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On the Craft of Interactive Stories*

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Abstract. This paper starts with a state-of-the-art survey of the major story-representation models and of the more widely used methods in narrative production. The use of the term 'story craft' is proposed, to emphasize that the task of generating and telling stories should be viewed as a technical process that requires very specific skills. The fundamental problem of story craft is divided into four sub-problems: 1. how to generate stories, 2. how to tell them to the public, 3. how to create, store and query the supporting knowledge bases, 4. how to model and improve user experience.

Keywords: Story Craft, Interactive Story Generation, Digital Storytelling, Artificial Intelligence.

Resumo. Este trabalho parte de uma revisão do estado da arte dos principais modelos para representação de estórias e das técnicas mais utilizadas na produção de narrativas. É proposto o uso do termo 'artesania de estórias', para enfatizar que a tarefa de geração e narração de estórias deve ser encarada como um processo técnico que requer habilidades específicas. O problema fundamental da artesania de estórias é dividido em quatro subproblemas: 1. como gerar as estórias, 2. como contá-las ao público, 3. como construir, armazenar e consultar a base de conhecimentos em que se apoia o processo, 4. como modelar e aperfeiçoar a experiência do usuário.

Palavras-chave: Artesania de Estórias, Geração Interativa de Estórias, Narração Digital de Estórias, Inteligência Artificial.

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1 Introduction

Storytelling is a central aspect of human life and culture. Schank [1990] points out that humans think in terms of stories, the world is understood in terms of stories and people often approach problem-solving and new ideas by referencing stories they already understand. Storytelling and narrative are therefore fundamental to human experience.

Interactive storytelling (IS) can be described as a form of digital entertainment that brings together techniques and tools for the creation, visualization, and control of interactive stories through digital means. But one must not restrict its field of application to entertainment alone.

IS, in its broadest sense, is hardly a new area. Already in the 1970s, the development of a computer program capable of automatically generating stories was a worthy research goal, the most famous of them being Tale-Spin [Meehan 1977], which generates stories from a simulation of characters pursuing specific goals. Nonetheless, the field remains unsettled, still presenting many open issues.

Studies in story generation started to regain importance after other areas in computer science were already more fully developed, especially, computer graphics, digital games and game AI, and — more recently — digital TV. The games industry is certainly one of the more interested in this kind of technology. While computer graphics has been able to generate amazingly life-like results, story generation and the use of storytelling in digital games still leaves a lot to desire, frustrating the expectations of many possible users.

One of the main challenges to interactive storytelling is the generation of stories that are both coherent and interesting. Also, adding interactivity into the mix further complicates the problem.

This work provides an overview of different models and systems to represent and create stories. Section 2 offers a state-of-the-art survey, detailing the major story-representation models and the more widely used methods in literary work production. It is argued that a key aspect of an interactive narrative is the story representation used to encode the author's vision of the possible narrative experiences, called a story space [Magerko 2007].

Section 3 is dedicated to 'story craft'. The term was chosen to emphasize that storytelling and story generation should be viewed as a process somewhat less hard-science oriented than engineering, but still requiring much skill and the use of specific techniques. The fundamental problem of generating interactive stories is divided into four sub-problems. The first is how to generate stories; the second is how to tell them to the public, the third is how to create, store and query the knowledge base used for the craft of stories. The last sub-problem regards how to model audience profiles and interests, and how to use this information in story generation to enhance audience experience.

Finally, in section 4, some concluding remarks and possible future developments are discussed.

2 Related Work

In this section we present a bibliographic review covering some of the most relevant studies in interactive story creation.

In section 2.1 we list the main implemented systems for the automatic creation of stories. Some of the main studies on stories in general are the focus of section 2.2, while section 2.3 presents a few of the most popular methods applied to the creation of stories.

2.1 Story Generation Systems

Developing a computer program capable of automatically generating stories is not, in itself, a new idea. Already in the 1970s, some Story Generation Systems (SGS) were presented, the most famous of them being Tale-Spin [Meehan 1977], that generated stories from a simulation of characters that pursued specific goals.

Afterwards, other important work appeared, notably Universe [Lebowitz 1985], TAILOR [Smith and Witten 1991], and Minstrel [Turner 1992], where besides character simulation, authorial goals constraints were added.

Recently, several research efforts were initiated aiming at creating and developing narratives that might be told via interactive media. While in the 1970s, 1980s, and 1990s studies in story generation were mostly concerned with the generation of stories in form of text, the goal of most SGSs today is the visualization of the generated results using computer graphics and some form of interaction.

Among the new SGSs we can highlight: Mimesis [Young 2001, Riedl 2004], Façade [Mateas and Stern 2003], LOGTELL [Pozzer 2005, Ciarlini et al. 2005, Karlsson et al. 2006], IDA [Magerko 2005, Magerko 2006], Mirage [El-Nasr 2007], and GADIN [Barber and Kudenko 2008].

Even though these works have a common motivation, they not necessarily try to solve the exact same problem. Some might show their results in the form of text and others in three dimensional worlds. Some focus on interactivity, while others might not. The way in which this interaction takes place also varies a lot. Also, each system uses a different knowledge base, thus generating stories in completely different genres.

Current SGSs can broadly be classified into three different groups: a) Autonomous character simulation; b) Plot based planning systems (mostly using STRIPS-like planning); or c) Experience management – a newer category focused on the user, not on the plot or in the characters. In this last category, systems tackle a wide range of problems, from user modelling and psychology profiling to motivational feedback and analysis of player moods.

We try here to provide a brief comparison between the presented works, highlighting their most important features, but a direct comparison is hard due to the previously identified differences.

In part this problem derives from the fact that most of the cited studies try to create “complete” systems that solve the whole problem of story craft, instead of breaking the problem into sub-problems and trying to solve each one at time. Also, as a consequence, there is little reuse among the different story generation solutions, especially regarding their supporting knowledge bases.

2.1.1 Tale-Spin

Tale-Spin [Meehan 1977, Meehan 1981] was one of the first programs created to address the problem of automatic story generation. It is capable of describing some simple stories, basically through simulation of the characters' behaviour in the story. During program execution, the user can define an initial story configuration and the main goal of the protagonist. The story then takes form through the interaction between characters in pursuing their goals and the resolution of the resulting sub-problems. A planning algorithm is responsible for generating the plan that will be used by the main character. Once generated, this plan is translated into natural language and then shown to the user.

Physical locations and types of characters are coded, besides procedures to solve problems like locomotion, persuasion and bargaining. A sample generated story is shown in Figure 2.1. One of the main contributions of Tale-Spin was to show that planning algorithms could be very useful in creating convincing characters in the context of a story. Influenced by Tale-Spin, a number of later story generating systems adopted some sort of planning approach.

Once upon a time George Ant lived near a patch of ground. There was a nest in an ash tree. Wilma Bird lived in the nest. There was some water in a river. Wilma knew that the water was in the river. George knew that the water was in the river. One day Wilma was very thirsty. Wilma wanted to get near some water. Wilma flew from her nest across the meadow through a valley to the river. Wilma drank the water. Wilma wasn't thirsty anymore.

George was very thirsty. George wanted to get near some water. George walked from his patch of ground across the meadow through the valley to a river. George fell into the water. George wanted to get near the valley. George couldn't get near the valley. George wanted to get near the meadow. George couldn't get near the meadow. Wilma wanted to get near George. Wilma grabbed George with her claw. Wilma took George from the river through the valley to the meadow. George was devoted to Wilma. George owed everything to Wilma. Wilma let go of George. George fell to the meadow. The end.

Figure 2.1: Story generated by Tale-Spin

Even though Tale-Spin is able to generate some interesting stories, most of them do not fare so well. Despite the characters being coherent, stories can turn out to be too short or simply uninteresting. Dehn's [1981] conclusion is that, besides the satisfaction of the character goals, it would also be necessary to incorporate some kind of authorial goal satisfaction. Since then, other programs have been created that tried to satisfy authorial goals in their stories, such as those used in systems like Universe and Minstrel (to be presented in the following sections).

Another important system that builds on the ideas of Tale-Spin is TAILOR [Smith and Witten 1991]. TAILOR differs from Tale-Spin in that it has no user input. The system works only as a problem-solving process where characters pursue their goals. One improvement towards dramatic effect is that TAILOR models a protagonist and explicit antagonists as characters. Thus the protagonist has goals that drive the story, while the antagonists try to foil them, which produces an ever-increasing conflict. However, there is no dramatic guidance, and so the resulting stories resemble a series of moves in a game, not much unlike a game of chess.

2.1.2 Universe

As Tale-Spin, Universe [Lebowitz 1984, Lebowitz 1985] is a computer program designed to generate stories through the use of planning algorithms. But, contrary to what happens in Tale-Spin, the goals and plans generated in Universe are not only related to characters' goals, but also — and especially — to authorial goals.

Characters are defined by personality traits, stereotypes and relations to other characters. With a good cast of characters, the planner uses plot fragments to reach the goals. Such plot fragments are created with the intention of fulfilling the author's goals, and are defined by a list of roles to be filled-up by the characters, a set of restrictions and consequences, and an ordered list of sub-tasks.

As happens in Tale-Spin, the story is shown to the user under the form of natural language text. A sample story generated by Universe is shown in Figure 2.2.

> Liz was married to Tony. Neither loved the other, and indeed, Liz was in love with Neil. However, unknown to either Tony or Neil, Stephano, Tony's father, who wanted Liz to produce a grandson for him, threatened Liz that if she left Tony, he would kill Neil. Convinced that he was serious by a bomb that exploded near Neil, Liz told Neil that she did not love him, that she was still in love with Tony, and that he should forget about her. Neil was eventually convinced and married Marie. Later when Liz was finally free from Tony (because Stephano had died), Neil was not free to marry her, and their troubles went on.

Figure 2.2: Story generated by Universe

2.1.3 Minstrel

Turner [1992] presents yet another SGS, called Minstrel. This system differs from Tale-Spin and Universe by applying a technique called Case-Based Reasoning, which means that it reuses pieces of previously known or pre-generated stories in the generation of new ones. As in Universe, Minstrel also tries to satisfy authorial goals.

