	Marciano Max	3 2	C
Course requirement separate from project.	Prepare a plan (as proposed by Willem-Paul Brinkman in slack) for the midterm from Interaction feedback session Design (30 may, 1 jul).	Dennis	Dennis Rico Marciano Max	4 4 4 4	D, the deadline is still pretty far away
As a developer, I want my virtual human to be able to negotiate with other stakeholders, so it can be better at achieving its goals.	Discuss with other groups about an implementation for making deals and trading property with other stakeholders.	Max	Dennis Rico	2 2	D, this is a more complicated version of implementing permits, which is currently still in development by Danshal.

			Marciano	2	
			Max	2	
As a developer, I want the virtual human to have a budget, so the game is not trivial and the virtual human has a challenge.	Research costs of buildings and land to decide an appropriate budget for the agent.	Marciano	Marciano	2	E, the budget can easily be changed and experience with the tygron environment will make this easier

Note: We expect to spend some more time than stated above. We will also spend time on meetings, sprint plan and retrospective, and emerging connector issues that we can't predict at the moment.

Sprint backlog #6

Context project: Virtual Humans for Serious Gaming

Group: WhySoSerious

User Story	Task	Member responsible	Assigned to	Estimated Effort (hours)	Priority (A-E)
As a developer, I want the connector to be able to assign our virtual human the best places to build, because it is not possible for the virtual human to do this.	Let the connector calculate the five best places to build student housing for the virtual human. (should be discussed with Frank).	Rico	Rico	7	A, is needed so we can show a proper demo.
			Marciano	7	
			Max	7	
As a developer I want to have a demo to show our progress to the stakeholders of the project.	Prepare demo for meeting with Bacchelli.	Max	Marciano	4	A, meeting is scheduled for this week.
			Dennis	4	
			Max	4	
			Rico	4	
As a developer, I want the virtual human to make sure that it will strive to have enough houses available to students so that students have enough houses.	Let the virtual human build student housing on owned property when it has this as a goal.	Dennis	Rico	8	A, this is necessary so we can show a demo next Friday.
			Dennis	8	
	Let the virtual human demolish constructions on owned land if no land is available to build on.	Max	Max	6	C, not essential for this week but still important for our bot to function correctly.
			Marciano	6	
Course requirement separate from project.	Attend feedback session of Interaction & Design.	Marciano	Dennis	0.5	B, meeting is scheduled for this week, but it is a smaller part of our grade than the SEM meeting.
			Rico	0.5	
			Max	0.5	
			Marciano	0.5	
As a developer, I want to see what the other team members are developing and be up to date with new code.	Review the code of other team members when a new pull request has been created.	Marciano	Marciano	6	B, it is important to make sure that each pull request is handled quickly.
			Max	6	
			Dennis	3	
			Rico	3	
As a developer, I want to stay in touch with the people at Tygron, so they can help us with possible problems and inform us about changes and difficulties with the engine.	Meeting at Tygron.	Rico	Rico	4	B, also discuss with Frank on how we should implement the first task of this sprint.
			Dennis	4	
As a virtual human I want to be able to buy land, so that I can build more student housing.	Implement buying land for the Tygron virtual human.	Dennis	Dennis	5	B, functionality that's useful for the demo on Friday.
As a virtual human I want to be able to sell land to increase my budget.	Implement selling land for the Tygron virtual human.	Dennis	Dennis	3	C, less important for the DUWO stakeholder than buying land. (since we don't have a lot of empty land).
As a developer I want to have an up to date architecture design paper, so that we have a high level description of our product.	Process EAD feedback and update it with the current state of the project.	Rico	Rico	3	C, this is important, as this is a weekly deliverable, but having a working agent is more important, especially because we need to give a demo this week.
			Marciano	3	
Course requirement separate from project.	Attend the SIG Lecture.	Marciano	Dennis	2	C, scheduled for this week.

