

Name_____ Student ID_____ Department/Year_____

Final Examination

Introduction to Computer Science
Class#: 901 E10110, Session#: 03
Spring 2011

15:40-17:20 Wednesday
June 22, 2011

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 **10** 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. There are in total **100** points to earn. 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 **English only** to answer the questions. Misspelling and grammar errors will be tolerated, but you want to make sure with those errors your answers will still 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. What is the network address of a domain containing the following IP addresses (10%):

(a) 140.112.42.224 to 140.112.42.255?

(b) 140.112.42.192 to 140.112.42.223?

ANSWER:

(a) 140.112.42.224/27

(b) 140.112.42.192/27

2. Given the following services, listed below are 2 solutions for each service. Based on your understanding of the two notions: client-server and peer-to-peer, point out the solution that is peer to peer in flavor for each service. (5%)

File sharing: (a) BitTorrent; (b) WWW

Learning: (a) taking lectures from a teacher; (b) participating in a student study group

Trading: (a) exchanging goods in a flea market; (b) buying from a super market

ANSWER:

File sharing (a)

Learning (b)

Trading (a)

3. Based on your understanding of public-key encryption, identify which of the following statements are correct. (5%)

- (a) a message encrypted by the public key can only be decrypted by the secret key
- (b) a message encrypted by the secret key can only be decrypted by the public key
- (c) a message encrypted by the public key can also be decrypted by the public key
- (d) a message encrypted by the secret key can also be decrypted by the secret key

ANSWER:

(a) (b)

4. Circle the portion of the program below in which control of the loop is initialized. Draw a rectangle around the portion in which the test for termination is performed. Underline the portion in which the state of the loop is moved toward the termination condition. (5%)

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

ANSWER:

Circle: $x \leftarrow 3$,

Rectangle: `while (x < 9),`

Underline: $x \leftarrow x + 1$

5. The Euclidean algorithm finds the greatest common divisor of two positive integer X and Y by the following process:

As long as the value of neither X nor Y is zero, continue dividing the larger of the values by the smaller and assigning X and Y the values of the divisor and remainder, respectively. (The final value of X is the greatest common divisor.)

Express this algorithm using the pseudocode primitives (10%)

ANSWER:

```
while (X is not 0 and Y is not 0) do
  TempX ← X
  TempY ← Y
  X ← the smaller of TempX and TempY
  Y ← the larger of TempX and TempY
  Y ← the remainder of X divides Y
X is the answer
```

6. What sequence of numbers would be printed when the following procedure are executed? (5%)

```
X ← 3;
while (X < 4) do
  (print the value of X;
  X ← X + 1)
print the value of X;
while (X > 2) do
  (print the value of X;
  X ← X - 2)
```

ANSWER: 3, 4, 4

7. When searching for the entry V within the list: (5%)

L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z

(Note that the list is in alphabetical order.)

(a) how many entries will be considered before discovering that the entry is present using the sequential search algorithm?

(b) how many entries will be considered before discovering that the entry is present using the binary search algorithm?

ANSWER: (a) 11, (b) 4

8. Use a while loop structure to produce a non-recursive program segment that prints the same sequence of numbers as the following recursive procedure. (10%)

```
procedure Factorial (Value)
  if (Value is 0)
    then Return 1 as the answer
  else Apply Factorial to (Value - 1),
        multiply the result by Value, and
        X ← the value of this product,
        Return the number assigned to X as the answer
```

ANSWER:

```
procedure Factorial (Value)
  X ← value
  Y ← 1
  while (X > 1) do
  (
    Y ← Y multiply X-1
    X ← X-1
  )
  Return Y as the answer
```

9. The following is a program segment and the definition of a procedure named sub.
(5%)

```
X ← 3;                                procedure sub (Y)
sub (X);                               Y ← 5;
print the value of X;
```

- (a) What value will be printed by the program segment if parameters are passed by value?
- (b) What value will be printed by the program segment if parameters are passed by reference?

ANSWER: (a) 3 (b) 5

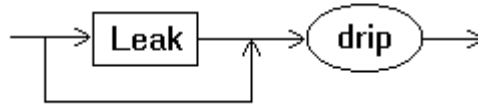
10. Based on the sketch of a class definition below, which methods can be invoked from outside an instance of the class? (5%)

```
class Example
{public void method1( )
  { . . . }
public void method2( )
  { . . . }
public void method3( )
  { . . . }
public void method4( )
  { . . . }
}
```

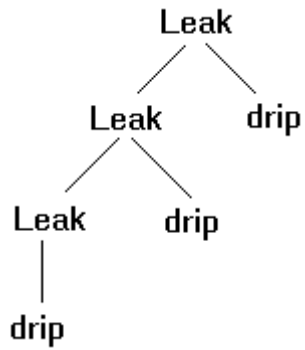
ANSWER: all 4 methods

11. Based on the grammar below, draw a parse tree showing that the string “drip drip drip” is a Leak. (5%)

Leak:



ANSWER:

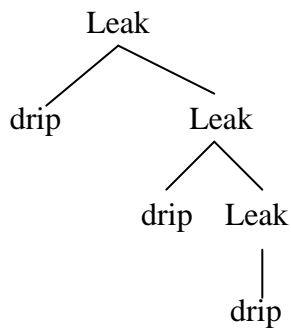
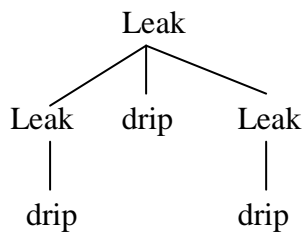


12. Show that the grammar below is ambiguous by drawing two distinct parse trees for the string “drip drip drip.” (10%)

Leak:



ANSWER: Possible answers include:



13. For the well-known searching and sorting problems, we learn 2 algorithms solving for each. Could you point out which of the solutions are more efficient asymptotically (i.e., when the size of the list to search/sort approaches infinity)? (5%)

Searching algorithms: (a) sequential search; (b) binary search

Sorting algorithms: (a) insert sort; (b) merge sort

ANSWER:

Searching: (b)

Sorting (b)

14. Is a polynomial solution to a problem always better than an exponential solution?

Explain your answer. (5%)

ANSWER:

No. For small inputs, an exponential algorithm might be faster. For example, the value of the exponential expression 2^x is less than the polynomial expression x^2 in the range of x in between 2 and 4.

15. Show how the statement could be simulated in Bare Bones. (10%)

```
name3 <- name1 + name2;
```

ANSWER:

```
clear name3, name4;  
while (name1 not 0)  
  incr name3;  
  incr name4;  
  decr name1;  
while (name4 not 0)  
  incr name1;  
  decr name4;  
while (name2 not 0)  
  incr name3;  
  incr name4;  
  decr name2;  
while (name4 not 0)  
  incr name2;  
  decr name4;
```