

NARRATIVE TEXT SUMMARIZATION

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ABSTRACT

In order to summarize a story it is necessary to access a high level analysis that highlights the story's central concepts. A technique of memory representation based on affect units appears to provide the necessary foundation for such an analysis. Affect units are conceptual structures that overlap with each other when a narrative is cohesive. When overlapping intersections are interpreted as arcs in a graph of affect units, the resulting graph encodes the plot of the story. Structural features of the graph then reveal which concepts are central to the story. Affect unit analysis is currently being investigated as a processing strategy for narrative summarization.

When a reader summarizes a story, vast amounts of information in memory are selectively ignored in order to produce a distilled version of the original narrative. This process of simplification relies on a global structuring of memory that allows search procedures to concentrate on central elements of the story while ignoring peripheral details. It is apparent that some hierarchical structure is holding memory together, but the precise formulation of this structure is much more elusive. How is the hierarchical ordering of a memory representation constructed at the time of understanding? Exactly what elements of the memory representation are critical in building this structure? What search processes examine memory during summarization? How are summaries produced after memory has been accessed? In this paper we will outline a strategy for narrative summarization that addresses each of these issues.

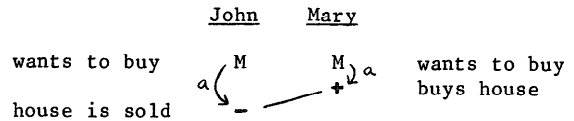
This proposed representation for high level narrative analysis relies on affect units. An affect unit is an abstract structure composed of three affect states and four affect links.

AFFECT STATES	AFFECT LINKS
Positive Events (+)	Motivation (m)
Negative Events (-)	Actualization (a)
Mental States (M)	Termination (t)
	Equivalence (e)

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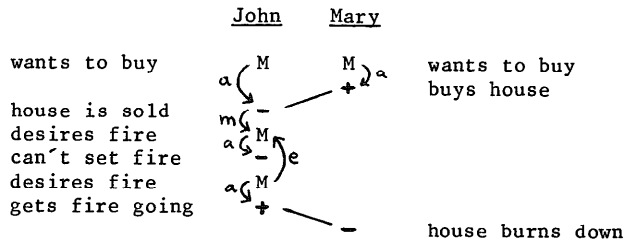
For example, if John wants to buy a house, his desire is a mental state (M). If John subsequently buys the house, his desire is actualized by a positive event (+). But if someone else buys it instead, John will experience that transaction as a negative event (-) signalling actualization failure. These particular affect states are derived by recognizing an initiated goal (M), an achieved goal (+), and a thwarted goal (-). The status of a goal is just one way that an affect state can be recognized. A more complete account of affect state recognition is presented in [3].

All affect states are relative to a particular character. If another buyer (Mary) takes the house, we have a negative event for John, and a positive event for Mary. We use a diagonal cross-character link to identify their two affect states as reactions to the same event:



The above configuration of four states and three links is the affect unit for "competition." Two actors have a goal, and success for one means failure for the other. "Success" and "failure" are primitive affect units contained within the competition unit. Success is recognized whenever a mental state is actualized by a positive event. Failure is the non-actualization of a mental state through a negative event.

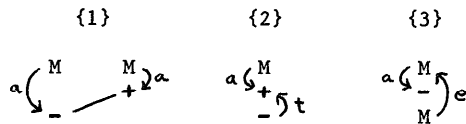
Now suppose John decides to get even by setting the house on fire. And suppose further that it takes two tries to get it going.



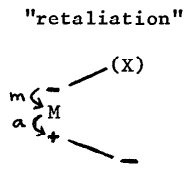
The sale of the house to Mary motivates John to set the house on fire (M). This mental state fails to be actualized (-) the first time he tries to commit

arson. But his desire persists in an equivalent mental state (M) and is then successfully actualized (+) by John setting the fire. This fire is a positive event (+) for John, but a negative event (-) for Mary who suffers a loss.

"Loss" is an affect unit that occurs whenever a negative event terminates a positive event in the sense of removing whatever satisfaction was derived from that positive event. When a loss wipes out a previous success, we get the affect unit for "fleeting success." When a smaller unit is embedded in a larger unit (e.g. "loss" is embedded in "fleeting success"), we recognize the structure of the larger unit as a "top level" affect unit. Using this convention, our story about John and Mary contains 4 top level affect units.

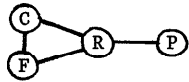


{1} represents "competition", {2} "fleeting success", and {3} "perseverance after failure." A fourth affect unit is recognized by merging the two equivalent mental states of John:



The unspecified (X) in the retaliation unit can be any affect state. In our story, John's negative event happened to be a positive event for Mary.

Top level affect units for a narrative can be used as the basis for a graph structure that describes narrative cohesion. The nodes of the graph represent top level affect units, and an arc exists between two nodes whenever the corresponding affect units share at least one common affect state. The affect unit graph structure for our simple story looks like:



Where C = "competition", F = "fleeting success", R = "retaliation", and P = "perseverance after failure."

In general, the affect unit graph for a cohesive narrative will be connected. And in many cases, the graph will have a unique node whose degree (number of incident arcs) is maximal over all nodes in the graph. In our example, the retaliation unit has a uniquely maximal degree of 3. We will call any node of maximal degree a "pivotal unit." If a story has a unique pivotal unit, then that unit encodes the "gist" of the story. A good summary for the story will be based on the pivotal unit and its adjacent units.

