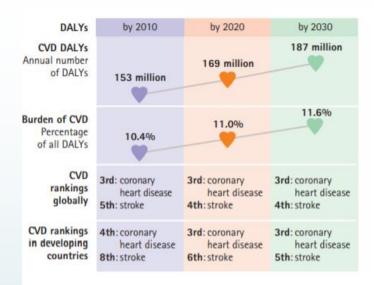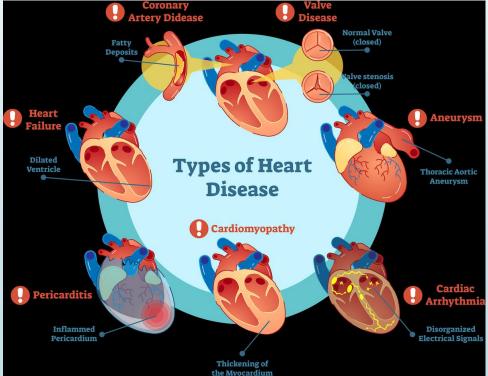# Risk factors for heart disease in different locations

by

Kalvin Dobler, Nicolas Huber, Nathalie Guttmann

Introduction to Data Science 2021

Cardiovascular disease (CVD)

➡ Nr. 1 worldwide for mortality and morbidity

➡ Mostly in low and middle-income countries

➡ High- socio-economic burden

➡ Most CVDs losses: ischemic heart disease and stroke

DALYs	by 2010	by 2020	by 2030
CVD DALYs Annual number of DALYs	153 million	169 million	187 million
Burden of CVD Percentage of all DALYs	10.4%	11.0%	11.6%
CVD rankings globally	3rd: coronary heart disease 5th: stroke	3rd: coronary heart disease 4th: stroke	3rd: coronary heart disease 4th: stroke
CVD rankings in developing countries	4th: coronary heart disease 8th: stroke	3rd: coronary heart disease 6th: stroke	3rd: coronary heart disease 5th: stroke

Research questions

- Risk factors predicting cardiovascular diseases?

- Meaningful different levels of heart diseases?
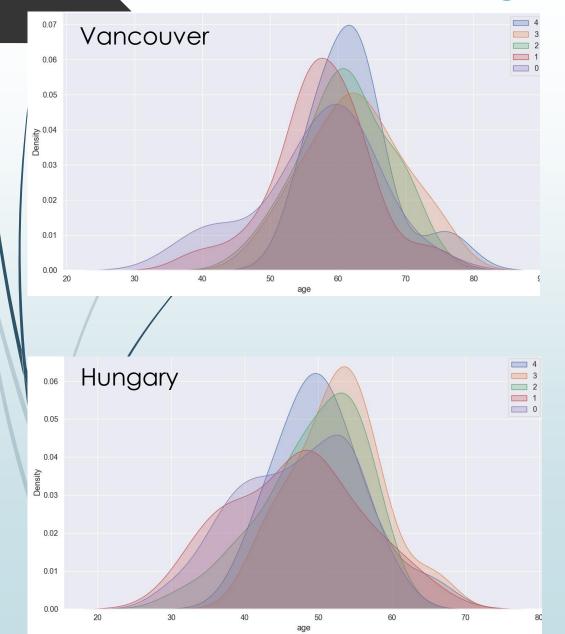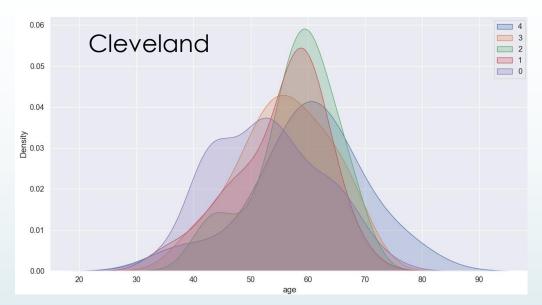
- Difference between locations?

Dataset

- Name: Heart Disease Data Set

- Source: UCI Machine Learning Repository

- Time: 1998

- Location: Hungary, Switzerland (incl. Zürich and Basel), Cleveland, Long Beach

- Disease: 0 : healthy, 1-4: different levels of heart disease

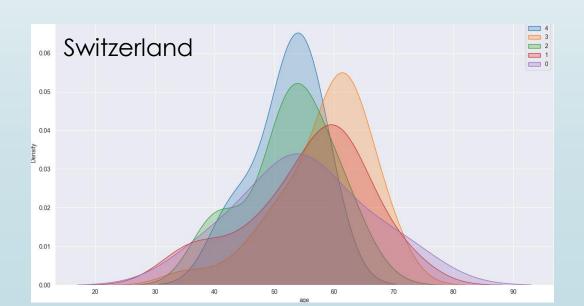- Attributes (75): sex, age, chest pain location, smoking….

