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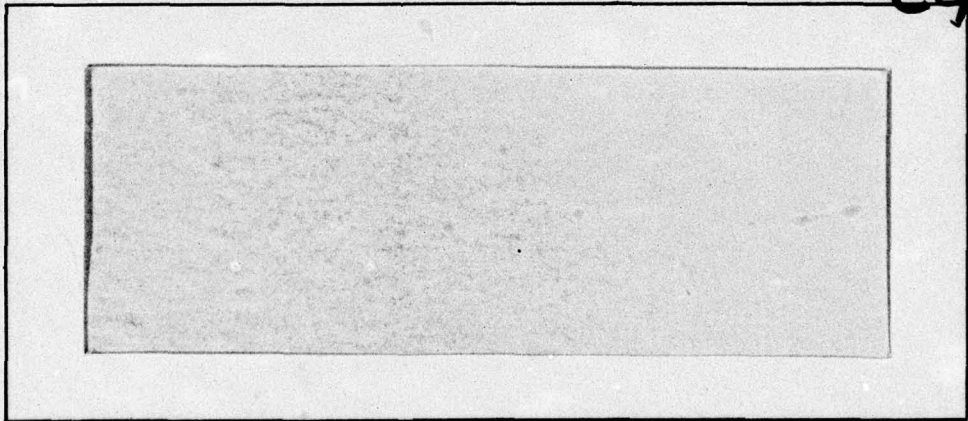
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Ideological Belief System Simulation

May 1977

Research Report #111

Jaime G. Carbonell, Jr.

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Ideological Belief System Simulation.

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ABSTRACT

↳ 'POLITICS' is a system of computer programs which simulate humans in comprehending and responding to World events from a given political or ideological perspective. The primary theoretical ^{purposes} motivations were: (1) The implementation of a functional system which applies the knowledge structures of Schank and Abelson (1977) to the domain of simulating political belief systems; (2) The development of a tentative theory of intentional goal conflicts and counterplanning. Secondary motivations for the politics project include developing a representation for belief systems, investigating cognitive processes such as goal-directed inferencing, and the integration of several types of knowledge representations into a functional system. ↗

INTRODUCTION AND BACKGROUND.

POLITICS is an automated political belief system simulator. Given a story about a political conflict and an ideology to use in interpreting the story, POLITICS generates a full story representation, predicts possible future events, makes suggestions about what should be done to rectify the situation, and answers a wide variety of questions. A subset of politics can function like Abelson's Goldwater machine (1965), but it solves most of the serious problem's faced by the Goldwater simulator. Abelson's Goldwater machine did not understand or represent physical reality. For instance, since Russia built the Berlin wall, the

The research described in this report was supported by the Advanced Research Projects Agency of the Department of Defense and monitored by the Office of Naval Research under contract N00014-75-C-1111.

program would predict that Castro would also build the Berlin wall. The program did not "understand" what it meant to build a wall, but if Russia did it, then it must be a bad thing. Communists do bad things. Cuba is also Communist. Ergo, Cuba would also build a Berlin Wall. There has been considerable progress since the late sixties both in theoretical insights and implementational mechanisms, such as the theory of predictive understanding and knowledge structures developed by Schank and Abelson (1977) which underlies the implementation of POLITICS.

Although the POLITICS project is implementational in nature, several new theoretical issues were encountered leading to some new ideas and representations. A functional representation for an ideology was developed which the programs can take easily as input data, thus enabling POLITICS to model any reasonable political ideology. Goal directed inferencing processes were developed to interact with scripts, thus making scripts more strongly predictive than in other implementations (e.g. Cullingford, 1977). Counterplanning strategies were investigated to a limited degree in order to model and understand the way in which political entities often scheme to thwart each other's goals. Some new question answering strategies were developed to interrogate hypothetical and predictive information. A limited form of learning new information about objects and political entities in the world model was developed to increase the effectiveness of POLITICS when it encountered previously unknown facts necessary to interpret a story.

In order to acquire a general feel for the POLITICS system, consider the following one sentence story:

(1) -- The Russians massed troops on the Czech border.

POLITICS interprets this story making appropriate inferences to incorporate the story in its internal memory representation in such a way that it can later answer questions, make predictions about possible future events, and comment as to what the United States should do about the situation. The story interpretation and other simulated cognitive processes assume a given political ideology; let us consider a right wing ideology in processing the above story. We stipulate that a politically conservative person might infer that Russia intends to either invade Czechoslovakia or threaten an invasion in order to force Czechoslovakia to capitulate to Soviet demands. If one recalls the 1968 Soviet invasion that toppled Dubcek one may infer rather specific reasons for the invasion. Otherwise it suffices to infer that since Russia always wants strong political control over all neighboring countries (especially in Eastern Europe), the present story is just another instance of Russia exerting its military muscle in order to expand its political domination. The process which makes the inferences and recalls what Russia is likely to do is described in a later section. POLITICS interprets story (1) largely by attributing goals and motivations to the actors in the story and integrating the story representation into its World Model. It can demonstrate its comprehension by answering questions as shown in the following actual question-answer dialogue:

(INTERPRET RIGHTWING)

INPUT STORY: Russia massed troops on the Czech border.

INTEPRETATION COMPLETED, READY TO ACCEPT QUESTIONS.

Q: Why did Russia do this?

A: BECAUSE RUSSIA THOUGHT THAT IT COULD TAKE POLITICAL CONTROL OF CZECHOSLOVAKIA BY SENDING TROOPS.

