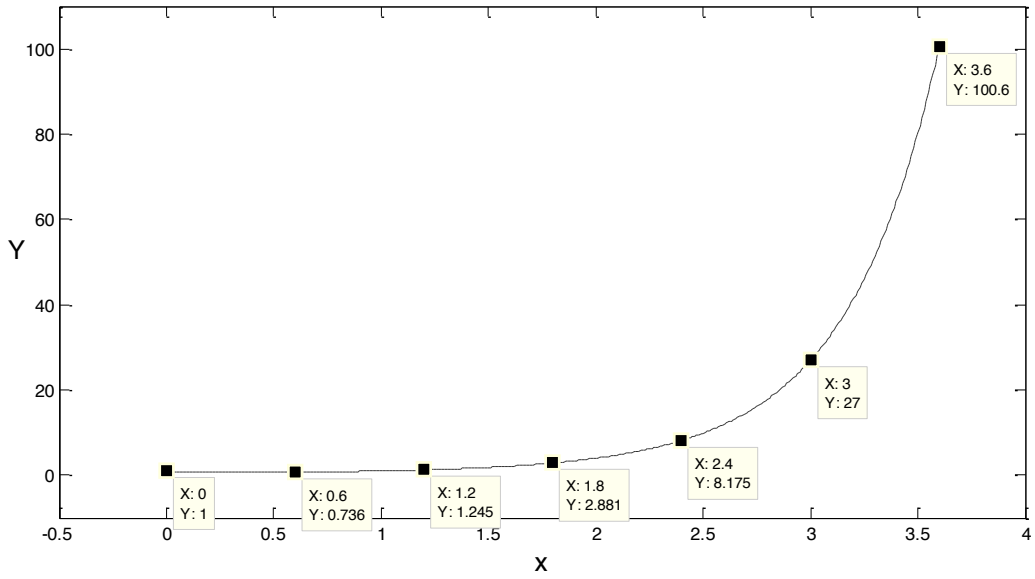
ENED 1091: Homework #5 Solutions

Problem 1: Use the data points show below and the trapezoidal rule to estimate the integral of the curve shown below from t = 0 to 3.6. **Be sure to clearly show your calculations – don't just give an answer.**



Data Points from Graph:

X	0	0.6	1.2	1.8	2.4	3	3.6
Y	1	0.736	1.245	2.881	8.175	27	100.6

Integral Estimate (Trapezoid): 54.5022

Calculations:

Problem 2: Repeat Problem 1 using Simpson's Rule to estimate the integral of the curve from x = 0 to 3.6. **Be sure to clearly show your calculations – don't just give an answer.**

Integral Estimate (Simpson's): 48.5816

Calculations:

Problem 3: The curve shown in problem 1 is for the function $y = x^x$. There is no expression for the indefinite integral of this function. However, we can estimate the definite integral using numerical integration as you have done in Problems 1 and 2. Write a MATLAB script that will:

- Begin with 3 data points (x-values) evenly distributed from 0 to 3.6 inclusive (Hint: linspace).
- Calculate the corresponding y-values for the function y = x^x.
- Estimate the integral of y from 0 to 3.6 using the Trapezoid Rule.
- Double the number of data points and get a new estimate for the integral of y from 0 to 3.6 using the trapezoid rule.
- Compare the new estimate to the previous estimate. If the absolute value of the difference between the two estimates exceeds 0.01, then double the number of data points again and repeat.
- Continue doubling the number of data points until the absolute value of the difference between the new estimate for the integral and the previous estimate for the integral does not exceed 0.01.
- Once your estimate has met the convergence specifications, add fprintf statements to display your final estimate of the integral, the final number of sections, and the final DeltaX value.

PASTE Results of fprintf statements here:

```
The estimated integral of x^x is:  47.794
The number of sections was: 383
The final DelataX value was:  0.00940
```

PASTE Script file here:

Problem 4: Repeat Problem 3 with the following changes: use Simpson's Rule instead of the Trapezoid Rule to estimate the integral and, instead of doubling the number of data points each time, use 2*N – 1 since you need an odd number of data points for Simpson's Rule.

PASTE Results of fprintf statements here:

```
The estimated integral of x^x is:  47.792
The number of sections was: 64
The final DelataX value was:  0.05625
```

PASTE Script file here:

Problem 5: For this problem, you will need to download HW5.mat from Blackboard. This data file has two vectors, Power (in Watts) and Time (in seconds). The vector, Power, was calculated from the 281,226 measurements of current through the input power lines in his house that Dr. Talaga took from November 1 to November 30th 2013. The vector, Time, indicates elapsed time. The total energy usage is simply the integral of power over time:

$$E = \int P(t)dt$$

Since we just have data points, we will need to use numerical integration to estimate the energy usage. If you look at the vector, Time, you will notice that the time interval between measurements (DeltaT) is not constant. So, we need to use the Trapezoid Rule to estimate the energy usage.

Write a script file that loads the HW5.mat file then uses the data in the Power and Time vectors to estimate the total energy usage in November using the Trapezoid Rule. Keep in mind that the DeltaT is not constant. ***Hint: this problem is extraordinarily similar to Lab 5: Part C where you integrated force with respect to height to estimate work and the DeltaH was not constant.*** Your energy usage will have units of Ws (Watt- seconds). Convert it to units of kWh – a more appropriate set of units for home energy usage. Then add an fprintf statement to your script to display the estimated energy usage in November in kWh.

Estimated Energy Usage in November: 365 kWh

PASTE Script file here: