

**Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Gopalganj**  
**Department of Computer Science & Engineering**  
**2<sup>nd</sup> Year 1<sup>st</sup> Semester B.Sc. (Engg.) Final Examination-2020**

**Course No.:CSE201**

Full Marks: 60

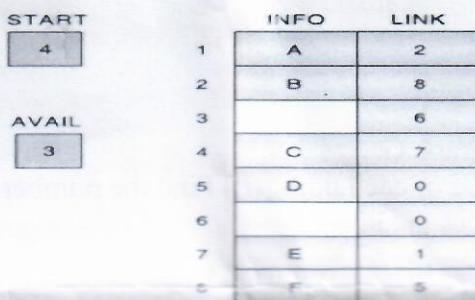
**N.B.:**

- i. Answer SIX questions, taking any THREE from each section.
- ii. All questions are of equal values

**Course Title: Data Structure**  
 Times: 3 Hours

**Section A**

1. a) Define Data Structure. Why do we need to know about different types data structures in the computer engineering field? 1+3
- b) What do you mean by garbage collection? Define Overflow and Underflow. 1+2
- c) What do you mean by the complexity of an algorithm? Discuss briefly the time-space tradeoff of algorithms. 1+2
2. a) What are the limitations of linear search algorithm? 2
- b) Apply binary search technique to the following sorted array, when search item is 40. 4  
 Array: 11, 22, 30, 33, 40, 44, 55, 60, 66, 77, 80, 88, 99
- c) Let's consider an array with values: 5, 1, 6, 2, 4, 3. Sort this array using the Bubble Sort algorithm. Show the first step's (pass 1) comparisons in detail. 4
3. Consider the following link list.



- a) Find the sequence of characters in the list. 1
- b) Suppose F and then C are deleted from the list and then G is inserted at the beginning of the list. Find the final structure. 2
- c) Suppose C and then F are deleted from the list and then G is inserted at the beginning of the list. Find the final structure. 2
- d) Suppose G is inserted at the beginning of the list and then F and then C are deleted from the structure. Find the final structure. 2
- e) What is two-way list? Write down the advantages and disadvantages of it. 3
4. a) Consider the following stack, where STACK is allocated N = 6 memory cells: 3  
 STACK: AAA, DDD, EEE, FFF, GGG, \_\_\_\_\_  
 Describe the stack as the following operations take place:  
 (i) PUSH(STACK, KKK), (ii) POP(STACK, ITEM), (iii) PUSH(STACK, LLL),  
 (iv) PUSH(STACK, SSS), (v) POP(STACK, ITEM) and (vi) PUSH(STACK, TTT).
- b) Consider the following arithmetic expression P, written in postfix notation: 3  
 P: 12, 7, 3, -, /, 2, 1, 5, +, \*, +

- X. a) Define Data Structure. Why do we need to know about different types data structures in the computer engineering field? 1+3

b) What do you mean by garbage collection? Define Overflow and Underflow. 1+2

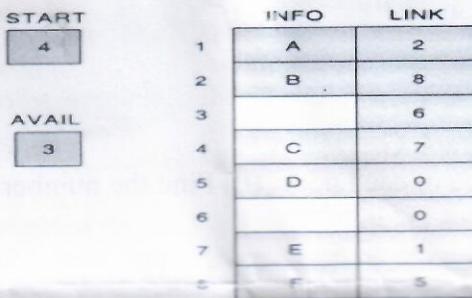
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Array: 11, 22, 30, 33, 40, 44, 55, 60, 66, 77, 80, 88, 99

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 (iv) PUSH(STACK, SSS), (v) POP(STACK, ITEM) and (vi) PUSH(STACK, TTT).

- (b) Consider the following arithmetic expression P, written in postfix notation:

P: 12, 7, 3, -, /, 2, 1, 5, +, \*, +

- (i) Translate P, by inspection and hand, into its equivalent infix expression.

- (ii) Evaluate the infix expression.

