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Numerical Analysis
Assignment 1

1)

i)

```
function [ result ,error] = fun( z,a,n )
```
-> Define a function which takes 3 arguments.

```
syms x real;
```
-> Define a symbol x.

```
f=sin(x);
```
-> Define a function sin(x)

```
sum=subs(f,'x',a);
```
-> Initialize sum as f(a)

```
prod=1;
```
-> Initialize prod as 1.

```
for j=1:n
```
-> for loop with j, 1 to n.

```
 prod=prod*(z-a)/j;
 sum=sum+prod*subs(diff(f,x,j),'x',a);
```
-> Calculate Taylors series

```
end

result=double(sum);

error=double(abs(result-subs(f,'x',z)));
```
-> Calculate Error.

```
end
```
……

```
z=input('z=');
```
-> input z value from user

```
a=input('a=');
```
-> input a value from user

```
for n=1:10
```

```
 [ result ,error] = fun( z,a,n );
```
-> Call function with different n values.

```
 v(n)=result;e(n)=error;
```
-> Store result and error

```
end
```
-> End for loop.

```
x=1:n;

disp( ' n n(1) error')

disp([x' v' e'])
```
-> Print the value and error.

```
fid=fopen('expsin.txt','w');

fprintf(fid,'%s\n',' n Pn(1) error');

fprintf(fid,'%2u %14.10f %14.10f\n',[x;v;e]);
```
-> Print in a file.

```
fclose(fid);
```

ii)

```
n f n(1)

[  1,                    1.0, 0.84147098480789650487565722869476]

[  2,                    1.0, 0.84147098480789650487565722869476]

[  3, 0.83333333333333333333333333333333, 0.84147098480789650487565722869476]

[  4, 0.83333333333333333333333333333333, 0.84147098480789650487565722869476]

[  5, 0.84166666666666666666666666666667, 0.84147098480789650487565722869476]

[  6, 0.84166666666666666666666666666667, 0.84147098480789650487565722869476]

[  7, 0.84146825396825396825396825396825, 0.84147098480789650487565722869476]

[  8, 0.84146825396825396825396825396825, 0.84147098480789650487565722869476]

[  9, 0.84147100970017640886311482972815, 0.84147098480789650487565722869476]

[ 10, 0.84147100970017640886311482972815, 0.84147098480789650487565722869476]
```

iii)
For n=10, max |Rn(x)|using above table vs error using Rn(x) formula is
0.00000002489227990398745760103338398039 3, -0.00000002505210838544171877505210838544 2
Which is very close to each other.

iv)
[1, 0.158529015192103495124342771305 24]

[2, 0.158529015192103495124342771305 24]

[3, 0.008137651474563134534889741189545]

[4, 0.008137651474563134534889741189545]

[5, 0.000195681858770169192496268806280 57]

[6, 0.000195681858770169192496268806280 57]

[7, 0.000002730839642528515298636193620041]

[8, 0.000002730839642528515298636193620041]

[9, 0.00000002489227990398745760103338398039 3]

[10, 0.00000002489227990398745760103338398039 3]

v)
For z=1, a=0,
$|Pn\ (z) - Pm(z)|$ is
m=6, n=1 => 0.158333333333333333333333333333333

m=6, n=1 => 0.158531746031746031746031746031 75

m=6, n=1 => 0.008134920634920634920634920634920 6

m=6, n=1 => 0.008137676366843075529781496394813 7

m=6, n=1 => 0.000195656966490257803551836938519 65

2.
The largest integer is 2,147,483,647. This is equal to 2^31-1, as the first bit is for sign and the rest 31 are for the number. The smallest integer is 2,147,483,648 as its represented in twos compliment form. The

range for floating point numbers is -3.40282e+38 to -1.17549e-38 and 1.17549e-38 to 3.40282e+38. Which is a range between (2- 2^-23) *2^127 and 2^-126.

3

i) The decimal number 4/3 cannot be exactly converted into a binary fraction. So the above calculation does not result in zero. The answer comes as 2^-52 which is a precision value.

ii)This is because 0.1 is not exactly represented in binary number.

iii) This is because of the order of operation.

iv) subtractions are performed with nearly equal operands, sometimes cancellation can occur unexpectedly. loss of precision

4.

sin(10^-7) = 1.0000e-07
sqrt(1-(cos(10^-7))^2) = 9.9960e-08

Sin(10^-8) = 1.0000e-08
sqrt(1-(cos(10^-8))^2) = 0

This is because there is a loss of precision when we are subtracting the numbers.

5.

If we substitute 10^(-12), we get 1.0001. For numbers less than this, the value is even lesser. Using the taylors polynomial we should actually get 1. This is because when we expand taylor polynomial for e^x. we get 1+x/1! + x^2/2! + x^3/3! + … If we subtract by 1 and divide by x we get, 1+x/2! + x^2/3!+…