```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
from sklearn.semi_supervised import SelfTrainingClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import confusion_matrix ,classification_report,accuracy_score,balanced_accuracy_score
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.semi_supervised import SelfTrainingClassifier
```

```
df=pd.read_csv(r"C:\Users\navde\Desktop\data.csv")
```

```
df.head()
```

	Cancer stage	Clump thickness	No of week	Clump thickness_new	No of week_new	True cancer stage
0	1.0	10.510076	6.166544	10.269649	11.999203	1
1	1.0	11.739776	7.024066	10.494287	6.495638	1
2	1.0	7.857070	5.909366	8.516879	7.102108	1
3	1.0	10.817929	5.920890	8.979736	9.196251	1
4	1.0	10.302407	6.984937	9.553005	7.120283	1

```
df.info()
```

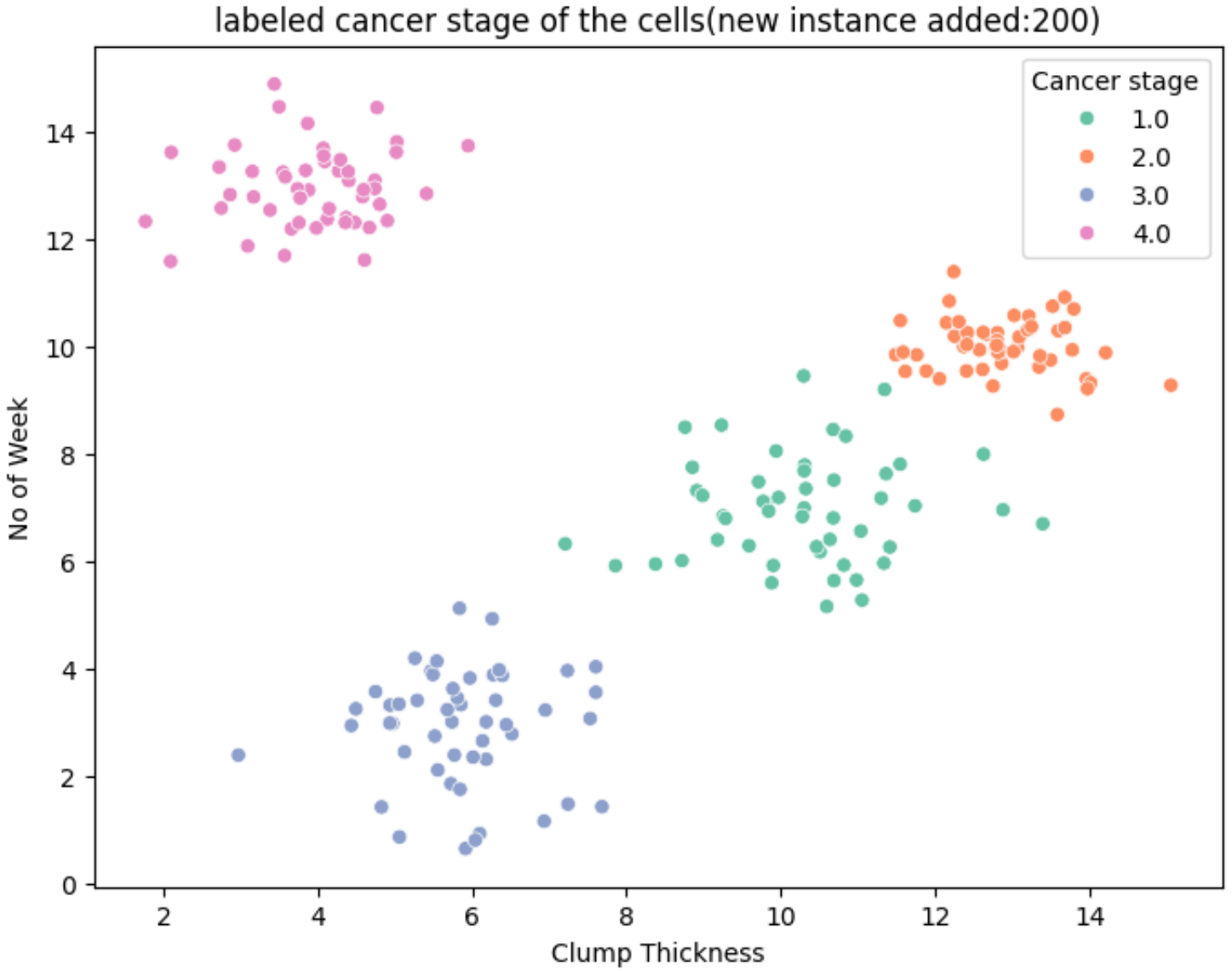
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2000 entries, 0 to 1999
Data columns (total 6 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   Cancer stage         200 non-null    float64
 1   Clump thickness      200 non-null    float64
 2   No of week           200 non-null    float64
 3   Clump thickness_new  2000 non-null   float64
 4   No of week_new       2000 non-null   float64
 5   True cancer stage    2000 non-null   int64  
dtypes: float64(5), int64(1)
memory usage: 93.9 KB
```

