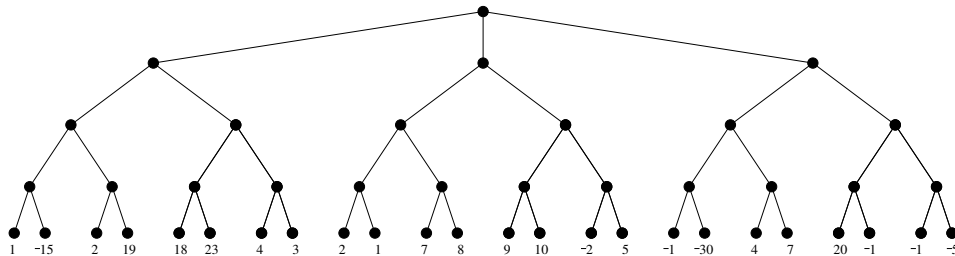# Exercises for Artificial Intelligence

Dr Sean B Holden, 2010-20

1   Games

1. Consider the following game tree:

   Large outcomes are beneficial for Max. How is this tree pruned by $\alpha - \beta$ minimax if Max moves first? (That is, Max is the root.) How is it pruned if Min is the root, and therefore moves first?

2. Implement the $\alpha - \beta$ pruning algorithm and use it to verify your answer to the previous problem.

3. Is the minimax approach to playing games optimal against an imperfect opponent? Either prove this is the case or give a counterexample.

2   Constraint satisfaction problems

1. Consider the following constraint satisfaction problem:
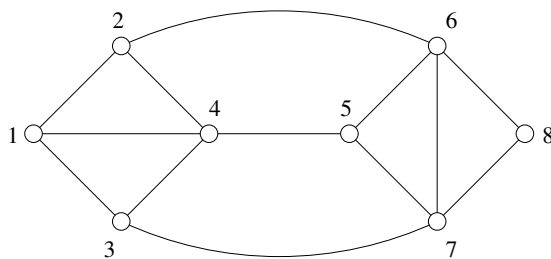
   We want to colour the nodes using the colours red (R), cyan (C) and black (B) in such a way that connected nodes have different colours.

   - 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.
   - Will the AC-3 algorithm detect a problem earlier in this case? Explain the operation of the algorithm in this example.
   - Implement the AC-3 algorithm and use it to verify your answer to the preceding problem.