AI Assignment 1

Question 1

First assigning the propositional variables to the sentences in the given statements.

1. A → The universe either will simply exist as it is.
2. B →The universe either will end in a heat death.
3. C→ There was a big bang.
4. D → Universe is expanding
5. E → Universe is accelerated.

The propositional logical statements are as follows.

1. $A \lor B$
2. $\neg C \rightarrow A$
3. $C \leftrightarrow D = (\neg C \lor D) \land (C \lor \neg D)$
4. $(D \land E) \rightarrow B$

Contrapositives of the above statements are

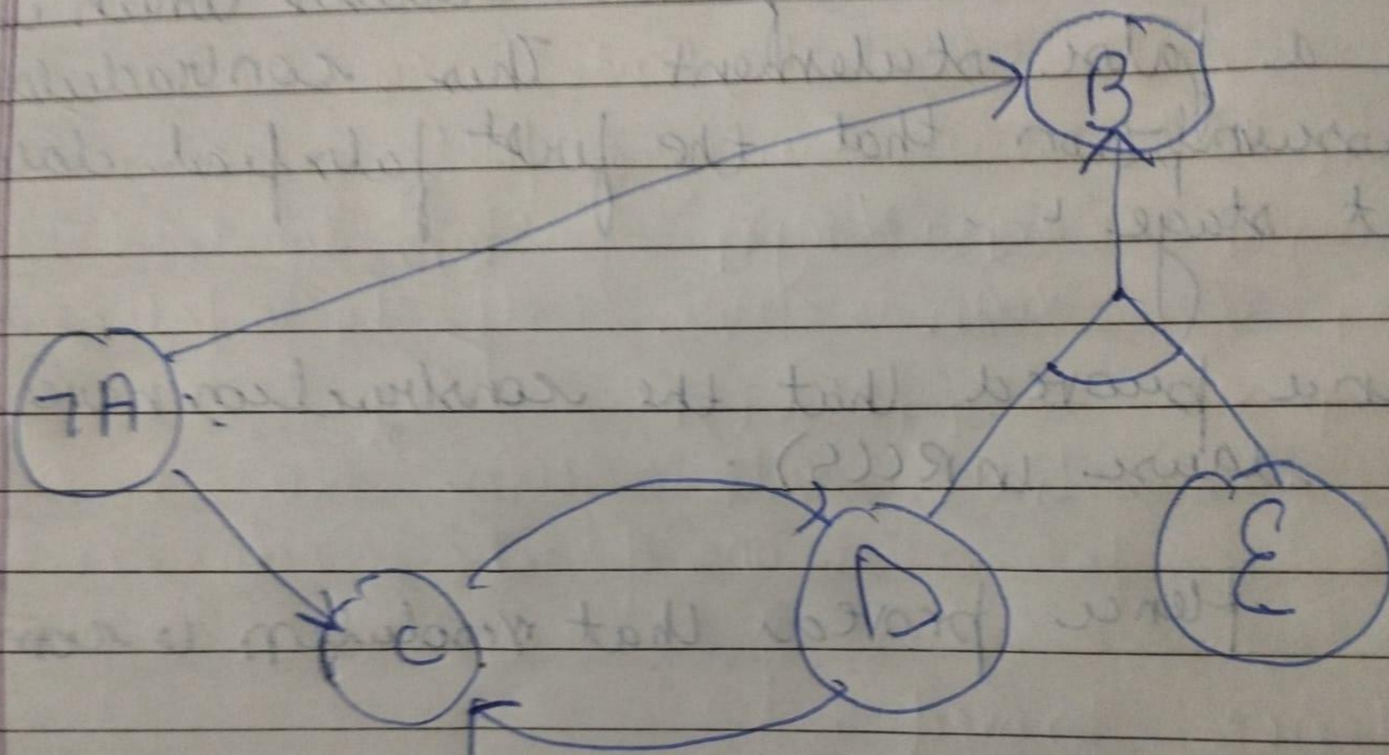
1. $\neg B \rightarrow A$
2. $\neg A \rightarrow C$
3. $\neg C \leftrightarrow \neg D$
4. $\neg B \rightarrow (\neg D \lor \neg E)$

Inferred:

1. If the universe will not end in a heat death (¬B), then it will not simply exist as it is (¬A) (from ¬B → ¬A).
2. If the universe did not simply exist as it is (¬A), then there was a big bang (C) (from ¬A → C).
3. If the universe is expanding (D), then there was a big bang (C), and if there was no big bang (¬C), then the universe is not expanding (¬D) (from D → C and C → D).
4. If the universe will not end in a heat death (¬B), then it is not both expanding and accelerated (¬(D ∧ E)).

