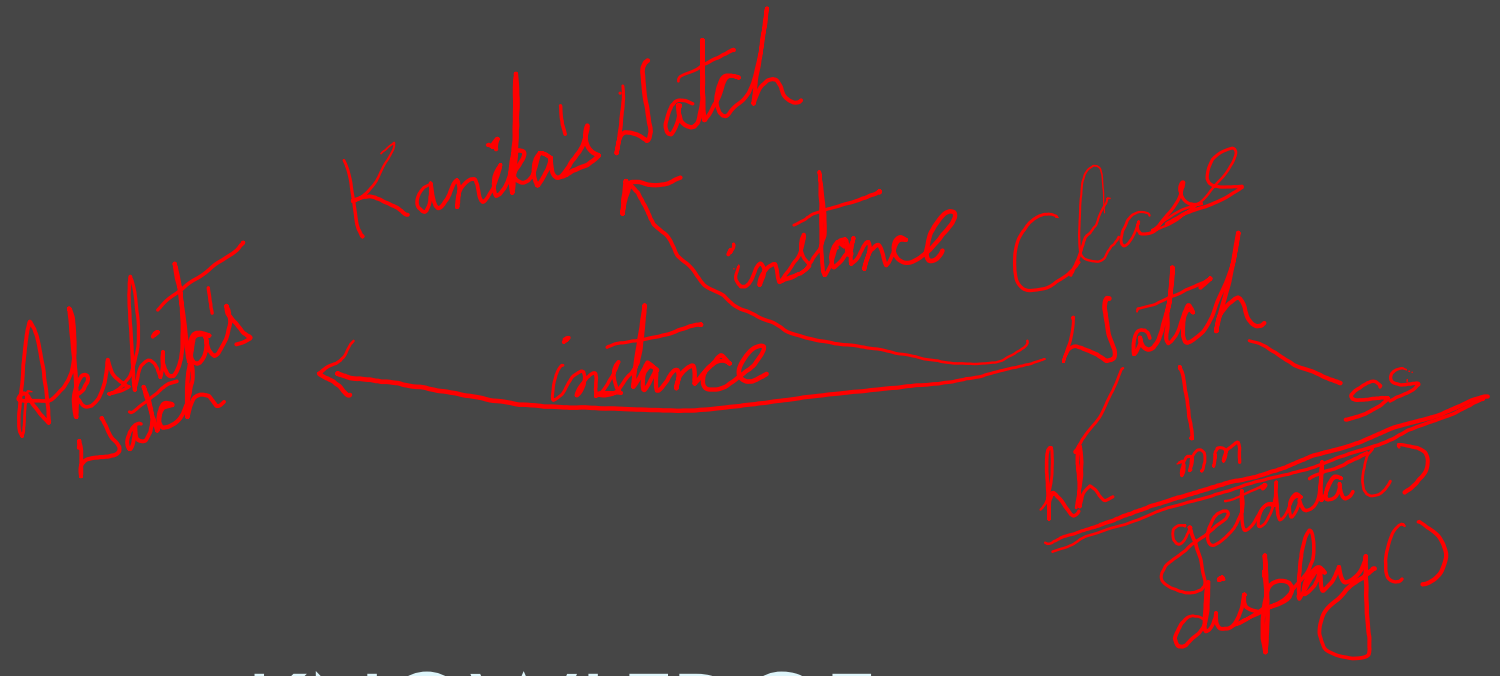
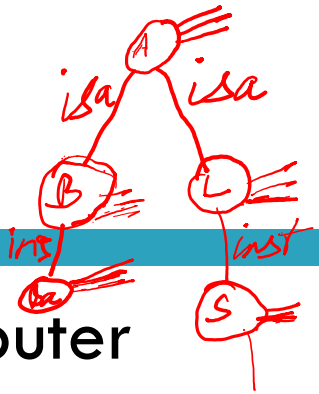


KNOWLEDGE REPRESENTATION

Knowledge and Representation



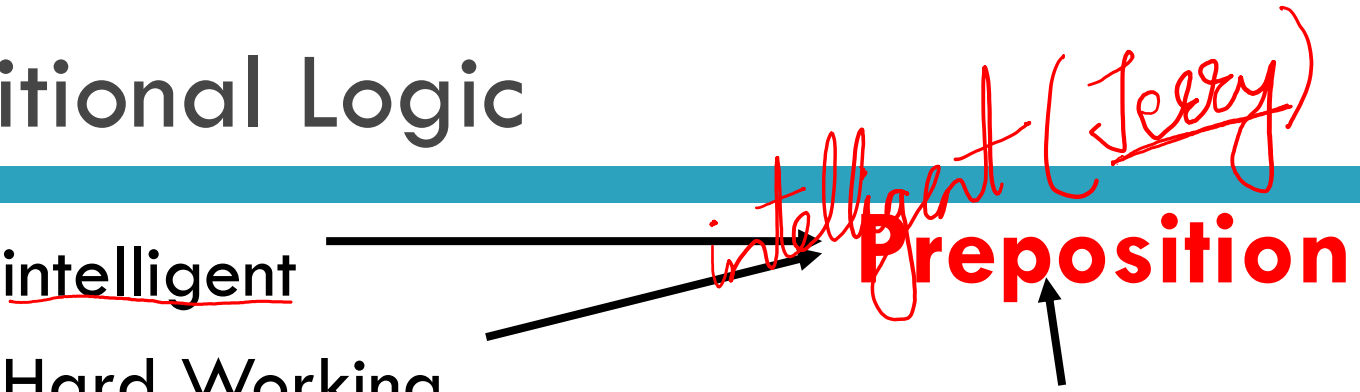
- Solve a real world problem through a computer
- Tools/Techniques required to transcribe Real World Knowledge into computer understandable format (Represent Knowledge)
- Semantic Nets, Frames, Inheritance, Logic (Prepositional and Predicate)