Workflow

- Pre-processing: removing missing values

- Data visualization: correlation between features

- Feature selection: Random Forrests

- Dimensionality reduction: t-SNE, UMAP, Autoencoders

- Classification: logistic regression, multinomial logistic regression, naive Bayes, SVM, KNN, neural networks

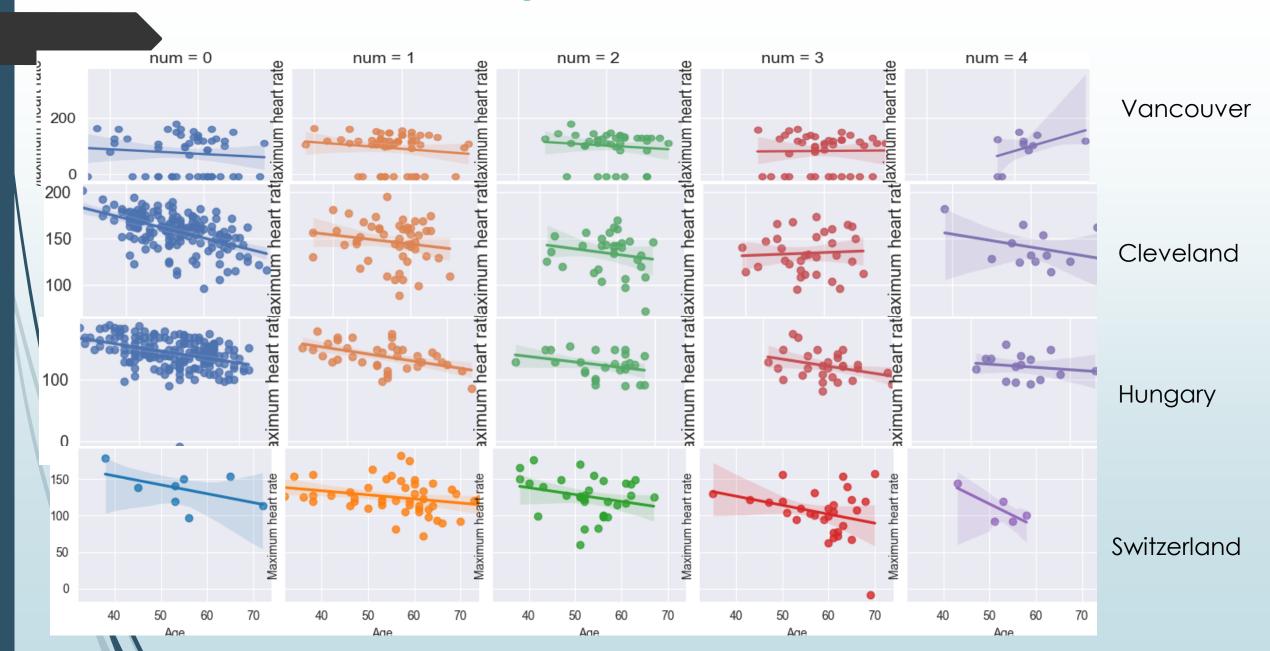- Performance measurement: Confusion matrix, ROC curve (incl. AUC)

