# Lab Assignment 2 - Anastasia Jeffcoat

# 200003415

https://github.com/ajeffcoat216/PY4SA23_Assignment.git

## If...else statements

### Question 1

**Is a number divisible by 3?**

In [83]:
```
x = 873
if x%3 == 0 :
    print(str(x) + " is divisible by 3.")
else:
    print(str(x) + " is not divisible by 3.")

y = 659
if y%3 == 0:
    print(str(y) + " is divisible by 3.")
else:
    print(str(y) + " is not divisible by 3.")
```

```
873 is divisible by 3.
659 is not divisible by 3.
```

### Question 2

**Is a fruit acceptable?**

In [3]:
```
fruits = ["apple", "orange", "pear", "kiwi", "strawberry"]
if 'apple' in fruits:
    print("Apple is acceptable.")
else:
    print("Apple is not acceptable.")
if 'banana' in fruits:
    print("Banana is accetable.")
else:
    print("Banana is not accetable.")
```

```
Apple is acceptable.
Banana is not accetable.
```

### Question 3

**How far apart are two co-ordinates?**

In [6]:
```
from haversine import haversine, Unit
#my home town to St. Andrews
#lat, long
#answer will be in km
bedworth = (52.4814, 1.4689)
```

```
standrews = (56.3398, 2.7967)
haversine(bedworth, standrews)
```

Out[6]: 437.5327443711939

## Pandas and NumPy

In [7]:
```
import numpy as np
import pandas as pd
ppt = pd.read_csv("portland_park_trees.csv", sep=",", header=0, encoding="ISO-88
```

In [8]:
```
#how many data points are we working with?
print(len(ppt))
```

25534

### Question 1

**How many trees are of the Quercus or Acer genus?**

In [9]:
```
qanda = ppt[(ppt["Genus"]=="Quercus") + (ppt["Genus"]=="Acer")]
print(len(qanda))
```

5675

### Question 2

**How many trees are of the Quercus or Acer genus, and have a DBH larger than 50 inches?**

In [10]:
```
qadbh50 = ppt[(ppt["Genus"]=="Quercus") + (ppt["Genus"]=="Acer") & (ppt["DBH"]>5
print(len(qadbh50))
```

124

### Question 3

**Which genus has the highest mean DBH of the following genera: Quercus, Acer or Fraxinus?**

In [11]:
```
quercus = ppt[ppt["Genus"]=="Quercus"]
acer = ppt[ppt["Genus"]=="Acer"]
fraxinus = ppt[ppt["Genus"]=="Fraxinus"]
quercusdbhm = quercus["DBH"].mean()
acerdbhm = acer["DBH"].mean()
fraxinusdbhm = fraxinus["DBH"].mean()
if quercusdbhm > acerdbhm and quercusdbhm > fraxinusdbhm:
    print (str("The genus Quercus has the highest mean DBH."))
elif acerdbhm > quercusdbhm and fraxinusdbhm:
    print(str("The genus Acer has the highest mean DBH."))
else:
    print (str("The genus Fraxinus has the highest mean DBH."))

print(f"The Quercus DBH is: {quercusdbhm}")
print(f"The Acer DBH is: {acerdbhm}")
print(f"The Fraxinus DBH is: {fraxinusdbhm}")
```

```
The genus Quercus has the highest mean DBH.
The Quercus DBH is: 23.56823839157492
The Acer DBH is: 18.419085331846066
The Fraxinus DBH is: 11.033609693877551
```

## Question 4

**How many different species of trees are recorded in the Acer genus?**

In [12]:
```
acercount = acer["Species"].count()
acer.groupby("Species")["Genus"].count()
acerspecies = pd.DataFrame()
acerspecies["Count"] = acer.groupby("Species")['Genus'].count()
rows_count = len(acerspecies.index)
print (f"The Acer genus has {rows_count} different species.")
```

```
The Acer genus has 20 different species.
```

In [13]:
```
wc = pd.read_csv("world_cities.csv", sep=",", header=0, encoding="ISO-8859-1")
wc.columns =[column.replace(" ", "_") for column in wc.columns]
wc["pop_m"] = wc["pop"] / 1000000
del wc['pop']
wc.head()
```

Out[13]:

| | city | country | lat | lon | capital | pop_m |
|---|---|---|---|---|---|---|
| **0** | 'Abasan al-Jadidah | Palestine | 31.31 | 34.34 | 0 | 0.005629 |
| **1** | 'Abasan al-Kabirah | Palestine | 31.32 | 34.35 | 0 | 0.018999 |
| **2** | 'Abdul Hakim | Pakistan | 30.55 | 72.11 | 0 | 0.047788 |
| **3** | 'Abdullah-as-Salam | Kuwait | 29.36 | 47.98 | 0 | 0.021817 |
| **4** | 'Abud | Palestine | 32.03 | 35.07 | 0 | 0.002456 |

## Question 5

In this first cell I import the .csv file and create a new column for population, in the millions. I then delete the original column for population.