Q: What will Russia do next?

A: RUSSIA MAY TELL ITS TROOPS TO START THE INVASION.

Q: What else can Russia do?

A: RUSSIA MAY WAIT FOR CZECHOSLOVAKIA TO GIVE IN TO RUSSIAN DEMANDS.

Q: What happens if Czechoslovakia does not give in?

A: RUSSIA MAY DECIDE TO START THE INVASION.

Q: What should the United States do?

A: THE UNITED STATES SHOULD INTERVENE MILITARILY.

Q: What else can the United States do?

A: THE UNITED STATES CAN DO NOTHING, OR IT CAN INTERVENE DIPLOMATICALLY BY CONFERRING WITH RUSSIA ABOUT CZECHOSLOVAKIA. THESE ALTERNATIVES ARE BAD FOR THE UNITED STATES.

THE POLITICS STORY INTERPRETER.

The POLITICS system is a set of computer programs written in MLISP by the author of this paper on the Yale University PDP-10. The system may be conceptually divided into three modules: a parser, a story comprehender called the interpreter and a question answerer. All three modules share a common data base, low level procedures and multiple communication channels. Due to the limited scope of this paper, discussion will primarily focus on the interpreter. The parser receives a story in English and converts it to Conceptual Dependency representation (Schank, 1972). Much of the information about the world stored in POLITICS memory is used in the parsing process. The POLITICS parser is modeled after Riesbeck's parser (Riesbeck, 1975) with changes relevant to the task domain of political stories.

One method of understanding a story is to recognize that the story is a specific instance of a more general sequence of actions which the understander knows about from previous experience. These sequences of actions, called scripts, are usually oriented towards achieving one or more goals and may be encountered with slight variations many times in the course of understanding stories. For instance, figure (1a) is the INVADE script which politics uses to understand story (1). Figure (1b) is the same script, after interpreting the Czechoslovakia story, with instantiated script roles, a dynamically selected "default" path, and (in one instance, i.e. the border) a scriptal concept substituted by a functionally equivalent concept in the input

story. The scripts are internally represented in full detail in Conceptual Dependency. For the sake of readability, figure (1) has been simplified and diagrammed. For notational convenience, the following conventions have been adopted: A '\$' in front of a word denotes a script name; an '&' denotes an uninstantiated script role analogous to a slot in a frame (Minsky, 1975); a word bracketed by asterisks denotes a real world entity such as a person or a country. Angle brackets mean that an English phrase has been substituted for the actual (often lengthy) representation when the latter is not of primary interest.

INVADE SCRIPT

SCRIPT ROLES:

```

&INVADER (ISA . *COUNTRY*)
&INVADEE (ISA . *COUNTRY*)
&FORCES1 (ISA . *ARMEDFORCES*) (PARTOF . &INVADER)
&FORCES2 (ISA . *ARMEDFORCES*) (PARTOF . &INVADEE)
&KEYPLACES (PARTOF . &INVADEE)
(FUNCTION <political control of &INVADEE>

```

```

GOALS: <goal of &INVADER is to take political control of &INVADEE.>
       <goal of &INVADEE is to prevent &INVADER from taking
       political control of &INVADEE.>

```

BODY OF \$INVADE (Causally connected sequence of actions.)