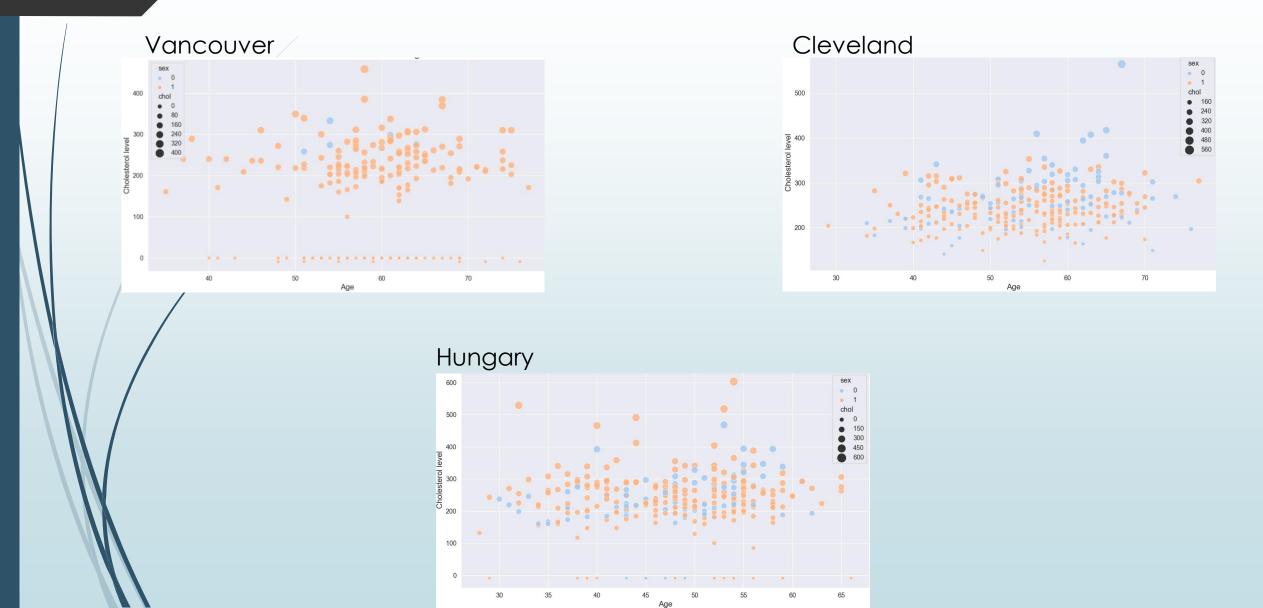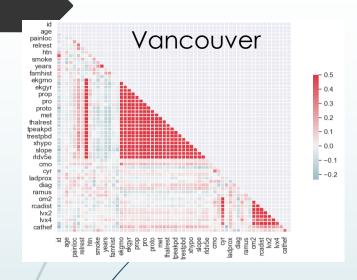# Distribution of age for the type of disease
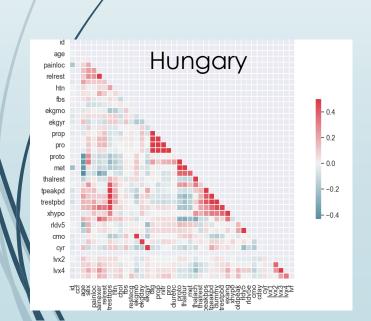
Effect of age on max. heart rate

Cholesterol levels

Vancouver
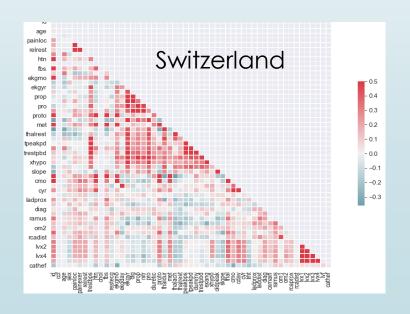

Cleveland

Hungary
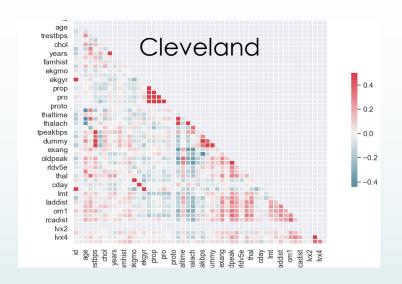
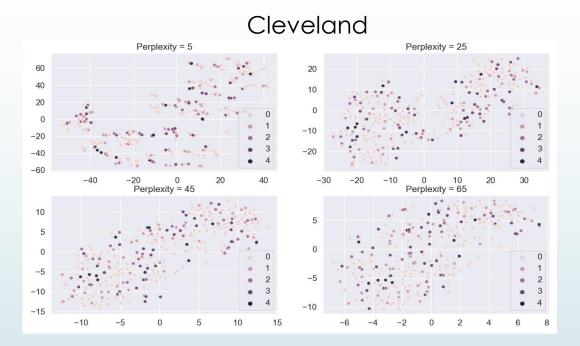# Correlation between features