Knowledge Representation

- We need a knowledge to represent a domain knowledge
- There must be a method to use this knowledge
- Inference Mechanism
- Syntax and Semantics of a language
  - Laugh(Tom) ---- ????
  - Likes(sita,geeta) ----- ????
- Logic is Formal Language

Statements Propositional Logic

Propositional Logic



- Jerry is intelligent
- Jerry is Hard Working
- If Jerry is intelligent and Jerry is hard working then Jerry will score good marks
- Objects and Relations of Preposition Logic

Prepositions

- Intelligent(Jerry) == Jerry is Intelligent
- Hardworking(Jerry) == Jerry is Hard Working

Towards the Syntax

- Intelligent(Jerry) = P
- Hardworking(Jerry) = Q

∧ Conjunction
∨ Disjunction
¬ negation

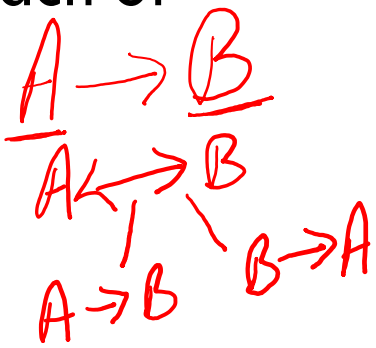
- What does P ∧ Q (P and Q) mean?
- What does P ∨ Q (P or Q) mean?

Elements of Propositional Logic

- Vocabulary
  - A set of Propositional Symbols (P,Q,R etc.) each of which can be True or False
  - Set of logical operators

    and ($\wedge$) or ($\vee$) not ($\neg$) implies ($\Rightarrow$) iff ($\Leftrightarrow$)
  - There are two special symbols

    True (T) and False (F) – these are logical symbols



How to form a Prepositional Sentence

- Each symbol (either preposition or a constant) is a sentence
- If P is a sentence and Q is a sentence

  then

  P is a sentence

  P $\wedge$ Q are a sentence

  P $\vee$ Q are a sentence

  $\neg$ P is a sentence

  P $\rightarrow$ Q is a sentence

  Nothing else is a sentence

- **Sentences are also called well formed formulae (wff)**

Example wff

- P
- True
- P ∧ Q
- P ∨ Q → R
- (P ∧ Q) ∨ R → S
- ¬(P ∧ Q)
- ¬(P ∨ Q) → R ∧ **S**

De Morgan's Theorem

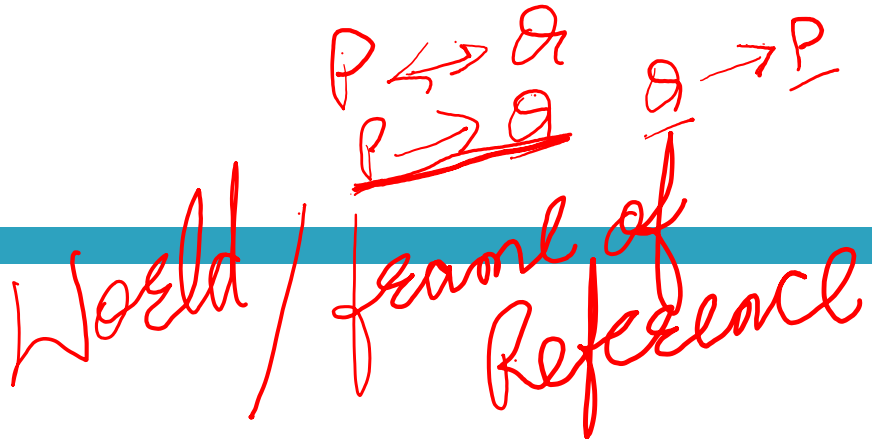
$\neg(P \wedge Q) = \neg P \vee \neg Q$

$\neg(P \vee Q) = \neg P \wedge \neg Q$

Implications $\rightarrow$

- $P \rightarrow Q$
- If P is true than Q is true
- If it rains than monsoon has arrived
- If I study than I will pass
- If I do not study than I will not pass ($\neg P \rightarrow \neg Q$)
- If I do not study than I will fail ($\neg P \rightarrow Q$)
- If it rains than roads are wet
- **If roads are wet than it rains (Cannot be inferred or implied backwards)**

