Computational Genomics (0382.3102)

Lecture 6

Brief Intro to **Machine Learning**, and to **Suffix Trees**

Prof. Benny Chor
School of Computer Science
Tel-Aviv University

Lecture based in part on chapter 1 in Scholkopf & Smola’s book, Learning with Kernels, and on a ppt presentation by Prof. Haim Kaplan (Tel-Aviv Univ.)
Pluto - General Background

Pluto, our loyal shepherd dog,
is highly intelligent and alert.

But where is Pluto?
Learning – Basic Scenario

- Pluto keeps an eye on a herd of *sheep*. 
Learning – Basic Scenario

• Pluto keeps an eye on a herd of *sheep*.
• There are *white* sheep and *black* sheep.
Learning – Basic Scenario

- Pluto keeps an eye on a herd of *sheep*.
- There are *white* sheep and *black* sheep.
- New sheep arrive at night time, carried by *storks*.
Learning – Basic Scenario

- Pluto keeps an eye on a herd of sheep.
- There are white sheep and black sheep.
- New sheep arrive at night time, carried by storks.
- Pluto should be able to identify the newly arriving sheep and report their color to the herd’s CEO.
Learning – Basic Scenario

- Pluto keeps an eye on a herd of sheep.
- There are white sheep and black sheep.
- New sheep arrive at night time, carried by storks.
- Pluto should be able to identify the newly arriving sheep and report their color to the herd’s CEO.
- Nights are pitch dark.
Learning – Basic Scenario

- Pluto keeps an eye on a herd of *sheep*.
- There are *white* sheep and *black* sheep.
- New sheep arrive at night time, carried by *storks*.
- Pluto should be able to identify the newly arriving sheep and report their color to the herd’s *CEO*.
- Nights are pitch dark.
- Even though Pluto is equipped with the latest night vision technology, it cannot see a thing . . . ahmmmm . . . sheep.
Learning – Basic Scenario

- Pluto keeps an eye on a herd of sheep.
- There are white sheep and black sheep.
- New sheep arrive at night time, carried by storks.
- Pluto should be able to identify the newly arriving sheep and report their color to the herd’s CEO.
- Nights are pitch dark.
- Even though Pluto is equipped with the latest night vision technology, it cannot see a thing . . . ahmmmm . . . sheep.
- Fortunately, newly arriving sheep are quite noisy, and Pluto’s has great senses of hearing and directionality.
The Sheep(ing) News

- Sheep of different colors do not mingle together.
The Sheep(ing) News

- Sheep of different colors do *not* mingle together.
- The same applies to the newcomers.
The Sheep(ing) News

• Sheep of different colors do not mingle together.
• The same applies to the newcomers.
• Pluto learns all sheep’s facts (e.g. location and colors) at daytime.
The Sheep(ing) News

- Sheep of different colors do not mingle together.
- The same applies to the newcomers.
- Pluto learns all sheep’s facts (e.g. location and colors) at daytime.
- Pluto then applies this knowledge to infer new sheep’s colors from their location.
Pluto, a Learning Expert

...the story of the sheep dog who was herding his sheep, and serendipitously invented both large margin classification and Sheep Vectors...
Better Classifier
Better (Too Good?) Classifier
Optimal Margins
Back to Pluto

- Pluto’s task would be rather easy if white and black sheep could be separated by a line in the 2D plane (in general, a hyperplane in $k$).
Back to Pluto

- Pluto’s task would be rather easy if white and black sheep could be separated by a line in the 2D plane (in general, a hyperplane in $\mathbb{R}^k$).
- Unfortunately, life is not always so linear.
Back to Pluto

- Pluto’s task would be rather easy if white and black sheep could be separated by a line in the 2D plane (in general, a hyperplane in $\mathbb{R}^k$).
- Unfortunately, life is not always so linear
Solution: Transform!