Administriva

• Did people manage to install PAPPI?
  – (see instructions from last Thursday)
The Puzzle of Language

• Language is a complex system
  – in terms of shades of meaning
  – in terms of the syntax
  – in terms of what is allowed and what is not

• Language is part of a generative system
  – you can compose constructions and create new sentences
  – people can have razor-sharp judgments about data they have never encountered before
  – not just in terms of grammaticality/ungrammaticality
  – but also in terms of semantic interpretation
The Puzzle of Language

• Compositionality of constructions
  • active: The militia arrested John
    – passive: John was arrested
      • simple: John is sad
    – raising: John seems to be sad
    – raising+passive: John seems to have been arrested
    – *passive+raising: John was seemed to be arrested
  • Note:
    – * indicates ungrammaticality (judgments are relative)
The Puzzle of Language

• What’s allowed and what’s not
  – subject relative clause: the man that knows me
    \((is\ not\ a\ liar)\)
  – object relative clause: the man that I know ...

• Omission of the relative pronoun
  – subject relative clause: *the man knows me \((is\ not\ a\ liar)\)
  – object relative clause: the man I know ...

• Why?
The Puzzle of Language

- (The King’s English: Fowler 1908)
  - The omission of the relative in isolated clauses (as opposed to coordinates) is a question not of correctness but of taste, so far as there is any question at all. [...] 
  - The omission of a defining relative subject is often effective in verse, but in prose is either an archaism or a provincialism. It may, moreover, result in obscurity ...
    - Now it would be some fresh insect won its way to a temporary fatal new development. H. G. Wells.
  - But when the defining relative is object, or has a preposition, there is no limit to the omission ...
The Puzzle of Language

• 2nd language learners of English worry about these rules a lot

– This is the student did it
  – ‘zero’-subject relatives common in Hong Kong English (Gisborne 2000)
The Puzzle of Language

• For semantics, we’re not just talking about (famous) sentences like
  – colorless green ideas sleep furiously
    (Chomsky 1957)

• but also many sentences for which we take the rules of interpretation for granted
  – suggests we’re operating with rules or principles which we’re not conscious or aware of
An Example

• Consider the \textit{wh}-question:
  – Which report did you file without reading?
An Example

• The *wh*-question:
  – Which report did you file without reading?

• is actually a pretty complicated sentence for a computer program to deal with

• let’s look at one problem for interpretation: **gaps**
  – *file* is a verb, there is a *filer* and *something* being filed
  – the *thing* being *filed* is the *report* in question
An Example

• Consider the *wh*-question:
  – Which report did you file without reading?

• Also
  – *read* is a verb, there is a *reader* and *something* being read
  – the *reader* must be the same person referred to by the pronoun *you*
  – the *thing* being *read* must be the same thing being *filed*, which must be the *report* in question

• there are no other possible interpretations (in this case)
An Example

• Consider the *wh*-question:
  – Which report did you file without reading?

• **there are no other possible interpretations (in this case)**

• meaning for example that:
  – we cannot be asking about some report that you filed but someone else read
An Example

– Which report did you file without reading?

• So only interpretation is:
  – Which report did you file [the report] without [you] reading [the report]?

• Can be viewed as a form of “compression”: 
  – Which report did you file [the report] without [you] reading [the report]?
  – there is an understanding between speaker and hearer that the hearer can decode and recover the missing bits because they share the same “grammar”
An Example

– Which report did you file without reading?

• So only interpretation is:
  – Which report did you file [the report] without [you] reading [the report]?

• A computer program has to know the rules of gap filling
  – (for this so-called parasitic gap sentence)
  – What are the rules of gap filling?
  – Were you taught these rules in school?
  – Can you find them in a grammar book?
An Example

• Rules of gap filling
  – Which report did you file without reading?
  – *Which book did you file the report without reading
  – *The report was filed without reading
  – *The report was filed after Bill read
  – These papers are easy to file without reading
  – This book is not worth reading without attempting to analyze deeply

• Can you come up with the right rules?
The “Rules”

• What do the rules look like?
• Are we sure we covered all the cases?
• How about
  – *Who left without insulting?*
  – Who left without insulting John?
• Debate:
  – How come “everyone” acquired the same rules?
  – Are these rules innate knowledge or learnt?
The “Rules”

