- If you have any scratch work, please circle your final answer.
- Any code you write should run in a Jupyter cell; every character counts!
- For all questions on this exam, assume that all necessary packages have been imported.

1. For the following problems, write down what each code block would display if executed in a Jupyter cell. If the code generates an error or infinite loop, write `Error`.

   (a)
   ```
   a, b = (0, 2)
   while a < 3:
       print(f'a/b = {a / b:.2f}')
       a += 1
   ```

   (b)
   ```
   a = np.linspace(0, 2, 3)
   a ** 2 + 1
   ```

   (c)
   ```
   xstr = ['a', 'b']
   ystr = ['c', 'd']
   for x in xstr:
       for y in ystr:
           print(x + y, end=',')
   ```

   (d)
   ```
   cats = ['tiger', 'lion', 'liger', 'tigon']
   list(zip([x for x in range(4)], cats))
   ```

2. The dataset `fruits.txt` contains a long series of fruit names, some of which might be repeated:

   ```
   banana,orange,strawberry,orange,...
   ```

   Suppose you read this data into the Python object `fruits` with the code

   ```
   with open('fruits.txt') as wf:
       fruits = wf.read()
   ```

   (a) Write code which creates a set of all unique fruit names in the dataset.

   (b) Write code which creates a dictionary with fruit names as keys, and their frequency in the dataset as values. For example, your dictionary might look like

   ```
   {'banana':1, 'orange':2, ...}
   ```

3. Write a **recursive** function `fruits_after(name, fruits)` which takes a name of a fruit `name` (which is a string) and a list `fruits`, and returns the list of elements of `fruits` *after* the first occurrence of `name`.

   For example, the list of fruits from the previous problem might look like

   ```
   fruits_list = ['banana', 'orange', 'strawberry', 'orange', ...]
   ```

   Using this list, `fruits_after('banana', fruits_list)` should return

   ```
   ['orange', 'strawberry', 'orange', ...]
   ```

   and `fruits_after('orange', fruits_list)` should return

   ```
   ['strawberry', 'orange', ...]
   ```

   Note: you MUST write a recursive function to get full credit on this problem.

4. Write code which would display a plot of the function $f(x) = x\sin(x)$ and its derivative on the same plot, over the domain $[0, 2\pi]$. Make one of the plots red, the other one blue, and give your plot the title `A Function and its Derivative`. Use 100 x-values for your plots.

   Note: you may use NumPy on this question, but it is not required.