**CS 4365 Artificial Intelligence**

**Assignment 2: Constraint Satisfaction Problem**

**Part I: Written Problems (50 points)**

Consider a constraint satisfaction problem where there are six variables A, B, C, D, E, and F, each with domain *{*1, 2, 3, 4, 5, 6*}*. There are six constraints: A *>* F, F *>* E, F = D, B *>* A, A = C, and B *>* D.

(a) (**20 pts**) Show how backtracking can be use to solve this problem. To select variables, use the **most constrained variable** heuristic, breaking ties using the **most constraining variable** heuristic. If ties still exist, break them alphabetically. To select values, use the **least constraining value** heuristic, breaking ties by preferring smaller values. Indicate the first 20 branches visited in the search tree (or stop when the solution is reached).

First 20:

1. A=1, F=1 failure
2. A=1, F=2 failure
3. A=1, F=3 failure
4. A=1, F=4 failure
5. A=1, F=5 failure
6. A=1, F=6 failure
7. A=2, F=1, B=3, D=1, C=1 failure
8. A=2, F=1, B=3, D=1, C=2, E=1 failure
9. A=2, F=1, B=3, D=1, C=2, E=2 failure
10. A=2, F=1, B=3, D=1, C=2, E=3 failure
11. A=2, F=1, B=3, D=1, C=2, E=4 failure
12. A=2, F=1, B=3, D=1, C=2, E=5 failure
13. A=2, F=1, B=3, D=1, C=2, E=6 failure
14. A=2, F=1, B=3, D=1, C=3 failure
15. A=2, F=1, B=3, D=1, C=4 failure
16. A=2, F=1, B=3, D=1, C=5 failure
17. A=2, F=1, B=3, D=1, C=6 failure
18. A=2, F=1, B=3, D=2 failure
19. A=2, F=1, B=3, D=3 failure
20. A=2, F=1, B=3, D=4 failure

(b) (**20 pts**) Show how **forward checking** can be used to solve this problem. To select variables, use the **most constrained variable** heuristic, breaking ties using the **most constraining variable** heuristic. If ties still exist, break them alphabetically. To select values, use the **least constraining value** heuristic, breaking ties by preferring smaller values. Indicate the first 20 branches visited in the search tree (or stop when the solution is reached).

First 20:

1. A=1 failure
2. A=2, F=1 failure
3. A=3, B=4, C=3, D=2, E=1, F=2 solution

(c) (**10 pts**) Apply constraint propagation (arc consistency) to eliminate values from the initial domains of the variables. Show the resulting domain of each variable after constraint propagation is applied.

Domains:

A: {3, 4, 5, 6}

B: {4, 5, 6}

C: {1, 2, 3, 4, 5, 6}

D: {1, 2, 3, 4, 5, 6}

E: {1, 2, 3, 4, 5, 6}

F: {2, 3, 4, 5, 6}