Computer Science 662: AI Programming
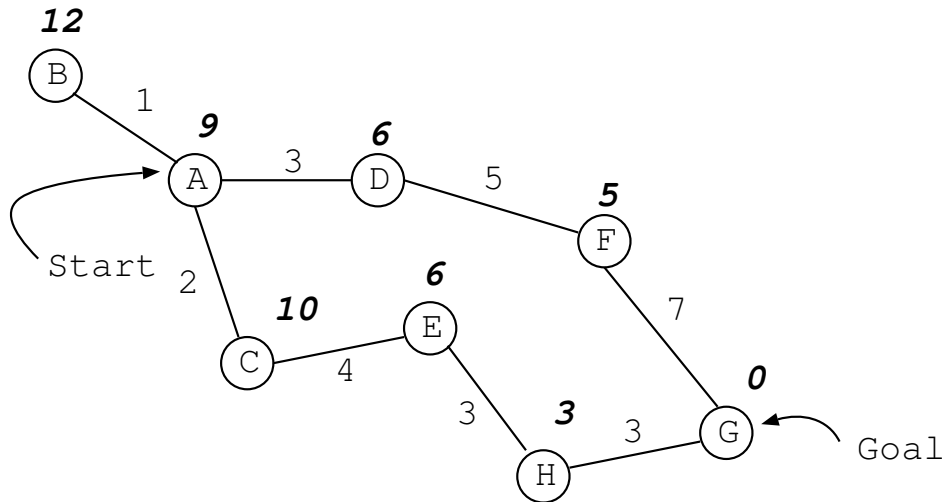### Sample Problems
Spring 2013

1. Given the following graph (Heuristic h() values in bold italic), and :

   (a) Is h() admissible?

   (b) Is h() monotonic?

   (c) Show the order that nodes would be expanded by Uniform Cost Search

   (d) Show the order that nodes would be expanded by A*

   (e) Show the order that nodes would be expanded by greedy

   (f) Show the path that A* would compute

   (g) Show the path that greedy would compute

2. **Adversarial Search**

   Consider the two player game of 21. A central pool starts out with 21 tokens. Each player takes 1, 2, or 3 tokens. The player to take the last token loses. We will consider the slightly simpiler game of 7 – which is exactly the same, except we start with 7 tokens instead of 21.

   Draw the complete game tree for a game of 7. Show the backed-up values for each node in the tree. Who wins, player 1 or player 2? For the 21 version, what is a winning strategy?

3. **Bayes Networks**

   Given the standard Disease $\Rightarrow$ Test $\Rightarrow$ Courier bayses network, all variables binary, with the link matricies:

   P(D)

P(¬d) = 0.9	p(d) = 0.1

P(T|D)

P(¬t | ¬d) = 0.9	p(t | ¬d) = 0.1
P(¬t | d) = 0.2	p(t|d) = 0.8

P(C|T)

P(¬c| ¬t) = 1	p(c| ¬t) = 0
P(¬c | t) = 0.2	p(c|t) = 0.8

What is the probability that the test was positive, given the courier did not give a message? What is the probability that the test was positive, given the courier did give a message? For full credit, show all your work! I don't care about arithmetic errors, if your equations are correct, and I can follow them!

4. **Neural Networks**

   (a) (3 points) Give a single perceptron that takes three inputs (plus a bias), and returns 1 if all of the inputs are 1. Assume that the threshold function is a step function.

   (b) (3 points) Give a two-layer neural network that has 3 inputs (plus biases), and returns true if exactly two of the inputs are 1. Assume that the threshold function is a step function.