

A large, stylized silhouette of a person's head and shoulders, facing right. Inside the silhouette, a vibrant cityscape is visible, featuring the Eiffel Tower, the Oriental Pearl Tower, and the Empire State Building, suggesting a global or multicultural theme. The background is a warm, golden-yellow gradient.

SKEMA BUSINESS SCHOOL

**Introduction to
Artificial Intelligence**
Dmitry A. Zaitsev
<http://daze.ho.ua>



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A woman's silhouette is shown from the back, with her hair in a bun. Inside her head and shoulders, a city skyline is visible, featuring the Eiffel Tower, Christ the Redeemer, and the Empire State Building. The background is a warm, orange-hued sky.

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Lesson 7

Supervised Machine Learning



Lesson 7

Supervised Machine Learning

Working with labelled datasets

Organization of neuron networks

Training neuron networks

Prediction with neuron networks

Machine learning procedure

Neuron network learns and applies results of learning

- collect dataset or get data in real time
- train neuron network – adjust NN parameters for your task
- test neuron network – check how it recognizes new data
- use neuron network – practical use for prediction, recognition, classification, recommendation, control
- upload NN onto FPGA – Field Programmable Gate Arrays – AI in a box

Examples of FPGA



Types of machine learning

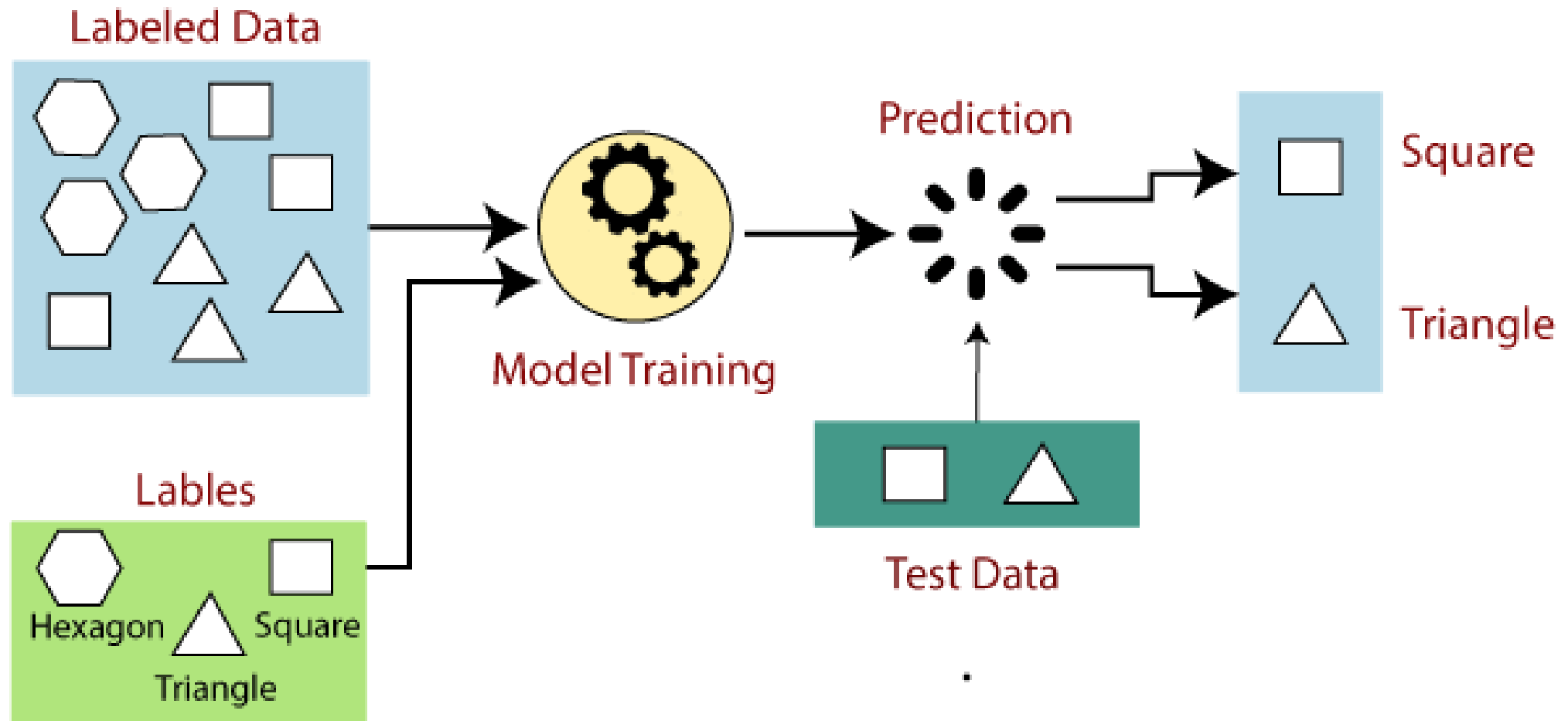
Learn and make predictions, find patterns, or classify data

