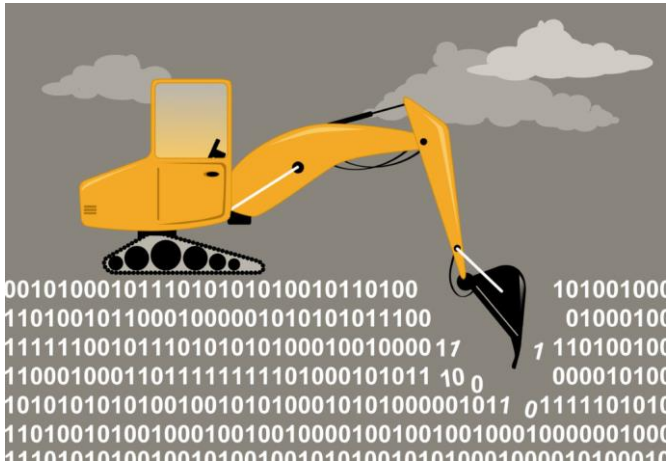
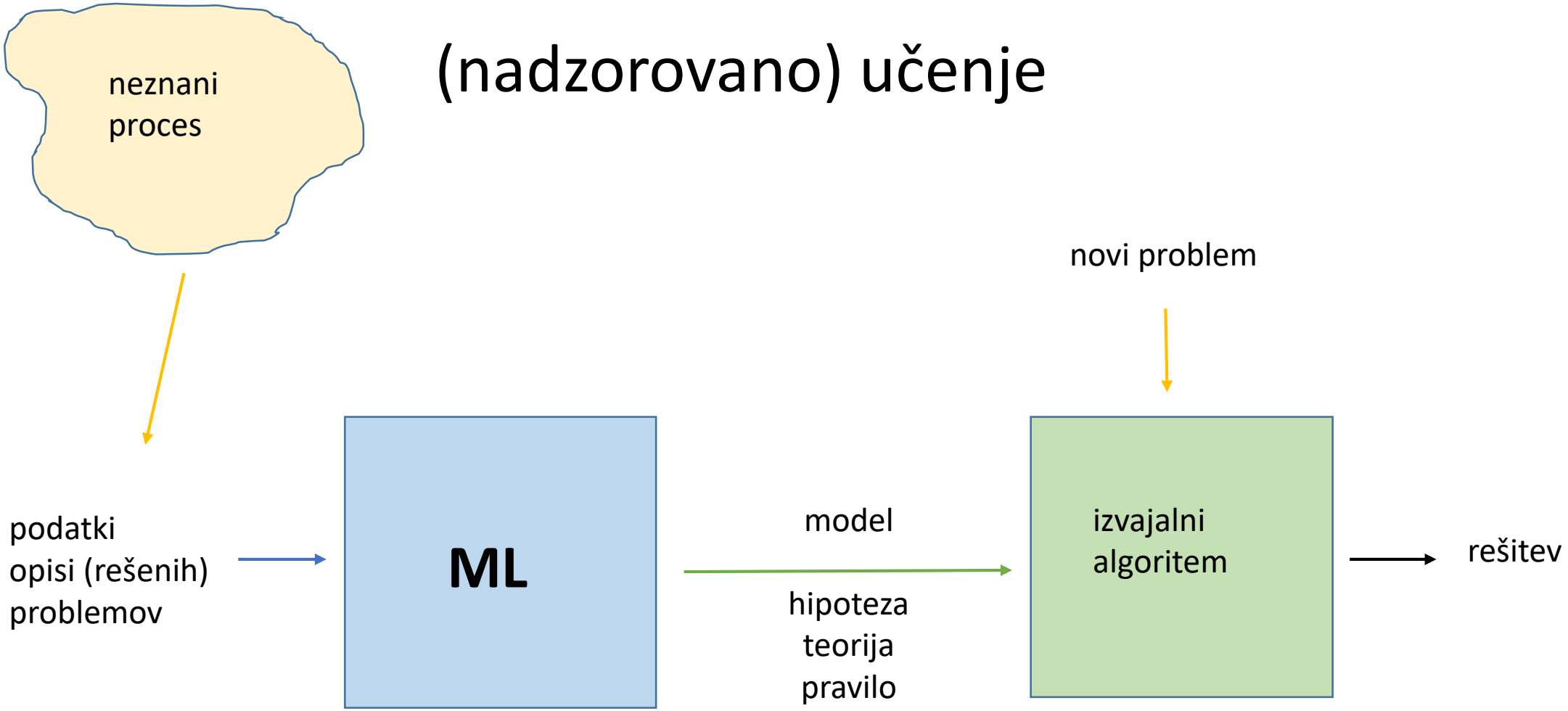
Kaj je strojno učenje?

Prišel bo čas, ko bomo morali pozabiti vse, kar smo se naučili. (Ramana Maharshi)

- Strojno učenje (machine learning)
- Odkrivanje zakonitosti v podatkovnih bazah (knowledge discovery in databases)
- Podatkovno rudarjenje (data mining)

