

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

## **Final Examination**

Introduction to Computer Science  
Class#: 901 E10110, Session#: 03  
Spring 2012

15:40-17:20 Wednesday  
June 20, 2012

### **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) 140.112.42.128 to 140.112.42.255?

(b) 140.112.41.192 to 140.112.41.193?

ANSWER:

(a) 140.112.42.128/25

(b) 140.112.41.192/31

2. Drawing analogy between sending data over the Internet and sending letters over the postal system, given your understanding of TCP and UDP, which of the mechanism resembles more the regular mail service and which one is more like the certified registered mail service (which provides both proof of mailing and proof of delivery)? (5%)

ANSWER:

Regular mail: UDP

Registered mail: TCP

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 be ensured of the authenticity of the sender
- (b) a message encrypted by the secret key can be ensured of the confidentiality to the reader
- (c) a message encrypted by the public key can be ensured of the confidentiality to the reader
- (d) a message encrypted by the secret key can be ensured of the authenticity of the sender

ANSWER:

(c) (d)

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

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

ANSWER:

```
X ← 3;
do
    (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. What sequence of numbers would be printed when the following procedure is executed? (5%)

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

ANSWER: 3, 1, 1, 1, 1, 1, 1, ...

7. When searching for the entry Z 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 Z, will be considered before discovering that the entry is present using the sequential search algorithm?

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

ANSWER: (a) 15, (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 ← value
  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 ← 6;                                procedure sub (Y)
sub (X);                               Y ← Y+2;
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) 6      (b) 8

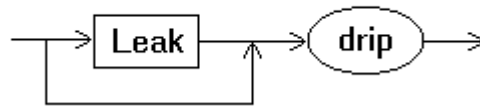
10. Based on the sketch of a class definition below, which methods can be invoked from outside an instance of the class? (5%)

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

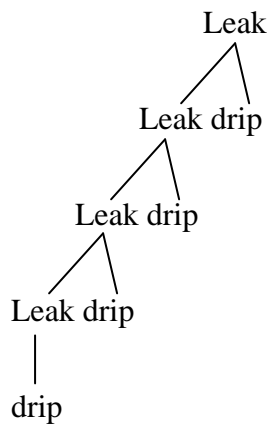
ANSWER: none

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

**Leak:**



ANSWER:

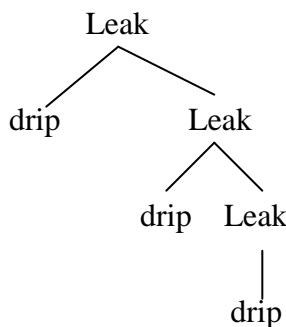
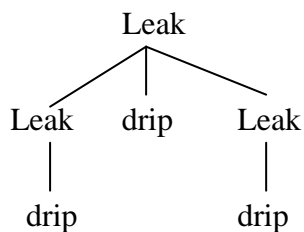


12. Show that the grammar below is ambiguous by drawing two distinct parse trees for the string “drip drip drip.” (10%)

**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 algorithm is  $O(N^2)$ , which is  $O(N \lg N)$ , which is  $O(N)$  and which is  $O(\lg N)$ , where  $N$  is the size of the list? (5%)

ANSWER:

insert sort:  $O(N^2)$

merge sort:  $O(N \lg N)$

sequential search:  $O(N)$ ;

binary search:  $O(\lg N)$

14. 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)

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)
  decr name3;
  incr name4;
  decr name2;
while (name4 not 0)
  incr name2;
  decr name4;
return name3;
```