General instructions:

- Please wait to open this exam booklet until you are told to do so.
- This examination booklet has 12 pages. You also have been issued a bubble sheet.
- Write your name, university ID number and date, and sign your name below. Also, write your name and ID number on your bubble sheet, and fill in the bubbles for your ID.
- The exam is open book and open notes, but is closed electronic device. The only exception is that you may use an electronic device to display a PDF copy of the book (all communication must be turned off and no other applications may be used).
- The exam is worth a total of 100 points (and 10% of your final grade).
- You have 1.25 hours to complete the exam. Be a smart test taker: if you get stuck on one problem go on to the next.
- Use your bubble sheet to answer all multiple-choice questions. Make sure that the question number and the bubble row number match when you are answering each question. Use the provided space in this exam booklet to answer the coding questions.

On my honor, I affirm that I have neither given nor received inappropriate aid in the completion of this exam.

Signature: ____________________________________________
Name: ________________________________________________
ID Number: ____________________________________________
Date: __________________________________________________

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Part I. Arrays

1. (4 points) What is printed by the following block of code?

```java
String[] names = {"Balbo", "Belba", "Belladonna", "Bingo", "Bungo"};
for(int i = names.length - 1; i >= 0; i -= 1) {
    String name = names[i];
    if(name.charAt(name.length() - 1) == 'a') {
        System.out.println(name);
        break;
    }
}
```

A. Belba   B. Belladonna   C. Bingo   D. Bungo   E. Answer not shown

2. (4 points) What is printed by the following block of code?

```java
int[] list = {5, 6, 8, 2, 3, 15};
System.out.println(list.length - 1);
```

A. 3   B. 5   C. 6   D. 15   E. Answer not shown

3. (4 points) What is printed by this block of code?

```java
int[] nums = {4, 2, 3, 5, 1};
int sum = 0;
for(int i = 0; i <= num.length; ++i) {
    sum += nums[i];
}
System.out.println(sum);
```

A. 11   B. 14   C. 15   D. Answer not shown   E. There is an error
4. (4 points) What is printed by this block of code?

```java
int[] list1 = {5, 3, 7};
int[] list2 = {4, 8, 3};
for(int i = 0; i < list1.length; ++i)
{
    if(list1[i] > list2[i])
    {
        int val = list1[i];
        list1[i] = list2[i];
        list2[i] = val;
    }
}
System.out.println(list2[1] + list2[2]);
```

A. 11  B. 12  C. 15  D. Answer not shown  E. There is an error

5. (4 points) What is printed by the following block of code?

```java
int[] numbers = {1, 16, 9, 4, 25};
System.out.println(numbers[numbers.length - 2]);
```

A. 1  B. 4  C. 9  D. 16  E. Answer not shown

6. (4 points) What is printed by the following block of code?

```java
int[] numbers = {4, 0, 2, 3, 1};
System.out.println(numbers[numbers.length]);
```

A. 0  B. 1  C. 2  D. 3  E. Answer not shown
7. (4 points) What is printed by this block of code?

```java
String[] invitations = new String[5];
invitations[1] = "Largo";
invitations[2] = "Laura";
invitations[3] = "Longo";
invitations[4] = "Lotho";
String out = "";
for(int i = 2; i >= 0; i -= 2)
{
    out += invitations[i];
}
System.out.println(out);
```

A. Laura  B. Longo  C. LongoLaura  D. LongoLargo  
E. Answer not shown

8. (4 points) What is printed by this program?

```java
public static String[] foo(String[] list)
{
    list[1] = list[2];
    return list;
}
public static void main(String[] args)
{
    String[] names = new String[3];
    names[1] = "Pansy";
    names[2] = "Peony";
    names[0] = "Polo";
    String[] list = foo(names);
    System.out.println(names[1]);
}
```

A. Pansy  B. Peony  C. Polo  D. Answer not shown  E. There is an error
Part II. Nested Loops

9. (4 points) What result is printed by this code block?

```java
int[] things = {3, 1, 2};
int bar = 0;
for (int i = 0; i < length.things; ++i)
    for (int j = i + 1; j < length.things; ++j)
        bar += things[j];
System.out.println(bar);
```

A. 2  B. 5  C. 11  D. Answer not shown  E. There is an error

**Solution:** Note: “there is an error” is an acceptable solution, as well.

10. (4 points) What is printed by this block of code?

```java
int[] numbers = {31, 37, 41, 43};
int k = 0;
for (int i = 0; i < numbers.length; i++)
    for (int j = i; j < numbers.length; ++j)
        ++k;
System.out.println(k);
```

A. 6  B. 10  C. 15  D. 16  E. Answer not shown

**Solution:** I will accept “answer not shown” for this problem (due to “numbers.length”).

11. (4 points) What is printed by this block of code?

```java
int[] numbers = {19, 23, 29};
int k = 0;
for (int i = 0; i < numbers.length; i++)
    for (int j = 0; j < numbers.length; ++j)
        ++k;
```