In addition, Turner distinguishes between four different kinds of authorial goals: theme, drama, consistency, and presentation.

Theme goals define the topic and purpose of the story, i.e. what the story is about. Drama goals are responsible for generating suspense, tragedy, presages, and characterizations in stories. Story consistency concerns its credibility and the rationality of the actions performed by the characters. Presentation, in turn, concerns the way in which the story is told to the reader.

Turner [1992] also tried to apply creativity models as a process of search and adaptation wherefrom original stories would ultimately result. In Minstrel, the story is also presented in text format, an example being shown in Figure 2.3.

> The Vengeful Princess. Once upon a time there was a Lady of the Court named Jennifer. Jennifer loved a knight named Grunfeld. Grunfeld loved Jennifer. Jennifer wanted revenge on a lady of the court named Darlene because she had the berries which she picked in the woods and Jennifer wanted to have the berries. Jennifer wanted to scare Darlene. Jennifer wanted a dragon to move towards Darlene so that Darlene believed it would eat her. Jennifer wanted to appear to be a dragon so that a dragon would move towards Darlene. Jennifer drank a magic potion. Jennifer transformed into a dragon. A dragon moved towards Darlene. A dragon was near Darlene. Grunfeld wanted to impress the king. Grunfeld wanted to move towards the woods so that he could fight a dragon. Grunfeld moved towards the woods. Grunfeld was near the woods. Grunfeld fought a dragon. The dragon died. The dragon was Jennifer. Jennifer wanted to live. Jennifer tried to drink a magic potion but failed. Grunfeld was filled with grief. Jennifer was buried in the woods. Grunfeld became a hermit. MORAL: Deception is a weapon difficult to aim.

Figure 2.3: Story generated by Minstrel

2.1.4 Mimesis

Mimesis [Young 2001] is an SGS that, unlike the others discussed so far, was built to be used in digital games. The system works as an intelligent controller for virtual environments. Mimesis tries to combine story planning with the use of the generated stories in a commercial game production system. Riedl [2004], in his PhD thesis, highlights two important properties that a story must have to be successful: coherence of plot and characters' believability.

Plot coherency exists when the main events in the story are relevant to its outcome and have a causal relationship between them. Character believability exists when the characters' actions are convincing and motivated by their beliefs, desires and goals.

Riedl [2004] divides SGSs into two groups. The first prioritizes the simulation of the characters in the world, and the second is more focused on plot coherency. According to its proponent [Riedl 2004], Mimesis is positioned between the two groups.

Story planning is initially performed without taking into consideration the desires and objectives of the characters. The generated plan is then extended to include information about the goals established by the events. From this point on, new goals are generated and the system keeps reasoning about the characters' motivations to reach such goals.

2.1.5 The 'Oz Project'

One of the most influential projects in adaptive narrative is the Oz project [Bates et al. 1992]. Developed over a span of about a decade, the research philosophy behind the Oz Project can be summarised as exploring believable agents and their applications to interactive drama.

Oz can be considered a seminal work in emergent narrative and virtual actors for its results in providing dramatically interesting "micro-worlds" that include social believable characters. A believable character is one who seems lifelike, whose actions make sense and lead the audience to suspend disbelief. Oz argues that believable agents are necessary if you want to build interactive story worlds, by providing engagement and motivation for users. Their work was greatly influenced by Egri's work on dramatic techniques [Egri 1960] on character-based narratives.

Originally Oz had a more strict character focus and used LISP-built systems as its presentation layer to generate English narrative text [Kantrowitz and Bates 1992]. On expanding the use of interactivity in the system, it tuned into an animated world where an user could interact with autonomous characters (called Woggles) as a preliminary step toward interactive drama [Bates et al. 1992b]

This version of the storyworld, Edge of Intention, was presented as an interactive animated art piece at SIGGRAPH-93 [Penny 1993] and was quite praised at the time [Maline 1993]. The system had no drama component at all. A player could interact with the Woggles (by playing the role of a fourth Woggle), while observing them. These autonomous characters "engage in simple social games, exhibit aggression, fear, sadness and joy, play and sleep, and perform several other behaviors" [Dannenberg et al. 1995]. Talk balloons were later added to the system as one method of expressing an agent's internal states graphically.

The Oz group defined a set of requirements for believability in agents that remains useful: Personality; Emotion (their own emotions and responses to the emotions of others in personality-specific ways); Self-motivation (they must have their own internal drives and desires); Change (they should grow and change with time); Social relationships with other characters; and Life-likeness (as in autonomy and responsiveness). Any good agent architecture should support these requirements. [Loyall 1997] offers a detailed analysis of the requirements for believability.

One of the major components of the Oz architecture is HAP [Loyall and Bates 1991]. HAP is a believable agent 'language" that aims to support expressing complex control relationships among behaviours. This architecture was later extended to include a model for manipulating emotional state called Em [Reilly 1996].

Moving beyond just character social interaction as means to create emergent narratives, the Oz project introduced the idea of plot graphs as an approach to drama [Kelso et al. 1993]. While many early interactive fiction projects use scripts defining branching sequences of events, a plot graph is a little more general, laying out scenes in a directed acyclic graph (DAG); where the arcs represent must-precede relationships. Only after all preceding plot points have happened can the next plot point be executed. Hints and obstacles can be associated with these arcs [Kelso 1993] to affect the change between scenes by the user.

In the plot graph model, major scenes of the story form a partial order and are thus linked together [Kelso et al. 1993]. Nodes represent events and situations that are the important moments of the story (also known as plot points). Kelso also introduces the notion of *dramatic destiny* to guide the experience of the user.

Building on the plot graph model, Weyhrauch [1997] introduces MOE, Oz interactive drama manager. It controls a story at the level of plot points to provide dramatic guidance. Given a particular set of plot points, the space of all possible stories is the set of permutations of all possible plot points.

MOE is based on the idea of centralized drama manager from the PLAYWRIGHT system [Laurel 1986]. Weyhrauch himself claims MOE is a successor of Laurel's PLAYWRIGHT approach [Weyhrauch 1997]. Laurel's system utilizes a playwriting expert system that "orchestrates system-controlled events and characters so as to move the action forward in a dramatically interesting way" [Laurel 1986]. It collects action suggestions from characters and then selects the first acceptable suggestion that can reach the formal specifications of next incident in story.

While PLAYWRIGHT uses an inference engine, MOE has two core components: a) an aesthetic evaluation function to judge quality of user experience; and b) an adversarial search mechanism that uses this function to guide experience. The evaluation function rates each permutation during search in this story space. It is important to note that although the story space counts every permutation, the search actually only deals with the frontier of available next nodes.

This function is defined by the interactive story author and is supposed to capture the story's aesthetic by trying to measure some authorial features of "emotional intensity" (such as user freedom, motivation, and excitement) and adequate the story to a tension curve.

Weyhrauch's system uses its adversarial search between "MOE moves" and user response actions (user moves). MOE moves are related to plot-fragments proposed by Lebowitz [1985], basically a set of tricks to guide the user experience at any given moment. Ex: bring new character into story, suddenly give a character a strong emotion, cause character to drop dead, etc. Not much unlike motifs [Aarne and Thompson 1961]. In order to perceive 'user moves' in the story world, MOE uses ‘recognizers’. Each user move has its own recognizer, simple programs written by the story author.

MOE is not a generative system. The set of moves needs to be created by hand for specific stories. Also, it requires programming the functions to be used to recognize user actions. Together, these restrictions make the system impractical for most authors. Another drawback of MOE is that there is a lack of explicit causality between events; comparing predicted player behaviour against possible future actions requires the entire set of events to be considered for search. There is also no means to logically infer conflicts.

By analysing Oz ideas, Mateas [2002] defines a new discipline called *Expressive AI* where AI research and art mutually inform each other and uses this discipline in developing yet another interactive drama system on top of the Oz tradition.

2.1.6 Façade

Façade [Mateas 2002, Mateas and Stern 2003] is a first-person game (which they call Interactive Drama) whose objective is to present the player with a dramatic situation, with which the player can then interact and unfold.

Mateas and Stern [2003] defend that there are two main approaches to the creation of interactive narratives: structured narratives and procedural simulations. Structured narratives are a more traditional form of narratives, with little possibility for interaction. Procedural simulation, on the other hand, consists in the simulation of a virtual world with several agents interacting with the player, thus generating sequences of events that can be interpreted as a narrative, then called emergent narrative [Aylett 1999]. One of the intents behind Façade was to situate it between these two approaches.

To achieve this a drama manager was developed that keeps monitoring the ongoing simulation and intervening in the story, handling to the user/player a more structured narrative experience. The drama manager uses the concept of *beat*, defined by McKee [1997] as the smallest unit of dramatic action that can change the state of a story. Each of these units have pre-conditions and effects in the states of the story, generating a graph with the narrative structure. The situations to be presented to the player are chosen from the existing beats, in such way that they reach the desired dramatic level for each moment in the story. Also, Façade tries to enhance the player’s dramatic experience; specifically, it encodes the dramatic arc using a mathematical function and uses this in selecting beats in a way that raises the tension in well defined steps.

In order to provide the drama with interesting evolving characters, Façade implements an behaviour definition language (ABL) that extends HAP [Loyall 1997], managing behaviour interrelations, sub-goal success and failure, and adding multi agent cooperation by using a mechanism for handling joint behaviours between two agents [Mateas and Stern 2005].

Although Façade has been a successful experience, its architecture requires a great effort from the prospective authors. It took two years just for authoring the game that has only one scene, two characters, and takes about 20 minutes to complete [Mateas and Stern 2003].

Moreover, it is highly debatable whether there is indeed an automatic generation of stories in Façade, as the graph of the narrative structure is pre-assembled and all dialogues have been previously recorded. The main contribution of Façade was to prove it to be possible to develop digital games with strong dramatic appeal.

Figure 2.4: A snapshot of interacting with the Façade system.