- supervised – labelled training sets and data – recognize and classify data (fruits or vegetables, cats or dogs)
- unsupervised – unlabelled data – identify patterns and make decision – clustering (customer preferences)
- reinforced – learn by interacting with its environment and getting a positive or negative reward (traffic control)

Supervised learning

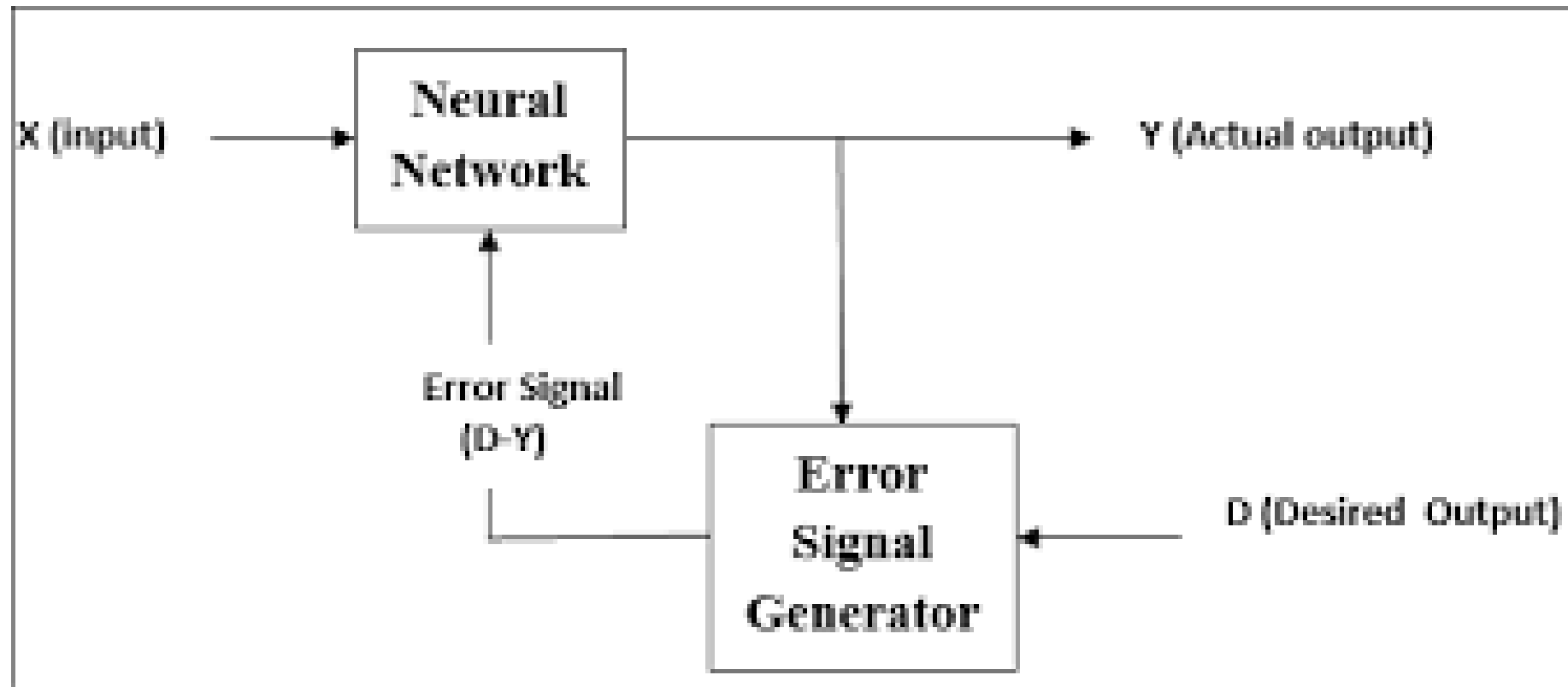
- Supervised learning describes a class of problem that involves using a model to learn a mapping between input examples and the target variable.
- Models are fit on training data comprised of inputs and outputs and used to make predictions on test sets where only the inputs are provided and the outputs from the model are compared to the target variables and used to estimate the skill of the model.
- Classification: Supervised learning problem that involves predicting a class label.
- Regression: Supervised learning problem that involves predicting a numerical label.

