PATUAKHALI SCIENCE AND TECHNOLOGY UNIVERSITY

COURSE CODE CCE 312
Numerical Methods Sessional

SUBMITTED TO:

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Assignment 06
Assignment title: False Position Method
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Root Finding

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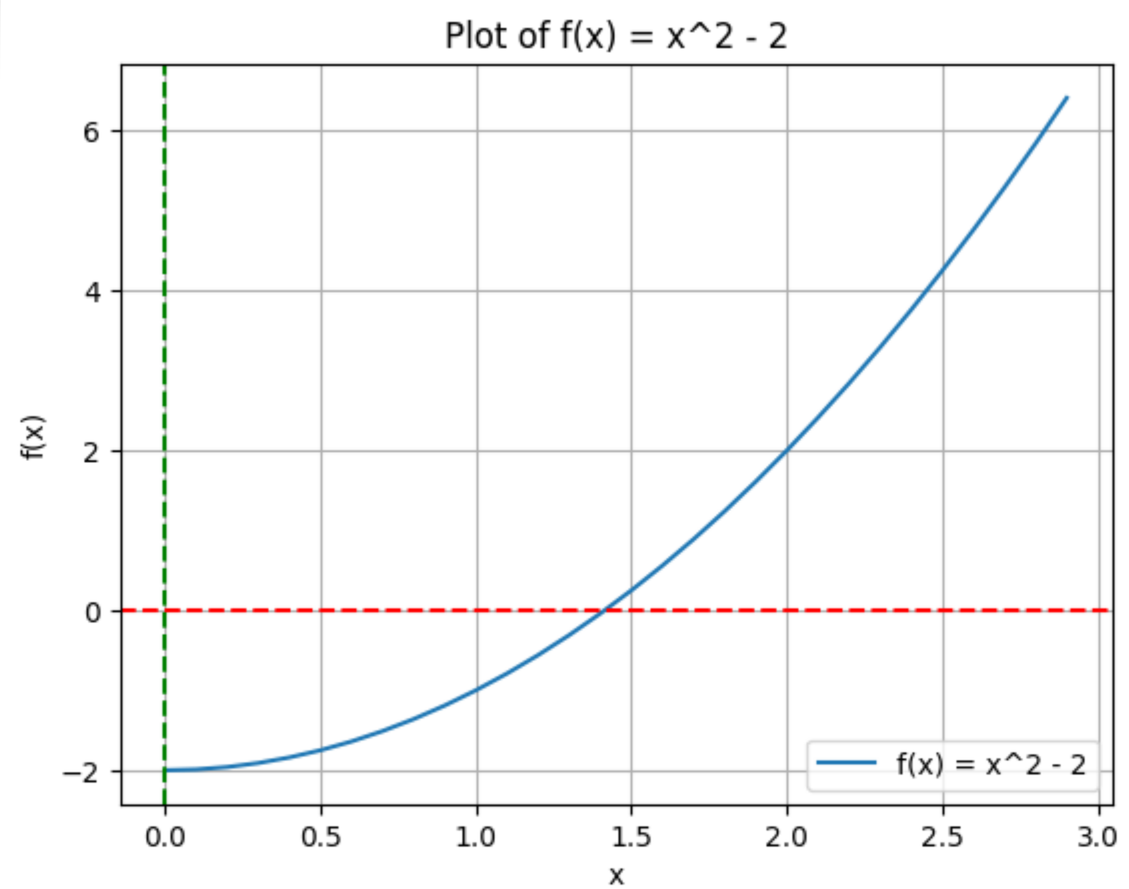
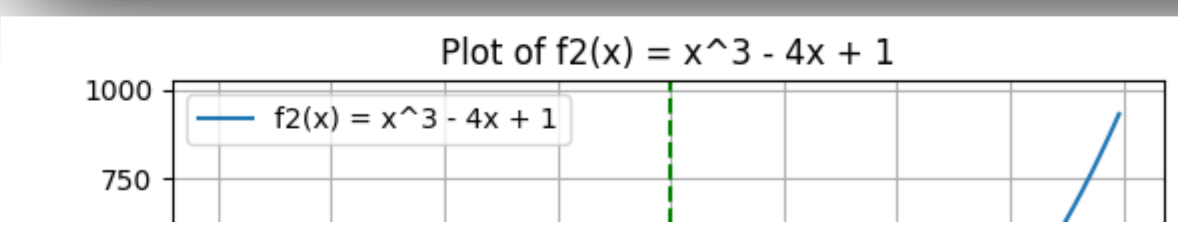
Root finding refers to the process of finding solutions to equations of the form f(x) = 0. This is a fundamental problem in numerical analysis and has various applications in science and engineering.

