

Übungsblatt 4

Aufgabe 1: Earley Erkennen

Grammatik

$S \rightarrow NP VP$

$VP \rightarrow VP PP$

$VP \rightarrow v NP NP$

$PP \rightarrow p NP$

$NP \rightarrow NP PP \mid d N1 \mid N1$

$N1 \rightarrow a N1 \mid n \mid \varepsilon$

		n	v	\$	
	0	1	2	3	
0	<p>S → • NP VP</p> <p>NP → • NP PP</p> <p>NP → • d N1</p> <p>NP → • N1</p> <p>N1 → • a N1</p> <p>N1 → • n</p> <p>N1 → •</p> <p>- c -</p> <p>NP → N1 •</p> <p>NP → NP • PP</p> <p>S → NP • VP</p> <p>- p -</p> <p>PP → • p NP</p> <p>VP → • VP PP</p> <p>VP → • vNPNP</p>	<p>N1 → • n</p> <p>- c -</p> <p>NP → N1 •</p> <p>S → NP • VP</p> <p>NP → NP • PP</p>			
1		<p>- p -</p> <p>VP → • VP PP</p> <p>VP → • vNPNP</p> <p>PP → • p NP</p>	VP → v • NPNP		

		n	v	\$	
	0	1	2	3	
0	$S \rightarrow \bullet NP VP$.. - c - .. - p - ..	$N1 \rightarrow \bullet n$ - c - $NP \rightarrow N1 \bullet$ $S \rightarrow NP \bullet VP$ $NP \rightarrow NP \bullet PP$	$S \rightarrow NP VP \bullet$		
1		- p - $VP \rightarrow \bullet VP PP$ $VP \rightarrow \bullet vNPNP$ $PP \rightarrow \bullet p NP$	$VP \rightarrow v \bullet NPNP$ - c - $VP \rightarrow vNP \bullet NP$ $VP \rightarrow vNPNP \bullet$		
2			$NP \rightarrow \bullet NP PP$ $NP \rightarrow \bullet d N1$ $NP \rightarrow \bullet N1$ $N1 \rightarrow \bullet a N1$ $N1 \rightarrow \bullet n$ $N1 \rightarrow \bullet$ - c - $NP \rightarrow N1 \bullet$ $NP \rightarrow NP \bullet PP$ - p - $PP \rightarrow \bullet p NP$		

Aufgabe 1

First- und Follow-Mengen

	First	Follow
N1	ϵ, a, n	$v, a, n, d, p, \$$
NP	ϵ, d, a, n, p	$v, a, n, d, p, \$$
PP	p	$v, a, n, d, p, \$$
VP	v	$p, \$$
S	d, a, n, p, v	$\$$

Aufgabe 1: Look-Ahead für Punktregel-Mengen

	LA		LA		LA
$S \rightarrow \bullet NP VP$	d, a, n, v	$S \rightarrow NP \bullet VP$	v	$S \rightarrow NP VP \bullet$	\$
$VP \rightarrow \bullet VP PP$	v	$VP \rightarrow VP \bullet PP$	p	$VP \rightarrow VP PP \bullet$	p\$
$VP \rightarrow \bullet v NP NP$	v	$VP \rightarrow v \bullet NP NP$	a, n, d, p, \$	$VP \rightarrow v NP \bullet NP$	a, n, d, p, \$
$PP \rightarrow \bullet p NP$	p	$PP \rightarrow p \bullet NP$	v, a, n, d, p, \$	$PP \rightarrow p NP \bullet$	v, a, n, d, p, \$
$NP \rightarrow \bullet NP PP$	d, a, n, p	$NP \rightarrow NP \bullet PP$	p	$NP \rightarrow NP PP \bullet$	v, a, n, d, p, \$
$NP \rightarrow \bullet d N1$	d	$NP \rightarrow d \bullet N1$	v, a, n, d, p, \$	$NP \rightarrow d N1 \bullet$	v, a, n, d, p, \$
$NP \rightarrow \bullet N1$	v, a, n, d, p, \$	$NP \rightarrow N1 \bullet$	v, a, n, d, p, \$	$N1 \rightarrow a N1 \bullet$	v, a, n, d, p, \$
$N1 \rightarrow \bullet a N1$	a	$N1 \rightarrow a \bullet N1$	v, a, n, d, p, \$	$VP \rightarrow v NP NP \bullet$	p\$
$N1 \rightarrow \bullet N1$	v, a, n, d, p, \$	$N1 \rightarrow N1 \bullet$	v, a, n, d, p, \$		
$N1 \rightarrow \bullet n$	n	$N1 \rightarrow n \bullet$	v, a, n, d, p, \$		
$N1 \rightarrow \bullet$	v, a, n, d, p, \$		v, a, n, d, p, \$		