Supervised learning example scheme

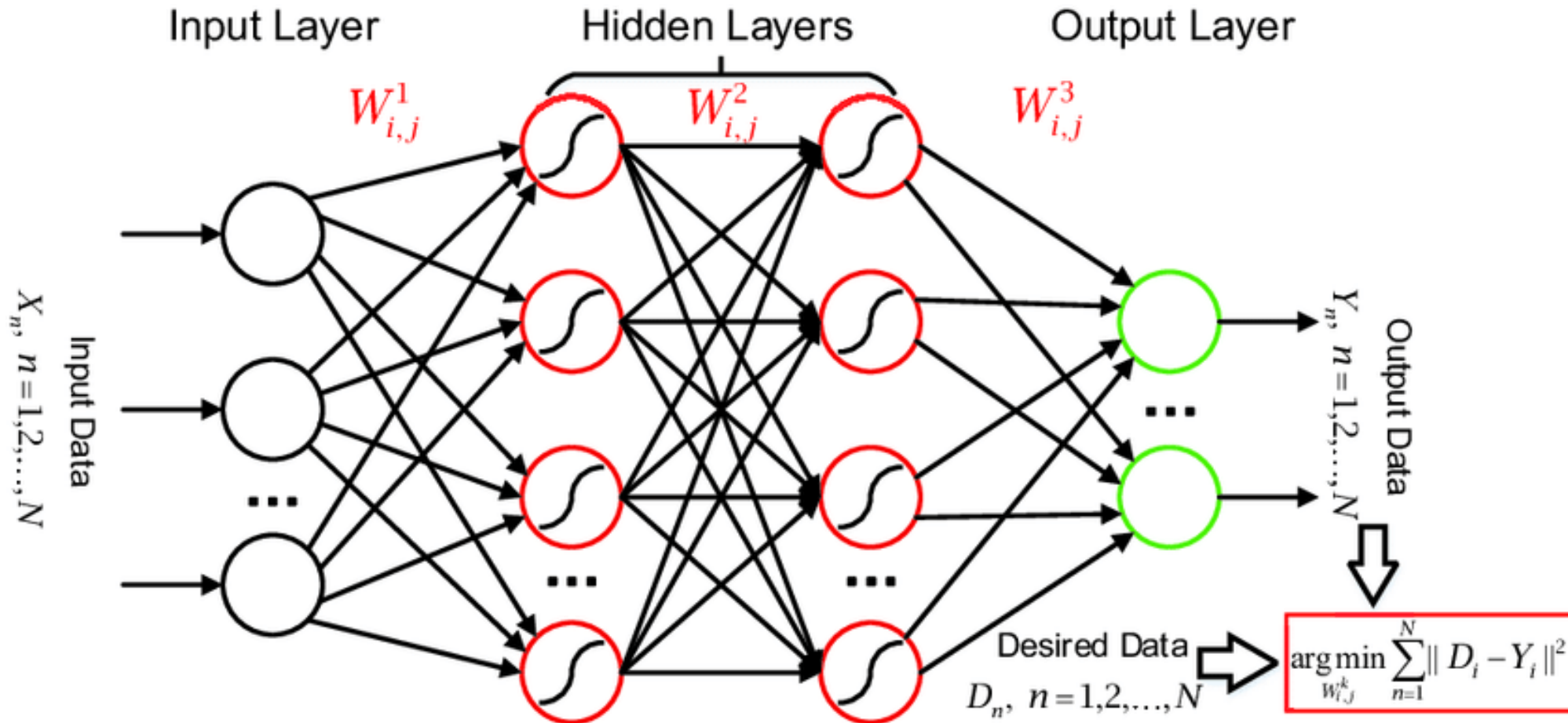


How to train NN

Error signal based correction



Neuron network for deep learning



Models for supervised learning

