

CS 280
Midterm Exam Example with Solution
Spring 2025

Total Points: 50

- 1. (10 points, 10 questions, 1 point each) True/False Questions:** For each of the following, write **T** if the statement is true and **F** if it is false. You must use **T** or **F**. Do not use x's or check marks they will be counted as wrong answers.

	Statement	T/F
1	BNF is a metalanguage for programming languages.	T
2	A grammar that generates a sentential form for which there are two or more distinct parse trees is said to be unambiguous.	F
3	The category of <i>Explicit heap-dynamic</i> variables are variables that are allocated and deallocated by explicit directives in C++ specified by the programmer.	T
4	In C++, variable declaration statements are not allowed to occur anywhere a statement can appear in a program.	F
5	Strings in C++ are defined as primitive type.	F
6	In C/C++, array index range checking is done.	F
7	Every regular expression can be expressed as a deterministic finite state machine	T
8	Lexical analyzers use table lookup to determine whether a possible identifier is in fact a reserved word or not.	F
9	A struct differs from an array in that its elements need not to occupy a consecutive block of memory cells.	F
10	In C++, Class template parameters can have <i>default values</i>	T

- 2. (40 points, 20 question, 2 points each) Multiple Choice Questions:** Circle one of the given choices for the answer of each question.

1. What have been the strongest influences on programming language design over the past 70 years?
 - a. Computer architecture only
 - b. Programming design methodologies
 - c. Both Computer architecture and Programming design methodologies
 - d. Diversity of application areas

ANS: C

2. What is the programming language category whose structure is dictated by the von Neumann computer architecture?
- Imperative
 - Logic
 - Functional
 - Object oriented

ANS: A

3. What is the correct EBNF for the following BNF rule?

term \rightarrow term * factor
 | term / factor
 | term % factor
 | factor

- term \rightarrow term (* | / | %) factor
- term \rightarrow term { (* | / | %) factor }
- term \rightarrow factor { (* | / | %) factor }
- term \rightarrow factor (* | / | %) factor

ANS: C

4. Given the following grammar rules:

$\langle \text{expr} \rangle \rightarrow \langle \text{expr} \rangle + \langle \text{term} \rangle \mid \langle \text{term} \rangle$
 $\langle \text{term} \rangle \rightarrow \langle \text{term} \rangle * \langle \text{factor} \rangle \mid \langle \text{factor} \rangle$

The grammar rules determine the precedence of * and + operators as follows.

- * operator has higher precedence than the + operator
- + operator has higher precedence than the * operator
- Both operators have the same precedence
- The precedence of operators cannot be determined from the given grammar rules

ANS: A

5. Consider the language defined by the following BNF grammar rules, where $\langle \text{CLAUSE} \rangle$ is the initial symbol, and a, b, and c are terminals.

$\langle \text{CLAUSE} \rangle ::= \langle \text{CLAUSE} \rangle \text{ AND } \langle \text{PHRASE} \rangle \mid \langle \text{PHRASE} \rangle$
 $\langle \text{PHRASE} \rangle ::= \langle \text{ITEM} \rangle \mid \langle \text{ITEM} \rangle \text{ OR } \langle \text{PHRASE} \rangle$
 $\langle \text{ITEM} \rangle ::= \text{NOT } \langle \text{UNIT} \rangle \mid \langle \text{UNIT} \rangle$

$\langle \text{UNIT} \rangle ::= (\langle \text{CLAUSE} \rangle) \mid a \mid b \mid c$

The grammar rules determine the associativity of AND and OR operators as follows.

- AND operator has right association and the OR operator has left association
- AND operator has left association and the OR operator has right association
- Both operators have the left association
- Both operators have the right association

ANS: B

6. Given the following grammar with nonterminals S , A , and B ?

$S \rightarrow A a B b$

$A \rightarrow A b \mid b$

$B \rightarrow a B \mid a$

Which of the following sentences is a valid one in the language generated by this grammar.

- baab**
- bbbab**
- bbaaaa**
- bbabb**

ANS: A

7. Consider the following C++ code segment,

```
double z;  
void myFun(void) {  
    int a;  
    . . .  
    for(int i = 0; i < 10; i++) {  
        . . .  
        . . .  
    }  
}
```

What are the lifetimes of the variables z , a , and i in the above code segment?

- The life time of z is the program execution time, the lifetime of a is the function call execution time, and the lifetime of i is the for-statement block execution time.
- The life times of z and a are the program execution time, and the lifetime of i is the for-statement block execution time.
- The life time of z is the program execution time, and the lifetimes of a and i are the function call execution time.

- d. The life times of *z* and *a* are the program execution time, and the lifetime of *i* is the function call execution time.

ANS: A

8. Given the following declaration,

```
int *ptr;  
int x = 5;
```

What is the *r-value* of *ptr* in the following statement?

```
ptr = & x;
```

- a. R-value of *x* variable.
- b. Pointer variables do not have an r-value.
- c. L-value of *x* variable.
- d. R-value for *ptr* has not been defined.

