The Game Master: A study on procedurally generated game storylines

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Resum— El desig de l'ésser humà de obtenir entreteniment i crear històries ha estat amb nosaltres des dels principis del temps, pel que és inevitable que amb els avenços tecnològics de la nostra era ens trobem amb que aquest entreteniment s'adapta als mitjans que ens trobem a la nostra disposició. És així com neixen els videojocs, i amb ells, la Narrativa Interactiva o la possibilitat de fer evolucionar les històries en una dimensió més de la que estàvem acostumats fins al moment, és a dir, permetent que l'espectador tingui un paper actiu. I no només això doncs oferint el paper de narrador als sistemes informàtics ens plantegem si no són aquests mateixos que podrien crear la ficció, oferir-nos aquest entreteniment. Al llarg d'aquest treball explorarem quines serien les bases per a poder convertir aquesta darrera premissa en una realitat, ens preguntarem què defineix la creativitat per a un sistema informàtic, com s'ha enfrontat aquest repte fins al moment i proposarem una primera solució per a una de les preguntes més complicades en aquest camp: Poden els sistemes computacionals ser creatius?

Paraules clau—Entreteniment basat en sistemes computacionals, Històries generades per ordinador, Intel·ligència artificial, Narrativa Interactiva, Sistemes basats en coneixement

Abstract— As a collective, Mankind has always had a strong desire to obtain entertainment and create stories. From the beginning of our days to the point of technological advance of our era, leisure has adapted and grown to take advantage of the potential of whichever media was available. This is what made video games possible, and with their conception, Interactive Narrative, which allows us to take a role previously never experienced story telling, as spectators were never able to fully become a part of the lore of the story. Although this is a significant difference with traditional media, as soon as we allow our computer systems to be the conductor of our stories, to narrate them and modify them as we play, why can't we let them take care of making the story as well? In the course of this project we will explore the foundations of story generation and research how we could define creativity to a computer system. We will also consider what previous solutions have been implemented in the past and we will make a small, humble proposal of our own to attempt to answer one of the most complicated questions of this field: Can computer systems be creative?

Index Terms— Artificial intelligence, Computer-based entertainment, Computer generated storylines, Knowledge based Systems, Interactive Narrative, Videogames

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1 Introduction

Mankind loves stories. We love learning, teaching and growing with fiction, and it is fiction what has made most of us become whom we are. As kids we play and yearn for entertainment, and in the same way that we did then we find ourselves as adults consuming products that solely exist for our amusement, yet we still wish they would never end.

This desire for entertainment to be endless is one of the main motivations of not just Interactive Narrative but all the available options for computer based entertainment, aside from discovering what the limitations are to porting human creativity to a computer based system.

Our motivation to make stories endless comes from both a personal background of interest in video game design and storytelling and the curiosity of knowing what the extent of our capabilities can deliver.

We want to explore and research the different connections and possibilities that Computer Schience offers in order to develop procedurally generated storylines, mostly for videogames, allowing the creation of computer-made art and endless entertainment.

For this intent, we will study the state of the art in Interactive Narrative, and the previous attempts at the task, we will research and determine what the best algorithm

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and data structures are in order to create an adequate System, as well as the frameworks, programming languages and platforms that make this possible. We will then create a simple web application that proves an easy model of story interaction.

The contents of this paper cover the entirety of our journey, from the studies of Interactive Narrative to our own humble attempt at the matter. In the first section of this paper we will review the state of the art in Interactive Narrative and story generation, including previously developed systems, their classification and common computational models used for this matter. Then we will explain the foundations of our design, algorithm and implementation. Next, we will present some of our results and their analysis. Finally, we will close with the conclusions we have extracted from this experience.

2 State of the art

2.1 Interactive Narrative

Games can be defined as activities that engage us to obtain amusement from them. Out of all the entertainment types that mankind has in their plate to obtain amusement from, computer games and computer generated experiences have one of the greatest impacts, especially in our day and age.

Linked to the constant necessity of storytelling that we have experienced since our early ages (from oral traditions to modern filmmaking), we know that stories and tales have existed since language developed [20]. Such stories and their media, which are out of the scope of this paper, have evolved in such a way that incorporating computer-generated entertainment was only the most natural and foreseeable step.

Here is where we encounter Interactive Narrative (I.N. for short), which is a form of digital entertainment, of interactive experience that compels users to create or become part of a storyline through their actions. Unlike it happens in other computer-based systems, the goal of I.N. isn't to provide a deliverable, product or service beyond entertainment. Instead, it intends to delve the user in a virtual world in a way that they become a part of the story that unfolds, that they believe their actions to be the cause of the direction or the outcome of said story. This is also the main distinction between I.N. and other forms of digital entertainment, the fact that the user doesn't simply get amusement from the activity, but is believed to be a key part of it.

Even though, when we consider I.N. at a deeper level, a few research questions come to our mind: What's the role of a computational system in regards of the narrative? What does it need to know in order to reason about the world that's being created? What's the level of intervention and how is that channeled so that the experience engages the user?

Throughout this project we will study and review different approaches that focus on answering the two first questions, which in the end relate to the fundamental quest for computational systems to show abilities only attributed to humans such as creating stories. We will also consider the other side of the spectrum, which mostly is reduced to the construction of a system that can absorb the user actions and guide them to their benefit.

We will review the different options available to us in both regards, as well as one of their classifications; some notable examples and the most commonly used computational models in the following sections of this document.

2.2 Story generators and drama managers

As we have mentioned previously, there are two main challenges that I.N. faces in order to become a fulfilling, complete and engaging experience. The first of them is to generate, to create, stories that are compelling to human beings. This is an incredibly hard subject, especially considering that it involves the use of creativity and the subjectivity it's always related to, making it hard to define what's creative even for human beings. It is also the main concern of this project, and therefore we will discuss it more later on.

The second challenge is to provide control and guidance over an already existing storyline (whether it has been authored or procedurally generated) in order for the player to navigate and participate successfully in the story. Bates [2], originally, called this entity a drama manager, also popularized as an experience manager in broader fields.

