3.1 Why Tell Stories?

Authors create stories for a bewildering variety of reasons. A mother spins a fanciful bedtime tale to lull her young child asleep; a rabbi crafts an elegant anecdote to illustrate the generosity of God; a distressed young woman writes a novel to heal the grief she feels over losing her mother. And not only do authors write for many different reasons, they often pursue many goals at once in their writing. Shakespeare wrote works that both illuminate the human condition and delight the ear; Jonathan Swift wrote stories that were both entertaining adventures and biting social commentary on the England of his day. The goals and purposes of storytelling are as diverse and varied as human intellect itself.

But whatever the reasons, it is clear that human authors write intentionally. The stories authors create are carefully crafted to achieve particular goals. These goals and the ways they are achieved differ greatly from author to author, but every author has an explicit awareness of writing as a way to achieve some personal goals.

The importance of author goals in storytelling is best illustrated by an early model of computer storytelling called TALESPIN. TALESPIN was a computer program developed at Yale by James Meehan (Meehan, 1976). TALESPIN had knowledge about the likely goals and plans of a cast of simple woodland creatures. To tell a story, TALESPIN generated some likely goals for these creatures and then simulated their attempts to achieve those goals:
3.2 Author Goals

If the uses of storytelling are as diverse as human intellect itself, then surely cataloging the goals of authors is a hopeless task. How then can we learn about the authoring process?

One way to begin is by identifying and defining the goals that are necessary to tell stories of a particular type. The hope is that by carefully examining the authoring process for one particular type of writing, something will be discovered about the authoring process in general. So although we may not understand everything about why authors write, we will learn something about how they write. And this knowledge will serve as a basis for further research that will lead to a deeper and more general understanding of author-level goals.

This approach has led to MINSTREL, a computer program that tells short, theme-based stories about King Arthur and his Knights of the Round Table. Narrowing the range of storytelling to a specific style, a specific length, and a specific milieu makes the storytelling problem manageable and permits MINSTREL to focus on the process of storytelling rather than the diverse "whys" of storytelling.

Restricting MINSTREL to theme-based stories limits the types of author goals MINSTREL must solve. Selecting a single, specific primary author goal—to tell a story that illustrates a particular theme—greatly narrows the range of author goals. MINSTREL does not have to tell bedtime stories, satires, or any of the other myriad types of stories. At the same time, theme-based stories are complex and rich enough to address a variety of issues in storytelling, the way certain storytelling styles—such as the stories of very young children, or mathematical story problems—would not.

Restricting the length of the stories it tells to about one page allows MINSTREL to concentrate on stories in which immediate character actions predominate. Longer works such as novels often use character interactions, interplays of moods and emotions, digressions, and complicated presentation techniques to effect their purposes. Limiting the length of MINSTREL’s stories concentrates this research on how one particular tool—creating story events—can be used to achieve a variety of author-level goals.

Finally, restricting MINSTREL’s storytelling to a specific milieu focuses this research on issues in storytelling rather than issues in understanding and representing knowledge about the world. The King Arthur-milieu is relatively straightforward: knights love princesses and kill dragons, hermits live in the woods and heal people. Were MINSTREL to tell stories in a more complicated milieu, or in several different milieus, more effort would have had to be expended to give MINSTREL knowledge about those milieus. Although this might have led to some interesting results, the time and effort it would take to understand and represent knowledge about different milieus would have subtracted from the time available to develop a general model of storytelling and
creativity. It was decided early in this research effort that the development of the general models of storytelling and creativity was of greater interest, and limiting MINSTREL to a single storytelling domain permitted a more in-depth development of this area of the storytelling model.

3.2.1 MINSTREL's Author-Level Goals

Limiting MINSTREL to telling short, theme-based stories about King Arthur revealed four important classes of author-level goals:

(1) Thematic Goals
(2) Drama Goals
(3) Consistency Goals
(4) Presentation Goals

Thematic goals are concerned with the selection and development of a story theme. Drama goals are concerned with the use of dramatic writing techniques to improve the artistic quality of a story. Consistency goals focus on creating a story that is plausible and believable. And presentation goals are concerned with how a story is presented to the reader.

To further explain these goals and illustrate how they combine to create a complete story, we look at the role each class of goals play in one of MINSTREL's stories. The story we use is called Richard and Lancelot. Except for typography, it is reproduced here exactly as written by MINSTREL:

Richard and Lancelot

It was the spring of 1089, and a knight named Lancelot returned to Camelot from elsewhere. Lancelot was hot tempered. Once, Lancelot lost a joust. Because he was hot tempered, Lancelot wanted to destroy his sword. Lancelot struck his sword. His sword was destroyed.

One day, a lady of the court named Andrea wanted to have some berries. Andrea went to the woods. Andrea had some berries because Andrea picked some berries. At the same time, Lancelot’s horse moved Lancelot to the woods. This unexpectedly caused him to be near Andrea. Because Lancelot was near Andrea, Lancelot saw Andrea. Lancelot loved Andrea.

