

1.(a) For a computer using 32-bit floating point binary numbers, what will be considered as:

+0, -0, +∞, -∞ and NaN? Explain and write the numbers in binary format.

Hints: The value of the number  $(-1)^s \times (1.f)_2 \times 2^{e-127}$

(b) Define and explain machine epsilon using the following example:

Let's look at this concept for a hypothetical word of 8 bits that stores a real number where the first bit is used for the sign of the number, the next three bits for the biased exponent, and the last four bits for the magnitude of the mantissa.

The number  $1_{10}$  is represented as  $1_{10} = 00110000$

(c) Let  $x = 7/22$  and  $y = 1/3$ . Calculate (i)  $x + y$ , (ii)  $x - y$ , (iii)  $x \times y$  and (iv)  $x / y$  using 4 digit chopping. Find relative and absolute error for each of the cases.

2.(a) Write an algorithm (or a program in C) to find a root of the function  $f(x) = ax^2 + bx + c = 0$  in the range  $x_1 < x < x_2$  using *False Position Method*.

(b) Consider finding the root of  $f(x) = e^{-x}(3.2 \sin(x) - 0.5 \cos(x))$  using *False Position Method*.

Let  $\epsilon_{\text{step}} = 0.001$ ,  $\epsilon_{\text{abs}} = 0.001$  and start with the interval [3, 4].

(c) Consider finding the root of  $f(x) = e^{-x}(3.2 \sin(x) - 0.5 \cos(x))$  using *Secant Method*.

Let  $\epsilon_{\text{step}} = 0.001$ ,  $\epsilon_{\text{abs}} = 0.001$  and start with the interval [4, 5].

3.(a) For an arbitrary system of equations, what are the possibilities of finding the solution?

(b) Write a program in C to find the roots of a system of linear equations using Basic Gauss Elimination Method in a following way.

- 1) The A and b is taken from a text file.
- 2) If the pivot element is zero, then the whole line will be swapped with the bottom line.
- 3) The program consists of three functions

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(a) read_data()
(b) forward_illimination()
and
(c) back_substitution()
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(c) Solve the following system of equations using Gauss Elimination Method.

$$2x_0 + x_1 + x_2^T - 2x_3^I = 0$$

$$4x_0 + 2x_2^T + x_3^I = 8$$

$$3x_0 + 2x_1 + 3x_2^T = 7$$

$$x_0 + 3x_1 + 2x_2^T = 3$$

Duration: 1 hour 30 minutes

Full marks: 30

1. Compare and contrast between collision resolve by separate chaining and open addressing. 2
2. Which one of the following hash functions on integers will distribute keys most uniformly over 10 buckets numbered 0 to 9 for  $i$  ranging from 0 to 2020? 4
  - i)  $h(i) = i^2 \bmod 10$
  - ii)  $h(i) = i^3 \bmod 10$
  - iii)  $h(i) = (11 * i^2) \bmod 10$
  - iv)  $h(i) = (12 * i) \bmod 10$
3. A hash table of length 10 uses open addressing with hash function  $h(k) = k \bmod 10$ , and linear probing. After inserting 6 values into an empty hash table, the table is as shown below. 4
 

		42	23	34	52	46	33		
0	1	2	3	4	5	6	7	8	9

Determine the order in which the key values could have been inserted into the table.

4. Given a text  $\text{txt}[0..n-1]$  and a pattern  $\text{pat}[0..m-1]$ , write a function  $\text{search}(\text{char } \text{pat}[], \text{char } \text{txt}[])$  that prints all occurrences of  $\text{pat}[]$  and its permutations (or anagrams) in  $\text{txt}[]$ . You may assume that  $n > m$  and all the characters in the pattern are distinct. Expected time complexity is  $O(n)$ . 5
5. Write a build function to build a suffix tree for a given text. Also write a search function to find a pattern in the suffix tree. 6
6. The computational complexity of Euclidean algorithm for GCD is  $O(\log_2 \min(a, b))$ . Explain. 3
7. In an RSA cryptosystem, a particular A uses two prime numbers  $p = 13$  and  $q = 17$  to generate her public and private keys. If the public key of A is 35. Then the private key of A is? 4
8. Solve  $12x \equiv 17 \pmod{19}$ . 2

**3<sup>rd</sup> Year 2<sup>nd</sup> Semester In-Course Examination, 2019**  
**CSE 3204 - Formal Language, Automata, and Computability**

