

# A Step Towards virtual life

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## Part I

# INTRODUCTION

## 1 The motivation

Non-player characters are an integral element of role playing games. In the game they can have many different roles that range from the small rat in the sewer over the mighty arch mage that is trying to conquer the world. They enrich the game experience by acting in a way that anticipated for the role they play. But the behavior of non-player characters can become a problem if they start to behave in a way that is unanticipated for their role. Such behavior is even worse in an open world role playing game where the non-player characters behavior is integral to maintain the illusion of life that is necessary for the game experience. Therefore it is necessary to create a system which can calculate the behavior of non-player character based on the information that are required to fully represent the role they play.

## 2 The content and circumference

This thesis provides an definition of the term non-player character and open world role playing game, which are used as basis to show where the behavior of non-player characters in open world role playing games does present a problem. It provides an analysis of three different situations from open world role playing games that show where non-player character behave wrong and what the consequences of this behavior are.

Following that the thesis provides an explanation how non-player character behavior can be improved and defines the components that are necessary to achieve this target.

After the components are defined the thesis provides an exemplary system that shows how the components interact with each other and calculate the behavior of an example character.

In respect to the time frame in which the thesis is created it is necessary to limit its circumference by reducing the the number of elements that are used in the example system and restricting the example to explain the system to a situation in which only the interaction of two different character is observed. The example system provided in this work is focused on the calculation of behavior in a confrontation based combat oriented game play. It will not include a representation that allows for more complex not confrontation based behavior.

## Part II

# THEORY

The following chapter provides the definition of the non-player character, its purpose in an open world role playing game and the open world role playing game. They form the basis to show what non-player character behavior has to provide and on what basis the behavior of non-player characters in open world role playing games can be analyzed. The following analysis of three different situations from two different open world role playing games does shows where the problems in the non-player character behavior lie and can be used to determine how those problems can be solved.

The last part of the chapter does provide an example how the behavior of non-player characters can be controlled in a open world role playing game and explains what is necessary to enable a system to provide better non-player character behavior.

### 3 The definition the non player character

The amount of different sources show that the term non-player character (NPC) is common knowledge, but a definition of the term and the purpose of the non player character is missing. The following part creates a definition for the term and the purpose of the non player character.

#### 3.1 Definition of the non player Character

The following can be found in the English Wikipedia:

*“A non-player character (NPC), sometimes known as a non-person character or non-playable character, in a game is any character not controlled by a player.”[Wikipedia NPC, 2013]*

The term non-player character is the negation of the term player character. In TSR Hobbies Understanding Dungeons and Dragons a player character is defined as a persona of a player.[TSR Hobbies, 1979] When the term is taken apart the meaning of non-player and character support the definition. The term non-player stands for the negation of the term player character. The word player describes someone that participates in any kind of game.[Oxford Dictionary player, 2013] A character is a person in a novel, play, film, or a part played by an actor. Based on that and the term non player character describes a person that is not played by the player.

Furthermore a non-player character is can fill any role that is not filled by a player character.[SR 4.0, 2009, S. 324] The difference in the definition is that a non-player character can fill any role that exist within the fictional world. Based on the similarities between a computer game and a tabletop RPG the definition is more accurate. In an tabletop RPG the game master is the equivalent to the

computer. Both control the beings that exist within the fictional game world and let them act based on a role they are fulfilling.

In conclusion a non player character can be defined as any role within the fictional game world, that is not filled by a player character.

### 3.2 Definition of the purpose of the non player character

Non-player characters can represent as allies, bystanders and competitors to the player.[Wikipedia NPC, 2013] Because a non-player character is a element of a game, and every element of a game exists to improve its game play, it is also the purpose of the non-player character.

How a non-player character supports the game play is entirely based on the game and experience the designer wants to create. As stated by Wikipedia , non-player characters can be allies, bystanders and competitors, others might only provide specific actions such as giving quest, trading or being the interface for another game element.[gd2, 2011]

Because non-player characters are the representation of a role within the game world they are part of the population.[gd2, 2011] Their actions create and maintain the illusion of a living world, as the actions of an actress create and maintain the illusion of the role she is embodying.[Wikipedia character, 2013] The roles and the way non-player characters represent them can guide a player through the narrative of the game and help them to understand it, like characters in literature guide readers through stories and help to understand plots.[Wikipedia character, 2013]

## 4 The definition of the open world role playing game

A basis of the decision what a non-player character has to provide in an open world role playing game, it is necessary to define the meaning of open world role playing game for the context of this work.

Todd Howard, game director at Bethesda Game Studios describes open world role playing games as:

*“Rather than presenting us with a thrilling, scripted roller coaster ride, titles such as The Elder Scrolls IV: Oblivion and the forthcoming Fallout 3 present us with vast worlds that we can inhabit, and decide what kind of character we want to be – whether it’s a Redguard bard with a penchant for alchemy or a lone Jet addict and his dog battling mutants in a post-nuclear wasteland.”[Sefton, 2008]*

Here a open world role playing game is described as a game with a vast game world that is inhabited by the player, who can decide what kind of character he wants to be. This is not fully true as the character can only choose what character he wants to be in the context that is provided, which can be seen by

the fact that the examples provided by Todd Howard are all inside the narrative frame of the game world. Based on this a open world role playing game must be contextual structured worlds that provide the player with many different possibilities.[Bartle, 2008]

This can be further specified by Ernest Adams statement that a open world is populated with opportunities in which story can happen, and that the player can interact with a open world in any order she chooses. Adams further states that many games include sandbox game play but do not include sandbox storytelling as their story is still linear.[Adams, 2010]

For the context of this work a open world role playing game will be defined as a game were the player can freely travel a vast game world. The player can decide what kind of character he wants to play. And the player is not constrained to a linear storyline but can experience the world in any order that she chooses.

## **5 The behavior of non-player characters in open world role playing games**

The following chapter shows what wrong non-player character behavior is by analyzing how non-player characters should behave and what can be the consequences of wrong behavior. There after follows an analysis of three different situations from open world role playing games to show where the problem is.

### **5.1 The problem in non-player character behavior in open world role playing games**

There are several sources were player complain about the behavior of non-player characters in open world role playing games like Fallout: New Vegas and The Elder Scroll's V: Skyrim.[npc behavior problems, 2013] The author did experience the described problems firsthand.

