About me

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Assistants

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Toon Callens

Tine Clays

Alireza Nameni

Arthur Declercq

Course specifications

5 credits

contents:

linear regression, logistic regression
support vector machine, random forest, gradient boosting, ensemble learning
deep neural networks, AI
programming with scikit-learn
build and evaluate your own models

final competences:

The student is capable of interacting at high level with data analysis specialists.
The student is capable of understanding the specific literature on machine learning based data analysis.

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Course specifications

calculation of the examination mark:

(continuous evaluation)
Jupyter notebook project (15%)
microteaching: teach other students about a machine learning method not discussed during the lectures (15%)
2 page report about the obtained Kaggle contest results (20%)

(period-specific evaluation)
written exam on 50% of the total score

Course specifications

Jupyter notebook project (15%)

Intro to Machine Learning
Intermediate Machine Learning

certificate send to me by email
sven.degroeve@ugent.be
(subject: kaggle certificate)

Intro to Machine Learning

Learn the core ideas in machine learning, and build your first models.

Begin Course

3 hours to go

Course Discussion

Lessons

		Tutorial	Exercise
1	**How Models Work** The first step if you're new to machine learning.		
2	**Basic Data Exploration** Load and understand your data.		
3	**Your First Machine Learning Model** Building your first model. Hurray!		
4	**Model Validation** Measure the performance of your model, so you can test and compare alternatives.		
5	**Underfitting and Overfitting** Fine-tune your model for better performance.		
6	**Random Forests** Using a more sophisticated machine learning algorithm.		
7	**Machine Learning Competitions** Enter the world of machine learning competitions to keep improving and see your progress.		

Course specifications

Jupyter notebook project (15%)

Intro to Machine Learning
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Intermediate Machine Learning

Handle missing values, non-numeric values, data leakage, and more.

Begin Course

4 hours to go

Course Discussion

Lessons

		Tutorial	Exercise
1	**Introduction** Review what you need for this course.		
2	**Missing Values** Missing values happen. Be prepared for this common challenge in real datasets.		
3	**Categorical Variables** There's a lot of non-numeric data out there. Here's how to use it for machine learning.		
4	**Pipelines** A critical skill for deploying (and even testing) complex models with pre-processing.		
5	**Cross-Validation** A better way to test your models.		
6	**XGBoost** The most accurate modeling technique for structured data.		
7	**Data Leakage** Find and fix this problem that ruins your model in subtle ways.		

Course specifications

Jupyter notebook project (15%)

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optional:
Data Visualization

Data Visualization

Make great data visualizations. A great way to see the power of coding!

Begin Course

4 hours to go

Course Discussion

Lessons

		Tutorial	Exercise
1	**Hello, Seaborn** Your first introduction to coding for data visualization		
2	**Line Charts** Visualize trends over time		
3	**Bar Charts and Heatmaps** Use color or length to compare categories in a dataset		
4	**Scatter Plots** Leverage the coordinate plane to explore relationships between variables		
5	**Distributions** Create histograms and density plots		
6	**Choosing Plot Types and Custom Styles** Customize your charts and make them look snazzy		
7	**Final Project** Practice for real-world application		
8	**Creating Your Own Notebooks** How to put your new skills to use for your next personal or work project		

Course specifications

2 page (Calibri (body) font, size 11, A4) report about the obtained Kaggle contest results (20%)

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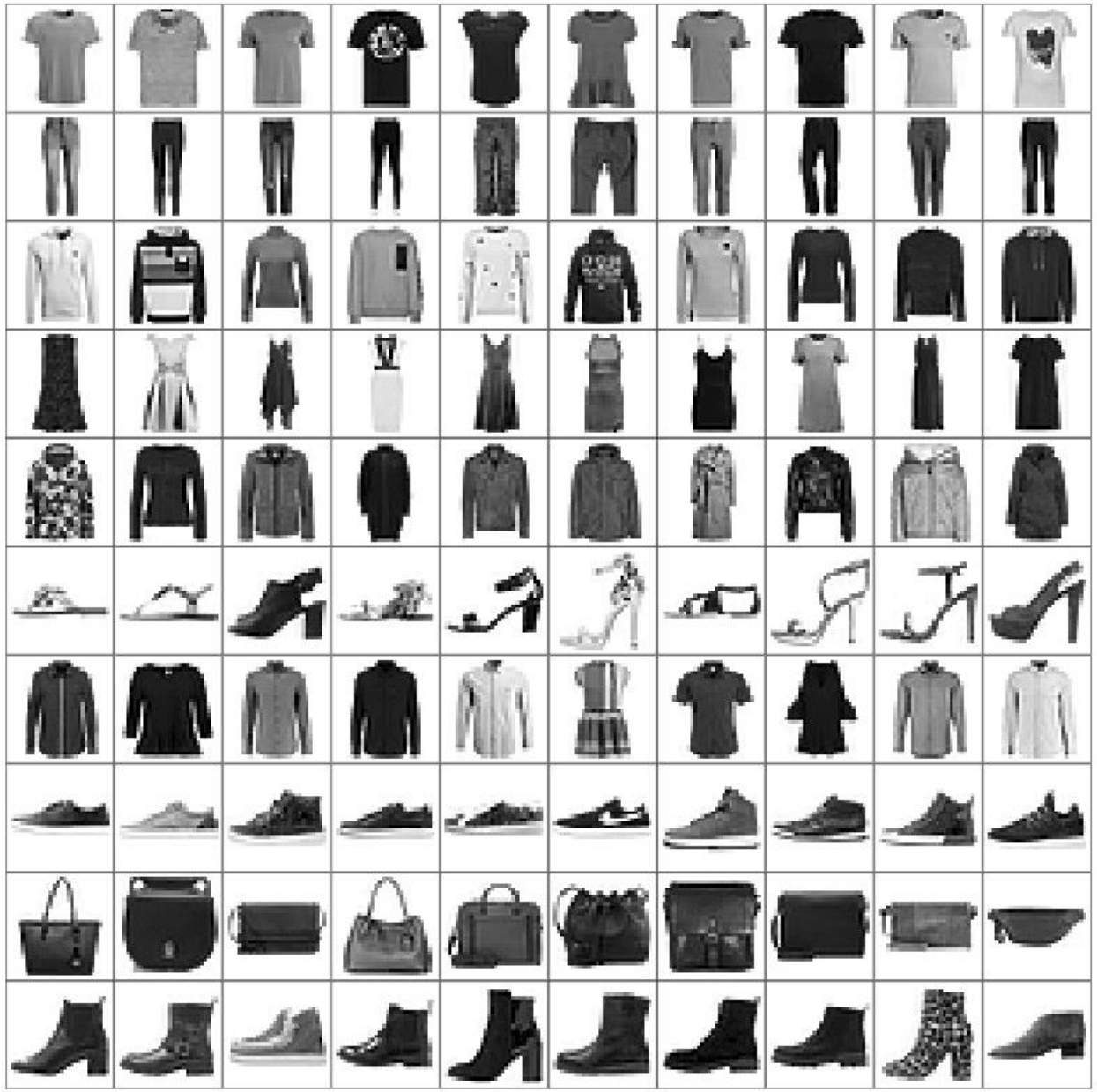
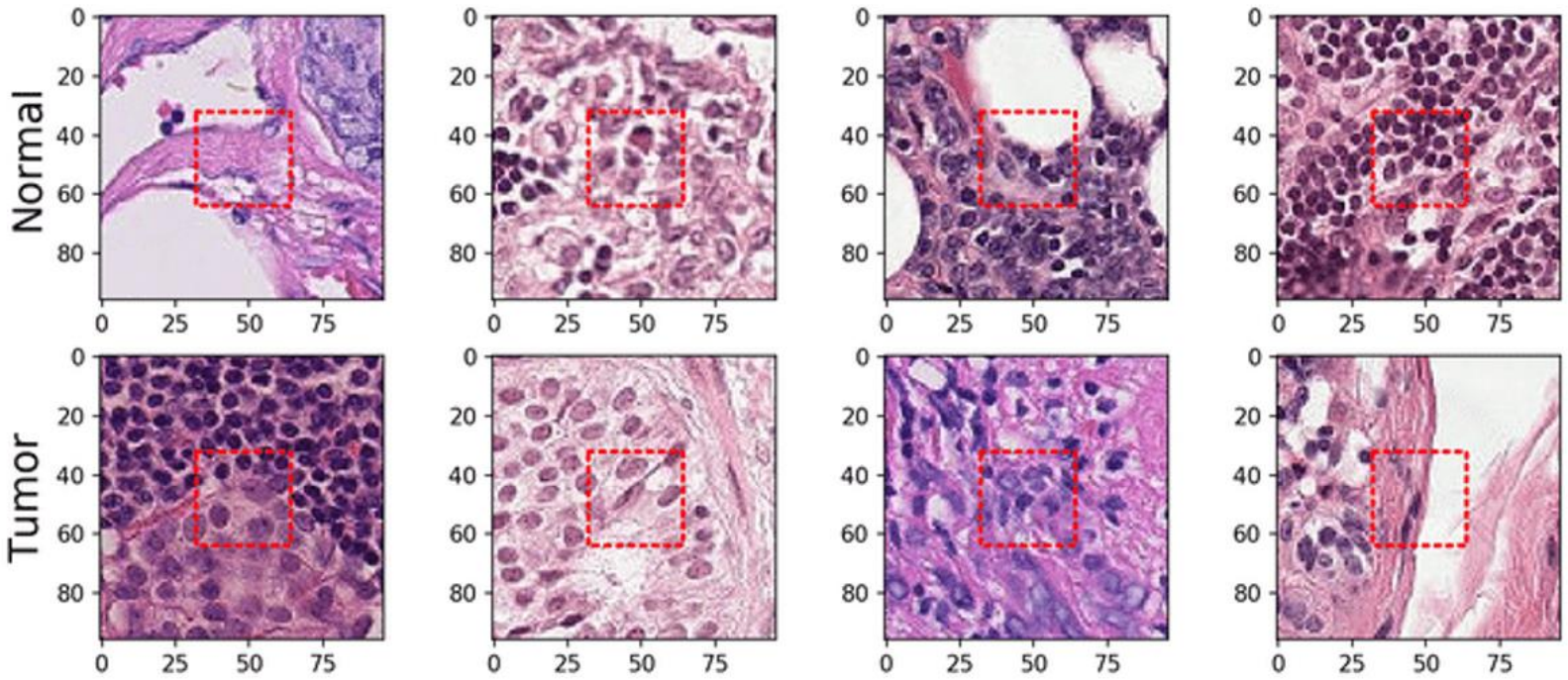