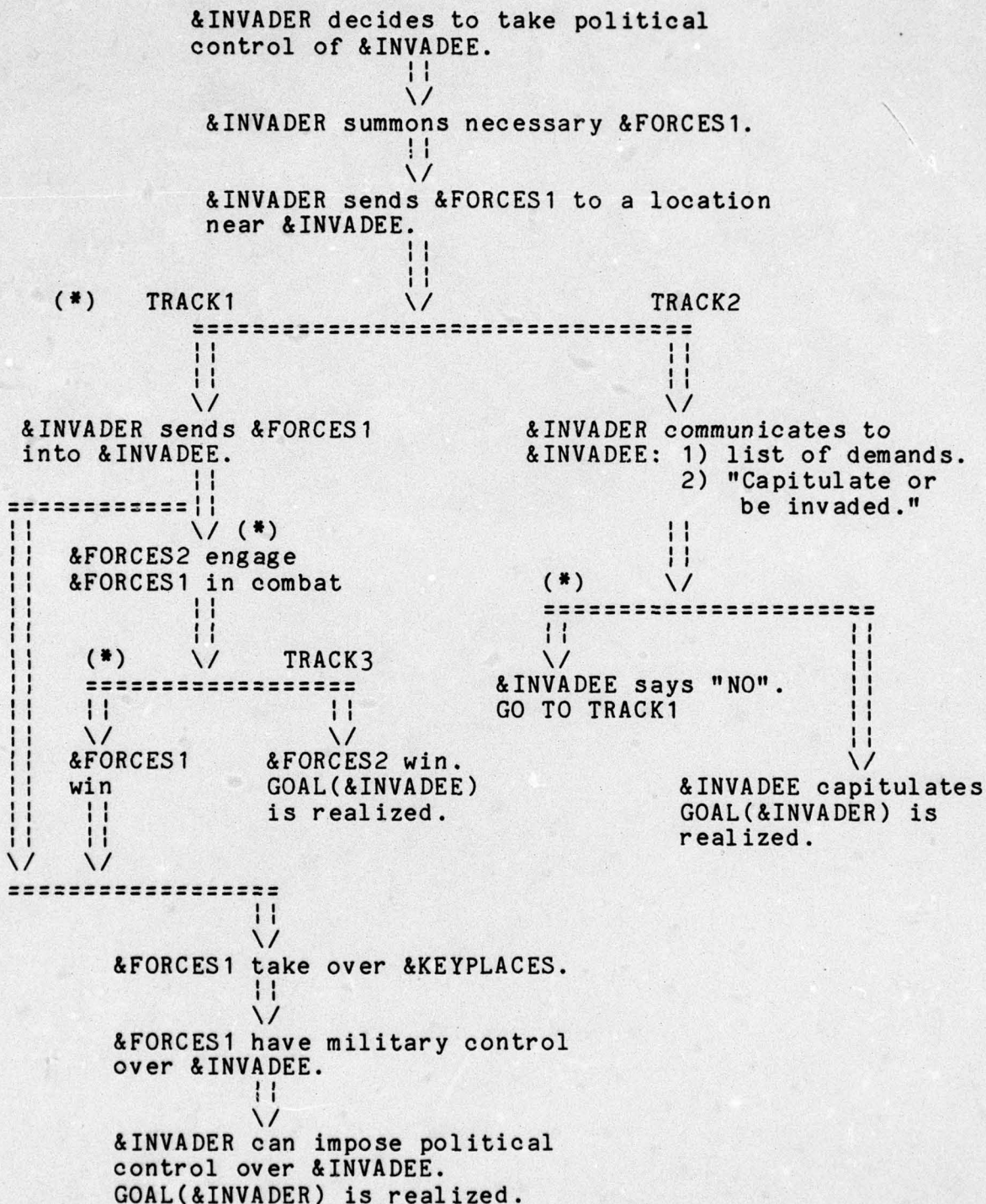


FIGURE 1a. Uninstantiated invade script in the POLITICS system. starred (*) tracks signify the default path in the right wing ideology.

INSTANTIATED SCRIPT ROLES:

```

&INVADER <- *RUSSIA*
&INVADEE <- *CZECHOSLOVAKIA*
&FORCES1 <- (*TROOPS* PARTOF (*RUSSIA*))
&FORCES2 <uninstantiated>
&KEYPLACES <uninstantiated>

```

INSTANTIATED GOALS:

```

GOAL OF RUSSIA: <Take political control of
                Czechoslovakia.>
  SUBGOAL: <Take military control of
            key places in Czechoslovakia.>
GOAL OF CZECHOSLOVAKIA: <Prevent Russia from
                        taking political control.>
  SUBGOAL: <Prevent Russian forces from taking
            military control of key places.>

```

INSTANTIATED PATH IN SCRIPT:

```

*RUSSIA* decides to take political
control of *CZECHOSLOVAKIA*

```

```

||
\ /

```

```

*RUSSIA* summons necessary TROOPS.

```

```

||
\ /

```

```

*RUSSIA* sends TROOPS to the border
between *RUSSIA* and *CZECHOSLOVAKIA*.

```

```

||
\ /

```

```

<Present point in the story time-line>
What follows is the default path in
the right wing ideology.

```

```

||
\ /

```

```

*RUSSIA* sends TROOPS into *CZECHOSLOVAKIA*.

```

```

||
\ /

```

```

Russian TROOPS defeat Czech TROOPS in combat.

```

```

||
\ /

```

```

Russian TROOPS take over Czech &KEYPLACES.

```

```

||
\ /

```

```

Russian TROOPS have military control over
*CZECHOSLOVAKIA*.

```

```

||
\ /

```

```

*RUSSIA* can impose political control over
*CZECHOSLOVAKIA*, achieving its goal.

```

FIGURE 1b. Instantiated invade script, initial segment followed by the predicted default path.

As exemplified in figure 1a, most scripts have many branching sequences of events which may rejoin each other at a later point in the temporal sequence. These parallel sequences are called tracks. In the instantiation of a script only one track is instantiated, the track describing the sequence of events in the story. When the story is incomplete, as in story (1), there are usually more than one possible uninstantiated tracks in the script which may describe future sequences of events. One of these tracks, labeled the default path, is judged to be the most likely one to take place. The default path is inferred for predicting future events unless there is evidence supporting some other track or evidence indicating that the script should be aborted. The default path is dynamically chosen depending on the point of view of the interpreter. For instance in the right wing ideology it is assumed that Russia's main goal is world domination at all costs, therefore the direct invasion track is chosen to be the default path. In a left wing ideology it is assumed that Russia's main goal is to avoid a nuclear war; expanding its political control is considered to be a lesser goal. Hence, the left wing ideology chooses the threat branch for its default path.

Consider the different aspects of the implementation of a script application system for a new task domain. The idea of Scripts comes from Schank and Abelson. The first working system applying scripts is SAM implemented primarily by Cullingford (1977). SAM applied scripts mostly to understanding 'routine' newspaper stories such as automobile accidents and visiting dignitaries. POLITICS is the second system to implement scripts,

although script application is only one of many processes in the system. The use of scripts in POLITICS is not just to understand what happened, but to set up a predictive framework to direct inferences, invoke ideologies and resolve goal conflicts via counterplanning strategies. Thus, our scripts need to have more than branching sequences of events to be matched to input stories. We associate goals with scripts (as illustrated above), and we associate subgoals with each branching sequence of events. The Script applier, once it decides to invoke a script, must:

- 1) Match the events in the story with the event chains in the script.
- 2) Instantiate the script roles according to the previous match and according to the whether the goals of the actors in the script match the goals of the actors in the in the selected political ideology.
- 3) If concepts in the story do not match the script, then substitute the story events for their functionally equivalent (fulfilling the same subgoal) events in the instantiated script.
- 4) Choose the default path whose goals best match the ideologically predicted goals for the instantiated actors.
- 5) Call the inferencer if either there is a reference specification problem in the matching process or the specific goals for an actor have not been determined.
- 6) Update the entries in the world model to incorporate new facts, of any, contained in the story.