Basic models

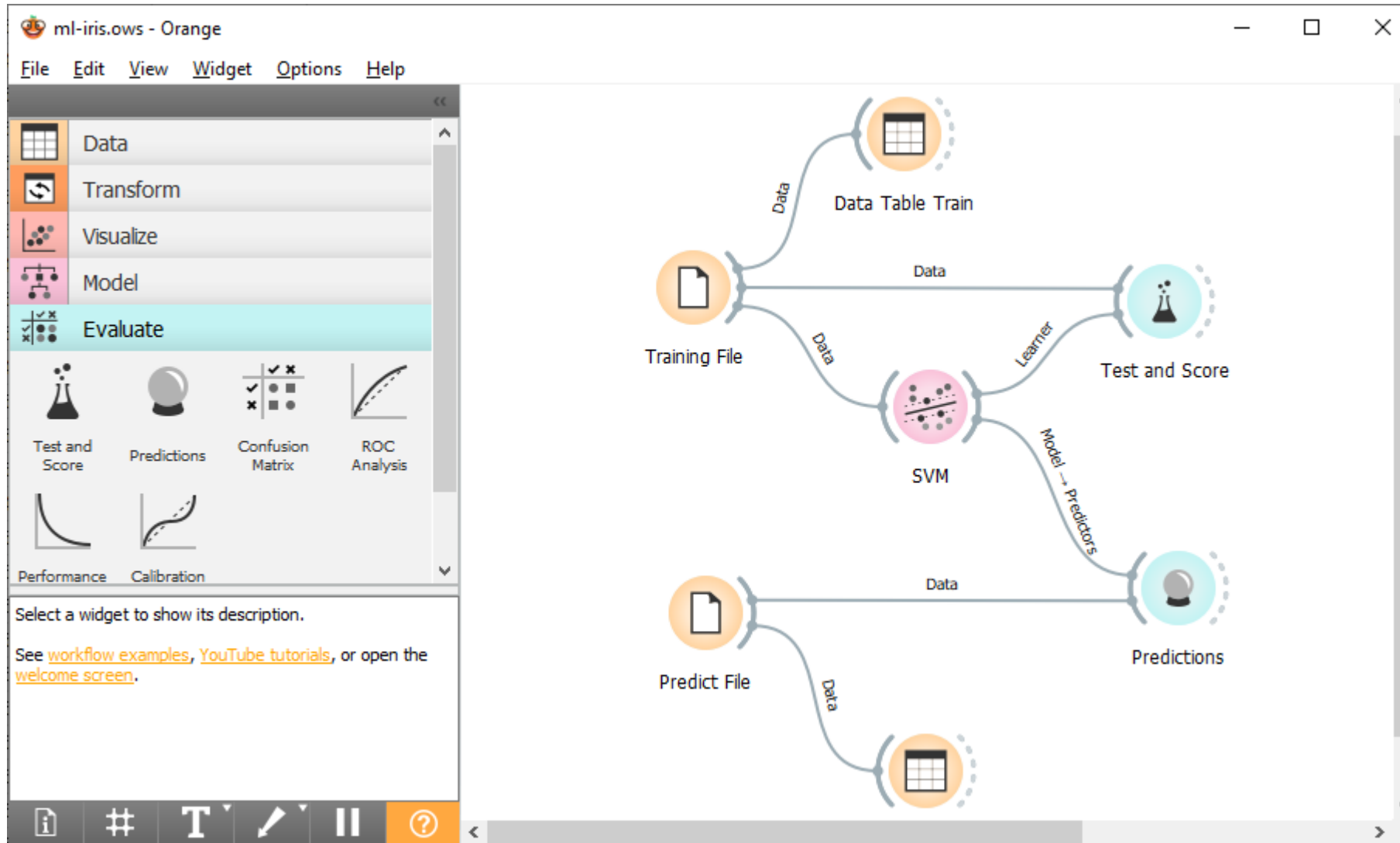
- Nearest Neighbor
- Naive Bayes
- Decision Trees
- Linear Regression
- Support Vector Machines (SVM)
- Neural Networks