Course specifications

2 page (Calibri (body) font, size 11, A4) report about the obtained Kaggle contest results (20%)

histopathologic scans of lymph node sections

binary label indicating presence of metastatic tissue



Course specifications

2 page (Calibri (body) font, size 11, A4) report about the obtained Kaggle contest results (20%)

format: technical report

should contain:

- a clear and concise description of the method(s) used to fit your model(s)

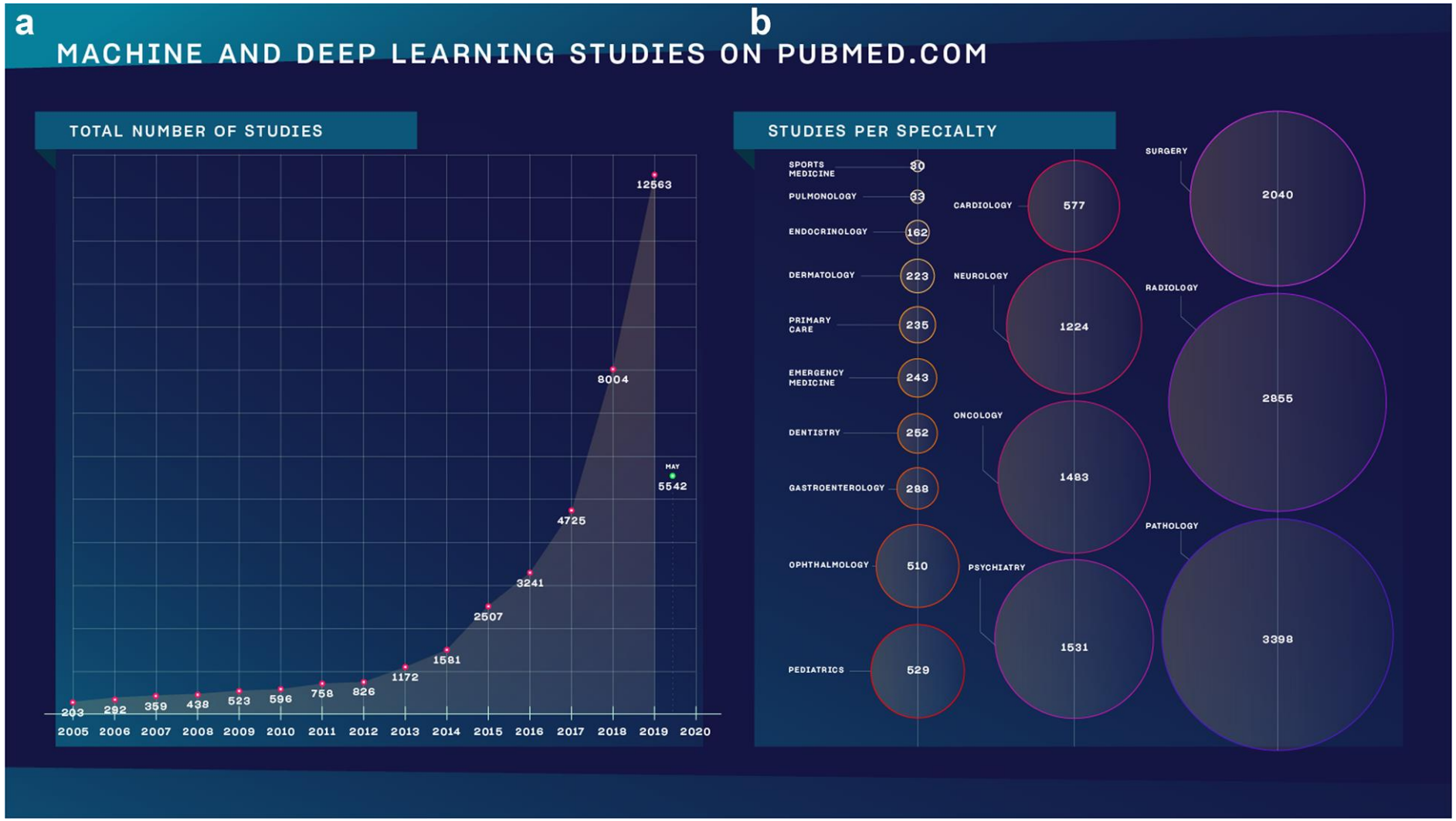
(show me you understand what you have done)

- a Table with optimal hyperparameter values
- a Table with evaluation results (both local CV and leaderboard test set)
- a section about what feature(s) are considered most important
- a short Discussion section
- clear plots are of course allowed as well!

Course specifications

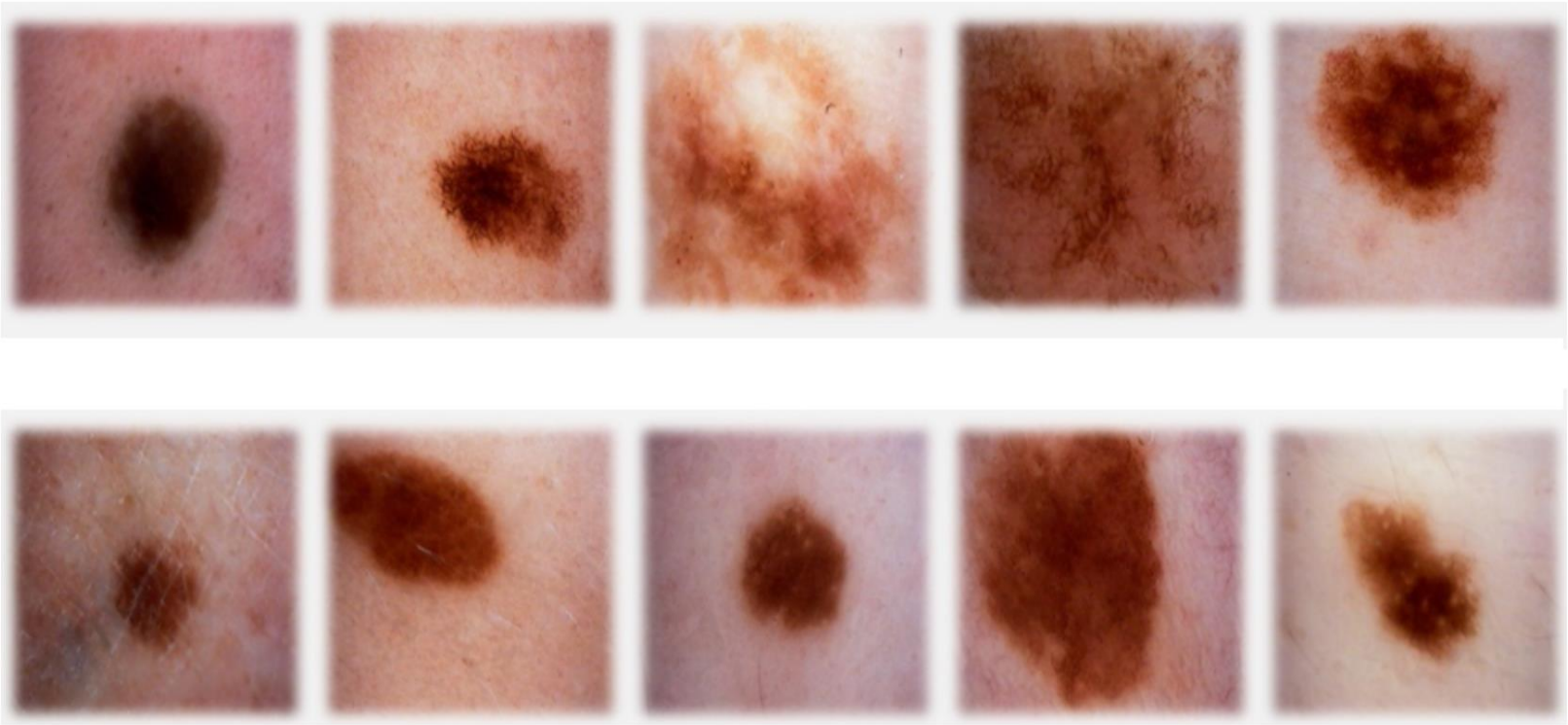
microteaching: teach other students about a machine learning method not discussed during the lectures (15%)

Why follow this course?



