challenge_test

July 9, 2020

[29]:
```python
import geopandas as gpd
import pandas as pd
from matplotlib import pyplot as plt
%matplotlib inline
```

0.1 Data preparation

[30]:
```python
# load AOI dataset
gdf_aoi = gpd.read_file("20200703_demo_grid_aoi.geojson")
```

[31]:
```python
gdf_aoi.shape
```

[31]: (1, 20)

[32]:
```python
# load tree dataset
gdf_tree = gpd.read_file("20200703_single_tree_berlin_excerpt.geojson")
```

[33]:
```python
gdf_tree.shape
```

[33]: (33225, 10)

[34]:
```python
# convert treetop diam, tree height, year of planting columns into numeric

gdf_tree["treetop_diam"] = pd.to_numeric(gdf_tree["treetop_diam"],␣
↪errors="coerce")
gdf_tree["tree_height"] = pd.to_numeric(gdf_tree["tree_height"],␣
↪errors="coerce")
gdf_tree["year_of_planting"] = pd.to_numeric(gdf_tree["year_of_planting"],␣
↪errors="coerce")
```

[35]:
```python
# create "age"-column calculated by actual year (2020) and column␣
↪"year_of_planting"
gdf_tree["age"]= 2020 - gdf_tree["year_of_planting"]

gdf_tree.head()
```

[35]:

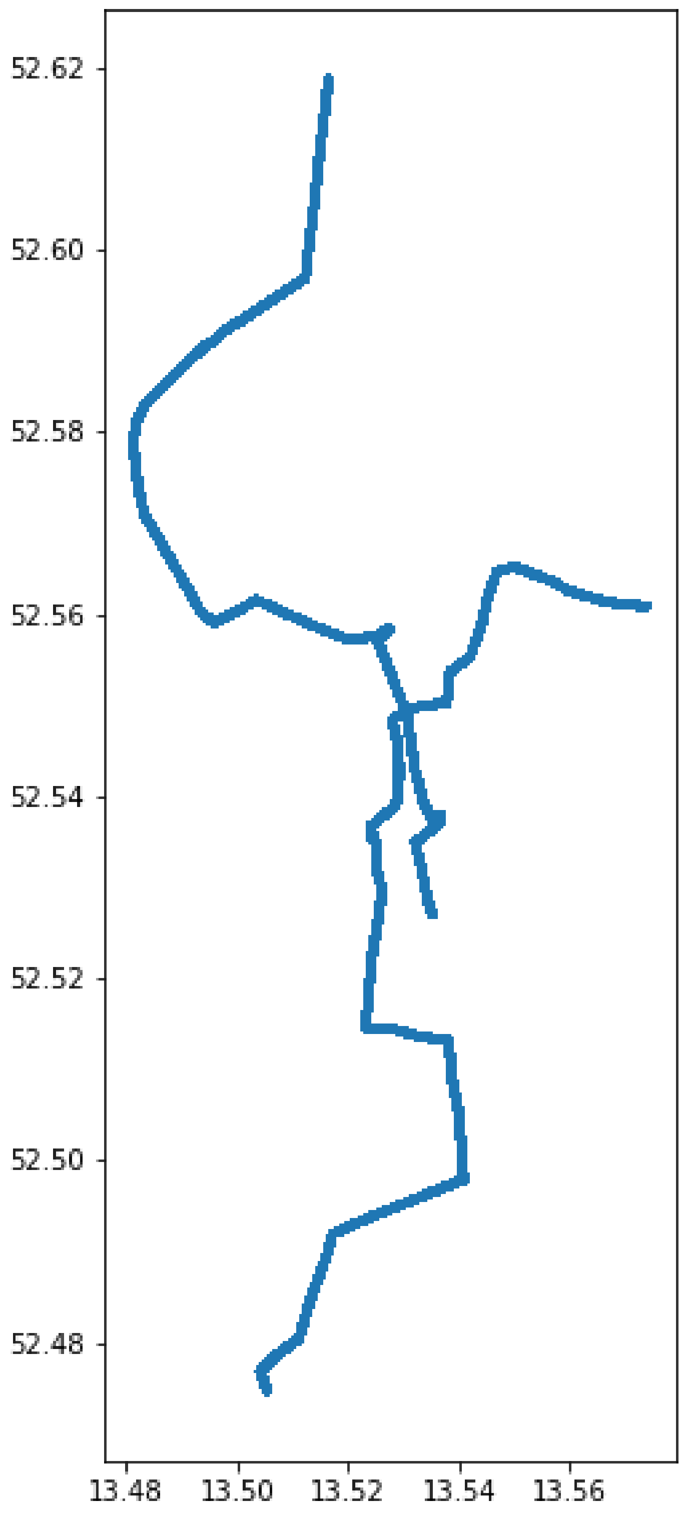
```
        id      genus     name_german          name_original  treetop_diam  \
0  3175201      Tilia    Winter-Linde         Tilia cordata           3.0
1  3175214  Elaeagnus            None  Picea pungens 'Glauca'          5.0
2  3175218       Acer     Spitz-Ahorn       Acer platanoides           7.0
3  3175465    Populus  Simons Pappel         Populus simonii          11.0
4  3175700       Acer     Spitz-Ahorn       Acer platanoides           5.0

   tree_height  year_of_planting                        license      credits  \
0          7.0            1998.0  Deutschland Namensnennung 2.0  Land Berlin
1          7.0            1991.0  Deutschland Namensnennung 2.0  Land Berlin
2          7.0            1985.0  Deutschland Namensnennung 2.0  Land Berlin
3         17.0            1982.0  Deutschland Namensnennung 2.0  Land Berlin
4          7.0            1996.0  Deutschland Namensnennung 2.0  Land Berlin

                    geometry   age
0  POINT (13.54829 52.52697)  22.0
1  POINT (13.56128 52.54016)  29.0
2  POINT (13.55523 52.54787)  35.0
3  POINT (13.55713 52.55021)  38.0
4  POINT (13.56698 52.53506)  24.0
```