Riedl [18] discussed them further, considering story generators a part of them. To them, these systems are the keystone of the whole experience, trying to determine the best intervention given the user actions and the structure of the story. They manage differentiated parts such as the setting, computer-controlled characters (also known as non-player characters or NPCs) and the different events that need to happen in order to make the story progress. Given their degree of interaction with the player, and the different degrees of freedom given the story and the personality of the NPCs we can classify them in a three-axis setup according to their level of authorial intent, virtual character autonomy and player modeling. We will see this classification in depth in the following section.

Finally, considering story generation as a part of its own we base our study in the path that Gervas [9] opened in his studies of computational creativity. Story managers are the unit that, analogously to human writers, bring together facts and predict behaviors and happenings in order to build a storyline that offers a degree of interest in order to have a player navigate through it. They build the underlying setting in which the story unfolds and gives both to it and the NPCs that belong to it the depth they need. It's interesting to consider which is the minimum unit of information that human spectators need in order to perceive or infer narrative from. This is especially obvious in games like The Sims, a life simulation video game series, developed by EA Maxis and published by Electronic Arts, in which we can see players construct stories with a set of goal oriented characters. Given that most times the features of interest of a story might change from subject to subject, this becomes especially important when thinking about delivering fulfilling procedurally generated settings.

2.3 Classification of I.N. systems

Although it isn't as widely extended of a field as other video game related areas, we can still see a broad diversity when it comes to classifying different I.N. systems. We will review Riedl's classification (fig. 1) of experience managers to get a better idea of the state of the art, as well as some notable examples situated along the spectrum.

This classification is based on three key concepts: authorial intent, virtual character autonomy, and player modeling.

Authorial intent defines the strength in which the story is constrained by the original motivation of the author and how tightly the experience manager has to stick to it. A system with loose authorial intent has a higher degree of creative responsibility throughout the user's experience.

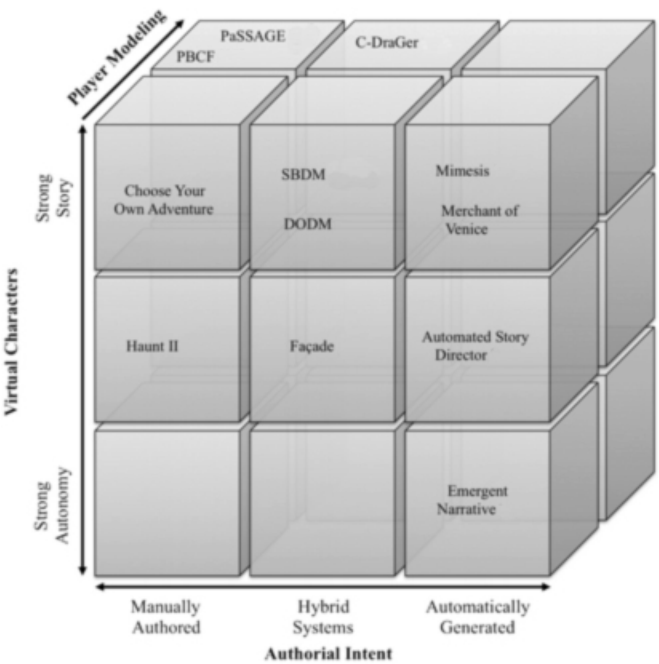

Fig. 1. Visual representation of Riedl's classification of I.N. systems

Virtual character autonomy refers to the degree of vinculation of the NPCs with the experience manager, drawing the line between the need of the characters to act consistently with their personality, motivations and circumstances and the need to fulfill a role in a story.

Player modeling responds to the adaptability of the system to the different behaviors of the user. This is widely seen in action games, where the NPCs adapt to the style of the player and modify their behavior in regards to the user's.

Some of these systems become of special importance for our research given their high amount of character autonomy like The Façade [15], others like The Merchant of Venice or The Automated Story Director become relevant because have low authorial intent and therefore the setting is closer to being automatically generated.

It's also interesting to consider Clute's [4] categorization of game narrative schemes. His model considers the following forms of narrative: frame, embedded, explorable, linear, multilinear, emergent, environmental and generative. These are loosely sorted in decreasing degrees of authorial intent.

Frame narratives are those narratives that while complete, play a secondary role in the development of the game. This would be implemented in any system with a strong authorial intent.

Embedded narratives take place before the game itself, and are integrated as units of action that the player has to explore.

Explorable narrative imply a single sequence of events like the former two but allow the player to travel throughout the story in different orders.

Linear narratives resemble embedded narratives in the way that the story is inserted into the game action, but they are fully linear and include the action between the different story fragments. This is the most common approach in video-game design.

Multilinear forms are an evolution of linear, including different timelines that might happen simultaneously and similarly to explorable models, allow the player to take multiple paths to traverse the story.

Emergent storylines take advantage of the fact that most stories include the existence of a goal that the player follows and the settings in which that goal is placed in order to achieve a considerable freedom of choice for the player.

Environmental models are mostly seen in wide worlds and multi-player games, as are based in creating a vast and detailed setting in which the player or players are free to interact and therefore perceive a sense of story from the richness of the background.

Generative narratives are the ultimate, far goal of most I.N., as it intends to create narrative as the player traverses the world, generating the story in response to their actions.

2.3 Computational models in I.N.

Given the complexity of the field, it is not a surprise to realize that there are a huge variety of methods that serve the purposes of I.N. to different extents. Some of them are as simple as a linear logic, a twist to classical logic, while others are as complex as cellular automatons.

In order to understand the inner workings of I.N. and their different systems, we reviewed a variety of models that are used in different areas and researched about their technical features as well as their main strong and weak points. Although not all of them are specifically designed for story generation they bring an interesting point of view or algorithm that relates to the task we have in our hands. Some of them are evidently more suitable to the purpose of maintaining the story development part of an experience manager, while the line that separates others is definitely blurrier. We have classified them loosely according to the different systems they might be mainly suitable for and the tasks they have accomplished mostly in the past.

We reviewed ISRST [15] and Scene flows as experience manager models, and bayesian networks [1] [5], linear logic [11], Planning Domain Definition Language (PDDL) [6] [7], rule-based systems, Markov systems and cellular automatons as story generation and virtual authoring algorithms and models.