Some time later, Lancelot’s horse moved Lancelot to the woods unintentionally, again causing him to be near Andrea. Lancelot knew that Andrea kissed with a knight named Frederick because Lancelot saw that Andrea kissed with Frederick. Lancelot believed that Andrea loved Frederick. Lancelot loved Andrea. Because Lancelot loved Andrea, Lancelot wanted to be the love of Andrea. But he could not because Andrea loved Frederick. Lancelot hated Frederick. Because Lancelot was hot tempered, Lancelot wanted to kill Frederick. Lancelot went to Frederick. Lancelot fought with Frederick. Frederick was dead.

Andrea went to Frederick. Andrea told Lancelot that Andrea was siblings with Frederick. Lancelot believed that Andrea was siblings with Frederick. Lancelot wanted to take back that he wanted to kill Frederick, but he could not because Frederick was dead. Lancelot hated himself. Lancelot became a hermit. Frederick was buried in the woods. Andrea became a nun.

Moral: ‘‘Done in haste is done forever.’’

This story was selected to illustrate MINSTREL's storytelling goals because, more so than MINSTREL's other stories, this story is straightforward and obvious in achieving those goals. This is particularly apparent in the third paragraph, where MINSTREL produces a long, overly detailed explanation of the character actions and reasoning. But although this makes the story clumsy and somewhat difficult to read, it also makes it easier to follow MINSTREL's purposes in creating the story.

3.2.2 Thematic Goals

The theme of a story is the main point or purpose of the story. Because there are many possible reasons to tell a story there are many possible story themes. MINSTREL tells stories about a particular type of theme called a Planning Advice Theme, or PAT. Planning Advice Themes represent concise pieces of advice about planning, and they can often be summarized by adages, such as "A bird in the hand is worth two in the bush."

MINSTREL's author-level thematic goals are concerned with selecting and illustrating a story theme. Richard and Lancelot is based on a Planning Advice Theme called PAT:Hasty-Impulse-Regretted. This theme advises a planner to avoid making hasty decisions that cannot be retracted if they turn out to be incorrect. The events in a story that illustrate the theme are called the story plot. In Richard and Lancelot, the following scenes illustrate the theme of the story:

Lancelot knew that Andrea kissed with a knight named Frederick because Lancelot saw that Andrea kissed with Frederick. Lancelot believed that Andrea loved
Frederick. Lancelot loved Andrea. Because Lancelot loved Andrea, Lancelot wanted to be the love of Andrea. But he could not because Andrea loved Frederick. Because Lancelot was hot tempered, Lancelot wanted to kill Frederick. Lancelot went to Frederick. Lancelot fought with Frederick. Frederick was dead.

Andrea told Lancelot that Andrea was siblings with Frederick. Lancelot believed that Andrea was siblings with Frederick. Lancelot wanted to take back that he wanted to kill Frederick, but he could not because Frederick was dead.

These events form an example of the abstract advice represented in the story theme. By structuring the stories it tells around themes, MINSTREL assures that they will have the purpose that was missing from stories told by TALESPIN.

MINSTREL has two author-level thematic goals. The first goal is to select a theme for storytelling. The second is to create a sequence of story events that form an example of the selected theme.

Chapter 4 discusses MINSTREL’s representation of story themes, MINSTREL’s thematic goals, and the plans MINSTREL uses to achieve those goals.

3.2.3 Drama Goals

Human authors use a wide variety of techniques to improve the craftsmanship and literary quality of their stories. Foreshadowing, characterization, irony, suspense, and tragedy are all examples of writing techniques that authors use to improve the quality and impact of their stories. Using these techniques is rarely the primary purpose of an author’s storytelling. Instead, these are secondary writing goals that improve the artistic values of a story while supporting the theme of the story.

MINSTREL implements four drama goals: suspense, tragedy, foreshadowing, and characterization. Two of these techniques are used in Richard and Lancelot.

Foreshadowing is used to increase the impact of the scene in which Lancelot (erroneously) discovers that Andrea loves another knight by echoing parts of that scene earlier in the story:

At the same time, Lancelot’s horse moved Lancelot to the woods. This unexpectedly caused him to be near Andrea. Because Lancelot was near Andrea, Lancelot saw Andrea. Lancelot loved Andrea.

[...]

Some time later, Lancelot’s horse moved Lancelot to the woods unintentionally, again causing him to be near Andrea. Lancelot knew that Andrea kissed with a knight named Frederick because Lancelot saw that Andrea kissed with Frederick.

Lancelot’s willful horse first causes him to unexpectedly meet and fall in love with Andrea, and then later causes him to unexpectedly see Andrea kissing Frederick and fall out of love with Andrea. This juxtaposition and repetition of similar scene elements improves the impact of the story theme by echoing and strengthening the underlying pattern of the story.

Characterization is used to establish the hot temper of Lancelot, which contributes to his later hasty decision:

Lancelot was hot tempered. Once, Lancelot lost a joust. Because he was hot tempered, Lancelot wanted to destroy his sword. Lancelot struck his sword. His sword was destroyed.

