2022 Spring CPSC 240

Practice Exercise 2: Gravitational Attraction

Preface

In this practice program we all learn a few important things.

1How to validate that an incoming number really is a float number

2How to store a constant in your program

3How to multiply and divide float numbers stored in xmm registers.

Program specification

Make a hybrid program where the active module is written in X86 assembly. A person plans to drop a marble from a known height measured in meters. The person wishes to know in advance how many seconds the marble will be in free fall before reaching earth.

Make a program that will input the height (64-bit float number) from a keyboard and then compute the free fall time in seconds. We will disregard uncontrollable factors such as horizontal wind and air resistance.

Sample dialog with the program.

Welcome to Gravitational Attraction maintained by Sergio Gonzalez.
This program was last updated on February 24, 2022.

If errors are discovered please report them to Sergio at sergio@colunbia.com for a rapid update. At Columbia, Inc, the customer comes first.

Please enter your first and last names: Isabel Mondragon

Please enter your job title (Nurse, Programmer, Teacher, Carpenter, Mechanic, Bus Driver, Barista, Hair Dresser, Acrobat, Senator, Sales Clerk, etc): Postal Person

Thank you Postal Person. We appreciate your business.

We understand that you plan to drop a marble from a high vantage point.

Please enter the height of the marble above ground surface in meters: 28.6

The marble you drop from that height will reach earth after 1.708322963 seconds.

Thank you Isabel Mondragon for your participation. May you always reach great heights.

The main driver received this number 1.708322963 and will simply keep it.

The driver will now send integer 0 to the operating system. Have a nice day. Bye.

Color codes

Yellow: output by assembly module
Pink: input by a human
Blue: Output from the driver module.

Replace Sergio's name with your own first and last names.

Replace the date with the suggested completion date for this program.

We like lots of digits in our outputted numeric answers.

Sample dialog with the user of the program with valid inputs.

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Please enter your first and last names: Elizabeth Torres

Please enter your job title (Nurse, Programmer, Gamer, Carpenter, Mechanic, Bus Driver, Barista, Hair Dresser, Acrobat, Farmer, Sales Clerk, etc): Hollywood Star

Thank you Hollywood Star. We appreciate your business.

We understand that you plan to drop a marble from a high vantage point.

Please enter the height of the marble above ground surface in meters: 36.7.9533

An error was detected in the input data. You may run this program again.

Thank you Elizabeth Torres for your participation. May you never lose sight of the goal.

The main driver received this number 9.9999999 and will simply keep it.

The driver will now send integer 0 to the operating system. Have a nice day. Bye.

Color legend
Yellow: driver
Green: X86
Blue: keyboard (stdin)

The program must detect invalid inputs for the height quantity. The following are invalid input and must be rejected.

29.567.122 //Float number may have only one radix point

16T4.43 //Only decimal digits are allowed

++45.99 //One leading '+' is allowed, but not two.

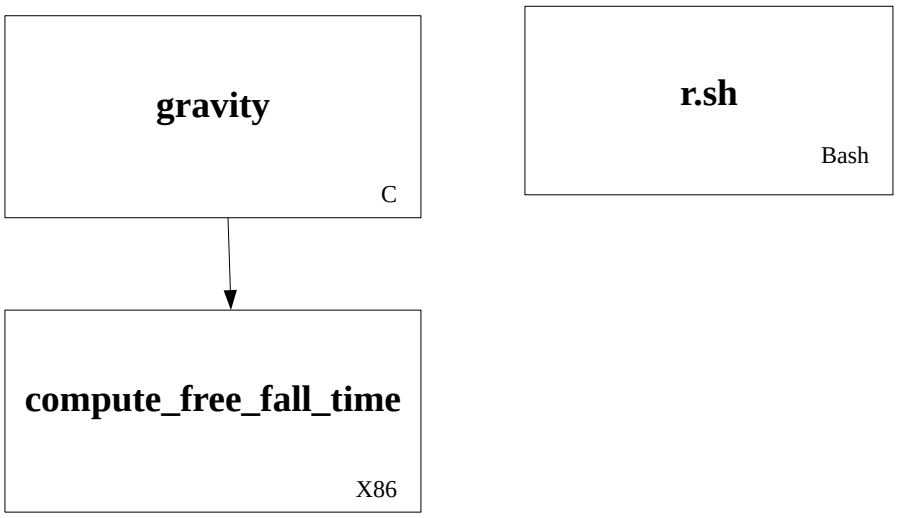
-+109.86 //Two leading signs are not allowed

34.9%16.2 //No special characters allowed

76.3 4962 //No internal spaces allowed

Modular construction

This program will have two files. The first one has the generic name “driver”, and the second one could be call “manager”. Here in assignment 1 the driver will call the manager.



The main function is written in C language. The function that does all the work, compute_free_fall_time, is written in X86, and the script file is written in bash.

Basic math from Wikipedia

The constant 9.8 is the acceleration due to gravity in near Earth space. The formula does not apply in distant space such as near the surface of the moon.

Let t be the number of seconds you want to compute.

Let H be the height of the object above the surface of the Earth. H is an input quantity for this program.

Let V be the initial velocity of the object at the moment it is release. The the object collides with earth at time t that satisfies the equation $-9.8\ t^2 + Vt + H = 0$.

The coefficient of t squared is negative because negative means falling towards earth.

For us V is zero

H is a positive number of meters above the earth surface. The user must input H.

Several of the class members should do a web search to verify that this is indeed the correct equation for gravity in near-earth space.

After you have the value for H, then you solve the equation for t and that will be the number of seconds elapsed when the ball hits the earth.

Timeline

February 22, 2022 @ 11:59pm

After this date this practice exercise will have expired and the class will move on to other current subjects. You need to move ahead with the class.

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