

Office
Bangabandhu Sheikh Mujibur Rahman Science and Technology University

Department of Computer Science and Engineering
4th Year 1st Semester B.Sc. Engineering Examination-2016

Course Title: Machine Learning
Total Marks: 60

Course No: CSE 440
Time: 3 (three) Hours

N.B.

- i) Answer SIX questions taking any THREE from each Section
- ii) All questions are of equal values.
- iii) Use separate answer script for each section

Section-A

1. a) What is Machine Learning (ML)? ML is an isolated topic. Do you agree or not? Explain 3
briefly.
b) What is information gain? How can you make a decision tree based on the following 7
table

age	income	student	credit_rating	buys_computer
<=30	high	no	fair	no
<=30	high	no	excellent	no
31...40	high	no	fair	yes
>40	medium	no	fair	yes
>40	low	yes	fair	yes
>40	low	yes	excellent	no
31...40	low	yes	excellent	yes
<=30	medium	no	fair	no
<=30	low	yes	fair	yes
>40	medium	yes	fair	yes
<=30	medium	yes	excellent	yes
31...40	medium	no	excellent	yes

2. a) What are supervised and unsupervised learning? 3
b) Discuss different kinds of attribute selection measurements technique. 4
c) How can we enhance basic decision tree induction? 3
3. a) What is the quality for good clustering? What are the requirements and challenges of clustering? 3
b) Define naive bayes classifier? For the above table 1(b) find class label if data sample X = (age <=30, Income = high, Student = yes, Credit rating= excellent). 6
c) What is zero-probability problem? 1
4. a) Define Hidden Markov models. 6

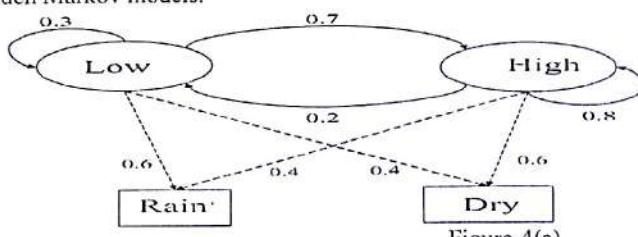


Figure-4(a)

From figure-4(a), Calculate a probability of a sequence of observations is {'Rain','Rain'}. Where initial probability of two state 'Low' and 'High' is equal.

- b) What do you mean by SVM? 4

Section-B

5. a) How can we measure accuracy, error rate, sensitivity and specificity, precision and recall for the following table? 6
- | Actual Class\Predicted class | cancer = yes | cancer = no | Total |
|------------------------------|--------------|-------------|-------|
| cancer = yes | 110 | 190 | 300 |
| cancer = no | 240 | 9460 | 9700 |
| Total | 350 | 9650 | 10000 |
- b) Describe k-nearest neighbor method. 4
6. a) Naive Bayes allows computing $P(Y|X)$ by learning $P(Y)$ and $P(X|Y)$. Why not learn $P(Y|X)$ directly? How can we learn $P(Y|X)$ directly? Explain with appropriate equations. 5
- b) Define back propagation rule. 5
7. a) What do you mean by sample dimension? How reduce dimension of sample? 2
- b) What is a Networked Virtual Environment (NVE)? What are the elements and components of NVE? 3
- c) What is ensemble learning? Discuss different kinds of ensemble learning? 5
8. a) Describe reinforcement learning. 4
- b) What do you mean by conditional probability? How Bayes probability can be used as classification. 4
- c) What are the advantages and disadvantages of Naive Bayesian Classifier? 2

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Section-A

1. a) Illustrate the parallel processing trends in case of the computer processing and operating systems point of view. 4
- b) How can we balance the bandwidth between memory and I/O devices? 3
- c) How does parallel processing contribute in the field of artificial intelligence and automation? 3
2. a) Explain the AT² model for parallel computers. 5
- b) What are the major structural differences between CISC and RISC processor? Explain with necessary figure. 5
3. a) How do non-linear pipelines differ from linear pipelines? 3
- b) Explain the mechanism of synchronous linear pipeline. 4
- c) Suppose a linear pipeline of 5 stages can process 1000 tasks. Calculate the pipeline efficiency and throughput with the clock cycle 0.5 sec. 3
4. a) Implement a pipenet with inserting delays between pipelines for the following systolic program graph (Fig-1). 5

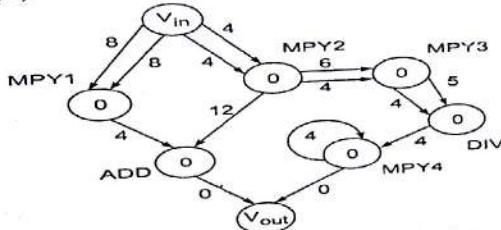


Fig-1: A systolic program graph

- b) Draw the block diagram of the interconnection structures in a generalized multiprocessor system. 3
- c) How does the C/S access memory organization combine the C-access and S-access? 2