			Rico	2	
			Max	2	
			Marciano	2	
As a developer, I want to improve the code coverage, so that the code of the EIS-Tygron connector is well tested.	Update the tygron connector tests so the code coverage (according to eCobertura) stays above 80%.	Max	Max	4	D, it is still important to test, but the demo has the top priority this week.
As a developer, I want to be able to efficiently test the code and increase the quality of the tests, so that more code can be covered in the end.	Add PowerMockito to the pom.xml of the environment.	Max	Max	1	E, we need to focus on implementing building student housing.
Course requirement separate from project.	Do Interaction & Design Maple assignments 1 till 4 and end assignment	Marciano	Marciano	1.5	E, deadline is still far away.
			Max	1.5	
			Dennis	1.5	
			Rico	1.5	

Sprint backlog #7

Context project: Virtual Humans for Serious Gaming

Group: WhySoSerious

User Story	Task	Member responsible	Assigned to	Estimated Effort (hours)	Priority (A-E)
As a developer, I want the connector to be properly tested, so we easily find out newly introduced bugs.	Test percentage above 75% for the actions.	Rico	Max	8	A, this is necessary to add custom actions to the connector.
			Rico	8	
As a developer, I want the virtual human to make sure that it will buy land when it has no land to demolish and land to build student housing, so that it can build student housing.	Make sure buying land works.	Marciano	Marciano	4	A, for the demo on wednesday.
			Dennis	4	
As a developer, I want the virtual human to sell land when it needs more money, so that it can achieve its goals.	Implement selling land.	Dennis	Dennis	3	A, for the demo on wednesday.
			Marciano	3	
As a developer, I want the virtual human to use its indicators, so it can achieve its goals.	Make sure indicators work as they should and the agent is able to percept them.	Dennis	Marciano	6	A, for the demo on wednesday.
			Dennis	8	
As a developer, I want the connector to be able to filter on certain zones, so that the virtual human can better choose where to build.	Design architecture for GetRelevantAreas (and add it to the EAD).	Max	Max	2	B, this is necessary to have a decent class, but not essential for our agent.
			Rico	2	
	Refactor GetRelevantAreas.java to make it more manageable.	Max	Max	4	
			Rico	4	
	Implement zone filter.	Max	Max	4	
As a developer, I want to see what the other team members are developing and be up to date with new code.	Review the code of other team members when a new pull request has been created.	Marciano	Marciano	3	B, it is important to make sure that each pull request is handled quickly.
			Max	3	
			Dennis	3	
			Rico	3	
As a developer, I want my virtual human to have deterministic and understandable behaviour, so that I can predict the actions of my agent.	Create workaround for the noBudgetMod problem (see Sprint Retrospective #6).	Marciano	Marciano	3	B, should be fixed before the end of the sprint.
			Dennis	3	
As a developer I want to be able to toggle certain percepts given to the virtual human so that I can mock these in tests.	Fix issue #64 (toggling percepts) on eishub.	Dennis	Dennis	7	B, this makes testing the virtual human a lot easier.
As a developer, I want to stay in touch with the people at Tygron, so they can help us with possible problems and inform us about changes and difficulties with the engine.	Meeting at Tygron.	Rico	Rico	4	C, will help us with sdk issues and meet with the outer groups.
			Marciano	4	
As a developer, I want my virtual human to have more influence in the information it gets from the environment, so that it gets the information it needs.	Create concrete filter implemented for get_relevant_areas action.	Marciano	Marciano	2	C, this is not strictly necessary, but it will decrease the number of costly calls the virtual human will make to the connector.
As a developer, I want to show my progress to the stakeholders of my project.	Prepare a demo for Koen.	Max	Marciano	2	C, we first need to make sure we have done the other tasks to create a proper demo.
			Rico	2	

			Dennis	2	
			Max	2	
Course requirement separate from project.	Attend the project skills lecture.	Rico	Marciano	4	D, scheduled for this week.
			Rico	4	
			Dennis	4	
			Max	4	
As a developer I want to have an up to date architecture design paper, so that we have a high level description of our product.	Process EAD feedback and update it with the current state of the project.		Max	3	D, can be done at the end of the week.
			Rico	3	
Course requirement separate from project.	Do Interaction & Design Maple assignments 1 till 4 and end assignment.	Marciano	Marciano	1.5	E, deadline is still far away.
			Max	1.5	
			Dennis	1.5	
			Rico	1.5	

