Assignment 2 – Part 1

Question 1

Recursive Best First Search (RBFS) is like the standard best-first search but only linear space. RBFS uses the f_{limit} variable to keep track of the f_{value} of the best alternative path available from any ancestor of the current node. If the current node exceeds the limit value, the recursion backs up to find an alternative path. RBFS is an optimal search algorithm if the heuristic function is admissible. Depending on the accuracy of the heuristic function and how often the best path changes, RBFS has linear space complexity in the depth of the optimal solution. RBFS uses a limited amount of memory (linear space), which can exponentially increase the complexity (with redundant paths).

Question 2

a. False

   Hill climbing makes locally optimal choices in each step, so optimality in the neighbourhood. In each iteration, hill climbing must look at the entire neighbourhood of the current state. In other words, the neighbour could be at a local minimum while its current state is on a slope leading to the local maximum point.

b. False

   For fixed temperature, the algorithm contains randomness to a certain degree. When the algorithm stops, there will be no guarantee that it will be in an optimal state.

Question 3

$$O + O = R + 10C_1$$
$$C_1 + W + W = U + 10C_2$$
$$C_2 + T + T = O + 10C_3$$
$$F = C_3$$

F, T, U, W, R, O are the variables, domain is $\{0,1,2,3,4,5,6,7,8,9\}$

C_1, C_2, C_3 are the carry variables that depend on the assigned values and can only take values $\{0,1\}$.

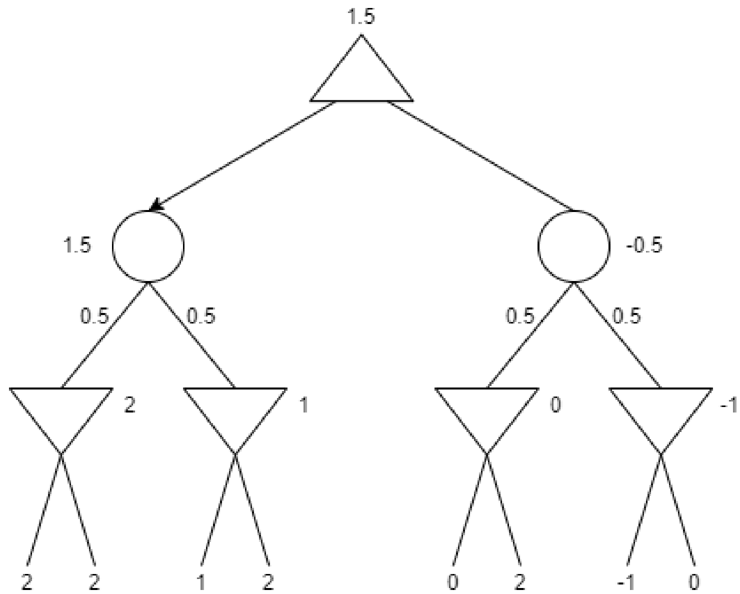
1. Choose the C_3 variable; domain is $\{0,1\}$.
2. Choose C_3 to be 1, because F and T cannot have leading zeros, so $F = 1, C_3 = 1$.
3. Choose F; then choose F to be 1.

4. Choose C_2; domain is $\{0,1\}$.
   a. Both C_1 and C_2 have 2 remaining values, but I chose to work the way up so C_2 first.
5. Choose C_2 to be 0.
6. Choose C_1; domain is $\{0,1\}$.
   a. C_1 has 2 remaining values; C_2 already set to 0's.
7. Choose C_1 to be 0.
8. Now that $O + O = R + 10(0); 0 + W + W = U + 10(0); 0 + T + T = O + 10(1); F = 1$, the variable O has the constraints to be less than 5, so that R does not exceed 9. At the same time, O is also the sum of $T + T$, with domain $\{0,2,3,4\}$.
9. Choose O to be 4, and R will be 8.
10. Choose R to be 8.
11. Choose T to be 7, because $T + T = 14$ from choosing O to be 4 and C_3 to be 1.
12. Now that we are left with $W + W = U$, with variables' domain $\{0,2,3,5,6,9\}$.
13. Choose U, as we know that U must be an even number less than 9. From forward checking we know that since W cannot be 1, so U can only be 6. Therefore, choose U to be 6.
14. Choose W. Choose W to be 3.
15. Solution is: $F = 1, T = 7, U = 6, W = 3, R = 8, O = 4$.

Question 4

1. Remove SA-V, delete R from SA.
2. Remove SA-WA, delete G from SA. Now SA can only be B.
3. Remove NSW-V, delete R from NSW
4. Remove NSW-WA, delete B from NSW. Now NSW can only be G.
5. Remove NT-SA, delete B from NT
6. Remove NT-WA, delete G from NT. Now NT can only be R.
7. Remove Q-NT, delete R from Q
8. Remove Q-NSW, delete G from Q.
9. Remove Q-SA, delete B from Q. Q has no color domain.

Question 5

a. 

b. We need to evaluate the seventh and eighth leaves given the first six leaves. If both leaves are $+\infty$, the minimum value node will also be $+\infty$ and thus changing the best move order.
   We do not need to evaluate the eighth leaf, given the first seven leaves. The minimum value will still be -1 if the eighth leaf is $+\infty$. The right-hand chance node remains to be -0.5, so the maximum node still chooses the left chance node.

c. If any of the third or fourth leaf node is -2, the left-hand chance node will be 0. Else if both third and fourth leaf nodes are 2, the left-hand chance node will be 2. The value range for the left-hand chance node will be from 0 to 2.

d.