Script application is one of the simpler aspects of story understanding. There is a potentially large number of scripts applicable to any task domain such as political conflict stories. The understanding system must decide which script is applicable;

often more than one script must be applied to understand a story. POLITICS currently has eleven active scripts with the theoretical potential of handling an arbitrary large number. In order to ascertain what scripts are applicable and what are the motivations (goals) of the actors in the story, it is necessary to have at least one other memory process, to wit, directed inferencing, functioning concurrently with script application.

INFERENCE PROCESSES

There are two types of inferences implemented in the POLITICS system, specification and goal inferences. The former is a low level memory process which at all times strives to specify each entity in the story and identify it as or relate it to entities in applicable scripts and entities in the world model. For instance, in story (1) the inferencer had to decide that the troops which the Russians massed on the Czech border were Russian troops before the \$INVADE script could be properly instantiated. A more interesting example of a specification inference is detailed in the interpretation of story (2) in a subsequent section of this paper. Specification inferences do not lead to a combinatorial explosion of inferences because there is usually a small number of entities to identify in a given story.

Goal directed inferencing is the process which strives to identify the motivations of the actors in the story, and, as a result of establishing the goals of the actors it becomes possible to infer which script is applicable in understanding the story.

Goal directed inference rules are somewhat complicated. We are considering the possibility of simplifying the rules to a small manageable set which can be combined to yield more complex rules, thus far with little success. An example of a complex inference rule, translated into English for intelligibility is: If a large country moves armed forces to a location inside or in the proximity of a smaller country then if predicate1(small country) and predicate2(small country, large country) are true then the goal of the large country is to give direct military support to the smaller country, else if predicate3(larger country), then the goal is to take over the smaller country. Predicate1(X) is true iff X is involved in a military conflict and needs assistance. Predicate2(X,Y) is true iff the relations between X and Y are good, and it is to their mutual benefit to aid each other. Predicate3(Y) is true iff a high level goal of Y is to expand its political control. The application of this rule to the interpretation of story (1) should be relatively clear, to wit, POLITICS must decide whether the Russian maneuver is targeted at taking political control of Czechoslovakia or at militarily aiding Czechoslovakia. (Predicate1 fails, predicate3 succeeds, hence the Russian goal is inferred to be a takeover.) The same inference rule, also under the right wing ideology, will decide that the reason that the United States sent troops to South Viet Nam was to aid the South Viet Nameese (Predicate1 and 2 succeed, predicate3 fails).

Fortunately, most inference rules are somewhat simpler than the example presented above; many have only one or two predicates. Thus, the application of the set of active inference rules, usually in an unordered sequence can be thought of as a production system. As evidenced in our example, most of the inference rules are domain specific, that is, specific to matters of foreign policy and political or military conflicts. Goal directed inference rules are selectively activated before the inferencer and the script applier are invoked. The activation process is the result of choosing a general scenario as the first step in story interpretation. The scenario consists of nothing more than a list of the main actors of the story and a description of the depicted action(s). Hence, if the story consisted of a (possible) conflict between the United States and Russia (see story (3) in a later section) none of the inferences involving small countries would be activated. Some of the simpler inference rules are listed below:

SPECIFICATION INFERENCE RULES.

- 1) If a country or its leader orders an agency (such as the army or police) then the agency is part of the aforementioned country.
- 2) If a country is in a state of civil war then expect to encounter factions asking for military aid.
- 3) If a political entity (e.g. country, faction or political party) receives aid from another political entity, then they share the same political beliefs (e.g. in story (2) both are communist.)

GOAL ACTIVATION INFERENCE RULES.

- 1) If a political entity builds or acquires weapons then it plans to activate its highest level military control goal. (In the right wing ideology this goal is defense of the Free World for the United States, or political

domination of the world for Russia. See Abelson 1973)

- 2) If a large country aids a political entity then it may have the goal of increasing its political control over said political entity as repayment for its aid.

The inferencer, which applies the active inference rules, and the script applier are implemented as coroutines in POLITICS because they need to call on each other in a bootstrapping process in order to interpret a story. Consider the interpretation of story (1). After the necessary specification inferences, the next inference generated is that a state of concentrated military force has been achieved by Russia. The establishment of a concentration of force is a subgoal to many possible courses of action; therefore the inferencer calls upon the applier to determine which course of action is applicable. The script applier generates two alternatives from the event depicted in the input story augmented by the two previous inferences: Russia may want to invade Czechoslovakia, or Russia may want to militarily aid Czechoslovakia. The inferencer is called again on a goal directed determination of which (if either) of these courses of action may fulfill Russian goals. By interrogating the World model, the inferencer determines that since Czechoslovakia is not involved in any military conflict nothing can be achieved by sending troops to its aid. On the other hand, one of Russia's goals, stronger political control over small nations, may be achieved as a result of an invasion. The script applier is called a second time to invoke the invasion script whose first scene involves the transfer of a sizable military force near the object of the contemplated invasion.

