

University of Dhaka
Department of Computer Science and Engineering
3rd Year 1st Semester B. Sc. Final Examination 2019
CSE 3101: Computer Networking

Duration: 3 hours

Credits: 3

Full Marks: 60

(Answer any four of the following six questions)

1. a. Suppose you are going to provide live streaming service for the examination hall so that the examiner can monitor students from his office. What type of transport layer service you are going to use? Justify your answer. 3
- b. Most wireless access points and devices have the option of encrypting traffic. In which OSI layer is that encryption taking place? 2
- c. Consider an e-commerce site that wants to keep a purchase record for each of its customers. Describe how this can be accomplished with cookies. 3
- d. What challenge do NATs introduce to the Internet with respect to overcoming failures? 4
- e. Why is changing the IP layer of the Internet protocol stack hard? 3
2. a. Consider a TCP Tahoe connection with an initial congestion window of one segment. Assume that end-to-end round trip time is constant and equal to 1 second. The threshold is initially set to 32,000 bytes. All segments carry 1,000 bytes of data. The receiver's advertised window is 64,000 bytes. Suppose that the connection does not experience processing or queuing delays. Also neglect the TCP connection establishment latency. Answer the following questions: 3
 - i. If there were no packet losses, how long will it take for the window to grow to the receiver advertised window size?
 - ii. If there were no packet losses, how long will it take to transfer a 200,000 bytes file (neglect application layer headers)?
 - iii. Suppose there is a packet loss when the window size is 32,000. How long will it take for the window to grow back to the receiver advertised window size if there were no further losses?
- b. In a TCP connection, the initial sequence number at the client side is 4181. The client opens the connection, sends three segments, the second of which carries 1000 bytes of data, and closes the connection. What is the value of the sequence number in each of the following segments sent by the client? 3
 - i. The SYN segment
 - ii. The data segment
 - iii. The FIN segment
- c. Describe retransmission scenarios of TCP. 3
- d. Draw the state diagrams of the life cycle of a TCP client and TCP server with minimum explanation. 3
- e. The *thresh* (Threshold) value for a TCP Tahoe station is set to 6 MSS. That station now is in the slow-start state with *cwnd* = 4 MSS. Show the values of *cwnd*, *thresh* and the state of the station before and after each of the following events: 3
 - i. Two consecutive nonduplicate ACKs arrived, followed by a time-out event, and
 - ii. Followed by three nonduplicate ACKs.
3. a. Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 223.1.1.17/24. Also suppose that Subnet 1 is required to support at least 60 interfaces, Subnet 2 is to support at least 90 interfaces, and Subnet 3 is to

- support at least 12 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints.
- b. Suppose that the five measured SampleRTT values are 106ms, 120ms, 140ms, 90ms, and 115ms. Compute the EstimatedRTT after each of these SampleRTT values is obtained, using a value of $\alpha = 0.125$ and assuming that the value of EstimatedRTT was 100ms just before the first of these five samples were obtained. Compute also the DevRTT after each sample is obtained, assuming a value of $\beta = 0.25$ and assuming the value of DevRTT was 5ms just before the first of these five samples was obtained.
 - c. Describe hidden terminal and exposed terminal problem with an example for wireless networks.
4. a. In a bus CSMA/CD network with a data rate of 10Mbps, a collision occurs $20\mu s$ after the first bit of the frame leaves the sending station. What should the length of the frame be so that the sender can detect the collision?
 - b. Consider the slotted ALOHA protocol. Assume that there are a total of N nodes and that all the nodes always have frames to transmit. Assume that each node transmits with a probability p during each slot.
 - i. We have already seen that the efficiency of slotted ALOHA is $Np(1-p)^{N-1}$. Find the value of p that maximizes this expression.
 - ii. Using the value of p found in 4.b.i, find the efficiency of slotted ALOHA by letting N approach infinity. Hint: $(1-1/N)^N$ approaches $1/e$ as N approaches infinity.
 - c. Describe Ethernet CSMA/CD algorithm with flowchart.
 - d. Why would the token passing protocol be inefficient if a LAN had a very large perimeter?
5. a. Write shortly about 802.15.
 - b. Describe 802.11 frame format with proper diagram.
 - c. Suppose an 802.11b station is configured to always reserve the channel with the RTS/CTS sequence. Suppose this station suddenly wants to transmit 1000 bytes of data and all other stations are idle at this time. As a function of SIFS and DIFS and ignoring propagation delay and assuming no bit errors, calculate the time required to transmit the frame and receive the acknowledgement.
 - d. Assume that a frame moves from a wired network using the 802.3 protocol to a wireless network using the 802.11 protocol. Show how the field values in the 802.11 frame are filled with the values of the 802.3 frame. Assume that the transformation occurs at the AP that is on the boundary between two networks.
 - e. How the mobility of a mobile node is maintained with indirect routing? Explain with proper diagram.
6. a. Describe RSA algorithm.
 - b. Write shortly about firewall.
 - c. Suppose you are sending an email from your Hotmail account to your friend, who reads his/her e-mail from his/her mail server using IMAP. Briefly describe how your email travels from your host to your friend's host. Also, what are the application layer and transport layer protocols involved?
 - d. Consider two hosts, A and B, connected by a single link of rate R bps. Suppose the two hosts are separated by m meters, and suppose the propagation speed along the link is s m/sec. Host A is to send a packet of size L bits to host B.
 - i. Express the propagation delay in terms of m and s .
 - ii. Determine transmission time, d_{trans} in terms of L and R .
 - e. Define "limited broadcast address" and "direct broadcast address".

