Beyond CFG - What CFGs do not capture

What CFGs do not capture

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

- Non-projective dependencies
- Non-local dependencies
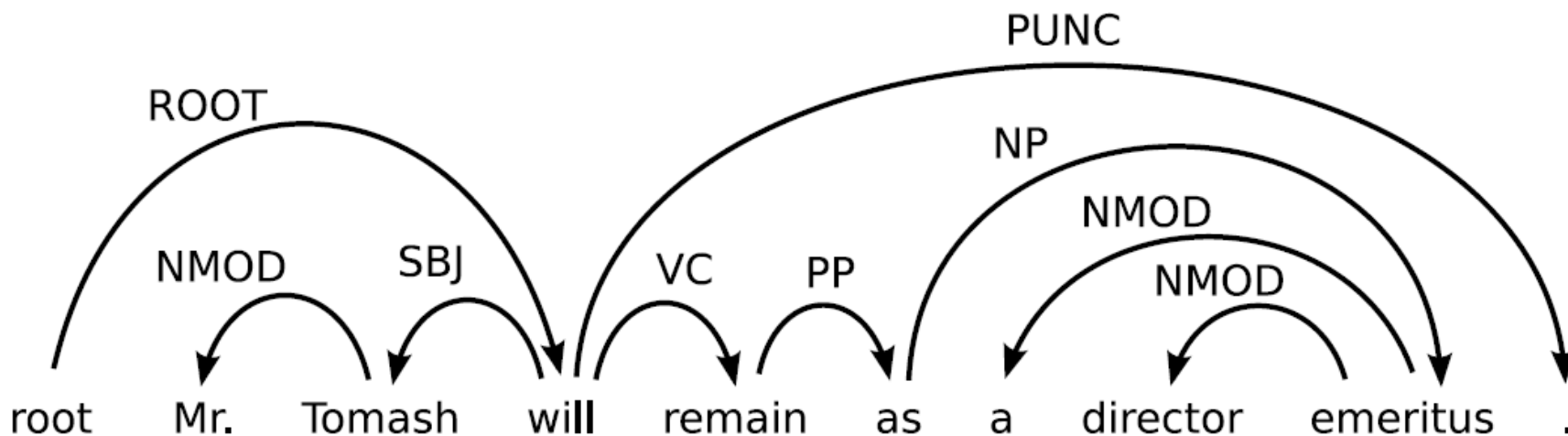- Interpreting missing/displaced constituent

Plan for the Talk

- What CFGs do not capture

- ➡ Non-projective dependencies
- Non-local dependencies
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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.
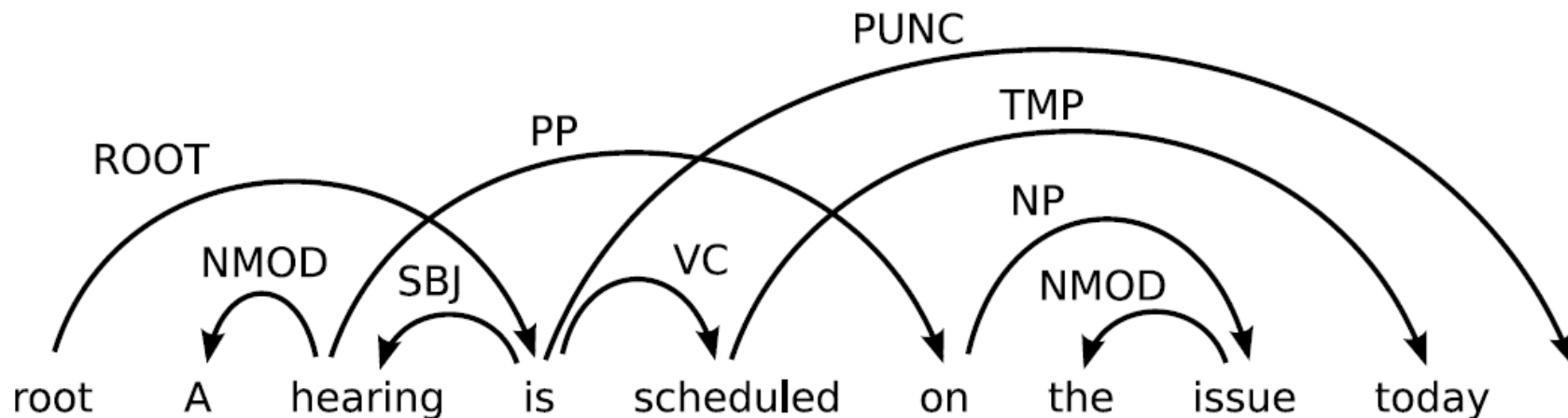
- Projective Dependency:
- Eg:

Example taken from Mcdonald and Satta (2007)

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- Non-projective dependency:

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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

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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 <u>seems</u> to sleep in NLP class.
    -- you cannot say "what does he seem?"

- Control (subject-object):
  - He <u>likes</u> to sleep in NLP class.
    -- you can say "what does he like?"
  - He <u>promises</u> her not to sleep in NLP class.
  - She <u>persuades</u> him not to sleep in NLP class.

Example taken from Julia Hockenmaier

Bounded Long-range Dependencies

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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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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

More on Coordination (Exercise)

What is the difference among the following examples?

- She bought <u>and</u> ate bananas.
- She bought bananas <u>and</u> apples.
- She bought bananas <u>and</u> he ate apples.

- She bought <u>and</u> he ate bananas.
- I give you an apple <u>and</u> him a pear.

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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.