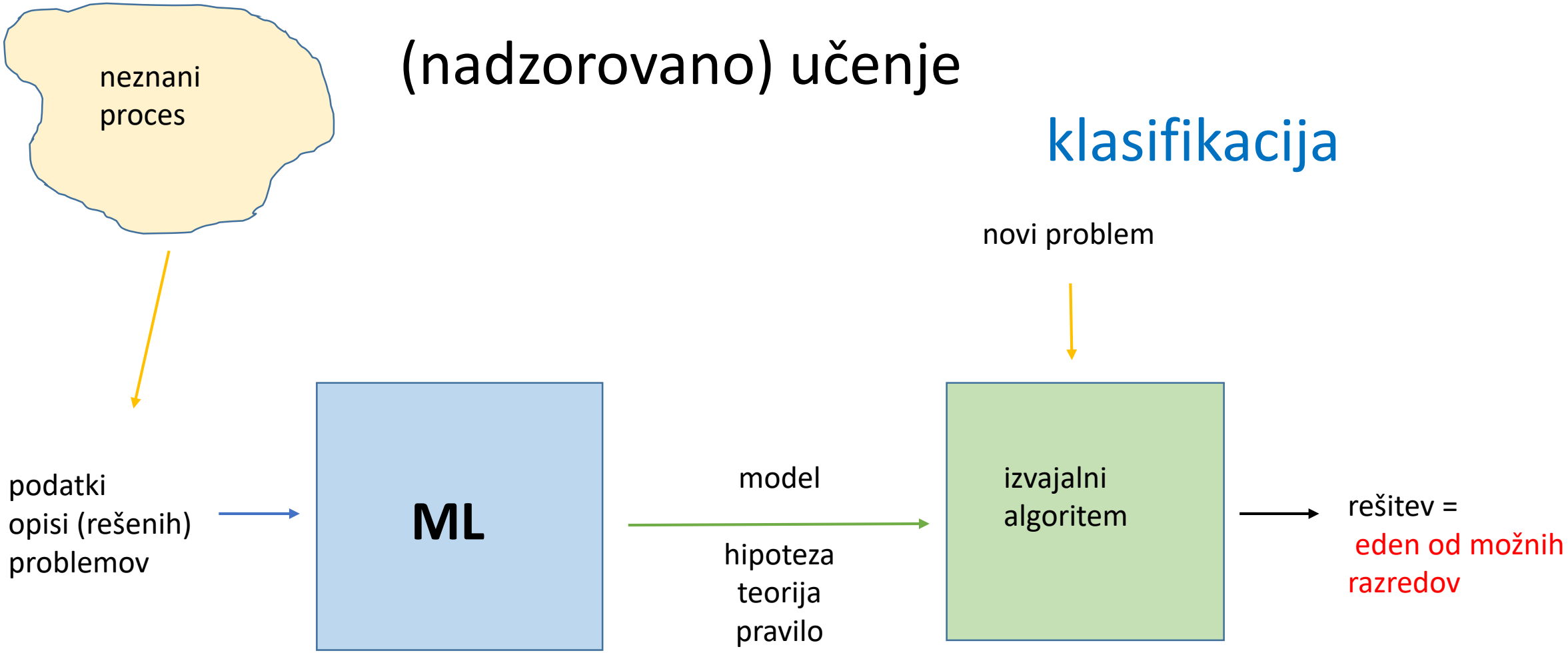


(nadzorovano) učenje



(nadzorovano) učenje

klasifikacija



Atributni opis primerov: klasifikacija

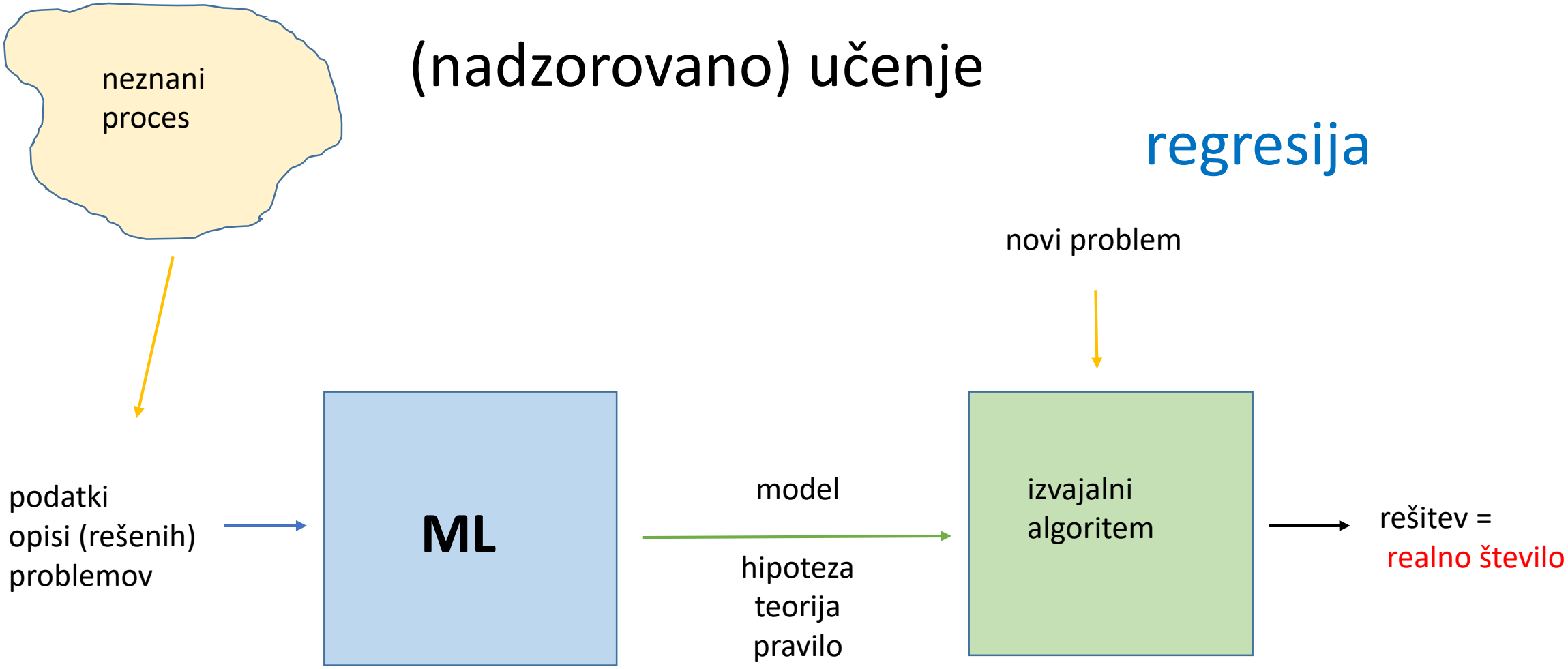
Primer	Atribut1	Atribut2	Atribut3	…	…	…	…	AtributA	Razred
1	V11	V12	V13					V1A	R1
2	V21	V22	V23					V2A	R2
3	V31	V31	V33					V3A	R3
…									
…									
…									
n	Vn1	Vn2	Vn3					VnA	Rn

Atributni opis primerov: klasifikacija, npr.

Pacient	Spol	Starost	Teža	…	…	…	…	Glavobol	Razred
1	m	39	81					Da	Diagnoza1
2	ž	27	63					Ne	Diagnoza4
3	ž	45	72					Da	Diagnoza2
…									
…									
…									
n	m	63	75					Da	Diagnoza2

(nadzorovano) učenje

regresija



Atributni opis primerov: regresija

Primer	Atribut1	Atribut2	Atribut3	…	…	…	…	AtributA	Ciljna spr. Regresijska spr.
1	V11	V12	V13					V1A	R1
2	V21	V22	V23					V2A	R2
3	V31	V31	V33					V3A	R3
…									
…									
…									
n	Vn1	Vn2	Vn3					VnA	Rn

Atributni opis primerov: regresija, npr.

Pacient	Spol	Starost	Teža	…	…	…	…	Glavobol	Dolžina zdravljenja
1	m	39	81					Da	10 dni
2	ž	27	63					Ne	14 dni
3	ž	45	72					Da	45 dni
…									
…									
…									
n	m	63	75					Da	25 dni