To develop the characterization of Lancelot as hot-tempered, MINSTREL creates a story scene which shows how his hot temper affects how he reacts to events. By establishing the personality of the main character early in the story, MINSTREL improves the plausibility of later events and enhances the overall quality of the story. Chapter 5 discusses MINSTREL’s use of dramatic writing techniques.

3.2.4 Consistency Goals

Another concern for authors is to tell stories that are consistent and believable. Characters should act rationally and events should happen in accordance with the author’s best understanding of how the world functions. Readers expect stories to reflect and agree with what they know about the world, and so the author must take care to maintain that plausibility, and to explain it when absent or different from common understanding.

Story inconsistencies normally arise as side-effects of other author-level goals. For example, when MINSTREL creates the story events needed to illustrate a story theme, it creates only the events necessary for the theme. This might include a scene in which a character dies. But unless the theme happens to also include scenes explaining how the character died, who killed him, and what emotional reactions all the characters in the story had to the character’s death, the resulting story will be incomplete. The reader expects explanations of how and why things happen. The purpose of MINSTREL’s consistency goals is to detect these types of situations and to correct them by adding explanatory story events.
MINSTREL implements a variety of author-level goals aimed at maintaining story consistency. One class of goals checks to see that characters are shown achieving all the steps of successful plans:

Lancelot was hot tempered, Lancelot wanted to kill Frederick. Lancelot went to Frederick. Lancelot fought with Frederick. Frederick was dead.

In Richard and Lancelot, Lancelot’s murder of Frederick was created to illustrate the story theme. After this scene is created, a consistency goal notices that a necessary precondition to fighting someone—being colocated with them—hasn’t been fulfilled. Although Frederick’s death is necessary to illustrate the story theme, an explanation of how Lancelot and Frederick came to be in the same place is not, and so MINSTREL’s thematic goals did not create one. To make the story understandable, a story event is created that achieves the colocation precondition. Consistency goals “repair” the story by noticing and correcting inconsistencies left over from other author-level goals.

Another class of goals checks to be sure that characters are reacting properly to events in their world:

Lancelot wanted to take back that he wanted to kill Frederick, but he could not because Frederick was dead. Lancelot hated himself.

People normally have emotional reactions to the events in their lives. They feel happy when they achieve important goals, sad when a major plan fails, anxious when they are worried about their self-preservation, and so on. In this example, Lancelot discovers that he has violated a major goal because of a character flaw, but has no emotional reaction to this event. A consistency goal notices this and creates a scene describing a plausible emotional reaction. This improves the consistency of the story and the believability of the character.

The range of MINSTREL’s consistency goals and the plans MINSTREL uses to achieve them are discussed in Chapter 6.

### 3.2.5 Presentation Goals

Presentation goals concern how the story is communicated to the reader. The author of the story must decide the order in which events in the story are presented to the reader, which events must be fully described and which can be summarized or omitted, and how each story event will be expressed in English.

*Richard and Lancelot* contains the following sequence of story scenes:

Lancelot was hot tempered. Once, Lancelot lost a joust. Because he was hot tempered, Lancelot wanted to destroy his sword. Lancelot struck his sword. His sword was destroyed...

Because Lancelot was hot tempered, Lancelot wanted to kill Frederick. Lancelot went to Frederick. Lancelot fought with Frederick. Frederick was dead...

The first scene is created by MINSTREL to illustrate the characterization of Lancelot as hot tempered. The second scene is part of the theme, and turns upon Lancelot’s hot temper. MINSTREL’s presentation goals must recognize the purposes of these two scenes and use that knowledge to order them correctly.

MINSTREL’s presentation goals are also concerned with selecting scenes to be in the story and with expressing story events in English. For more on MINSTREL’s presentation goals and how they are achieved, see Turner (1993).

### 3.3 Author-Level Planning and Problem Solving

The previous sections identified four classes of important author-level goals and showed how they combined to create a complete story. Now we shift our attention to the process of how those goals arise and are achieved.

As noted earlier, authors tell stories to achieve particular goals. The process of storytelling involves selecting a goal from the author’s pool of goals, trying to find a plan to achieve that goal, and executing the plan, possibly adding new goals to the agenda or deleting old ones. This continues until the author is satisfied with the story, that is, until the author has no more unsatisfied author-level goals.

MINSTREL models this using two processes. The *planning process* is concerned with the management of author-level goals. The planning process maintains the pool of author goals and when necessary, selects a goal to achieve. The *problem solving process* is concerned with solving author-level goals. It takes a goal selected by the planning process and finds, evaluates, and executes a plan to achieve that goal. These processes are illustrated in Figure 3.1.

#### 3.3.1 Author-Level Planning

MINSTREL uses an agenda-based planning model, patterned on similar models in Lenat (1976) and Warren (1978). As goals arise they are given a priority and placed on an agenda. Priorities are represented by integer numbers on a scale of 1 to 100. At each planning cycle, the highest priority goal is selected from the agenda and passed to the problem solving process.

