CS 344
Artificial Intelligence

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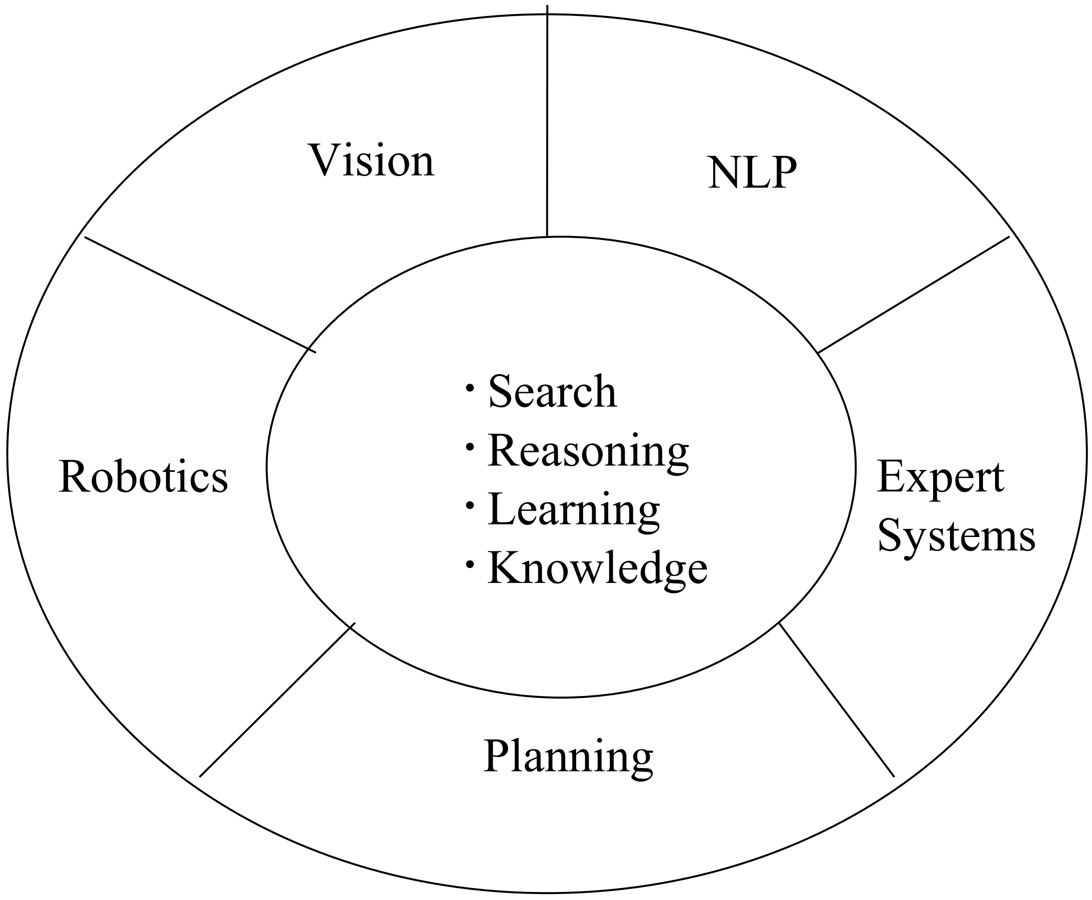
Logic and inferencing



Obtaining implication of given facts and rules -- Hallmark of intelligence

Inferencing through

- Deduction (General to specific)
- Induction (Specific to General)
- Abduction (Conclusion to hypothesis in absence of any other evidence to contrary)

<u>Deduction</u>

Given: All men are mortal (rule)
Shakespeare is a man (fact)
To prove: Shakespeare is mortal (inference)

<u>Induction</u>

Given: Shakespeare is mortal
Newton is mortal (Observation)
Dijkstra is mortal
To prove: All men are mortal (Generalization)

If there is rain, then there will be no picnic

Deduction

Fact1: There was rain
Conclude: There was no picnic

Fact2: There was no picnic
Conclude: There was no rain (?)

Induction and abduction are fallible forms of reasoning. Their conclusions are susceptible to retraction

Two systems of logic

1) Propositional calculus
2) Predicate calculus

Propositions

- Stand for facts/assertions
- Declarative statements
  - As opposed to interrogative statements (questions) or imperative statements (request, order)

Operators

$$AND\,(\wedge),\ OR\,(\vee),\ NOT\,(\neg),\ IMPLICATION\,(\Rightarrow)$$

=> and ¬ form a minimal set (can express other operations)

- Prove it.

Tautologies are formulae whose truth value is always T, whatever the assignment is

<u>Model</u>

In propositional calculus any formula with n propositions has 2^n models (assignments)

- Tautologies evaluate to T in all models.