Sprint backlog #8

Context project: Virtual Humans for Serious Gaming

Group: WhySoSerious

User Story	Task	Member responsible	Assigned to	Estimated Effort (hours)	Priority (A-E)
As a developer, I want to have a report on the product, so my stakeholders understand how to use the product.	Create a draft of the Final report	Max	Marciano	8	A, deliverable for this sprint
			Max	8	
			Dennis	8	
			Rico	8	
Course requirement separate from project.	Create an individual essay on team dynamics within our project team (2 pages A4)	Max	Marciano	3	A, deliverable for this sprint
			Max	3	
			Dennis	3	
			Rico	3	
Course requirement separate from project.	Let several people play against our virtual human for the report of interaction design (field evaluation).	Dennis	Marciano	2	A, deliverable for this sprint
			Max	2	
			Dennis	2	
			Rico	2	
	Create and integrate the report for interaction design into our final product.	Rico	Marciano	2	A, deliverable for this sprint
			Max	2	
			Dennis	2	
			Rico	2	
As a developer I want to have an up to date architecture design paper, so that we have a high level description of our product.	Create the final version of the Emergent Architecture Design	Dennis	Max	3	A, deliverable for this sprint
			Dennis	3	
			Rico	0.5	
			Marciano	0.5	
As a virtual human, I want to have ways to handle my budget when it is low, so that I can fulfill as much indicators as possible	When the virtual human is low on money (in the lowBudget module) build cheap student housing (if our variety indicator allows it)	Rico	Rico	2	A, listening to our indicators is necessary cause this will tell if the agent is doing its job correctly.
	When the virtual human is low on money (in the lowBudget module) sell land (if our variety indicator tells us to build luxury student housing)	Rico	Rico	2	
Course requirement separate from project.	Create a document as a response of our information skills feedback.	Dennis	Max	1	B, It could save us time on having to do the resit
			Dennis	1	
	Work on the information skills resit	Marciano	Marciano	3	A, needed to complete the course.
			Max	3	

			Dennis	3	
			Rico	3	
As a developer I want my code to be properly tested so that it is easy to see that it works.	Write tests for the goal agent	Dennis	Dennis	6	B, important because of the the software engineering aspects of the course
			Rico	4	
As a develop, I want my virtual human to have space enough space to build on so that it can improve its student housing indicator.	Demolish the biggest piece of land (gardens/nature) first.	Rico	Rico	2	B, we need land to build on but we don't need to demolish everything.
As a developer, I want my virtual human to sell land that it doesn't need, so it won't lower its indicators by selling needed land.	Sell land that has buildings that do not influence our building and variation indicators (in noBudgetMod)	Marciano	Marciano	2	B, selling land will help the agent
As a developer, I want my virtual human to be able to react to buy and sell requests from other stakeholders.	React to requests from other stakeholder.	Marciano	Marciano	3	B, important for interacting with other agents
As a developer, I want to stay in touch with the people at Tygron, so they can help us with possible problems and inform us about changes and difficulties with the engine.	Meeting at Tygron.	Marciano	Marciano	3	C, will help us with sdk issues and meet with the other groups.
			Max	3	
As a developer I want to be able to test my goal code so that continuous integration is possible	Create tests for the filterpercepts action in the connector	Dennis	Dennis	4	C, We don't have much time for this anymore but it doesn't interfere with the functionality of the agent
As a user, I want my program to be fast and responsive, so I can efficiently do my job.	Attempt to make GetRelevantActions faster by filtering on buildings owned by the active stakeholder only.	Max	Max	2	D, this is not necessary for the virtual human to behave correctly.
As a developer, I want my virtual human to have a good relationship with the Municipality, so it is easier to have it reach its goals.	Upgrade flats to flats with green rooftops to get a better trust-relation with Municipality	Marciano	Marciano	2	D, not strictly necessary, but our agent might get more permissions from Municipality. We expect this to have more effect in the long run than the task below.
			Rico	2	
	Immediately sell some green land to the Municipality when the game starts.	Marciano	Marciano	1	E, not strictly necessary, but our agent might get more permissions from Municipality.

This week's sprint includes a lot of A priority tasks. This is because it is a week with a lot of deliverables