2440016804 - Rio Pramana - LA01 - Assignment 9

Import libraries and dataset

In [1]:
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.tree import DecisionTreeClassifier
```

In [2]:
```python
# Importing the dataset, downloaded file is in the same folder
csv_path = "Social_Network_Ads.csv"
ads_df = pd.read_csv(csv_path)
```

Run a quick check on the dataset

In [3]:
```python
ads_df.shape
```

Out[3]:
```
(400, 3)
```

In [4]:
```python
ads_df.head(5)
```

Out[4]:

	Age	EstimatedSalary	Purchased
0	19	19000	0
1	35	20000	0
2	26	43000	0
3	27	57000	0
4	19	76000	0

In [5]:
```python
ads_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 3 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   Age              400 non-null    int64
 1   EstimatedSalary  400 non-null    int64
 2   Purchased        400 non-null    int64
dtypes: int64(3)
memory usage: 9.5 KB
```

The independent variables are all numeric and there's no missing data

In [6]:
```python
ads_df.describe()
```

Out[6]:

	Age	EstimatedSalary	Purchased
count	400.000000	400.000000	400.000000
mean	37.655000	69742.500000	0.357500
std	10.482877	34096.960282	0.479864
min	18.000000	15000.000000	0.000000
25%	29.750000	43000.000000	0.000000
50%	37.000000	70000.000000	0.000000
75%	46.000000	88000.000000	1.000000
max	60.000000	150000.000000	1.000000

Feature Scalling before Predict Perform/Fitting Classifier

In [7]:
```python
#Extracting independent variables:
X = np.array(ads_df.drop(columns = 'Purchased'))
X
```

Out[7]:
```
array([[    19,  19000],
       [    35,  20000],
       [    26,  43000],
       [    27,  57000],
       [    19,  76000],
       [    27,  58000],
       [    27,  84000],
       [    32, 150000],
       [    25,  33000],
       [    35,  65000],
       [    26,  80000],
       [    26,  52000],
       [    20,  86000],
       [    32,  18000],
       [    18,  82000],
       [    29,  80000],
       [    47,  25000],
       [    45,  26000],
       [    46,  28000],
       [    48,  29000],
       [    45,  22000],
       [    47,  49000],
       [    48,  41000],
       [    45,  22000],
       [    46,  23000],
       [    47,  20000],
       [    49,  28000],
       [    47,  30000],
       [    29,  43000],
       [    31,  18000],
       [    31,  74000],
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       [    21,  16000],
       [    28,  44000],
       [    27,  90000],
       [    35,  27000],
       [    33,  28000],
       [    30,  49000],
       [    26,  72000],
       [    27,  31000],
       [    27,  17000],
       [    33,  51000],
       [    35, 108000],
       [    30,  15000],
       [    28,  84000],
       [    23,  20000],
       [    25,  79000],
       [    27,  54000],
       [    30, 135000],
       [    31,  89000],
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       [    18,  44000],
       [    29,  83000],
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       [    27,  58000],
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       [    25,  87000],
       [    23,  66000],
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       [    23,  82000],
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       [    24,  27000],
       [    20,  23000],
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       [    22,  27000],
       [    28,  87000],
       [    26,  17000],
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       [    26,  81000],
       [    35,  50000],
       [    22,  81000],
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       [    60,  42000],
       [    39,  59000],
       [    46,  41000],
       [    51,  23000],
       [    50,  20000],
       [    36,  33000],
       [    49,  36000]], dtype=int64)
```

In [8]:
```python
#Extracting dependent variable:
y = np.array(ads_df["Purchased"])
y
```

Out[8]:
```
array([0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1,
       0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 0,
       1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0,
       1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1,
       0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1,
       1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1,
       0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 1, 0,
       1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1,
       0, 1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1,
       1, 1, 0, 1], dtype=int64)
```

In [9]:
```python
#Performing feature scaling using StandardScaler
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_scaled = sc.fit_transform(X)
```

In [10]:
```python
X_scaled[0:5] #Contoh 5 row yang sudah di scale
```

Out[10]:
```
array([[-1.78179743, -1.49004624],
       [-0.25358736, -1.46068138],
       [-1.11320552, -0.78528968],
       [-1.01769239, -0.37418169],
       [-1.78179743,  0.18375059]])
```

Splitting training and test data

With 400 data, I decided to split the dataset into 3:1 ratio (Training set contains 300 data, Test set contains 100 data)

In [11]:
```python
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size = 0.25, random_state = 0)
print('Train set: ', X_train.shape, y_train.shape)
print('Test set: ', X_test.shape, y_test.shape)
```