**Total: 40**

**Time: 1 Hour 20 Minutes**  
*(Answer All Questions)*

1. Convert the following DFA into Regular Expression (Use State Elimination method). 8

	0	1
$\rightarrow *p$	$s$	$p$
$q$	$p$	$s$
$r$	$r$	$q$
$s$	$q$	$r$

2. Convert the following Regular Expression into an NFA with  $\epsilon$ -transitions: 7

$$(01^*(0+1))^*$$

3. Consider the following  $\epsilon$ -NFA. (a) Compute  $\epsilon$ -closure of each state (b) Convert the automaton to DFA 8

	$\epsilon$	a	b	c
$\rightarrow p$	$\emptyset$	{p}	{q}	{r}
q	{p}	{q}	{r}	$\emptyset$
$*r$	{q}	{r}	$\emptyset$	{p}

4. For the following DFA: 10

	0	1
$\rightarrow A$	B	A
B	A	C
C	D	B
$*D$	D	A
E	D	F
F	G	E
G	F	G
H	G	D

(a) Draw the table of distinguishabilities for this automaton.

(b) Use this table to minimize this DFA

5. Find the regular expression for the following languages, where the alphabet is  $\Sigma = \{0,1\}$  7

(a)  $L = \{w \mid w \text{ has at least three (3) 0s and always ends with a } 0\}$

(b)  $L = \{w \mid w \text{ has alternating 0s and 1s}\}$

**University of Dhaka**  
**Department of Computer Science and Engineering**  
**In-Course Examination**  
**3<sup>rd</sup> Year 2<sup>nd</sup> Semester, Session: 2018-2019**  
**STAT – 3205, Introduction to Probability and Statistics**

Total Marks: 30

Time: 1 Hour 30 Minutes

**(Answer All of the following Questions)**

1. Fifty people are grouped into four categories— A, B, C, and D—and the number of people who fall into each category is shown in the table:

Category	Frequency	Category	Frequency
A	11	A	11
B	14	B	14
C	20	C	20
D	5	D	5

- a) What is the experimental unit? 0.5  
 b) What is the variable being measured? Is it qualitative or quantitative? 0.5  
 c) Construct a pie chart to describe the data. 1.5  
 d) If we draw the bar chart, does the shape of the bar chart change depending on the order of presentation of the four categories? Is the order of presentation important? 1.5

2. We collected 50 pennies and recorded their ages, by calculating AGE = CURRENT YEAR - YEAR ON PENNY.

5	1	9	1	2	20	0	25	0	17
1	4	4	3	0	25	3	3	8	28
5	21	19	9	0	5	0	2	1	0
0	1	19	0	2	0	20	16	22	10
19	36	23	0	1	17	6	0	5	0

- a) Use the range approximation to approximate the standard deviation of these 50 measurements. 0.5  
 b) Construct a relative frequency histogram to describe the distribution of penny ages. 2  
 c) Find the mean, and the mode. 1  
 d) What can you say about the shape of this distribution from 2. b)? 0.5  
 e) Calculate the sample variance and standard deviation using calculator. 1  
 f) Compare the range and the standard deviation. The range is approximately how many standard deviations? 1  
 g) Calculate the z-score for the smallest and largest observations. Is either of these observations unusually large or unusually small? 1  
 h) Can you use Tchebysheff's Theorem to describe this data set? 3

3. Consider this set of bivariate data: (1, 6), (3, 2), and (2, 4).

- a) Calculate the covariance  $S_{xy}$ . 1  
 b) Calculate the correlation coefficient  $r$ . 1  
 c) Calculate the equation of the regression line using the computing formulas. 1  
 d) Plot the three points and the straight line on a scatterplot. Does the line pass through the middle of the three points? 1

4. a) 2 green, 4 red and 3 blue M&Ms are in a box. Three of them are selected at random.

- i) Consider the three events: A: 1st is red, B: 2<sup>nd</sup> is green and C: 3<sup>rd</sup> is blue. Now find  $P(A \cap B \cap C)$   
 ii) Find the probability that at least 2 of those are red or at most 1 of those is green. 2

- b) If event A and B are independent, show that  $P(A) \cap P(\bar{B}) = P(A) \cdot P(\bar{B})$  (Venn Diagram) 2

5. a) Use the definition of independent events to determine whether the events from rolling a die are independent or dependent. Show your work. 2

- i) The event odd numbers and the event 3 or 6  
 ii) The event even numbers and the event prime numbers

- b) Two fair dice are tossed. What is the probability that the sum of the number of dots shown on the upper faces is less than 9? What is the probability that the number of one upper face is double than other upper face? 2

- c) A survey of people in a given region showed that 20% were smokers. The probability of death due to lung cancer, given that a person smoked, was roughly 10 times the probability of death due to lung cancer, given that a person did not smoke. If the probability of death due to lung cancer in the region is .006, what is the probability of death due to lung cancer given that a person is a smoker? 2