ENG TECH 1PR3 Programming Principles

String manipulation, Arrays, File I/O and Graphics

Assignment 03

Be sure to assign all input to appropriate variables. Do NOT use the control name directly in the calculations. Instead, assign the value of a control to a variable and use the variable in the calculations. Assign the result of the calculations to an appropriate form control. Ensure the forms are well-behaved. A form must contain an Exit button, sensible tabbing and alt-shortcuts where appropriate.

1. Tensile strength is a measurement of the force required to pull something such as rope, wire, or a structural beam to the point where it breaks. It is known that the tensile strength (psi) of a plastic increases as a function of the time (min) it is heat treated. An experiment was conducted and the following data are collected:

Time (t)	10	15	20	25	40	50	55	60	75
Tensile Strength (s)	5	20	18	40	33	54	70	60	78

Use $s = mt + b$ to estimate the tensile strength, where

$$m = \frac{n\sum_{i=1}^{n} t_i s_i - \sum_{i=1}^{n} t_i \cdot \sum_{i=1}^{n} s_i}{n\sum_{i=1}^{n} (t_i)^2 - \left(\sum_{i=1}^{n} t_i\right)^2}, \quad \text{and} \quad b = \bar{s} - m\bar{t}$$

$\bar{s}$ and $\bar{t}$ are the average values of s and t and n = 9 (number of data points for each variable).

Write a VB program that will estimate the tensile strength (s) of a plastic for any time (t). There are multiple ways of solving the above problem, four of them are mentioned below.

(a) Use two 1-D arrays, initialize these arrays in the click event procedure with values given in above table (i.e. User input is not required)

(b) Use one 2-D array, initialize the array in the click event procrdure with values given in above table (i.e. User input is not required)

(c) Write a function that will accept the size of an array, ask the user to enter values into an array using the inputbox and return the array with values. You can choose either 1D or 2D array.

(d) When your program runs, it must store above data into a text file in two column format via form load event procedure. First and second column represent time and strength repectively. When the user click estimate button, your program should read data from a file, perform calculations and display results.

Add option buttons for each option (a) – (d). Set the 1D array option as default. When the user clicks **estimate** button, your program should display results using the selected option. You are also required to add the following functions and procedures.

- Add a function **getTime()** that will ask the user to enter any time between 10 minutes to 75 minutes (inclusive) using inputbox. If the time is outside the given range, display an error message in a message box and do not perform calculations. This function must be called from the click event procedure.

- Add two sub procedures **Tensile_1D** and **Tensile_2D** that should calculate m, b, t and s for options (a) and (b) respectively. This procedure must be called from the click event procedure.

- Add a sub procedure **printValues()** that will print the values of m, b, t, and s in a label control. Format m and b to 3 decimal places and remaining values to one decimal place. This procedure must be called from the click event procedure.

NOTE: $\sum_{i=1}^{n} t_i s_i = t_1 s_1 + t_2 s_2 + t_3 s_3 + \cdots\cdots\cdots + t_n s_n$ (Expanded form)

2. As per the Ideal gas law

$$pV = nRT$$

where R = 8.314 $Jk^{-1}mol^{-1}$, p is the pressure in Pa, V is the volume in m^3 and T is the temperature in Kelvin. Suppose we have n = 1000 moles of a gas and we want to study this gas. Develop an application in which

a. The user provides the parameter name, value and the units from a file `idealGas.txt`. For example, the contents of this input file might include:

```
Pressure 101325 Pa
Temperature 298 K
```

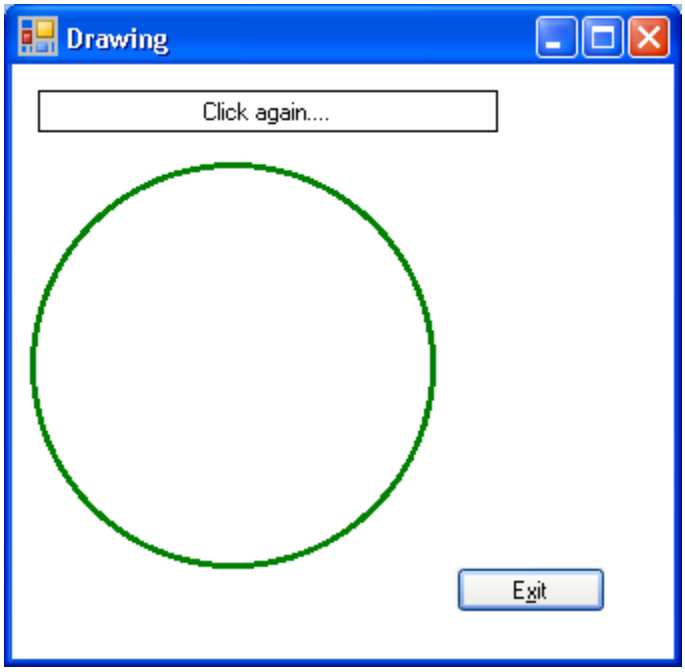
b. The user determines one of the three unknowns, i.e., p, V or T via the above formula. So, in the above example, the program should know that the unknown we are looking for is V and calculate it.
NOTE: The units must be Pa, m^3 and K, respectively. No other units are acceptable!

c. Display the input parameters, the constants and the calculated parameter to the user.
d. Write the above results to the same file, namely **`idealGas.txt`**.

