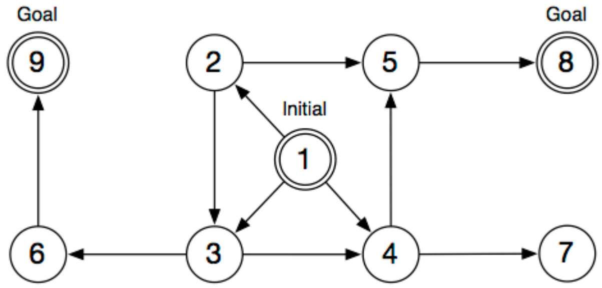
ITS336 Practice Midterm Examination

Disclaimer: *This is my attempt to help you study for the examination. Materials in here might not be in the real exam and vice versa. Do not use this as your sole study tool. There might be some typos and/or mistakes. Use it at your own risk.*

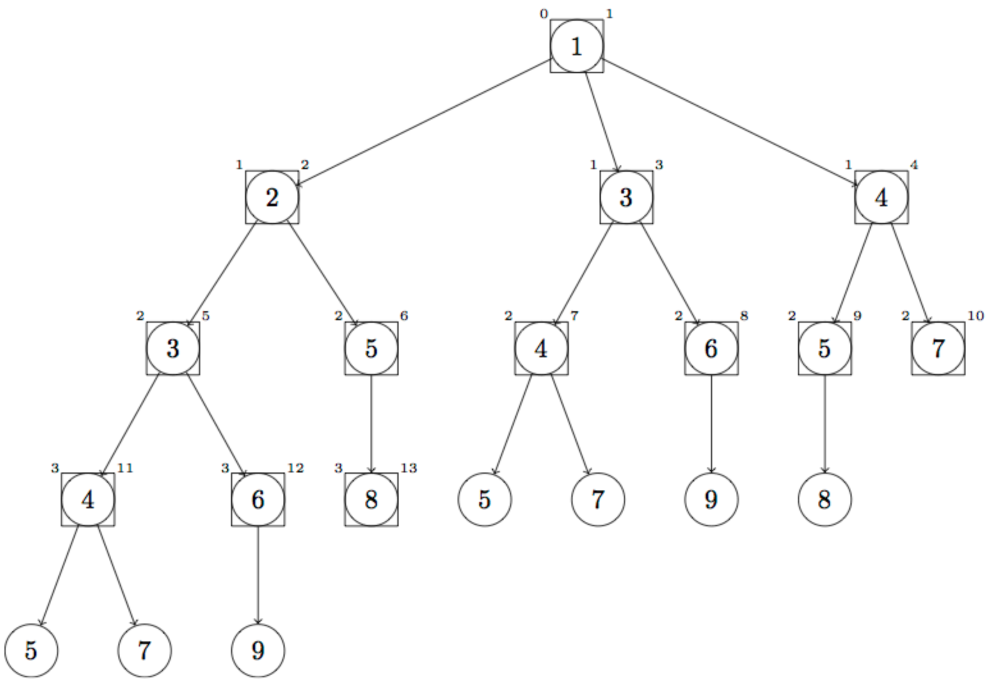
1. The following graph shows the state space of a search problem.



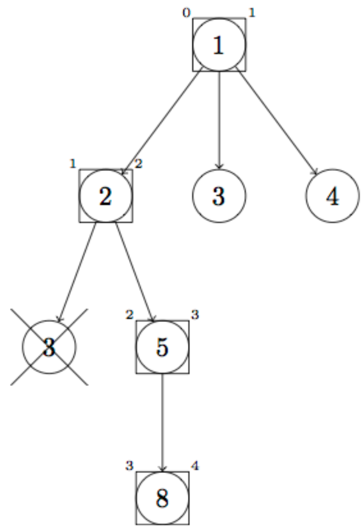
Each node of the graph represents a state. Each directed edge points to a successor. State **1** is the initial state. The search starts from this state. There are two goal states which are state **8** and state **9**. The search stops when either one of them is visited. Draw a search tree for each of the following uninformed search strategies.

