SVM, Bayesian Network, and Markov Models / Chains

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Topics

- Support vector machines
- Bayesian networks
- Markov models / chains

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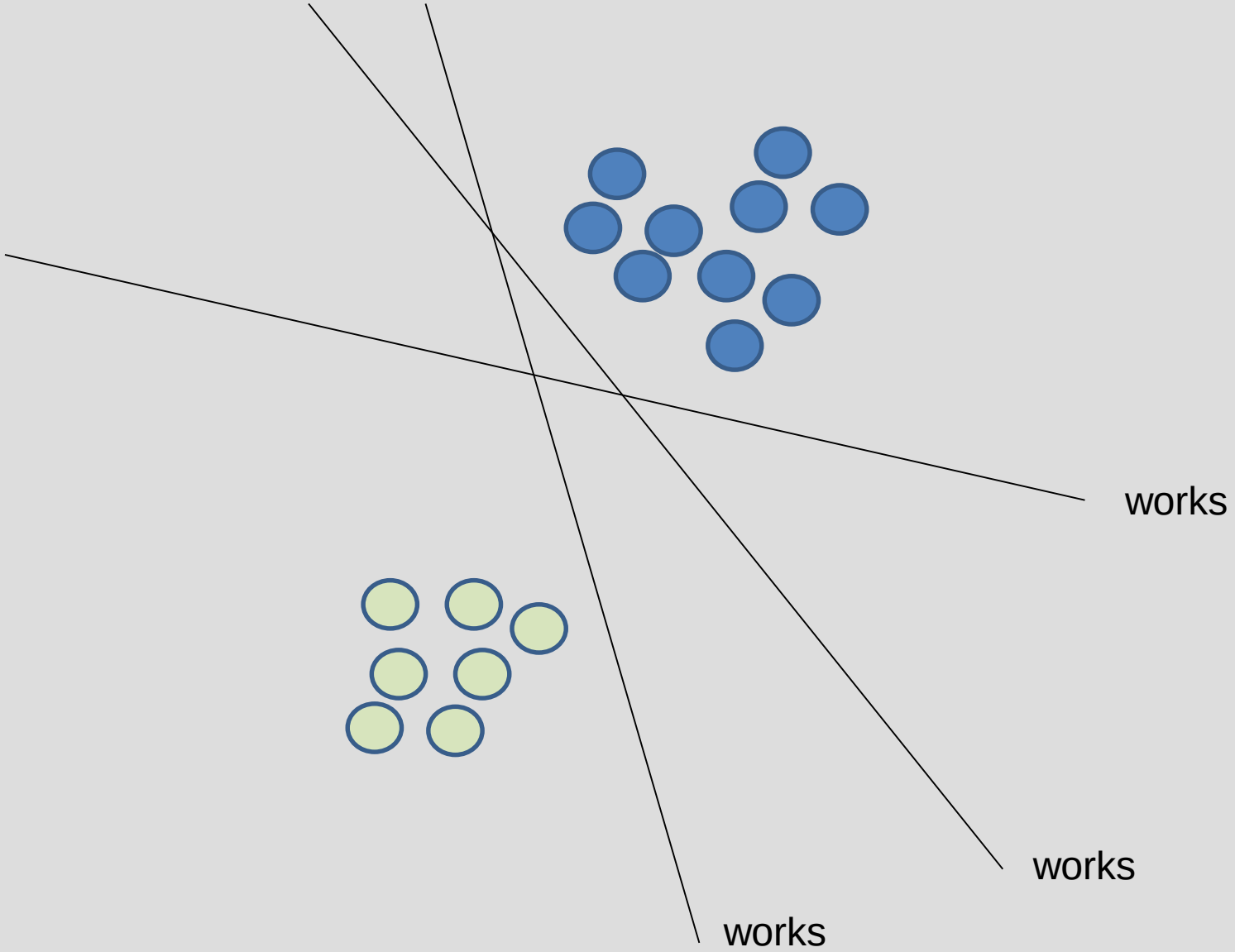
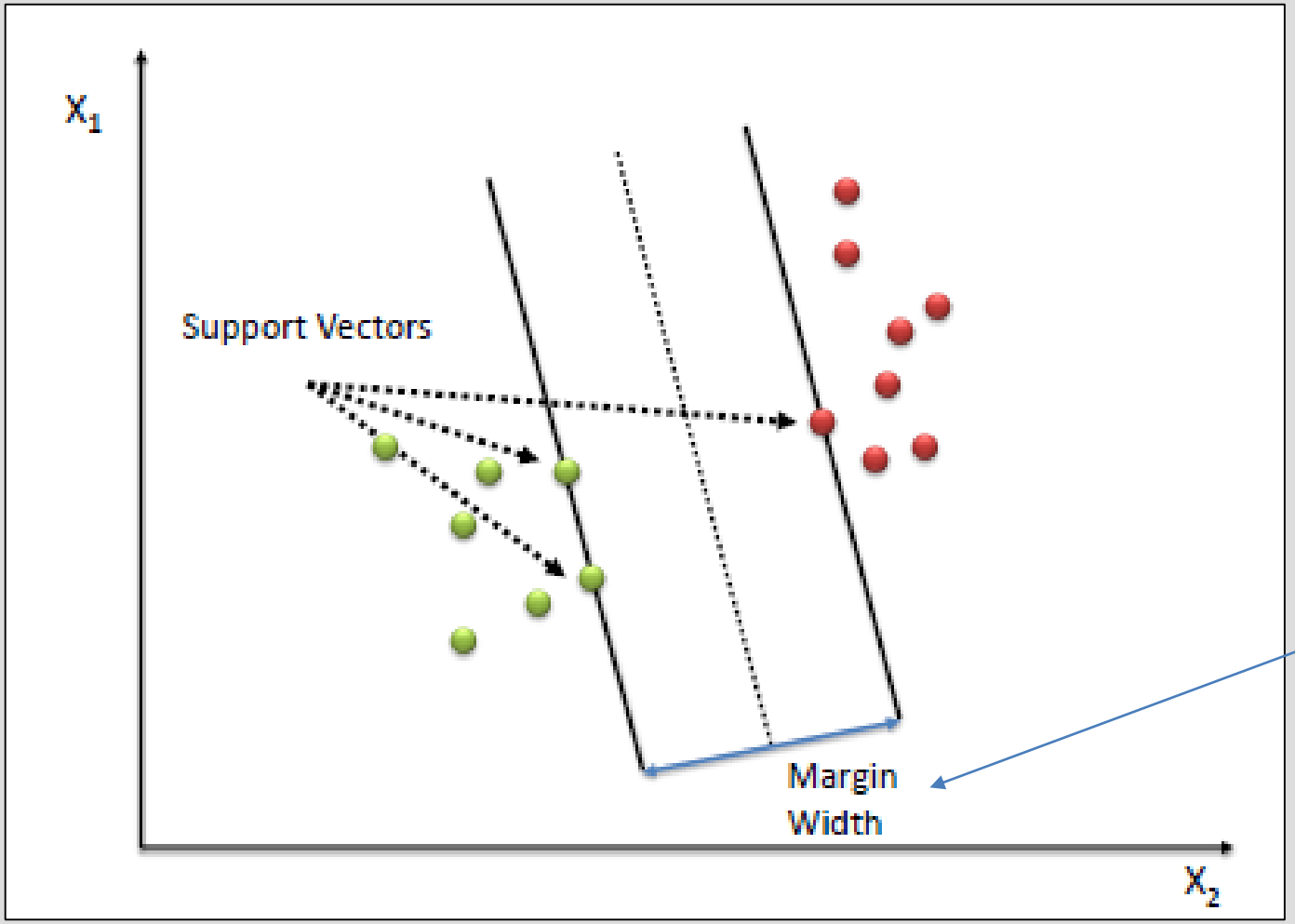
Which Solution?