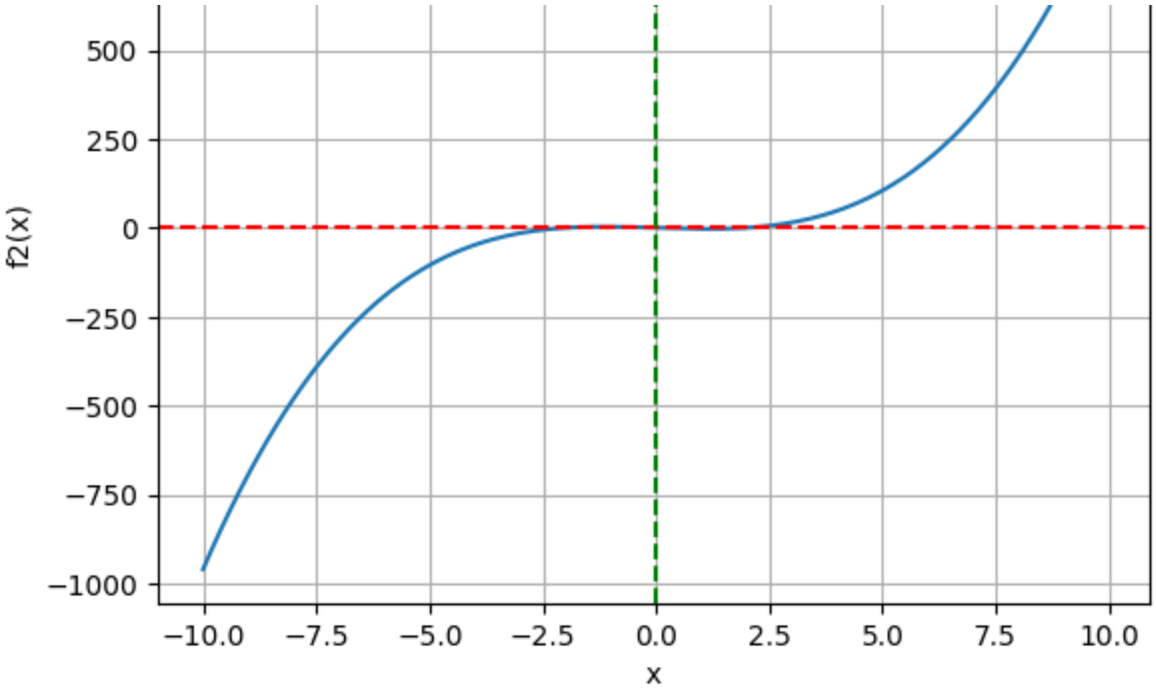
```
# First let's import necessary libs
import matplotlib.pyplot as plt
import numpy as np
import math
```

```
# Our first function
def f(x):
  return x**2 - 2

# Let's plot the function
x = np.arange(0, 3, 0.1)
plt.plot(x, f(x), label='f(x) = x^2 - 2')

plt.axhline(0, color='red', linestyle='--')
plt.axvline(0, color='green', linestyle='--')

plt.xlabel('x')
plt.ylabel('f(x)')

plt.title('Plot of f(x) = x^2 - 2')
plt.grid()
plt.legend()
```




```python
# Our second function
def f2(x):
  return x**3 - 4 * x + 1

# Let's plot the function
x = np.arange(-10, 10, 0.1)
plt.plot(x, f2(x), label='f2(x) = x^3 - 4x + 1')

plt.axhline(0, color='red', linestyle='--')
plt.axvline(0, color='green', linestyle='--')

plt.xlabel('x')
plt.ylabel('f2(x)')

plt.title('Plot of f2(x) = x^3 - 4x + 1')
plt.grid()
plt.legend()
```