There is one quality in common between the two experience manager models that we're reviewing, which is what made us consider them in such a category: they're clearly specified as for their intent. While the rest of systems are flexible and commonly applied to a wide range of AI necessities, both ISRST and Scene flows are undoubtedly related to I.N., which proves the specificity of the domain of the problem that an experience manager faces in comparison with story generation, which in the end can be minified to a search in a tree with the right amount of authored content and the structure to hold it

The analysis of these different systems is what allowed us to imagine a simple way to design our project so we could reach the goal we have in mind, which we will explain in the following sections.

The system we designed consists of a very simple story generator. This implies that it will have a very low degree of authorial intent (although it's impossible to avoid authoring traces for reasons we'll discuss in the results section) and highly autonomous characters. Since there's no actual player character or player interacton in the story generation process, there will be no player modeling at all.

3 Design

3.1 Chosen approach

Our approach will consist of a database of traits that will be combined given a set of rules in order to create characters and a rule-based system that will determine how those characters will interact. We will most likely combine this with a Markov system in order to add more probabilistic generation.

All this will be implemented as a web application in order to provide the fastest and most pleasant experience to the user given the text format of the story.

Here are some mockups of the expected result:

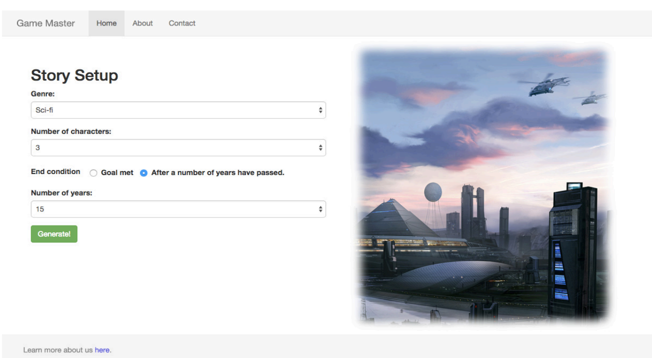

Fig. 2. Screenshot of the first step of the story generation.

This is the parameter selection screen for the generation of the story. It will allow the user to select between a few different choices in order to add more variation to the story generated afterwards

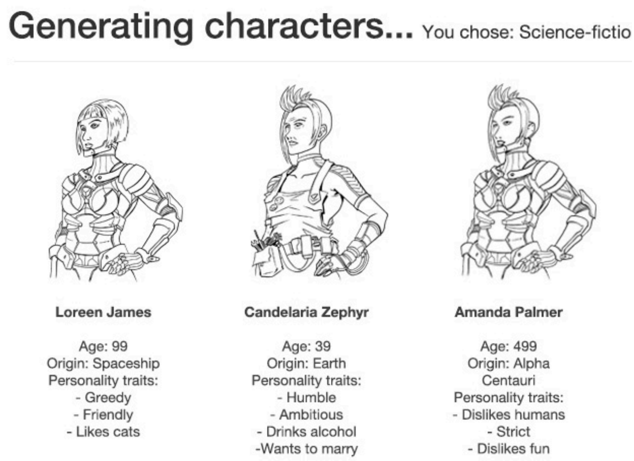

Fig. 3. Showing the results of the character generation.

This screen will show real-time character generation, loading the different traits and characteristics of the protagonists of the story. Ideally, their images will also have a degree of variety, but this will be randomly generated.

Finally, the user will be also able to see a real-time AJAX updated generation of the story as the allowed time goes by or until the objective selected is fulfilled. It will show the portrait of the character(s) depicted on the last loaded segment, the year in which the events happened and the actions occurred on that period.

3.2 Origins of our algorithm

Our main idea has always been to develop a simple rule-based system in which procedurally generated characters would evolve for a number of steps or until a condition is reached.

Those characters would generate according to a set of traits that will be stored in a database, which would determine their personality, motives and behavior. We considered allowing user input and character creation so that the pool of traits could increase with time and allowed a bigger number of combinations and generated stories. These traits would also layout the possible set of rules. For instance, a character that is ambitious will always want to find a way to lay their hands on money, and therefore will interact with those characters that are wealthy.

In order to set the environment and/or the goal to be reached, we would allow the user to choose between a limited set of genres, which would also help shape the set of rules that will take place. Some of the genres considered were: Murder-mystery, Fantasy and Sci-fi. For instance, murder mysteries require the existence of a victim, a culprit and witnesses. Those are conditions that would need to be fulfilled in order to be able to consider the story finished. This would also generate a good starting point for a procedurally generated murder mystery that would be playable afterwards, where the user would have to trace back the happenings in the story and figure out who the murderer was.

We were also considering adding Markov chains to the story generation process, so that we could include a probablilistic chance in the results. Creating a set of probabilities and allowing the happenings to respond to those would increase the range of variability introduced and add more expected results than the ones obtained by combining traits and deciding what the outcome of those combinations would be according to man-made rules.

3.3 World setting

Out of the three different settings that we were considering (fantasy, murder mistery and sci-fi), we chose to develop a science fiction world for our final product. The rationale behind that decision was that it didn't just include an interesting and challenging point of view for our stories to generate, but it also added variables that would make characters fluctuate between states with a higher frequency.

Another advantage is the fact that, in contrast to a more realistic setting as murder-mystery would have been, since the background chosen is completely fictional, it allows us to make up whatever social structure or framework necessary for our rules to be set much more easier than having to adjust to historical correctness would have been.

We wanted for the characters to have the possibility, and sometimes the necessity, to interact with their surroundings, so we have set different rules and actions available depending on their location, aside from traveling from one point to the other if they have the necessary resources. Although one of the limitations of our current approach is the consideration that characters have perfect information about other characters' locations (although this might change in the near future), the need for them to interact with others (or a character in particular) will increase their mobility between locations. Travelling also has a resource consumption, so in case that might be an obstacle for them they might need to look upon the different possibilities in their current one in order to obtain more resources. Maybe stealing or a negative interaction might stem from this.

