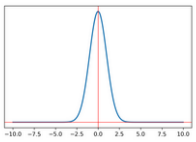
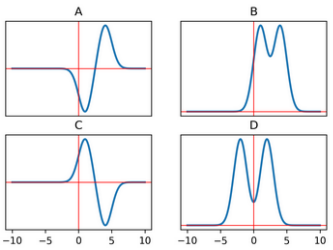
Question 1

If y=f(x) is



then, y=f(x-1)+f(x-4) is



- A
- B
- C
- D
- None of the above

Question 2

If $\mathbf{u}$ and $\mathbf{v}$ are two column vectors with n components, then which of the following is true about $\mathbf{W} = \mathbf{u}\mathbf{v}^T + \mathbf{v}\mathbf{u}^T$ and $\mathbf{X} = \mathbf{u}^T\mathbf{v} + \mathbf{v}^T\mathbf{u}$

- W is a n-dimensional vector and X is a scalar
- W is a scalar and X is a n-dimensional vector
- W is always symmetric n x n matrix and X is always a scalar
- W is any n x n matrix and X is always scalar

Question 3 **Max. score: 5.00**

Due to covid lockdown, a person is allowed to wait at the bus stop only for 15 minutes.

Ram plans to meet with his friend Gopal at the bus stop between 2 and 3 pm. The agreement between them is that after one arrives they will wait until the other shows up, 15 minutes passes or it becomes 3 pm, whiever is earlier.

If Ram is covid-positive, what is the probability that Gopal gets the infection from Ram?

- 1/4
- 3/16
- 13/16
- 3/4

Question 4

Consider the system of equations

$$x - y + 2z = 1$$
$$2x - y + 7z = 2$$
$$-x + 2y + z = b$$

- if b = -2, there are infinitely many solutions
- if b = -1, there is no solution
- if b = 3, there is no solution
- if b = 4, there is unique solution

Question 5

Let the vector $\mathbf{u} = [a, b, c]^T$ and the matrix $\mathbf{A} = \begin{pmatrix} a^2 & ab & ac \\ ab & b^2 & bc \\ ac & bc & c^2 \end{pmatrix}$ is formed by the operation $\mathbf{A} = \mathbf{u}\mathbf{u}^T$ where a, b, c are non-zero real numbers. What among the following is true about the matrix $\mathbf{A}$?

- The matrix A has three real, non-zero eigen values
- The matrix A has one complex and two real non-zero eigen values
- The matrix A has only one non-zero eigen value
- The matrix has two non-zero eigen values

Question 6 **Max. score: 5.00**

An email server automatically scans incoming mails for spam by using rules that search that for specific keywords. One spam rule it uses is to see if the subject line contains "You should read this!!". Say 4 in 10 emails are spam, 1% of all spam mails have the subject “You should read this!!”, while 1 in 250 non-spam emails actually have “You should read this!!” as a valid subject. What is the probability that an email that was marked as spam using this spam rule is indeed a spam email?

- 0.125
- 0.625
- 0.3125
- 0.25

Question 7

The following code computes the nth number in the Fibonacci sequence. What is the complexity of this program?

```
int Fib(int n)
{
  if(n==0) return 0;

  else if(n==1) return 1;

  else return Fib(n-1) + Fib(n-2);
}

int main()
{
  int n;

  scanf("%d",&n);

  Fib(n);
}
```

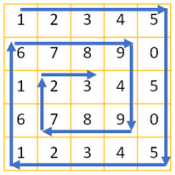
- O(n)
- O(n^2)
- O(log n)
- O(nlog n)

Question 8 **Max. score: 10.00**

Spiral traversal - 1

Say you are given a square matrix M of size $n \times n$. Give the program to traverse and print the items in the matrix in a clockwise spiral order, starting from the top left corner $(0, 0)$.

M_{5x5}



Answer:
1 2 3 4 5 0 5 0 5 4 3 2 1 6 1 6 7 8 9 4 9 8 7 2 3

Sample input

```
5
1 2 3 4 5
6 7 8 9 0
1 2 3 4 5
6 7 8 9 0
1 2 3 4 5
```

Sample output

```
1
2
3
4
5
0
5
0
5
4
```

Question 9 **Max. score: 5.00**

Diagonally dominant matrix

Write a program to test whether a square matrix A is diagonally dominant.

A square matrix is said to be diagonally dominant if for every row of the matrix, the magnitude of the diagonal entry in a row is larger than or equal to the sum of the magnitudes of all the other (non-diagonal) entries in that row.

You will read the input and write the output from/to standard IO (console). Sample template code to read and write from I/O is provided for C, C++, Java. Choose one of the languages comfortable to you.

Input format:

The data type of elements of A is **FLOAT**. You read the matrix A from the standard console input as explained below.

The first row has the value of N, which gives the size of A. The following N rows are rows of A, with each row having N integers separated by a space. There is a trailing space at the end of a line.

Output format:

You should output "True"/"False" to standard console output

Sample input

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

Sample output

```
False
```