Linear Algebra
Course Themes

Thom Pietraho

Bowdoin College

Linear Algebra

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Three sheaves of good crop, 2 sheaves of mediocre crop, and 1 sheaf of bad crop are sold for 39 dou. Two sheaves of good, 3 of mediocre, and 1 of bad are sold for 34 dou. One sheaf of good, 2 of mediocre, and 3 of bad are sold for 26 dou. What is the price for a sheaf of good crop, mediocre crop, and bad crop?

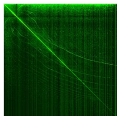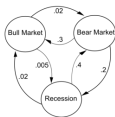*-Chiu-chang Suan-shu, Nine Chapters in Arithmetic (200 BC)*

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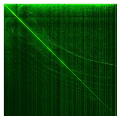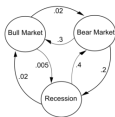
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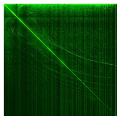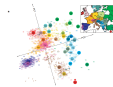
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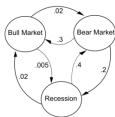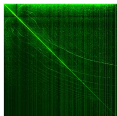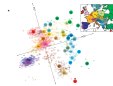
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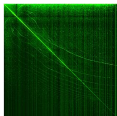
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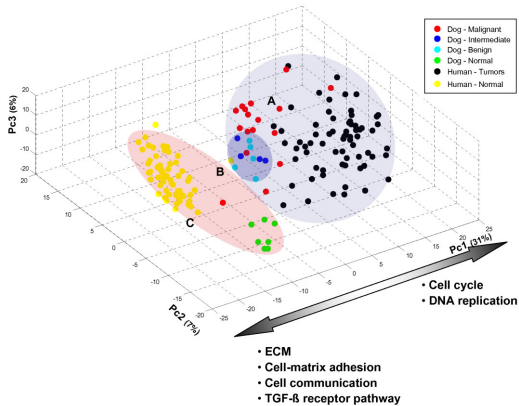*-Chiu-chang Suan-shu, Nine Chapters in Arithmetic (200 BC)*

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Course Goal: Introduce the mathematical tools and techniques necessary to be able to use linear algebra in these contexts.

Application: Data Visualization

"Genes mirror geography in Europe," Novembre et al, 2008.

Application: Clustering

Tissue samples, Uva et al. (dark blue = benign, red = normal.)
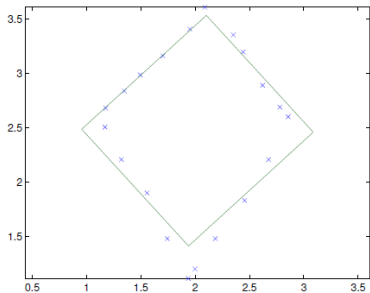
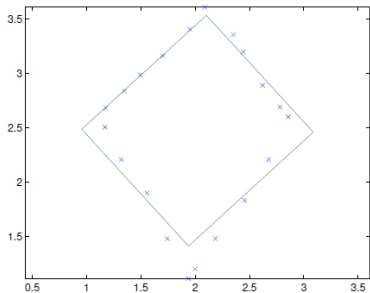# Application: Clustering

Voting records in Quebec.

Application: Pattern Fitting

Fitting a particular shape to a set of sample points.
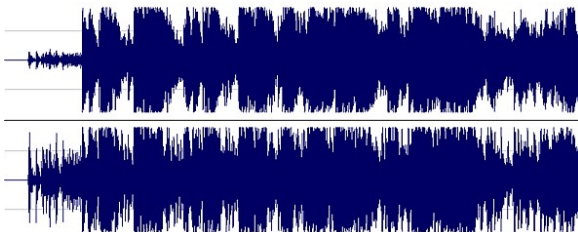
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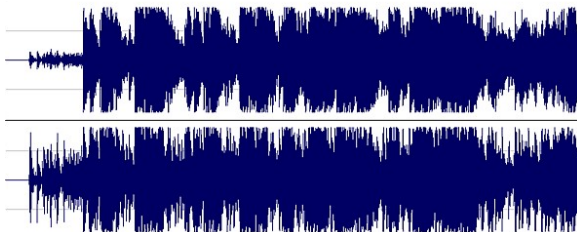