Some characters might not want to interact with any characters at a given moment, meaning that they might want to satisfy an introspective need given by their personalities at that cycle (or recover their resources). We haven't delved into this side of character development too deeply, as it would have required implementing a goal oriented behavior system (or goal oriented action planning) and it would be out of the scope of the resources of this project, so we have dramatically simplified it. This is why it's crucial that the environment offers a simple version of those needs (and that the rules contemplate both failure and success) that it's also changing depending on the setting.

For this project we have chosen three different locations: a spaceship, a big city and a village. Each one of the locations has a different character capacity, which also encourages movement between characters and impedes all of them circulating to wherever resources might be easier to achieve by an imbalance we haven't been able to foresee. Some professions will also only be available in some of these locations, and the traveling costs will differ from one point to the other (although it will always be possible to represent as an undirected graph).

3.4 Character generation

As we considered the way we create the world so that the interaction between characters is maximized, we have tried our best in modeling said characters in a way that they're flexible and compatible enough to coexist with our setting and between themselves.

The process in which characters are created is mostly random with a set of limited parameters, which also ensures the likelihood of obtaining different stories at each run of the process. Even though, some of the parameters of our characters depend on previous values and the values of surrounding or known characters. This also means that we will have a group of set characteristics and a variable one (fig.4).

Set characteristics are those that relate to personality. We are aware that realistic, round characters change with time, experiences and circumstances but unfortunately introducing such variables to that deep of a level would increase dangerously the complexity of the project. Even though, we have tried to keep their immobility to a minimum, and we only specify statically their attributes. This includes, but isn't limited to, their intelligence, strength or charisma. These express themselves as modifiers to the likelihood of success in doing the action they want to take (as determined by the rule-based system). They also have some set traits that could either be defects or advantages, which expands the set of matching rules and actions available to them. For instance, a greedy character that doesn't need to interact with anybody else is going to prefer working towards gathering more resources than spending more.

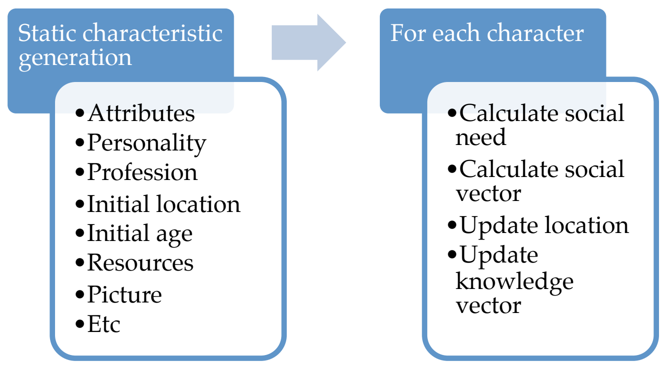

Fig. 4. Workflow of the character creation process.

Variable attributes include everything that relates to their surroundings, their social interactions, and their resources, as well as their age and health status. Aside from obvious reasons, such as the fact that characters need to grow old and die, we need to take into account the spending and increasing of resources, the likelihood of a character wanting to interact with another one and the influence of previous actions into the status of the character. As for the second point, a variety of factors come into play: their personality and level of extroversion, the amount of time they spent without social interaction, their sexual orientation and their intent or type of interaction.

Their physical appearance will also be randomly gen-

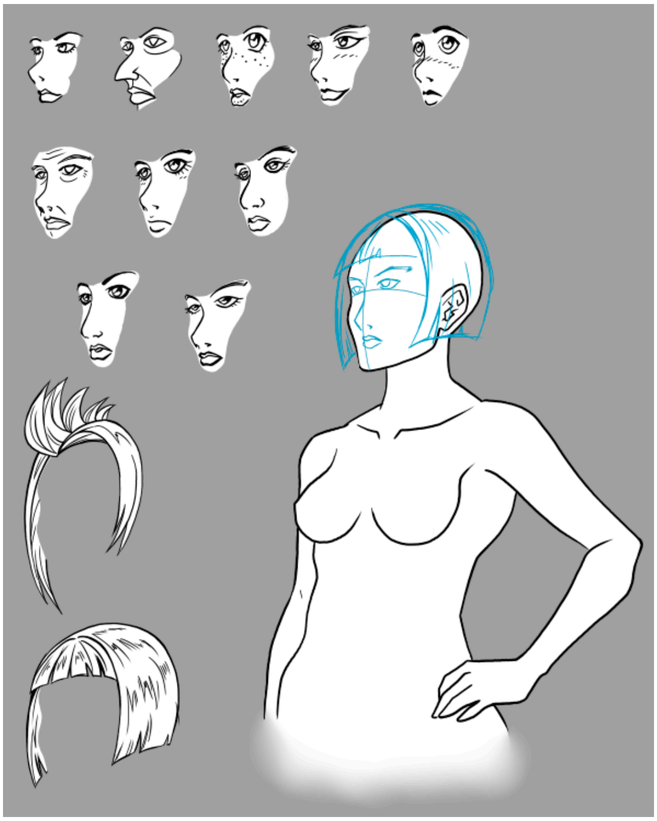

Fig. 5. Template for female character appearances.

erated, according to their set gender. Since we are aware of the fact that people sometimes encounter gender dysphoria in their lives, we are considering including the possibility of adding gender changes as a possibility, but we haven't been able to implement that option yet.

Fig. 5 shows some examples of the making-of the template for female character features.

3.2 Current algorithm

From all that we considered and the different possibilities we experimented with, we came up with the following algorithm to develop the story generation that we see in The Game Master.

First of all, characters are generated. The number of characters to generate is specified by the user from the interface of the website. Their names, genders, starting ages and locations are randomly generated or chosen from a database. Then, their attributes are generated inside of a range. Once their attributes, age and location are set, we randomly select a profession from the pool of suitable professions for said attributes. This is by itself a very simple and primitive rule based system. Then we add an arbitrary amount of virtues and defects from a list. From this set of static characteristics, we generate their world vector. This will include the bonuses and penalties to the different sets of actions available. Lastly, we select the ids of the sprites that will represent their physical appearances.

As soon as the basic character generation has completed for the full amount of characters desired by the user, we begin to populate their social matrices in a way that it reflects the likelihood of the different types of desires that they will have regarding other characters. This is affected by factors like virtues and defects, character attributes and location. In order to add a little bit more variation and depth to their relationships, some of the characters might randomly have a deeper relationship with each other, symbolized by the index of confidence with the other one.

Once character generation is fully completed, the information about the characters will be displayed to the user. Then, we will populate and update the rule-based system database with the available knowledge of the system and start the story generation loop. This loop will continue for as many iterations as units of time the user has selected. We are still tweaking the amount of iterations per year that feel eventful enough.

The story generation loop is a basic rule-based system loop, meaning that for each character it will consider its different indexes in order to determine which is the most pressing need or desire, starting with determining if the action that it wishes to take is internal or external (social or asocial) and then checking the available set of rules in order to determine which action should the character take. We push the action taken in a descriptive form to the array of strings that will be displayed to the user at the end of the loop and update the character vectors accordingly. Whenever we execute the action of the last character, we send the resulting array of action strings to the client and start the story generation loop again until a condition is reached (the user might have selected that they want to see the death of a character) or the amount of desired time/iterations is reached.

3.3 Tools of the trade

We decided to take a simple and time efficient approach as for the architecture and technical layour of the project. Our methodologies are simple and are based on both fast languages (such as Python, mostly used as a scripting language) and stable front-end frameworks.

This is why we chose a Python Pylons Pyramid [17] server on the back end and supported by Bootstrap [16] on the front end. Regarding Pylons and Pyramd, it because it's a lightweight web framework designed with the intent to emphasize flexibility and quick iteration.

The Pylons Project created Pylons with the intent to combine qualities from Ruby, Python and Perl, which allowed them to provide a structured but extremely flexible Python web framework. It's also one of the first projects to leverage the emerging WSGI standard, which allows extensive re-use and flexibility. Since Pylons aims to make web development fast, flexible and easy we have chosen to implement it for our back end. Since their creators are continuing most of their effort through their Pyramid project, it is most likely that this will be our choice as well, as that would provide us the most updated code and the highest warranty of having available documentation.

As for Bootstrap, we have chosen to use it for our front end given the high level of flexibility and the power that it brings to web applications. It doesn't just ensure that the websites created with it will have a high standing aesthetic, but that will also be scalable to all kind of devices. Bootstrap was created at Twitter in mid-2010. It's an open source project that doesn't associate with the Twitter brand anymore and is maintained by both code team engineers and the community.

Finally, we decided to host our code in an OpenSource repository, while setting up the server locally given the lack of available PAASs that would support Python Pyramid as their server technology.

Software-wise, we have used Coda 2, Sublime Text and Sequel Pro for code and database management respectively.

4 Methodology

4.1 Metrics

When considering a metric to evaluate the success of our project, we have to give some forethought to the nature of the product we're developing. Neither creativity nor storytelling are concepts traditionally associated with computer science, and there are no traditional methods to analyze the success of either, as they lack in the precision that most systems would need in order to be evaluable.

In our case, we will base our success in two different factors: the plausibility of the combination of actions chosen by the agents and the variability of the stories generated.

For the first criteria, we have to define what we consider credible. To that effect, we consider credible any behavior that mimics the human conduct to some extent. It is likely that a human being in need of health care would look for a doctor instead of playing a video game, for instance (although even human beings sometimes defy the laws of common sense).

For the second one, we will simply compare different iterations and see the variability that has occurred between them.

4.2 Results

We have run the simulation an uncountable number of times, trying to see what the different stories generated looked like. In most of our prior approaches we found all kinds of incoherent attitudes, mostly induced by failures in the coherence of our rule system. We obtained characters that travelled back and forth from the different locations, unable to find what they wanted, and characters that secluded themselves in their original locations, avoiding interaction with the rest of the system.

Here is where we implemented a basic testing system, so that we could bring to light where the failures in the web of rules that we had were. We learnt about the nature of rule-based systems, and understood the implications of properly updating the database. We faced technical limitations as well, as some of the data structures that we used in first implementations of the algorithm wouldn't allow us proper update and propagation of the information.

Overall, we like to think that our results are satisfactory, as in all occasions the behaviours that take place and the happenings that they provoke are coherent enough to cause an effect in the mind of the spectator, who interprets a story being generated between the different events that the system brings to the web application.

We have also been able to establish fairly large systems (about 30 characters) with imposed limitations such as only allowing a certain number of people per location or only making it possible to work certain professions in certain locations to generate both characters (including their graphical representation) and stories in times that rarely exceed a couple of seconds, which we are also satisfied about.

We will examine two cases against the criteria that we defined in the previous section in order to prove our success. Both of these runs go for 4 seasons of 5 years.

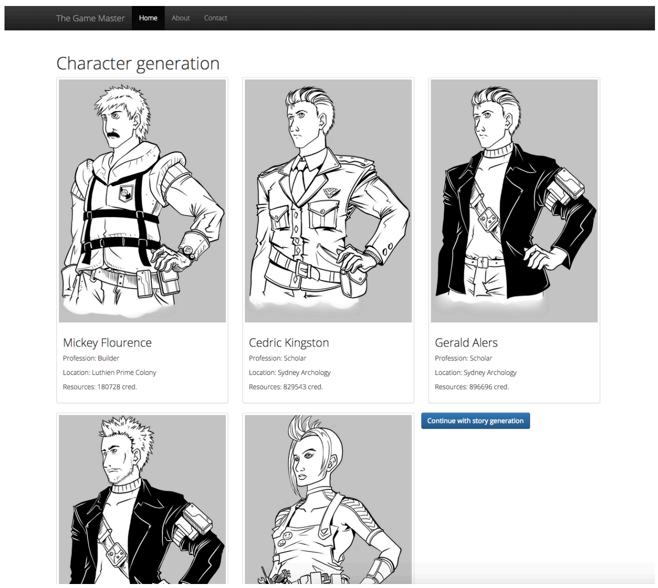

Fig. 6. Case 1 generated characters

Case 1: (5 Characters generated) The 5 characters we generated in this case are four males and one female of ages between 22 and 35 and professions such as builders, scholars and politicians. Their names are Mickey Florence, Cedric Kingston, Gerald Alers, Sanford Hawke and Tenisha Rutherford.

