L-4/T-2/CSE Date : 10/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 471** (Machine Learning)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What do you mean by PAC-learnability and shattering? Show the probability that the version space $VS_{H,D}$ is not ε-exhausted (with respect to c) is less than or equal to $|H|e^{-Em}$. Here the symbols have their usual meaning. **(15)**

   (b) Imagine yourself as an apprentice chef in a restaurant. Your first task is to figure out how to make a salad. The rules are supposedly simple: you are free to combine any of the ingredients as they are and you can also slice any of the ingredients into two distinct pieces before mixing them. Since you have learnt PAC learning theory, you wonder how much effort you would need to figure out the makeup in a salad.

   (i) Suppose that a naive chef makes salads by combining only any of the ingredients. Given N available ingredients and that each salad made out of these constitutes a distinct hypothesis. How large would the hypothesis space be? Explain how you arrive at your answer. **(3)**

   (ii) Suppose that a more experienced chef follows both rules when making a salad. How large is the hypothesis space now? Explain. **(3)**

   (iii) An experienced chef decides to train you to discern the makeup of a salad by showing you the salad samples he has made. There are 6 available ingredients. If you would like to learn any salad at 0.01 error with probability 99%, how many sample salads would you want to see? Show your workings in clear steps. **(5)**

   (c) Consider a 2D space or x1–x2 plane. What is the VC dimension of circles where points inside are labeled as 1's and those outside as 0's? Draw an example scenario with minimal number of points where these circles would fail to shatter the space. **(3)**

   (d) Explain case based reasoning using an appropriate example. **(6)**

2. (a) Discuss the key properties of *k*-nearest neighbor and locally weighted regression. **(5)**

   (b) Nearest neighbor approaches are sensitive to the *curse of dimensionality*. Explain at least two different methods to solve this problem. **(11)**

   (c) "The working procedure of the distance-weighted regression and the radial basis function network is very much similar" – Justify the statement. **(9)**

   (d) How does the radial basis function network differ from the feed-forward neural network? Why will the former network be more suitable than the later one for solving regression problems? **(5)**

Contd P/2

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Contd ... Q. No. 2

(e) In k-nearest neighbors, the classification is achieved by majority vote in the vicinity of data. Suppose there are two classes of data, each of $n/2$ points overlapped to some extent in a 2-dimensional space. Describe what happens to the training error (using all available data) when the neighbor size k varies from n to 1. **(5)**

3. (a) With the help of a Pseudo code, describe the FOIL algorithm in detail for learning a set of first-order rules. **(20)**

   (b) What are the most essential differences between FOIL and Sequential-covering and Learn-one-rule algorithms? **(5)**

   (c) Explain when and why a rule based learning method will be suitable over the black box learning method. **(5)**

   (d) Explain how you can avoid the local optima problem of sequential covering algorithm. **(5)**

4. (a) Explain when and why semi-supervised learning will provide much worse performance than supervised learning. **(5)**

   (b) How can a machine learning approach be used for e-mail filtering? **(5)**

   (c) With analytical formulations, describe negative correlation learning. **(7)**

   (d) Write the analytical form of the error measure used for classification and regression problems. **(2)**

   (e) Why the use of learning inside an evolutionary process may help in finding better solutions of a given problem. **(4)**

   (f) Give the flow chart of genetic programming in solving a problem. **(4)**

   (g) Describe all the components of genetic algorithm for obtaining the weights of a neural network. **(8)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Derive the expression for and interpret the significance of *information gain* heuristics used in ID3 algorithm. Given the following training examples, find a decision tree using information gain heuristics. Discuss the limitation of the tree generated. Propose a *gain ratio* based approach to remove the limitation of *information gain* based approach. What further issue does *gain ratio* face? **(25)**

Contd P/3

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Contd ... Q. No. 5(a)

Day	Outlook	Temperature	Humidity	Wind	Venue	Play Tennis
D1	Sunny	Hot	High	Weak	Dhaka	No
D2	Sunny	Hot	High	Strong	Chittagong	No
D3	Overcast	Hot	High	Weak	Rajshahi	Yes
D4	Rain	Mild	High	Weak	Khulna	Yes
D5	Rain	Cool	Normal	Weak	Sylhet	Yes
D6	Rain	Cool	Normal	Strong	Barisal	No
D7	Overcast	Cool	Normal	Strong	Rangpur	Yes
D8	Sunny	Mild	High	Weak	Bogra	No
D9	Sunny	Cool	Normal	Weak	Comilla	Yes
D10	Rain	Mild	Normal	Weak	N. Gonj	Yes
D11	Sunny	Mild	Normal	Strong	Rangpur	Yes
D12	Overcast	Mild	High	Strong	Dinajpur	Yes
D13	Overcast	Hot	Normal	Weak	Pabna	Yes
D14	Rain	Mild	High	Strong	Tangail	No

**Outlook, Temperature, Humidity Wind* and *Venue* are attributes and *Play tennis* is the function to be learned.

(b) Describe a typical design cycle for a machine learning problem. **(10)**

6. (a) State the CANDIDATE-ELIMINATION algorithm. Show that the version space generated by the CANDIDATE-ELIMINATION algorithm from the following set of examples is invariant to the ordering of the examples. Hints: Simulate the algorithm using the examples in the given and the reverse orders. **(23)**

Example	Sky	AirTemp	Humidity	Wind	Water	Forecast	EnjoySport
1	Sunny	Warm	Normal	Strong	Warm	Same	Yes
2	Rainy	Cold	High	Strong	Warm	Change	No
3	Sunny	Warm	High	Strong	Warm	Same	Yes
4	Sunny	Warm	High	Strong	Cool	Change	Yes

*EnjoySport is the target concept to be learned.

(b) Explain rule pruning in decision tree learning. What are the benefits of rule pruning over tree pruning? **(12)**

Contd P/4

CSE 471

7. (a) Define *sample error, true error* and *confidence interval* for a discrete value hypothesis. With appropriate assumptions on *sample, hypothesis*, and the *distribution of samples, relate the parameters of sample error* and *true error* to a Binomial distribution. Show why the *sample error* is an unbiased estimator of the *true error*. Derive the expression for confidence interval when the sample size is sufficiently large. **(23)**

   (b) Define *version space, general boundary,* and *specific boundary* of a *version space*. How do the positive and negative examples influence the general and specific boundaries of the version space? **(12)**

8. (a) Briefly describe the attributes that training experience should have in a typical machine learning problem. **(9)**

   (b) Differentiate between ID3 and CANDIDATE-ELIMINATION algorithms in terms of the hypothesis spaces that they search, and the search strategies that they follow. From this, define preference bias and restriction bias. **(11)**

   (c) Derive the expression for "confidence interval" for the estimation of difference of error of two learning algorithms when the sample size is limited. **(15)**

