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Modeling Narrative Conflict to Generate Interesting Stories

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Abstract

From subtle political intrigue to outright physical combat, conflict is essential to interesting stories. Narratology research emphasizes that conflict provides structure and engagement, so narrative systems stand to benefit greatly from a computational model of this phenomenon. We present such a model based on AI planing, along with formulas for measuring seven essential properties: participants, subject, duration, directness, intensity, balance, and resolution. We also sketch an algorithm which uses this model to create stories structured around a central struggle.

Introduction

The field of Narratology tells us that conflict, from an argument between lovers to a war between nations, is a key component of interesting stories. Abbott notes that it is "so often the life of the narrative" (2008). Herman, Jahn, and Ryan go so far as to declare it a "minimal condition for narrative" (2005), while Brooks and Warren tell us that "story means conflict" (1979).

Screenwriting handbooks also highlight the importance of a story's central struggle (Vale 1973; Egri 1988; Tierno 2002). Conflict is a primary source of interest because it provides impetus for the plot to move forward and it keeps the audience engaged (Gerrig 1993; Abbott 2008)

Scholars analyzing computational storytelling have come to similar conclusions (Meehan 1977; Szilas 1999; Sgouros 1999; Barber and Kudenko 2007; Medler, Fitzgerald, and Magerko 2008). Szilas, creator of IDtension, declares that "conflict is the core of the drama" (1999).

Despite this universal agreement on the importance of conflict, little has been written to explain or define it. Even Aristotle neglected to discuss conflict directly (Tierno 2002). Perhaps it is so ingrained in our consciousness that critics do not see a need to explain it. Since machines have no such consciousness to fall back on, this important topic demands a more direct analytical treatment.

The most familiar form of conflict in video games is violence. Crawford offers one explanation:

> Game designers cling to violence only because they cannot imagine other forms of conflict. [...] Violence in games in like Wagner played for 18 hours with the bass turned up. [...] It's overdone. It's so much of the same thing that it's distasteful. (Crawford 2003)

We feel he misses a key point: violent games like *Space Invaders* are much simpler than social conflict games like *Façade*. More subtle forms of conflict require more sophisticated AI models. We attempt to provide such a model here.

First we define conflict and discuss how it can be represented with AI planning. We then set out seven important dimensions of conflict: participants, subject, duration, directness, intensity, balance, and resolution. The ability to control these seven dimensions allows a system to produce many different kinds of conflict. We conclude with an overview of a story generation algorithm based on this model.

Conflict is a defining feature of narrative. The ability to represent and reason about it will increase the ability of digital systems to manipulate narrative at a very fundamental level and will widen the spectrum of stories they can produce.

Previous Work

In order to focus on other aspects of story, many narrative systems have avoided formalizing conflict by leaving the basic plot in human hands. In his description of UNIVERSE, Lebowitz states:

> The goal state is simply assumed to be an interesting one with no further justification other than our own experience with melodramatic stories. This avoids the need for detailed analysis of what makes a plot fragment interesting. (1985)

Many narrative systems use similar assumptions, and thus they implicitly model conflict by providing plot structures that must contain it. This is a valid solution, but it relies on human authorship which is scarce and expensive. Also, the system does not embody an understanding of conflict, so it cannot adapt an interactive story on the fly if the central conflict is compromised.

Early narrative systems modeled the relationship between protagonist and antagonist with zero sum games or adversarial planning (Smith and Witten 1987). This approach oversimplifies the motivations of characters; they should act against one another only when they must do so to achieve their goals.

Barber and Kudenko generated stories using momentary dilemmas—user choices that affect the fortunes of characters in the world (2007). This work models narrative principles, but it only represents a small subset of all possible conflicts, and since their dilemmas are resolved immediately they cannot express developing or thematic struggles.

Medler, Fitzgerald, and Magerko did preliminary work on sociological models of conflict (2008), and Zambetta, Nash, and Smith modeled conflict as an arms race scenario using a system of linear differential equations (2007). We believe narratology will provide a more effective foundation for fictional story generation than these because it focuses more on engaging story structures than real world simulation.

