Temat: Komputerowe wspomaganie diagnozowania zawałów z wykorzystaniem algorytmu k-NN.

Opis problemu medycznego jako zadania klasyfikacji wraz z identyfikacją klas oraz cech

Zadanie klasyfikacji w projekcie polega na wspomożeniu rozpoznania stanów zawałowych wśród pacjentów na podstawie danych zebranych podczas badań na osobach u których potwierdzono jedną z poniższych diagnoz:

1. **Ból nie pochodzący z organu serca - inne.txt**
2. **Dusznica bolesna (dławica piersiowa) - ang_prect.txt**
3. **Dusznica Prinzmetala (dławica naczynioskurczowa) - ang_prct_2.txt**
4. **Pełnościenny zawał serca - mi.txt**
5. **Podwsierdziowy zawał serca - mi_np.txt**

Wynikiem zadania klasyfikacji jest przydzielenie, każdego z pacjentów do jednej z powyższych klas. Klasom przydzieliliśmy odpowiednią numerację zgodną z wypunktowaniem powyżej.

Większość z zawartych cech w danych ma charakter dyskretny, natomiast te które w rzeczywistości są ciągłe zostały zdyskretyzowane za pomocą odpowiednich przedziałów jak np. czas trwania ostatniego bólu:

1. **krócej niż 5 minut**
2. **od 5 do 30 minut**
3. **od 30 do 60 minut**
4. **od 1 do 6 godzin**
5. **od 6 do 12 godzin**
6. **dłużej niż 12 godzin**

Liczba klas: 5

Liczba cech: 59

Import libraries

In [ ]:

```
from google.colab import drive
drive.mount('/content/gdrive')
import pandas as pd
from sklearn.feature_selection import SelectKBest, chi2, f_classif
import seaborn as sns
import matplotlib.pyplot as plt
import glob
%cd /content/gdrive/My Drive/Colab Notebooks/MTSwM
```

```
Mounted at /content/gdrive
/content/gdrive/My Drive/Colab Notebooks/MTSwM
```

Dataset features

In [ ]:

```
dataset_features_columns = [
    'Age',
    'Sex',
    # Pain
    'Pain location',
    'Chest pain radiation',
    'Pain character',
    'Onset of pain',
    'Number of hours since onset',
    'Duration of the last episode',
    # Associated symptoms
    'Nausea',
    'Diaphoresis',
    'Palpitations',
    'Dyspnea',
    'Dizziness/syncope',
    'Burping',
    # Palliative factors
    'Palliative factors',
    # History of similar pain
    'Prior chest pain of this type',
    'Physician consulted for prior pain',
    'Prior pain related to heart',
    'Prior pain due to MI',
    'Prior pain due to angina prectoris',
    # Past medical history
    'Prior MI',
    'Prior angina prectoris',
    'Prior atypical chest pain',
    'Congestive heart failure',
    'Peripheral vascular disease',
    'Hiatal hernia',
    'Hypertension',
    'Diabetes',
    'Smoker',
    # Current medication usage
    'Diuretics',
    'Nitrates',
    'Beta blockers',
    'Digitalis',
    'Nonsteroidal anti-inflammator',
    'Antacids/H2 blockers',
    # Physical examinations
    'Systolic blood pressure',
    'Diastolic blood pressure',
    'Heart rate',
    'Respiration rate',
    'Rales',
    'Cyanosis',
    'Pallor',
    'Systolic murmur',
    'Diastolic murmur',
    'Oedema',
    'S3 gallop',
    'S4 gallop',
    'Chest wall tenderness',
    'Diaphoresis',
    # ECG examination
    'New Q wave',
    'Any Q wave',
    'New ST segment elevation',
    'Any ST segment elevation',
    'New ST segment depression',
    'Any ST segment depression',
    'New T wave inversion',
    'Any T wave inversion',
```

```
    'New intraventricular conduction defect',
    'Any intraventricular conduction defect',
    'Class'
]
```