L-4/T-2/CSE **Date : 17/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 473** (Pattern Recognition)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Explain different constraints, including Itakura constraints and Sakoe and Chiba constraints, which are used in template matching algorithms. Indicate which of them are used in *edit distance* algorithm. How do the constraints have impact on search cost? What is the significance of following a non-monotonic path in template matching? **(25)**

   (b) State and describe the three basic problems in *hidden Markov models*. **(10)**

2. (a) Explain the significance and the relation of *internal energy* and *external energy* in deformable template matching. **(10)**

   (b) A pattern classification problem has been modeled using a *hidden Markov model* (HMM) with discrete observation, this means, the training observation string consists of only quantized vectors. Formulate an *expectation maximization* (EM) algorithm to estimate the parameters of the HMM. **(20)**

   (c) Explain the margin maximization concept used in *support vector machine*. **(5)**

3. (a) With an example, show how a transformation function can be used to transfer a set of linearly non-separable objects to a set of linearly separable objects. **(10)**

   (b) Explain *kernel trick*. How is it useful in designing a non-linear *support vector machine* classifier? **(15)**

   (c) Explain the parsing approach using transition networks. **(10)**

4. (a) Given the primitives and the set of example patterns shown in Fig. 4(a), find a *finite state grammar* (FSG) that satisfies the set of example patterns and draw the graphical representation of the FSG. Convert the FSG to *Chomsky normal form* (CNF). Draw a *Cocke-Younger-Kasami* (CYK) table to determine whether the test pattern given the Fig. 4(a) satisfies the corresponding grammar. **(25)**

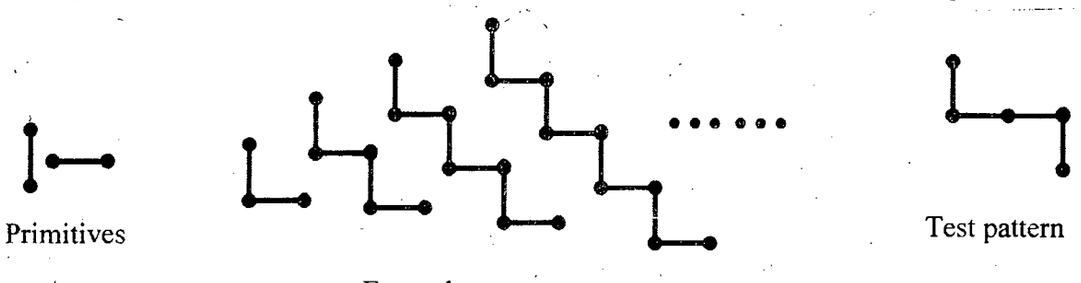


Figure for Question No. 4(a)

Contd P/2

CSE 473

Contd ... Q. No. 4

(b) From the following Bayesian belief network (BBN) in Fig. 4(b), find the probability that a person exercises given that he has heart disease. **(10)**

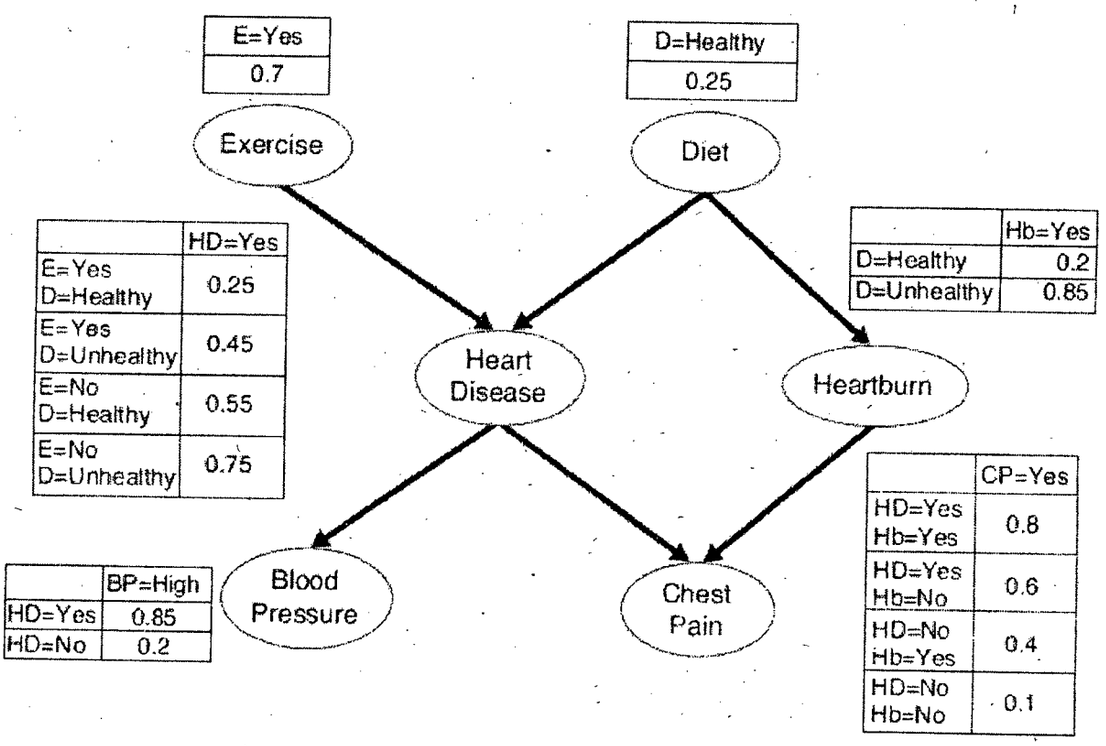


Figure for Question No. 4(b)

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) With a concrete example, explain why a single layer feed-forward neural network cannot solve non-linear problems. How does a multi layer network overcome the above mentioned shortcoming of the single layer network? **(15)**

   (b) Derive the weight update equation for the hidden layer to the output layer of a multi-layer perceptron network using the back-propagation learning algorithm. **(15)**

   (c) Explain the problems that may arise when you use a large or a small learning rate for training a neural network using the back-propagation learning algorithm. **(5)**

6. (a) Briefly describe different ways for handling missing attributes in data. **(15)**

   (b) Briefly describe basic steps involved in designing a classification system. **(15)**

   (c) What are the differences between the Bayes learning rule and Perceptron learning rule? **(5)**

Contd P/3

CSE 473

7. (a) "The cluster criterion (e.g. similarity or dissimilarity measure) is an important component in clustering" – Justify the statement. **(7)**

   (b) What are the problems associated with hierarchical clustering? Give some intuitive ideas on how we can avoid those problems. **(15)**

   (c) Would the cosine measure be the appropriate similarity measure to use in the *K*-means clustering for the time series data? Why or why not? If not, what similarity measure would be more appropriate? **(7)**

   (d) Clustering algorithms that automatically determine the number of clusters claim that this is an advantage. List at least two situations in which this is not the case. **(6)**

8. (a) Show that in a multiclass classification task, the Bayes learning rule minimizes the error probability. **(12)**