A Multi-World Planning Model of Conflict

The *Routledge Encyclopedia of Narrative Theory*, *A Dictionary of Narratology*, and the *The Cambridge Introduction to Narrative* provide subtly different definitions of conflict, but they all focus on a single idea:

> [Conflict] is the thwarting of intended actions by unplanned events, which may or may not be the effect of other characters' intended actions. (Herman, Jahn, and Ryan 2005)

At the heart of conflict is planning; it occurs when a goal-seeking agent encounters difficulty in carrying out its plan. These difficulties may arise from the environment or other agents (external conflict), or even the agent itself (internal conflict).

The mature AI formalism of STRIPS-style action representations combined with partial order causal link (POCL) planning provides the foundation of our representation. It was chosen over other planning formalisms because it closely resembles existing narratology models (Cavazza and Pizzi 2006) and is readily mapped onto psychological models of story comprehension (Christian and Young 2004).

Creating conflict is an interesting challenge for a planning system because it needs to create plans which are incompatible. We adopt a simulation model similar to other modern narrative systems (especially Cavazza, Charles, and Mead, 2002; Brenner, 2010) in which multiple agents with different beliefs and goals are continually planing, acting, and re-planning to generate a story. In this model causal links, a construct originally used for avoiding conflict, can be extended to capture useful narrative properties while still providing logical soundness. In the remainder of this section we provide informal definitions of terms used to describe conflict.

Plans A **plan** is a partially ordered sequence of steps which are instances of STRIPS-like operators (Fikes and Nilsson 1971). An **operator** represents an action with **preconditions** which must be met before it can be executed and **effects** that describe how the world is changed afterward. The first, or **initial step**, has only effects representing the initial state and the last, or **goal step**, has only preconditions representing the desired final state.

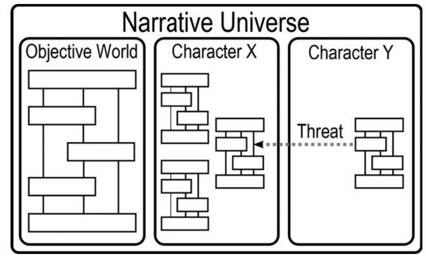

Figure 1: A multi-world planning model of conflict.

World states, as well as the preconditions and effects of operators, are described using first order atomic sentences. People, places, and things in the planning universe are represented as logical constants.

Ordering constraints, in the form $s_j \prec s_k$ where s_j and s_k are plan steps, define a partial ordering of events. Ordering constraints can exist between two steps in the same plan or between steps from different plans.

Character Worlds The planning **universe** consists of multiple worlds: one objective world and one world per character[1]. A **character world** is a private mental space in which an agent forms plans to reach its goals. The state of a character world reflects the agent's beliefs about the objective world (which may be incorrect). An agent's plans reflect how it wishes events in the objective world to proceed based on its beliefs.

The **objective world** has exactly one plan—the **objective plan**—which describes how things actually occur in the story. It is equivalent to a narrative *fabula* (Propp 1968). This plan is composed of the successfully executed steps from agent plans. For purposes of detecting conflict, the objective world can also represent the environment (see footnote 1).

As we will see later, conflicts arise when incompatible plans form in the various worlds of the narrative universe.

Intentionality All character plans have a **window of intention** $\{s_j, s_k\}$ where s_j and s_k are steps in the objective plan such that $s_j \prec s_k$. Before s_j, the character has not yet formed the plan. After s_k, the character no longer intends to carry out the plan. Note that s_k may occur before the end of a plan, representing a plan which has been abandoned before completion. Steps outside the window are preserved to make the character's motivation explicit.

The objective plan can be said to have its own first and last steps as a window of intention.

Maintenance Goal Plans When a plan is formed in a character world, a corresponding **maintenance goal plan** is formed parallel to it which contains only an initial and goal step. The initial and goal states are identical and represent all the true facts about the world that the character wishes to remain true at the end of the plan.

