ITP 168 Final Exam Sample Questions

Short Answer Questions

Write your answer to the questions in the space provided. If the question requires an example you must provide one. If it does not, you may choose to provide one, but your example must support your answer otherwise it will be counted against you.

1. What is the difference between the integration functions **trapz()** and **cumtrapz()**? Discuss specifically the difference in what the two functions produce as output.

   Trapz() does full area under the curve: produces a scalar
   Cumtrapz() does integration along the X points: produces a vector

2. If we are creating X, Y, and Z arrays to plot a surface using the **surf()** function, when are we required to use the **meshgrid()** function?

   We need to use the meshgrid() function when the Z values are dependent on the X and Y values

3. If a system is given by AX = B, where A is a 5x3 array, can a unique solution exist? Why or why not?

   A unique solution CAN exist since there are 5 rows and 3 columns. There may be 3 unique equations

4. Fit a polynomial of order 3 to the data given by X and Y (where X is the independent variable and Y is the dependent variable).

   p = polyfit(X,Y,3);

Coding

Please write your answers on a separate paper. You don't need to write comments, H1 lines, or header info. Your code doesn't need to be perfect, but you must have proper syntax. Be neat and legible. Cross out any code you do not want to submit as part of your answer. You must follow all the style guides outlined in this course.

1. Write a function called **replacechar()** that operates in the following manner:
    - The function takes in a character vector and two character scalars. It replaces the characters in the character vector with new characters (given by the second and third input)
    - The function takes in three inputs
        - All three inputs must be character vectors
        - The second and third input must be scalars (only one character)
    - Validate the inputs
    - Make sure the function receives the correct number of inputs
    - The function returns one output
        - The output is the original character vector with some characters changed

    Sample output:

```
>> newStr = replacechar('String to replace stuff From', 'f', 'r')


newStr =


    'String to replace sturr From'
```

```
function out = replacechar(str, c, r)
if ~ischar(str) || ~ischar(c) || ~ischar(r)
    error('Inputs must be character vectors');
end

if ~isscalar(c) || ~isscalar(r)
    error('Characters to replace must be single characters');
end

where = str == c;
```

```
out = str;
out(where) = r;

end
```

