NANYANG TECHNOLOGICAL UNIVERSITY

SEMESTER 1 EXAMINATION 2014-2015

CZ3006/CSC302 – NET-CENTRIC COMPUTING

Nov/Dec 2014 Time Allowed: 2 hours

INSTRUCTIONS

1. This paper contains **SEVEN (7)** questions and comprises **EIGHT (8)** pages.
2. Answer **ALL** questions.
3. This is a closed-book examination.
4. Questions **DO NOT** carry equal marks.
5. An appendix for Question 2 is provided on Pages 7 and 8.

---

1. (a) Answer the following questions and explain your answers (note: the signal travels 200 meters per micro second in the cable).

(i) To run a CSMA/CD network at 100 Mbps over a 2-km cable, what is the minimum frame size?

(3 marks)

(ii) To run a CSMA/CD network at 1Gbps over a 2-km cable, what is the minimum frame size?

(3 marks)

(iii) Is it possible to run a CSMA/CD network at 1Gbps and keep the same minimum frame size as that calculated in Q1(a)(i)?

(3 marks)

(b) Explain what flow control and congestion control are. Furthermore, describe a situation where flow control is needed but congestion control is not, and another situation where congestion control is needed but flow control is not.

(6 marks)

2. Suppose machine A is communicating with machine B using the sliding window protocol in Assignment 1 (attached in the **Appendix** on pages 7 and 8). Suppose B has received frames 0, 1, 2, 3, 4, and 6 from A. Answer the following questions:

(a) What sequence numbers are within the receiving window of B?

(2 marks)

(b) Which frame(s) can B deliver to the network layer?

(2 marks)

(c) Which frame(s) can B save in the buffer?

(2 marks)

(d) Which sequence number can B positively acknowledge A?

(2 marks)

(e) Which sequence number can B negatively acknowledge A?

(2 marks)

3. Consider the subnet in Figure Q3. Suppose distance vector routing is used, and the following vectors have just come into router C:

- from B: (6, 0, 8, 12, 6, 2);
- from D: (12, 14, 6, 0, 9, 10); and
- from E: (2, 6, 3, 9, 0, 4).

The measured delays to B, D and E, are 9, 8, and 12, respectively. What is C's new routing table? Give both the outgoing line to use and the expected delay in your answer.

(15 marks)

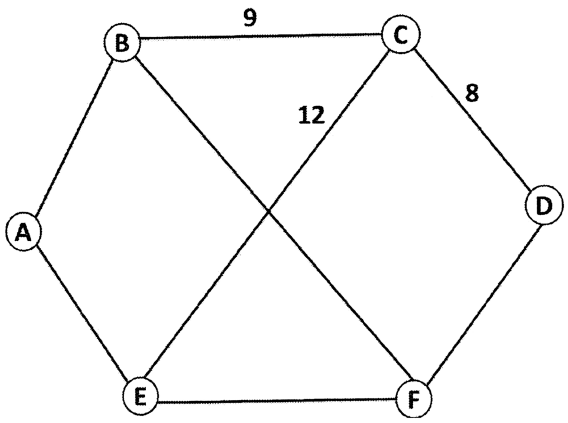


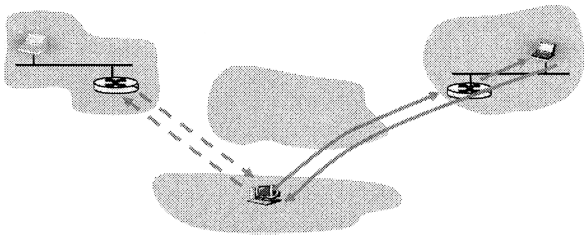
Figure Q3

4. Consider a TCP machine sending windows of 65,535 bytes over a 1Gbps channel. What line efficiency can be achieved if the round-trip time of this channel is 100ms and 400ms, respectively? Explain your answers.

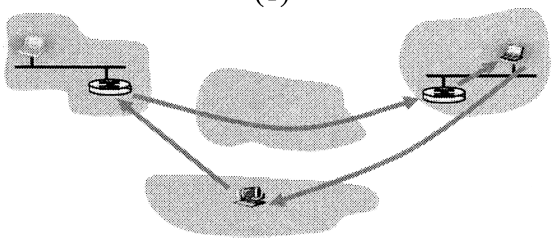
(10 marks)

5. Figure Q5 depicts two routing schemes in handling mobility. Please name the two schemes and link them to the two subfigures in Figure Q5. Illustrate the major steps in the routing cycle of the two schemes.