During the first year of the generated story, we see some of these characters focus on their respective professions (Cedric Kingston researched during the spring of 3456) while others seek engagement. For instance, Mickey Florence travelled to a different location because of a conflict he had with Gerald Alers, and although they argued, they became closer from it. Other characters tried to find love and failed, such as Sanford Hawke, who was rejected by Tenisha Rutherford. He was devastated by it, and engaged in malicious activities such as stealing. Fortunately enough, the person he stole from never realised about it, and didn't change the impression he had from him.

These characters continued going on with their lives for four years more. Some of them engaged in social activities such as playing virtual games (or physical games) together. Some of them focused on work, and others played games and deepened their friendships. At the end of the period, there had bloomed friendships between characters like Gerald Alers and Mickey Florence or Tenisha Rutherford. Unfortunately for poor Sanford, Tenisha kept rejecting him.

We included the transcript of this case in Annex 1.

Case 2: (4 Characters generated) In this case, all of the 4 characters generated were male. Overall, most of the characters and the story develops in a similar fashion, but a marriage happens between two of these characters in this generated story. There's an obvious bound between these characters throughout the story from that moment on, and we can see them interacting between them more often.

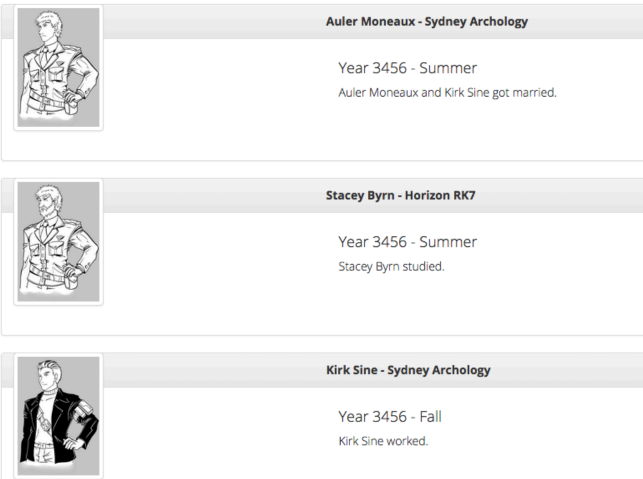

Fig. 7. A marriage takes place.

Even though we generated a smaller amount of characters in order to make the story more condensable for the purpose of this paper, the results are always more interesting when a higher amount of characters are involved and more interactions can take place. That being said, we don't necessarily always see the same type of interactions.

It would be really appealing to implement a timeline to represent the most important happenings that take place in the different stories in order to see more clearly when an event of relevance took place and track what were the previous steps that lead to it

That being said, it's apparent that although the stories generated are fairly simple, they do fulfil both of the criteria that we had in mind when we wanted to analyze the effectivity of the system, as they're different from one another since the characters that are featured in them are different and their actions don't seem unreasonable according common sense.

4.3 Analysis

In order to analyze the results we obtained properly we feel like we have to cover three main areas: the simplicity of the system, the role that testing has played during the process and the effect produced by the way we chosen to display the information.

As it might be obvious to the reader who is familiarised with the topic of Artificial Intelligence, most systems that appear to be intelligent or make decisions in a fashion that tries to imitate humans are usually incredibly simple. We want to create a system that resembles our way of thinking, but we are limited in the knowledge of models that are able to represent such a complex thing. Computers work with databases, mathematical models and data representations, but the associations that we make between concepts and our capacity of abstraction goes beyond any lineal representation we can try to use to approach it. This is why a computer such as we know it nowadays will never be creative, as it's limited to simply use a portion of the mindset of the authors of the software and work with it as if it was dealing with a mathematical problem or a puzzle. This is why, when we analyse the rule-based system that we have, it strikes us how incredibly simple it is and how complicated it was to establish parameters that would help create a model that would resemble the decision process that a person has to go through on an everyday basis.

This is what brings us to our first realization: a procedurally generated story maker will always be as complex as the system modelled is. The ratio in which the information produced will resemble real life will only increase with the incremental addition of details to the different aspects modelled, but not in the system itself. We can add different variables to introduce probabilities and that random component that always escapes our control when making everyday decisions, but in the end, even we know that said randomness only comes from the lack of perfect information of the viewer.

Another important aspect of the development of this type of easy yet complex system is the ability to test the connection between the model and the different rules that are created, and assure that there will always be a connection between them. In being able to determine a reliable way of checking the whole system for inconsistencies lies our ability of creating a more complex representation of the world. Unfortunately, analogously to the modelling of the system itself, we can only think of as many types of tests for a rule system we have created as we humanly can, and there are and will exist variables that escape our ability to foresee. Being methodical and thorough in this aspect is definitely extremely important.

Finally, something else that has come to our attention is the fact that it doesn't matter how complex or how much of an exact representation of reality the model is if we can't find a proper way of displaying both the status and the evolution of the system. We have only scratched the surface in UI design when it comes to portraying everything that is actually taking place behind the curtains, but overloading the user with information isn't the solution either, as it usually only creates confusion. It's necessary to be able to find a balance, the right amount of information to display and the right pattern to do so.

5 Conclusions

During the analysis section we have gone over some of the points that will be our main conclusions for this project. First of all, the limitations of a system such as the one we're trying to accomplish are apparent, but it is always easier than people imagine when we try to approach this type of subject. Definitely, a computer system isn't anywhere near generating fiction autonomously, but it is possible to create the illusion of fiction and stories considering that the consumer will always be a human being. In the same fashion that we learn from observation and we are able to infer knowledge from those facts we have observed, we are able to do so with creativity and stories, and key points on a timeline are most times sufficient for us in order to create interest in a viewer and suscite curiosity, wanting to know what the next step was, or inferring what the motivations and details between those happenings were.

