Natural Language Processing

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Syntax
Syntax

• Syntax is the study of formal relationships between words
• The word syntax comes from the Greek ‘syntaxis’ meaning ‘setting out together or arrangement’
Part of Speech Tagging

• Words are traditionally grouped into equivalence classes called
  – parts of speech
  – word classes
  – morphological classes
  – lexical tags.

• The part of speech for a word gives a significant amount of information about the word and its neighbors.
ADJECTIVE - modifies a noun.
Examples: yellow, pretty, useful
Adjectives have three degrees: Positive, Comparative, and Superlative.

Example: old, older, oldest

ARTICLE - specifies whether the noun is specific or a member of a class.

Examples: a, an, the

ADVERB - modifies a verb or an adjective. Many adverbs have the suffix -ly.

Examples: very, extremely, carefully
English Part of Speech

• CONJUNCTION - joins components of a sentence or phrase.
  Examples: and, but, or

• INTERJECTION - is used for exclamations.
  Examples: Oh!, Aha!

• NOUN - names an object or action. *Common nouns* refer to ordinary things. *Proper nouns* are usually capitalized and refer to persons, specific things or specific places.
  Examples: mouse, fire, Michael
English Part of Speech

• **PREPOSITION** - indicates relationship or relative position of objects.
  Examples: in, about, toward

• **PRONOUN** - is used in place of a noun. *Personal pronouns* are used to refer to persons. *Interrogative pronouns* introduce questions. *Demonstrative pronouns* refer to a previously mentioned object or objects. *Relative pronouns* introduce clauses.
  Examples: he, this

• **VERB** - specifies an action or links the subject to a complement. The tense of a verb indicates the time when the action happened, e.g., past, present, of future.
  Examples: take, is, go, fire
Part of Speech Tagging

- Part-of-speech tagging (or just tagging for short) is the process of assigning a part-of-speech or other lexical class marker to each word in a corpus

  - VB  DT  NN  .
  - Book that flight .
  - VBZ  DT  NN  VB  NN  ?
  - Does that flight serve dinner ?

- *book* is ambiguous. That is, it has more than one possible usage and part of speech
## Degree of ambiguity

<table>
<thead>
<tr>
<th>Unambiguous (1 tag)</th>
<th>35,340</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambiguous (2-7 tags)</td>
<td>4,100</td>
</tr>
<tr>
<td>2 tags</td>
<td>3,760</td>
</tr>
<tr>
<td>3 tags</td>
<td>264</td>
</tr>
<tr>
<td>4 tags</td>
<td>61</td>
</tr>
<tr>
<td>5 tags</td>
<td>12</td>
</tr>
<tr>
<td>6 tags</td>
<td>2</td>
</tr>
<tr>
<td>7 tags</td>
<td>1 (&quot;still&quot;)</td>
</tr>
</tbody>
</table>

**Figure 8.7** The number of word types in Brown corpus by degree of ambiguity (after DeRose (1988)).
## Tag sets for English

