Knowledge Representation Foundation

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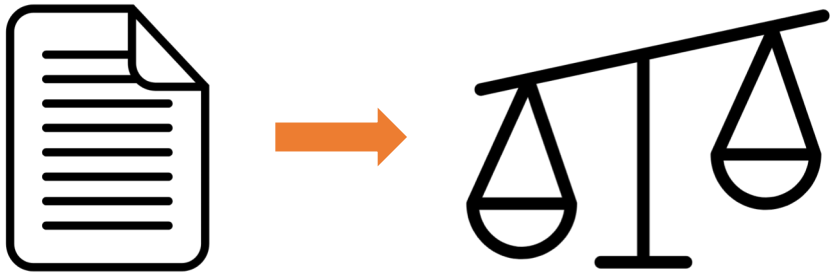
Propositional Logic

- Proposition: A **statement** that expresses a **judgement**



Nondeclarative Sentences

- **Imperative**
  - Wake up!
- **Interrogative**
  - How are you today?

- **Can we justify the statement?**

Declarative Sentences

- **Is today Wednesday?**

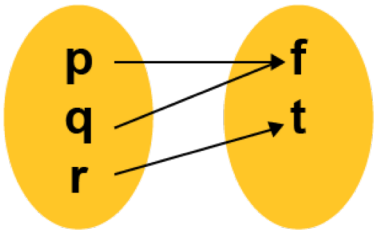
- **Turn declarative sentences into formulas**
  - Formalism
  - Manipulate

Alphabet of Propositional Logic

- **Alphabet of propositional logic**
  - Signature → atoms (p,q,r)
  - Connectives → Binary, Unary, True, False
  - Parentheses

Interpretation and Valuation

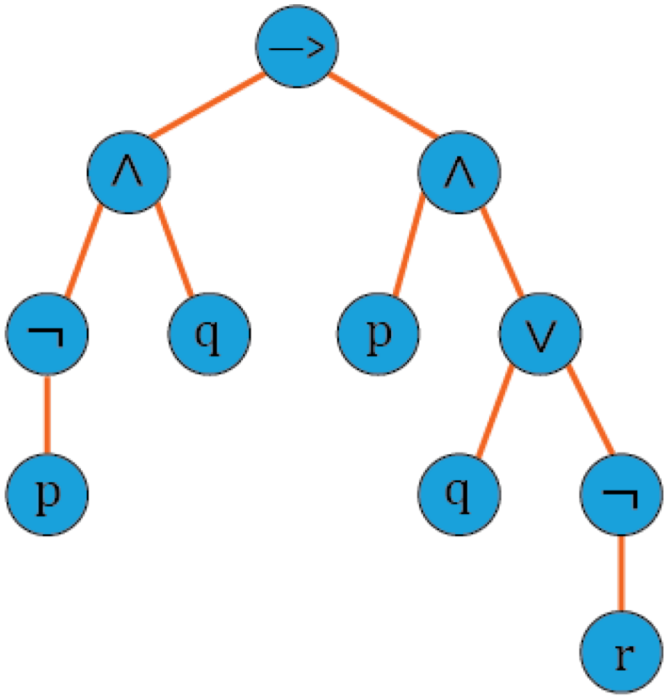
- Interpretation: A **function** from σ to T,F



- Valuation: **assignment** of **each** propositional **atom** to a **truth value**
- more will be covered in Module 2

Parse Tree

- $(((\neg p) \wedge q) \longrightarrow (p \wedge (q \vee (\neg r))))$



- **Priority of connectives:** $\neg, \wedge, \vee, \longrightarrow$

$$\neg p \wedge q \longrightarrow p \wedge (q \vee \neg r)$$

The need for a richer language

Propositional Logic

- Study of declarative sentences, statements about the world which can be given a truth value, e.g. : *not, and, or, if, …, then*
- Limitations: Cannot deal with modifiers like *there exists, all, among, only*.

The need for a richer language

- **We need a richer language to deal with quantifiers**
  - *if it rains, I will be carrying an umbrella. It rains today.*

    $p, p \rightarrow q$

  - *For any day it rains, I will be carrying an umbrella. It rains today. Today is September 14.*

    $\forall x(R(x) \rightarrow Carry(umbrella, x)), R(x_0)$

Predicate Logic as a Formal Language

- **Terms** $\rightarrow$ Objects such as a (Andy) and p (Paul).

- **Expressions** $\rightarrow$ Formulas which can be given truth values

- **A predicate vocabulary consists of 3 sets:**
  - Predicate symbols $\mathcal{P}$
  - Function symbols $\mathcal{F}$
  - Constants $\mathcal{C}$

Summary

- Propositional logic
- Declarative vs. nondeclarative sentences
- Alphabet of propositional logic
- Interpretation and valuation
- Predicate logic as a formal language