

Prior-Knowledge Survey Spring 2020

COMP 526 – Applied Algorithmics

For each question, select **exactly one** answer!

Some Statistics

Which **course** of study are you enrolled in?

- A:** MSc Computer Science
- B:** MSc Advanced Computer Science
- C:** MSc Advanced Computer Science with Internet Economics
(MSc in Computation and Game Theory)
- D:** MSc Big Data and High Performance Computing
- E:** MSc Data Science and Artificial Intelligence
- F:** Other:

Why did you choose to take COMP 526?

(Please select the most important motivation.)

- A:** It is a compulsory module in my course.
- B:** Module was recommended to me.
- C:** I heard it is easy to pass.
- D:** The topics sound interesting.
- E:** The topics will help me find a job.
- F:** The topics will help me succeed in my later job.
- G:** Other:

Do you fancy to do a **PhD**?

- A:** Yes!
- B:** No way.
- C:** Maybe.

Problem 1 (Math basics)a) What is $\frac{2}{3} + \frac{3}{4}$?

A: $\frac{5}{7}$

C: $\frac{16}{12}$

E: $\frac{18}{12}$

G: Don't know

B: $\frac{15}{12}$

D: $\frac{17}{12}$

F: 1

b) What is $x^a (x^2y)^b$?

A: $x^{2ab}y^b$

D: $x^{a+b+2}y^b$

G: $2x^a y^b$

J: Depends on a and b .

B: $x^{ab^2}y^b$

E: $x^a + x^{2b}y^b$

H: 1

C: $x^{a+2b}y^b$

F: $(xy)^a$

I: 42

K: Don't know.c) What is $\log_2\left(\frac{a^2}{4}\right)$? ($a > 0$)

A: $\log_2(a) - 2$

D: $4\log_2(a) - 2$

G: $2\log_2(a) - 1$

J: ∞

B: $2(\log_2(a) - 1)$

E: $\log_2\left(\frac{a}{4}\right)$

H: $2(\log_2(a) + 1)$

K: Depends on a and b .

C: $4\log_2(a) - 4$

F: $2\log_2(a)$

I: 2

L: Don't know.**Problem 2 (Java ints)**

Which values can an int in Java take?

A: 0 or 1.

G: $\{-2^{31}, \dots, 2^{31}\}$

M: $\{-2^{63} - 1, \dots, 2^{63}\}$

B: $\{0, \dots, 255\}$

H: $\{-2^{31}, \dots, 2^{31} - 1\}$

N: any natural number.

C: $\{-128, \dots, 127\}$

I: $\{-2^{31} - 1, \dots, 2^{31}\}$

O: any integer.

D: $\{-127, \dots, 128\}$

J: $\{0, \dots, 2^{64}\}$

P: any rational number.

E: $\{0, \dots, 2^{32}\}$

K: $\{-2^{63}, \dots, 2^{63}\}$

Q: any real number.

F: $\{0, \dots, 2^{31}\}$

L: $\{-2^{63}, \dots, 2^{63} - 1\}$

R: I don't know Java.

Problem 3 (Limits)

What interval do the following *limits* fall into?

a) $\lim_{x \rightarrow \infty} \frac{13x^3 + 7x^2 + x - 100}{x^3 - 1}$

A: $(-\infty, -1)$

D: $[0.5, 1]$

G: $(42, \infty)$

B: $[-1, 0)$

E: $(1, 2]$

H: Don't know.

C: $[0, 0.5)$

F: $(2, 42]$

b) $\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n$

A: $(-\infty, -1)$

D: $[0.5, 1]$

G: $(42, \infty)$

B: $[-1, 0)$

E: $(1, 2]$

H: Don't know.

C: $[0, 0.5)$

F: $(2, 42]$

c) $\lim_{x \rightarrow \infty} \frac{\ln x}{\sqrt{x}}$

A: $(-\infty, -1)$

D: $[0.5, 1]$

G: $(42, \infty)$

B: $[-1, 0)$

E: $(1, 2]$

H: Don't know.

C: $[0, 0.5)$

F: $(2, 42]$

Problem 4 (Stacks & Queues)

Consider the code to the right for a container class.

What ADT does `Container` implement?