```
df.describe()
```

	Cancer stage	Clump thickness	No of week	Clump thickness_new	No of week_new	True cancer stage
count	200.00000	200.000000	200.000000	2000.000000	2000.000000	2000.000000
mean	2.50000	8.241801	8.207201	7.998163	8.317333	2.500000
std	1.12084	3.663026	3.824028	3.378117	3.878011	1.118314
min	1.00000	1.766717	0.641304	0.136884	-1.799827	1.000000
25%	1.75000	4.882482	5.141287	5.166022	5.722102	1.750000
50%	2.50000	7.643025	9.198574	8.408072	8.165913	2.500000
75%	3.25000	11.645020	11.432148	10.818985	11.519238	3.250000
max	4.00000	15.056272	14.877980	16.372177	16.765200	4.000000

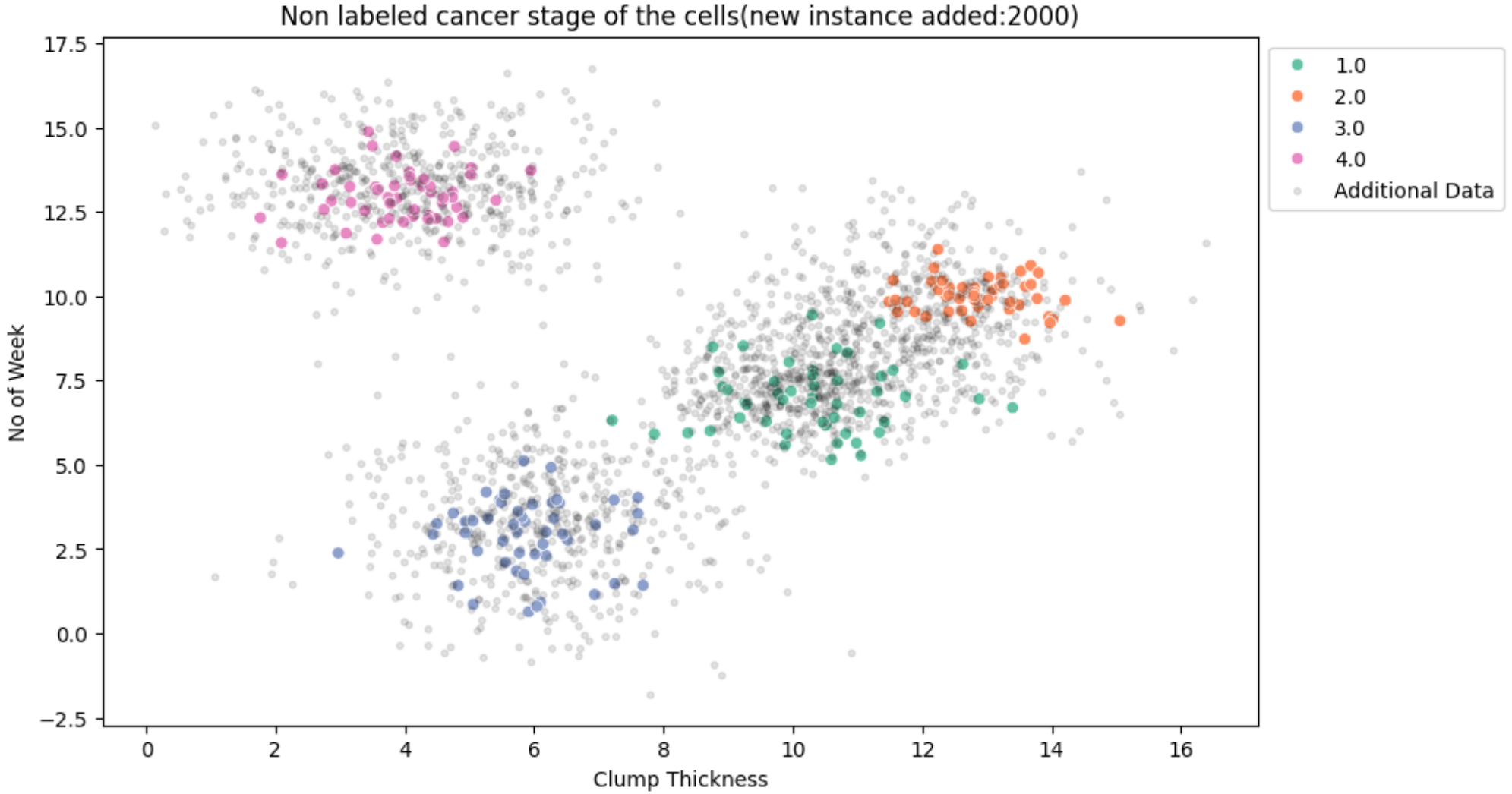
```
plt.figure(figsize=(8, 6))
sns.scatterplot(x='Clump thickness',y='No of week',data=df,hue='Cancer stage',palette="Set2")
plt.title('labeled cancer stage of the cells(new instance added:200)')
plt.xlabel('Clump Thickness')
plt.ylabel('No of Week')
```