Machine learning with Orange

Draw workflow, attach dataset, and use

- Model:
- Calibrated Learning, kNN, Tree, Random Forest, Gradient Boosting, SVM, Linear Regression, Logistic Regression, Naïve Bayes, Ada Boost, Curve Fit, Neural Network, Stochastic Gradient descend
- Evaluate:
- Test and Score, Prediction, Confusion Matrix, ROC Analysis, Performance Curve, Calibration Plot

Classifying with Orange



Training data set - irises

Data Table Train - Orange

Info						
150 instances (no missing data)						
4 features						
Target with 3 values						
No meta attributes.						
Variables						
<input checked="" type="checkbox"/> Show variable labels (if present)						
<input type="checkbox"/> Visualize numeric values						
<input checked="" type="checkbox"/> Color by instance classes						
Selection						
<input checked="" type="checkbox"/> Select full rows						
		iris	sepal length	sepal width	petal length	petal width
1	Iris-setosa	5.1	3.5	1.4	0.2	
2	Iris-setosa	4.9	3.0	1.4	0.2	
3	Iris-setosa	4.7	3.2	1.3	0.2	
4	Iris-setosa	4.6	3.1	1.5	0.2	
5	Iris-setosa	5.0	3.6	1.4	0.2	
6	Iris-setosa	5.4	3.9	1.7	0.4	
7	Iris-setosa	4.6	3.4	1.4	0.3	
8	Iris-setosa	5.0	3.4	1.5	0.2	
9	Iris-setosa	4.4	2.9	1.4	0.2	
10	Iris-setosa	4.9	3.1	1.5	0.1	
11	Iris-setosa	5.4	3.7	1.5	0.2	
12	Iris-setosa	4.8	3.4	1.6	0.2	
13	Iris-setosa	4.8	3.0	1.4	0.1	
14	Iris-setosa	4.3	3.0	1.1	0.1	
15	Iris-setosa	5.8	4.0	1.2	0.2	
16	Iris-setosa	5.7	4.4	1.5	0.4	
17	Iris-setosa	5.4	3.9	1.3	0.4	
18	Iris-setosa	5.1	3.5	1.4	0.3	
19	Iris-setosa	5.7	3.8	1.7	0.3	
20	Iris-setosa	5.1	3.8	1.5	0.3	
21	Iris-setosa	5.4	3.4	1.7	0.2	
22	Iris-setosa	5.1	3.7	1.5	0.4	
23	Iris-setosa	4.6	3.6	1.0	0.2	
24	Iris-setosa	5.1	3.3	1.7	0.5	
25	Iris-setosa	4.8	3.4	1.9	0.2	
26	Iris-setosa	5.0	3.0	1.6	0.2	
27	Iris-setosa	5.0	3.4	1.6	0.4	
28	Iris-setosa	5.2	3.5	1.5	0.2	
29	Iris-setosa	5.2	3.4	1.4	0.2	
30	Iris-setosa	4.7	3.2	1.6	0.2	
31	Iris-setosa	4.9	3.1	1.6	0.2	

Restore Original Order

☒ Send Automatically

? | 150 | 150 | 150

Training File - Orange

Source

☒ File: iris.tab

☐ URL:

File Type

Automatically detect type

Info

Iris flower dataset

Classical dataset with 150 instances of Iris setosa, Iris virginica and Iris versicolor.

150 instances
4 features (no missing values)
Classification; categorical class with 3 values (no missing values)
0 meta attributes

Columns (Double click to edit)

	Name	Type	Role	Values
1	sepal length	N numeric	feature	
2	sepal width	N numeric	feature	
3	petal length	N numeric	feature	
4	petal width	N numeric	feature	
5	iris	C categorical	target	Iris-setosa, Iris-versicolor, Iris-virginica

? | 150

Activate Windows
Go to Settings to activate Windows.

Prediction

Predictions - Orange

Show probabilities for (None)

