Final Examination

Introduction to Computer Science
Class#: 901 10110, Session#: 03
Spring 2005

15:40-17:20 Wednesday
June 22, 2005

Prohibited

1. You are not allowed to write down the answers using pencils. Use only black- or blue-inked pens.
2. You are not allowed to read books or any references not on the question sheets.
3. You are not allowed to use calculators or electronic devices in any form.
4. You are not allowed to use extra sheets of papers.
5. You are not allowed to have any oral, visual, gesture exchange about the exam questions or answers during the exam.

Cautions

1. Check if you get 9 pages (including this title page), 15 questions.
2. Write your name (in Chinese), student ID, and department/year down on top of the cover page.
3. You have 100 minutes to answer the questions. Skim through all questions and start from the questions you feel more confident with.
4. You are allowed to use only English to answer the questions. Please make sure your answers make sense.
5. If you have any extra-exam emergency or problem regarding the exam questions, raise your hand quietly. The exam administrator will approach you and deal with the problem.

1. Suppose the address of a network on the Internet is quoted as 33.42.18.0.
   (a) what is the address in hexadecimal notation? (4%)
   (b) what is the address's bit pattern? (4%)

ANSWER:
(a) 00100001 00101010 00010010 00000000
(b)212A1200

2. Many people use the terms Internet and world-wide web interchangeably. What is the difference between the Internet and the world-wide web? (4%)

ANSWER:
The Internet is the infrastructure used by the world-wide web. That is, the world-wide web is only one application of the Internet. Other applications include email, ftp, and telnet.

3. As an encryption system, what is unique about public-key encryption (that is, why is public-key encryption so named)? (4%)

ANSWER:
In a public-key encryption system, knowing the encryption key does not allow one to decipher a message. Thus, the encryption key can be public knowledge without violating security.

4. Name at least one distinction between UDP and TCP? (4%)

ANSWER:
(1) UDP is a connectionless protocol whereas TCP establishes a two way communication between the origin and destination of a message.
(2) TCP is a reliable protocol in that the origin and destination work together to confirm that the entire message was successfully transferred. In contrast, UDP merely transmits the message without confirming it reception.

5. Which layer of the TCP/IP hierarchy (Application, Transport , Network, Link) does the following: (4%)
      (a) Deciding the direction in which message segments are transferred across the Internet.
      (b) Presenting incoming messages to the computer user
      (c) Deciding which application should receive an incoming message

ANSWER:
(a) Network layer
(b) Application layer
(c) Transport layer

6. When searching within the list:

Lewis, Maurice, Nathan, Oliver, Pat, Quincy, Roger, Stan, Tom

(a) Which of these entries, Lewis, Pat, or Tom, will be found most quickly using the sequential search algorithm? (4%)

(b) Which of these entries, Lewis, Pat, or Tom, will be found most quickly using the binary search algorithm? (4%)

ANSWER:

(a) Lewis

(b) Pat

7. Circle the portion of the program below in which control of the loop is initialized. (4%) Draw a rectangle around the portion in which the test for termination is performed. (4%) Underline the portion in which the state of the loop is moved toward the termination condition. (4%)

```
X ← 3;
while (X < 9) do
  (X ← X + 1)
```

ANSWER:

Circle: X ← 3,

Rectangle: while (X < 9),

Underline: X ← X + 1

8. Rewrite the following routine using a prettest while statement. (8%)

```
repeat (print the value of X;
        X ← X + 1)
until (X > 5)
```

ANSWER: One possible solution is:

```
print the value of X;
X ← X + 1;
while (X ≤ 5) do
  (print the value of X;
   X ← X + 1)
```

9. The following procedure was designed to compute the largest integer whose square is no greater than N, where N is assumed to be a positive number. (If N is 5, then the procedure should report the value 2.) Find and correct the error. (4%)

```
procedure squareroot (N)
X ← 0;
while (X² ≤ N) do
  (X ← X + 1);
report the value of X
```

ANSWER: The value reported should be X - 1.

10. What sequence of numbers would be printed if the following procedure were executed with the value of N being 0? (4%)

```
procedure xxx (N)
print the value of N;
if (N < 2)
    then (apply the procedure xxx to the value N + 1)
    else (print the value of N)
print the value of N
```

ANSWER: 0, 1, 2, 2, 2, 1, 0

11. Rewrite the following instructions using a single if-then-else statement. (8%)

```
      if (X = 5) goto 50
      goto 60
 50   print the value of Z
      goto 100
 60   print the value of Y
100   . . .
```

ANSWER:
```
if (X = 5)
    then (print the value of Z)
    else (print the value of Y)
```

12. (a) Translate the high-level statement

```
      if (X equals 0)
          then Z ← Y + W
          else Z ← Y + X
```

into the machine language of Appendix C, assuming that W, X, Y, and Z are all values represented in two's complement notation, each using one byte of memory.   Assume the program starts at address 00.   Let W stored in the memory with address WW, X with address XX, Y with address YY, and Z with address ZZ. (8%)

(b) Was it necessary to identify the type of data associated with the variables in order to translate the statements? Why do many high-level programming languages require the programmer to identify the type of each variable at the beginning of a program? (4%)

ANSWER:

(a)

00	2000
02	11XX
04	12YY
06	B10E
08	5012
0A	30ZZ
0C	C000
0E	11WW
10	B008

(b) The op-code for add two binary values maybe different depending on whether the two values are two integers or two real numbers.

13. The following is a program segment and the definition of a procedure named sub.

```
X ← 8;
apply procedure sub;
print the value of X;

procedure sub
   X ← 2;
```
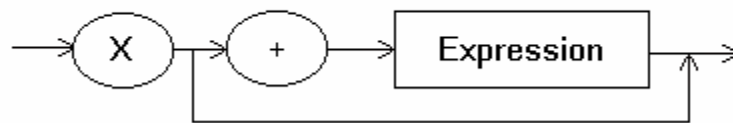
(a) What value will be printed by the program segment if X is a global variable? (4%)
(b) What value will be printed by the program segment if X is a declared as a local variable within the procedure? (4%)
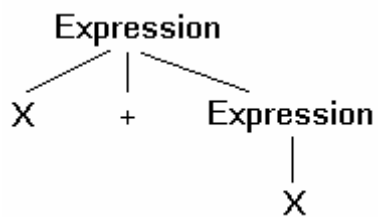
ANSWER:
(a) 2
(b) 8

14. Which of the following is not a parse tree of an expression based on the following grammar? (4%)

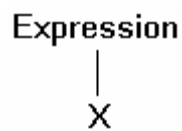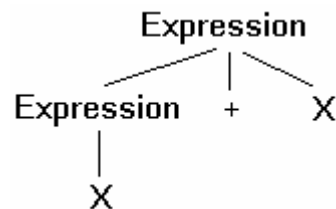Expression:

A.
```
        Expression
        /    |    \
      X      +    Expression
                      |
                      X
```

B
```
   Expression
        |
        X
```

C
```
             Expression
            /     |     \
    Expression    +      X
        |
        X
```

ANSWER:
C

15. Show that the grammar below is ambiguous by drawing two distinct parse trees for the string "drip drip drip." (8%)

Leak:

ANSWER:
Possible answers include: