Name_____ Student ID_____ Department/Year_____

Final Examination

Introduction to Computer Science
Class#: 901 E10110, Session#: 03
Spring 2015

15:40-17:20 Wednesday
June 24, 2015

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 **12** pages (including this title page), **14** 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. Based on your understanding of IP address and network prefix, address the following questions. (5%)
    (a) What is the group of IP addresses represented by 140.112.42.128/25
    (b) What is the network prefix to represent 140.112.42.64~140.112.42.127

Sample Solution:
(a) 140.112.42.128~140.112.42.255
(b) 140.112.42.64/26

2. Which of the following network services over the Internet use TCP as the transport layer protocol? (5%)
    (a) FTP
    (b) WWW
    (c) Facebook Messenger
    (d) LINE text messages
    (e) YouTube live video streaming

Sample Solution:
(a), (b), (c), (d)

3. What would happen if a user clicked the mouse on the term “hippopotamus” while viewing the html document shown below? (5%)

```
<html>
<head>
<title>This is the title</title>
</head>
<body>
<h1>Favorite Animals</h1>
<p>Of all the animals in the world, the
<a href=”http://pigs.org/pigs.html”>pig</a> is
perhaps the most charming.</p><p>However, the
<a href=”http://hippopotamuscity.org/hippo.html”>
hippopotamus</a> is also cute.</p>
</body>
</html>
```

Sample Solution:
The http://hippopotamuscity.org/hippo.html page will be downloaded and displayed on screen.

4. 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 private key can only be decrypted by the public key
   (c) a message encrypted by the public key can provide confidentiality
   (d) a message encrypted by the private key can provide authentication

Sample Solution:
(a), (b), (c), (d)

5. Consider the following algorithm.

```
Latest <- 0;
CurrentValue <- 1;
while (CurrentValue < 50) do
    (print the value assigned to CurrentValue;
     Temp <- Latest;
     Latest <- CurrentValue;
     CurrentValue <- Latest + Temp;)
```

(a) Rewrite the algorithm using a repeat-until loop than a while-do loop. (5%)

(b) Rewrite the algorithm using a recursive structure than an iterative structure. (10%)

Sample Solution:

(a)

```
Latest <- 0;
CurrentValue <- 1;
repeat
    (print the value assigned to CurrentValue;
     Temp <- Latest;
     Latest <- CurrentValue;
     CurrentValue <- Latest + Temp;)
until (CurrentValue >= 50)
```

(b)

```
procedure MysteryWrite (Lasest, CurrentValue)
if (CurrentValue < 50) then
    (print the value assigned to CurrentValue;
     Temp <- CurrentValue + Lastest;
     MysteryWrite (CurrentValue, Temp))

MysteryWrite (0, 1)
```

6. When searching for an entry within the list. Which entry to search will result in the worst-case performance for the sequential search algorithm and which entry to search will result in the worst-case performance for the binary search algorithm? (5%)

   A, B, C, D, E, F, G, H, I, J, K, L, M, N, O
   (Note that the list is in alphabetical order.)

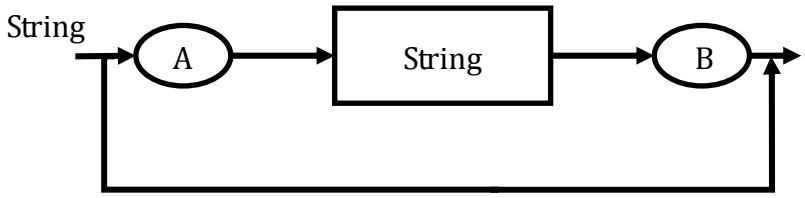
Sample Solution:
worst case for sequential search: O (15 entries considered)
worst case for binary search: A, C, E, G, I, K, M, or O (4 entries considered)

7. When sorting (in alphabetical order) for a list possibly containing the following entries. Which sequence will result in the worst-case performance for the insertion sort algorithm presented in the lectures and which will result in the worst-case performance for the merge sort algorithm presented in the lectures? (10%)

   A, B, C, D, E, F, G, H

Sample Solution:
worst case for insertion sort: H, G, F, E, D, C, B, A
worst case for merge sort: any sequence is equally worst

8. Describe the structure of the possible strings coming out of the String diagram below. (5%)



Sample Solution:

A^nB^n, where n is a nonnegative integer

9. Consider the following definition of the class Example in an object-oriented program. (5%)

```
class Example
 {private int var1
  public int var2
  private void method1( )
    { . . . }
  public void method2( )
    { . . . }
 }
```

(a) How many instance variables are there in the class Example?