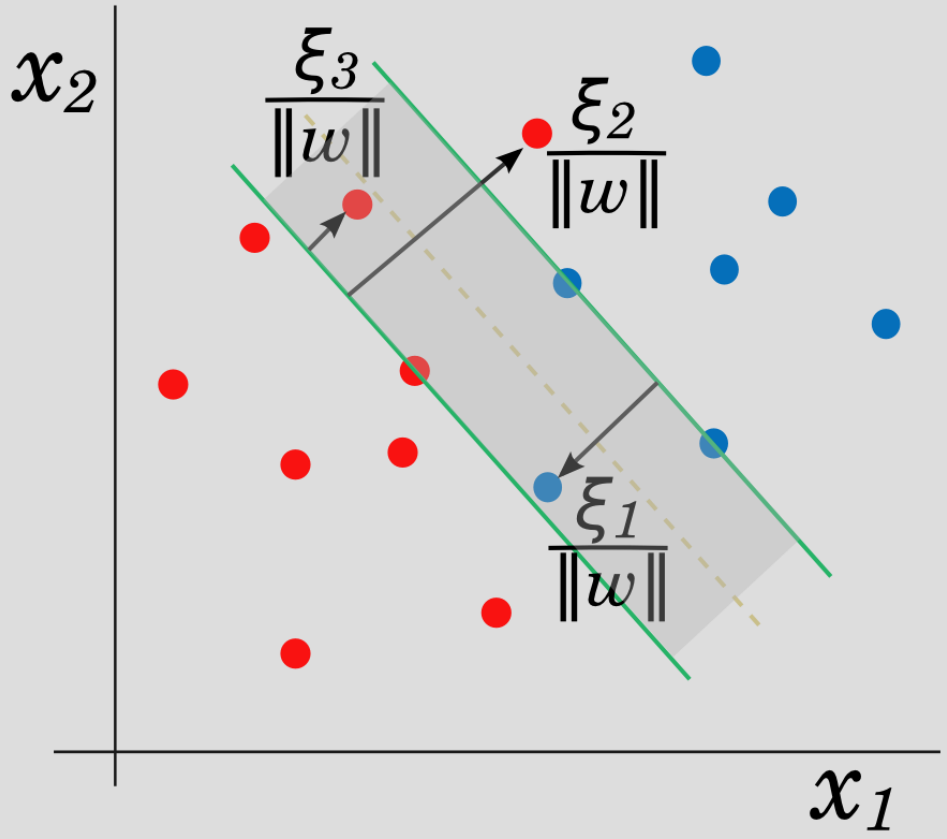


Support vector machine

- Clear definition of unique solution via margin



Nonlinear and soft margin



Some points now in the margin and others in the wrong class

Slack variables let us relax the SVM and solve! (regularization)