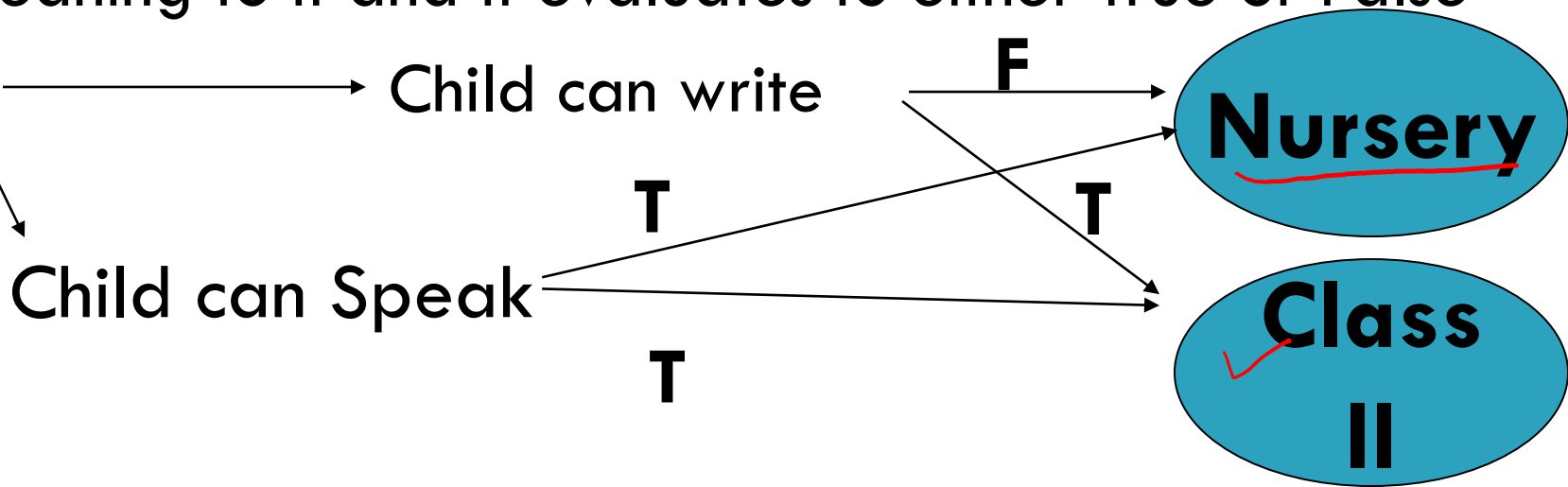
Equivalence



- P ⇔ Q
- Example?
- If the two sides of the triangle are equal than two base angles of the triangle are equal
- If two base angles of a triangle are equal than two sides are equal (Q ⇔ P)
- Requires two sentences
- P → Q and Q → P

What does a wff mean ---- Semantics

- Interpretation in a world
- When we interpret a sentence in a world we assign meaning to it and it evaluates to either True or False
- P → Child can write



So how do we get the meaning?

- Sentences can be compound prepositions
- Interpret each atomic preposition in the same world
- Assign truth values to each interpretation
- Compute the truth values of the compound prepositions

Example

- P : likes(sneha,shivangi)
- Q : knows(richa,purnima)

- World: sneha and shivangi are friends and richa and purnima know each other
- P=T, Q=T
- $\therefore P \wedge Q = T$
- $P \wedge (\neg Q) = F$

Validity of Sentence

- If a preposition sentence is true under all possible interpretation, it is VALID

- Tautology

  $P \vee \neg P$ will always be true

Questions

Express the following sentences in preposition logic

1. It rain in July
2. The book is not costly
3. If it rain today and Tom does not have an umbrella he will get drenched

Rain (July)

¬ Costly (book)

Rain (today) ∧ ¬ have (Tom, umbrella)

→ get drenched (Tom)

Questions

- If P is true and Q is true then are the following true or false

1. $P \rightarrow Q$
2. $(\neg P \vee Q) \rightarrow Q$
3. $(\neg P \vee Q) \rightarrow P$
4. $(\neg P \vee P) \rightarrow T$

1. Tom is a manual
2. Tom drinks milk
3. Tom and Jerry are friends
4. Divya is a good girl
5. Divya and Saumya are friends
6. Divya likes chocolates

manual(tom)
drinksmilk(tom)
friends(tom, Jerry)
goodgirl(Divya)
friends(Divya, Saumya)
likes(Divya, chocolates)

1. if Divya scores good marks then she will get a good job

scores (Divya, good marks) ⟶ get (Divya, job)

2. If Saumyata and Lakshmi prepare food then it would be delicious

prepare food (Saumyata, Lakshmi) ⟶ food (delicious)