- c) Define priority queue. Consider the following queue of characters, where QUEUE is a 4 circular array which is allocated six memory cells:

FRONT = 2 REAR = 4 QUEUE: . , A, C, D, . ,

(For notational convenience, we use “ ” to denote an empty memory cell). Describe the queue as the following operations take place:

- (i) F is added to the queue  
 (ii) K, L, and M are added to the queue  
 (iii) R is added to the queue  
 (iv) S is added to the queue

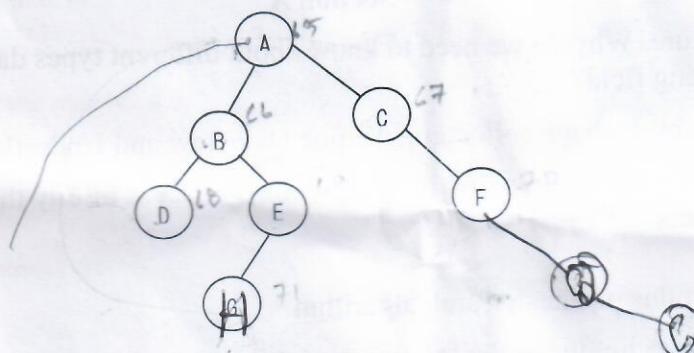
## Section B

5. a) What is heap? State max-heap and min-heap property. 1+2  
 b) Write the Huffman's Algorithm. Suppose A, B, C, D, E, F, G and H are 8 items and suppose they are assigned Weights as follows: 4

Data Item : A B C D E F G H  
 Weight : 22 5 11 19 2 11 25 5

Construct a tree using Huffman's algorithm.

- d) Deduce the preorder, in order, and post order sequences for the following binary tree: 3



6. a) Consider the following list of letters is inserted into an empty binary search tree: 4+3  
 J, R, D, G, T, E, M, H, P, A, F, Q  
 i. Find the final tree T (show each step separately) and  
 ii. Describe the tree after the node R is deleted

- b) Suppose inorder and preorder traversals of a binary tree are as follows: 3

Inorder: D B H E A I F J C G

Preorder: A B D E H C F I J G

Draw the binary tree.

7. a) Consider the following directed graph G. 4  
 (i) Find the indegree and outdegree of each node. (ii) Find the number of simple paths from v<sub>1</sub> to v<sub>4</sub>. (iii) Are there any sources or sinks?



- b) Suppose the graph G (Figure 7) represents the daily flights between cities of some airline. 6  
 Now find the minimum path from the city A to city E using BFS, where the each edge has length 1.

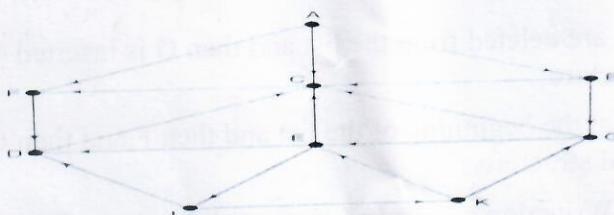
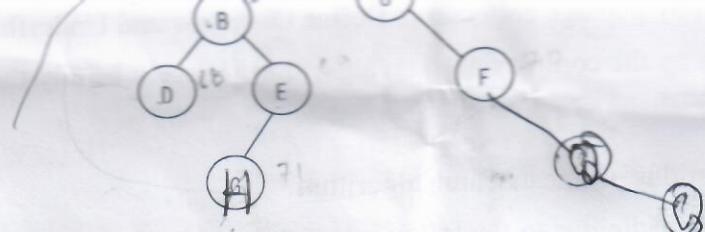


Figure 7: A directional graph G

8. a) Suppose an array A contains 6 elements as follows: 99 2 34 18 76 14 3  
 Insertion sort algorithm is applied on array A to sort its elements. Depict the state of the array after each pass of the algorithm.  
 b) Suppose S is the following list of 14 alphabetic characters: 4  
 R A T A S T R U C T U R E S



6. a) Consider the following list of letters is inserted into an empty binary search tree: 4+3

J, R, D, G, T, E, M, H, P, A, F, Q

i. Find the final tree T (show each step separately) and

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Inorder: D B H E A I F J C G

Preorder: A B D E H C F I J G

Draw the binary tree.



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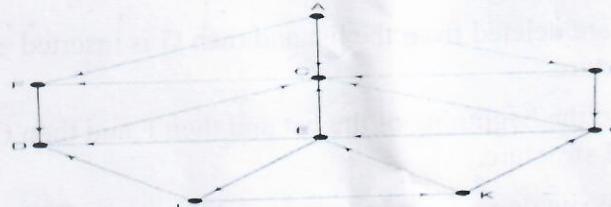


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Insertion sort algorithm is applied on array A to sort its elements. Depict the state of the array after each pass of the algorithm.