Load & merge datasets

In [ ]:

```
data_list = []

for i, file in enumerate(glob.glob("data/*.txt"), 1):
  data_set = pd.read_csv(file,sep="\t", header=None).transpose()
  data_set['Class'] = i
  data_list.append(data_set)

dataset = pd.concat(data_list, axis=0)

dataset.columns = dataset_features_columns

dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 901 entries, 0 to 262
Data columns (total 60 columns):
 #   Column                                Non-Null Count  Dtype
---  ------                                --------------  -----
 0   Age                                   901 non-null    int64
 1   Sex                                   901 non-null    int64
 2   Pain location                         901 non-null    int64
 3   Chest pain radiation                  901 non-null    int64
 4   Pain character                        901 non-null    int64
 5   Onset of pain                         901 non-null    int64
 6   Number of hours since onset           901 non-null    int64
 7   Duration of the last episode          901 non-null    int64
 8   Nausea                                901 non-null    int64
 9   Diaphoresis                           901 non-null    int64
 10  Palpitations                          901 non-null    int64
 11  Dyspnea                               901 non-null    int64
 12  Dizziness/syncope                     901 non-null    int64
 13  Burping                               901 non-null    int64
 14  Palliative factors                    901 non-null    int64
 15  Prior chest pain of this type         901 non-null    int64
 16  Physician consulted for prior pain    901 non-null    int64
 17  Prior pain related to heart           901 non-null    int64
 18  Prior pain due to MI                  901 non-null    int64
 19  Prior pain due to angina prectoris    901 non-null    int64
 20  Prior MI                              901 non-null    int64
 21  Prior angina prectoris                901 non-null    int64
 22  Prior atypical chest pain             901 non-null    int64
 23  Congestive heart failure              901 non-null    int64
 24  Peripheral vascular disease           901 non-null    int64
 25  Hiatal hernia                         901 non-null    int64
 26  Hypertension                          901 non-null    int64
 27  Diabetes                              901 non-null    int64
 28  Smoker                                901 non-null    int64
 29  Diuretics                             901 non-null    int64
 30  Nitrates                              901 non-null    int64
 31  Beta blockers                         901 non-null    int64
 32  Digitalis                             901 non-null    int64
 33  Nonsteroidal anti-inflammator         901 non-null    int64
 34  Antacids/H2 blockers                  901 non-null    int64
 35  Systolic blood pressure               901 non-null    int64
 36  Diastolic blood pressure              901 non-null    int64
 37  Heart rate                            901 non-null    int64
 38  Respiration rate                      901 non-null    int64
 39  Rales                                 901 non-null    int64
 40  Cyanosis                              901 non-null    int64
 41  Pallor                                901 non-null    int64
 42  Systolic murmur                       901 non-null    int64
```

```
 43  Diastolic murmur                          901 non-null    int64
 44  Oedema                                    901 non-null    int64
 45  S3 gallop                                 901 non-null    int64
 46  S4 gallop                                 901 non-null    int64
 47  Chest wall tenderness                     901 non-null    int64
 48  Diaphoresis                               901 non-null    int64
 49  New Q wave                                901 non-null    int64
 50  Any Q wave                                901 non-null    int64
 51  New ST segment elevation                  901 non-null    int64
 52  Any ST segment elevation                  901 non-null    int64
 53  New ST segment depression                 901 non-null    int64
 54  Any ST segment depression                 901 non-null    int64
 55  New T wave inversion                      901 non-null    int64
 56  Any T wave inversion                      901 non-null    int64
 57  New intraventricular conduction defect    901 non-null    int64
 58  Any intraventricular conduction defect    901 non-null    int64
 59  Class                                     901 non-null    int64
dtypes: int64(60)
memory usage: 429.4 KB
```

Feature ranking

SelectKBest

In [ ]:

```
def build_features_ranking(x, y, score_func):
    features_num = x.shape[1]
    k_best_selector = SelectKBest(score_func=score_func, k=features_num)
    k_best_selector.fit(x, y)
    scores_ranking = [
        (name, round(score, 2))
        for name, score in zip(x.columns, k_best_selector.scores_)
    ]
    scores_ranking.sort(reverse=True, key=lambda x: x[1])
    return scores_ranking
```

