CSci 4511
Midterm 2

Name: _____

Student ID: _____

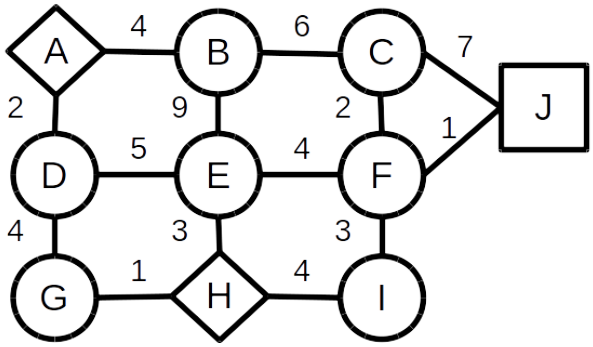
Instructions: The time limit is 75 minutes. Please write your answers in the space below. The exam is open book and notes. You may use electronic devices to ONLY look at either an e-book version or electronic notes. You may not search the internetor use other outside resources. For all questions you must **show work**.

Problem (1) [20 points]
You are going grocery shopping and have a $20 budget. You are trying to buy at least 1700 calories, 38g of protein and 120% iron. Assume the grocery store comes stocked with the items listed below (can buy multiple of each).

(1) Set this up as a constraint satisfaction problem. Then (2) describe whether you think using consistency constraints and inference or a more basic search is applicable to this problem.

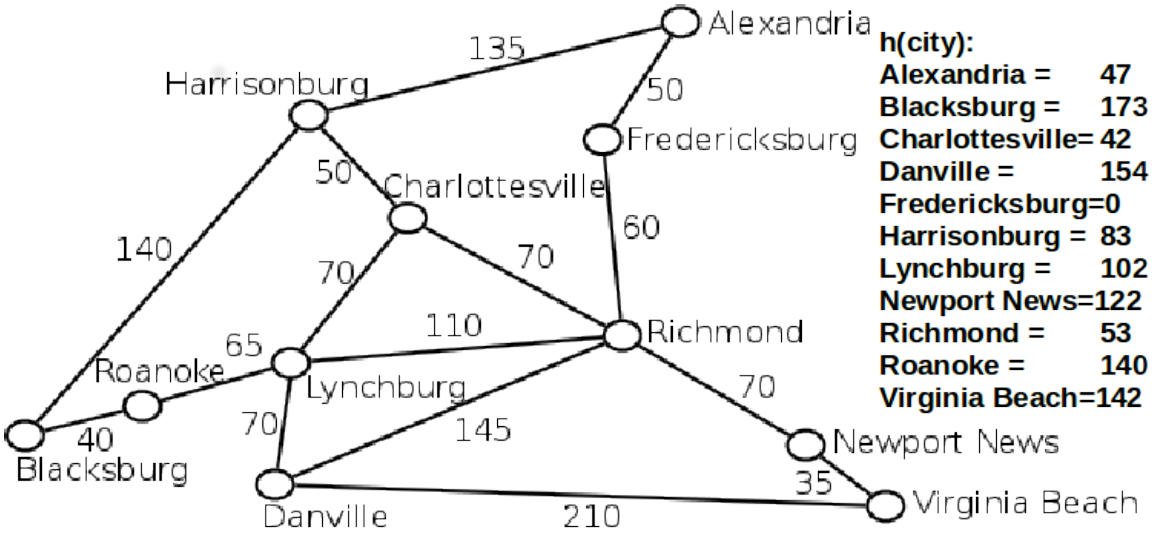
- Potatoes. 110 calories, 3g protein and 6% iron for $1.
- Cereal (healthy-ish). 250 calories, 6g protein, 90% iron for $3
- Beef. 290 calories, 22g protein and 15% iron for $4

Problem (2) [20 points]
Perform local beam search with 2 beams on the graph below. The initial points are indicated by diamonds (Nodes A and H) and the goal is a square (Node J). Show enough work step-by-step so that we know you are actually running local beam search.