		d	n	v	d	n	p	d	n
	0	1	2	3	4	5	6	7	8
0	$S \rightarrow \bullet NP VP$ $NP \rightarrow \bullet NP PP$ $NP \rightarrow \bullet d N1$ $NP \rightarrow \bullet N1$ $N1 \rightarrow \bullet n$ $N1 \rightarrow \bullet$ $-c-$ $NP \rightarrow N1 \bullet$ $-p-$	$NP \rightarrow d \bullet N1$ $-c-$ $NP \rightarrow d N1 \bullet$	$-c-$ $NP \rightarrow d N1 \bullet$ $S \rightarrow NP \bullet VP$						$S \rightarrow NP VP \bullet$
1		$-p-$ $N1 \rightarrow \bullet n$ $N1 \rightarrow \bullet$	$N1 \rightarrow n \bullet$						
2			$-p-$ $VP \rightarrow \bullet VP PP$ $VP \rightarrow \bullet vNP NP$	$VP \rightarrow v \bullet NP NP$ $VP \rightarrow v NP \bullet NP$	$VP \rightarrow v NP \bullet NP$	$VP \rightarrow v NP \bullet NP$ $VP \rightarrow v NP NP \bullet$ $VP \rightarrow VP \bullet PP$		$VP \rightarrow v NP NP \bullet$ $VP \rightarrow VP PP \bullet$	
3				$-p-$ $NP \rightarrow \bullet NP PP$ $NP \rightarrow \bullet d N1$ $NP \rightarrow \bullet N1$ $N1 \rightarrow \bullet n$ $N1 \rightarrow \bullet$ $-c-$ $NP \rightarrow N1 \bullet$	$NP \rightarrow d \bullet N1$ $-c-$ $NP \rightarrow d N1 \bullet$	$-c-$ $NP \rightarrow d N1 \bullet$ $NP \rightarrow NP \bullet PP$		$NP \rightarrow NP PP \bullet$	

4					<p>-p- N1 → • n N1 → • NP → • NP PP NP → • N1</p>	<p>N1 → n • -c- NP → N1 • NP → NP • PP</p>	<p>NP → NP PP •</p>	<p>NP → NP PP •</p>	<p>NP → NP PP •</p>
5					<p>-p- NP → • NP PP NP → • N1 N1 → • PP → • p NP -c- NP → N1 • NP → NP • PP</p>	<p>PP → p • NP -c- PP → p NP •</p>	<p>-c- PP → p NP •</p>	<p>-c- PP → p NP •</p>	
6					<p>-p- NP → • NP PP NP → • d N1 NP → • N1 N1 → • -c- NP → N1 •</p>	<p>NP → d • N1 -c- NP → d N1 •</p>	<p>NP → d • N1 -c- NP → d N1 •</p>	<p>-c- NP → d N1 •</p>	
7							<p>-p- N1 → • n N1 → •</p>	<p>N1 → n •</p>	

