Tutorial Exercises for March 9th/12th

de Kleer's assumption based truth maintenance system

The ATMS is given by

- 1. a number of *nodes* associated with reasoning problems (let's make these formulas)
- 2. a subset of nodes are assumptions
- 3. a number of *justifications* saying how a node can be justified; write

$$n_1, \ldots, n_i \Rightarrow n_j$$

to indicate that node n_j can be justified from the nodes n_1, \ldots, n_i .

- 4. An *environment* is a set of assumptions (read conjunctively)
- 5. A node n holds in environment E if n can be derived from E using the current justifications.
- 6. A special node \perp is used for the false proposition.
- 7. The ATMS *context* is the set formed by the assumptions of a consistent environment cobined with all nodes derivable from those assumptions.
- 8. The *label* for a node n is a set of environments, such that
 - (a) n holds in each environment
 - (b) each environment is consistent (does not derive \perp)
 - (c) the set is complete: if n follows from a consistent environment E', then for some E in the label, E ⊂ E'.
 - (d) the label is minimal, in that there are no two environments E, E' in the label such that $E \subset E'$.
- 9. We can take nodes to hold (formula,label,justifications); assumptions are self-justifying.

1. Suppose there are assumption nodes A, B, C, D, E, and that $\{A, B, E\}$ is inconsistent. Suppose we have nodes

$$F \qquad (x + y = 1, \{ \{ A, B \}, \{ B, C, D \} \}, \dots)$$

$$G \qquad (x = 1, \{ \{ A, C \}, \{ D, E \} \}, \dots)$$

$$H \qquad (y = 0, \{ \}, \{ \})$$

Now suppose our problem solving system finds a new justification:

$$F, G \Rightarrow H.$$

Work out the new label for H (recall: first look at all possible unions of contexts, one from each antecedent formula in the justification; then throw away inconsistent environments, and make the lable minimal).

2. Sketch an algorithm to propagate label changes round the nodes, to ensure all nodes are properly labelled.

Why does this algorithm terminate?

- 3. A node is said to be *in* if it has at least one non-empty environment in its label. Explain why the set of *in* nodes does not grow monotonically when new nodes and justifications are added to the network.
- 4. How can we use the ATMS to answer simply a question of the form: can I consistently take assumption A to be true and have node N hold?