MFDS_A2_Q4

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3 MATHS7027 Mathematical Foundations of Data Science

3.1 Assignment 2 - Question 4

In Practical 2, we saw how to define and plot functions in Python. In this question, we will explore this in more detail.

3.2 4(a)

Define the following functions in Python:

3.2.1 (i) $f_1(x) = \dfrac{-x^2}{x^4+5}$

3.2.2 (ii) $f_2(x) = (x-7)^2 - 2$

[22]:

```
import sys  #adding miniconda path variable for importing libraries [IGNORE IT]
sys.path.append('/home/shubharthak/miniconda3/lib/python3.12/site-packages')
print(sys.path)
```

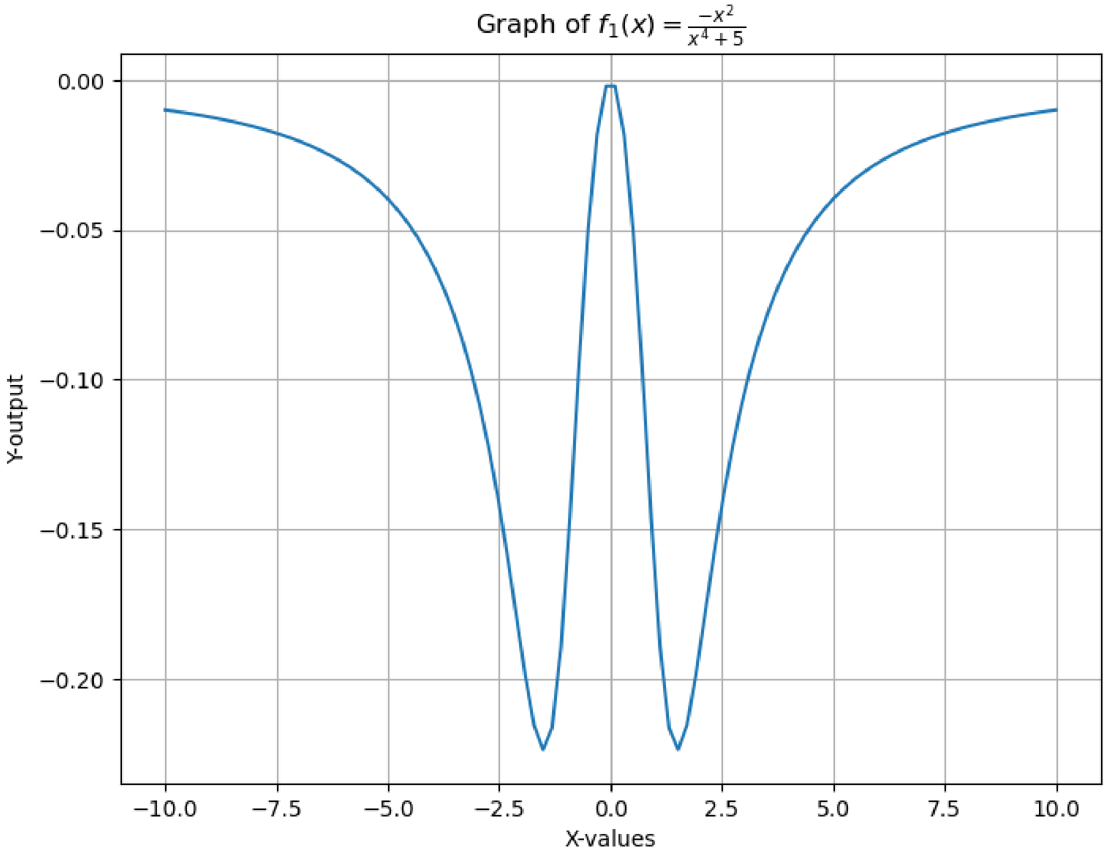
```
['/usr/lib/python312.zip', '/usr/lib/python3.12', '/usr/lib/python3.12/lib-
dynload', '', '/usr/local/lib/python3.12/dist-packages', '/usr/lib/python3/dist-
packages', '/home/shubharthak/miniconda3/lib/python3.12/site-packages',
'/home/shubharthak/miniconda3/lib/python3.12/site-packages',
'/home/shubharthak/miniconda3/lib/python3.12/site-packages',
'/home/shubharthak/miniconda3/lib/python3.12/site-packages']
```