A example for such behavior are non-player characters that engage an enemy that they have no chance of beating in combat. In The Elder Scroll's V: Skyrim many inhabitants of villages try to fight dragons instead of running away from them. This stands in contrast to the behavior of the characters in the live action trailer of The Elder Scroll's V: Skyrim. In the trailer every character does run away, including the the characters which do have armor and weapons. The only character does not run away is the protagonist of The Elder Scroll's V: Skyrim.[Skyrim trailer, 2013]

The behavior of the characters in the live action trailer is anticipated. The characters have a much higher chance of survival and protection of their loved ones when they try to run away with them instead of trying to beat the dragon. This is also true for the villagers in The Elder Scroll's V: Skyrim but they instead of running away try to beat the dragon. Their behavior is unanticipated.



Games simulate parts of reality, in case of open world role playing games The Elder Scroll's V: Skyrim one of the aspects they try to simulate human behavior as they depict a world which resembles the reality in certain aspects.[RoP, 2004, S. 457] The player therefore uses her understanding of human behavior in reality to orient in the narrative frame of the game world. The understanding of human behavior in The Elder Scroll's V: Skyrim can be changed or extended by providing information from the necessary frame that explain that certain behavior in the game world is different then the behavior in reality. This in turn means that the human behavior the player anticipates is based on their understanding of human behavior in reality and the narrative frame of the game.

As an example to show that the anticipated behavior is based on the knowledge of the world in which the behavior occurs: If being a farmer in a medieval fantasy world means that the character has neither fighting abilities nor equipment and being a dragon hunter in a medieval fantasy world means that the character has advanced fighting abilities, advanced equipments and the duty to protect the people from dragon attacks, a player would not anticipate that both characters would react the same way when they encounter a dragon. The player anticipates that the farmer runs away because he has no chance of winning a fight against a dragon and no direct reason to fight it and that the dragon hunter fights the dragon because he has fighting experience against dragons, he is equipped to kill dragons and has the duty to protect the nearby village.

The information the player has about human behavior is based on the experience she has made herself and the information that are provided by the media. A farmer is a person who owns or manages a farm. [Oxford Dictionary farmer, 2013] The narrative frame of the game world can extend this description by defining that a farmer is also a dragon hunter as it is necessary to manage a farm in this world.

To find behavior of non-player characters that is wrong it is necessary to answer the questions "Is the behavior anticipated?" and "Does the narrative frame of the game world provide a explanation?".

## **5.2 The analysis of situations in modern open world role playing games**

The following analysis of three different situations from the open world role playing games THE ELDER SCROLLS V: SKYRIM and FALLOUT NEW VEGAS analyzes the behavior of the non-player character in the situation using the questions established in 5.1. The analysis shows where the behavior of non-player character is not believable and explains why it is not believable, where the problems in the behavior lie and provides example for more believable non-player character behavior in the given situation.

### 5.2.1 Elder Scroll's V: Skyrim - Trade caravan versus dragon

The situation takes place on the road between Nilheim and Sarethi Farm. The player character does only observe what happens and is therefore not part of the situation.

Example situation 1: A group of merchants is on their way to Riften to sell their goods when a dragon appears in the sky and prepares to attack the caravan. The merchants and their guards wait until the dragon has landed and attack him. All traders and guards are killed by the dragon in the following fight.

**guards** The guards are experienced fighters which earn their money by protecting the merchants against bandits. They wear different kinds of armor and weapons but they are all equipped to fight the normal dangers of Skyrim.

**merchants** The merchants are not wearing significant armor and have simple weapons such as daggers. They are not experienced in combat.

**dragon** The dragon is a powerful mythical beast which has returned to Skyrim. They attack throughout all of Skyrim and are powerful enemies. The dragon is protected by strong scales and can attack with its powerful claws, tail and breath. A dragon is one of the strongest beasts in the Skyrim.

Do the guards and the merchants behave in a way that is anticipated by the player?

The behavior that the guards and the merchants show in this situation would normally not be anticipated by the player as it does not fit into their stereotypes. The guards are hired to protect the caravan from dangers on their way through the rift. They are probably paid, trained and equipped to protect the merchants from any probable danger that might surface on this way. A dragon is not a probable danger, as they have been legends for thousands of years and have returned only a short while ago, so that the most people have either not heard of their return or do not believe that it is true. Additionally there is probably no obvious reason for the guards to believe that a dragon, if it exists, would have a reason to attack them.

In defiance of being unprepared in body, mind and equipment they attack the dragon head on. This behavior is not anticipated as the guards are faced with a new unforeseen danger. This danger is more powerful than anything they have faced before. Most of the guards' knowledge of dragons comes from legends so that they lack knowledge to estimate what their chances are and how they could fight it. This leads to a situation where the guards are faced with a great danger that they have no chance of overcoming as they lack everything that would be necessary to do so.

They have to compare the danger that they are faced with what they have to lose, which would be payment and some reputation as they did not protect the caravan. Their targets should be to protect their own life, and the life of the merchants as they have only been paid to face the probable dangers and it is still their job to protect the merchants.

There are several different anticipated behaviors that fit into this situation. They could try to flee in panic to save their own lives, which would show the player that they fit their stereotype. Or it is possible that some of them could try to divert the attacks of the dragon while the rest helps the merchants escape. Which would show that at least some of them are more than normal guards.

The behavior of the merchants is not anticipated because they, like the guards attack the dragon head on, but on the contrary to the guards they do are not trained or equipped to fight. They have nothing to gain from attacking the dragon but they have much to gain from escaping from it. As the guards the merchants lack real experience to assess how powerful a dragon is and how they should fight against it. The merchant's target is to protect their own life and their goods. Those targets are best served when they try to escape and not when they fight the dragon.

They are anticipated to try to escape from a fight they can not win and rescue as much of their trade goods as they can. If necessary to ensure their survival they should let go of their trade goods as those can be bought again, but their life can't.

Does the game offer an explanation for the unanticipated behavior of the guard and the merchant?

The game does not provide an explanation for the unanticipated behavior. It could be possible that the guards are elite warriors that are trained enough to attack the dragon but the merchants are no elite warriors and therefore the game provides no explanation for the unanticipated behavior.

The behavior of the dragon is anticipated as he can have several reasons for attacking the caravan. The first reason would be that it sees the guards, merchants and pack animals as food source. Another reason would be, as dragons have intelligence, that it hates lower life forms like humans and wants to kill them or that it wants to be feared.

### **5.2.2 Elder Scroll's V: Skyrim - Food merchant versus powerful player character**

The situation takes place on the marketplace of the city of Whiterun. It is around midday and two guards of Whiterun that patrol the marketplace.

