THEMATIC KNOWLEDGE, EPISODIC MEMORY AND ANALOGY IN MINSTREL, A STORY INVENTION SYSTEM

Scott R. Turner
Michael G. Dyer

Authors:
Scott R. Turner
Michael G. Dyer

Addresses:
Artificial Intelligences Laboratory
Computer Science Department
University of California
Los Angeles, CA 90024
(213) 825-5199
srt@UCLA-LOCUS.ARPA
dyer@UCLA-LOCUS.ARPA

First, the story is very believable and logically consistent. TALESPIN has a good grasp of how characters can go about solving their goals. This is a reflection of TALESPIN's strong planning component and illustrates (at least intuitively) that planning is an important component of storytelling.

On the other hand, the story seems pointless and somewhat boring. In general, hearing about the plans to solve various goals (particularly goals like satisfy hunger) is not particularly interesting and does not convey any particular point to the reader. This too is an artifact of TALESPIN's strong planning component. Because TALESPIN is controlled by the planner it never seeks to fulfill any story criteria above the level of character planning.

Meehan realized this and added to TALESPIN a component that forced the planner to follow a pre-designated template for a story. This template reduced the story of "The Fox and the Crow" to a plan to use flattery to gain control of some object. Given two characters, the template was then able to use its world knowledge to set up a situation where one character would use flattery to gain control of some object the two valued in common. A "Fox and the Crow"-like story resulted. So an interesting negative result of Meehan's work was that story invention based on planning could not produce interesting or memorable stories, thus requiring an ad hoc, pre-canned template. This result showed that a general theory of themes, morals or interesting situations is needed.

Story Themes

What is a story theme and what makes them interesting to the reader? Dyer [Dyer 1983] pointed out that one class of themes (or morals) consist of planning advice and some explanation for its validity, often provided in terms of the negative consequences that result when the advice is not followed. In "The Fox and the Crow" the theme is "Don't trust flatterers"; this says to avoid assuming a goal at the behest of someone else if they do so by appealing to some facet of you in an exaggerated way. Of course, themes may also be explained by showing the positive consequences resulting from good planning. Some examples of story themes are:

1.   "Be kind to strangers."

POOR WOMAN AND THE PRINCE

An old, poor woman finds a stranger who has been robbed and beaten. She nurses him back to health and discovers that he is a prince, and she is richly rewarded.

This theme gives advice about what criterion to use in selecting plans (i.e., choose plans that have good benefits for others) and gives some reasoning as to why this is good advice (i.e., the stranger might turn out to be someone important who can do you a good turn).

2.   "Violence begets violence."

The theory of TAUs has two parts. The first says that TAUs represent important planning advice. The themes mentioned above all contain planning advice even though they do not specifically deal with planning failures. Instead, they represent rules that can apply at various choice points in the planning process that can guide planning to avoid failures. For instance, "Never say die" is advice to the mechanism that decides when to extinguish goals. Knowing to keep a goal alive even in the face of a lack of plans may avoid a failure. Thus these themes also deal with avoiding plan failures.

The second part of the theory of TAUs claims that TAUs organize episodic memory so that an episode contiaining a TAU is likely to cause a reminding of a related episode that contains the same TAU. For instance, the story:

FELLOWSHIP

John realized that he only had money for two more quarters of college, and decided to drop out immediately to look for a job. He went to Murphy Hall to fill out the proper forms and discovered that he had been awarded a fellowship.

tends to remind people of the previous story, "CANCER CURE" because they both embody the same TAU.

MINSTREL

Story themes are closely related to TAUs. MINSTREL, a story-telling program undergoing development at the UCLA AI Lab, makes use of TAUs to tell interesting stories. TAUs are used by MINSTREL to develop stories that have a theme, instead of the wandering, pointless stories that TALESPIN produced.

Inspiration

"Every good play must have a well formulated premise."
-- Lajos Egri [Egri 1960]

How does an author decide upon a theme in the first place? How does a theme come to mind? Often the selection is based upon an interaction between the author's values and his personal experiences. An author might write about "Be kind to strangers" because that plan had just worked in a spectacular way for him, or, conversely, because he had just suffered a major failure by not following that plan. He might have just seen an adorable kitten, and that recalled a time where he received a kitten as a reward for being kind to someone. Human authors are sometimes explicitly told what theme to use, as in a writing class assignment, but these types of writing situations are difficult for the author.