2.1.7 LOGTELL

LOGTELL [Ciarlini et al. 2005, Pozzer 2005] is a system that targets the generation and three-dimensional presentation of stories. It differs from other systems by allowing interaction already at the generation phase of story events, while (for now) the user does not participate directly in the story during dramatization and playback. LOGTELL uses a planning approach with goal inference for its characters, whose actions are restricted to a pre-defined repertoire, conforming to the pioneering work by Vladimir Propp [1973].

The starting point in LOGTELL is modelling the genre of the stories to be generated, by way of three conceptual schema: static, dynamic and behavioural. The static schema must indicate the valid states in the chosen literary genre. The dynamic schema describes which transitions are possible between two valid states. The behavioural schema concerns characters' goal inference logic model, where which set of goal inference rules to be applied is defined by character type.

In this approach the generation of events takes place in a step by step way, allowing the user, at each reached state, to accept the generated state or to request the planner to try and produce other alternatives. The user can also insert additional goals or even specific events. To support this interaction with the system, the user can query a library of typical plans (a plan hierarchy) that matches the specified pre-requirements [Karlsson et al. 2006]. LOGTELL in its current form, as well as Tale-Spin, does not provide for a mechanism to manipulate authorial goals, although it is possible to embed them partially (and in an indirect way) into the rules of the behavioural schema. Consequently, these kind of goals can only be addressed and reached by way of user interaction. It is important to note that work on a conceptual model and its stronger integration into the system are ongoing [Karlsson et al. 2009].

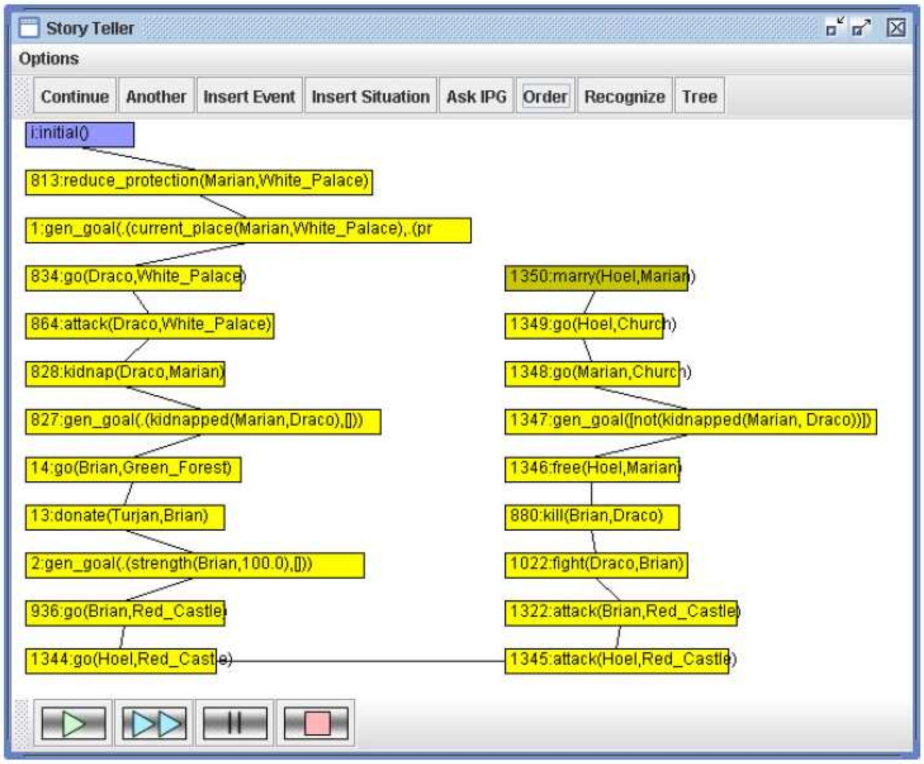

Figure 2.5: An example plot generated using LOGTELL.

Figure 2.6: A scene during the dramatization of a plot in LOGTELL.

2.1.8 Systems Based on Author/User Modelling

More recent research has sharpened the focus on some sort of user experience and satisfaction modelling. Different approaches taking this model into account when generating/adapting a story present interesting results, even though they are mostly oversimplified. This is a wide area that uses different capabilities; the works grouped here are recent promising systems that try to tackle the user experience problem.

2.1.8.1 IDA

Magerko's Interactive Drama Architecture (IDA) uses an author-centric approach to interactive drama [Magerko 2006]; and views the medium of Interactive Drama as the means for a human author to communicate an artistic vision [Magerko 2005]. IDA uses an omniscient story director agent to maintain the plot's progression, which is (as in MOE [Weyhrauch 1997]) essentially the playwright described by Laurel in her thesis [Laurel 1986]. This director agent is connected to a game engine, thus providing players a rich 3D environment where to interact with a story.

IDA's director agent follows the characters in the storyworld, giving directions to them when necessary to perform particular plot elements and to guide the player to stay within the story space. It also tries to prevent violations of the story by triggering reactive or pre-emptive behaviours to help avoid the possible problems.

These director actions receive a score dependent on the current situation needs. If a situation is urgent (requiring reactive direction), action weights will be assigned to favour effectiveness. Characters in the story are agents developed in the Soar architecture (Laird et. al 1987).

One of the most interesting aspects of this system is its use of a player model to adapt the story and try to avoid violations to its coherency. IDA hypothesizes future player behaviour, represented by the player's goals and the knowledge that they have gathered [Magerko 2005].

The story representation used revolves around the partial ordering of abstract plot points. In order for a given event to be possible in a story, it needs to be created by an author and included in IDA's library of plot points.

The timing of events in IDA is based on preconditions, as well as when the player is expected to violate a set of constraints imposed by the author on the plot. But a key difference from other systems is that the representation has no explicit concept of causality as nodes in the "plot graph" do not have explicit post-conditions. At the beginning of the experience, any plot points without parents are labelled as active. The director keeps a list of all active plot points.

The system starts with a pre-written story to guide the player and makes use of the mentioned inferred player knowledge to make part of its experience player-specific. It models short-term player behaviour and treats the results of that model as a hypothesis of future player behaviour [Magerko 2006].

In order to make use of these hypothesis the system needs to maintain an internal simulation of the game environment an author-defined player model on that environment. By contrasting the observations from this simulation with the plot representation, the system tries to direct characters to avoid plot violations. Director actions are rated by the author in terms of two dimensions, subtlety and effectiveness.

The player model is somewhat complex, based in an internal probabilistic rule-based model of the player's behaviour that should be specified by the author of the interactive experience. Magerko also states that the model is domain-dependent and needs to be created by the author as a programmer [Magerko 2006].

Even though the usage of a player model brings interesting considerations into play, expecting the author of an interactive story to program a complex user model is impractical in most situations. Another possible issue with IDA's approach is that the use of a collection of plot point with no representation of causality makes the author works much harder in creating an environment where the coherency and dramatic quality of a story can be guaranteed.

2.1.8.2 GADIN

A more generative system is GADIN (Generator of Adaptive Dilemma-based Interactive Narratives), where the story designer is only required to provide genre specific storyworld knowledge, such as information on characters and their relations, locations and actions [Barber and Kudenko 2007a]. The system is provided with knowledge of generic story actions and dilemmas based on a set of clichés encountered in soap operas. The focus around dilemmas helps to create dramatic tension and the system also employs a user model to try to ensure user's enjoyment.

The main focus of the generated stories in this system is the dilemmas. GADIN will basically work to expose the user to a dilemma by planning to satisfy a dilemma's preconditions. The plan to achieve a dilemma thus becomes a storyline (or part of it).

On being passed a dilemma the planner finds all plans to achieve this dilemma - given the current storyworld state and background knowledge – and then performs a search among the plans to pick one. Shorter plans are favoured, arguably to result in "less opportunity for the user to violate the plan" [Barber and Kudenko 2007a].

Another interesting feature of GADIN's usage of dilemmas is that not only the user character will face them. Non-player characters (NPCs) will also experience dilemmas throughout the story. This increases the believability of the characters as they exist in the story in a more life-like manner, that also provides for a richer and more dynamic storyworld. On the extreme case, the system can create a non-interactive story, so there is always a story going on whether or not the user interacts with it.

The user model is based on predicting the choices he's going to make(dependent on his previous choices) [Barber and Kudenko 2007b] and combined with a fixed author-defined 'interestingness' value for each dilemma outcome, is used to select the next dilemma to be presented to the user. Each dilemma has associated assumptions as to how the modelled values change dependent on the user decision.

Currently GADIN makes use of 5 different types of dilemma: betrayal, sacrifice, greater good, take down (an action which will result in the worst possible utility but also the worst outcome for the enemy), and favour [Barber and Kudenko 2008]. An overarching story connects these dilemmas within a plotline that is dynamically created, starting from a random selected goal among the ones available when the story starts.

Even though the use of dilemmas increases dramatic tension and the NPCs in the world exhibit a good level of autonomy, GADIN's approach presents some shortcomings. The use of dilemmas alone does not guarantee that the selected plotline will be interesting. Also, it currently is a text only control-based system. This means that the story presentation, especially the interactivity with the story, is not fully developed. In its current version the user selects a sequence of actions until he chooses to pass control to the system, which then acts until a user action is required. In this scenario, a lot of possible story violations will simply not happen as the user's ability to interact with the plot is severely limited, thus possibly limiting player engagement.

2.1.8.3 Mirage

Another recent storytelling system that utilizes player knowledge to help illicit user engagement is Mirage. It does so by heavily borrowing from acting theory in the definition of its characters behaviours [El-Nasr 2004] along with inferred knowledge about player actions. For instance, in order to choose character goals that oppose the user, a representation of user intention or goals is required.

Mirage's actors choose between different tactics (adaptive acting behaviours) [El-Nasr 2007] based on predicted player behaviour to try and reach their goals for a certain scene. If a goal is not reached by a certain behaviour, actors will select another approach to continue trying, giving the player a good demonstration of their intentions and creating a "feeling of empathy through an understanding of characters' emotions and choices" [El-Nasr 2007].

In this aspect, Mirage resembles the approach to believable agents as improvisational actors used in the Virtual Theater project [Rousseau and Hayes-Roth 1998]. However, Virtual Theater models actor personalities, which is not the focus of El-Nasr's system. Another difference is that, while in Virtual Theater users participate in the construction of the story through directions sent to their avatars, in Mirage they have more direct control.

