

## Chương 3

### 1/ Given the CFG:

1.  $S \rightarrow NP VP$

4.  $VP \rightarrow V$

2.  $NP \rightarrow ART N$

5.  $VP \rightarrow V NP$

3.  $NP \rightarrow ART ADJ N$

a) Define a lexicon for the sentence: “The man walked the old dog”.

b) Construct a top-down chart parse and bottom-up chart parse of the above sentence.

*Giải*

a)

the: ART

man: N, V

walked: V

old: ADJ, N

dog: N, V

b)

S (luật 1)					
(1 NP1, 2 VP1)					
		VP1 (luật 5)			
		(1 V2, 2 NP3)			
			NP3 (luật 3)		
			(1 ART2, 2 ADJ12, 3 N3)		
NP1 (luật 2)			NP2 (luật 2)		
(1 ART1, 2 N1)			(1 ART2, 2 N2)		
	V1			N2	V3
ART1	N1	V2	ART2	ADJ1	N3
The	man	walked	the	old	dog

2. Use the dependency parser (3.3.5 MaltParser) to parse the following sentences:

a) He books me the morning flight

b) Chúng tôi đăng ký vé máy bay ra Hà Nội.

**Note:** the Vietnamese sentence b) has six words: chúng tôi, đăng ký, vé, máy bay, ra, Hà Nội

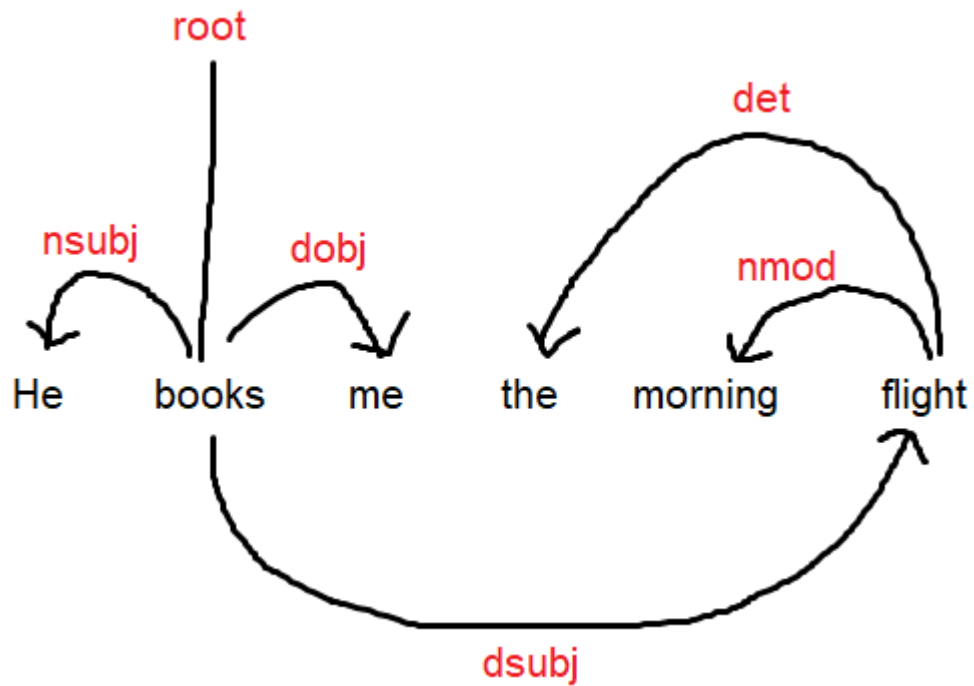
**Then, draw dependency trees by sets of dependency relations (dependency arcs) A, which are as the outputs of appropriate parses**

*Giải*

a)

	ROOT	He, books, me, the, morning, flight	
Shift	ROOT, He	books, me, the, morning, flight	
LA <sub>nsubj</sub>	ROOT	books, me, the, morning, flight	{nsubj(books, he)} = A <sub>1</sub>
Shift	ROOT, books	me, the, morning, flight	
RA <sub>dobj</sub>	ROOT, books, me	the, morning, flight	A <sub>1</sub> ∪ {dobj(books, me)} = A <sub>2</sub>
Shift	ROOT, books, me, the	morning, flight	
Shift	ROOT, books, me, the, morning	flight	
LA <sub>nmod</sub>	ROOT, books, me, the	flight	A <sub>2</sub> ∪ {nmod(flight, morning)} = A <sub>3</sub>
LA <sub>det</sub>	ROOT, books, me	flight	A <sub>3</sub> ∪ {det(flight, the)} = A <sub>4</sub>
Reduce	ROOT, books	flight	