A key point of this project has been from the start to try to find a way to make video games more interactive and the entertainment they pose, endless. We haven't been able to implement any gasification to our system yet, but we believe that there are a good amount of options that would allow us to make a game out of the stories that are being generated. A very first approach to gamificating The Game Master would be adding the possibility of authoring one of the characters that are being a part of the story generated. This alone would motivate interest from the viewer, who would now be emotionally attached (curious if nothing else) to that entity they created and their progress. This would still be far away from the possibility of integrating a Player Character, but would produce a greater deal of entertainment. As for integrating a player character and importing the world status generated here into a graphically represented system, the possibilities are endless, as the main point of what we've created with this project is a model, a data representation of said model and it's evolution. Therefore, being able to implement this behaviour to 3D modelled characters and their surroundings, incrementing the level of detail using Goal Oriented Behaviours and Goal Oriented Action Planning it would be possible to experience this world in first person.

As a final conclusion, we pose a final question to ourselves, and we invite our readers to answer it as well. Are we satisfied with our results? Do we believe that a computer-based system is or will be able to be creative? This is harder to answer than one might imagine, as we are not generated characters who base their satisfaction in a finite amount of defined emotions and meters. We will say that although it is always disappointing to realise that Artificial Intelligence isn't as romantic as the imaginative vision of if we had in our childhood, it is always motivating and encouraging to see how fairly simple it is to create fiction that suscites some degree of interest, which implies that we will be never satisfied with the amount of knowledge achieved, but always happy.

ACKNOWLEDGEMENTS

Manuel Ramos Acuña for his invaluable contribution as an artist, making our characters come to life and Enric Martí Gòdia, our tutor, for his help thoughout the entirety of the project.

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ANNEX

A1. STORY CASE TRANSCRIPT

Year 3456 - Summer
Mickey Flourence - Luthien Prime Colony
Mickey Flourence went to Sydney Archology searching for Gerald Alers.
...
Year 3456 - Summer
Cedric Kingston - Sydney Archology
Cedric Kingston researched.
...
Year 3456 - Summer
Gerald Alers - Sydney Archology
Gerald Alers argued with Mickey Flourence but they became closer from it.
...
Year 3456 - Summer
Sanford Hawke - Sydney Archology
Sanford Hawke was rejected by Tenisha Rutherford.
…
Year 3456 - Summer
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford argued with Mickey Flourence but they became closer from it.
...
Year 3456 - Fall
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3456 - Fall
Cedric Kingston - Sydney Archology
Cedric Kingston researched.
...
Year 3456 - Fall
Gerald Alers - Sydney Archology
Gerald Alers played virtual sports with Sanford Hawke, Mickey Flourence, Mickey Flourence, and won.
...
Year 3456 - Fall
Sanford Hawke - Sydney Archology
Sanford Hawke was rejected by Tenisha Rutherford.
...
Year 3456 - Fall
Tenisha Rutherford - Sydney Archology

Tenisha Rutherford argued with Mickey Flourence.
...
Year 3456 - Winter
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3456 - Winter
Cedric Kingston - Sydney Archology
Cedric Kingston researched.
...
Year 3456 - Winter
Gerald Alers - Sydney Archology
Gerald Alers focused on studying.
...
Year 3456 - Winter
Sanford Hawke - Sydney Archology
Sanford Hawke violently stole 393459 credits from Tenisha Rutherford.
...
Year 3456 - Winter
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford argued with Mickey Flourence but they became closer from it.
...
Year 3456 - Spring
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3456 - Spring
Cedric Kingston - Sydney Archology
Cedric Kingston worked out.
...
Year 3456 - Spring
Gerald Alers - Sydney Archology
Gerald Alers played virtual sports with Mickey Flourence, Sanford Hawke, Tenisha Rutherford, Cedric Kingston, and didn't win.
...
Year 3456 - Spring
Sanford Hawke - Sydney Archology
Sanford Hawke fought Mickey Flourence and lost.
...
Year 3456 - Spring
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford argued with Mickey Flourence.
...
Year 3457 - Summer
Mickey Flourence - Sydney Archology
Mickey Flourence worked.
…
Year 3457 - Summer
Cedric Kingston - Sydney Archology
Cedric Kingston researched.
...
Year 3457 - Summer
Gerald Alers - Sydney Archology
Gerald Alers focused on studying.
...
Year 3457 - Summer
Sanford Hawke - Sydney Archology
Sanford Hawke violently stole 224469 credits from Tenisha Rutherford.
...
Year 3457 - Summer
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford argued with Mickey Flourence but they became closer from it.
...
Year 3457 - Fall
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3457 - Fall
Cedric Kingston - Sydney Archology
Cedric Kingston focused on studying.
...
Year 3457 - Fall
Gerald Alers - Sydney Archology
Gerald Alers focused on studying.
...
Year 3457 - Fall
Sanford Hawke - Sydney Archology
Sanford Hawke violently stole 6163 credits from Gerald Alers.
...

Year 3457 - Fall
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford argued with Mickey Flourence but they became closer from it.
...
Year 3457 - Winter
Mickey Flourence - Sydney Archology
Mickey Flourence worked.
...
Year 3457 - Winter
Cedric Kingston - Sydney Archology
Cedric Kingston played virtual sports with Mickey Flourence, Gerald Alers, and didn't win.
...
Year 3457 - Winter
Gerald Alers - Sydney Archology
Gerald Alers focused on studying.
...
Year 3457 - Winter
Sanford Hawke - Sydney Archology
Sanford Hawke fought Mickey Flourence and lost.
...
Year 3457 - Winter
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford and Gerald Alers spent some time together.
...
Year 3457 - Spring
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3457 - Spring
Cedric Kingston - Sydney Archology
Cedric Kingston focused on studying.
...
Year 3457 - Spring
Gerald Alers - Sydney Archology
Gerald Alers played chess with himself and won.
...
Year 3457 - Spring
Sanford Hawke - Sydney Archology
Sanford Hawke violently stole 670242 credits from Gerald Alers.
...
Year 3457 - Spring
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford researched.
...
Year 3458 - Summer
Mickey Flourence - Sydney Archology
Mickey Flourence worked.
...
Year 3458 - Summer
Cedric Kingston - Sydney Archology
Cedric Kingston focused on studying.
...
Year 3458 - Summer
Gerald Alers - Sydney Archology
Gerald Alers played chess with Tenisha Rutherford, and won.
...
Year 3458 - Summer
Sanford Hawke - Sydney Archology
Sanford Hawke went to Luthien Prime Colony.
...
Year 3458 - Summer
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford and Gerald Alers spent some time together.
...
Year 3458 - Fall
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3458 - Fall
Cedric Kingston - Sydney Archology
Cedric Kingston played virtual sports with Tenisha Rutherford, Mickey Flourence, and didn't win.
...
Year 3458 - Fall
Gerald Alers - Sydney Archology
Gerald Alers played virtual sports with Tenisha Rutherford, Mickey Flourence, and won.
...
Year 3458 - Fall
Sanford Hawke - Luthien Prime Colony
Sanford Hawke studied.
...
Year 3458 - Fall
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford researched.
...
Year 3458 - Winter
Mickey Flourence - Sydney Archology
Mickey Flourence worked.
...
Year 3458 - Winter
Cedric Kingston - Sydney Archology
Cedric Kingston focused on studying.
...
Year 3458 - Winter
Gerald Alers - Sydney Archology
Gerald Alers focused on studying.
...
Year 3458 - Winter
Sanford Hawke - Luthien Prime Colony
Sanford Hawke was rejected by Tenisha Rutherford.
...
Year 3458 - Winter
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford wanted to travel but couldn't.
...
Year 3458 - Spring
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3458 - Spring
Cedric Kingston - Sydney Archology
Cedric Kingston focused on studying.
...
Year 3458 - Spring
Gerald Alers - Sydney Archology
Gerald Alers played chess with Mickey Flourence, and won.
...
Year 3458 - Spring
Sanford Hawke - Luthien Prime Colony
Sanford Hawke researched.
...
Year 3458 - Spring
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford researched.
...