DOCUMENTED STORY INTERPRETATION AND PROTOCOL.

In order to better illustrate the inference process, we present a complete POLITICS run, including all the internal messages and additional annotation where appropriate. This protocol also illustrates the parser and question answering modules which were implemented as part of POLITICS. Unfortunately, a detailed discussion of either of these two modules is outside the scope of this paper; suffice it to say that the former is modeled after the SAM system parser (Riesbeck, 1975) and the latter borrows many of its ideas from Lehnert's (1977) question answerer.

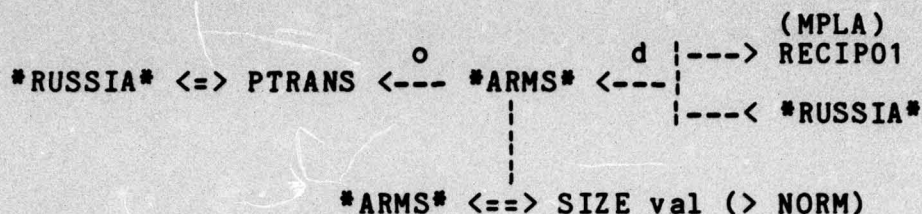
Right wing interpretation of story (2).

*(INTERPRET RIGHTWING)

INPUT TEXT: Russia sends massive arm shipments to the MPLA in Angola.

PARSING...(UNKNOWN WORD: MPLA)
 (SYNTACTIC EXPECTATION: NOUN)
 (SEMANTIC EXPECTATION: (FRAME: (ATRANS PTRANS) SLOT: RECIP
 REQ: (LOC ACTOR)))
 COMPLETED.

The parser tries to parse the input story into conceptual dependency representation. Upon encountering "MPLA", a word that it does not recognize, instead of returning an error the parser fills the slot in the conceptual dependency parse with a token of unknown identity but which has to fulfill the parser expectations. That is, the unknown entity has to be a noun which is either a location or an actor, and has to fit in the recipient slot of an ATRANS or PTRANS framework. Hence, the parse looks as follows:



As the story interpretation continues, a memory entry is created for RECIP01 when the specification inferences using the parser expectations and information about the world decide that the MPLA is probably a communist political faction of Angola. More specifically, the system knows that Angola is in a state of civil war, infers that sending arms is an instance of giving military aid, and knows that Russia is communist. Using this knowledge, and the inference rules discussed in the previous section POLITICS is able to create a memory entry for the MPLA. This information is used in the script application and question answering phases of the protocol. One can view the automated creation of new memory entries and the addition of information to existing entries as a form of rudimentary learning. This aspect of the system was developed mostly on pragmatic grounds, but it may well be worth future investigation. We continue with the interpretation of story (2).

INTERPRETING STORY FROM A REAGAN-GOLDWATER IDEOLOGY.

```

INFERENCE:  *MPLA* MAY BE A POLITICAL FACTION OF *ANGOLA*
INFERENCE:  *RUSSIA* ATRANS *ARMS* TO *MPLA*
INFERENCE:  *MPLA* IS PROBABLY *COMMUNIST*
INFERENCE:  GOAL OF *MPLA* IS TO TAKE OVER *ANGOLA*
INSTANTIATING SCRIPT:  $AIDMF
INFERENCE:  *RUSSIA* MAY WANT TO CONTROL *ANGOLA* THROUGH *MPLA*

```

INTEPRETATION COMPLETED, READY TO ACCEPT QUESTIONS.

Two goal directed inferences determined that the MPLA wants to take control of ANGOLA, and that Russia is using the MPLA for its own ends: gaining political control of a small country. The first goal inference is forward deduction. The goal of political factions in general is to take political control of countries. (Recall that we are under the right wing ideology.) The MPLA is probably a political faction. Having weapons is a precondition for military takeover. Military takeover leads to political control. Ergo, the MPLA has the active goal of taking over Angola. In spite of this example there is little forward deduction implemented in POLITICS, the primary reason being the possible combinatorial explosion in the number of plausible inferences. The inference pertaining to Russia's goal comes from the instantiation of the military aid script which says that the reason why one country aids another is that the first country expects something in return. (i.e. the fulfillment of one of its own goals.) Under the right wing ideology, the only Russian goal that the MPLA can fulfill is to give Russia a measure of political control over Angola.

The question answer dialogue for story (2) follows.

(1)

Q: Why did Russia do this?

QUESTION TYPE IS: WHY
SEARCHING INFERENCES...

A: RUSSIA WANTS TO CONTROL ANGOLA THROUGH THE MPLA.

(2)

Q: What will the MPLA use the arm shipments for?

QUESTION TYPE IS: WFR
SEARCHING GOLDWATER IDEOLOGY
SEARCH FAILURE...TRY AGAIN DECISION

SEARCHING SCRIPT: \$AIDMF

A: THE MPLA WANTS TO TAKE OVER ANGOLA USING THE WEAPONS.

