

# Homework 2

Haukur Páll Jónsson  
NLP 2017

November 21, 2017

**Question 1.** Chomsky Normal Form (CNF)

**Answer a):** The converted grammar is:

$S \rightarrow NP VP$

$S \rightarrow I\_VP PP$ . We make the rule binary

$I\_VP \rightarrow I VP$

$I \rightarrow i$ . When we make terminal symbols we do not make non-terminal symbols

$NP \rightarrow Det N$

$VP \rightarrow V NP$ . We use the fact that  $V \rightarrow ate$  instead of creating a new rule which does exactly the same

$VP \rightarrow ate$ . We eliminate unit rules

$PP \rightarrow Pre NP$

$V \rightarrow ate$

$Det \rightarrow the \mid a$

$N \rightarrow fork \mid salad$

$Pre \rightarrow with$

**Question 2.** PCFGs and the CYK algorithm

**Answer a):** For any given parse, we compute the probability of that parse by;  $p(rule) * p(element\ of\ rule) * p(element\ of\ rule)$  Lets start with the cell marked B:

$VP \rightarrow V Obj Obj$ , we get:  $0.3 * 0.6 * 0.2 * 0.175 = 0.0063$

$VP \rightarrow V Obj$ , we get:  $0.5 * 0.6 * 0.175 = 0.0525$

$VP \rightarrow V small$ , we get:  $0.2 * 0.6 * 0.08 = 0.0096$

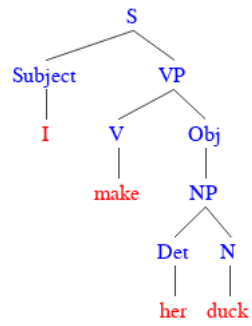
For the cell marked A we essentially get all of the probabilities of B times 0.3:

$S \rightarrow Subj VP$ , we get:  $1.0 * 0.3 * 0.0063 = 0.00189$

$S \rightarrow Subj VP$ , we get:  $1.0 * 0.3 * 0.0525 = 0.01575$

$S \rightarrow Subj VP$ , we get:  $1.0 * 0.3 * 0.0096 = 0.00288$

**Answer b):** The most probable parse:



**Question 3.** Dependency parsing /MST

**Answer a):** CLE

**Answer b):** Final step

**Question 4.** Dependency parsing / Transition based

**Answer a):** Arc-standard system