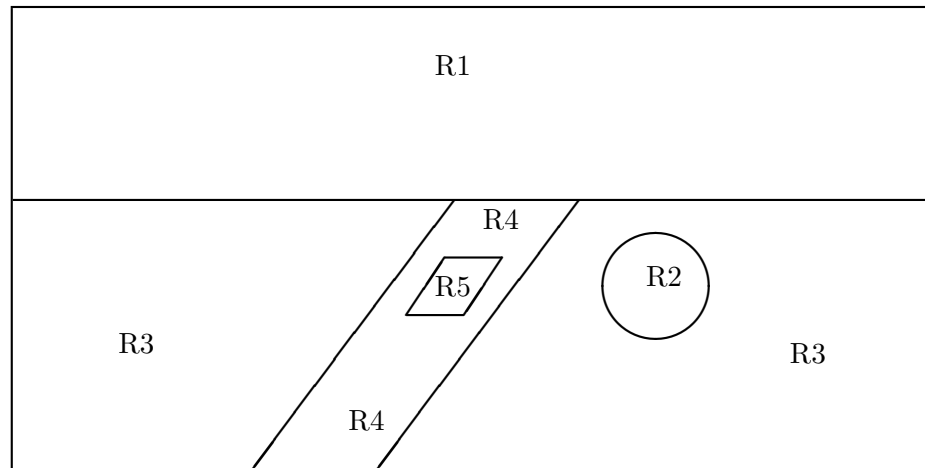


# 1 Constraint Satisfaction Problems

1. Consider the map shown below. There are five regions, and the following information is available about what they can represent.
  - (a) R1 can only be the sky or grass,
  - (b) R2 can only be trees or a road,
  - (c) R3 can only be grass or trees,
  - (d) R4 can only be road or grass,
  - (e) R5 can only be a car.



Furthermore, we have the following knowledge about the real world, and the map:

- (a) A car cannot be next to grass.
- (b) No two neighboring regions can be the same.
- (c) Only one region is a road.

The problem is to find what each region in the figure represents.

- (a) Represent the above problem as a CSP. You must specify the meaning of each variable assignment. (That is, in our representation, how can one read off a solution to the problem from an assignment of values to the variables).
  - (b) Apply forward checking to solve the problem. Use the heuristic of always assigning next the variable with fewest remaining values (you can break ties as you choose). You *do not* need to show the updated current domains, only show the nodes of the search tree visited by forward checking and the assignments made at those nodes.
  - (c) How many solutions are there, and what are they?
2. Consider a CSP with the following variables and constraints:
    - Variables  $A, B, C, D, E$  with all variables having the domain  $1, 2, 3, 4$

- Constraints:
  - $E - A$  is even.
  - $C \neq D$
  - $C > E$
  - $C \neq A$
  - $B > D$
  - $D > E$
  - $B > C$

Draw these variables and constraints as a constraint graph. Then, perform GAC-Enforce on the graph. Write the domains for each variable that exist after you've completed GAC-Enforce.