ANS: C

9. Consider the following C function definition,

```
void function(void) {  
    int a, b, c; //definition 1  
    . . .  
  
    while (. . .) {  
        int b, d; //definition 2  
        . . .  
        . . .  
        if (. . .) {  
            int e, a; //definition 3  
            . . . //Point 1  
        }  
    }  
}
```

Determine the visible variables at Point 1, inside the if statement of the function, using the labelled definition statements by comments in the function,

- a. Variables *a* and *e* from definition 3, and variables *b* and *d* from definition 2.
- b. Variables *a* and *e* from definition 3, variables *b* and *d* from definition 2, and variables *c* from definition 1.
- c. Variables *a* and *e* from definition 3, and variables *b* and *c* from definition 1.
- d. Variables *a* and *e* from definition 3 only.

ANS: B

10. Which of the following is true of l-values and r-values of a variable?

- a. An l-value is a logical value, and an r-value is a real value.
- b. L-values are always to the left of r-values.
- c. An l-value refers to a variable's location while an r-value to its current value.
- d. L-values are local and r-values are relative.

ANS C

11. Given the following declaration in a C++ function:

```
int * ptr = new int [5];
```

The ptr variable is defined and initialized to:

- a. The address of an array stored in the run-time stack Segment.
- b. The address of an array stored in the heap segment.
- c. The address of an array stored in the data segment.
- d. The address of an array stored in the code segment.

ANS: B

12. Given the following struct definition for a Student, and the following declarations,

```
struct Student{  
    int id;  
    string name;  
    float gpa;  
};  
Student astud;  
Student * stptr = & astud;
```

Indicate which of the following choices is not a correct method to access a Student field.

- a. astud.name
- b. (*stptr).name
- c. stptr->name
- d. *stptr->name

ANS: D

13. Given the definition of class One, and the MyFun partial function definition,

```
class One
{
    public:
        One ( int x = 0) : val(x) { };
        . . . . .
    private:
        int val;
};

void MyFun()
{
    One obj1(5), obj2;
    int x = 4;

    . . . . .
    obj2 = x * obj1;
    . . .
}
```

It is required that a binary operator * to be overloaded to allow the execution of the following assignment statement in MyFun() definition:

obj2 = x * obj1;

Identify from the following choices the correct declaration of the operator*() function to be added either as a member or as a friend of the One class.

- a. Member function of class One: One operator*(int val);
- b. Global function: One operator*(int val, One obj);
- c. Member function of class One: One operator*(int val, One obj);
- d. Member function of class One: One operator*(One obj, int val);

ANS: B

14. Given the following declaration,

```
int value = 0;
```

A C++ reference variable, valRef, needs to be declared, which of the following options is the correct declaration statement for the valRef?

- a. `int & valRef = value;`
- b. `int & valRef = &value;`
- c. `int * valRef = value;`
- d. `int * valRef = &value;`

ANS: A

15. Examine the following code segment and select from the following choices the missing expression to make this loop continue until either ten values have been read or the file runs out of data. Where, `inData` is assumed an input `fstream` object.

```
int count = 0;
inData >> value;
while ( _____ )
{
    cout << value;
    inData >> value;
    count++;
}
```

- a. `count < 10 && inData`
- b. `count < 10 || !inData`
- c. `count <=10 && inData`
- d. `count < 10 && !inData`

ANS: A

16. Most existing languages can be tokenized using:

- a. Zero-character lookahead
- b. One-character lookahead.
- c. Two-character lookahead
- d. Any-character lookahead

ANS: B

17. Which regular expression that matches a sequence of a string of one or more even digits of any length followed by one or more letters?

- a. `[0 2 4 6 8]*[a-zA-Z]+`
- b. `[0 2 4 6 8]+ [a-zA-Z]+`
- c. `[0 2 4 6 8][a-zA-Z]`
- d. `[0 2 4 6 8]?[a-zA-Z]*`

ANS: B

18. What does it mean when an automaton (FSA) representing a token pattern reaches the Final state?
- a. The token has been determined.
 - b. There is an error in the input character string.
 - c. The input character string is incomplete.
 - d. The token has not been determined.

ANS: A

19. Given the following definition that describes regular expression of real numbers in scientific notation, what is the string of the following choices that does not match the given regular expression definition?

`[+-]? [0-9] \. ? [0-9]* e[+-] [0-9]+`

- a. **1.25e+3**
- b. **0.25e-4**
- c. **.25e-2**
- d. **-2e+2**

ANS: C

20. Given the following definition of a function template:

```
template <class T> T maximum(T x, T y) {  
    T res;  
    if(x > y)  
        res = x;  
    else  
        res = y;  
  
    return res;  
}
```

Assume the following variables definitions in a program unit:

```
double x, y, z;  
float i, j, k;
```

Which of the following calls to the maximum function from the program unit would cause a syntax error?

- a. `z = maximum(x, y);`


```
b. k = maximum(i, j);  
c. z = maximum(i, x);  
d. z = maximum <double>(i, x);
```

ANS: C