t-SNE

Cleveland
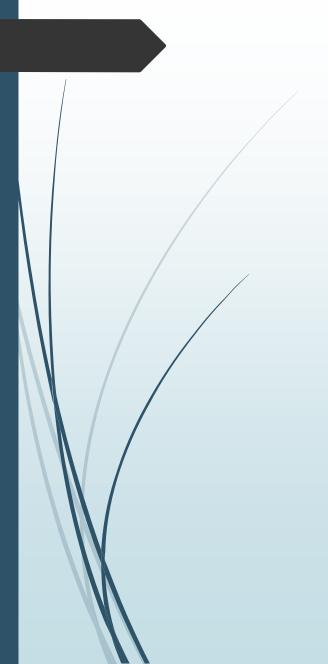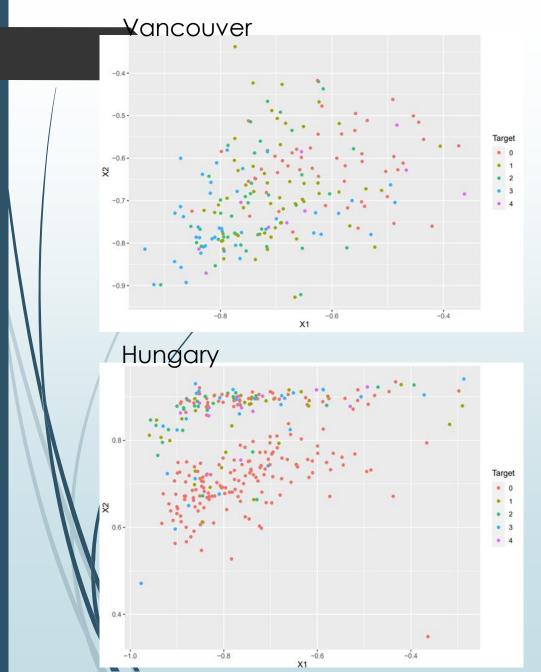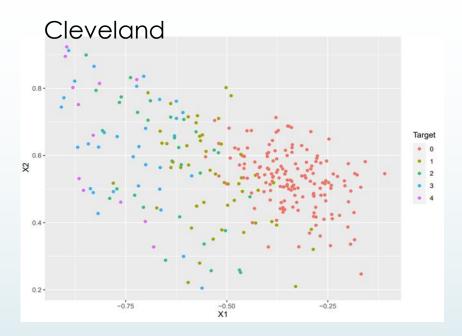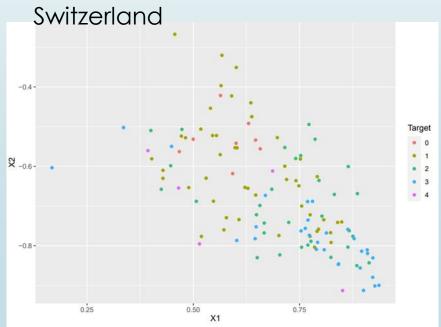
No pattern for all locations-> UMAP and autoencoders

Autoencoders

Vancouver

Cleveland

Hungary

Switzerland
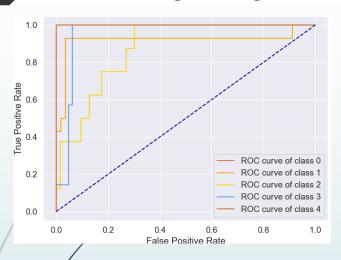
Top 5 most important risk factors
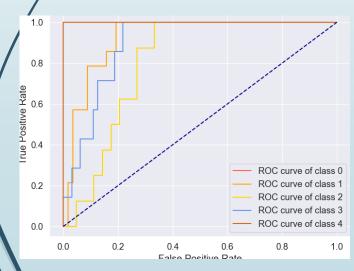
| Cleveland	Vancouver	Switzerland	Hungary
Distal left anterior descending artery	Proximal right coronary artery	Circumflex	Chest pain
Thallium scintigraphy	Proximal left anterior descending arte	ID	Pain provoked by exertion
First obtuse marginal branch	ID	Maximum heart rate acheived	Induce ST depression relative to rest
Number of major vessel	Circumflex	Peak exercise systolic blood pressure	Lvx4
Proximal right coronary artery	Day of cardiac catheterization	Age of patients	Exercise-induced angina

