Worcester Polytechnic Institute

Interactive Media and Game Development
and
Department of Computer Science

Final Design Report
for

Prince of Pride:
A Social AI Game

by
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Major Qualifying Project

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Abstract

for the design of
Prince of Pride: A Social AI Game
By
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This is the Final Design Review for the Major Qualifying Project *Social AI in Games*. The project consists of the planning, design, development, and completion of a fully playable video game showcasing the use of a middleware artificial intelligence (AI) system.

This document discusses the planning, design, and schedule of development for the project. This document is comprised of the outlining of gameplay, art and technological requirements for the game *Prince of Pride* along with the social AI middleware. The game will be a single-player, third-person, two-dimensional game with a cartoon art style. The main focus of the game will be the balancing and management of emotions within a pride of lions and dealing with the different situations that can arise through interaction with a social AI. The middleware will focus on the social interactions of small groups. This document also contains the schedules detailing the construction of all of the aspects of the project and major milestones.

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1 Introduction

This document contains the details regarding the completion of the *Prince of Pride*: A Social AI Game project. The project is split up into two sub-projects: construction of a Social AI Middleware System and two proofs of concept in the form of the game *Prince of Pride*, and a tech demo. The information is organized in the following categories: gameplay, art, game technology, and AI technology. The presented ideas are all subject to change due to testing and refining.

1.1 One-Sentence Description

Take control of a pride of lions as you help guide and stabilize its members while traveling through the barren savannah in search of an oasis.

1.2 One-Paragraph Description

As prince of a pride of lions, you must offset the shortcomings of your father's harsh, unforgiving rule. Can you strengthen the bonds of the pride through cooperation and coordination? Can you gain the respect of the youth and the elders through noble and brave acts? Will you stabilize the pride, help them survive the arduous journey, and lead them to their new home, or will you be left behind in the wasteland?

1.3 Matter-of-Fact Description

Prince of Pride will be a game that tests the managerial skills of the player. Through a realistic, yet exaggerated, cartoon approach the game art and UI will provide feedback to the player to keep the pride together. Through the use of a unique social AI middleware, the game will force the player to keep the emotions and needs of a pride of lions in check as they all attempt to do what they can to help reach the end of their journey.

1.4 Project Development

This project will have three phases beginning in A-Term and concluding in C-Term of the 2009-2010 academic school year at Worcester Polytechnic Institute.

1.4.1 A-Term

A-Term will encompass the design phase of the game. The design will be categorized by: Gameplay, Art, Game Technology, and AI middleware. There will be several documents created throughout the term (PPR, PDR, CDR) that will culminate with a final design report at the end of A-Term. This document will mark the end of the first phase of the project, and will contain sufficient detail to successfully complete the project on time and as envisioned.

1.4.2 B-Term

B-Term is the implementation phase of the project. Our group will take the design concepts from the first phase and create the game and AI middleware. We will use the XNA Game Studio along with C# to produce the various stages of the working game. During this phase the team will go through three major stages, first alpha, second alpha, and final alpha. At the end of this term, we will have a working version of our game and AI middleware.

1.4.3 C-Term

C-Term is the debugging and release phase of the design. The main focus for the beginning of the term will be debugging the game. This will be followed up by play-testing and feedback from outside sources. The project will finish at the end of C-Term with a completed final version of the game for use online.

2 Gameplay Overview

This is the story of a group of lions journeying across the African savanna. As the prince of the pride, the player must make sure he/she keeps the pride stable so that it can survive the dry season. There will be five stages of social interaction with the other lions. The player will take on tasks that he/she must complete for the different members of the pride in order to keep them appeased. There will be four hunts, one between each pair of social interaction stages. The results of each hunt and social interaction stage will reflect how the pride is doing and if the pride is leaning toward disbanding or continuing.

This game has similarities to the original Final Fantasy and Zelda. The perspective of the player is three-quarters view. The game is also in two dimensions. The game will also share managerial similarities with other games. For example, in Oregon Trail you have to manage goods and meet the needs of a group of individuals on a difficult journey. This game, however, will have much more of a focus on social AI.

2.1 Game Timeline

Each social stage will only be two simulated days in the African savanna. Each hunt will take place the following day. The journey, in total, will take 15 days. The player will have to manage his/her time and resources. He/she will have to decide who needs the most help and what actions would be most effective to help that pride member in the amount of time given.

2.2 Character Descriptions

Table 1 is a brief description of each member of the pride and how they are associated to the other members within the pride. The names were taken from an African baby name book.

Table 1: Character Descriptions

Character	Description
King Kojo	He is a vicious and harsh ruler.
	He is the tallest and strongest of the pride.
	He is old.
	He has a thick mane of dark gray hair and dark brown fur.
Queen Aba	She is very kind and gentle, but too afraid to ever question her husband's rule.
	She is the largest of the female lions (about ½ Kojo's size)
	She is four years younger than Kojo.
	She has very light off-white fur.
Prince Sefu (Player)	He is Kojo and Aba's son.
	He is not like his father; he is naturally a nice lion.
	He is about three fourths Kojo's size and the third largest male lion.
	He is only a teenager but mature for his age.
Amadi	He is the greatest of the hunters and older brother of Aba.
	He only stays with the pride for his family and because Kojo once saved his life. He feels he is in Kojo's debt and must stay.

	He is the second largest male lion.
	He is a middle-aged lion.
	He has a mangled mane of jet black hair and scarred light brown fur.
Denisha	She is the wife of Amadi.
	She is the smallest of all the adult lions.
	She is very fragile and weak because she has an unknown sickness.
	She has a sickly, ghostly white color fur.
Safara	She is the daughter of Amadi and Denisha.
	She is a very skilled hunter for being a teenager.
	She is not very big (in-between Aba and Denisha).
	She has very clean darker tan fur.
Wekesa	He is the eldest lion, unnaturally old for a lion, but still healthy.
	He is considered the wise elder of the pride.
	He is very quiet and therefore usually overwhelmed by Kojo's booming voice. However, Kojo will not silence his undermining tone because he was a great friend of Kojo's father.
	He is the smallest of the adult male lions.
	He has a white mane and almost silvery fur.
Zabia	She is a young widow with a baby girl.
	She is very depressed and saddened by her husband's tragic death.
	Her husband was killed by a poacher.
	She is about the same size as Safara.
	She has lighter tan fur.
Binta	She is the daughter of Zabia.
	She is only a cub, but very playful and outgoing. She sometimes speaks out loud what her mother is too afraid to say.
	She is more the support for her mother than her mother is for her.
	She is the only cub.
	She has light tannish skin like her mother.
Mosi	He is considered the loner of the group.
	He doesn't like being a part of this pride, but is a wanted lion on the savannah, and safe in the sanctuary of this pride, so he puts up with Kojo.
	He is the second smallest lion, but makes up for his stature with his cunning.
	He has a light brown fur and a darker brown mane.

2.3 Job Description

Each character in the game will have a job that they must do in order for the pride to maintain itself, except Kojo. The player cannot maintain the pride alone, so the other characters will have to help.

Table 2 shows their contributions to the good of the pride.

Table 2: Job Descriptions

Name	Job	Description	Associated Actions
Kojo	Ruler	He just lounges around yelling at people to work harder.	Laying, big roaring
Aba	Consoler	She attempts to bring Zabia out of her depression.	Rubbing with paw
Sefu (Player)	Stabilizer	His job is to keep the pride together. He manages the emotions of the other members.	No additional actions.
Amadi	Commander	He makes sure everyone is doing their exercises to stay fit for the hunt.	Swiping paw, jumping, clawing ground (the person he's training mimics)
Denisha	Doctor	Being sickly herself, she has become an expert on remedies for sickness.	Laying, feeding medicine
Safara	Cleaner	She makes sure everyone's fur is clean so no one gets sick.	Licking
Wekesa	Informer	He recommends who in the pride Sefu should help.	No additional actions.
Zabia	Mother	She takes care of her cub; nursing her and teaching her to run.	Feeding her cub, cub mimics her running slowly
Binta	Booster	She just brings a positive attitude to everyone in the pride, except Kojo.	Jumping, rolling, little roaring
Mosi	Scout	He goes ahead of the group to find the next safe resting point on their journey.	The only pride member allowed to go out of the area

2.4 Needs Description

There are some needs that are applicable to all the lions, such as staying clean and healthy. These needs will have to be satisfied for all lions in order for the pride to stay together. However, there will be a unique need for each lion that must be fulfilled at different points in the. Table 3 shows the unique needs of everyone aside from the main character and his family.

Table 3: Needs Description

Name	Need	Emotional Impact
Amadi	He needs Sefu to go and find him sticks and bones that he can gnaw his teeth on to sharpen them for the hunt.	Good: + Happiness Bad: - Angry He starts off with the highest morale.
Denisha	She needs Sefu to go and find her the stems of Bermuda grass to use for medicine. He also needs to strip the leaves off the grass for her because she is very weak.	Good: + Happiness Bad: - Sadness She starts off with the lowest morale. Also, if she gets happy/sad, Amadi will get happy/angry.
Safara	She needs Sefu to talk to his father so that she is allowed to rest in the shade. This way she will not sweat as much, and be better at cleaning people's coats.	Good: + Happiness Bad: - Sadness She starts out with the average morale. Also, if she gets happy/sad, Denisha gets happy/sad.
Wekesa	All he wants is Sefu to help out the lions that he has asked Sefu to.	Good: + Happiness Bad: - Sadness He starts out with the second highest morale.
Zabia	She needs Sefu to find her some extra meat, usually a forgotten carcass, so that she will have enough energy to care for and feed her cub.	Good: + Happiness Bad: - Sadness She starts out with the second lowest morale.
Binta	She just wants Sefu to run around and play with her.	Good: + Happiness Bad: - Sadness She does not have morale, but her feelings will reflect on Zabia. So if she is happy/sad, Zabia will be happy/sad.
Mosi	He wants Sefu to talk with Safara. Tell her how nice Mosi is, so she likes Mosi.	Good: + Happiness Bad: - Sadness He starts out with the average morale. Also, if Safara gets happy/sad, Mosi gets happy/sad.

2.5 Emotional Connections Diagram

Figure 1 is a diagram that summarizes the emotional impacts that each of the pride members can have on each other, not including their effects on the overall morale of the pride. The player and his family cannot be emotionally impacted by the player or other characters because they are the royal family. They will either be exiled together or be the only ones to stay after the rest of the pride has disbanded. The arrows represent each lion's emotional impact on the other lion. For example, in Figure 1, Denisha impacts Amadi emotionally. So if Denisha becomes happier, Amadi will also become happier because he knows his wife is happy.

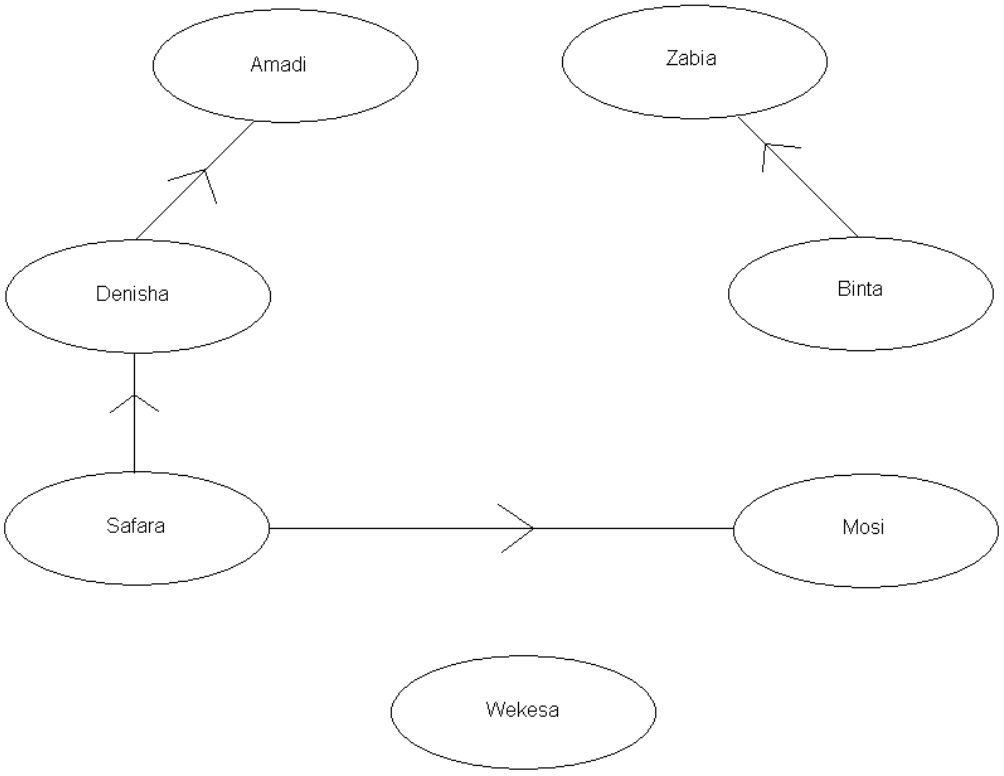

Figure 1: Emotional Connections Diagram

2.6 Rationing/Trading Event

In addition to the management of a pride of lions, one unique event will be triggered in each level if the player so chooses. Each level will have an item placed somewhere in the environment that only the player will be able to pick up. Whether this is a piece of meat or some type of herbal medicine for the lions, the player will use this item to supplement his attempt to keep the pride together. In the example with the piece of meat, once the player has found it, he can decide to either keep it and save it for later or simply not use it, try and give a little bit to every member of the pride, or strategically give it to whoever may need it most. It all depends on the status of the pride and its members at the time when the item is obtained.

2.7 Environments

There will be five different locations where the stages of social interaction between the lions will take place. As the player progresses through the game the amount of vegetation becomes sparser, making satisfying the pride's needs more difficult.

2.7.1 Map of Game World

Figure 2 displays the journey of the pride through the African savanna.

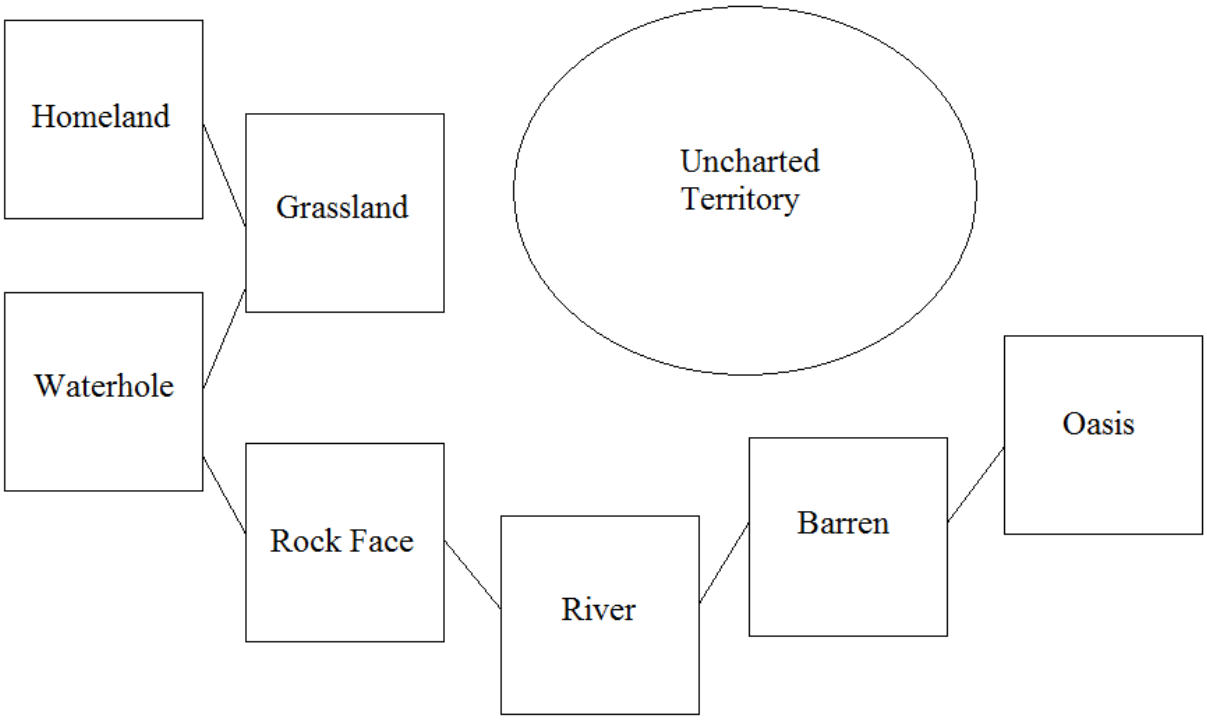

Figure 2: Game World Map

The first map is a general outline of the game world, but the map displayed for examination by the player will take on a more artistic style (see Figure 3). The style will be similar to that of *Lead the Meerkats* by Inaria Interactive.