We believe that the author recalls an episode from episodic memory and its related TAU and uses this as the basis for a story. This recall is based on the many inputs an author has: his immediate goals, the environment around him, things he has lately been told, and so on. In

A better method for deriving a skeletal plot from a theme is to recall a story involving the same theme and borrow the plot (or plot elements) from it.

The Role of Episodic Memory in Plotting

At the time the author is searching for a plot, he has available to him his theme, his initial inputs, and at least one recalled episode (the one that prompted the theme). This material may be enough to provide him with further remindings. Even if it does not, he has one episode to borrow a plot from.

Note that this method avoids the above objections to plot rules. The number of plots is limited only by the number of relevant remindings, the episodes recalled provide a great deal of material for later use by the story teller, the planning problem is already solved and new plots can be learned by generalizing and mutating the recalled episodes, perhaps to form rules like those suggested above.

Given an episode that illustrates the theme, borrowing a plot from the episode involves mapping the pieces of the episode into the story domain.

Plotting Through Analogical Mappings

There are two facets to this analogical process. First, we must maintain our story knowledge through the mapping. That is, we must remember how the elements of the episode relate to and exemplify the theme. Secondly, we must map world features of the recalled episode into our story domain.

Maintaining the story knowledge can be done by retaining the high level memory structures (such as TAUs) that index the remembered episode. Maintaining the TAU through the mapping retains the abstract knowledge about the theme that is embodied in the episode. Through the TAU we can identify important components of the theme, such as the planning failure and the negative consequence.

Performing an analogy on world features requires recognizing elements of the episode in terms of their functions, and mapping these into elements with equivalent functions in the new domain. Thus, a car in a 20th century story might map into a chariot in the medieval domain because they both function as vehicles, and a job interview might map into an audience with the king, because they both are examples of social interactions with a possible social superior.

From Plotting to Story

Given a theme and an initial plot, what more is left to do before we have a story? One task left is fleshing out the plot. A character at this stage might be represented as a role (i.e., KNIGHT) and have no other features.

2. Create goal conflicts. A scene is more dramatic if the main character is pursuing a goal which comes into conflict with other active goals.

3. Increase the rewards and punishments. A goal which leads to important consequences is more dramatic than one whose outcome is trivial.

Increasing the reader's anticipation:

1. Eliminate favorable solutions to the goal. Structure the story so that the main character has only one solution to his goal.

2. Make the main character use a dangerous plan. A plan which has dangerous failure consequences is more dramatic than one that does not.

3. Insert a secondary incident between the assumption of the goal and its conclusion. This serves both to extend the conclusion of the main incident and to increase its drama by repetition.

4. Make the goal important to the reader. This technique assumes a model of the reader's goal hierarchy. The reader is encouraged to worry about the main goal for a reason other than empathy. Consider: How hard is it to write a sympathetic story about a cannibal?

Above we showed how a scene with a KNIGHT fighting a monster might arise when we needed the KNIGHT to be at physical risk. When this scene is created, the suspense rules fire (it is a scene involving physical risk) and suspense techniques are applied to make the scene more dramatic. For instance, if the technique "Insert a secondary incident" was used, the KNIGHT would lose his sword in the midst of the battle, forcing him to suddenly scramble for another weapon, and making the scene as a whole more dramatic and suspenseful.

A Control Structure for Storytelling

To this point we have discussed the process of storytelling as a linear one: discover a theme, build a plot, flesh out the plot, fulfill literary goals. The storytelling process is not at all linear.

To see why this is, consider the example above where we constructed a scene with a KNIGHT fighting a monster in the course of fleshing out another scene. Constructing this fight scene would cause us to be reminded of other memorable fight scenes. This reminding brings with it a wealth of imagery that can be used to further flesh out the current fight scene, and it may also recall a new theme and plot. Suddenly the author, concerned with fleshing out a scene, has become reminded of another story, and finds himself thinking about the theme and plot of that story. He has suddenly shifted back to the stage of storytelling concerned with theme and plot.

