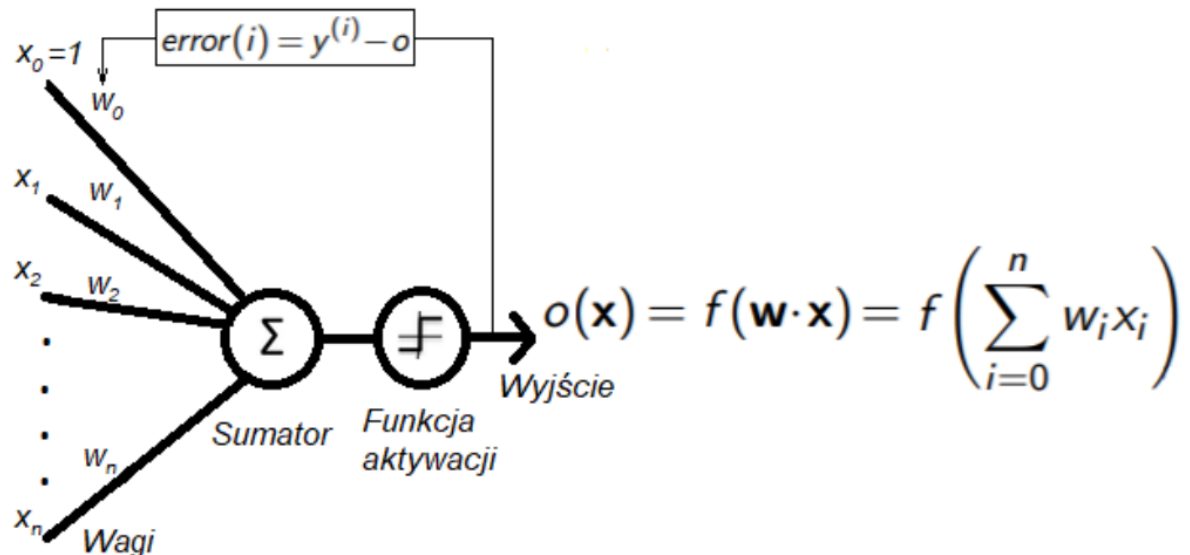# Perceptron oraz Adaline

1. Opis problemu Zadaniem była implementacja perceptronu i nauczenie go poprawnej klasyfikacji gatunków irysów, dla zbioru danych Iris.data. Neuron należało zaimplementować petodą perceptronu oraz Adaline, a następnie porównać klasyfikowanie na podstawie dwóch i trzech klas.
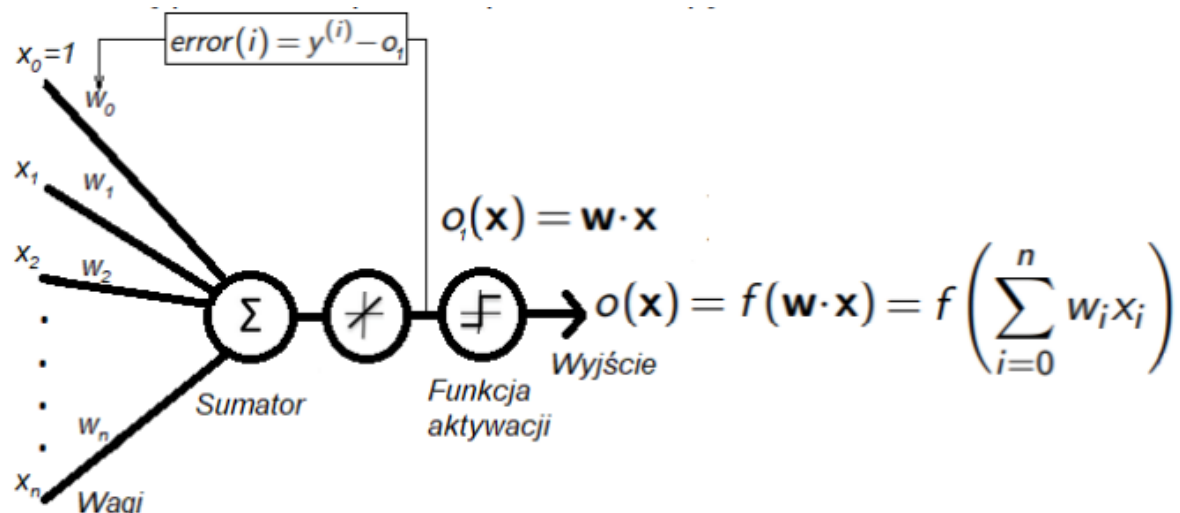
2. Przebeg zadania

   1. Perceptron $\$

   $\$ Dla zbioru $Z = \{(x^{(1)},y^{(1)}),...,(x^{(N)},y^{(N)})\}$ $\$ od ustalonej liczby n_{epoch} nalezy iterować po zbiorze Z $\$ dla i=1,...,N nalezy obliczyć wagi, $\$ $error(i)=y^{(i)}-o(x^{(i)})$ $\$ $\Delta w = \eta * error(i)*x^{(i)}$
   $\$ $w=w+\Delta w$ $\$ η to współczynnik uczenia z przedziału (0,1). Zbiór Z to 80% danych z każdej klasy. Zbiór testowy to pozostałe 20%, na tym zbiorze testowany jest perceptron.