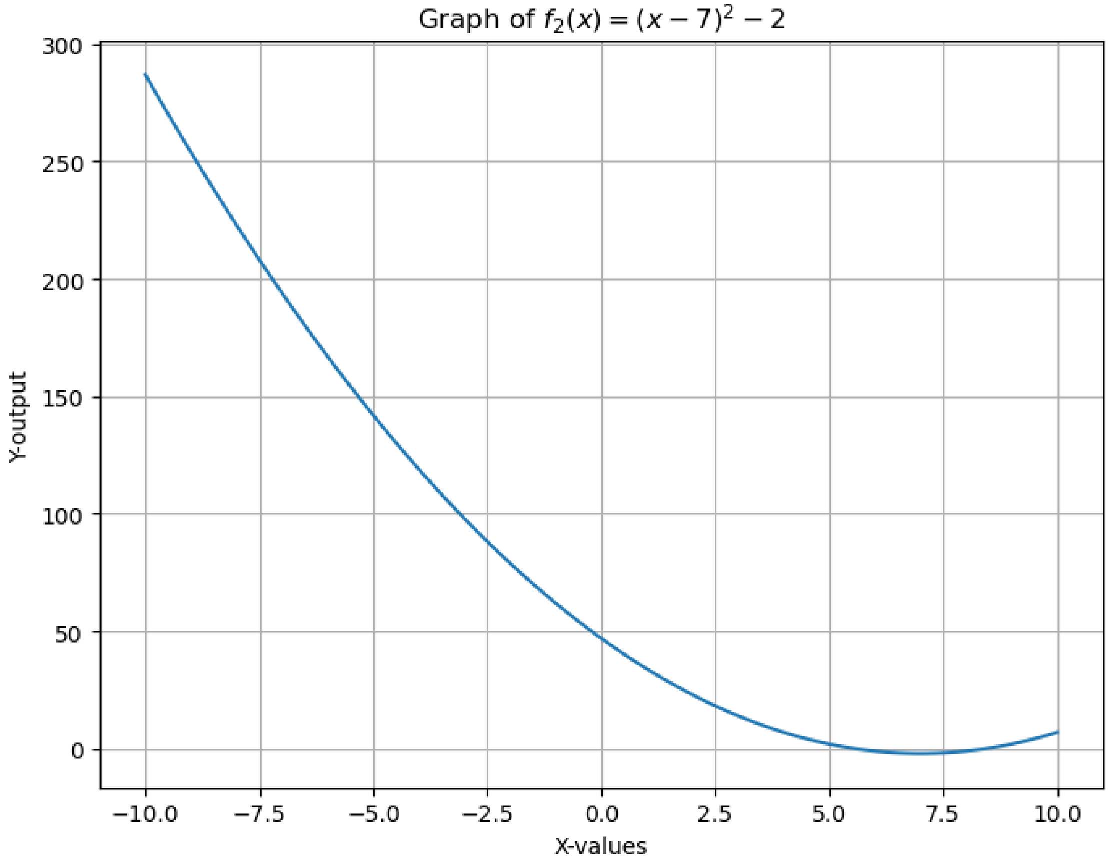
[24]:

```
### Enter your answer to question 4.a here
import matplotlib.pyplot as plt
import numpy as np
# to plot these equations we will use a function and matplot lib library
def f1(x: float) -> float:
    return (-x ** 2) / (x**4 + 5)

def f2(x: float) -> float:
    return (((x - 7) ** 2) - 2)
```

[36]:

```
#lets plot the graph of both functions
#first create some random values either using np.arange or np.linspace (i feel␣
 ↪linspace is more helpful here because it will create evenly distributed␣
 ↪values that help to visulize plot more better)
# x = np.arange(0, 4, 4/15)
x = np.linspace(-10, 10, 100)

plt.figure(figsize=(8, 6))
plt.xlabel("X-values")
plt.ylabel("Y-output")
plt.title("Graph of $f_1(x) = \\frac{-x^{2}}{x^{4}+5}$")
plt.plot(x, f1(x)) #plot first function
plt.grid();
plt.show();

plt.figure(figsize=(8, 6))
plt.xlabel("X-values")
plt.ylabel("Y-output")
plt.grid();
plt.title('Graph of $f_2(x) = (x - 7)^2 - 2$')
plt.plot(x, f2(x)) #plot second function
plt.show();
```


Graph of $f_1(x) = \frac{-x^2}{x^4+5}$
0.00
−0.05
−0.10
−0.15
−0.20
Y-output
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
X-values



3.3 4(b)

Produce plots for each of the following:

3.3.1 (i) $f_1 \circ f_2$

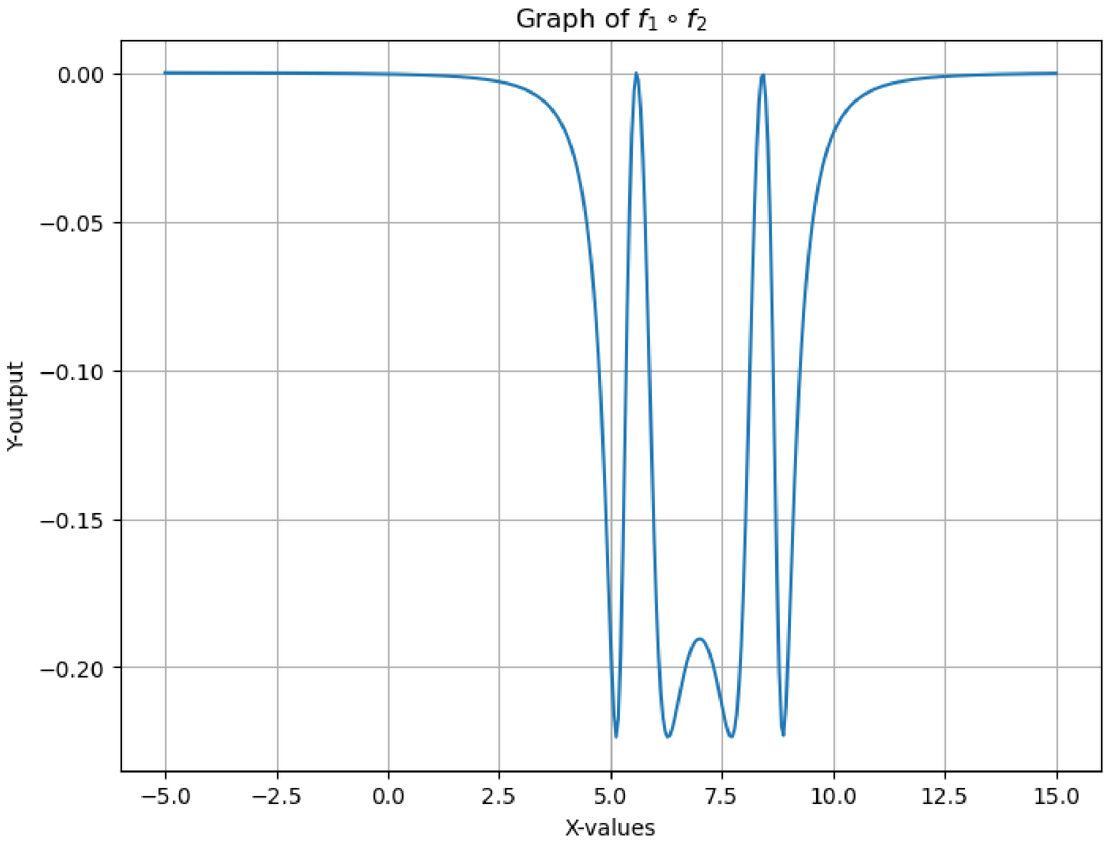
3.3.2 (ii) $f_2 \circ f_1$

In each case, you should choose settings (e.g., domain, number of samples) to produce a smooth plot which displays the key features of each function. You may need to experiment with different values to find a plot that shows the right amount of detail for each fucntion.