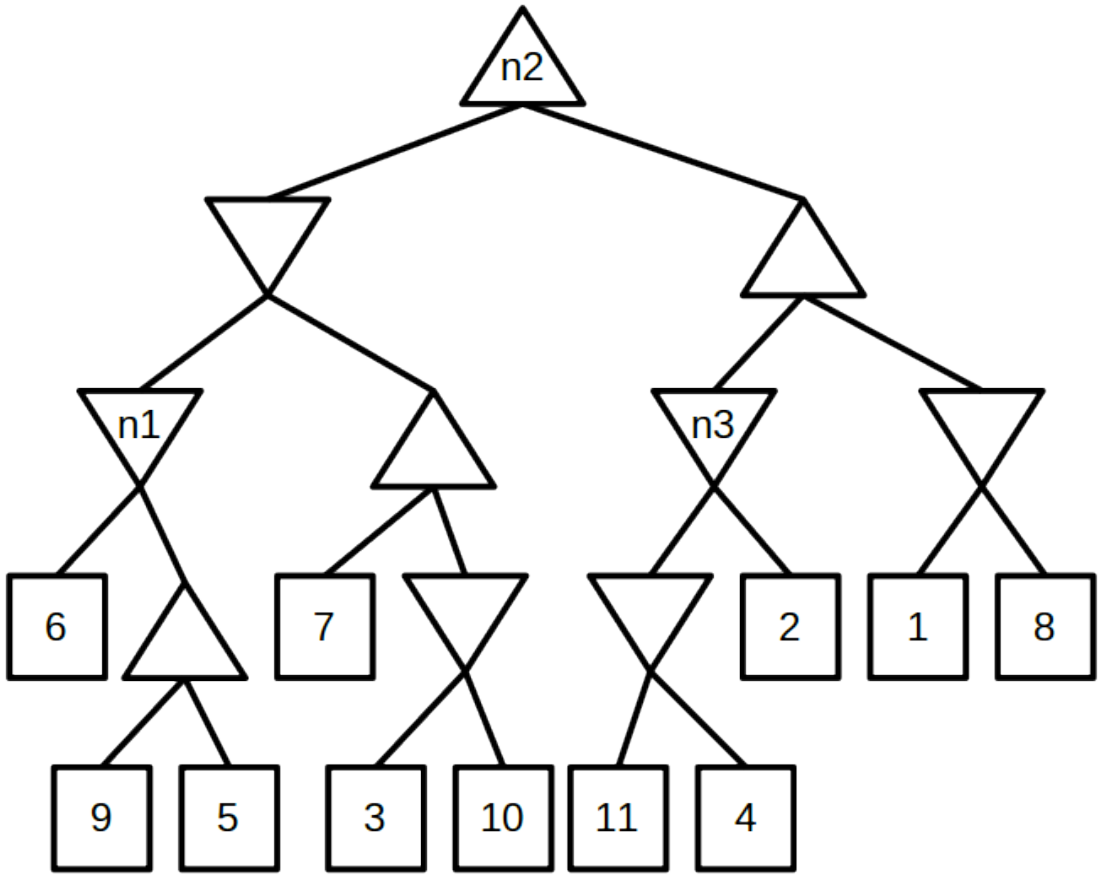


Heuristic:
A=10
B=7
C=8
D=11
E=6
F=5
G=33
H=9
I=8
J=0

Problem (3) [20 points]
The graph shown below is of a road network of cities in the state of Virginia. The goal is to reach Fredericksburg starting from Blacksburg.
(1) What is the path basic hill-climbing will find? (Show work.)
(2) If stochastic hill-climbing is used instead, what are all the potential paths that could be taken?



Problem (4) [20 points]
Below is a picture of a tree.
(1) Indicate which leaves nodes can be pruned using alpha-beta pruning if searching left-to-right. (Show work)
(2) If the value of two leaf nodes could be swapped, what swap should you do? How many additional nodes will this allow you to prune?



Problem (5) [20 points]
Find a single payoff matrix that has all of the three following properties:

- (1) The Nash equilibrium has player 1 doing action 1 40% of the time and action 2 60% of the time.
- (2) The Nash equilibrium has player 2 doing action 1 75% of the time and action 2 25% of the time.
- (3) All numbers in the payoff matrix are unique. (i.e. two rewards cannot both be "4" but it is okay to have one reward "1" and another reward "11".)