MINSTREL begins storytelling with an initial goal to “tell a story.” This goal breaks down into subgoals including selecting a theme, illustrating a theme, applying drama goals, checking the story for consistency, and presenting the story to the reader. At each cycle, MINSTREL selects the author-level goal with
goals that a straightforward, top-down approach would not be able to solve, but it also simplifies MINSTREL's planning model by eliminating the need for a mechanism to correctly select amongst competing author-level goals.

MINSTREL's planning model, and in particular, the role that re-queuing of goals plays in MINSTREL's storytelling are further discussed in Chapter 8.

3.3.2 Author-Level Problem Solving

It's not unusual to view artists with something approaching awe. The process of making art seems very different from the kinds of prosaic tasks one tackles in day-to-day life. So few are successful at art, and what they produce is so different and interesting, that there is an automatic tendency to assume that art involves unique and special mental processes.

But although Koestler (1964), Wallas (1926), and others have argued that creative domains such as storytelling, art, and music are somehow fundamentally different from more mundane problem domains, most psychological evidence suggests the opposite (Weisberg, 1986). People solve problems in creative domains in much the same way they solve problems in more traditional problem solving domains. In art as in day-to-day life, people have goals, find or create plans to achieve those goals, apply the plans, evaluate the results, and so on. We are not used to thinking of artistic endeavors such as painting and music in terms of problem solving, but at a general process level there is little to distinguish between creating and playing a musical piece and creating and writing a thank-you note.

MINSTREL's author-level model of problem solving is shown in Figure 3.2. Author-level goals are input at the left side, where they are used to recall similar past storytelling situations. The author-level plans used in these past situations are then adapted and applied to the current goal. Finally, the adapted plan is assessed to determine if it meets domain-specific considerations (i.e., if you are telling a realistic story you might reject a plan that would be acceptable for a fantasy). Although this model is being applied to author-level problems, it is the same case-based model used for all problem solving processes in MINSTREL. The portion of this model within the dotted lines is the same model described in Chapter 2. All that has been changed is the types of goals being solved.

In MINSTREL, a single problem solving model is used for all problem domains, artistic and otherwise. MINSTREL's author-level storytelling goals are solved by the same process used to solve character-level goals in the King Arthur domain and to invent devices in the mechanical invention domain. Uniformity of the problem solving process is a fundamental tenet of this research.

The process of problem solving is invariant across problem domains.

One interesting consequence of MINSTREL's uniform model of problem solving
is that the same creative process used to invent new story scenes and new solutions to problems in the King Arthur domain is also active in problem solving at the author level. But before we can look at the role of creativity in solving author-level goals, it is necessary to digress momentarily to discuss the representation of author-level goals and plans.

3.3.2.1 Representation of Author-Level Goals And Plans

Character-level goals in MINSTREL's stories are represented using goal schemas. For example, Lancelot's goal to kill a dragon is represented as a &GOAL schema with appropriate values for the TYPE, ACTOR, and OBJECT slots. An example of a character-level goal is shown in Figure 3.3. MINSTREL's author-level goals are also represented using goal schemas. Each of MINSTREL's goals in telling a story is represented using a &GOAL schema and appropriate values for the TYPE, ACTOR, and OBJECT slots. Figure 3.4 shows an example of an author-level goal to check the consistency in a particular story scene. Note that the actor of this goal is &MINSTREL, a symbol that MINSTREL uses to refer to itself, and that the object of this goal is an event in the story being told. This example author-level goal represents MINSTREL's desire to check the schema pointed to by the OBJECT slot (&State.99) for consistency.

A consistent representation permits MINSTREL to treat character-level and author-level goals identically. The same processes can be used to store, recall, and manipulate both types of goals.

Unlike the representation of goals, MINSTREL's representation of plans is not consistent across the character and author levels. Character-level plans in MINSTREL are represented as interconnected collections of goal, act, and state schemas. Figure 3.5 shows the representation for a knight's plan to achieve the goal of destroying a dragon. This plan is represented as a goal (destroy a dragon, &Goal.15), a plan to achieve that goal (fight the dragon, &Act.17), and the result of executing that plan (the dragon is dead, &State.7).

Although the same type of representation could be used for MINSTREL's author-level plans, it would be clumsy and time consuming. Schemas for complicated computational actions such as looping, recursion, and so on would have to be defined and an interpreter built to perform those actions. Fortunately, MINSTREL is built upon a representation for computation—Lisp. Rather than reinvent the wheel, MINSTREL uses Lisp to represent its author-level plans and uses the Lisp interpreter to execute those plans.

Each of MINSTREL's author-level plans (ALPs) is a structured, independent block of Lisp code. Each ALP contains a test that determines when the plan is applicable and a body that executes the plan. Because Lisp code can be difficult to understand, the author-level plans presented in this text are shown in a structured English format. An example of this format appears in Figure 3.6. The author plan shown in Figure 3.6 is one of the plans MINSTREL uses to check the consistency of a story. This plan assures that characters who are injured react
particular instance of a goal. Finally, the **Body** of the ALP is the series of actions required to execute the plan.