Section-B

5. a) How do *scatter vector instructions* operate? 2
- b) Mention four requirements of the critical section for the shared-variable communication. 2
- c) Distinguish between fine-grain and coarse-grain parallel computer in four points. 4
- d) Compare the synchronous and asynchronous message passing model. 2
6. a) How does an actor model operate in parallel programming? 3
- b) Vectorize the following scalar operations using the loop distribution method: 3

Do 10 I = 1, N
 $D(I) = E(I) + A(I)$
 $D(I) = E(I) + B(I, J) * C(I, J)$

20 Continue
 $E(I, 1) = 0$

10 Continue
- c) Which features should be considered for developing a parallel programming tool? 4
7. a) Differentiate between shared memory architecture and distributed memory architecture for a distributed system. 3
- b) Compare between workstation model and workstation-server model. 4
- c) How can we get benefit of using distributed system in case of resource sharing and flexibility? 3
8. a) Illustrate the Bully Election algorithm to synchronize the processes. 5
- b) Differentiate between DDBMS and distributed processing. 2
- c) For designing a distributed system how we can handle the following issues:
 i. Reliability ii. Performance 3

Full Marks: 60 Time: 03 hours

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Section-A

- | | |
|--|---|
| 1. a) Define Simulation. | 1 |
| b) When simulation can be chosen as an appropriate tool? | 3 |
| c) Differentiate between the term endogenous and exogenous in one point. | 1 |
| d) Explain the steps of simulation study with appropriate flowchart. | 5 |
| 2. a) Which issues should be considered for selecting a simulation software? | 3 |
| b) Define the term Bootstrapping. | 2 |
| c) In a single-channel queuing system, the arrival time and service time of five customers is shown in Table-1. Here, the simulation will be start, when the first customer arrive in the system and it will be terminate when the last customer complete his/her service. | 5 |

Table-1: Simulation Table for Single-Channel Queuing System

Customer	Arrival Time(Minutes)	Service Time(Minutes)
1	0	3
2	2	4
3	8	2
4	12	.4
5	15	5

Using the Table-1, calculate the following terms:

- i. Average waiting time for a customer
 - ii. The probability that a customer has wait in the queue
 - iii. The proportion of idle time of the server
 - iv. The average service time
 - v. The average inter arrival time
3. a) What types of statistical distributions are typically suitable for the followings: i. Queuing systems ii. Inventory and supply-chain systems 2
- b) A computer repairperson is "beeped" each time there is a call for service. The number of beeps per hour is known to occur in accordance with a Poisson distribution with a mean of $\mu = 2$ per hour. Find the probability of –
i. three beeps in the next hours
ii. two or more beeps in a 1-hours period 4
- c) Explain "Poisson distribution" as a statistical model in simulation. 3
- d) When we use the empirical distribution? 1
4. a) What is queuing model? How it is useful for Simulation? Explain all different kind of Queuing Model in detail. 5
- b) There are two workers competing for a job. Able claims an average service time that is faster than Baker's, but Baker claims to be more consistent, even if not as fast. The arrival occur according to a Poisson process at the rate $\lambda = 2$ per hour (1/30 per minutes). Able's service statistics are an average service time of 24 minutes with a standard deviation of 20 minutes. Baker's service statistics are an average service time of 25 minutes, but a standard deviation of only 2 minutes. If the average length of the queue is the criterion for hiring, which worker should be hired? 5

Section-B

5. a) Compare between random numbers and random variates. 2
- b) Generate the five random numbers using the linear congruential method, where the seed is 27, multiplier is 17, increment is 43 and modulus is 100. 3
- c) Suppose that the five numbers 0.44, 0.81, 0.05, 0.14 and 0.93. Now, using the Kolmogorov-Smirnov test, perform a test for uniformity with the 0.05 level of significance. 5
6. a) Demonstrate the step-by-step procedure for generating random variates for exponential distribution, using the inverse-transform technique. 4
- b) Generate three Poisson variates with mean $\mu = 0.2$, using the following sequence of random 4

numbers: 0.4357, 0.4146, 0.8353, 0.9952, 0.8004, 0.7471, 0.7161, 0.8682, 0.9056, 0.8225

- | | |
|--|---|
| c) Illustrate the convolution method. | 2 |
| 7. a) Explain data collection and analysis for input modeling. | 2 |
| b) Mention the suggestive estimators for the following distributions: i. Gamma ii. Normal | 1 |
| c) Which considerations should be taken in the model verification process? | 4 |
| d) "Calibration is the iterative process of comparing the model to the real system" – Explain it. | 3 |
| 8. a) Able and Baker are technical support call center servers. Able's utilization for four independent runs or replications of two hours duration is given in Table-2. Calculate the overall point estimator, variance, standard error and 95% confidence interval half-width of Able's true utilization. | 6 |

Table-2: Able's Utilization of four independent runs of two hour duration.