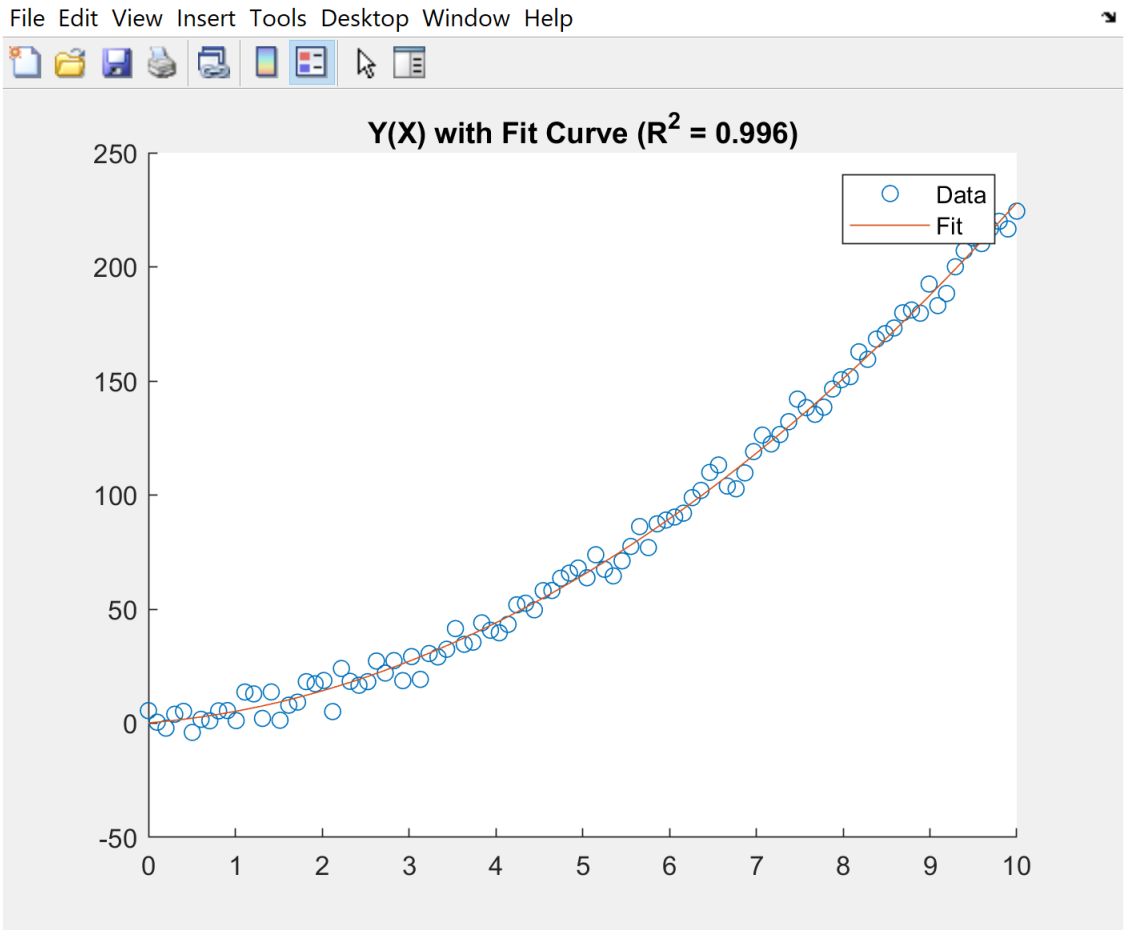
2. Write a function called **fullpoly()** that operates in the following manner:
    - The function takes in two vectors and one scalar. The two vectors are data vectors X and Y, the scalar represents the order of the polynomial fit to apply. The function then performs the polynomial fit and plots the data as data points and overlays the fit polynomial over the data, provides a legend, and a descriptive title showing the R^2 value in the title. Plot the fit from the minimum and maximum X values.
    - The function takes in three inputs
        - The first two inputs must be numeric vectors of the same length
        - The third input is optional and represents the order of the polynomial fit to apply. If no third input is given, the order is defaulted to 1. This input must be a positive, numeric, scalar, whole number value.
    - Validate the inputs
    - Make sure the function receives the correct number of inputs
    - The function has no output
    - The equation for R^2 is:

$$R^2 = 1 - \frac{\sum((y_i - f_i)^2)}{\sum((y_i - \bar{y})^2)}$$

    - Here y_i is the y values from the data vector, $\bar{y}$ is the average of the data from the y vector, and f_i is the expected value from the fit polynomial.

    Sample output (assume x and y exist as data vectors)

    ```
    fullpoly(x,y,2)
    ```




```
function fullpoly(x,y,order)

if nargin == 2
    order = 1;
end

if nargin < 2
    error('Too few inputs')
end
```

```
if ~isvector(x) || ~isvector(y) || ~isnumeric(x) || ~isnumeric(y) ||
length(x) ~= length(y)
    error('Inputs must be numeric vectors of the same length')
end

if ~isscalar(order) || ~isnumeric(order) || order <= 0 ||
floor(order) ~= order
    error('Order must be positive, numeric, scalar, integer value');
end

pFit = polyfit(x,y,order);

plotX = linspace(min(x), max(x));
plotY = polyval(pFit, plotX);

rSqF = polyval(pFit, x);

rSq = 1 - sum((y-rSqF).^2)/sum((y-mean(y)).^2);

figure();
scatter(x,y);
hold on
plot(plotX, plotY);
hold off
legend('Data','Fit');
title(sprintf('Y(X) with Fit Curve (R^2 = %.3f)',rSq));
```