Now I will subset the world cities according to 'A Coruna', the first city that starts with 'A', like my first name, 'Anastasia'>

In [14]:
```
acities = wc[wc['city'].str.startswith('A')]
print (acities)
```

```
                     city    country    lat     lon  capital     pop_m
127                A Coruna      Spain  43.33   -8.42        0  0.243088
128               A Estrada      Spain  42.70   -8.50        0  0.021997
129               A Laracha      Spain  43.25   -8.59        0  0.010856
130   A Pobra do Caraminal       Spain  42.61   -8.94        0  0.009955
131             A Ver-o-Mar   Portugal  41.40   -8.76        0  0.010971
...                     ...        ...    ...     ...      ...       ...
2628                Azuma      Japan  36.34  139.24        0  0.023382
2629   Azuqueca de Henares      Spain  40.57   -3.27        0  0.024880
2630                 Azur     Israel  32.02   34.80        0  0.010224
2631                Azusa        USA  34.14 -117.91        0  0.048992
2632         Azzano Decimo      Italy  45.89   12.72        0  0.014072

[2506 rows x 6 columns]
```

Now I will create a list of the 5 most populous cities in Spain, where 'A Coruna' is located.

In [15]:
```
import numpy as np
import pandas as pd
spanishcities = wc[wc["country"]=="Spain"]
spanishcities.nlargest(5,'pop_m')
```

Out[15]:

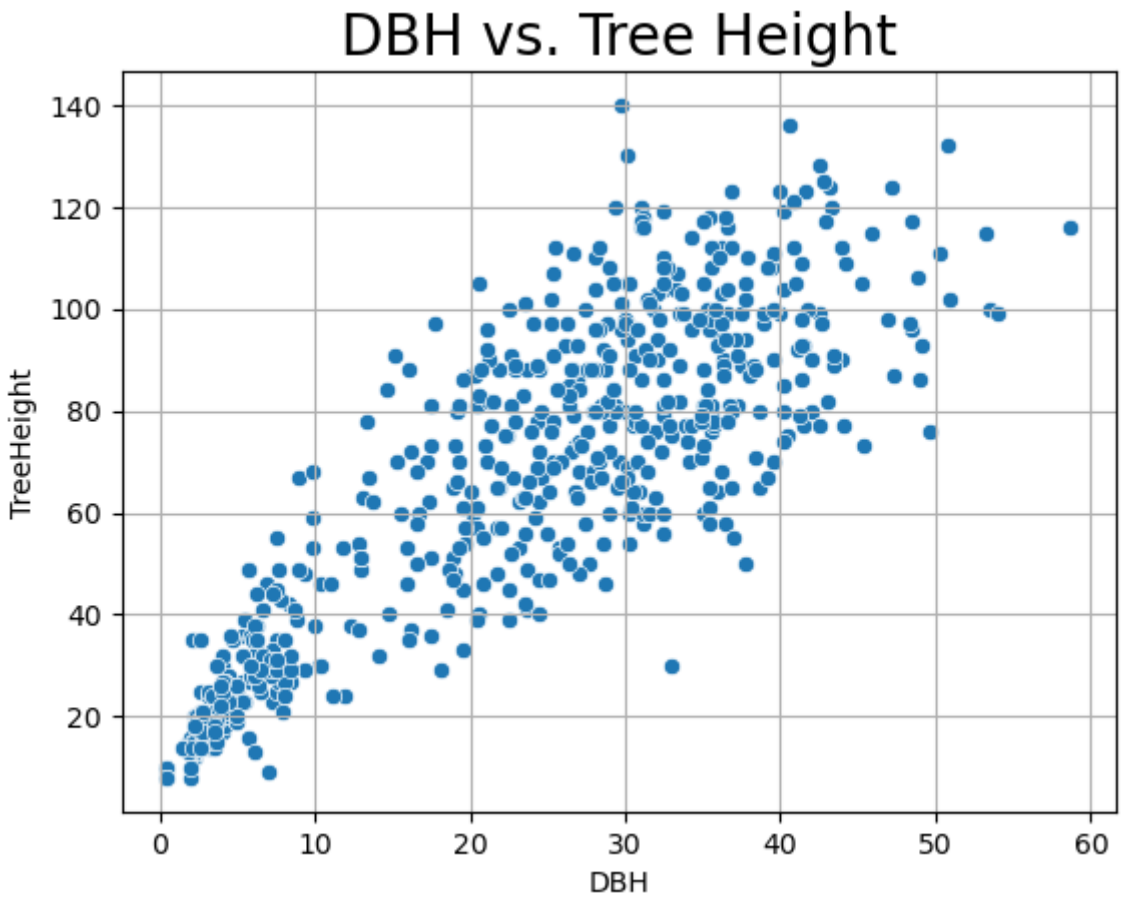
| | city | country | lat | lon | capital | pop_m |
|---|---|---|---|---|---|---|
| **22032** | Madrid | Spain | 40.42 | -3.71 | 1 | 3.146804 |
| **3385** | Barcelona | Spain | 41.40 | 2.17 | 0 | 1.591485 |
| **39931** | Valencia | Spain | 39.48 | -0.39 | 0 | 0.803438 |
| **34629** | Sevilla | Spain | 37.40 | -5.98 | 0 | 0.702516 |
| **42691** | Zaragoza | Spain | 41.65 | -0.89 | 0 | 0.658186 |