   (b) Explain when and why the solution obtained by a Perceptron learning rule is optimal. **(8)**

   (c) About 2/3 of your email is spam so you downloaded an open source spam filter based on word occurrences that uses the Naïve Bayes classifier. You find that the spam filter uses a prior $p(\text{spam}) = 0.1$. Explain why this might be sensible. **(3)**

   (d) Lunar tosses a die multiple times, hoping for a 6. The sequence of his 10 tosses is 1, 3, 4, 2, 3, 3, 2, 5, 1, and 6. Lunar is suspicious whether the die is biased towards 3 (or fair). Conduct a simple analysis based on the Bayes theorem to inform on Lunar – to what degree is the die biased? Explain your reasoning. Assume in general every 100 dice contain 5 unfair dice that are biased towards 3 with the probability distribution of the six faces (1, 2, 3, 4, 5, 6) as P = [0.1, 0.1, 0.5, 0.1, 0.1, 0.1]. **(12)**

L-4/T-2/CSE **Date : 17/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 463** (Computational Geometry)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Give an O(nlogn) time randomized incremental algorithm for Delaunay triangulation and prove the correctness of the algorithm. **(8+10)**

   (b) Give an example of a simple polygon consisting of 15 vertices where $O(n^2)$ algorithm of triangulation by ear removal performs worst. Show the output of the algorithm for the polygon (order of the diagonals). **(10)**

   (c) Prove that, the lower bound of convex hull in 2D is O(nlogn). **(7)**

2. Give an O(nlogn) algorithm for partitioning a simple polygon into y-monotone polygons. Derive the run time of the algorithm. **(35)**

3. (a) Write down the properties of Delaunay triangulation. **(5)**

   (b) Describe Chan's algorithm for convex hull in 2D and derive the running time. **(30)**

4. (a) Give a divide and conquer algorithm for constructing Voronoi diagram which runs in O(nlogn) time. Prove the time complexity of the algorithm. **(5+6)**

   (b) Give an algorithm which will find the largest empty circle whose center is in the convex hull of a set of *n* sites *S*. Prove the correctness of the algorithm. **(6+14)**

   (c) Prove that every polygon must have at least one strictly convex vertex. **(4)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) For the graph shown in Figure for Q. No. 5(a), show the visibility representation. **(22)**

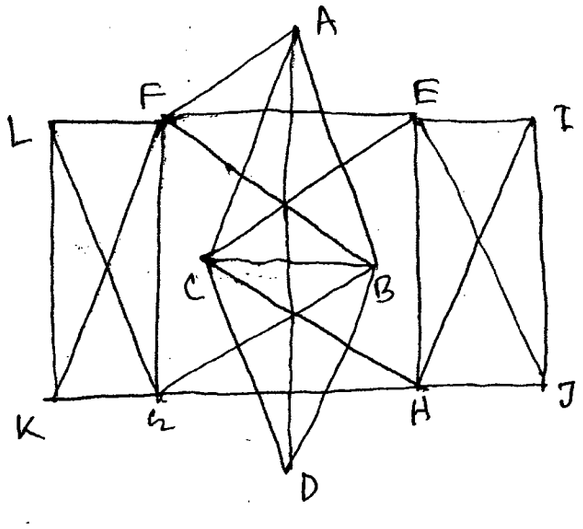


Figure For Question No. 5(a)

Contd P/2

CSE 463

Contd ... Q. No. 5

(b) Prove that, in a simple arrangement of n lines, the number of vertices, edges, and faces are $V = {}^nC_2$, $E = n^2$ and $F = {}^nC_2 + n + 1$, respectively, and no nonsimple arrangement exceeds these quantities. **(13)**

6. For the graph shown in Figure for Q. No. 6, find the Schnyder labeling, Realizer and straight line drawing of the graph using Realizer-Drawing Algorithm with necessary figures. **(35)**

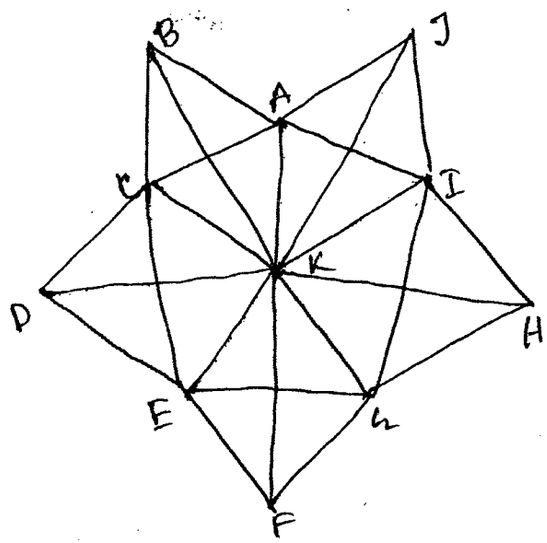


Figure for Question no. 6.

7. (a) Give an example of 2-dimensional kd-tree consisting of 15 points. Analyze the performance of 2-dimensional kd-tree. **(7+16)**

(b) Define edge contraction and separating triangle with examples. Let G be a triangulated plane graph of $n \geq 4$ vertices, and let a, b, and c be the outer vertices of G. Then the outer vertex a has a neighbor x other than b and c such that edge (a,x) is contractible. **(5+7)**

8. (a) Prove that every triangulated plane graph has a canonical ordering. **(18)**

(b) Prove that the "Ham-sandwich cut" of two set of points dualize to the median level of the dual arrangement of lines. **(10)**

(c) Prove that, for a st-digraph G, the incoming edges for each vertex v of G appears consecutively around v, and so do the outgoing edges. **(7)**

L-4/T-2/CSE **Date : 24/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **HUM 275** (Economics)

Full Marks : 140 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What is meant by production possibility frontier (PPF)? Explain how resources can be allocated in a society with the help of production possibility frontier. **(13 ⅓)**

   (b) Explain the following applications of production possibility frontier **(10)**

   (i) Choice between Necessities and Luxuries

   (ii) Choice between public goods and private goods

   (iii) Choice between current consumption goods and investment.

2. (a) Discuss the various internal economies of scale of production. **(5)**

   (b) Describe the various classification of market. **(5)**

   (c) Explain the short run equilibrium of a firm under monopoly market. **(6 ⅓)**

   (d) Calculate the profit maximizing level of output and maximum profit from the following total revenue (TR) and total cost (TC) function **(7)**

   $TR = 4000Q - 33Q^2$

   $TC = 2Q^3 - 3Q^2 + 400Q + 5000$

3. (a) Define optimization. How can optimization be achieved? Discuss. **(5 ⅓)**

   (b) What is meant by the concept of long run? Explain how would you derive long run average cost (LAC) curve of a firm from its short run average cost curves. Why is LAC curve often called the planning curve? **(8)**

   (c) State and prove the application of Euler's theorem in the theory of distribution of production. **(5)**

   (d) Given that **(5)**

   GNP = Tk. 1,05,000 crore

   Depreciation = Tk. 9,000 crore

   Indirect tax = Tk. 12,000 crore

   Subsidy is 25% of indirect tax

   Calculate national income.