Figure 3: ***Lead the Meerkats*** **Map**

2.7.2 The Grassland

The first area that the player will interact in is the grasslands. This area will be located in the plains of the savannah. It will only include one medium sized tree, some small bushes, and a few larger rocks (Figure 4).

Figure 4: Grassland Concept Art

2.7.3 The Waterhole

After the grasslands and the first hunt, the pride moves on to the waterhole. This area contains a small waterhole surrounded by mud and soft earth. This area of soft earth will be surrounded by grassland.

2.7.4 The Rock Face

The rock face area will be a small rocky hill with grassland at the bottom.

2.7.5 The River

The river area will have a very thin river off to one side with the rest remaining grassland.

2.7.6 The Barren

The barren will be similar to the grassland, but plant life will be much scarcer due to the oppressive heat of the dry season.

2.8 Hunting Information/Results

The hunting information will be displayed using a point system based on the animal or animals the pride was able to capture and kill.

Table 4 is a list of the possible prey and how it will affect the overall morale of the pride. The lack of results will have adverse effects on the group.

Table 4: Hunting Information

Animal	Impact for Pride	Impact per Person
Springbok	Smaller boost to morale	Smaller boost to happiness
Oryx	Small boost to morale	Small boost to happiness
Zebra	Medium boost to morale	Medium boost to happiness
Wildebeest	Large boost to morale	Large boost to happiness
Elephant Calf	Extra large boost to morale	Extra large boost to happiness

2.9 Point Scoring System

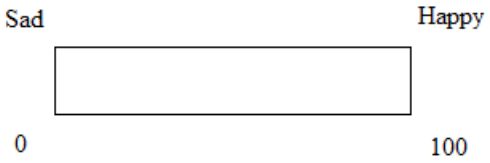

Figure 5: Emotional Bar

2.9.1 Emotional Summary

Each pride member will have an emotional bar (Figure 5) that represents their emotional status. The bar will range from sad at one end to happy at the other. The starting point in the emotional bar for each member will depend on their emotional make-up at the beginning of the game (Table 5). The bar will "tick" once towards the sad end after a given amount of time because the need of the lion has not been met (Table 6). The player and other pride members must do what they can to move the bar back in the happy direction.

Each member's emotional status as well as the hunting results (Table 7) will be taken into account when determining the overall pride morale. This pride morale will reflect an average status of all of the pride members. Amadi, the only member of the pride that could possibly overthrow Sefu will have an exclusive additional emotional bar. That bar will range from angry to calm (same structure as sad to happy). This emotional bar will be dependent on the pride

morale. As the pride morale dips below 50 out of 100, the angry to calm bar will start to "tick" once every given time interval towards the angry emotion for Amadi. If his anger becomes too great, at the point in the game where Sefu is supposed to take control of the pride, Amadi will force him and his mother into exile.

Table 5: Character Emotional Position

Character	Starting Emotional Position
Zabia	50
Denisha	55
Mosi	65
Wekesa	70
Safara	80
Amadi	85

Table 6: Point Values

Event	Point Value
One "tick" of time	-1
Help from Player	+10
Help from anyone else	+5

Table 7: Hunting Point Values

Animal	Pride Boost	Member Boost
Springbok	+5	+1
Oryx	+10	+2
Zebra	+20	+4
Wildebeest	+25	+5

Elephant Calf	+40	+8

2.10 Difficulties

There will be two difficulties to this game. The first will have the pride members' emotional statuses start at an easy enough setting so that if the player were not to interact with the pride at all, the pride will still be able to make the journey. This implementation of the game will focus on watching the functionality of the social AI. The other difficulty setting will make it so it is impossible to complete the game without the player managing the pride. If the player does not strategize correctly, then all the needs of the different pride members cannot be met before the conclusion of their journey.

2.11 Screenplay

The screenplay for the game has been split into two sections: the cinematic screenplay and the in-game screenplay. The cinematic screenplay contains the dialogue and settings for the different cut scenes that take place throughout the game (see Appendix B for script and Appendix H for assets). The in-game screenplay is the dialogue used during gameplay. That dialogue will be developed as the game is developed.

3 Art

3.1 Character assets

There will be ten lion sprites created for *Prince of Pride*, drawn from a 2D pseudo-top-down perspective, similar to early SNES-era Zelda and Final Fantasy games. The lions will be drawn facing left/right, forward, and backwards, and in addition to walking, will perform a variety of lion-specific actions as well (

Table 8 and Table 9).

In order to expedite the art creation process, the lions will be separated into three main groups. These will be the Old/Adult male lions, the Adult female lions, and the Cub male and female lions. The sprites will be created as movie clips in flash, so that they are scalable, and the heads will be separate from the bodies so that it is possible to differentiate between the lions. The general and specific actions will be outlined in black and white for each animation, and afterwards, they will be colored, detailed, and scaled according to their personal character description (as seen in Figure 6).

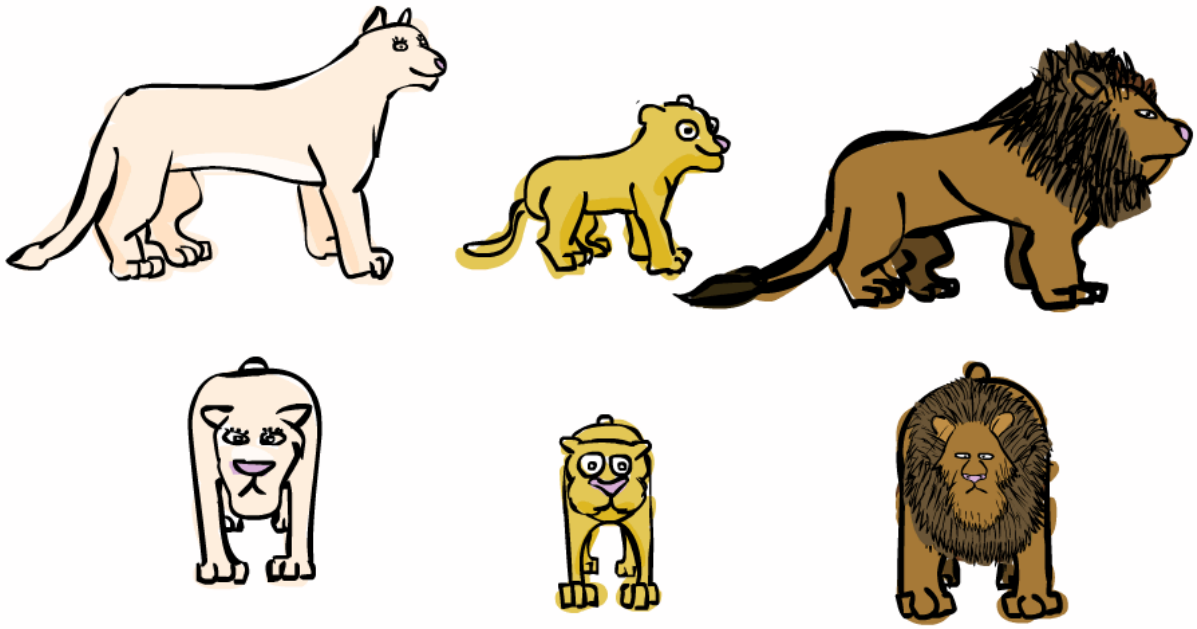

Figure 6: Body Concept Art

Table 8: General Lion Animations

Forward face running (7 frames)	Forward face walking (7 frames)	Forward face standing
Sideways face running (7 frames)	Sideways face walking (7 frames)	Sideways standing
Backwards face running (7 frames)	Backwards face walking (7 frames)	Backwards standing

Each lion also has various specific actions that will be animated:

Table 9: Specific Lion Animations

Character	**Character Specific Animations**
Old/Adult (Male)	Roaring Swiping paw Jumping Clawing ground
Adult (Female)	Rubbing Feeding her cub Running slowly (Same as running animation, but slower)
Cub (Male/Female)	Jumping Rolling Roaring

For a full listing of all character asset sprites that will be created, refer to Appendix E. For each character's sound assets refer to Appendix I.

3.2 Character Concept Art

Emotions will not be visible on each main lion sprite, as it would effectively double the amount of art assets required. Instead, when a lion is selected, their mood will be portrayed by a lion's face at the bottom of the screen, next to the message window (see Figure 7).

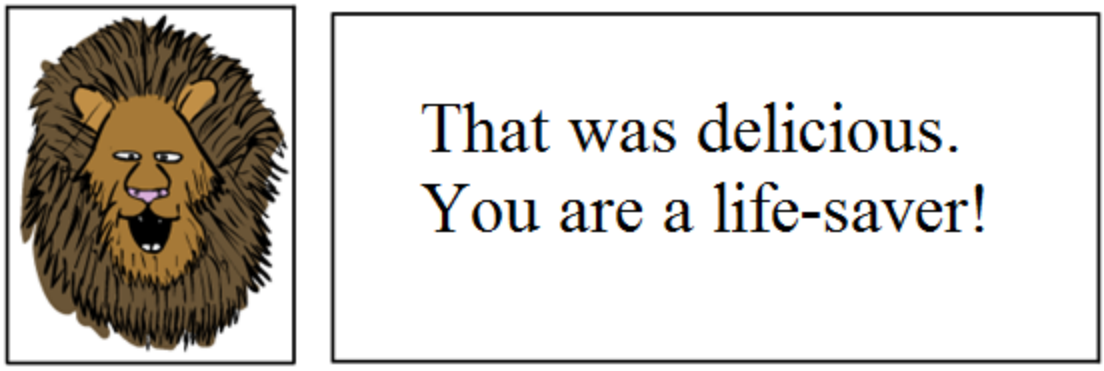

Figure 7: UI Face

Two faces will be drawn for each lion, representing a happy state and a sad/angry state. Figure 8 shows an approximation of what these faces will look for the adult male lions and cub.

Figure 8: Lion Face Concept Art

3.3 User Interface

The user interface for *Prince of Pride* will depict branches and dried overgrown vegetation in order to fit the theme of the African savanna. Figure 9 shows the layout of the user interface. Figure 10 shows the artistic vision for the user interface. There will be several assets making up the UI as Figure 9 would imply. For a complete list of the assets, refer to Appendix F.

