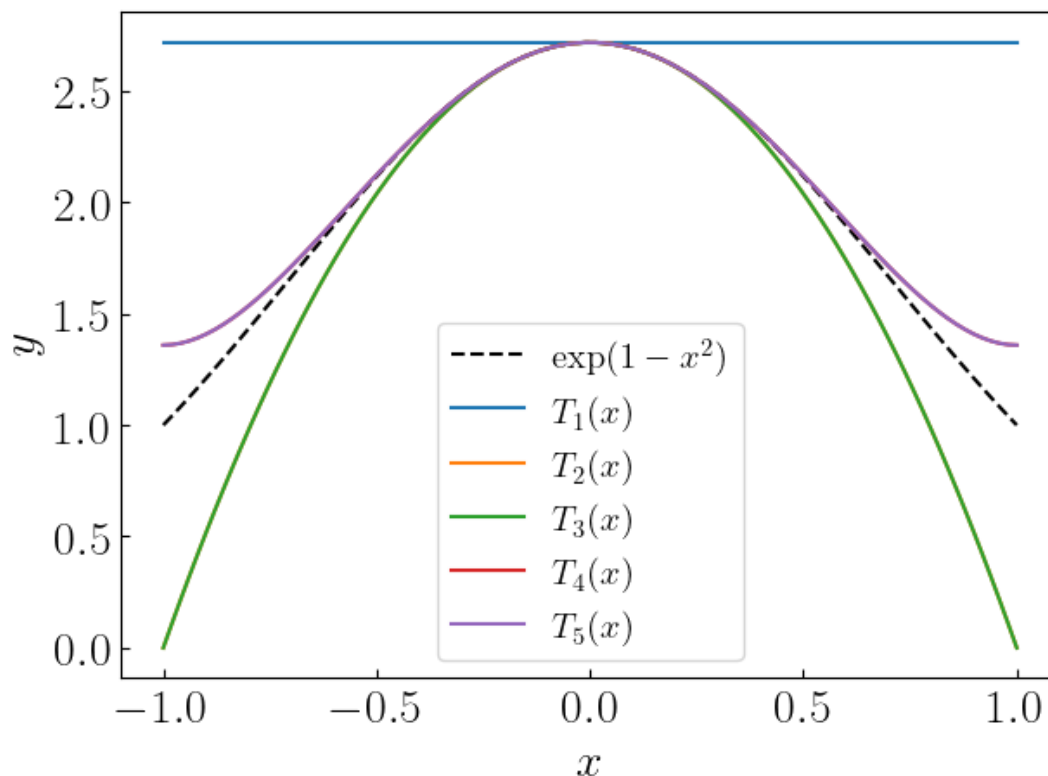


4)



```
#!/usr/bin/env python3

import numpy as np
import sympy as sp
import matplotlib.pyplot as plt
from matplotlib import rcParams
rcParams['text.latex.preamble'] = r'\usepackage{amsmath}'
rcParams['text.usetex'] = True
rcParams['font.family'] = 'sans-serif'
rcParams['font.sans-serif'] = ['Helvetica']

x = sp.Symbol('x')
f = sp.exp(1-x**2)
f_num = sp.lambdify(x, f, 'numpy')

X = np.linspace(-1,1,100)
fig, ax = plt.subplots(1,1,figsize=(7,5))
ax.plot(X,f_num(X), 'k--', label=r'$\exp(1-x^2)$')
for i in range(1,6):
    fi = f.series(x,0,i+1)
    fi = fi.removeO()
    print('T_{}(x) = {}'.format(i, fi))
    fi_num = sp.lambdify(x, fi, 'numpy')
    ax.plot(X,np.vectorize(fi_num)(X), label=r'$T_{{{} }}(x)$ %i')

ax.set_xlabel(r'$x$', size=20)
ax.set_ylabel(r'$y$', size=20)
ax.tick_params(axis='both', which='major', labelsize=20, direction='in')
ax.legend(fontsize=15)
plt.savefig('./prob4.png', bbox_inches='tight')
```

5)

```

initial guess: -5.00 --> approximate root: nan
initial guess: -1.00 --> approximate root: 3.374e-11
initial guess: -0.05 --> approximate root: 1.600e-16
initial guess: 0.00 --> approximate root: 0.000e+00
initial guess: 0.05 --> approximate root: -1.600e-16
initial guess: 1.00 --> approximate root: -3.374e-11
initial guess: 5.00 --> approximate root: nan

```

```

#!/usr/bin/env python3

import numpy as np
import sympy as sp

def secant(F,Fp,x0,M=1e5,delta=1e-10,eps=1e-10):
    x1 = x0 - F(x0)/Fp(x0)
    u = F(x0)
    v = F(x1)
    for i in range(int(M)):
        if abs(x1-x0) < delta:
            break
        if abs(u) < eps:
            x1 = x0
            break
        elif abs(v) < eps:
            break
        temp = x1
        x1 = x1 - v*(x1-x0)/(v-u)
        x0 = temp
        u = v
        v = F(x1)
    return x1

x = sp.Symbol('x',real=True)
f = sp.atan(x)
fp = sp.diff(f,x)

f_num = sp.lambdify(x,f,'numpy')
fp_num = sp.lambdify(x,fp,'numpy')

x0 = np.array([-5.0,-1.0,-0.05,0.0,0.05,1.0,5.0])
print('The root of {} using the secant method was found using the following
      initial guesses:'.format(f))
for _ in x0:
    r = secant(f_num,fp_num,_)
    print('initial guess: {:.2f} --> approximate root: {:.3e}'.format(_,r))

```