The above two questions illustrate the results of the previously discussed goal directed inferencing. Each question is analyzed into a question type indicating the type of information desired by the person posing the question. (See Lehnert, 1977 for a full elaboration on the theory of question answering.) Then the answering module either searches the appropriate section of memory for the answer, or calls upon the inferencer (hence the script applier which is called by the inferencer) for further computation. The search for an answer is heuristically guided. On failing to find the answer on the first try POLITICS chooses an alternative search or computation if it is deemed that the desired information may be plausibly found by such alternate means. The questions and answers presented below illustrate information retrieval from the military aid script and further inferencing to predict possible future actions. For instance, the system knows that in a civil war there is more than one faction in military conflict, each faction with the goal of political control of the country. Hence, the same general course of action is predicted for other hypothetical factions, namely seeking military aid. In the right wing ideology the United States is always ready to oppose communist expansion, therefore it would satisfy both the goals of the United States and the goals of the factions opposed to the MPLA if the United States were to send arms to the aforementioned factions.

(3)

Q: What will the other factions in Angola do?

A: THE OTHER FACTIONS MAY ASK SOME OTHER COUNTRY FOR ARMS.

(4)

Q: Which country?

ATTEMPTING FURTHER SPECIFICATION OF *COUNTRY* IN CURRENT CONTEXT.

A: PROBABLY THE UNITED STATES.

(5)

Q: Should the United States do anything about it?

A: YES, THE UNITED STATES SHOULD SEND ARMS TO THE OTHER FACTIONS IN ANGOLA.

Two entries in the World model before story interpretation:

ENTRY	INFORMATION
1) *MPLA*	NIL
2) *RUSSIA*	((ISA . *COUNTRY*) (GOVERNMENT . *COMMUNIST*) (SIZE . *LARGE*) (PROX *CZECHOSLOVAKIA* *CHINA*) (CAPITAL . *MOSCOW*) (LEADER . *BREZHNEV*) <No currently active goals>

Same entries after the interpretation of story (2).

ENTRY	INFORMATION
1) *MPLA*	((ISA . *FACTION*) (IDEOLOGY . *COMMUNIST*) (PAROF . *ANGOLA*) (GOALS: ((ACTOR (*MPLA*) IS (*SCONT* OBJECT (*ANGOLA*) VAL (10))))))
2) *RUSSIA*	((ISA . *COUNTRY*) (GOVERNMENT . *COMMUNIST*) (SIZE . *LARGE*) (PROX *CZECHOSLOVAKIA* *CHINA*) (CAPITAL . *MOSCOW*) (LEADER . *BREZHNEV*) (GOALS: ((ACTOR (*RUSSIA*) IS (*SCONT* OBJECT &COUNTRY VAL &MAXNUM))) ((ACTOR (*RUSSIA*) IS (*SCONT* OBJECT (*ANGOLA*) VAL (8)) INST ((ACTOR (*MPLA*) IS (*SCONT* OBJECT (*ANGOLA*) VAL (10))))))))

<Active goals only>

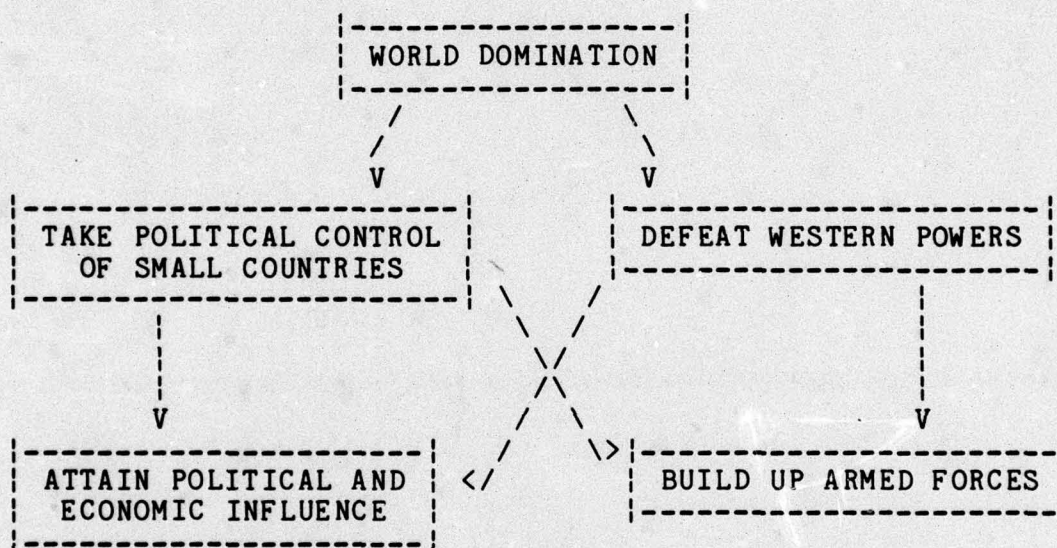
This story illustrates a case where the major part of the story interpretation and question answering phases were accomplished through the inferencing mechanism rather than through script application. The interpretation of stories (1) and (3) rely more heavily on the script(s) involved. Comparing the memory entries for Russia and the MPLA before and after processing Story (3) illustrates the previously mentioned acquisition of information from surrounding context.

HOW POLITICAL IDEOLOGIES ARE REPRESENTED.

Abelson (1973) represents Senator Goldwater's political ideology as a rather simple master script. The master script is internally encoded in a procedural manner by a set of rules of the following form: If A then B in which case C to prevent D, where A, B, C and D are categories of actions. Colby's (1973) representation of his belief system for PARRY appears to be distributed throughout his programs, strongly influenced by the story chosen for PARRY to tell whenever it gets a chance (i.e. persecution by the Mafia.).