Pregled metod strojnega učenja

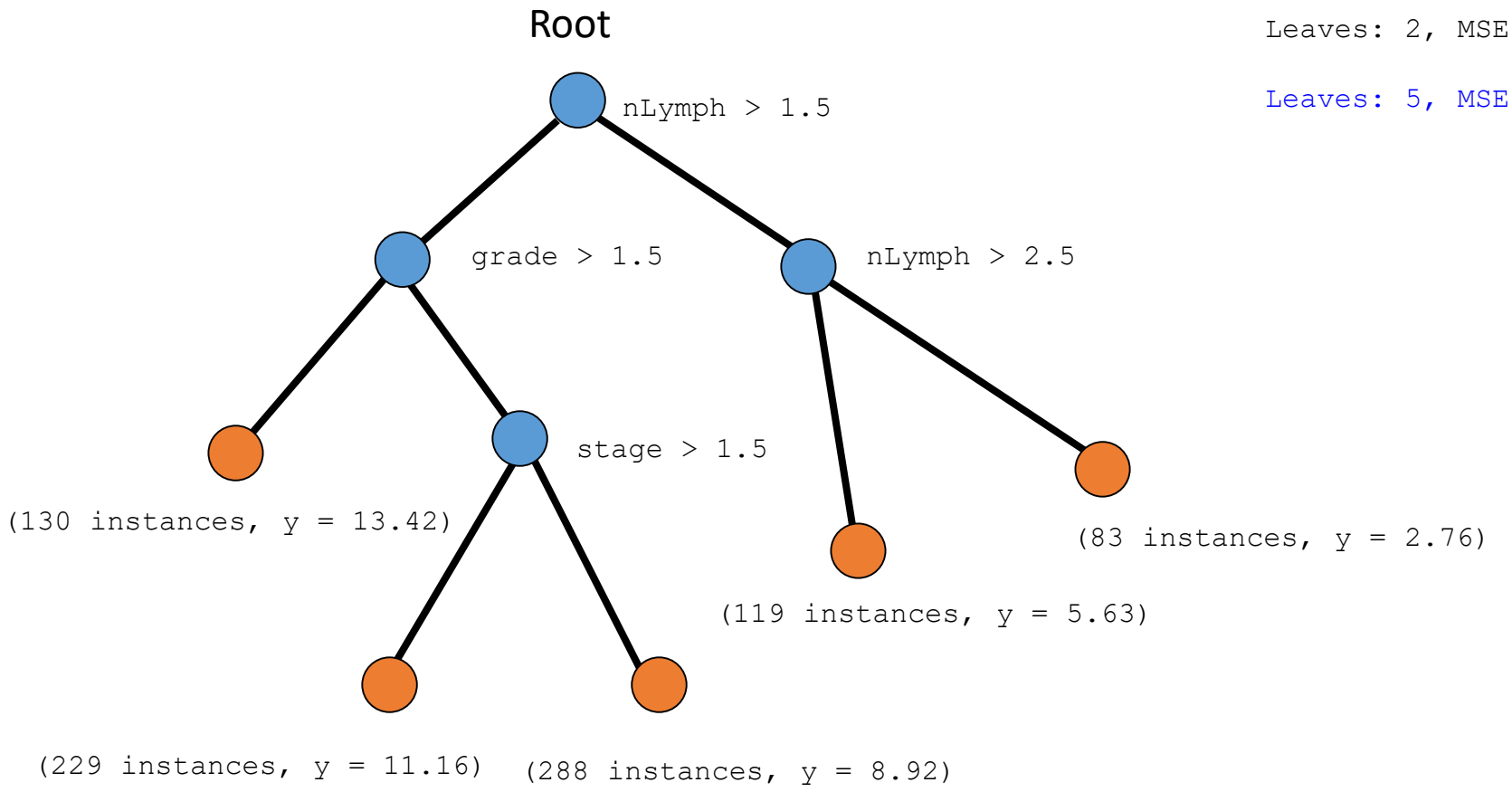
- klasifikacija:
  - Odločitvena drevesa
  - naivni Bayesov klasifikator
  - Klasifikator z najbližjimi sosedi
  - Diskriminantne funkcije
  - metoda podpornih vektorjev (SVM)
  - Naključni gozdovi
  - Umetne nevronske mreže
  - Globoke nevronske mreže
- regresija:
  - Regresijska drevesa
  - Linearna regresija
  - Lokalno utežena regresija
  - Regresijske funkcije
  - Metoda podpornih vektorjev
  - Naključni gozdovi
  - Umetne nevronske mreže
  - Globoke nevronske mreže

