Taylor Approximations I [1]

In this exercise, we will visualize how Taylor polynomials approximate a given function. Let $f(x) = lnx$. Define this function in MATLAB:

```
>> f = inline('log(x)')
```

As we have shown in class, the first four Taylor polynomials for $f(x)$ at $a = 1$ are:

$P_1(x) = x - 1$

$P_2(x) = x - 1 + \frac{1}{2}(x-1)^2$

$P_3(x) = x - 1 - \frac{1}{2}(x-1)^2 + \frac{1}{3}(x-1)^3$

$P_4(x) = x - 1 - \frac{1}{2}(x-1)^2 + \frac{1}{3}(x-1)^3 - \frac{1}{4}(x-1)^4$

Define these functions in MATLAB as follows:

```
>> P1 = inline('x-1')
>> P2 = inline('x-1-(x-1)^2/2')
>> P3 = inline('x-1-(x-1)^2/2+(x-1)^3/3')
>> P4 = inline('x-1-(x-1)^2/2+(x-1)^3/3-(x-1)^4/4')
```

Now let us plot these functions. Enter:

```
>> hold on
>> ezplot(f, [0.5, 2])
>> ezplot(P1, [0.5, 2])
>> ezplot(P2, [0.5, 2])
>> ezplot(P3, [0.5, 2])
>> ezplot(P4, [0.5, 2])
```

Add the title "MATLAB homework number 1" to your graph and print it for possible submission. On your printout, indicate by pencil which graph belongs to which function. You may have to plot the graphs one by one again and compare with your printout for this. If you want to do this redo of the graphing, remember to start with:

```
>> hold off
```

Now let us see what happens if we look at the Taylor polynomials at a larger interval. If your hold is still set to "on" you can do this by simply entering:

```
>> ezplot(P4, [0.5, 3])
```

Make sure that all five functions are shown on the graph, give it a title, and print it for possible submission. Indicate on the printout how the graph shows that although higher-order Taylor polynomials at a point a are better approximations of the given function for x close to a, they are not necessarily better approximations *for all x*.