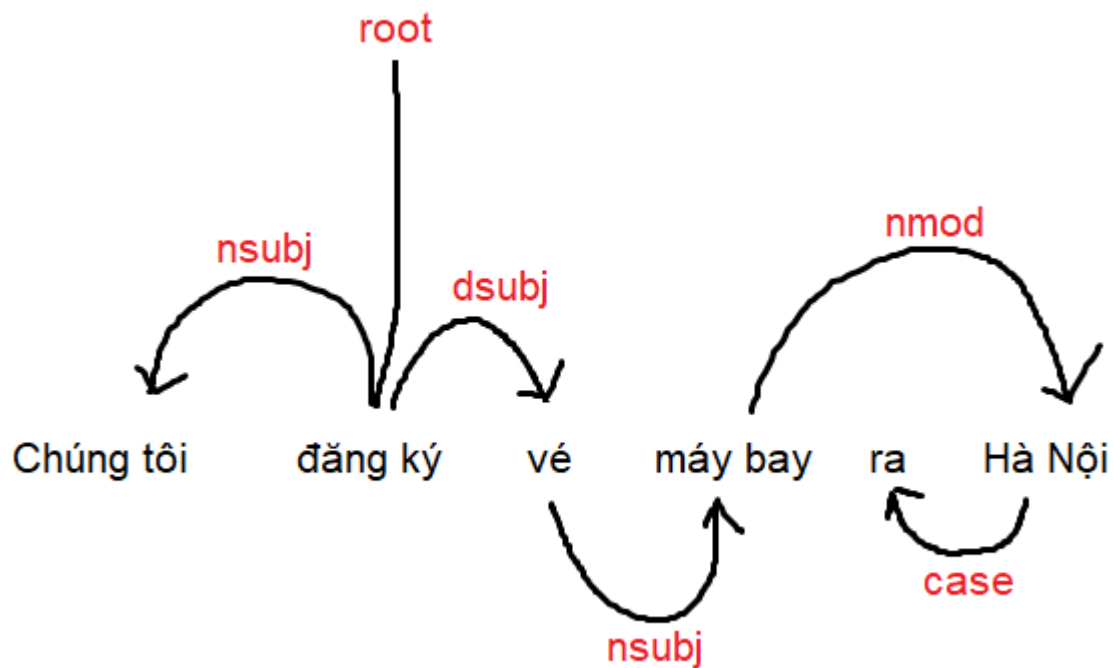
$RA_{dsubj}$	ROOT, books, flight		$A_4 \cup \{dsubj(books, flight)\} = A_5$
Reduce	ROOT, books		



b)

	ROOT	Chúng tôi, đăng ký, vé, máy bay, ra, Hà Nội	
Shift	ROOT, Chúng tôi	đăng ký, vé, máy bay, ra, Hà Nội	
$LA_{nsubj}$	ROOT	đăng ký, vé, máy bay, ra, Hà Nội	$\{nsubj(đăng ký, chúng tôi)\} = A_1$
Shift	ROOT, đăng ký	vé, máy bay, ra, Hà Nội	
$RA_{dsubj}$	ROOT, đăng ký, vé	máy bay, ra, Hà Nội	$A_1 \cup \{dsubj(đăng ký, vé)\} = A_2$

$RA_{nmod}$	ROOT, đăng ký, vé, máy bay	ra, Hà Nội	$A_2 \cup \{nmod(vé, máy\ bay)\} = A_3$
Shift	ROOT, đăng ký, vé, máy bay, ra	Hà Nội	
$LA_{case}$	ROOT, đăng ký, vé, máy bay	Hà Nội	$A_3 \cup \{case(Hà\ Nội, ra)\} = A_4$
$RA_{nmod}$	ROOT, đăng ký, vé, máy bay, Hà Nội		$A_4 \cup \{nmod(máy\ bay, Hà\ Nội)\} = A_5$
Reduce	ROOT, đăng ký, vé, máy bay		
Reduce	ROOT, đăng ký, vé		
Reduce	ROOT, đăng ký		



#### Chương 4:

1. Extend the lexicon in Figure 4.2, slide 12, and the grammar in figure 4.3, slides 13.

So that the following two sentences are accepted:

a) He was sad to see the dog cry.

b) He saw the man saw the wood with the saw.