   2. Adaline $\$

   $\$ Dla zbioru $Z = \{(x^{(1)},y^{(1)}),...,(x^{(N)},y^{(N)})\}$
   $\$ od ustalonej liczby n_{epoch} nalezy iterować po zbiorze Z
   $\$ dla i=1,...,N nalezy obliczyć wagi,
   $\$ $error(i)=y^{(i)}-o_1(x^{(i)})$ $\$ $\Delta w = \eta * error(i)*x^{(i)}$
   $\$ $w=w+\Delta w$ $\$ η to współczynnik uczenia z przedziału (0,1). Zbiór Z to 80% danych z każdej klasy. Zbiór testowy to pozostałe 20%, na tym zbiorze testowany jest Adaline.

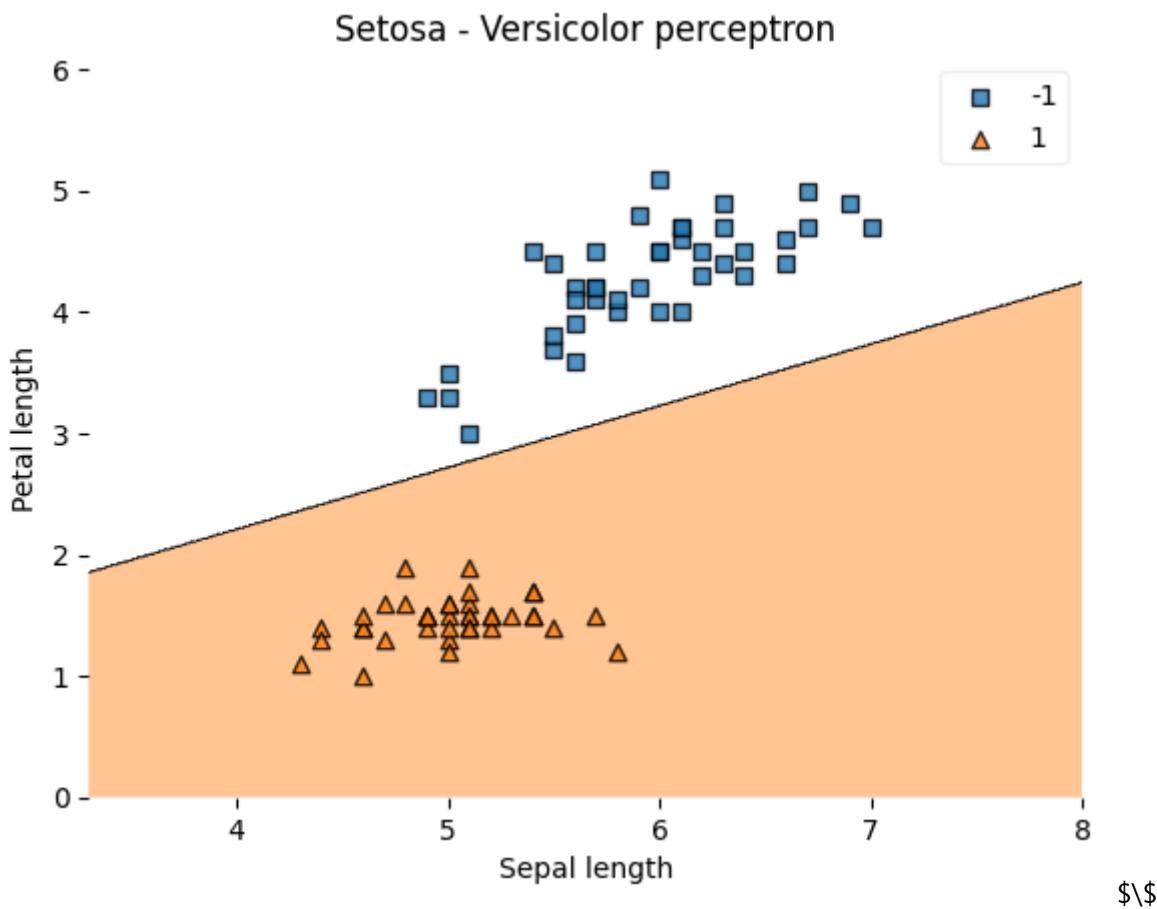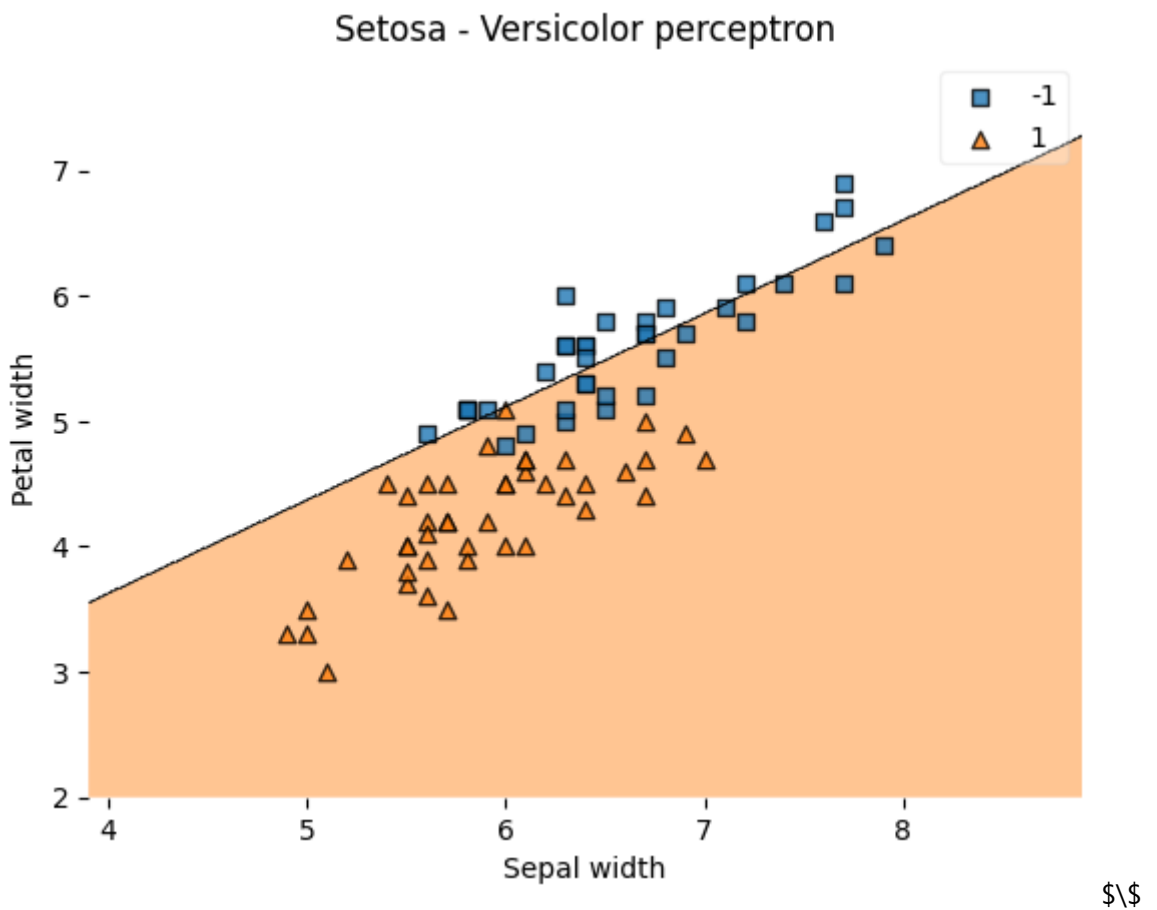3. Wyniki:

1. Perceptron, 2 klasy $\$$ Trening na długościach: $\$$

$\$$

Trening na szerokościach: $\$$

$\$$

Test na długościach: $\$$

Setosa - Versicolor perceptron, lengths

$\$

Test na szerokościach: $\$

Setosa - Versicolor perceptron, widths
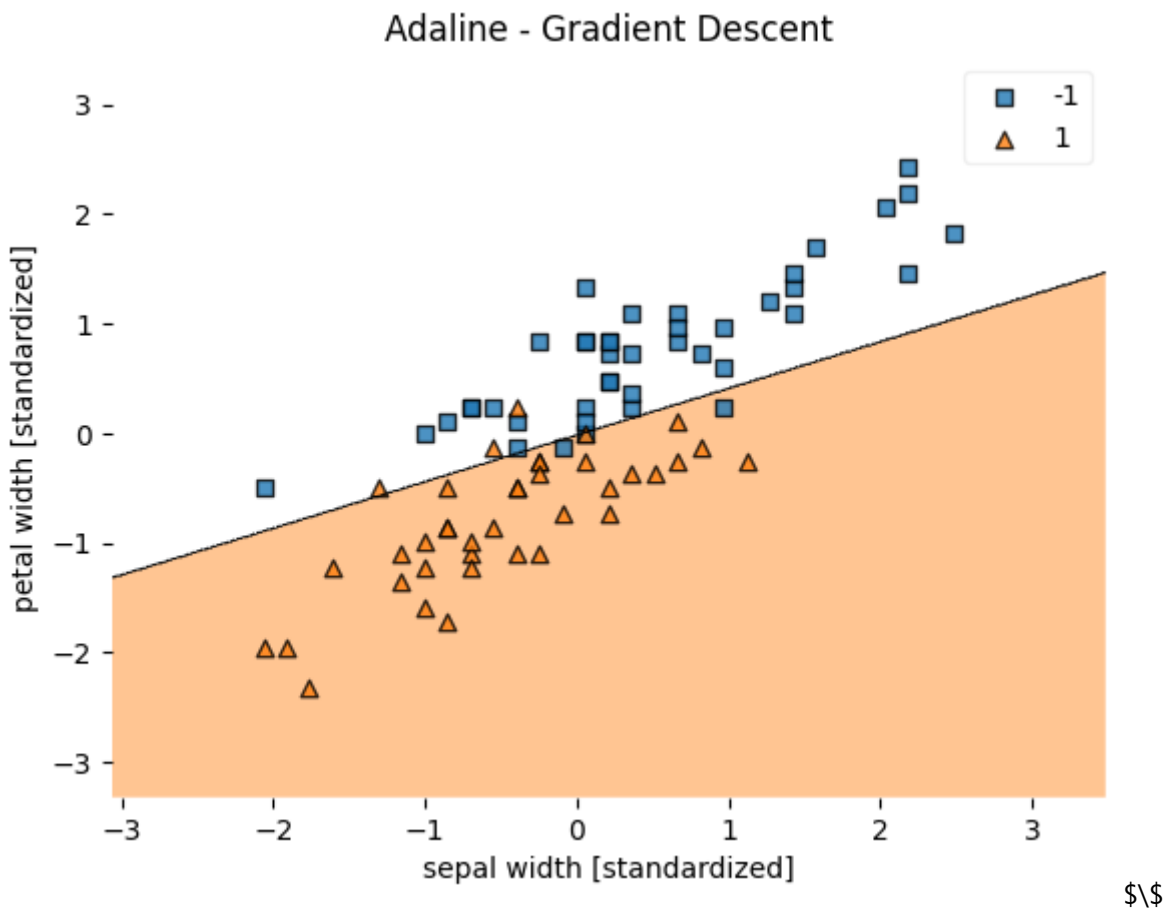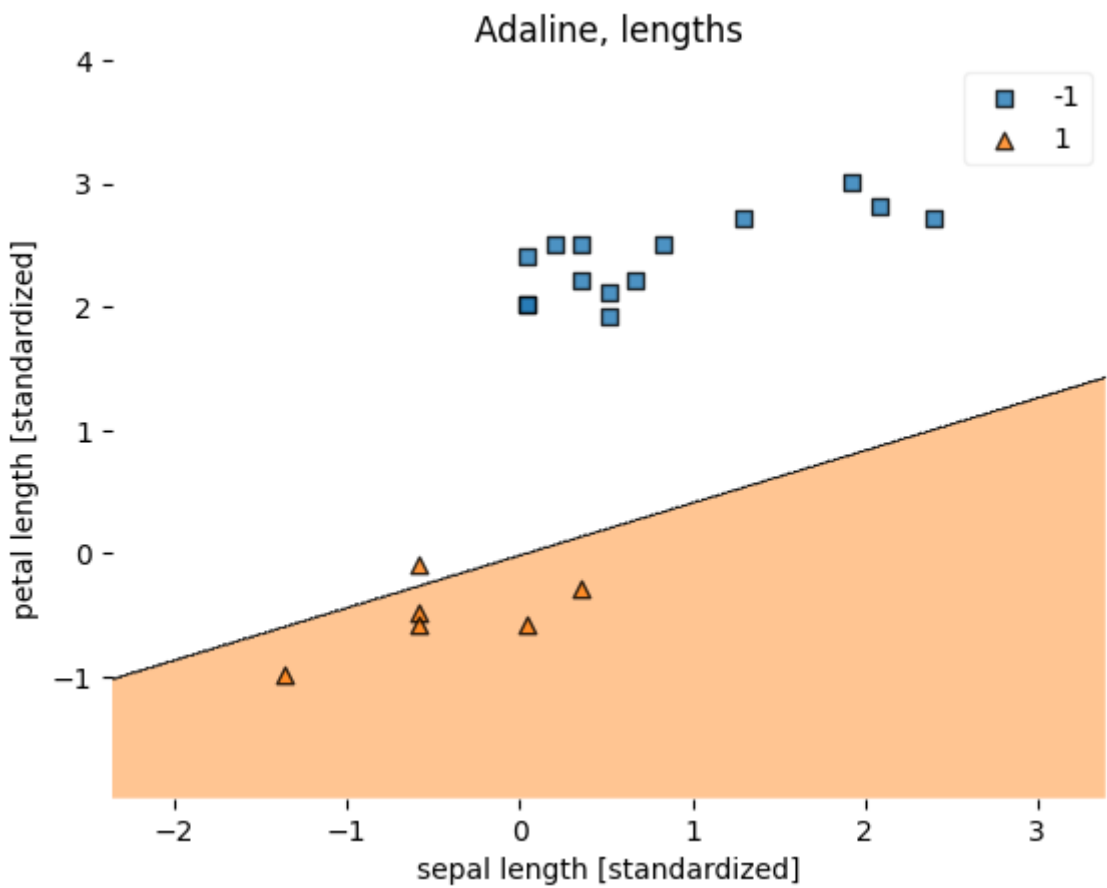
$\$
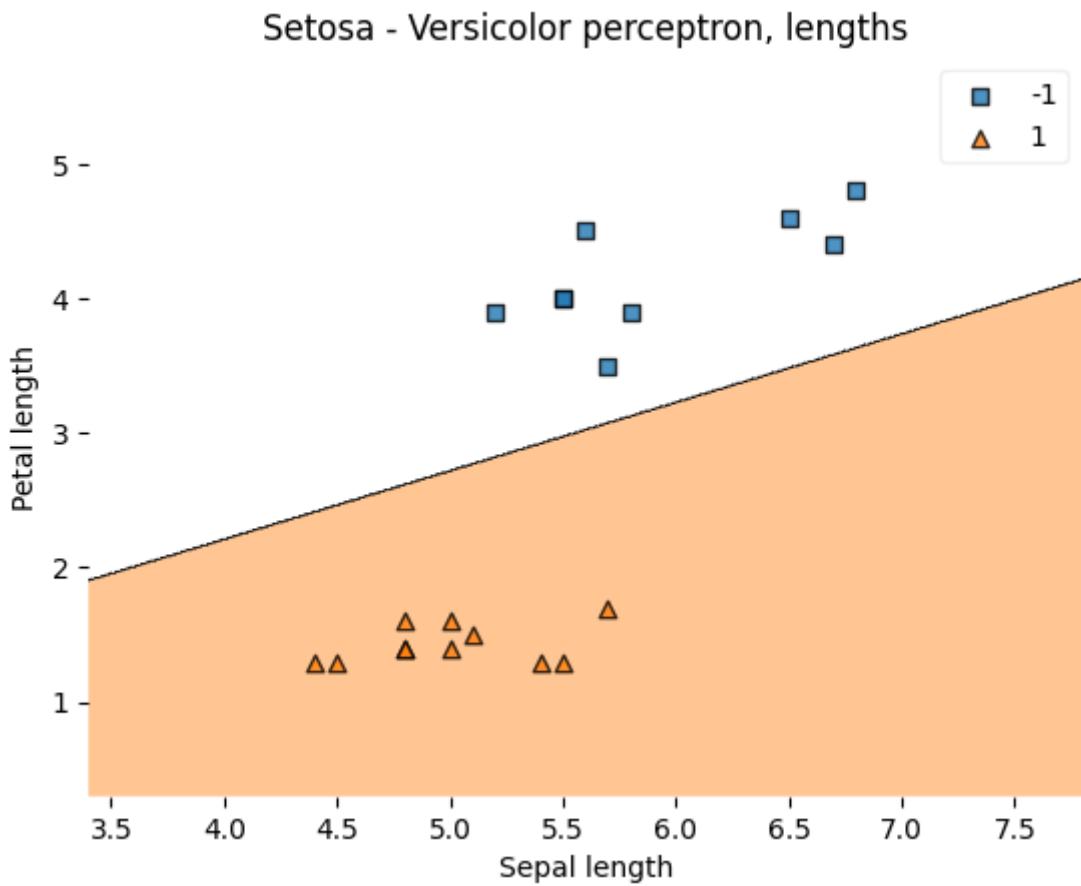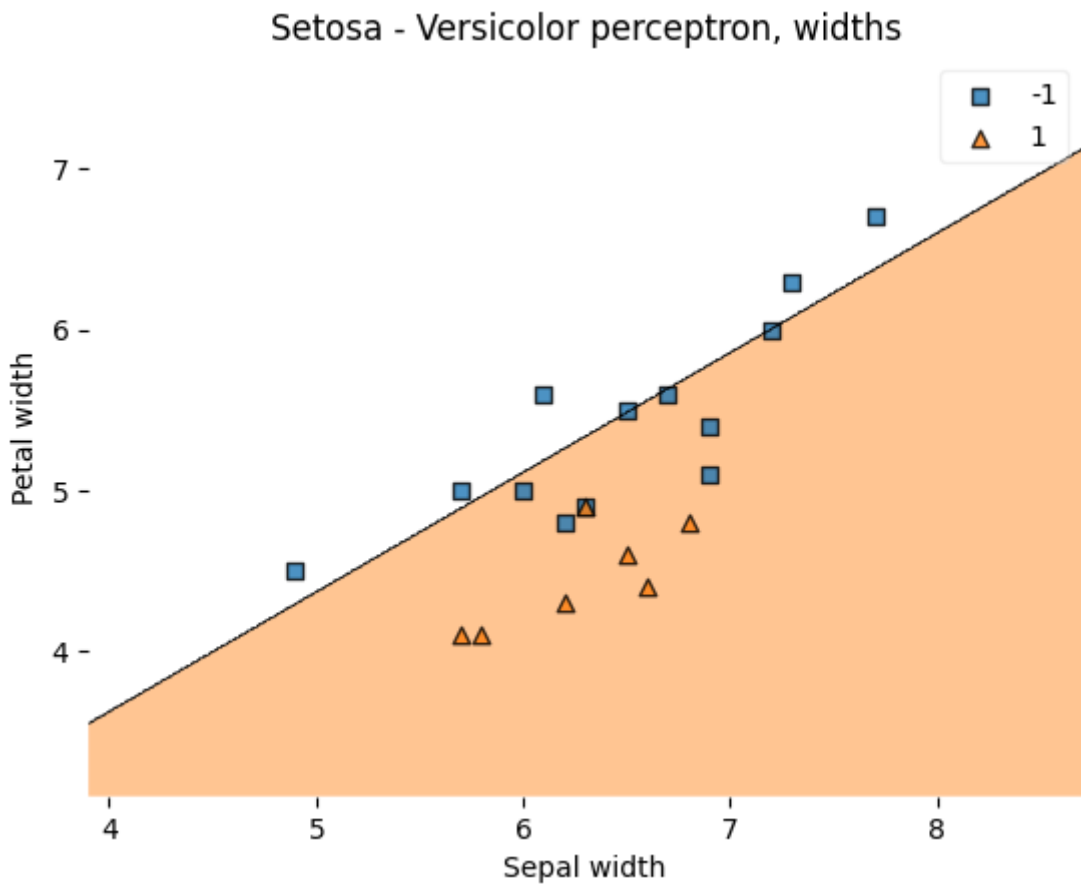
2. Adaline, 2 klasy $\$ Trening na długościach: $\$

