Advanced Topics in Machine Learning

A. LAZARIC (*INRIA-Lille*)

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SequeL – INRIA Lille

Outline

Elements of Statistical Learning Theory

Online Learning (a.k.a. Sequence Prediction)

Multi-armed Bandit Problem
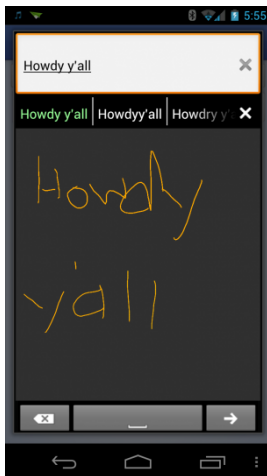
Administrative Stuff

Outline

Elements of Statistical Learning Theory

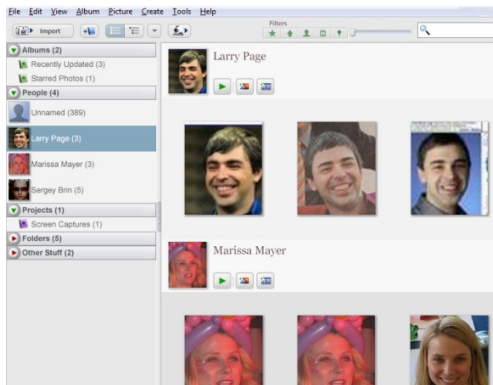Online Learning (a.k.a. Sequence Prediction)

Multi-armed Bandit Problem

Administrative Stuff

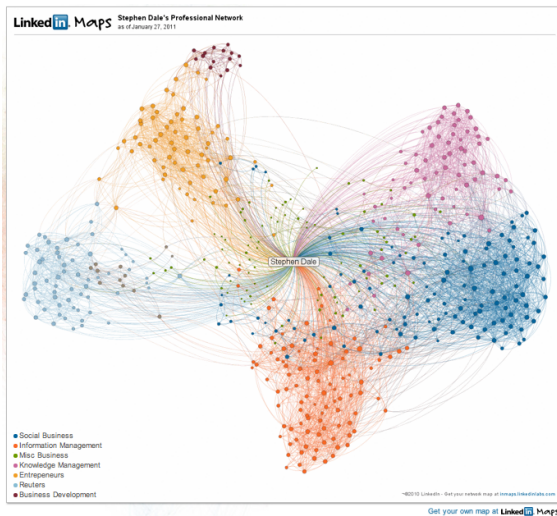# Machine Learning

Handwriting recognition

Machine Learning
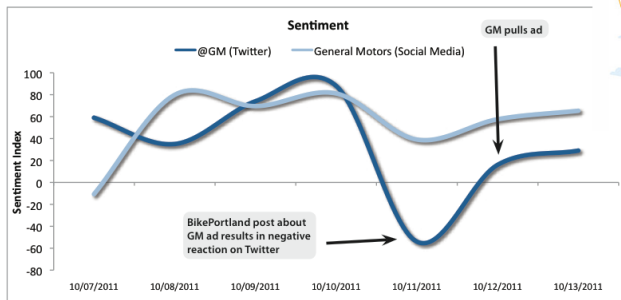

Face detection/recognition

Machine Learning

Page ranking

Machine Learning

Machine Learning

Sentiment classification
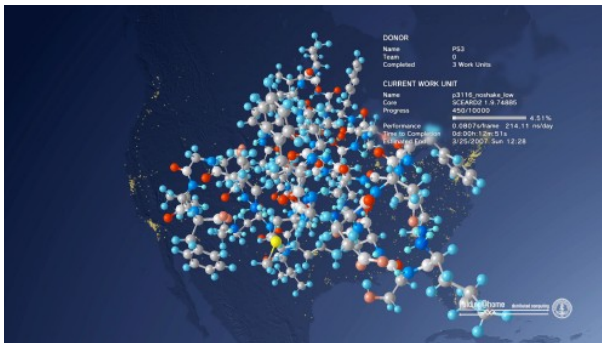
Machine Learning