Meskó, B., Görög, M. A short guide for medical professionals in the era of artificial intelligence. npj Digit. Med. 3, 126 (2020)

classification

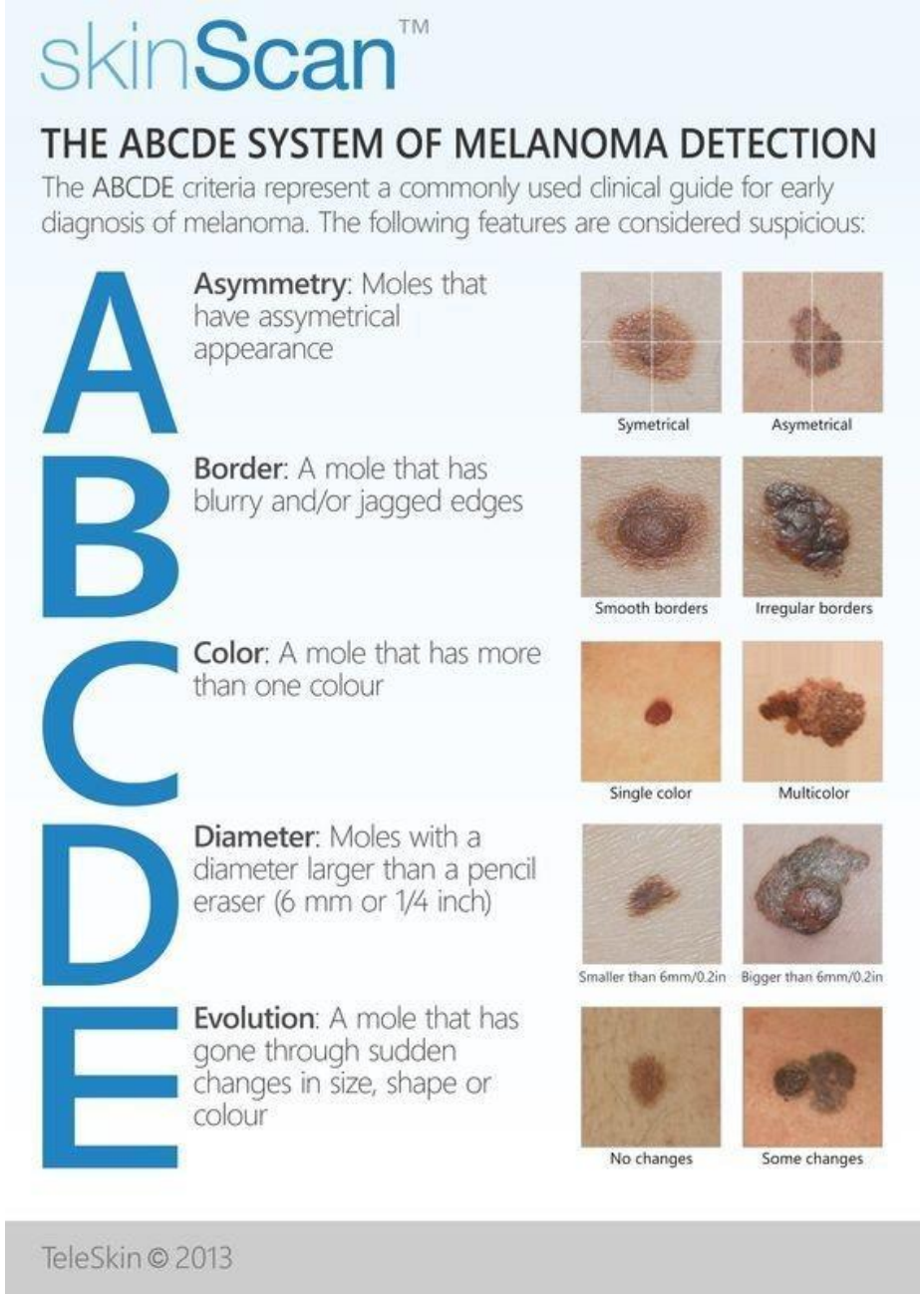


sign of cancer

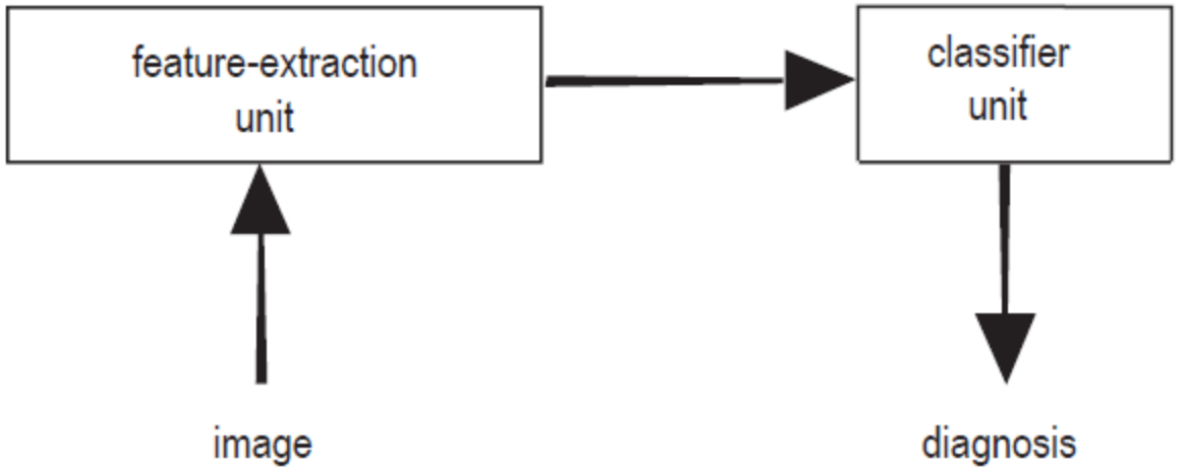
top row malignant

bottom row benign

classification



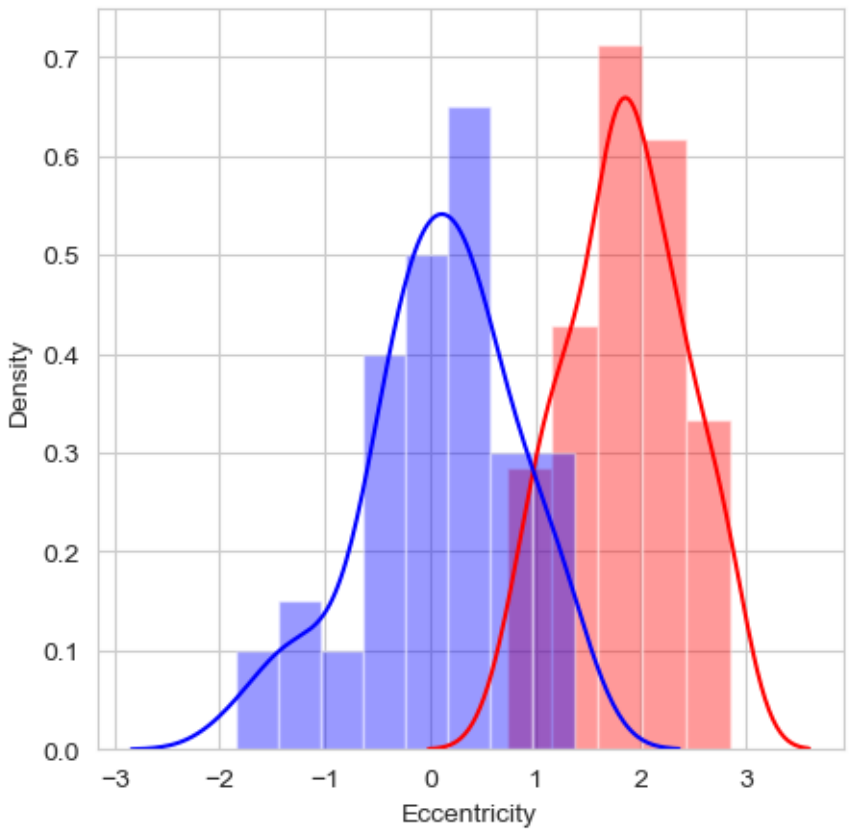
classification: terminology



feature extraction: features (a.k.a. properties or attributes)

