Logic Programming

- A logic program is a collection of axiom from which theorems can be proven
- A program is a theorem
  - The language tries to find a collection of axioms and inference steps that imply the goal
- Axiom are written in a standard form known as Horn clauses
  - A Horn clause consists of a consequent (head H) and a body (terms \( B_i \))
    
    \[ H \leftarrow B_1, B_2, \ldots, B_n \]
  
  - Semantics: when all \( B_i \) are true, we can deduce that H is true
Resolution

- Horn clauses can capture most logical statements
  - But not all
- The derivation of new statements is known as \textit{resolution}
  - The logic programming system combines existing statements to find new statements
  - For instance,

\[
\begin{align*}
C & \leftarrow A, B \\
D & \leftarrow C \\
\text{If we know that } A \text{ and } B \text{ imply } C, \\
\text{and that } C \text{ implies } D, \\
\text{then we can deduce that } A \text{ and } B \text{ imply } D
\end{align*}
\]

Example

- \textit{Variable}:
  \[
  \text{flowery}(X) \leftarrow \text{rainy}(X)
  \]
  \[
  \text{rainy}(\text{Rochester})
  \]
  
  \[
  \text{flowery}(\text{Rochester})
  \]

- \textit{Predicate Applied to a Variable}:
  \[
  \text{flowery}(X)
  \]
  \[
  \text{rainy}(X)
  \]

- \textit{Predicate Applied to an Atom}:
  \[
  \text{rainy}(\text{Rochester})
  \]

- \textit{Free Variable X acquired value}:
  Rochester during the resolution

- \textit{This is known as Unification}
Prolog

- **PROgramming in LOGic**
- It is the most widely used logic programming language
- Its development started in 1970 and it was result of collaboration between researchers from Marseille, France, and Edinburgh, Scotland
- Main applications:
  - Artificial intelligence: expert systems, natural language processing, …
  - Databases: query languages, data mining,…
  - Mathematics: theorem proving, symbolic packages,…

Reading Assignment

- Read
  - Scott Ch. 11 intro
  - Scott Sect. 11.3 intro, 11.3.1