Example situation 2: The player character enters the marketplace of Whiterun. Several merchants offer their goods for sale at their market stall. The player character approaches the market stall of Carlotta Valentia and takes an apple. Carlotta Valentia is aware of the actions of the player character as she does not conceal her actions. Carlotta Valentia approaches the player character and starts a conversation. In the conversation she warns the player character to not steal anything from her again and takes the apple back.

Following that the player character gains a bounty by taking two apples from the market stall. A nearby guard of Whiterun is alarmed and starts a conversation with the player character. The guard offers four dialog options.

The player character can either pay the bounty, go to jail, declare that she is the thane of Whiterun or resist the arrest. The player character chooses to resist the arrest. She kills the attacking guard and the other guards that come to fight her.

**player character** She has mastered the use of light armor and ranged combat. She is an expert in two handed and one handed combat. Within the year since she arrived in Skyrim she has killed several thousand enemies. They consisted of several dozen dragons, bandit groups, undead hordes and other monster and wildlife that can be found in Skyrim. As she is the Dragonborn she can use powerful dragon-roars to overpower her enemies. Her legendary armor is made from dragon scales and bones, her legendary weapons were forged from Ebony. All of her equipment is enchanted with powerful magic.

**Carlotta Valentia** She is a non-player character that works as a food merchant at her market stall in the Whiterun marketplace. As she is a normal merchant she is not significantly skilled in any combat related skill and has no significant combat related equipment.

**Whiterun guard** The guards of Whiterun impersonate city defense and police force. They are very experienced fighters and have good equipment. The guards of Whiterun are the military force of the city and have to maintain order.

Does Carlotta Valentia behave in way that is anticipated by the player when she demands the apple back?

Carlotta Valentia does not act in a way that is anticipated by the player. In the situation the player character takes an apple from her market stand without paying for it. It is logical that she wants it back. But there are more factors that influence her behavior.

As shown in the description of the player character, she is one of the most powerful fighters in Skyrim and has obtained political power and financial power.

In the Elder Scroll's V: Skyrim the rule system allows that a character can become very powerful. The player character is powerful enough that she can take on beasts that can destroy whole cities and destroy whole armies. Carlotta Valentia, as an inhabitant of the world, must be aware that there is nothing in Whiterun that can compare to the power of the player character.

The player character also has political power. Because of the many deeds she has done for the citizens of Whiterun she was named Thane. She is respected throughout Whiterun and can use this title as a jail free card. Her political power is enough represent a danger to Carlotta Valentia.

The money that player character has obtained over the course of her adventures makes her an important customer for the trader in the city and makes her even more important to the cities well being. She can use her money to bribe the guards if this does become necessary.

The player character is known for having killed thousands of enemies among them were legendary bandit groups, Draugh Deathlords, dragons and many

other powerful beings. This alone would be enough to make anyone, who does not know better, consider her very dangerous but she did all the killing without any mercy. Whoever attacked her or stood in her way was killed. In Skyrim the player character should be known for her ruthless behavior.

Another factor that does influence her behavior is the damage that is done to her by the theft of the player character. The apple is worth almost nothing and therefore it should be much easier for Carlotta to ignore the damage.

Given this factors it is unlikely that Carlotta Valentia would go against the player character and demand her apple back as she is faced with a character which has every means to destroy her and might even be willing to do so. Additionally she can not be sure that if she demands her apple back she will be protected by the guards when the player character refuses. The player character can use her money or her title to bribe the guards or simply threaten those that confront her.

Even if she would demand the apple back, she wouldn't do so in such a relaxed neutral manner. She would be angry that someone took something or she would ask the player character to pay for it.

Does the game offer an explanation for the unanticipated behavior of Carlotta Valentia?

The game does not provide a direct explanation but Carlotta Valentia is portrayed as a strong willed person which could be an explanation for the behavior. But given the difference in power between Carlotta Valentia and the player character it is hard to believe that even a strong willed person would act in such a way.

Do the guards behave in way that is anticipated by the player when they confront her after she has stolen the apples or when they attack her because she is not willing to pay the bounty or go to jail?

In both situations the behavior of the guards is not anticipated by the player. The guards have the duty to maintain law and order in Whiterun. They have to consider the effect their actions will have on the city.

As written before, the player character has political power that she can use and is powerful enough to pose an enormous threat to everyone in Whiterun. When the guards confront her they risk that she does use her political power. The crime that the player character perpetrated is very small and it is more plausible if the guards decide to ignore the matter, or if they tell Carlotta Valentia to ignore the matter. Instead they risk that the player character uses force to prevent them from taking her in. This is a great threat to Whiterun.

That the guards attack the player character because she refuses to get arrested or pay the bounty for stealing two apples is also unanticipated. Because the guards are aware that she can and probably will kill them if they attack her, they would not use force against her as long as it is not absolutely necessary. Endangering their own lives and the lives of those they should protect for two apples is not a behavior that is anticipated from the guards, as they are a stereotype that takes their work serious but it is still work and therefore they

won't risk their life for nothing. Additionally they have to consider what effect their actions will have on the public order and are aware that a fight with the player character will devastate the city.

Does the game offer an explanation for the unanticipated behavior of the guards?

The game does not provide an explanation for the behavior of the guards. The guards are not stronger than other guards and the conversation with the guard shows that he is aware who stands before him and therefore he should be aware how powerful this person is.

### 5.2.3 **Fallout: New Vegas - Legion assassins versus food merchant**

The situation takes place at the location Grub n' Gulp rest stop in the periphery of New Vegas. Fitz and Lupe are food traders that stand at their market stands. They are part of the New California Republic. The Legion assassins are part of the enemy of the New California Republic Caesar's Legion.

Example situation 3: The player character is following the street passing by the location. He is followed by a group of legion assassins that tries to catch up to him. As the Legion assassins come in range of Fitz and Lupe they start attacking them. In the following gunfight Fitz and Lupe are killed.

**player character** He is very powerful as she has reached the maximal level and wears very powerful and rare equipment. The members of the New California Republic have great respect for him and many think that he is a hero. He can kill the group of Legion assassins without a problem and has done so several times.

**Fitz** He is a non-player character that works as a food merchant at his market stall at Grub n' Gulp rest stop. He is equipped with normal clothes and a handgun.

**Lupe** She is a non-player character that works as a food merchant at his market stall at Grub n' Gulp rest stop. She is equipped with normal clothes and a handgun.

**Legion assassins** A group of four members of Caesar's Legion which are sent to kill the player character. Because they are well equipped and trained they pose a great threat to the normal inhabitants of the wasteland.