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System.out.println(k);

A. 0  B. 3  C. 9  D. 16  E. Answer not shown
12. (4 points) What is printed by this block of code?

```java
int [] elems = {3, 1, 2, 4, 5};
int [] agg = int[3];

for(int i = 0; i < agg.length; ++i)
{
    agg[i] = 0;
    for(int j = 0; j < 3; ++j)
    {
        agg[i] += elems[i+j];
    }
}
System.out.println(agg[2]);
```

A. 5  B. 7  C. 9  D. 11  E. Answer not shown

**Solution:** I will also accept: “Answer not shown” (due to the initialization of `agg`)

13. (4 points) What is printed by this block of code?

```java
int [] numbers = {3, 7, 5, 2, 1, 3, 5};

for(int i = 1; i < numbers.length; i += 2)
{
    for(int j = 0; j < numbers.length; j += 2)
    {
        if(numbers[i] == numbers[j])
        {
            System.out.println(i);
            return();
        }
    }
}
```

A. 0  B. 2  C. 5  D. 6  E. Answer not shown
Part III. Searching and Sorting

14. (4 points) What result is printed by this code block?

```java
int [] things = {3, 8, 1, 1, 7};
int query = 7;

for(int i = 0; i < length.things; ++i)
{
    if(things[i] == query)
    {
        System.out.println(i);
        break;
    }
}
```

A. 0  B. 4  C. 5  D. Answer not shown  E. There is an error

**Solution:** I will accept “there is an error” for this question (due to “length.things”)

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15. (4 points) What result is printed by this program?

```java
public static int foo(int[] things, int a)
{
    int top = 0;
    int bottom = things.length;
    int k = 0;
    while (top != bottom)
    {
        int center = (top+bottom)/2;
        if (a == things[center])
        {
            return k;
        } else if (a > things[center])
        {
            top = center+1;
        } else
        {
            bottom = center;
        }
        ++k;
    }
    return k;
}

public static void main(String[] args)
{
    int a = 11;
    int[] b = {5, 7, 11, 13, 17, 19, 23};
    System.out.println(foo(b, a));
}
```

A. 1  B. 2  C. 3  D. Answer not shown  E. There is an error

16. (4 points) What result is printed by this program? Assume the same definition of `foo()` as above.

```java
public static void main(String[] args)
{
    int a = 13;
    int[] b = {5, 7, 11, 13, 17, 19, 23};
    System.out.println(foo(b, a));
}
```

A. 1  B. 2  C. 3  D. **Answer not shown**  E. There is an error
17. (4 points) What result is printed by this program?

```java
public static int baz(int[] list)
{
    for(int i = 0; i < list.length - 1; ++i)
    {
        if(list[i] > list[i+1])
        {
            return i;
        }
    }
    return -1;
}

public static void main(String args[])
{
    int[] nums = {2, 4, 7, 8};
    System.out.println(baz(nums));
}
```

A. -1  B. 0  C. 3  D. Answer not shown  E. There is an error

18. (4 points) What result is printed by this program? Assume the same definition of the method `baz()` as above.

```java
public static void main(String args[])
{
    int[] nums = {3, 4, 9, 8, 11};
    System.out.println(baz(nums));
}
```

A. -1  B. 1  C. 2  D. Answer not shown  E. There is an error
Part IV. Coding

19. (14 points) Write a **method** that takes as input an array of doubles sorted in **descending order** and a new double, and returns a new array that contains all doubles and is sorted in descending order.

Examples:
- (8, 4, 3), 7 → (8, 7, 4, 3)
- (9, 5, 3, 2), 10 → (10, 9, 5, 3, 2)
- (7, 3), 1 → (7, 3, 1)

**Solution:**

```java
public static double[] sortDescending(double[] list, double newVal) {
    double[] newList = new double[list.length + 1];
    int i;

    // Before new value
    for (i = 0; i < list.length; ++i){
        if(list[i] < newVal){
            // We found the place for the new value
            break;
        } else{
            newList[i] = list[i];
        }
    }

    // Add new value
    newList[i] = newVal;

    // After new value
    for(; i < list.length; ++i){
        newList[i+1] = list[i];
    }

    return newList;
}
```
20. (14 points) Write a **method** that takes as input an array of ints and returns **true** if the array contains two numbers whose values are consecutive.

Examples:

- (3, 8, 4) → true (3 and 4)
- (7, 3, 0, 6, 11) → true (6 and 7)
- (8, 3, 17, 5, 1, 11, 13) → false

**Solution:**

```java
public static boolean find(int[] list)
{
    // Loop through all elements
    for (int i = 0; i < list.length; ++i)
    {
        // Loop through all elements to compare against
        for (int j = 0; j < list.length; ++j)
        {
            // Do they match?
            if (list[i] == list[j] + 1)
            {
                // Yes: we are done
                return true;
            }
        }
    }
    // No matches
    return false;
}
```