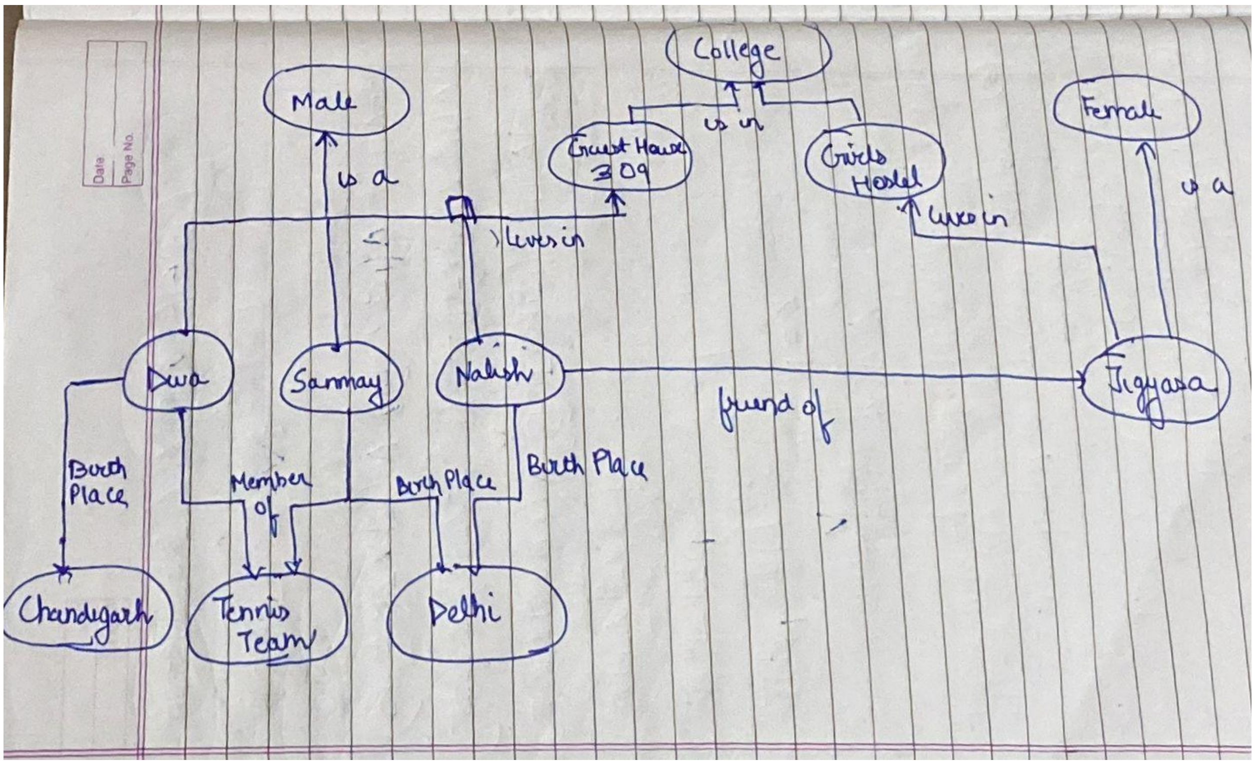
Not Inferred:

1. The original statements do not provide enough information to directly infer whether the universe is currently expanding (D) or not (¬D). They mainly discuss the implications of expansion in relation to the big bang.
2. The original statements do not provide direct information about whether there was a big bang (C) or not (¬C) if the universe is not currently expanding (¬D). They mainly discuss the conditions under which there was a big bang in relation to expansion.



¬A
B
C
D
E

Question 2



Semantic Network

Single inheritance:

1. In the given semantic graph Guest House 309 and girls hostel show single inheritance as they inherit only from the parent entity college.

Multiple inheritance:

1. Dua and Sanmay show multiple inheritance as they inherit from 'Male' and 'Tennis Team'.

Location:

1. Nalish, Dua and Sanmay live in Guest House 309 whereas Jigyasa lives in Girls Hostel.

Gender:

1. Gender of Nalish, Dua and Sanmay is male as they inherit from 'Male' whereas the gender of 'Jigyasa' is female as she inherits from 'Female'.

Question 3

Ans 3 Soundness

Consider two given ~~vated~~ statements

$P: l_1 \vee l_2 \vee l_3 \cdots \vee l_k$

$Q: m_1 \vee m_2 \vee m_3 \cdots \vee m_n$

Consider the literal l_i that is complementary to m_j. If l_i is true ~~com~~ then m_j is false & hence $m_1 \vee \cdots \vee m_{j-1} \vee m_{j+1} \cdots \vee m_n$ must be true as $m_1 \cdots \vee \cdots \vee m_n$ is given. If l_i is false then $l_1 \vee \cdots \vee l_{i-1} \vee l_{i+1} \cdots \vee l_k$ must be ~~tr~~ true because $l_1 \vee \cdots \vee l_k$ is given. Now l_i is ~~a~~ either true or false - so one of the conclusion holds hence an 'or' of them will be true too.

Hence proved

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Completeness of Resolution:

let us define resolution closure ~~the~~ RC(S) of a set of clauses S, which is the set of all clauses derivable by repeated application of the resolution rule to clauses in S or their derivatives

Resolution closure has the property that if a set of clauses is unsatisfiable, then the resolution closure of those clauses contains the empty clause.

~~If we prove the above statement~~
The above statement implies that resolution is complete. We need to ~~sho~~ prove the statement

We will prove its contrapositive
If the closure RC(S) does not contain empty clause, then S is satisfiable.
Let us construct a model S with suitable truth values $P_1, .. P_n$
~~From i to~~ For i 1 to n

If a clause in RC(S) contains literal $\neg P_i$ & all its other literals are false then assign false to P_i
- Otherwise assign true to P_i

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This assignment $P_1, \ldots P_k$ is a model of S.
To prove this assume the opposite

At some stage i, assigning P_i causes some clause C to be false.

C must look like either (false $\vee$ false .. $\vee P_i$) or (false $\vee$ false $\vee$ .. $\neg P_i$).

If just one of them is present in RC(S) then the algo will assign truth value to P_i to make C true so C can only be falsified if both of these clauses are in RC(S).

Since RC(S) is closed under resolution, it will contain resolvent of these clauses which will be a false statement. This contradicts our assumption that the first falsified clause appears at stage i.

Hence proved that the construction never falsified a clause in RC(S).

Hence proved that resolution is complete