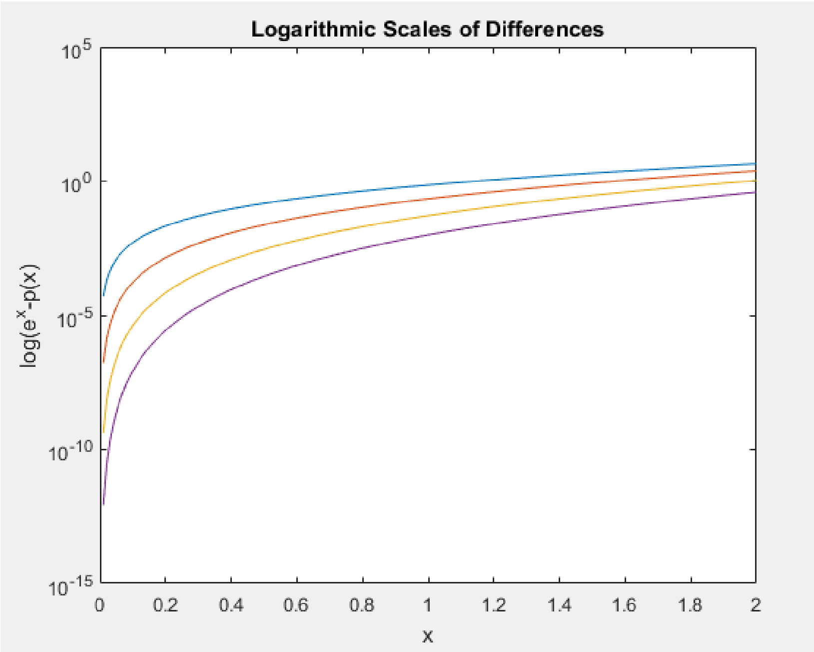
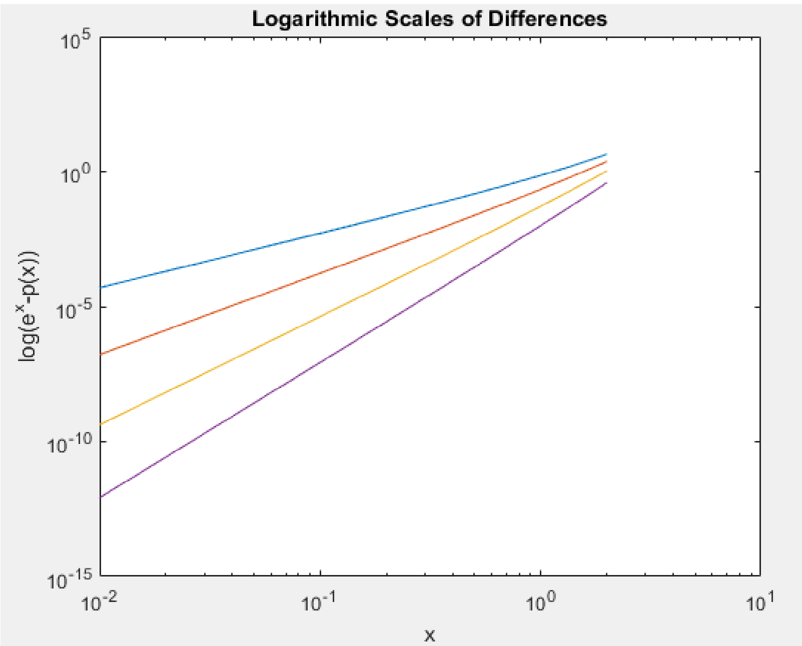
1. MATLAB Code & Plots:

Check the differences:

```
>> semilogy(xlist,linerrs,xlist,quaderrs,xlist,cuberrs,xlist,quarterrs)
>> xlabel('x')
>> ylabel('log(e^x-p(x)')
>> title('Logarithmic Scales of Differences')
```




```
>> loglog(xlist,linerrs,xlist,quaderrs,xlist,cuberrs,xlist,quarterrs)
>> xlabel('x')
>> ylabel('log(e^x-p(x))')
>> title('Logarithmic Scales of Differences')
```



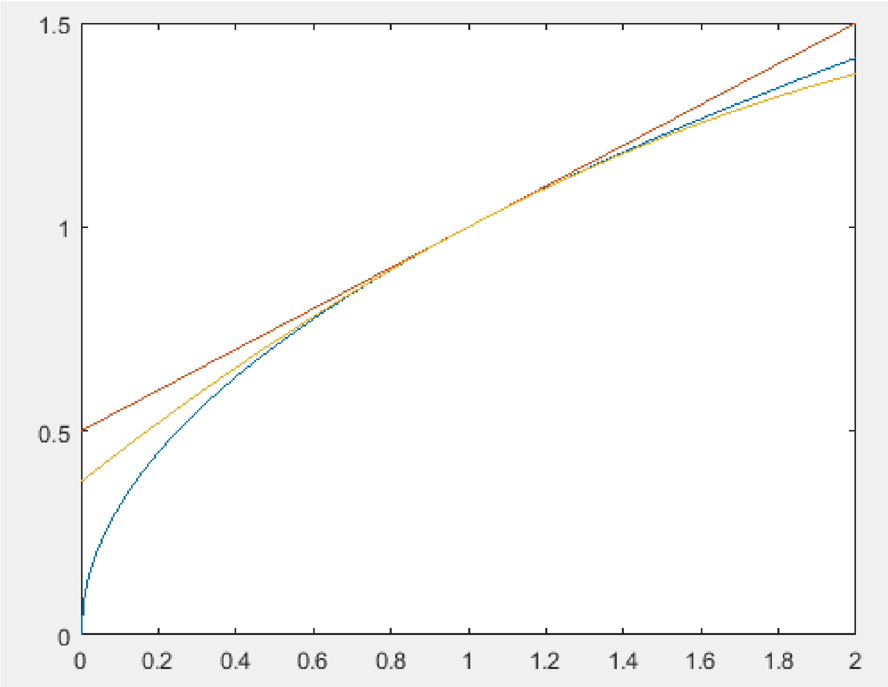
2. Textbook Problem 2:

(a) $f(x) = \sqrt{x}, a = 1$

Linear tp: $p(x) = 1 + \frac{1}{2}(x-1)$

Quadratic tp: $p(x) = 1 + \frac{1}{2}(x-1) - \frac{1}{8}(x-1)^2$

```
>> xlist = 0:.01:2;
>> expvals = sqrt(xlist); %compute sqrt of x for every entry
>> linvals = 1 + (xlist-1)/2; %compute linear tp
>> quadvals = 1 + (xlist-1)/2 - (xlist-1).^2/8; %compute quadratic tp
>> plot(xlist,expvals,xlist,linvals,xlist,quadvals)
```



Where the blue line represent the **function**, the red line represents the **linear** Taylor polynomial, and the yellow line represents the **quadratic** Taylor polynomial.

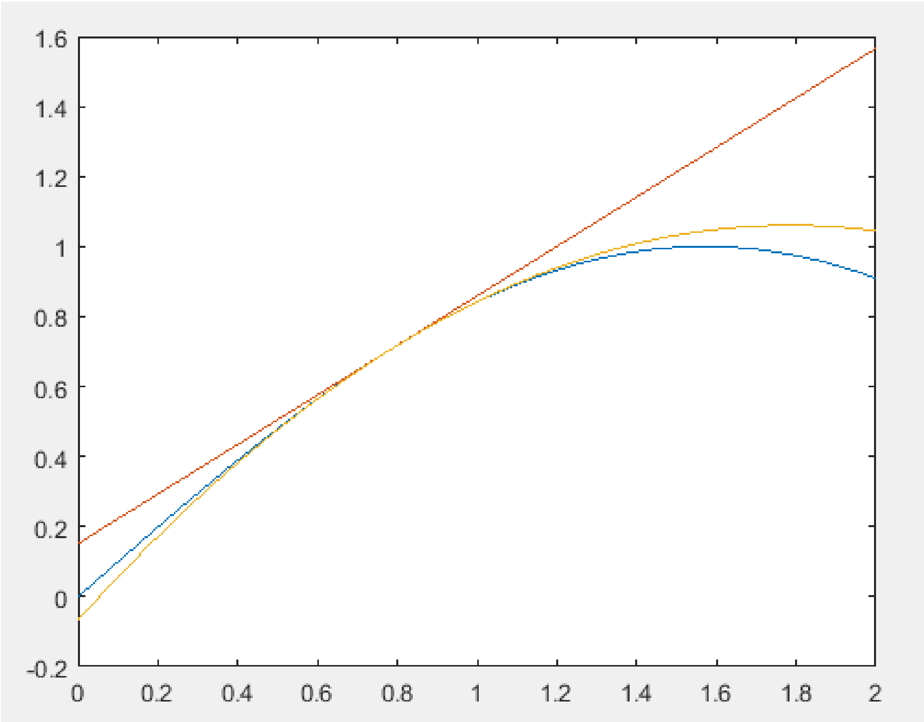
(b) $f(x) = sin(x), a = \frac{\pi}{4}$

Linear tp: $p(x) = \sin\left(\frac{\pi}{4}\right) + \cos\left(\frac{\pi}{4}\right) * (x - \frac{\pi}{4}) = \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}(x - \frac{\pi}{4})$

Quadratic tp:

$$p(x) = \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\left(x - \frac{\pi}{4}\right) - \frac{1}{2}\sin\left(\frac{\pi}{4}\right) * \left(x - \frac{\pi}{4}\right)^2 = \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\left(x - \frac{\pi}{4}\right) - \frac{1}{2\sqrt{2}}(x - \frac{\pi}{4})^2$$

```
>> xlist = 0:.01:2;
>> expvals = sin(xlist); %compute sin of x for every entry
>> linvals = 1/sqrt(2) + (xlist-pi/4)/sqrt(2); %compute linear tp
>> quadvals = 1/sqrt(2) + (xlist-pi/4)/sqrt(2)...
-(xlist-pi/4).^2/(2*sqrt(2)); %compute quadratic tp
>> plot(xlist,expvals,xlist,linvals,xlist,quadvals)
```



Where the blue line represent the **function**, the red line represents the **linear** Taylor polynomial, and the yellow line represents the **quadratic** Taylor polynomial.

(c) $\boldsymbol{f(x) = e^{cos(x)}, a = 0}$

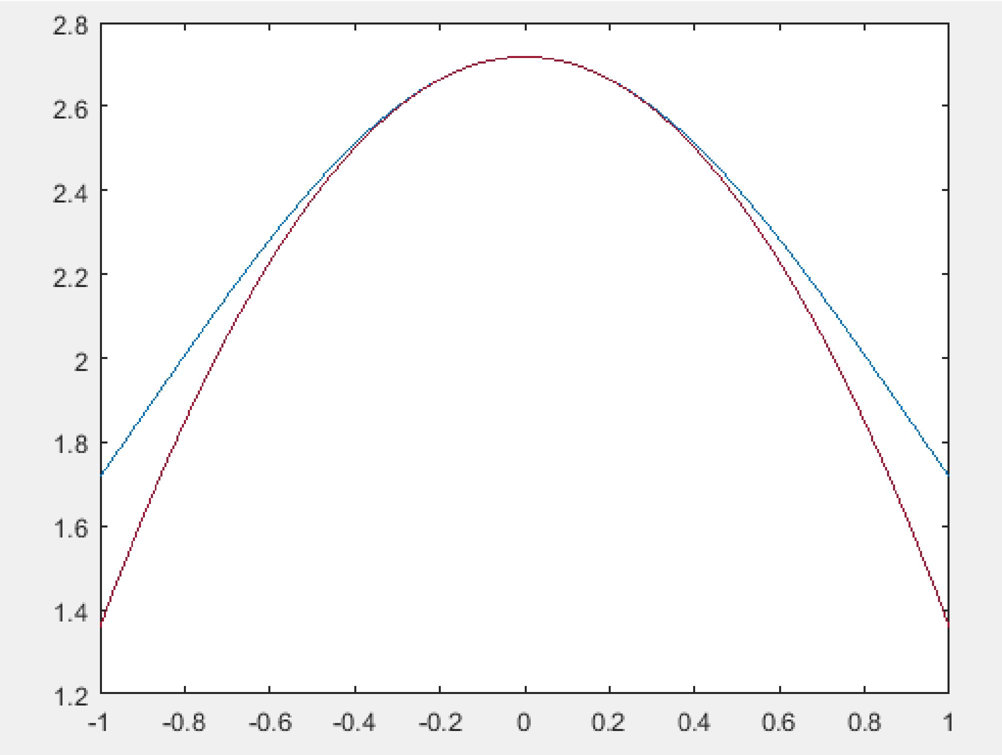
Linear tp: $p(x) = e + \left(-\sin(0) * e^{\cos(0)}\right) * (x - 0) = e$

