Psych 156A/ Ling 150: Acquisition of Language II

5/3/2012
Midterm Review

Marr’s 3 Levels
Any problem can be decomposed into 3 levels:
Computational level
  What’s the problem to be solved?
Algorithmic level
  What (abstract) set of rules solves the problem?
Implementational level
  How are those rules physically implemented?

Computational Level
Abstract Problem:
  How do we regulate traffic at an intersection?
Goal:
  Direct lanes of traffic to avoid congestion/accidents

Algorithmic Level
What kind of rules can we use?
  Let Lane go whenever X cars are waiting?
  Let Lane go every X minutes?
  Let 1 car at a time go through the intersection?
  Make one direction always yield to the other?
Implementational Level
How do we physically implement the rule?
- Set up a stop light
- Set up a blinking stop light
- Put up a stop sign
- Have someone direct traffic
- Put up nothing and have drivers implement the rules themselves!

Transitional Probability
TP(AB) = P(AB|A) = # of times you saw AB / # of times you saw A
- ka/ko/si
- ko/li/je
- ja/ko
- li/je/vo

TP(ko/si) = # of times ko/si / # of times ko
TP(ja/vo) = # of times ja/vo / # of times ja

TP Minima
TP can be though of like a tide
Every time the TP is at “low tide” we put a boundary

Precision & Recall
I wonder how well I can segment this sentence today
Iwonder how well Ican seg ment this sen tencetoday
Precision & Recall

I wonder how well I can segment this sentence today.

Precision:
\[
\frac{\text{# of correct}}{\text{# guessed}} = \frac{3}{9}
\]

Recall:
\[
\frac{\text{# of correct}}{\text{# true words}} = \frac{3}{10}
\]

Stress-based Segmentation

How WELL can a STRESS based LEARNER SEGment THIS?

If we assume Stress-INITIAL syllables:

How WELL can a STRESS based LEARNER SEGment THIS?

Precision = 3/6
Recall = 3/9

If we assume Stress-FINAL syllables:

How WELL can a STRESS based LEARNER SEGment THIS?

Precision = 0/5
Recall = 0/9
Bayesian Learning

All (statistical) learning is a form of **inference**

We have data...
But which hypothesis is true?

\[ P(H|D) \]

\[ P(H|D) = \frac{P(D|H) \cdot P(H)}{P(D)} \]

likelihood prior prob. of data

Cross-Situational Learning

Use information across trials to identify a word/meaning mapping

Scene 1:  "dugme"  "lutka"  "prozor"
Object 1  Object 2  Object 3

Scene 2:  "lutka"  "zid"   "prozor"
Object 1  Object 3  Object 4

\[ P(H|D) = \frac{P(D|H) \cdot P(H)}{P(D)} \]

Posterior = likelihood * prior / prob. of data

Given a picture of a beagle:

\[ P(data|H3) = \frac{1}{\# \text{ of beagles}} \]

\[ > P(data|H2) = \frac{1}{\# \text{ of dogs}} \]

\[ > P(data|H1) = \frac{1}{\# \text{ of mammals}} \]
Contrastive Sounds

A pair of sounds are contrastive if:
Switching the sounds changes the MEANING

In English:
“food”: [f u d] ← Contrastive
“rude”: [r u d]

In German:
“street”: [s t R a s o] ← Not contrastive
“street”: [s t r a s o]

Learning Sounds

Maintenance & Loss Theory:
If you use a distinction in your language
Keep it
If you don’t use it
Ignore the distinction

Functional Reorganization:
Create a filter between acoustics and phonemes
If you hear a language sound
Impose filter to ignore non-native distinctions
If you hear a non-language sound
Don’t impose the filter

Sound Identification

Sound Discrimination

Figure 11.1. Test of the categorical perception of low and high by Americans and Japanese adults. American listeners show the characteristic peak in discrimination of the phoneme boundary, Japanese listeners do not. (From Miyake et al., 1991)