University of Dhaka
Department of Computer Science and Engineering
3rd Year 1st Semester B. Sc. Final Examination 2019
CSE 3102: Software Engineering

Duration: 3 hours

Credits: 3

Full Marks: 60

(Answer any four of the following six questions)

1. a. State the advantages and disadvantages of the evolutionary model of software development. 5
b. Is it (evolutionary model) more, or less, suitable than the waterfall model for safety-critical projects? Justify your answer. 5
c. What is the main criterion for deciding whether or not to use the waterfall model in a software development project? Explain whether there would be any difference for a hardware development project. 5
2. a. Suggest one primary, one secondary, and one indirect stakeholder of a university student records system. Make sure to motivate the answer. 5
b. Give one advantage and one disadvantage of specifying requirements in natural language only. 3
c. Describe four use-cases and draw a use-case diagram of a self-scanning system in a shop. A self-scanning system allows a user to scan European Article Number (EAN) codes of all articles, and deduct the sum from the customer's shopping account. Special solutions apply to alcohol, tobacco and non-packaged articles, such as, vegetables. 7
3. a. Write down one functional and one non-functional requirement of a mail management client, for instance MS Outlook. Give two reasons of why it is a good idea to classify and separate functional requirements and non-functional requirements in a requirements specification. 4
b. Verification and Validation are two process areas at CMMI level 3. For both of these areas provide i) a definition; and ii) a description of how you can fulfill the area in your testing activities. 7
c. Describe two different software metrics which measure the same quality factor. Don't forget the motivation and the description of how to obtain the numerical values. 4
4. a. Decomposing a system into subsystems reduces the complexity developers have to deal with by simplifying the parts and increasing their coherence. Decomposing a system into simpler parts usually results into increasing a different kind of complexity: Simpler parts also mean a larger number of parts and interfaces. If coherence is the guiding principle driving developers to decompose a system into small parts, which competing principle drives them to keep the total number of parts small? 4
b. Assuming one of your design goals is to enable future developers to substitute the planning algorithm that decides on the next move with a better one, which design pattern would you consider to satisfy the goal? Justify your choice. 4
c. Consider a system that includes a database client and two redundant database servers. Both database servers are identical: the first acts as a main server, the second acts as a hot back-up in case the main server fails. The database client accesses the servers through a single component called a "gateway," hence 4

hiding from the client which server is currently being used. A separate policy object called a “watchdog” monitors the requests and responses of the main server and, depending on the responses, tells the gateway whether to switch over to the back-up server. What do you call this design pattern? Draw a UML class diagram to justify your choice.

- d. What are test data? Design the test data to validate a birth date of a person in the online job application form where age should be less or equal to 30 years as on 30th June, 2019. 3
5. a. Consider the following program segment 6

```

w = x; // node 1
if (m > 0)
{
    w++; // node 2
}
else
{
    w=2*w; // node 3
}
// node 4 (no executable statement)
if (y <= 10)
{
    x = 5*y; // node 5
}
else
{
    x = 3*y+5; // node 6
}
z = w + x; // node 7

```

Draw a control flow graph for this program fragment. Use the node numbers given above.

- b. Which nodes have *defs* for variable *w*? Which nodes have *uses* for variable *w*? 3
- c. Enumerate all of the du-paths for variables *w* and *x*. 6
6. At Department of Computer Science and Engineering, University of Dhaka (CSEDU), faculties manually take attendance in every class each day. They spend time to do that during class time. As a result, it takes lots of time and sometimes some students come to class late and request for attendance. That's why CSEDU wants to develop a class attendance system to keep track of the presence of the students in a class. The Automatic Attendance System will help them do this process in an easy way by using fingerprint or face recognition technology. The main scope of this project is to make attendance process more organized in every class. The system will give a report to the department chairman as well as all the students by monthly basis. Besides this, the system will give the late attendance to the students who come after a specific time period and will consider three late attendances as one attendance. As a computer science student, you are asked to further the requirement analysis and prepare a requirement document for software developers so that they can develop the Attendance software using the software requirement analysis document.

