COMEX: A COMMODITIES SUPPORT SYSTEM.

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We are developing an intelligent support system, COMEX, to manage the data that a commodities analyst receives in agricultural reports. COMEX must have the following capabilities: 1) finding relevant facts, 2) determining implications, 3) checking reliabilities, 4) monitoring, 5) alerting, 6) reporting, 7) answering queries. The research involves natural language, representation, common sense reasoning, qualitative simulation and user modelling. Here, I address representation and reasoning by describing COMEX-0 a working prototype of a module of COMEX.

COMEX-0 uses frames (Minsky, 1975), (Goldstein & Roberts, 1977) for representing knowledge. About twenty types of event are represented, together with crop-states, weather, commodities, quantities and prices. Frame structures are Interwoven with procedures. COMEX-0 builds frame structures by means of a formal dialogue with a user: Each frame has procedures for requesting information to instantiate its slots. Procedures attached to slots check that responses satisfy the requirements of the slot. Unsatisfied requirements complain giving a reason for unacceptability.

Representing evants.

EVENTS relate objects and actors around several central actions. Represented events include TRANSFER, GIVE, BUY, SELL, TRANSPORT, CHANGE, TAKE, INCREASE, DECREASE, CAUSE, EXCHANGE, MOVE, EXPORT and IMPORT. COMEX-0 forms new event representations in two ways, INSTANTIATION of an event and AGGREGATION of several events.

Instantiation is illustrated by MOVING which is a kind of CHANGING. A pseudo-english version of part of the MOVING frame is shown in figure 1.

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MOVING          IS A    CHANGING
   CHANGED         (must be a LOCATION slot)
   SUBJECT         (must be the frame which changed)
   OLD-VALUE       (must be a PLACE)
   NEW-VALUE       (must be a PLACE)
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figure 1

MOVING has an extra SUBJECT slot for the thing moved and has requirements that give more detailed specifications of the slot values. It inherits time information from CHANGING which, in turn, inherits from EVENT. If-added and requirement procedures, as well as assertions, are inherited.

Aggregation is exemplified by EXCHANGING which has two parts, both of them TRANSFERINGS, which occur at the same time. When we instantiate EXCHANGING, mapping commands use definitions to construct the subcomponents so as to represent that ACTOR1 transfered OBJECT1 to ACTOR2 and ACTOR2 transfered OBJECT2 to ACTOR 1. This mapping makes inferences, since assertions about TRANSFERING have become available through expanding the definition of EXCHANGING. Mappings take account of constraints among slots of the sub-components. They are like Merlin mappings (Moore and Newell, 1973) but are used differently. Parts of a defined structure which use different frames but contain common elements are mapped into each other.

A more complex event that COMEX-0 can build is EXPORTING. This includes a TRADING and a TRANSPORTING as subevents. The TRADING is an instance of EXCHANGING and has two TRANSFERS. The TRANSPORTING is a CAUSING to MOVE. The MOVE is a CHANGE.

Generic frames have instructions for building their instances. These specify the parts, their arrangement and the constraints between them. Controlling the effects of constraints is the hardest part. The power of COMEX-0's representation scheme depends on further solutions to this.

Inferencing.

Inferencing is done in three ways: 1) definition expansion 2) constraints 3) matching. Expansion has been dealt with already.

Constraints are exemplified by SUPPLY-DEMAND frames which specify amounts of wheat in various sectors of the market. Constraints between slots of this frame (e.g. old-supply * production - new-supply) are represented as if-added theorems attached to the slots. No search is needed to invoke these.

Matching is a third inference mechanism. When two matching structures represent one object, each may have some unique information. When merged, the information will all be directly related. COMEX-0 can match arbitrary frame structures. The requirements restricting values of a slot are used when the slot is matched against a structure. Local matching functions specify how to match against specific frame types. The test for matchability of two frames is whether a generic description of each fits the other.

Conclusion

COMEX-0 is being extended to include a qualitative simulation of wheat growth. By this we mean it deals with descriptive and incomplete information as well as exact quantitative data. The event representation mechanism is being used to set up qualitative process scenarios such as rain and snow falling on, being absorbed by and running off soil.

References.

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