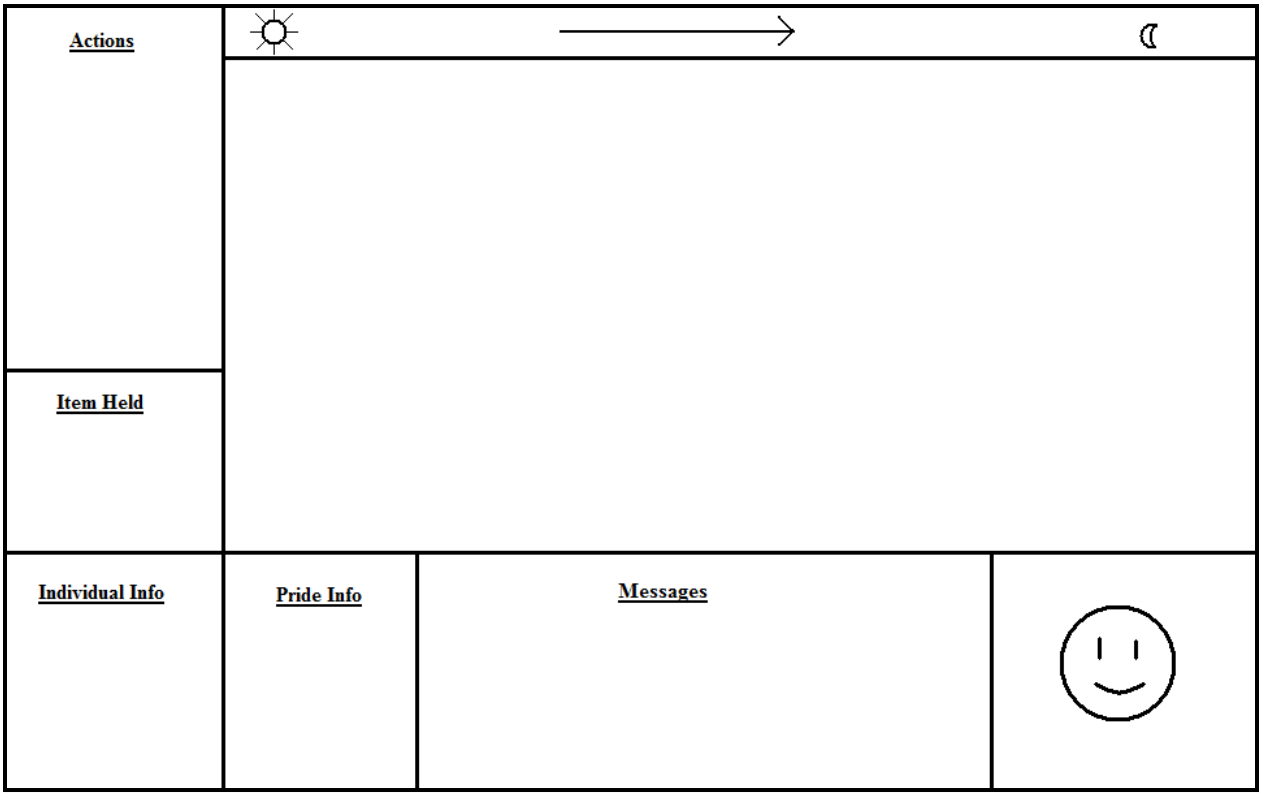

Figure 9: User Interface Sketch

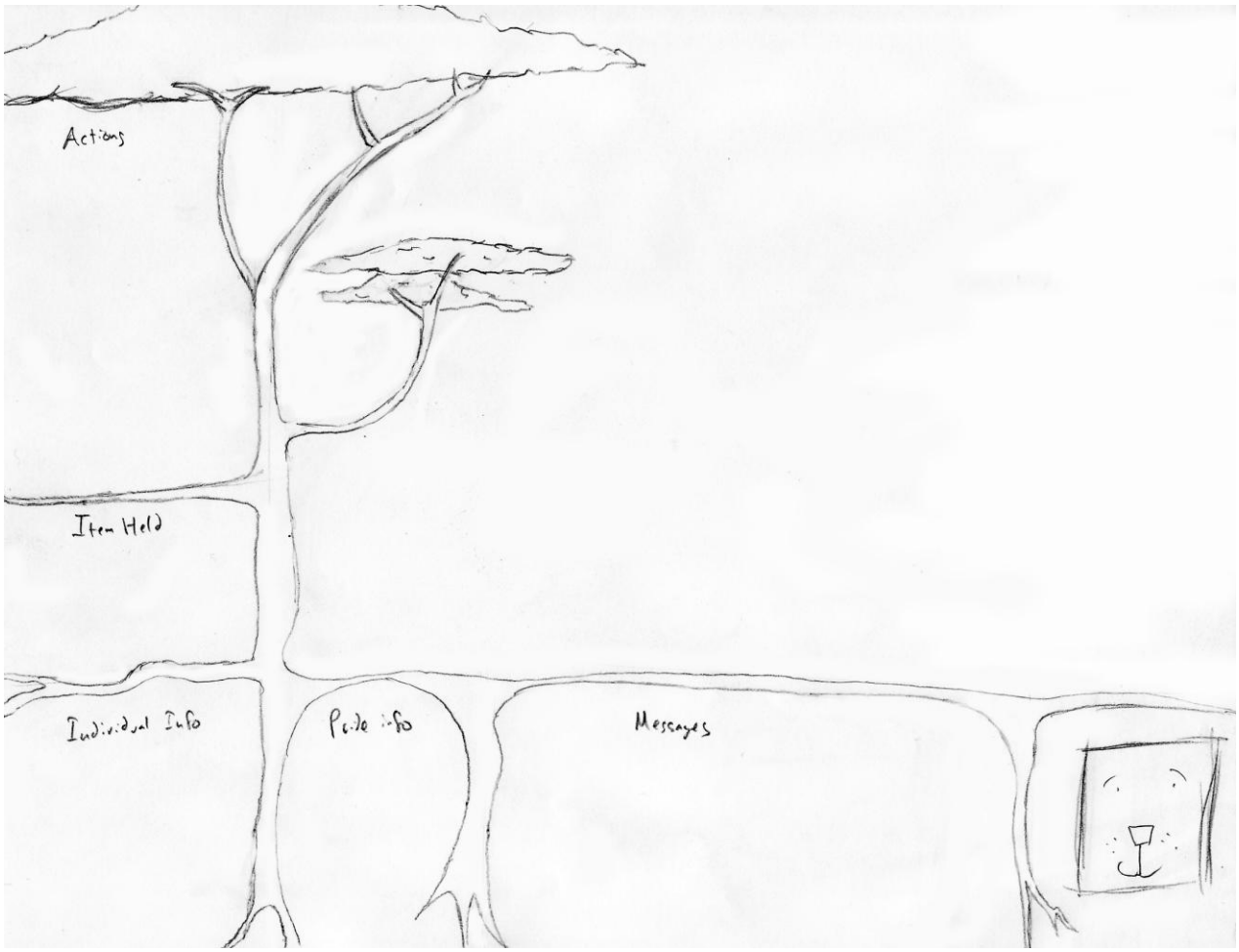

Figure 10: User Interface Artwork

3.3.1 Click selection

The user interface will exhibit a click selection interface which changes what is displayed on the rest of the interface depending on what selectable object on screen is chosen. Selectable objects on the current screen will have a translucent blue box around them when the mouse goes over them. When selected, this box will turn to translucent green. If the object can no longer be selected, the box around it will instead be translucent red.

3.3.2 Selected Object Image

The selected object image, located in the lower mid-left area of the screen, will be a picture of the selected object. If a lion is selected, the image will show how thrilled the lion is with Sefu and the degree of anger, happiness, or sadness they have in regards to Sefu. This can be extremes of these emotions and varying degrees as well as blends between angry and happy and, sad and happy.

3.3.3 Messages

The message box will display text related to the selected object. This can be a short bit of information or, if it is a living being, it could be dialogue from the selected lion.

3.3.4 Individual status

Below the Action List and to the left of the Selected Object Image is the Individual Status area of the User Interface which will show the player information on the selected object's needs, the object's name if it has one, its individual morale, its importance, and what the object is feeling most (be it anger, happiness, or sadness).

3.3.5 Pride status

In the far-right-bottom corner of the screen, next to the Messages area, is the Pride Status area of the screen which displays an information bar on how well the pride's needs are being met and how high or low the pride's morale is.

3.3.6 Action list

In the upper-left corner of the screen is the Action List area which displays what options the player has to interact with the game world. There are two types of actions displayed. Actions that will always be displayed are the basic actions which include walking and running. Depending on the object selected, there will also be specialized actions that the player can choose.

3.3.7 User Interface Test

The team performed an in-house test of the User Interface (UI) by creating each element of the interface with a scrap of paper. The paper was arranged to fit our planned interface, and a mock demonstration of our game was performed.
The test was linearly constructed and consisted of the following steps:

1. Target non-player lion: Amadi (Figure 11)

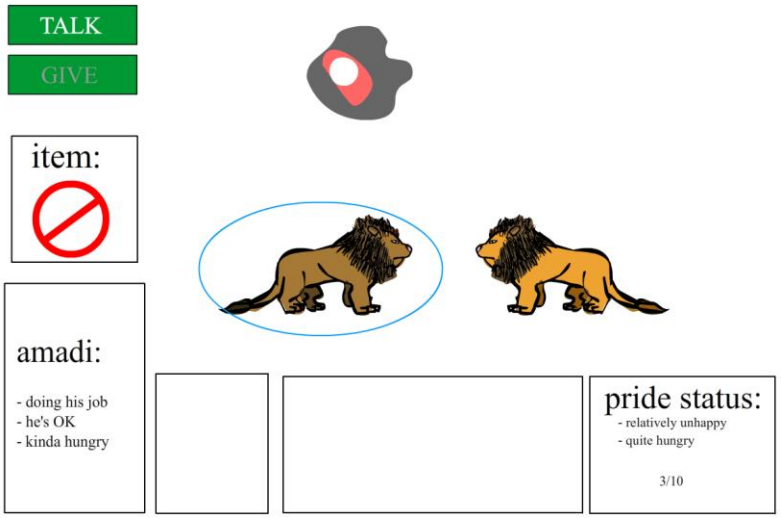

Figure 11: UI Test Step 1

2. Target object: piece of meat (Figure 12)

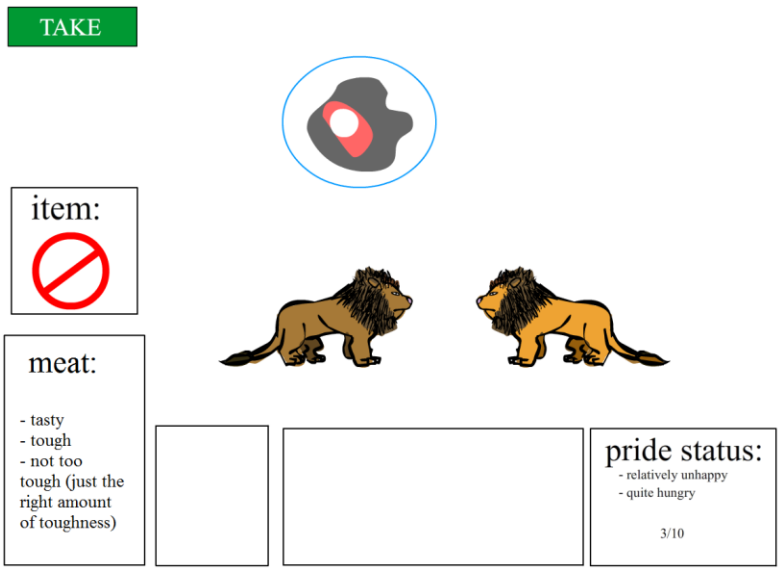

Figure 12: UI Test Step 2

3. Take meat (Figure 13)

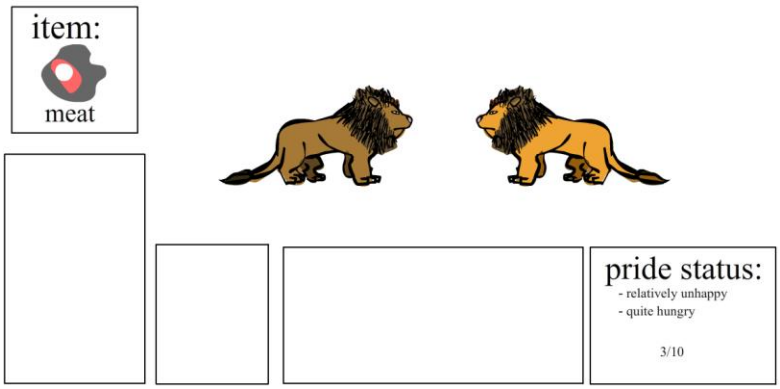

Figure 13: UI Test Step 3

4. Target non-player lion: Amadi (Figure 14)

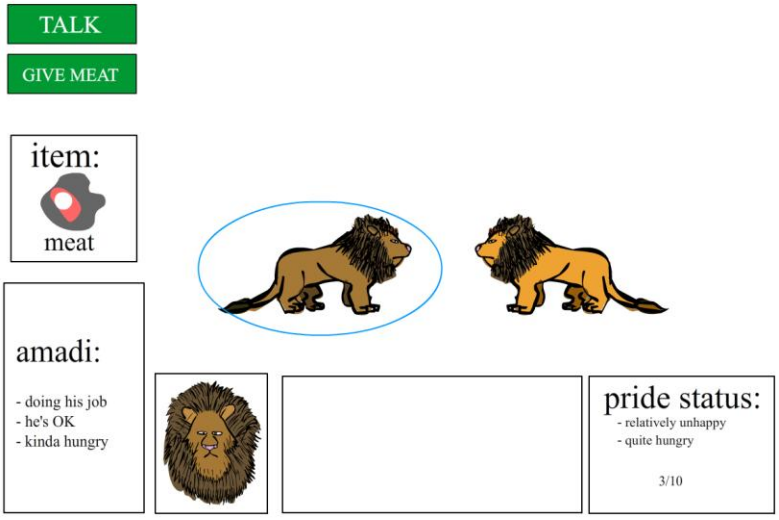

Figure 14: UI Test Step 4

5. Give meat to Amadi (Figure 15)

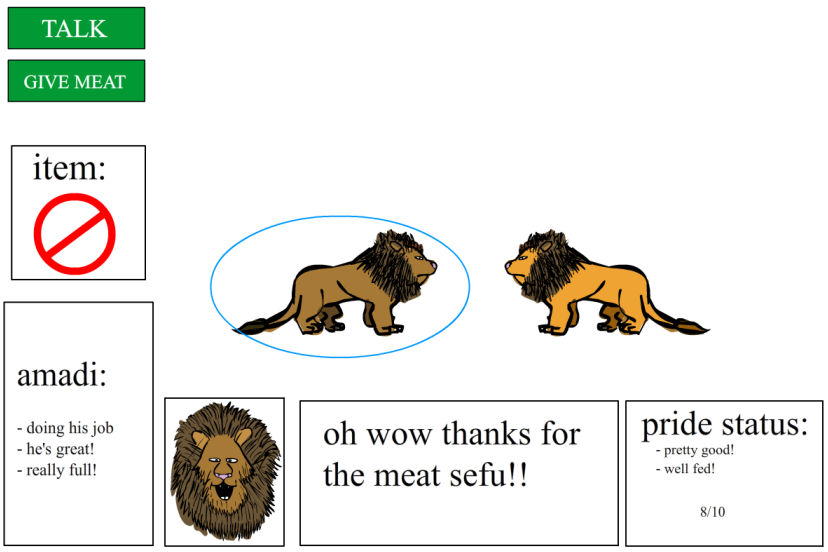

Figure 15: UI Test Step 5

The test was shown to and approved by all team members, and is the most efficient interface for our game. This UI test has been compacted into a Flash demonstration, so that the interface can be easily distributed and critiqued by multiple people. Our initial tests have already led to improvements on the interface, which is pictured in Figure 9, located in section 3.3.

3.4 Environmental Background

The environmental background will follow the savannah motif as the game is based in the savannah of Africa where lions are commonly found. The savannah's vegetation is comprised mostly of tall grass and low shrubs with low-growing trees. As a result the background will reflect this as it will contain all these elements and at the same time will tie into the game as the vegetation will be illustrated in a cartoon style. The background will be non-interactive by the player; instead anything that can be interacted with will be made into a sprite. Figure 16 shows the basic concept and motif of the background art.

Figure 16: Background Concept Art

3.4.1 Environment assets

The environments of *Prince of Pride* will all contain the same general sprites. The only differences will be the number of sprites on screen and the background, which varies depending on what stage the player is on. Generally used sprites can be split up into two groups: interactive and non-interactive. Examples of interactive sprites are items that the player can pick up such as carcasses, bones, and sticks which can be found in the environment. Some non-interactive sprites include trees, rocks, and bushes. For a more in-depth list of environment assets, refer to Appendix G and Appendix I.

4 Game Technology

The game technology aspect of the project is focused on the construction of the game and connecting to the AI middleware system. Some of the major features of the game tech are the game engine decision, graphics, construction of a user interface, setup of controls and movement, the creation of character interactions, talking to the AI middleware, and the construction of an event timeline.

4.1 Game Engine

A game engine will be modified to handle the player's actions and accommodate the social AI system. The engine that we have chosen for this project is the Xbox New Architecture (XNA) Game Studio.

The XNA engine benefits greatly from its large community. Due to the size of the community, there is a large number of examples and support. This project is going to be a two dimensional game. There are a large number XNA games and tutorials that focus on 2D. Another advantage of using XNA is that the amount of content needed to be designed by the team is reduced because the source code available provides basic functionalities such as rendering sprites, playing audio tracks, and keyboard input handlers. However, there are several disadvantages to using this engine. The fact that no one on the team has used XNA is a large problem because that means everyone will be starting from square one. Also, no one has worked extensively with the language that XNA uses, C#. This is less of a factor since there is a lot of online documentation regarding the language and also it is very similar to both Java and C++, which all of the programmers have used.

4.2 Graphics

The graphics of the game will be two dimensional as stated earlier, and because of this, things will be properly set up in the game engine used to handle only two dimensions. XNA can handle both two and three dimensions; however it requires modifications to use only two dimensions. Along with changing the dimensions, a dynamic graphical overlay shader will be written to change the saturation and colors of the user interface and game world.

4.3 User Interface

A user interface (UI) will be constructed through the cooperation of the artists and the programmers on the project. While the artists design the UI the programmers will code the actions and controllers behind the various menus, buttons, and frames. Along with the in-game interface, menus will be setup to allow the users to start the game, access to help information, and exit the game.

4.4 Controls and Movement

In order to control the player's character, controls will be mapped to performing various actions. Along with setting up these controls for the user, the non-player characters (NPC) will also have AI specific actions that they will perform. Movement, which will require path-finding, will also be implemented in order for characters to move around the game world.

4.5 Character Interactions

Along with movement, characters need to be capable of interacting with one another. The designers will create actions that affect the state of the game world and its participants. Each of these will be matched with an action created in the AI middleware system. Some actions will be specific to individual lions while other actions will be useable by all. These actions are the main driving force behind the entire game, allowing the player to perform actions and NPC's to interact with each other.

4.6 Event Timeline

While the majority of the game will be driven by the player's interactions with various characters, there are still some events that will occur outside of the scope of character interactions. This requires that there be an object that will take care of initiating such events at specific times. An event timeline will be made that will allow the game to instantiate events that affect the entire game world. It will handle major story events, end of levels, and hunt scenes. This will handle many kinds of events, so events can cover a large range of objects, but all can be placed on the timeline. This means that the team will have the freedom to create new events that it decides are necessary during the development phase of the project without having to completely rewrite the architecture of the game system.

4.7 Game Architecture

The game architecture was developed such that the construction and execution of the game would be both straightforward and easy to test. The architecture is split into multiple components that will have very clearly defined interfaces, allowing for the development of all the parts of the game independently. This also facilitates the testing aspect of the game. While constructing each separate component, it is very simple to create small stub interfaces that allow the developers to test functionality without needing to have constructed interaction components.

Figure 17 depicts the architecture drawn out by the team in the Universal Modeling Language. It contains all the main components of the Architecture and the majority of the game specific classes such as the Lion class and LionAction class.

