# Grammar Formalisms

# What is a Grammar Formalism? From Formal Language Theory

- A language
  - A language L is a possibly infinite set of strings.
  - The strings are made from a finite alphabet.
    - The “alphabet” might be the words of English
    - Henceforth, we will call it the “vocabulary”
  - Some strings of language L:
    - Bears live in the forest.
    - Never have I seen such ridiculous beasts.
  - Some strings are not in L:
    - *Never I have seen such ridiculous beasts.
    - *Live bears the in forest.
    - (* means that the string is not a member of the set of strings that comprise the language L.)

# What is a Grammar Formalism?
## From Formal Language Theory

- A Grammar:
  - A set of production rules.
  - In addition to the vocabulary, the production rules can use other symbols
    - N  (noun)
    - V  (verb)
    - NP (noun phrase)
    - VP (verb phrase)
  - One symbol is special:
    - S (sentence)

# What is a grammar formalism? Production Rules

- S → NP VP
- NP → Det  N
- VP → V  NP
- DET → the
- DET → a
- N → boy
- N → girl
- V → saw
- V → sees

These production rules have a non-terminal symbol on the left, then an arrow, then some terminal (from the vocabulary) and non-terminal symbols on the right.

This is one instance of a grammar formalism.

We will see that other grammar formalisms use other types of symbols and production rules.

# What is a grammar formalism? Derivation

- The production rules are interpreted as instructions:
  - Parsing: when you find the string on the right hand side, replace it with the string on the left hand side.
  - Generation: when you find the symbol on the left hand side, replace it with the string on the right hand side.
  - Different grammar formalisms will have different instructions.
- Your job:
  - Generation: get from the special symbol S to a terminal string (only symbols from the vocabulary).
  - Parsing: get from a terminal string to the special symbol S

# What is a grammar formalism? Derivation

- A derivation is the ordered list of production rules that you use to get from the special symbol to the terminal string or vice versa.
- S
- NP VP
- Det N VP
- Det N V NP
- Det N V Det N
- The N V Det N
- The girl V Det N
- The girl sees Det N
- The girl sees a N
- The girl sees a boy

S → NP VP
NP → Det N
VP → V NP
DET → the
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# What is a Grammar Formalism for?

- Distinguish strings that are in the language from those that are not in the language.
  - The girl sees a boy.
  - *Girl the the.
    - No derivation exists using the grammar rules.
- Identify a structure for the sentence.

# Structure

- S
- NP VP
- Det N VP
- Det N V NP
- Det N V Det N
- The N V Det N
- The girl V Det N
- The girl sees Det N
- The girl sees a N
- The girl sees a boy