Parse two above sentences by Top-Down Chart Parsing.

*Giải*

a)

S1[-inv] → (NP1 AGR 3s) (VP1 {past} AGR 3s)							
NP1 AGR 3s (1 PRO1)	VP1 VFORM past AGR 3s (1 V1, 2 ADJP1)						
		ADJP1 VFORM past (1 ADJ1, 2 VP2)					
			VP2 VFORM inf (1 TO1, 2 VP3)				
				VP3 VFORM base SUBCAT none (1 V2, 2 NP2)			
					NP2 (1 ART1, 2 N1, 3 VP3)		
							VP3 VFORM base SUBCAT none (1 V3)
PRO1	V1	ADJ1	TO1	V2	ART1	N1	V3

AGR 3s	VFORM past SUBCAT _adj AGR 3s	SUBCAT _vp:inf		VFORM base SUBCAT _np	AGR {3s 3p}	AGR 3s	VFORM base SUBCAT none
He	was	sad	to	see	the	dog	cry

b)

S1[-inv] → (NP1 AGR 3s) (VP1 {past} AGR 3s) INV									
NP1  AGR 3s  (1 PRO1)	VP1  VFORM past  AGR 3s  (1 V1, 2 NP2)								
		NP2  AGR 3s  (1 ART1, 2 N1, 3 VP2)							
				VP2  VFORM base  (1 V2, 2 NP3, 3 PP1)					
					NP3  AGR 3s  (1 ART2, 2 N2)		PP1  AGR 3s  (1 P1, 2 ART3, 3 N3)		
PRO1  AGR 3s	V1  VFORM past  AGR 3s  SUBCAT _np	ART1  AGR {3s 3p}	N1  AGR 3s	V2  VFORM base  SUBCAT _np _pp	ART2  AGR {3s 3p}	N2  AGR 3s	P1	ART3  AGR {3s 3p}	N3  AGR 3s

He	saw	the	man	saw	the	wood	with	the	saw
----	-----	-----	-----	-----	-----	------	------	-----	-----

**2. Specify an augmented context free grammar and lexicon for simple subject-verb-object sentences. The grammar only allows appropriate pronouns in subject and object positions and does number agreement between the subject và verb.**

**Tus it should accept “ I hit him” but not “me love you”**

*Giải*

	Agreement	Subject (SUBJ)	Object (OBJ)
Singular	1	I	Me
	2	You	You
	3	He/She/It	Him/Her/It
Plural	1	We	Us
	2	You	You
	3	They	Them

Lexicon: hit: V, love: V

CFG:

1.  $S \rightarrow NP VP$
2.  $NP \rightarrow SUBJ$
3.  $NP \rightarrow NP\_1$
4.  $NP\_1 \rightarrow ART N$
5.  $NP\_1 \rightarrow ART ADJ N$
6.  $VP \rightarrow V$
7.  $VP \rightarrow V NP\_2$
8.  $NP\_2 \rightarrow OBJ$
9.  $NP\_2 \rightarrow NP\_1$

Khi đó ta có thể phân tích

S (luật 1)

AGR 1s VFORM present (1 NP1, 2 VP1)		
	VP1 (luật 7) AGR 1s VFORM present (1 V1, 2 NP2_1)	
NP1 (luật 3) AGR 1s (1 SUBJ1)		NP2_1 (luật 8) (1 OBJ1)
SUBJ1 AGR 1s	V1 AGR 1s VFORM present SUBCAT _np_2	OBJ1
I	hit	him

Tương tự, ta cũng có thể phân tích các câu:

I love the dog.