In the POLITICS system adopting a belief system consists of attributing a goal tree to each important actor in the world model. A Goal tree is a set of goals for a given actor arranged in a hierarchy of importance and interdependence. More concretely, consider what the goal tree of the United States might be from a right wing view point. A plausible primary goal is to maintain the western world free from Communist domination. This

goal may have as subgoals military containment of communist aggression, preventing communist subversion from within, keeping technologically and economically ahead of the Soviet Union and maximizing western influence in neutral nations. The first of these subgoals can itself have the subgoals of maintaining military superiority and establishing (and maintaining) free world alliances. The goal tree of the Soviet Union under the same ideology is diagrammed below:



It is possible for an actor to have two or more goals which may be ranked in order of importance, but neither need be a subgoal of the other. For instance, under the right wing ideology the United States may have elimination of economic foreign aid as a low importance goal. (e.g. stop wasting resources sending food to India.) This goal does not fit into the subgoal hierarchy mentioned above for the United States. Therefore, one actor can have more than one goal-subgoal tree where the trees themselves can be arranged into a tree hierarchy as a function of importance.

In practice, however, this extra mechanism does not seem necessary for POLITICS because an actor has usually only one active goal-subgoal tree. As the reader may have noted from the above diagram, goal trees are represented internally as directed acyclic graphs to economize storage when a certain goal may be the subgoal of several higher level goals.

An advantage of this method, aside from pragmatic considerations, is that it is possible for the POLITICS system to handle different ideologies merely by attributing a different set of goal trees to the actors in the world. At present both a right wing and a left wing ideology have been implemented. The processing of story (3) below illustrates how the same system can respond to the same story in a strikingly different manner where only the ideology was changed.

Right wing interpretation of story (3).

*(INTERPRET RIGHTWING)

INPUT TEXT: The United States Congress voted to fund the Trident submarine project.

PARSING...COMPLETED.

INTERPRETING STORY FROM A RIGHT WING IDEOLOGY.

INFERENCE: (#ARMEDFORCES PART (*US*)) TO RECEIVE FUNDS

INSTANTIATING SCRIPT: \$FUNDING

INFERENCE: (#ARMEDFORCES PART (*US*)) TO BUILD (#WEAPONS TYPE (*SUBMARINES*))

INFERENCE: *US* INCREASE IN MILITARY POWER

INFERENCE: GOAL OF *US* IS (#COUNTRIES TYPE (*COMMUNIST*)) SIZE (LARGE)) TO FEAR *US*

INSTANTIATING SCRIPT: \$CONFRONTATION

INFERENCE: (#COUNTRIES TYPE (*COMMUNIST) SIZE (LARGE)) TO STOP EXPANDING POLITICAL-CONTROL

INTERPRETATION COMPLETED, READY TO ACCEPT QUESTIONS.

(1)

Q: What did the US Congress do this for?

A: THE UNITED STATES CONGRESS WANTS THE UNITED STATES ARMED FORCES TO BE STRONGER.

(2)

Q: Why should the US be stronger?

A: THE UNITED STATES ARMED FORCES SHOULD BE STRONG TO STOP COMMUNIST EXPANSION.

(3)

Q: What should the US do if Russia builds Submarines?

A: THE UNITED STATES SHOULD BUILD MORE SUBMARINES.

Left wing interpretation of story (3).

*(INTERPRET LEFTWING)

INPUT TEXT: The United States Congress voted to fund the Trident submarine project.

PARSING...COMPLETED.

INTERPRETING STORY FROM A LEFT WING IDEOLOGY.

INFERENCE: (#ARMEDFORCES PART (*US*)) TO RECEIVE FUNDS

INSTANTIATING SCRIPT: \$FUNDING

INFERENCE: (#ARMEDFORCES PART (*US*)) TO BUILD (#WEAPONS TYPE (*SUBMARINES*))

INFERENCE: *US* INCREASE IN MILITARY POWER

INFERENCE: (#COUNTRIES TYPE (*COMMUNIST*)) SIZE (LARGE)) TO BUILD (#WEAPONS TYPE (*UNSPEC*))

INSTANTIATING SCRIPT: \$ARMSRACE

INFERENCE: GOAL CONFLICT UNRESOLVED *US* AND (#COUNTRIES TYPE (*COMMUNIST*)) SIZE (LARGE))

INTEPRETATION COMPLETED, READY TO ACCEPT QUESTIONS.

(1)

Q: What did the US Congress do this for?

A: THE UNITED STATES CONGRESS FEARED FALLING BEHIND IN THE ARMS RACE.

(2)

Q: What will Russia do next?

A: RUSSIA WILL PROBABLY BUILD MORE WEAPONS.

(3)

Q: What should the US do if Russia builds Sumbarines?

A: THE UNITED STATES SHOULD NEGOTIATE WITH RUSSIA TO STOP THE ARMS RACE.

Question 2 is different in each Q/A dialog because in each case it is a follow-up of the respective answer to the first question.

Both interpretations of the trident story began along the same track: establishment of a minimal comprehension of the event described in the input story (e.g. instantiating the funding script) and a determination of who the relevant actors were. Once goal inferencing started, the goal trees imposed by the two different ideologies caused the two interpretations to diverge. The final story representations differed somewhat, especially in their future predictions and suggestions for possible future courses of actions. The question interpretation program often needs to look at the activated or instantiated goal trees before deciding where to search for the answer.

