1st Midterm Exam
Tuesday February 24
75 minutes == 75 points
open book and notes

1. 15 points
You are given the following graph, where each node has an identifier (a letter) and an \( h \) value. A number along an arc indicates the cost of the arc.

```
A
  ^
  |  10
  |   
  v   
B \( h=12 \)  ---  C \( h=6 \)
  |        |  6
  |        v
E \( h=1 \)  ---  D \( h=1 \)
  | 20
  |   
  v   
G \( h=0 \)
```

1. Show in what order A* expands nodes from Start to G. G is the goal node. For each node expanded during the search show its \( f \) and \( g \) values. If a node is reached on multiple paths show its \( f \) and \( g \) values each time the node is reached, and indicate its parent node.

2. What is the solution path found?

3. Is the \( h \) function admissible? is it consistent? Justify your answer.

2. 15 points
Suppose you decide to do best-first search using the following evaluation function \( f(n) = (1 - w)g(n) + wh(n) \).

1. Assuming that \( h(n) \) is admissible, what are the values of \( w \) that guarantee the algorithm will find an optimal solution? Justify your answer.

2. Is there a range of values of \( w \) which guarantees that the algorithm using the evaluation function \( f \) is admissible? If yes, what is the range? Justify your answer.

**Turn to the next page for more questions**
3. **15 points**

Suppose you have two admissible heuristics, $h_1$ and $h_2$. You decide to create the following new heuristic functions defined as follows:

\[
    h_3(n) = \max(h_1(n), h_2(n))
\]

\[
    h_4(n) = \max(h_1(n), 1.1 \times h_2(n))
\]

\[
    h_5(n) = \min(h_1(n), 3 \times h_2(n))
\]

\[
    h_6(n) = \frac{h_1(n) + h_2(n)}{2}
\]

For each of the new heuristics specify if it is admissible or not. Justify your answer. Would you use any of these heuristics instead of using $h_1$ or $h_2$?

4. **15 points**

Answer these questions briefly but precisely.

1. Would Hill-Climbing be appropriate for the Missionaries and Cannibals Problem? Why (or why not?).

2. Is it possible for Iterative Deepening Depth-First Search to do worse than Depth-First? Explain your reasoning.

3. Explain briefly when you would use LRTA* instead of Online-DFS.

5. **10 points**

Write a function, `remove-adj-dup`, to remove all adjacent duplicate elements in a list. It should work like this:

(\texttt{(remove-adj-duplicates '(a b b c b d d d))})

(\texttt{(a b c b d)})

6. **5 points**

Write a function, `add--numbers`, to add all the values in an association list that are numbers. It should work like this:

(\texttt{(add-all-numbers '(((color red) (weight 3) (type apple) (id 120452)))}}

120455

You reached the end of the exam