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
<th>Example</th>
<th>Tag</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td>Coordin. Conjunction</td>
<td><em>and, but, or</em></td>
<td>SYM</td>
<td>Symbol</td>
<td><em>+, %, &amp;</em></td>
</tr>
<tr>
<td>CD</td>
<td>Cardinal number</td>
<td><em>one, two, three</em></td>
<td>TO</td>
<td>“to”</td>
<td><em>to</em></td>
</tr>
<tr>
<td>DT</td>
<td>Determiner</td>
<td><em>a, the</em></td>
<td>UH</td>
<td>Interjection</td>
<td><em>ah, oops</em></td>
</tr>
<tr>
<td>EX</td>
<td>Existential ‘there’</td>
<td><em>there</em></td>
<td>VB</td>
<td>Verb, base form</td>
<td><em>eat</em></td>
</tr>
<tr>
<td>FW</td>
<td>Foreign word</td>
<td><em>mea culpa</em></td>
<td>VBD</td>
<td>Verb, past tense</td>
<td><em>ate</em></td>
</tr>
<tr>
<td>IN</td>
<td>Preposition/sub-conj</td>
<td><em>of, in, by</em></td>
<td>VBG</td>
<td>Verb, gerund</td>
<td><em>eating</em></td>
</tr>
<tr>
<td>JJ</td>
<td>Adjective</td>
<td><em>yellow</em></td>
<td>VBN</td>
<td>Verb, past participle</td>
<td><em>eaten</em></td>
</tr>
<tr>
<td>JJR</td>
<td>Adj., comparative</td>
<td><em>bigger</em></td>
<td>VBP</td>
<td>Verb, non-3sg pres</td>
<td><em>eat</em></td>
</tr>
<tr>
<td>JJS</td>
<td>Adj., superlative</td>
<td><em>wildest</em></td>
<td>VBZ</td>
<td>Verb, 3sg pres</td>
<td><em>eats</em></td>
</tr>
<tr>
<td>LS</td>
<td>List item marker</td>
<td><em>1, 2, One</em></td>
<td>WDT</td>
<td>Wh-determiner</td>
<td><em>which, that</em></td>
</tr>
<tr>
<td>MD</td>
<td>Modal</td>
<td><em>can, should</em></td>
<td>WP</td>
<td>Wh-pronoun</td>
<td><em>what, who</em></td>
</tr>
<tr>
<td>NN</td>
<td>Noun, sing. or mass</td>
<td><em>llama</em></td>
<td>WPS</td>
<td>Possessive wh-</td>
<td><em>whose</em></td>
</tr>
</tbody>
</table>
# Tag sets for English

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
<th>Example</th>
<th>Tag</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>NNS</td>
<td>Noun, plural</td>
<td><em>llamas</em></td>
<td>WRB</td>
<td>Wh-adverb</td>
<td><em>how, where</em></td>
</tr>
<tr>
<td>NNP</td>
<td>Proper noun, singular</td>
<td><em>IBM</em></td>
<td>$</td>
<td>Dollar sign</td>
<td>$</td>
</tr>
<tr>
<td>NNPS</td>
<td>Proper noun, plural</td>
<td><em>Carolinias</em></td>
<td>#</td>
<td>Pound sign</td>
<td>#</td>
</tr>
<tr>
<td>PDT</td>
<td>Predeterminer</td>
<td><em>all, both</em></td>
<td>“</td>
<td>Left quote</td>
<td>(‘ or “)</td>
</tr>
<tr>
<td>POS</td>
<td>Possessive ending</td>
<td>’s</td>
<td>”</td>
<td>Right quote</td>
<td>(’ or ”)</td>
</tr>
<tr>
<td>PP</td>
<td>Personal pronoun</td>
<td><em>I, you, he</em></td>
<td>(</td>
<td>Left parenthesis</td>
<td>([, (, {, &lt;)</td>
</tr>
<tr>
<td>PP$</td>
<td>Possessive pronoun</td>
<td><em>your, one’s</em></td>
<td>)</td>
<td>Right parenthesis</td>
<td>(], ), }, &gt;)</td>
</tr>
<tr>
<td>RB</td>
<td>Adverb</td>
<td><em>quickly, never</em></td>
<td>,</td>
<td>Comma</td>
<td>,</td>
</tr>
<tr>
<td>RBR</td>
<td>Adverb, comparative</td>
<td><em>faster</em></td>
<td>.</td>
<td>Sentence-final punc</td>
<td>( . ! ?)</td>
</tr>
<tr>
<td>RBS</td>
<td>Adverb, superlative</td>
<td><em>fastest</em></td>
<td>:</td>
<td>Mid-sentence punc</td>
<td>(: ; ... – -)</td>
</tr>
</tbody>
</table>
Sinhala Part of Speech

1. **Noun** - යුතු වේ.
2. **Verb** - පැරණි වේ.
3. **Upasarga** – පිමිත වේ (no direct matching with English grammar)
4. **Nipatha** – ප්‍රමුඛ වේ (no direct matching with English grammar)