# Python Data Visualization

## Graph 1.

### Scatterplot for the genus 'Ulmus' according to DBH and Tree Height

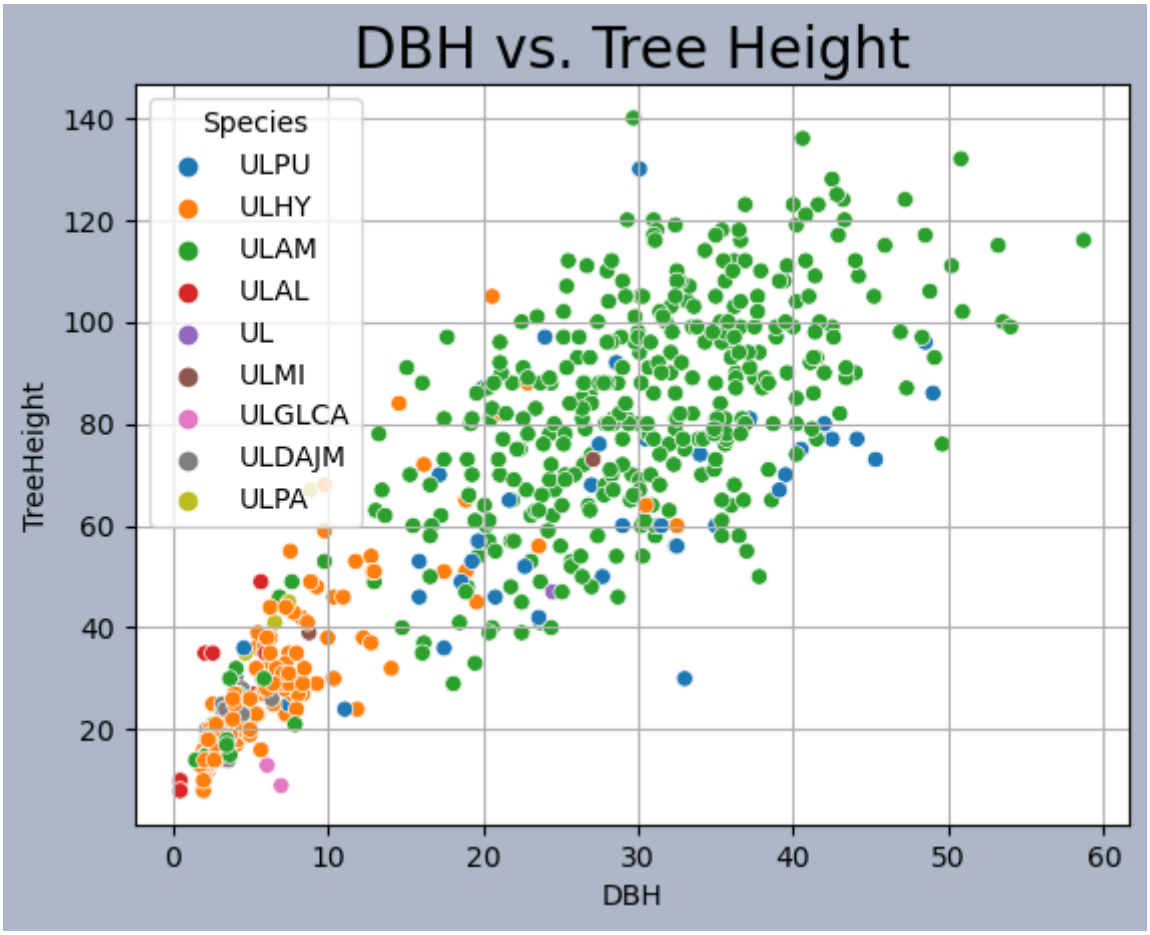
In [18]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
#I have uploaded portland_park_trees previously but want a new code for the data
ptrees = pd.read_csv("portland_park_trees.csv", header=0)
ulmus = ptrees[ptrees["Genus"]=="Ulmus"]
fig, axs = plt.subplots(1, 1)
sns.scatterplot(ax=axs, x="DBH", y="TreeHeight", data=ulmus)
axs.set_title("DBH vs. Tree Height", fontsize=20, color="#000000")
axs.grid(True)
plt.show(fig)
```




## Graph 2.

**Scatterplot for the genus 'Ulmus' according to DBH and 'Tree Height', coloured according to species of 'Ulmus'**

In [20]:
```
fig, axs = plt.subplots(1, 1)
sns.scatterplot(ax=axs, x="DBH", y="TreeHeight", hue='Species', data=ulmus)
axs.set_title("DBH vs. Tree Height", fontsize=20, color="#000000")
handles, labels = axs.get_legend_handles_labels()
axs.grid(True)
fig.patch.set_facecolor('#adb7c7')
plt.show(fig)
```

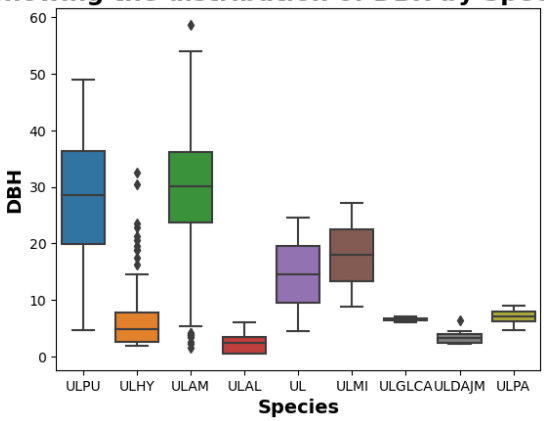



Graph 3.

A series of boxplots for the genus 'Ulmus', each boxplot shows a different species.

In [21]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
ptrees = pd.read_csv("portland_park_trees.csv", header=0)
ulmus = ptrees[ptrees["Genus"]=="Ulmus"]
ulspdbh = sns.boxplot( x=ulmus['Species'], y=ulmus['DBH'])
ulspdbh.set_xlabel('Species', fontsize= 14, fontweight='bold')
ulspdbh.set_ylabel('DBH', fontsize= 14, fontweight='bold')
ulspdbh.set_title('Series of boxplots showing the distribution of DBH by Species
```

