

ECE 468/573 — Midterm 1

September 30, 2015

Name: _____

Purdue email: _____

Please sign the following:

I affirm that the answers given on this test are mine and mine alone. I did not receive help from any person or material (other than those explicitly allowed).

X _____

Note: ECE 468 students *do not* have to complete Part 6.

Part	Points	Score
1	15	
2	20	
3	15	
4	15	
5	25	
6	10	
Total	90 (+ 10)	

Part 1: Compiler types and phases (15 points)

The following questions are multiple choice, and worth 3 points each. Circle the *one* choice that you think best answers the question.

1) You are the compiler developer at a company that has their own programming language. You realize on your first day of work that your predecessor used “fore” instead of “for” as the keyword for for-loops. Which phases of your compiler do you need to change to fix the problem?

- a) The parser and the scanner
- b) Only the parser
- c) Only the scanner
- d) The code generator

2) The computers NASA sends into space tend to be much slower and more resource-constrained than earth-bound computers because they have to be radiation hardened. But it is still important that code executing on the space-based computers run fast. What kind of compiler infrastructure should NASA use for the software they run on the space station:

- a) An ahead-of-time compiler that generates machine code
- b) A compiler that generates byte code that can be run in an interpreter
- c) A compiler that generates byte code that’s compiled “just in time” when it is run

3) If I want to add a new instruction to the intermediate representation of my compiler, what phases of the compiler do I have to change?

- a) The parser
- b) The code generator
- c) The code generator and optimization passes
- d) None of the above answers are correct

4) If I have a compiler for Intel chips, and Intel adds a new instruction to the x86 ISA, what phases of the compiler do I have to change?

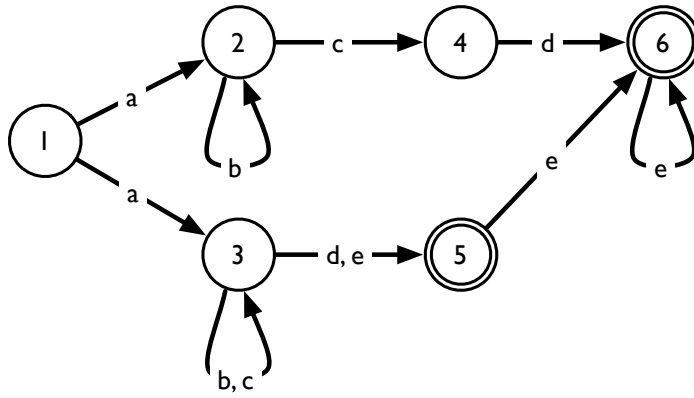
- a) The parser
- b) The code generator
- c) The code generator and optimization passes
- d) None of the above answers are correct

5) You want to add a new type of looping construct to your programming language, that uses a new keyword and syntax, but otherwise behaves exactly like a while loop. Your compiler uses three address code as its intermediate representation. What phase(s) of the compiler do you have to change?

- a) The scanner
- b) The parser and the scanner
- c) The code generator
- d) The entire front end

Part 2: Regular expressions, finite automata and scanners (20 points)

- 1) Consider the following NFA. Fill in the transition table below with its corresponding DFA using the subset construction. You may not use all of the rows (10 points):



State	Final?	a	b	c	d	e

- 2) How many states does the reduced version of this machine have? (5 pts) Draw the reduced machine (5 pts):

Part 3: First and Follow Sets (15 points)

Let G be the grammar to the right.

Using this grammar, answer the following multiple-choice questions.

$$S \rightarrow AAB\$$$

$$A \rightarrow xA$$

$$A \rightarrow CB$$

$$B \rightarrow z$$

$$B \rightarrow \lambda$$

$$C \rightarrow y$$

$$C \rightarrow \lambda$$

1) Which of these are the first set of A (5 points)

- a) $\{x\}$
- b) $\{x, z\}$
- c) $\{x, y, z\}$
- d) $\{x, y, z, \lambda\}$
- e) None of the above

2) Which of these are the follow set of B (5 points)

- a) $\{\$ \}$
- b) $\{x, \$ \}$
- c) $\{z\}$
- d) $\{x, y, z, \$ \}$
- e) $\{z, \lambda\}$
- f) None of the above

3) Which of these are the first set of "BCx" (5 points)

- a) $\{z\}$
- b) $\{x\}$
- c) $\{x, z\}$
- d) $\{y, z\}$
- e) None of the above

Part 4: LL parsers (15 points)

Consider the following grammar:

1. $S \rightarrow AB\$$ The first and follow sets for the non-terminals of this grammar are:

2. $A \rightarrow xA$	First(S) : {x, z, y, \$}	Follow(S) : { }
3. $A \rightarrow B$	First(A) : {x, z, y, λ }	Follow(A) : {z, y, \$}
4. $B \rightarrow zB$	First(B) : {z, y, λ }	Follow(B) : {z, y, \$}
	First(C) : {y, λ }	Follow(C) : {z, y, \$}