Do the Legion assassins behave in a way that is anticipated by the player when they attack Fitz and Lupe?

The attack on Fitz and Lupe is unanticipated because the Legion assassins target is the player character. That the Legion assassins attack Fitz and Lupe is logical if the only controlling factor is the affiliation. The Legion assassins are part of Caesar's Legion, Fitz and Lupe are part of their enemy the New California Republic. But the Legion assassins represent highly trained members of the Legion that were sent to kill the player character. Additionally in Caesar's

Legion failure is punishable by death. The Legion assassins are trained enough to ignore all characters that do not pose a direct threat to them. They should follow the player character like a bloodhound ignoring Fitz and Lupe as long as they do not attack. Additionally if they manage to kill the player character while Fitz and Lupe are watching, they can act as witnesses for the death of a hero of the New California Republic and tell others what they seen.

Does the game offer an explanation for the unanticipated behavior of the legion assassins?

The game does not provide an explanation for the behavior of the Legion assassins.

Do Fitz and Lupe behave in way that is anticipated by the player when they fight against the Legion assassins?

The behavior of Fitz and Lupe is unanticipated as they try to fight against the Legion assassins after they have started to attack instead of trying to flee from a superior enemy. The Legion assassins are four men which are better trained and better equipped. That Fitz and Lupe stay to fight them of is suicide for them.

Does the game offer an explanation for the unanticipated behavior of Fitz and Lupe?

The game does not provide an explanation for this behavior. That Fitz and Lupe want to protect their market stalls does is not probable as the value of their goods is not high. It would be easier for them to flee and return to rebuild if necessary after the Legion assassins are gone.

## 6 The behavior in current open world role playing games

Fallout: New Vegas and The Elder Scroll's: Skyrim use the Radiant A.I. to control the behavior of non-player characters.[gameInformer, 2011] In the explanation this work focuses on the version of the Radiant A.I. that is used in Skyrim as it utilizes a more advanced version than New Vegas. The Radiant A.I. provides the non-player characters with tasks that they perform. The tasks are chosen based on the environment in which the non-player characters are located. This creates a more coherent illusion of life as the non-player character use the facilities provided by the game world to perform their tasks. When traveling through a village the player can see non-player characters cut wood or run logs through a mill.[gameInformer, 2011]

The non-player characters develop a relation to the player character based on how she acts. When the player character plunders the home of a non-player character he can react with an appropriate level of hostility. The adequate of their reactions is the result of their actions and the relation with the with the

player character that has been established before.[gameInformer, 2011]

## 7 The approach to improve the behavior

The analysis in 5.2 shows that unanticipated behavior of non-player characters mainly results from the fact that the player lacks information about the the non-player characters or that the non-player characters do not have sufficient information about who they are. An example for the former would be that the player was not aware that the farmer that attacks the dragon was once a veteran dragonhunter. An example for the latter would be that the non-player character is only aware that the dragons is his enemy, he is not aware that he stands no chance in a fight or that he has no reason to fight a dragon which does not endanger his family or home. To improve the behavior it is necessary to identify all information that are necessary to represent all roles in a open world role playing game.

A method to gather as much information as possible about the role comes from method acting. Here a set of different techniques is used by actors to create a set feelings and thoughts about the role they are playing. Four questions serve to identify the areas of information that the system needs to provide in order to represent the roles of non-player character in an open world role playing game[britannica method acting, 2013]: The four questions are: “(1) who am I (character)”, “(2) where am I (place)”, ”(3) what am I doing (action and intention)” and “(4) what happened before I came here (given circumstances)”.

The questions can be divided in mainly two different areas of information: the first area is the one that offers more insight about the character itself, the second helps to identify the situation the character is located in. The questions 1 and 3 belong to the first area of information (the character) while the questions 2 and 4 address the situation as second area of information.[britannica method acting, 2013]

### 7.1 The character

In a pen and paper role playing games the character consists out of its capabilities and its characterization.

The capabilities are the information that represent what the character can do. Pen and paper role playing games like Shadow Run or Dungeons and Dragons use attributes, skills, abilities and equipment to represent the capabilities of a character. Both rule systems do use abilities in a different way, in Shadowrun they represent special attributes of the character and in Dungeons and Dragons they represent special abilities that add, change or remove the behavior of actions. An example for would be an ability enables the character to cast a spell with maximal effect and thereby removing the random element of the dice[SR 4.0, 2009, S. 89, S. 91][DnD player, 2006, S. 9, S. 73, S. 105]

As mentioned in the different role playing games Shadowrun and Dungeons and Dragons, the representation of the capabilities of a character is based on the



rule system that underlies the game. Fallout: New Vegas uses attributes, like strength and charisma, to represent the physical and mental capabilities of the character, skills to represent the experience the character has in certain actions and perks to represent special abilities that the character has. Skyrim does not use attributes but skills and abilities.

The person playing the character is the one who is responsible for the characterization of the character they are playing. Every character in a pen and paper role playing game is either played by the player or by the game master. [SR 4.0, 2009, S. 82, S. 324] [DnD player, 2006, S. 4][DnD gamemaster, 2004, S. 127] Every character has its own motivation for its behavior and relation to the world.[SR 4.0, 2009, S. 315] [DnD gamemaster, 2004, S. 127, S. 157]In a pen and paper role playing game they are provided by the player and the gamemaster, in a video game they are provided by player and the game. To fully represent the character of a non-player character the system has to provide the motivations that drive the character and the relation that the character has with the game world.

As this thesis does only propose a system to improve the basic behavior of simple non-player characters it is not necessary that the characterization contains information that describe the type of characterization the character has, for example if the character is easy to anger or a notorious thief.

## 7.2 The situation

The situation represents the given circumstances under which the calculation of the behavior of the non-player characters occurs.[britannica method acting, 2013] What information this are based on the game play and the rule system that are used in the game.

In a pen and paper role playing game the situation is provided by the gamemaster. The gamemaster describes the location at which the player characters are, says what characters are also present and describes what they are doing.[SR 4.0, 2009, S. 82] The primary information that are provided by the gamemaster are the location, the present characters and their behavior. To provide the information that are necessary for the calculation of the behavior of non-player characters the situation has to provide the same information.

The location is relevant as the behavior of a characters is different based on the location. As an example, a thief that is hunted by the city guard will try to hide if he is running into a maze of alleyways while he will not try to hide when he is running onto the empty marketplace.

