

Name\_\_\_\_\_ Student ID\_\_\_\_\_ Department/Year\_\_\_\_\_

## **Final Examination**

Introduction to Computer Science  
Class#: 901 E10110, Session#: 03  
Spring 2013

15:40-17:20 Wednesday  
June 19, 2013

### **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), **13** 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) 140.112.42.0 to 140.112.42.255?
- (b) 140.112.41.64 to 140.112.41.127?

ANSWER:

- (a) 140.112.42.0/24
- (b) 140.112.41.64/26

2. Based on your understanding of the WWW, HTML, HTTP, and the Internet, which of the following formulation is more correct and why? (10%)

- (a) WWW = Internet
- (b) WWW = Internet + HTTP
- (c) WWW = Internet + HTTP + HTML

ANSWER:

(c)

WWW is a collection of HTML documents transmitted via the HTTP protocol over the Internet.

3. Alice is sending a document to Bob using the public-key encryption mechanism.

Which(s) of the following statement is(are) true? (5%)

- (a) To ensure that the document is readable only by Bob, Alice should encrypt the document using Bob's secret key.
- (b) To ensure that the document is readable only by Bob, Alice should encrypt the document using Bob's public key.
- (c) To ensure that sender of the document is indeed Alice, Alice should encrypt the document using Alice's secret key.
- (d) To ensure that sender of the document is indeed Alice, Alice should encrypt the document using Alice's public key.

ANSWER:

(b) (c)

4. Given the following pseudo code, replace the for-loop by a repeat-loop. (5%)

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

ANSWER:

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

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. 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)
  if ( value is 0)
    then Return 1 as the answer
  else
    (
      X ← value
      Y ← value
      while (X > 1) do
        (
          Y ← Y multiply X-1
          X ← X-1
        )
      Return Y as the answer
    )
```

7. When searching for the entry L 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, including L, will be considered before discovering that the entry is present using the sequential search algorithm?
- (b) how many entries, including L, will be considered before discovering that the entry is present using the binary search algorithm?

ANSWER: (a) 1, (b) 4

8. For the well-known searching and sorting problems, we learn 2 algorithms solving for each. The efficiency of insert sort is  $O(N^2)$ , merge sort  $O(N \lg N)$ , sequential search  $O(N)$ , and binary search  $O(\lg N)$ . (10%)

- (a) Sort and list the 4 algorithms by the efficiency as  $N$  approaches  $\infty$ , from the fastest to the slowest.
- (b) Name the algorithms mentioned above that belong in class P.

ANSWER:

- (a) binary search, sequential search, merge sort, insert sort.
- (b) all

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

```
X ← 1;                               procedure sub (Y)
sub (X);                               Y ← Y+1;
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) 1      (b) 2

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

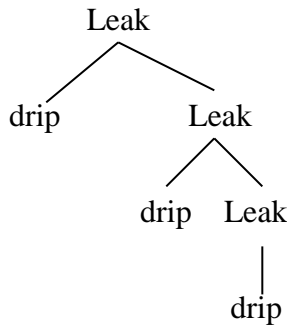
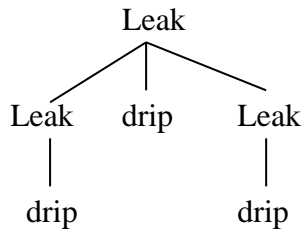
ANSWER: method3

11. 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:





12. Which one of the following statement is correct? (5%)

- (a) The halting problem is computable.
- (b) The sorting problem is computable.
- (c) The halting problem is a P class problem.
- (d) The sorting problem is a NP problem.

ANSWER: (b)

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

```
name2 <- name1;
```

ANSWER:

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