Restore Original Order

	Random Forest	sepal length	sepal width	petal length	petal width
1	Iris-setosa	5.1	3.5	1.4	0.2
2	Iris-setosa	4.9	3.0	1.4	0.2
3	Iris-setosa	4.7	3.2	1.3	0.2
4	Iris-setosa	4.6	3.1	1.5	0.2
5	Iris-setosa	5.0	3.6	1.4	0.2
6	Iris-setosa	5.4	3.9	1.7	0.4
7	Iris-setosa	4.6	3.4	1.4	0.3
8	Iris-setosa	5.0	3.4	1.5	0.2
9	Iris-setosa	4.4	2.9	1.4	0.2
10	Iris-setosa	4.9	3.1	1.5	0.1
11	Iris-setosa	5.4	3.7	1.5	0.2
12	Iris-setosa	4.8	3.4	1.6	0.2
13	Iris-setosa	4.8	3.0	1.4	0.1
14	Iris-setosa	4.3	3.0	1.1	0.1
15	Iris-setosa	5.8	4.0	1.2	0.2
16	Iris-setosa	5.7	4.4	1.5	0.4
17	Iris-setosa	5.4	3.9	1.3	0.4
18	Iris-setosa	5.1	3.5	1.4	0.3
19	Iris-setosa	5.7	3.8	1.7	0.3
20	Iris-setosa	5.1	3.8	1.5	0.3
21	Iris-setosa	5.4	3.4	1.7	0.2
22	Iris-setosa	5.1	3.7	1.5	0.4
23	Iris-setosa	4.6	3.6	1.0	0.2
24	Iris-setosa	5.1	3.3	1.7	0.5
25	Iris-setosa	4.8	3.4	1.9	0.2
26	Iris-setosa	5.0	3.0	1.6	0.2
27	Iris-setosa	5.0	3.4	1.6	0.4
28	Iris-setosa	5.2	3.5	1.5	0.2

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Prediction

Predictions - Orange

Show probabilities for (None)

Restore Original Order

	SVM	kNN	Random Forest	Neural Network	sepal length	sepal width	petal length	petal width
1	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.1	3.5	1.4	0.2
2	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.9	3.0	1.4	0.2
3	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.7	3.2	1.3	0.2
4	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.6	3.1	1.5	0.2
5	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.0	3.6	1.4	0.2
6	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.4	3.9	1.7	0.4
7	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.6	3.4	1.4	0.3
8	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.0	3.4	1.5	0.2
9	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.4	2.9	1.4	0.2
10	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.9	3.1	1.5	0.1
11	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.4	3.7	1.5	0.2
12	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.8	3.4	1.6	0.2
13	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.8	3.0	1.4	0.1
14	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.3	3.0	1.1	0.1
15	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.8	4.0	1.2	0.2
16	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.7	4.4	1.5	0.4
17	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.4	3.9	1.3	0.4
18	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.1	3.5	1.4	0.3
19	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.7	3.8	1.7	0.3
20	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.1	3.8	1.5	0.3
21	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.4	3.4	1.7	0.2
22	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.1	3.7	1.5	0.4
23	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.6	3.6	1.0	0.2
24	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.1	3.3	1.7	0.5
25	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	4.8	3.4	1.9	0.2
26	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.0	3.0	1.6	0.2
27	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.0	3.4	1.6	0.4
28	Iris-setosa	Iris-setosa	Iris-setosa	Iris-setosa	5.2	3.5	1.5	0.2

Activate Windows

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62°F Partly sunny

ENG

9:15 AM
4/1/2023

Test and Score

Test and Score - Orange

☒ Cross validation
 Number of folds: 5
☒ Stratified

☐ Cross validation by feature
 [Dropdown]

☐ Random sampling
 Repeat train/test: 10
 Training set size: 66 %
☒ Stratified

☐ Leave one out
☐ Test on train data
☐ Test on test data

Evaluation results for target: (None, show average over classes)