- b) Suppose S is the following list of 14 alphabetic characters: 4

D A T A S T R U C T U R E S

Suppose The characters in S are to be sorted alphabetically. Use the quicksort algorithm to find the final position of the first character D.

- c) Suppose 9 cards are punched as follows: 348, 143, 361, 423, 538, 128, 321, 543, 366. 3

Sort the numbers using Radix sort.

# Bangabandhu Sheikh Mujibur Rahman Science and Technology University

Department of Computer Science & Engineering

2<sup>nd</sup> Year 1<sup>st</sup> Semester B.Sc. Engineering Examination-2020

Course Code: CSE205

Full Marks: 60

Course Title: Java Technology

Time: 3 hours

Answer Three questions from each section

## Section A

- Q.1 (a) Why is object oriented design used for large scale software projects such as java? 3  
(b) Explain about Public, Private and protected access specifiers with proper example. 3  
(c) What is interface, why do we need interface? justify your answer with a proper example. 4
- Q.2 (a) Why java is Object-oriented, Platform independent and Multi-threaded? 3  
(b) Briefly describe Encapsulation, Polymorphism and Inheritance with real life example. 5  
(c) Write down the difference between constructor and method in java. 2
- Q.3 (a) What are the functions of class constructors? 3  
(b) Explain function overriding and function overloading with proper examples. 4  
(c) Why bytecodes are important in java. What are the functions of JVM? 3
- Q.4 (a) Explain the use of the final keyword in variable, method and class. 3  
(b) Explain class and objects in java? 3

Translate the following algorithm into Java Code:

- Step1: Declare a double variable named miles with initial value 100  
Step2: Declare a double constant named KILOMETERS\_PER\_MILE with value 1.609  
(c) Step3: Declare a double variable named kilometers, multiply miles and KILOMETERS\_PER\_MILE, and assign the result to kilometers.  
Step4: Display kilometers to the console.

## Section B

- Q.5 (a) What is a Thread? How many ways a thread can be created, answer it with proper examples? 3  
(b) Explain Thread life cycle. 4  
(c) How does an exception propagate in the code? give example. 3
- Q.6 (a) What do you mean by class variable? What do you understand by an instance variable and a local variable? 4  
(b) What are the advantages of Packages in Java? Give examples. 3  
(c) Multiple inheritance is not allowed in java but Multilevel is allowed; justify it. 3
- Q.7 (a) What do you mean by data encapsulation, JDK, JVM, JRE? 4  
Write output of the following code:  
public class InterviewBit{  
 final static int a=10;  
 public static void main(String[] args)  
 {  
 a++;  
 System.out.println(a);  
 }  
}
- (b) Use relevant properties to highlight the differences between interfaces and abstract classes. 3
- Q.8 (a) Do final, finally and finalize keywords have the same function? 3  
(b) When can you use super keyword? 2  
(c) What are the differences between C++ and Java? Can the static methods be overloaded? Can the static methods be overridden? 4

# Bangabandhu Sheikh Mujibur Rahman Science and Technology University

## Department of Computer Science and Engineering

### 2<sup>nd</sup> Year 1<sup>st</sup> Semester B.Sc. Engineering Examination-2020

Course Code: CSE203

Course Title: Digital Logic Design

Total Marks: 60

Time: 3 (Three) Hours

N.B. i) Answer any SIX questions taking THREE from each section.

#### SECTION-A

1. a) Find out the 11's and 10's complement of  $(5192.19)_{11}$ . 3
- b) Implement the function  $F = \Pi(1, 2, 3, 4, 5, 7)$  with only NAND gates. 3 ✓
- c) Simplify the function  $F = \Sigma(2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$  by using the tabulation method. 4 ✓
2. a) Design a logic circuit that converts a BCD number into a Gray code number. 4
- b) Design a 4-input priority encoder with the priority  $2 < 1 < 0 < 3$ . 3
- c) Design a full subtractor with a decoder and basic logic gates. 3
3. a) Implement the function  $F = \Sigma(1, 3, 4, 5, 7, 8, 9, 13, 15)$  with only one 4X1 MUX. 4 ✓
- b) Design a combinational circuit that compares two 4-bit numbers A and B to check whether B is 2's complement of A. 4
- c) Design a 4X1 MUX using two 2X1 MUXes. 2 ✓
4. a) Design a sequential circuit that performs the following operations on a 4-bit binary number using necessary MUXes with selectors  $S_1$  and  $S_0$ . 8

