ENED1090

Engineering Models I

MATLAB Lab 8: Debugging

October 2015

The equations that govern the velocity and height of a rocket launched vertically, neglecting air resistance, while thrust is being produced, are given below (.

Note: all variables in these equations are the same as in the script.

After all of the fuel has been burnt (time=b), the equations are:

A couple of special equations:

where (words in italic are units):

* initial mass of rocket **with** fuel in or *kg* (variable m0 in script)
* = mass of rocket **without** fuel in or *kg* (variable emptymass in script)
* rate at which the rocket burns fuel in or (variable q in script)
* exhaust velocity of burned fuel relative to rocket in or (variable u in script)
* or 9.81 (variable g in script)

Initially, assume the following (the code will prompt you for this input):

* or 1460 kilograms (variable emptymass in script)
* Mass of fuel = 100 slugs or 1460 kilograms (variable fuelmass in script)
* q = 1 or (variable q in script)
* u= or (variable u in script)

Additionally, you will be asked for a name for the rocket (Weather Sat) and for a height that the rocket must attain (variable maximumheight in script) (for this program, use 200,000 feet or 57,700 meters.) If the rocket does not reach the desired altitude, add fuel (variable addfuel in script) at 20 slugs or 200 kilograms per iteration, until it reaches the desired height.

The program computes the following and displays the following:

* the maximum velocity of the rocket and what time that occurs (variables maxvel and maxveltime)
* the maximum height of the rocket and what time that occurs (variables maxheight and maxheighttime)
* a plot of the velocity of the rocket from 0 until it hits the ground
* a plot of the height of the rocket from 0 until it hits the ground
* the amount of fuel needed to reach the desired height

**This is a work on your own lab. You are not permitted to talk to anyone else in lab. Your TA is not permitted to help you. Your job is to debug the code.**

You will be given the code in three sections: input, then calculations and finally output. Each section contains common syntax and programming errors. Your job will be to identify as many of the errors as possible in the time allotted. You will report the number of errors you found to your TA. Everyone will start with a 50. In the input section the first error is worth 10 points, the second and third are worth 3 points and the final 4 are worth 1 point each. In the calculation section you get 5 points for each equation. In the output section the first error is worth 10 points, all others are worth 2 points each. You need to debug both SI and gravitational units.

If you find yourself with an error that you can’t seem to get out of, try using <cntl>C to terminate the program. Try to fix the error and then re-run. **You should not add any lines of code.**

**Input Section**

Most of the errors in the input section are syntax errors: missing commands, misspelled commands, commands that don’t have proper MATLAB syntax. There are 7 total errors.

When you successfully find all the errors in the SI input section, the output on you display should look like this. **Make sure the gravitational constant is correct.**

**gravitational constant = 9.81 m/sec^2**

**empty mass of rocket = 1460.0 kg**

**mass of fuel = 1460.0 kg**

**rate at which rocket buns fuel = 14.6 kg/sec**

**velocity of rocket thrust = 2440.0 m/sec**

**burn time will be 100.0 seconds**

**total initial mass of rocket plus fuel is 2920.0 kg**

**the desired height of the rocked is 57700 meters**

**is your input correct? yes/no [yes]**

**if this is you first time getting this message be sure to look very carefully**

**at your display. Is the value of g actually printed?**

**congratulations, you found all the errors in the SI section**

**to find all errors you need to also debug the gravitational section**

**>>**

When you successfully find all the errors in the gravitational section your display should look like this. **Make sure the velocity of rocket thrust is correct.**

**gravitational constant = 32.20 ft/sec^2**

**empty mass of rocket = 100.0 slugs**

**mass of fuel = 100.0 slugs**

**rate at which rocket buns fuel = 1.0 slugs/sec**

**velocity of rocket thrust = 8000.0 ft/sec**

**burn time will be 100.0 seconds**

**total initial mass of rocket plus fuel is 200.0 slugs**

**the desired height of the rocked is 2000 feet**

**is your input correct? yes/no [yes]**

**if this is you first time getting this message be sure to look very carefully**

**at your display. Is the value of "velocity of rocket thrust" correct?**

**congratulations, you found all the errors in the gravitational section**

**to find all errors you need to also debug the SI section**

**>>**

**Calculation Section**

For the Calculation section, all of the variables have been ‘hard coded’ so you don’t need to enter anything except unit type. One of the main variables in this section is the loop counter, **profile**. The program calculates the maximum height of the rocket and compares that to the desired height. If the maximum height is less than the desired height, **profile** is indexed and more fuel is added (**addfuel**).