0.2 Task 1

identifying trees inside the AOI. Since *gpd.overlay()* does not intersect polygons with points, *sjoin()* was used to separate the data

[36]:

```python
# join tree dataset points with AOI
join = gpd.sjoin(gdf_aoi, gdf_tree, how="inner", op="intersects")
join.plot(figsize=(10,10))
plt.show()
```



[37]:
```
join.shape # check number of rows
```

[37]: (725, 31)

[38]:
```
join.head()
```

[38]:
```
   id_left     full_id     osm_id osm_type cables frequency gez layer name  \
0        1  w166885638  166885638      way      3        50
0        1  w166885638  166885638      way      3        50
0        1  w166885638  166885638      way      3        50
0        1  w166885638  166885638      way      3        50
0        1  w166885638  166885638      way      3        50

           operator  … id_right      genus                name_german  \
0  Stromnetz Berlin  …  2903005     Prunus             Traubenkirsche
0  Stromnetz Berlin  …  2878942      Malus                 Holz-Apfel
0  Stromnetz Berlin  …  2892059       Acer               Eschen-Ahorn
0  Stromnetz Berlin  …  2892062       Acer               Eschen-Ahorn
0  Stromnetz Berlin  …  2904980  Gleditsia  Amerikanische Gleditschie

           name_original treetop_diam tree_height year_of_planting  \
0         Pinus strobus          NaN         7.0              NaN
0      Pinus sylvestris          NaN         5.0              NaN
0          Acer negundo          NaN        17.0              NaN
0          Acer negundo          8.0        15.0              NaN
0  Gleditsia triacanthos          5.0        17.0              NaN

                          license      credits age
0  Deutschland Namensnennung 2.0  Land Berlin NaN
0  Deutschland Namensnennung 2.0  Land Berlin NaN
0  Deutschland Namensnennung 2.0  Land Berlin NaN
0  Deutschland Namensnennung 2.0  Land Berlin NaN
0  Deutschland Namensnennung 2.0  Land Berlin NaN

[5 rows x 31 columns]
```