```
Train set:  (300, 2) (300,)
Test set:  (100, 2) (100,)
```

Predict Purchased (1) or Not Purchased (0) using Decision Tree Classifier

In [12]:
```python
#Putting decision tree classifier into a variable
clf = DecisionTreeClassifier(random_state = 0, criterion = 'entropy')
# Train the classifier
model = clf.fit(X_train, y_train)
```

In [13]:
```python
#Predicting purchased (1) or not purchased (0)
y_pred = clf.predict(X_test)
```

In [14]:
```python
y_pred
```

Out[14]:
```
array([0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1,
       0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0,
       1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1,
       0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1,
       1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 1], dtype=int64)
```

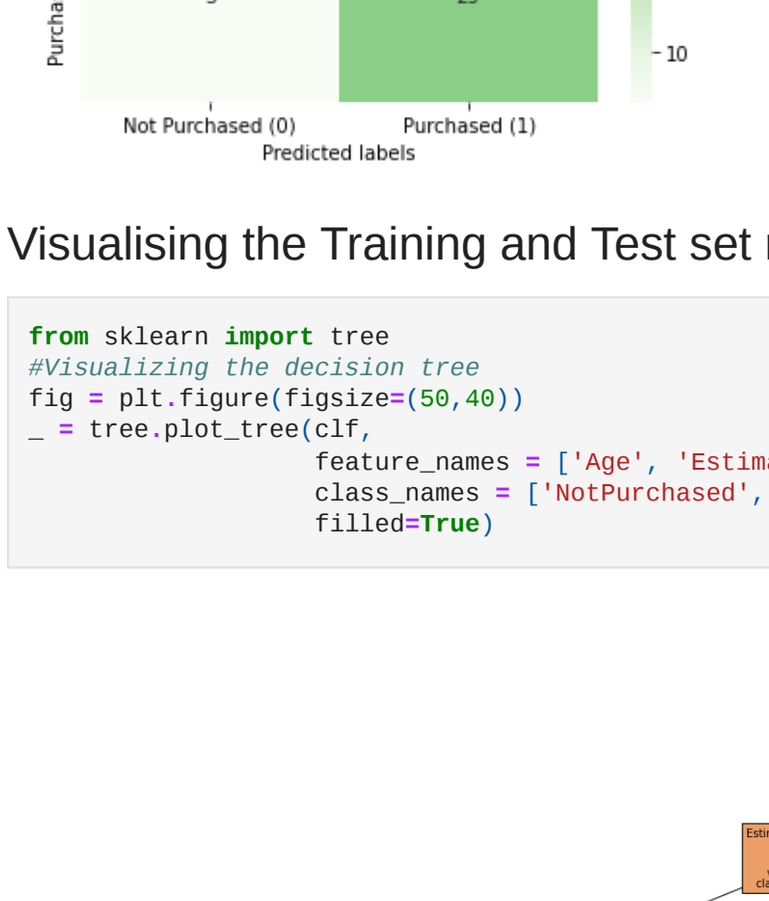
Calculated Accuracy Score using Confusion Matrix

In [15]:
```python
#Print accuracy score
from sklearn.metrics import confusion_matrix, classification_report
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.95      0.91      0.93        68
           1       0.83      0.91      0.87        32