Now considering the above requirements, answer the following questions.

- a. Identify functional and non-functional requirements of the Attendance system. 5
- b. Describe the data flow of the Attendance system with the DFD diagram. 5
- c. Draw a class diagram of the Attendance system. 3
- d. How the activity diagrams are useful in eliciting the requirements of software system? 2

University of Dhaka
Department of Computer Science and Engineering
3rd Year 1st Semester B. Sc. (Hons) Final Examination, 2019
CSE-3103: Microprocessor and Microcontroller

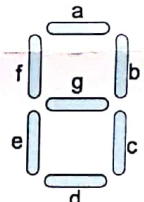
Total Marks: 20

Time: 3 Hours

(Answer any four (4) of the following questions)

- 1 a) Describe addressing modes of 8086 microprocessor with suitable examples. [10]
 b) Compare memory mapped I/O and I/O mapped I/O. [3]
 c) Describe function of ALE and $\overline{DT}/\overline{R}$ pins of 8086. [2]

- 2 a) Suppose your x86 processor is equipped with peripheral controller which is connected to an 8-bit A/D converter chip. To get a sample reading from ADC, you just read at I/O address 300H. Assume that a sine wave is fed to the ADC, your job is to write an assembly language program which calculates the frequency of the sine wave. [7]
 b) What do you mean by Assembler Directives? [3]
 c) What is the difference between a Macro and a Procedure? [3]
 d) Which of the followings produce the same 4 bytes? [3]
 A1 BYTE "1234"
 A2 BYTE 1,2,3,4
 A3 BYTE 4,3,2,1
 A4 WORD 1,2,3,4
 A5 DWORD 01020304H
 A6 DWORD 01020304
 A7 DWORD 04030201

- 3 a) A typical 7-segment display is shown below. Assume the pins (a-g) of 7-segment display are connected to data bits at I/O address 301H ($D_0 \rightarrow a$, $D_1 \rightarrow b$, and so on). Write down an assembly language function which will take any digit between 0-9 and show that number on 7-segment display. [6]

 b) What is a re-entrant procedure? [3]
 c) Explain segment addressing in protected mode. [4]
 d) Suppose there were no PUSH instruction. Write a sequence of two other instructions that would accomplish the same as PUSH EAX. [2]

- 4 a) Suppose LSB data bus of I/O port 300h is connected properly to drive a LED. Write an assembly function which can control the intensity of the LED. Intensity of LED is a numerical value from 1 to 100 supplied as a parameter of the function. [6]
 b) Use the following data definition for this question: [4]
 dArray DWORD 10 DUP(?)
 dSize = (\$ - dArray)
 byte1 BYTE 0FFh,1,2
 word3 SWORD 7FFFh,8000h

Where marked by a letter (a, b, c, d, e, f, g, h) in the following code segment, give your answer and explain your reasons. Suppose the code segment is executed sequentially from top to bottom. Note that some instructions may be illegal.

mov ax,dSize	a. ax = ?
mov ax,[word3+2]	b. ax = ?
mov eax,[word3+4]	c. eax = ?
mov OFFSET byte1,10h	d. byte1 = ?
mov ebx,OFFSET byte1	
mov al,[ebx+3]	e. al = ?
movsx eax,byte1	f. eax = ?
mov al,80h add al,80h	g. ZF,CF,SF,OF = ?
mov al,00110011b test al,2	h. ZF,CF,SF = ?

- c) Translate the following C code snippet into assembly language: [3]
- ```
unsigned char data;
char count;
while(data) {
 data = data & (data - 1);
 count++;
}
printf("%d\n", count);
```

- d) Consider the following C code fragment: [2]
- ```
main(void)
{
    unsigned short  us = 269;
    signed short   ss = -35;

    printf("%d %d\n", us, ss);
    printf("%u %u\n", us, ss);
    printf("%hd %hd\n", us, ss);
    printf("%hu %hu\n", us, ss);
}
```

Write down the output from the program above and explain your answer.

- 5 a) What are the functions of Assembler, Linker, and Loader? [3]
b) Consider the following C code: [4]

```
func(int i)
{
    char a[8];
    if(i==1) return 1;
    else func(i-1);
}
```

```
main(void)
{
    func(5);
}
```

Show how the stack grows before the program terminates.