Quadratic tp:

$$p(x) = e + 0 + \frac{1}{2}(-\cos(0) * e^{\cos(0)} + \left(-\sin(0)^2 * e^{\cos(0)}\right) * (x - 0)^2$$

$$= e - e * \frac{1}{2}x^2$$

```
>> xlist = -1:.01:1;
>> expvals = exp(cos(xlist)); %compute exponent of cos(x) for every entry
>> linvals = exp(1); %compute linear tp
>> quadvals = exp(1)-exp(1)*xlist.^2/2; %compute quadratic tp
>> plot(xlist,expvals,xlist,linvals,xlist,quadvals)
```



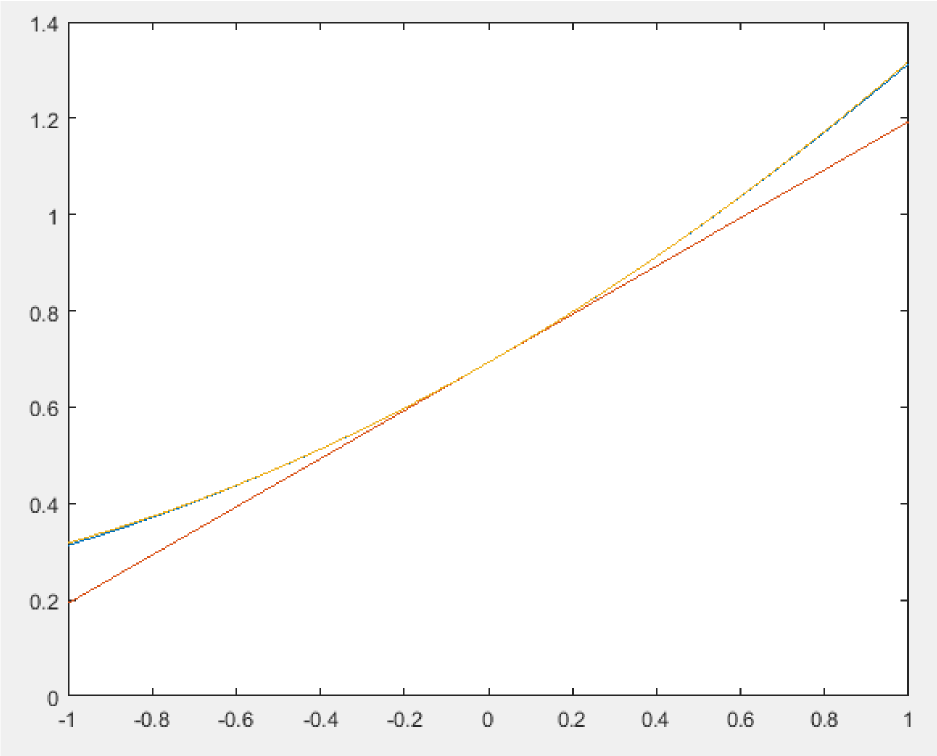
Where the blue line represent the **function**, the red line represents the **quadratic** Taylor polynomial. (The Taylor polynomials of this function only has even powers.)

(d) $\boldsymbol{f(x) = log(1 + e^x), a = 0}$

Linear tp: $p(x) = \log(2) + \frac{e^0}{e^0+1} * (x - 0) = \log(2) + \frac{1}{2}x$

Quadratic tp: $p(x) = \log(2) + \frac{1}{2}x + \frac{1}{2}x * \frac{e^0(1+e^0)-e^0e^0}{(1+e^0)^2} = \log(2) + \frac{1}{2}x + \frac{1}{8}x^2$

```
>> xlist = -1:.01:1;
>> expvals = log(1+exp(xlist)); %compute lof of (1+e^x) for every entry
>> linvals = log(2)+xlist/2; %compute linear tp
>> quadvals = log(2)+xlist/2+xlist.^2/8; %compute quadratic tp
>> plot(xlist,expvals,xlist,linvals,xlist,quadvals)
```



Where the blue line represent the **function**, the red line represents the **linear** Taylor polynomial, and the yellow line represents the **quadratic** Taylor polynomial.

(The quadratic Taylor polynomial is very close to the original function.)