Expressing Knowledge

- ontology – the kinds of objects that will be important to the agent and the properties that these objects are thought of as having.
- Example: Soap Opera World

Vocabulary

- named individuals
  - maryJones
  - johnQsmith
  - faultyInsuranceCompany
  - evilvilleTownCouncil
  - norasJacuzzi
  - earing35
  - butchertknife1
  - laurasMortgage

Basic Facts

- On(john)
- Woman(jane)
- Company(faultyInsuranceCompany)
- Knife(butchertknife1)
- Rich(john)
- ~HappilyMarried(jim)
- WorksFor(jim, fic)
- fic = faultyInsuranceCompany
- bestFriend(jim) = john

Complex Facts

- ∀y Rich(y) ∧ Man(y) → Loves(y, jane)
  “All the women, with the possible exception of Jane, love John.”

- ∀x, y Loves(x, y) → ~Blacksails(x, y)

- Loves(jane, john) ∨ Loves(jane, jim)

- ∃x Adult(x) ∧ Blackmails(x, john)

Closure Sentences

- ∀x Person(x) → (x = jane ∨ x = john ∨ x = jim . . .)
  - Limit relation MarriedTo to a specific set of pairs.

- Limit the individuals that exist to 5 named individuals.

Terminological Facts

- Disjointness
  - ∀x Man(x) → ~Woman(x)

- Subtypes
  - ∀x Surgeon(x) → Doctor(x)

- Exhaustiveness
  - ∀x Adult(x) → (Man(x) ∨ Woman(x))
### Terminological Facts (cont)

**Symmetry**
\[ \forall x, y \text{MarriedTo}(x, y) \rightarrow \text{MarriedTo}(y, x) \]

**Inverses**
\[ \forall x, y \text{ChildOf}(x, y) \rightarrow \text{ParentOf}(y, x) \]

**Type Restrictions**
\[ \forall x, y \text{MarriedTo}(x, y) \rightarrow (\text{Person}(x) \land \text{Person}(x) \land \text{OppositeSex}(x, y)) \]

### Full Definitions
\[ \forall x \text{RichMan}(x) \equiv \text{Rich}(x) \land \text{Man}(x) \]

### Entailments/Questions

\[ \exists x \text{Company}(x) \land \text{LOVES(CEOOf(x), Jane)} \]

Assume that \( \mathcal{I} \) satisfies \( \text{Rich(john)}, \text{Man(john)}, \forall y \text{Rich}(y) \land \text{Man}(y) \rightarrow \text{LOVES}(y, Jane), \) and \( \text{john} = \text{CEOOf(fic)} \).

### An Important Fact

\[ KB \models (\alpha \rightarrow \beta) \iff KB \cup \{\alpha\} \models \beta \]

### Another Example

\[ \forall x [\text{Man}(x) \rightarrow \neg \text{BLACKMAILS}(x, \text{John})] \rightarrow \exists y [\text{LOVES}(\text{John}, y) \land \text{BLACKMAILS}(y, \text{John})] \]

Assume that \( \mathcal{I} \) satisfies
\[ \exists x \text{Adult}(x) \land \text{BLACKMAILS}(x, \text{John}) \text{ and } \forall y \text{Woman}(y) \land y \neq \text{Jane} \rightarrow \text{LOVES}(y, \text{John}) \]

- Proof
- What about negative answers? Not entailed. Must produce an interpretation that satisfies KB and the negation of the query.

### Misc

- **Proof**
  - What about negative answers? Not entailed. Must produce an interpretation that satisfies KB and the negation of the query.

### Abstract Individuals (Reification)

e.g., purchase

\[ \text{PURCHASE(p23)} \land \text{agent(p23)} = \text{John} \land \text{object(p23)} = \text{bike} \land \text{source(p23)} = \text{sears} \land \text{amount(p23)} = \$20 \]

\[ \text{MARRIAGE(m17)} \land \text{groom(m17)} = \text{John} \land \text{wife(m17)} = \text{Jane} \land \text{date(m17)} = \text{June 10/2002} \land \text{witness(m17)} = \text{y} \]
Other Facts: Beyond FOL

- Statistical and Probabilistic Facts
- Default and Prototypical Facts
- Intentional facts (mental attitudes)