$\$

Trening na szerokościach: $\$

$\$

Test na długościach: $\$

Adaline, lengths

$\backslash$

Test na szerokościach: $\backslash$

Adaline, widths

$\backslash$
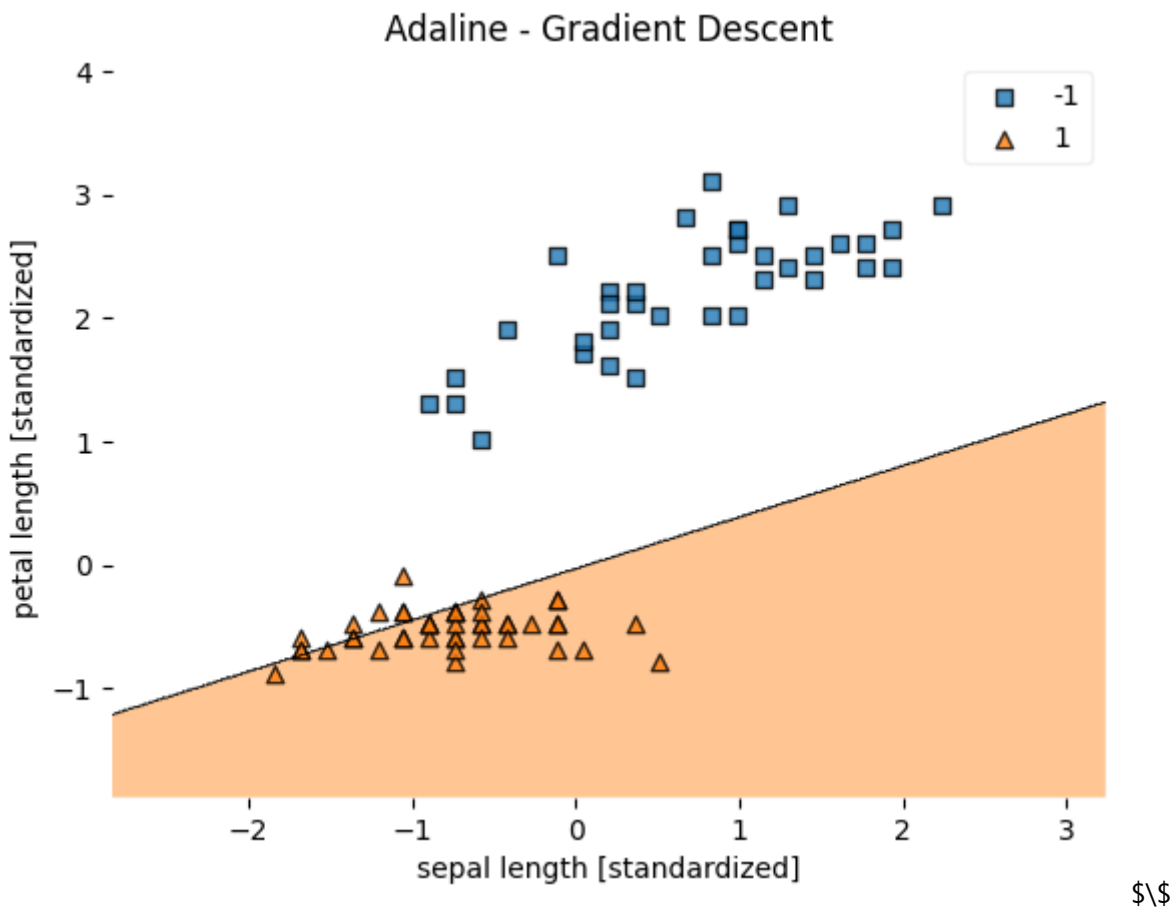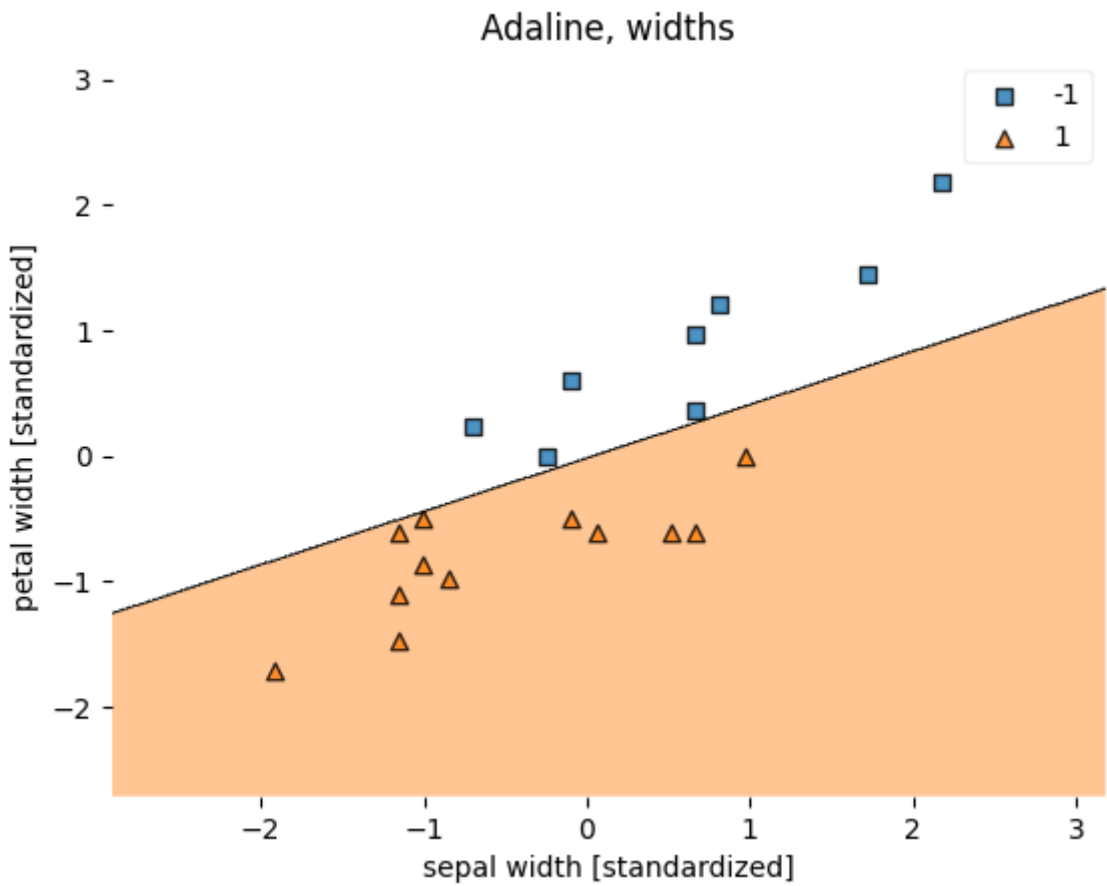
3. Perceptron, 3 klasy $\$ Liczba błędnych klasyfikacji: $\$

```
  1  ppn_seto = Perceptron(epochs=50, eta=0.001)
  2  ppn_seto.train(X_seto_train, y_seto_train)
  3
  4  print(f"count of incorrect categorizations for 3 classes, lengths: {(y_seto_test != ppn_seto.predict(X_seto_test)).sum()} out of {len(y_seto_test)}")
[126]  ✓  0.0s
···  count of incorrect categorizations for 3 classes, lengths: 0 out of 30
```

```
  1  # dla klasy Virginica
  2  ppn_virg = Perceptron(epochs=50, eta=0.001)
  3  ppn_virg.train(X_virg_train, y_virg_train)
  4
  5
  6  print(f"count of incorrect categorizations for 3 classes, lengths: {(y_virg_test != ppn_virg.predict(X_virg_test)).sum()} out of {len(y_virg_test)}")
[127]  ✓  0.1s
···  count of incorrect categorizations for 3 classes, lengths: 2 out of 30
```

```
  1  # dla klasy Versicolor
  2  ppn_vers = Perceptron(epochs=50, eta=0.01)
  3  ppn_vers.train(X_vers_train, y_vers_train)
  4
  5  print(f"count of incorrect categorizations for 3 classes, lengths: {(y_vers_test != ppn_vers.predict(X_vers_test)).sum()} out of {len(y_vers_test)}")
[128]  ✓  0.1s
···  count of incorrect categorizations for 3 classes, lengths: 12 out of 30
```

