

Studying for the SE115 Final Exam

Week 12

Question 1

Write a function that returns the position of a dropped object on earth's gravity, as a function of time. Use meters and seconds as your units. Assume the start position is at 0 meters.

Question 2

Write a function that returns the position of a dropped object on earth's gravity, as a function of time and start position. Use meters and seconds as your units.

Question 3

Write a function that returns the position of a dropped object in a gravity field, as a function of gravity g , time and start position, and initial velocity. Use meters and seconds as your units. You will recall that the formula for the position is $h = h_0 + t \cdot v_0 - gt^2/2$. Define a constant g for earth's gravity as 9.8 meter/sec² to be used as the default value.

Question 4

Recall that earth's gravity is actually not constant but depends on the distance h to earth's center with the formula $g = GM_{\text{earth}}/h^2$. G is the gravity constant $6.67 \times 10^{-11} \text{ m}^3/\text{kgsec}^2$. M_{earth} is The mass of Earth at $6 \times 10^{24} \text{ kg}$. Instead of solving differential equations, we can numerically calculate the position of an object over time in small increments of t . At each increment you must recalculate g , based on the new position. Modify the function in question 3 to calculate g based on the start position, and then iteratively update it at each increment.

Question 5

A polynomial of degree n is of the form $a_0 + a_1x + a_2x^2 + \dots + a_nx^n$, where a_0, a_1, \dots, a_n are real numbers, and n is a non-negative integer.

- Define a class for polynomial;
- Provide constructor method(s)
- Provide a method for returning the degree of the polynomial
- Provide a method for adding a second polynomial to a polynomial object
- Provide a method for multiplying a second polynomial to a polynomial object

Question 6

Write the function that calculates the summation given below.

$$f(N, M) = \sum_{i=1}^N \sum_{j=1}^M (i + j)^2$$

Question 7

It is common to show the size of a file in bytes; but if the size is greater than 1024 bytes, we use kilobytes (KB); and if the size is greater than 1024 KB, we use megabytes (MB); and if the size is greater than 1024 MB, we use gigabytes (GB).

For example, if the file size is 2KB, it is 2048 bytes. However, the operating system rounds the numbers. If the file size is 2200 bytes, it is still displayed as 2KB.

Create a class that stores the file size in bytes as an integer value and has a method that returns the size as a string, such as “2KB” or “10MB”.

Question 8

A family tree is made up of the relations between the parents and the children. Assume that one of your grand-grand-parents have N number of children, and those children also have M number of children, and those children also have P number of children, and so on and on until there are no longer any children.

Think of a method that writes the name of an individual and then starts going through the list of the individual’s children. It processes each child similarly; prints the name, and goes through the list of children, until of course, the individual does not have any.

Give the pseudocode for this method, but make sure you specify the inputs, output, and steps clearly.

Question 9

For a list of N elements, we can say that there are $N(N-1)/2$ combinations of two pairs. For example, for {1, 2, 3, 4} the pairs are (1, 2), (1, 3), (1, 4), (2, 3), (2, 4) and (3, 4). Write a method that prints such pairs for a given integer array L.

Question 10

Write a method that takes two sorted lists and returns a merged sorted list. The pseudocode is given below.

INPUT: Sorted list A, Sorted list B

OUTPUT: Merged list C

STEPS:

Create a counter for each A, B and C lists; ACtr, BCtr, and CCtr

Initialize the counters to 0

While CCtr < length of C

 If A[ACtr] < B[BCtr] then C[CCtr++] = A[ACtr++]

 Else C[CCtr++] = B[BCtr++]

 If ACtr is equal to the length of A,

 then copy the remaining values in B to C and exit the loop.

 If BCtr is equal to the length of B,

 then copy the remaining values in A to C and exit the loop.

Question 11

What would be the output of the following statements? Explain why.

```
String a = "kaya"  
String b = "kaya"  
System.out.println(a == b);
```