$S_1$	$S_0$	Operation
0	0	Set
0	1	Reset
1	0	Shift left
1	1	1's complement

- b) What is carry propagation? Why is it used? 2

#### SECTION-B

5. a) What do you mean by multiplexers? Implement a 8-to-1 multiplexer using two 4-to-1 and one 2-to-1 multiplexer. 6
- b) Make a 2-to-1 multiplexer using NAND gate. 4
6. a) A sequential circuit has following equations-  
 $A(t+1) = (CD' + C'D)x + (CD + C'D')x'$ ;  
 $B(t+1) = A$ ;  
 $C(t+1) = B$ ;  
 $D(t+1) = C$   
Obtain the sequence of states when  $x = 1$ , starting from state  $ABCD = 0001$ . 3
- b) What is self-correcting counter? Design a synchronous counter with  $T$  flip-flop for the following sequence.  $000 \rightarrow 001 \rightarrow 011 \rightarrow 100 \rightarrow 110 \rightarrow 111$ . If state 010 is encountered, it moves to valid state 011 and for state 101, it moves to state 110. 5
- c) What are the conditions for state reduction? 2
7. a) There are 4 states as 00, 01, 10, 11 for a machine. It moves from a state to another which 1's complement of the previous state when input  $x = 0$  and 2's complement of the previous state when input  $x = 1$ . Design the sequential circuit with JK flip-flop. 6

- b) Implement the function  $F = \Pi(1, 2, 3, 4, 5, 7)$  with only NAND gates. 3 ✓
- c) Simplify the function  $F = \Sigma(2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$  by using the tabulation method. 4 ✓
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- b) Convert a D flip-flop to T flip-flop. Use necessary gates. 2
- c) Derive the characteristic table and the characteristic equation for a JK flip-flop. 2
8. a) Explain the memory unit and its operating principles with block diagram. 4
- b) Design a 4-bit Johnson Counter. What is the disadvantage of Johnson Counter? What is the difference between Johnson Counter and Ring Counter? 4
- c) Write the difference between ROM and PLA. 2

**Bangabandhu Sheikh Mujibur Rahman of Science and Technology University**

**Department of Computer Science and Engineering**

**2<sup>nd</sup> Year 1<sup>st</sup> Semester B.Sc. (Engg.) Final Examination-2020**

**Course Code: STA205, Course Title: Applied Statistics and Queuing Theory**

**Full Marks: 60**

**Time: 3 Hour**

**Section A**

[Answer any **three** of following questions]

1. a) Define the following terms with example: Statistics, Variable, Data 3
- b) Distinguish among the following: Qualitative and quantitative variable, Bar diagram and histogram, Mean and median.
- c) Classify the following variables as nominal, ordinal, interval or ratio: 4  
Number of patients seen, Social Status, Quality of manufacturing product, Occupation, Country, Running Speed of an athletic.
  
2. a) Show that  $\sum_{i=1}^n (x_i - \bar{x}) = 0$  2
- b) Prove that arithmetic mean is dependent on both origin and scale of measurement. 3
- c) The following table shows the age distribution of 50 workers of a pharmaceutical company 5

Age in years	25-29	30-34	35-39	40-44	45-49	50-54
Number of workers	3	9	15	12	6	5

Calculate mean and median.

3. a) What do you mean by dispersion? State the name of some measures of dispersion. 2
  - b) The following table gives the marks of 30 students in physics in an examination 5
- | Marks              | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 |
|--------------------|-------|-------|-------|-------|-------|
| Number of students | 8     | 12    | 6     | 2     | 2     |
- Calculate variance and hence standard deviation.
- c) Show that the variance is independent on the origin but dependent on the scale of measurement. 3
  4. a) Define and illustrate with example: Probability, Sample space, Event, Experiment 4
  - b) Distinguish between: Deterministic experiment and Random experiment. 2
  - c) A newly married couple is planning to have two children and suppose that each child is equally likely to be a boy or a girl. Construct a sample space and find the probability that the couple will have i) two boys ii) one boy and one girl iii) at least one girl. 4

**Section B**

[Answer any **three** of the followings]

5. a) What is regression analysis? Mention some properties of correlation coefficient. 4  
What are the differences between regression and correlation analysis?

