MA410 Artificial Intelligence - CSP Definitions

Constraint Satisfaction Problem

Defined as a triple $\langle X, D, C \rangle$:

X	set of variables
$\mathcal{D}$	domain of values
C	Constraints of form $\langle t, R \rangle$ where t = tuples of variables R= tuples of relations.

Model of CSP

A ***model*** of a CSP is an assignment of values to variables that satisfy all the constraints.

Domain Consistency

A variable is ***domain consistent*** if no value of the domain of the node is ruled impossible by any of the constraints.

Constraint Network

A ***constraint network*** ia a graph with

- one node for each variable
- one node for each constraint

Unidirected edges running between variable nodes and constraint nodes whenever a given variable is involved in a given constraint.

Arc Consistency

An arc $\langle A, r(A, B) \rangle$ is ***arc consistent*** if for each value of $X \in dom(A)$, there is some value $Y \in dom(B)$ such that $r(X, Y)$ is satisfied.

Arc Consistency Algorithm

procedure AC(*V, dom, R*)

Inputs

V: a set of variables

dom: a function such that dom(X) is the domain of var X

R: set of relations to be satisfied

Output

arc consistent domains for each variable

Local

D_X is a set of values for each variable X

for each variable X **do**

$D_X \leftarrow dom(X)$

end for each

$TDA \leftarrow \{\langle X, r\rangle \mid r \in R$ is a constraint that involves $X\}$

while $TDA \neq \{\}$ **do**

select $\langle X, r\rangle \in TDA$;

$TDA \leftarrow TDA \setminus \{\langle X, r\rangle\}$;

$ND_X \leftarrow \langle\{x \mid x \in D_X, \exists y \in D_y s.t. r(x, y)\}$;

if $ND_X \neq D_X$ **then**

$TDA \leftarrow TDA \cup \{\langle Z, r'\rangle \mid r' \neq r$ and r involves $X,\ Z \neq X\}$;

$D_X \leftarrow ND_X$;

end if

end while

return $\{D_X \mid X$ is a variable $\}$

end procedure