

# Midterm Review

PLT-4115  
(Fall 2020)

# Midterm Info

- Content:
  - Introduction to Compilers
  - Lexical Analysis
  - Syntactic Analysis
- Open-book and Open-notes. (No Internet Access)
  - printed slides/textbook /hand-written notes
- In Person Exam
  - Monday, March 6th March 10:10 AM EST to 11:30 AM (Class Time)
- It will contain a mixture of short-answer and multiple-choice questions
- Solutions and students' responses will be released.
- Regrade requests can be made up to 1 week after the release of the grades.
- Clarification questions are OK to be asked publicly.

# Intro: Q1

Q1. What advantages are there to a language-processing system in which the compiler produces assembly language rather than machine language?

# Intro: Q2

Which of the following terms:

- a. Imperative,
- b. Functional
- c. Scripting,
- d. Static,
- e. Dynamic

Apply to which of the following languages:

- 1. C
- 2. C++
- 3. Java
- 4. Scala
- 5. Perl
- 6. Python
- 7. JavaScript

Answer:

- C: imperative, static
- C++: imperative, static
- Java: imperative, static
- Scala: Functional, static
- Perl: Scripting, dynamic
- Python: Scripting, dynamic
- Javascript: Scripting, dynamic

# Intro: Q3

What is printed by the following C code?

```
#define a (x + 1)

int x = 2;
void b() { x = a; printf("%d\t", x); }
void c() { int x = 1; printf("%d\n", a); }
void main () { b(); c(); }
```

**Answer: 3 2**

# Lexical Analysis: Q1

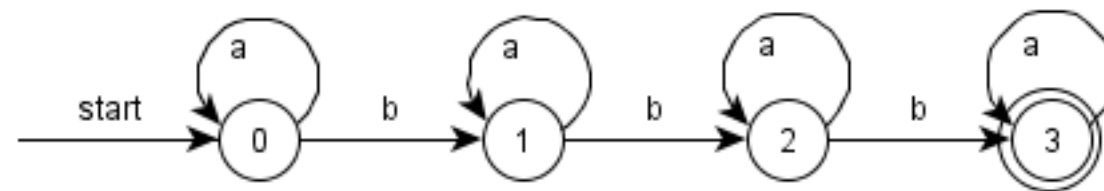
Try to describe the language defined by the following regular expressions:

1.  $a(a|b)^*a$
2.  $a^*ba^*ba^*ba^*$
3.  $(aa|bb)^*((ab|ba)(aa|bb)^*(ab|ba)(aa|bb)^*)^*$

## Answer

1. A string of a and b that begins and ends with a.
2. A string of only 3 b consisting of a and b.
3. A string of a and b with an even number a and an even number b.

# Lexical Analysis: Q2



Write the corresponding regular expression

**Answer:**

$a^* b a^* b a^* b a^*$

# Lexical Analysis: Q3

Some languages, like SQL, are case insensitive, so a keyword can be written either in lowercase or in uppercase, or in any mixture of cases.

Example: the SQL keyword SELECT can also be written select, Select, or sElEcT, for instance.

Write a regular expression for the keyword “select” in a case insensitive language .

**Answer: select -> [Ss][Ee][Ll][Ee][Cc][Tt]**



# Lexical Analysis: Q4

For the following C++ program:

```
float capSqr(float r) {  
    return (r <= -10.0 || r >= 10.0) ? 100 : r * r;  
}
```

- Tokenize the program using appropriate lexemes and associated lexical values.
- Mention the lexical specifications (i.e., regular definition) you assumed to tokenize.

# Lexical Analysis: Q5

- For an alphabet  $\{0,1\}$ , draw a DFA representing modulo 3 operations
- (The DFA only accepts strings divisible by 3 (e.g., 0,11,etc.))



Q1. Consider the context-free grammar:

$S \rightarrow SS + \mid SS * \mid a$ , and the string  $aa + a^*$

1. Give a leftmost derivation for the string.
2. Give a rightmost derivation for the string.
3. Give a parse tree for the string.
4. Is the grammar ambiguous or unambiguous? Justify your answer.

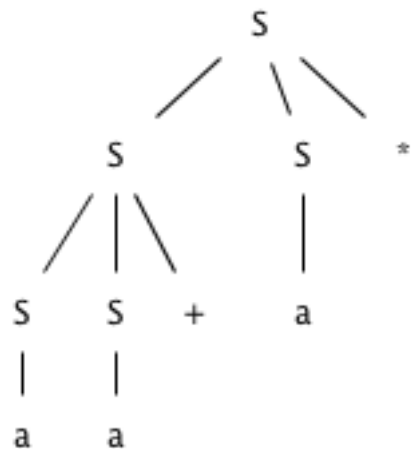
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Answers:

1.  $S \Rightarrow SS^* \Rightarrow SS+S^* \Rightarrow aS+S^* \Rightarrow aa+S^* \Rightarrow aa+a^*$
2.  $S \Rightarrow SS^* \Rightarrow Sa^* \Rightarrow SS+a^* \Rightarrow Sa+a^* \Rightarrow aa+a^*$
- 3.



4. Unambiguous

## Q2. Design grammars for the following languages:

1. The set of all strings of 0s and 1s that are palindromes; that is, the string reads the same backward as forward.
2. The set of all strings of 0s and 1s with an equal number of 0s and 1s.

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Answers:

1.  $S \rightarrow 0S0 \mid 1S1 \mid 0 \mid 1 \mid \epsilon$

2.  $S \rightarrow 0S1S \mid 1S0S \mid \epsilon$

Q3. Is this ambiguous grammar?

- Stmt  $\rightarrow$  if expr then stmt | if expr then stmt else stmt
- Discuss w.r.t. the following statement:
  - If E1 then S1 else if E2 then S2 else S3