[1]A character is anything that acts, including nature. A natural entity such as a volcano must be represented as a character if it is to change the world state during the story.

Maintenance goals are kept in separate plans so that a character can plan to undo its own goals, but *only by creating an internal conflict with itself*. This allows a character to sacrifice one goal for another more important goal.

Causal Links A **causal link** $s_j \xrightarrow{c} s_k$ connects an effect c of some step s_j to a precondition of some step s_k such that the effect and precondition unify. A causal link describes how a precondition for a step gets established.

A causal link $s_j \xrightarrow{c} s_k$ is **threatened** by a step s_t just when s_t has an effect that unifies with $\neg c$. In other words, s_t can undo what the casual link has established.

A causal link is **potentially threatened** just when $s_j < s_t < s_k$ is a valid ordering based on universe's ordering constraints. A causal link is **necessarily threatened** just when $s_j < s_t < s_k$ must be true in all orderings.

A causal link is **locally threatened** just when s_t belongs to the same plan as s_j and s_k. A causal link is **globally threatened** just when s_t belongs to a different plan than s_j and s_k.

A plan is valid when it contains no potentially locally threatened causal links, and all the preconditions of its steps have been established. A complete narrative universe contains only valid plans.

Conflict Links

A narrative universe is said to contain a conflict if it contains a necessarily globally threatened causal link and if the duration of the conflict is greater than zero (defined below). We call these links **conflict links** because they arise when one plan undoes another.

It is important to note that these are *narrative* incompatibilities rather than *logical* ones. The absence of potentially locally threatened causal links ensures that a plan is internally sound—that is, it *could be executed*. Conflict links exist when two valid plans *cannot both be executed*.

Measuring Dimensions of Conflict

Our formalism provides a broad definition of an extremely diverse phenomenon. In order to distinguish different kinds of conflict, we introduce seven dimensions. The first three—participants, subject, and duration—have discrete values that can be derived from our model. The last four—directness, intensity, balance, and resolution—rely on continuous measurements and can be estimated with simple heuristics.

We define vertical bar notation to mean "with respect to." Since some dimensions of conflict depend on the point of view from which they are measured, it is important to distinguish between $\text{intensity}(x|y)$, which means "the intensity of a conflict between x and y from x's point of view," and $\text{intensity}(x, y)$, which means "the overall intensity of a conflict between x and y."

Because there is no precise, widely adopted narratological study of conflict, these dimensions were compiled from a number of sources (especially Herman, Jahn, and Ryan, 2005; Crawford, 2003; Thomas and Dunnette, 1976; Egri, 1988). Whether or not this list is complete is an open question.

We rely on the well known story of Little Red Riding Hood for some simple examples throughout.

Participants

If a conflict arises between character worlds, those two characters are the participants[2]. If a conflict arises with the objective world, a character is in conflict with the environment. If a conflict arises between two plans in the same world, a character is in conflict with itself.

The Wolf clearly forms conflicts with Red Riding Hood and her grandmother when he intends to eat them.

Subject

The subject of a conflict is the most general unifier of the precondition and effect linked by a conflict link. It describes which fact in a world state is contested—potentially one way or the other depending on who prevails.

Conflict links usually arise in pairs with complementary subjects. Red Riding Hood thwarts the Wolf's plan to eat, and simultaneously the Wolf thwarts Red's plan to stay alive. The subjects of these conflicts are $\neg\text{hungry}(Wolf)$ and $\text{alive}(Red)$ respectively. Note that $\text{alive}(Red)$ is from one of Red's maintenance goal plans since it is true in the beginning and she wishes it to remain so.

Duration

The duration of a conflict is the span of time during which both participants intend their incompatible plans. Because the narrative universe is partially ordered, only upper and lower bounds can be determined for duration until a total ordering is imposed.