The architecture described in [El-Nasr 2004] uses a representation that is adapted from acting theory [Benedetti 1994] which, in order to stimulate engagement, abstracts some narrative constructs. These narrative constructs are defined as: I) Relationship values: relationships between characters; II) Dramatic tension/conflict in a drama; III) Character immediate goals; IV) The object/character the user is attending to; and V) User stereotype estimates.

In performing the dramatic narrative, Mirage tries to follow the Dramatic Arc principle. A story is divided into scenes, which in turn are further divided into beats [El-Nasr 2004]. Each scene and beat has goals, pre, and post conditions. When a scenic goal is achieved the narrative advances towards achieving the narrative objective. In order to proceed with this goal, the system selects beats, that when executed, will move the story forward. The system allows modulation of projected dramatic tension by selecting beats that increase or decrease tension appropriately.

The dramatization of Mirage's single interactive narrative happens in a rich 3D world supported by an architecture that implements an agent model and utilizes varying animations attached to the same action with different 'adverbs' associated to them, i.e. if a character wants do draw a sword, it can do it *slowly*, *violently*, etc. Mirage also makes use of a scripting language [El-Nasr 2007] that allows designers to define an evaluation function that influences the way the system estimates a user's character given its actions and story context.

Initial usability studies with cinema and theatre experts suggest that actor behaviour in Mirage managed to be adaptive and to instil empathy [El-Nasr 2007] .

2.1.8.4 PaSSAGE

Yet another SGS that tries to model the player to tailor his experience is PaSSAGE (Player-Specific Stories via Automatically Generated Events). PaSSAGE uses automatic player modeling to learn player's preferred style of play, and then uses that model to dynamically select the content of an interactive story [Thue at al. 2007] .

It is distinct from Mirage in that Mirage tries to model player's character [El-Nasr 2007], while PaSSAGE attempts to fit the player into categories of playing style. Mirage defines its model as values along traits of character stereotypes (e.g. cowardice, self-interest, etc.). PaSSAGE, on the other hand, categorizes player type stereotypes (fighter, power gamer, etc.); which are quite similar to the player archetypes for Multi-User Dungeons (MUDs) defined by [Bartle 1996].

PaSSAGE assembles its stories by drawing from a library of possible events, called encounters, each having been annotated by an author with information concerning which player types it would be suitable for. When determining which encounter to run, PaSSAGE examines each encounter's set of branches, quite in a game-tree like way. To help maintain a stronger sense of story, encounters are grouped into sets corresponding to the many phases of the Monomyth [Campbell 1949]. As it is, the creation of a story space requires a lot of manual labour.

These encounters can go through refinements (via role passing and hinting) [Thue at al. 2007] and are implemented by the use of triggers, usually started when a player approaches a suitable location. Characters satisfying the encounter's trigger conditions assume the behaviours authored for this event, which are tailored to encourage the player's preferred styles of play.

The player model vector then changes depending on player action selection. For instance, if the player is showing an interest in gaining riches, the model's value for the Power Gamer type increases. The five stereotypes are: Fighter, Method-Actor, Storyteller, Tactician, and Power Gamer; and each is associated with a value that fluctuates.

2.1.9 Other Relevant Systems

Some other systems, although not so often mentioned in the literature, are also relevant to this discussion and will be briefly described here.

The approach adopted in the DEFACTO project [Sgouros 1999] uses successive evaluations of rules to control the generation of an interactive story where the user is the protagonist. The interaction among characters' goals is explicitly represented and an Aristotelian conception of plot (more on Aristotle ideas will be discussed in Section 2.2.1) is used to lead the story to a climax and then resolve it.

The chaining of events, however, is not explained by pre and post-conditions, making the control of what can and what cannot occur rather complex. Additionally, it does not allow the use of planning algorithms to develop sequences of events for the achievement of goals. The need of user intervention seems to be high if one wishes to generate a complete plot. Goals are inferred by means of rules analyzing the current situation, but the choice of actions to achieve goals appears to be more reactive than deliberative.

The approach described in [Cavazza, et al. 2002] adopts a character-based model to make user interventions at any possible time. Characters are autonomous agents, executing plans to achieve their goals, and, from their interactions, it is expected that a narrative will eventually emerge. Users are spectators but can "physically" interact with the context and even advise characters, affecting their decisions and the resulting stories. In order to decide, at real-time, the actions to be performed, characters consult a Hierarchical Task Network (HTN), corresponding to pre-compiled plans. In this way, the system does not have to pay the price of using problem-solving planners while presenting a 3D animation. It might demand more effort to model the behaviour of the characters, but it makes sense if one does not consider maximizing the alternatives as a requirement. The main doubt about pure character-based approaches is to what extent dramatic and engaging narratives may actually result. The task seems to be easier with genres like sitcoms, wherein the climax of a story is not so clearly distinguishable. On the other hand, the usage of HTNs in storytelling seem very promising, even though the ordering of events is more rigidly set than in other planning approaches.

[Paiva, et al. 2001] presents the Teatrix environment, where Propp's functions are used to model synthetic characters that interact with other characters, directed by children, in a virtual world. Each child directs one character and the synthetic characters are autonomous. All characters have a role in the story, specifying the functions in which they can take part.

Synthetic characters have goals that change according to the situation. They plan and try to execute actions (i.e. functions) according to their roles. The approach seems interesting for education, but the control of the consistency of actions and goals and the generation of dramatic situations are not guaranteed. Additionally, the use of predefined plans in the planning process can enhance the performance, but might limit the amount of different stories that can be generated.

Yet another approach related to Propp, but this time in a case based reasoning (CBR) system, is the one followed by Fairclough and Cunningham [2003], which uses an expert case-based character director system where cases in the case base are closely tied to Propp's functions.

The use of approaches like Propp's ideas in pure plot-based approaches leads to systems more concerned with the guidance of interactive stories than with their generation [Spierling et al. 2002]. For each "Proppian" function within a story of a certain genre, such systems present alternatives to be chosen by the users. Still, we claim that to obtain an effective method to generate stories, it is necessary to extend Propp's ideas, adding semantics to the functions (and to their specializations), so that preconditions, effects and goals can be fully expressed. As previously discussed, this is exemplified in LOGTELL [Pozzer 2005].

Another SGS proposal that deserves special mention in this category, for its "early influence", is Erasmatron. Developed by Chris Crawford, Erasmatron is a system initially intended for the use by artists to create stories.

The Erasmatron system [Crawford 1999] was intended to support the authoring process of interactive stories. It tries to balance plot-based and character-based approaches by using the notions of verbs and sentences. Actions are represented by verbs with roles assigned to characters to form sentences. Such a proposal is close to the way Propp's functions are extended in LogTell. Functions are implemented as logical operations, with parameters, pre and post-conditions.

Even though Crawford claims that humanly interesting stories can be created only by artists [Crawford 1999], Erasmatron provides a system where authors can create "artist's algorithms" that automatically direct character behaviour to some extent.

2.2 Story Models

The creation of stories is a task regarded as non-trivial or difficult to perform by even the most renowned authors. Among other things, it is important to have a deep understanding of certain minimum requirements regarding stories, as it is known that not every sequence of events results in a story of quality.

The development of a program capable of evaluating the quality of a story is still an open issue that is far from being solved by current technology [Mueller 2003]. Moreover, it can be argued that there is no exact solution for this problem as the elements that make a story compelling and interesting vary according with personal tastes.

From this comes the following question: how to generate a good story using a computer, if there is no precise formulation of what that means?

There are two ways of facing the field of Artificial Intelligence (AI), usually called ‘strong’ AI and ‘weak’ AI. Followers of 'strong' AI claim that a computer can be programmed so that it can be compared to a human mind and is capable of everything that our mind is capable of doing [Searle et al. 1980]. On the other hand, in 'weak' AI the computer is seen as a tool, with which it is possible to simulate models that only mimic the behaviour of the human mind [Searle et al. 1980].

Models are simplifications of reality, created from some well-defined hypotheses. At least in theory it is possible to create a model of what constitutes a good story and apply it to a SGS. This work is strongly based in this hypothesis. As there are simplifications, not every story considered as good by a person will be considered so by the model, and vice-versa. The better the model, the better this relationship will be. Add to this mismatch the fact that people with different tastes and life experiences, tend to prefer different models.

Each author usually uses his/her own model for the creation of stories. Differences in the model originate differences in each author’s ‘style’. There is no ideal, right, or wrong model. But there are models that can be more easily adapted to certain situations.

There are several studies seeking to understand what is a story and what are the key elements for its analysis. This section will present some of these studies, which were selected because they are widely known and utilized, as well as for being useful in building a model for the automatic generation of stories.

2.2.1 Aristotle

Aristotle [2004], in the 4th century BC, was one of the first to try to put down on paper the fundamental principles on which stories are based. Despite having focused mainly on tragedy, his comments are applicable to other areas and his work still continues relevant today. Many of the most important concepts on the subject were originally submitted by him.

One of his ideas was the division of tragedy in six fundamental parts. They are:

- Mythos or 'plot'
- Ethos or 'character'
- Dianoia or 'thought', 'theme'
- Lexis or 'diction', 'speech', 'elocution'

- Melos or 'melody', 'music'
- Opsis or 'spectacle'

Plot concerns the combination of the acts; while characters, the characteristics of the agents in play. Thought relates to everything that is said and is related to the subject; while music, elocution, and spectacle define the media and place in which the imitation (mimesis) is to be made [Aristotle 2004].

According to him, the plot is the most important part, followed by characters, thought, elocution, music, and spectacle; in this order. Aristotle [2004] was also the first to decompose the plot structure into sub-parts. He defines tragedy as an imitation of an action that is admirable, complete (composed of an introduction, a middle part and an ending), and possesses magnitude. Therefore, according to Aristotle, so that the plots are well formed, they must not begin or end at random, but established under the conditions indicated.

Several other important contributions were made in his work. Aristotle also gave some valuable advice for the composition of tragedies, as shown in section 2.3.