Run	Able's Utilization
1	0.808
2	0.875
3	0.708
4	0.842

- | | |
|---|---|
| b) Compare the following terms: | 3 |
| i. Terminating simulation and Non-terminating simulation | |
| ii. Confidence interval and Prediction interval | |
| c) When we use the turing test for input-output validation? | 1 |

Appendix-A: Steady-State parameters of the M/G/1 queue

$$\begin{aligned} \rho &= \frac{\lambda}{\mu} \\ L &= \rho + \frac{\lambda^2(1/\mu^2 + \sigma^2)}{2(1-\rho)} = \rho + \frac{\rho^2(1+\sigma^2\mu^2)}{2(1-\rho)} \\ w &= \frac{1}{\mu} + \frac{\lambda(1/\mu^2 + \sigma^2)}{2(1-\rho)} \\ w_Q &= \frac{\lambda(1/\mu^2 + \sigma^2)}{2(1-\rho)} \\ L_Q &= \frac{\lambda^2(1/\mu^2 + \sigma^2)}{2(1-\rho)} = \frac{\rho^2(1+\sigma^2\mu^2)}{2(1-\rho)} \\ P_o &= 1 - \rho \end{aligned}$$

Appendix-B: Percentage points of the Student's t distribution with v degrees of freedom

v	t _{0.005}	t _{0.01}	t _{0.025}	t _{0.05}	t _{0.10}
1	63.66	31.82	12.71	6.31	3.08
2	9.92	6.92	4.30	2.92	1.89
3	5.84	4.54	3.18	2.35	1.64
4	4.60	3.75	2.78	2.13	1.53
5	4.03	3.36	2.57	2.02	1.48
6	3.71	3.14	2.45	1.94	1.44
7	3.50	3.00	2.36	1.90	1.42
8	3.36	2.90	2.31	1.86	1.40
9	3.25	2.82	2.26	1.83	1.38
10	3.17	2.76	2.23	1.81	1.37
11	3.11	2.72	2.20	1.80	1.36
12	3.06	2.68	2.18	1.78	1.36
13	3.01	2.65	2.16	1.77	1.35
14	2.98	2.62	2.14	1.76	1.34

Appendix-C: Kolmogorov-Smirnov Critical Values

Degrees of Freedom (N)	D _{0.10}	D _{0.05}	D _{0.01}
1	0.950	0.975	0.995
2	0.776	0.842	0.929
3	0.642	0.708	0.828
4	0.564	0.624	0.733
5	0.510	0.565	0.669
6	0.470	0.521	0.618
7	0.438	0.486	0.577
8	0.411	0.457	0.543
9	0.388	0.432	0.514
10	0.368	0.410	0.490
11	0.352	0.391	0.468
12	0.338	0.375	0.450
13	0.325	0.361	0.433
14	0.314	0.349	0.418
15	0.304	0.338	0.404
16	0.295	0.328	0.392
17	0.286	0.318	0.381
18	0.278	0.309	0.371
19	0.272	0.301	0.363
20	0.264	0.294	0.356
25	0.24	0.27	0.32
30	0.22	0.24	0.29
35	0.21	0.23	0.27

Full Marks: 60

Times: 3 Hours

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Section A

- | | |
|--|---|
| 1. a) What do you understand by digital signal processing? | 1 |
| b) Distinguish between Sonar and Radar. | 2 |
| c) Discuss the properties by which the continuous-time sinusoids can be characterized. | 2 |
| d) DSP has revolutionized many areas in science and engineering. Explain. | 5 |
| 2. a) What is system? | 1 |
| b) How can you say that a system is linearity? | 2 |
| c) Discuss the basic set of operation on signal. | 4 |
| d) Illustrate the decomposition of signals. | 3 |
| 3. a) What are static and dynamic systems? | 2 |
| b) Check for following systems are linear, causal, time invariant, stable, static <ul style="list-style-type: none"> i) $y(n) = x(2n)$ ii) $y(n) = \cos(x(n))$ | 4 |
| c) Distinguish between cross-correlation and autocorrelation. | 2 |
| d) Find the convolution of the following sequence $x(n) = (1, 2, -1, 1)$, $h(n) = (1, 0, 1, 1)$ | 2 |
| 4. a) Write down the reasons for using z-transform. | 1 |
| b) What is Region of convergence? State the properties of Region of convergence | 3 |
| c) Explain the convolution property of z-transform. | 3 |
| d) Find the Z transform of <ul style="list-style-type: none"> i) $x(n) = [(1/2)n - (1/4)n] u(n)$ ii) $x(n) = n(-1)^n u(n)$ iii) $x(n) (-1)^n \cos(\pi n/3) u(n)$ | 3 |