5. $B \rightarrow C$

6. $C \rightarrow yC$

7. $C \rightarrow \lambda$

1) Fill in the following parse table. If there are two entries for a given cell in the parse table, list both. (12 points)

	x	y	z	\$
S				
A				
B				
C				

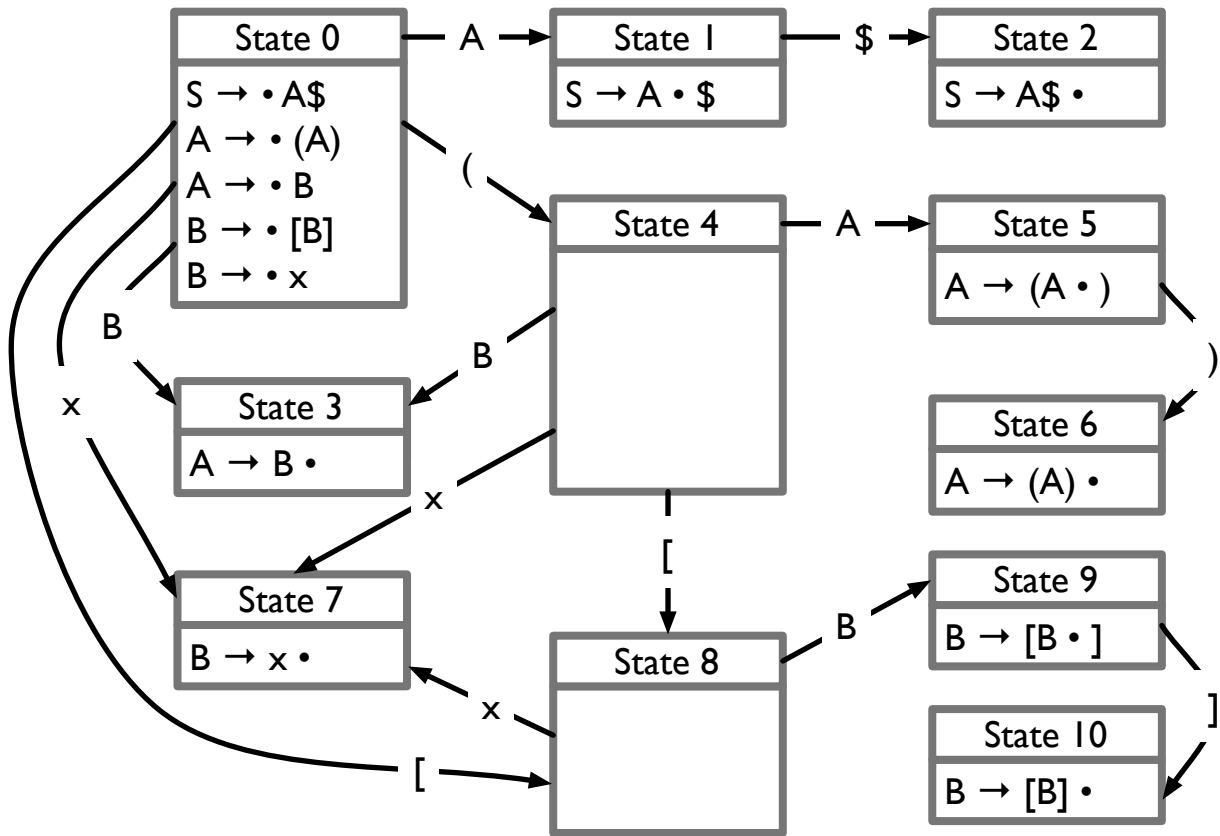
2) Is the grammar LL(1)? Why or why not? (3 points)

Part 5: LR(0) Parsers (25 points)

Use the following grammar for the next questions:

1. $S \rightarrow A\$$
2. $A \rightarrow (A)$
3. $A \rightarrow B$
4. $B \rightarrow [B]$
5. $B \rightarrow x$

1) Fill in the information for states 4 and 8 in this CFSM (10 points). In addition, two arrows are missing from the CFSM—draw those in (3 points).



2) For the following sub-questions, use the CFSSM you built in the previous question. Each question will provide the state of the parser in mid-parse, giving the state stack (most recent state on the right) and the next token. For each question, give the action the parser will take next, using the format “Shift X” for shift actions (where X is the state being shifted to) and “Reduce R, goto X” for reduce actions (where R is the rule being reduced, and X is the state the parser winds up in after finishing the reduction). Also provide the new state stack. (3 points each)

a) State stack: 0 4 4 8. Next token: [

b) State stack: 0 4 4 8 7. Next token:]

c) State stack: 0 4 8 8 9 10. Next token:]

d) State stack: 0 4 4 8. Next token: (

Part 6 (573 only): LR(1) Parsers (10 points):

1) For the following grammar, show what the *first* state of the LR(1) machine would be (8 points):

$$S \rightarrow A\$$$

$$A \rightarrow Bx$$

$$A \rightarrow By$$

$$B \rightarrow \lambda$$

$$B \rightarrow Cz$$

$$C \rightarrow x$$

$$C \rightarrow \lambda$$

2) Is there a conflict in the first state? If so, what is it? (2 points)

Use this sheet for scratch paper, if you need it.

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