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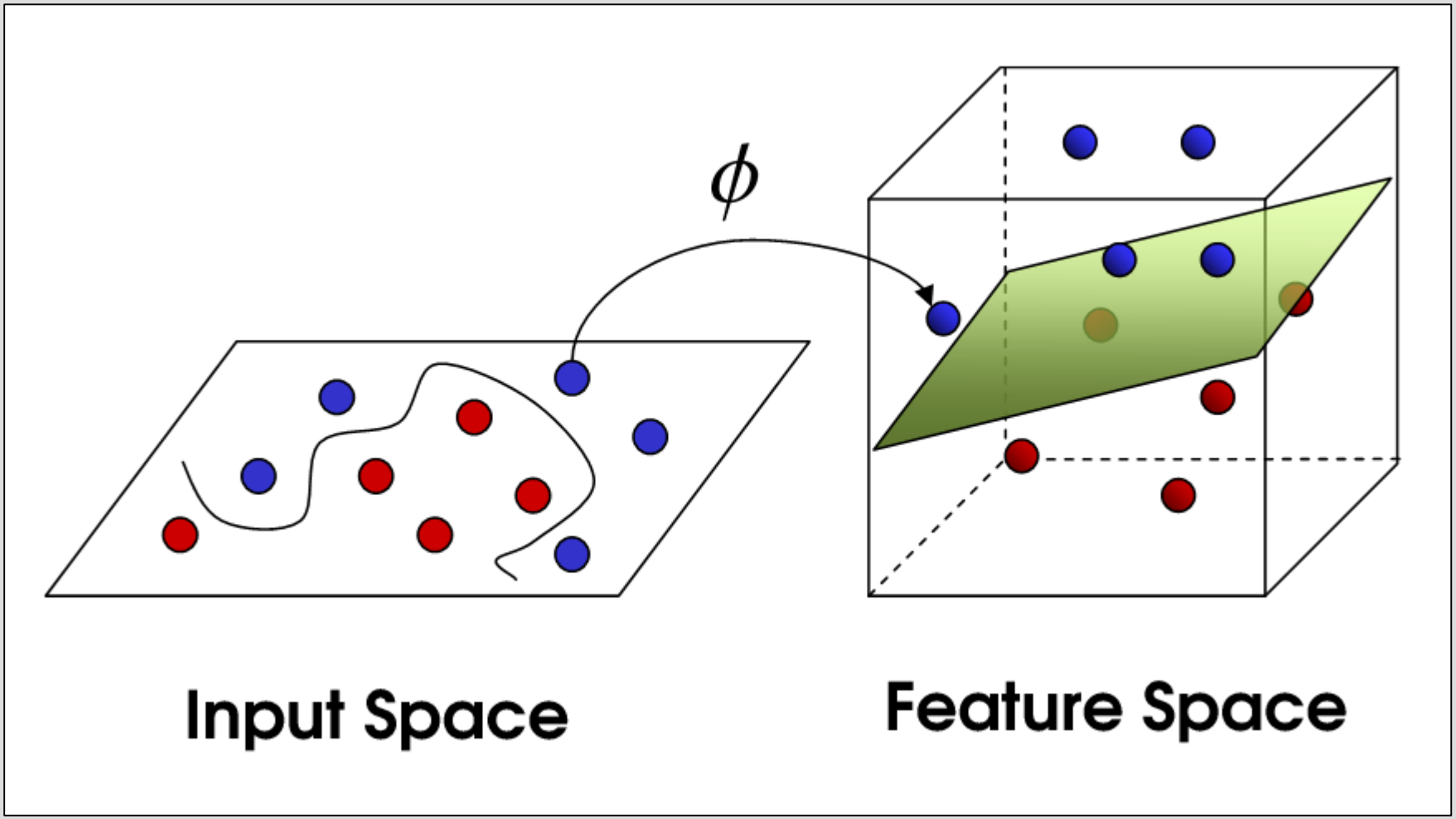
Nonlinear and kernel



No linear solution, so perform “mapping” to a new space!

https://www.jeremyjordan.me/support-vector-machines/

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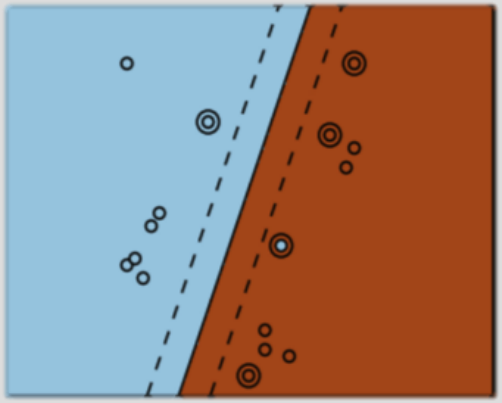
Kernels

- Avoid manually mapping low to high space
- Kernel function works on low dimensional data
- Gives same result as inner product in high space
- But … which kernel?