ROC curve
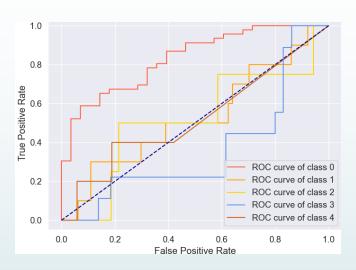
Cleveland: Logistic Regression

Hungary: Logistic Regression
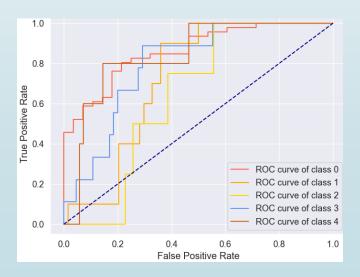
Cleveland: naive Bayes

Hungary: naive Bayes

Performance measurement

Methods	Cleveland	Hungarian	Vancouver	Switzerland
Log regression accuracy	84%	59%	74%	65%
Log regression AUC-Score	95%	75%	85%	-
Naive Bayes accuracy	77%	46%	54%	-
Naive Bayes AUC-Score	93%	55%	88%	-
SVC linear accuray	86%	58%	84%	-
SVC multi (deg 3) accuracy	68%	62%	38%	-
SVC kernel (rbf) accuracy	58%	62%	20%	-
KNN accuracy	73%	57%	46%	42%
Neural network accuracy	48%	42%	8%	23%

Conclusion

- Variation in accuracy between methods for prediction of heart disease
- For some dataset: prediction not good

- Difficulty to differentiate the different targets
  - Merge all levels for heart disease or more patients data for each targets

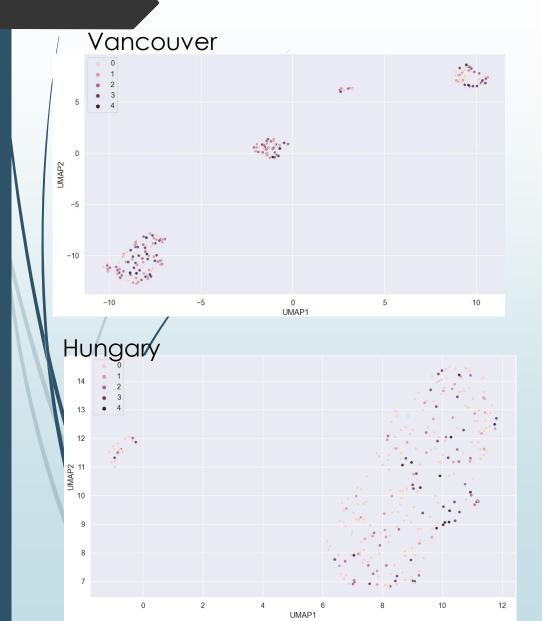- Minor differences between locations

Limitations and Outlook

- Old dataset

- Switzerland dataset unbalanced

- Missing description of features

- Missing (important) features (e.g cholesterol in CH)

- Some selection of features senseless

- Fine tune models generators

- Use of more features
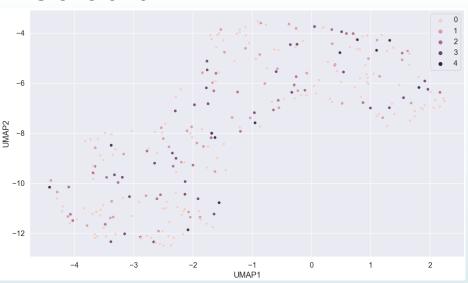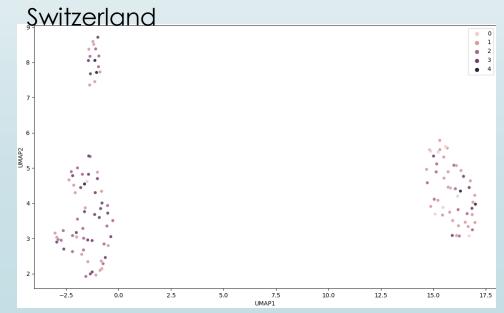
- Find updated datasets

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- http://content.time.com/time/covers/0,16641,19810601,00.html