Bisection Method

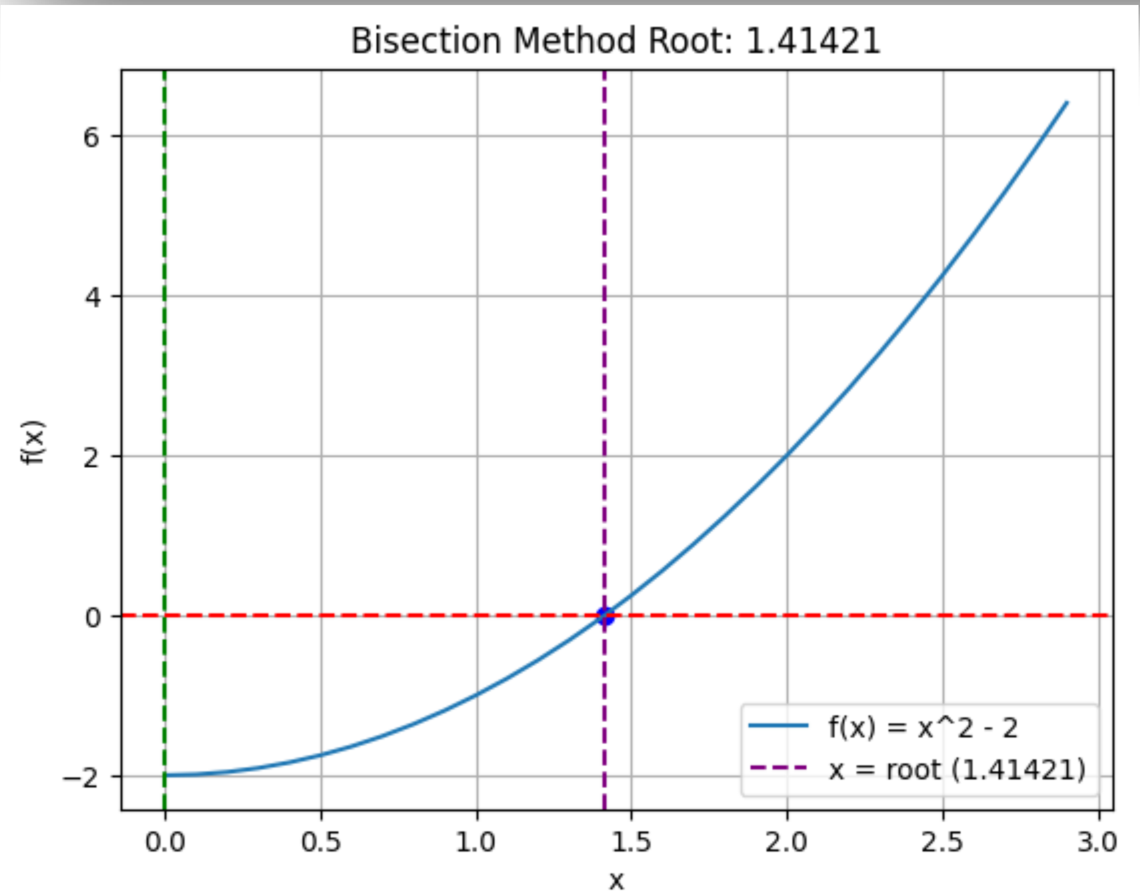
Bisection method finds the root of a function *f* in the interval [a, b].

```
Parameters:
- f : function
  The function for which we want to find the root.
- a : float
  The start of the interval.
- b : float
  The end of the interval.
- tol : float
  The tolerance for convergence.

Returns:
- float
  The approximate root of the function.
```