<table>
<thead>
<tr>
<th>TAG</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>NNR</td>
<td>Common Noun Root</td>
<td>යුතු, පැරණි, වේ</td>
</tr>
<tr>
<td>NNM</td>
<td>Common Noun Masculine</td>
<td>වේ, මැල වේ, නෝයා වේ</td>
</tr>
<tr>
<td>NNF</td>
<td>Common Noun Feminine</td>
<td>කිජ, අභාලකා වේ</td>
</tr>
<tr>
<td>NNN</td>
<td>Common Noun Neuter</td>
<td>මාලික, අභාලකා වේ</td>
</tr>
<tr>
<td>NNPA</td>
<td>Proper Noun Animate</td>
<td>නාකාලකා වේ</td>
</tr>
<tr>
<td>NNPI</td>
<td>Proper Noun Inanimate</td>
<td>නාකාලකා, නාකාලකා වේ</td>
</tr>
<tr>
<td>PRPM</td>
<td>Pronoun Masculine</td>
<td>මාලික, මාලික, අභාලකා වේ</td>
</tr>
<tr>
<td>PRPF</td>
<td>Pronoun Feminine</td>
<td>නාකාලකා, නාකාලකා වේ</td>
</tr>
<tr>
<td>PRPN</td>
<td>Pronoun Neuter</td>
<td>නාකාලකා, නාකාලකා වේ</td>
</tr>
<tr>
<td>PRPC</td>
<td>Pronoun Common</td>
<td>නාකාලකා, නාකාලකා වේ</td>
</tr>
<tr>
<td>QFNUM</td>
<td>Number Quantifier</td>
<td>පදි, රංජන, පොදු, පොදු</td>
</tr>
<tr>
<td>DET</td>
<td>Determiner</td>
<td>යුතු, පැරණි, වේ, නෝයා වේ, වේ, නෝයා වේ</td>
</tr>
<tr>
<td>JJ</td>
<td>Adjective</td>
<td>මැල වේ, යුතු වේ</td>
</tr>
<tr>
<td>RB</td>
<td>Adverb</td>
<td>යුතු, යුතු වේ</td>
</tr>
<tr>
<td>RP</td>
<td>Particle</td>
<td>යුතු, යුතු, වේ, යුතු වේ, යුතු වේ</td>
</tr>
</tbody>
</table>

- **VFM** Verb Finite Main යුතු, වේ
- **VNF** Verb Non Finite යුතු, වේ, යුතු, වේ, යුතු
- **VP1** Verb Partciple 1 යුතු, වේ, වේ
- **VP2** Verb Participle 2 යුතු, වේ, වේ
- **VP3** Verb Participle 3 යුතු, වේ, වේ
- **VP4** Verb Participle 4 යුතු, වේ, වේ, වේ
- **VNN** Verbal Non Finite Noun යුතු, වේ, වේ, වේ
- **POST** Postpositions යුතු, වේ, වේ
- **CC** Conjunctions යුතු, වේ, වේ, වේ
- **NVB** Noun in Kriya Mula යුතු, වේ, වේ, වේ, වේ, වේ
- **JVB** Adjective in Kriya Mula යුතු, වේ, වේ, වේ, වේ, වේ
- **UH** Interjection යුතු, වේ, වේ, වේ
- **FRW** Foreign Word Computer
- **SYM** Not Classified A4

3/28/2020 Budditha Hettige (budditha@yahoo.com) 12
Tagging algorithms

- **Rule-based taggers** and **Stochastic taggers**.
- **Rule-based taggers** generally involve a large database of hand-written disambiguation rules which specify
  - **ENGTWOL**
- **Stochastic taggers** generally resolve tagging ambiguities by using a training corpus to compute the probability of a
  - **HMM tagger**
Rule based Tagging

• earliest algorithms for automatically assigning part-of-speech were based on a two-stage architecture

• The first stage used a dictionary to assign each word a list of potential parts of speech

• The second stage used large lists of hand-written disambiguation rules to winnow down this list to a single part-of-speech for each word.