### 3.3.3 Creativity in Author-Level Problem Solving

MINSTREL has a consistent representation for goals and a single model of problem solving that is used to solve problems at both the character and author levels. This model of problem solving includes creativity—the ability to invent new problem solutions when needed. Consequently, when MINSTREL cannot solve an author-level goal, creativity heuristics will be applied to try to invent a new plan for solving that goal, just as happens when MINSTREL cannot solve a character-level goal.

There are three steps to the creative problem solving process:

1. **Transform the original problem specification.**
2. **Recall a similar past problem situation.**
3. **Adapt the associated plan to the original problem.**

Because MINSTREL has a consistent representation for both author-level and character-level goals, and a single model of episodic memory, the first two steps of creative problem solving are the same for both author-level and character-level problem solving. The primary difference between character-level and author-level creativity lies in the third step: adapting the associated plan.

MINSTREL’s character-level plans are represented by act and state schemas, and MINSTREL’s creativity heuristics (TRAMs) know how to modify and adapt this representation. But MINSTREL’s author-level plans are represented as structures of Lisp code, and MINSTREL’s TRAMs do not know how to adapt Lisp code. MINSTREL’s author-level plans are opaque and nonadaptable, and so MINSTREL cannot adapt author-level plans. This limits the creativity heuristics (TRAMs) that MINSTREL can apply when problem solving at the author level.

In case-based problem solving, plans to solve problems are found by recalling similar past problems. Creativity requires recalling plans from past problems different from the current problem and adapting them to the current problem. But because MINSTREL cannot adapt plans at the author-level (because they are opaque blocks of Lisp code) MINSTREL cannot apply any creativity heuristics which involve plan adaptation. However, there are a few types of creativity that do not require plan adaptation.

Consider, for example, a problem solver finding his way home from a newly built shopping mall. The problem solver never come home from this mall before, so standard problem solving will not recall any ready-made plans. But if he recalls that the shopping mall stands on the site of a former restaurant he frequented, then he can recall a route for driving home from the restaurant and use...
it without change. The problem solver has invented a solution to a problem by making use of an old solution without adaptation.

We call this type of creativity "nonadaptive creativity," because it hinges upon finding a solution that can be applied to a new problem without having to change the solution.

At the character-level, we have already seen some examples of creativity heuristics that do not require adaptation. One of these is TRAM:Recall-Act. TRAM:Recall-Act suggests that if you are trying to find an act that fits some particular set of constraints, then you can probably ignore all the constraints except the goal the act is intended to fulfill and the intended effects of the action. By ignoring the other constraints, TRAM:Recall-Act permits the problem solver to recall solutions which he would not have otherwise recalled, because they would not fulfill the extraneous constraints. And because the extra problem constraints are extraneous, the recalled solution—even though it does not fill those constraints—does not need adaptation.

TRAM:Recall-Act illustrates the central feature of nonadaptive creativity: redirecting recall to a new area of memory where immediately useful plans are likely to be found. TRAM:Recall-Act finds new solutions to a problem by redirecting recall to solutions that lack the extraneous constraints.

So although MINSTREL cannot use all types of creativity at the author-level, it can use nonadaptive creativity. To understand MINSTREL's author-level nonadaptive creativity works, it is first necessary to understand how MINSTREL's author-level episodic memory is organized.

MINSTREL's author-level plans are indexed in episodic memory according to specific past goals they have solved, just as character-level plans are indexed according to past goals they have solved. So, for example, the author-level plan ALP:Make-Consistent-P-Health is indexed under a goal of type &Check-Consistency applied to a &State schema. A portion of MINSTREL's author-level episodic memory illustrating this organization is shown in Figure 3.7. Episodic memory is organized as a tree of (feature, value) pairs. &Goal.16 is an author-level goal from a past instance of storytelling in which MINSTREL's goal to check the consistency of a particular state in a story (&State.99) was achieved by ALP:Make-Consistent-P-Health. This is organized in episodic memory by the features and values of &Goal.16, including the object of the goal, &State.99. If a new goal is encountered with similar features, ALP:Make-Consistent-P-Health will be recalled.

MINSTREL also has generalized author-level plans. These are plans that can apply to a number of different objects. Generalized author-level plans have a null Object and are indexed accordingly. Figure 3.7 shows the indexing for a generalized author-level plan called ALP:Default-Consistent. ALP:Default-Consistent is a simple plan that recognizes a schema as consistent if it has had its Type slot filled in.

When MINSTREL has a goal to check the consistency of a state schema, the goal will be used as an index to memory and because it's features and values match those of &GOAL.16, MINSTREL will find &GOAL.16 and its associated plan, ALP:Make-Consistent-P-Health. This is standard problem solving—recalling a similar past problem and using the solution to that problem for the current problem.

Nonadaptive creativity comes into play when this fails. When an author-level goal does not recall a similar past goal and its associated solution, or if all the
recalled solutions fail, then MINSTREL must look elsewhere in author-level episodic memory for an author-level plan that can be applied to the current goal without adaptation. There is one place that such a plan can be found: a general-ized author-level plan.

