Tribhuvan University

Institute of Science and Technology

2070

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Master Level / First Year/ IInd Semester/ Science
Computer Science and Information Technology (CSc. 551)
(Compiler Optimization)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

Candidates are required to give their answers in their own words as for as practicable.
The questions carry equal marks.

Attempt all questions.

1. What type of performance challenges can be encountered in instruction pipelining? Can it be removed using compiler optimization? Explain.
2. Define data dependence. What are the different types of data dependence? Explain with example.
3. What types of subscripts can be seen during dependence testing? How do we perform ZIV test? Explain.
4. What is induction variable? Explain with example about induction variable substitution and elimination.
5. Explain the advantages of scalar replacement of array elements.
6. Illustrate loop peeling and loop unrolling. Are they always appropriate? Explain with example.
7. What do you understand by branching? Explain different types of branching with example.
8. Explain about various category of "if simplifications".
9. Define interprocedural analysis and optimization. Describe constant propagation in interprocedural analysis.
10. Explain briefly about procedure cloning.

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Master Level / First Year/ IInd Semester/ Science
Computer Science and Information Technology (CSc. 552)
(Web Systems and Algorithms)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

Candidates are required to give their answers in their own words as for as practicable.
The figures in the margin indicate full marks.
Attempt all questions.

1. What do you mean by triangle of intelligence? What types of application can benefits from intelligence? (3+3)

2. How does search engine work? Explain with architecture of search engine. (6)

3. How do recommendation engines work? Explain the architecture of collaborative filtering with working mechanism. (1+5)

4. List the clustering issues in very large datasets. How DBSCAN works? (3+3)

5. Differentiate between clustering and classification. How Bayesian theorem can be used for spam detection? (2+4)

6. What are the purposes of combing the classifiers? Explain the intention of bootstrapping aggregating. (2+4)

7. Define ontology? Semantic web has the significance role in today's web application. Explain. (2+4)

8. Consider the problem of clustering the following documents using K-means with K = 2 using cosine similarity.

   Doc1: "go Longhorns go"
   Doc2: "go Texas"
   Doc3: Texas Longhorns"
   Doc4: "Longhorns Longhorns"

   Assume Doc1 and Doc3 are chosen as initial seeds. Assume simple term frequency weights (no IDF) to construct the document vector. Use cosine similarity for similarity measurement. The algorithm should converge after only 2 iterations. (6)

9. In search engine what is the role of user clicks? Does it remove the ambiguity problem? What precision and recall resembles in searching? (2+2+2)

10. Write short notes on: (3+3)

    a. Web Crawler in search engine
    b. HITS algorithm

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Master Level / First Year/ IInd Semester/ Science
Computer Science and Information Technology (CSc. 553)
(Machine learning)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

Candidates are required to give their answers in their own words as for as practicable.
The questions carry equal marks.
Attempt all questions.

1. Define machine learning. Explain the importance of machine learning with suitable example.

2. Explain why normal equations are the ways to perform the minimization explicitly and without resorting to an iterative algorithm. Derive the equation for O that minimizes cost function J(O).

3. List the three basic assumptions about the conditional distribution of y (target variable) given x (input features) for generalized linear models (GLM). Show that linear regression hypothesis $h_O(x) = O^T x$ and logistic regression hypothesis $h_O(x) = 1/(1+e^{-OTx})$ are the special case of the GLM family of models.

4. Describe the Gaussian Discriminant analysis (GDA) model with suitable parameters. Describe the classification of training set contours in GDA.

5. Describe the concept of functional and geometric margin used for optimal margin classifier. List the optimization problem for optimal margin classifier.

6. Define the terms shatter and VC dimension with suitable example. Explain the significance of the following sentence "the number of training examples needed to learn well using hypothesis class H is linear in the VC dimension of H".

7. Define the term feature selection. Explain the forward search for feature selection as wrapper model algorithm.

8. Define marginal and conditional distribution of random variables with a joint multivariate Gaussian distribution. Use them to define factor analysis model.

9. Use the properties of eigenvectors to derive the solution for principal component analysis (PCA) model. Explain some PCA applications.

10. Write short notes on:
    a. Reinforcement learning
    b. Online learning algorithm
    c. Markov decision processes (MDP)

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Master Level / First Year/ IInd Semester/ Science
Computer Science and Information Technology (CSc. 554)
(Computational Geometry)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

Candidates are required to give their answers in their own words as for as practicable.
The figures in the margin indicate full marks.
Attempt all Questions.