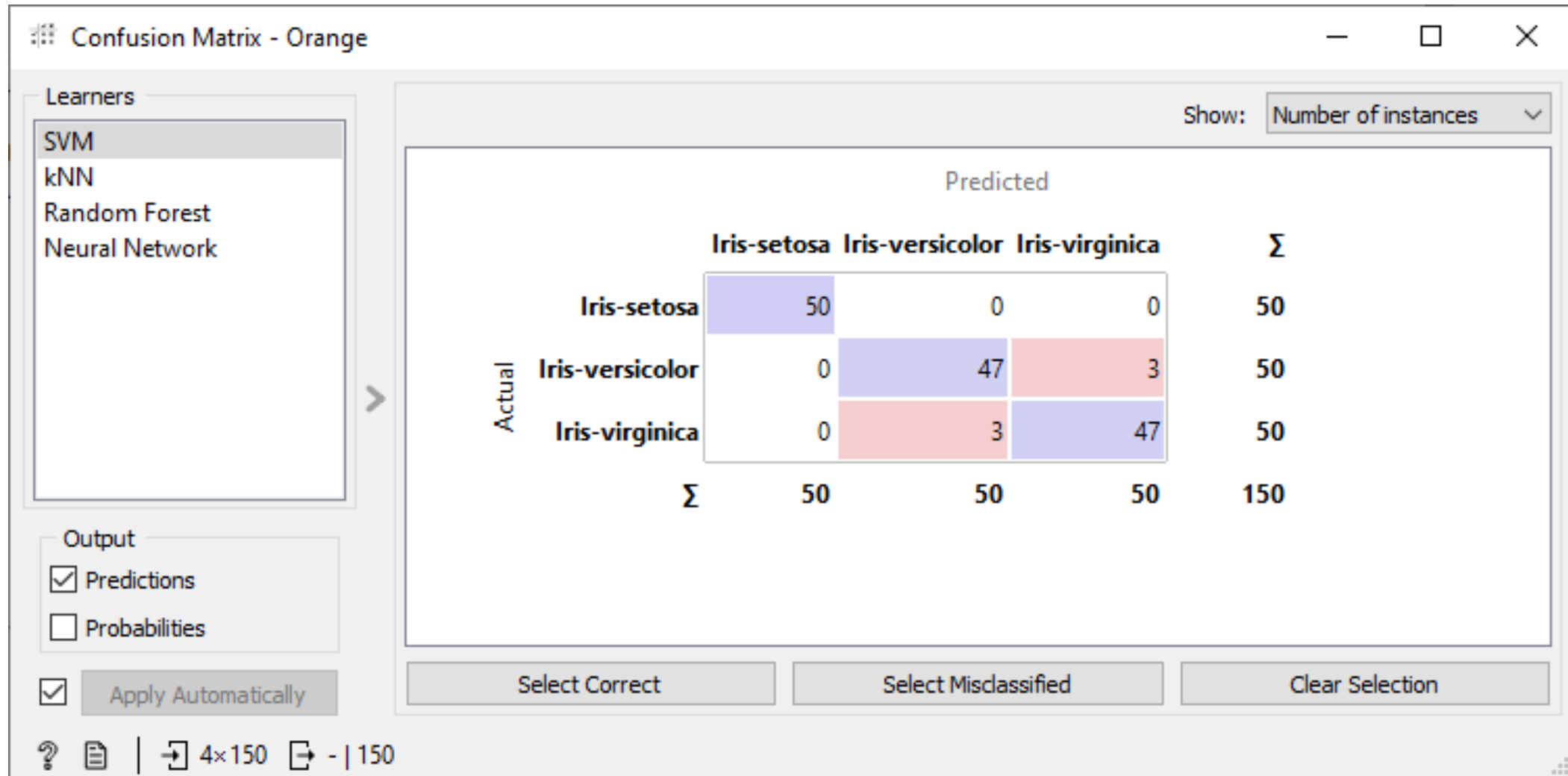
Model	AUC	CA	F1	Precision	Recall
Neural Network	0.993	0.947	0.947	0.948	0.947
SVM	0.997	0.960	0.960	0.960	0.960
kNN	0.987	0.967	0.967	0.967	0.967
Random Forest	0.991	0.967	0.967	0.967	0.967

Compare models by: Classification accuracy
☐ Negligible diff.: 0.1

	Neural Network	SVM	kNN	Random Forest
Neural Network		0.169	0.187	0.187
SVM	0.831		0.271	0.271
kNN	0.813	0.729		0.500
Random Forest	0.813	0.729	0.500	

Table shows probabilities that the score for the model in the row is higher than that of the model in the column. Small numbers show the probability that the difference is negligible.

