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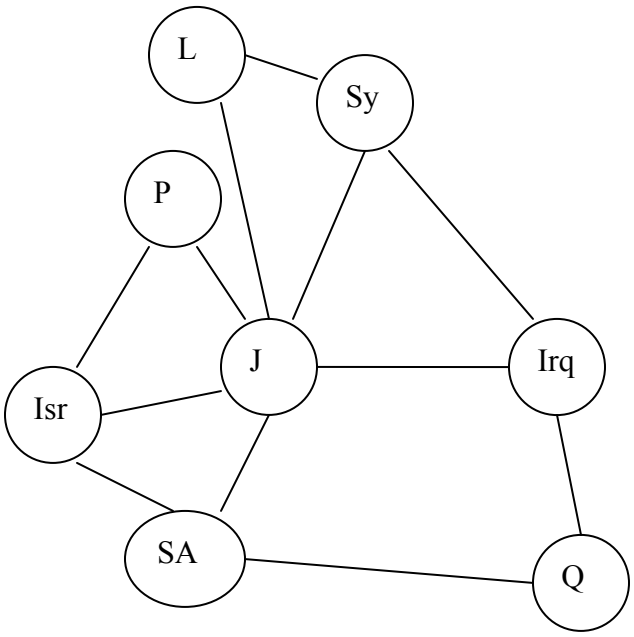
Constraint Satisfaction Problem

Three elements:

Variables {Xi … Xn}
Domains {Di.. Dn}
Constraints {Ci .. Cn}

Example :

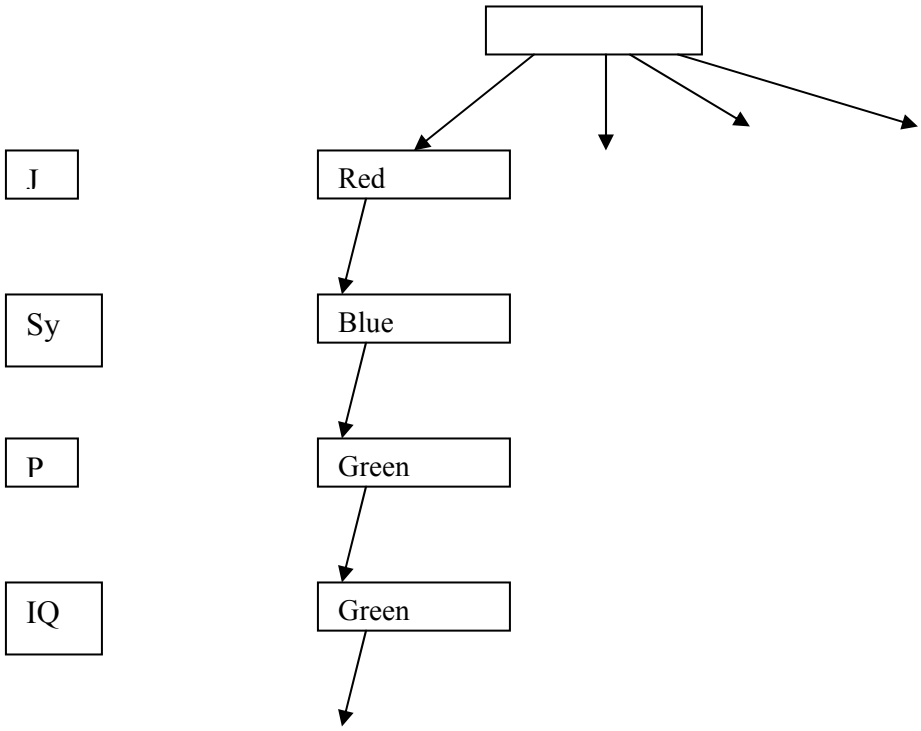
Map Coloring
Let's look at Middle East Map
Variables : {Iraq, SA, Syria, Jordon, Israel, Lebanon, Kuwait, Palestine}
Domains: {Blue, Red, Green, Yellow}
Constraints: Two Neighboring countries cannot have same color



Let's try filling in variables:
Notice that first state is Initial State, i.e. empty assignment.

Steps to solve by backtracking

Pick a variable, assign a color.
Pick another variable, assign a color subject to constraints
Until we can't move any further, then come back and take the alternative route.



A simple backtracking method proves to be very un-intelligent. It works like an exhaustive search.

Following are some ideas for improvement.

Forward Checking
As soon as you pick a variable, delete some of the options from other variable domains.

Variable Picking Heuristic:
Pick the variable that has least number of choices available. This will result in the failure fastest.

Value Picking Heuristic:
Pick the value that keeps rest of the variables with most options. It may appear a bit of opposite to variable picking. We pick a variable with least number of options, but we pick a value that will keep the most number of options for other variables.

Using the Variable Picking Heuristic with Forward checking we get the following table.

	J	L	Isr	SA	Sy	Irq	Q	P
1	RGB	RGB	RGB	RGB	RGB	RGB	RGB	RGB
2	**R**	GB	GB	GB	GB	GB	RGB	GB
3	R	**G**	GB	GB	B	GB	RGB	GB
4	R	G	GB	GB	**B**	G	RGB	GB
5	R	G	GB	GB	B	**G**	RB	GB
6	R	G	**G**	B	B	G	RB	B
7	R	G	G	**B**	B	G	R	B
8	R	G	G	B	B	G	R	**B**
9	R	G	G	B	B	G	**R**	B

3-SAT problem

Variables: {a, b, c, d, …. }
Domain: {T, F}
Constraint: Each clause has to evaluate to True.

Example:
{(a| b'|c), (a'| e | d), (e' | f | a'), (a | c' | d), (d | e | f)}

Above example contains 6 variables and 5 clauses.