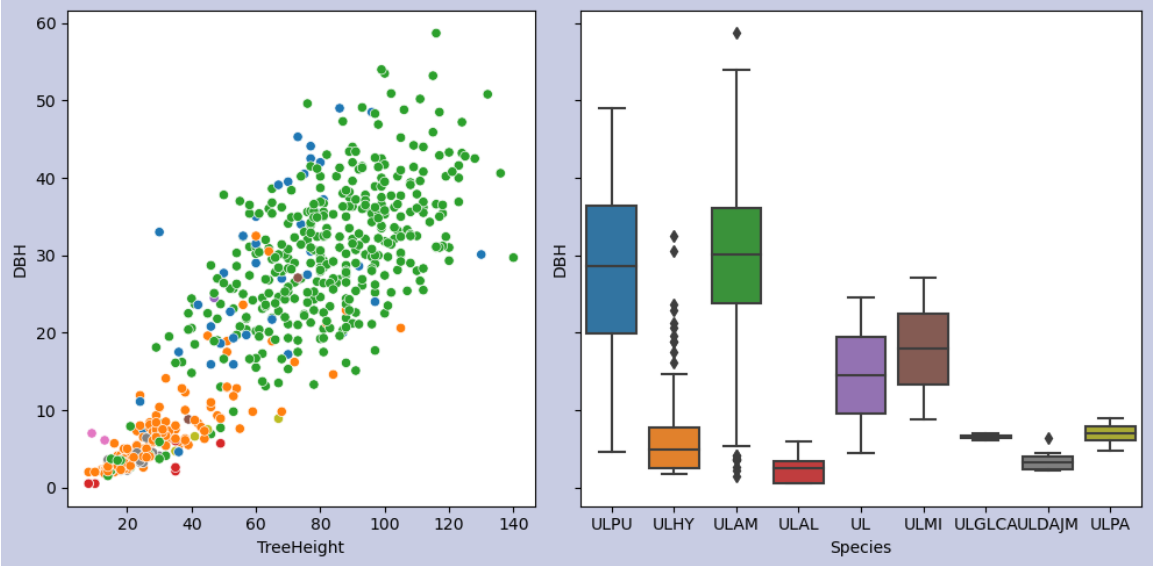
**Series of boxplots showing the distribution of DBH by Species of the Ulmus genus**




Graph 4.

**Combining Graphs 1 and 3 into a single figure.**

In [23]:
```
f, axs = plt.subplots(1,2, figsize=(10,5),sharey=True,gridspec_kw=dict(width_rat
sns.scatterplot(data= ulmus, x="TreeHeight", y="DBH", hue="Species", ax=axs[0],
sns.boxplot(data=ulmus, x = "Species", y="DBH", ax=axs[1])
f.tight_layout()
f.patch.set_facecolor('#c8cce3')
f.legend=False
```