The present characters are relevant because they represent a role of their own and this role can change the context of the situation. The same thief that was chased by the city guard will try to escape if he enters a backyard with two city guards waiting for him and ask for help if he enters a backyard where two fellow thieves are standing.

The behavior of the present characters can be the reason for the calculation of the behavior of a non-player character as he calculates how to react to the two enemies attacking him or offering him a night full of fun.

## Part III

# IMPLEMENTATION

The following chapter illustrates how an exemplary system for the calculation of non-player characters could work. As basis for the implementation this example uses a simple combat oriented rule system that has been created for this work. The rules of the system are explained with each step of the implementation. Additionally each area of the implementation provides a information for the example characters A and B that are used in the explanation of the work flow. The character follow the same rule system with an exception. Character A is a non-player character and character B is a player character. The goals of a player character are provided by the player and have no representation in the example system.

## 8 The implementation of the character

### 8.1 The attributes

Attributes in video games, just like the attributes in pen and paper role playing games, represent the basic physical and mental capability of the character. [SR 4.0, 2009, S. 89][DnD player, 2006, S. 9] How developed can also provide information about how huge the difference in capability is when the attributes of two different characters are compared to each other. It can also show that a character is above average or exceptional when compared to an average value or a maximal value. Each attribute can either be assigned directly or is based on other attributes. In Dungeons and Dragons the health of a character is based on his level, the class of the character and the level of the constitution attribute.[DnD player, 2006, S. 9, S. 27] In some rule systems attributes have an influence on other areas of the character. For a character in Shadow Run its is possible to use the corresponding attribute to execute an action when he does not possess the skill that is needed.[SR 4.0, 2009, S. 89] In Dungeons and Dragons attributes have an influence of the level of the skills that correspond to them.[DnD player, 2006, S. 9]

The rule system used in this example provides four attributes that are directly assigned, strength, agility, charisma and intelligence and two attributes that are calculated based on the four attributes, health and stamina. Strength represent how strong the character is and is used to define if a character can use a weapon and how high the damage is when using melee weapons. Agility does represent how fast and agile the character is. Charisma represents the ability of the character to lead and impress other characters. Intelligence represents the ability of the character to solve logic problems and the amount of knowledge he possess. Health does represent how much damage the character can take before he dies. Stamina does represent how often the character can attack with a melee weapon before he collapses from exhaustion. The average value of the four di-

rectly assigned attributes is three. A character with a value of 21 in strength would be seven times as strong as the average character using the example rule system.

The value of each attribute is based on its significance in the rule system. The significance for the rule system can be defined by the influence the attribute has. In the example rule system strength is used to define if a character can use a certain weapon, how much damage the character does and has an influence on how high health and stamina are. Agility is less significant because it has only influence on how high stamina is.

name	acronym	description	value
Strength	STR	Is required to use weapons and influences the damage of melee weapons	5
Agility	AGI	Defines how agile a character is	2
Charisma	CHA	Defines the charisma of a character	1
Intelligence	INT	Defines the intelligence of a character	2

Table 1: example rule system: directly assigned attributes

name	acronym	formula	value / point (vp)
Health	HE	$5 * (STR + INT)$	2
Stamina	ST	$2 * (AGI + STR)$	5

Table 2: example rule system: calculated attributes

attribute	value	attribute	value
Strength	3	Strength	12
Agility	4	Agility	15
Charisma	5	Charisma	6
Intelligence	4	Intelligence	5
Health	35	Health	85
Stamina	14	Stamina	52

(a) character A attributes (b) character B attributes

Table 3: attributes of character A and B

## 8.2 The skills

Skills in role playing system are used to measure the experience that the character has in a certain activity. In rule systems they are used to determine how effective an activity is executed or how high the chance is that the character can execute the activity successfully. [SR 4.0, 2009, S. 91][DnD player, 2006, S.

73] The representation of skills as numeric values instead as verbal description enables the system to compare the values of skills from different characters and calculate that a character is worse, equal or better in a certain skill, a skill group or another skill which is used for the same activity. When compared to a maximal value or a average value the skill value provides information if the character is exceptional in that skill and how exceptional he is.[SR 4.0, 2009, S. 145] Given two swordsmen in a rule system where skills range from 0 to 100. The average value in a skill is 10. Swordsmen A has a sword fighting skill with a value of 30/100 and swordsmen B has a sword fighting skill with a value of 90/100. The system can use this information, if no other information is relevant, to calculate that A will has a very low chance of winning a sword fight against B and that B is a master sword fighter while A is still an apprentice.

The value a skill has for the system can be based on its significance in the rule system. In a rule system that is based around combat a non-combat skill is not as significant to determine the capabilities of the character as it will not be of any use for the character in most of the situations. The value of the skill does also represent how developed the skill is.

The example rule system uses skills to represents the chance of an action that is associated to the skill completing successful. Each skill has a maximal value of 100 and a minimal value that is based on the corresponding attribute (CAT) multiplied by two. To determine if an action is completed successfully it is necessary to generate a random number between 1 and 100. A result that is below the value of the skill means that the action is completed successfully while a result is equal or above the value of the skill means that the actions is completed unsuccessfully.

The huge number of skills that are associated with combat oriented actions show that the rule system is combat oriented. The sneak skill and the speech skill are the only skills that are not associated with combat oriented actions therefore they have less value for the determination of capabilities.

Name	CAT	Description	Value/Point (VpP)
Melee	STR	Chance to hit with a melee attack	4
Firearms(conventional)	AGI	Chance to hit with conventional firearms	4
Firearms(energy)	INT	Chance to hit with energy firearms	4
Armor(light)	AGI	Percentage of AR used by character	4
Armor(Heavy)	STR	Percentage of AR used by character	4
Sneak	AGI	Chance to stay undetected by other characters	2
Speech	CHA	Chance to persuade a character	2

Table 4: example rule system: skills

name	CAT	minimal value	value
Melee	STR	6/100	10/100
Firearms(conventional)	AGI	8/100	20/100
Firearms(energy)	INT	8/100	8/100
Armor(light)	AGI	8/100	10/100
Armor(Heavy)	STR	6/100	6/100
Sneak	AGI	8/100	20/100
Speech	CHA	10/100	50/100

Table 5: character A skills

name	CAT	minimal value	value
Melee	STR	24/100	90/100
Firearms(conventional)	AGI	30/100	80/100
Firearms(energy)	INT	10/100	100/100
Armor(light)	AGI	30/100	30/100
Armor(Heavy)	STR	24/100	75/100
Sneak	AGI	15/100	15/100
Speech	CHA	12/100	30/100

Table 6: character B skills

### 8.3 The abilities

Abilities represent the special capabilities of the character. These special capabilities can have a wide range. In Dungeons and Dragons it can mean that a character use two-handed weapons instead of one-handed weapons when dual wielding or that the character can cast a spell with maximal damage instead of determining the damage by rolling dice.[DnD dbdk, 2005, S. 95][DnD player, 2006, S. 123] Abilities provide information about the the capabilities of the character and about what makes him special. A character that attacks you with dual wielding warhammers is different from a character that attacks with only one warhammer.