He hates beautiful flowers.

The dog loves bones.

...



## Chương 5:

1) Using the grammar developed in 5.3, show the analyses of the following questions in chart form, as show in figure 5.8:

a) In which town were you born ?

b) Where were you born ?

c) When did they leave ?

d) What town were you born in ?

*Giải*

a)

S2  VFORM past  (1 PP1, 2 S1)					
PP1  WH Q  AGR 3s  (1 P1, 2 NP1)			S1 [INV+]  AGR {2s 2p}  VFORM past  GAP (PP1 {loc})  (1 AUX1, 2 NP2, 3 VP1)		
	NP1  WH Q  AGR 3s  (1 DET1, 2 CNP1)				
	DET1  AGR 3s  (1 QDET1)	CNP1  AGR 3s		NP2  AGR {2s 2p}  (1 PRO1)	VP1  VFORM pastprt  GAP (PP {loc})

					(1 V1, 2 Empty-PP1)
P1  {loc}	QDET1  WH Q  AGR {3s 3p}	N1  AGR 3s	AUX1  ROOT be  VFORM past  AGR {2s 2p 3p}  COMPFORM pastprt	PRO1  AGR {2s 2p}	V1  VFORM pastprt  SUBCAT _pp
In	which	town	were	you	born

b)

S2  VFORM past  (1 PP1, 2 S1)			
	S1 [INV+]  AGR {2s 2p}  VFORM past  GAP (PP1 {loc})  (1 AUX1, 2 NP1, 3 VP1)		
PP1  WH Q  PFORM {loc}		NP1  AGR {2s 2p}  (1 PRO1)	VP1  VFORM pastprt  GAP (PP {loc})  (1 V1, 2 Empty-PP1)
PP-WRD1  WH Q  PFORM {loc}	AUX1  ROOT be  VFORM past	PRO1  AGR {2s 2p}	V1  VFORM pastprt  SUBCAT _pp

	AGR {2s 2p 3p} COMPFORM pastprt		
Where	were	you	born

c)

S2 VFORM past (1 PP1, 2 S1)			
	S1 [INV+] AGR {3p} VFORM past GAP (PP1 {time}) (1 AUX1, 2 NP1, 3 VP1)		
PP1 WH Q PFORM {time}		NP1 AGR {3p} (1 PRO1)	VP1 VFORM base GAP (PP {time}) (1 V1, 2 Empty-PP1)
PP-WRD1 WH Q PFORM {time}	AUX1 ROOT be VFORM past AGR {1s 2s 3s 1p 2p 3p} COMPFORM base	PRO1 AGR {3p}	V1 VFORM base SUBCAT _pp{time}
When	did	they	leave

d)

S2  VFORM past  (1 NP1, 2 S1)					
NP1  WH Q  AGR 3s  (1 DET1, 2 CNP1)		S1 [INV+]  AGR {2s 2p}  VFORM pastprt  GAP (NP AGR 3s)  (1 AUX1, 2 NP2, 3 VP1)			
DET1  WH Q  AGR {3s 3p}  (1 QDET1)	CNP1  AGR 3s  (1 N1)		NP2  AGR {2s 2p}  (1 PRO1)	VP1  VFORM pastprt  GAP (NP AGR 3s)  (1 V1, 2 PP1)	
					PP1  GAP (NP AGR 3s)  (1 P1, 2 Empty-NP1)
QDET1  WH Q  AGR {3s 3p}	N1  AGR 3s	AUX1  ROOT be  VFORM past  AGR {2s 2p 3p}  COMPFORM pastprt	PRO1  AGR {2s 2p}	V1  VFORM pastprt  SUBCAT _pp	P1 {loc}
What	town	were	you	born	in

**2) GPSG allows certain rules to have multiple head sub constituents. For instance VP  
→ VP and VP.**

a) How does the presence of multiple heads effect the algorithm that produces propagation of the gap feature? In order to answer this question consider the following sentences

Who did you see and give the book to?

What man did Mary hate and Sue love?

Also consider that the following sentences are ill-formed:

\*Who did you see and give the book to John?

\*What man did Mary hate John and Sue love ?

b) Write out the VP rule showing the GAP feature and then draw the chart for the sentence:

Who did Mary see and Sue see ?

