NLP

Introduction to NLP

Knowledge Representation

Knowledge Representation

- Ontologies
- Categories and objects
- Events
- Times
- Beliefs

Knowledge Representation

- Object
  - Martin the cat
- Categories
  - Cat
- Ontology
  - Mammal includes Cat, Dog, Whale
  - Cat includes PersianCat, ManxCat
- ISA relation
  - ISA (Martin,Cat)
- AKO relation
  - AKO (PersianCat,Cat)
- HASA relation
  - HASA (Cat, tail)

Semantics of FOL

- FOL sentences can be assigned a value of *true* or *false.*

  ISA(Milo,Cat) = true

- *Milo is younger than Martin*

  <(AgeOf(Milo),AgeOf(Martin)) = true

  =(AgeOf(Milo),AgeOf(Martin)) = false

Examples with Quantifiers

- All cats eat fish

  $\forall x: ISA(x, Cat) \Rightarrow EatFish(x)$

Representing Events

- Martin ate
- Martin ate in the morning
- Martin ate fish
- Martin ate fish in the morning

One Possible Representation

- FOL representations
  - Eating1(Martin)
  - Eating2(Martin,Morning)
  - Eating3(Martin,Fish)
  - Eating4(Martin,Fish,Morning)
- Meaning postulates
  - Eating4(x,y,z) -> Eating3(x,y)
  - Eating4(x,y,z) -> Eating2(x,z)
  - Eating4(x,y,z) -> Eating1(x)

Example from Jurafsky and Martin

Second Possible Representation

- Eating4(x,y,z)
  - With some arguments unspecified
- Problems
  - Too many commitments
  - Hard to combine Eating4(Martin,Fish,z) with Eating4(Martin,y,Morning)

Example from Jurafsky and Martin

Third Possible Representation

- Reification
  - ∃ e: ISA(e,Eating) ∧ Eater(e,Martin) ∧ Eaten(e,Fish)

Example from Jurafsky and Martin

Representing Time

- Example
  - Martin went from the kitchen to the yard
  - ISA(e,Going) ^ Goer(e,Martin) ^ Origin (e,kitchen) ^ Target (e,yard)
- Issue
  - no tense information: past? present? future?
- Fluents
  - A predicate that is true at a given time: T(f,t)