If we define $\text{index}(s)$ to be the integer index of step s in a total ordering, B_x and E_x to be the beginning and end of character x's plan's window of intention, and B_y and E_y to be y's plan's window of intention, we get:

$$\begin{aligned}
\text{start}(x, y) &= \max(\text{index}(B_x), \text{index}(B_y)) \\
\text{end}(x, y) &= \min(\text{index}(E_x), \text{index}(E_y)) \\
\text{duration}(x, y) &= \text{end}(x, y) - \text{start}(x, y)
\end{aligned}$$

For Red and the Wolf, conflict lasts from the moment the Wolf plans to eat her until he actually does so. It does not start until both plans have been formed and ends once one plan is finished or abandoned.

Directness

The directness of a conflict is a measure of how closely the participants are related. There are many kinds of closeness: friendship, family relation, etc., so the $\text{directness}(x|y)$ of a conflict between agents x and y is simply the average of all n kinds of closeness:

[2]The objective world contains the successfully executed actions of plans from character worlds, so character/character conflicts may get duplicated into the objective world. If x is in conflict with y and y's plan succeeds, x will now also have a conflict with the objective world. These duplicate conflicts are ignored.

$$0 \leq \text{directness}(x|y) = \frac{\sum_{i=1}^{n} \text{closeness}_i(x|y)}{n} \leq 1$$

This average can be weighted to make certain kinds of closeness more important. Such weights will depend on the genre of the story.

Since directness can change over the course of a plan, it should be measured when the conflict-causing action occurs.

Many kinds of closeness can be reduced to binary predicates, such as $\text{friends}(x, y)$. We also model things such as physical closeness and "interpersonal closeness," which occurs when one agents uses others to accomplish its goals.

The overall directness of a conflict is simply the average[3] of its participants' individual values:

$$\text{directness}(x, y) = \frac{\text{directness}(x|y) + \text{directness}(y|x)}{2}$$

Red considers the Wolf a friend but not vice versa. Assuming we measure friendship, family relation, physical distance, and interpersonal closeness as binary values, $\text{directness}(Red|Wolf) = 1 + 0 + 1 + 0/4 = 0.5$, while $\text{directness}(Wolf|Red) = 0 + 0 + 1 + 0/4 = 0.25$, and $\text{directness}(Red, Wolf) = 0.375$. Note how the conflict is more direct for Red because she falsely believes her and the Wolf to be friends.

Intensity

Intensity measures how much is on the line—what a character risks by being involved in a conflict. For this we must introduce $\text{utility}(x, s_j)$, which denotes how satisfied some agent x is after some step s_j. Utility is evaluated in the world from which s_j comes. If s_j is in x's world, we are discussing x's perceived utility. If s_j appears in agent y's world, we are discussing x's utility if the world were as y believes it to be.

Quantifying risk is difficult because it requires one to imagine any number of ways that a plan could go wrong. Luckily, when dealing with conflict, one important alternative outcome is already given in the plan of the opposing agent. This provides a simple but useful heuristic for measuring how badly a plan can fail.

The intensity of a conflict for agent x can be approximated as the inverse of its utility if the conflicting plan succeeds. Assuming s_y is the last step in agent y's plan:

$$0 \leq \text{intensity}(x|y) = 1 - \text{utility}(x, s_y) \leq 1$$

Like directness, the overall intensity of a conflict is simply the average of the individual participant values:

$$\text{intensity}(x, y) = \frac{\text{intensity}(x|y) + \text{intensity}(y|x)}{2}$$

[3]Again, this can be a weighted average if certain characters are more important than others. We avoid this only because the importance of a character is a concern for the *sujet*, not the fabula, and our model is concerned with fabula only. This is also why overall directness is an average rather than a min or max.

If we assume that being dead yields a utility of 0 and being alive but hungry a utility of 0.8, $\text{intensity}(Red|Wolf) = 1$, while $\text{intensity}(Wolf|Red) = 0.2$, and $\text{intensity}(Red, Wolf) = 0.6$. The conflict is maximally intense for Red because her life is on the line, while the Wolf risks only a lost meal.

Balance

Balance measures the relative likelihood that each participant in the conflict will prevail. This implies that plans have the potential to fail, which transcends classical planning.