Generalized author-level plans will not be found by standard problem solving because the Object slot of the current goal will not match the null slot under which the generalized plans are indexed. But precisely because these plans are generalized we know that they can be applied without adaptation to any goal of the proper type. What is needed is a creativity heuristic that will find these plans by looking in the appropriate place, that is, a nonadaptive creativity heuristic.

MINSTREL's TRAM for achieving this is called TRAM:Generalized-AL-Plans. This TRAM finds generalized plans to apply to a specific author-level goal by eliminating the Object slot from the current goal and returning without adaptation whatever plans it finds. TRAM:Generalized-AL-Plans is shown in Figure 3.8. When TRAM:Generalized-AL-Plans is applied to the author-level goal illustrated in Figure 3.4, it eliminates the Object slot and uses the transformed goal as an index to memory. This recalls ALP:Default-Consistent, which is then applied to achieve the original goal.

Because MINSTREL's TRAMs cannot adapt MINSTREL's author-level plans, creativity at the author-level is limited to nonadaptive creativity. Although nonadaptive creativity is not as powerful as other types of creativity, it does illustrate the invariance of MINSTREL's model of problem solving and demonstrate that the same creative problem solving process used to solve character-level goals can also solve author-level goals.

3.3.4 Achieving Author-Level Plans

Our examination of the authoring process began with the identification of author goals. For the particular type of stories that MINSTREL tells, we identified four important classes of author-level goals. Then we looked at the processes of planning and problem solving: How author goals were managed, and how plans to solve author-level goals were found or created. The last step is to look at the contents of author-level plans: What they do to achieve author-level goals.

The following chapters will discuss in detail each of MINSTREL's author-level plans, identifying what goal each plan applies to, and describing how the plan achieves that type of goal. But before we turn to the details of MINSTREL's author-level plans, we should like to examine this problem in more general terms. What does an author do to illustrate a theme, use a dramatic tech-nique, or correct a causal inconsistency?

Consider a hypothetical author writing a short story about Lancelot, with a goal to portray Lancelot as deceptive. He achieves this goal in two steps.

First, the author uses his knowledge of the goal he is trying to achieve and his knowledge of how stories are told to specify his goal as an abstract description of story events which, if part of the story, would achieve his goal. In this case, the author knows that "deception" is a character trait and that character traits are reflected in character actions. From this he realizes that his goal of portraying Lancelot as deceptive will be achieved if the story contained some scenes in which Lancelot used a deception plan. Note that the author hasn't yet achieved his goal. He has only further specified it as a particular, abstract description of story events which would achieve the goal.

The abstract specification the author arrives at will depend on his knowledge of storytelling. From reading and writing stories, he will have built up a library of author-level plans that translate author-level goals into story specifications. Illustrating a character trait by including a story event demonstrating the trait might be a plan the author learned through conscious study, or by reading many stories that used this technique.

Next, the author tries to create story elements to fulfill this abstract specification. Using his knowledge of the genre of the story, the goals of the story, and the already-completed portions of the story, the author tries to invent scenes to fit the abstract specification. Thinking about one person deceiving another may remind the author of a time when a coworker fooled him with a falsified memo from their boss. Being reminded of this scene, the author may decide to use it as the basis for the Lancelot story scene. But to make that reminding work in his story, the author must make some adaptations. Lancelot will have to take the coworker's place, the memo will have to be replaced with something appropriate to the King Arthur milieu—perhaps a note from the king—and so on. The end result is a scene in which Lancelot fools Guinevere by forging a note from the King.

We call this process of taking an abstract specification and general story constraints and inventing scenes to fit the specification instantiation.

1. Define an abstract specification of a needed story element.
2. Create a specific story element to match the abstract specification.
3.3.5 The Role of Episodic Memory in Storytelling

How is instantiation achieved? In the foregoing example, the author instantiated his abstract specification by a process of transform, recall, and adapt, which the reader will recognize as creative case-based problem solving. In fact, instantiating an abstract concept description can be viewed as a special form of creative case-based problem solving. But instantiation differs from normal problem solving in an important way. In normal problem solving, the problem solver uses a complete problem description to recall similar past problems, so that the problem solver can use the associated plans. But in instantiation, the problem solver uses an incomplete description to recall a complete description, without any interest in the associated plans.

The product of normal problem solving is a plan for the current problem. Suppose, for example, that a knight finds himself threatened by a dragon and wants to save himself. The knight recalls a past situation in which he was threatened by a troll. He’d solved that by charging the troll on his horse, so he decides to apply that same plan to the dragon. By recalling a similar past problem solving situation, the knight has found a plan to solve his current problem.

In instantiation, though, the product of problem solving is the recalled problem situation, not the associated solution. Suppose, for example, that an author is creating a scene in which “Lancelot, a knight, is endangered.” This abstract description is passed to case-based problem solving and recalls a past situation in which a knight was threatened by a troll and consequently killed the troll by charging it on his horse. The author can now use the recalled problem situation to fill in or instantiate the current scene. The associated plan (charging the monster on horseback) may or may not be used, depending on the author’s particular storytelling needs. In fact, the scene being instantiated could be a belief, an emotion, or some other type of story element that does not have a plan associated with it at all.

Because there is not necessarily an associated problem solution, and because instantiation may not make use of the problem solution even if it exists, there is no need to perform the second and third steps of problem solving: adapting the recalled solution and assessing the result. Instantiation requires only the recall of a similar past scene, and not the rest of the problem solving effort.

However, a problem arises when the author cannot recall a similar past scene. In this case, recall alone is not sufficient, because the author needs to create a story scene to fit his abstract scene description.

The solution is to use imaginative memory. Imaginative memory incorporates creativity into the recall process, permitting episodic memory to invent a memory to match a set of recall indices. If the recall indices are the features of an abstract scene specification, then imaginative memory will either recall or invent the specific story scene needed to instantiate the scene specification. Instantiation is thus simply the process of imagination—using creativity and the knowledge in episodic memory to imagine scenes to fit a particular criteria.

Instantiation is achieved through imaginative memory.

It's a common intuition to link imagination with storytelling. By explicitly representing instantiation as a fundamental process in storytelling and showing how instantiation can be achieved by imaginative memory, MINSTREL identifies and defines the link between imagination and storytelling. And by showing how creativity can be incorporated into the recall process, MINSTREL demonstrates the link between creating new problem solutions and the ability to imagine plausible new situations and ideas.

3.3.6 Planning With Many Constraints

One reason storytelling is a difficult task for humans and computers alike is that it requires the storyteller to solve a large number of interdependent goals simultaneously. In a successful story, the events of a story fulfill a range of goals. They illustrate the theme of the story, develop the literary value of the story, maintain the story consistency, and so on. But it is difficult for humans to solve planning situations that involve a number of simultaneous goals (Flower & Hayes, 1980). Each added goal increases the complexity of the planning task, until it may be nearly impossible. “The act of writing is best described as the act of juggling a number of simultaneous constraints.” (Flower & Hayes, 1980, p. 31).

One solution to planning with many constraints which is often applied to the storytelling problem is to partition the problem into semi-independent subproblems (Flower & Hayes, 1980). Rather than try to solve all the problems involved in creating a story at once, the author breaks the writing process down into a sequence of goals, that is, theme, drama, consistency, presentation.

The technique of delaying constraints is often sound in writing handbooks:

...begin by doing some “free writing”. This simply means writing down whatever comes into your mind about a subject... this is not the time to think about spelling, punctuation, or the correct choice of words... What you'll produce is generally called the first or “rough”
draft, and it will probably need some revisions and changes... (Tchudi & Tchudi, 1984, pp. 21-24)

Delaying constraints or partitioning the storytelling problem into semiindependent subproblems permits the author to solve problems that would otherwise be too complex. But one consequence of this strategy is that solving one subproblem may violate another. For example, MINSTREL creates the following story scene in order to illustrate the theme “Done in haste is oft regretted”:

One day, Lancelot wanted to kill Frederick. Lancelot fought with Frederick. Frederick was dead.

This scene does serve to illustrate the theme (by showing Lancelot performing a hasty action he will later regret). But it is otherwise incomplete. It does not explain why Lancelot wants to kill Frederick, or how Lancelot came to be in the same location as Frederick. The goal to illustrate the theme has been achieved, but other goals have not.

Human authors have the same difficulties when they partition complex problems. Problem constraints may be violated or even forgotten. An article on revising that appeared in Writer’s Digest includes a “Tactical Analysis Checklist” of mistakes of this sort:

- Look at the motives of your major story characters. Have you included sufficient information about their past lives to make it credible that they want what they want, feel what they feel, think as they think, act as they act, or have the skills they call on in your plot? (Bickham, 1992, p. 28)

For both human and computer authors, breaking a complex problem into simpler, semiindependent subproblems is a valuable writing strategy. But because a story is an integrated whole, no subproblem can be truly independent of the other subproblems. So the author must be prepared to detect and correct constraint violations during the writing process. In MINSTREL, this is achieved through opportunistic goals.

3.3.7 Active Versus Opportunistic Goals

At any time during the storytelling process, MINSTREL has a number of goals that it is actively trying to achieve. Each of these goals is present on the goal agenda and the active goal with the highest priority is being achieved. Initially, the active goals include the goals (1) to tell a story illustrating a particular theme, and (2) to present the story to the reader in English. These goals are achieved via author-level plans that may create additional active goals (i.e., subgoals).

In addition to the active goals, storytelling conditions can cause opportunistic goals to arise. An opportunistic goal is an author-level goal that becomes active whenever a specified storytelling situation arises. For example, MINSTREL has an opportunistic goal that arises whenever a story scene is created that contains inconsistencies. When an inconsistent story scene is created an opportunistic goal to correct the inconsistency is triggered. Similarly, MINSTREL has opportunistic author-level goals to achieve various dramatic writing purposes, such as building suspense. When a story scene is created that is suitable for suspense (such as a character’s life being threatened), an opportunistic goal arises to consider building suspense in that scene.

