

## Solution notes

### Artificial Intelligence I 2005 – Paper 3 Question 3 (SBH)

This addresses the section of the course on constraint satisfaction problems.

- (a) Any reasonable material is acceptable. For example, CSPs provide a *general* representation for a large number of search-type problems and so we can develop algorithms and heuristics that are widely applicable rather than having to design heuristics specific to individual problems. A potential drawback is the need to make a problem of interest fit the CSP framework.
- (b) We have  $n$  variables  $V_1, \dots, V_n$  each  $V_i$  having a domain  $D_i$  specifying values it can take. We have  $m$  constraints  $C_1, \dots, C_m$ . Each involves a set of variables and specifies allowable collections of values. A solution is an assignment of values to variables and is complete if it assigns a value to every variable and consistent if it violates no constraints.
- (c) The naive application of breadth-first-search in a tree where each step picks a variable and assigns a value leads to a tree with

$$nd \times (n-1)d \times \dots = n!d^n$$

leaves. This is huge and there are in fact only  $d^n$  possible assignments.

- (d) Backtracking performs a depth-first search exploiting the fact that the order of assignments does not matter and backtracking whenever the process becomes stuck.
- (e) Minimum remaining values is used when choosing which variable to assign next. It assigns first to the variable with the fewest remaining possibilities. Degree chooses a variable involved in the largest number of constraints on unassigned variables. Least constraining value is used in choosing a value to assign and leaves the maximum amount of flexibility in assigning to neighbours.