Contd P/2

HUM 275 (CSE)

4. (a) Illustrate the concept of inflation. **(5)**

   (b) What are the causes of inflation? Discuss. **(3 ⅓)**

   (c) Discuss the various policies for controlling inflation with reference to the context of Bangladesh. **(5)**

   (d) Explain the concept of Gross National Product (GNP) and Net National Product (NNP). **(10)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What are the twin themes of Economics? How can the three basic problems faced by any economic entity be solved? **(6)**

   (b) Mention the exceptional cases of demand curve. Explain the factors that affect the changes in supply. **(10 ⅓)**

   (c) Given demand and supply equations **(7)**

   $Q = P^{1/11}$ and $Q = 4096/P$

   Draw the demand and supply curves. Find out the equilibrium price and quantity and then show graphically.

6. (a) Show graphically the relationship between 'total utility' and 'marginal utility'. **(9 ⅓)**

   (b) From the data find the price elasticity of demand and make comment on it. **(8)**

   $P_1 = 1800, Q_1 = 4800, P_2 = 2200, Q_2 = 3200$

   (c) Explain price elasticity of demand, cross elasticity of demand and income elasticity of demand. **(6)**

7. (a) What is indifference map? Explain the characteristics of an indifference curve. **(6)**

   (b) The utility function of Mr. Atik is given by $U = f(x, y) = x^{3/4}y^{1/4}$. Find out the optimal quantities of good 'x' and good 'y'. The prices of 'x' and 'y' are Tk. 6 per unit and Tk. 3 per unit respectively. The income of Mr. Atik is Tk. 120. **(7)**

   (c) How can a consumer's equilibrium be obtained with the help of "law of equi-marginal utility"? **(10 ⅓)**

8. (a) "The more inelastic the demand curve, the less tax burden on the producer, if the per unit tax is imposed on a producer" – Justify the statement. **(11 ⅓)**

   (b) What is "paradox of bumper harvest"? What Policies can be adopted to minimize the losses faced by the farmers during the bumper harvest? **(12)**

L-4/T-2/CSE Date : 31/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **HUM 371** (Financial and Managerial Accounting)

Full Marks : 140 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Explain two secondary qualities of Accounting Information with example according to Conceptual Framework of Accounting. **(3 ⅓)**

(b) Mr. "X" has the following transaction during his first month of operation in May, 2011. **(20)**

May-1 : Started his firm investing Tk. 750,000 cash and an equipment of Tk. 45,000.

May-3 : Paid office rent in advance for next two months Tk. 8,000.

May-5 : Purchased a car for office purpose for Tk. 100,000. Paid cash Tk. 40,000 and signed a notes payable for the remaining amount.

May-6 : Received Tk. 50,000 cash by providing services. Performed another services on account for Tk. 20,000.

May-10 : Paid Tk. 5,000 for advertising bill.

May-12 : Withdrew Tk. 4,000 for personal use.

May-15 : Payment of notes payable Tk. 40,000 related to transaction May-5.

May-22 : Received an electricity bill for Tk. 5,000.

May-26 : Additional investment made by the owner Tk. 50,000

May-30 : Purchase supplies on credit Tk. 20,000.

Required: Prepare a tabular summary from the above transaction for the month of May.

2. (a) Can a business enter into a transaction in which only the left side of the basic Accounting equation is affected? If so, give an example. **(3 ⅓)**

(b) Mr. Polin opened a law office. During February, 2013 the following transaction occurred– **(20)**

February-1 : Service performed but not yet received Tk. 60,000.

February-3 : Received Tk. 50,000 from a client, service will be provided in next month.

February-5 : Incurred utility expense for the month on account Tk. 1,000.

February-7 : Advertisement expense paid in advance cash Tk. 10,000.

February-10 : Insurance premium paid for the period in cash Tk. 5,000

February-12 : Investment made by the owner in cash Tk. 60,000.

February-14 : Purchase office equipment Tk. 25,000 on account.

February-18 : Cash received from the customer Tk. 40,000 related to transaction 1.

February-20 : Payment made related to February-14 transaction.

February-25 : Payment of owner's personal expenses from the business in cash Tk. 5,000.

Required:

(i) Prepare necessary Journal entries in good form.

(ii) Prepare Ledger of "Cash Account".

Contd P/2

HUM 371 (CSE)

3. (a) "An adjusting entry may affect more than one balance sheet or income statement account". Do you agree? Why or why not? **(3 ⅓)**

(b) The trial balance of "Crescent Company" before adjustment on May-31, 2010 is given below– **(20)**

"Crescent Company"
Trial Balance
May 31, 2010

Accounts Title	Debit (Tk.)	Credit (Tk.)
Cash	3,500	
Supplies	2,200	
Prepaid insurance	2,280	
Land	12,000	
Machinery	60,000	
Furniture	15,000	
Accounts payable		4,800
Unearned rent		3,300
Bank loan		35,000
Capital		46,380
Rent revenue		10,300
Advertising expense	600	
Salaries expense	3,300	
Utility expense	900	
Total	**99,780**	**99,780**

Additional information:

→ Prepaid insurance is a one year policy, starting from May-1, 2010.

→ A count of supplies shows Tk. 750 of unused supplies on May-31, 2010.

→ Annual depreciation is Tk. 3,000 on the machinery and Tk. 2,700 on furniture.

→ The bank loan interest rate is 12%. (The bank loan was taken out in May-1).

→ Unearned rent Tk. 2,500 has been earned.

→ Salaries of Tk. 750 are accrued and unpaid at May-31.

Required:

(i) Journalize the adjusting entries on May-31.

(ii) Prepare an adjusted trial balance on May-31.

4. (a) Define current liability. What basis is used for arranging individual items within the current liability section? **(3 ⅓)**

(b) The trial balance of "Solar Power Company" is given below– **(17)**

Contd P/3

HUM 371 (CSE)

Contd ... Q. No. 4(b)

"Solar Power Company"
Trial Balance
31st December, 2011

Accounts Title	Debit (Tk.)	Credit (Tk.)
Cash	30,500	
Accounts receivable	15,000	
Accounts payable		12,000
Mortgage payable		3,700
Merchandise inventory (01.01.2011)	5,800	
Purchase	20,100	
Sales		40,500
Sales return	1,200	
Purchase discount		500
Capital		36,200
Drawings	2,300	
Salaries	3,400	
Prepaid insurance	3,600	
Machinery	16,000	
Rent expense	5,000	
Goodwill	20,000	
Bond payable		20,000
Tax payable		5,000
Unearned revenue		5,000
Total	**122,900**	**122,900**

Other information:

- Merchandise inventory on December 31st 2011 is Tk. 6,700.
- Rent is 40% administrative and 60% selling.