2.2.2 Separation in Levels

After Aristotle, a long time passed without more deep studies in the subject. His treaty on poetics was relegated in favour of his more famous Rhetoric, Poetics only became hugely influential after a long while, especially since the 18th century AD with the Age of Enlightenment.

An important movement that helped boost current story models was the Russian formalism that took place in the early 20th century AD in Russia.

Shklovsky [apud Landa, 1990] was one of the leaders of this movement. One of his major contributions was the division of stories into two separate levels, called fabula and *sjuzhet*. While fabula corresponds to a chronological sequence of events, *sjuzhet* is a different representation specific to these events, be it through a temporal re-ordering of the events, the use of narrative techniques, or the use of different points of view.

This separation proved very useful in helping analyse literary works. Another Russian formalist, Tomashevski [apud Landa, 1990] defined the structure of a narrative as resulting from the tension between fabula and *sjuzhet*. According to him, when a reader receives the text in form of a *sjuzhet*, he needs to reconstruct the fabula in his mind as a necessary step to understand the story. For him, the *sjuzhet* has its own structure, where coherence is not guided by constraints of time or causality, but by artistic needs as suspense, curiosity, and sympathy.

More recently, some scholars and authors came to utilize similar divisions.. Chatman [1978], for example, in his work divides stories into two levels: story and discourse. This model is often used, including by some SGSs [Young 2001, Riedl 2004].

Mieke Bal, in her book [Bal 1997], utilizes another separation in three levels: *fabula*, *story*, and *text*. One can argue that the *sjuzhet* is divided into story and text. The later being related to the medium used to tell the story, be it a book, movie, virtual environment, or any other communication medium. In the remainder of this work we'll use the term *narration* when referring to Bal's *story*, in order to avoid confusion with "story" in the habitual sense .

This separation is more interesting (in this context) than the ones proposed by Shklovsky [apud Landa, 1990] or by Chatman [1978], as usually the same generated story can be told using different media. This aspect alone can much facilitate reuse among SGSs.

2.2.3 Motifs

When looking at stories and story structure, the analysis of the constituent parts of popular stories can yield very useful insight and information. Folktales, myths, and popular culture have pooled together rich repertoires of stories and motifs along the years from which inspiration can be drawn in creating new stories.

In order to categorize and compare folk tales, and understand their distribution and inter relations, they are often catalogued in terms of tale types and motifs. The most influential attempt to catalogue and categorize these narratives is the monumental guide by Aarne and Thompson [1961], which became the *de facto* catalog for this kind of tales. The index builds upon Aarne's system devised to organize and index Scandinavian collections; Thompson enlarged its scope and introduced the AT-number system as a bibliographic tool for ease of reference.

A tale type is basically a self-sufficient narrative, and a motif can be seen as the smallest unit within such narrative. A motif can be any recurring element that has symbolic significance in a story: an idea, an object, a place, and incident, or a combination of statements about them. Also, as a narrative unit, it can also determine with which other motifs it can be combined.

Paraphrasing Haring [2006], the concept of a "tale type" arises when people apply their capacity for abstracting to their experience of hearing a story in different words or with different features, then determining how similar they are. A tale type encompasses one or several motifs. Also, it represents a high level relation between stories with a certain degree of similitude, and "not a constant unit of measure or a way to refer to lifeless material from the past. Instead, it is adaptable, and can be integrated into new thematic compositions and media" [Uther 2004]. Examples of tale types according to the AT-number system include: AT300 – Dragon Slayer; AT310 - Maiden in the Tower. Rapunzel; AT510 – Cinderella; and AT545b – Puss in Boots.

Although these definitions have often been criticized for being too imprecise and not accounting for the functionality of the motifs in the tales, "these are nevertheless useful terms to describe the relationships among a large number of narratives with different functional and formal attributes from a variety of ethnic groups, time periods, and genres" [Uther 2009] and, as such, can be useful in providing material for further understanding storytelling and the evolution of stories.

Criticism towards the type index states that often only few variants are presented and that there is too much focus on oral tradition, leaving out important tales in written form. A systematic inspection also showed that many folktale complexes that had not previously been included in the tale type index could be integrated with no difficulty [Uther 2000]. The catalogue has later been expanded to address these issues; and an extended reference system proposed as the ATU system [Uther 2004].

Both the indexes using the AT-number system and the ATU system, list tale types and their variations, origins of the tale, as well as provide and analysis of the tale and lists of its constituent motifs. An index of motifs [Thompson 1989] is used as reference for individual motifs throughout the type index.

[Thompson 1989] classifies and indexes motifs in folk literature in an elaborate classification of these into broad categories. As previously stated, motifs can be as simple as magic objects (e.g. the *magic cap* [D1067.2,]), statements about character roles (e.g. the *unpromising hero* [L100,]), or incidents (the *magic air journey* [D2120,], *sacrifice of human being to dragon* [B11.10,],) and fantastic events (*waking from magic sleep by letting a tear fall on sleeper* [D1978.2,], *external soul - a person keeps his soul or life separate from the rest of his body* [E710,]).

As stated by Thompson, each of these motifs lives on because they have been found attractive by generations of tale-tellers [Leach 1972]. This is precisely one of the reasons why the usage of such motifs can be seen as a promising way of guaranteeing a certain level of "interestingness" to a story.

Tale types provide insight into the relation between motifs and on variations and analogies between different stories. Motifs, besides presenting "popular" story pieces, often contain ingenious solutions to contradictions or dead-ends in stories.

2.2.4 Literary Functions

Strongly influenced by the work of the Russian formalists, Vladimir Propp [1973], performed a study where he intended to establish a proper method to classify Russian folk tales and its parts. In contrast to tale types and motif indexes (as Aarne and Thompson [1961]), Propp's approach tried to identify the purpose of each part or action in the tales.

In his effort, Propp drilled into about one hundred tales and by analyzing character and action types he then introduced the concept of literary function as a character procedure, defined from the point of view of its importance to the unfolding of the action.

Propp realized that the same actions were attributed to characters in different stories. Thus it was possible to examine the tales from the character functions. He defined the names and attributes of the characters as variables, and the actions (functions) they play as constants. In his work the main interest resided in knowing what was done and not by whom or how it was done.

He drew four main conclusions. The first was that the constant elements are the roles of characters, which form the basic constituent parts of a tale. The second conclusion was that there are a limited number of functions in Russians folk tales. The third was that the sequence of functions is always identical.

From there, Propp [1973] reached a conclusion completely unexpected for him. According to the established criteria, all folk tales had the same classification. This happened because they are all derived from the same primordial tale, which contains the set of all literary functions.

2.2.5 Monomyth

Besides Propp [1973], other researchers have faced the possibility that all stories could be defined from a single scheme of story. One of these researchers was Campbell [1968], considered one of the greatest scholars of universal mythology. His study is of great relevance, as many of the modern success stories were built based on his theory.

Campbell [1968] dealt basically with mythological stories, with the hero's figure and its journey into the story; and reached for some support from psychology for comprehending the transformation that take place in the hero's mind.

Some psychology scholars believe that the rites of passage that one must go through in the myths represent in some way the human psyche. Carl Jung followers associate the emergence of universal types and motifs, mythical or not, to action of the so called archetypes of the collective unconscious [Furtado 2006].

Campbell compares dreams and numerous stories involving myth from different places and times, and finds a great deal of similarities among them. He then elaborated a theory according to which all the stories about myths in the world are in fact based on a single outline. And this outline or scheme he named monomyth (borrowing the term from James Joyce's work as homage [Campbell 1968]).

In his journey, conforming to this scheme, the hero must go through a series of steps or stages that ties into a cyclical diagram. The journey is divided in three main parts: departure (or separation), initiation, and return. In the first part, the hero leaves the comfort of his world to enter an unknown world of strange powers and events.

At initiation he gets to know better the other world and faces obstacles until achieving his main goal. In the last part, he decides to return to his home world, where order must be restored and the hero can enjoy the gains achieved in his journey.

2.3 Methods for the Creation of Stories

The studies discussed so far are important in helping the goal of defining a model for stories. But they do not help in determining the quality of a given story, especially as this is concept that depends too much on individual tastes.

Although there is not much scientific literature on how to write good stories, there are numerous guides written by experienced authors who tried to somehow formalize their techniques for the creation of interesting stories [Field 1982, Howard and Mabley 1995, Vogler 1998, McKee 1997, Tobias 2003]. These efforts can serve as a base or as help in the development of a story generator.

These guides were chosen among other reasons for their popularity, availability and because they are potentially easier to program in a computer. Although each book focuses on a specific medium, the interest here is to seek elements that could be used in any other media.

2.3.1 A Good and Well Told Story

McKee [1997] compares a good and well told story to an orchestra, in the following way: A good and well told story – in which structure, configuration, characters, genres, and ideas mix continuously – is like a symphonic piece. To achieve *harmony*, the writer needs to study the elements in a story as if they were instruments in an orchestra, first separately and then in harmonic accord [McKee 1997].

There are several elements essential to the quality of a story. However, just a few will be addressed in this work. According to Aristotle [2004], the most important elements are plot and character, in this order. And these elements will receive most attention.

Most guides do not make a clear distinction between story levels. But, when translating the method to a computer, this distinction is fundamental. Thus, the story generation process can be divided into three main problems: the construction of the characters, the generation of the fabula, and the generation of "narration".

There is still no consensus on the order in which this problem should be addressed. Aristotle [2004] states that the plot must be defined before the characters. On the other hand, there are also authors who defend the opposite [Egri, 1960 apud Glassner, 2004]. Many times both can be addressed in parallel. This decision is up to the tastes of each author and certainly will influence the final 'style' of the generation technique.

2.3.2 Characters

A character is presented to the audience through its actions and these are what define its characterization. Field [1982] goes beyond and affirms several times that "Character is action — what a person does is what she is, not what she says".

McKee [1997] emphasizes that personality is shown to the audience during times of great tension and pressure. A real character is revealed through choices that a human being takes under pressure – the bigger the pressure, bigger the revelation, more real is the choice to the essential nature of the character.

"The function of a character is to bring to the story the necessary characterization qualities to make choices in a credible way. [...] Each character must bring to the story the combination of qualities that allow the audience to believe that the character can and must do what it does" [McKee 1997].