The abilities in the example rule system are combat oriented. Cowboy and Firestarter increase the damage done by either conventional firearms or energy firearms. The ability Power Armor User increases the AR of power armor. The only ability that is not combat oriented is Merchant which will provide a larger profit when trading items. Each Ability has requirements that have to be meet before the character can benefit from the ability.

The value of an ability is based on its significance for the rule system. In a combat oriented rule system that facilitates combat oriented behavior the value of the combat oriented ability Cowboy is higher then the value of the non-combat oriented ability merchant. The significance if also shown by the power of the ability. An ability with small effect has lesser value then an ability with greater effect.

name	requirement	description	value
Cowboy	Firearms (conventional) 70	The damage of conventional firearms is multiplied by two	250
Firestarter	Firearms (energy) 70	The damage of energy firearms is multiplied by two	250
Merchant	Speech 50	The character buys items for 75% of their value instead of 100% The character sells items for 75% of their value instead of 50%	25
Power Armor User	Armor (heavy) 50	The character has + 5 AR when wearing power armor	150

Table 7: example rule system: abilities

name	name
-	Firestarter
	Power Armor User

(a) character A

(b) character B

Table 8: skills of character A and B

## 8.4 The equipment

In games the equipment that is used by the character represents its progress in power. The comparison of base damage of daggers from The Elder Scroll's V: Skyrim in table 9: The equipment show that a dagger in Skyrim has a higher base damage when it is made of glass than of iron. The level corresponding to the material shows that daggers made out of glass correspond with a character that has reached level 27. In Dungeons and Dragons the level of an encounter is used to determine how much the reward for the encounter is worth and how powerful the equipment is that the players gain for completing the encounter. [DnD gamemaster, 2004, S. 64. S. 65] For the system it is therefore necessary to understand that equipment does provide information that are based on the rules of the game and information that are on the narrative frame of the game world.

An good example for this can be found in The Fellowship of the Ring. In the book the mithril shirt worn by Fordo Baggins protects him from a spear thrown by an orc chieftain. Without the mithril shirt Frodo would have died. The information of the effectivity is based in the rule system. An armor made out of mithril is much more powerful then an armor made from iron. [Lotr book 1, 2005] In Skyrim a dagger made from dragonbone does three times the damage a dagger made out of iron does. The quality of the dagger has a direct influence on the power of the character that wields it. In Shadow Run 4.0 on the other hand all sub machine guns, form the basic rule book, do the same damage. The

examples show that Equipment in Skyrim and Lord of the Rings is much more significant than in Shadowrun.

Gandalf says that Frodo’s mithril shirt is worth more than the shire because mithril is very rare. [Lotr book 1, 2005] These information come from the narrative frame of the world. It is necessary to include these information in the representation as the system has to be aware that behavior of non-player characters changes based on their equipment. A character with extra ordinary equipment will be treated different from a character with ordinary equipment.

In the example rule system the equipment is narrowed down to weapons and armors. Every piece of equipment has a rarity value that represents how rare the item is in the narrative of the game world. In the example it is used to represent that the laser Gatling and the power armor are technologies that have been lost in time and the inhabitants of the game world are not capable of creating something equally powerful. Weapons have the five attributes type, damage, damage per second (DPS), attacks per second (APS) and requirement. Type defines which skill is used to attack with the weapon. While damage represents the damage a single attack of the weapon does, DPS represents the damage a weapons does in a second. It is calculated by multiplying the damage value with the APS value. The requirement defines how much strength is necessary to use the weapon. Armors use the attributes type, armor rating (AR) and effects to define which skill is used to define the effectivity of the armor, the value of damage that the armor absorbs from each attack and the additional effects that the armor has.

The value of each piece of equipment is based on its power and its rarity. The power is determined by the bonus it provides in relation to the game play of the rule system. A powerful weapon in a combat oriented game play has a higher value than a non-combat oriented armor. The rarity is based on how rare the equipment is and how impressive it is to other characters.

material	base damage(skill 0/100)	level
iron	4	1
steel	5	2
oricish	6	6
dwarven	7	12
elven	8	19
glass	9	27
ebony	10	36
deadric	11	46
dragonbone	12	NA

Table 9: daggers in Skyrim

weapon	type	damage	DPS	APS	requirement	rarity	value
dagger	melee	5 + STR	4	0.5	2	5	250

armor	type	AR	effects			rarity	value
light armor	light	5	-			5	250

Table 10: character A equipment

weapon	type	damage	DPS	APS	requirement	rarity	value
laser Gatling	energy	20	100	5	5	200	5000

armor	type	AR	effects			rarity	value
power armor	heavy	40	STR + 5			200	5000

Table 11: character B equipment

## 8.5 The goals

The goals of a character represent the reason for the actions of the non-player character. Every action that a non-player character executes is controlled by the goals that drive him.[SR 4.0, 2009, S. 315] Each goal contains information that describe what it wants, the type, and how important it is in relation to the other goals, the relevance. It is more important, for character A, to stay a life then to maintain the current level of wealth.

The goals are based on the drive of self driven beings and are not represented in the rule system. Many non-player characters have no goals because they are not used as self driven entity but as game play element.

name	type	relevance
STAY_ALIFE	protect(self)	5,0
MAINTAIN_WEALTH	protect(wealth)	3,0

Table 12: goals of character A

## 9 The implementation of the situation

The situation provides information about the location, the present characters and their behavior. The exact information that are provided are based on the rule system and game play of the game. Because of the circumference of this work the implantation of the situation for the example system does not contain information about the location. The information that are provided are the present characters and the event that has occurred. The event represents the information about the behavior of the present characters.



information	information
present character	character A, character B
event	THEFT (character B has stolen a log of venison from character A)

Table 13: the information provided by the situation

## 9.1 The event

The event represents the reason for the calculation of the behavior of character A. As each type of event represents a different trigger each type of event contains different information. The only event necessary for the example system is an event that represents that a character has stolen something from another character. The information the event of the type THEFT contains are the victim of the crime, the object that has been stolen and the perpetrator of the crime.