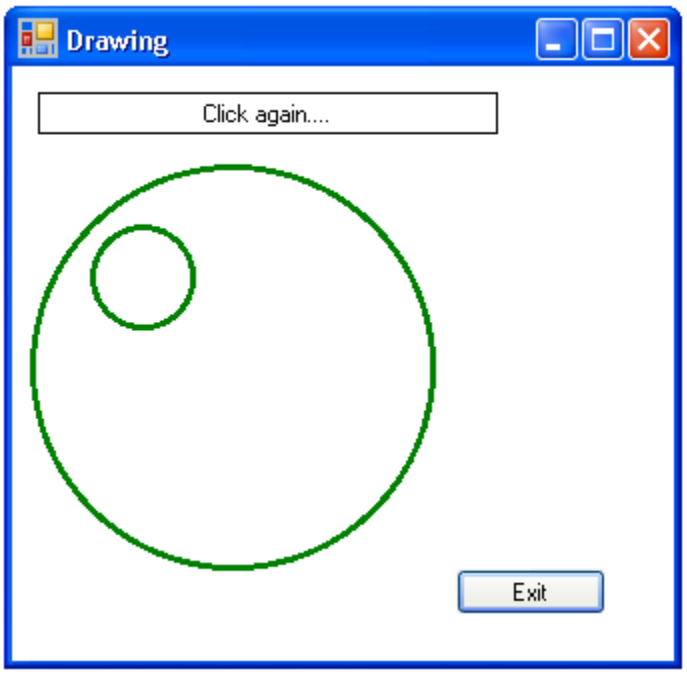
3. Create an application that will draw graphic elements on the form. Each time the user clicks on the form a piece of the drawing will appear, until all of the drawing is complete. Use at least 3 different graphics functions in your application (DrawEllipse, DrawRectangle, DrawArc, FillRectangle, Fill Ellipse, etc), and at least 5 drawn elements in total. Include a label containing a message indicating that the user should click or the drawing is complete. An example is provided on the next page, but do not use this for your submission. Be creative and submit your own drawing.

Form Load:

Click 1 (notice the change in the label):

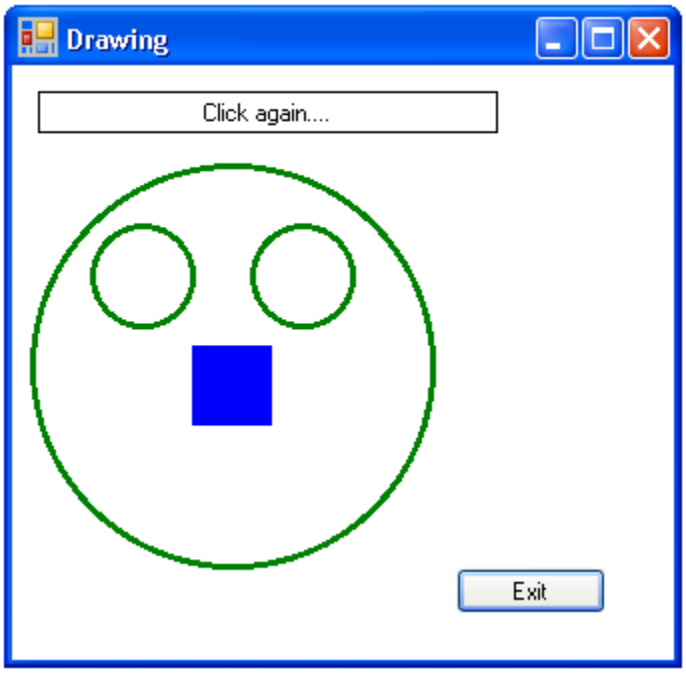


Click 2:

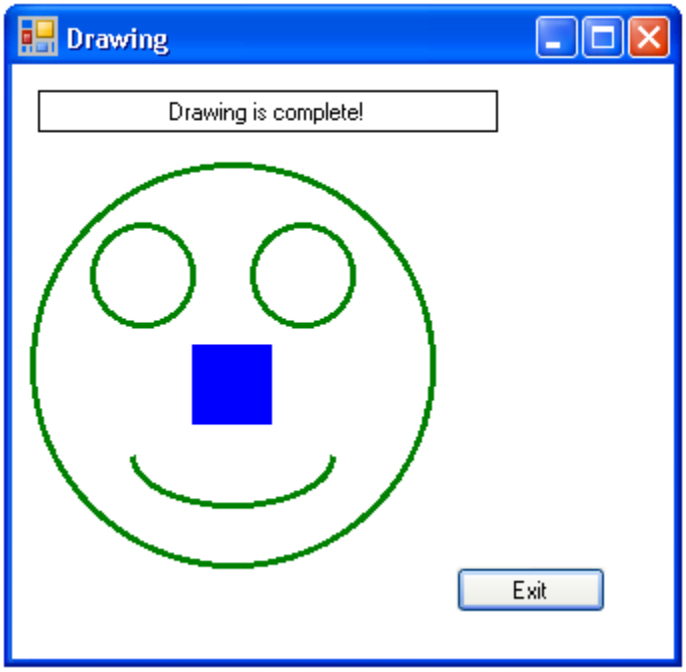


Click 3:

Click 4:



Click 5 (notice the change in the label):



Submitting the Lab

In order for your Lab/Assignment to be eligible for grading you must submit the following:

- The code must contain your Full Name and Student ID in a comment block at the top of each form module.
- A .zip compressed file containing the entire VB.NET project to AVENUE. Use .zip compression only (no RAR, TAR etc). If there is more than one project, create a separate .zip file for each individual project. Be sure to add all project files and folders to the .zip file. If the compressed file is missing files/folders such that the project will not open or run, the lab/assignment will receive a grade of 0.
- A Word .doc (or .docx) file containing:
    - A cover page that includes your name, Student ID, and MAC ID
    - The form code (event and other subprocedures and functions) including programmer's block
    - Screen captures of the form showing sample input and output.

Upload the Word file and .zip file(s) **separately** to the appropriate assignment drop-box on AVENUE.

Labs and assignments will not be accepted for evaluation if any of the above items are omitted and will result in a grade of 0.