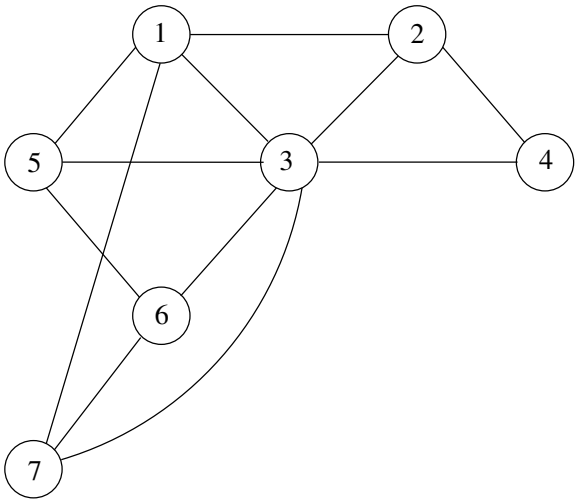
2010 Paper 4 Question 1

Artificial Intelligence I

This question addresses the problem of colouring the following graph using a *constraint satisfaction* approach.



The colours available are amber, black and crimson which we will denote by A, B and C respectively. We want to assign a colour to each node in the graph in such a way that if there is an edge (n_1, n_2) between any pair of nodes then n_1 and n_2 have different colours.

(a) Explain how this problem can be represented as a constraint satisfaction problem. [2 marks]

(b) Explain how we can apply *forward checking* in the process of solving a constraint satisfaction problem. Illustrate your answer using the above graph colouring problem where the initial steps are, in order, $1 = A$, $2 = B$, $6 = B$, $5 = C$. In particular, you should show how the process can *reduce branching* and *induce backtracking*. [8 marks]

(c) Explain how we can apply *constraint propagation* using *arc consistency* in the process of solving a constraint satisfaction problem. Illustrate your answer using the same initial steps in the same order. Determine whether or not backtracking occurs earlier in this case and explain why. [10 marks]