EES Auto Grader

In this class we are going to auto grade your homework programs written in EES.

Why do this? One obvious reason is that grading more than 220 homework submissions manually is time consuming and therefore takes away from time where we could actually be trying to help you learn the material. Because the auto grader can adjust the input parameters, it becomes possible for us to tell you the right answers for one or more specific set of input parameters (i.e., test cases). By doing this you will be able to know (or at least have a good idea) if your homework solution is working or not. If it is not giving you the right answers, then you can keep working on it and, if necessary, come get help at one of the many office hours that are scheduled throughout the week.

The eventual grading process will occur with an entirely different set of input parameters. This approach is similar to a computer science class where you have test cases that allow you to test your program and once your program is turned in it is run using onther parameters.

In order for the auto grader to work properly it's very important that you name the variables correctly, use the specified units, and not accidentally set the value of input parameters within your program. Computers are no good at all at giving partial credit. There are a number of things that we'll do to help you make sure you have not messed up the format of the assignment. For each of the EES assignments there will be a starter code to download that will contain a header that you should not change. The header will set the inputs to one of their test case values and indicate clearly what variables you will need to calculate and what units those variables should be in. If you are using a recent version of EES you can check that each of the required output variables are present and spelled right. Finally, the header will give you a second test case allowing you to change the inputs and be sure that the output variables also change.

Here let's do a simple homework problem. We want to calculate the volume and surface area of a cylinder given its length and diameter.

Problem Statement

Consider a cylinder with a diameter of Dcm = 50 cm and a length of Lft = 12 ft.

a.) Compute the total surface area of the cylinder, Asin2 ($inch^2$).
b.) Compute the volume of the cylinder, Vliter (liter).

Here's the starter code that you will be given for this problem.

```
"!EESyGrader Header Start"
"!Do not change anything in the header other than the value of the inputs"
"!To check your submission for required outputs select Calculate->Check/Format"
$CheckUnits AutoOn
$AutoSetUnits Off
$AutoSetArrayUnits Off
$Syntax On
$IfNot Macro
  "Inputs"
  Dcm = 50 [cm]
  Lft = 12 [ft]
$EndIf
{$EESyGraderOutputs  Asin2 Vliter}
"Your EES code must solve and provide values for the variables listed below."
"The correct outputs are shown for the test case input values"
```

```
"  Asin2 = 9514 [in^2]"
"  Vliter = 718.2 [liter]"

"If you change the inputs to:"
"  Dcm = 30 [cm]"
"  Lft = 6 [ft]"
"...then the outputs should change to:"
  "Asin2 = 2891 [in^2]"
  "Vliter = 129.3 [liter]"
"!EESyGrader Header End"
```

Notice that the starter code assigns the values of the input variables and tells you exactly what variables need to be calculated and what the correct values are. You will know if you are doing the problem right based on whether you get these values. It also gives you a second test case to verify your solution.

Let's do the calculations needed to answer the question. My calculations have to go outside of the EESyGrader Header. Here I'll initially convert the diameter and length into base SI units to make the calculations easier.

```
"convert inputs to base SI units"
D = Dcm*Convert(cm,m)
L = Lft*Convert(ft,m)
```

Then I can calculate the cross-sectional area of the cylinder:

$$A_c = \frac{\pi D^2}{4},$$

and the surface area of the cylinder sides:

$$A_{sides} = \pi D L.$$

```
A_c = pi*D^2/4                  "cross-sectional area"
A_sides = pi*D*L                "surface area of sides"
```

Finally, I can compute the volume and the surface area according to:

$$V = A_c L, \text{ and}$$

$$A_s = A_{sides} + 2 A_c.$$

```
V = A_c*L                       "volume"
A_s = 2*A_c+A_sides             "surface area"
```

Because I used inputs in base SI units, I know that all of these calculations involve base SI units (m^2 or m^3).

Finally – I'll calculate the output variables required by the problem statement. Make sure that they have the name and unit specified in the problem statement or you won't receive any credit. For this problem I need two output variables. The first one must be named Vliter and is the volume of the cylinder expressed

in liter. The second one must be named Asin2 and is the total surface area of the cylinder expressed in inch^2.

```
"Output variables"
Vliter=V*Convert(m^3,liter)
Asin2=A_s*Convert(m^2,in^2)
```

The resulting Equations and Solutions Window are shown in Figure 1.