Representing Time

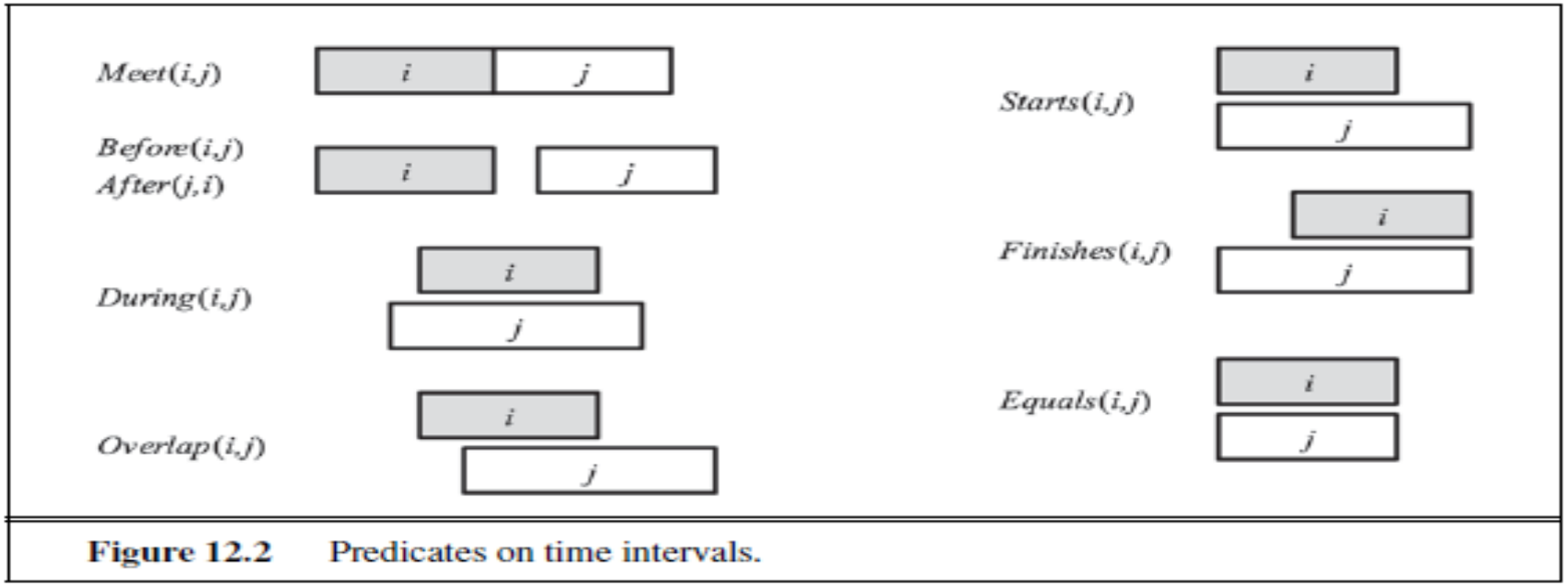
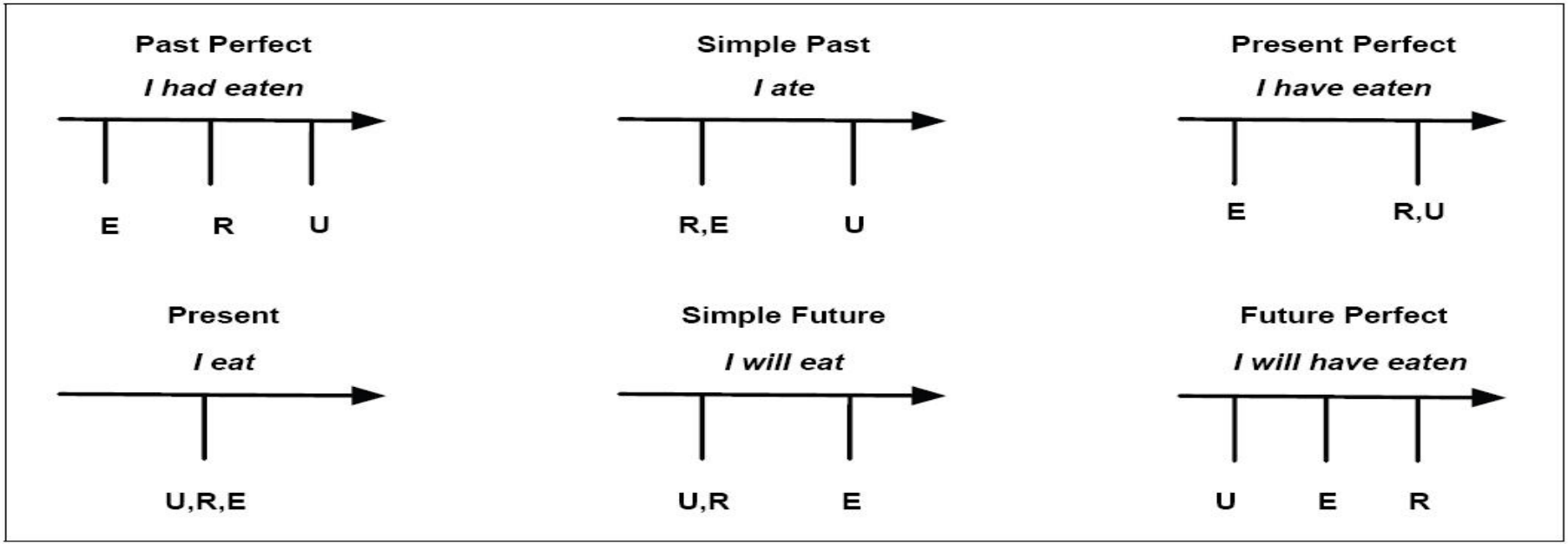


Figure 12.2 Predicates on time intervals.

Example from Russell and Norvig

Representing Time



Example from Jurafsky and Martin

Representing Beliefs

- Example
  - Milo believes that Martin ate fish
- One possible representation
  - ∃ e,b: ISA(e,Eating) ∧ Eater(e,Martin) ∧ Eaten(e,Fish) ∧ ISA(b,Believing) ∧ Believer(b,Milo) ∧ Believed(b,e)
- However this implies (by dropping some of the terms) that "Martin ate fish" (without the Belief event)
- Modal logic
  - Possibility, Temporal Logic, Belief Logic

NLP