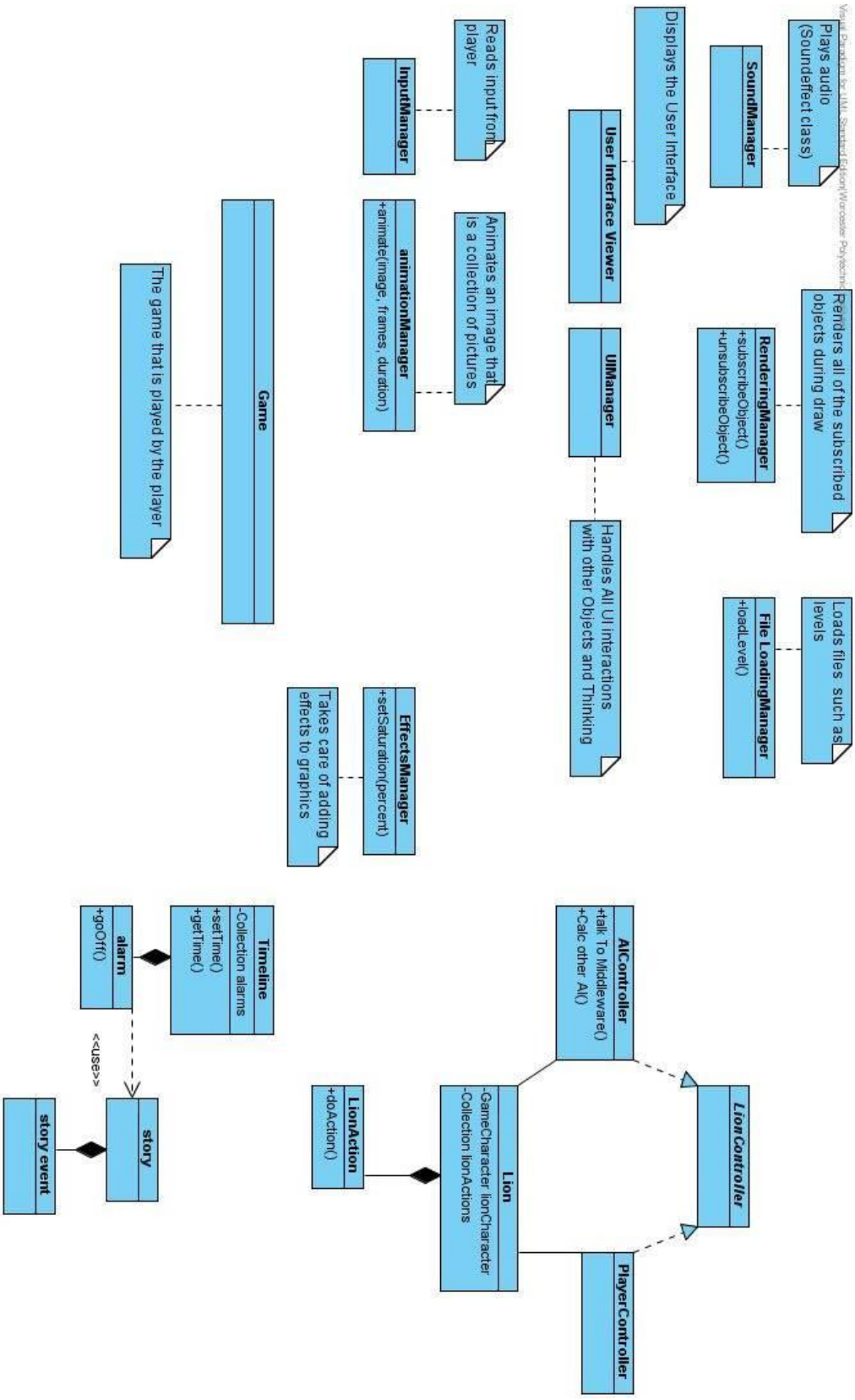

Figure 17: Game Architecture Diagram

The game architecture uses some basic object oriented design patterns to solve some problems encountered in the design phase. In talking to the RendererManager, objects will register to this class using the subscribe design pattern, allowing for a simple solution to determining what objects to render. The CharacterController and AIController use the template pattern to allow for a lion to easily use either controller regardless of how they operate behind their interface.

4.8 Game Data Flow

The game data flow is depicted in Figure 18. The diagram depicts the direction that the data travels from the different components of the game architecture and with each component there is a list associated with it. This list contains of all the different places and kinds of data that the component can be sent.

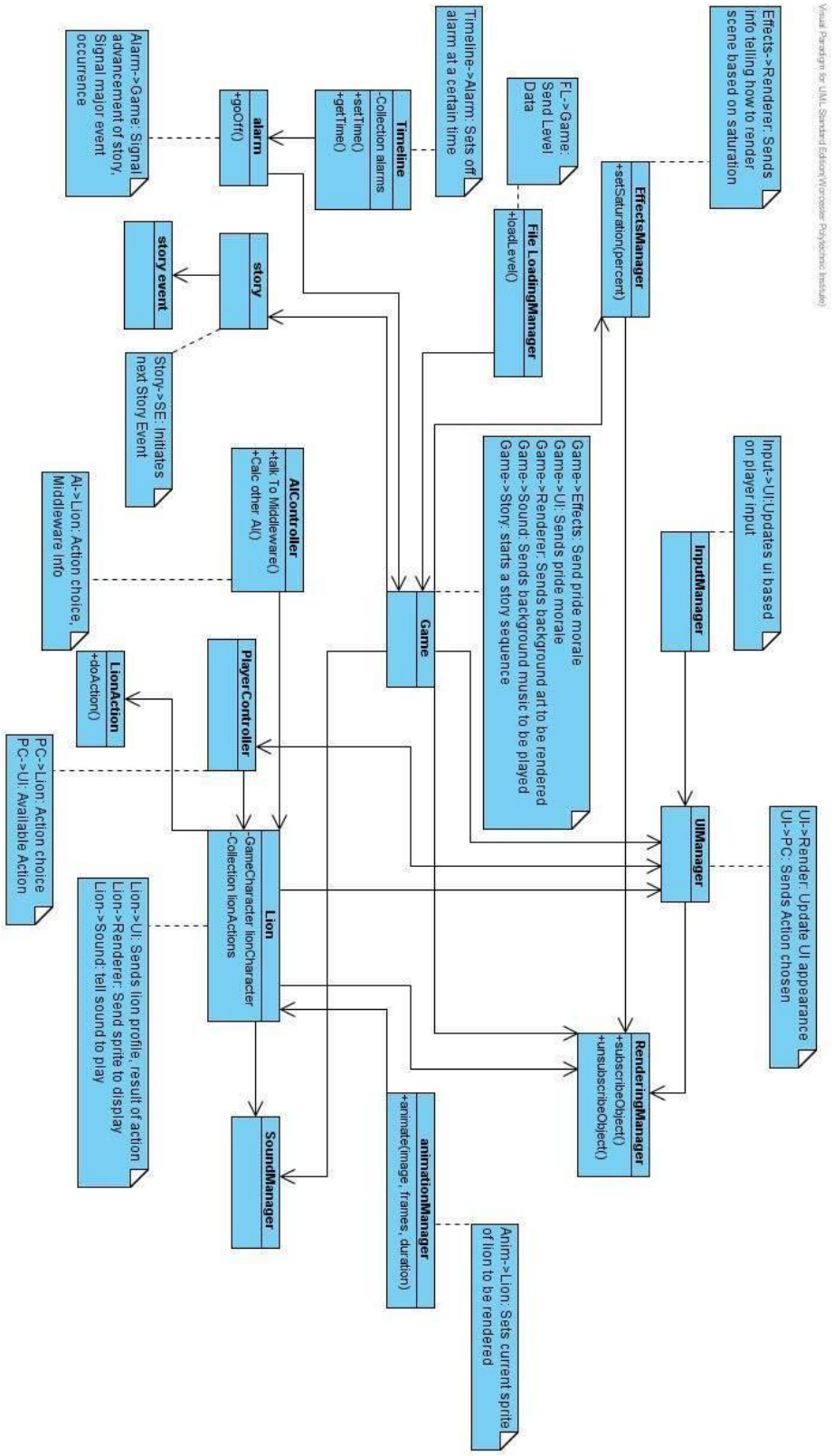

Figure 18: Game Data Flow Diagram

4.9 Game Control Flow

The game control flow is the order of control of the system throughout the entire game displayed in Figure 19 using arrows to show the direction of flow. The game at times splits control between two different events, such as when drawing the environment and starting a timeline. This means that both events are occurring simultaneously and either one can affect the control flow of the game.

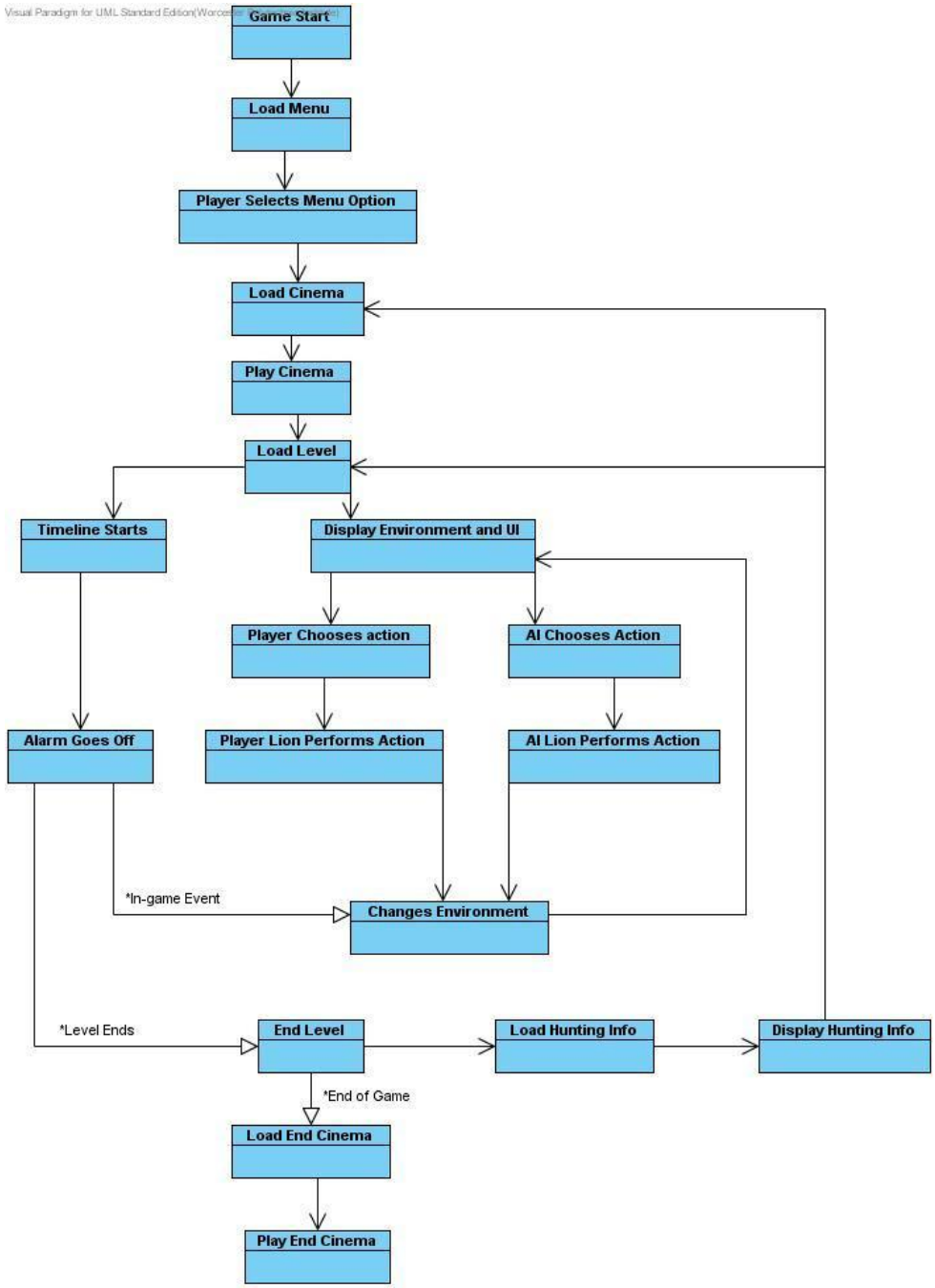

Figure 19: Game Control Flow Diagram

5 AI Technology

In order to model the social aspects of small groups, we will create an AI engine that other programs or games can interface with. The engine will be flexible so that developers can use it in various situations (for other examples see Appendix C and Appendix D). The AI engine doesn't expect the game designer to be a psychologist who can explain why a character takes certain actions. The goal is to let a designer create characters who behave in a believable way as easily and efficiently as possible.

Because we are attempting to model small groups, the primary entity of our engine will be the character. In addition, we will have groups which are abstractions of individuals, allowing the designer more flexibility with modeling real social groups.

5.1 Character

A character represents a single entity. Though the name implies a single person, a character can also be used to abstractly model a homogenous group. If a designer wishes for all members of a group to act and react as one, a character can be used to represent that group. Should a designer wish to have a group where individuals can act independently, then the Group entity, discussed later, is more appropriate.

Currently a character is defined by five attributes: Emotions, Attitudes, Needs, Importance, and Actions (see Figure 20). Each of these attributes contributes to allowing a character to behave realistically given its personal state, the state of other characters, and the environment around them.

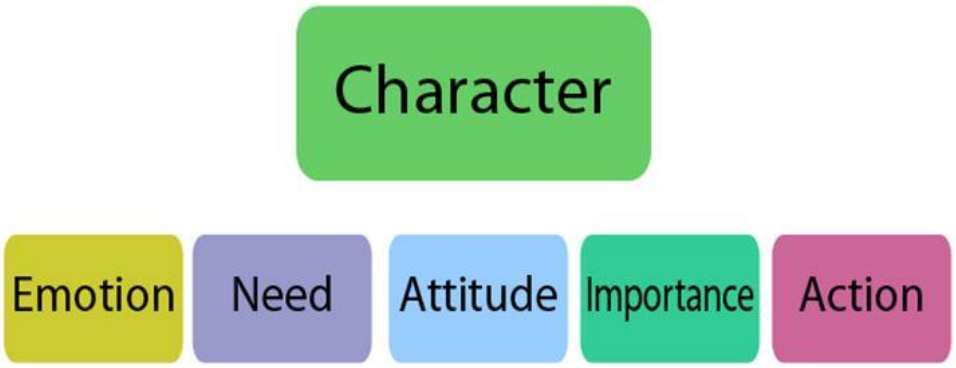

Figure 20: AI Character

5.1.1 Emotions

Emotions are used to describe how a character is feeling. These range from the basic such as sad, angry or excited, to the complex: manipulated, inspired, guilty or focused. A character can have any number of emotions. The more emotions a character has, the better one can represent their state. Emotions will be used in a range, similar to the needs in the Sims are used to represent the status of a character (Figure 21).

Figure 21: Character Status in the Sims

Adams and Rollings describe four different classifications of characters in stories by their dimensionality. By using binary values for the range of emotions, one can represent very simple characters easily. More complex characters will have one or more emotions. The most complex characters can have emotions that are conflicting.

Zero-dimensional characters have emotional states that are fixed, and there is no area in between. They may have more than two emotional states (Figure 22).

Figure 22: Zero-Dimensional Character

One-dimensional characters have a single emotion, but that emotion can vary (Figure 23).

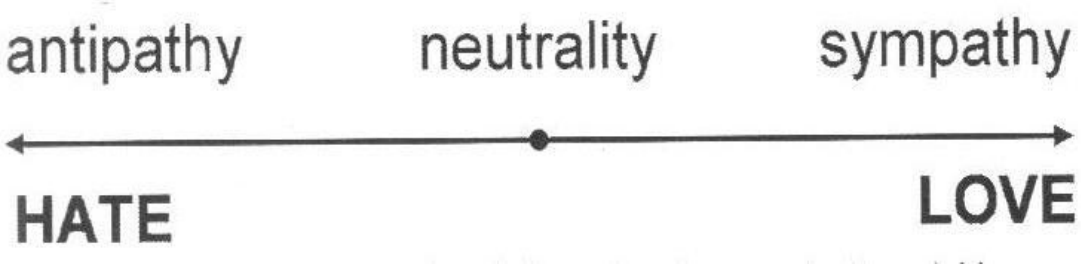

Figure 23: One-Dimensional Character

Two-dimensional characters do not necessarily have two emotions (Figure 24). They can have many emotions. However, these emotions are orthogonal, which means that the character never faces emotional ambiguity.