- *How is the knowledge of language acquired?*
- From (Chomsky 1986)
- Standard belief 30+ years ago
  - language acquisition is a case of “overlearning”
  - language is a habit system assumed to be overdetermined by available evidence
- Plato’s Problem
  - the problem of “poverty of stimulus”
  - accounting for the richness, complexity and specificity of shared knowledge given the limitations of the data available
  - poverty of evidence
The “Rules”

• Idea then that
  – we’re pre-wired to learn language
  – data like the sentences we’ve been looking at are (in part) determined by the architecture and machinery of the language faculty
  – we’re not acquiring these rules from scratch
  – the pre-wiring is part of our genetic endowment
  – reasonable to assume what is pre-wired must be universal
  – if so, the pre-wiring must be flexible enough to account for language variation
  – yet reduce the learning burden
The “Rules”

**Minimalist Program (MP)**
- current linguistic technology (*research area*)
- language is a computational system
- even fewer mechanisms

**Principles-and-Parameters Framework (GB)**
- reduction of construction rules to
  - fundamental principles (the atoms of theory)
  - explanatory adequacy
- we’ll be using such a system for homework 1

**Rule-based systems**
- *construction-based*
- monostratal, e.g. context-free grammars
- multiple levels, e.g. transformational grammars
Discussion
Interesting things to Google

• Example:
  – colorless green ideas sleep furiously

• First hit:

```
Colorless green ideas sleep furiously
Chomsky's famous sentence 'Colorless green ideas sleep furiously' is examined and is shown to be a specimen of irony rather being meaningless.
home.tiac.net/~cri/1997/chomsky.html - 4k - Cached - Similar pages
```
Interesting things to Google

• Example:
  – colorless green ideas sleep furiously

• First hit:
  – A green idea is, according to well established usage of the word "green" is one that is an idea that is new and untried.
  – Again, a colorless idea is one without vividness, dull and unexciting.
  – So it follows that a colorless green idea is a new, untried idea that is without vividness, dull and unexciting.
  – To sleep is, among other things, is to be in a state of dormancy or inactivity, or in a state of unconsciousness.
  – To sleep furiously may seem a puzzling turn of phrase but one reflects that the mind in sleep often indeed moves furiously with ideas and images flickering in and out.
Interesting things to Google

• Example:
  – colorless green ideas sleep furiously

• Another hit: (a story)
  – "So this is our ranking system," said Chomsky. "As you can see, the highest rank is yellow."
  – "And the new ideas?"
  – "The green ones? Oh, the green ones don't get a color until they've had some seasoning. These ones, anyway, are still too angry. Even when they're asleep, they're furious. We've had to kick them out of the dormitories - they're just unmanageable."
  – "So where are they?"
  – "Look," said Chomsky, and pointed out of the window. There below, on the lawn, the colorless green ideas slept, furiously.
Interesting things to Google

• Examples:
  – (1) colorless green ideas sleep furiously
  – (2) furiously sleep ideas green colorless

• Chomsky (1957):
  – . . . It is fair to assume that neither sentence (1) nor (2) (nor indeed any part of these sentences) has ever occurred in an English discourse. Hence, **in any statistical model for grammaticalness**, these sentences will be ruled out on identical grounds as equally `remote' from English. Yet (1), though nonsensical, is grammatical, while (2) is not.

• Statistical Experiment (Pereira 2002)
Interesting things to Google

• Examples:
  – (1) colorless green ideas sleep furiously
  – (2) furiously sleep ideas green colorless

• Statistical Experiment (Pereira 2002)

\[ p(w_1 \cdots w_n) = p(w_1) \prod_{i=2}^{n} p(w_i|w_{i-1}) \, . \]

Using this estimate for the probability of a string and an aggregate model with \( C = 16 \) trained on newspaper text using the expectation-maximization (EM) method (Dempster, Laird, & Rubin, 1977), we find that

\[ \frac{p(\text{Colorless green ideas sleep furiously})}{p(\text{Furiously sleep ideas green colorless})} \approx 2 \times 10^5 \, . \]

Thus, a suitably constrained statistical model, even a very simple one, can meet Chomsky’s particular challenge.