Assignment02

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Description: Plot the graph of Taylor approximation

1 import Libraries

- import libraries, numpy and matplotlib.pyplot for math functions and plot drawing
- define each object, np and plt

```
In [1]: import numpy as np
        import matplotlib.pyplot as plt
```

2 Define function and derivative

- define a function: $f(x) = x^3 \cdot \cos x - x^2 \cdot \sin 2x + x \cdot \cos x$

```
In [2]: def Function(x):
            f = np.cos(x)*x*x*x-np.sin(2*x)*x*x+np.cos(x)*x
            return f
```

- define the derivative function : $f(x) = -x^3 \cdot \sin x + 3x^2 \cdot \cos x - 2x \cdot \sin 2x - 2x \cdot \cos 2x - x \cdot \sin x + \cos x$

```
In [3]: def DerivativeFunction(x):
            d = -x*x*x*np.sin(x)+3*x*x*np.cos(x)-2*x*np.sin(2*x)-2*x*np.cos(2*x)-x*np.sin(x)+np.
            return d
```

3 Pick 3 points

- If we can get $f(a)$ and $f'(a)$ at a, we can find tangent line at the specific point and use $f(x)$ approximation. $f(x) \approx f(a) + f'(a)(x - a)$
- For that, pick a, b, c

$x_a : 11, \quad x_b : 3, \quad x_c : 12 \qquad y_a : f(x_a), \quad y_b : f(x_b), \quad y_c : f(x_c)$

```
In [4]: xs = [12,17,24]
        ys = [Function(12),Function(17),Function(24)]
```

4 Define tangent lines

- define the tangent lines at the points
  - $f(x) = f(x_a) + f'(x_a)(x - x_a)$
  - $f(x) = f(x_b) + f'(x_b)(x - x_b)$
  - $f(x) = f(x_c) + f'(x_c)(x - x_c)$

```
In [5]: def DerivativeFunction(x):
            d = -x*x*x*np.sin(x)+3*x*x*x*np.cos(x)-2*x*np.sin(2*x)-2*x*np.cos(2*x)-x*np.sin(x)+np.
            return d
        def tangentFunctionA(x):
            t1 = Function(12) + DerivativeFunction(12)*(x-12)
            return t1
        def tangentFunctionB(x):
            t2 = Function(17) + DerivativeFunction(17)*(x-17)
            return t2
        def tangentFunctionC(x):
            t3 = Function(24) + DerivativeFunction(24)*(x-24)
            return t3
```

5 Define the domain

- define the domain: $x = [10 : 0.1 : 30]$

```
In [6]: x = np.arange(10, 30, 0.1)
```

6 Calculate functions

```
In [7]: f=Function(x)
        d=DerivativeFunction(x)
        t1=tangentFunctionA(x)
        t2=tangentFunctionB(x)
        t3=tangentFunctionC(x)
```

7 Plot the graphs of the functions

```
In [8]: plt.figure(1)
        plt.title('First order')
        plt.grid(True)
        plt.plot(x, f, 'b', label="function")
        plt.plot(xs,ys,'k.')
        plt.plot(x, t1, 'y', label="tangent1")
        plt.plot(x, t2, 'g',label="tangent2")
        plt.plot(x, t3, 'r',label="tangent3")
        plt.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
        plt.show()
```


First order
function
tangent1
tangent2
tangent3
50000
0
−50000
−100000
−150000
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
30.0