Required:

(i) Prepare a multiple step (classified) income statement.

(ii) Prepare a statement of owner equity.

(iii) A classified Balance Sheet as on 31st December, 2011.

(c) From the above information, also compute **(3)**

(i) Current ratio,

(ii) Quick or Acid Test ratio,

(iii) Debt to total asset ratio.

Contd P/4

HUM 371 (CSE)

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Differentiate among cost, expense and loss. **(3 ⅓)**

(b) Explain the difference between a product cost and a period cost. **(2)**

(c) Superb Company was organized on March 1, 2010. After five months of start-up losses, the income statement for August also showed a loss. **(18)**

Superb Company
Income Statement
For the month ended August 31, 2010

Sales		Tk. 450000
Less Operating Expenses:		
Direct labour cost	Tk. 70000	
Raw materials purchased	165000	
Manufacturing overhead	85000	
Salaries	100000	
(70% for factory and 30% for selling and administrative)		
Utilities	42000	462000
(40% for factory and 60% for selling and administrative)		
Net operating loss		Tk. (12000)

Inventory balances at the beginning and end of August were:

	August 1	**August 31**
Raw Materials	Tk. 8000	Tk. 13000
Work in process	16000	21000
Finished goods	40000	60000

Required:

(i) Prepare a schedule of cost of goods manufactured for August, 2010.

(ii) Prepare a new income statement for August. Comment.

6. (a) What is contribution margin ratio? How is this ratio useful in planning business operations? **(3 ⅓)**

(b) Feather Friends, Inc. distributes a high-quality wooden birdhouse that sells for Tk. 20 per unit. Variable costs are Tk. 8 per unit, and fixed costs total Tk. 180,000 per year. **(20)**

Required:

(i) Compute the CM ratio and the break-even point in units.

(ii) If sales increase by Tk. 75,000 during the next year, by how much should net operating income increase (or net loss decrease) assuming that fixed costs do not change?

Contd P/5

HUM 371 (CSE)

Contd ... Q. No. 6(b)

(iii) Assume that the operating results for last year were:

Sales	Tk. 400000
Variable expense	160,000
Contribution margin	240,000
Fixed expense	180,000
Net operating income	Tk. 60,000

(A) Compute the degree of operating leverage.

(B) If sales increase by 20% next year, by what percentage should net operating income increase?

(iv) Refer to the original data. Assume that 18000 units were sold last year. Further assume a 10% reduction in the selling price, combined with a Tk. 30000 increase in advertising, and an increase in annual sales units by one-third. Prepare two contribution format income statements, one showing the results of last year's operations and one showing the results of operations if these changes are made. Comment.

7. (a) What effect does an increase in volume have on —? **(5 1/3)**

(i) Unit fixed costs?

(ii) Unit variable costs?

(iii) Total fixed costs?

(iv) Total variable costs?

(b) Nova Company's total overhead cost at various levels of activity are presented below: **(18)**

Month	Machine hours	Total Overhead Cost
April	70,000	Tk. 198,000
May	60,000	174, 000
June	80,000	222,000
July	90,000	246,000

Total overhead cost above consists of utilities, supervisory salaries, and maintenance. The breakdown of these costs at the 60,000 machine-hour level of activity is:

Utilities (variable)	Tk. 48,000
Supervisory salaries (fixed)	21,000
Maintenance (mixed)	105,000
Total overhead cost	Tk. 174,000

Required:

(i) Estimate how much of the Tk. 246,000 of overhead cost in July was maintenance cost.

(ii) Using the high-low method, estimate a cost formula for maintenance.

(iii) Express the company's total overhead cost in the linear equation form $Y = a + bX$.

Contd P/6

HUM 371 (CSE)

8. (a) Under absorption costing, how is it possible to increase net operating income without increasing sales? **(3 ⅓)**

(b) If the units produced exceed unit sales, which method would you expect to show the higher net operating income, variable or absorption costing? Why? **(2)**

(c) Lyra company produces and sales a single product. Selected cost and operating data relating to the company's first year are given below: **(18)**

Selling price per unit	Tk. 50
Variable costs (per unit):	
Direct material	Tk. 6
Direct labor	9
Variable manufacturing overhead	3
Variable selling and administrative costs	4
Fixed costs (per year):	
Fixed manufacturing	Tk. 300000
Fixed selling and administrative	190000

During the year the company produced 25000 units and sold 20000 units.

Required:

Prepare income statements under variable costing and absorption costing methods.

EXTRA

L-4/T-2/CSE Date : 10/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 461** (Algorithm Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Prove that, the expected running time of a RANDOMIZED-QUICKSORT of n-element array is O(n lg n). **(15)**

   (b) Give the mathematical proof of having the expected attempts to reach success in randomized 8-queen problem is 8. **(7)**

   (c) Find the matrix representation of single qbit Hadamard gate and two qbit Controlled Not gate. Hence prove the reversibility for each gate. **(3+5+2+3=13)**

2. Define set-covering problem. Give a polynomial time (ln |X| + 1)-approximation algorithm for set-covering problem, where X represents a finite set of elements. Derive the approximation ratio. **(5+10+20=35)**

3. (a) Present a 4-approximation algorithm for SBR problem and prove that the approximation ratio of the algorithm is indeed 4. **(15)**

   (b) Number of steps to sort a permutation of length n is at most (n – 1), why? Give an example showing the (n – 1) steps for any n > 4. **(5+3=8)**

   (c) (i) State the superposition principle. Write the equation of superposition principle for multibit system. **(4)**

   (i) State 'no cloning' theorem with an example. **(4)**

   (iii) Write the process of generating Bell states. **(4)**

4. (a) Show that the expected running time of an insertion in a n-element skip list is O(lg n). **(8)**

   (b) Show that if an edge is picked at random using Karger's min-cut algorithm, the probability that it lies across the minimum cut is at most 2/n. **(8)**

   (c) Find the actual cost of a k-bit Increment Binary Counter using potential method of amortized analysis. **(8)**

   (d) Prove that amortized number of rotations by a Splay operation on an n-node BST is at most 3 lg n + 1. **(8)**

   (e) Define ILCS problem with an example. **(3)**

Contd P/2

CSE 461

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) How do you prove that Problem X and Problem Y are equally hard? Show that the vertex cover problem and the independent set problem are equally hard. **(5+12)**

   (b) Show that Independent Set $\leq_P$ Set Packing. **(8)**

   (c) Show that 3-SAT $\leq_P$ Hamiltonian Cycle. **(10)**

6. (a) Suppose X is an NP-complete problem. Then show that X is solvable in polynomial time if and only if $P = NP$. **(9)**

   (b) Define the decision version of the k-coloring problem. Show that 2-coloring problem is in P. **(3+5)**

   (c) Show that the 3-coloring problem is NP-hard. **(10)**

   (d) Explain the relationship among P, NP, $Co\text{-}NP$ and $PSPACE$ problems. **(8)**

