Faculty of Engineering, University of Jaffna
Department of Computer Engineering
EC1011 – Computing
Lab 06 - Domain Specific Programming Languages
STRUCTURED PROGRAMMING

Date: 22 July 2022 **Duration: 3 Hours**

Instructions:

- Any plagiarized work will be given 0 marks.
- Use comments in your code
- Submit your lab work as a pdf file named ***Lab0Z_2021EXXX.pdf*** *(XXX – Your Registration Number & Z is your lab number)* on/before given deadline via team
  Teams EC1011 ➔ Assignments ➔ Lab_0Z_GroupY
  (Y is your group number & Z is your lab number)
- Final submission should contain **lab report as pdf** format and all **.m files**.
- Prepare your lab report with the screen shots of your answers.

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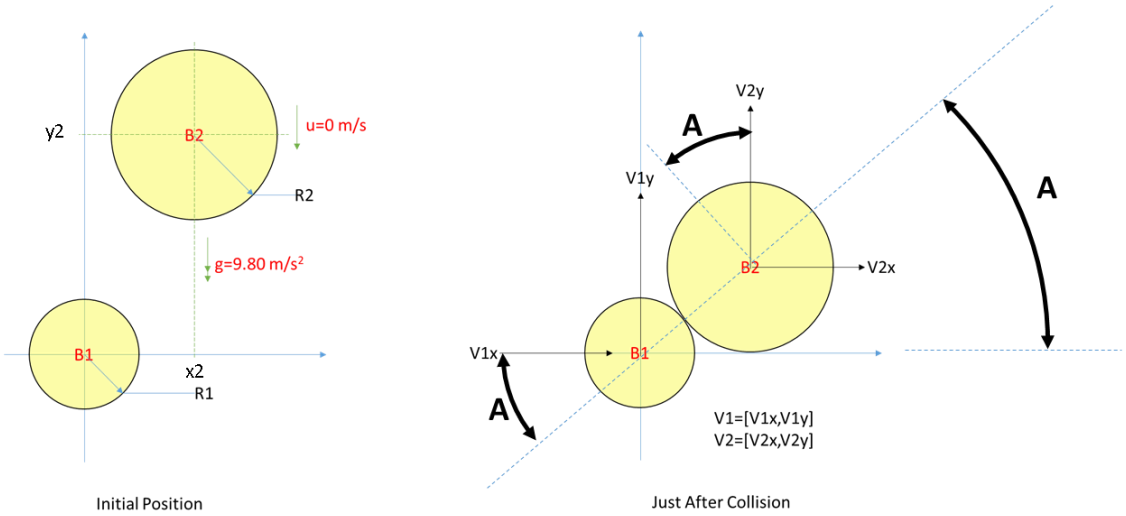
1. Imagine two solid, rigid spheres B1 and B2 with radius R1 and R2 in meters and mass M1 and M2 in kilograms. B1 initially has its center of mass at the origin and is confined to always move along the x axis. B2 has its center of mass located at coordinates (x2, y2) where $0 < x2 < (R1 + R2)$ and $\sqrt{(R1 + R2)^2 - x2^2} < y2$. Gravity acts in the negative y direction with constant **g = 9.8 m/s²**.

Reference: https://www.mathworks.com/matlabcentral/cody/problems/323-mechanics-1



V1y=0; by question

$\cos(A) = \frac{x2}{R1+R2}$

V – Velocity of ball 2 before collision

$V=\sqrt{2 \times 9.8(y2-(R1+R2)\sin(A))}$

Along collision axis, Newton's Law of Restitution; velocity of approach = velocity of reproach

$V\sin(A)=V2_y\sin(A)+V2_x\cos(A)-V1_x\cos(A)$

Along x-axis conservation of linear momentum for the system

$M1V1_x+M2V2_x=0$

Perpendicular to collision axis downwards, conservation of linear momentum for ball 2

$-M2V2_y\cos(A)+M2V2_x\sin(A)=M2*V*\cos(A)$

Write a **function** that returns the velocity of both spheres in m/s after B2 is allowed to fall and just after the collision, assuming a lossless collision occurs.

The function signature will look like below,

[V1,V2] = balldrop_puzz(M1,M2,R1,R2,x2,y2)

Keep in mind that the answers should be two-element row vectors. For example, if M1=2, M2=4, R1=1, R2=0.25, x2=0.5 and y2=6, then:

V1 = [-10.8362631979321 0]

V2 = [5.41813159896603 2.66024980473149]

Hint:

When equations are put in a matrix form they are easier to solve

Use:

- *Newton's Law of Restitution, which for an elastic collision is*

Velocity of approach = Velocity of reproach

- *Conservation of linear momentum*
  - *For the system along x-axis*
  - *Perpendicular to collision axis for ball 2*

2. Write a **script** to display the grade of a subject, based on the marks using the table given below

Marks (X)	Grade
85-100	A+
80-84	A
75-79	A-
70-74	B+
65-69	B
60-64	B-
55-59	C+
50-54	C
45-49	C-
40-44	D+
35-39	D
00-34	E

Test your script for following cases

i) X= 54 ii) X= 87 iii) X= 20 IV) X= 44 v) X= 60

3. In mathematics, the Fibonacci numbers or Fibonacci series or Fibonacci sequence are the numbers in the following integer sequence: 0, 1, 1, 2, 3, 5, 8, 13, 21, …
   By definition, the first two numbers in the Fibonacci sequence are 0 and 1, and each subsequent number is the sum of the previous two.

   $F_n = F_{n-1} + F_{n-2}$ where $F_0 = 0, F_1 = 1$

   Write a MATLAB **Function** to find the number of unique Fibonacci numbers in a given vector of positive integers (don't count repeats). **You must not use the inbuilt 'fibonacci' function.**

   The function signature will look like below,

   function y = fib_count(x)

   Example:

   x = [1 2 3 4 5 6 7 8 8]

   y = 5

   Hint:

   *You can use the command '**unique'** to remove repeating values in x*

   Reference: https://www.mathworks.com/matlabcentral/cody/problems/44481-how-many-fibonacci-numbers

4. Write a **function** which when given a vector a, finds the number(s) that is/are repeated consecutively most often. For example, if you have

a = [1 2 2 2 1 3 2 1 4 5 1]

The answer would be 2, because it shows up **three consecutive** times.

If your vector is a row vector, your output should be a row vector. If your input is a column vector, your output should be a column vector. You can assume there are no Inf or NaN in the input.

The function signature will look like below,
function val=longrun(a)

Reference: https://www.mathworks.com/matlabcentral/cody/problems/672-longest-run-of-consecutive-numbers