Opportunistic goals serve two purposes in MINSTREL. First, opportunistic goals provide a mechanism for detecting and correcting constraint violations. As described earlier, MINSTREL reduces the difficulty of the storytelling problem by breaking it into a sequence of semiindependent subgoals. Opportunistic goals provide a mechanism for detecting when the solution of one subgoal violates the constraints of another subgoal, as for example when a scene created to illustrate the theme of a story contains causal inconsistencies.

Second, opportunistic goals are used to represent secondary author goals. In general, we suppose that any author has a variety of goals when telling a story, some which are primary and some which are secondary. These two categories represent a sharp, qualitative divide in author priority. The author’s primary goals are those which the author considers essential to the telling of the current story. If the author cannot achieve his or her primary goals, then the storytelling process has failed. For MINSTREL, the primary goals are (1) to tell a story concerning a particular theme, (2) to make the story consistent and believable, and (3) to present the story in English. If any of these goals fail, then the storytelling process itself has failed.

Secondary goals, on the other hand, represent goals that are desirable but not essential to the storytelling process. The author is pleased if he or she can achieve these goals, because it means that the story is better than it might otherwise be. But if the opportunities do not arise, the story is not a failure. MINSTREL’s goals to use literary techniques are secondary goals. If they succeed, they add additional quality and complexity to the stories MINSTREL tells, but the story can succeed even if they fail. (Although it will likely have less literary value.)

Of course, how an author categorizes his or her goals varies from author to author, and from story to story. For a writer of mystery stories, building suspense is probably an essential goal in the writing process. But for the writer of romantic fantasies, it is a secondary goal, and for the writer of comedy it may be actively avoided. And even for a single author, goal priorities will vary from story to story.

In terms of the storytelling process, primary and secondary goals differ primarily in how they arise. Primary goals are self-directed, while secondary goals are reactive. In MINSTREL, primary goals arise directly from MINSTREL’s
initial storytelling goal. MINSTREL's initial goal ("tell a story") creates sub-
goals to tell a story about a particular theme, to tell a consistent and believable
story, and to tell the story in English, that is, all of MINSTREL's primary goals.
The secondary goals, on the other hand, arise in reaction to the developing story.
In MINSTREL, each secondary goal is represented by an opportunistic goal. If
the opportunity arises to achieve a secondary goal, then the opportunistic goal
triggers. Thus primary goals are guaranteed to arise and be attempted, while sec-
ondary goals may or may not arise, depending on the story development.

It is also interesting to note that author-level plans used to achieve a primary
goal are generally not suitable for achieving that same goal opportunistically, and
vice versa. For example, MINSTREL has an author-level plan to add suspense to
a story scene by having a character attempt an escape from a dangerous situation.
This plan cannot be used actively, because it depends on the prior existence of a
dangerous situation. In general, plans to achieve primary goals must be able to
create the story events necessary to achieve the goal from scratch, while oppor-
tunistic goals can be achieved by plans that modify or augment existing story
scenes.

3.4 Conclusions

MINSTREL has three major advancements over previous models of storytelling.
First, MINSTREL demonstrates the importance of an explicit author model in
storytelling. The particular author-level goals and plans MINSTREL uses to
tell stories are of great interest, and are fully discussed in the following chapters.
But as important is MINSTREL's architecture as a storyteller with an explicit
knowledge of its own goals.

Second, MINSTREL models storytelling as problem solving. By this, MIN-
STREL clarifies the relationship between achievements in artistic domains such
as storytelling and achievements in traditional problem solving domains such as
mechanical repair. MINSTREL demonstrates the fundamental similarities
between artistic endeavors and traditional problem solving, and MINSTREL is
prima facie evidence that artistic ability can be explained in terms of problem
solving, and that no further or different cognitive process need be stipulated.

Third, MINSTREL explicitly models instantiation as a fundamental story-
telling process. By recognizing the importance of instantiation, MINSTREL is
able to clarify and define a process that has previously been unrecognized and
unilluminated. And by implementing instantiation using imaginative memory,
MINSTREL further defines the links between creativity, memory, and problem
solving.

4.1 Introduction

When MINSTREL tells a story, its primary goal is to illustrate a particular story
theme. MINSTREL's story themes are stereotypical planning situations, which
can often be summarized by an adage such as "A bird in the hand is worth two
in the bush" or "Deception serves the devil." To understand the role of story
themes in MINSTREL's storytelling process, there are five issues that must be
addressed:

1. What is a theme?
2. How is a theme represented?
3. What themes does MINSTREL know?
4. What author-level thematic goals does MINSTREL have?
5. What plans does MINSTREL have to achieve these goals?

4.2 What Is a Theme?

Webster's New Collegiate Dictionary defines a theme as "the subject or topic of
discourse or of artistic expression"; Roget's Thesaurus lists synonyms for
themes that include "point," "motif," "topic," "pattern," and "design." The
theme of a story is the underlying concept or topic that organizes the story into a
coherent whole; it is the theme that gives rise to a story's organization and struc-
ture.

But stories are told for a wide variety of purposes. People use stories as