[39]:
```
gdf_tree.columns
```

[39]:
```
Index(['id', 'genus', 'name_german', 'name_original', 'treetop_diam',
       'tree_height', 'year_of_planting', 'license', 'credits', 'geometry',
       'age'],
      dtype='object')
```

[ ]:
```

```

[40]:
```
# separate trees outside the AOI from main tree dataset
trees_outside_AOI = gdf_tree[~gdf_tree['id'].isin(join['id_right'])]
trees_outside_AOI.shape
```

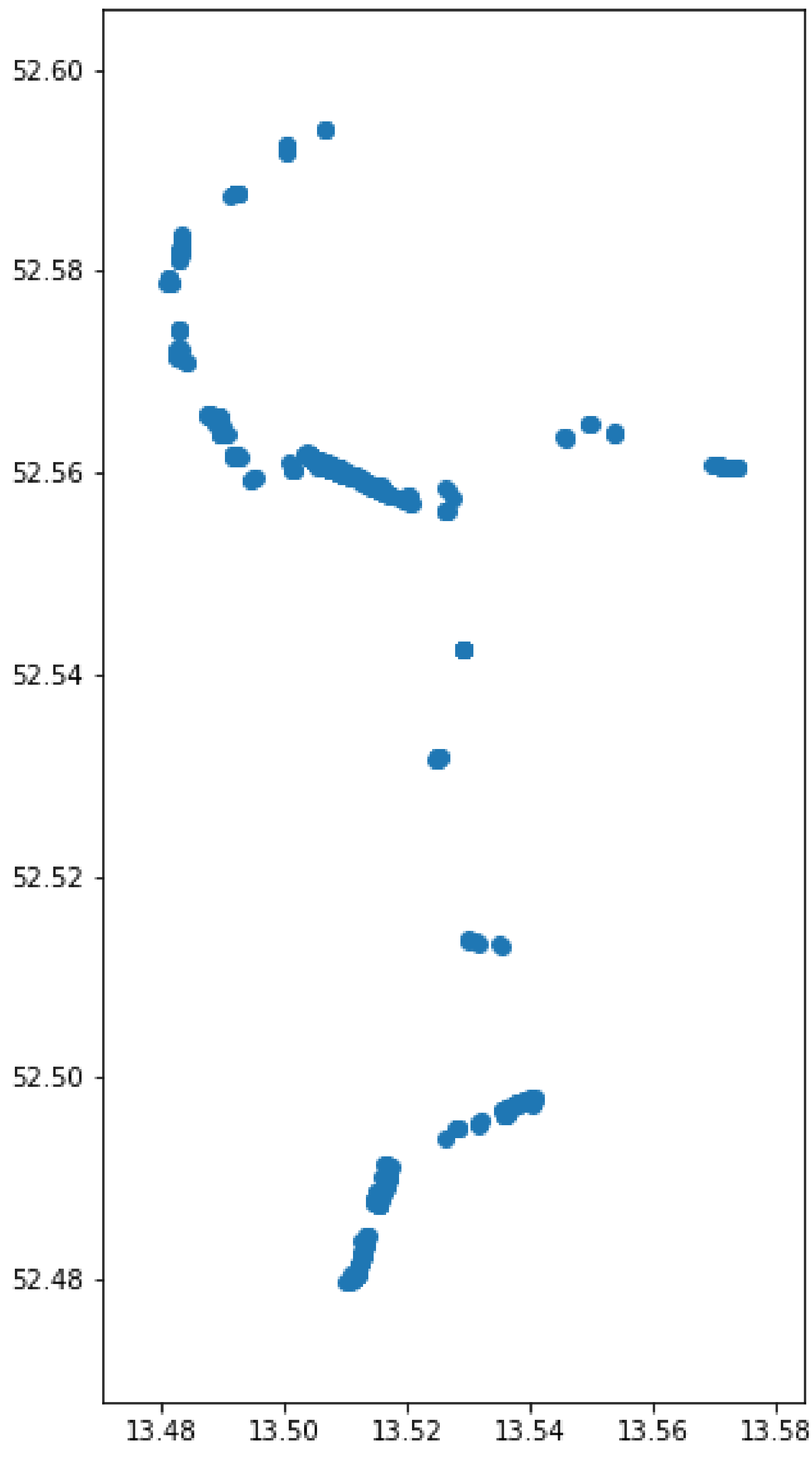
[40]: (32500, 11)