a) Breadth-first tree search

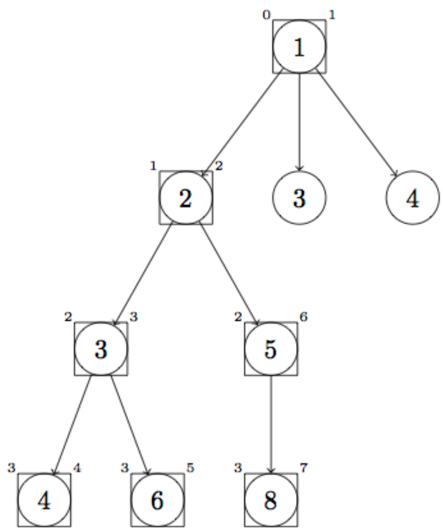
Each *circle* shows that a node is generated and added to the frontier. Each *rectangle* shows that a node is visited.



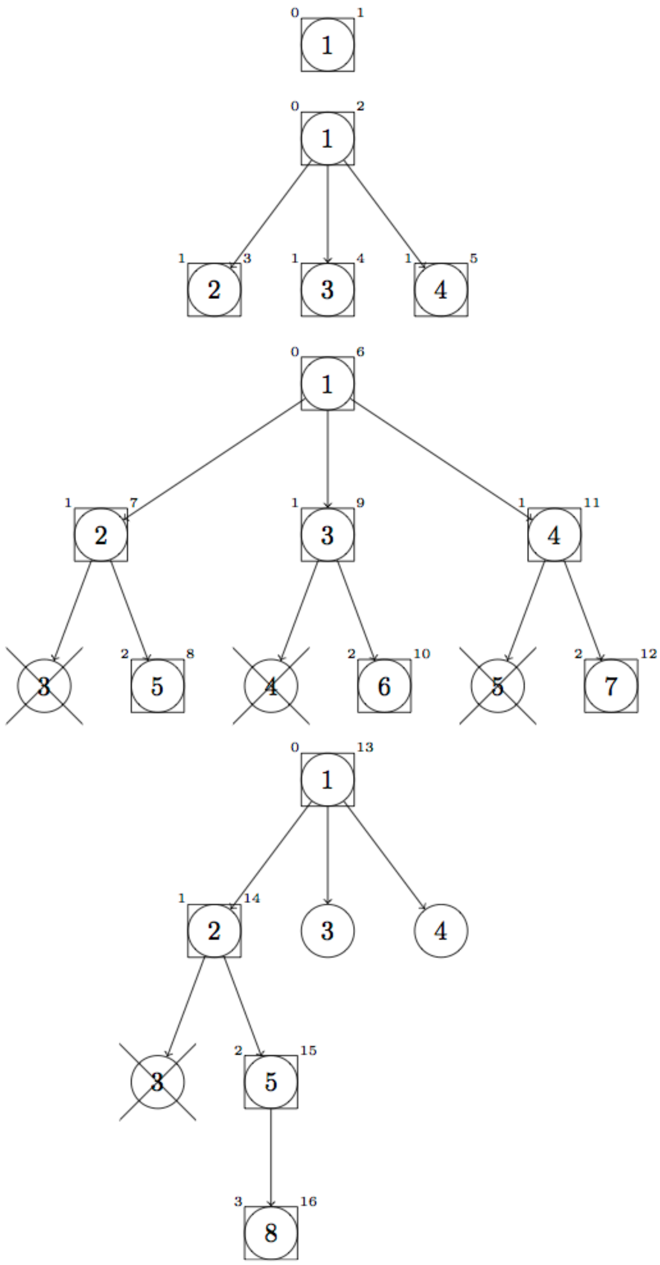
b) Depth-first graph search



c) Depth-limited tree search with $l = 3$



d) Iterative deepening depth-first graph search

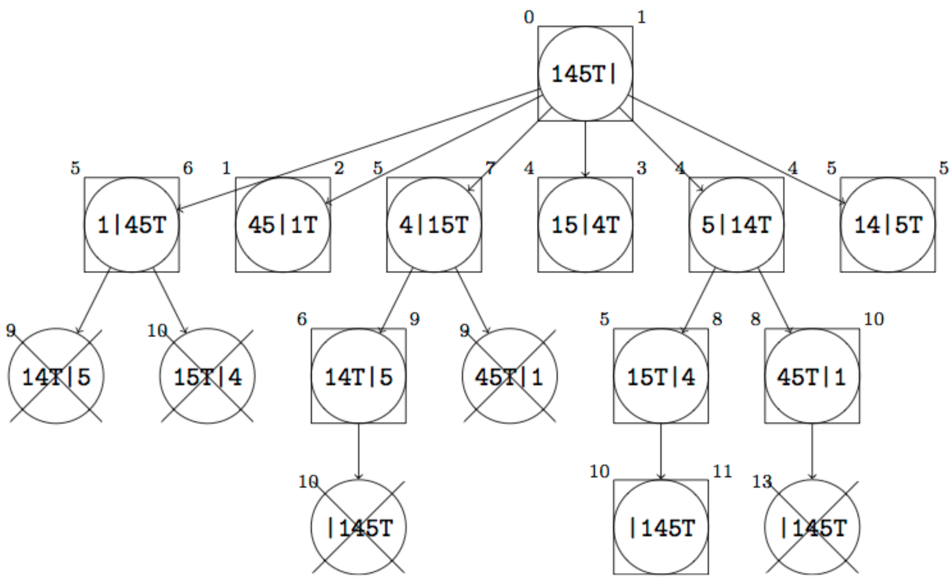


2. The *bridge and torch* problem is a logic problem that a group of people want to cross a river in the night. There is a bridge which can hold up to two people at a time, and the torch is