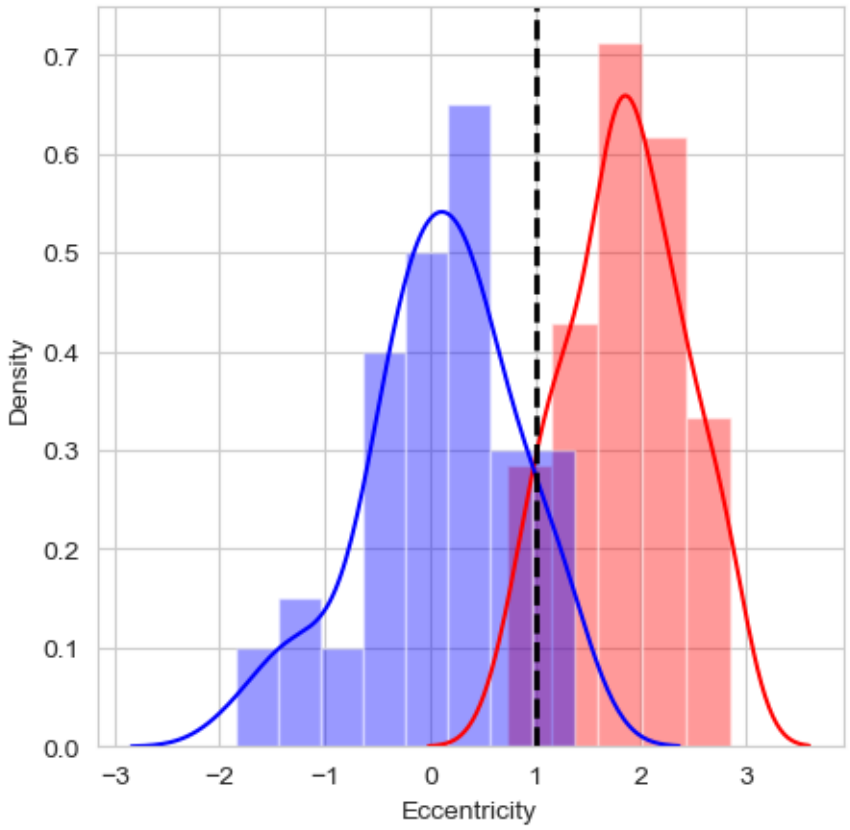
data set, sample (a.k.a. example, instance or data point), label (a.k.a. target)

classification: a feature



feature: eccentricity of lesion (how nearly circular the lesion is)

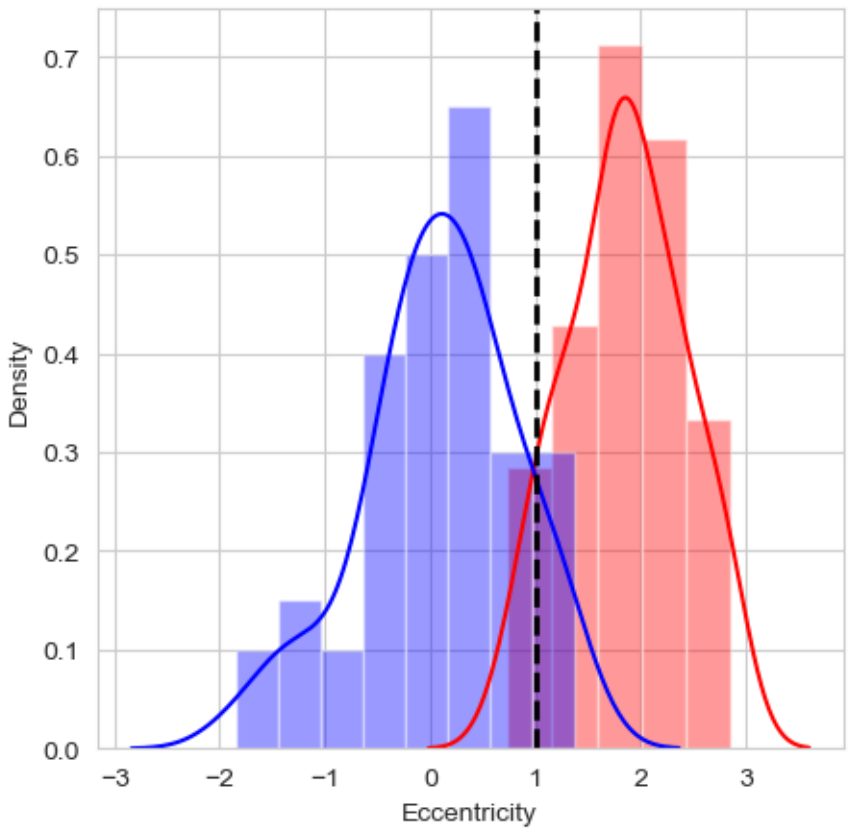
classification: the model

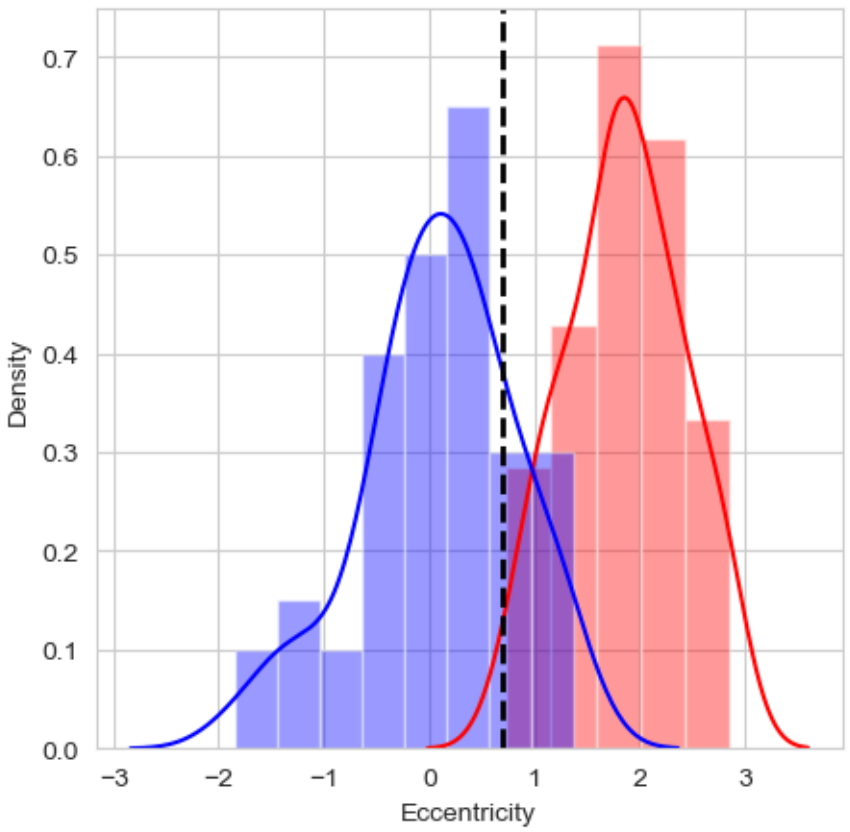


feature: eccentricity of lesion (how nearly circular the lesion is)

model: threshold ***t***

classification: the model





feature: eccentricity of lesion (how nearly circular the lesion is)

model: threshold ***t:*** consequence of the predictions

classification: prediction errors

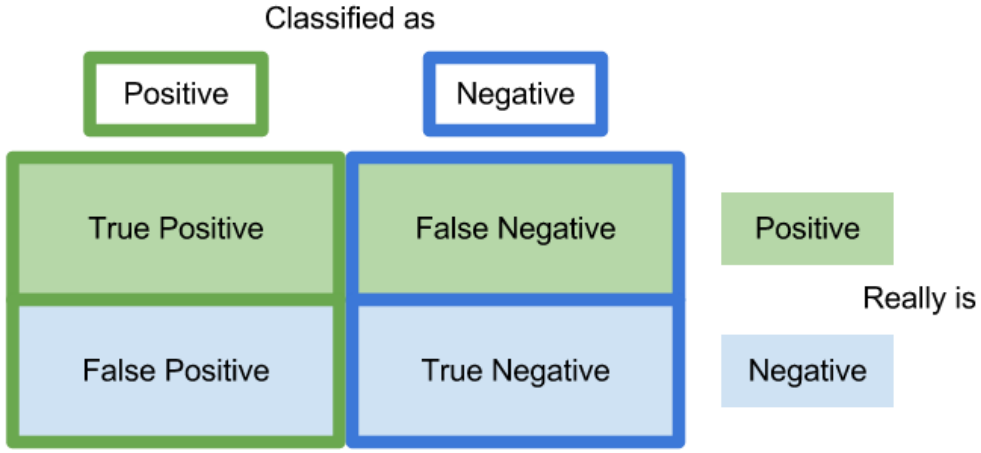
malignant: **positive** class
benign: **negative** class