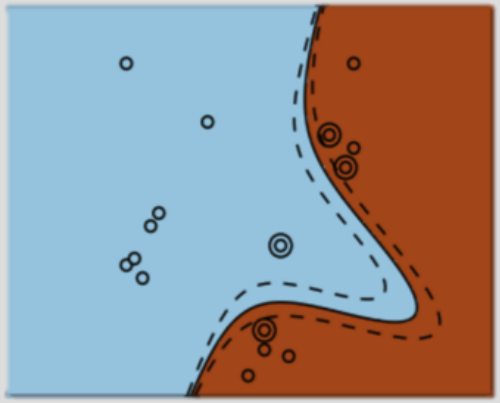
$$K(x_1, x_2) = exp\left(-\gamma * (x_1 - x_2)^2\right)$$

Linear Kernel



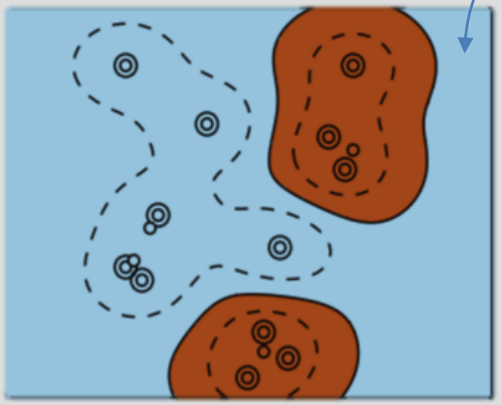
C hyperparameter

Polynomial Kernel



C plus gamma, degree and coefficient hyperparameters