## Python Geopandas

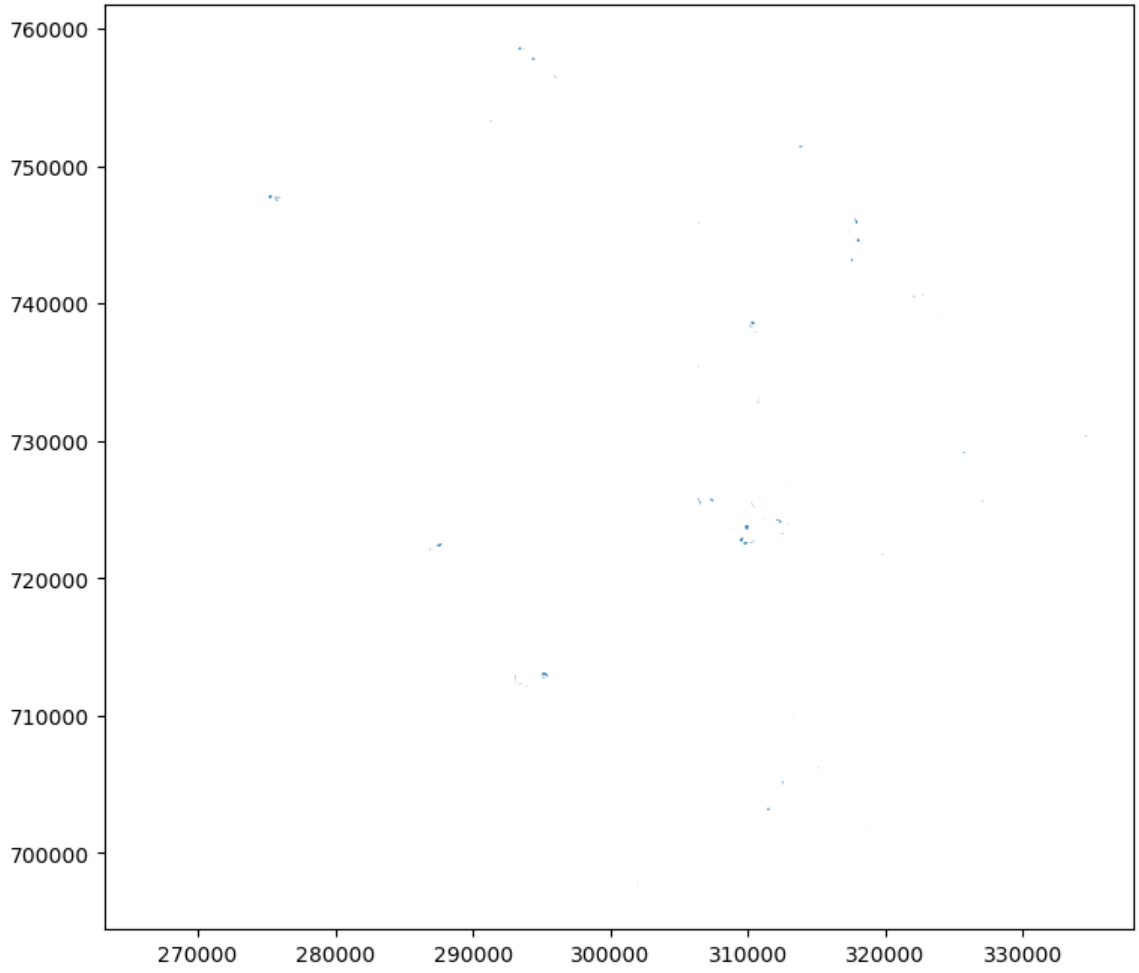
**T1.**

Read the shapefile of Tree Preservation Orders of the Perth and Kinross Council through using geopandas:

In [24]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import os
os.environ['USE_PYGEOS'] = '0'
import geopandas as gpd
import contextily as ctx
import rasterio as rio
from rasterio import plot
plt.rcParams['figure.figsize'] = [10, 8]

TreesPKC = gpd.read_file('Tree_Preservation_Order.shp')
TreesPKC.plot()
```

Out[24]: <AxesSubplot: >




This plot of the Tree Preservation Orders is unclear and confusing as to what is being shown. I will use '.explore()' to visualise better this shapefile.

In [25]:
```
TreesPKC.explore()
```

Out[25]: Make this Notebook Trusted to load map: File -> Trust Notebook

**T2 & T3.**

Plot the first and final 5 sets of records from the SG_UrbanRural_2020 shapefile.

Note: these data points are difficult to see on the .explore() maps, they are in bright blue but very small in size.

In [26]:
```
gpd.read_file('Tree_Preservation_Order.shp')
TreesPKC5 = TreesPKC.nlargest(5, 'MI_PRINX')
TreesPKC05 = TreesPKC.nsmallest(5, 'MI_PRINX')
TreesPKC5.explore(column='TOWN')
```

Out[26]: Make this Notebook Trusted to load map: File -> Trust Notebook

**TOWN**

Blairgowrie
Fortingall
Inchture
Perth

In [27]:
```
TreesPKC05.explore(column='TOWN')
```

Out[27]: Make this Notebook Trusted to load map: File -> Trust Notebook

**TOWN**

Aberfeldy
Abernethy
Almondbank
Auchterarder

**T4.**

The co-ordinate system for this shapefile is: EPSG:27700 / British National Grid (EPSG:27700). This was obtained by the https://www.spatialdata.gov.scot website, but also from this code:

In [104…]
```
TreesPKC.crs
```

Out[104]:
```
<Derived Projected CRS: EPSG:27700>
Name: OSGB36 / British National Grid
Axis Info [cartesian]:
- E[east]: Easting (metre)
- N[north]: Northing (metre)
Area of Use:
- name: United Kingdom (UK) - offshore to boundary of UKCS within 49°45'N to 6
1°N and 9°W to 2°E; onshore Great Britain (England, Wales and Scotland). Isle o
f Man onshore.
- bounds: (-9.0, 49.75, 2.01, 61.01)
Coordinate Operation:
- name: British National Grid
- method: Transverse Mercator
Datum: Ordnance Survey of Great Britain 1936
- Ellipsoid: Airy 1830
- Prime Meridian: Greenwich
```

**T5.**

This dataset contains 15 features, or columns, which were obtained by this code:

In [28]:
```
len(TreesPKC.columns)
```

Out[28]:
```
15
```

This dataset also has 88 data points, obtained by this code:

In [29]:
```
len(TreesPKC)
```

Out[29]:
```
88
```

**T6 & T8.**

Now I am creating and plotting a new geopandas dataframe to see all the trees with a preservation order in the town of Auchterarder. The legend shows the code names for each tree, coloured to show where they are around the town of Auchterarder.

In [30]:
```
Atrees = TreesPKC[TreesPKC["TOWN"]=="Auchterarder"]
Atrees.explore(column='NEW__ID', legend=True, cmap='gist_rainbow')
```

Out[30]: Make this Notebook Trusted to load map: File -> Trust Notebook

**NEW__ID**

A10
A11
A3
A4
A5
A7
A8
A9

### T7 & T8

Now I am creating and plotting a new Geopandas dataframe using a numerical attribute - perimeter. The map below shows the trees with a preservation order that have a perimeter of more than 400cm.

In [31]:
```
Peritrees = TreesPKC[(TreesPKC["PERIMETER"]>400)]
Peritrees.explore(column='TOWN', legend=True, cmap='gist_rainbow')
```

Out[31]: Make this Notebook Trusted to load map: File -> Trust Notebook

**TOWN**

Almondbank
Auchterarder
Bankfoot
Blairgowrie
Bridge of Cally
Coupar Angus
Crieff
Fortingall
Glencarse
Kinross
Milnathort
Murthly
Perth
Pitlochry
Powmill

## Python Rasterio

### T1.

Reading the 'elev.tif' file as a Rasterio dataset, the code is below:

In [32]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import os
os.environ['USE_PYGEOS'] = '0'
import geopandas
import seaborn as sns
import rasterio as rio
import earthpy as et
import earthpy.spatial as es
import earthpy.plot as ep

elevation = rio.open('elev.tif')
```