- https://feedabrain.com/change-of-heart-on-fat/

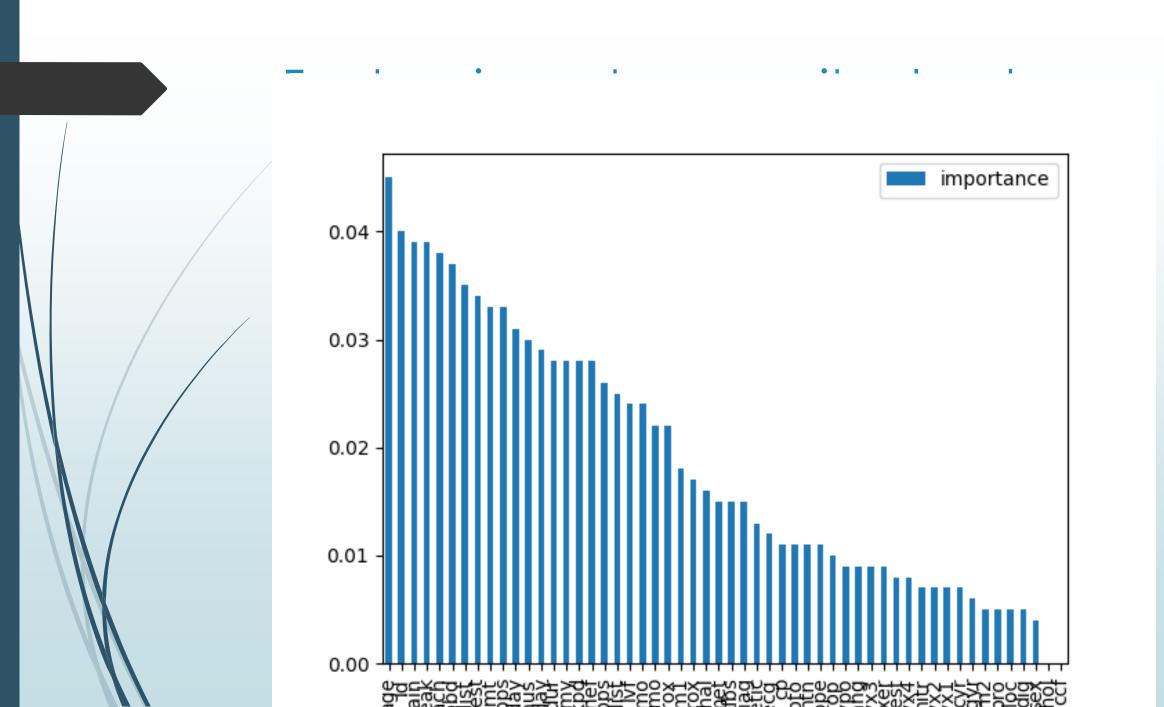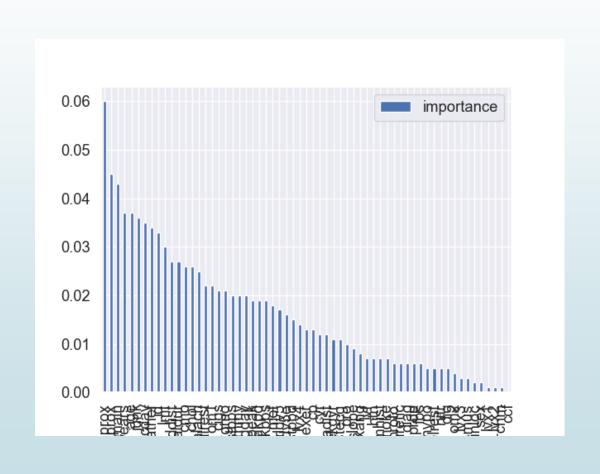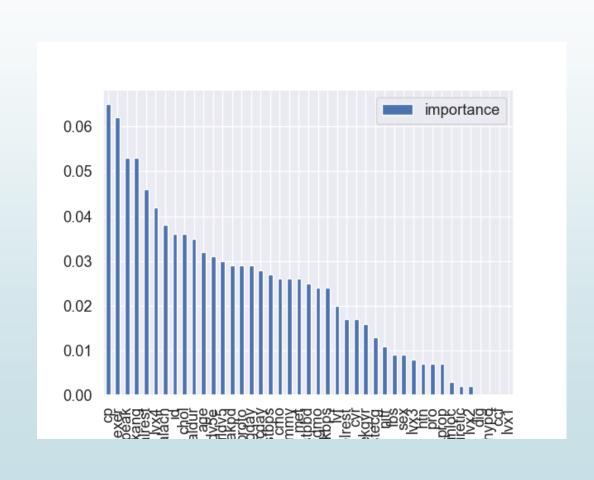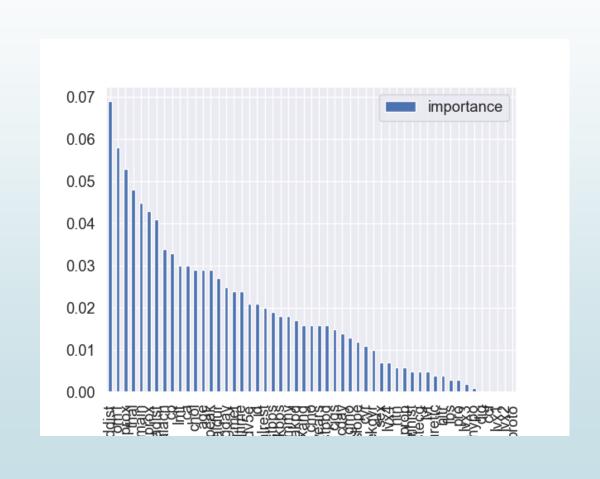- https://twitter.com/skynews/status/936351789464551426