THEFT event		
victim	perpetrator	stolen object
character A	character B	leg of venison

Table 14: event of type THEFT in the example situation

# 10 The layout and work flow of the system

## 10.1 The layout of the system

The following area contains the explanation of the different components, how they are connected to each other and what they are doing in the system.

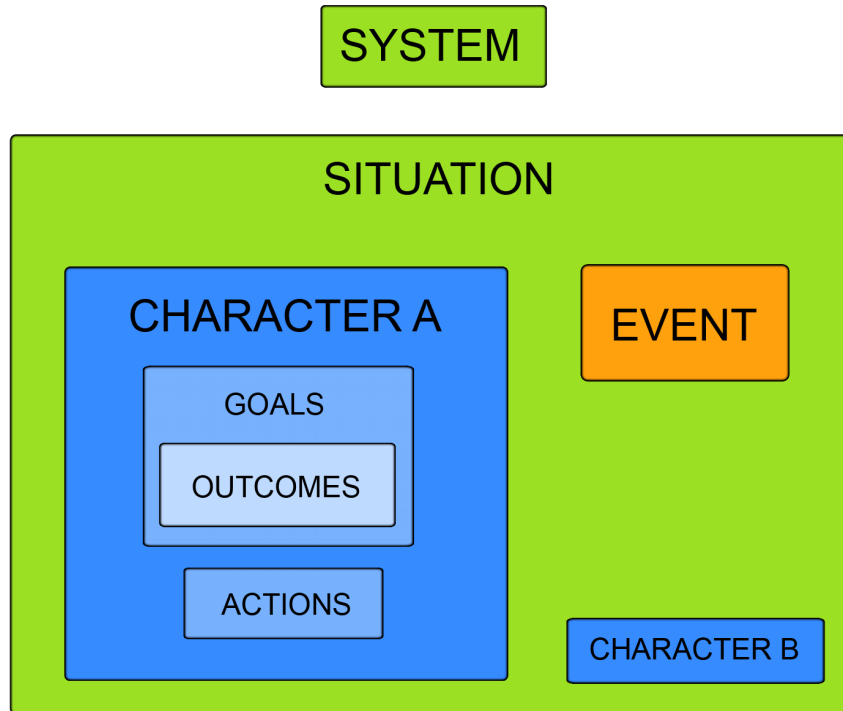


Figure 1: components of the exemplary system

**System** The system manages the behavior of the characters. It provides the situation based on which the non-player characters calculate their behavior, decides when it is necessary to recalculate the behavior and which non-player character needs to recalculate their behavior.

**Situation** The situation contains all information described in 9 which are used by the non-player characters to calculate their behavior. It also provides information about the event that is the reason for the calculation.

**Event** The event contains the information about what type of event it is, the characters that are involved and how circumstances of their involvement. The types of events of the system are based on the possible actions of the rule system and the game play for which the rule system is used. In the example the only event type that is used is the THEFT type. The THEFT type event provides information about the victim, the object that was stolen and the perpetrator.

**Characters** The character contains all information that have been defined in 8. Additionally to the attributes, skills, abilities, equipment and goals the

character does also contain the action that the non-player character can execute in the given situation.

**Action** The action represents one of the actions that the non-player character can execute. Like the events the types of actions are based on the actions that are possible in the rule system and the game play. The example system has two actions. The CLAIM action represents that the non-player character that executes this action will try to regain the stolen object from the thief. The NO\_CLAIM action represents that the non-player character accepts will not try to take back the stolen object and.

**Goal** Each Goal represents one of the things a non-player character wants. Together they represent what the non-player character wants to achieve with its behavior and which of the goals is more important to him. The goals can also contain an outcome for each of the actions possible in the given situation.

**Outcome** The outcome is a value that represents the probability with which an action meets the requirement of the goal. The value can range from 0,0 to 1,0.

## 10.2 The information for the example

The explanation of the narrative frame and the example situation. The situation is used to explain how a system could calculate the behavior of character A based on the information that are provided.

### 10.2.1 The narrative frame of the example

The game world is earth several hundred years after an apocalyptic event that exterminated most of humanity. The world is covered by vast primal forests and jungles filled with exotic lifeforms. The remains of society are widespread throughout the world and consist out of small villages or cities which reverted back to a medieval level. Most people think that the technology that can be found in ruins deep in the jungle are the remains of a war that was fought by gods at the beginning of the world. The average day of work is worth 20 units of their currency.

### 10.2.2 The example situation used for the explanation of the system

Character A is a merchant that is at his market stand at a street in a village. Character B is a adventurer that has just entered the village by the street at which the market stand of character A stands. Character B steals a an item from the market stand of character A and proceeds to the center of the town. The item is a leg of venison which is worth half a day of work. Character A has an overall wealth which is equivalent to 50 workdays.