How is this situation to be handled in a storytelling program? Ignoring these fortuitious remindings is one choice, but a bad one. These remindings are the essence of creativity; what we

Thus episodic memory becomes a rich storehouse not only of the finished stories, but also the partially completed stories and story fragments that were generated along the way. Writers become better writers by writing, a process that builds their store of episodes, and provides them with a greater range of material for future writing endeavors.

Interactions and Examples

In this section we give some examples of the material presented above and show how it might interact to produce a story.

In this case, episodic memory already contains a conceptual representation of the following story (a simplified synopsis of "It's a Wonderful Life"):

> *A banker is kind to many of the members of his community and loans them money when they are in need. He then misplaces some money and is threatened with loss of his bank. At the heighth of his despair his friends arrive with the money needed to save the bank.*

This story is indexed by TAU-GOOD-DEEDS-REWARDED, which also contains the advice "Be generous to others and they may return the favor." Episodic memory also contains information about bankers in addition to knowledge about the King Arthur domain.

The input to MINSTREL is:

A banker died.

In this particular case, the input recalls "It's a Wonderful Life," not because it involves TAU-GOOD-DEEDS-REWARDED, but because they are both interesting incidents involving bankers (for a discussion of indexing by content see [Kolodner, 1980]). When the banker incident is recalled MINSTREL decides to tell a story about generousity (specifically, TAU-GOOD-DEEDS-REWARDED). In addition, the mention of "death", an important goal to the author, sets up a fleshing goal of using P-HEALTH.

The theme has been selected, so now plotting gets priority. Looking at the recollected episode, the plotter finds this skeleton:

Person X has skill Y. (1)
X uses Y to help Z.
Z is grateful to X.
Calamity befalls X.
Z saves X from calamity (because of 1)
X is grateful to Z.

This skeleton is now mapped into the King Arthur domain. There is no analog of "banking" in the King Arthur domain (in so far as MINSTREL's knowledge extends), so MINSTREL attempts to find some other skill that an agent can apply to another (since X uses Y to help Z). There

An old woman of the woods knows how to heal.
A knight fights a troll and is injured.
The old woman is out picking berries and finds the injured knight.
The old woman heals a knight.
The knight is grateful.
The old woman is attacked by a dragon.
The knight saves the old woman.
The old woman is grateful.

At this point the previously mentioned rule for building suspense in scenes involving physical danger fires on the scene of the old woman being attacked by the dragon. One of the rules for building suspense is:

Build suspense in a physical fight scene by making the protagonist physically weaker.

Unfortunately, the old woman is already weak (knowledge we have about the role of being an old woman), so this rule fails. Another rule is:

Build suspense by eliminating all solutions to the problem except the one that will work.

In this case, one plan for saving one's life is to run from the threat. MINSTREL eliminates this by trapping the old woman in her cottage:

An old woman of the woods knows how to heal.
A knight fights a troll and is injured.
The old woman is out picking berries and finds the injured knight.
The old woman heals a knight.
The knight is grateful.
The old woman is trapped in her cottage by a dragon.
The knight saves the old woman.
The old woman is grateful.

Now focus turns to the knight saving the old woman. Again this is recognized as a scene worthy of suspense, so the above rules fire again. This time, the first rule:

Build suspense in a physical fight scene by making the protagonist physically weaker.

can fire. The knight is made physically weaker by making him injured. The planner now looks for a way that he might be injured. One way is if he was involved in battle. Another way is if a previous healing wasn't completely effective. This is chosen and we have:

An old woman of the woods knows how to heal.
A knight fights a troll and is injured.
The old woman is out picking berries and finds the injured knight.

Conclusions

MINSTREL is a program to model human story telling behavior. We have seen that the basis for story-telling is a cycle of writing-rewriting that is fueled by information derived from the theme of the story and from fortuitious remindings that occur during the process of fleshing out the story. This process involving episodic memory and reminding-driven construction is one of the basic processes behind human creativity.