    accuracy                           0.91       100
   macro avg       0.89      0.91      0.90       100
weighted avg       0.91      0.91      0.91       100
```

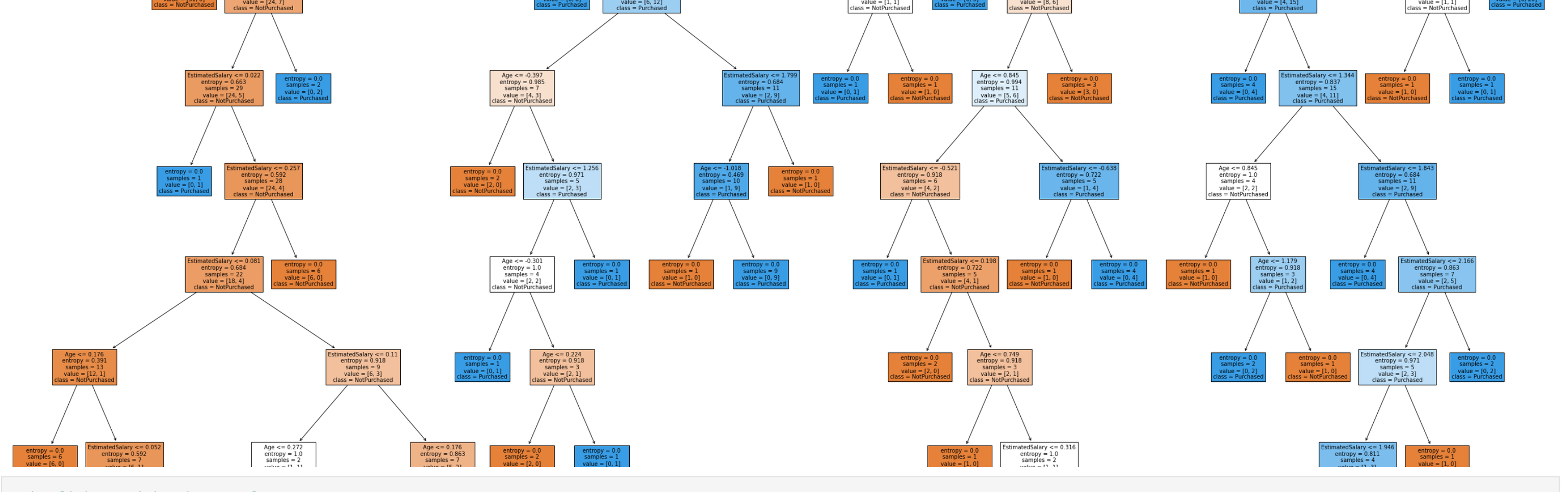
The accuracy score is 0.91 (91%)

In [16]:
```python
#Visualizing confusion matrix
cm = confusion_matrix(y_test, y_pred)
ax = plt.subplot()
sns.heatmap(cm, annot=True, fmt='g', ax=ax, cmap = 'Greens');