RBF Kernel



C plus gamma hyperparameter

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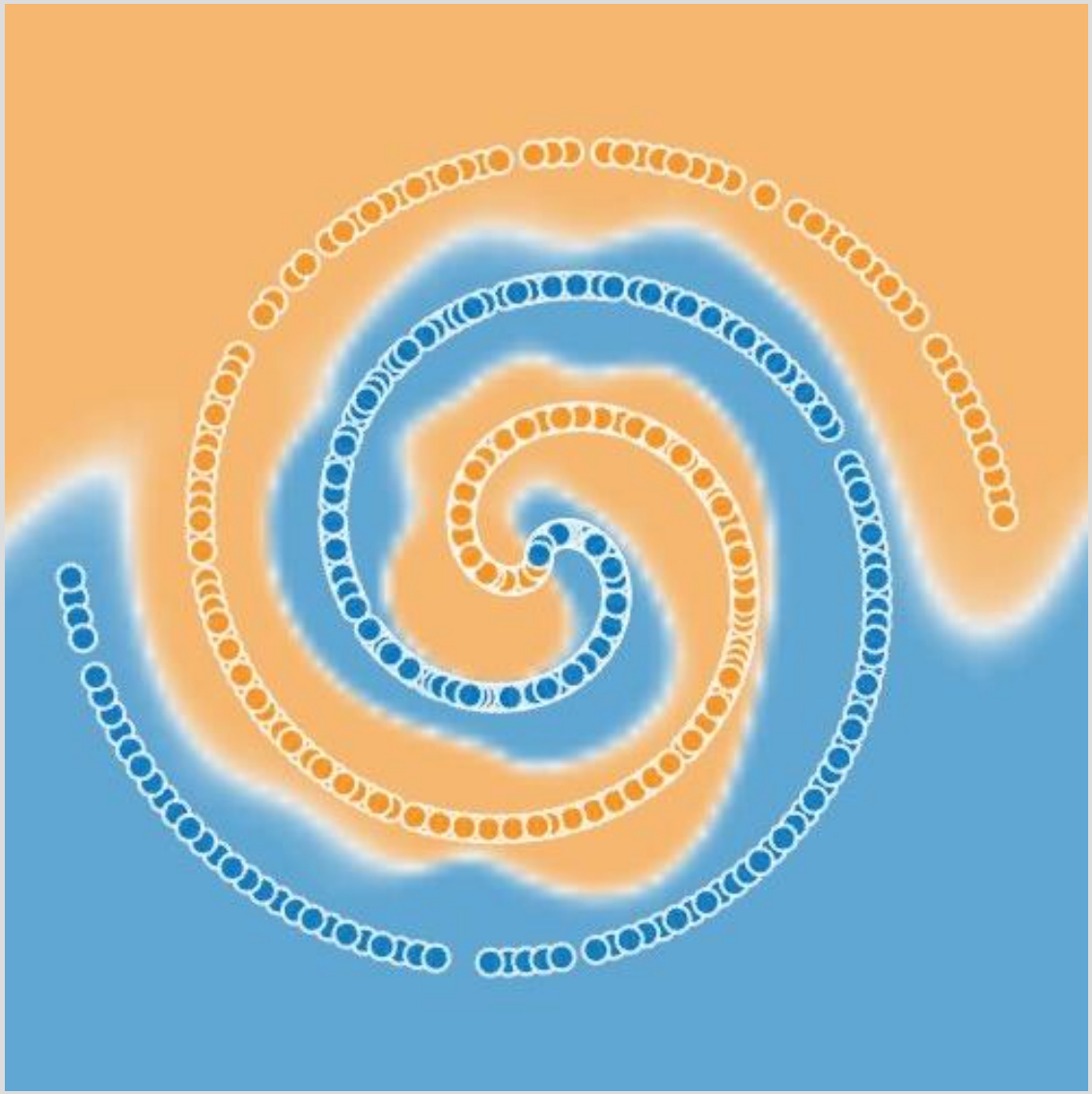
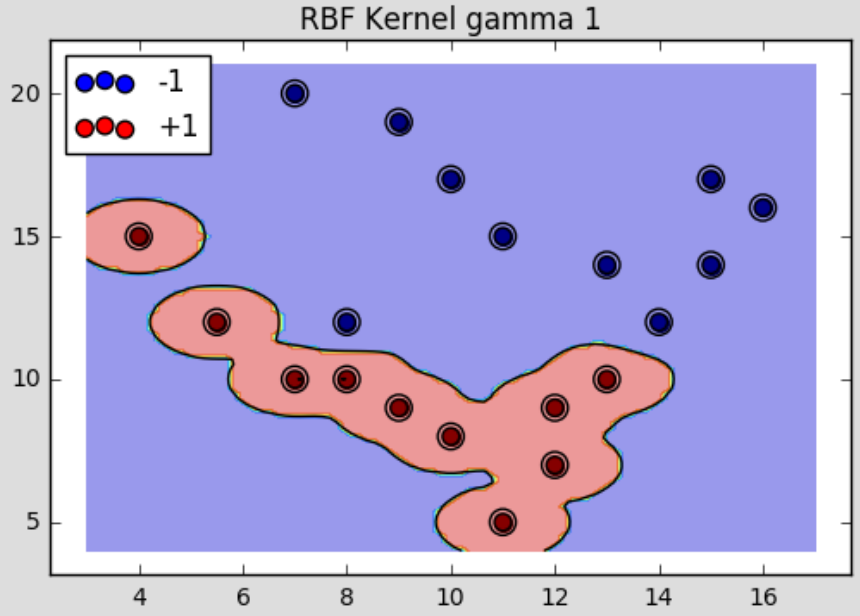
Yes, overfitting can and does occur





