Assignment Three: CSPs
Solution

Question One

We have four vars HC, BH, GD, RA. The domains are the locations. We can write these as pairs, such as $(1, 2)$ or as a single number such as 12 representing the lake position.

It is possible to have the domains being all of the locations, and have domain constraints, but it is probably simpler to have it domain consistent initially. Thus the domains of HC and BH is $\{02, 20, 21, 22\}$. The domain of RA is $\{01, 02, 11, 21, 22\}$. The domain of GD is $\{10, 20\}$.

There are pairwise constraints saying each variable is different. For the other constraints see the AIPython representation at
http://www.cs.ubc.ca/~poole/cs322/2020/as3/cs322as3q1.py
or the AIspace representation at:
http://www.cs.ubc.ca/~poole/cs322/2020/as3/322as3q1.xml
load this link into the AIspace CSP applet.

There are 4 solutions. They all have RA at 1,1 and the GD us either at 10 or 20 and one of HC and BH is at 02 and the other is at 22.

Question Two

See:
    http://www.cs.ubc.ca/~poole/cs322/2020/as3/streeCountSol.py
There are two solutions and 1241 failing branches (with 416 nodes expanded).

The best static orders have 74 failing branches. These are [['D', 'E', 'F', 'C', 'G', 'H', 'B', 'A'], ['D', 'E', 'F', 'C', 'G', 'H', 'A', 'B'], ['E', 'D', 'F', 'C', 'G', 'H', 'B', 'A'], ['E', 'D', 'F', 'C', 'G', 'H', 'A', 'B']]

To find a small tree, a good heuristic is to always choose the most constrained variable. This is the variable that is in the most constraints with other variables. Another good heuristic is to prefer the one that is in the most constraints with previous variables in the ordering, and to break ties by choosing the variable that is in the most constraints.

You could have done better by having a non-uniform tree. That is, where which variable chosen depends on the context. You could possibly do better than the 27 nodes expanded. (Just as Figure 4.1 in the textbook is smaller than any static ordering.)

Question Three

It should not have taken more than a few hours. Most of this should have been in understanding the material, not in doing busy work. I hope it was reasonable, and you learned something.