Let us analyze why the answers to the three questions differ substantially depending on the ideology. In the right wing analysis of why Congress voted to fund the Trident submarines, the system finds that funding submarines leads to an increase in weapons which give the United States military power. This is a goal in the right wing goal tree of the United States, therefore it is the answer to why the funding was voted. In the left wing interpretation no such goal is fulfilled. The arms race script was instantiated as a result of trying and failing to attribute a high level goal to the US military buildup, and the scriptal goal of each nation participating in an arms race is fear of falling behind in military power. The third question is again more easily answered by the right wing ideology. If the Russians build weapons then they are activating their goal of military superiority, which the United States can only thwart by activating their own goal of military superiority (or equality). One of the

counterplanning strategies discussed in the following section is applied at this point in the inferencing. In this case only one country can have military superiority, therefore by arms buildup the US would thwart Russia's top level goal of World Domination.

Consider the left wing interpretation of the third question. Military buildup by any nation causes further military buildups (i.e. the arms race script). The goal of military strength is an enabling subgoal to military action. Military action violates World Peace, the highest level left wing goal. Therefore military buildup has to be stopped. (This process involves tracing a path through a goal tree, a relatively simple task.) A counterplanning strategy states that if the two actors involved in a conflict agree on their highest level goal (e.g. world peace) and this goal may be violated by their conflict, then negotiation is in order.

PLANNING, COUNTERPLANNING AND GOAL CONFLICTS

In the course of forming a story representation and formulating ideologically based predictions, one needs a mechanism for understanding the conflicts between the goals of one or more political actors. Inferring what the goals are and applying scripts for the more stereotyped goal interactions and conflicts only solves a (rather large) slice of the full problem. The process of deciding what course of action to take in order to achieve an active set of goals is usually called planning. There is substantial work described in the AI literature on the problem

solving aspect of planning. Schank and Abelson (1977) and Wilensky (1977) have studied planning from a story understanding perspective in a social context. For the POLITICS project we investigated the idea of couterplanning, i.e. how to thwart an adversary's plans, or how to recover from stumbling blocks put by the adversary in the path of an actor's plans.

POLITICS realizes that there are many actors in the political world some of which may have active conflicting goals. We define a set of goals to be in conflict if they are mutually exclusive, that is, the achievement of one goal in the set precludes any other goal from being achieved. For instance, the case where many factions are striving for political control of a country represents a case of mutual goal exclusion (barring possible coalitions). The mutual exclusion principle gives the first two couterplanning rules: (let A be the actor doing the counterplanning.)

RULE C1: To stop actor X from accomplishing his goal G(X) see if there any goal G(A) which is mutually exclusive with G(X). If so, give high priority to accomplishing G(A).

RULE C2: If A wishes to accomplish G(A) and G(A) is being blocked by X working on a mutually exclusive G(X) then try to thwart G(X) by some other means.

These and other rules listed below are implemented in politics in rather obscure LISP code. It would be more asthetically pleasing and easier to add new rules if a clearer, more declarative representation was formulated. The rules are applied mostly at question answering time when POLITICS is asked questions of the type: "What should the US do about X?" or "How

might Russia respond if the US did Y" (where Y may be some hypothetical plan to thwart Russia's X). The best examples of counterplanning are in the right and left wing interpretations of story (3) in the previous section. The implemented counterplanning rules are little more than functionally encoded common sense knowledge. As such, they are more general than many of the goal inferences and particular scripts of the POLITICS world. There probably are detailed counterplanning rules specific to the world of international politics, but we deemed it more productive to investigate the more general rules. These common sense rules are shared by the different ideologies, but their application (triggered by active goals) differs depending on the interpretation of the story and inferred motives of the actors. There is no claim of completeness for the implemented counterplanning rules. A few other rules were considered but not implemented. The following are the four other counterplanning rules in the POLITICS system:

- RULE C3: To prevent X from achieving G(X) threaten a higher level goal of X, say G'(X). Thus, expect X to divert its efforts to G'(X).
- RULE C4: To prevent X from achieving G(X) prevent X from achieving a necessary subgoal of G(X).
- RULE C5: To achieve G(A) if X is blocking a subgoal of G(A) try to find an alternative plan (or script) for G(A).
- RULE C6: If G(A) and G(X) are in conflict and there exists a G'(A) = G'(X) where the G' goal is higher level than the G goals, then A should try mediating with X to mutually achieve G' and abandon their respective G goals. (Metaphorically speaking: Why fight over a molehill when together we can conquer a mountain.)

CONCLUSION

The POLITICS system has successfully met most of its goals. POLITICS can simulate more than one political belief system and is not troubled by the main problems that beset Abelson's Goldwater simulator. The representation of an ideological belief system as the attribution of a set of goal trees is a pragmatic success; hence, it is probably significant to future research on belief systems. The theory of predictive understanding (Schank and Abelson, 1977), which underlies the implementation of POLITICS, circumvents many of the problems faced by Brown (1974) and Bruce (1975) in their belief systems.

The concept of counter planning strategies as high level procedural knowledge used to thwart an opponents plan and thereby prevent him from achieving his goal was investigated. Some strategies have been successfully implemented as illustrated in the last section, but further investigation is required before a coherent theory of counter planning (if there be such) can be established. It is important to analyze the interactions and conflicts between the goals of two or more actors in order to predict and understand their behavior. We hope that POLITICS has made some headway in this direction, illustrating the need for future investigation.

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