7. (a) Define the competitive ratio for an online algorithm. Explain the competitive ratio taking the Ski-rental problem as an example. **(4+6)**

   (b) Prove that the competitive ratio of Moving to Front (MTF) algorithm for linear list search is 2.0. **(15)**

   (c) Describe the k-server problem. Show that the greedy algorithm for a k-server problem is not good. **(4+6)**

8. (a) Explain the key idea behind the branch and reduce algorithm for finding a maximum independent set in a graph, and write the algorithm. Using a branching tree, illustrate the steps of the branch and reduce algorithm and find all maximum independent sets of the graph given in the figure. Show that the time complexity of the algorithm is $O^*(3^{n/3})$. **(4+3+6+7)**

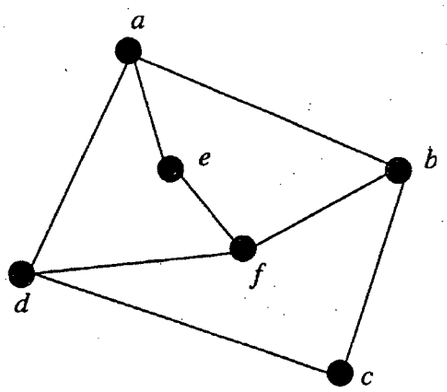


Figure for Question Number 8(a).

(b) Explain the basic principle of a branch-and-bound technique. Solve the following instance of the 0/1 knapsack problem by branch-and-bound algorithm. **(5+10)**

Item	Weight	Profit
1	2 kg	Tk. 12
2	1 kg	Tk. 10
3	3 kg	Tk. 21
4	2 kg	Tk. 16

Capacity W = 5

Extra

L-4/T-2/CSE **Date : 07/06/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 409** (Computer Graphics)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

You need not to multiply any matrix to answer any of the questions. It will be just waste of time and bring you no marks.

1. (a) **[3D Problem]** A camera is located at the origin. Its current viewing direction is along the +Y axis and up direction is along +Z axis. Derive the view transformation matrix, so that it looks at +Z axis, and its up direction remains along +Y axis. **(15)**

   (b) **[3D Problem]** For the projection matrix shown in Figure 1(b), determine the projection plane corresponding to the projection matrix. Assume that, the matrix represents one-point perspective projection. Also, determine the only vanishing point for this projection matrix. **(10)**

Projection Matrix

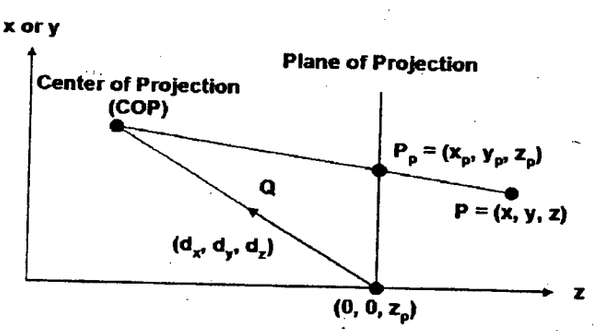
$$\begin{pmatrix} 12 & 9 & 0 & 12 \\ 5 & 16 & 0 & 6 \\ 3 & 0 & 6 & -3 \\ 1 & 0 & 2 & -1 \end{pmatrix}$$

Figure for Question 1(b)

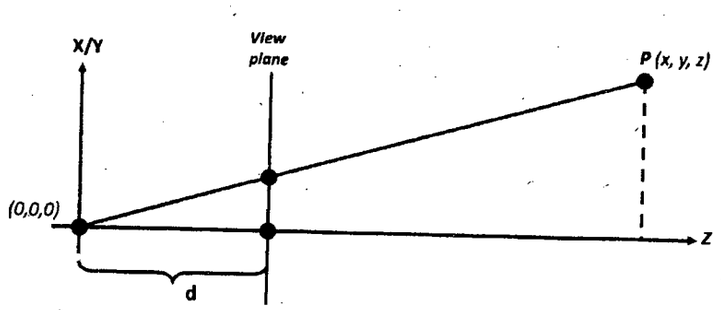
(c) Figure 1(c) shows the generalized projection matrix and a specific one-point perspective projection scenario. Use the given generalized projection matrix to derive the projection matrix for the specific one-point perspective projection scenario. **(10)**

Generalized Projection Matrix

$$M_{gen} = \begin{pmatrix} 1 & 0 & -\frac{d_x}{d_z} & z_p\frac{d_x}{d_z} \\ 0 & 1 & -\frac{d_y}{d_z} & z_p\frac{d_y}{d_z} \\ 0 & 0 & -\frac{z_p}{Qd_z} & \frac{z_p^2}{Qd_z}+z_p \\ 0 & 0 & -\frac{1}{Qd_z} & \frac{z_p}{Qd_z}+1 \end{pmatrix}$$



One point perspective Projection Scenario



..... P/2

Figure for Question 1(c)

CSE 409

2. (a) **[3D Problem]** Consider the Rodrigue's Formula for composite rotation and a particular composite rotation matrix as shown in Figure 2(a). From this information, compute the arbitrary rotation axis (k_x,k_y,k_z) and rotation angle θ corresponding to the particular composite rotation matrix. All the symbols used bear their usual meaning. **(15)**

Rodrogue's Formula

$$\begin{pmatrix} X' \\ Y' \\ Z' \\ 1 \end{pmatrix} = \begin{pmatrix} K_xK_x(1-C)+C & K_yK_x(1-C)-K_zS & K_xK_z(1-C)+K_yS & 0 \\ K_yK_x(1-C)+K_zS & K_yK_y(1-C)+C & K_yK_z(1-C)-K_xS & 0 \\ K_zK_x(1-C)-K_yS & K_zK_y(1-C)+K_xS & K_zK_z(1-C)+C & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$$

Composite Rotation Matrix

$$\begin{bmatrix} 0.9 & -0.32 & 0.297 \\ 0.387 & 0.9 & -0.203 \\ -0.203 & 0.297 & 0.932 \end{bmatrix}$$

Figure for Question 3(a)

(b) **[2D Problem]** Given a value t at which a Bezier curve is to be split, use the de Casteljau construction to find the left and right division matrices. **(15)**

(c) **[3D Problem]** What do you mean by vanishing point? In which type of projection transformation do the vanishing points occur? **(5)**

3. (a) **[3D Problem]** Suppose, you are designing a shooting game named "Peculiar Shooting". The game consists of the following rules and features: **(15)**

- The game has a hero and a devil.
- The hero has a robotic arm that can be oriented in any direction as the hero wishes. The robotic arm holds a pistol, which can fire bullets. Assume that the bullet travels in the same direction as the robotic arm's current direction.
- The hero has a spiritual eye from which he can throw UV-ray that can burn the devil. Assume that the UV-ray spreads along a 3D plane defined by the two vectors: eyes viewing direction and robotic arm's direction.
- Hero wins when he burns the devils body and fires a bullet into the devils nose simultaneously.