Recommendation systems

Machine Learning

Recommendation systems
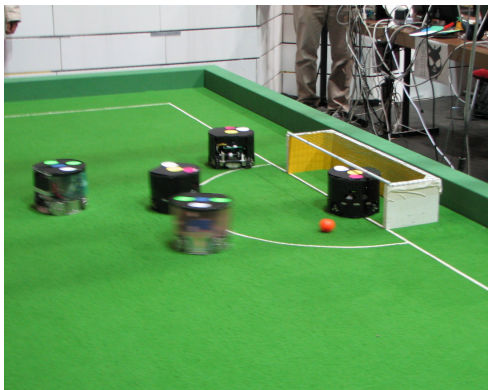
Machine Learning

Bioinformatics

Machine Learning

Robotics

Machine Learning

Robotics

Machine Learning

Natural Language Processing
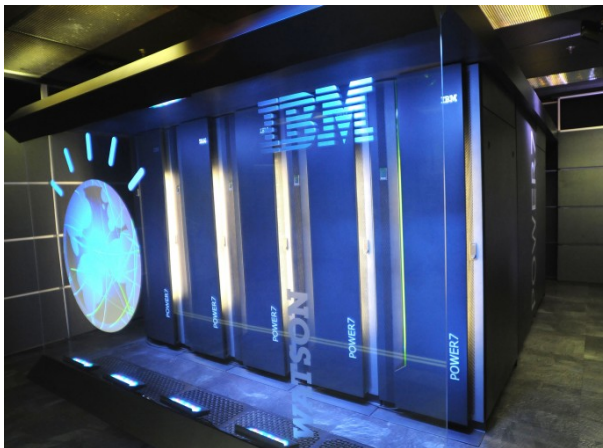
Machine Learning

Natural Language Processing

Machine Learning
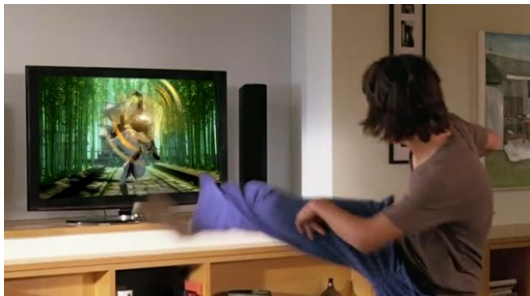
Entertainment

Elements of Statistical Learning Theory

What: Theoretical analysis of the *behavior* of a learning algorithm.

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Why: Learning algorithms work on *noisy* data (i.e., noisy data) and thus their behavior is *non-deterministic* (but ***predictable!***).

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How: Overview on

- Concentration of measures inequalities
- VC–Theory for binary classification
- L1-Regularized least–squares regression

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Online Learning (a.k.a. Sequence Prediction)

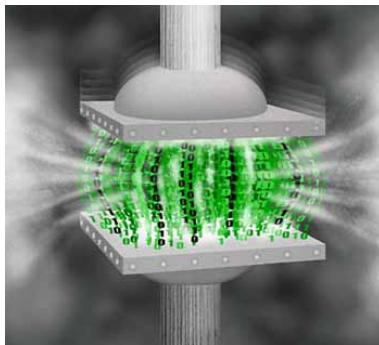Multi-armed Bandit Problem

Administrative Stuff

Online Prediction

Binary prediction

Online Prediction

Online data compression
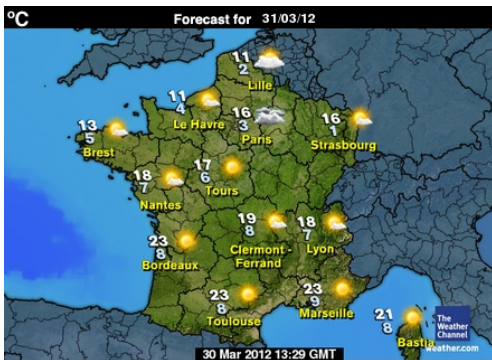
Online Prediction

