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```
clear all;clc

x = pi/4;

h = pi/12;
```

Function handles for all

```
f =@(x) sin(x);
derivative_byforwardapproxo1 =@(x,h) (f(x+h)-f(x) )/h;
derivative_byforwardapproxo2 =@(x,h) (-3*f(x)+4*f(x+h)-f(x+2*h))/
(2*h);
derivative_bybackwardapproxo1 =@(x,h) (f(x)-f(x-h))/h
derivative_bybackwardapproxo2 =@(x,h) (-3*f(x-h) + 4*f(x) -
 f(x-2*h) )/(2*h);
derivative_bycentraldifferenceapproxo2 =@(x,h) (f(x+h)-f(x-h))/(2*h);
derivative_bycentraldifferenceapproxo4 =@(x,h) (-f(x+2*h) + 8*f(x+h)-
f(x-h) +f(x-2*h))/(12*h);
```

```
derivative_bybackwardapproxo1 =

  function_handle with value:

    @(x,h)(f(x)-f(x-h))/h
```

Function calls

```
dfp01 = derivative_byforwardapproxo1(x,h)
dfp02 =derivative_byforwardapproxo2(x,h)
dbp01 = derivative_bybackwardapproxo1(x,h)
dbp02 = derivative_bybackwardapproxo2(x,h)
dbc02 = derivative_bycentraldifferenceapproxo2(x,h)
dbc04 = derivative_bycentraldifferenceapproxo4(x,h)
```

```
dfp01 =

    0.6070
```

```
dfp02 =

    0.7197


dbp01 =

    0.7911


dbp02 =

    2.0428


dbc02 =

    0.6991


dbc04 =

    1.8211
```

Analytical solution is

```
analytical_solution = cos(pi/4)


analytical_solution =

    0.7071
```

True percent of relative error is

```
dfpo1_er = ((dfp01-analytical_solution)/analytical_solution)*100;
dfpo2_er = ((dfp02-analytical_solution)/analytical_solution)*100;
dbpo1_er = ((dbp01-analytical_solution)/analytical_solution)*100;
dbpo2_er = ((dbp02-analytical_solution)/analytical_solution)*100;
dbco2_er = ((dbc02-analytical_solution)/analytical_solution)*100;
dfco4_er = ((dbc04-analytical_solution)/analytical_solution)*100;
```

printing all solutions

```
fprintf('\nDerivate by forward approximation for O(h) is %f and
 Relative error is %f',dfp01,dfpo1_er);
fprintf('\nDerivate by forward approximation for O(h^2) is %f and
 Relative error is %f\n',dfp02,dfpo2_er);
```

```
fprintf('\nDerivate by backward approximation for O(h) is %f and
 Relative error is %f\n',dbp01,dbpo1_er);
fprintf('\nDerivate by backward approximation for O(h^2) is %f and
 Relative error is %f\n',dbp02,dbpo2_er);
fprintf('\nDerivate by central approximation for O(h^2) is %f and
 Relative error is %f\n',dbc02,dbco2_er);
fprintf('\nDerivate by central approximation for O(h^4) is %f and
 Relative error is %f\n',dbc04,dfco4_er);
```

```
Derivate by forward approximation for O(h) is 0.607024 and Relative
 error is -14.153783
Derivate by forward approximation for O(h^2) is 0.719741 and Relative
 error is 1.786732

Derivate by backward approximation for O(h) is 0.791090 and Relative
 error is 11.876969

Derivate by backward approximation for O(h^2) is 2.042801 and Relative
 error is 188.895682

Derivate by central approximation for O(h^2) is 0.699057 and Relative
 error is -1.138407

Derivate by central approximation for O(h^4) is 1.821082 and Relative
 error is 157.539824
```

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