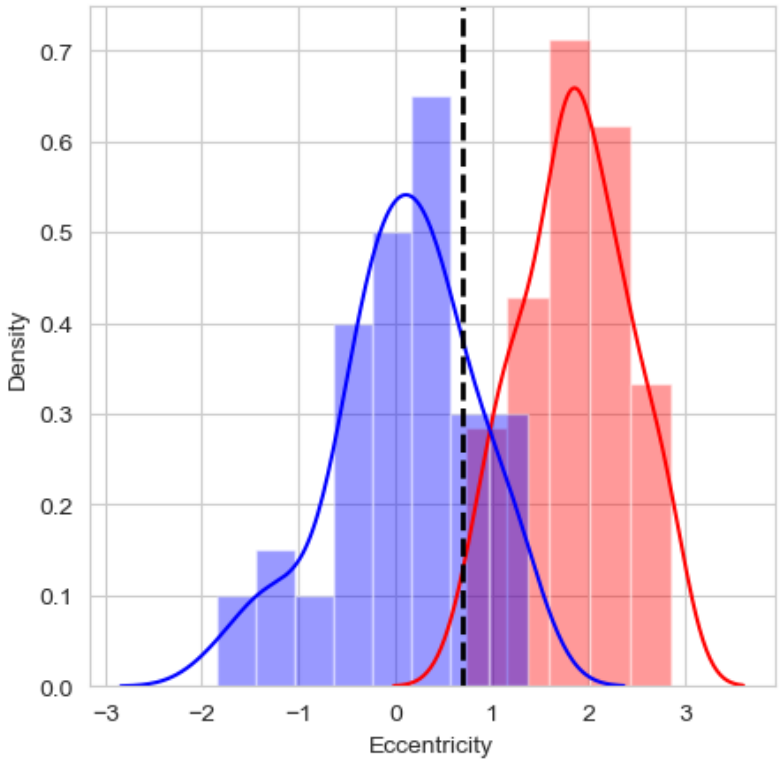
count the number of malignant images with eccentricity value $\geq t$: **true positive** predictions (TP)

count the number of malignant images with eccentricity value $< t$: **false negative** predictions (FN)

count the number of benign images with eccentricity value $\geq t$: **false positive** predictions (FP)

count the number of benign images with eccentricity value $< t$: **true negative** predictions (TN)





classification: prediction errors

	Classified as: Positive	Classified as: Negative
Really is: Positive	True Positive	False Negative
Really is: Negative	False Positive	True Negative

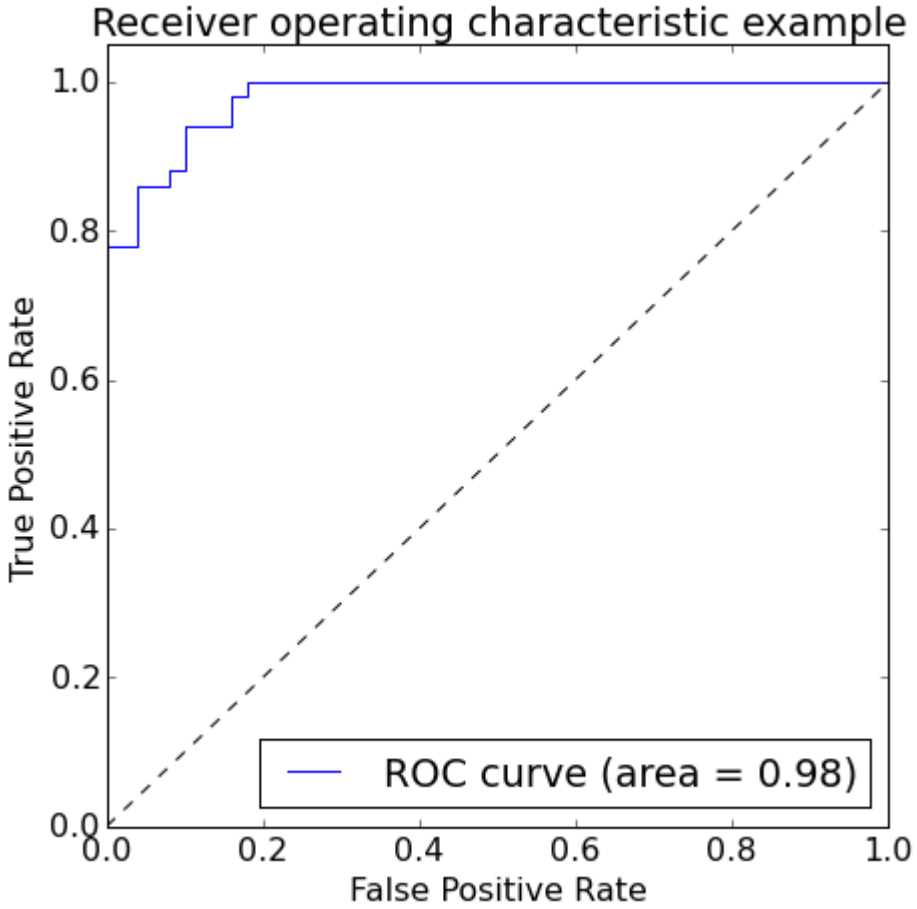
$$\text{accuracy} = \frac{TP + TN}{TP + FP + TN + FN}$$

$$\text{TPR} = \frac{TP}{TP + FN}$$

$$\text{FPR} = \frac{FP}{FP + TN}$$

classification: prediction errors

$$\mathrm{TPR} = \frac{TP}{TP + FN}$$



$$\mathrm{FPR} = \frac{FP}{FP + TN}$$

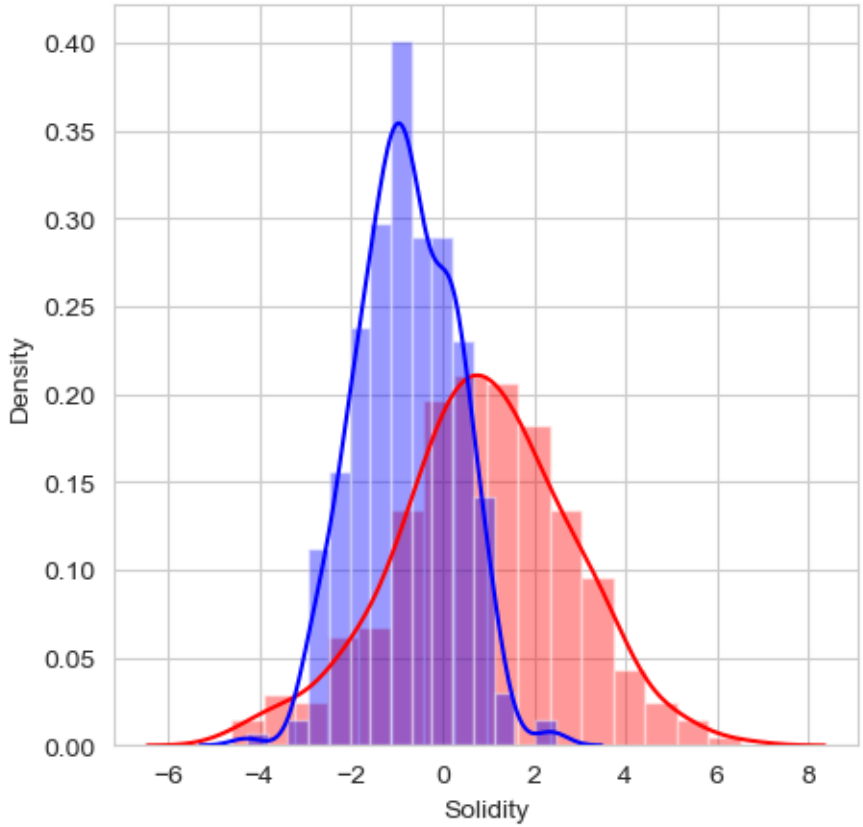
model that classifies all images as malignant:
TPR=1 and FPR=1

model that classifies all images a benign:
TPR=0 and FPR=0

vary threshold *t*

Area Under the Curve (AUC)