A common solution for planning under uncertainty is to give operators multiple sets of effects, each with an associated probability that dictates the likelihood of that outcome. This representation lends itself nicely to many traditional game and narrative settings (where success might be dependent on a dice roll) but is not strictly necessary for our model.

Since the story world is inhabited by multiple agents, a plan can fail any time one acts to make another's plan impossible. In the interest of generality, we introduce the function $\text{P}(plan)$ to denote the likelihood that a plan will succeed.

Two conflicting plans might be independent events, meaning $\text{P}(plan_x) + \text{P}(plan_y) \neq 1$, but balance is a dependent notion. Thus, the formula for x's individual value of balance is the likelihood that x will prevail relative to y, assuming that one of them will succeed:

$$0 \leq \text{balance}(x|y) = \frac{\text{P}(plan_x)}{\text{P}(plan_x) + \text{P}(plan_y)} \leq 1$$

It should never occur that $\text{P}(plan_x) + \text{P}(plan_y) = 0$, but for the sake of completeness we will define that case to have a balance of 0.

Overall balance should be high when both participants are evenly matched and low when one is clearly more likely to succeed:

$$\text{balance}(x, y) = 1 - |\text{balance}(x|y) - \text{balance}(y|x)|$$

Red knows the way to her grandmother's house and has been there before, but the woods are dangerous, so we assume $\text{P}(plan_{Red}) = 0.7$. Since the Wolf is an efficient predator and Red a naive girl, we assume $\text{P}(plan_{Wolf}) = 0.9$. Therefore $\text{balance}(Red|Wolf) = 0.4375$, and $\text{balance}(Wolf|Red) = 0.5625$. The Wolf is more likely to succeed, so the balance is skewed in his favor. The characters are not quite evenly matched; thus $\text{balance}(Red, Wolf) = 0.875$.

Resolution

Resolution measures the outcome, favorable or not, of a conflict for some agent. It is that agent's change in utility after the conflict is over. If s_b is the first step in x's plan and s_e is the last step within the window of intention for the plan (the last successfully executed step), then:

$$-1 \leq \text{resolution}(x|y) = \text{utility}(x, s_e) - \text{utility}(x, s_b) \leq 1$$

Because resolution is "personal" to each agent, it does not make sense to define $\text{resolution}(x, y)$; however, we can define at least three discrete types of resolution based on each agent's personal value: collaboration (win/win), contest (win/lose), and disaster (lose/lose).

Since the Wolf eats Red, theirs is clearly a win/lose contest. Using the same assumptions from our discussion of intensity, $\text{resolution}(Red) = 0$ and $\text{resolution}(Wolf) = 1$ because Red dies and the Wolf gets a hearty meal.

We are currently extending the model to represent more types of resolution such as compromise (also a win/win but different from collaboration) and trickery.

Conflict Grouping

Incompatible plans are often mutually thwarting, especially when they arise between two characters. In these cases it is helpful to consider them one conflict. We call these **aggregate conflicts**. These groupings also allow us to model situations like replanning for the same goal when the first plan fails.

The overall dimension formulas (i.e. $\text{intensity}(x, y)$) need to be adjusted slightly for aggregate conflicts, but these changes are straight-forward. For example, the average intensity would need to be extended to handle three or more participants.

Generating Stories with Conflict

First we described a model for stories that is tailored to represent conflict. Then we offered some means of measuring the properties of those conflicts. The process of generating stories to fit that model with ideal values for those formulas is equal parts least commitment planning and constraint satisfaction.

Abbott tells us that "conflict structures narrative" (2008). The climax of a story is usually the resolution of its central conflict. Acts, chapters, and subplots are often organized around a conflict as well. For this reason, we focus on the generation of narrative episodes—mini-stories in which a conflict arises and is resolved. Complete stories may contain one or more episodes that are woven together based on certain storytelling maxims such as "the intensity of conflict is higher in episodes closer to the end of the story," or "a story should contain one long episodes that is punctuated by several smaller ones."