UMAP

Vancouver

Cleveland

Hungary
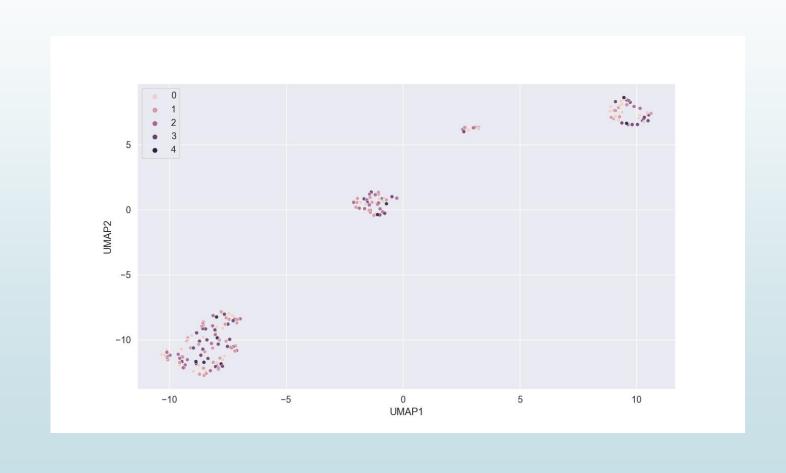
Switzerland

Feature importance vancouver

Feature importance hungary

Feature importance cleveland

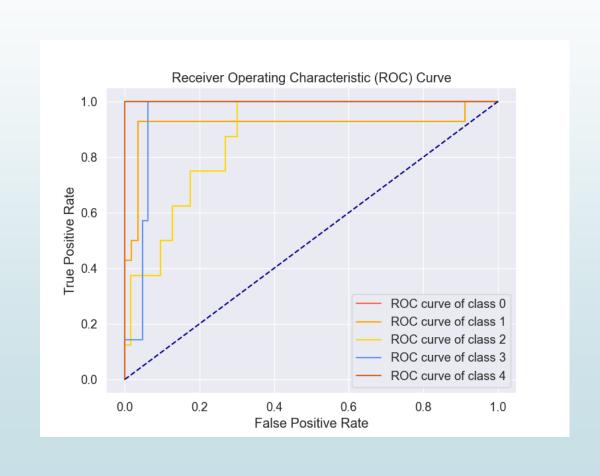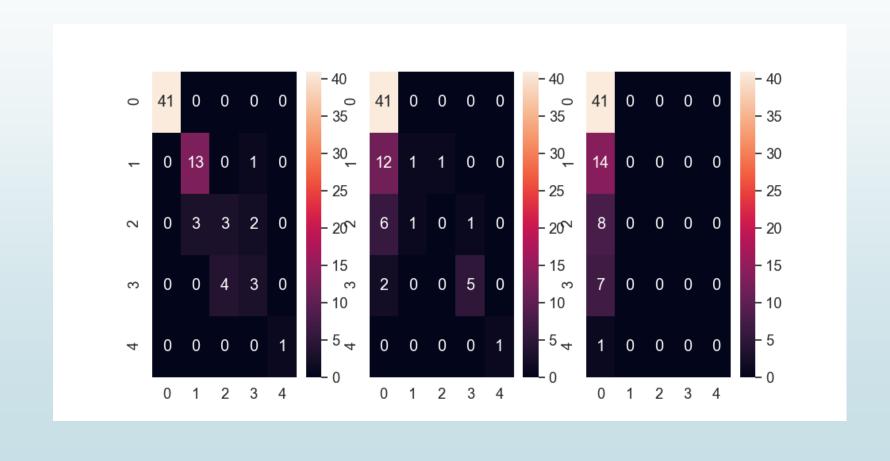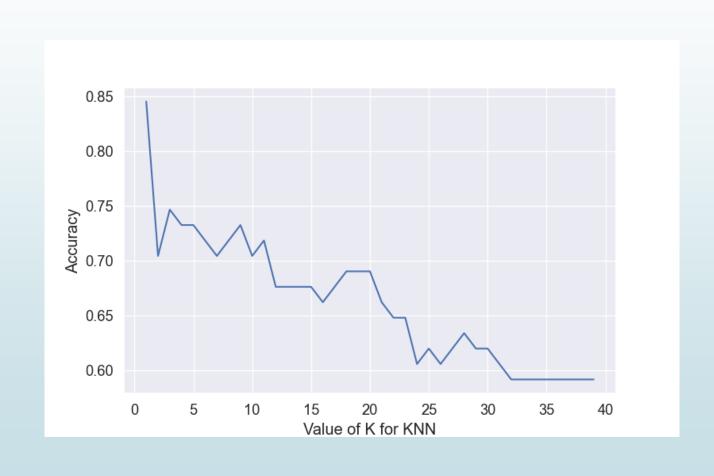# UMAP vancouver