Section B

- | | |
|--|---|
| 5. a) Define DIT and IDFT. | 2 |
| b) What are magnitude and phase angle of twiddle factor? | 2 |
| c) Compute the DIT of the sequence whose values for one period is given by $x(n) = \{1, 1, -2, -2\}$. | 4 |
| d) Distinguish between aperiodic continuous and aperiodic discrete. | 2 |
| 6. a) What is FFT? Why FFT is needed? | 3 |
| b) Distinguish between Fourier series and Fourier transform. | 2 |
| c) Find the DIT of a sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using DIF algorithm. | 5 |
| 7. a) Explain the bit-reversal technique in DIT algorithm. | 3 |
| b) Write down the differences and similarities between DIT and DIF algorithms. | 3 |
| c) Compute 4-point DIT of a sequence $x(n) = \{0, 1, 2, 3\}$ using DIT algorithm. | 4 |
| 8. a) Write down the general purposes of using digital filters. | 3 |
| b) Distinguish between FIR and IIR filter. | 2 |
| c) Briefly explain recursive implementation of the moving average filter. | 2 |
| d) Write down the characteristics of the Blackman and Hamming windows. | 3 |

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Section-A

1. a) What is data communications? What are the protocols of data communication? 3
b) How does the term jitter effect on effective data communication systems? 2
c) Draw a hybrid topology with a ring backbone and three bus networks. 3
d) "Security is one of the most important criteria in Networking" – justify this. 2
2. a) What is protocol? Describe the key elements of a protocol. 4
b) Distinguish between baseband transmission and broadband transmission. 3
c) Assume we need to download text documents at the rate of 100 pages per sec. A page is an average of 25 lines with 80 characters in each line. What is the required bit rate of the channel? 3
3. a) What is impairment? What are the cause of impairment? Discuss briefly. 4
b) What are the propagation time and the transmission time for a 3-MB message if the bandwidth of the network is 1 Mbps? Assume that the distance between the sender and the receiver is 10,000 km and that light travels at 2.5×10^8 m/s. 3
c) For transmitting broadcasting TV images which transmission technique is preferable and why? 3
4. a) Differentiate between Nyquist theorem and Shannon's theorem for a communication channel in two points? 1
b) Consider a noiseless channel with a bandwidth 4000 Hz, transmitting a signal with three bits per signal level. Calculate the maximum bit rate for this channel. 3
c) Convert the data, 10010 into a digital signal, using the following line coding schemes:
i. NRZ-I ii. Manchester. 4
d) We want to digitize the human voice. What is the bit rate, assuming 8 bits per sample? 2

Section-B

5. a) What do you mean by Amplitude Shift Keying and Frequency Shift Keying? 4
b) Find the bandwidth for a signal transmitting at 12 Mbps for QPSK. The value of d = 0. 3
c) What do you understand by propagation and transmission delay and latency? 3
6. a) Why analog-to-analog conversion is needed? 1
b) How FM works? 3
c) An analog signal has a bit rate of 8000 bps and it has 128 signal elements. Find out the baud rate for this signal. 2
d) Draw the constellation diagram for the following cases. Find the peak amplitude value for each case and define the type of modulation (ASK, FSK, PSK, or QAM).
The numbers in parentheses define the amplitude of in-phase and quadrature carrier, respectively.
i. Two points at (3, 0) and (4, 0). ii. Four points at (1, -1), (1, 1), (2, -1), and (2, 1). 4
7. a) In the optical fiber communication, how step index differs from graded index? 2
b) Why microwaves are used in Cellular Telephones? 3
c) Four channels, two with a bit rate of 600 kbps and two with a bit rate of 500 kbps, are to be multiplexed using multiple slot TDM with no synchronization bits, Answer the following questions:
i. What is the size of a frame in bits? ii. What is the frame rate?
iii. What is the duration of a frame? iv. What is the data rate? 5
8. a) What is Hamming distance? What is the minimum Hamming distance? 2
b) Suppose sender sends data to the receiver through unreliable transmission. During transmission receiver gets corrupted codeword i.e. 10011. Find out the correct data-word using the Block Coding technique.
Table-1 shows the data-words with corresponding code-words. 4

Data-word	Code-word
00	00000
01	00010
10	00011
11	00100

Table 1: A code for error correction

- c) Describe the process of checksum. What kind of error is undetectable by the checksum?

4