Confusion matrix



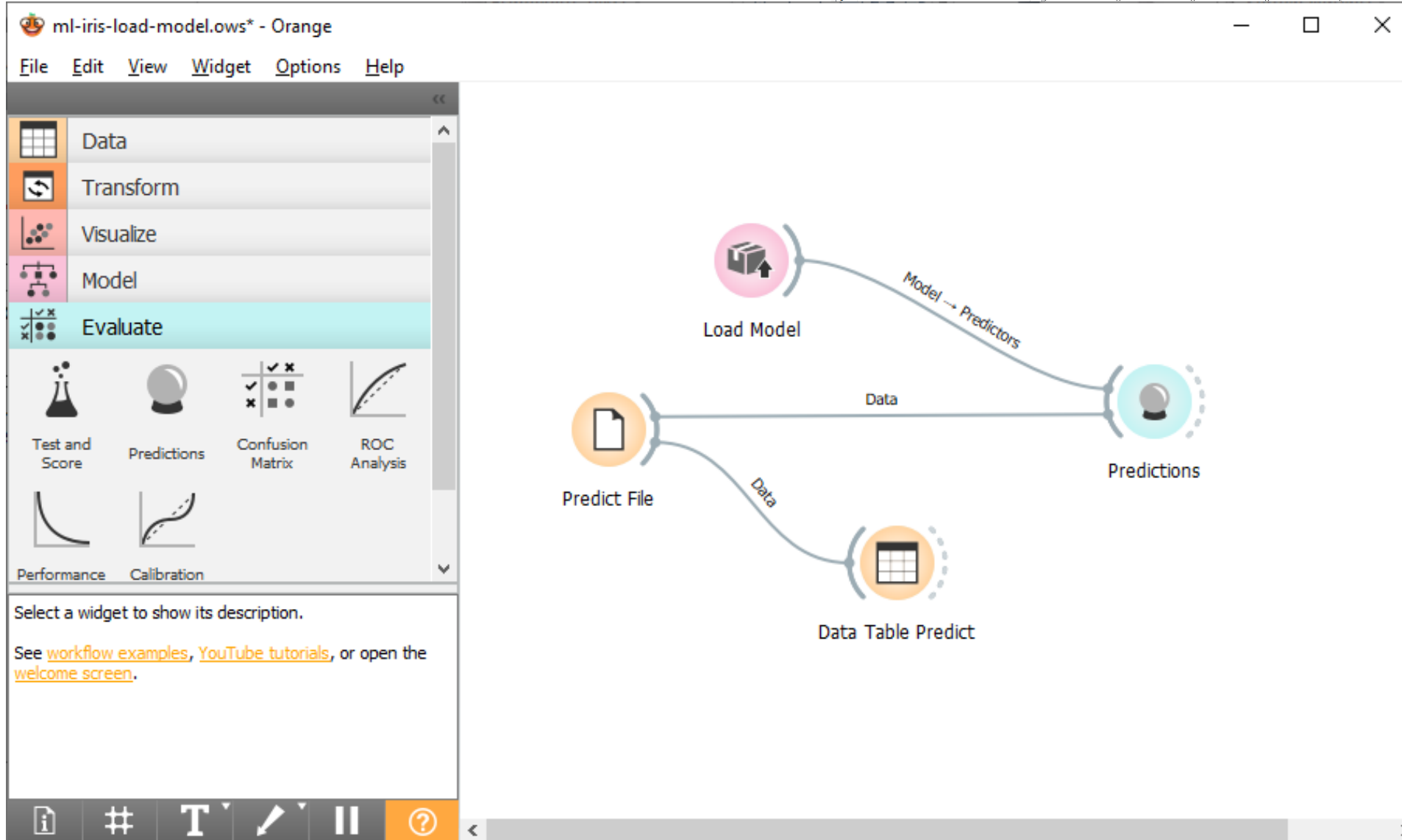
Save the best trained model

Use saved model

Predictions - Orange

Show probabilities for (None)

		sepal length	sepal width	petal length	petal width
1	Iris-setosa	5.1	3.5	1.4	0.2
2	Iris-setosa	4.9	3.0	1.4	0.2
3	Iris-setosa	4.7	3.2	1.3	0.2
4	Iris-setosa	4.6	3.1	1.5	0.2
5	Iris-setosa	5.0	3.6	1.4	0.2
6	Iris-setosa	5.4	3.9	1.7	0.4
7	Iris-setosa	4.6	3.4	1.4	0.3
8	Iris-setosa	5.0	3.4	1.5	0.2



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Task 1

Find dataset, train and predict, save the best model

1. Fish
2. Birds
3. Fruits
4. Vegetables
5. Whales
6. Mosquito
7. Viruses
8. Roses
9. Bushes
10. Trees

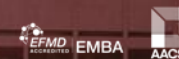
- Find on Internet dataset according to your variant
- Adjust dataset to have 3-5 species
- Train and compare models
- Adjust parameters of models
- Use models for prediction
- Save and reuse the best model

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