Project #2 Solutions

EECS 592

WN 2020

1. R&N Problem 5.12:

The minimax algorithm for non-zero sum games will work in the same way as it does for multiplayer games. Each utility will be a vector of values (one for each player) and at each step the player who is selecting an action is trying to maximize their own utility. Alpha-beta pruning wouldn't work, since any unexplored node could be optimal for both players, therefore every node would need to be explored. If the utility value for each state for both players differed by at most k then the game would become more cooperative, since moves that benefit one player will likely also benefit the other player. However, since there is no constraint on the actual utility values (only their difference) there still remains the possibility that there is an unexplored node that is the optimal node for both players.

2. R&N Problem 6.8:

1. A_1 = red
2. H = red (conflicts with A_1), H = green
3. A_4 = red
4. F_1 = red
5. A_2 = red (conflicts with A_1), A_2 = green (conflicts with H), A_2 = blue
6. F_2 = red
7. A_3 = red (conflicts with A_4), A_3 = green (conflicts with H), A_3 = blue (conflicts with A_2), so backtrack. Conflict set = $\{H, A_4, A_2\}$, Jump to A_2.
8. A_2 conflict set is $\{A_1, H\} \cup \{H, A_4, A_2\} - A_2 = \{A_1, H, A_4\}$. Jump to A_4.
9. A_4 conflict set is $\{H\} \cup \{A_1, H, A_4\} - A_4 = \{A_1, H\}$. A_4 = green (conflicts with H), A_4 = blue.
10. F_1 = red
11. A_2 = red (conflicts with A_1), A_2 = green (conflicts with H), A_2 = blue
12. F_2 = red
13. A_3 = red
14. T = red (conflicts with F_1), T = green (conflicts with H), T = blue
15. Done. Map shown in Fig. 1.

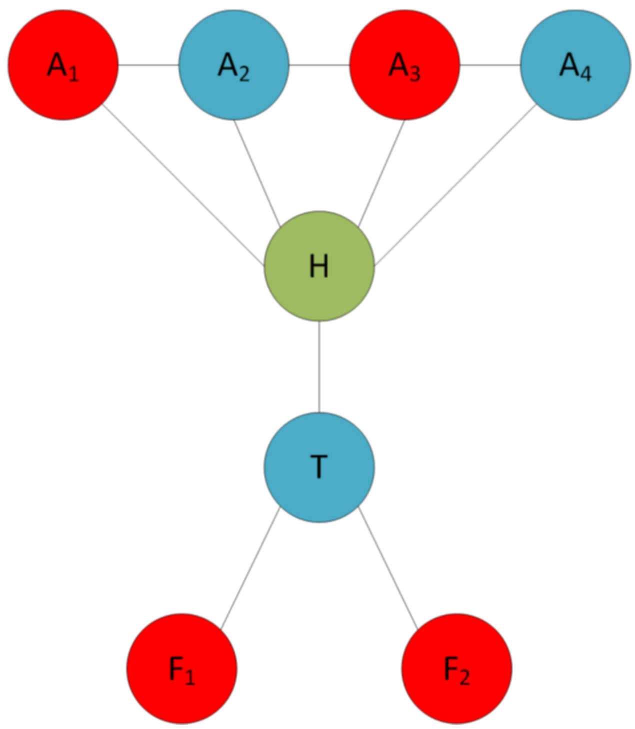

Figure 1: Map coloring provided by conflict-directed backjumping.

3. Logic Introduction:

The number of models for each sentence is equal to the number of true (1) entries in the truth table. I used Karnaugh maps (square version of truth tables) for my convenience to go from simplified expressions to the truth table but in no way are you required or expected to use them.

a. ¬A ∨ ¬B ∨ D

AB \ CD	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	0	1	1	0
10	1	1	1	1

\# of models = $\boxed{14}$

b. (A ∧ C) ∨ (B ∧ D)

AB \ CD	00	01	11	10
00	0	0	0	0
01	0	1	1	0
11	0	1	1	1
10	0	0	1	1

\# of models = $\boxed{7}$

c. (A ⇒ B) ∧ A ∧ C
(¬A ∨ B) ∧ A ∧ C
B ∧ A ∧ C

AB \ CD	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	0	1	1
10	0	0	0	0

\# of models = $\boxed{2}$

d. (A ⇒ B) ∧ (C ⇒ D)
(¬A ∨ B) ∧ (¬C ∨ D)
(¬A ∧ ¬C) ∨ (¬A ∧ D) ∨ (B ∧ ¬C) ∨ (B ∧ D)

AB \ CD	00	01	11	10
00	1	1	1	0
01	1	1	1	0
11	1	1	1	0
10	0	0	0	0

\# of models = $\boxed{9}$

4. R&N Problem 7.14:

a) (i) No; this sentence asserts, among other things, that all conservatives are radical, which is not what was stated. (ii) Yes, this says that if a person is a radical then they are electable if and only if they are conservative. (ii) No, this is equivalent to ¬R ∨ ¬C ∨ E ∨ ¬E which is a tautology, true under any assignment.

b) (i) Yes:

$$(R \wedge E) \iff C$$
$$((R \wedge E) \Rightarrow C) \wedge (C \Rightarrow (R \wedge E))$$
$$((R \wedge E) \Rightarrow C) \wedge (C \Rightarrow R) \wedge (C \Rightarrow E)$$
$$(\neg R \vee \neg E \vee C) \wedge (\neg C \vee R) \wedge (\neg C \vee E)$$

(ii) Yes:

$$
\begin{aligned}
&R \Rightarrow (E \iff C) \\
&R \Rightarrow ((E \Rightarrow C) \wedge (C \Rightarrow E)) \\
&\neg R \vee ((\neg E \vee C) \wedge (\neg C \vee E)) \\
&(\neg R \vee \neg E \vee C) \wedge (\neg R \vee \neg C \vee E)
\end{aligned}
$$

(ii) Yes,

$$
\begin{aligned}
&R \Rightarrow ((C \Rightarrow E) \vee \neg E) \\
&R \Rightarrow ((\neg C \vee E) \vee \neg E) \\
&\neg R \vee True
\end{aligned}
$$