There are at least two ways to generate stories with conflict. A **conflict last** approach lets characters form their own plans and then weaves them together in a conflicting way. This is character-centric story planning, but is limited by what characters would do on their own. A **conflict first** approach decides on a conflict and then builds character plans around it. This is author- or story-centric planning, and the approach that we advocate.

Assumptions

We make several assumptions regarding other aspects of narrative generation. Firstly, agents follow the popular Beliefs Desires Intentions (BDI) model (Bratman 1987). Beliefs are modeled as the state of each agent's individual world. Desires are used to calculate utility. Intentions represent goals toward which the agent will plan.

We also assume some way to define which actions an agent is willing to take (a subset of all the actions an agent can take). This restriction ensures that agents act "in character." We can easily create intense conflicts by having loving family members kill one another for no reason, but these kinds of stories will seem unreasonable to a reader.

Lastly we assume a set of conflict resolution rules. Given two agents in conflict, the system can decide which one will prevail. These decisions relate to genre or moral, which we do not attempt to capture.

Algorithm

Space constraints preclude a full description of the algorithm. Its important features are summarized here:

- Determine from user input all constraints on the episode, including candidate characters, candidate subjects, and upper and lower bounds on duration, directness, intensity, balance, and resolution.
- Calculate the set of all possible conflict links and the operators that threaten them. This is achieved by considering each unifying effect/precondition pair that can be undone by some operator in the planning domain or by the initial or goal state of any agent's plan.
- Add each conflict link and threatening action to its own partial plan. Using forward search[4] through refinements of these plans, find ones which lead to the accomplishment of some candidate character's intention. These results further constrain participants and subject.
- Once we have calculated these pairs of minimally-constrained conflicting plans which agents might form, create pairings of each set of plans with each pair of agents who might form them. For these possible universes, perform best first backward chaining search toward a dynamic initial state (Ware and Young 2010) until a plan is found that satisfies all constraints. The best first heuristic is scored based on how close the last four dimensions (directness, intensity, balance, and resolution) are to their target values. Backtracking occurs if max duration is violated.

The search process is very similar to planning with trajectory constraints, so for more detail readers are referred to Porteous and Cavazza (2009). The main departure from this method is that the initial state of the problem is not fully specified (Riedl and Young 2005), which allows the planner to create a story world that is more conducive to the kinds of conflicts we want to generate. Refinements to the initial state may change a character's attributes in order to ensure that they form conflicting plans.

[4]Completeness would require complete forward search, but any real implementation of this system will want to impose a limit. This is both for efficiency's sake and because the climax of an episode should occur toward the end, meaning that we don't want plans to extend much farther than their conflicts.

Limitations of this Model

To our knowledge, this is the first work leading towards a formalization of narrative conflict. We admit several limitations that we hope to improve upon soon.

First is a problem we have deemed "imaginary conflict." This occurs when character x tries to predict what character y will do, predicts wrongly, and moves to thwart the plan which y never actually forms. This is conflict, but our model cannot detect it. One solution would be to add "imaginary character worlds," i.e. a world for what x thinks y's world is, but this will quickly explode in complexity and faces a potentially infinite regress.

Because a conflict requires two plans, the model will also miss conflicts that arise when a character wants something but cannot form any plan to achieve it. Some narratologists refer to this case as "tension" rather than conflict.

For now, our algorithm only generates individual episodes. We intend to make it more robust by giving it a means to integrate many episodes using narrative guidelines.

Conclusion and Future Work

In this paper we presented a preliminary planning-based model of narrative conflict inspired by narratology research. We also gave initial characterizations of seven important dimensions of conflict and an overview of the algorithm which builds instances of this model in our system.

We believe that conflict is essential to interesting stories both as content and as structure. The ability to manipulate narrative at such a fundamental level will increase the ability of computer systems to generate rich and diverse stories with less reliance on human authors.

This research is part of the CIRCUS (Controlling Intent Revision and Conflict Underlying Stories) project at NC State University. It will soon be integrated into a larger research system used to generate narratives to be realized in a commercial video game engine for human user evaluation.

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