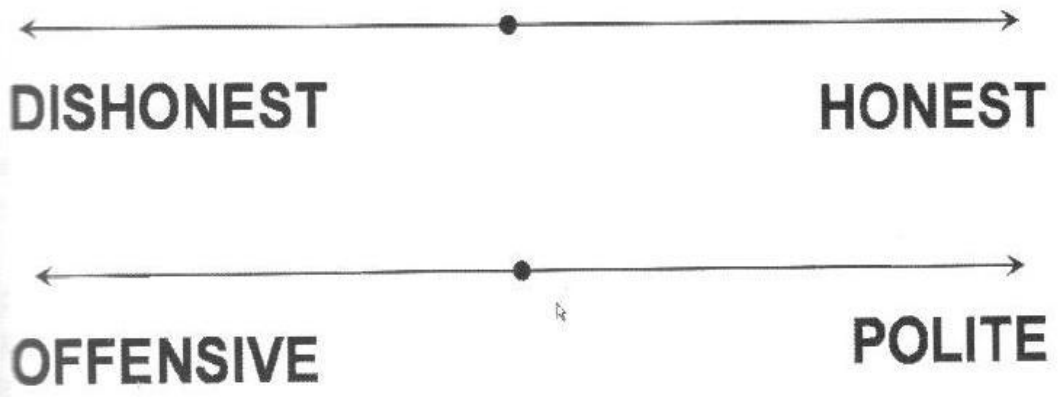

Figure 24: Two-Dimensional Character

The most complex characters are three-dimensional (Figure 25). They have multiple emotions that can create conflicting impulses, which "sometimes [causes] them to behave in inconsistent ways."

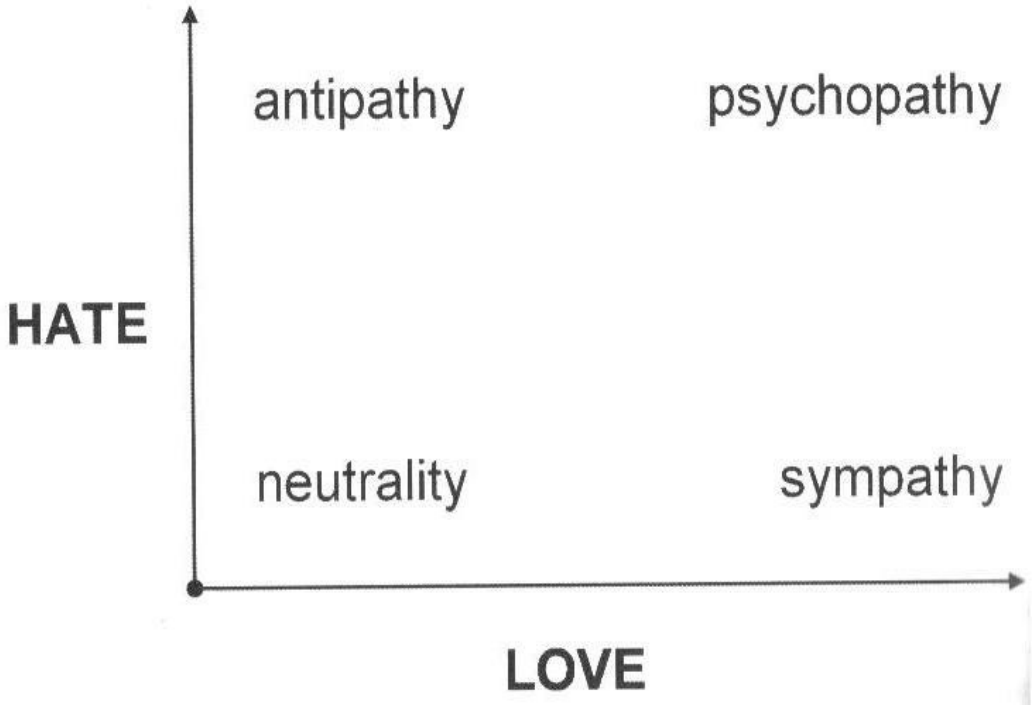

Figure 25: Three-Dimensional Character

By accommodating all of these types of characters in a single entity, we give the game designer the freedom to make any character imaginable.

5.1.2 Attitudes

A character has attitudes towards other characters and groups. A character can only interact with characters and groups it has an attitude towards. For example, in a situation involving an organized crime ring and a police agency, neither side knows about the characters of the other.

However, if one Mafioso decides to reveal secrets to a specific police detective, then those two individuals can interact, though neither can interact with other members of the other group.

Most characters will have single attitudes towards other characters, though this is not a requirement. They can range from simple, such as respect, to complex such as romantic-interest. This allows a designer to make a romance-game for example, where characters have romantic, platonic, and physical, and perhaps even novelty interest attitudes towards other characters. By combining attitudes with emotions, one can create realistic interactions. For example, in the event that a character's sadness [emotion] is too great, the character will go to the person with the highest friendship [attitude] (the best friend!) for comfort.

This allows the designer to create social networks similar to one in a television series or movie. Below is an image of a social network of the characters of the show *24* (Figure 26). However, in our engine, these relationships are two-way, thus allowing characters to manipulate or deceive other characters due to the imbalance.

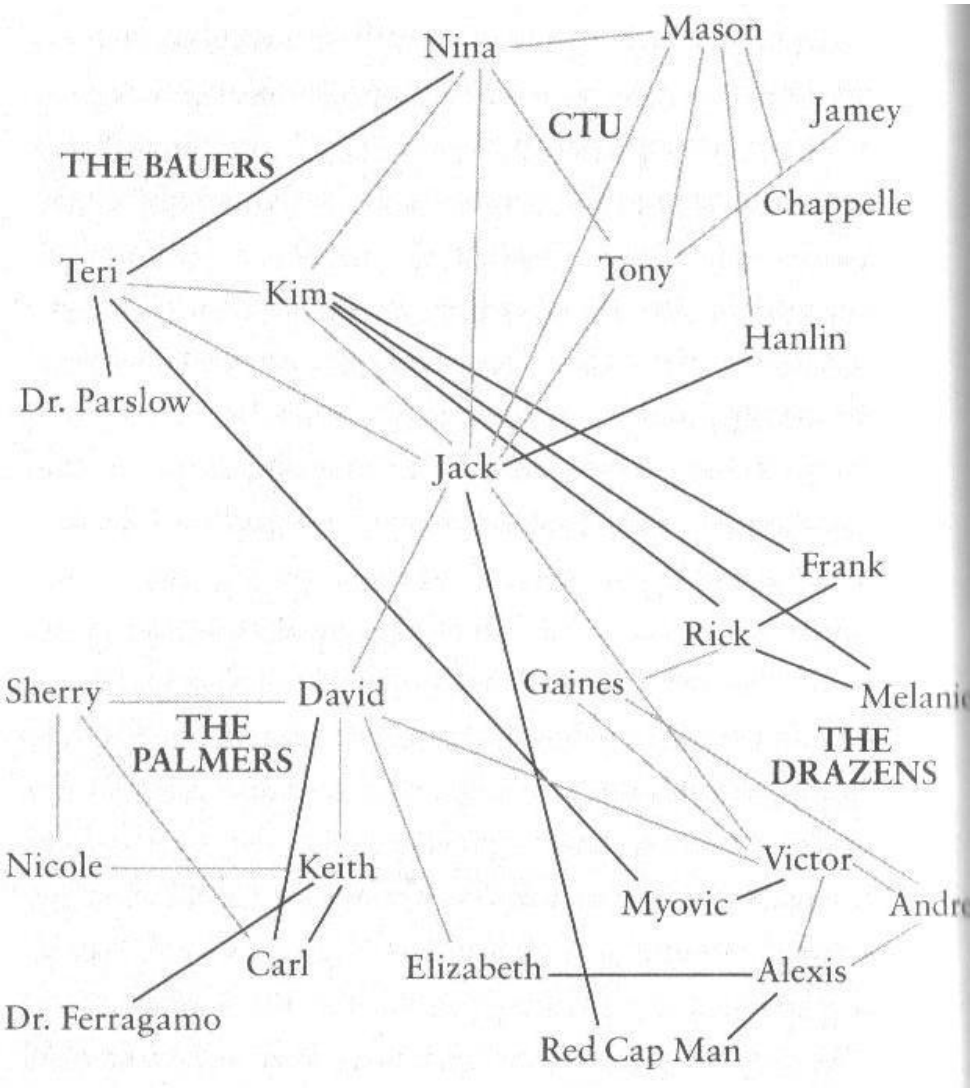

Figure 26: Social Network of *24*

5.1.3 Needs

Each character has needs that represent goals, essential commodities, or achievements. Thus a character could need to be the best player on a team, own a car, or be happy. A character could also have a need to have five friends, which would mean having a reciprocal friendship attitude towards five other characters. If a character has an 'ideal' state, such as having full happiness, then often that character will have a need to increase happiness. However, emotions such as politeness may only be affected by outside events, and thus a character will not associate a need with that emotion. A character may become more polite, but won't attempt to change that emotion through actions.

A character's needs do not only pertain to the attitudes and emotions of that character. One may care about the health of a group, the success of another character, or something unrelated to either. For example, a character that is addicted to cigarettes may have a need to smoke every hour or two, even though this doesn't affect any character's emotions or needs. A designer could have this need affect an emotion, such grumpiness, but there is no requirement that a need be tied to an emotion or attitude in order to make a character attempt to achieve that need.

5.1.4 Importance

A character will have a method of determining which need is most important at a given time. For example, if a character needs sleep, but a character also needs to finish a paper, the engine needs to decide what a character will do, sleep now and write later, or write later and sleep now. This decision algorithm is unique to each character. Some characters may use a simple random value to determine which need to fulfill, while others may carefully weigh their different needs and emotions to decide on an action. The more emotions and attitudes a character has, the more complex this decision-making algorithm is. It is expected that some randomness will be incorporated into this algorithm, since characters should be realistic, but not perfectly predictable all of the time.

5.1.5 Actions

After deciding which need to pursue based on importance, which draws on the state of this character's emotions and attitudes, a character must determine how to go about fulfilling a need.

As a basic example, if a character is hungry [emotion] and reduce hunger [need] is the most important need, then the character will take an action that will reduce its hunger. In this case, since this will not affect another character, no AI action will be taken. However, a message will be sent from the AI to the game indicating that this character is attempting to find something to reduce hunger.

At this point, the game will be responsible for turning this action into game terms. Perhaps the game will determine that food is available, and the game will send back a message saying that hunger is immediately decreased by 10. Alternatively, the game may determine that to get food, the game-character must find a place with food, walk there, purchase food, and then eat the food. In that case, the game will tell this AI character to wait before re-sorting importance, because the desired action is being performed. When the game-character finishes eating, or some other event happens that changes the state of the AI character, the game sends a message to this character to re-sort the importance of needs and determine the next action.

Actions which affect other characters work the same way, except they also change the state of other characters when the game affirms that the action is completed in game. Thus, a talk-to action increases friendship attitude between two characters. When one character decides to take that action, then that character tells the game to go talk. When the conversation is finished, the game tells the character that the action is finished, and the action completes, updating the attitudes of the characters.

5.2 Groups

It is not efficient for actions which affect large numbers of characters to require messages to all those characters. Instead, characters that are part of a larger social group are able to get a general idea of the state of these groups without needing to generate an impression given the characters one knows.

A group has only two of the five attributes that characters have. It also has a list of members, which are characters. A character can be in more than one group, so characters can join and leave groups as the situation changes.

5.2.1 Emotions

Emotions are similar to those of characters, though they are always at least one-dimensional since groups, by their nature, always have internal disagreement. If a group has no internal disagreement, one can use a Character entity to represent a homogenous group.

These emotions are weighted averages of the emotions of the members, so the two are tied together. By having weighted averages, the importance of some characters can be reduced or augmented within a group. Thus, a designer is free to create a group where ‘when mama ain’t happy, ain’t nobody happy’.

5.2.2 Attitudes

The attitudes of a group represent the overall attitude of that group towards either another group or a character. A question about an attitude between a group and a character might be akin to asking ‘How do my friends feel about this person?’ or ‘Does this person seem me differently than my social group?’ or even ‘Is our tribe at war with this other tribe?’ Again, these are weighted averages, since in some cases only one or two people count for deciding how everyone else should act towards a group.

5.3 AI System Interaction

There are three different situations that require interaction between the game and the AI during gameplay. Each of these situations is handled slightly differently, though all involve the game manager sending a request to the AI Manager, followed by the AI Manager sending a response message.

1. The game needs information about the state of a character or group
2. The game needs to update the state of a character or group

3. The character chooses an action and needs the game to perform it

In the first case, the game sends a request for information to the AI Manager. This request query includes the character or group, and attribute desired. The AI Manager then requests this information from the group or character and upon receiving it, sends a message back to the game with the relevant information.

The second case is similar to the first, except instead of asking for a current value, the game is updating that value. Thus, the message includes the character or group, attribute desired, and the new value. A programmer will recognize these first two cases as the get and set commands.

The third case is the most important one. Every turn or cycle of the game engine, the game will ask the AI for a set of actions. Then the AI Manager will poll the Characters to see which ones are not busy, have them calculate their importance, and get an action from each. Upon giving an action, the character will become busy, and this will not change until the game updates that character's state, indicating that an action has been completed. Then it will send a message about these actions to the game manager. Upon receiving an action, a game character will determine the best way to perform this action. Thus, an action "get food" could involve decreasing a food counter in a granary, going to a refrigerator and making of a sandwich, or hunting of an animal. Upon completion of that action, the game will update the state of the character to be not-busy, which is a specific form of case 2.

Because the AI is never asking the game for information, the AI can be plugged into an existing game and still work correctly. Thus a designer can use the AI engine for as much or as little as would be appropriate for the game.

5.4 AI Architecture

In order for our AI engine to be completely independent from the design of the game that will work with it, we have designed the architecture so that all interaction between the AI Engine and the game is handled by the AI Manager or AI Controller. By having the AI Manager interact with the characters, and those characters interacting with other characters on their attitude lists, all external queries can be answered by the AI Manager, while characters and groups can communicate independent of the manager (see Figure 27). A more detailed UML version can be found in Figure 28.

