Artificial Intelligence: Supervision 2

Daniel Chatfield

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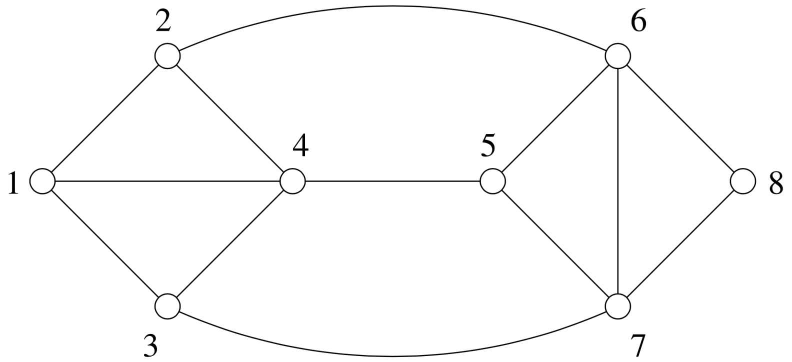
5 Constraint Satisfaction Problems

1. Consider the following constraint satisfaction problem:



We want to colour the nodes using the colours red (R), cyan (C) and black (B) in such a way that connected nodes have different colours.

(a) Assume we attempt the assignments $1 = R$, $4 = C$, $5 = R$, $8 = C$, $6 = B$. Explain how forward checking operates in this example, and how it detects the need to backtrack.

	1	2	3	4	5	6	7	8
START	BRC	BRC	BRC	BRC	BRC	BRC	BRC	BRC
1=R	=R	BC	BC	BC	RBC	RBC	RBC	RBC
4=C	=R	B	B	=C	RB	RBC	RBC	RBC
5=R	=R	B	B	=C	=R	BC	BC	RBC
8=C	=R	B	B	=C	=R	B	B	=C
6=B	=R	!	B	=C	=R	=B	!	=C

(b) Will the AC-3 algorithm detect a problem earlier in this case? Explain the operation of the algorithm in this example.

	1	2	3	4	5	6	7	8
START	BRC	BRC	BRC	BRC	BRC	BRC	BRC	BRC
1=R	=R	BC	BC	BC	RBC	RBC	RBC	RBC
4=C	=R	B	B	=C	RB	RC	RC	RBC
5=R	=R	B	B	=C	=R	!	!	RBC

As can be seen, the AC-3 algorithm has detected a problem earlier.

When $4 = C$ is applied, the only thing remaining in the domains of 2 and 3 is black. The removal of cyan from these causes the algorithm to recheck the $6 \rightarrow 2$ and $7 \rightarrow 3$ constraints. Black is then removed from these.

When red is assigned to 5 it is removed from 6 and 7, leaving both with just cyan. This also adds the 6-7 and 7-6 constraints to be checked. Since they both consist of just cyan a problem is detected as the algorithm removes the last member of the domain.

6 Knowledge representation and reasoning

1. There have in fact been two queries suggested in the notes for obtaining a sequence of actions. The details for

$$\exists a \exists s . sequence(a, s_0, s) \wedge goal(s)$$

were given on the last slide, but earlier in the notes the format

$$\exists actionList . Goal(\ldots actionList \ldots)$$

was suggested. Explain how this alternative form of query might be made to work.

Not sure

2. Making correct use of the situation calculus, write the sentences in FOL required to implement the Shoot action in Wumpus World.

$$\boxed{\begin{array}{l} At(l,s) \land Available(arrow,l,s) \implies Poss(shoot,s) \\ Poss(shoot,s) \implies \neg Have(arrow,result(shoot,s)) \end{array}}$$