https://people.revoledu.com/kardi/tutorial/Python/SVM+in+Python.html

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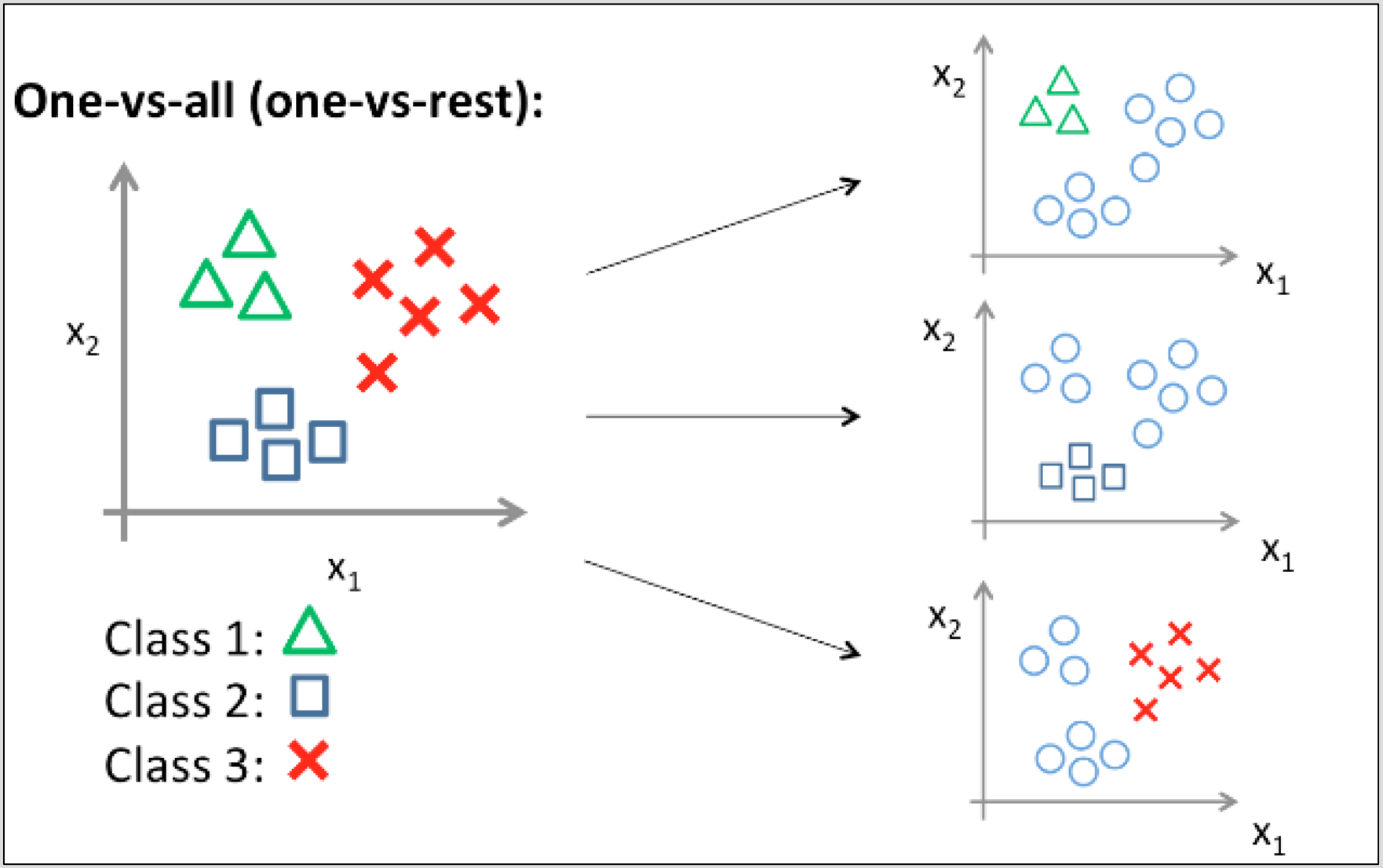
Multi-Class SVM One vs. All



