Artifical Intelligence Problem Set 4

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Problem 1.

1. $A \implies \neg(B \wedge C)$
2. $C \iff \neg(D \vee E)$
3. $D \implies B$
4. $(D \wedge E) \implies \neg B \wedge A$
5. $D \iff E$

1. $\neg A \vee \neg B \vee \neg C$
2. $(C \implies \neg(D \vee E)) \wedge (\neg(D \vee E) \implies C)$
3. $\neg D \wedge B$
4. $(\neg D \vee \neg E) \vee (\neg B \wedge A)$
5. $(D \implies E) \wedge (E \implies D)$

1. $\neg A \vee \neg B \vee \neg C$
2. $(\neg C \vee (\neg D \wedge \neg E)) \wedge ((\neg D \wedge \neg E) \vee C)$
3. $\neg D \wedge B$
4. $(\neg D \vee \neg E \vee \neg B) \wedge (\neg D \vee \neg E \vee A)$
5. $(\neg D \vee E) \wedge (\neg E \vee D)$

1. $\neg A \vee \neg B \vee \neg C$
2. $(\neg C \vee \neg D) \wedge (\neg C \vee \neg E) \wedge (C \vee \neg D) \wedge (C \vee \neg E)$
3. $\neg D \wedge B$
4. $(\neg D \vee \neg E \vee \neg B) \wedge (\neg D \vee \neg E \vee A)$
5. $(\neg D \vee E) \wedge (\neg E \vee D)$

Final answer in CNF:

1. $\neg A \vee \neg B \vee \neg C$
2. $\neg C \vee \neg D$

3. $\neg C \vee \neg E$
4. $C \vee \neg D$
5. $C \vee \neg E$
6. $\neg D \wedge B$
7. $\neg D \vee \neg E \vee \neg B$
8. $\neg D \vee \neg E \vee A$
9. $\neg D \vee E$
10. $\neg E \vee D$

Problem 2. Choice 1: A = TRUE

1. $\neg B \vee \neg C$
2. $\neg C \vee \neg D$
3. $\neg C \vee \neg E$
4. $C \vee \neg D$
5. $C \vee \neg E$
6. $\neg D \wedge B$
7. $\neg D \vee \neg E \vee \neg B$
8. $\neg D \vee E$
9. $\neg E \vee D$

Choice 2: B = TRUE

1. $\neg C$
2. $\neg C \vee \neg D$
3. $\neg C \vee \neg E$
4. $C \vee \neg D$
5. $C \vee \neg E$
6. $\neg D \vee \neg E$
7. $\neg D \vee E$
8. $\neg E \vee D$

~~Choice 3: C = TRUE~~ results in failing statement 1. Revert back to choice 2 and try B = FALSE

1. $\neg C \vee \neg D$
2. $\neg C \vee \neg E$
3. $C \vee \neg D$
4. $C \vee \neg E$
5. $\neg D$

6. $\neg D \vee E$
7. $\neg E \vee D$

Choice 3: C = TRUE

1. $\neg D$
2. $\neg E$
3. $\neg D$
4. $\neg D \vee E$
5. $\neg E \vee D$

D = FALSE, E = FALSE
Final solution: A = TRUE, B = FALSE, C = TRUE, D = FALSE, E = FALSE

Problem 3.

1. For each index X, there is at least one vertex at position X. We can think of this as either AX or BX or CX ... or KX is true.
2. No vertex is at more than one position in the list. We can think of this as not(A1 and A2), or any combination of two indices with one vertex. So in the general case, with any vertex V, and any two indices X_1 and X_2, we want $\neg(VX_1 \wedge VX_2)$.
3. No position in the list is occupied by two vertices. Given two vertices, V_1 and V_2, we want them to not share the same position X. So in the general case, we want $\neg(V_1X \wedge V_2X)$.
4. If two vertices are not connected in the graph, then they are not both in the list, in any positions. We have to see the composition of the graph to give a definitive list of sentences for this constraint. Anyhow, we can represent this as $\neg(V_1X_1 \wedge V_2X_2)$ where V_1, V_2 are vertices such that they do not have an edge between them, and X_1 and X_2 are two indices.

For the specific example:

1.
   - $A1 \vee A2 \vee A3 \vee A4$
   - $B1 \vee B2 \vee B3 \vee B4$
2.
   - $\neg(A1 \wedge A2)$
   - $\neg(A1 \wedge A3)$
3.
   - $\neg(A1 \wedge B1)$
   - $\neg(A1 \wedge C1)$
4.
   - $\neg(A1 \wedge C2)$
   - $\neg(A1 \wedge C3)$