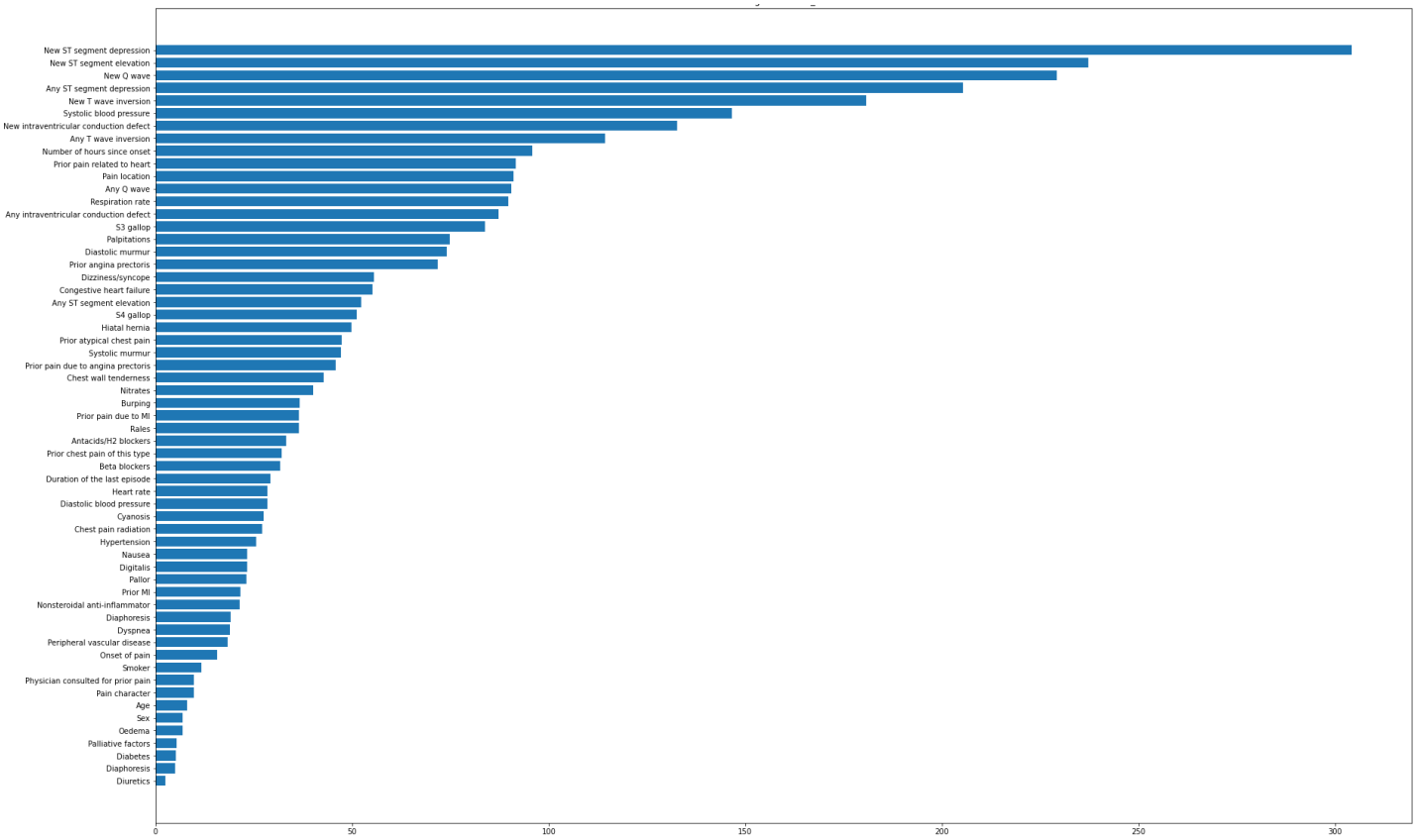
In [ ]:

```
def print_features_ranking_with_plot(features_ranking, used_score_func):
  print(f'Features ranking after using {used_score_func} score function:')
  for i, feature in enumerate(features_ranking, 1):
    print(f"{i}. {feature[0]} {feature[1]}")
  # display bar plot
  plt.figure(figsize=(30,20))
  estimator_num = len(features_ranking)
  # sort ascending because horizontal bars print in reverse order
  ascending_features = sorted([(f[0], f[1]) for f in features_ranking], key=lambda f: f[
1])
  plt.barh(range(estimator_num), [feature[1] for feature in ascending_features], align='
center') # extract score value
  plt.yticks(range(estimator_num), [feature[0] for feature in ascending_features]) # ext
ract the feature label
  plt.title(f'Ranking based on {used_score_func}')
  plt.show()
```