We first derive a baseline summary from the pivotal unit by accessing a "generational frame" associated with the pivotal unit. For example, a generational frame for retaliation is:

"When Y caused a negative event for X,
X caused a negative event for Y."

This is a conceptually abstract description of retaliation. To produce a reasonable summary, we must (1) instantiate the generational frame, and (2) augment it with information from units adjacent to the pivotal unit. We will try to convey what's involved by showing how a baseline summary evolves into a reasonable summary with the addition of information from adjacent units. (This sequence is not intended to reflect actual processing stages).

S1 = Retaliation (the baseline summary)

"When Mary prevented John from getting something he wanted, John set her house on fire."

S2 = S1 + Competition

"When Mary bought something that John wanted, John set her house on fire."

S3 = S2 + Fleeting Success

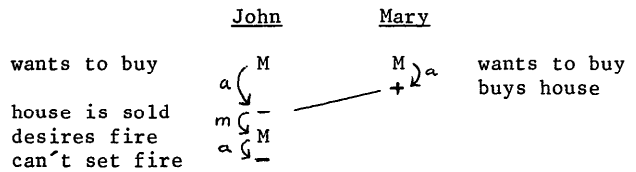
"When Mary bought a house that John wanted, John set the house on fire."

S4 = S3 + Perseverance After Failure

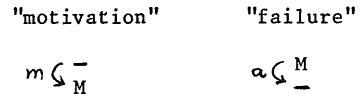
"When Mary bought a house that John wanted, John set the house on fire after two tries."

If the information from the perseverance unit seems less important than the other contributions, there is a good reason for this. "Perseverance after failure" resides between two equivalent mental states that are merged within the retaliation unit. It is often desirable to ignore units that are lost when equivalent mental states are merged.

Suppose for comparison, that John gave up on his intended arson after the first unsuccessful attempt. Then our affect analysis for the story would be a truncated version of the original:



We still have a competition unit, but the other top level units are now "motivation" and "failure":



The affect unit graph now contains three connected units, with motivation acting as the pivotal unit:



The baseline summary is therefore built from a generational frame associated with motivation:

"When a negative event happened to X, X wanted Z."

Augmenting this baseline summary with information from the competition and failure units, we derive a reasonable summary:

S1 = Motivation (the baseline summary)

"When Mary prevented John from getting something he wanted, John wanted to set her house on fire."

S2 = S1 + Competition

"When Mary bought a house that John wanted, John wanted to set it on fire."

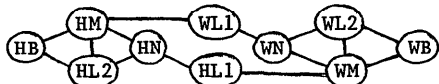
S3 = S2 + Failure

"When Mary bought a house that John wanted, John unsuccessfully tried to set it on fire."

These two examples illustrate how pivotal units and their adjacent units can be used to drive processes of narrative summarization. While many simple stories will succumb to an algorithm that uses a pivotal unit for the baseline summary, other stories yield affect unit graphs that do not have unique pivotal units. For example, consider "The Gift of the Magi" by O. Henry.

In this story a young couple want to buy each other Christmas presents. They are very poor but Della has long beautiful hair, and Jim has a prized pocket watch. To get money for the presents, Della sells her hair and Jim sells his pocket watch. Then she buys him a gold watch chain, and he buys her expensive ornaments for her hair. When they realize what they've done, they feel consoled by the love behind each other's sacrifices.

The affect unit analysis is perfectly symmetrical across the two characters. Both characters have affect units for nested subgoals, a regrettable mistake, two distinct losses, and a hidden blessing. The affect unit graph for this story is connected, but there is no unique pivotal unit:



Both "HM" and "WM" are pivotal units. These units correspond to their regrettable mistakes. Let the family of a node N be the set of nodes adjacent to N. Then this graph can be partitioned into the families of "HM" and "WM." "HN", "WN", "HL1", and "WL1" are boundary units in the sense that each of their families cross this partition. It is not easy to come up with a one sentence summary of "The Gift of the Magi," but it can be done by concentrating on the boundary units of maximal degree ("HN" and "WN"). These are the units for their nested subgoals:

"Della sold her long locks of hair to buy her husband a watch chain, and he sold his watch to buy her ornaments for her hair."

This example shows how the summarization algorithm must be sensitive to structural features of affect unit graphs. In this case the connected graph can be partitioned into two families of two pivotal units, and the simplest summary originates from the boundary units of maximal degree.

The process of narrative text summarization relies on (1) a high level of conceptual representation that readily encodes coherence within the narrative, and (2) a process of language generation that can easily be driven by that high level memory representation. In this paper we have attempted to show how affect units and their resulting graph structures are well-suited to these requirements.

We have necessarily omitted important explanations concerning techniques of recognition for affect units and the processes of generation that express target summaries in English. The representational system itself requires further explication concerning which affect unit configurations are legitimate (there are 15 legal configurations of the form "state" - "link" - "state" rather than the combinatorially possible 36). Using these 15 primitive configurations, we can represent speech acts, voluntary compliance, coerced compliance, the notion of a double-cross, and similar abstractions of equivalent conceptual complexity [3].

The use of affect units in narrative summarization is currently being explored by psychological experiments on text comprehension and within a computer implementation for the BORIS system [2]. While related work on text summarization has been conducted using story grammars, there are serious flaws in that approach due to the top-down nature of story grammars [1]. These difficulties will not arise with affect unit approach because affect units are constructed by bottom-up processing at the time of understanding. The resulting affect unit graphs are consequently far more flexible in their content and structure than the rigid hierarchies of fixed story grammars. This flexibility is the key to recognizing a diverse range of plot structures without recourse to an a priori taxonomy of all possible plot types.

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