Assume that, that devil is currently standing along the **x-y** plane, i.e., its z component is 0 and its nose is located somewhere along the positive **x-axis**. The hero is currently located at the origin, looking at ***EYE*** direction and the robotic arm is located in the ***ARM*** direction. You have to determine the rotation matrix which rotates the hero and his arm by some certain angle so that the hero finds himself in a position to win the game instantly.

[**Special Instruction:** use the properties of special orthogonal matrices]

(b) **[2D Problem]** What is a Koch snowflake? Show that, the area of a Koch snowflake with infinite order is only some constant multiple of the area of a Koch snowflake with zero order. **(15)**

Contd P/3

CSE 409

Contd ... Q. No. 3

(c) **[3D Problem]** Suppose, the following matrix is a 3D rotation matrix which performs rotation of a certain angle about y-axis. Is there something wrong with this rotation matrix? If yes, what is that? **(5)**

Rotation Matrix about y-axis

$$\begin{bmatrix} 0.5 & 0 & -0.707 & 0 \\ 0 & 1 & 0 & 0 \\ 0.866 & 0 & 0.5 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Figure for Question 3(c)

4. (a) **[2D Problem]** For the objects shown in Figure 4(a), derive the transformation matrix that transforms the initial object into the transformed object. **(15)**

[**Special Instruction:** You cannot use rotation for the transformation.]

[**Hints:** Mirroring might be handy]

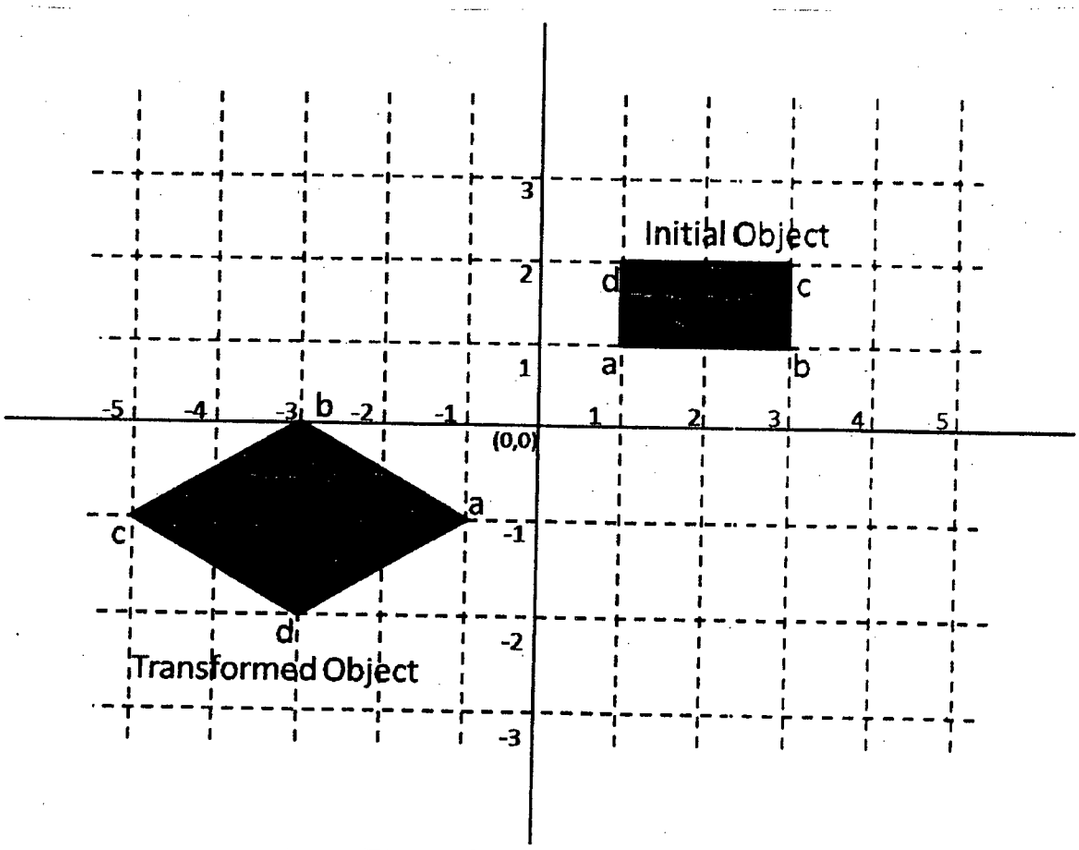


Figure for Question 4(a)

CSE 409

Contd ... Q. No. 4

(b) **[2D Problem]** Suppose the equations relating the Hermite geometry to Bezier geometry were of the form $R_1 = \beta(P_2 - P_1)$, $R_4 = \beta(P_4 - P_3)$. Now, we know that the velocity at any point of a straight line is constant. So, consider the four equally spaced Beizer control points $P_1 = (0, 0)$, $P_2 = (2, 2)$, $P_3 = (4, 4)$, $P_4 = (6, 6)$. Show that, for the parametric curve $Q(t)$ to have constant velocity from P_1 to P_4 the coefficient β must be equal to 3. For your convenience, the Hermite basis matrix is given below: **(15)**

$$\underbrace{\begin{bmatrix} 2 & -2 & 1 & 1 \\ -3 & 3 & -2 & -1 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}}_{M_{Hermite}} \underbrace{\begin{bmatrix} x_1 & y_1 \\ x_2 & y_2 \\ \frac{dx_1}{dt} & \frac{dy_1}{dt} \\ \frac{dx_2}{dt} & \frac{dy_2}{dt} \end{bmatrix}}_{G_{Hermite}}$$

Figure for Question 4(b)

(c) **[2D Problem]** Show that the two curves $\gamma(t) = (t^2 - 2t, t)$ and $\eta(t) = (t^2 + 1, t + 1)$ are both C^1 and G^1 continuous where they join at $\gamma(1) = \eta(0)$. **(5)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) See the top view of a scene in Figure for Q. No. 5(a) where surface normal is shown for each polygon face. Here, AB || CD || HI. Similarly, AF || BE, and CE || GD, and FH || GI (the symbol) || stands for parallel). AB and CD lie in the same plane, that is, coplanar. Extension of CE intersects at F and extension of BE intersects at G. **(7½+7½=15)**

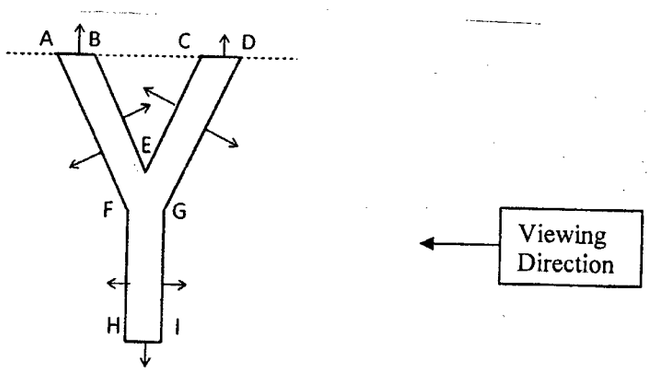


Figure for question no. 5(a)

(i) Construct a BSP tree considering *AB* as root. Consider the dotted line as the first division of the region.