A: array

F: deque

B: singly linked list

G: priority queue

C: doubly linked list

H: heap

D: stack

I: Don't know ADT.

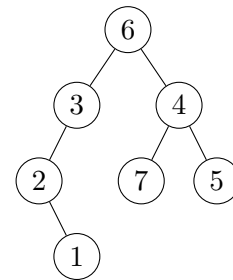
E: queue

J: Don't know.

```
class Container {
    Node node = null;
    class Node {
        Object item;
        Node next;
    }
    void add(Object item) {
        Node oldfirst = node;
        node = new Node();
        node.item = item;
        node.next = oldfirst;
    }
    Object del() {
        Object item = node.item;
        node = node.next;
        return item;
    }
}
```

Problem 5 (Binary Trees)

Consider the binary tree to the right.
 Give the labels of the nodes as they are encountered in an **in-order traversal** of the tree.



Answer:

Problem 6 (Combinatorics)

How many possibilities are there to select a subset of exactly 3 objects out of 10 pairwise different, identifiable objects?

- | | | | |
|--------------|---------------|----------------|-----------------------|
| A: 6 | D: 30 | G: 504 | J: 59049 |
| B: 27 | E: 120 | H: 720 | |
| C: 20 | F: 240 | I: 1000 | K: Don't know. |

Problem 7 (Sorting Complexity)

What is the complexity of sorting n comparable objects?

- | | | | |
|---------------------------------|-----------------------------------|------------------------------|--|
| A: $\mathcal{O}(\log n)$ | E: $\Omega(n)$ | I: $\Theta(n \log n)$ | M: Don't know
$\mathcal{O}, \Omega, \Theta.$ |
| B: $\Omega(\log n)$ | F: $\Theta(n)$ | J: $\mathcal{O}(n^2)$ | |
| C: $\Theta(\log n)$ | G: $\mathcal{O}(n \log n)$ | K: $\Omega(n^2)$ | N: Don't know. |
| D: $\mathcal{O}(n)$ | H: $\Omega(n \log n)$ | L: $\Theta(n^2)$ | |

Problem 8 (Low-level coding)

Consider the following pseudocode procedure:

```

1  procedure m(s) {
2      x1 = 0
3      while ( s >= 0 ) {
4          load(x2, s)
5          x1 = x1 + x2
6          x3 = s + 1
7          load(s, x3)
8      }
9      return x1
10 }
    
```

Address	Content
	:
77200	-98208
77201	77213
77202	00017
77203	77207
77204	-00007
77205	-00001
77206	77205
77207	-00005
77208	77214
77209	-54813
77210	15487
77211	-00003
77212	-00001
77213	-77204
77214	00004
77215	77204
77216	-00001
77217	00113
	:

Here, load(x, a) copies the value at memory address a into the register/variable x.

What is the **result** of the call m(77202) when the memory contents are as given to the right?

- | | | | | |
|------------------|--------------|-----------------|-----------------|---|
| A: -98208 | G: 6 | M: 12 | S: 77205 | Y: Don't understand the code.
Z: Don't know. |
| B: -1 | H: 7 | N: 13 | T: 77206 | |
| C: 0 | I: 8 | O: 17 | U: 77207 | |
| D: 1 | J: 9 | P: 77202 | V: 77208 | |
| E: 4 | K: 10 | Q: 77203 | W: 77209 | |
| F: 5 | L: 11 | R: 77204 | X: 77210 | |

Problem 9 (Java Semantics)

What is the output of the following Java fragment?

Assume that each class resp. interface is stored in a suitably named file and that we call the program as java Main.

```
1 interface I { int m(int p) ; }
2 class A implements I {
3     public int m(int p) { return p/2; }
4 }
5 class B extends A {
6     public int m(int p) { return 2*super.m(p); }
7 }
8 class Main {
9     public static void main (String[] a) {
10         I i = new B();
11         System.out.println(i.m(7));
12     }
13 }
```

A: -7

B: 3

C: 3.5

D: 6

E: 6.999998

F: 7

G: 7.000001

H: 8

I: 42

J: Hello World

K: i.m(7)

L: no output

M: throws exception

N: Don't understand the code.

O: Don't know.