Today: Pragmatics and the problem of inference

- Text coherence
- Scripts for text understanding

**Pragmatics**
Understanding sentences in context.

<table>
<thead>
<tr>
<th>Analysis:</th>
<th>Hearer</th>
</tr>
</thead>
<tbody>
<tr>
<td>(parsing):</td>
<td></td>
</tr>
<tr>
<td>NP</td>
<td>VP</td>
</tr>
<tr>
<td>article noun</td>
<td>verb</td>
</tr>
<tr>
<td>The students are</td>
<td>dead</td>
</tr>
<tr>
<td>(semantic interpretation):</td>
<td></td>
</tr>
<tr>
<td>Tired (Students)</td>
<td></td>
</tr>
<tr>
<td>not (Alive (Students))</td>
<td></td>
</tr>
<tr>
<td>(pragmatic interpretation):</td>
<td></td>
</tr>
<tr>
<td>Tired (Students,S3)</td>
<td></td>
</tr>
<tr>
<td>not (Alive (Students,S3))</td>
<td></td>
</tr>
</tbody>
</table>

**Interpretation in Context**

Jack took out a match. He lit a candle.

Jack took out a match. The sun set.

Useful to divide context into:

- **discourse context:** information from preceding sentences
- **situational context:** relevant world knowledge

**The Problem of Inference**

When the balloon touched the light bulb, it broke. This made the baby cry. Mary gave John a dirty look and picked up the baby. John shrugged and picked up the balloon.
NLU as Abduction

If A → B is true and B true, then A true.

\[ X = \text{Fred desperately needed money for the mortgage payment.} \]

\[ B = \text{Fred called his sister.} \]

**Rule 1** = If you need money then you can get it from a family member.

**Rule 2** = If you want to get something from someone, then you can ask them for it.

**Rule 3** = One way to ask someone for something is to call them.

---

Framework for Using World Knowledge

**Expectation-Based Processing**

1. Assume setting of discourse is represented by content of previous sentences and any inferences made when interpreting those sentences.

2. Use this information to generate a set of expectations about plausible eventualities.

3. Match possible interpretations of new sentences against expectations generated from the previous discourse.

---

Knowledge About Action and Causality

**Forms of Causality:**

-[**effect causality**] Set of intended effects or side effects typically caused by an action.

-[**precondition causality**] Set of conditions that typically must hold just before action starts.

-[**enablement**] A enables B if the effects of the first establish the preconditions of the second.

-[**decomposition**] A is a substep of B if A is one of a sequence of steps that constitute the execution of B.

---

Definition of BUY

**Roles:** Buyer, Seller, Object, Money

**Constraints:** Human(Buyer), SalesAgent(Seller), IsObject(Object), Value(Money, Price(Object))

**Preconditions:** AT(Buyer, Loc(Seller)), OWNS(Buyer, Money), OWNS(Seller, Object)

**Effects:** ¬OWNS(Buyer, Money), ¬OWNS(Seller, Object), OWNS(Buyer, Object), OWNS(Seller, Money)

**Decomposition:** GIVE(Buyer, Seller, Money), GIVE(Seller, Buyer, Object)
**Scripts [Schank & Abelson]**

- Prepackaged chain of causal relations between events and states that encodes expectations.
- Don’t have to generate expectations from first principles using causality reasoning.
- Knowledge structure that encodes stereotypical sequences of events.

*John was hungry. He went into Schneider’s and ordered a pastrami sandwich. It was served to him quickly. He left the server a large tip.*

---

**$RESTAURANT$ Script**

**Roles:** Customer(S), Server(W), Cook(C), Cashier(M), Food(F)

**Props:** Table, Utensils, etc.

**Constraints:** HUMAN(S), HUMAN(W), etc.

**Preconditions:** HAS-MONEY(S)

**Effects:**

- HAS-LESS-MONEY(S), HAS-MORE-MONEY(M),
- ¬HUNGRY(S), ¬PLEASED(S)

---

**Decomposition (Conceptual Dependency form):**

1. **Enter:** S PTRANS S into Restaurant; S ATTEND Eyes to Tables; S MBUILD where to sit; S PTRANS S to Table; S MOVE S to sitting position.
2. **Order:** S MTRANS food-order to W (main)
3. **Eat:** S INGEST X (main)
4. **Exit:** S ATRANS money to M (main)

---

**Using Scripts to Understand a Story**

Assume: script $S$, consisting of events $e_1, e_2, \ldots$

For each sentence, $s$ in text:

1. Parse $s$ into its propositional CD form.
2. While event, $e$, in list of script events:
   
   (a) If $s$ matches $e$,
      
      i. Instantiate $e$ with current script roles.
      
      ii. Instantiate all intervening events, $i$, with current script roles.
   
   (b) Else move pointer to next event, saving $e$ in $i$.

Output is instantiated script.
Problems with Scripts

1. Script selection
2. Managing multiple scripts
3. Aborting scripts
   * John went to Schneider’s. He left.
4. Allowing for optional paths through scripts
   * John was pick-pocketed on the way to restaurant.
5. Knowledge engineering requirements

Novel Situations

* John was hungry. He took out some ground beef.

* John was hungry. He took out the Yellow Pages.

* John needed money for the mortgage payment. He called his sister.

* John needed money for the mortgage payment. He got a gun.