According to Bates et al. [1992], in order for the audience to believe that a character can and must do something, it must be guided by its goals, intentions, and emotions. Every story must have a main character, called the protagonist. According to Field [1982], the first task in creating a character is defining what he needs. Antagonists can be defined as the forces that stops the protagonist from fulfilling its needs. This force can be internal or external, as shown in Howard and Mabley [1995].

The antagonist is the opposing force, the difficulty that actively resists the protagonist efforts to reach its goals. These two forces form the story conflict or conflicts. [...] there are various movies where protagonist and antagonist are, clearly and distinctively, different persons in opposition one to the other. In this kind of story, the protagonist has what's called an external conflict, a conflict with other. But, in many other movies, the protagonist is its own antagonist [...] the main conflict takes place inside the central character [Howard and Mabley 1995]. Besides the protagonist, and possible antagonist, several other characters can appear in the story, each and every one with a specific function.

According to Vogler [1998], by relating collective unconscious archetypes with story characters, Campbell [1968] assigned to these characters functions they must obey in the story. Vogler [2007] lists in his book some of these archetypes and their functions, they are: hero, mentor, threshold guardian, herald, shapeshifter, shadow, ally, and trickster.

2.3.3 Fabula

Frank Daniel [apud Howard and Mabley, 1995] defined, in a much simpler way, the basic dramatic circumstance of a good story: Someone needs desperately something and is having difficulties in obtaining it. The author's task is finding out what is this thing and how is the search for it going to take place.

Some authors state that it is possible to enumerate all the dramatic situations found in stories. The dramatic situations describe what the story is about; for example, if it is a story of rescue, revenge, or disaster.

Polti [1945] created a list with 36 dramatic situations. For each one he presents a brief description and a set of character roles. Even if the soundness of such lists is arguable, they can be very useful in the automatic generation of stories.

Both McKee [1997] and Field [1982] describe a simple technique, very popular among movie script authors, using small paper cards. The technique consists in writing in each card a description in few words of a scene or sequence, until all scenes are defined. From there on, each scene is incremented with descriptions more and more complete, until they get to their final versions. Different card colours can be used to differentiate between different parts (or acts) of the story.

In other words, the usage of this technique implies building an event hierarchy in the story, using a top-down approach to its resolution. First one must define what the story is about, who the protagonist is, and what's its dramatic need. Then the story is divided into acts and the acts are decomposed into scenes, which are in turn refined into sequences of character actions.

2.3.3.1 Divisions of Fabula

There are several ways to divide a fabula. Usually it begins with the event that "provokes" the story, upsetting the stability of the protagonist's home world. Then the main character goes through progressive complications until getting face to face with a situation (crisis) calling for a tough and momentous decision. After that, the story reaches its highest point (climax) and then moves towards its closing [Howard and Mabley 1995, McKee 1997, Field 1982].

Field [1982], strongly influenced by Aristotle, defined a structure that must be adopted in order for a story to be successful. In summary, this structure (that he called paradigm) comprises three acts, having a turning point at the end of the two first acts. The main purpose of the first act is to present the protagonist and his dramatic needs to the audience, as well as the circumstances in which the events take place. During the second act, numerous obstacles to his goals are presented to the protagonist. And, during the last act, the story is resolved in a relatively satisfying way.

Field defends his proposal, with some reservation: "Do all good scripts conform to this paradigm? Yes. But this does not guarantee that they are good scripts or good movies. The paradigm is a form, not a formula [...] it is what keeps story cohesion. The spinal cord, the skeleton and the story are what determine the structure; the structure does not determine the story" [Field 1982].

McKee [1997] describes yet other divisions into acts that are also used. According to him, stories with many acts tend to cause a smaller impact on the audience.

2.3.3.2 Comparative Studies

There are several comparative studies related to stories, and they often deal with the fabula level, concerning the actions that are performed by the characters.

Among these studies, the work by Propp [1973] is certainly the most utilized in SGSs. This comes from its easy integration with existing Artificial Intelligence techniques, especially those applied to planning/scheduling, and to its appropriateness to game-like scenarios. In his study, Propp defined 31 literary functions, as the building blocks of Russian folk tales.

Lord Raglan [2003], in his study on heroes, traced parallels between several hero stories in mythology, and found some important similarities. Based on his observations, he defined a pattern indicating 22 steps for the hero's progress.

Another comparative study of great importance was performed by Campbell [1968]. His model is one of the most popular in story generation in different media. One can notice its application in a wide range of popular books and movies.

Starting from Campbell's work, Vogler [1998] proposed a method for the creation of stories based on the monomyth. Vogler [1998] claims that stories that follow the steps in the monomyth have a higher chance of being successful.

Even though Campbell [1968] and Raglan [2003] seem to have had far more influence on the actual production of books and films than Propp [1973], we found no reference to the application of their models to current automatic story generation systems, apart from a few casual mentions to Campbell's work. However we believe that their ideas can be very useful to story crafting.

2.3.4 Story (*Narration*)

While the fabula is the set of all events in a story, the *narration* contains only the events that will be shown to the public, laid out in the order in which they will be presented [Bal 1997].

Howard and Mabley [1995] highlight what should be added at the level of narration to enhance the quality of stories:

"A good and well told story includes another crucial element: the way in which the audience lives/feels the story. What a spectator knows, when he gets to know, what he knows that some character does not, what the spectator expects, what he fears, what he can anticipate, what surprises him – all these are elements that are part of the technique of telling a story" [Howard and Mabley 1995].

It is through narration level techniques that the author manages to attract the audience's attention. There are many such techniques, but we will cover only a few of them.

Several techniques depend mostly on the chosen medium, while some others are more general. It is important to notice that each medium has its own attraction mechanisms (cf. for example, with respect to comics, the insightful remarks of Scott McCloud [McCloud 1994, McCloud 2006] on story presentation). Moreover, when a story is adapted from a medium to another — a book to a movie, for instance — many changes may need to be done in order to keep the audience's attention.

When comparing interactive media with non-interactive ones, even bigger differences can be noticed. The techniques presented here are mainly based on non interactive media, or on media with limited interactivity. As a simplifying hypothesis, we shall assume that the narration will be built from an already generated fabula.

According to McKee [1997], curiosity and consideration are two key elements in keeping the audience interested, which can be attained by means of three different techniques: mystery, suspense, and dramatic irony.

In mystery, the characters know something that the audience does not know, but has interest in knowing. In this case the interest is kept due to the audience's curiosity.

On the other hand, in dramatic irony, the opposite happens. It is the audience that knows something that the characters do not know. Attention is kept by the compassion the audience feels towards the characters. According to Howard and Mabley [1995], dramatic irony puts the spectator in a position of superiority and this translates into a feeling of participation.

In suspense, both the audience and the characters have the same information. Suspense then combines both curiosity and consideration. Ninety per cent of movies, comedies and dramas, create interest in this way. In suspense, however, curiosity does not concern facts, but consequences. Characters and audience move side by side through the narrative, sharing the same knowledge. But what nobody knows is "how is everything going to end?" We are led to feel empathy and relate to the protagonist [McKee 1997].

According to Genette [apud Bal, 1997], one way to capture a lesser or greater degree of attention to some specific episodes is to alter exhibition timing. This can be accomplished through ellipses, summaries, slow-motion, and pauses. An ellipsis happens when some event in the story is omitted. A summary, when some event is presented to the spectator in a shortened form. With slow-motion and pauses the opposite happens: a long time is spent with an event regarded as small at the original fabula level.

Another important technique when analysing the narration level is the story point of view [Bal 1997, McKee 1997]. A given story may be seen through different points of view, each one able to result in a complete different experience to the spectators.

3 The Craft of Stories

In this chapter we will discuss the central research topic of this work. In sections 3.1 and 3.2 some related work is mentioned with an emphasis on the attendant terminology, and in section 3.3 we introduce and motivate the term that we chose to designate the topic. Then, in section 3.4, the fundamental problem of this study is presented, and in section 3.5 we discuss a sub-division of the problem into smaller problems. In the last section we offer a few remarks resulting from this discussion.

3.1 Interactive Storytelling

Numerous terms are used to define the field of study in which the generation of stories fits in, the most popular and widely used being *Interactive Storytelling* [Glassner 2004, Crawford 2005].

This term is usually applied in the context of digital games, where, in most cases, the story is already defined before the game begins. In this case, the only role for the computer to play is telling the story and its variations to the player.

Even though the term is adequate to digital games, its use is arguably correct in other applications, especially in applications where narration is not the most important aspect, the act of telling stories being part of a larger process.

Most of the work published in the area is aimed at applications to digital games. In this context, the stronger emphasis is on narrating stories in ways that augment player immersion in the virtual world [Murray 2003, Glassner 2004, Crawford 2005]. But this work sees narration as just part of the whole process, highlighting important conceptual aspects affecting not only the narration but also the generation of stories.

3.2 Narrative Intelligence

Another term that is widely used is *Narrative Intelligence*. According to Mateas and Sengers [1999], the study of Narrative Intelligence tries to relate the usage of narratives in human experience with their applications in Artificial Intelligence.

This is a very wide area, encompassing from the application of narratives to the design of user interfaces to complex systems to interpret stories, including interactive fiction.

The subject of this report can be categorized as part of Narrative Intelligence, which in turn can be categorized within Artificial Intelligence. Even so, the present work concerns a much more specific problem, albeit considerably wide and complex, demanding a great deal of research effort from academia until its main problems can be well understood.

3.3 Story Craft

We propose the use of the term *Story Craft*, defined as: the art and science of applying scientific and common knowledge and techniques to the conception, generation, and narration of stories. Another option would be *Story Engineering*, but, since the approach adopted so far is not so formal, and in view of the consideration given to individual tastes, we feel "craft" would be more fitting than "engineering".

On using this nomenclature, we posit that the generation of stories must be seen as a skilled craftsmanship process, whose methods and techniques to find solution to the problems involved must be precisely (if not formally) specified. In order to tackle this objective, it is necessary to have well defined models concerning what is a story and what is a good story.

