# Sample Questions for MDS Online Test

The online test consist of multiple choice questions. The question consists of the following topics

- Basics of Probability and Statistics;
- Basics of Linear Algebra
- Basics of Machine Learning
- Basics of Algebra and Calculus
- Basics of Algorithms and Programming

Some of the sample question on these topics are given below.

## Sample Questions on Basics of Probability and Statistics

1. Suppose two unbiased coins are tossed; then what is the probability of getting at most one head:

   **(a)** $\frac{1}{4}$
   **(b)** $\frac{1}{8}$
   **(c)** $\frac{1}{2}$
   **(d)** $\frac{3}{4}$

2. Let $X$ be a random variable that takes a value of either $+1$ or $-1$, each with probability $1/2$. What are the mean and variance of $X$?

   **(a)** Mean=0, Variance=0
   **(b)** Mean=0, Variance=1
   **(c)** Mean=1, Variance=0
   **(d)** Mean=1, Variance=1

3. Let $A$ and $B$ be two events. $P(A)$ and $P(B)$ denote the probability of events $A$ and $B$ occurrence, respectively. $P(AB)$ denotes the probability of occurrence of $A$ and $B$ together.

   $P(A) = 1/3, P(B) = 1/4$ and $P(AB) = 1/5$. What is the probability of occurrence of event $A$ given that $B$ has already occurred $P(A|B)$?

   **(a)** $\frac{3}{5}$
   **(b)** $\frac{1}{5}$
   **(c)** $\frac{1}{2}$
   **(d)** $\frac{4}{5}$

4. Suppose a fair coin is tossed three times; then what is the probability that all three outcomes are identical?

**(a)** $\frac{1}{8}$

**(b)** $\frac{1}{16}$

**(c)** $\frac{1}{2}$

**(d)** $\frac{1}{4}$

5. Suppose a bag consists of 6 red, 8 blue, and 3 green balls. Suppose two balls are drawn randomly (without replacement and without looking at their colour), then what is the probability that both balls are of red colour?

   **(a)** none of the above

   **(b)** $\frac{5}{51}$

   **(c)** $\frac{7}{53}$

   **(d)** $\frac{6}{54}$

## Sample Questions on Basics of Linear Algebra

1. What is the inner product (dot product) of the following vectors: $(1, 2, 1)$ and $(-1, 2, 4)$

   **(a)** 5

   **(b)** 7

   **(c)** 3

   **(d)** 11

2. What is the rank of the following matrix:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

   **(a)** 2

   **(b)** 1

   **(c)** 3

   **(d)** none of these

3. Suppose $A, B$ are square matrices of size $n \times n$. Let denote the determinant of the matrix by $det(A)$. Then which one of the following is not true:

   **(a)** $det(kA) = k^n det(A)$

   **(b)** $det(AB) = det(A)det(B)$

   **(c)** $det(A + B) = det(A) + det(B)$

   **(d)** $det(A^T) = \frac{1}{det(A^{-1})}$

4. Which of the following statements is true about the trace of a matrix $X$

   **(a)** It is the sum of diagonal elements of $X$

   **(b)** Trace is a linear function

   **(c)** Both (A) and (B)

   **(d)** Neither (A) and (B)

5. What should be the values of scalars $a, b, c$ so that the vector $(1, 1, 1)$ can be written as a linear combination of the following vectors: $(1, 2, 3), (1, 0, 1), (1, 1, 0)$

   **(a)** $a = 1/2, b = 1/4, c = 1/4$

   **(b)** $a = 1/4, b = 1/2, c = 1/4$

   **(c)** $a = 1/4, b = 1/4, c = 1/4$

   **(d)** $a = 1/4, b = 1/4, c = 1/2$

## Sample Questions on Basics of Machine Learning

1. What is the time complexity of computing the optimal solution for k-means clustering on the $n$ data points in $d$-dimensional vector space?

   **(a)** Time complexity is an exponential function of $n$

   **(b)** Time complexity is a linear function of $n$

   **(c)** Time complexity is constant

   **(d)** Time complexity is sublinear function of $n$

2. Let $A \in R^{n \times d}, x \in \mathbb{R}^d, b \in \mathbb{R}^n, n \gg d$. Consider the following optimization problem for least square regression

   $$x_{opt} = argmin_x ||Ax - b||_2.$$

   Which one of the following is the correct value of $x_{opt}$

   **(a)** $x_{opt} = A^{\dagger} b$

   **(b)** $x_{opt} = A^{-1} b$

   **(c)** $x_{opt} = Ab$

   **(d)** None of the above

3. Which one the following is not a dimensionality reduction method

   **(a)** SVD

   **(b)** PCA

   **(c)** ICA

   **(d)** $k$-means clustering

4. Which of the following is not a supervised learning

   **(a)** SVD

   **(b)** Linear Regression

   **(c)** Naive Bayes

   **(d)** Decision Tree

## Sample Questions on Basics of Algebra and Calculus

1. For which value of $x$ the polynomial $(x–1)(3–x)$ attain its maximum value?

   **(a)** $x = 0$

   **(b)** $x = 1$

   **(c)** $x = 2$

   **(d)** None of the above

2. For what values of $x$ , the function $\frac{x^3}{3} - x^2 + 3$ will have a horizontal tangent

   **(a)** only 0

   **(b)** only 2

   **(c)** 0 and 3

   **(d)** None of the above

3. Consider the equation of the following two lines:

$$x + y = 9$$
$$3x - 2y = 12$$

   **(a)** $x = 9, y = 0$

   **(b)** $x = -9, y = 0$

   **(c)** $x = 6, y = 3$

   **(d)** $x = 7, y = 2$

## Sample Questions on Basics of Algorithms and Programming

1. What is the average time complexity of merge sort to sort an array of $n$ elements?

   **(a)** $O(n \log n)$

   **(b)** $O(n \log^2 n)$

   **(c)** $O(n^2)$

   **(d)** $O(n)$

2. Consider an array `arr`. How to access the second element of arr using the pointer notation?

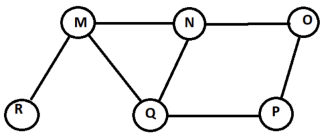
   **(a)** *(*`arr`+2)

   **(b)** *(`arr`+2)

   **(c)** &(`arr`+2)

   **(d)** (*`arr`+2)

3. What will be the order of nodes if the following graph is visited via the BFS algorithm (implemented via queue data structure)?



**(a)** MNOPQR

**(b)** QMNPOR

**(c)** QMNPRO

**(d)** NQMPOR

4. What is the output of the following C program?

```c
#include <stdio.h>
int main(){
   int a,b,c;
   a=0x10; b=010;
   c=a+b;
   printf("\nAddition is= %d",c);
   return 0;
}
```

**(a)** Addition is = 24

**(b)** Addition is = 20

**(c)** Compilation error

**(d)** Addition is = garbage value