Expressive Range Analysis of a Possible Worlds Driven Emergent Narrative System

Ben Kybartas(✉)[1], Clark Verbrugge[1], Jonathan Lessard[2]

[1] McGill University, Canada
ben.kybartas@mail.mcgill.ca, clump@cs.mcgill.ca
[2] Concordia University, Canada
jonathan.lessard@concordia.ca

Abstract. Analyzing the potential and affordances of emergent narrative systems is an ongoing challenge, especially in novel or experimental systems. In this poster we explore the use of expressive range analysis (ERA) [1] to analyze an emergent system based upon the possible worlds model of Ryan [2]. We introduce the system and the properties of conflict that can be identified in a given work made in the system. The ERA analysis is performed by treating an emergent system as an exploration of a conflict space through actions. This paper serves as a foundation for deeper exploration of possible worlds narrative systems and quantifiable means for understanding them.

Keywords: Emergent Narrative, Possible Worlds, Expressive Range Analysis

1 Introduction

Emergent, or simulationist, narratives are an approach to interactive storytelling that often eschews the concept of fixed linear plots, in favour of exploring the potential of character-driven simulation [3,4]. A concern in many such systems is understanding the ability of the system itself to express certain narrative properties, and also how to evaluate the possible narratives of a given work designed in the system. Often, evaluation is done through user studies or the analysis of specific playthroughs [3], however deeper, player-agnostic and formal means of analyzing such systems remains interesting challenge. In this paper we analyze an emergent narrative system based upon the possible worlds (PW) model of Ryan [2] using expressive range analysis [1]. The system is described in a previous work [5], and models characters as having a set of desires treated as possible worlds of the current state of the actual world in the system. To analyze this system, we re-frame it as a set of generative methods for creating *conflicts*, using Ryan's definition of conflict as conflicting values between possible worlds. This allows us to use expressive range analysis to see the *space* of possible conflicts given by an initial configuration of the system, as well as how these conflicts may be realized through the available *actions* which may be taken in the system. Although preliminary, the aim of this work is dual purpose, both to

Themes = {*Hunger*, *Pride*} Actual World = $\langle T, F, F \rangle$
Propositions = {*Has cheese (Raven)*, *Has cheese (Fox)*, *Showing off (Raven)*}
Actions = {*Take Cheese*, *Sing*}

Action	Precondition	Postcondition
Take Cheese	$\langle F, F, \bot \rangle$	$\langle \bot, T, \bot \rangle$
Sing	$\langle \bot, \bot, \bot \rangle$	$\langle F, \bot, T \rangle$

Characters = {*Fox*, *Raven*}

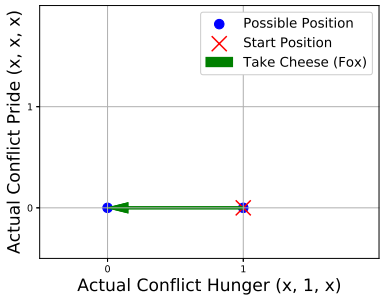
Character	Actions	Worldviews	
		Hunger	Pride
Fox	{*Take Cheese*}	$\langle \bot, T, \bot \rangle$	$\langle \bot, \bot, \bot \rangle$
Raven	{*Sing*}	$\langle T, \bot, \bot \rangle$	$\langle \bot, \bot, T \rangle$

Fig. 1: The components of the narrative system for modelling the "Fox and the Raven" fable.

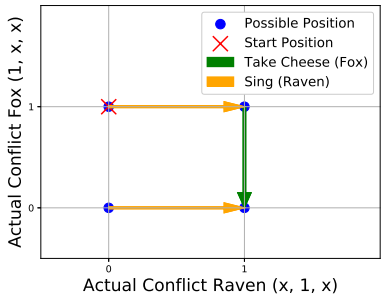
analyze a given work made in the system, but also in more deeply understanding Ryan's original model and perspectives on conflict and narrative.

2 Possible Worlds Model

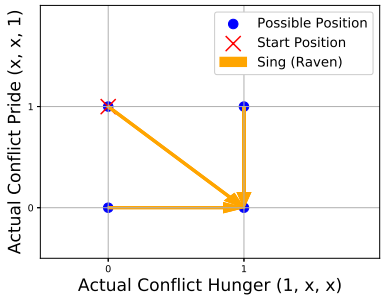
Our system implements Ryan's concept of *wish worlds* and *conflict*. Essentially, in the system each character has a set of *wish worlds*, which are the ideal states of the *actual world* according to some theme (e.g. politics, religion, personal desires, etc.). The goal of each character is to make changes to the actual world through actions so that all the propositions in their wish worlds are true. However, this is impossible, as each character has different desires and even their internal desires may conflict. The resulting narrative then, emerges out of the character's attempts to achieve their goal, and the resulting conflicts that emerge both internally and between characters provides the main conflicts. The system is described in the previous work [5], but in essence our system consists of a set of *characters* and an *actual world*, with each character having a set of desired *worldviews* and a set of *actions* they can take. Both the actual world and each desired worldviews are a vector of values (in this case boolean) that show the state of each possible *proposition* in the world. Notably a character may not care about the state of a proposition in a given worldview, indicated by $\bot$. Each desired worldview is labelled with a specific *theme*, and each character has one desired worldview per theme. A *conflict* is any proposition for which two worlds hold a different value. For example, if two characters disagree on a given proposition for a worldview, then this is identified as an *interpersonal conflict*. An *internal conflict* occurs when a character has two worldviews that conflict (e.g. their religious beliefs conflict with their political beliefs). Lastly, the *actual conflict* is the number of propositions where a worldview's values differs from that of the actual world. This is in essence the Manhattan distance between the actual world and a given worldview, and we say the *distance* between any two worlds is number of propositions for which each world has differing values. In



