Schemas in Directed Emergent Drama

Maria Arinbjarnar and Daniel Kudenko

Department of Computer Science
The University of York
Heslington, YO10 5DD, York, UK
maria@cs.york.ac.uk, kudenko@cs.york.ac.uk

Abstract. A common problem in creating interactive drama is the authoring bottleneck. If pre-authored stories are directly incorporated into an interactive virtual environment then there is a need to consider all possible interactions and story twists, which for a sizeable drama is infeasible.

One proposed solution to this problem is to use search and planning algorithms along with narrative structures. This leads to a huge state space and planning becomes intractable for real-time solutions.

A way to address this problem is to distribute the story planning to autonomous characters so that the drama emerges from their interactions. However without predefined structure or directives the drama is unlikely to emerge into the intended story or even the intended genre.

We propose to divide the drama into narrative episodes which we call schemas. Schemas are used by a director and a set of actors to structure the drama so that it emerges into a fully developed drama. The schemas are pre-authored in an abstract way such that they can be deployed multiple times in the same drama, which removes the authoring bottleneck. In this article, we define the structure of the schemas and how the director and actors use schemas in Directed Emergent Drama (DED).

1 Introduction

Creating a truly interactive drama is a difficult challenge. The response of actors needs to be believable, i.e. it needs to be influenced by that which has transpired immediately before and the character's state of mind as well as the emergent drama as a whole. At the same time the emergent drama needs to conform to a specific genre and to a dramatic arc with the expected rise and fall in suspense for the player to be fully immersed in the ongoing drama.

We use a central agent, the director, that directs – but does not prescribe – actions of a set of autonomous actors. By the term "directs" we mean that the director is giving general directions in the form of schemas that guide the actors in developing the drama and engage the player in a Directed Emergent Drama (DED). The director chooses schemas dependent on how the drama plays out and the actions of the player, rather than following a pre-authored script. The schemas are not sequentially ordered, each actor will be in more than one schema at any given time and some schemas are deployed multiple times during each drama.

The actor's goal is to entertain and engage the player and to conform to the intended genre. We ensure that the DED conforms to the intended genre by making the actors responsible for the emergent drama.

For the director and actors' decision mechanism we use Multi-Agent Influence Diagrams (MAIDS) that have been proven to grow linearly with respect to the number of decisions [7]. This is far better than many planning techniques such as STRIPS which is PSPACE-complete [4].

Our first test bed for DED is the classical English murder mystery. The murder mystery genre is a good test bed due to its fairly simple and generic structure and repetitive motifs.

2 Related work

The novelty of our work is focused around the use of schemas (as we define them) and Multi Agent Influence Diagrams (MAIDS) [7] – which extends Bayesian network and influence diagrams to represent decision problems involving multiple agents.

Our work is in many ways based on the findings of the OZ system [6]. They did a study on live interactive drama with a director, actors, script, observers and player and discovered that it is important to have the player in control of the speed at which the drama proceeds. The player seems to be ready to justify most actions by the characters as being part of the drama, but considers interactions with the director as an intervention.

Facade is comprised of a Drama Manager, beats, characters, story values, actions and natural language processing [10, 11]. Contrary to the schemas in DED the beats are explicitly pre-authored in such a way that all actions within the beat are authored explicitly, and the actions for all roles are strictly coordinated to allow for multi-agent coordination ([10], p.45). Additionally all higher level goals and behaviours that drive a character are located in the beats rather than the character. Still the character retains some autonomy when it comes to base level goals and actions such as facial expressions or personality moves ([10], p.45).

The Interactive Drama Architecture (IDA) [9] uses a director and a set characters that enact a fully structured story that is authored by a human author. The director in IDA gives direct commands to the characters, and the characters have very little autonomy.

IDtension [14] bases it's approach on narratology and structuralism. The system is authored by defining and scripting a set of tasks that need to be completed in a causal order to complete a certain goal. There are several such causal pathways to complete each goal and thus it provides an emergent drama to a certain degree. It does not use centralized command as DED does, or anything similar to schemas.

GADIN [3] is an emergent system for creating clichéd dramas, as are commonly found in soaps. The system uses central planning to generate actions for characters in the game world with respect to the characters' personalities and current interests, rather than distributing the planning between the characters. The system periodically generates dilemmas to create conflicts in the unfolding drama.

The FAtiMA agent architecture [2] is a character based system that uses lessons from live action role-play games(RPGs) and pen and paper RPGs. They emphasises on the need of a Games Master (GM) to guide the emergent narrative without constricting the interactive play. The GM uses hierarchical planning and way-points to help it in plotting the narrative in response to the interactive play between characters. DED uses schemas rather than way-points to structure the drama and distributes the computation between the autonomous decision mechanisms of the actors.

3 The Murder Mystery Drama

The DED architecture is intended for any type of drama, we choose the murder mystery as an initial set-up because it is very structured and contains well known motifs. A typical English murder mystery can be divided into 3 acts, a prologue, a large middle part and an epilogue [15] and it is shaped into a dramatic arc with exposition, complication, climax, fall, and closure [12].

In act I, the exposition, the characters are introduced, the scene is displayed including any secret drawers, hidden compartments, etc. The inciting event is the discovery of the body.

In act II, the complication, the detective interviews all suspects and observes all clues. Many of which are irrelevant to solving the mystery. This means that all clues are revealed by the end of act II.

In act III, climax, fall, and closure, the murderer is revealed by showing that only the murderer had motive, means and opportunity.

We can see from this that there are certain definable goals that need to be fulfilled before progressing from act I to act II and from act II to act III. The three acts can be further divided into even smaller sections, or schemas. Schemas have a much quicker rise and climax than the main drama, albeit less intensity, and thus serve to keep the player engaged [5].