name	value
a day of work	20
leg of venison	10
wealth of character A	500

Table 15: wealth of character A in relation to a workday

### 10.3 The work flow of the system

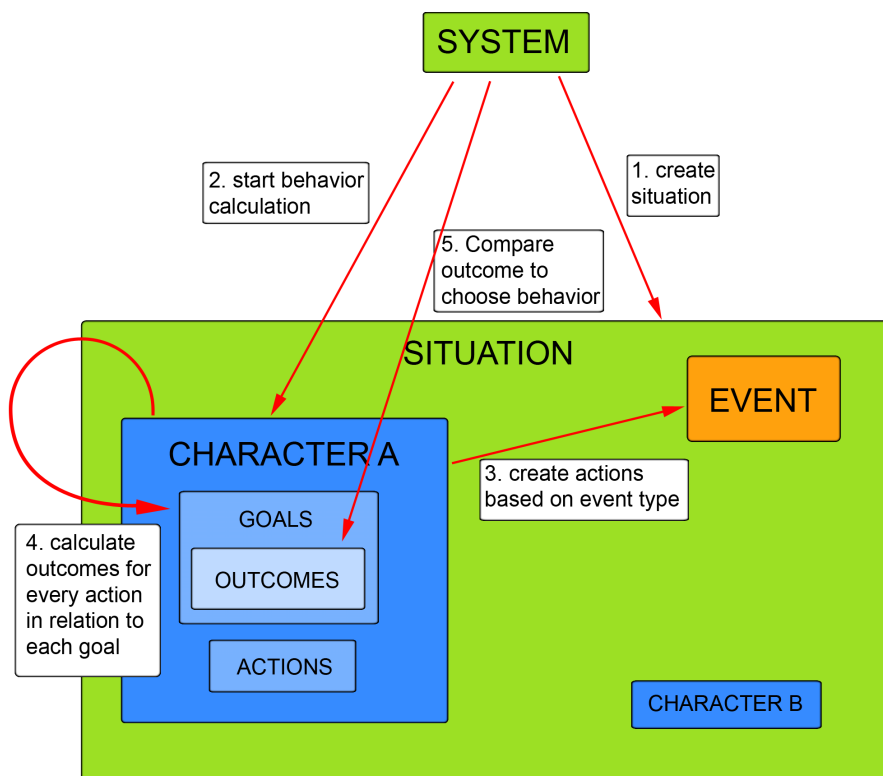


Figure 2: work flow of the exemplary system

The system calculates the behavior of non-player characters when an event occurs. The trigger for the calculation is the theft described in the example situation in 10.2.2. The target is to calculate how character A react to the event.

The system starts by defining the characters that are involved in the situation and providing the information about the event for the situation. In the example the event has the event type THEFT, A as the victim, the leg of venison as the stolen object and character B as the perpetrator. After the all information

necessary for the situation are provided the system starts the calculation of the behavior of character A.

Character A chooses his behavior based on the chance of each action to meet his goals. The system calculates the probable outcome of every action in relation to each goal and combines the outcomes for each action. The result is a value that represents which action meets the goals of character A the most. The action is then chosen by comparing which action has the highest value.

Following the establishing of the situation the system starts the calculation of the behavior of character A. The actions are determined by the type of event. In the example the event type is THEFT which provides the character with two possible actions, NO\_CLAIM and CLAIM.

The outcome for STAY\_ALIFE and NO\_CLAIM is not calculated because character B will not attack character A if character A executes NO\_CLAIM. The outcome is defined as 1,0 to represent that character A has the highest chance of survival if he does not confront character B.

The outcome for STAY\_ALIFE and CLAIM is calculated by comparing the value of character A to character B. The value of character A and character B is calculated by combing the values of all attributes, skills, abilities and equipment for each character. The combined value of character A is divided by the combined value of character B to gain the factor by which character B is stronger then character A. This value is the outcome that represents the probability of survival if character A executes CLAIM.

character A		character B	
area	value	area	value
attributes	181	attributes	410
skills	356	skills	1590
abilities	0	abilities	400
equipment	500	equipment	10000
powerA	1037	powerB	12400

Table 16: the value of character A and B

character A				character B			
attribute	value	factor	result	attribute	value	factor	value
Strength	3	5	15	Strength	12	5	60
Agility	4	2	8	Agility	15	4	60
Charisma	5	1	5	Charisma	6	1	6
Intelligence	4	2	8	Intelligence	5	2	10
Health	35	2	75	Health	85	2	170
Stamina	14	5	70	Stamina	52	5	104
			181				410

Table 17: the value of the attributes of character A and B

name	CAT	value	factor	result
Melee	STR	10/100	4	40
Firearms(conventional)	AGI	20/100	4	80
Firearms(energy)	INT	8/100	4	32
Armor(light)	AGI	10/100	4	40
Armor(Heavy)	STR	6/100	4	24
Sneak	AGI	20/100	2	40
Speech	CHA	50/100	2	100
				356

Table 18: the value of the skills of character A

name	CAT	value	factor	value
Melee	STR	90/100	4	360
Firearms(conventional)	AGI	80/100	4	320
Firearms(energy)	INT	100/100	4	400
Armor(light)	AGI	30/100	4	120
Armor(Heavy)	STR	75/100	4	300
Sneak	AGI	15/100	2	30
Speech	CHA	30/100	2	60
				1590

Table 19: the value of the skills of character B

character A		character B	
item name	value	item name	value
dagger	250	laser Gatling	5000
light armor	250	power armor	5000
	500		10000

Table 20: the value of the equipment of character A and B

---

**Algorithm 1** outcome for CLAIM for STAY\_ALIFE

---

$$\begin{aligned}
 outcome &= powerA / powerB \\
 outcome &= 1037 / 12400 \\
 outcome &= 0,08362
 \end{aligned}$$


---

The outcome of MAINTAIN\_WEALTH and NO\_CLAIM is calculated by dividing the wealth of character A without the stolen object by the wealth of character A with the stolen object. The result is the outcome and represents the portion of the wealth of character A that remains if character A executes NO\_CLAIM. For the calculation is  $c$  500 which is the current wealth of character A and  $l$  is 10 which is the value of the leg of venison.

---

**Algorithm 2** outcome for NO\_CLAIM and MAINTAIN\_WEALTH

---

$$\begin{aligned}
 outcome &= (c - l) / c \\
 outcome &= (500 - 10) / 500 \\
 outcome &= 0,98
 \end{aligned}$$


---

The outcome of MAINTAIN\_WEALTH and CLAIM is 1.0 as it represents that character A executes CLAIM with the result that he regains the stolen object.

goal name	relevance	NO_CLAIM outcome	result	CLAIM outcome	result
STAY_ALIFE	5,00	1,00	5,00	0,08	0,40
MAINTAIN_WEALTH	3,00	0,98	2,85	1,00	3,00
			7,85		3,40

Table 21: result of the outcome calculation for character A

The last step is to multiply the outcome of each action with the relevance provided by the goal and add the outcome for every action from each goal together. The action that has the highest result is the action that is executed by character A. The result represents the probability of each action to meet all goals. The action with the highest value meets all different goals the most.

## **Part IV**

# **CONCLUSION**

## **11 The conclusion of the thesis**

The methods used by actors to increase their understanding of the role they play can be used to define what information are necessary for a system that calculates the behavior of non-player characters but the complexity of the system stands in direct relation to the rule system, the game play and the complexity of the behavior that has to be calculated. The example system is a simple example but to represent a character in a game like Fallout: New Vegas the system would need to be significantly larger.

The complexity of human behavior and the amount of different sources that are necessary to understand it make it even complexer to great a system that calculates the behavior of non-player characters with a high reliability. Therefore it necessary to improve the system before it can be used in a game.

## **12 The lookout**

As the system used in this thesis is a simple example it is necessary to improve the behavior of non-player characters further.

Faction that represent the relation between characters and groups of characters, memory that makes it possible for the non-player characters to react to past events are only two possible areas which needs to be implemented. Another question that needs to be answered is how much behavior is necessary and how much performance can it cost.



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