```
Text(0, 0.5, 'No of Week')
```



```
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Clump thickness',y='No of week',data=df,hue='Cancer stage',palette="Set2")
plt.scatter(df['Clump thickness_new'], df['No of week_new'], label='Additional Data',color="black", alpha=0.1,marke
# Customize the plot
plt.title('Non labeled cancer stage of the cells(new instance added:2000)')
plt.xlabel('Clump Thickness')
plt.ylabel('No of Week')

# Add legend for the additional data
plt.legend(loc='upper left', bbox_to_anchor=(1, 1))
```

```
<matplotlib.legend.Legend at 0x22ee18b7050>
```



```
df1 = df.loc[:199, ['Cancer stage', 'Clump thickness', 'No of week']]
df2 = df.loc[:, ['Clump thickness_new', 'No of week_new', 'True cancer stage']]
df2.rename(columns={'Clump thickness_new': 'Clump thickness', 'No of week_new': 'No of week', 'True cancer stage':'
```

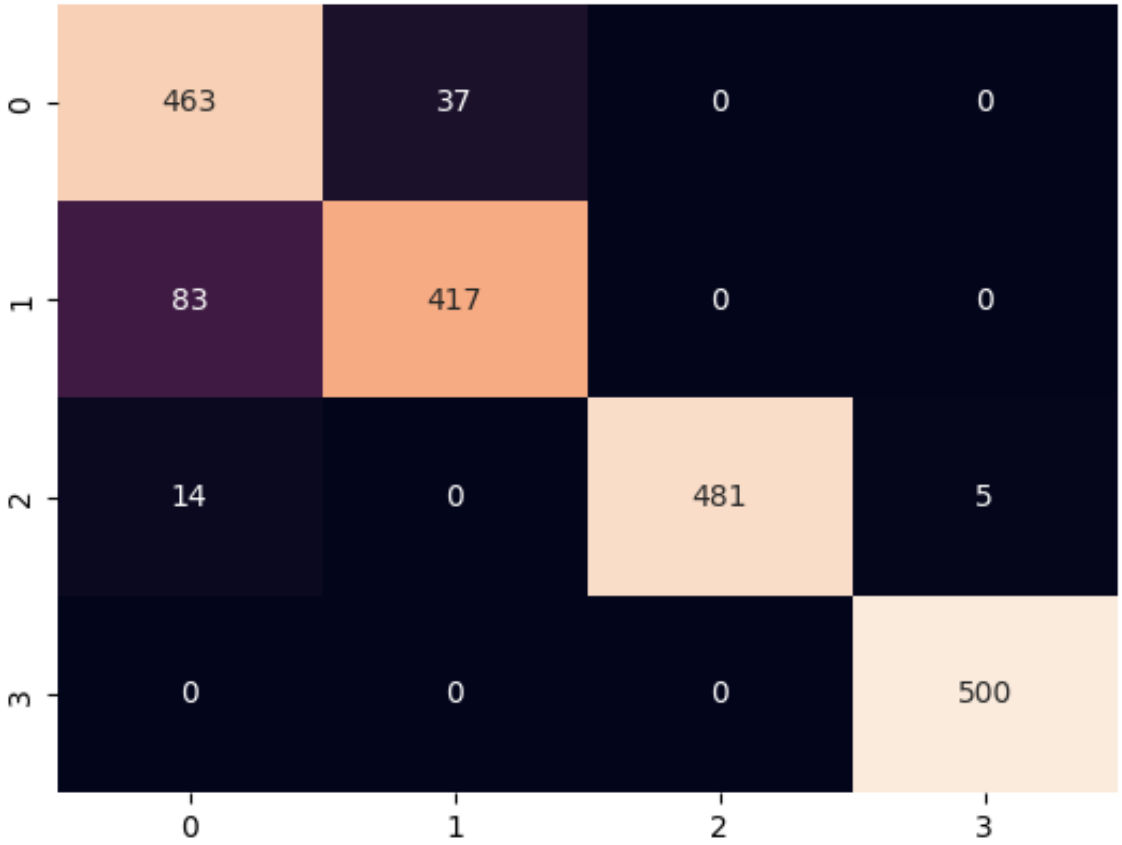
```
feature = df1[['Clump thickness', 'No of week']]
target = df1['Cancer stage']

feature_new = df2[['Clump thickness', 'No of week']]
target_new = df2['Cancer stage']

k_values = np.arange(1, 199)
val_scores = {}
for k in k_values:
    knn = KNeighborsClassifier(n_neighbors=k)
    knn.fit(feature, target)
    val_score = knn.score(feature_new, target_new)
    val_scores[k] = val_score

optimak_k = max(val_scores, key=val_scores.get)
print(f"Best K value: {optimak_k}")
```

```
Best K value: 93
```

```
knn1 = KNeighborsClassifier(n_neighbors =93)
knn1.fit(feature, target)
model = SelfTrainingClassifier(knn1)
model.fit(feature, target)
y_predicted = model.predict(feature_new)
cm = confusion_matrix(target_new, y_predicted)