[41]:
```
# determine trees inside AOI
trees_inside_AOI = gdf_tree[gdf_tree["id"].isin(join["id_right"])]
trees_inside_AOI.shape
```

[41]: (725, 11)

There are 725 trees inside the AOI

[42]:
```
#plot the location of the trees inside the AOI
trees_inside_AOI.plot(figsize=(10,10))
plt.show()
```


52.60
52.58
52.56
52.54
52.52
52.50
52.48
13.48
13.50
13.52
13.54
13.56
13.58

0.3 Task 2

Calculate Mean, Std, Median for tree_height, treetop_diam, age

[43]:

```python
# in AOI treetop_diam
print("mean of treetop_diam inside AOI: ",trees_inside_AOI["treetop_diam"].
 ↪mean())
print("median of treetop_diam inside AOI: ",trees_inside_AOI["treetop_diam"].
 ↪median())
print("standard dev of treetop_diam inside AOI:␣
 ↪",trees_inside_AOI["treetop_diam"].std())
print("____________________________")
# in AOI height
print("mean of tree_height inside AOI: ",trees_inside_AOI["tree_height"].mean())
print("median of tree_height inside AOI: ",trees_inside_AOI["tree_height"].
 ↪median())
print("standard dev of tree_height inside AOI:␣
 ↪",trees_inside_AOI["tree_height"].std())
print("____________________________")
# in AOI age
print("mean of age inside AOI: ",trees_inside_AOI["age"].mean())
print("median of age inside AOI: ",trees_inside_AOI["age"].median())
print("standard dev of age inside AOI: ",trees_inside_AOI["age"].std())
print("____________________________")
# outside AOI treetop_diam
print("mean of treetop_diam outside AOI: ",trees_outside_AOI["treetop_diam"].
 ↪mean())
print("median of treetop_diam outside AOI: ",trees_outside_AOI["treetop_diam"].
 ↪median())
print("standard dev of treetop_diam outside AOI:␣
 ↪",trees_outside_AOI["treetop_diam"].std())
print("____________________________")
# outside AOI height
print("mean of tree_height outside AOI: ",trees_outside_AOI["tree_height"].
 ↪mean())
print("median of tree_height outside AOI: ",trees_outside_AOI["tree_height"].
 ↪median())
print("standard dev of tree_height outside AOI:␣
 ↪",trees_outside_AOI["tree_height"].std())
print("____________________________")
# outside AOI age
print("mean of age outside AOI: ",trees_outside_AOI["age"].mean())
print("median of age outside AOI: ",trees_outside_AOI["age"].median())
print("standard dev of age outside AOI: ",trees_outside_AOI["age"].std())
```

```
mean of treetop_diam inside AOI:  5.652958152958153
median of treetop_diam inside AOI:  5.0
standard dev of treetop_diam inside AOI:  2.4864623161034163
```

```
----------------------------
mean of tree_height inside AOI:  12.32551724137931
median of tree_height inside AOI:  12.0
standard dev of tree_height inside AOI:  5.851898913961083
----------------------------
mean of age inside AOI:  39.74792703150912
median of age inside AOI:  35.0
standard dev of age inside AOI:  17.84390070044359
----------------------------
mean of treetop_diam outside AOI:  5.898360603246774
median of treetop_diam outside AOI:  5.0
standard dev of treetop_diam outside AOI:  3.591145299445828
----------------------------
mean of tree_height outside AOI:  11.67966049382716
median of tree_height outside AOI:  10.0
standard dev of tree_height outside AOI:  6.835936555390318
----------------------------
mean of age outside AOI:  39.428951769805785
median of age outside AOI:  35.0
standard dev of age outside AOI:  24.575478343753666
```