• The ENGTWOL tagger is based on the same two stage architecture
<table>
<thead>
<tr>
<th>Word</th>
<th>POS</th>
<th>Additional POS features</th>
</tr>
</thead>
<tbody>
<tr>
<td>smaller</td>
<td>ADJ</td>
<td>COMPARATIVE</td>
</tr>
<tr>
<td>entire</td>
<td>ADJ</td>
<td>ABSOLUTE ATTRIBUTIVE</td>
</tr>
<tr>
<td>fast</td>
<td>ADV</td>
<td>SUPERLATIVE</td>
</tr>
<tr>
<td>that</td>
<td>DET</td>
<td>CENTRAL DEMONSTRATIVE SG</td>
</tr>
<tr>
<td>all</td>
<td>DET</td>
<td>PREDETERMINER SG/PL QUANTIFIER</td>
</tr>
<tr>
<td>dog’s</td>
<td>N</td>
<td>GENITIVE SG</td>
</tr>
<tr>
<td>furniture</td>
<td>N</td>
<td>NOMINATIVE SG NOINDEFDETERMINER</td>
</tr>
<tr>
<td>one-third</td>
<td>NUM</td>
<td>SG</td>
</tr>
<tr>
<td>she</td>
<td>PRON</td>
<td>PERSONAL FEMININE NOMINATIVE SG3</td>
</tr>
<tr>
<td>show</td>
<td>V</td>
<td>IMPERATIVE VFIN</td>
</tr>
<tr>
<td>show</td>
<td>V</td>
<td>PRESENT -SG3 VFIN</td>
</tr>
<tr>
<td>show</td>
<td>N</td>
<td>NOMINATIVE SG</td>
</tr>
<tr>
<td>shown</td>
<td>PCP2</td>
<td>SVOO SVO SV</td>
</tr>
<tr>
<td>occurred</td>
<td>PCP2</td>
<td>SV</td>
</tr>
<tr>
<td>occurred</td>
<td>V</td>
<td>PAST VFIN SV</td>
</tr>
</tbody>
</table>
Transformation-Based Tagging

• TBL is based on rules that specify what tags should be assigned to what words
• TBL is a machine learning technique, in which rules are automatically induced from the data.
• TBL is a supervised learning technique; it assumes a pre-tagged training corpus
Other Issues

• Multiple tags and multiple words
• **Tag indeterminacy** arises when a word is ambiguous between multiple tags and it is impossible or very difficult to disambiguate.
  – Some taggers allow the use of multiple tags
• The second issue concerns **multi-part words**
  – allow prepositions like ‘*in terms of*’ to be treated as a single word by adding numbers to each tag
• **Unknown words**
Context-free grammar
Constituency

• The fundamental idea of constituency is that groups of words may be constituent have as a single unit or phrase, called a constituent

• Example
  – noun phrase often acts as a unit

• Context-free grammars allow us to model these constituency facts
preposed or postposed constructions

On September seventeenth, I’d like to fly from Atlanta to Denver
I’d like to fly on September seventeenth from Atlanta to Denver
I’d like to fly from Atlanta to Denver on September seventeenth

But again, while the entire phrase can be placed differently, the individual words making up the phrase cannot be:

*On September, I’d like to fly seventeenth from Atlanta to Denver
*On I’d like to fly September seventeenth from Atlanta to Denver
*I’d like to fly on September from Atlanta to Denver seventeenth
English Noun Phrase

\[
\text{<noun phrase> =}
\begin{array}{l}
"\text{the}" \text{ <specific proper noun> | }\\
\text{<proper noun> | }
\text{<non-personal pronoun> |}
\text{<article> [<adverb>* <adjective>] <noun> | }
\text{[<adverb>* <adjective>] <noun-plural> |}
\text{<proper noun-possessive> [<adverb>* <adjective>] <noun> |}
\text{<personal possessive adjective> [<adverb>* <adjective>] <noun> |}
\text{<article> <common noun-possessive> }
\text{[<adverb>* <adjective>] <noun>}
\end{array}
\]

"\text{the}" <specific proper noun>
the Atlantic Ocean
the Sahara

<proper noun>
John
America
Dr. Allen
State Street

<non-personal pronoun>
someone
anyone
this

<article> [<adverb>* <adjective>] <noun>
a very long bridge
the book
the extremely pretty dress

[<adverb>* <adjective>] <noun-plural>
very yellow flowers
books
Context-Free Grammar