ac = accuracy_score(target_new, y_predicted)
```

```
clf = classification_report(target_new, y_predicted)
sns.heatmap(cm, annot=True, fmt='d', cbar=False)
```

```
C:\Users\navde\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packag
  warnings.warn("y contains no unlabeled samples", UserWarning)
<Axes: >
```



```
true_labels = df['True cancer stage'].dropna()

accuracy = accuracy_score(true_labels, y_predicted)
print(f'Accuracy Score: {accuracy}')

print('Classification Report:')
print(classification_report(true_labels, y_predicted))
```

```
    Accuracy Score: 0.9305
    Classification Report:
                  precision    recall  f1-score   support

               1       0.83      0.93      0.87       500
               2       0.92      0.83      0.87       500
               3       1.00      0.96      0.98       500
               4       0.99      1.00      1.00       500

        accuracy                           0.93      2000
       macro avg       0.93      0.93      0.93      2000
    weighted avg       0.93      0.93      0.93      2000
```

```
# Scatter plot for the labeled and unlabeled data with predicted labels for the unlabeled data points
plt.scatter(feature['Clump thickness'], feature['No of week'], c=target)
plt.scatter(feature_new['Clump thickness'], feature_new['No of week'], marker='.', c=y_predicted)
plt.title('Fitted Labels for Unlabeled Data by Semi-supervised Learning method - cell cancer stage')
plt.xlabel('Clump thickness of the cell (in millimetres)')
plt.ylabel('Number of weeks since the formation of the clump')
plt.legend()
plt.show()
```

```
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are ignor
```