[44]:
```
# overview of basic statistics
# Median = row "50%"
trees_inside_AOI.describe()
```

[44]:

	treetop_diam	tree_height	year_of_planting	age
count	693.000000	725.000000	603.000000	603.000000
mean	5.652958	12.325517	1980.252073	39.747927
std	2.486462	5.851899	17.843901	17.843901
min	1.000000	2.000000	1890.000000	2.000000
25%	4.000000	7.000000	1970.000000	30.000000
50%	5.000000	12.000000	1985.000000	35.000000
75%	7.000000	17.000000	1990.000000	50.000000
max	18.000000	45.000000	2018.000000	130.000000

[45]:
```
trees_outside_AOI.describe()
```

[45]:

	treetop_diam	tree_height	year_of_planting	age
count	31231.000000	32400.000000	29297.000000	29297.000000
mean	5.898361	11.679660	1980.571048	39.428952
std	3.591145	6.835937	24.575478	24.575478
min	1.000000	1.000000	1068.000000	1.000000
25%	4.000000	7.000000	1970.000000	23.000000
50%	5.000000	10.000000	1985.000000	35.000000
75%	8.000000	15.000000	1997.000000	50.000000
max	38.000000	89.000000	2019.000000	952.000000

0.4 Task 3

determine most abundant genus

[46]:
```
genus_outside_AOI = trees_outside_AOI["genus"].value_counts(dropna = False)
top_genus_outside_AOI = genus_outside_AOI.head(1)
print(top_genus_outside_AOI)

genus_inside_AOI = trees_inside_AOI["genus"].value_counts(dropna = False)
top_genus_inside_AOI = genus_inside_AOI.head(1)
print(top_genus_inside_AOI)
```

```
Acer    8443
Name: genus, dtype: int64
Acer    252
Name: genus, dtype: int64
```

The most abundant genus outside the AOI is Acer with 8443 trees

The most abundant genus inside the AOI is Acer with 252 trees

0.5 Task 4

plot correlation between age and tree height

[47]:
```
# removing NaN values
trees_inside_AOI["age"].isna().sum() # identify nan
trees_inside_AOI_not_nan = trees_inside_AOI[lambda x: x['age'].notnull()]
```

[48]:
```
print(trees_outside_AOI["tree_height"].isna().sum())
trees_outside_AOI_not_nan = trees_outside_AOI[lambda x: x["age"].notnull() &␣
↪x["tree_height"].notnull()]
print(trees_outside_AOI_not_nan["tree_height"].isna().sum())
print(trees_outside_AOI_not_nan.shape)
```

```
100
0
(29268, 11)
```

[49]:
```
import numpy as np

x = trees_inside_AOI_not_nan['age']
y = trees_inside_AOI_not_nan["tree_height"]
coef_in = np.corrcoef(x,y)
print("Correlation coefficient is: ", coef_in[0][1])
```