### T2.

The Co-ordinate Reference System (CRS) for this dataset is EPSG:32617, which was received by this code:

In [33]:
```
print(elevation.crs)
```

```
EPSG:32617
```

### T3.

I will now describe the dataset, using the following code. This code reveals the name, the bands, and the extent of the raster. I also discovered the number of columns and rows in this dataset, from the 'height' and 'width' codes.

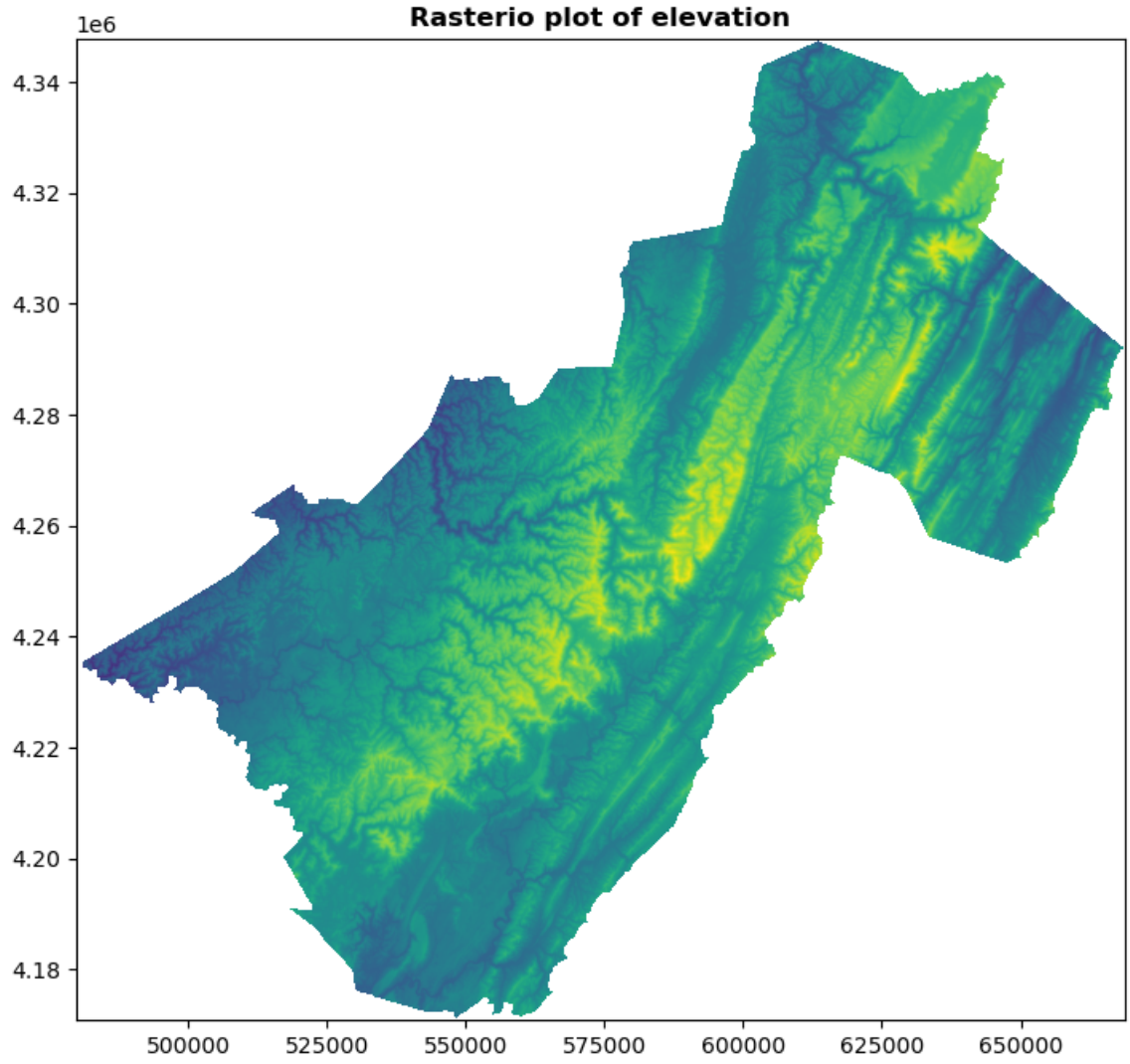
In [34]:
```
print(elevation.name)
print(elevation.count)
print(elevation.width)
print(elevation.height)
print(elevation.bounds)
```

```
elev.tif
1
6303
5897
BoundingBox(left=479753.39945587853, bottom=4170823.2037591375, right=668843.39
94558785, top=4347733.203759138)
```