For this section you need to enter the equations for velocity and height of the rocket as it burns fuel (the first two equations on page one) into lines 87 and 90. **If you have the equations correct you’ll get the following output when choosing SI units.**

If you run the program without making any changes you get the following error message:

**Index exceeds matrix dimensions.**

**Error in rocket\_calculations\_werrors (line 107)**

**vel(275:300,:)**

**>>**

**>> vel(275:300,:)**

**ans =**

**1.0e+03 \***

**-1.0065 -0.8375 -0.7029**

**0 -0.8473 -0.7127**

**0 -0.8571 -0.7225**

**0 -0.8669 -0.7323**

**0 -0.8767 -0.7421**

**0 -0.8865 -0.7519**

**0 -0.8963 -0.7618**

**0 -0.9061 -0.7716**

**0 -0.9159 -0.7814**

**0 -0.9257 -0.7912**

**0 -0.9356 -0.8010**

**0 -0.9454 -0.8108**

**0 -0.9552 -0.8206**

**0 -0.9650 -0.8304**

**0 -0.9748 -0.8402**

**0 -0.9846 -0.8500**

**0 -0.9944 -0.8599**

**0 -1.0042 -0.8697**

**0 -1.0140 -0.8795**

**0 -1.0238 -0.8893**

**0 -1.0337 -0.8991**

**0 -1.0435 -0.9089**

**0 -1.0533 -0.9187**

**0 0 -0.9285**

**0 0 -0.9383**

**0 0 -0.9481**

**>>**

**>> height(275:300,:)**

**ans =**

**1.0e+04 \***

**-0.0095 2.1258 3.3900**

**0 2.0415 3.3192**

**0 1.9563 3.2475**

**0 1.8701 3.1747**

**0 1.7830 3.1010**

**0 1.6948 3.0263**

**0 1.6057 2.9506**

**0 1.5155 2.8739**

**0 1.4244 2.7963**

**0 1.3323 2.7177**

**0 1.2393 2.6381**

**0 1.1452 2.5575**

**0 1.0502 2.4759**

**0 0.9542 2.3933**

**0 0.8572 2.3098**

**0 0.7592 2.2253**

**0 0.6603 2.1398**

**0 0.5604 2.0533**

**0 0.4594 1.9659**

**0 0.3575 1.8774**

**0 0.2547 1.7880**

**0 0.1508 1.6976**

**0 0.0460 1.6062**

**0 0 1.5139**

**0 0 1.4205**

**0 0 1.3262**

**>>**

**Output Section**

For this section all of the inputs have again been ‘hard coded’ and are correct. Most of the errors in the output section are syntax errors: missing commands, misspelled commands, commands that don’t have proper MATLAB syntax and programming errors. There are 6 total errors. **You need to add one line of code in this section!**

The correct output for SI units should be:

**rocket name: Weather Sat**

**to reach the desired height you need 1860 kg of fuel**

**max velocity = 748.9852 meters/sec at 127.00 sec**

**max height = 59080.8530 meters at 203.00 sec**

**total flight time = 313.00 seconds**

**the rocket hits the ground at -1075.6748 meters/sec**

**>>**

with two plots:





for gravitational units the output is:

**rocket name: Weather Sat**

**to reach the desired height you need 140 slugs of fuel**

**max velocity = 2495.7499 feet/sec at 140.00 sec**

**max height = 200781.1022 feet at 218.00 sec**

**total flight time = 329.00 seconds**

**the rocket hits the ground at -3590.0501 feet/sec**

**>>**

with two plots:



