Applications of AI Planning: Story Telling

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1 Introduction

The classic types of problems dealt with in the field of artificial intelligence planning are problem-solving tasks where the length of plans and the time for finding them are to be minimized. This is referred to as "classical planning". AI planning in this traditional sense is already applicable to various practical tasks, such as route planning or logistics. Additional areas of application can be found where the task at hand can be modeled in a way that is structurally similar to classical planning problems. One such area is *story telling*, where AI planning has been applied for well over a decade and currently is the dominant technology in use[1].

For a first intuition of how "story telling by means of planning" can look like, one can consider a story as being modeled as a sequence of actions performed by story characters. Given an initial world state, a goal and a set of characters with certain actions they can perform, a planner can create a coherent story leading from its beginning to the end. This is, of course, just a very basic notion. The inherent differences between classic problem-solving tasks and stories lead to significant deviations from techniques in classical planning and interesting challenges when more sophisticated approaches to narrative generation are considered.

The remainder of this document is a general introduction to story telling as an application area of AI planning. It is structured as follows:

- Section 2, "Differences to classical planning", describes what differences arise when dealing with stories instead of classic problem-solving tasks as a basis for planning.
- Section 3, "Story world modeling", discusses ways of translating a story into a planning problem.
- Section 4, "Concrete approaches", showcases two approaches of using planning for story telling.
- Section 5, "Conclusion", sums up the subject matter with a short discussion.

2 Differences to classical planning

Although the process of generating a story can be modeled as a planning task, the underlying nature of a classic planning problem and a narrative is very different. As a consequence there are similarities at a coarse level and differences once more complex properties are taken into account. An essential similarity on a very simple level: both the solution to a planning problem and a narrative are a sequence of successive steps, leading from a beginning to an end. In contrast, a key difference: a desired quality of a classic planning problem solution is shortness. Qualities sought in narratives, however, are less easily quantifiable, aesthetic properties such as "interestingness" and "originality". While there is no obvious solution as to how such properties can be encoded in a planning problem and optimised for, it is easily recognizable that shortness is not an optimum. A basic approach towards generating interesting stories is introducing variation. For a given, rough outline of a story, variation in character actions (within reasonable bounds of the story world) or changes in perspective can make for an interesting narrative.

Depending on what properties of a narrative are taken into account, further requirements or constraints have to be considered. These can sometimes be incorporated into the modeling of the story world – such that the resulting planning problem can be solved by an off-the-shelf solver – some efforts, however, make use of custom a solver. An example for such a solver, tailored for narrative planning, is IPOCL[2], which takes causality and character intentionality into account.

Since a common use case for narrative planning is interactive story telling, there is a need for systems capable of replanning in response to changes to the story world introduced by a human element. This is less of a difference between classical and narrative planning in and of themselves but a special requirement for certain narrative planning systems due to forementioned characteristic use case.

3 Story world modeling

The notion of a story as a sequence of character actions is easy to understand. However, the actual modeling of a story world as a planning problem can – depending on the level of sophistication of the modeling – be quite involved.

As a baisc example, consider the following story:

> "In a fictional world with a continent named Westeros, the high-born refugee Viserys sold his younger sister Daenerys to a warlord in exchange for the warlord's army. He used the army to conquer Westeros and become its king."

In order to create a planing problem from this textual representation one has to decide on how to identify predicates and operators. From there, initial and goal states can be defined. Actions can, for example, be acts carried out by characters and predicates the character's circumstances. For above example this would yield the predicates $A = \{\texttt{V-has-army}, \texttt{V-king}, \texttt{D-sold}\}$ and operators $O = \{\texttt{V-sell-D}, \texttt{V-conquer-W}\}$ where:
$\texttt{V-sell-D} = \langle \neg\texttt{V-has-army} \wedge \neg\texttt{D-sold} \ , \ \texttt{V-has-army} \wedge \texttt{D-sold} \rangle$
$\texttt{V-conquer-W} = \langle \texttt{V-has-army} \wedge \neg\texttt{V-king} \ , \ \texttt{V-king} \rangle$
Building upon the identified predicates:

$\texttt{I} = \neg\texttt{V-has-army} \wedge \neg\texttt{V-king} \wedge \neg\texttt{D-sold}$	(initial state)
$\gamma = \texttt{V-king}$	(goal formula)
$\Pi = \langle A, I, O, \gamma \rangle$	(planning task)

Above example shows how a very minimal story can be modeled as a planning task but it doesn't really make it clear why this would be useful. The problem is, that it is a mere one-to-one "translation" and solving the planning task results in nothing more than the story which was used a as starting point. Narrative generation becomes useful once its result is something *new*. This is the case, for example, when things like story variations or interactivity are introduced or when planning story structures based on fundamental world rules and a set of characters. This is also when the modeling process becomes more involved. Chapters 4.2, "Planning a fabula", and 4.3, "Planning a discourse", will describe two instances of such modeling approaches in more detail.

4 Concrete approaches

4.1 Narratology excursion

The following two subsections (4.2 and 4.3) will showcase two concrete cases of story telling by application of AI planning. Because they approach the

subject matter on different levels a distiction is required. It will be necessary to distinguish between *fabula* (or *story*) on the one hand, and *discourse* (or *plot*) on the other hand.
Chatman writes in [3] (furthermore cited in [4]):

> "In simple terms, the story is the *what* in a narrative that is depicted, discourse is the *how*."
>
> (Note: Since *story* and *plot* are more commonly used in everyday language and might lead to confusion or wrong assumptions the remander of this document will refer to the two concepts as *fabula* and *discourse*.)

To illustrate the difference with an example: viewers of a movie might be presented with a character A, talking about what a character B has done (assume A's report to be truthful and B's action to be relevant for the movie). On the level of the fabula (the narrative structure), we have B doing something. On the level of the discourse (how this is conveyed to the recipient) we have A talking about it. When watching a movie or reading a book one is presented with a discourse and automatically constructs a fabula in their head.

4.2 Planning a fabula

[5]

4.2.1 Story world modelling

4.2.2 Planning

4.3 Planning a discourse

[1]

4.3.1 Story world modelling

4.3.2 Planning

5 Conclusion

References

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