- c) Write an assembly language program which can rotate a 64bit binary number (stored in RAX) to 5 places on left. You are not allowed to use the built-in rotate instruction. [4]
d) Explain the purpose of the following flags: [4]
i. TF
ii. IF
iii. OF
iv. DF

- 6 a) Consider the following C code: [4]

```
void f(char *str)
{
    char buffer[16];
    strcpy(buffer, str);
}

void main(int argc, char **argv)
{
    f(argv[1]);
}
```

Show how stack is used to manage the local variables and function parameters.

- b) You want to exploit the stack overflow vulnerability and shift the program execution to a new address (0x55667788). What will be the input parameter to do so? [3]
c) It is very unlikely that you get the address of some malicious code (as assumed in previous question) that you can use to exploit stack overflow. Give a more practical way to exploit stack overflow. [5]
d) What is the benefit of using EBP to access the parameters of a function instead of ESP? [3]

University of Dhaka
Department of Computer Science and Engineering
3rd Year 1st Semester B. Sc. Final Examination 2019
CSE 3104: Database Management System II

Duration: 3 hours

Credits: 3

Full Marks: 60

(Answer any four of the following six questions)

1. a. What are the factors for choosing a RAID level? 3
 b. "RAID improves reliability via redundancy as well as performance via parallelism."- Explain properly. 4
 c. How variable-length records arise in database systems? Describe a technique to implement variable-length records while organizing file. 1+
4
 d. Indices speed query processing, but it is usually a bad idea to create indices on every attribute, and every combination of attributes, that is potential search keys. Explain why. 3
2. a. When a hash index is better than a B⁺-tree index? Explain with an example. 4
 b. Construct a dynamic hash index structure on search key Branch-name for the following database and hash addresses. Assume that each bucket can contain 2 entries 11

Hash function

Branch-name	h(Branch-name)
Brighton	0010
Downtown	1010
Mianus	1100
Perryridge	1111
Redwood	0011
Round Hill	1101

Database

Account-number	Branch-name	Balance
A-217	Brighton	750
A-101	Downtown	600
A-110	Downtown	600
A-215	Mianus	700
A-102	Perryridge	400
A-201	Perryridge	900
A-222	Redwood	700
A-305	Round Hill	350

3. a. Define the terms: i) Query processing ii) Query optimization. 3
 b. How can dynamic programming be used to handle a huge amount of evaluation plans in a query optimization process? 4
 c. Suppose that B⁺-tree index on *branch_city* is available on relation *branch* on schema *Branch(branch_name, branch_city, assets)*, and that no other index is available. List different ways to handle the following selections that involved negation: 3

i) $\sigma_{\neg (branch_city < "Brooklyn")}(branch)$

- ii) $\sigma_{\neg (branch_city = "Brooklyn")}(branch)$
- iii) $\sigma_{\neg (branch_city < "Brooklyn") \vee assets < 5000}(branch)$
- d. What do you understand by heuristics optimization? What steps are followed in typical heuristics optimization? 3
- e. Consider the materialized view $v = r \bowtie s$ and an update to r . Let set of tuples inserted to and deleted from r are denoted by i_r and d_r . Also r^{old} and r^{new} denote the old and new states of relation r . Now show the relational algebra expressions for incremental view maintenance. 2
4. a. What are the factors that limit speedup and scaleup in parallel database system? 2
- b. What different interconnection network architectures exist for parallel database? Mention characteristics of each with advantages and disadvantages. 4
- c. What factors could result in skew when a relation is partitioned on one of its attribute by: i) Hash partitioning ii) Range partitioning? In each case, what can be done to reduce the skew? 5
- d. Define the terms: 4
- i) Interquery and Intraquery parallelism
- ii) Pipelined and Independent parallelism
5. a. Differentiate homogeneous and heterogeneous distributed databases. 3
- b. What are the approaches of data fragmentation in distributed database? What advantage you may gain by these approaches? 4
- c. What is false cycle? How unnecessary rollbacks occur in global wait-for graph due to false cycle? 3
- d. Let r_1 be a relation with schema R_1 stores at site S_1 . Let r_2 be a relation with schema R_2 stores at site S_2 . Evaluate the expression $r_1 \bowtie r_2$ using semijoin strategy and obtain the result at S_1 . 3
- e. Consider a relation that is fragmented horizontally by *plant_number*: 2
- employee (name, address, salary, plant_number)*
- Assume that each fragment has two replicas: one stored at the New York site and one stored locally at the plant site. Describe a good processing strategy for the following queries entered at the San Jose site.
- i) Find all employees at the Boca plant.
- ii) Find the average salary of all employees.
- iii) Find the highest-paid employee at each of the following sites: Toronto, Edmonton, Vancouver, Montreal.
- iv) Find the highest-paid employee in the company.
6. a. What do you understand by a data warehouse? What are the design issues to be addressed in building a data warehouse? 2+
- b. Define star schema for a data warehouse with suitable example. 4
- c. What is persistent programming language? Mention the basic differences between object relational and object oriented data model. 3
- d. With suitable example explain unnesting and nesting of a nested relation. 1+
- 2
- 3