https://houxianxu.github.io/2015/04/25/support-vector-machine/

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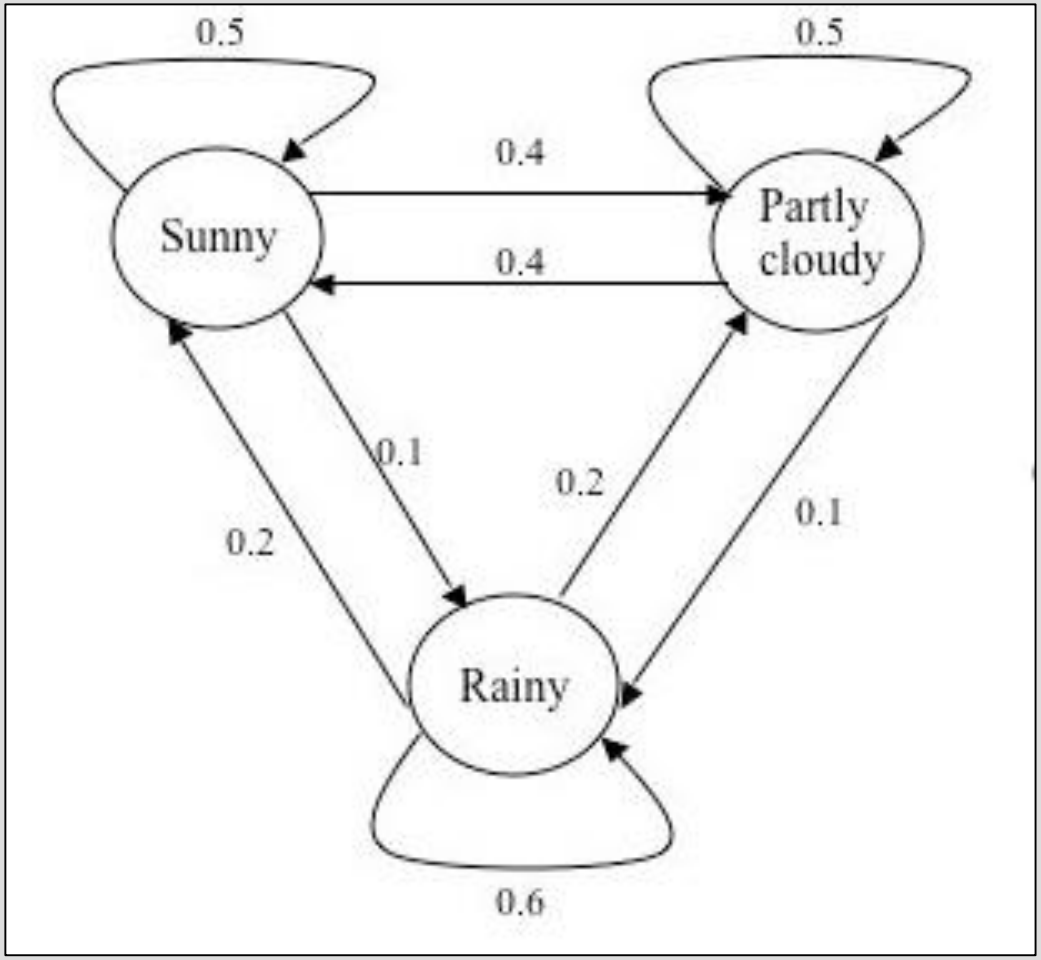
Markov Models / Chains

- Stochastic process
- States
- Transitions
- Markov property

http://setosa.io/ev/markov-chains/

https://flowingdata.com/2015/12/15/a-day-in-the-life-of-americans/



https://en.wikipedia.org/wiki/Markov_chain

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Markov chains

- Transition matrix
  - P(i,j) = P(go from state i to state j)
- Conditional independence
  - P(X(t+1) | X(t), X(t-1), …) = P(X(t+1) | X(t))
- Answers questions like
  - What's the probability of current state at any moment?
  - What's the average time for the system to go back to each state?

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Questions?