Faculty of Engineering, Mathematics and Science
School of Computer Science & Statistics

Integrated Computer Science Programme
Year 3 Annual Examinations

CS3071 – Compiler Design 1

??, ???????th Example 2019 Unknown Hall ???:?? – ???:??

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Instructions to Candidates:
Students must attempt all questions. Each question in Sections A-C is worth 3 marks. An incorrect answer in Sections A-C loses 20% of the correct mark. Marks for Section D are calculated based on the fraction of correct States identified in sequence. Enter your answers on the 3071 Optical Mark Recognition Answer Sheet provided. You may not start this examination until you are instructed to do so by the Invigilator. Exam Paper is not to be removed from venue.

Materials permitted for this examination:

Non-programmable calculators are permitted for this examination — please indicate the make and model of your calculator on each answer book used. To be accompanied by a CSU33071-1 Optical Mark Recognition Answer Sheet.
Q A.1
How many of the following 6 strings (whitespace and \n indicate a new string and are not part of the test data)

iiiiii i iiiii ii iiii iii

are accepted, in part or whole, by the Thompson’s construction nondeterministic finite state automaton shown below

(A) 2 (B) 4 (C) 5 (D) 6 (E) 3 (F) OTHER (3 marks)

Q A.2
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

dmmmd hhhmmh dddhhhhdddd dmm mmmmmmmmm mhhhh dhmmm ddddmnnn mnmdddm mdddmmnn mmmmmmmm mmmmmmmmm ddddd dmmnhh mdddhhhh mmmmdddhhh

are accepted, in part or whole, by the Thompson’s construction nondeterministic finite state automaton shown below

(A) 12 (B) 9 (C) 8 (D) 10 (E) 2 (F) OTHER (3 marks)

Q A.3
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

llnnnn lllvll vvvvnnll vvvvnnnn nllnn nnnvnnnn nnnnnv lllnnn nnnvVVV llllll nnnvVVVNVV VVNL vnnlll vvvll vvvvv

are accepted, in part or whole, by the Thompson’s construction nondeterministic finite state automaton shown below
Q A.4

How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

zzaazzz iaaaaa aaaaaa aiaiiii iiiazzz aiiiiiz zzzzza iaaaaa iiiaiiii aiaaaaaa iaaaz azza iiiaiiizz ziiiiii iiiiiiiiiiiiiiiii

are accepted, in part or whole, by the Thompson’s construction nondeterministic finite state automaton shown below

(A) 15 (B) 13 (C) 11 (D) 6 (E) 5 (F) OTHER (3 marks)

Q A.5

How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

aiiihhhh aiiiiiihh aiiiiih aaaaaaiah aaaaihh aaaaaaaiiiah aiihh aaiiiah aiiiaiiih aiiiiiiiihh aiih aaiih

are accepted, in part or whole, by the Thompson’s construction nondeterministic finite state automaton shown below

(A) 3 (B) 9 (C) 10 (D) 11 (E) 15 (F) OTHER (3 marks)
Q A.6

How many of the following 15 strings (whitespace and \n indicate a
new string and are not part of the test data)

\llllllllcc lccczzzz zzzllllzzzz ccccccccc cccllllzzz ccclllllcc lllllllllzzlllll zzzzzzzzzzz zzzlcc lllllllc llllllllzzllllll lllllllllzzz

are accepted, in part or whole, by the Thompson’s construction
nondeterministic finite state automaton shown below

(A) 1 (B) 7 (C) 12 (D) 14 (E) 6 (F) OTHER (3 marks)
Section B

Q B.1
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

ffkff DDDkf DDDfkk DDDk kkkk kkkffk fDDD fffffDDD ffkk kffffff fkkkk kff kkkk fff Dkkkkk

are matched at least once, in part or whole, by the Flex regular expression k[a-z]D

(A) 2 (B) 12 (C) 9 (D) 1 (E) 14 (F) OTHER (3 marks)

Q B.2
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

SSSS hhhSSS hhhh hhSSS iiSSSS SSsihh hSii hhhhSSS hhiSSSS SSShhhhhh Sii SSii hhSShh SSiiSSS hhhSSS

are matched at least once, in part or whole, by the Flex regular expression i[^a-z]S

(A) 3 (B) 10 (C) 9 (D) 5 (E) 15 (F) OTHER (3 marks)