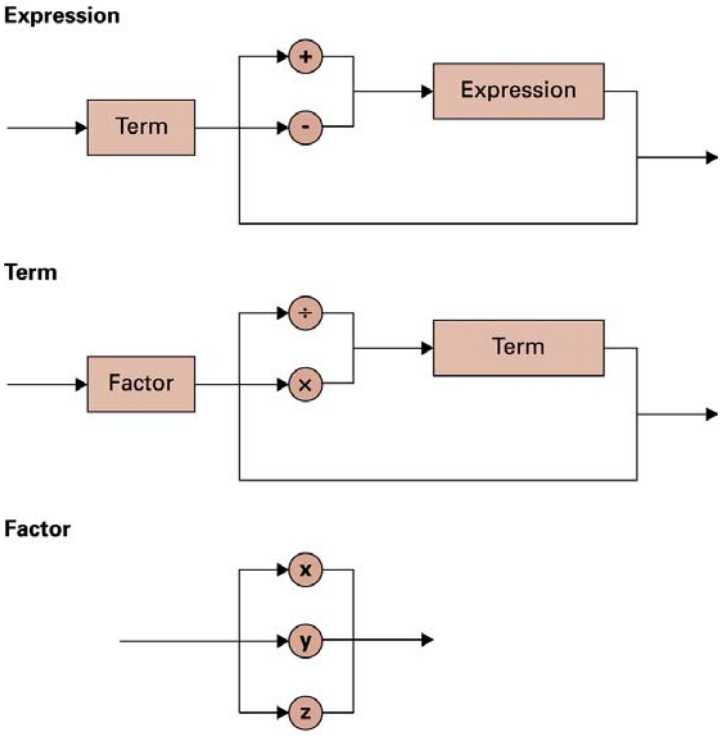
(b) Which instance methods can be invoked from outside an instance of the class Example?

Sample Solution:

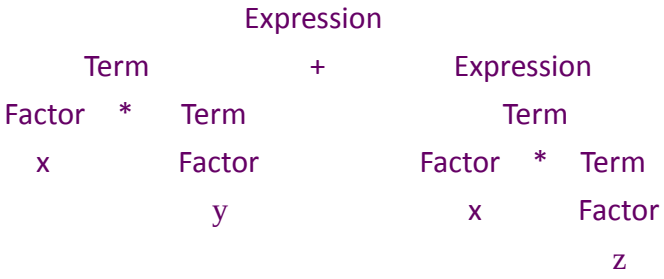
(a) 2

(b) method 2

10. Given the syntax rules below. Draw one possible parse tree for x*y+x*z (10%)



Sample Solution:



11. Populate the truth table below such that you can show clearly whether any of the following statements can be resolved from (P ∨ Q) and (R ∨ ¬Q). (10%)

(a) P ∨ R

(b) P ∧ R

(c) ¬P ∨ R

P	R	Q	P ∨ Q	R ∨ ¬Q	P ∨ R	P ∧ R	¬P ∨ R
T	T	T	T	T	T	T	T
T	T	F	T	T	T	T	T
T	F	T	T	F	T	F	F
T	F	F	T	T	T	F	F
F	T	T	T	T	T	F	T
F	T	F	F	T	T	F	T
F	F	T	T	F	F	F	T
F	F	F	F	T	F	F	T

Sample Solution:

(a)

12. Compare 4 algorithms of different computation complexity. Sort and list the 4 algorithms by the efficiency as N approaches ∞, from the fastest to the slowest. (5%)
    (a) $(\lg N)^2$
    (b) $N(\lg N)^2$
    (c) $N^2 \lg N$
    (d) $N \lg N^2$

Sample Solution:
(a), (d), (b), (c)

13. Which one(s) of the following statement is(are) correct? (5%)
    (a) The LinearSearch algorithm is P.
    (b) The sorting problem is P.
    (c) The MergeSort algorithm is P.
    (d) The halting problem is non-P.
    (e) The searching problem is P.

Sample Solution:
(a) (b) (c) (e)

14. Assume name1 and name2 are integers and name1 is a multiple of name2. Show how the statement could be simulated in Bare Bones. (10%)

```
name3  <- name1 / name2;
```

Sample Solution:

```
clear trackName2;
clear trackName1;
clear name3
while (name1 not 0) {
    while (name2 not 0) {
        decr name2;
        decr name1;
        incr trackName2;
        incr trackName1}
    while (trackName2 not 0) {
        incr name2;
        decr trackName2;}
    incr name3
}
while (trackName1 not 0) {
    decr trackName1;
    incr name1;}
```