$\$

4. Adaline, 3 klasy $\$ Liczba błędnych klasyfikacji: $\$

```
  1  #setosa
  2  ada = AdalineGD (epochs=50, eta=0.01)
  3  ada.train(X_seto_train, y_seto_train)
  4
  5  print(f"count of incorrect categorizations, adaline: {(y_seto_test != ada.predict(X_seto_test)).sum()} out of {len(y_seto_test)}")
[129]  ✓  0.0s
···  count of incorrect categorizations, adaline: 21 out of 30
```

```
  1  #virginica
  2  ada = AdalineGD (epochs=50, eta=0.01)
  3  ada.train(X_virg_train, y_virg_train)
  4
  5  print(f"count of incorrect categorizations, adaline {(y_virg_test != ada.predict(X_virg_test)).sum()} out of {len(y_virg_test)}")
[130]  ✓  0.0s
···  count of incorrect categorizations, adaline 21 out of 30
```

```
  1  #versicolor
  2  ada = AdalineGD (epochs=50, eta=0.01)
  3  ada.train(X_vers_train, y_vers_train)
  4
  5  print(f"count of incorrect categorizations, adaline {(y_vers_test != ada.predict(X_vers_test)).sum()} out of {len(y_vers_test)}")
[131]  ✓  0.0s
···  count of incorrect categorizations, adaline 22 out of 30
```