Q B.3
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

QQQQjjj QQjjjjddd QQQQQQ dQQQQQ dddjjjddd jjjQQQQQ djjd jjjjQQQ dddQQQQ jjjQQQQQ jjjjddd jjjjjjjjjjj jjjjjjjdd

are matched at least once, in part or whole, by the Flex regular expression j[^A-Z]Q

(A) 9 (B) 14 (C) 7 (D) 8 (E) 3 (F) OTHER (3 marks)
Q B.4
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

```
mmmmmm VVmmnnn nmmnnn mmnnVVV nnmmmmmm VVVVV nVVmm VVVVVVV mmnVV
```

are matched at least once, in part or whole, by the Flex regular expression

```
nn[a-zA-Z][a-zA-Z]*m
```

(A) 6 (B) 12 (C) 14 (D) 9 (E) 2 (F) OTHER (3 marks)

Q B.5
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

```
WWWvve vvvvvvv eeeeWW eeeWWW vvvWWeee eeeWee vveeeee eeevvve WWee vvWee eeeWWWe evWW eeWWWW WWev Wvvee
```

are matched at least once, in part or whole, by the Flex regular expression

```
v[a-zA-Z][a-zA-Z]???e
```

(A) 12 (B) 8 (C) 4 (D) 7 (E) 2 (F) OTHER (3 marks)

Q B.6
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

```
ssLL kksLL Lsss LLLLL kLLkk sssk Lks kkssss skks sLLL skkk ssLLL skLL LLLskk ssLLk
```

are matched at least once, in part or whole, by the Flex regular expression

```
(sss|kk)
```

(A) 10 (B) 9 (C) 6 (D) 8 (E) 15 (F) OTHER (3 marks)
Q B.7
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

mmmmzz zmP zmP mmmmm zzzz Pmm zzzPP Pmzz PPPP zPPzz mPz mPmm PPzz zPP mmzzP

are matched at least once, in part or whole, by the Flex regular expression

\([A-Z]\{2,3\}|[a-z]\{4\}\)

(A) 13 (B) 5 (C) 11 (D) 12 (E) 10 (F) OTHER (3 marks)

Q B.8
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

Gxxxxvvv GGGvvx vvvv\G GGGvvv vGGGx GGGGxxx xxxxxxG vvvvxvv xvxxxx vvx xxG G xxxG GGGxx GvGGG xxxGGG

are matched at least once, in part or whole, by the Flex regular expression

..vG.

(A) 12 (B) 1 (C) 6 (D) 15 (E) 4 (F) OTHER (3 marks)

Q B.9
How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

rXtt rrrrtt trtr XrrXX tttXX Xtttt rtr rtXX tXXX ttttXX rrrrX rXr trrXX XXXt

are matched at least once, in part or whole, by the Flex regular expression

[a-z][A-Z]$ 

(A) 12 (B) 10 (C) 8 (D) 2 (E) 5 (F) OTHER (3 marks)
Q B.10

How many of the following 15 strings (whitespace and \n indicate a new string and are not part of the test data)

ssss Zzs Zsz ssZZZ zzZz ZZzzZ zzzz zssz ssZz Zszz zZZss ZZzzss
sszz zssZZ zzsz

are matched at least once, in part or whole, by the Flex regular expression

(z{2}|Z{1,2}|[A-M]+)$

(A) 2 (B) 9 (C) 10 (D) 6 (E) 8 (F) OTHER (3 marks)
Section C

Q C.1
How many of the following 7 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

rrr rr rrrrr r rrrr KRVdNvZ sentence

are in the language defined by the Bison Context Free Grammar

%token r

sentence: r | r sentence
;

(A) 6 (B) 3 (C) 1 (D) 7 (E) 5 (F) OTHER (3 marks)

Q C.2
How many of the following 8 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

h hhhhhh hhhhhhh hhhh sentence AvoINoH hhh hh

are in the language defined by the Bison Context Free Grammar

%token h

sentence: h | sentence h
;

(A) 2 (B) 8 (C) 6 (D) 4 (E) 3 (F) OTHER (3 marks)
Q C.3
How many of the following 7 sentences (whitespace and \n indicate a
new sentence and are not part of the test data)

ssssUUUUU ssUssssUUU sUU sentence sssUUU B7ZrLEQ

are in the language defined by the Bison Context Free Grammar

%token s U

sentence: sub | sub sentence
  sub: s | U

(A) 5 (B) 6 (C) 7 (D) 4 (E) 2 (F) OTHER (3 marks)

