ENGINEERING 1D04, Lab 6: Loops, Arrays and Methods with Array Arguments

This assignment should be submitted via ELM before the end of the lab session. If you are not done the lab, please finish it at a later time and submit it using ELM. Although the submissions for unmarked labs are not graded, it is good to have a record of the work that you have done in ENG 1D04.

Assignment: Ball "Fired" Vertically.

The application must determine the motion of a ball "fired" vertically (using a spring), and then moving under constant acceleration due to gravity. The situation is shown in Figure 1.

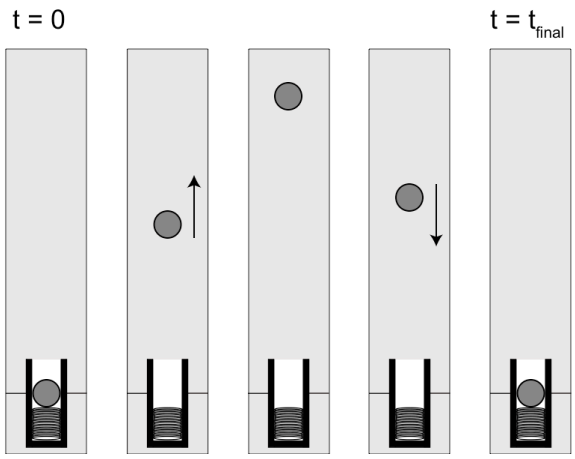


Figure 1.

The initial velocity of the ball upward is v_0.

Relevant formulae are:

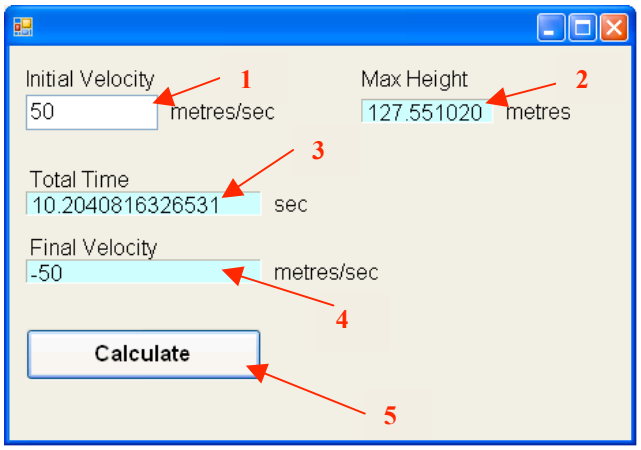
$$v(t) = v_0 - gt$$

$$y(t) = y_0 + v_0 t - \frac{1}{2} g t^2$$

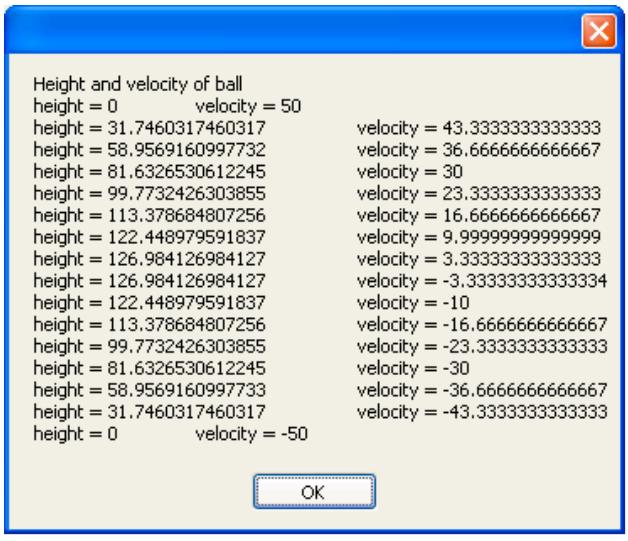
where g is acceleration due to gravity (9.8 metres/sec^2), t is time (secs), v(t) is velocity at time t (metres/sec), and y(t) is the height of the ball measured from its starting position, at time t (metres), with the initial height of the ball, $y_0 = 0$ (m). Assume that y and v are measured as positive upwards (already taken into account in the formulae). Time starts at 0 seconds.

Requirements

Consider Figure 2. The figure shows the main application window. All descriptive labels are in 12 point Arial.



1. Textbox for input of v_0. Arial 12 point, left-aligned.
2. Label to display maximum height of the ball. Arial 12 point, left-aligned.
3. Label to display the total time taken (t_{final}) from the time the ball is fired to the time it returns to its starting position. Arial 12 point, left-aligned.
4. Label to display v(t) at time t_{final}. Arial 12 point, left-aligned.
5. Calculate button. Arial bold 12 point, centred. When clicked the values in 2, 3 and 4 are calculated using the value in 1. In addition, a message box containing results for y(t) and v(t) at $t = t_0, t_1, t_2, \ldots, t_r$ where $t_r = t_{final}$ and r = 15 must be shown. The time steps should all be equal. Make sure your solution can cope easily with a change to the value of r. An example is shown beside this text.



Recap:
`MessageBox.Show(s);`
(where s is a string) will display the string s in a message box.

`\n` in the string will start a new line
`\t` will insert a tab character in the string

So, `s = "Hi dere,\nThis is an example.";`
will display as

Hi dere,
This is an example.

Implementation

Your implementation should use arrays of doubles to store the heights and velocities. Call your arrays `height` and `velocity`.

You should use a method to display the message box described in Step 5. The interface for this method should be:

```
void displayResults(double [] h, double [] y)
```

Testing. Remember to test your application. This is a good habit to get into because testing will be a part of all marked labs.

Debugging

The Visual C# IDE (Integrated Development Environment) provides a range of tools to help you understand programming and to find errors (bugs) in your programs. Your textbook (Doyle) describes the debugging tools on pages 652-658. Please take some time during the lab to review the following features that Visual C# provides:

1. Breakpoints – points where the program will halt execution
2. Stepping through code – you can step through your code to see the control flow
3. Watches – you can watch how the variables are changing

Submission

Zip your project folder to a file named Name_Lxx_Lab6.zip where Name is your name (last name followed by initials – no spaces), and xx is your lab section. Upload this file and submit it as a solution in the Lab Assignments section on ELM, for "Lab 6."

Important: Click "Save All" to save your project before uploading it and submitting it. Please test that your work submitted properly by retrieving your submission from ELM into a different folder and verifying that your project will still Run.