以下に示す条件のもとで、2つの課題に取り組んだ。

input sentence:　The boy hits the dog with a rod.

Grammar　rules:

sentence → np, vp

np → det, n

np → np, pp

vp → verb, np

vp → vp, pp

pp → prep, np

det → [the] | [a]

n → [boy] | [dog] | | [rod]

verb → [hits]

prep → [with]

1. Show the steps of Shift-Reduce parsing for phrase structure grammar, as shown in p.65 in the lecture slide

与えられた文法規則に基づいて、Shift-Reduce 構文解析を入力文に行った結果を図 1 に示す。

	stack S	queue Q	operation
(1)		The boy hits the dog with a rod	shift
(2)	The	boy hits the dog with a rod	reduce
(3)	det	boy hits the dog with a rod	shift
(4)	det boy	hits the dog with a rod	reduce
(5)	det n	hits the dog with a rod	reduce
(6)	np	hits the dog with a rod	shift
(7)	np hits	the dog with a rod	reduce
(8)	np verb	the dog with a rod	shift
(9)	np verb the	dog with a rod	reduce
(10)	np verb det	dog with a rod	shift
(11)	np verb det dog	with a rod	reduce
(12)	np verb det n	with a rod	reduce
(13)	np verb np	with a rod	reduce
(14)	np vp	with a rod	reduce
(15)	sentence	with a rod	shift
(16)	sentence with	a rod	reduce
(17)	sentence prep	a rod	shift
(18)	sentence prep a	rod	reduce
(19)	sentence prep det	rod	shift
(20)	sentence prep det rod		reduce
(21)	sentence prep det n		reduce
(22)	sentence prep np		reduce
(23)	sentence pp		

図 1　Shift-Reduce 構文解析結果①

図 1 のように解析をした結果、最終ステップにおいて stack が sentence のみとならず、構文解析に失敗した。そのため、ステップ(14)で reduce せずに shift を行う場合も探索した。その結果を図 2 に示す。

	stack S	queue Q	operation
(1)		The boy hits the dog with a rod	shift
(2)	The	boy hits the dog with a rod	reduce
(3)	det	boy hits the dog with a rod	shift
(4)	det boy	hits the dog with a rod	reduce
(5)	det n	hits the dog with a rod	reduce
(6)	np	hits the dog with a rod	shift
(7)	np hits	the dog with a rod	reduce
(8)	np verb	the dog with a rod	shift
(9)	np verb the	dog with a rod	reduce
(10)	np verb det	dog with a rod	shift
(11)	np verb det dog	with a rod	reduce
(12)	np verb det n	with a rod	reduce
(13)	np verb np	with a rod	reduce
(14)	np vp	with a rod	shift
(15)	np vp with	a rod	reduce
(16)	np vp prep	a rod	shift
(17)	np vp prep a	rod	reduce
(18)	np vp prep det	rod	shift
(19)	np vp prep det rod		reduce
(20)	np vp prep det n		reduce
(21)	np vp prep np		reduce
(22)	np vp pp		reduce
(23)	np vp		reduce
(24)	sentence		

図 2　　Shift-Reduce 構文解析結果②

図 2 の解析では、最終ステップにおける stack は sentence のみとなり、構文解析に成功した。

2. Complete the CKY table, as shown on p.3 of this slide

与えられた CKY 表の初期状態に基づいて、CKY 法による構文解析を行った結果を図 3 に示す。

det	np			np sentence			sentence np
the	n						
	boy	verb		vp			vp
		hits	det	np			np
			the	n			
				dog	prep		pp
					with	det	np
						a	n
							rod

図 3　CKY 法による構文解析結果