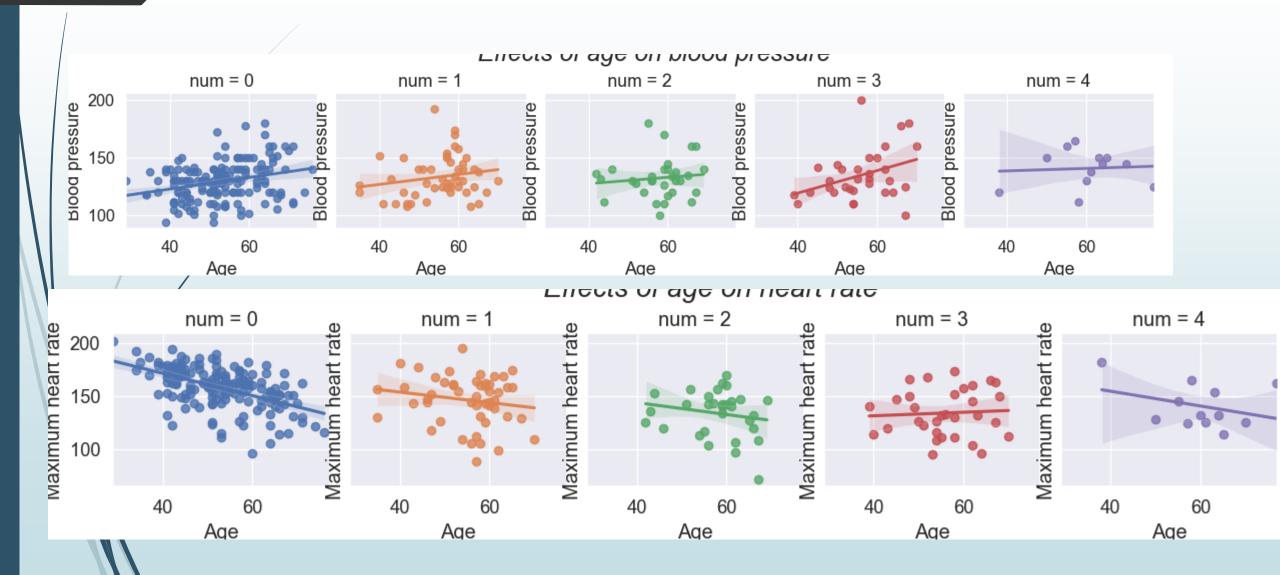# Cholesterol vancouver

Cleveland roc 14

Confusion matrices SVC cleveland

KNN cleveland

celveland

Effects of age on blood pressure

Effects of age on heart rate

https://www.berelianimd.com/blog/i-cant-believe-its-not-butter-thats-been-clogging-my-arteries-for-the-last-60-years