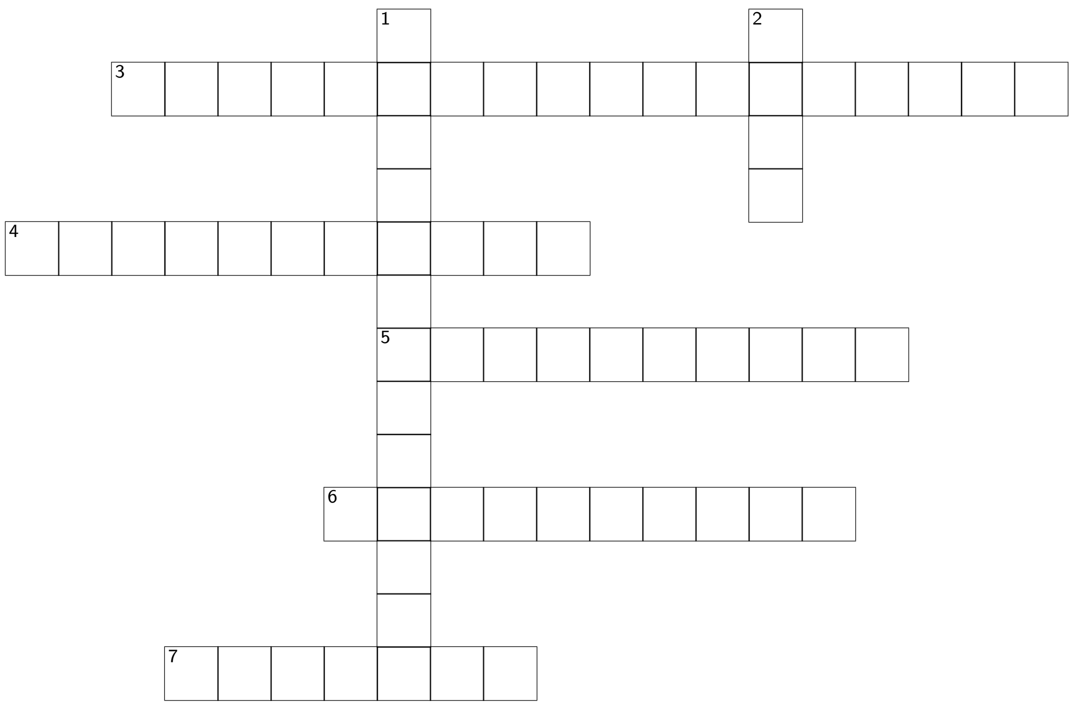
1 Missing in the Mountains

The 15-281 Course Staff decided to climb the Rocky Mountains together over Winter Break. On their way back down from the mountains, they realize they left Harlene at the top of the tallest mountain! They have no idea where on the mountain they are or which mountain they are on, and are worried about how they will find Harlene before lecture on Monday. Help the 281 Staff remember all of the local search algorithms they have learned so they can save Harlene!



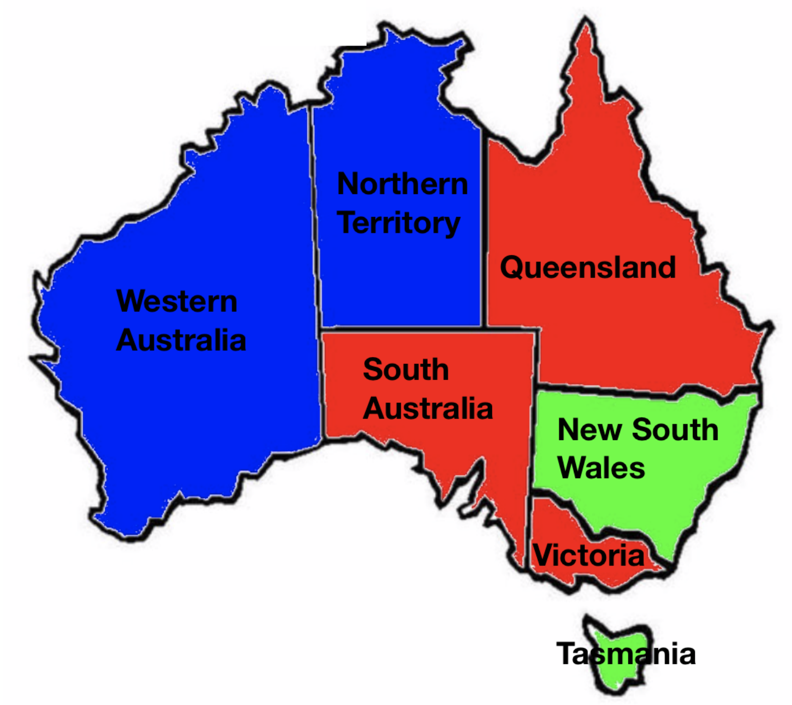
Down

1. A variant of hill-climbing where you conduct a series of searches from randomly generated starting states until the goal is found.
2. While keeping track of k states, generate all successors and retain the best k successors of all of them.