Q C.4
How many of the following 10 sentences (whitespace and \n indicate a
new sentence and are not part of the test data)

HHH nnnHHH nnnHHHH nHHH nnHHH nHHH nnn nnnnHHH nHHHH nHHH

are in the language defined by the Bison Context Free Grammar

%token n H

sentence: n | H | n sentence

(A) 1 (B) 2 (C) 5 (D) 10 (E) 6 (F) OTHER (3 marks)

Q C.5
How many of the following 10 sentences (whitespace and \n indicate a
new sentence and are not part of the test data)

uuuHH uuuHHHH uHHH uuuuH H uuuuHHH uuHHH uuuu uuuu uuuuHHHH

are in the language defined by the Bison Context Free Grammar

%token u H

sentence: u | H | sentence u

(A) 5 (B) 2 (C) 9 (D) 7 (E) 10 (F) OTHER (3 marks)
Q C.6

How many of the following 10 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

eel eELL eeeeLL eLL eeeL LLL eeeLLL eeeLLL

are in the language defined by the Bison Context Free Grammar

%token e L
sentence: e | L | L sentence
;

(A) 4 (B) 1 (C) 7 (D) 2 (E) 6 (F) OTHER (3 marks)

Q C.7

How many of the following 10 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

xxxOOO xO0000 xO00 00 x0 xxx0 xxx xx0000 x00

are in the language defined by the Bison Context Free Grammar

%token x O
sentence: x | O | sentence O
;

(A) 3 (B) 4 (C) 2 (D) 10 (E) 7 (F) OTHER (3 marks)

Q C.8

How many of the following 5 sentences (whitespace and \n indicate a new sentence and are not part of the test data)

cccccc;cccc;cc ccccccc;cccc ccccc;c; ccc;ccc ccc;c;cc;ccc

are in the language defined by the Bison Context Free Grammar

%token c
sentence: list | sentence list
list: listc ';'
listc: c | c listc
;

(A) 5 (B) 3 (C) 2 (D) 4 (E) 1 (F) OTHER (3 marks)
Q C.9

How many of the following 7 sentences (whitespace and \n indicate a
new sentence and are not part of the test data)

PP,P,PPPPP,PPP PP,PPP,PPPPP PPPPPP, PPPP,P,PPPPP, PPPPP,PPP,PPPPP,PPP,PPPPP,PPP,PPPPP,PPP,PPPPP,PPP,

are in the language defined by the Bison Context Free Grammar

%token P
%%
sentence: listc | listc ',' sentence
listc: P | P listc
;

(A) 1 (B) 3 (C) 7 (D) 6 (E) 4 (F) OTHER (3 marks)

Q C.10

How many of the following 7 sentences (whitespace and \n indicate a
new sentence and are not part of the test data)

b,bb,b,b, bbb,b,b,; bb,bb b,b,b,; bb,bbbb bbbb,b,; b,b,bb,bb

are in the language defined by the Bison Context Free Grammar

%token b
%%
sentence: commal ';'
commal: listc | listc ',' commal
listc: b | b listc
;

(A) 4 (B) 6 (C) 0 (D) 7 (E) 2 (F) OTHER (3 marks)
Section D

Q D.1

Given the following tokens
```
"+" { return PLUS; }
"-" { return MINUS; }
":=" { return ASSIGN; }
[a-z] { yylval = yytext[0]; return ID; }
\n { return EOL; }
```

and the following Bison Context Free Grammar
```
0 $accept: S $end
1 S: stmt EOL
2 stmt: ID ASSIGN expr
3 expr: expr PLUS ID
4 | expr MINUS ID
5 | ID
```

which generates the Bison Shift Reduce Parser

What sequence of states will the Bison Shift Reduce Parser go through parsing the sentence
```
g:=a+b+++
```

(11 marks)
Q D.2

Given the following tokens

```
"^" { return POWER; }
"-" { return MINUS; }
":" { return ASSIGN; }
[a-z] { yylval = yytext[0]; return ID; }
\n{ return EOL; }
```

and the following Bison Context Free Grammar

```
0 $accept: S $end
1 S: stmt EOL
2 stmt: ID ASSIGN expr
3 expr: unary POWER expr
4 | unary
5 unary: MINUS unary
6 | ID
```

which generates the Bison Shift Reduce Parser

What sequence of states will the Bison Shift Reduce Parser go through parsing the sentence

```
a:=b^c^d
```

(11 marks)