needed in order to walk on the bridge. Each person can cross the bridge at the different pace measured in the number of minutes. When two people cross the bridge together, they must move at the slower person's pace. The question is, how to make them get across the bridge, and how many minutes in minimum they need to get across the bridge.

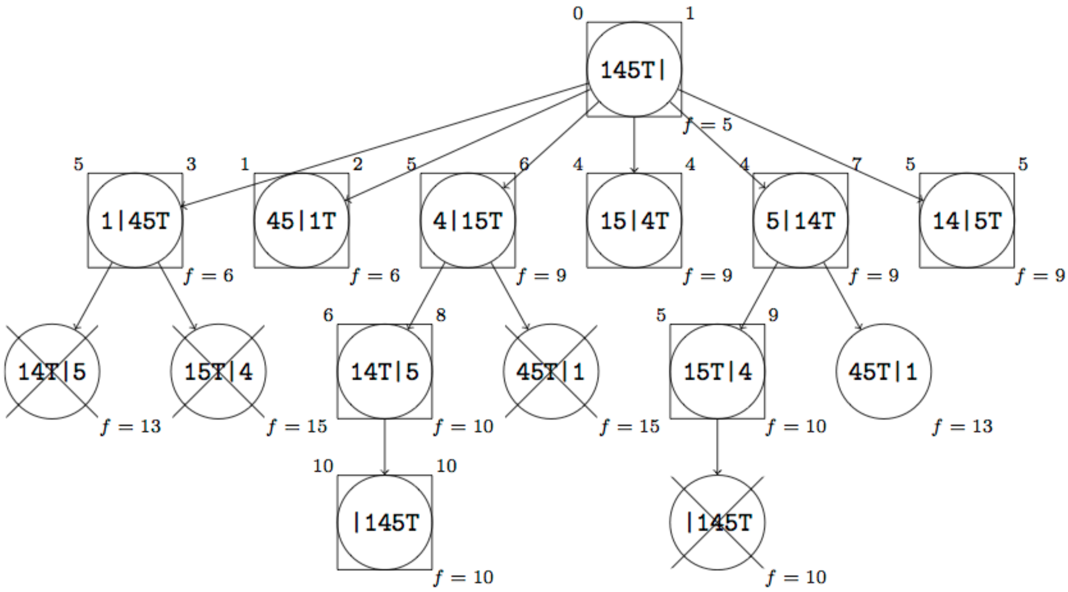
   Here, three people want to cross the river. They needs *1 minutes, 4 minutes*, and *5 minutes* to walk on the bridge, respectively. We are going to use *Uniform-Cost Search* and *A* Search* to find a solution.