As previously discussed (section 2.2), it is not possible to define an ideal or sound model for a good story, as the quality of a story depends heavily on tastes and expectations of those watching or participating in it. One of the goals of story craft, therefore, is to find models that might be used in specific situations, fulfilling the expectations of a good percentage of the interested audience.

Different techniques must be used for the generation of stories according to which model is utilized. The difference between these techniques should then reflect the differences in 'style' among the story generation systems based on each model.

3.4 The Fundamental Problem

The fundamental problem in Story Craft, as described by Guerra [2008], can be summarized as follows:

Problem 3.1 Given a knowledge base subjected to a set of constraints, a computer system should be able to generate and tell stories to a given audience, with or without interaction, in a way that satisfies the constraints.

The generated stories may be original or not, and must obey whatever well defined constraints that may have been prescribed. The necessary data that must be in the knowledge base can, of course, vary from application to application. How the data is gathered, stored, queried, and processed is another issue that must also be addressed.

In order to help understanding the problem, some examples are shown of specifications that one might wish to pass to an ideal process of generation of stories:

- A story with emotion and suspense, that takes place in Rio de Janeiro during the 1960s, featuring a schizophrenic character and leading to a surprising ending;
- A story geared towards seven year old children, that helps them comprehend the geography of Brazil's centre-west region;
- An interactive story where the user plays the role of the protagonist and must try to explain a mysterious series of murderers.

Currently, there is no technology or know-how to, on the basis of just these descriptions, automatically generate quality stories. This is a very hard problem and constitutes one of the great challenges for Artificial Intelligence investigation in this century.

3.5 Sub-problems

As in any process, the first step to take is to get to know better the problem and its inputs and outputs and, only then, look for a strategy for its resolution. Many considerations can be made starting from the problem definition. A first observation is that there is a big difference between the story generation and narration phases.

In the generation phase a story description is produced, containing enough information for starting its future narration. In the narration phase, stories are cast in the form they will be told, more often than not already considering the peculiarities of the specific medium in which they will be presented. It is also at this stage that possible interactions with the audience must be anticipated.

During the rest of this chapter the term (story) *generator* is used to refer to the module responsible for generating stories, and the term (story) *narrator* for the module responsible for the narration of the stories. The term storyteller is not used here to avoid possible misunderstandings, as it is already used with different meanings in different contexts.

Note that any change to the story is performed by the generator. If any unplanned change to the story is made, the narrator must interact with the generator. This way, the narrator can be seen as a mediator between the generator and the audience, which allows for greater flexibility in handling different approaches for audience interactivity.

An example of the passage from generation to narration can be observed in the movie industry. In this kind of production there is a neat separation between the stages of *scripting*, where it is defined in detail how the story develops, and *execution*, where the story is then produced in its final version. In this context, each stage is usually performed by totally different teams.

Another problem in the craft of stories resides in the transfer of knowledge between human authors and the computer. A SGS needs access to some knowledge base that describes how stories may be generated and told. What is this data and what is the best way to build such knowledge base are some of the issues discussed in section 3.5.3.

We propose a conceptual separation of the fundamental problem of automatic story craft into four basic sub-problems:

- Story generation;
- Story narration;

- Knowledge base representation;
- User experience evaluation.

These four problems will be discussed in more detail in the next sections. This separation and the inter dependencies among the separate problems can be more easily visualized in Figure 3.1.

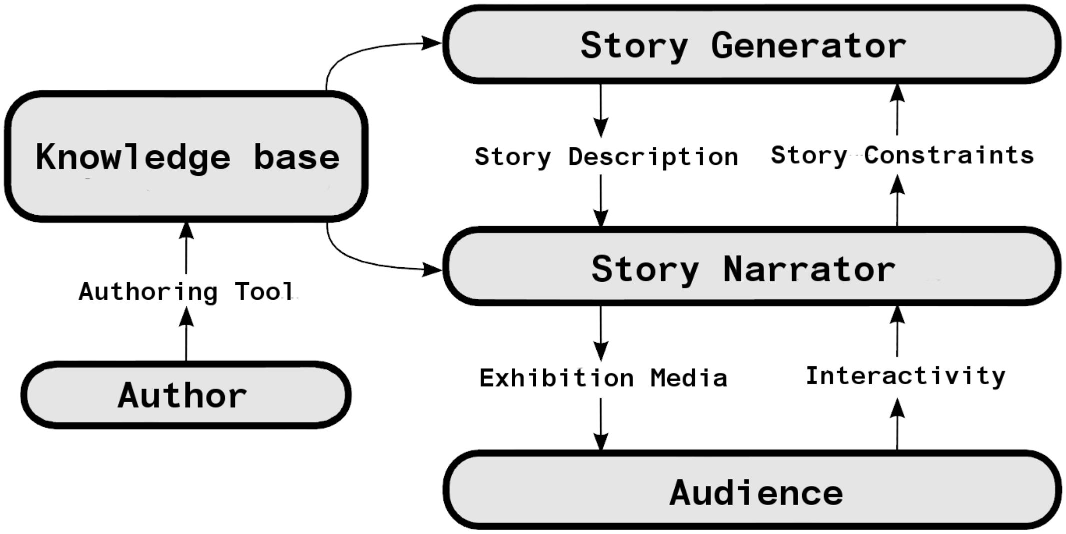

Figure 3.1: Guerra's [2008] schema for the generation and narration of stories

It must be clear that Figure 3.1 refers to the fundamental problem of story craft in an abstract form. It does not refer to a specific implementation.

The fourth problem, user experience evaluation, was not contemplated in Guerra's original formulation; in the figure, it relates to the audience box. As briefly mentioned in section 2.1.9, when describing some systems that try to model user experience, this problem covers a wide range of issues: user modelling; behaviour analysis; plan recognition; user/player/audience points of view; psychology profiling; motivational feedback; emotion and moods; player classification; evaluation of dramatic qualities; etc. Even though determining what makes a story (or its parts) more interesting and rewarding to the audience is an important issue and interesting in itself, further detailing what is needed to properly treat those items is beyond our present scope (except for the brief description already mentioned).

The knowledge base concerns all the available knowledge data, not necessarily stored in the same place or available to every program module. Ideally it should be properly assisted by authoring tools to help prospective authors in creating the story space with less effort.

The generation of stories can be performed in a sequence of steps, the same being true for story narration. Also, an alternation scheme can be adopted, with each generation step followed by a corresponding narration step. The best way to organize this process depends entirely on the needs of specific implementations.

Still, it is important that generation and narration be handled separately. Thus research efforts will be able to focus only on sub-problems pertaining to one or to the other, without the need to address the whole problem at the same time. It is important to note that separating narration and generation does not mean that there can't be an interchange of information between the modules responsible for each sub-problem.

Nowadays it is very common to see the creation of story generation systems whose performance is limited to very specific subjects or scenarios. This makes it difficult, among other inconveniences, to compare different works in story generation. It is important that the research community develop tools that allow reuse across different story generation systems (Guerra [2008] provides a case study on a framework with this issue in mind).

3.5.1 Story Generator

A story generator can be seen as a tool for the creation of stories, at the fabula level. The generator must guarantee that stories satisfy any specified constraints.

A simplified representation of the story generator comprises the generator method itself, the knowledge base to be accessed and the constraints that must be obeyed. The output must be a (simplified) representation of the generated story. For convenience, it is assumed that all necessary knowledge data is available in a single knowledge base.

It is important to stress that the description of the story at the fabula level will always be simplified, since the amount of information necessary for a description fully matching a human author's intuition would be too big for representation in digital media. The degree of simplification, however, varies according to the needs of each application.

Depending on the application it may be possible for the generator to create only story pieces, instead of complete stories. A partial description can be particularly useful to allow interactive generation, whereby the full story is only completed after multiple calls to the generator combined with user interventions.

In addition to generating the sequence of events (fabula level), restrictions can also be set to prepare for the narration. However, the final presentation order and timing of the events can be stipulated by the story narrator (cf. section 3.5.2), as long as it does not violate any of the constraints imposed by the generator.

3.5.1.1 Plot Manager

Plot managers are interactive story generators, which receive as input an already executed piece of story and present as output a suggestion on how to continue the story. Its main function is to effect corrections so that the story plot can develop correctly. If some inconsistency is detected in the input, the manager intervenes in order to reach the original goal, satisfying all the necessary constraints [Mateas and Stern 2003, Roberts and Isbell 2007].

These corrections can be made by, for example, forcing the execution of some events or preventing others from happening. A frequent source of inconsistencies in plots is user interaction, especially when the story narrator allows a high interactivity level.

Plot managers are widely used in a special genre of digital games called interactive drama. In this context, they are called drama managers. A good description of the role of drama managers can be found in the work of Roberts and Isbell [2007].

3.5.2 Story Narrator

A story narrator can be seen as a mediator between the story generator and the audience. It must be able to receive one or more stories from the generator and, possibly, some constraints on how these stories must be told. Having access to a knowledge base, it should manage to tell these stories to an audience, through a pre-determined exhibition medium.

By definition, the function of the story narrator is simply to narrate stories delivered to it. But if by any reason (e.g. user interaction) the input stories become non-valid, the narrator must autonomously ask the story generator to try and fix it or create a new valid story.

Conversely, it is important to recall that the generator/author role does not need to be at all times played by any automatic software facilities. The user himself must always have the option to assume this role.

3.5.2.1 Story Representation

There are multiple ways in which stories can be represented. For example, the story narrator may receive the story under the form of a tree or forest data structure, in which each node represents a possible variation of the story and each edge represents user interaction.

A story can also be represented through a simple sequence of actions and a partial or total ordering. These actions can be grouped into sequences of actions or scenes, which in turn can be grouped into acts. Thus the story can ultimately be viewed as a hierarchy of actions.

Regardless of the chosen representation, the narration should be coherent with the input data, and, if interactive, the narrator must know how to deal with audience interaction in the exhibition medium.

3.5.2.2 Exhibition Media

Every story narration happens through some exhibition medium. Stories can be told, for example, under the guise of comics, text, animation, or digital games, which in turn, according to [Apperley 2006], can utilize different "video-game genres", such as simulation, strategy, action, or RPG.