Examples:

1) $p \wedge \neg p$
2) $\neg(p \wedge q) \Leftrightarrow \neg p \vee \neg q$ - De Morgan with AND

Semantic Tree/Tableau method of proving tautology

To prove: $\neg(p \wedge q) \Rightarrow \neg p \vee \neg q$

Start with the negation of the formula to be proved a tautology

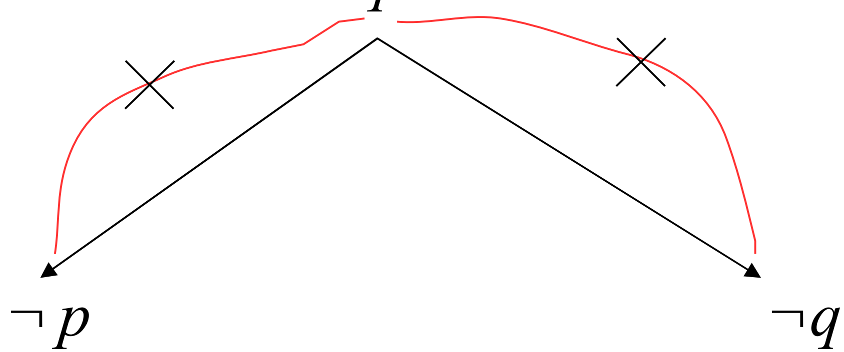
$$[\neg(p \wedge q) \Rightarrow \neg p \vee \neg q]$$

$\neg(p \wedge q)$ - β - formula

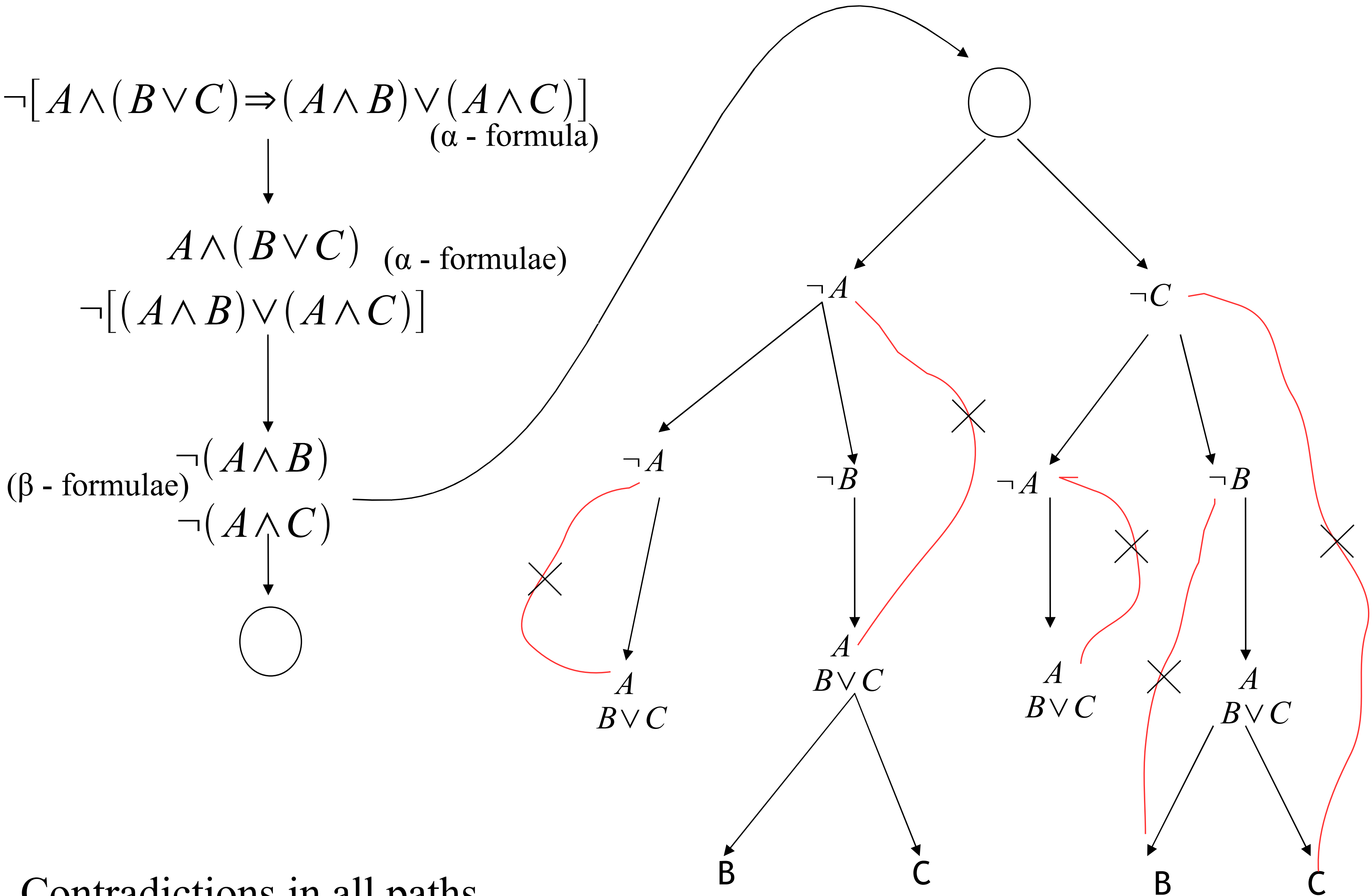
$\neg(\neg p \vee \neg q)$ - α - formula

p

q



Example 2: $A \wedge (B \vee C) \Rightarrow (A \wedge B) \vee (A \wedge C)$



Contradictions in all paths

Exercise:

Prove the backward implication in the previous example