Aufgabe 2: Chomsky Normalform

$PP \rightarrow p \ NP$

$NP \rightarrow NP \ PP \mid d \ N1 \mid N1$

$N1 \rightarrow a \ N1 \mid n \mid \varepsilon$

Aufgabe 2: Chomsky Normalform

Schritt 1-3

$S \rightarrow NP VP$	$NP \rightarrow NP PP$	$N1 \rightarrow \text{eps}$
$VP \rightarrow VP PP$	$NP \rightarrow D N1$	$V \rightarrow v$
$VP \rightarrow V NP2$	$NP \rightarrow N1$	$P \rightarrow p$
$NP2 \rightarrow NP NP$	$N1 \rightarrow A N1$	$N \rightarrow n$
$PP \rightarrow P NP$	$N1 \rightarrow N$	$A \rightarrow a$

Aufgabe 2: Chomsky Normalform

Schritt 4

$S \rightarrow NP VP$	$NP \rightarrow NP PP$	$N1 \rightarrow A$
$VP \rightarrow VP PP$	$NP \rightarrow D N1 \mid D$	$V \rightarrow v$
$VP \rightarrow V NP2$	$NP \rightarrow N1 \mid \text{eps}$	$P \rightarrow p$
$NP2 \rightarrow NP NP$	$N1 \rightarrow A N1$	$N \rightarrow n$
$PP \rightarrow P NP$	$N1 \rightarrow N$	$A \rightarrow a$

$S \rightarrow NP VP \mid VP$	$NP \rightarrow NP PP \mid PP$	$N1 \rightarrow A$
$VP \rightarrow VP PP$	$NP \rightarrow D N1 \mid D$	$V \rightarrow v$
$VP \rightarrow V NP2$	$NP \rightarrow N1$	$P \rightarrow p$
$NP2 \rightarrow NP NP \mid NP \mid \text{eps}$	$N1 \rightarrow A N1$	$N \rightarrow n$
$PP \rightarrow P NP \mid P$	$N1 \rightarrow N$	$A \rightarrow a$

Aufgabe 2: Chomsky Normalform

Schritt 4

$S \rightarrow NP VP \mid VP$	$NP \rightarrow NP PP \mid PP$	$N1 \rightarrow A$
$VP \rightarrow VP PP$	$NP \rightarrow D N1 \mid D$	$V \rightarrow v$
$VP \rightarrow V NP2 \mid V$	$NP \rightarrow N1$	$P \rightarrow p$
$NP2 \rightarrow NP NP \mid NP$	$N1 \rightarrow A N1$	$N \rightarrow n$
$PP \rightarrow P NP \mid P$	$N1 \rightarrow N$	$A \rightarrow a$

Aufgabe 2: Chomsky Normalform

Schritt 5

$S \rightarrow NP VP \mid VP$	$NP \rightarrow NP PP \mid PP$	$N1 \rightarrow A$
$VP \rightarrow VP PP$	$NP \rightarrow D N1 \mid D$	$V \rightarrow v$
$VP \rightarrow V NP2 \mid V$	$NP \rightarrow N1$	$P \rightarrow p$
$NP2 \rightarrow NP NP \mid NP$	$N1 \rightarrow A N1$	$N \rightarrow n$
$PP \rightarrow P NP \mid P$	$N1 \rightarrow N$	$A \rightarrow a$

$S \rightarrow NP VP \mid VP PP$	$NP2 \rightarrow D N1 \mid d \mid A N1 \mid n \mid a$	$N1 \rightarrow A N1 \mid n \mid a$
$S \rightarrow V NP2 \mid v$	$PP \rightarrow P NP \mid p$	$V \rightarrow v$
$VP \rightarrow V NP2 \mid v$	$NP \rightarrow NP PP \mid P NP \mid p$	$P \rightarrow p$
$NP2 \rightarrow NP NP$	$NP \rightarrow D N1 \mid d$	$N \rightarrow n$
$NP2 \rightarrow NP PP \mid P NP \mid p$	$NP \rightarrow A N1 \mid n \mid a$	$A \rightarrow a$

Aufgabe 4:

First- und Follow-Mengen

	First	Follow
S	d, a, n, p, v	p, \$
VP	v	p, \$
PP	p	v, p, \$
SBAR	c	p, \$
NP	ϵ , d, a, n, p	v, p, \$
N1	ϵ , a, n	v, p, \$

Aufgabe 5:

First- und Follow-Mengen

	First	Follow
S	n	\$
VP	v	p , \$
PP	p	v , p , \$
NP	n	v , p , \$

Grammatik ist ambig

Sprache ist nicht ambig

Aufgabe 5:

Punktregel-Mengen und Übergänge

```
[0, [r(NP, [., NP, PP]), r(NP, [., n]), r(S, [., NP, UP]), r(S+, [., S])]]
[1, [r(NP, [n, .])]]
[2, [r(PP, [., p, NP]), r(UP, [., v, NP]), r(UP, [., UP, PP]), r(S, [NP, ., UP]), r(NP, [NP, ., PP])]]
[3, [r(S+, [S, .])]]
[4, [r(NP, [., NP, PP]), r(NP, [., n]), r(PP, [p, ., NP])]]
[5, [r(NP, [., NP, PP]), r(NP, [., n]), r(UP, [v, ., NP])]]
[6, [r(PP, [., p, NP]), r(S, [NP, UP, .]), r(UP, [UP, ., PP])]]
[7, [r(NP, [NP, PP, .])]]
[8, [r(PP, [., p, NP]), r(PP, [p, NP, .]), r(NP, [NP, ., PP])]]
[9, [r(PP, [., p, NP]), r(UP, [v, NP, .]), r(NP, [NP, ., PP])]]
[10, [r(UP, [UP, PP, .])]]
[0, NP, 2]
[0, S, 3]
[0, n, 1]
[2, PP, 7]
[2, UP, 6]
[2, p, 4]
[2, v, 5]
[4, NP, 8]
[4, n, 1]
[5, NP, 9]
[5, n, 1]
[6, PP, 10]
[6, p, 4]
[8, PP, 7]
[8, p, 4]
[9, PP, 7]
[9, p, 4]
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Aufgabe 5:

LR(0)- Kontrolltabelle

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[[0,n,[1]], [0,p,[]], [0,v,[]], [0,$,[]], [0,NP,[2]], [0,PP,[]], [0,S,[3]], [0,UP,[]]]
[[1,n,[[r,2]], [1,p,[[r,2]], [1,v,[[r,2]], [1,$,[[r,2]], [1,NP,[]], [1,PP,[]], [1,S,[]], [1,UP,[]]]
[[2,n,[]], [2,p,[4]], [2,v,[5]], [2,$,[]], [2,NP,[]], [2,PP,[7]], [2,S,[]], [2,UP,[6]]]
[[3,n,[]], [3,p,[]], [3,v,[]], [3,$,[acc]], [3,NP,[]], [3,PP,[]], [3,S,[]], [3,UP,[]]]
[[4,n,[1]], [4,p,[]], [4,v,[]], [4,$,[]], [4,NP,[8]], [4,PP,[]], [4,S,[]], [4,UP,[]]]
[[5,n,[1]], [5,p,[]], [5,v,[]], [5,$,[]], [5,NP,[9]], [5,PP,[]], [5,S,[]], [5,UP,[]]]
[[6,n,[[r,1]], [6,p,[4,[r,1]], [6,v,[[r,1]], [6,$,[[r,1]], [6,NP,[]], [6,PP,[10]], [6,S,[]], [6,UP,[]]]
[[7,n,[[r,5]], [7,p,[[r,5]], [7,v,[[r,5]], [7,$,[[r,5]], [7,NP,[]], [7,PP,[]], [7,S,[]], [7,UP,[]]]
[[8,n,[[r,6]], [8,p,[4,[r,6]], [8,v,[[r,6]], [8,$,[[r,6]], [8,NP,[]], [8,PP,[7]], [8,S,[]], [8,UP,[]]]
[[9,n,[[r,4]], [9,p,[4,[r,4]], [9,v,[[r,4]], [9,$,[[r,4]], [9,NP,[]], [9,PP,[7]], [9,S,[]], [9,UP,[]]]
[[10,n,[[r,3]], [10,p,[[r,3]], [10,v,[[r,3]], [10,$,[[r,3]], [10,NP,[]], [10,PP,[]], [10,S,[]], [10,UP,[]]]
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