In [ ]:

```
x = dataset.drop('Class', axis=1)
y = dataset['Class']
# f_classif: ANOVA test (F-value between label/feature for regression tasks)
features_ranking_classif = build_features_ranking(x, y, f_classif)
print_features_ranking_with_plot(features_ranking_classif, 'f_classif')
# chi-squared stats of non-negative features for classification tasks.
features_ranking_chi = build_features_ranking(x, y, chi2)
print_features_ranking_with_plot(features_ranking_chi, 'chi2')
```

```
Features ranking after using f_classif score function:
1. New ST segment depression 304.24
2. New ST segment elevation 237.16
3. New Q wave 229.16
4. Any ST segment depression 205.43
5. New T wave inversion 180.8
6. Systolic blood pressure 146.52
7. New intraventricular conduction defect 132.6
8. Any T wave inversion 114.27
9. Number of hours since onset 95.74
10. Prior pain related to heart 91.66
11. Pain location 90.97
12. Any Q wave 90.55
13. Respiration rate 89.65
14. Any intraventricular conduction defect 87.17
15. S3 gallop 83.8
16. Palpitations 74.79
17. Diastolic murmur 74.17
18. Prior angina prectoris 71.71
19. Dizziness/syncope 55.57
20. Congestive heart failure 55.24
21. Any ST segment elevation 52.26
22. S4 gallop 51.23
23. Hiatal hernia 49.76
24. Prior atypical chest pain 47.42
25. Systolic murmur 47.26
26. Prior pain due to angina prectoris 45.89
27. Chest wall tenderness 42.72
28. Nitrates 40.13
29. Burping 36.7
30. Prior pain due to MI 36.53
31. Rales 36.47
32. Antacids/H2 blockers 33.26
33. Prior chest pain of this type 32.04
34. Beta blockers 31.71
35. Duration of the last episode 29.32
36. Heart rate 28.48
37. Diastolic blood pressure 28.43
38. Cyanosis 27.43
39. Chest pain radiation 27.2
40. Hypertension 25.62
41. Nausea 23.39
42. Digitalis 23.22
43. Pallor 23.05
44. Prior MI 21.65
45. Nonsteroidal anti-inflammator 21.32
46. Diaphoresis 19.18
47. Dyspnea 18.86
48. Peripheral vascular disease 18.42
49. Onset of pain 15.67
50. Smoker 11.76
51. Physician consulted for prior pain 9.74
52. Pain character 9.73
53. Age 7.98
54. Sex 6.94
55. Oedema 6.83
56. Palliative factors 5.31
57. Diabetes 5.23
58. Diaphoresis 4.91
59. Diuretics 2.49
```



Features ranking after using chi2 score function:

1. Systolic blood pressure 1980.23
2. Number of hours since onset 978.58
3. Pain location 340.52
4. New ST segment depression 223.47
5. New Q wave 200.26
6. New T wave inversion 193.4
7. New ST segment elevation 188.22
8. Any ST segment depression 177.0
9. New intraventricular conduction defect 159.89
10. Any T wave inversion 151.67
11. Respiration rate 120.3
12. Diastolic murmur 117.16
13. Any intraventricular conduction defect 117.1
14. Prior angina prectoris 116.64
15. Chest pain radiation 114.72
16. Heart rate 109.56
17. Any Q wave 108.82
18. S3 gallop 105.09
19. Prior pain related to heart 101.63
20. Prior pain due to MI 89.17
21. S4 gallop 87.11
22. Prior pain due to angina prectoris 85.87
23. Congestive heart failure 85.27
24. Systolic murmur 84.5
25. Hiatal hernia 83.61
26. Dizziness/syncope 83.29
27. Palpitations 82.35
28. Beta blockers 79.73
29. Diastolic blood pressure 78.56
30. Nitrates 76.57
31. Any ST segment elevation 75.29
32. Antacids/H2 blockers 73.57
33. Duration of the last episode 63.42
34. Digitalis 60.11
35. Cyanosis 58.81
36. Prior MI 56.67
37. Age 56.54
38. Rales 54.04
39. Chest wall tenderness 53.81
40. Pain character 50.83
41. Prior atypical chest pain 49.97
42. Nausea 45.57
43. Pallor 45.25

44. Burping 43.21
45. Hypertension 41.36
46. Prior chest pain of this type 40.41
47. Dyspnea 36.73
48. Nonsteroidal anti-inflammator 35.55
49. Peripheral vascular disease 28.19
50. Diaphoresis 27.68
51. Onset of pain 21.99
52. Diabetes 15.45
53. Physician consulted for prior pain 15.17
54. Smoker 15.06
55. Oedema 14.0
56. Palliative factors 12.86
57. Sex 10.84
58. Diaphoresis 6.58
59. Diuretics 5.19