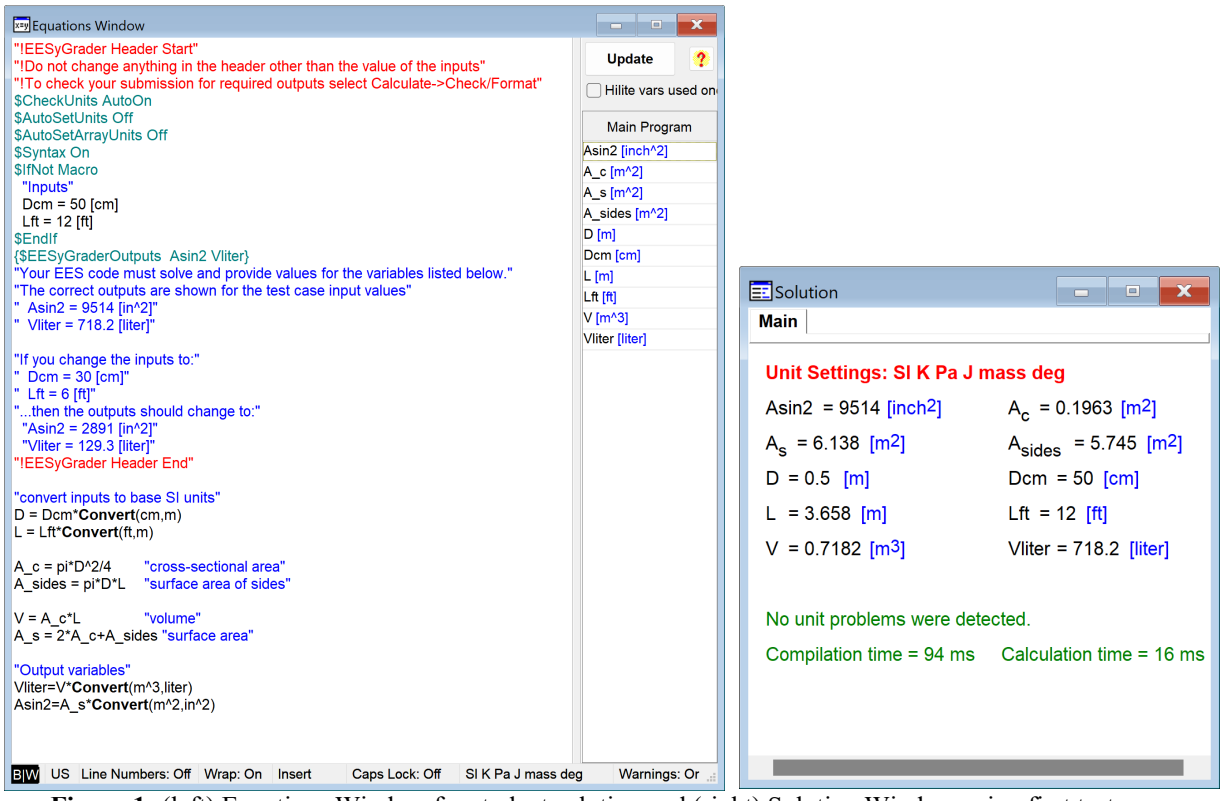

Figure 1: (left) Equations Window for student solution and (right) Solution Window using first test case.

Note that I have computed the two required output variables – they're each named correctly and have the right units. Further, they have the values (Vliter = 718.2 liter and Asin2 = 9514 in^2) that are consistent with the correct values listed in the test case – I think this is ready to submit but I probably should doublecheck. There's a couple of way to make sure. The first is two change the inputs values assigned in the header to those values listed in the second test case (Dcm = 30 [cm] and Lft = 12 [ft]) and make sure that the calculated output variables also change to their correct values. This is shown in Figure 2.