In [35]:
```
elevation.indexes
```

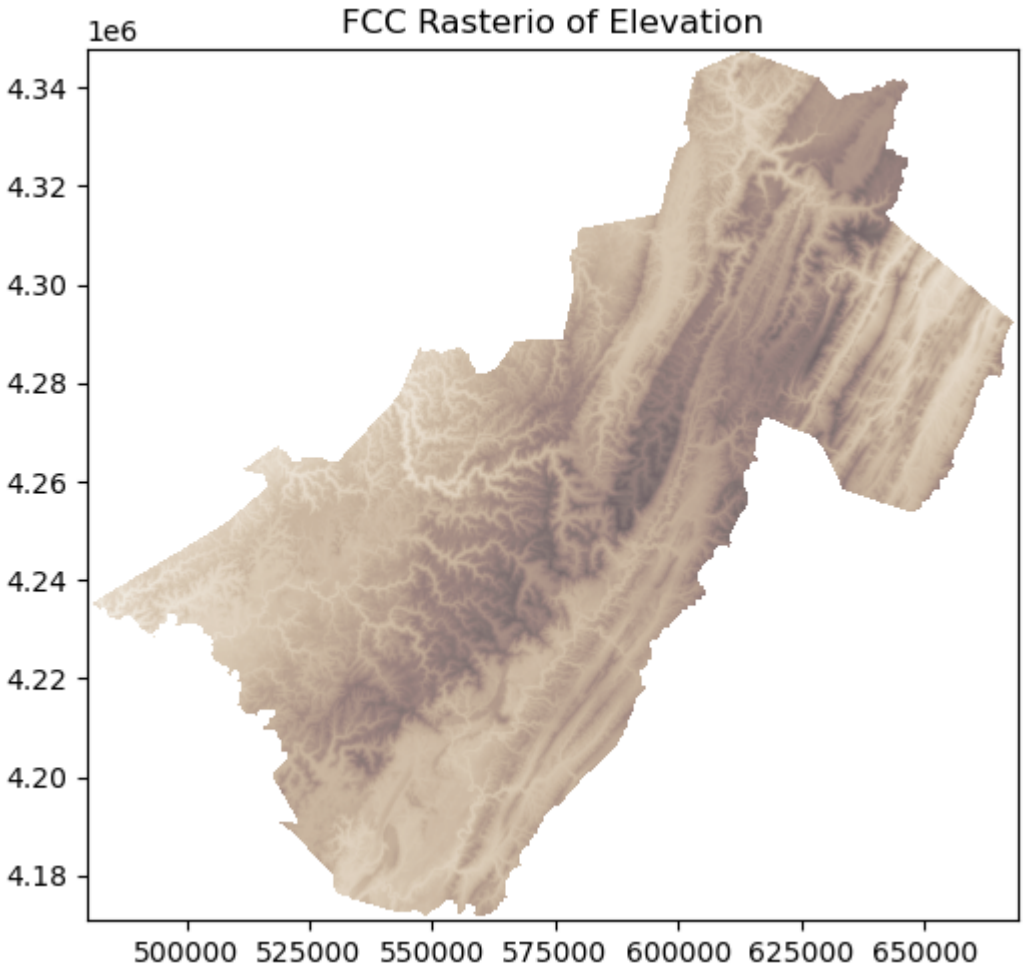
Out[35]:
```
(1,)
```

In [36]:
```
from rasterio.plot import show
show(elevation, 1, title='Rasterio plot of elevation')
#I had issues with this section of the assignment, the following map was not alw
#Often there was a purple square with a blank yellow shape and green outline
#I believe it must have either taken the rasterio code a while to read the plot
#or after completing the next code (creating a FCC) allowed it to carry out this
#This is confusing however
```