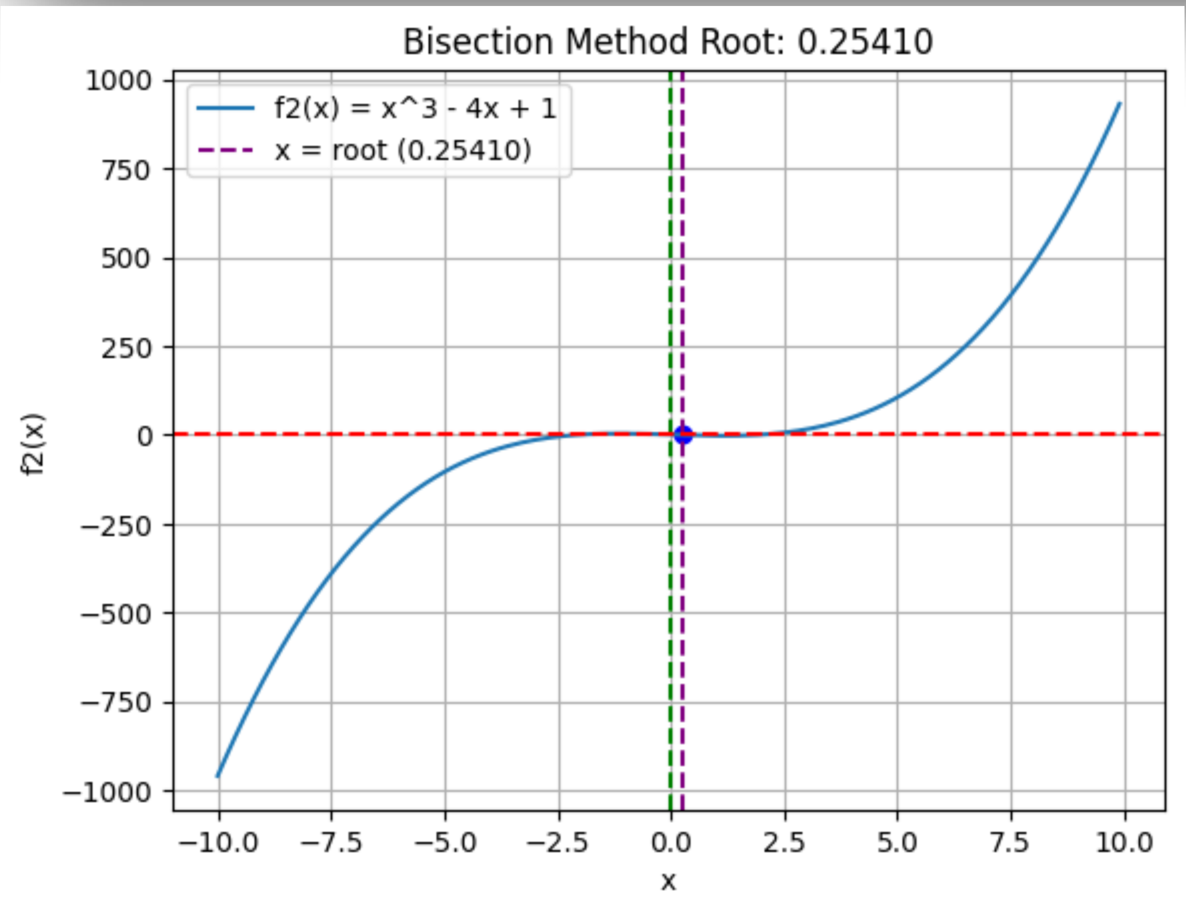
```
def bisection_method(f, a, b, tol=1e-5):
    if f(a) * f(b) >= 0:
        raise ValueError("f(a) and f(b) must have opposite signs.")

    mid = (a + b) / 2.0

    if abs(f(mid)) < tol:
```

```
        return mid
    elif f(a) * f(mid) < 0:
        return bisection_method(f, a, mid, tol)
    else:
        return bisection_method(f, mid, b, tol)
```

```
root = bisection_method(f, 0, 10)

# Let's plot the result
x = np.arange(0, 3, 0.1)

plt.plot(x, f(x), label='f(x) = x^2 - 2')
plt.scatter(root, f(root), color='blue')  # Mark the root on the plot
plt.axvline(root, color='purple', linestyle='--', label=f'x = root ({root:.5f})')

plt.axvline(0, color='green', linestyle='--')
plt.axhline(0, color='red', linestyle='--')

plt.xlabel('x')
plt.ylabel('f(x)')
plt.title(f"Bisection Method Root: {root:.5f}")
plt.grid()
plt.legend()
```



```
root = bisection_method(f2, -1, 1)

# Let's plot the result
x = np.arange(-10, 10, 0.1)

plt.plot(x, f2(x), label='f2(x) = x^3 - 4x + 1')
plt.scatter(root, f2(root), color='blue')  # Mark the root on the plot
plt.axvline(root, color='purple', linestyle='--', label=f'x = root ({root:.5f})')

plt.axvline(0, color='green', linestyle='--')
plt.axhline(0, color='red', linestyle='--')

plt.xlabel('x')
plt.ylabel('f2(x)')
plt.title(f"Bisection Method Root: {root:.5f}")
plt.grid()
plt.legend()
```