- b) A departmental store has the following statistic on sales (y) for a period of last one year of 10 salesmen, who have varying years of sales experience (x). 6

Salesperson	1	2	3	4	5	6	7	8	9	10
Years of experience (x)	1	3	4	4	6	8	10	10	11	13
Sales (y)	80	97	92	102	103	111	119	123	117	136

- i) Find the regression of y on x.
- ii) Predict the annual sales volume of persons who have 12 and 15 years of sales experience.

6. a) Define: Joint probability, Conditional probability. 2

- b) Examination results of 150 students showed that 95 students passed mathematics, 75 students passed economics and 135 students passed at least one of the above subjects. A student is selected at random. What is the probability that the student

- i) Passed both mathematics and economics?
- ii) Failed both the subjects?
- iii) Passed mathematics but failed economics?

- c) What is independence of events? A fire brigade has two fire engines operating independently. The probability that a specific fire engine is available when needed is 0.99

- i) What is the probability that an engine is available when needed?
- ii) What is the probability that none is available when needed?

7. a) Define probability distribution. What conditions to be satisfied for a probability mass function? An unbiased coin is tossed three times. Let X be the number of heads obtained as a result of the outcomes of this experiment. Find the probability distribution of X. 6

- b) A continuous random variable X has the following density function:

$$f(x) = \begin{cases} \frac{2(x+1)}{27}, & 2 < x < 5 \\ 0, & \text{elsewhere} \end{cases}$$

Find (i)  $P(X < 4)$  and (ii)  $P(3 < X < 4)$

8. a) What is the differences between Bernoulli and Binomial distribution? State the important properties of Binomial distribution. 3

- b) Find mean and variances of Binomial distribution. 4

- c) A traffic control officer reports that 75% of the trucks passing through a check post are from within Dhaka city. What is the probability that at least three of the next five cars are from outside of Dhaka city? 3

$\checkmark$   
 $\checkmark$   
 $\checkmark$   
 $\checkmark$   
 $\checkmark$   
 $\checkmark$

### Bangabandhu Sheikh Mujibur Rahman Science and Technology University

#### Department of Computer Science & Engineering

2<sup>nd</sup> Year 1<sup>st</sup> Semester B.Sc. Engineering Examination, 2020

Course Code: MAT205, Course Title: Vector, Matrix and Fourier Analysis

Time: 3 hours

Full Marks: 60

- N.B. i) Answer SIX questions, taking any THREE from each section.  
 ii) All questions are of equal values.

#### SECTION-A (30 Marks)

- Q.1 (a) Define unit vector. Find a unit vector parallel to the resultant of vectors  $r_1 = 2\hat{i} + 4\hat{j} - 5\hat{k}$  and  $r_2 = \hat{i} + 2\hat{j} + 3\hat{k}$  5
- (b) Find the unit tangent vector to any point on the curve  $x = t^2 + 1$ ,  $y = 4t - 3$ ,  $z = 2t^2 - 6t$ . Also determine the unit tangent at the point where  $t = 2$ . 5
- Q.2 (a) Define gradient, divergence and curl. Find the directional derivative of  $\phi = x^2yz + 4xz^2$  at  $(1, -2, -1)$  in the direction  $2\hat{i} - \hat{j} - 2\hat{k}$ . 6
- (b) Prove that:  $\nabla \times (\phi A) = (\nabla \phi) \times A + \phi(\nabla \times A)$  4
- Q.3 (a) Define line integrals, surface integrals and volume integrals. 6  
 Find the total work done in moving a particle in a force field given by  
 $F = 3xy\hat{i} - 5z\hat{j} + 10x\hat{k}$  along the curve  $x = t^2 + 1$ ,  $y = 2t^2$ ,  $z = t^3$  from  $t = 1$  to  $t = 2$ .
- (b) Evaluate  $\iint_S A \cdot n \, dS$ , where  $A = zi + xj - 3y^2zk$  and  $S$  is the surface of the cylinder  $x^2 + y^2 = 16$  included in the first octant between  $z = 0$  and  $z = 5$ . 4
- Q.4 (a) State and prove Green's theorem in the plane. 6
- (b) Verify Green's theorem in the plane for  $\oint_C (xy + y^2)dx + x^2dy$  where  $C$  is the closed curve of the region bounded by  $y = x$  and  $y = x^2$ . 4