Odločitvena in regresijska drevesa

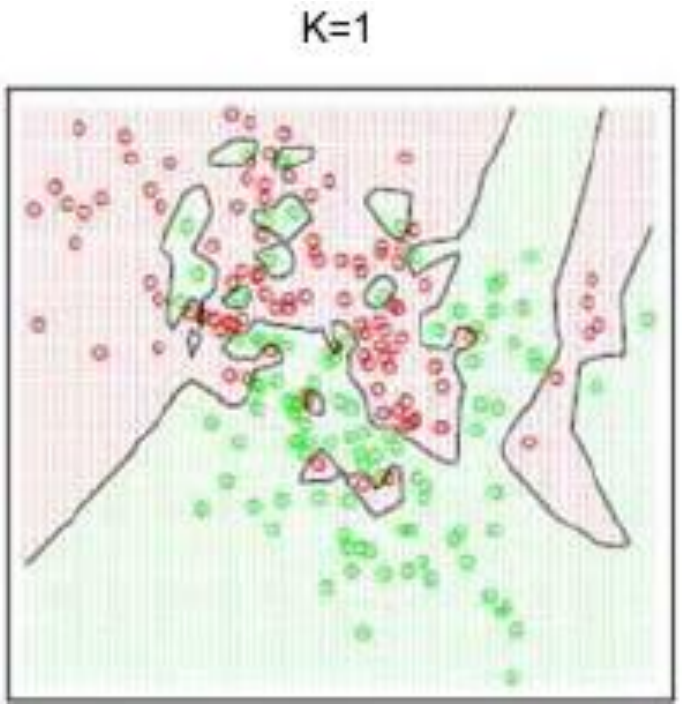
Leaves: 1, MSE = 41.46

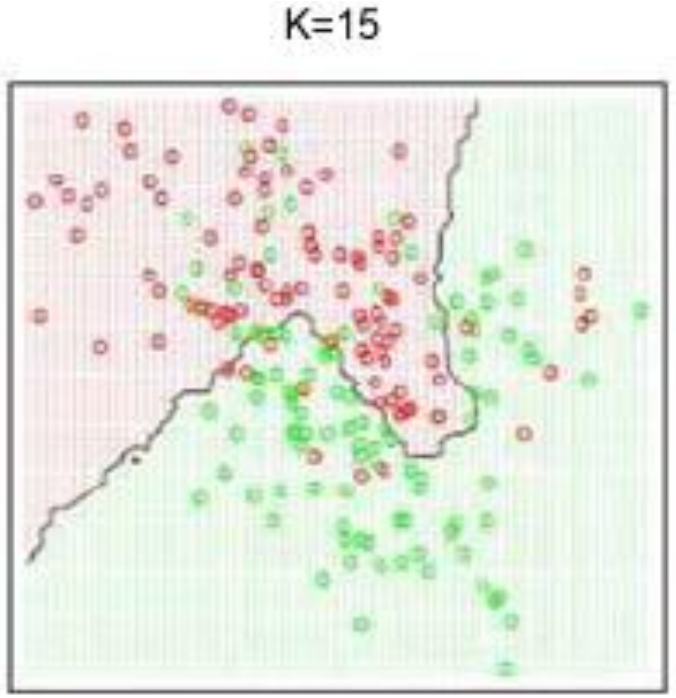
Leaves: 2, MSE = 36.32

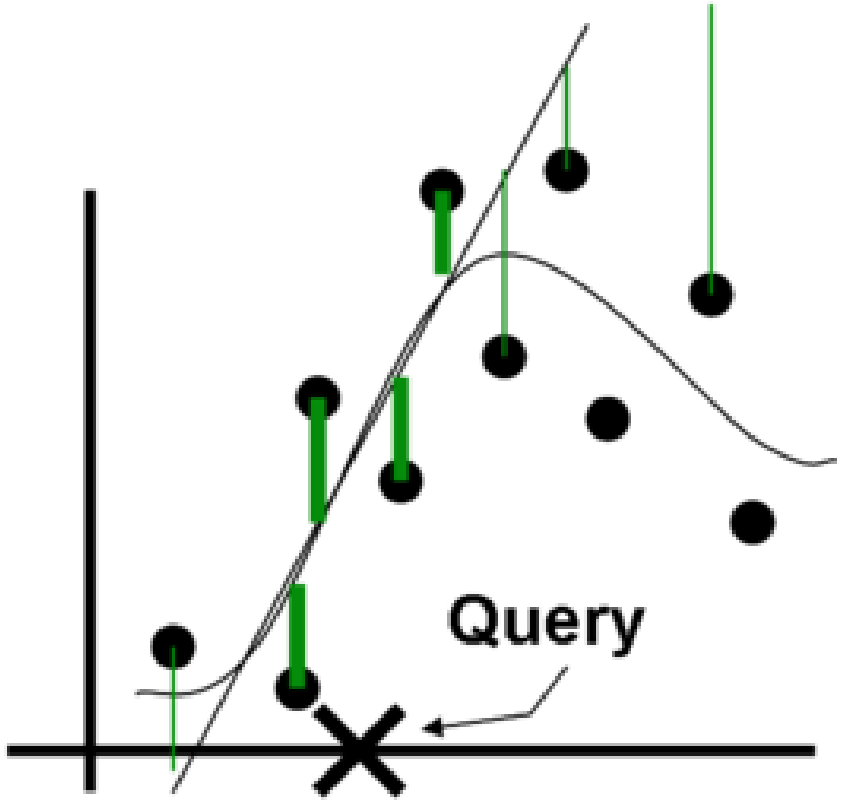
Leaves: 5, MSE = 34.81



k najbližjih sosedov in lokalno utežena regresija







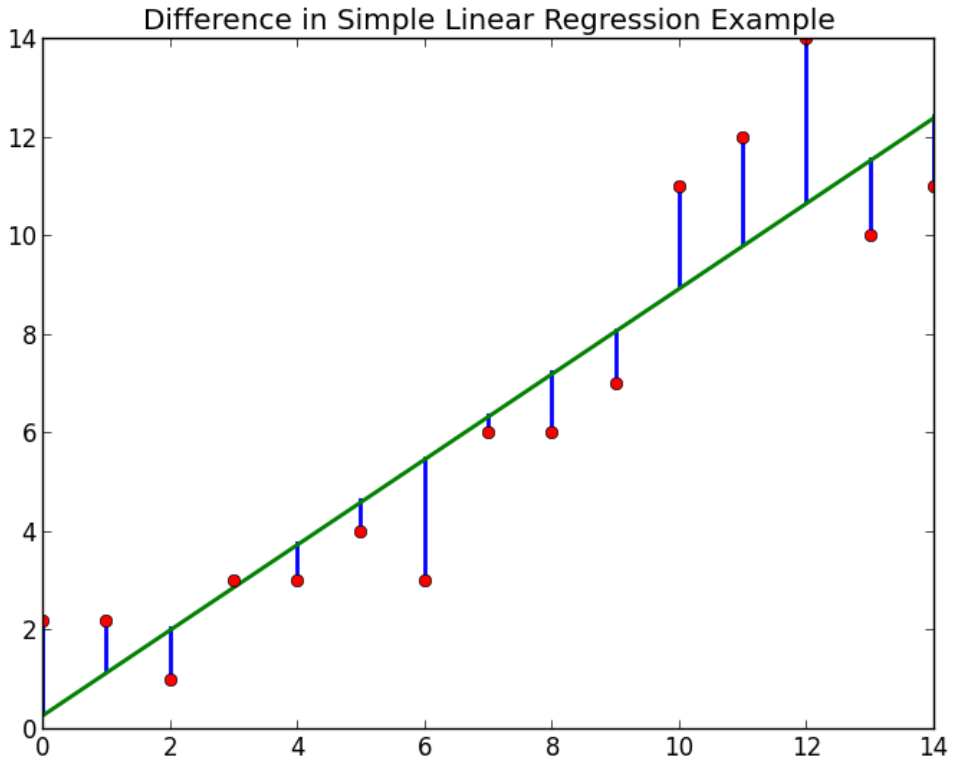
Hastie, Tibshirani, Friedman: Elements of Statistical Learning, 2009

Naivni Bayes in linearna regresija

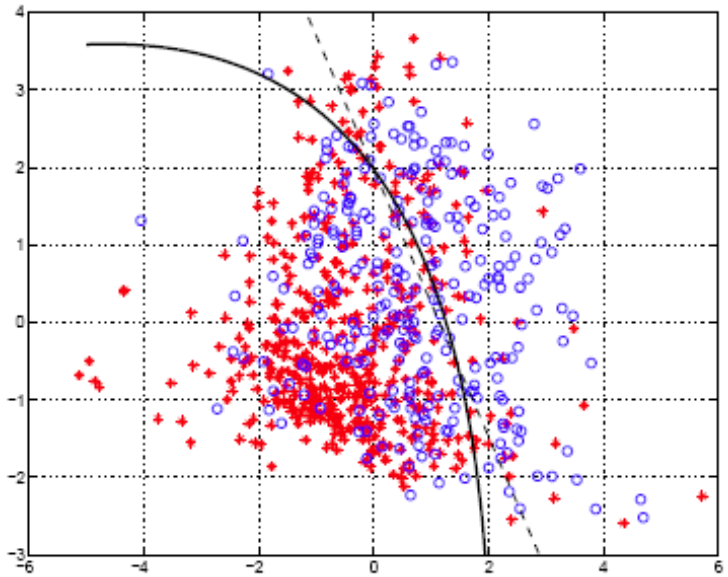
- Predpostavka: atributi so med seboj **neodvisni pri danem razredu**

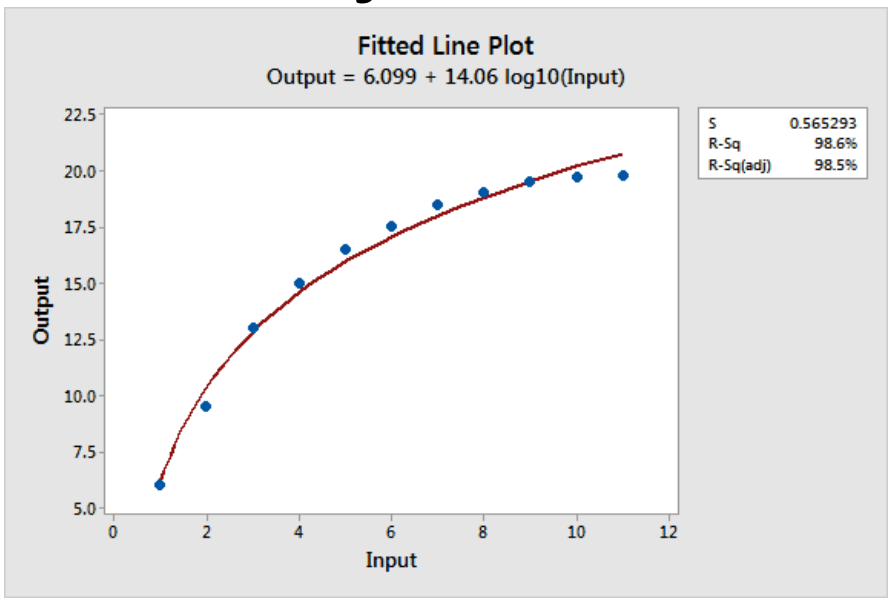
$$P(C|X_1X_2 \dots X_n) = \frac{P(C)\cdot P(X_1X_2 \dots X_n|C)}{P(X_1X_2 \dots X_n)} = \frac{P(C)\cdot \prod_i P(X_i|C)}{\prod_i P(X_i)}$$

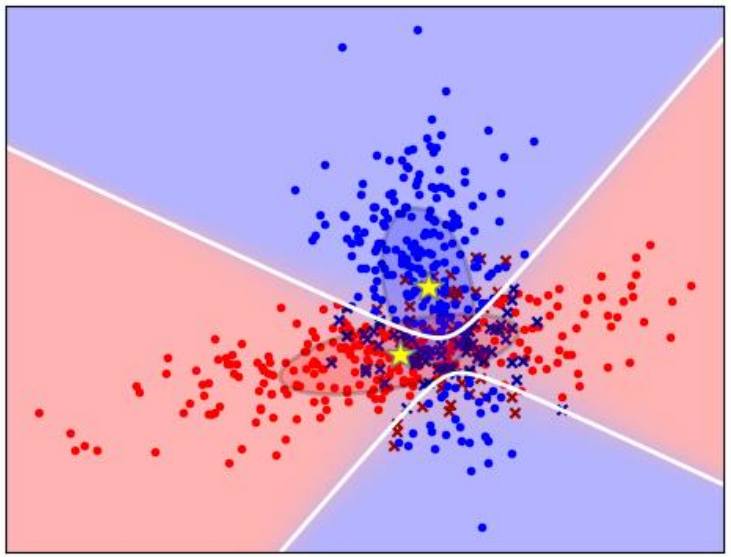
$$P(C|X_1X_2 \dots X_n) = \frac{P(C)\cdot \prod_i P(C|X_i)}{\prod_i P(C)}$$