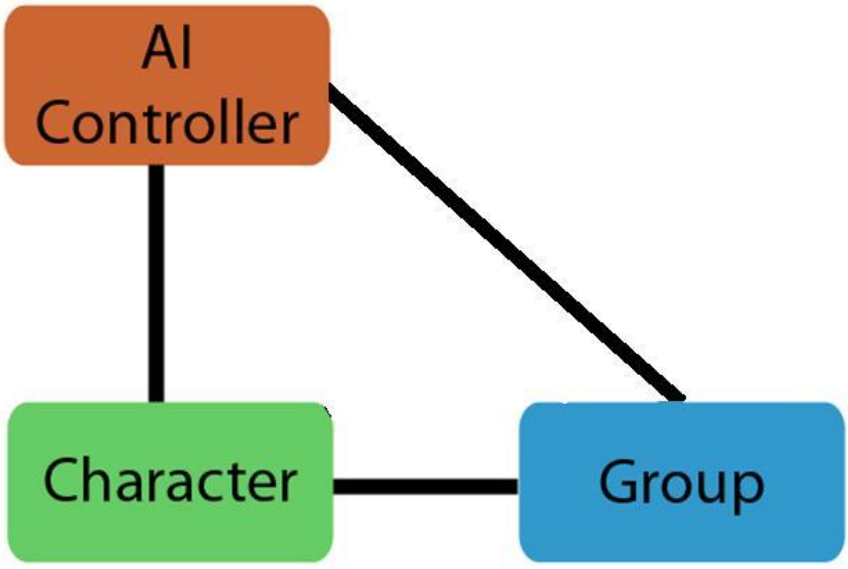

Figure 27: AI Controller Communication

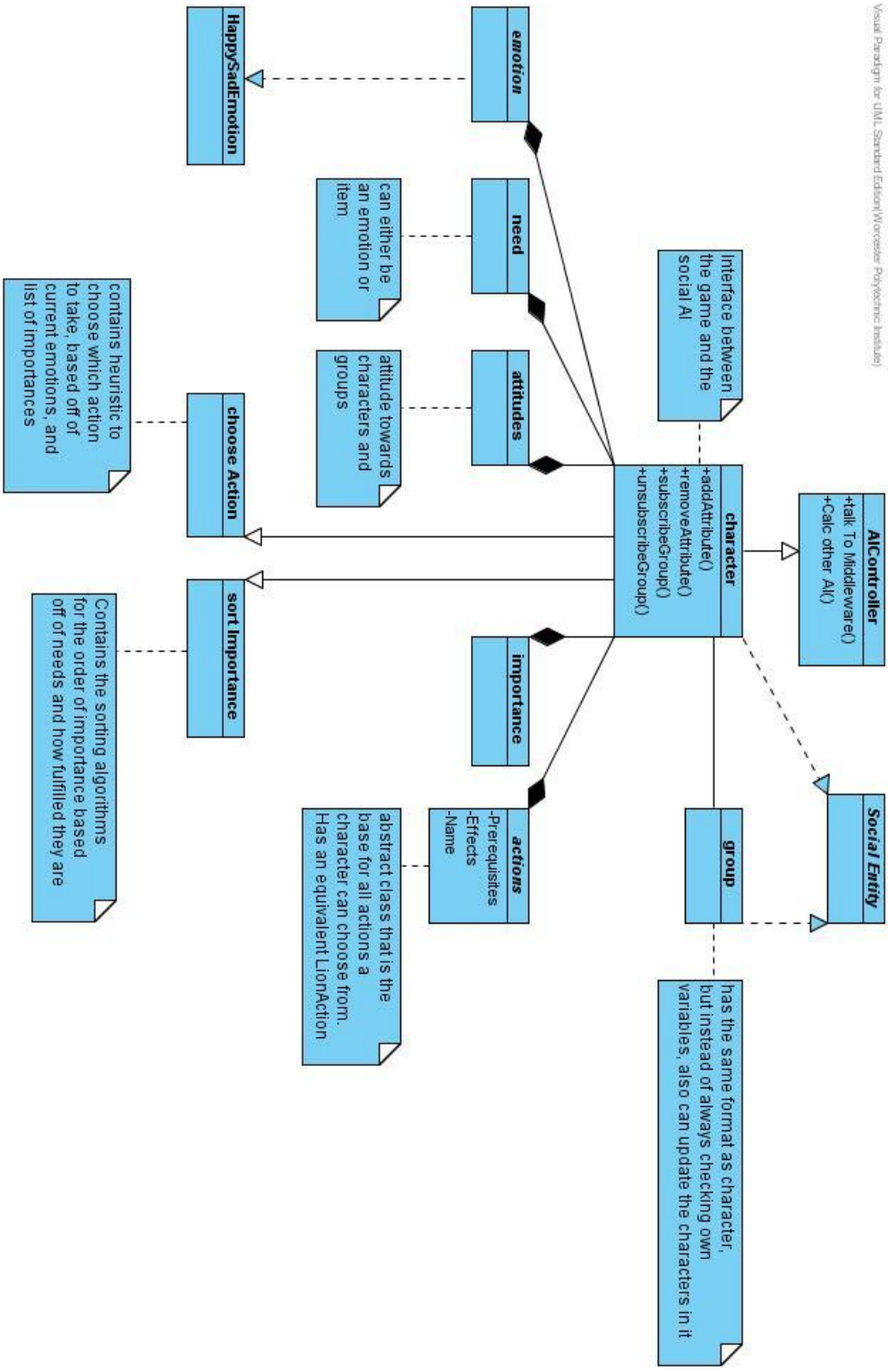

Figure 28: AI Architecture

5.5 AI Data Flow

As stated before, there are two forms of data flow, a flow between social entities (groups and characters) and a flow between the AI Manager and these social entities (Figure 29).

The AI Manager is responsible for all outgoing and incoming communications beyond the AI Engine. Thus, other programs need only know how to interact with the AI Manager in order to use the AI Engine. Thus, the game is always the initiator of communications between the AI and itself. Upon requesting information about social entities, requesting an update to one or more social entities, or having the AI Engine generate a set of actions, the AI Manager will produce a response that the game can interpret.

However, in order to determine actions, the characters or groups may need to get information about the state of other characters or groups. These communications do not involve the AI Manager. Instead, characters will talk to each other directly in order to get the necessary information.

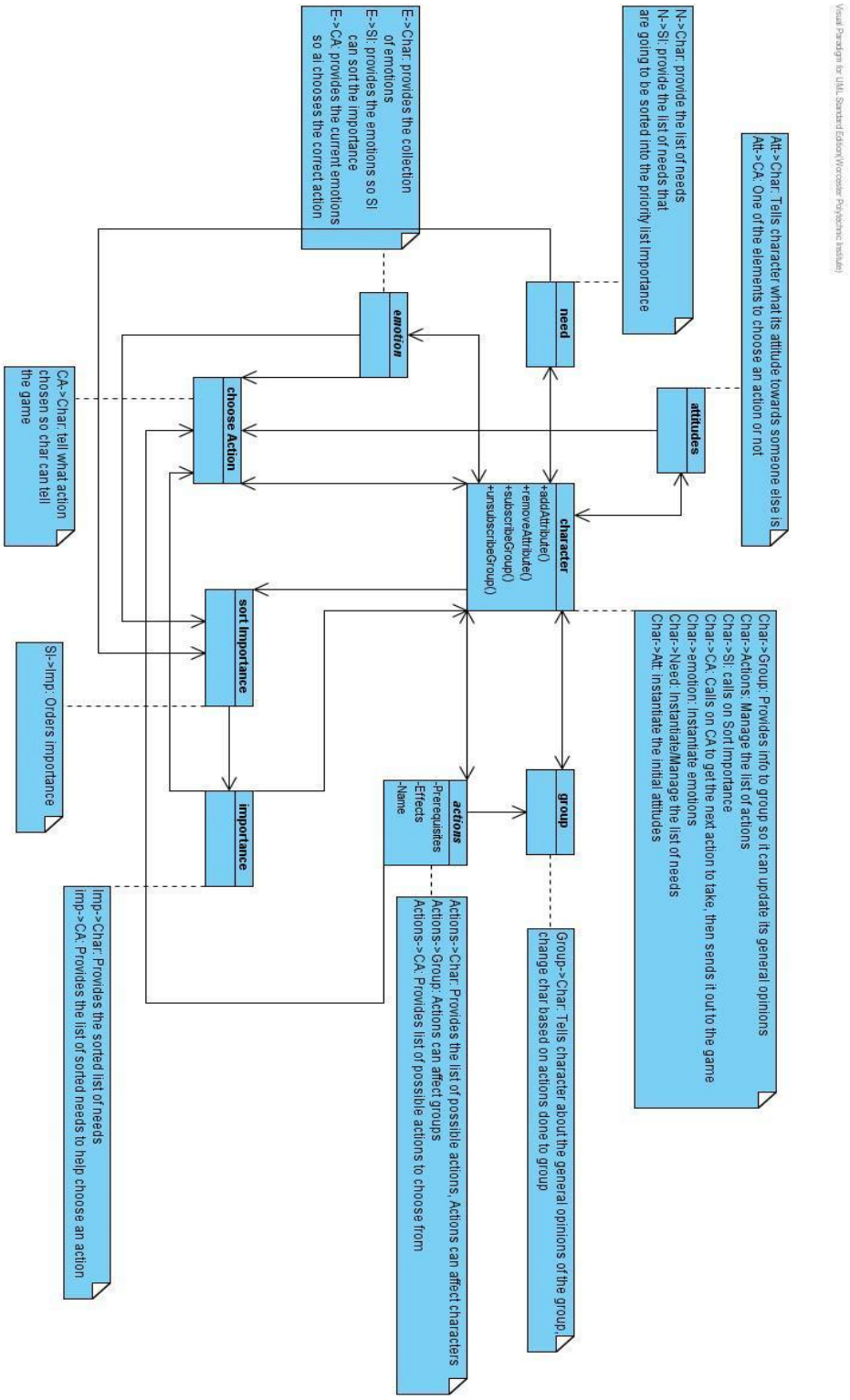

Figure 29: AI Data Flow Diagram

5.6 AI Control Flow

Control flow in the AI Engine is completely linear. After instantiation, it waits for instructions from the game or program using it. Every instruction or query passed to the AI Engine will pass control to the AI engine until the instruction is performed or an answer is found, at which point control returns to the game.

At first, the AI Engine will generate groups, characters and such, as dictated by the game or program utilizing it. Alternatively, the game can have the AI Engine load its information from a file. After at least one character exists, the game can ask the AI for a set of actions. The AI Manager will query each character to see if the character is busy. If the character is not busy, control is passed to that character while the character determines its next action. Upon choosing an action, the character returns control to the AI Manager, which goes on to the next character who is not busy. When all characters have been polled, the AI Manager takes the list of actions and returns these to the game. Thus, control passes from the game, to the AI Manager, to the characters, and back up again.

6 Project Milestones

Though there will be biweekly meetings to discuss progress throughout the term, there will also be larger deadlines that the group will meet. Table 10 is a list of the major accomplishments that will occur throughout the course of the project and by when they will be met. If this schedule is adhered to, the finished game will be completed by the end of C-Term.

Table 10: Project Milestones

Milestone	Deadline	Description
Design Document	October 15, 2009	All design decisions of the game will be finalized.
First Alpha	November 24, 2009	A very primitive form of the game will be produced displaying the basic functionality of the AI middleware.
Second Alpha	December 17, 2009	A more advanced form of the game will be produced displaying improvements in the AI middleware as well as the content of our specific game.
Final Alpha	January 14, 2010	The nearly completed game with functional AI, art, tech, and gameplay. This will be the last version before public release.
Initial Beta	February 5, 2010	The completed game with full development in all aspects of the game. This will be the time for public play-testing and feedback. Freeze-date for changing gameplay. Only minor revisions to gameplay will be made after this deadline.
Final Beta	March 5, 2010	The complete, bug-free version of the game with full functionality ready to be played.

7 Schedules

7.1 Art Schedule

Table 11 shows the schedule Ross and Jon will adhere to for completing art assets with respect to the overall game milestones. By the time the design document is completed, all of the concept art for the game will be finished, and the style of the art will be well established. For the first playable, the black and white outlines will be completed for all art assets, including animations. This will ensure that the tech team can utilize the assets when ready, despite them being unfinished. The sprites will be colored in and shaded by the second playable test. At this point, all changes made to the sprites will be based on suggestions made by the testers or any other cosmetic changes deemed necessary.

Table 11: Art Schedule

Deadline	Completed Art Assets	Game Milestone	Description
15-Oct-09	Concept Art	Design Document	All design decisions on the game will be finalized.
24-Nov-09	Outlines/Flatly Colored Sprites	First Playable	A very primitive form of the game will be produced displaying the basic functionality of the AI middleware.
17-Dec-09	Colored/Shaded Sprites	Second Playable	A more advanced form of the game will be produced displaying improvements in the AI middleware as well as the content of our specific game.
14-Jan-10	Improvements/Suggestions	Final Alpha	The nearly completed game with functional AI, art, tech, and gameplay. This will be the last version before public release.
5-Feb-10	Improvements/Suggestions	Initial Beta	The completed game with full development in all aspects of the game. This will be the time for outside play-testing and feedback.
5-Mar-10	Improvements/Suggestions	Final Beta	The complete, bug-free version of the game with full functionality ready to be played.

7.2 Game Technology Schedule

The game technology schedule (Figure 30) lays out the implementation that Ryan and Fran must follow for the first and second alpha phases of the game in detail (B-term). The Final Alpha and beta versions of the game are as they are in Project Milestones.

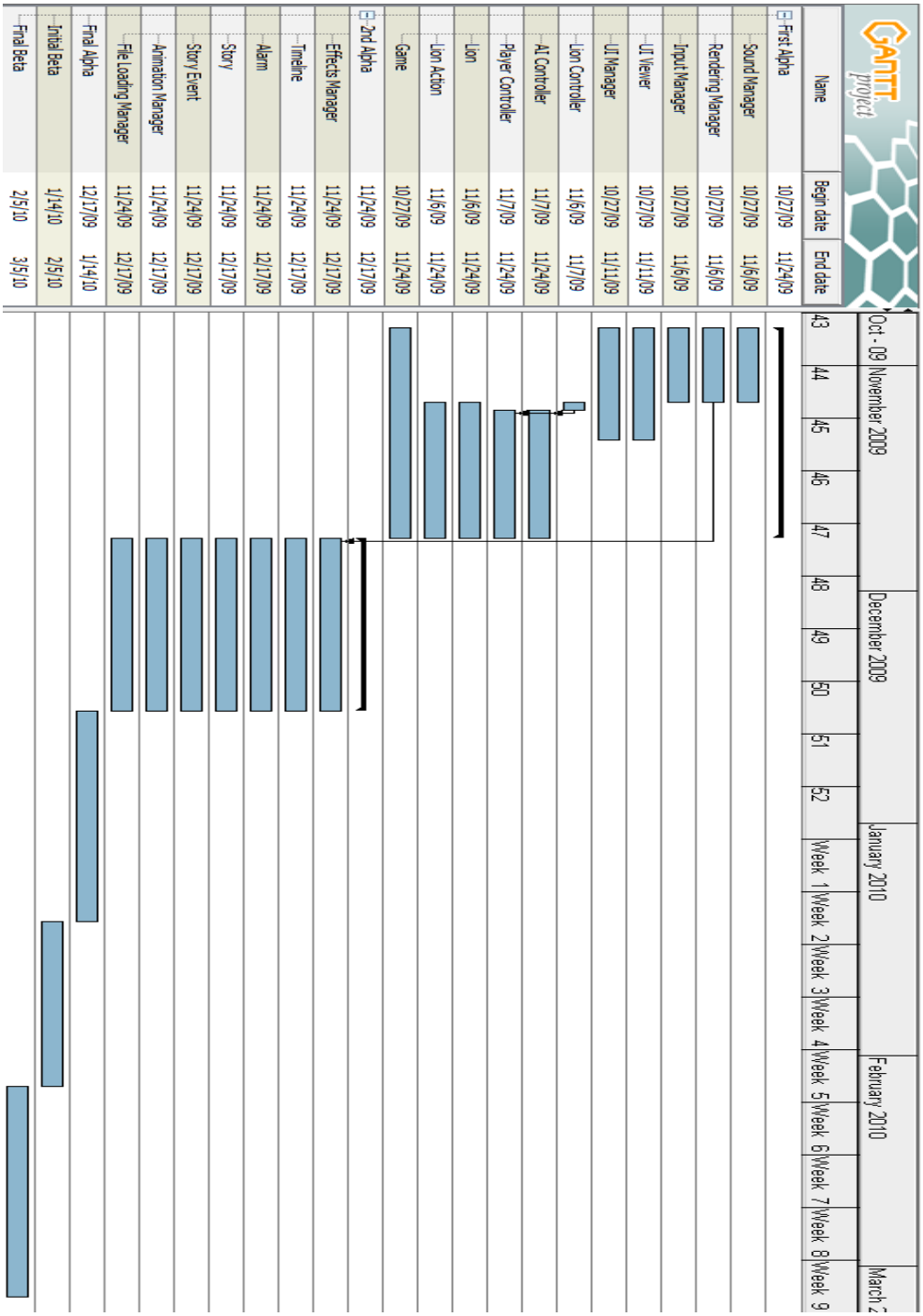

Figure 30: Game Tech Schedule

7.3 AI Technology Schedule

The AI technology schedule (Figure 31) lays out the implementation Greg and Jon must follow for the first and second alpha phases of the game in detail (B-term). The Final Alpha and beta versions of the game are as they are in Project Milestones.