#### SECTION-B (30 Marks)

- Q.5 (a) Define symmetric matrix, hermitian matrix and orthogonal matrix with example. Show that  $A = \begin{pmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{pmatrix}$  is a idempotent matrix. 6
- (b) Show that, every square matrix can be uniquely expressed as the sum of a symmetric matrix and a skew-symmetric matrix. 4

$$R_1 = \frac{R_1}{3}$$

$$R_2 = R_2 - R_1$$

$$R_3 = R_3 - 2R_1$$

$$R_2 = -\frac{1}{4}R_2$$

Q.6 (a) Using row canonical form, find the inverse of the following matrix:

$$A = \begin{bmatrix} 3 & 4 & -1 \\ 1 & 0 & 3 \\ 2 & 5 & -4 \end{bmatrix}$$

(b) Define rank of a matrix.

$$\text{Find the rank of the matrix } A = \begin{bmatrix} 1 & 3 & 1 & -2 & -3 \\ 1 & 4 & 3 & -1 & -4 \\ 2 & 3 & -4 & -7 & -3 \\ 3 & 8 & 1 & -7 & -8 \end{bmatrix}.$$

$$R_1 = R_1 - \frac{1}{3}R_2$$

$$R_3 = R_3 - \frac{7}{3}R_2$$

Q.7 (a) Define Fourier series.

$$\text{Find the Fourier series of the function } f(x) = \begin{cases} 0, & -\pi \leq x \leq 0 \\ 1, & 0 \leq x \leq \pi \end{cases}.$$

$$R_3 = \frac{2}{5}R_3$$

(b) Find the Fourier integral of the function  $f(x) = e^{-kx}$  when  $x > 0$  and  $f(-x) = f(x)$  for 5

$$k > 0, \text{ and hence prove that } \int_0^\infty \frac{\cos ux}{k^2 + u^2} du = \frac{\pi}{2k} e^{-kx}.$$

$$R_1 = R_1 - 3R_3$$

Q.8 (a) Find the Fourier transform of  $f(x)$  defined by  $f(x) = \begin{cases} 1, |x| < a \\ 0, |x| > a \end{cases}$ .

$$R_2 = R_2 + \frac{5}{2}R_3$$

(b) Use finite Fourier transforms to solve 6

$$\frac{\partial U}{\partial t} = \frac{\partial^2 U}{\partial x^2}; \quad U(0, t) = 0; U(\pi, t) = 0; U(x, 0) = 2x \text{ where } 0 < x < \pi, t > 0.$$

$$\iint_A A \cdot n ds = \iint_R A \cdot n \frac{dxdz}{|J_n|}$$

$$\Delta (x^2 + y^2) \\ \nabla^2 (x^2 + y^2)$$

$$\frac{1}{2} \times 2 = 1$$
$$\frac{1}{2} = 0.5$$
$$\frac{1}{2} = 0.5$$
$$\frac{1}{2} = 0.5$$

## 10107 What is the Median?

Median plays an important role in the world of statistics. By definition, it is a value which divides an array into two equal parts. In this problem you are to determine the current median of some long integers. Suppose, we have five numbers  $\{1,3,6,2,7\}$ . In this case, 3 is the median as it has exactly two numbers on its each side.  $\{1,2\}$  and  $\{6,7\}$ . If there are even number of values like  $\{1,3,6,2,7,8\}$ , only one value cannot split this array into equal two parts, so we consider the average of the middle values  $\{3,6\}$ . Thus, the median will be  $(3+6)/2 = 4.5$ . In this problem, you have to print only the integer part, not the fractional. As a result, according to this problem, the median will be 4 !

### Input

The input file consists of series of integers  $X$  ( $0 \leq X < 2^{31}$ ) and total number of integers  $N$  is less than 10000. The numbers may have leading or trailing spaces.

### Output

For each input print the current value of the median.

### Sample Input

```
1  
3  
4  
60  
70  
50  
2
```

### Sample Output

```
1  
2  
3  
3  
4  
27  
4
```