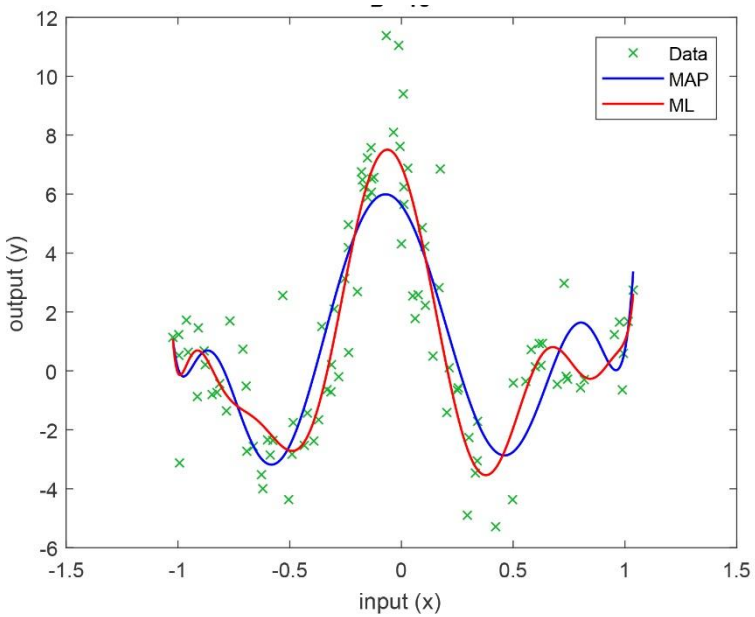


Diskriminantne in regresijske funkcije

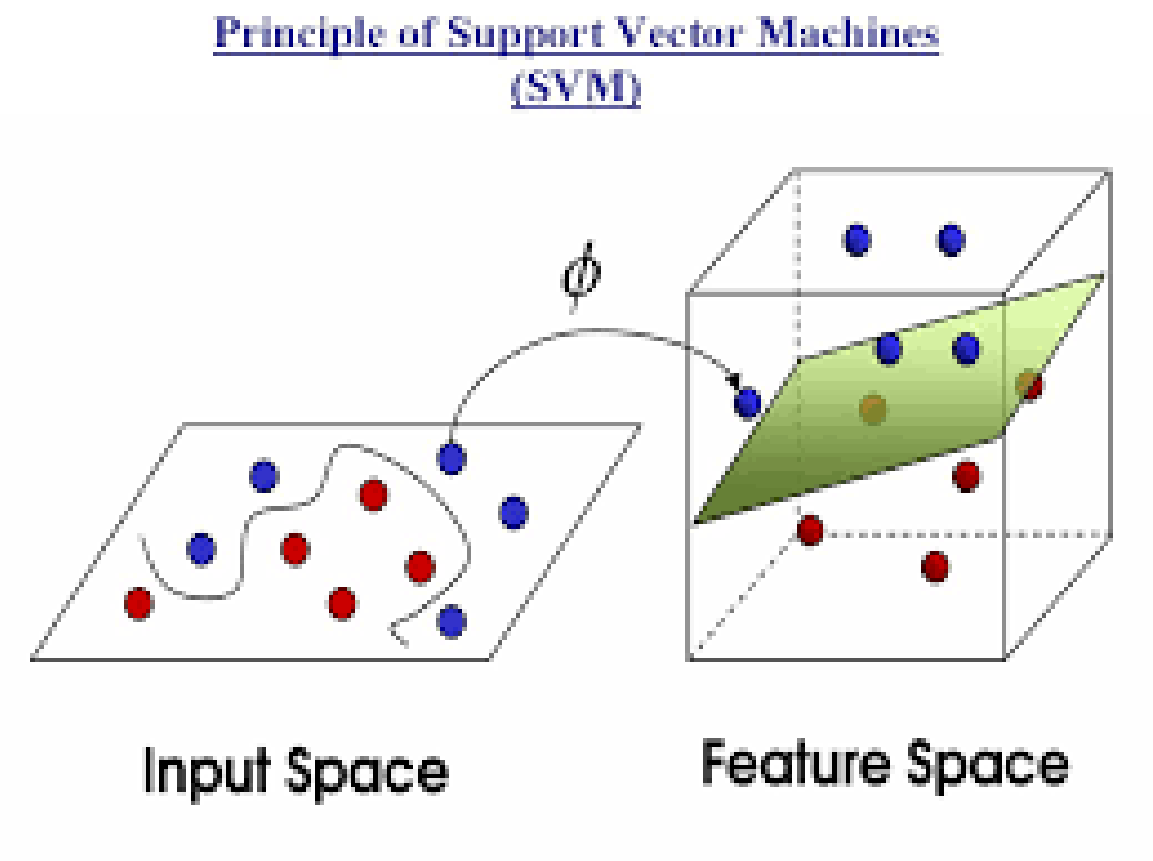


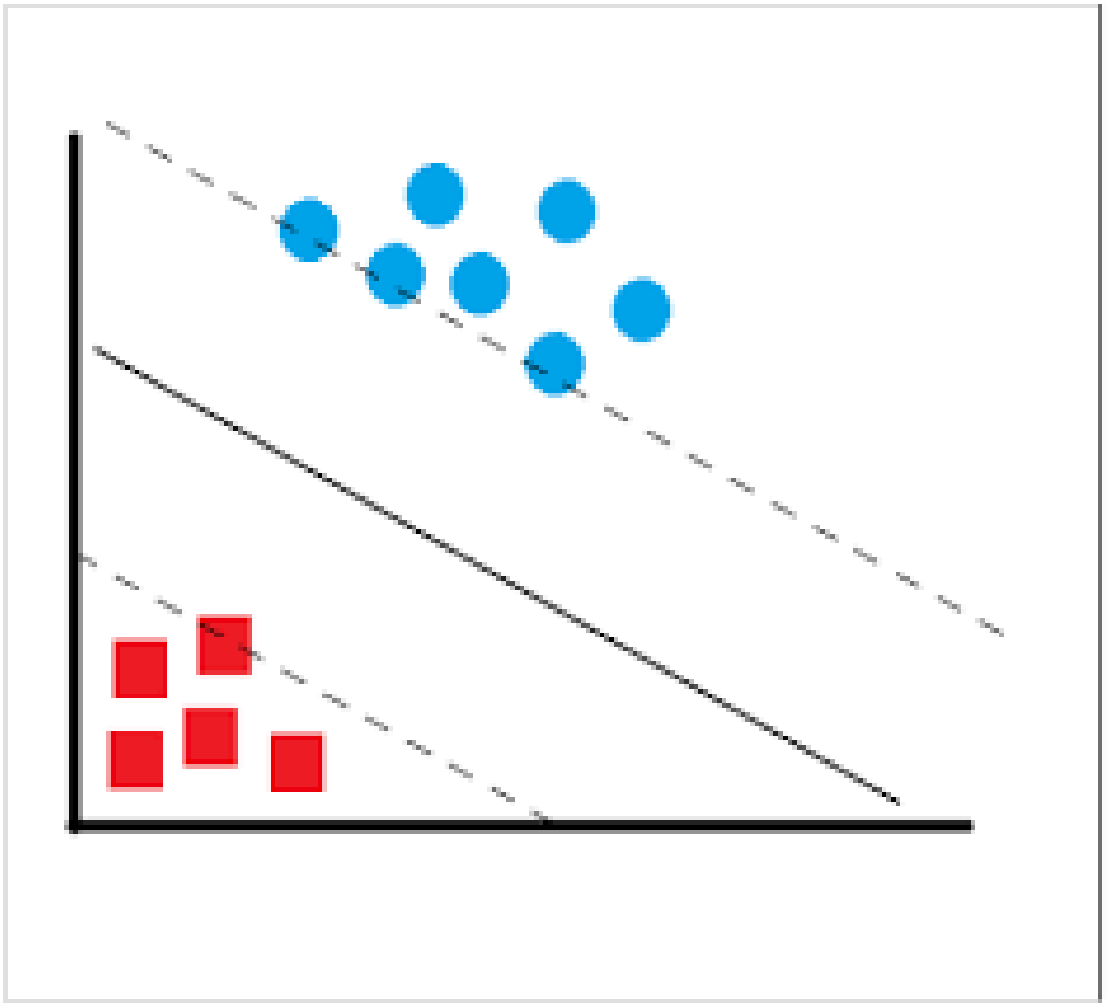