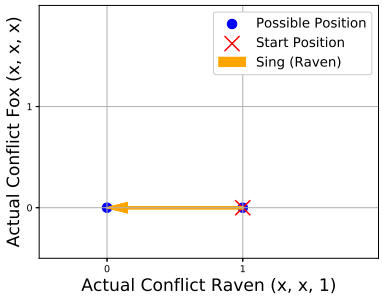
(a) Internal conflict space of the fox



(b) Interpersonal conflict space of hunger



(c) Internal conflict space of the raven



(d) Interpersonal conflict space of pride

Fig. 2: Interpersonal and Internal Potential Conflict in the "Fox and Raven".

Figure 1, a formal model of the Aesop's fable of the "Fox and the Raven" is shown, with two characters, the Fox and the Raven, two themes of the story, Pride and Hunger, as well as a set of actions.

3 Analysis

In this section we explore the potential space of conflicts afforded to us by the system with the "Fox and Raven" model using expressive range analysis. As stated previously, the core of the system surrounds each character's attempts to align all their worldviews with the actual world, however this overarching goal is impossible due to the constraints of actions and the interpersonal and internal conflict. What is then interesting to understand is precisely how each component affects this overarching goal and, in essence, the shape they form. Any action taken in the actual world will affect the actual conflict of each worldview, and we can thus treat any action as a change in distance for all possible worlds in the system. To create a conflict space, for each set of worldviews, the system iterates over all possible states of the actual world, and at each point plots the

actual conflict for each worldview giving the expressive range of what areas of conflict we can explore in this given work. In each figure, arrows show directions we can move in the space given some action, ie. if this action is taken, then the two points mark the new actual conflict for both worldviews at the new actual world. For simplicity, we do not mark any action that keeps both worlds at the same distance. In this sense, the actions show the possible paths through the conflict space and any point that does not have at least one arrow entering it is considered "inaccessible" unless it is the start position. Since the overarching goal is for all worlds to have an actual conflict of zero, we can say that for the internal space, both characters want to reach point (0, 0), and for interpersonal space, they care more about reaching a position where their own conflict is 0. If the 0 position does not exist, or is inaccessible, then we are in a state where that particular conflict can never be resolved.

For the "Fox and Raven" work, there are four two-dimensional conflict spaces, the internal conflict space of the fox and raven, and the interpersonal conflict space for hunger and pride. Figure 2 shows each conflict space. In the case of the Fox and Raven, we can see that the fox's internal conflict (Figure 2a) and the pride interpersonal conflict (Figure 2d) may be resolved. Essentially, the fox need only take the cheese to be fully satisfied, and the raven singing fulfills pride. This is sensical, since the fox has no particular care about pride, nor the raven singing, so neither direction creates any conflict. The main source of conflict, however is hunger (Figure 2b) and the raven (Figure 2c). Focusing first on hunger, we start in a state where the raven is fully satisfied, and the fox is conflicted in terms of not having cheese. There are, however, two actions which can resolve the fox's hunger, which is the raven singing followed by the fox taking the cheese. The (0, 0) point is inaccessible, thus we see that the interpersonal hunger conflict cannot be resolved. Similarly for the Raven, the optimal point is never accessible, with the only possible action being one that conflicts the hunger. Interestingly, a state where the fox and raven both have cheese and the raven is singing is ideal for both characters, however there is no set of actions that can make that actual world possible.

4 Conclusion

Possible worlds afford a number of possibilities for emergent narrative. In this paper, we used Ryan's work on possible worlds as an inspiration for an emergent narrative system and used Ryan's concepts of conflict to be able to quantify conflict in the system. We used this quantification in tandem with expressive range analysis to explore how conflict may be treated as an abstract space that is explored through actions. In an attempt to model a short fable, we showed some of the complexities of the conflict space, and we propose that expressive range analysis may be used even at the authoring level. Future work aims to further extend this analysis, ideally to the creation of an authoring tool that can assist in the production and understanding of larger works, as well as visualizing how new extensions to the system affords new manipulation of the conflict space.

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