Using grammar augmented on the figure 5.6 with your rule only show the constituents that are used in the final analysis, but be sure to show all the feature values for each constituent.

*Giải*

Ta thêm luật mới

$(S[+INV] \text{ WH ?w GAP ?g}) \rightarrow (AUX \text{ COMPFORM ?s AGR ?a})$

$(NP \text{ WH ?w AGR ?a GAP-}) (VP \text{ VFORM ?s GAP ?g})$

AND

$(NP \text{ WH ?w AGR ?a GAP-}) (VP \text{ VFORM ?s GAP ?g})$

a)

S2

VFORM past

(1 NP1, 2 S1)

	S1[+inv]  VFORM past  AGR {2s 2p}  GAP (NP AGR {3s 3p})  (1 AUX1, 2 NP2, 3 VP3)							
			VP3  VFORM base  GAP (NP AGR {3s 3p})  (1 VP1, 2 AND1, 3 VP2)					
					VP2  VFORM base  GAP (NP AGR {3s 3p})  (1 V2, 2 NP4, 3 PP1)			
NP1  WH Q  AGR {3s 3p}  (1 PRO1)		NP2  AGR {2s 2p}  (1 NAME1)	VP1  VFORM base  GAP (NP AGR {3s 3p})  (1 V1, 2 Empty-NP1)			NP4  AGR 3s  (1 ART1, 2 N1)		PP1  AGR {3s 3p}  GAP (NP AGR {3s 3p})  (1 P1, 2 Empty-NP1)
PRO1  WH Q	AUX1  VFORM past	NAME1  AGR {2s 2p}	V1  VFORM base	AND1	V2  VFORM base	ART1  AGR {3s 3p}	N1  AGR 3s	P1 {mot}

AGR {3s 3p}	AGR {1s 2s 3s 1p 2p 3p}  COMFORM base		SUBCAT _np		SUBCAT _np_pp: to			
Who	did	you	see	and	give	the	book	to

S2  VFORM past  (1 NP1, 2 S1)							
NP1  WH Q  AGR 3s  (1 DET1, 2 CNP1)		S1[+inv]  VFORM past  AGR 3s  GAP (NP AGR {3s 3p})  (1 AUX1, 2 NP2, 3 VP1, 4 AND1, 5 NP3, 6 VP2)					
DET1  WH Q  AGR 3s  (1 QDET1)	CNP1  AGR 3s  (1 N1)		NP2  AGR 3s  (1 NAME1)	VP1  VFORM base  GAP (NP AGR {3s 3p})  (1 V1, 2 Empty-NP1)		NP3  AGR 3s  (1 NAME2)	VP2  VFORM base  GAP (NP AGR {3s 3p})  (1 V2, 2 Empty-NP1)
QDET1  WH Q  AGR {3s 3p}	N1  AGR 3s	AUX1  VFORM past  AGR {1s 2s 3s 1p 2p 3p}	NAME1  AGR 3s	V1  VFORM base  SUBCAT _np	AND1	NAME2  AGR 3s	V2  VFORM base  SUBCAT _np

		COMFORM base					
What	man	did	Mary	hate	and	Sue	love

b)

S2 VFORM past (1 NP1, 2 S1)						
	S1[INV+] VFORM past GAP (NP1 AGR {3s 3p}) (1AUX1, 2 NP2, 3 VP1, 4 AND, 5 NP3, 6 VP2)					
		NP2 AGR 3s (1 NAME1)	VP1 VFORM base GAP (NP1 AGR {3s 3p}) (1 V2, 2 Empty- NP1)		NP3 AGR 3s (1 NAME2)	VP2 VFORM base GAP (NP1 AGR {3s 3p}) (1 V2, 2 Empty-NP2)
PRO1 WH Q AGR {3s 3p}	AUX1 VFORM past AGR { 1s 2s 3s 1p 2p 3p} COMFORM base	NAME1 AGR 3s	V1 VFORM base SUBCAT _np	AND1	NAME2 AGR 3s	V2 VFORM base SUBCAT _np
Who	did	Mary	see	and	Sue	see