# labels, title and ticks
ax.set_xlabel('Predicted labels'); ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
ax.xaxis.set_ticklabels(['Not Purchased (0)', 'Purchased (1)']); ax.yaxis.set_ticklabels(['Not Purchased (0)', 'Purchased (1)']);
plt.show()
```



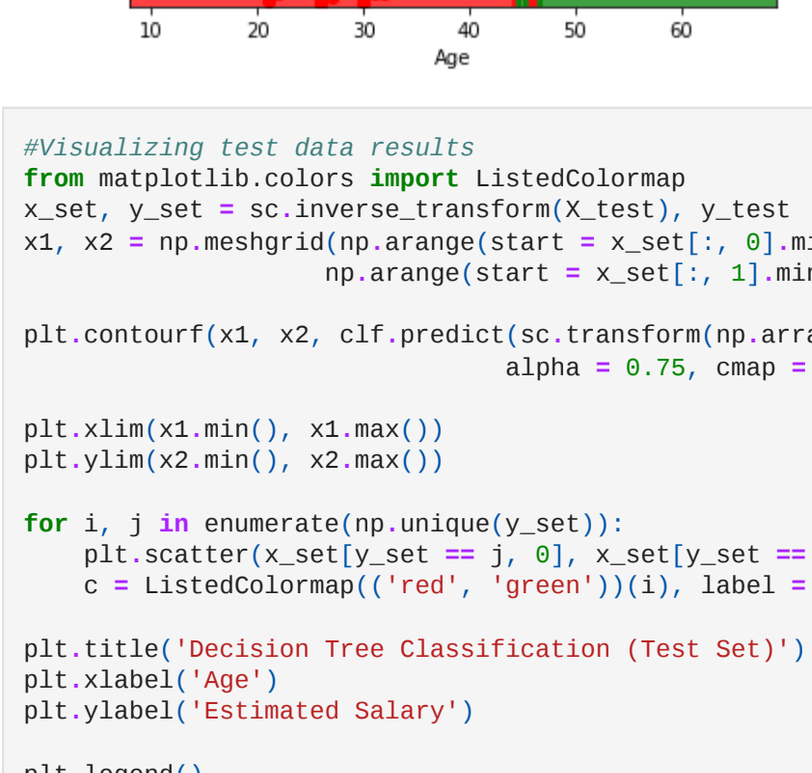
Visualising the Training and Test set results

In [17]:
```python
from sklearn import tree
#Visualizing the decision tree
fig = plt.figure(figsize=(50,40))
_ = tree.plot_tree(clf,
                   feature_names = ['Age', 'EstimatedSalary'],
                   class_names = ['NotPurchased', 'Purchased'],
                   filled=True)
```



In [18]:
```python
#Visualizing training data results
from matplotlib.colors import ListedColormap
x_set, y_set = sc.inverse_transform(X_train), y_train
x1, x2 = np.meshgrid(np.arange(start = x_set[:, 0].min()-10, stop = x_set[:, 0].max()+10, step = 1),
                     np.arange(start = x_set[:, 1].min()-1000, stop = x_set[:, 1].max()+1000, step = 1))

plt.contourf(x1, x2, clf.predict(sc.transform(np.array([x1.ravel(), x2.ravel()]).T)).reshape(x1.shape),
                                 alpha = 0.75, cmap = ListedColormap(('red', 'green')))

plt.xlim(x1.min(), x1.max())
plt.ylim(x2.min(), x2.max())

for i, j in enumerate(np.unique(y_set)):
    plt.scatter(x_set[y_set == j, 0], x_set[y_set == j, 1],
    c = ListedColormap(('red', 'green'))(i), label = j)

plt.title('Decision Tree Classification (Training Set)')
plt.xlabel('Age')
plt.ylabel('Estimated Salary')

plt.legend()
plt.show()
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should be avoided as value-mapping will have precedence in case its length matches with *x* & *y*.  Please use the *color* keyword-argument or provide a 2D array with a single row if you intend to specify the same RGB or RGBA value for all points.
*c* argument looks like a single numeric RGB or RGBA sequence, which should be avoided as value-mapping will have precedence in case its length matches with *x* & *y*.  Please use the *color* keyword-argument or provide a 2D array with a single row if you intend to specify the same RGB or RGBA value for all points.
```



In [19]:
```python
#Visualizing test data results
from matplotlib.colors import ListedColormap
x_set, y_set = sc.inverse_transform(X_test), y_test
x1, x2 = np.meshgrid(np.arange(start = x_set[:, 0].min()-10, stop = x_set[:, 0].max()+10, step = 1),
                     np.arange(start = x_set[:, 1].min()-1000, stop = x_set[:, 1].max()+1000, step = 1))

plt.contourf(x1, x2, clf.predict(sc.transform(np.array([x1.ravel(), x2.ravel()]).T)).reshape(x1.shape),
                                 alpha = 0.75, cmap = ListedColormap(('red', 'green')))

plt.xlim(x1.min(), x1.max())
plt.ylim(x2.min(), x2.max())

for i, j in enumerate(np.unique(y_set)):
    plt.scatter(x_set[y_set == j, 0], x_set[y_set == j, 1],
    c = ListedColormap(('red', 'green'))(i), label = j)

plt.title('Decision Tree Classification (Test Set)')
plt.xlabel('Age')
plt.ylabel('Estimated Salary')

plt.legend()
plt.show()
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should be avoided as value-mapping will have precedence in case its length matches with *x* & *y*.  Please use the *color* keyword-argument or provide a 2D array with a single row if you intend to specify the same RGB or RGBA value for all points.
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```