Anish Sachdeva
DTU/2K16/MC/13

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Class Assignment (Natural Language Processing)

⇒ **Production Rules**

(1) S → VP NP
(2) S → NP VP
(3) VP → V
(4) NP → Det Adj NP
(5) VP → V NP
(6) NP → Det N

- **Terminals**

N → dog | man | cat
Det → the | a
Adj → old | small
V → ate | cried

Sentence: "The dog ate"

Matched	Stack	Input	Backup Rules	Action
	S $	The dog ate $		
	VP NP $	The dog ate $	(2)	(1) S → VP NP
	V NP $	The dog ate $	(3) (5)	(3) VP → V
	ate NP $	The dog ate $	(4) (5)	V → ate
		Mismatch		
	cried VP $	The dog ate $	(3) (5)	V → cried
		Mismatch we will backtrack		
	V NP NP $	The dog ate $	(4)	(5) VP → V NP
	ate NP NP $	The dog ate $	(6)	V → ate

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Mismatch,

matched	Stack	Input	Backup Rules	Action
	cried NP VP $	The dog ate $	(2)	V → cried
	Mismatch, and now we backtrack.			
✓	NP VP $	The dog ate $	(2)	S → NP VP
	Det Adj NP VP $	The dog ate $	(6)	(4) NP → Det Adj NP
The	Adj NP VP $	The dog ate $		Det → the
		Mismatch,		
The	Adj NP NP $	dog ate $	(6)	~~Adj →~~
The	old NP VP $	dog ate $	(6)	Adj → old
				Mismatch
The	small NP VP $	dog ate $	(6)	Adj → old
				mismatch,
	we backtrack.			
✓	Det N VP $	The dog ate $		
	The N VP $	The dog ate $		Det → The
				matched.
The	✓ N VP $	~~dog~~ ate $		
	dog VP $	dog ate $		N → dog
				matched.
The dog	✓ VP $	ate $		

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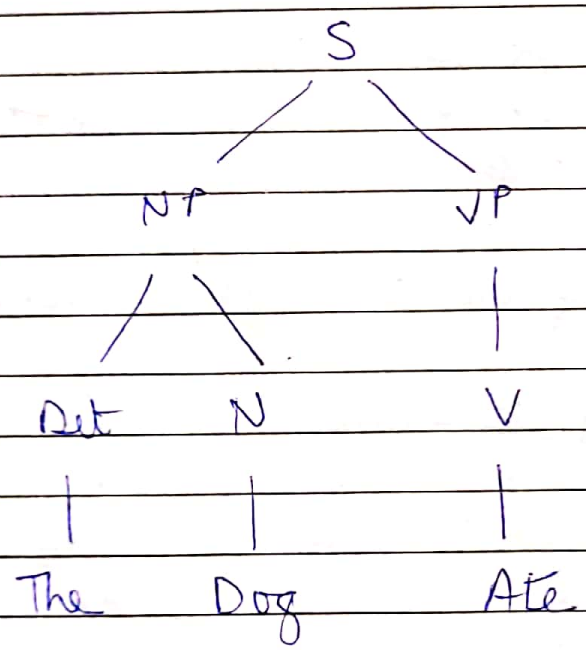
The dog	VP V $	ate $	(3) VP → V
The dog	ate $	ate $	V → ate
			Matched.
The dog ate	$	$	

This sentence is grammatically correct.



PCFG (Probabilistic Context Free Grammar)

S → VP NP	(0.1)	N → dog (0.2) | man (0.6) | cat (0.2)	
S → NP VP	(0.9)	Det → the (0.5) | a (0.5)	
VP → V	(0.5)	~~Adj → a (0.5) | the~~	
VP → V NP	(0.5)	Adj → old (0.3) | small (0.7)	
NP → det Adj NP	(0.4)	V → ate (0.8) | cried (0.2)	
NP → Det N	(0.6)		

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The productions used are :-

$S \rightarrow NP\ VP$	(0.9)
$NP \rightarrow Det\ N$	(0.6)
$Det \rightarrow The$	(0.5)
$N \rightarrow dog$	(0.2)
$VP \rightarrow V$	(0.5)
$V \rightarrow ate$	(0.8)

The probability of the sentence will be

$$\prod_{i \in \text{Productions}} P(\text{productions}_i) = (0.9)(0.6)(0.5)(0.2)(0.5)(0.8)$$

$$= 0.02160$$

$$= 2.16 \times 10^{-2}$$