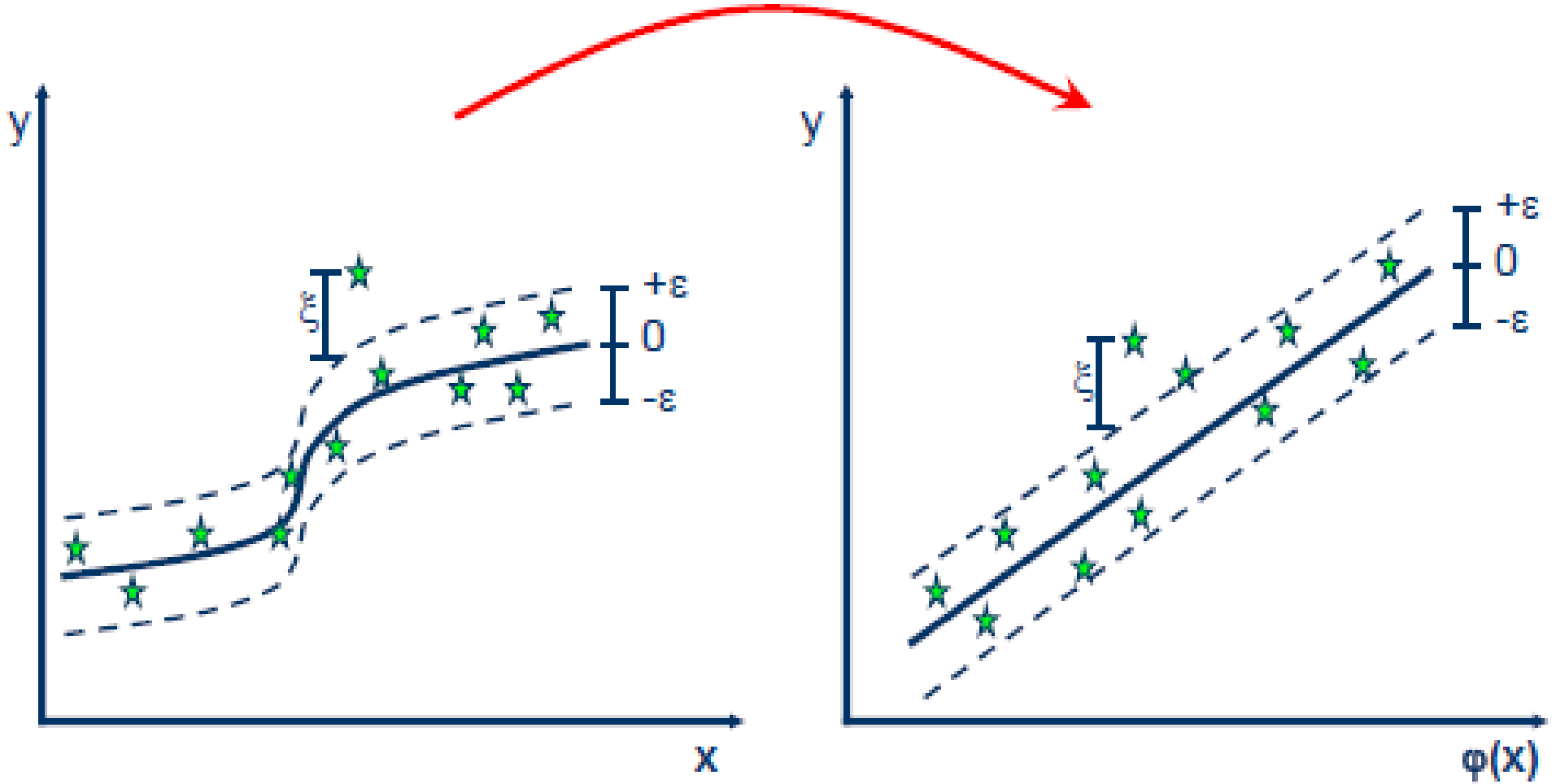


SVM- metoda podpornih vektorjev

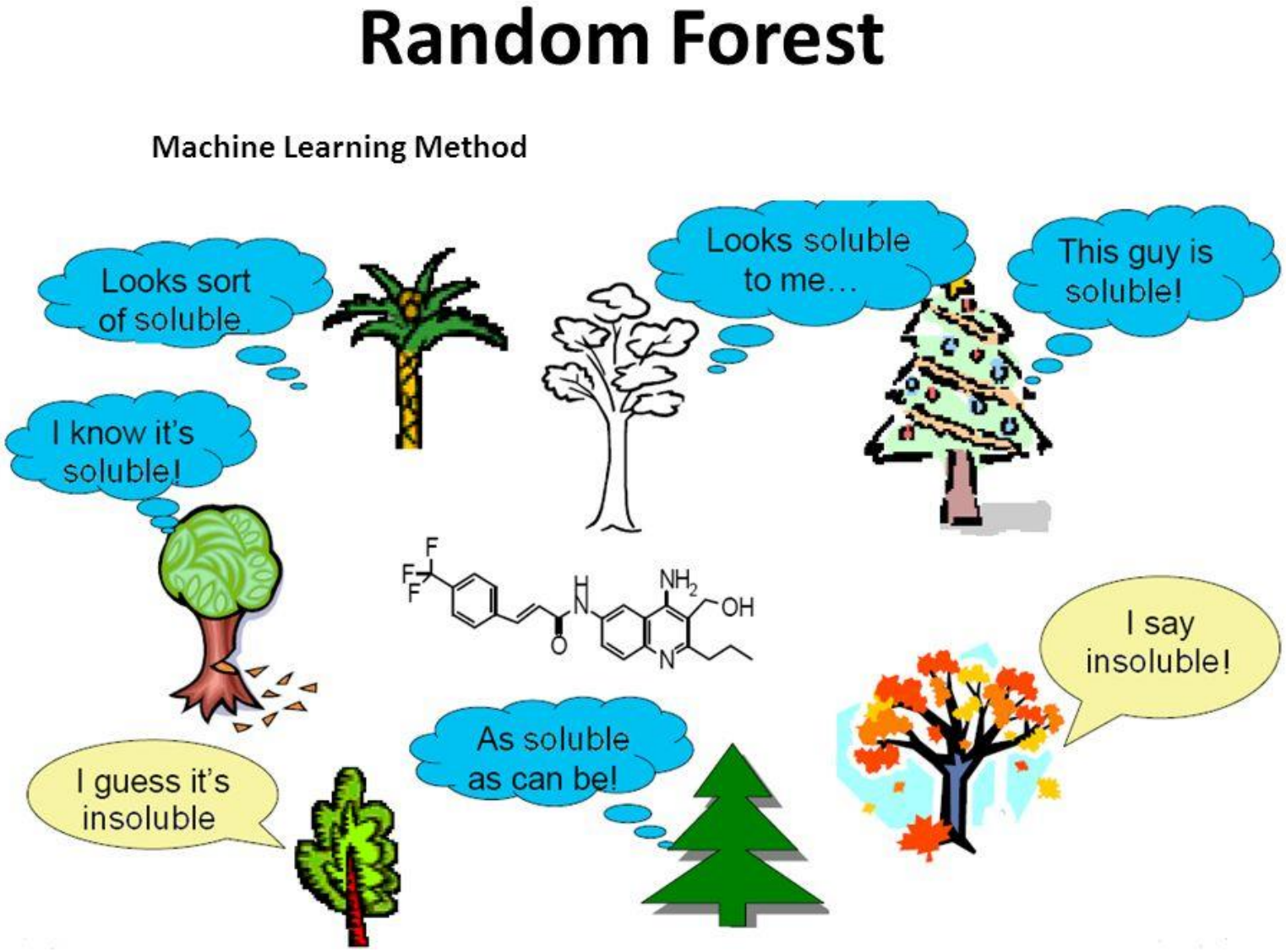




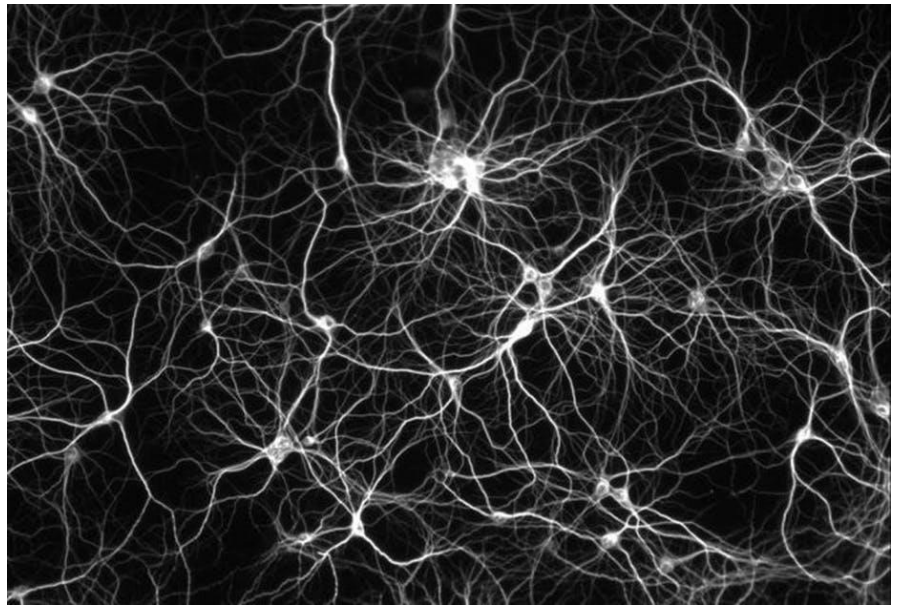