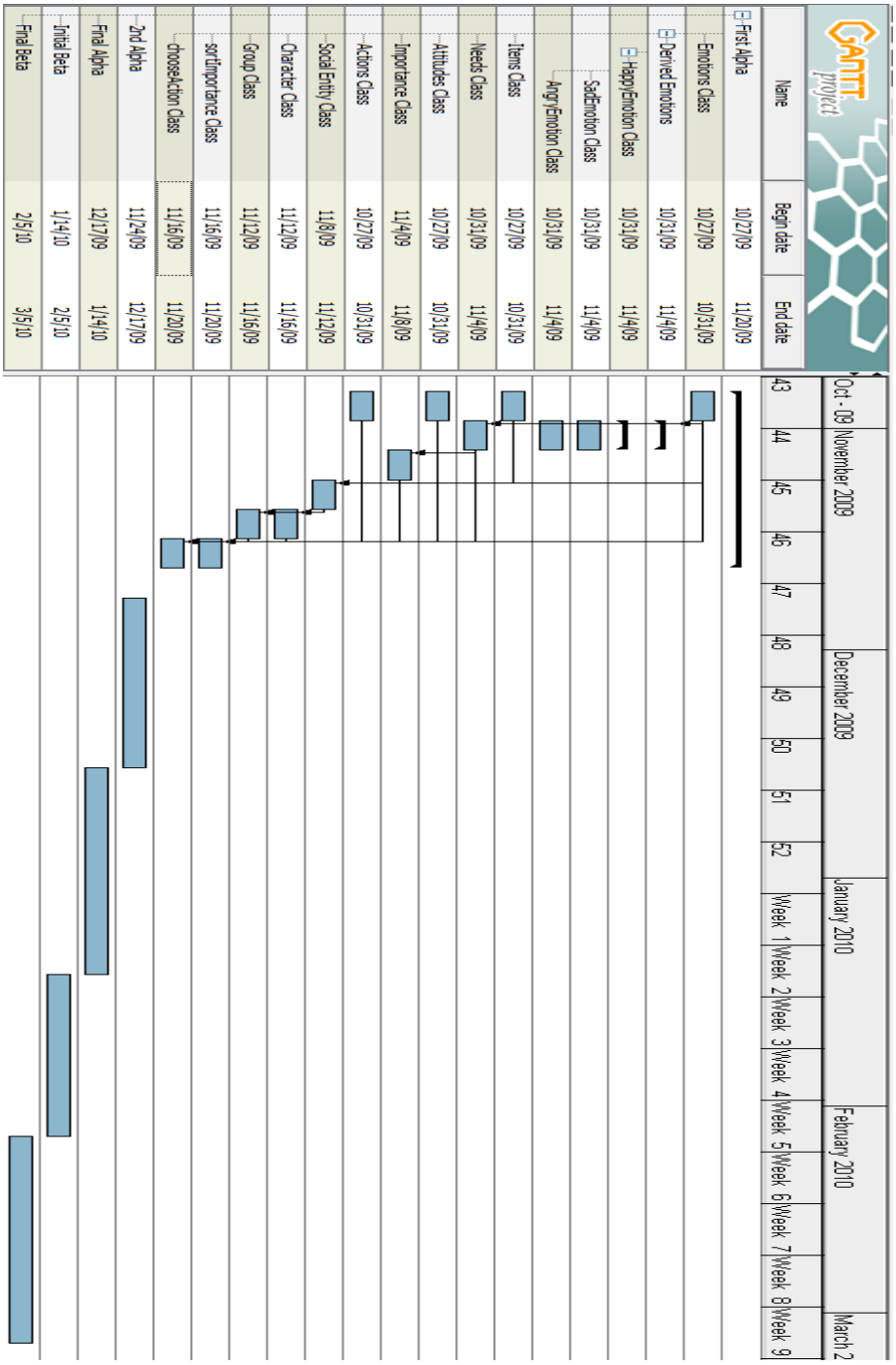

Figure 31: AI Schedule

7.4 Testing Schedule

There will be three levels of testing done during the implementation of the game: in-house testing, outer testing, and public testing. In-house testing is when the project team tests the game. Outer testing is when acquaintances of the project team test the game. Public testing is when the game is available online to the general public and they test the game.

Testing of the different phases of the game will be as follows:

- In-house testing will be run on each phase of the game as it is produced.
- Outer-testing will be run on each phase of the game after that phase's completion, during the production of the next phase of the game; feedback regarding the previous phase will be implemented during the next phase.
    - Ex: Outer-testing feedback for the First Alpha will be implemented during the Second Alpha's production

7.5 Technology Demo Schedule

The first technology demonstration will be completed by Greg before the AI is ready, on November 30th. It will aid us in testing our AI system. Further, it will ensure that the AI will work independently of our game engine. The second test, also done by Greg, requires a larger simulation to be run. As such, it will take more time to complete. It once again will be independent of our game engine. Our goal is to finish it by December 15th. Development of both demonstrations will occur simultaneously.

8 Conclusion

By combining gameplay, art, game technology and artificial intelligence technology, we will deliver a middleware system for game developers, as well as a fully functional game. Our gameplay, built around exotic environments, interesting characters with diverse jobs and needs, and a strong storyline will engage the player. A cartoon art style will draw the player in while allowing us to convey the emotions of the characters. Technology built to handle the actions of the pride will allow our game to run quickly and smoothly, while a separate social AI will enable us to model the interactions of the lions.

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Appendix B Scene Script

Introduction

Grandpa:

There once was a proud pride, a strong pride; the most powerful pride ever seen in the African savannah. This pride belonged to the Emeka lions. However, the pride fell on tough times when they came under the rule of the tyrannous King Kojo. Fearing his harsh and strict hand, many members of the pride fled and the pride's numbers began to fall. The pride has now dwindled down to only ten. It is feared that if something is not done soon to stem this flow of hate and fear, that the once most powerful pride in all of Africa will be no more. This is where you come in Sefu. If our great pride is to live on, you must do all in your power to keep this pride together. I am entrusting it to you. Make me proud Sefu.

Sefu:

I will Grandpa.

[Day breaks. Sefu awakes from his dream. His mother is standing beside him. His father is in front of them, standing on a tall rock. They are under the shade of a great tree. Everyone else is lying out in the scorching sun.]

Aba:

Sefu... Sefu... It's time to wake up. Don't want to be left behind do you?

Kojo:

Let's go everyone! I want to reach the oasis before I die! The dry season is going to be brutal! Get a move on! That includes you Sefu! No son of mine is going to lag behind! Now let's move!

Aba:

Come son, we are starting our journey. We are off to the great oasis of Kadija.

[Everyone gets up. The pride starts their journey to the oasis.]

Narrator:

The first hunt of the journey has been a disaster. No one but Amadi has caught anything because they never get enough rest having to sleep out in the open. The only ones to eat are Kojo, Aba, and Sefu. Kojo takes the kill for himself and he will not allow sharing with the others. Sefu is beginning to see signs of anger within the pride and knows he must do something fast.

[Day breaks. Kojo, Aba, and Sefu have taken shelter under the only tree. Everyone else is on the grass surrounding the tree.]

Gameplay Story

Narrator:

After (the third stage of) *hunting the lions stop to get a drink and camp out along the river. However, as night grows darker Sefu notices that his father has not returned from the river.*

Sefu:

Mother, where is father?

Aba:

I don't know, son. I've been around and asked everybody, but no one has seen him since we went to down to the river. I must go down and see if he is alright.

Sefu:

I'm coming with you.

Narrator:

Aba and Sefu make their way down to the river. Lying there beside the river is Kojo. This time is different, however, from the many other times he is seen lying down. He is sagging to the ground, he looks lifeless. As Sefu and his mother investigate further, they find their suspicions are true; Kojo is dead.

Sefu:

How can this be?

[Amadi walks into view.]

Amadi:

Your father was a fighter, but he was old. It appears the one thing you can't fight off has finally overcome him.

(This is a crucial point in the game. If the pride morale is high enough and everyone appreciates you being around then the following will happen.)

Amadi:

So, young prince, it is time to take up your post. We are all counting on you.

Aba:

My son.

[Aba looks admiringly up at her son through her tear-filled eyes.] (Game continues.)

(If the pride morale is too low then the following will happen.)

Amadi:

It seems it is finally the right time to say this. Aba, Sefu, we have decided it is time for the pride to part ways with your family.

Sefu:

What!?

[Sefu starts walking towards Amadi.]

Aba:

No, son! We must know when we are not wanted! Come with me. (Lose condition.)

Conclusion

Narrator:

Mosi spots a tree at the top of the cliff. He and Sefu race for the tree at the top. Mosi gets there first turns around and smiles.

Mosi:

We are here.

Sefu:

Yes, we are here. WE ARE HERE!

Narrator:

The pride makes their way into the oasis to enjoy some much needed rest under as many tall trees as they could fathom, something to drink from the many waterholes, and as much food from the bountiful creatures within. That night as Sefu lays down to sleep he slips into a familiar dream.

Grandpa:

I am so proud of you.

Sefu:

Thanks Grandpa.

Appendix C Technology Demo 1

Arbiter

In this game, Joe and Mary are a couple. Mary likes pie, while Joe likes cake. Rather than eat food they don't like, they each decide to bake their own dessert. Last night, they put their desserts into identical-looking containers without realizing. Upon leaving this morning, they each took one of the covered plates in their refrigerator. Sadly, they took the wrong packages. Normally, this would be easy to solve, but the two of them had a fight last night, and are unwilling to speak to the other. Because they are both fighting, they are unwilling to trade with each other, yet neither is happy with his/her respective dessert.

The player is a trusted friend of the couple. Though the two will not trade with another, they are willing to trade with the player. As such, the player must trade with the couple in order to make sure that both Joe and Mary get the desserts they want.

Number of characters: 3 (Player, Joe, Mary)
Number of AI characters: 2 (Joe, Mary)
Number of objects: 3 (Pie, Cake, Favor)

Joe
Emotions: Satisfaction == item value
Needs + Importance: Pie = 1, Favor = 2, Cake = 3
Attitudes: Player-trusted[1], Mary-not trusted[0]
Item: Pie

Mary
Emotions: Satisfaction == item value
Needs+Importance: Pie = 3, Favor = 2, Cake = 1
Attitudes: Player-trusted[1], Joe-not trusted[0]
Item: Cake

Player
Item Values: no values on items, any item can be traded for any other item
Item: Favor
Trust: Joe, Mary

Realism and demonstration:

The primary goal of this demonstration is to show our AI working in the simplest system possible. While realistically, the two individuals of this scenario would probably work things out since all they are dealing with is desserts, it does show that those who do not have needs and emotions, the arbiters, are able to influence systems in ways that AI characters cannot. Thus, we show that the player has a great ability to affect the game world, allowing us to build games centered on the player.

Trust code arrangement:

```
When interacting with a character to make a trade, determine if
this character is trusted. If so, begin trading, otherwise,
refuse to trade.

Once trading begins, determine if the offered item is worth more
than the currently held item.

if (attitude < 1)
{
//Do not trade
}

if (attitude == 1)
{
//Decide if it is a fair trade
     if (otherItem.value > myItem.value)
     {
     //Make this trade
     }
     else
     {
     //This trade is not worth it
     }
}
```

Appendix D Tech Demo 2

This technology demonstration has two goals. First, it must show that our AI works even when modeling more abstract groups rather than pure individual entities. Second, it will be run without any user input, showing that the AI is capable of maintaining and balancing a system autonomously.

Our demonstration scenario takes place at a factory in the USA during the industrial revolution. The management and the workers are struggling to work out their differences. Both groups are dependent on each other. The management cannot make any money if the workers don't produce a product. The workers cannot sell the product without management's help. The market is quickly fluctuating. Thus, management is constantly striving to hire the right number of workers to make optimum profit. The problem comes from the workers demanding job security, forcing the management to only fire workers when absolutely necessary.

Group 1: Management
This group represents the small number of powerful, wealthy individuals who manage the factory.

Emotions: Wealth
Needs + Importance:

1. Keep money > 0
2. Keep worker satisfaction over 50
3. Hire enough workers to make optimum profit i.e. greatest amount of money

Actions: Hire worker, Fire Worker
Attitudes: Workers -> Cooperative always

Group 2: Workers
This is a much larger group, representing maybe a hundred individuals. They are mostly poor and few of them speak English.

Emotions: Work Satisfaction
Needs + Importance:

1. Get highest satisfaction

Actions: nothing, go on strike
Attitudes: Management -> Cooperative if satisfaction > 25

Actions:

Hiring workers increases satisfaction by a small amount, as the new workers are happy with the company. However, firing workers results in a greater loss of satisfaction as the fired workers are upset, and the other workers worry about their job security. If too many people are fired at once, the workers will go on strike to protest the layoffs. However, satisfaction goes up the longer an individual works at the factory, thus as long as the management does not hire or fire workers every season, the overall satisfaction should be maintained.

If the workers go on strike, the management will not make any money for that term, resulting in them losing lots of potential profit, though not paying the workers helps alleviate this cost. If the company runs out of money though, then the factory is shut down, and everybody loses.

Realism and demonstration:

The more needs added to this scenario, the more realistically the two groups will behave. If the management only cared about the first and third need, then they would eventually cause the workers to get fed up, and then the factory would close. By contrast, if the workers had a need for the factory not to close (money > 0), and a strike would bankrupt the company, the workers might just deal with being unsatisfied for a month or two in order to give management a chance to recover. Thus, we can show that the more accurately one models the needs of an individual or group, the more likely the character or group will show "foresight" and make intelligent long-term plans instead of merely reacting to events as they transpire.