classification: multi-dimensional

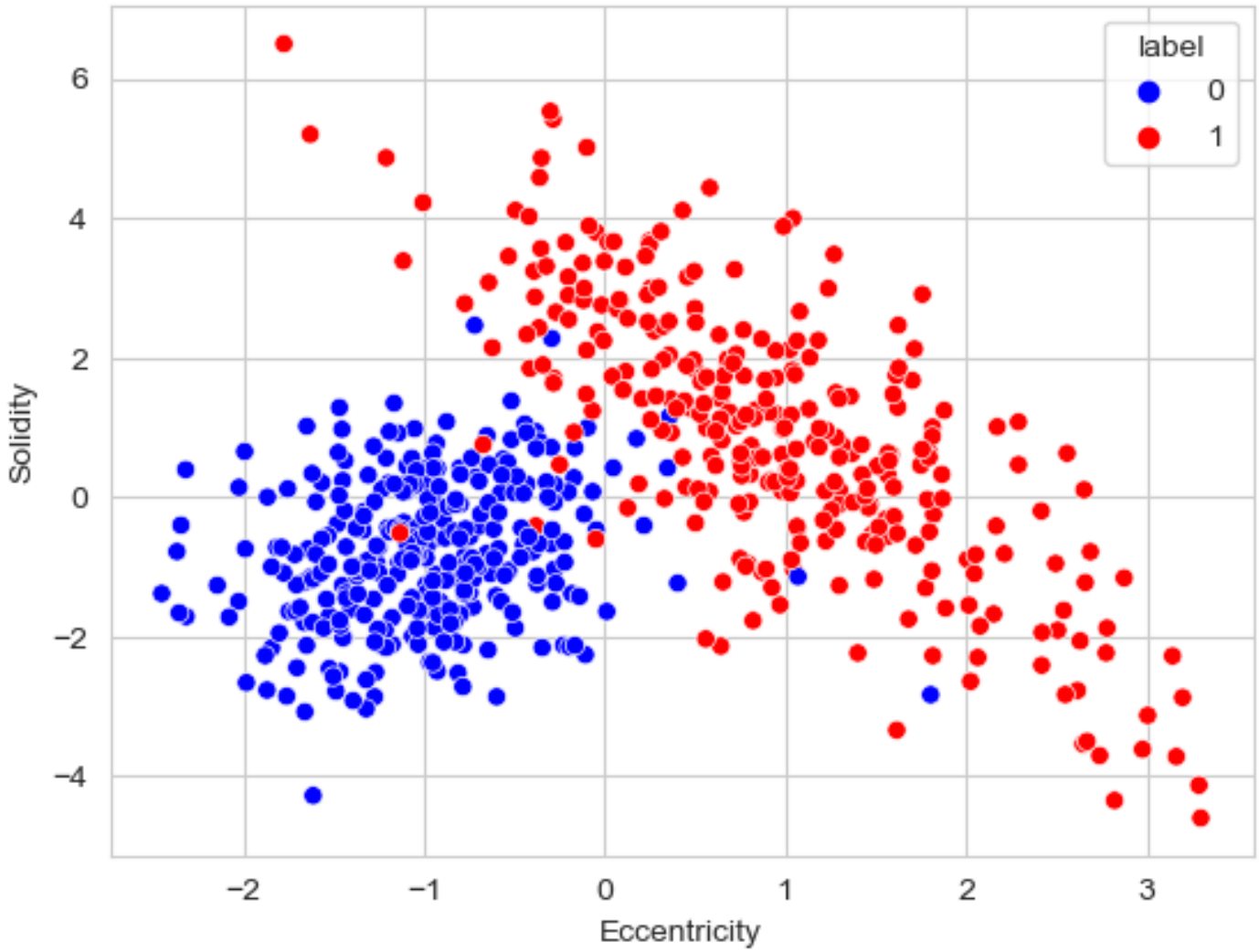


add another feature?