$\$

5. Różne kombinacje, perceptron. $\$ Wpierw $\eta = 0.01$, nastepnie $\eta = 0.5$ $\$ W kolejności setosa, virginica, versicolor $\$ Liczba błędnych klasyfikacji: $\$

```
Perceptron count of incorrect categorizations for Sepal length and sepal width: 1
Perceptron count of incorrect categorizations for petal length and petal width: 0
Perceptron count of incorrect categorizations for Sepal length and petal length: 0
Perceptron count of incorrect categorizations for Sepal length and petal width: 0
Perceptron count of incorrect categorizations for sepal width and petal length: 0
Perceptron count of incorrect categorizations for 4DIM: 0
Average accuracy Perceptron: 0.9944444444444445

Perceptron count of incorrect categorizations for Sepal length and sepal width: 15
Perceptron count of incorrect categorizations for petal length and petal width: 1
Perceptron count of incorrect categorizations for Sepal length and petal length: 1
Perceptron count of incorrect categorizations for Sepal length and petal width: 3
Perceptron count of incorrect categorizations for sepal width and petal length: 7
Perceptron count of incorrect categorizations for 4DIM: 4
Average accuracy Perceptron: 0.8277777777777778

Perceptron count of incorrect categorizations for Sepal length and sepal width: 17
Perceptron count of incorrect categorizations for petal length and petal width: 11
Perceptron count of incorrect categorizations for Sepal length and petal length: 9
Perceptron count of incorrect categorizations for Sepal length and petal width: 16
Perceptron count of incorrect categorizations for sepal width and petal length: 20
Perceptron count of incorrect categorizations for 4DIM: 12
Average accuracy Perceptron: 0.5277777777777778

Perceptron count of incorrect categorizations for Sepal length and sepal width: 0
Perceptron count of incorrect categorizations for petal length and petal width: 0
Perceptron count of incorrect categorizations for Sepal length and petal length: 0
Perceptron count of incorrect categorizations for Sepal length and petal width: 0
Perceptron count of incorrect categorizations for sepal width and petal length: 0
Perceptron count of incorrect categorizations for 4DIM: 0
Average accuracy Perceptron: 1.0

Perceptron count of incorrect categorizations for Sepal length and sepal width: 12
Perceptron count of incorrect categorizations for petal length and petal width: 6
Perceptron count of incorrect categorizations for Sepal length and petal length: 1
Perceptron count of incorrect categorizations for Sepal length and petal width: 2
Perceptron count of incorrect categorizations for sepal width and petal length: 1
Perceptron count of incorrect categorizations for 4DIM: 1
Average accuracy Perceptron: 0.8722222222222222

Perceptron count of incorrect categorizations for Sepal length and sepal width: 12
Perceptron count of incorrect categorizations for petal length and petal width: 8
Perceptron count of incorrect categorizations for Sepal length and petal length: 17
Perceptron count of incorrect categorizations for Sepal length and petal width: 10
Perceptron count of incorrect categorizations for sepal width and petal length: 9
Perceptron count of incorrect categorizations for 4DIM: 21
Average accuracy Perceptron: 0.5722222222222223
```

$\$

6. Różne kombinacje, Adaline $\$ Wpierw $\eta = 0.01$, nastepnie $\eta = 0.5$ $\$ W kolejności setosa, virginica, versicolor $\$ Liczba błędnych klasyfikacji: $\$

```
Adaline count of incorrect categorizations for Sepal length and sepal width: 0
Adaline count of incorrect categorizations for petal length and petal width: 27
Adaline count of incorrect categorizations for Sepal length and petal length: 28
Adaline count of incorrect categorizations for Sepal length and petal width: 27
Adaline count of incorrect categorizations for sepal width and petal length: 0
Adaline count of incorrect categorizations for 4DIM: 18
Average accuracy Adaline: 0.444444444444444

Adaline count of incorrect categorizations for Sepal length and sepal width: 4
Adaline count of incorrect categorizations for petal length and petal width: 24
Adaline count of incorrect categorizations for Sepal length and petal length: 21
Adaline count of incorrect categorizations for Sepal length and petal width: 26
Adaline count of incorrect categorizations for sepal width and petal length: 2
Adaline count of incorrect categorizations for 4DIM: 17
Average accuracy Adaline: 0.4777777777777777

Adaline count of incorrect categorizations for Sepal length and sepal width: 7
Adaline count of incorrect categorizations for petal length and petal width: 17
Adaline count of incorrect categorizations for Sepal length and petal length: 20
Adaline count of incorrect categorizations for Sepal length and petal width: 16
Adaline count of incorrect categorizations for sepal width and petal length: 5
Adaline count of incorrect categorizations for 4DIM: 21
Average accuracy Adaline: 0.5222222222222223

Adaline count of incorrect categorizations for Sepal length and sepal width: 27
Adaline count of incorrect categorizations for petal length and petal width: 29
Adaline count of incorrect categorizations for Sepal length and petal length: 26
Adaline count of incorrect categorizations for Sepal length and petal width: 23
Adaline count of incorrect categorizations for sepal width and petal length: 28
Adaline count of incorrect categorizations for 4DIM: 23
Average accuracy Adaline: 0.1333333333333333

Adaline count of incorrect categorizations for Sepal length and sepal width: 22
Adaline count of incorrect categorizations for petal length and petal width: 20
Adaline count of incorrect categorizations for Sepal length and petal length: 26
Adaline count of incorrect categorizations for Sepal length and petal width: 23
Adaline count of incorrect categorizations for sepal width and petal length: 23
Adaline count of incorrect categorizations for 4DIM: 20
Average accuracy Adaline: 0.2555555555555554

Adaline count of incorrect categorizations for Sepal length and sepal width: 17
Adaline count of incorrect categorizations for petal length and petal width: 17
Adaline count of incorrect categorizations for Sepal length and petal length: 18
Adaline count of incorrect categorizations for Sepal length and petal width: 11
Adaline count of incorrect categorizations for sepal width and petal length: 21
Adaline count of incorrect categorizations for 4DIM: 19
Average accuracy Adaline: 0.4277777777777778
```

$\$

4. Wnioski:

- współczynnik uczenia nie ma większego wpływu na klasyfikację trzech klas metodą perceptronu.
- Adaline sprawdza się lepiej przy dwóch klasach
- Perceptron sprawdza się lepiej przy trzech klasach