Appendix E Character Asset List

filename	colors
GENERAL ACTIONS:	
adultmale-walk-01-f	4
adultmale-walk-02-f	4
adultmale-walk-03-f	4
adultmale-walk-04-f	4
adultmale-walk-05-f	4
adultmale-walk-06-f	4
adultmale-walk-07-f	4
adultmale-walk-01-b	4
adultmale-walk-02-b	4
adultmale-walk-03-b	4
adultmale-walk-04-b	4
adultmale-walk-05-b	4
adultmale-walk-06-b	4
adultmale-walk-07-b	4
adultmale-walk-01-l	4
adultmale-walk-02-l	4
adultmale-walk-03-l	4
adultmale-walk-04-l	4
adultmale-walk-05-l	4
adultmale-walk-06-l	4
adultmale-walk-07-l	4
adultmale-walk-01-r (reversible)	4
adultmale-walk-02-r (reversible)	4
adultmale-walk-03-r (reversible)	4
adultmale-walk-04-r (reversible)	4
adultmale-walk-05-r (reversible)	4
adultmale-walk-06-r (reversible)	4
adultmale-walk-07-r (reversible)	4
adultmale-run-01-f	4
adultmale-run-02-f	4
adultmale-run-03-f	4
adultmale-run-04-f	4
adultmale-run-05-f	4
adultmale-run-06-f	4

adultmale-run-07-f	4
adultmale-run-01-b	4
adultmale-run-02-b	4
adultmale-run-03-b	4
adultmale-run-04-b	4
adultmale-run-05-b	4
adultmale-run-06-b	4
adultmale-run-07-b	4
adultmale-run-01-l	4
adultmale-run-02-l	4
adultmale-run-03-l	4
adultmale-run-04-l	4
adultmale-run-05-l	4
adultmale-run-06-l	4
adultmale-run-07-l	4
adultmale-run-01-r (reversible)	4
adultmale-run-02-r (reversible)	4
adultmale-run-03-r (reversible)	4
adultmale-run-04-r (reversible)	4
adultmale-run-05-r (reversible)	4
adultmale-run-06-r (reversible)	4
adultmale-run-07-r (reversible)	4
adultmale-stand-f	4
adultmale-stand-b	4
adultmale-stand-l	4
adultmale-stand-r (reversible)	4
adultfemale-walk-01-f	3
adultfemale-walk-02-f	3
adultfemale-walk-03-f	3
adultfemale-walk-04-f	3
adultfemale-walk-05-f	3
adultfemale-walk-06-f	3
adultfemale-walk-07-f	3
adultfemale-walk-01-b	3
adultfemale-walk-02-b	3
adultfemale-walk-03-b	3
adultfemale-walk-04-b	3
adultfemale-walk-05-b	3
adultfemale-walk-06-b	3

adultfemale-walk-07-b	3
adultfemale-walk-01-l	3
adultfemale-walk-02-l	3
adultfemale-walk-03-l	3
adultfemale-walk-04-l	3
adultfemale-walk-05-l	3
adultfemale-walk-06-l	3
adultfemale-walk-07-l	3
adultfemale-walk-01-r (reversible)	3
adultfemale-walk-02-r (reversible)	3
adultfemale-walk-03-r (reversible)	3
adultfemale-walk-04-r (reversible)	3
adultfemale-walk-05-r (reversible)	3
adultfemale-walk-06-r (reversible)	3
adultfemale-walk-07-r (reversible)	3
adultfemale-run-01-f	3
adultfemale-run-02-f	3
adultfemale-run-03-f	3
adultfemale-run-04-f	3
adultfemale-run-05-f	3
adultfemale-run-06-f	3
adultfemale-run-07-f	3
adultfemale-run-01-b	3
adultfemale-run-02-b	3
adultfemale-run-03-b	3
adultfemale-run-04-b	3
adultfemale-run-05-b	3
adultfemale-run-06-b	3
adultfemale-run-07-b	3
adultfemale-run-01-l	3
adultfemale-run-02-l	3
adultfemale-run-03-l	3
adultfemale-run-04-l	3
adultfemale-run-05-l	3
adultfemale-run-06-l	3
adultfemale-run-07-l	3
adultfemale-run-01-r (reversible)	3
adultfemale-run-02-r (reversible)	3
adultfemale-run-03-r (reversible)	3
adultfemale-run-04-r (reversible)	3

adultfemale-run-05-r (reversible)	3
adultfemale-run-06-r (reversible)	3
adultfemale-run-07-r (reversible)	3
adultfemale-stand-f	3
adultfemale-stand-b	3
adultfemale-stand-r	3
adultfemale-stand-l	3
cub-walk-01-f	3
cub-walk-02-f	3
cub-walk-03-f	3
cub-walk-04-f	3
cub-walk-05-f	3
cub-walk-06-f	3
cub-walk-07-f	3
cub-walk-01-b	3
cub-walk-02-b	3
cub-walk-03-b	3
cub-walk-04-b	3
cub-walk-05-b	3
cub-walk-06-b	3
cub-walk-07-b	3
cub-walk-01-r	3
cub-walk-02-r	3
cub-walk-03-r	3
cub-walk-04-r	3
cub-walk-05-r	3
cub-walk-06-r	3
cub-walk-07-r	3
cub-walk-01-l (reversible)	3
cub-walk-02-l (reversible)	3
cub-walk-03-l (reversible)	3
cub-walk-04-l (reversible)	3
cub-walk-05-l (reversible)	3
cub-walk-06-l (reversible)	3
cub-walk-07-l (reversible)	3
cub-run-01-f	3
cub-run-02-f	3
cub-run-03-f	3

cub-run-04-f	3
cub-run-05-f	3
cub-run-06-f	3
cub-run-07-f	3
cub-run-01-b	3
cub-run-02-b	3
cub-run-03-b	3
cub-run-04-b	3
cub-run-05-b	3
cub-run-06-b	3
cub-run-07-b	3
cub-run-01-l	3
cub-run-02-l	3
cub-run-03-l	3
cub-run-04-l	3
cub-run-05-l	3
cub-run-06-l	3
cub-run-07-l	3
cub-run-01-r (reversible)	3
cub-run-02-r (reversible)	3
cub-run-03-r (reversible)	3
cub-run-04-r (reversible)	3
cub-run-05-r (reversible)	3
cub-run-06-r (reversible)	3
cub-run-07-r (reversible)	3
cub-stand-f	3
cub-stand-b	3
cub-stand-l	3
cub-stand-r	3

SPECIFIC ACTIONS:

adultmale-roar-01-f	4
adultmale-roar-02-f	4
adultmale-roar-03-f	4
adultmale-roar-04-f	4
adultmale-roar-05-f	4
adultmale-roar-01-b	4
adultmale-roar-02-b	4

adultmale-roar-03-b	4
adultmale-roar-04-b	4
adultmale-roar-05-b	4
adultmale-roar-01-l	4
adultmale-roar-02-l	4
adultmale-roar-03-l	4
adultmale-roar-04-l	4
adultmale-roar-05-l	4
adultmale-roar-01-r (reversible)	4
adultmale-roar-02-r (reversible)	4
adultmale-roar-03-r (reversible)	4
adultmale-roar-04-r (reversible)	4
adultmale-roar-05-r (reversible)	4
adultmale-swipe-01-f	4
adultmale-swipe-02-f	4
adultmale-swipe-03-f	4
adultmale-swipe-04-f	4
adultmale-swipe-05-f	4
adultmale-swipe-01-b	4
adultmale-swipe-02-b	4
adultmale-swipe-03-b	4
adultmale-swipe-04-b	4
adultmale-swipe-05-b	4
adultmale-swipe-01-l	4
adultmale-swipe-02-l	4
adultmale-swipe-03-l	4
adultmale-swipe-04-l	4
adultmale-swipe-05-l	4
adultmale-swipe-01-r (reversible)	4
adultmale-swipe-02-r (reversible)	4
adultmale-swipe-03-r (reversible)	4
adultmale-swipe-04-r (reversible)	4
adultmale-swipe-05-r (reversible)	4
adultmale-jump-01-f	4
adultmale-jump-02-f	4

adultmale-jump-03-f	4
adultmale-jump-04-f	4
adultmale-jump-05-f	4
adultmale-jump-01-b	4
adultmale-jump-02-b	4
adultmale-jump-03-b	4
adultmale-jump-04-b	4
adultmale-jump-05-b	4
adultmale-jump-01-l	4
adultmale-jump-02-l	4
adultmale-jump-03-l	4
adultmale-jump-04-l	4
adultmale-jump-05-l	4
adultmale-jump-01-r (reversible)	4
adultmale-jump-02-r (reversible)	4
adultmale-jump-03-r (reversible)	4
adultmale-jump-04-r (reversible)	4
adultmale-jump-05-r (reversible)	4
adultmale-claw-01-f	4
adultmale-claw-02-f	4
adultmale-claw-03-f	4
adultmale-claw-04-f	4
adultmale-claw-05-f	4
adultmale-claw-01-b	4
adultmale-claw-02-b	4
adultmale-claw-03-b	4
adultmale-claw-04-b	4
adultmale-claw-05-b	4
adultmale-claw-01-l	4
adultmale-claw-02-l	4
adultmale-claw-03-l	4
adultmale-claw-04-l	4
adultmale-claw-05-l	4
adultmale-claw-01-r (reversible)	4
adultmale-claw-02-r (reversible)	4

adultmale-claw-03-r (reversible)	4
adultmale-claw-04-r (reversible)	4
adultmale-claw-05-r (reversible)	4
adultfemale-rub-01-f	3
adultfemale-rub-02-f	3
adultfemale-rub-03-f	3
adultfemale-rub-04-f	3
adultfemale-rub-05-f	3
adultfemale-rub-01-b	3
adultfemale-rub-02-b	3
adultfemale-rub-03-b	3
adultfemale-rub-04-b	3
adultfemale-rub-05-b	3
adultfemale-rub-01-l	3
adultfemale-rub-02-l	3
adultfemale-rub-03-l	3
adultfemale-rub-04-l	3
adultfemale-rub-05-l	3
adultfemale-rub-01-r (reversible)	3
adultfemale-rub-02-r (reversible)	3
adultfemale-rub-03-r (reversible)	3
adultfemale-rub-04-r (reversible)	3
adultfemale-rub-05-r (reversible)	3
adultfemale-feed-01-f	3
adultfemale-feed-02-f	3
adultfemale-feed-03-f	3
adultfemale-feed-04-f	3
adultfemale-feed-05-f	3
adultfemale-feed-01-b	3
adultfemale-feed-02-b	3
adultfemale-feed-03-b	3
adultfemale-feed-04-b	3
adultfemale-feed-05-b	3
adultfemale-feed-01-l	3
adultfemale-feed-02-l	3

adultfemale-feed-03-l	3
adultfemale-feed-04-l	3
adultfemale-feed-05-l	3
adultfemale-feed-01-r (reversible)	3
adultfemale-feed-02-r (reversible)	3
adultfemale-feed-03-r (reversible)	3
adultfemale-feed-04-r (reversible)	3
adultfemale-feed-05-r (reversible)	3
adultfemale-run-slowly (re-use frames)	3
cub-jump-01-f	3
cub-jump-02-f	3
cub-jump-03-f	3
cub-jump-04-f	3
cub-jump-05-f	3
cub-jump-01-b	3
cub-jump-02-b	3
cub-jump-03-b	3
cub-jump-04-b	3
cub-jump-05-b	3
cub-jump-01-l	3
cub-jump-02-l	3
cub-jump-03-l	3
cub-jump-04-l	3
cub-jump-05-l	3
cub-jump-01-r (reversible)	3
cub-jump-02-r (reversible)	3
cub-jump-03-r (reversible)	3
cub-jump-04-r (reversible)	3
cub-jump-05-r (reversible)	3
cub-roll-01-f	3
cub-roll-02-f	3
cub-roll-03-f	3
cub-roll-04-f	3
cub-roll-05-f	3

cub-roll-01-b	3
cub-roll-02-b	3
cub-roll-03-b	3
cub-roll-04-b	3
cub-roll-05-b	3
cub-roll-01-l	3
cub-roll-02-l	3
cub-roll-03-l	3
cub-roll-04-l	3
cub-roll-05-l	3
cub-roll-01-r (reversible)	3
cub-roll-02-r (reversible)	3
cub-roll-03-r (reversible)	3
cub-roll-04-r (reversible)	3
cub-roll-05-r (reversible)	3
cub-roar-01-f	3
cub-roar-02-f	3
cub-roar-03-f	3
cub-roar-04-f	3
cub-roar-05-f	3
cub-roar-01-b	3
cub-roar-02-b	3
cub-roar-03-b	3
cub-roar-04-b	3
cub-roar-05-b	3
cub-roar-01-l	3
cub-roar-02-l	3
cub-roar-03-l	3
cub-roar-04-l	3
cub-roar-05-l	3
cub-roar-01-r (reversible)	3
cub-roar-02-r (reversible)	3
cub-roar-03-r (reversible)	3
cub-roar-04-r (reversible)	3
cub-roar-05-r (reversible)	3

LION FACES:

amadi-angry	1
amadi-happy	1
denisha-happy	1
denisha-sad	1
safara-happy	1
safara-sad	1
wekesa-happy	1
wekesa-sad	1
zabia-happy	1
zabia-sad	1
binta-happy	1
binta-sad	1
mosi-happy	1
mosi-sad	1

TOTAL ASSETS REQUIRED: 1237

Appendix F UI Asset List

Filename	Amount
General UI	
tree border high morale	1
tree border normal morale	1
tree border low morale	1
brown background for all areas but messages	3
Time Scroll Bar	
top scroll sun	2
top scroll moon	2
Action Bar	
action label	1
General actions	
walk icon	1
walk depressed icon	1
Specialized actions	
talk icon	1
talk depressed icon	1
give icon	1
give depressed icon	1
take icon	1
take depressed icon	1
eat icon	1
eat depressed icon	1
Messages Area	
message label	1
black background	1
Inventory Area	
sticks picture	1
sticks label	1
bones picture	1
bones label	1
bermuda grass picture	1
bermuda grass label	1

bermuda grass stem picture	1
bermuda grass stem label	1
meat picture	5
meat label	5
no item held picture	1
no item held label	1

Pride Information Area

pride info label	1
morale label	1
morale sun on horizon icon	3
happiness slider bar	1
happiness slider	1

Individual Info Area

individual name label	1
job label	1
emotion label	1
emotion slider bar	1
emotion slider	1
morale slider bar	1
morale slider	1

Environment Area

mouse cursor	2
selected object ring	1
not selectable clicked	1

Total Assets:	61

Appendix G Environment List

File Name	Amount
Rocks	
rock sprite small	3
rock sprite medium	2
rock sprite large	1
Trees	
tree sprite small	2
tree sprite medium	1
tree sprite large	1
Grass	
grass bunch sprite	4
Pile of sticks	
pile of stick sprite	3
Carcasses	
springbok carcass	1
oryx carcass	1
zebra carcass	1
wildebeest carcass	1
elephant calf carcass	1
Bermuda Grass	
bermuda grass sprite	2
Leftover Bones	
springbok bones	1
oryx bones	1
zebra bones	1
wildebeest bones	1
elephant bones	1
Bushes	
bush sprite	4
Backgrounds	
barren	1
waterhole	1
river	1

grassland	1
rock face	1
Total Necessary Assets:	38

Appendix H Story Asset List

filename	shot type	description
intro-001-kojolionking	wide	Male lion stands on rock, other lions below.
intro-002-kojomean	close-up	Kojo: fierce ruler.
intro-003-pridedepressed	wide	Pride, in sorry state of affairs.
intro-004-sefusavior	close-up	Sefu as a savior.
intro-005-sefusleeping	wide	Sefu sleeping, Aba nearby, Kojo looking back.
intro-006-amadislave	wide	Amadi bringing food to Kojo, looking back.
climax-001-lionsdrinking	wide	Lions drinking from the river.
climax-002-sefuabashelter	medium	Sefu and Aba take shelter under a tree.
climax-003-abasefu see kojo	over-the-shoulder	Aba and Sefu see Kojo, lying on the ground.
climax-004-abasefu walk down	wide	Aba and Sefu walk towards Kojo.
climax-005-kojodead	medium, pan	Kojo dead, Aba and Sefu shocked - pan to Amadi.
climax-006-a-abahappyandsad	close-up	Aba looks admiringly at her son, with tears.
climax-006-b-sefushocked	close-up, jump	Sefu shocked, jump-cut.
climax-007-b-abadespair	close-up	Aba's crushing despair.
end-001-lionsspottree	wide	Mosi and Sefu spot a tree at the top of a hill.
end-002-lionpovoasis	pov	Mosi and Sefu's POV of the oasis down below.
end-003-lionsenjoyingoasis	wide	Happy lions enjoying life at the oasis.
end-004-sefuregal	close-up	Sefu, looking regal.

Appendix I Sound Asset List

Asset	Amount
Character	
lionsnarl-stereo.wav	1
liongrowl.wav	1
lion-shortroar2.wav	1
lionsnarl.aif	1
lion-roar-scare.wav	1
lion-irritated.wav	1
lion-shortroar.aif	1
lion-shortroar-fierce.wav	1
lion-cough.wav	1
lion-snore.wav	1
lioncub-whine.wav	1
lionroar-reverb.wav	1
lion-battlecry.wav	1
lion-roar-multiple.wav	1
lion-roar-upset.wav	1
lion-hiss.wav	1
lion-cub-teen-roar.wav	1
lion-cub-baby-whine.wav	1
Music	
background music	3
Environment SFX	
noises according to morale	3
stepping through grass	3
wind moving leaves	2
running water	1
playing in water	1
walking through sand	1
walking on rocks	1
UI Sound effects	
click sound-selected	1
click sound-cannot select	1
Total Sound Assets	**28**