feature vector X

Euclidean vector space

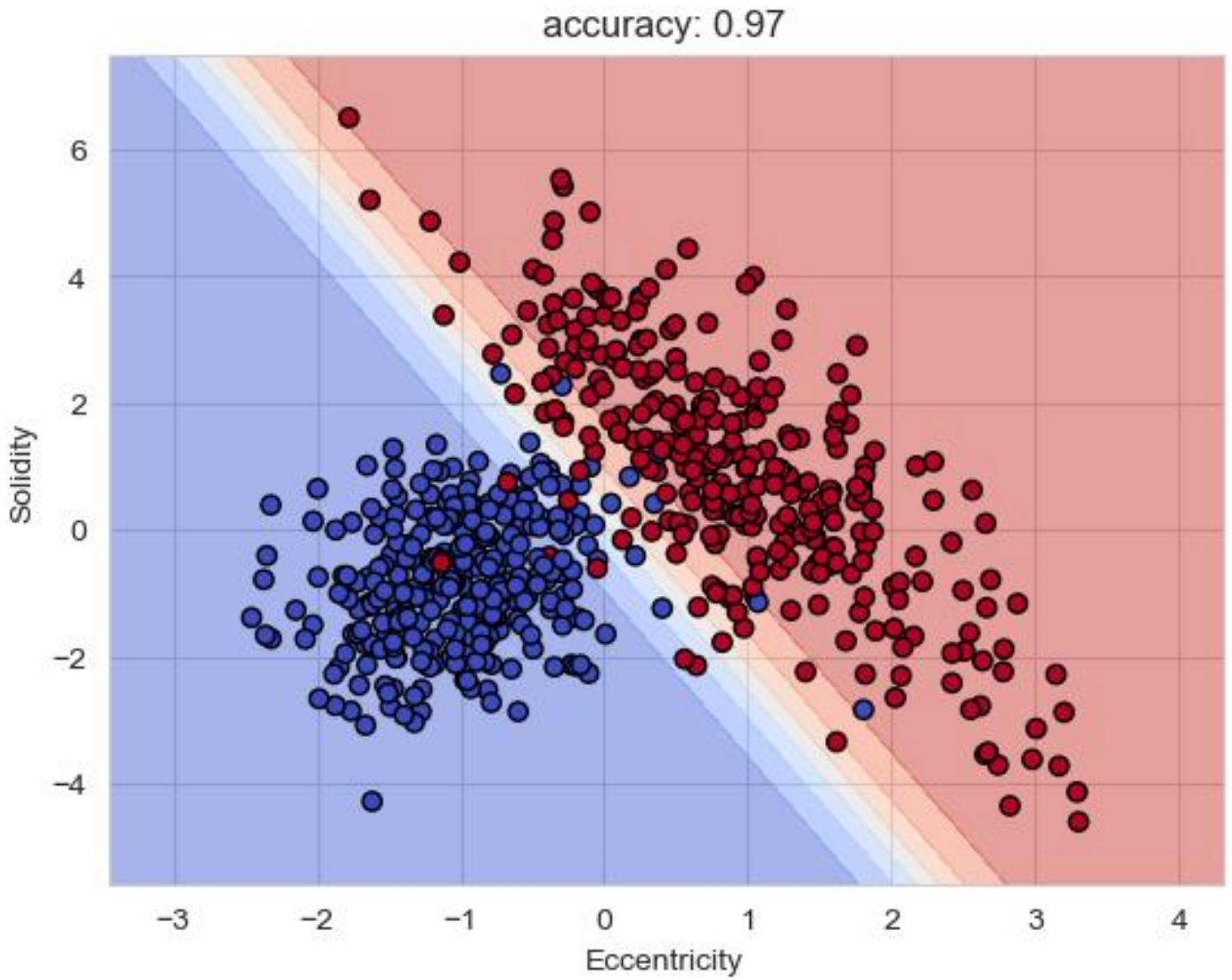
classification: multi-dimensional



feature vector X

Euclidean vector space

classification: multi-dimensional



linear decision boundary

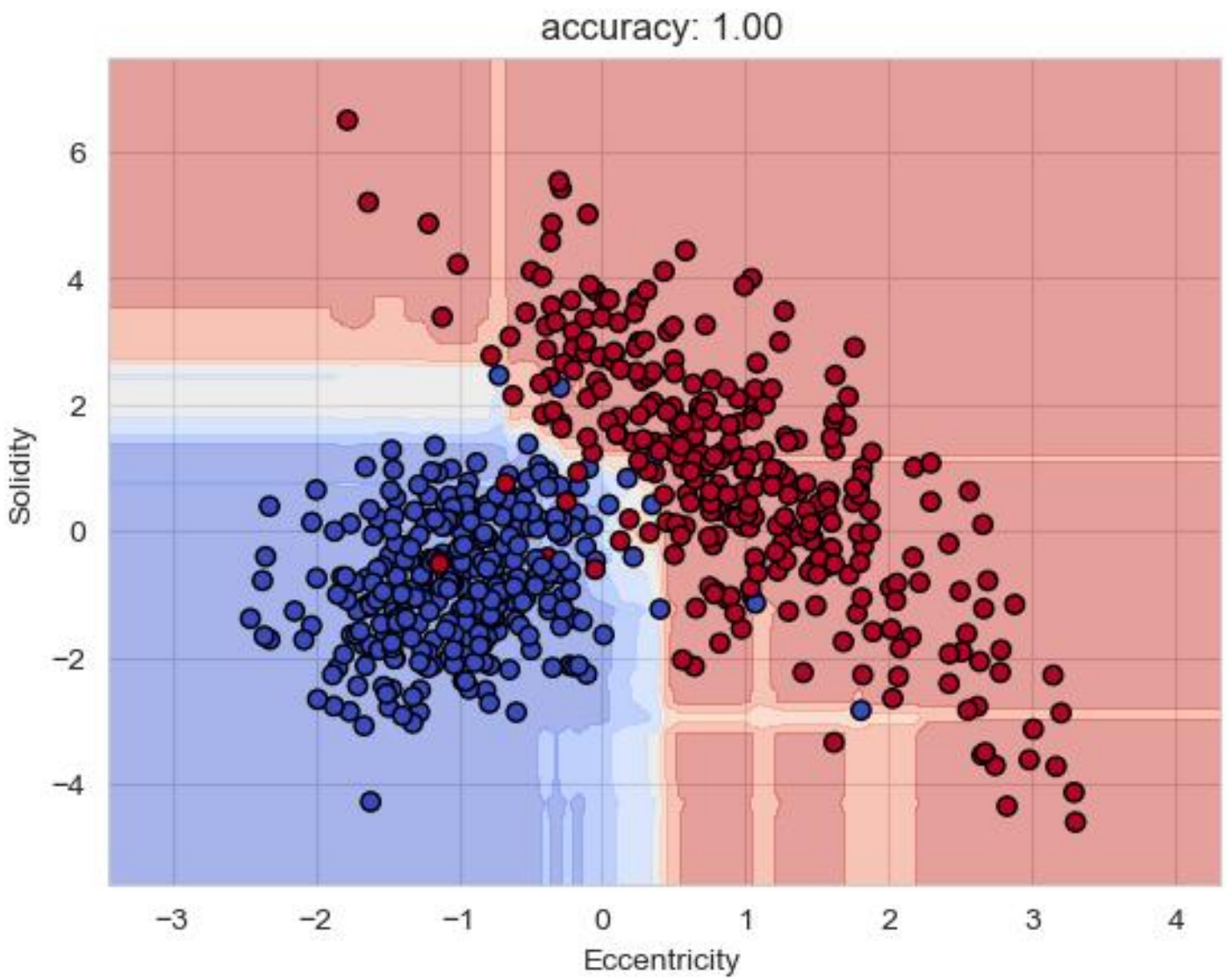
blue region malignant, red region benign

yet more features

can’t look at the decision boundary

more complex

classification: model complexity

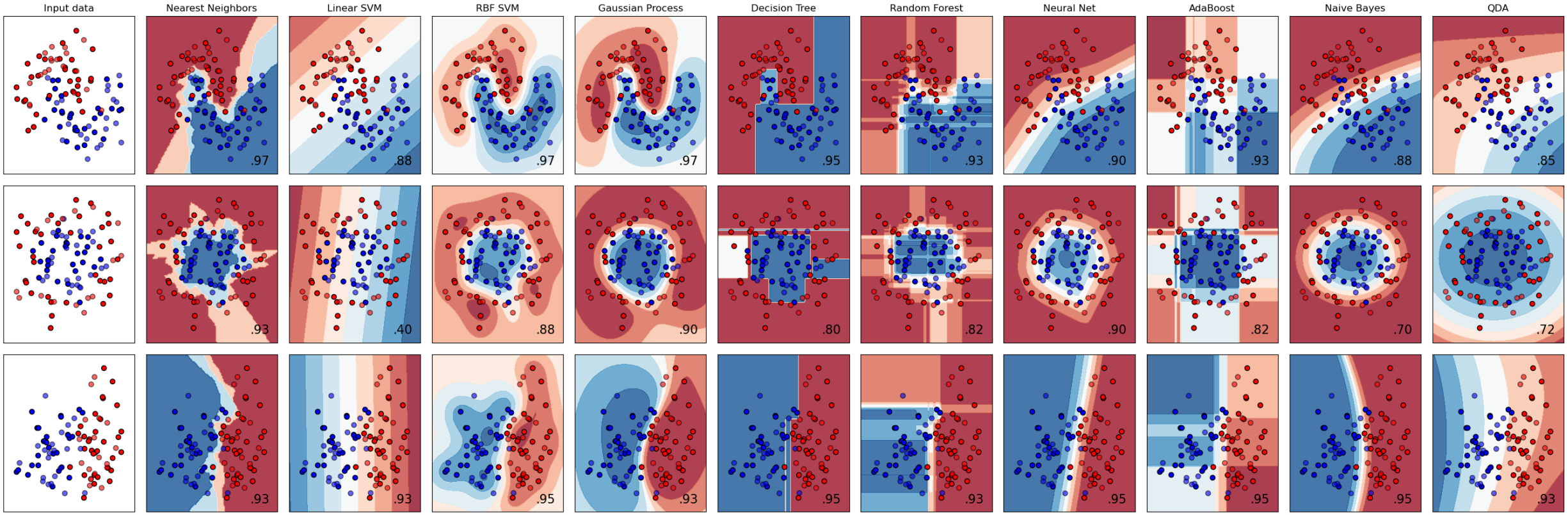


unseen external images

generalization

overfitting

scikit-learn



data normalization

make all features same scale

Eccentricity [0,100], Solidity [-5,7]