Across

3. A local search technique where you allow for downhill moves but make them rarer as time goes on.
4. A variant of hill-climbing where you generate successors randomly (one by one) until a better one is found.
5. A local search technique where you uniformly randomly choose a neighbor to move to.
6. A variant of hill climbing in which you choose a move randomly from the uphill moves, with the probability of a move being chosen dependent on the “steepness” (amount of improvement from making that move).
7. A variant of stochastic beam search where successors are generated by combining two parent states instead of modifying a single state.

2 Map Coloring with Local Search



Recall the various local search algorithms presented in lecture. Local search differs from previously discussed search methods in that it begins with a complete, potentially conflicting state and iteratively improves it by reassigning values. We will consider a simple map coloring problem, and will attempt to solve it with hill climbing.

(a) How is the map coloring problem defined (In other words, what are variables, domain and constraints of the problem)? How do you define states in this coloring problem?

(b) Given a complete state (coloring), how could we define a neighboring state?

(c) What could be a good heuristic be in this problem for local search? What is the initial value of this heuristic?

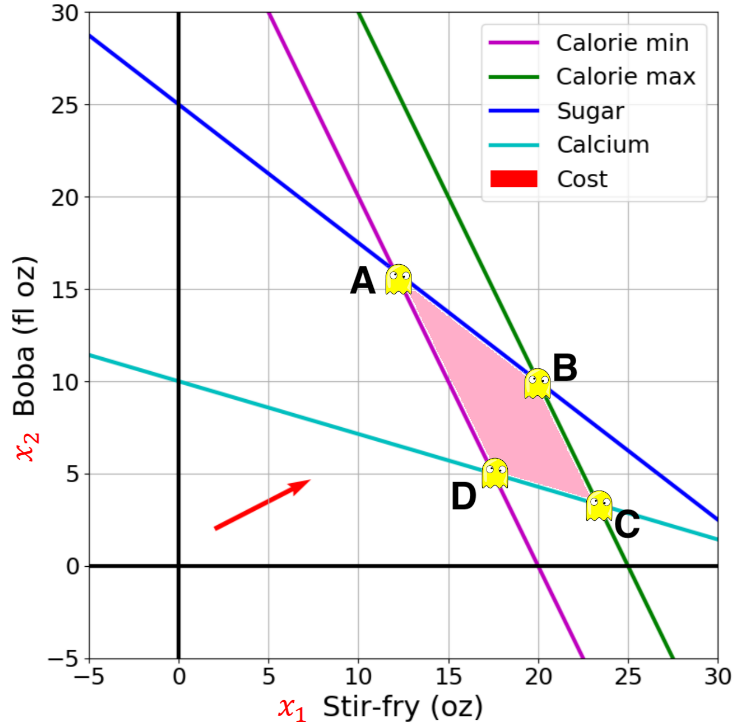
(d) Use hill climbing to find a solution based on the coloring provided in the graph.

(e) How is local search different from tree search?

3 Algorithms for Solving Linear Programming

In Wednesday's lecture, we went through two algorithms for solving linear programming programs - vector enumeration and the simplex algorithm.

Recall the "Healthy Squad Goals" example from Wednesday's lecture. The goal is to minimize the cost, and the cost vector (red) is perpendicular to the purple and green lines.



1. Briefly describe both algorithms and explain how they differ. (hint: use terms such as vertices, intersections and neighbors).

2. Run simplex algorithm starting from point B. Now try running the algorithm starting from point C. How do their solutions differ?

4 Cargo Plane: Linear Programming Formulation

A cargo plane has three compartments for storing cargo: front, centre and rear. These compartments have the following limits on both weight and space:

Compartment	**Weight capacity (tonnes)**	**Space capacity (cubic metres)**
Front	10	6800
Centre	16	8700
Rear	8	5300

The following four cargoes are available for shipment on the next flight:

Cargo	**Weight (tonnes)**	**Volume (cubic metres/tonne)**	**Profit ($/tonne)**
C1	18	480	310
C2	15	650	380
C3	23	580	350
C4	12	390	285

Any proportion of these cargoes can be accepted. The objective is to determine how much of each cargo C1, C2, C3 and C4 should be accepted and how to distribute each among the compartments so that the total profit for the flight is maximised. **Formulate** the above problem as a linear program (what is the objective and the constraints?). Think about the assumptions you are making when formulating this problem as a linear program.