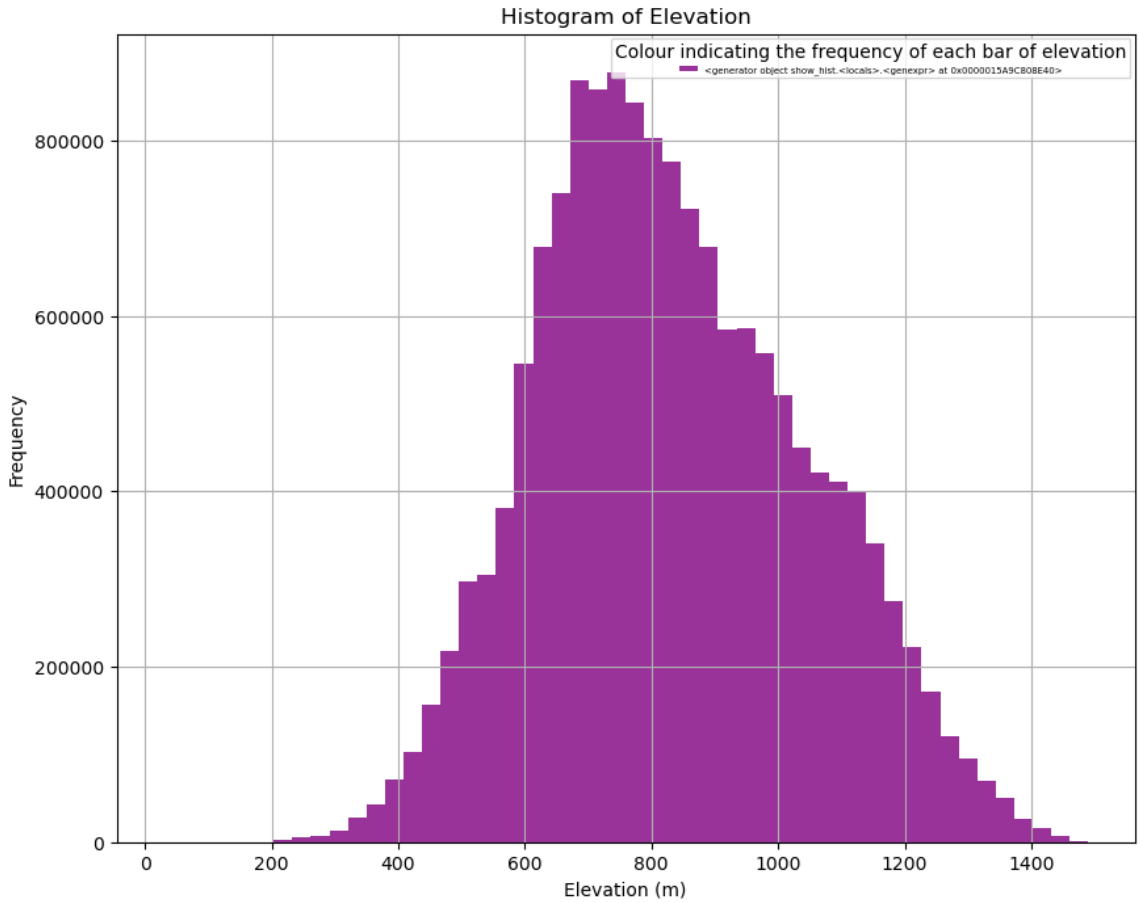

Out[36]: <AxesSubplot: title={'center': 'Rasterio plot of elevation'}>

In [37]:
```
#googled how to create a more beige/'realistic' plotting, where you can more cle
#a false colour composite (FCC) or true colour composite (TCC)
fig, ax = plt.subplots(figsize=(6,6))
show(elevation, cmap='Blues', ax=ax, alpha=0.33)
show(elevation, cmap='Greens', ax=ax, alpha=0.33)
show(elevation, cmap="Reds", ax=ax, alpha=0.33)
plt.title("FCC Rasterio of Elevation")
plt.show()
```




Created a Histogram of the Rasterio file

In [68]:
```
from rasterio.plot import show_hist
fig, axhist = plt.subplots(1, 1)
show_hist(source=elevation, bins=50, facecolor='purple', histtype='stepfilled',
          lw=0.0, stacked=False, label=None, alpha=0.8, ax=axhist)
axhist.set_xlabel('Elevation (m)')
axhist.set_ylabel('Frequency')
axhist.set_title('Histogram of Elevation')
legend = plt.legend(title="Colour indicating the frequency of each bar of elevat
#do not know how to change the label of purple in the legend box
#googled but to know avail
```


Histogram of Elevation
Colour indicating the frequency of each bar of elevation
<generator object show_hist.<locals>.<genexpr> at 0x0000015A9C80BE40>
Frequency
0
200000
400000
600000
800000
0
200
400
600
800
1000
1200
1400
Elevation (m)