- Most commonly used mathematical system for modeling constituent structure
- Phrase-Structure Grammar

\[\begin{align*}
S & \rightarrow \text{NP VP} \\
\text{NP} & \rightarrow \text{ART NOUN} \\
\text{NP} & \rightarrow \text{NP PP} \\
\text{PP} & \rightarrow \text{P NP} \\
\text{VP} & \rightarrow \text{VERB NP} \\
\text{VP} & \rightarrow \text{VERB NP PP} \\
\text{ART} & \rightarrow \text{the} \\
\text{ART} & \rightarrow \text{a} \\
\text{NOUN} & \rightarrow \text{telescope} \\
\text{NOUN} & \rightarrow \text{man} \\
\text{NOUN} & \rightarrow \text{spider} \\
\text{VERB} & \rightarrow \text{saw} \\
\text{VERB} & \rightarrow \text{complimented} \\
\text{P} & \rightarrow \text{with} \\
\text{P} & \rightarrow \text{in}
\end{align*}\]
Context-free grammar

• Consists of a set of rules or productions
• Context free rules can be hierarchically embedded
• Symbols that correspond to words in the language (‘the’, ‘nightclub’) are called terminal symbols
• The symbols that express clusters or generalizations of these are called nonterminals
• In each context-free rule, the item to the right of the arrow (→) is an ordered list of one or more terminals and nonterminals
String a flight can be derived from the nonterminal NP

Sequence of rule expansions is called a derivation of the string of words

Represent a derivation by a parse tree

Bracketed notation is another way to represent a parse tree

\[
\begin{align*}
NP & \rightarrow \text{Det Nominal} \\
NP & \rightarrow \text{ProperNoun} \\
\text{Nominal} & \rightarrow \text{Noun} \mid \text{Noun Nominal} \\
\text{Det} & \rightarrow a \\
\text{Det} & \rightarrow \text{the} \\
\text{Noun} & \rightarrow \text{flight}
\end{align*}
\]
A more formal definition

- A CFG is a 4-tuple \(<N, \Sigma, P, S>\) consisting of
  
  - a set of non-terminal symbols \(N\)
  - a set of terminal symbols \(\Sigma\)
  - a set of productions \(P\)
    - \(A \rightarrow \alpha\)
    - \(A\) is a non-terminal
    - \(\alpha\) is a string of symbols from the infinite set of strings \((\Sigma \cup N)^*\)
  - a designated start symbol \(S\)
What context free means

All the use of the term context-free really means is that the non-terminal on the left-hand side of the rule is sitting over there all by itself.

A → B C

In other words, I can rewrite A as BC, regardless of the context in which I find the A.
An example lexicon

<table>
<thead>
<tr>
<th>Noun</th>
<th>flights</th>
<th>breeze</th>
<th>trip</th>
<th>morning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verb</td>
<td>is</td>
<td>prefer</td>
<td>like</td>
<td>need</td>
</tr>
<tr>
<td>Adjective</td>
<td>cheapest</td>
<td>non-stop</td>
<td>first</td>
<td>latest</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>other</td>
</tr>
<tr>
<td>Pronoun</td>
<td>me</td>
<td>I</td>
<td>you</td>
<td>it</td>
</tr>
<tr>
<td>Proper-Noun</td>
<td>Alaska</td>
<td>Baltimore</td>
<td>Los Angeles</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chicago</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Determiner</td>
<td>the</td>
<td>a</td>
<td>an</td>
<td>this</td>
</tr>
<tr>
<td>Preposition</td>
<td>from</td>
<td>to</td>
<td>on</td>
<td>near</td>
</tr>
<tr>
<td>Conjunction</td>
<td>and</td>
<td>or</td>
<td>but</td>
<td></td>
</tr>
</tbody>
</table>
An example grammar

\[
S \rightarrow NP\ VP \quad \text{I + want a morning flight}
\]

\[
NP \rightarrow \begin{align*}
\text{Pronoun} & \quad \text{I} \\
\text{Proper-Noun} & \quad \text{Los Angeles} \\
\text{Det Nominal} & \quad \text{a + flight}
\end{align*}
\]