Year 3459 - Summer
Mickey Flourence - Sydney Archology
Mickey Flourence worked.
…
Year 3459 - Summer
Cedric Kingston - Sydney Archology
Cedric Kingston focused on studying.
...
Year 3459 - Summer
Gerald Alers - Sydney Archology
Gerald Alers focused on studying.
...
Year 3459 - Summer
Sanford Hawke - Luthien Prime Colony
Sanford Hawke studied.
...
Year 3459 - Summer
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford and Gerald Alers spent some time together.
...
Year 3459 - Fall
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3459 - Fall
Cedric Kingston - Sydney Archology
Cedric Kingston played virtual sports with Gerald Alers, Tenisha Rutherford, Mickey Flourence, and didn't win.
...
Year 3459 - Fall
Gerald Alers - Sydney Archology
Gerald Alers played virtual sports with Mickey Flourence, Mickey Flourence, Cedric Kingston, and didn't win.
...
Year 3459 - Fall
Sanford Hawke - Luthien Prime Colony
Sanford Hawke fought Mickey Flourence and lost.
...
Year 3459 - Fall
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford worked out.
...
Year 3459 - Winter
Mickey Flourence - Sydney Archology
Mickey Flourence worked.
...
Year 3459 - Winter
Cedric Kingston - Sydney Archology
Cedric Kingston played chess with Tenisha Rutherford, and didn't win.
...
Year 3459 - Winter
Gerald Alers - Sydney Archology
Gerald Alers focused on studying.
...
Year 3459 - Winter
Sanford Hawke - Luthien Prime Colony
Sanford Hawke researched.
...
Year 3459 - Winter
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford and Gerald Alers spent some time together.
...
Year 3459 - Spring
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3459 - Spring
Cedric Kingston - Sydney Archology
Cedric Kingston focused on studying.
...
Year 3459 - Spring
Gerald Alers - Sydney Archology
Gerald Alers played chess with Cedric Kingston, and didn't win.
...
Year 3459 - Spring
Sanford Hawke - Luthien Prime Colony
Sanford Hawke studied.
...
Year 3459 - Spring
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford researched.
...
Year 3460 - Summer
Mickey Flourence - Sydney Archology
Mickey Flourence worked
...
Year 3460 - Summer
Cedric Kingston - Sydney Archology
Cedric Kingston played chess with Mickey Flourence, and won.
...
Year 3460 - Summer
Gerald Alers - Sydney Archology
Gerald Alers played chess with Mickey Flourence, and won.
...
Year 3460 - Summer
Sanford Hawke - Luthien Prime Colony
Sanford Hawke researched.

...
Year 3460 - Summer
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford worked out.
...
Year 3460 - Fall
Mickey Flourence - Sydney Archology
Mickey Flourence and Gerald Alers spent some time together.
...
Year 3460 - Fall
Cedric Kingston - Sydney Archology
Cedric Kingston focused on studying.
...
Year 3460 - Fall
Gerald Alers - Sydney Archology
Gerald Alers played virtual sports with Cedric Kingston, Tenisha Rutherford, Mickey Flourence, and didn't win.
...
Year 3460 - Fall
Sanford Hawke - Luthien Prime Colony
Sanford Hawke was rejected by Tenisha Rutherford.
…
Year 3460 - Fall
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford and Gerald Alers spent some time together.
...
Year 3460 - Winter
Mickey Flourence - Sydney Archology
Mickey Flourence worked.
...

Year 3460 - Winter
Cedric Kingston - Sydney Archology
Cedric Kingston played virtual sports with Gerald Alers, Tenisha Rutherford, and didn't win.
...
Year 3460 - Winter
Gerald Alers - Sydney Archology
Gerald Alers focused on studying.
...
Year 3460 - Winter
Sanford Hawke - Luthien Prime Colony
Sanford Hawke studied.
...
Year 3460 - Winter
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford studied.
...
Year 3460 - Spring
Mickey Flourence - Sydney Archology
Mickey Flourence went to Luthien Prime Colony.
...
Year 3460 - Spring
Cedric Kingston - Sydney Archology
Cedric Kingston focused on studying.
...
Year 3460 - Spring
Gerald Alers - Sydney Archology
Gerald Alers played virtual sports with Cedric Kingston, Tenisha Rutherford, and didn't win.
...
Year 3460 - Spring
Sanford Hawke - Luthien Prime Colony
Sanford Hawke fought Mickey Flourence and lost.
...
Year 3460 - Spring
Tenisha Rutherford - Sydney Archology
Tenisha Rutherford and Gerald Alers spent some time together.