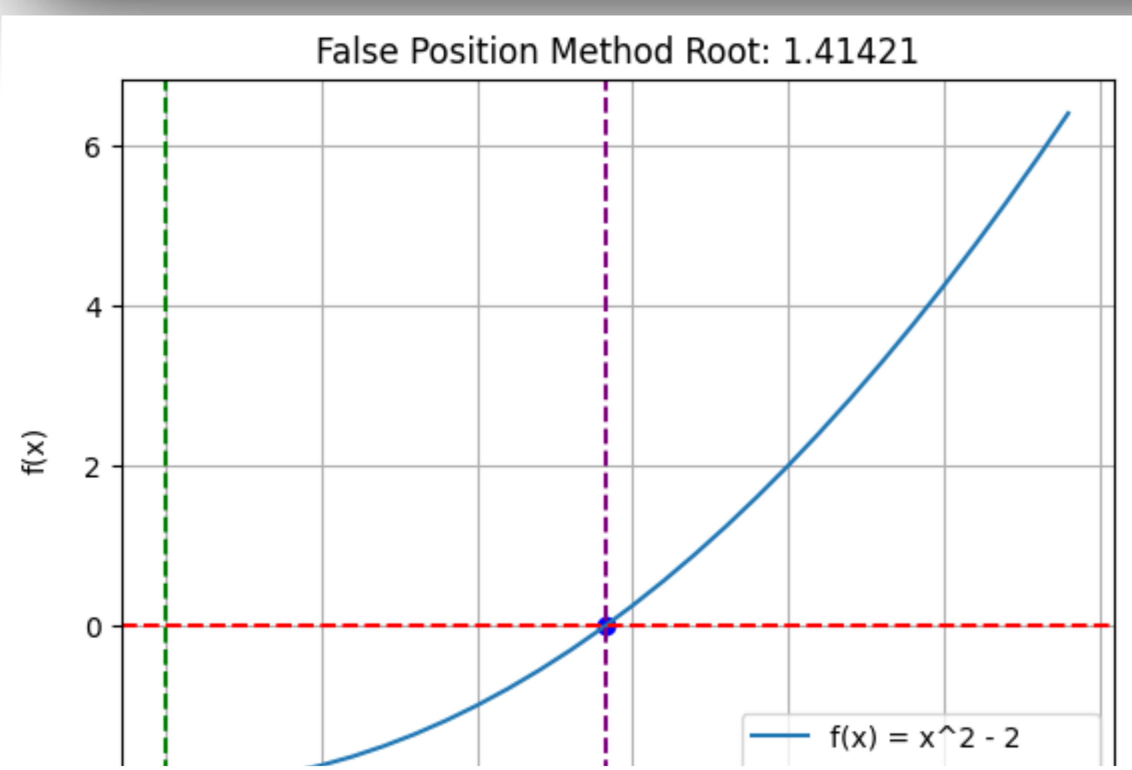


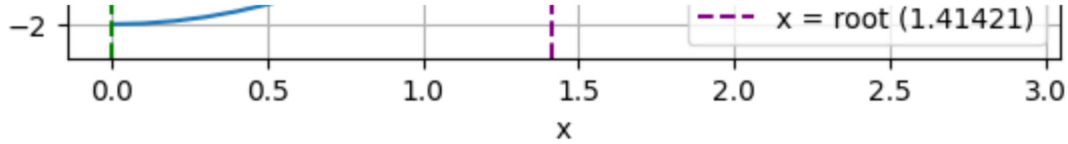
False Position Method

```
def false_position_method(f, a, b, tol=1e-5):
```

```python
def false_position_method(f, a, b, tol=1e-5):
    if f(a) * f(b) >= 0:
        raise ValueError("f(a) and f(b) must have opposite signs.")

    c = a - (f(a) * (b - a)) / (f(b) - f(a))

    if abs(f(c)) < tol:
        return c
    elif f(a) * f(c) < 0:
        return false_position_method(f, a, c, tol)
    else:
        return false_position_method(f, c, b, tol)
```

```python
root = false_position_method(f, 0, 10)

# Let's plot the result
x = np.arange(0, 3, 0.1)

plt.plot(x, f(x), label='f(x) = x^2 - 2')
plt.scatter(root, f(root), color='blue')  # Mark the root on the plot
plt.axvline(root, color='purple', linestyle='--', label=f'x = root ({root:.5f})')

plt.axvline(0, color='green', linestyle='--')
plt.axhline(0, color='red', linestyle='--')

plt.xlabel('x')
plt.ylabel('f(x)')
plt.title(f"False Position Method Root: {root:.5f}")
plt.grid()
plt.legend()
```






```
root = false_position_method(f2, -1, 1)

# Let's plot the result
x = np.arange(-10, 10, 0.1)

plt.plot(x, f2(x), label='f2(x) = x^3 - 4x + 1')
plt.scatter(root, f2(root), color='blue')  # Mark the root on the plot
plt.axvline(root, color='purple', linestyle='--', label=f'x = root ({root:.5f})')

plt.axvline(0, color='green', linestyle='--')
plt.axhline(0, color='red', linestyle='--')

plt.xlabel('x')
plt.ylabel('f2(x)')
plt.title(f"False Position Method Root: {root:.5f}")
plt.grid()
plt.legend()
```