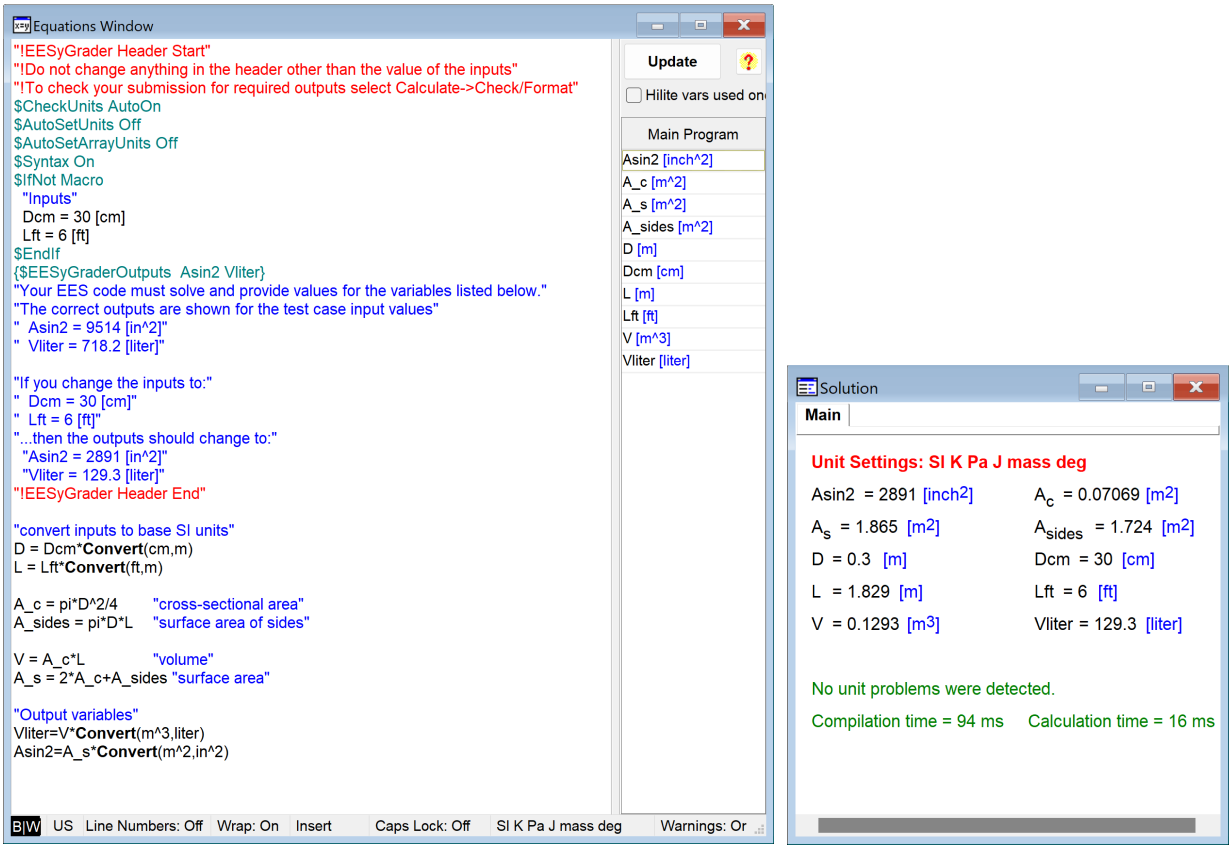

Figure 2: (left) Equations Window for student solution and (right) Solution Window using second test case.

Finally, I can make sure that I didn't misspell the name of any of the output variables by selecting Check/Format from the Calculate menu which will bring up the message shown in Figure 3 indicating that all output variables required by EESyGrader are present.

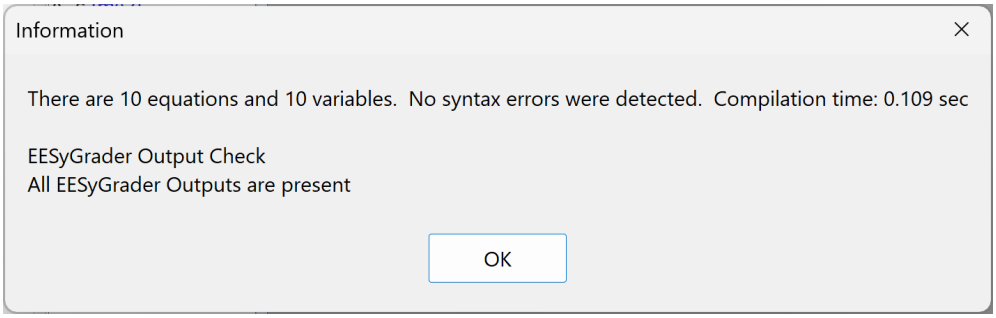

Figure 3: Message indicating that all required output variables are present.

At this point I can hand in my homework submission with some confidence that I've done it both correctly (the test case solutions match my solutions) and also haven't made a mistake regarding variable naming.