Tools for Education – A Personalized View

Mihaela van der Schaar

University of California, Los Angeles
http://medianetlab.ee.ucla.edu
Motivation

- Education increasingly takes place in larger and larger classes - both in traditional classroom teaching and in MOOCs.
- Challenges:
  - heterogeneous student backgrounds and abilities
  - heterogeneous student styles of learning
- Personalization is important to maintain student engagement and reduce drop-outs.
- Education is a life-long pursuit – beyond college....
My Agenda

- Use Machine Learning and Data Mining to create a personalized interactive environment for each student – *One teacher for one student*
- Personalized Remedial Materials
- Life-long Education/Personal Growth
- Study and Support Networks
- Incentivizing Collaborations
Goal: Identify students who need help (grade/performance prediction)

...as early as possible
...with predefined confidence

- Assumption: Early performance assessments (e.g. homeworks, quizzes) available
- Constraint: Only early class performance used
- Tested on: Digital Signal Processing (DSP) (Undergrad) Course

Goal: Identify students who need help (grade/performance prediction)

Grade Prediction Algorithm

Wait or Predict?

Assessment 1
Wait
Store Score and Feature Vector
Load Data from Past Years

Assessment 2
Wait
Acknowledge Final Prediction
Store Score and Feature Vector

Assessment 3
No Need to Load Data

Assessment K
Store Overall Grade

Final Prediction for Current Student Made after Assessment 2

Take Corrective Actions in Consequence of the Predicted Grade

Performance Assessments

Grade Prediction

Database
Feature Vectors & Grades from Past Years

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Benchmarks:
- Use single/few past assessments
- Linear regression
- k-Nearest Neighbors

Advantages:
- Personalized prediction (stopping)
- Confidence/guarantees
- Rescuing students
- More assessments early on can improve prediction
- Use data from past classes
Goal: Adapt the teaching methodology to

- maximize student performance/learning
- minimize student time/effort

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C. Tekin, J. Braun and M. van der Schaar, "eTutor: Online Learning for Personalized Education," ICASSP, 2015
Ongoing

- Personalized Course Sequence Recommendation
- Life-long Education/Personal Growth
- Study and Support Networks
- Incentivizing Collaborations

Tools

- Novel Multi-Armed Bandit Algorithms
- Novel Clustering Methods
- Novel Game-Theoretic Methods (Repeated Matching, Network Formation, etc.)

Y. Xiao, F. Dörfler and M. van der Schaar, "Incentive Design in Peer Review: Rating and Repeated Endogenous Matching"