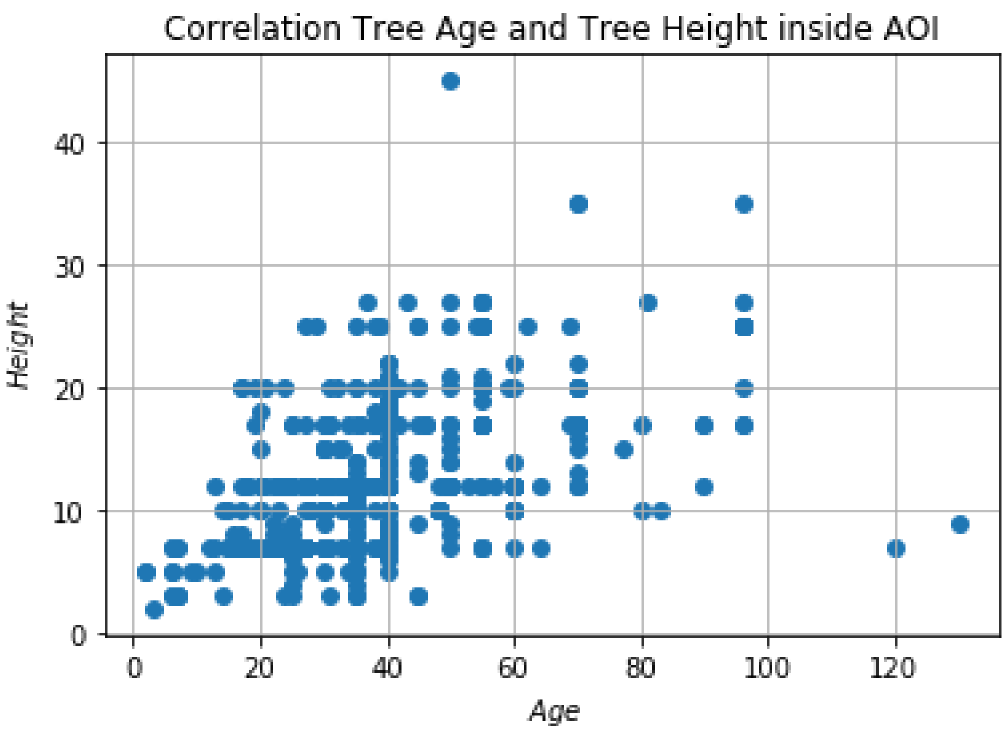
```
Correlation coefficient is:  0.5126036551638135
```

[50]:
```
x0 = trees_outside_AOI_not_nan["age"]
y0 = trees_outside_AOI_not_nan["tree_height"]
```

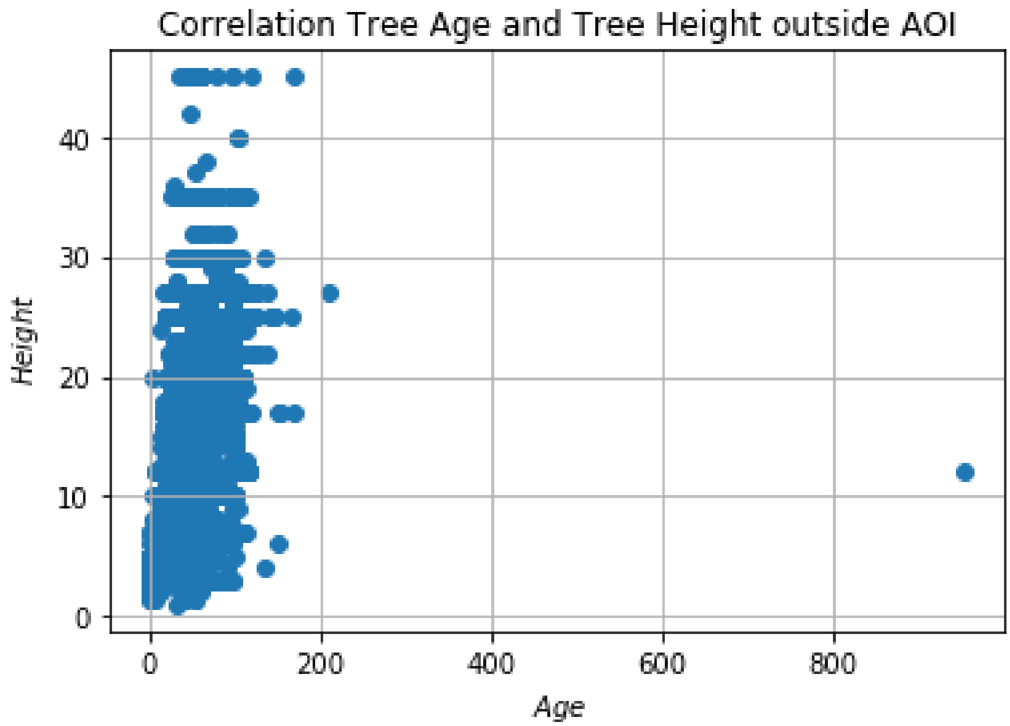
```
coef_out = np.corrcoef(x0,y0)
print("Correlation coefficient is: ", coef_out[0][1])
```

```
Correlation coefficient is:  0.6672077126830828
```