   Let `[145T|]` show the initial state of the problem. All the people are staying at the starting side with a torch. Each number represents one person, and "T" represents the position of the torch.

   a) Draw the search tree when the *Uniform-Cost Graph Search* is used. Use the above notation to represent each state. Write *the cumulative cost* with *the visiting order* for every node.



b) Draw the search tree when the *A* Graph Search* is used to solve this problem. Use the maximum number of minutes on the starting side as the heuristic value. For example, the heuristic value of the state `[14|5T]` is 4.



c) Propose the heuristic function that works more efficiently for the A* Search than the heuristic function used in the previous question.

```
if (T is on the starting side) {
  return the max value on the starting side
}
else {
  return the max value on the starting side
         + the min value on the end side
}
```

3. Answer the following questions about *local search* techniques.

a) Explain how the search is conducted when we use *stochastic hill climbing* with $T = 10^{100}$.

The search is equivalent to the random search.

b) What is a common characteristic of *local beam search* and *genetic algorithm*?

More than one states are kept in each iteration.

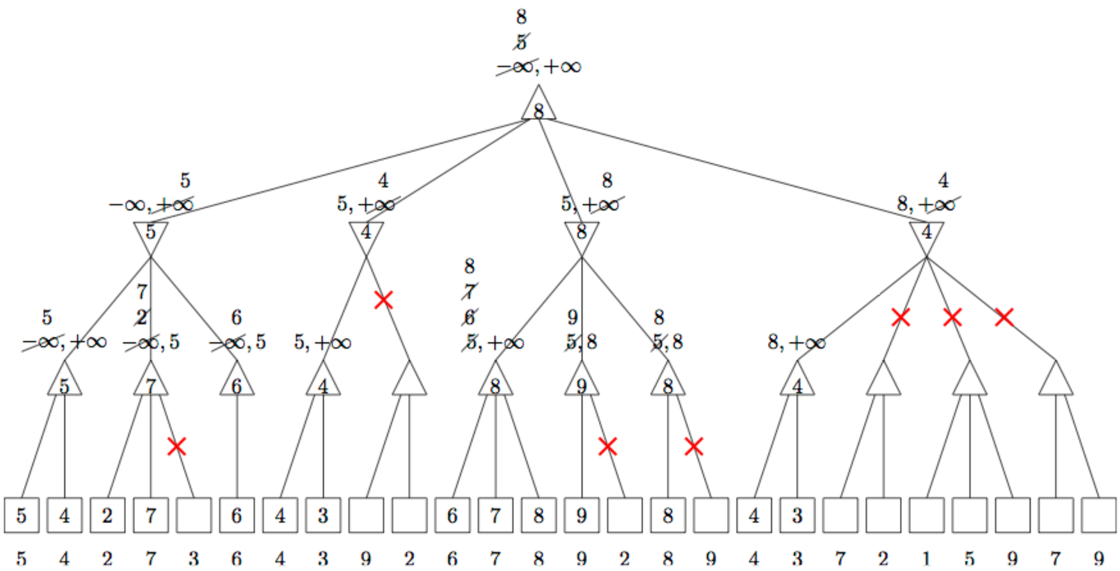
c) What are the two main properties that each local search strategy should trade off?

Diversification and Intensification

d) In the real-world application, how can we know that the solution, that we got from a local search technique, is the global optimum (either the global maximum or minimum)?

We cannot know whether the obtained solution is the global optimum.

4. Consider the following game tree, use *alpha-beta pruning* algorithm to cross out unnecessary subtrees. Assume that the tree is evaluated by backtracking algorithm from left to right.



5. What is an advantage of using *backtracking* search for evaluating minimax values in the game trees?

The backtracking search requires less space in the memory while the search is conducted.