(10 marks)



(1)



(2)

Figure Q5

6. Figure Q6a shows the display of a javascript embedded HTML document. Figure Q6b gives the source code of this HTML document with embedded JavaScript. The HTML document contains a form for collecting a student's GPA information. There is a "Name" text box which takes the student's name. The "No." text box takes the student's ID number. The "Score" text box takes the score of the student. The "GPA" text box displays the student's GPA corresponding to the student's score. Upon submission, the form data will be sent back to the same server and handled by a PHP script "transcript_handler.php" in the same folder.

Complete the source code in Figure Q6b by filling in boxes **A** to **H** each with a single statement or expression (2 marks for each box). Your code should implement the following functionality.

First, the student's ID must **begin with a letter, followed by 7 digits, and end with a letter** (e.g., U5024718H as depicted in Figure Q6a). If the input is not valid, an alert message is popped up and the input in the "No." text box is focused and selected.

Question No. 6 continues on Page 4

Second, whenever the input in the "Score" text box changes, the form of the input will be checked and the GPA is recalculated. The result is displayed in the "GPA" text box. A valid input for "Score" is defined **a number in the range [0, 100], either an integer (e.g., 92) or with one decimal place (e.g., 85.4)**. If the input is not valid, an alert message is generated. The "Score" text box is then focused and selected. The mapping between the score and GPA is as follows:

Score	0-19	20-39	40-59	60-79	80-100
GPA	1	2	3	4	5

Third, the "GPA" text box should **be blurred** whenever it acquires focus as this text box is not intended for user input.

(16 marks)

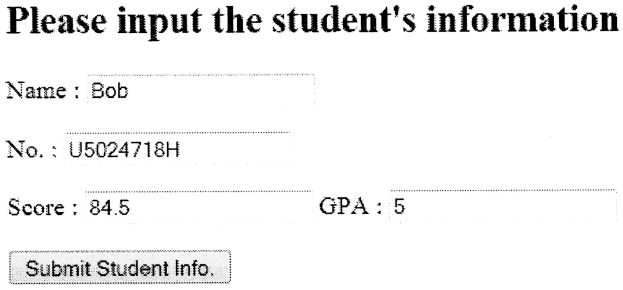


Figure Q6a

```
<html xmlns="http://www.w3.org/1999/xhtml"><head><title>Transcript</title>
<script type="text/javascript">
<!--
function checkNo() {
        var stud_no = document.getElementById("studno");
        var pos = stud_no.value.search(      A      );
        if (pos != 0) {
                alert("The student No. you entered is not in the correct form. \n");
                stud_no.focus();
                stud_no.select();
        }
}

function SetGPA(score) {
        [      B      ]
}
```

Question No. 6 continues on Page 5

```
function checkScore() {
        var stud_score = document.getElementById("studscore");
        if ( [ C ] ){
                alert("The student score you entered is not in the correct form. \n");
                stud_score.focus();
                stud_score.select();
        }
        [ D ]
}
//--></script>
</head><body>
[ E ]
<h2> Please input the student's information </h2>
<p> Name : <input type = "text" name = "studname" id = "studname" /> </p>
<p> No. : <input type = "text" name = "studno" id = "studno" [ F ] /> </p>
<p> Score : <input type = "text" name = "studscore" id = "studscore" [ G ] />
GPA : <input type = "text" id = "studgpa" [ H ] /></p>
<p> <input type = "submit" id = "submit" value = "Submit Student Info."/> </p>
</form></body></html>
```

Figure Q6b

7. Continuing from Q6, a server side PHP script "transcript_handler.php" receives and processes the student records submitted from the client. On receiving the information, the PHP script will update a record file named "transcripts.dat" that maintains and updates the students' information. The file maintains the updated student name, number, and score, as depicted in Figure Q7a. The PHP script ensures that **the entries of the students are sorted according to their scores**.

Complete the PHP source code in Figure Q7b by filling in boxes **A** to **L** each with a single statement or expression to provide the above mentioned functionalities (2 marks for each box).

(24 marks)

```
student_name: David student_number: U4322164X student_score: 90
student_name: Bob student_number: U5024718H student_score: 84.5
student_name: Alice student_number: U1143931P student_score: 76.3
```

Figure Q7a

Question No. 7 continues on Page 6

```
<html xmlns="http://www.w3.org/1999/xhtml">
<head><title>Transcripts</title></head><body>
<?php
        $name = $_POST[ A ];
        $number = $_POST[ B ];
        $score = $_POST [ C ];

        $file = fopen("transcripts.dat","r");
        $count = 0;
        $studname = array();
        $studno = array();
        $studscore = array();

        while( D ) {
                $array = explode(" ",fgets($file)); //Read a line from the transcript.txt
                if ($array[1] != "") {
                        $studname[$count] = $array[1];
                        $studno[$count] = $array[3];
                        $studscore[$count] = $array[5];
                        $count = $count + 1;
                }
        }
        E
        $last = $count - 1;
        while ($last >=0) {
                if ($studscore[$last] > $score)
                        F
                $studname[$last + 1] = $studname[$last];
                $studno[$last + 1] = $studno[$last];
                $studscore[$last + 1] = $studscore[$last];
                G
        }
        H
        $studname [$insert] = $name;
        $studno[$insert] = $number;
        $studscore[$insert] = $score;
        I
?>
<h2> Record has been updated </h2>
<?php
        J
        for ($index = 0; $index < $count; $index++) {
                $output = K ;
                L
        }
        fclose($file);
?></body></html>
```

