Lecture 1. Introduction & Syllabus

Sep. 1. 2017

This course plans to cover the following topics. Extensive experimental projects are conducted.

I. Geometric Data Analysis
(1) Dual Geometry of Principal Component Analysis (PCA) and Multidimensional Scaling (MDS):
(2) Robust PCA: PCA with outliers
(3) Sparse PCA: PCA with variable selection
(4) Manifold Learning:
- Locally Linear Embedding (LLE) from PCA
- Laplacian LLE, Diffusion map, LTSA etc.
- ISOMAP from MDS
- Graph Realization as manifold local MDS

(5) Supervised PCA:
- Ridge Regression and PCA
- Slice Inverse Regression (SIR)
- Classification and Linear Discriminant Analysis (LDA)

(6) Further representation learning
- tSNE
- Steerable PCA
- Dictionary Learning and matrix factorization
- Deep learning

Spectral Method

"Can you hear the shape of a drum?"

by Hermann Weyl

Mark Kac

⇒ Can you hear the shape of data?

II. Topological data analysis
(1) clustering
- k-center
- k-means
- hierarchical linkage

(2) Morse theory and Topological data analysis
- Reeb graph and mapper
- Persistent homology and discrete Morse theory
- *Critical nodes and graphs

(3) *Euler Calculus and signal processing

(4) Connecting geometry and topology: Hodge Theory

Spectral clustering and graph Laplacian

Statistical Ranking and graph Helmholtzian

Game Theory

Courseweb

http://math.stanford.edu/~yuany/course/2017.fall

Time & Venue

Mon. 3-4:20pm

Fri. 10:30-11:50 am

1027 LSK

No Final Exam !

Yes: weekly homeworks (?), no grading (no TA)

monthly mini-projects

Final Project

Peer Reviews !! (poster workshop / github reports

w. doodle vote).

take a look at previous course