University of Dhaka
Department of Computer Science and Engineering
3rd Year 1st Semester B. Sc. (Hons) Final Examination, 2019
MATH-3105: Multivariable Calculus and Geometry

Total Marks: 60

Time: 3 Hours

(Answer any four (4) of the following questions)

1. a) Determine whether each statement is true or false. Explain your answer briefly. [6]
 Assume everything is described in 3D.
 - i. Two lines parallel to a third line are parallel.
 - ii. Two lines perpendicular to a third line are parallel.
 - iii. Two planes parallel to a third plane are parallel.
 - iv. Two lines perpendicular to a plane are parallel.
 - v. Two lines either intersect or are parallel.
 - vi. A plane and a line either intersect or are parallel.
 - b) Find parametric equations and symmetric equations for the line through the origin [5]
 and the point (4, 3, -1).
 - c) Find equations of the planes that are parallel to the plane $x + 2y - 2z = 1$ and two [4]
 units away from it.
2. a) Is $\lambda = 4$ an eigenvalue of $\begin{bmatrix} 3 & 0 & -1 \\ 2 & 3 & 1 \\ -3 & 4 & 5 \end{bmatrix}$? If so, find one corresponding eigenvector. [6]
 - b) Diagonalize $\begin{bmatrix} 2 & 2 & -1 \\ 1 & 3 & -1 \\ -1 & -2 & 2 \end{bmatrix}$. Show full process in details. [9]
3. a) Find the domain and range of $g(x, y) = \sqrt{9 - x^2 - y^2}$ and sketch the level curves [3]
 of the function for $k=0, 1, 2, 3$.
 - b) Show if the following polynomials are linearly independent [4]

$$p_1(t) = 1 + 2t^2 \rightarrow [p_1(t)]_B = (1, 0, 2)$$

$$p_2(t) = 4 + t + 5t^2 \rightarrow [p_2(t)]_B = (4, 1, 5)$$

$$p_3(t) = 3 + 2t \rightarrow [p_3(t)]_B = (3, 2, 0)$$
 - c) Let $A = \begin{bmatrix} 3 & -6 & 0 \\ -6 & 0 & 6 \\ 0 & 6 & -3 \end{bmatrix}$. Show that A is orthogonally diagonalizable by finding an [6]
 orthogonal matrix U and a diagonal matrix D such that $A = UDU^T$.
 - d) Sketch the graph of the function $f(x, y) = 6 - 3x - 2y$ [2]

4. a) Find the local maximum and minimum values and saddle point(s) of the given [9]
functions.
- $x^2 + xy + y^2 + y$
 - $y^3 - 3x^2y - 6x^2 - 6y^2 + 2$
 - $e^x \cos y$
- b) Use Lagrange multipliers to find the maximum and minimum values of the [6]
function subject to the given constraint:
- $f(x, y) = 3x + y; x^2 + y^2 = 10$
 - $f(x, y) = e^{xy}; x^3 + y^3 = 16$
5. a) Calculate the iterated integral: [6]
- $\int_1^4 \int_0^2 (6x^2y - 2x) dy dx$
 - $\int_0^2 \int_0^4 y^3 e^{2x} dy dx$
- b) Evaluate the double integral: [9]
- $\iint_D y^2 dA, D = \{(x, y) \mid -1 \leq y \leq 1, -y - 2 \leq x \leq y\}$
 - $\iint_D x \cos y dA, D$ is bounded by $y = 0, y = x^2$ and $x = 1$
 - $\iint_D y^2 dA, D$ is a triangular region with vertices $(0, 1), (1, 2), (4, 1)$.
6. a) Use polar coordinates to find the volume of the given solid under the cone [5]
 $z = \sqrt{x^2 + y^2}$ and above the disk $x^2 + y^2 \leq 4$
- A cylindrical drill with radius r is used to bore a hole through the center of a sphere [5]
of radius R . Find the volume of the ring-shaped solid that remains.
 - A swimming pool is circular with a 40-ft diameter. The depth is constant along [5]
east-west lines and increases linearly from 2 ft at the south end to 7 ft at the north
end. Find the volume of water in the pool.