CS255: Artificial Intelligence
Seminar Sheet 3 — CSPs

1. Explain the following heuristics, and how they are used in a backtracking search.

   - minimum remaining values (MRV),
   - degree heuristic, and
   - least constraining value (LCV).

2. Suppose that you have a CSP containing the variables $\{A, B, C, D\}$, with the domains $D_A = \{1, 2, 3\}$, $D_B = \{1, 2, 3, 4\}$, $D_C = \{1, 2\}$ and $D_D = \{2, 3, 4, 5\}$, such that the following constraints hold:
   $A < B$, $A \neq D$, $A \neq D + 1$, $B > C$, $B \neq C$, $C + 1 \leq D$.

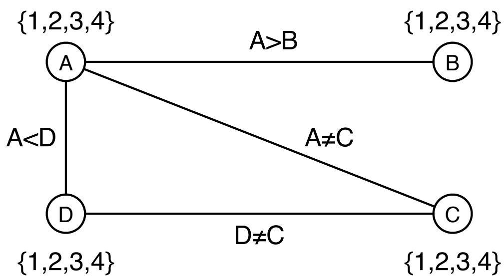
   (a) Draw the constraint graph for this problem, and state the degree of each node.

   (b) Using appropriate heuristics (MRV, degree, and LCV) and stating how they are used, show how a backtracking search (without pruning) operates to solve this problem.

3. Consider the constraint graph below containing the variables $\{A, B, C, D\}$, each having the domain $D = \{1, 2, 3, 4\}$.

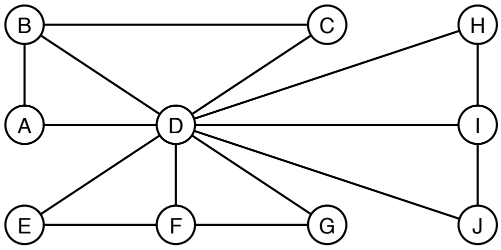
   (a) Show the result of applying the Arc Consistency Algorithm, stating the arc and relation considered at each step and which, if any, values are removed from which domain. Show the resulting arc-consistent constraint graph.

   (b) Show how a backtracking search (without pruning and using appropriate heuristics) operates on the arc-consistent constraint graph.



4. Using the (arc consistent) constraint graph that results from question 3(b) above, show the results of domain splitting on variable A.

5. Given the following constraint graph, explain how *cutset conditioning* operates, and why it might be useful. State the upper bound on the number of nodes expanded with and without cutset conditioning. Assume that each variable has the same domain, namely $\{1, 2, 3\}$.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