Market prediction

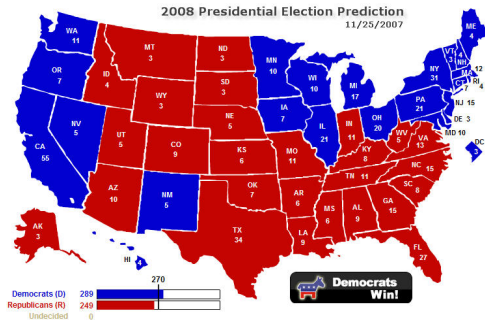# Online Prediction

Betting systems

Online Prediction

Weather forecast

Online Prediction

Elections prediction

Online Prediction
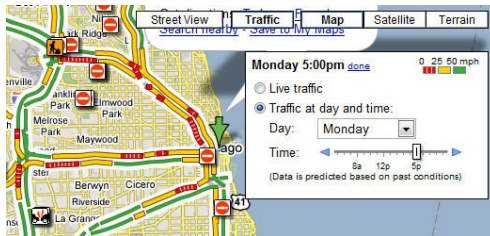
Traffic forecast

Online Learning (a.k.a. Sequence Prediction)

What: Prediction of *any sequence* of elements in an *online* fashion (e.g., stock market, binary sequences, weather, ...).

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How: Overview on

- ▶ Learning with expert advice for continuous prediction
- ▶ Learning with expert advice for discrete prediction
- ▶ Efficient forecasters

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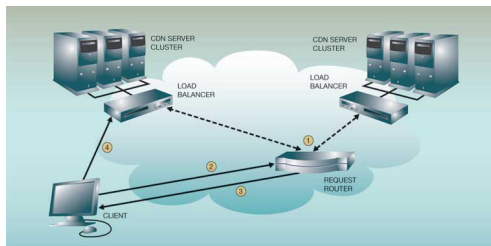
Multi-armed Bandit Problem

Administrative Stuff

Online Prediction

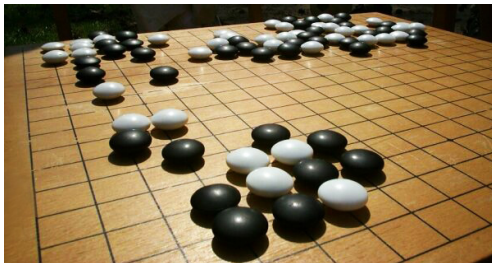Online web advertising

Online Prediction

Adaptive routing

Online Prediction

Clinical trials

Online Prediction

Computer games

Online Prediction
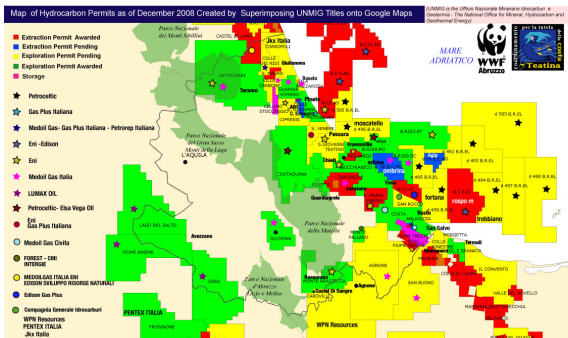
Oil/gas mining

Online Prediction

Adaptive marketing

Multi-armed Bandit Problem

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How: Overview on

- The exploration–exploitation dilemma
- Stochastic bandits (UCB)
- Non–stochastic bandits (Exp3)
- Extensions to large set of arms
- Connections to game theory

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Schedule

Topic	Day/Time	Location
Statistical Learning Theory	Apr. 2nd, 9:00-13:00	Sala Seminari
Statistical Learning Theory	Apr. 3rd, 9:00-13:00	Sala Seminari
Online Learning	Apr. 4th, 9:00-13:00	Sala Seminari
Online Learning	Apr. 11th, 9:00-13:00	Sala Seminari
Multi–armed Bandits	Apr. 12th, 9:00-13:00	Sala Seminari
Multi–armed Bandits	Apr. 13th, 9:00-13:00	Sala Seminari

Assignements

- **Option 1**: Report on 2-3 papers (better if you propose them)
- **Option 2**: Presentation on 2-3 papers (on the last day)
- **Option 3**: Short project (if some interesting research questions come out)

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