[51]:
```
# plot correlation between trees inside AOI with removed NaN values
plt.scatter(x,y)

plt.xlabel('$\ Age$')
plt.ylabel('$\ Height$')
plt.grid()
plt.title("Correlation Tree Age and Tree Height inside AOI")
plt.show()
```



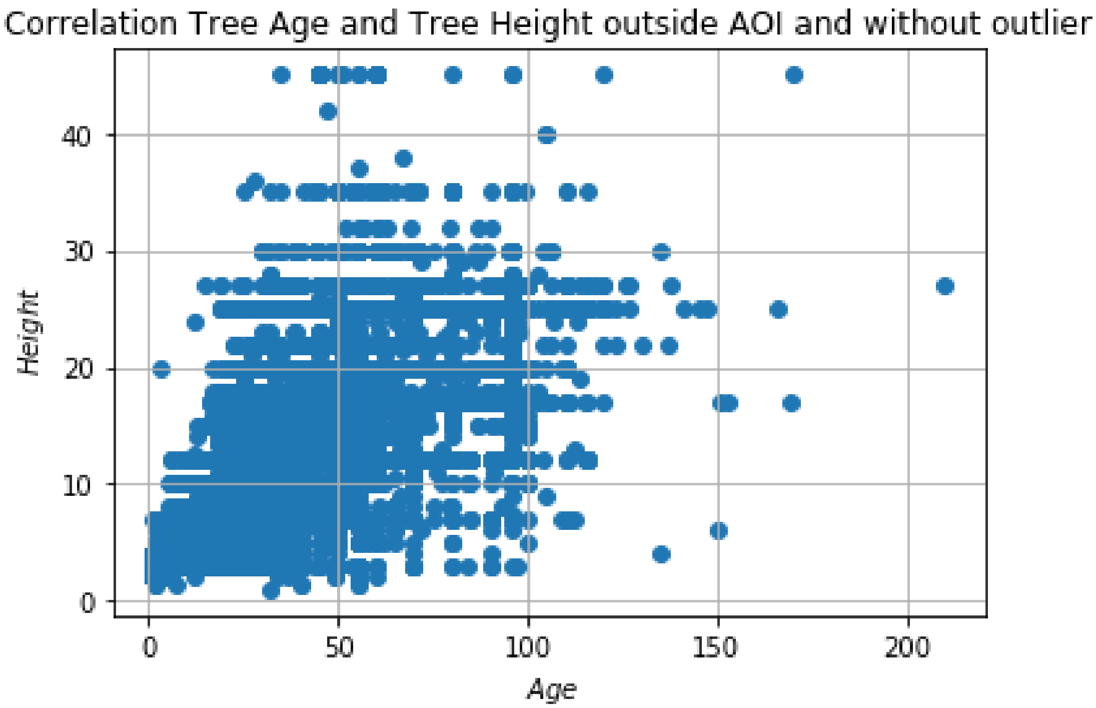
[52]:
```
# plot correlation between age and height of trees outside of AOI with removed␣
↪NaN values
plt.scatter(x0,y0)

plt.xlabel('$\ Age$')
plt.ylabel('$\ Height$')
plt.grid()
plt.title("Correlation Tree Age and Tree Height outside AOI")
plt.show()
```



[53]:
```
# removing outlier
trees_outside_AOI_filtered =␣
↪trees_outside_AOI_not_nan[trees_outside_AOI_not_nan["age"] < 900]
trees_outside_AOI_filtered.shape # to check if value was removed
```

[53]: (29267, 11)

[54]:
```
# plot without outlier
x1 = trees_outside_AOI_filtered["age"]
y1 = trees_outside_AOI_filtered["tree_height"]
plt.scatter(x1,y1)

plt.xlabel('$\ Age$')
plt.ylabel('$\ Height$')
plt.grid()
plt.title("Correlation Tree Age and Tree Height outside AOI and without␣
↪outlier")
plt.show()
```


Correlation Tree Age and Tree Height outside AOI and without outlier
Height
Age
0
10
20
30
40
0
50
100
150
200