Nominal \rightarrow \begin{align*}
\text{Noun Nominal} & \quad \text{morning + flight} \\
\text{Noun} & \quad \text{flights}
\end{align*}

\[
VP \rightarrow \begin{align*}
\text{Verb} & \quad \text{do} \\
\text{Verb NP} & \quad \text{want + a flight} \\
\text{Verb NP PP} & \quad \text{leave + Boston + in the morning} \\
\text{Verb PP} & \quad \text{leaving + on Thursday}
\end{align*}
\]

\[
PP \rightarrow \begin{align*}
\text{Preposition NP} & \quad \text{from + Los Angeles}
\end{align*}
\]
A simple parse tree

```
( S
  (NP)
    (Pro) I
    (Verb) prefer
    (Det) a
    (Noun) morning
    (NP)
      (Nom)
        (Noun) flight
  (VP)
    (NP)
      (Nom)
```

I prefer a morning flight.
Sentence-level Constructions

• Consistency we will continue to focus on sentences

<English Sentence> = 
  <Simple Sentence> | 
  <Compound Sentence>

<Simple Sentence> = 
  <Declarative Sentence> | 
  <Interrogative Sentence> | 
  <Imperative Sentence> | 
  <Conditional Sentence>

<Compound Sentence> = 
  <Simple Sentence> <conjunction> <Simple Sentence> | 
  "Either" <Declarative Sentence> "or" <Declarative Sentence> 
  "Either" <Imperative Sentence> "or" <Imperative Sentence>
Basic types of sentences

Declaratives

- John left.
- S → NP VP

Imperatives

- Leave!
- S → VP

Yes-No Questions

- Did John leave?
- S → Aux NP VP

WH Questions (who, where, what, which, why, how)

- When did John leave?
- S → Wh-NP Aux NP VP
- S → Wh-NP VP
Recursion

• Nominal $\rightarrow$ Nominal PP (PP) (PP)
  – Is an example of RECURSIVE rule

• Other examples:
  – NP $\rightarrow$ NP PP
  – VP $\rightarrow$ VP PP

• Recursion a powerful device, but could have bad consequences (see lectures on parsing)
Recursion and VP attachment

- Flights to Miami
- Flights to Miami from Boston
- Flights to Miami from Boston in April
- Flights to Miami from Boston in April on Friday
- Flights to Miami from Boston in April on Friday with lunch.
Coordination

- NP → NP and NP
  - John and Mary left
- VP → VP and VP
  - John talks softly and carries a big stick
- S → S and / but / S
  - Kim is a lawyer but Sandy is reading medicine.
- In fact, probably English has a
  - XP → XP and XP rule
<noun phrase> =
  "the" <specific proper noun> | 
  <proper noun>   | 
  <non-personal pronoun> | 
  <article> [<adverb>* <adjective>] <noun> | 
  [<adverb>* <adjective>] <noun-plural> | 
  <proper noun-possessive> [<adverb>* <adjective>] <noun> | 
  <personal possessive adjective> [<adverb>* <adjective>] <noun> | 
  <article> <common noun-possessive> 
           [<adverb>* <adjective>] <noun>
Write suitable CFG for English VP

<verb> = <V1s> | <V2s> | <V3s> |<Vlp> | <V2p> | <V3p> |<Vpast> | <linking verb>

<linking verb> = "am" | "are" | "is" | "was" | "were" | "look" | "looks" | "looked" | "become" | "became" | "become" | ...

<verb phrase> =
   ("had" | "have" | "has") ["not"] <Vpastp> |
   ("had" | "have" | "has") ["not"] "been" [<Vpastp> | <Ving>] |
   <auxV> ["not"] "have" <Vpastp> |
   <auxV> ["not"] "have" "been" [<Vpastp> | <Ving>] |
   <auxV> ["not"] "be" [<Vpastp> | <Ving>] |
   <auxV> ["not"] <Vinf> |
   "ought" ("to" | "not") <Vinf> |
   "ought" ("to" | "not") "be" [<Vpastp> | <Ving>] |
   "ought" ("to" | "not") "have" <Vpastp> |
   "ought" ("to" | "not") "have" "been" [<Vpastp> | <Ving>] |
   ("do" | "does" | "did") ["not"] [<Vinf>] |
   ("am" | "are" | "is" | "was" | "were") ["not"] [<Vpastp> | <Ving>] |
   ("am" | "are" | "is" | "was" | "were") ["not"] "being" [<Vpastp>] |
   ("am" | "are" | "is" | "was" | "were") ["not"] "going" "to" [<Vinf>]