Beyond CFG - What CFGs do not capture
What CFGs do not capture

- Last class, we talked about the “over-generation” problem of CFG
- Today, we will think about the “incorrect analysis” of natural language when using plain CFG

- Non-projective dependencies
- Non-local dependencies
- Interpreting missing/displaced constituent
Plan for the Talk

• What CFGs do not capture

• Non-projective dependencies
  • Non-local dependencies
  • Interpreting missing/displaced constituent
Non Projective Dependencies

- Projective dependencies: when the tree edges are drawn directly on a sentence, it forms a tree (without a cycle), and there is no crossing edge.

- Projective Dependency:
- Eg:

Example taken from Mcdonald and Satta (2007)
Non Projective Dependencies

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- Non-projective dependency:

Eg:

Example taken from Mcdonald and Satta (2007)
Exercise

- which word does “on the issue” modify?
  - We scheduled a meeting on the issue today.
  - A meeting is scheduled on the issue today.

1. Use Stanford Parser to draw parse trees
   http://nlp.stanford.edu:8080/parser/index.jsp
2. Do they seem correct? If not, draw correct structure
3. Draw the structure directly on a sentence, and determine projectivity/non-projectivity
Plan for the Talk

- What CFGs do not capture
  - Non-projective dependencies
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Local Dependencies

- Local dependencies generally cover the following two:

1. Arguments relations
   - subjects, objects, complements...

2. Adjuncts/Modifiers
   - adjectives modify nouns
   - adverbs modify verbs or adjectives
   - PPs modify NPs or VPs
Long-range Dependencies

- Most argument relations are local, but some are long-range
- Bounded long-range dependencies
- Unbounded long-range dependencies
Bounded Long-range Dependencies

What is the subject argument of “sleep”?

- Raising:
  - He *seems* to *sleep* in NLP class.
    -- you cannot say “what does he seem?”

- Control (subject-object):
  - He *likes* to *sleep* in NLP class.
    -- you can say “what does he like?”
  - He *promises* her not to *sleep* in NLP class.
  - She *persuades* him not to *sleep* in NLP class.

Example taken from Julia Hockenmaier
Bounded Long-range Dependencies

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• Control (subject-object):
  • He likes to sleep in NLP class.
    -- you can say “what does he like?”
  • He promises her not to sleep in NLP class.
  • She persuades him not to sleep in NLP class.

Example taken from Julia Hockenmaier
Unbounded Long-range Dependencies

-- 1. Extraction

What is the object argument of “like”?

- **Wh-movement**
  - the guy that [I believe Peter told me you thought] you like.
  - who do [you believe Peter told you I thought] I like?

- **Topicalization:**
  - That guy, [I believe Peter told me you thought] you like.

- **Clefts:**
  - It’s that guy that [I believe Peter told me you thought] you like.

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Example taken from Julia Hockenmaier
Unbounded Long-range Dependencies
-- 2. Coordination (and, or)

What is the object argument of the verb highlighted in red?

• Right-node raising:
  • [[She bought] and [he ate]] bananas.

• Argument-cluster coordination:
  • I give [[you an apple] and [him a pear]].

• Gapping:
  • She likes sushi, and he sashimi

Example taken from Julia Hockenmaier
More on Coordination (Exercise)

What is the difference among the following examples?

- She bought and ate bananas.
- She bought bananas and apples.
- She bought bananas and he ate apples.
- She bought and he ate bananas.
- I give you an apple and him a pear.
More on Coordination

What is the difference among the following examples?

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→ Coordination of non-constituents is challenging!
Unbounded Long-range Dependencies
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Plan for the Talk

• What CFGs do not capture
  • Non-projective dependencies
  • Non-local dependencies
  ➔ Interpreting missing/displaced constituent
Transformational Grammar

- When using CFG analysis, some constituent seem to be displaced or missing.

- Passive:
  - “The homework was eaten.”
  - No NP object, even though “eat” usually requires one.

- Question:
  - “What did my horse eat?”
  - The object of “eat” precedes the subject.

- Elliptical constructions:
  - “I will submit my homework, if I can _____.”
Transformational Grammar

- Transformational Grammar considers “a sequence of” parse trees for each sentence.
- The first parse tree is called as “deep structure”.
- The actual parse tree for the observed sentence is called as “surface structure”.

- Deep structure has all the displaced or missing constituents in their canonical locations.
- Semantic relations (thematic roles) are more transparent at deep structure. The observed sentence is called as “surface structure”.

- “transformation rules” permute, delete, and insert elements in trees, arriving at the observed sentence.
Examples of Transformation

- Passive:
  - Deep: “(My horse) ate the homework.”
  - Surface: “The homework was eaten.”

- Question:
  - Deep: “My horse ate what”
    => what my horse ate
    => what did my horse ate
  - Surface: “What did my horse eat?”

- Elliptical constructions:
  - Deep: “I will submit my homework, if I can submit my homework.”
  - Surface: “I will submit my homework, if I can _____.”
Final Quiz

- Give a new example of a sentence with non-projective dependency

- Give a new example of a sentence with non-constituent coordination.