Fitting a particular shape to a set of sample points.
Example: Linear regression in statistics. Many more.
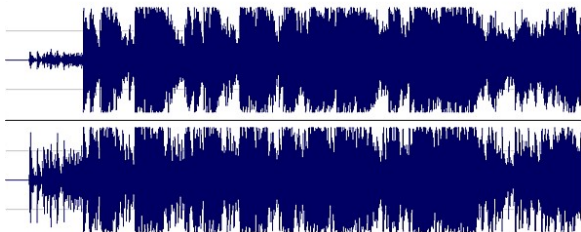
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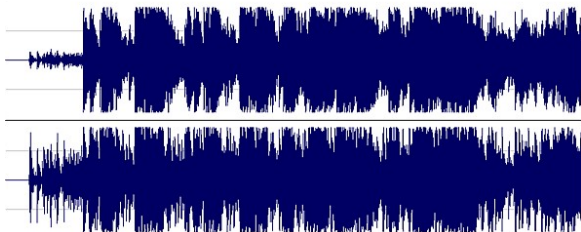
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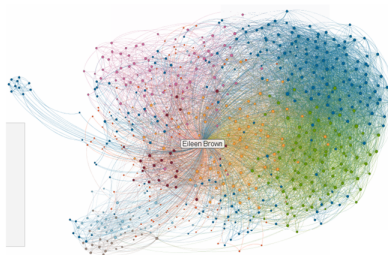

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Moral: As the class goes on, some of our results will be done in more general setting than $\mathbb{R}^n$.

Networks

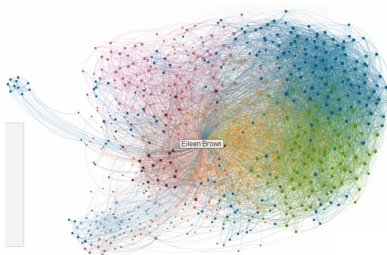Eileen Brown's Social Network:

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Networks

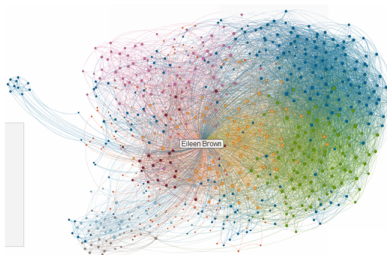Eileen Brown's Social Network:

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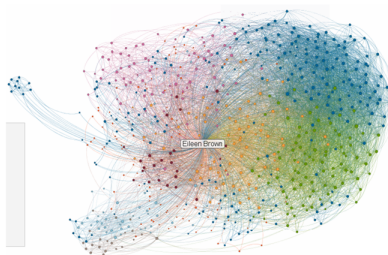Eileen Brown's Social Network:

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Eileen Brown's Social Network:

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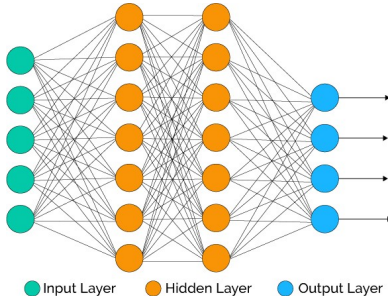**Upshot:** Can use linear algebra to analyze the graph.
Questions: Find cliques, model disease propagation.
Question: How to graphically render the graph to display most information?

Neural Networks and Machine Learning

An Artificial Neural Network:

Input Layer • Hidden Layer • Output Layer

Machine learning employs a considerable amount of linear algebra, and it turns out that sometimes linear algebra can be *learned* by neural networks. But more on that later ...

Image: medium.com