SVM za regresijo

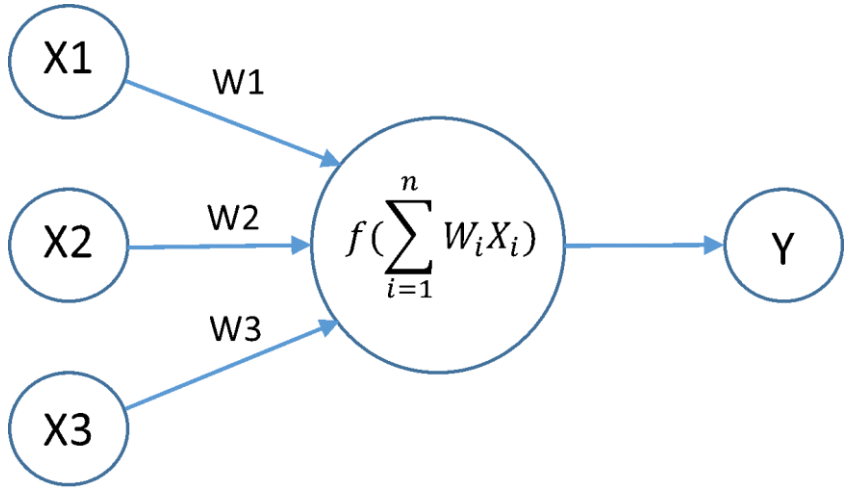


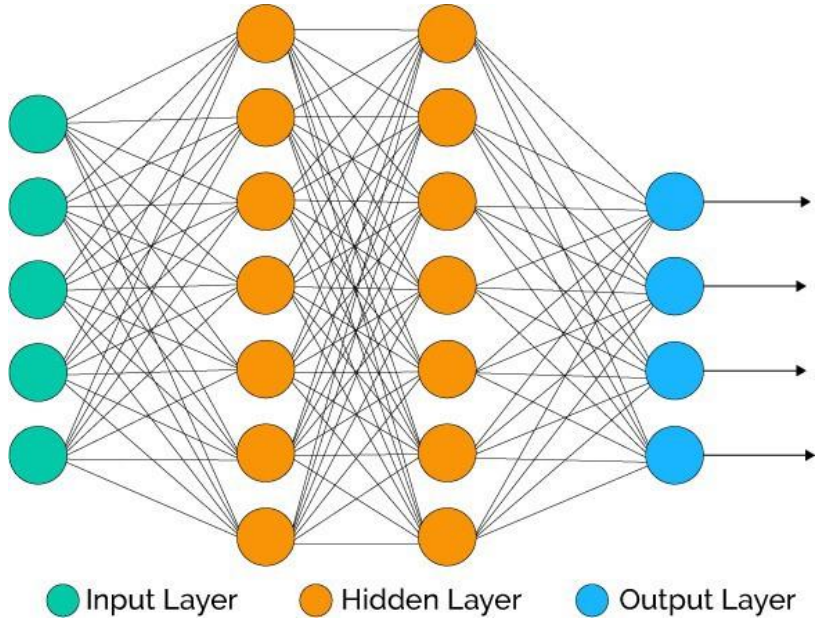
Naključni gozdovi (RF) – klasifikacija in regresija