weights all features equally in their representation

standardization

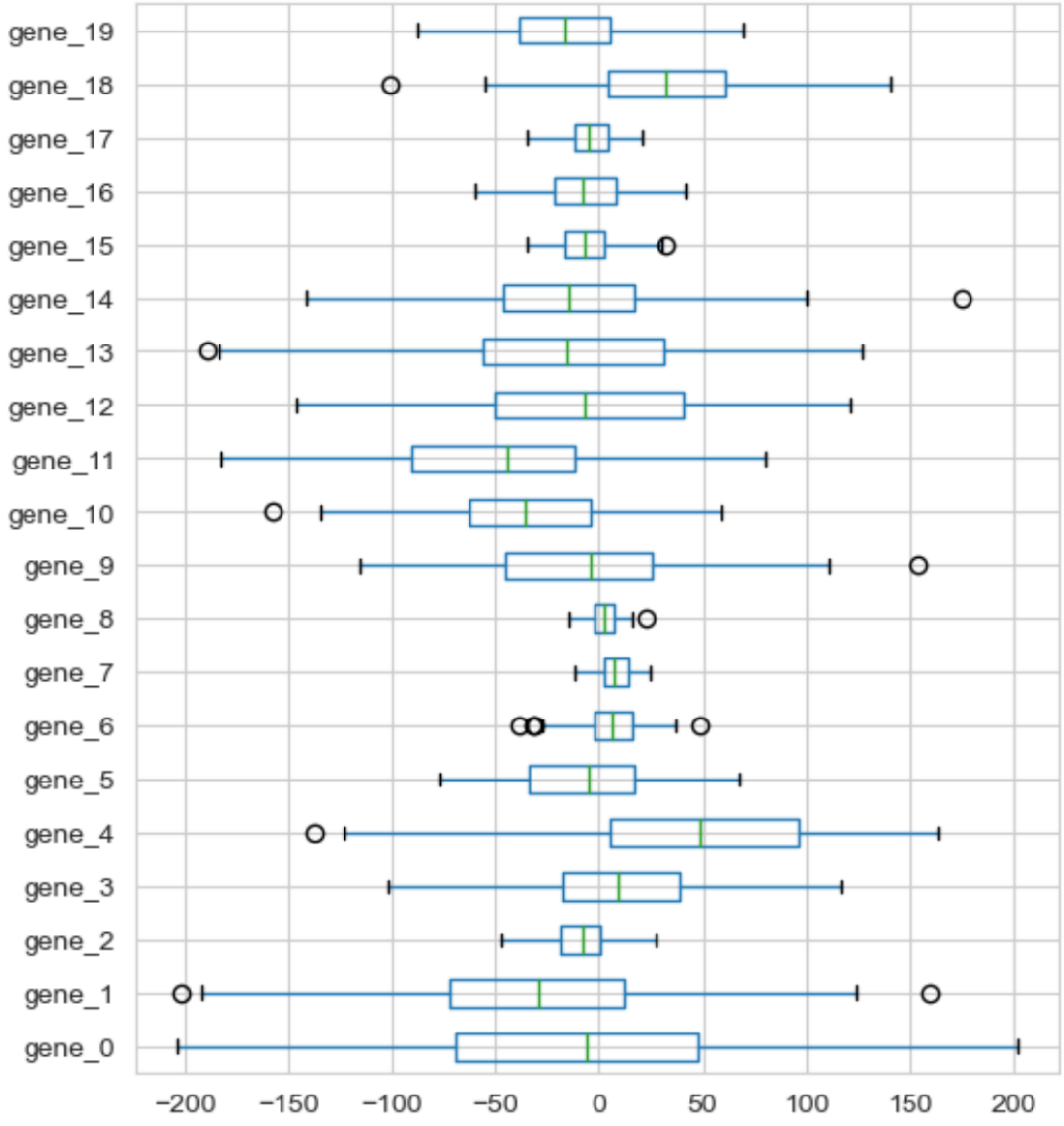
$$\mu = 0 \quad \sigma = 1$$

$$x_{norm} = \frac{x - \mu}{\sigma}$$

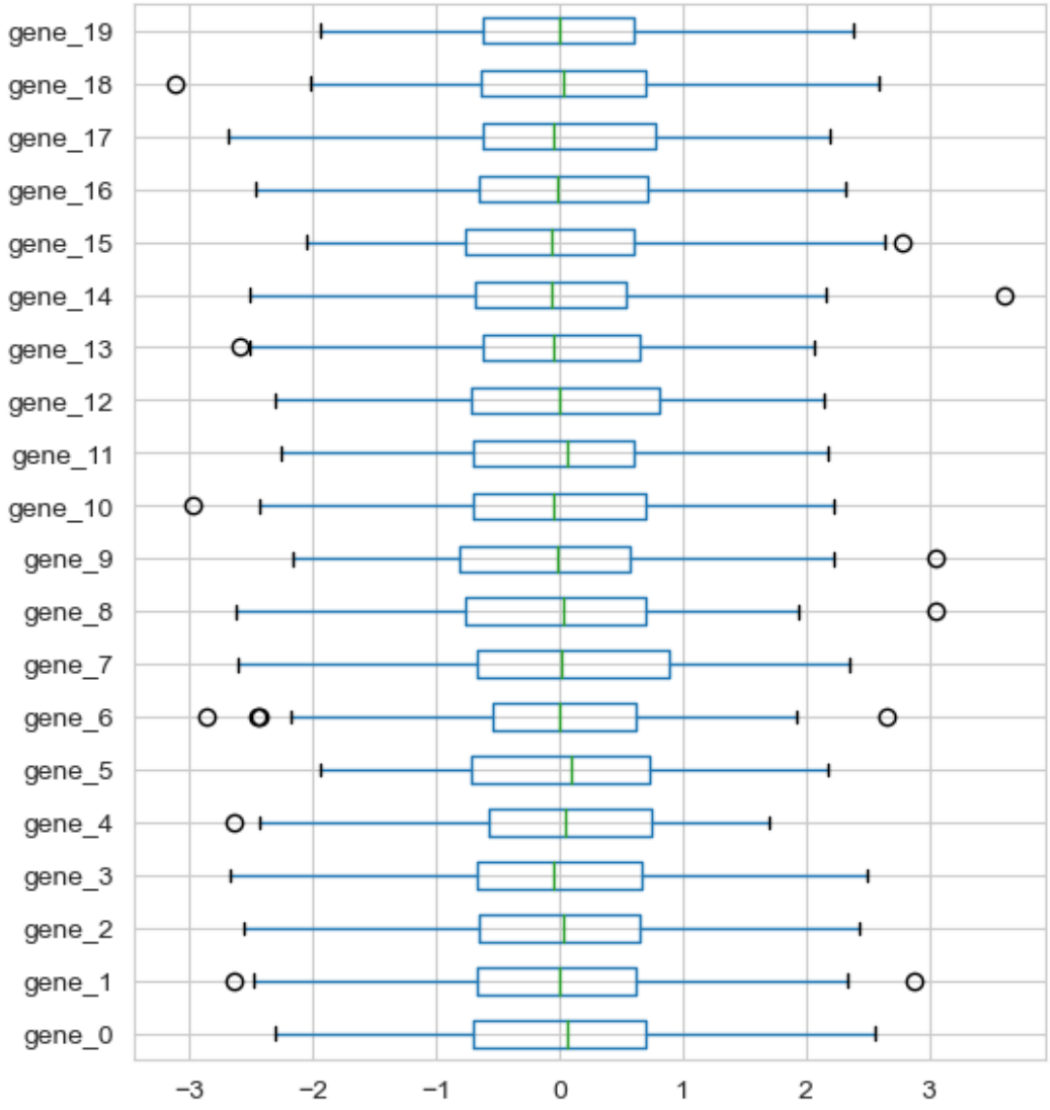
$$x_{norm} = \frac{x - x_{min}}{x_{max} - x_{min}}$$

min-max scaling: scale the features to a fixed range

data normalization

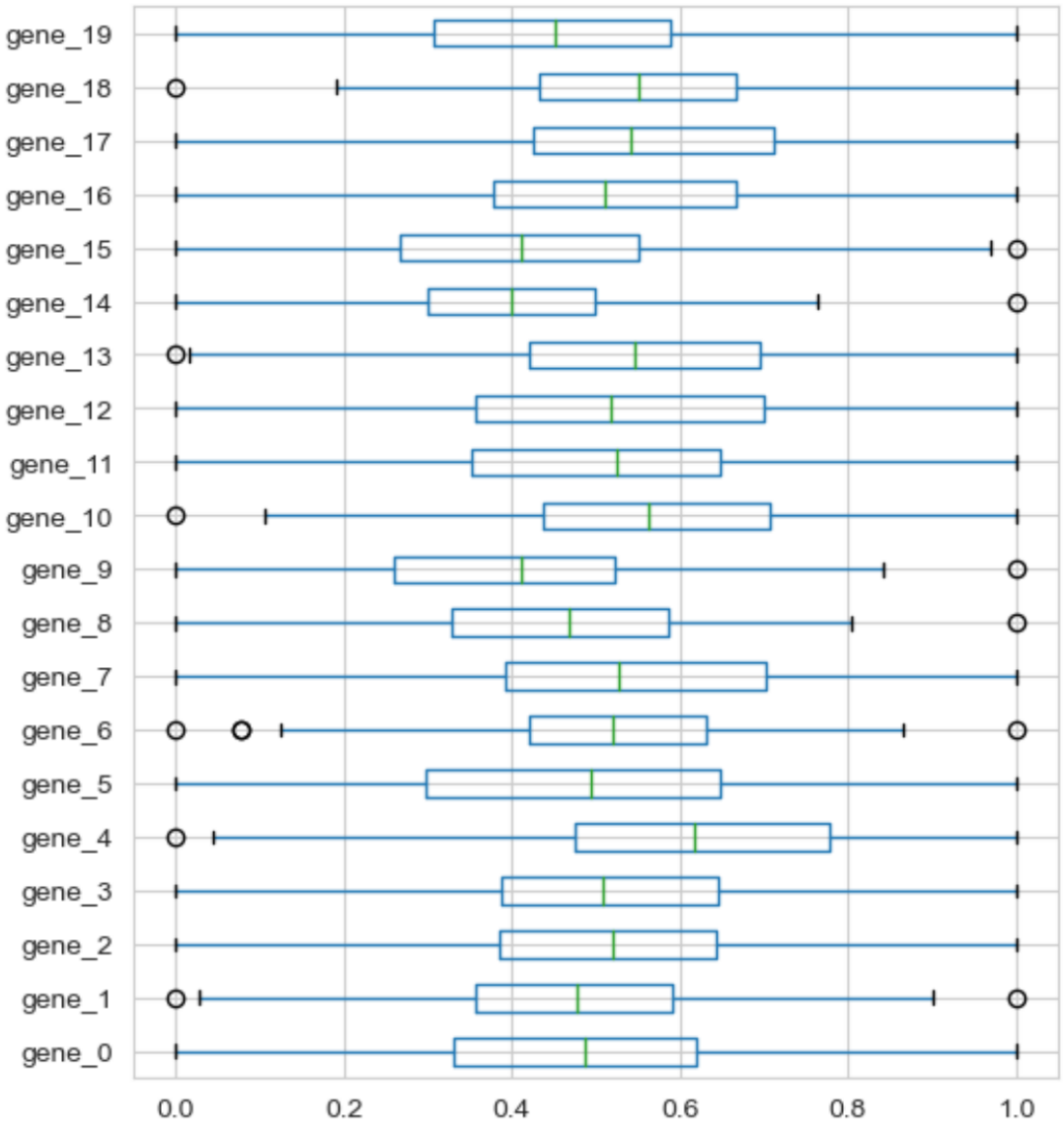


data normalization: standardization



$$x_{norm} = \frac{x - \mu}{\sigma}$$

data normalization: min-max scaling



$$x_{norm} = \frac{x - x_{min}}{x_{max} - x_{min}}$$