AI Theory

Logic:

→ Review

Syntax of Prop. Logic

$\wedge$, $\vee$, ...

Model:

A model ω is a propositional logic is an assignment of truth values to propositional symbols.

Example: $2^2 = 4$ for A, B

AA, AB, BA, BB

each is a model.

Interpretation function

Let f be a formula.

Let ω be a model.

$$\underbrace{\text{If } f(\omega) = \text{true}, \ 1 \text{ else } 0}_{M(f)}$$

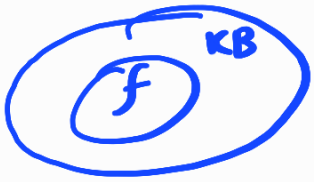
Knowledge base

Set of formulas representing their conjunction / intersection.

$$M(KB) = \bigcap_{f \in KB} M(f)$$

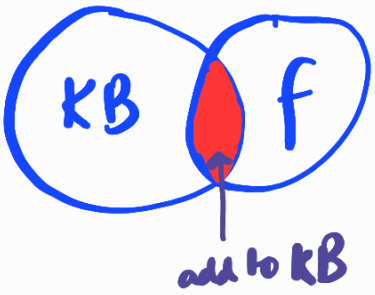
Adding to the knowledge base

- Entailment (Symbol, $\models$)



- Contradiction $M(\sim f)$

- Contingency



<u>Shrinking</u>:

$$M(B) \cap M(f) = \{ \quad \}$$

<u>Relation</u>:

KB contradicts f if KB entails $\sim f$.

Tell operation

Tell[f]

Already knew ← entailment ($KB \models f$)

Don't believe ← contradiction ($KB \models \sim f$)

update KB ← contingency

Ask Operation

Ask [f]

Satisfiability

A Knowledge base is satisfiable if $M(KB) \neq 0$.

Reduce Ask[f], Tell[f] to Satisfy:

If $KB \cup \{\neg f\}$ satisfiable?

- no → entail
- yes → is $KB \cup \{f\} \models \checkmark$?
  - no → contradiction
  - yes → contingency

Inference Rules

Forward Chaining

"Modus ponens inference rules"

For any propositional symbols p and q:

$$\frac{p, \quad p \rightarrow q}{q}$$

$$\frac{\begin{array}{c} p \\ p \rightarrow q \end{array}}{q}$$

(Discrete Math 101!)

Algorithm

from Book.

Example:

Rain

Rain → wet

---

wet

add to KB

wet → Slippery

Slippery

"Modus Ponens is not Complete"

Soundness / Completeness

Study from book the difference

Horn clause:

A horn clause is either:

- definite clause
- goal clause

Definite clause:

$$(p \wedge q) \rightarrow r$$

r should hold given $(p \wedge q)$

Update Modus Ponens:

Modus ponens w/ horn clauses

Conjunctive Normal Form:

Conjunction of clauses.

$$(A \vee B \vee C) \wedge (\sim B \vee D)$$

How to convert to CNF:

On slides

First Order Logic

$\forall x$ Student $(x) \rightarrow$

Knows $(x, \text{arithmetic})$

more powerful!

If a student takes course he knows concept.

$$\forall x \forall y \forall z \left(\left(\text{Student}(x) \wedge \text{Takes}(x,y) \wedge \text{Course}(y) \wedge \text{Covers}(y,z) \wedge \text{Concept}(z) \right) \rightarrow \text{Knows}(z) \right)$$

x = Student

y = course

z = Concept

Rest you can Read from Book.