(note: When a polygon *P* is selected at node *N* for dividing the area into two half spaces, if there is any other polygon which **lies in the same plane** as *P* (neither at the front nor at the back of *P*), then insert that polygon into the same node *N* as *P*.)

(ii) For the viewing direction shown in figure, write down the order of displaying the polygons.

Contd P/5

CSE 409

Contd ... Q. No. 5

(b) You have to apply Phong shading for drawing the object shown in the Figure for Q. No. 5(b). Here, normals at the vertices A, B, C, D, E, F, G, H are shown by m_A, m_B, m_C, m_D, m_E, m_F, m_G, and m_H respectively. Consider the scan line S_c. For the first intersecting pixel (X1, Y_S), normal is calculated as: $m_{X1} = m_C + (m_A - m_C)(Y_S - Y_C)/(Y_A - Y_C)$. **(5+5+5=15)**

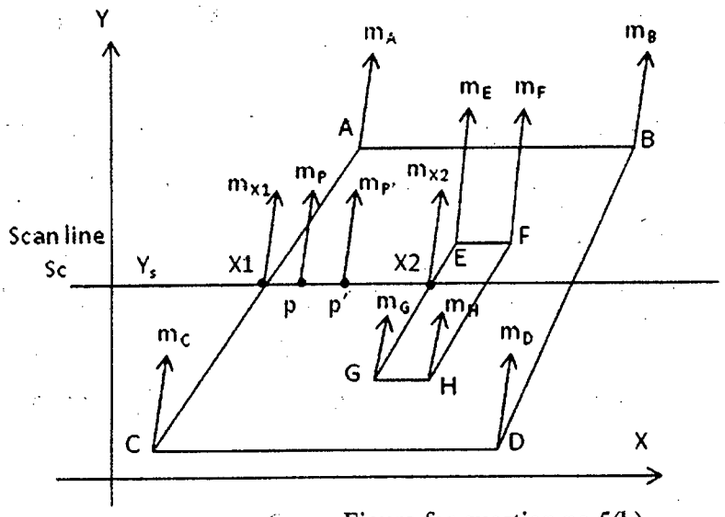


Figure for question no 5(b)

(i) Find the normal $\mathbf{m}_{X2}$ at pixel (X2, Y_S)

(ii) Find the normal $\mathbf{m}_P$ at an arbitrary pixel **p** on the same scan line using the value of $\mathbf{m}_{X1}$ and $\mathbf{m}_{X2}$.

(iii) Write down the incremental equation in terms of $\mathbf{m}_p$ and constants for finding normal $\mathbf{m}_{p'}$ at the next successive pixel **p'** on the same scan line.

(c) Explain why line and surface require one and two parameters respectively in vector form of definition. **(5)**

6. (a) Consider Midpoint ellipse scan conversion algorithm. **(12+5+6=23)**

(i) Show necessary calculations for decision variable **d** for drawing the arc of the ellipse that lies in the **third quadrant** as shown in the figure. Also show the calculations to derive initial value of **d**.

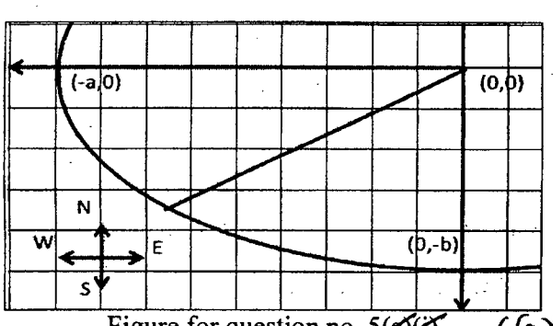


Figure for question no. ~~5(a)(i)~~ 6(a)(i)

(ii) Does 8-way symmetry help in ellipse scan conversion? If yes, explain how. If not, then suggest a value for **n**, such that n-way symmetry helps in ellipse scan conversion.

CSE 409

Contd ... Q. No. 6

(b) You have to remove a surface based on Back-Face Culling. The surface is given in the parametric form {C, $\underline{a}$, $\underline{b}$}, where C is a point, $\underline{a}$ and $\underline{b}$ are vectors. How can you know which side of the surface/plane is the front face? **(6)**

(c) During scan conversion polygon, in what case can 'Sliver' occur? Explain with figure. **(6)**

7. (a) Write down the Barycentric equation of a plane. How would you compute the coefficients associated with triangle points in that equation? Derive the formulas for intersecting a ray with a Barycentric Triangle. **(3+3+7=13)**

(b) Find out the total red, blue, and green components of the reflected light intensity from a surface Q in the presence of 5 light sources based on Phong Model of illumination. **(7)**

(c) Describe necessary calculations for Gupta-Sproull algorithm for antialiased scan conversion of lines. **(15)**

8. (a) Let abcdefghkm and ABCD be the polygon to be clipped and viewing window, respectively as shown in the figure. Using Sutherlan-Hodgman polygon clipping algorithm, show the steps of clipping the polygon in the following order of clipping edges: **(7 ½+7 ½=15)**

(i) Top clip edge AB

(ii) Right clip edge BC

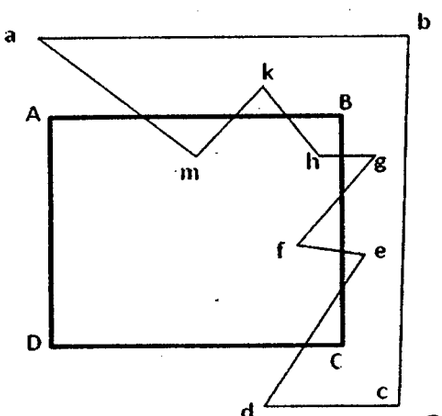


Figure for question no. ~~8(b)~~ 8(a)

(b) Some lines are to be clipped against a Pentagon viewing window (as shown in Figure) using Cohen-Sutherland algorithm. For this case, **(5+5+5=15)**

(i) How many bits are required to present the region outcodes?

(ii) Explain how would you interpret each bit of the region outcode.

(iii) How many region outcodes will be used?

Contd P/7

CSE 409

Contd ... Q. No. 8(b)

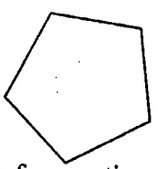


Figure for question no. 8(b)

(c) Below is a usual flow of graphics pipeline. In which step/steps of this pipeline the 'hidden surface removal' is performed and why? **(5)**

Scene graph Object geometry → Modeling and Transformation → Trival Rejection → Illumination → Viewing Transformation → Clipping → Projection → Rasterization → Display

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