In the case of comics or film, the interaction is limited to moving a little bit forward or backward, pausing, or resuming. We can say that this is a passive type of interaction where the user cannot change the story generated. In contrast, for example in some digital games, the user can change the story being told, thereby performing active interaction. Active interaction is particularly interesting, because it increases public participation in the story.

On the other hand, this higher degree of interaction can generate inconsistencies in the plot. There are two ways of dealing with the problem. The first is to install a plot manager (as explained in section 3.5.1.1) to remedy the inconsistencies and the second is limiting the power of user interaction.

There are games that restrict the interaction of a player to a few actions (limiting interaction opportunities and possibly affecting user engagement), and other games that give greater freedom to player interaction (thus potentially diminishing the dramatic properties of the experience). It is also part of the role of the story narrator to define the degree of freedom that the player will have when interacting with the story.

Story narrators need to answer two main questions:

1. What actions are allowed to be taken by the audience?

2. At what time can these actions be executed?

A typical “story-focused” digital game allows few actions to be performed by the user, and only at specific moments of the game. The higher the level of interactivity, together with a wider variety of actions, the more difficult it is to guarantee a coherent and interesting narrative. But this is no drawback to more open-ended games which do not adopt a plot-based approach.

3.5.2.3 Interactive Narratives

Mateas and Stern [2003] indicate that there are two main approaches to the interactive narration of stories: structured narratives and procedural simulations.

In the first approach, only a small set of actions is allowed when the audience is interacting with the story, which makes it easier to avoid inconsistencies due to interactions. Thus the stories generated this way tend to have a more coherent plot, but the creation of believable characters becomes more difficult. This is due to the fact that instead of having the characters “striving” for their personal goals, they are often obliged to take “forced” actions in order for the story to have a satisfactory closing.

The procedural simulation approach is very popular among current digital games. It consists of simulations of a virtual world with numerous agents interacting with the player. In this approach it is much easier to have credible characters, as their behaviour is not restricted by plot-related constraints, thus possessing much higher autonomy. The generated “emerging narratives” [Aylett 1999] are the simple result of the player's interaction with the characters of the story, and as a consequence may be poorly structured.

Indeed the distinction between plot-centred and character-centred narratives, which is widely recognized, appears to be similar in nature to the distinction between structured narratives and procedural simulations [Riedl 2004].

There are several studies that seek to establish systems centred both on plot and on characters. One way of achieving this double requirement is through the use of plot handlers configured to correct the possible failures resulting from characters’ actions in the story. An example of such systems is Façade, which was described in section 2.1.5 and, in more detail, in the work of Mateas and Stern [2003]. A possible alternative is to include elements in the story generator that make characters more convincing and credible. An example where such approach is successfully utilized is Mimesis, reported in detail in Riedl [2004].

3.5.2.4 Adaptation

Stories can be adequately adapted to the different media where they may be presented, and also to try and satisfy some audience-defined restrictions and constraints.

For example, one may wish to exclude from a presentation any scenes of violence or nudity that may figure in the description of a story. Or yet, one may prefer to emphasize fight scenes and comic situations. In general, it is possible to show stories in ways that may please a larger number of people.

The adaptation of stories is performed by a special kind of story generator, here called *adaptor*. The main difference between an adaptor and other story generators is that it receives as input a previously created story together with a new set of restrictions. As output, it presents a possibly much modified story that satisfies the additional restrictions.

3.5.3 Knowledge Base

The knowledge base represents the set of all available data for the generation and narration of stories. A story craft application must be equipped with means for the representation, acquisition, storage, and access to this knowledge.

There are multiple ways in which stories may be represented. For example, as mentioned before, the narrator can receive the story as a multi-level hierarchy of actions.

Also, one can represent characters via behavioural rules or some sort of character models. Information on the virtual world, restrictions of the chosen literary genre, user models for interaction with the audience, amongst many other types of information, perhaps even graphical assets, can also be part of the knowledge base.

Having authorial tools in place to make the underlying complexity of the knowledge base transparent to authors is a very desirable goal, especially if the representation uses complex formal models or specialized programming languages. There is not much perspective for a system that places too great a burden on potential authors.

For example, although Façade has been a successful experience, its architecture requires a great effort from the prospective authors. It uses four different content languages; and two years were spent just for authoring a game that has only one scene, two characters, and takes about 20 minutes to complete [Mateas and Stern 2003].

3.5.3.1 Types of Information

Many further details are important for the generation and narration of stories concerning, for instance, the models and techniques presented in sections 2.2 and 2.3.

The amount of information depends on how specific or generic is the literary genre of interest. For example, in stories of chivalry, the characters can wear armour and fight with swords, but the use of motor vehicles and firearms would be incongruous. Moreover, to generate or adapt a story that includes passages through different times and wide spaces it is necessary to have available information on their diverse technological and cultural characteristics.

A simple knowledge base can store information about the specific actions that each character can perform. Axioms with logical propositions (what must be valid within the story world) can also be stored, besides the facts that must hold at the beginning of the story.

Pozzer [2005] proposes to model a literary genre through the use of three conceptual schemas: static, dynamic, and behavioural. The first determines what states are valid in view of the conventions of the literary genre. The dynamic scheme indicates the actions that can be performed by the characters, and defines their pre-conditions and their effects in the world. The behavioural scheme tells how the characters are supposed to react to certain situations, which motivate them to pursue goals compatible with their assumed roles.

3.5.3.2 Story Repository

Studies on the creation of stories teach that reading literary works is a great help in writing books or film scripts [Field 1982, Vogler 2007, McKee 1997, Howard and

Mabley 1995, Aarne and Thompson 1961, Uther 2004]. It is convenient then that the knowledge base be able to include a repository of stories.

Some pieces of past stories can be used and adapted to generate new stories. Examples of such usage are systems that apply case-based reasoning over recorded plots [Fairclough and Cunningham 2003] and the use of a library (or hierarchy) of typical plans inspired in motifs and story functions to support the generation of stories [Karlsson et al. 2006].

Borrowing from existing stories is a standard practice, leading to stories that share common elements (intertextuality). But it is also desirable that the methods for drawing from a repository can manage, as much as possible, to avoid the generation of stories that are too predictable.

3.5.3.3 Reuse

Almost every SGS discussed in this study uses very restricted knowledge bases that can only operate with specific genres. In addition, each SGS usually comes with its own knowledge base implementation, both in terms of structure and data contents, which are often not described in any level of detail. That practically makes any direct comparison impossible between the various existing story generation algorithms.

Although there are similarities between SGSs, no effort was found in the surveyed references to draw up a common knowledge base, which would be rich and flexible enough to be shared with other SGSs. One should also notice that the quality of the generated stories is still very dependent on the quality of the knowledge base used.

3.5.3.4 Common Sense Knowledge

Some stories involve lots of events from people's daily lives. The generation of stories like these will only be possible with the use of common sense knowledge. This kind of knowledge is based on "obvious" information that people have been learning through experience [Minsky 2006]. For example, we all know that walking with untied shoelaces can cause one to trip and fall.

Few studies in the available references make use of common sense knowledge reasoning techniques in the generation of stories [Minsky 2000, Liu and Singh 2002]. But for the creation of more comprehensive SGSs, it is an inevitable necessary step to have access to such knowledge.

3.6 Some Remarks

In this section the term Story Craft was suggested to define an area of study that is of great importance to digital entertainment.

The fundamental problem of crafting stories was presented, and the four sub-problems that must be addressed were discussed: the generation of stories, the narration of stories, the manipulation of the knowledge base, and the problem of evaluating user experience (although the latter was only briefly treated). Some of the issues, approaches, and possible developments of the main problem were also presented.

It became clear to us that this is a difficult problem to tackle and that the current attempts towards viable solutions are still far from satisfactory results, raising a strong demand for research projects in the area.

4 Final Considerations

Interactive storytelling (as a general area of research), although studied for some time, has regained considerable interest recently. Even tough studies on the subject have yielded a number of promising approaches, ideas, and experiments, it is still a problem far from settled.

Most of the research on IS has focused on developing systems for specific "experiences", i.e. to a simple specific story; important examples are Façade [Mateas and Stern 2005] and Mirage [El-Nasr 2007]. The somewhat narrow scope of those efforts confirms that IS is a complex problem, and that it may be advisable to invest on more controlled experiments. Also, most of the approaches presented here fail to break down the problem into manageable sub-parts, which would have made it less difficult to reuse components, or at least to compare different initiatives.

Except for a few soap-opera-inspired systems [Lebowitz 1985, Barber and Kudenko 2007, Thue et al. 2007, Weyhrauch 1997], there are few generative approaches and few attempts to present a conceptual model for a given genre (one such ongoing effort is the LogTell-R prototype [Furtado 2008, Karlsson et al. 2009], featuring a conceptual model and a model-based generative system).

Another interesting area that has been amassing efforts is the management of user experience in an IS environment. As the presentation of the different approaches to user experience in Section 2.1.9 suggests, this includes evaluating pieces of stories or continuing episodic storylines ("story arcs"), but — perhaps more importantly — modelling the user intentions or motivations while the system is running in order to improve the "interestingness" of the story and users' engagement..

Even after defining and breaking down the problem (proposing possible structures to represent story knowledge and user models, how to create/populate such models, and story generation per se), a lot of effort remains to be done in the area of dramatization or visualization of the stories. The final objective should be to provide to the target audiences some sort of engaging and immersive environment.

Efforts towards automatic background music generation [Casella and Paiva 2001], light control for dramatic intensity [El-Nasr et al. 2006], animation systems that convey emotions of the characters [Perlin and Goldberg 1996], and intelligent camera placement [Passos et al. 2008] are additional indications of the broad scope of the area.

Pervading all the above research lines is a concern with the development of tools, especially for non-technical users. Little attention has been given to the creation of tools for designing, populating and exploring the supporting knowledge bases and, in general, to help prospective authors at the various stages of story composition and adaptation. It is unrealistic to expect that the field of IS will effectively take shape and gain popularity while there is scarce user-friendly support to the creation of interactive content by prospective authors.

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