1. Given a set of vertices $V_1, V_2, \ldots V_n$ in a plane, now at what conditions segments joining these vertices can formulate a polygon? Without appealing to the Fisk's proof, justify how many guards are needed to guard a simple polygon with n vertices? (2.5+3.5)

2. How can you assure that a polygon with more than four vertices have a diagonal? Prove that a dual of triangulation of a polygon is not a graph. (3+3)

3. Is just left turn test sufficient for detecting segment intersection? Justify your answer with an example. What about the use of the turn test for identifying point inclusion in polygons? (3+3)

4. Describe how merge vertices and end vertices are handled in plane-sweep algorithm for trapezodaliation? Configure a non-monotone polygon and show the two cases. (6)

5. Give your justification to the statement that there can be at most two essential diagonals at any reflex vertex. For a polygon with n reflex vertices, what can be the optimal number of convex pieces after partitioning? (3+3)

6. What does it mean to compute the convex hull? Given n points in a plane, use the naïve algorithm for extreme points to find the convex hull of the points. Perform the complexity analysis of the algorithm. (2+4)

7. How Voronoi Diagrams can be interpreted in terms of half planes? Construct a Voronoi diagram containing at least 6 point sites. Add a new point in the point sites and show update of the Voronoi diagram using incremental approach. (2+2+2)

8. How visibility graph can be used in Path Planning Problem? Justify that the collision free path is contained in visibility graph of obstacle polygons. (3+3)

9. What do you mean by range searching problem? How 1-dimentional range searching can be solved using balanced binary search trees? (2+4)

10. When a mesh is said to be valid and confirming? Show, with an example, how global vertex numbering can be used to represent topology of mesh triangulation. (2+4)

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Master Level / First Year/ IInd Semester/ Science
Computer Science and Information Technology (CSc. 557)
(System Programming)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

Candidates are required to give their answers in their own words as for as practicable.
The figures in the margin indicate full marks.
Attempt all questions.

1. Write brief answers of following questions. (3x5=15)
   a. Describe addressing modes supported by SIC/XE (simple instructional computer/extended edition) machine architecture
   b. Calculate target address for object codes 002600 & 03C030. Assume (B) = 6000, (PC) = 3000, and (X) = 90
   c. Why modification cards need to be created for format-4 instructions in a SIC/XE programs?
   d. Differentiate between Linking Loader and Linkage editor with suitable diagram.
   e. What is macro time variable? How can you set value of macro time variable? Explain with example.

2. Translate (by hand) the following assembly program to SIC/XE object code. Also show all data structures. (10)

Gauss	START	1000
First	LDA	=X'01'
	LDB	#Two
	BASE	Two
	ADD	K
	MUL	K
	LDS	Two
	DIVR	S,A
Two	WORD	2
K	WORD	100
	END	First

3. Consider following macro definition. Show expanded macro for the macro invocation "RDWR F1,05, 2 " and also all data structures created in pass1 and pass2 of macroprocessor (5)

RDWR.	MACRO	&IN,&OUT,&C
	IF	(&C EQ 1)
	TD	=X'&IN'
	JEQ	*-3
	RD	=X'&IN'
	ELSE	
	TD	=X'&OUT'
	JEQ	*-3
	WD	=X'&OUT'
	MEND	

4. Consider the following BNF grammar, devise token coding for this, and then design finite automata to recognize tokens. Explain any assumptions made in designing automata. Assume that id must start from character always and value can be any integer constants. (5)

<exp>→id|value|<exp>+<exp>|<exp>-<exp>

5. Consider following assembly program written for SIC/XE machine architecture and perform following with this: (25)
   a. Generate LOC column and also show all data structures created in pass1. (4)
   b. Generate object code column for the program. (7)
   c. Create Object code fild. (4)
   d. Load object code files into memory and show linking process along with data structures used by linking loader. Assume that programs are loaded from memory location 2000 contiguously. (10)

Ex	START	1000
	EXTDEF	Outdev
	EXTREF	One, Zero, Newline
First	+LDA	One
	STA	I
Loop	+LDX	Zero
	+JSUB	Newline
	LDA	I
	+ADD	One
	STA	I
	COMP	K
	JLT	Loop
	RSUB	
Outdev	BYTE	X'06'
I	RESW	1
K	WORD	11
	END	First

Newline	EXIDEF	Zero, One
	EXTREF	Outdev
	+TD	Outdev
	JEQ	Loop
	LDCH	CRLF
	+WD	Outdev
	RSUB	
One	WORD	1
Zero	WORD	0
CRLF	BYTE	X'00'
	END	FIRST

Assume following mnemonic codes: {LDX=04, LDT=74, LDCH=50, STCH=54, TIXRB8 JLT=38, LDA=00, STA=0C, JSUB=48, ADD=18, COMP=28, RSUB=4C, TD=E0, JEQ=30, WD=DC}