Figure Q7b

Appendix: A Sliding-Window Protocol (for Question No. 2)

```
#define MAX_SEQ 7
#define NR_BUFS ((MAX_SEQ + 1)/2)
typedef enum {frame_arrival, cksum_err, timeout, network_layer_ready, ack_timeout}
event_type;
#include "protocol.h"
boolean no_nak = true;
seq_nr oldest_frame = MAX_SEQ + 1;

static boolean between(seq_nr a, seq_nr b, seq_nr c)
{   return ((a <= b) && (b < c)) || ((c < a) && (a <= b)) ||  ((b < c) && (c < a)); }

static void send_frame(frame_kind fk, seq_nr frame_nr, seq_nr frame_expected, packet
buffer[ ])
{
        frame s;  s.kind = fk;
        if (fk == data) s.info = buffer[frame_nr % NR_BUFS];
        s.seq = frame_nr;
        s.ack = (frame_expected + MAX_SEQ) % (MAX_SEQ + 1);
        if (fk == nak) no_nak = false;
        to_physical_layer(&s);
        if (fk == data) start_timer(frame_nr % NR_BUFS);
        stop_ack_timer();
}

void Sliding-Window-Protocol(void)
{
        seq_nr ack_expected, next_frame_to_send, frame_expected, too_far;
        int i;
        frame r;
        packet out_buf[NR_BUFS];
        packet in_buf[NR_BUFS];
        boolean arrived[NR_BUFS];
        event_type event;

        enable_network_layer(?);
        ack_expected = 0;
        next_frame_to_send = 0;
        frame_expected = 0;
        too_far = NR_BUFS;

        for (i = 0; i < NR_BUFS; i++) arrived[i] = false;
```

Appendix continues on Page 8

```
while (true) {
  wait_for_event(&event);
  switch(event) {
    case network_layer_ready:
      from_network_layer(&out_buf[next_frame_to_send % NR_BUFS]);
      send_frame(data, next_frame_to_send, frame_expected, out_buf);
      inc(next_frame_to_send);
      break;
    case frame_arrival:
      from_physical_layer(&r);
      if (r.kind == data) {
        if ((r.seq != frame_expected) && no_nak)
          send_frame(nak, 0, frame_expected, out_buf); else start_ack_timer();
        if (between(frame_expected, r.seq, too_far) &&
                    (arrived[r.seq % NR_BUFS]==false)) {
          arrived[r.seq % NR_BUFS] = true;
          in_buf[r.seq % NR_BUFS] = r.info;
          while (arrived[frame_expected % NR_BUFS]) {
            to_network_layer(&in_buf[frame_expected % NR_BUFS]);
            no_nak = true;
            arrived[frame_expected % NR_BUFS] = false;
            inc(frame_expected);
            inc(too_far);
            start_ack_timer();
          } } }
        if((r.kind==nak) && between(ack_expected, (r.ack+1) % (MAX_SEQ+1),
                                    next_frame_to_send))
          send_frame(data, (r.ack+1) % (MAX_SEQ+1), frame_expected,
    out_buf);
        while (between(ack_expected, r.ack, next_frame_to_send)) {
          enable_network_layer(?);
          stop_timer(ack_expected % NR_BUFS);
          inc(ack_expected);
        }
        break;
    case cksum_err:
      if (no_nak) send_frame(nak, 0, frame_expected, out_buf);
      break;
    case timeout:
      send_frame(data, oldest_frame, frame_expected, out_buf);
      break;
    case ack_timeout:
      send_frame(ack, 0, frame_expected, out_buf);
  } } }
```

END OF PAPER

CZ3006 NET CENTRIC COMPUTING
CSC302 NET CENTRIC COMPUTING

Please read the following instructions carefully:

1. **Please do not turn over the question paper until you are told to do so. Disciplinary action may be taken against you if you do so.**

2. You are not allowed to leave the examination hall unless accompanied by an invigilator. You may raise your hand if you need to communicate with the invigilator.

3. Please write your Matriculation Number on the front of the answer book.

4. Please indicate clearly in the answer book (at the appropriate place) if you are continuing the answer to a question elsewhere in the book.