4 The External Structure of Schemas

The director overlooks the emergence of the drama and uses schemas to direct the drama by giving the actors appropriate schemas to play out.

The drama can not move between acts until the objectives of the acts have been adequately satisfied. As an example, the drama will not move from act I to act II until characters' key characteristics have been exposed. If a character is to be intelligent, playful and curious then she needs to have played out actions that are intelligent for a value above a given threshold $\mathcal{T}$, and the same for playfulness and curiosity.

Skilfully winning a chess game or making 3-4 correct estimates about, for instance, the age of old furniture or showing good arithmetic skills would be sufficient. The algorithm summarises the percentiles to see if it has reached the threshold $\mathcal{T}$. The director's role is to give the actors an opportunity to show their characteristics by choosing schemas that would be a good fit.

In the example of the murder mystery then characteristics are revealed, but not in direct connection to the true motive behind the character's actions. The player will need to connect motives with actions and characteristics of the suspects. The same applies to revealing clues. The clues should be clearly observable but the player needs to understand how they can be a piece in the puzzle and how to put the pieces together to make a whole picture.

Each schema has a finite set of roles that are annotated as being essential or non-essential. It is only necessary to fill the essential roles to successfully execute a schema, the non-essential roles add variety and increase flexibility. Each role is annotated with a finite set of characteristics that it supports. The characteristics also have a numerical value attached to them, this represents to what degree the display of this characteristic is supported by the role, (see Example 1).

The director uses the set of characteristics to match the roles to actors trying to deploy the schemas that best compliment the various characteristics of the characters. The director is not in a good position to make decisions about direct interactions with the player, because the director would need to be constantly aware of everything that takes place – including the internal state of every character in the drama. This would quite rapidly escalate into an intractable computation problem for the director.

The schemas themselves are annotated with the type of clue they can reveal and which act they belong to. The director uses these annotations to filter out schemas that are not appropriate for the current part of the drama. For instance, the director will not consider deploying the *find the body* schema until the victim has been properly introduced.

Example 1 (Interrogation schema). There must be a suspect to interrogate and there can be some witnesses and some policemen present, This schema would be deployed multiple times during the drama. Only the *suspect* is a necessary role besides the player who is the interrogator:

- Drama annotation: can be used in act II only, reveals motive and opportunity to a large degree and means to a small degree.
- Roles: at least one suspect; zero or more witnesses; zero or more policemen.
- Suspect: $\{0.8 * \mathit{intelligence}, 0.7 * \mathit{gullibility}, 0.9 * \mathit{arrogance}, 0.3 * playfulness, 0.1 * \mathit{competitiveness}\}$.
- Witness: $\{0.4 * \mathit{intelligence}, 0.8 * \mathit{gullibility}, 0.9 * \mathit{arrogance}\}$.
- Police: $\{0.8 * \mathit{intelligence}, 0.8 * \mathit{gullibility}, 0.9 * \mathit{arrogance}, 0.9 * \mathit{competitiveness}\}$.

5 The Internal structure of Schemas

The schemas do not occur in a strict sequential order. Instead the schemas are overlapping and actors typically play out multiple schemas at any given time. The actor uses the schemas to determine which action to carry out. However note that the actions are influenced by the characteristics and state of the character, which are not imposed by the director or the schema. In this way it can be ensured that actions are always coherent and consistent, even when multiple schemas are active.

The role that an actor plays in a schema is represented by a finite set of actions that the actor can choose from. Some of these actions are essential in that she must play them to complete the schema, and some are not. These actions are annotated by a set of feelings and a set of characteristics that the action can represent. The actors march these sets with their current state of feelings and with their characteristics.

We see an angry woman as *aggressive* if she shakes someone and we see a happy woman as playful if she shakes someone. The action of shaking another character is annotated with both aggressive and playful. The player can be safely trusted to interpret it as intended because they will have seen a happy character laughing, smiling and generally acting in a happy manner, while the angry character will have demonstrated angry behaviour. It may be that a character should show playfulness when happy but not when she is angry. This is achieved with a Bayesian net that the actor uses to gouge the current status of the character she is playing, i.e. the character will be more playful when happy.

The actors' goals are to engage the player and to support the drama progression. The actor is aiming to demonstrate those characteristics of the character they are playing which have an associated value above a given threshold and to meet any other required goals within the unfolding drama. Because the actor is responding directly to the player, she may find that demonstrating characteristics other than those intended by the director will better serve these goals. This is good as it increases the probability that the goals of the act will be reached in response to the actual interactions of the player and other actors.

The schema also contains any knowledge that is necessary or useful in playing the schema in the form of a Bayesian network. The actor uses a Bayesian network as a knowledge base and to describe her beliefs about: other characters; the player; and the state of the drama environment. For more details on this application of Bayesian networks see [1].

6 Outlook and Conclusions

Implementation of these techniques has begun in Libsecondlife [8] and C#, which is a library to program bots that can log in and act in every way as an avatar in the Second Life virtual world [13]. Second Life is a good test bed as it allows access to a very large pool of testers. Libsecondlife has been tested to the extent that we have been able to determine that it is robust enough to support our implementation of DED.

The work completed thus far shows great promise. The schemas are an excellent way of dividing the drama into manageable narrative structures; and defining the roles, action, and knowledge base of the actors.

Complexity is clearly reduced by our architecture as the autonomous agents need only tackle problems that directly affect their own goals rather than attempting to optimise plans for multiple other agents. Additionally, this type of distributed computation greatly simplifies computing by reducing the size of each problem with clearly defined structures and filters.

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