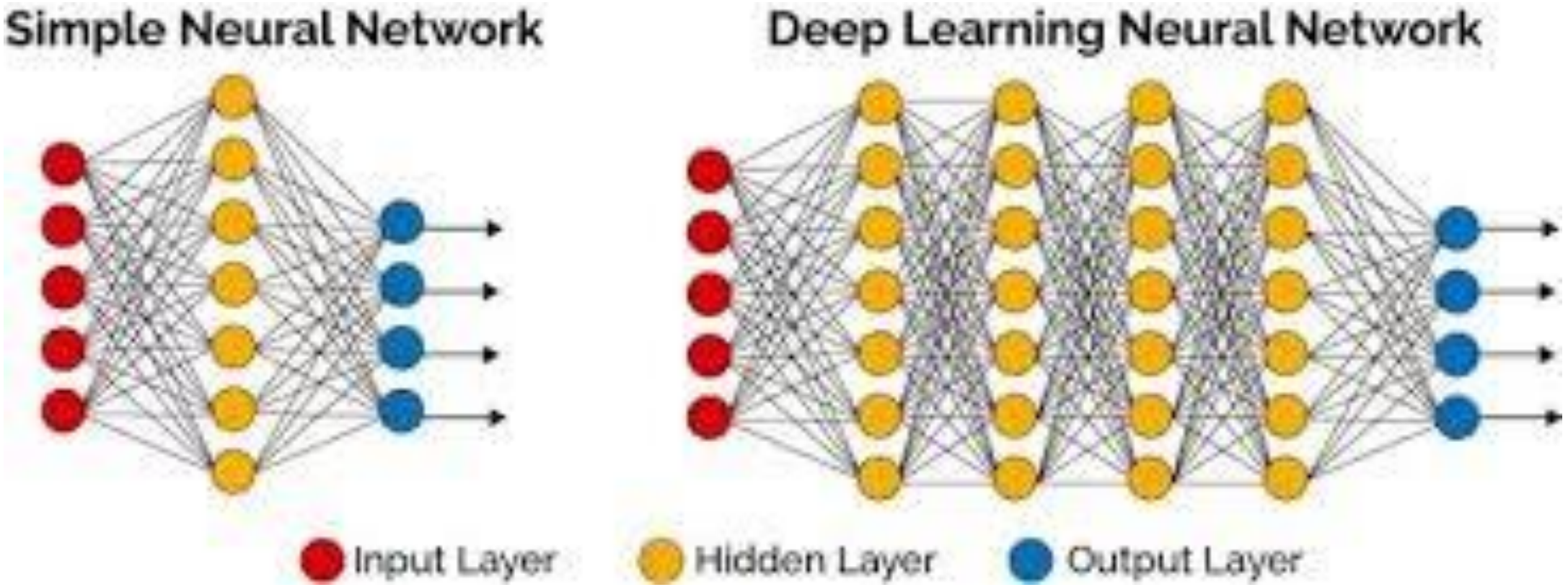
Umetne nevronske mreže





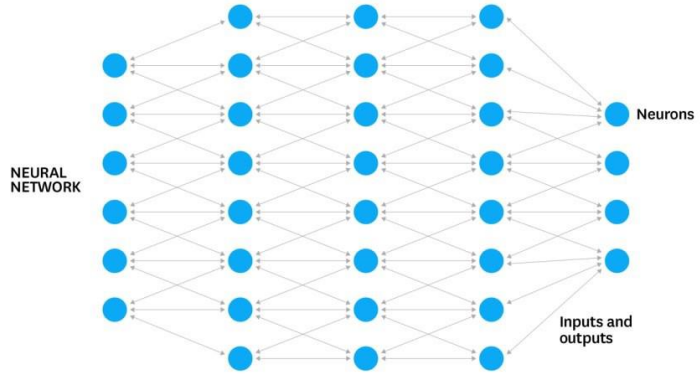


Globoke nevronske mreže (DNN)

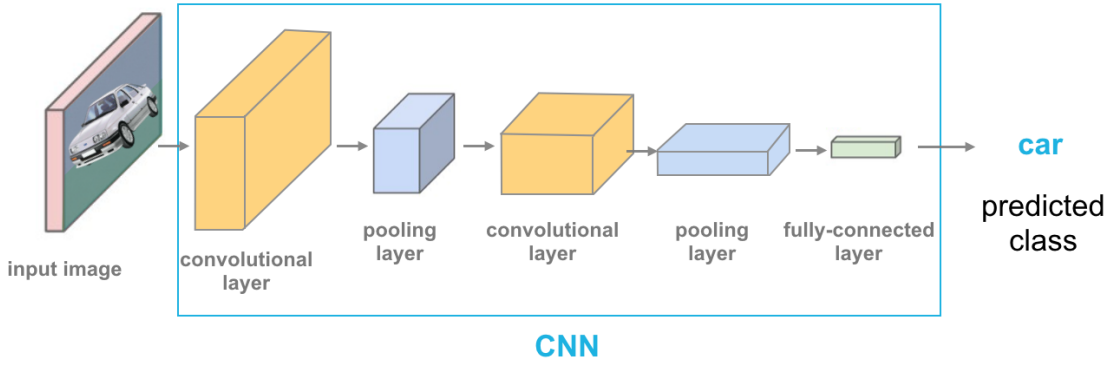


Globoke nevronske mreže: DNN

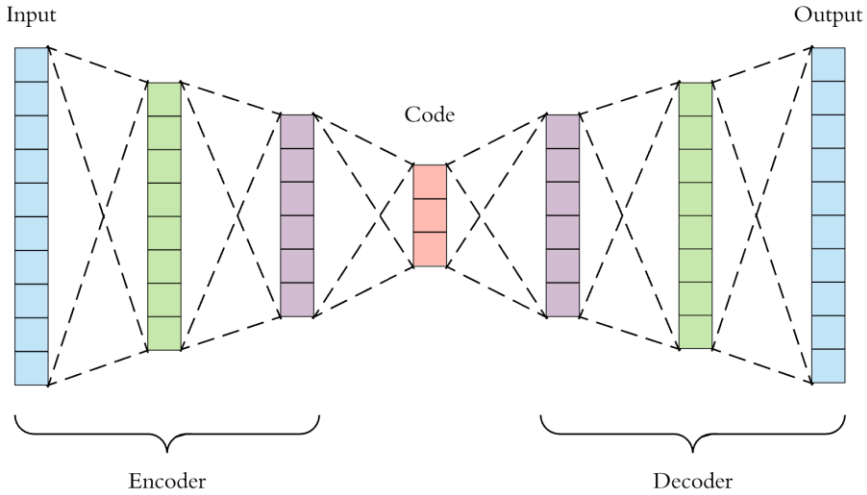
- Polno povezane



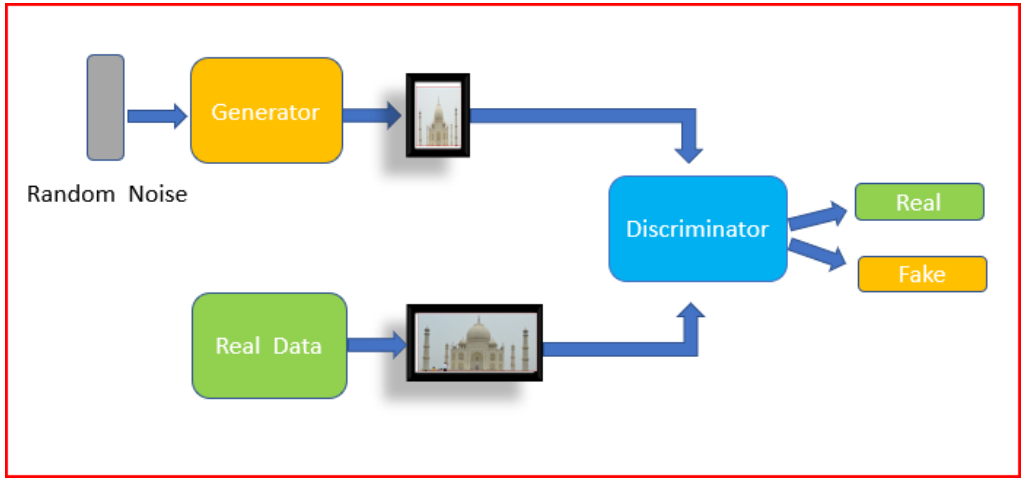
- Konvolucijske



- Autoenkoderji



- GAN



Rekurentne nevronske mreže: RNN

- 2.1 Fully recurrent
- 2.2 Recursive
- 2.3 Hopfield
  - 2.3.1 Bidirectional associative memory
- 2.4 Elman networks and Jordan networks
- 2.5 Echo state
- 2.6 Neural history compressor
- 2.7 Long short-term memory
  - 2.7.1 Second order RNN
- 2.8 Gated recurrent unit
- 2.9 Bi-directional
- 2.10 Continuous-time
- 2.11 Hierarchical
- 2.12 Recurrent multilayer perceptron
- 2.13 Multiple timescales model
- 2.14 Neural Turing machines
- 2.15 Differentiable neural computer
- 2.16 Neural network pushdown automata