[37]:

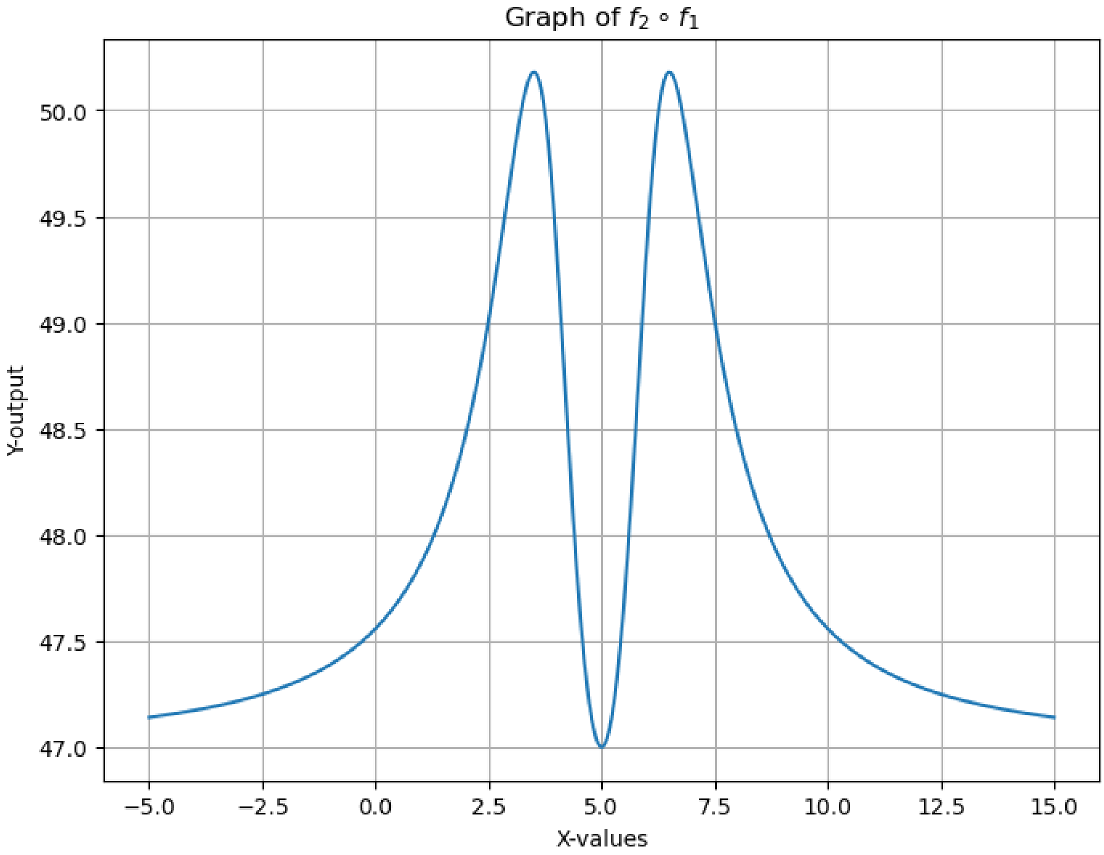
```
### Enter your answer to question 4.b.i here
# to get f1 o f2 we will first define the function
def f1_f2(x):
    return f1(f2(x))

#now we will plot it using matplot
x_f2 = np.linspace(-5, 15, 400)  # Domain for f2
```

```
plt.figure(figsize=(8, 6))
plt.xlabel("X-values")
plt.ylabel("Y-output")
plt.title("Graph of $f_{1} \\circ f_{2}$")
plt.plot(x_f2, f1_f2(x_f2)) #plot first function
plt.grid();
plt.show();
```



[39]:

```
### Enter your answer to question 4.b.ii here
# to get f2 o f1 we will first define the function
def f2_f1(x):
    return f2(f1(x))

x_f1 = np.linspace(-10, 10, 400) # Domain for f1
plt.figure(figsize=(8, 6))
plt.xlabel("X-values")
plt.ylabel("Y-output")
plt.title("Graph of $f_{2} \\circ f_{1}$")
plt.plot(x_f2, f2_f1(x_f1)) #plot first function
plt.grid();
plt.show();
```


Graph of $f_2 \circ f_1$
Y-output
X-values