Hes·so
Haute Ecole Spécialisée de Suisse occidentale
Fachhochschule Westschweiz
University of Applied Sciences Western Switzerland

MSE | MASTER OF SCIENCE IN ENGINEERING

Multimodal Processing, Recognition and Interaction

Practical Information
Introduction

Moodle key: `mpri_20`

Elena Mugellini, Stefano Carrino,
Omar Abou Khaled

MPRI Organization

- Class
  - Tuesday 15h00 - 17h25, Provence A7
  - Moodle key: **mpri_20**
- Practical Work (TD, TP, mini-proj)
  - ~Once every two weeks
  - Often after the theoretical class => after @home
- Teachers
  - elena.mugellini@hefr.ch
  - stefano.carrino@he-arc.ch
  - omar.aboukhaled@hefr.ch

Course Objectives

- À la fin de ce cours, l'étudiant est capable de:
  - D'identifier les **cas d'utilisation** de techniques de machine learning
  - D'**évaluer et** de **choisir** les **meilleures approches d'apprentissage automatique** pour correspondre au mieux aux spécificités d'une application pour le traitement d'une activité spécifique.
  - Connaitre les spécificités et savoir traiter les tâches de **classification**, **prédiction**, **détection des anomalies** et **clustering**
  - D'expliquer les concepts d'apprentissage à partir des données, d'apprentissage **supervisé** vs **non supervisé**.
  - De **comparer** et **appliquer** les méthodes de machine learning, incluant les Support Vector Machines, les modèles de Markov cachés, etc.
  - De **comparer**, de **choisir** et d'**utiliser** de **différentes solutions technologiques** pour l'implémentation de techniques multimodales du traitement de signal.
  - D'**utiliser** des **frameworks** ou biblithèques de machine learning et data mining tels que scikit-learn, NumPy, Pandas sur des données concrètes.
  - D'**identifier les différents moyens d'interaction** possibles faisant appel à la multimodalité (voix, gestes, mouvements, etc.).
  - D'**analyser**, de **concevoir** et d'**implémenter** un **système d'interaction multimodale** basé sur les techniques d'apprentissage automatique.

Content

- Introduction to multimodal processing, recognition and interaction
  - General schema for multimodal processing, recognition and interaction
- Cases study: Classification problem
  - Hidden Markov Models – applied to time series
- Cases study: Prediction problem
  - Decision Trees / Artificial Neural Networks – Regression
- Cases study: Anomaly Detection
  - Support Vector Machine
- Cases study: Unsupervised and Semi-supervised approaches and clustering
  - K-means, Active learning, co-learning…
- Case study: ML and creativity (generative models)
- Advices about ML, Data fusion, Feature extraction…

Evaluation

- Exam 70%
  - Oral exam (no documentation allowed)
  - Theoretical and practical questions (including content presented during TPs/TDs)
- Practical work 30%
  - Mini-Project (challenge)
  - Small report (model will be provided)
  - Présentation

Practical Work

- **Goal**
  - Apply theoretical concepts to implement a specific MPRI problem
  - Using SVM, HMM, RF (or other algorithms)
- **Organization**
  - Completion of the assignments is mandatory
  - Each work that is not submitted on Moodle impact the final results (**-0.5**)
  - Bonus/malus on the final note!

Practical Work (2)

- TD
  - individual work
  - during the lecture
- TP
  - groups of 2 students
  - over 1-2 weeks
  - to return on Moodle
- Mini-Project
  - groups of 3 students
  - over 3-4 weeks
  - final presentation + report

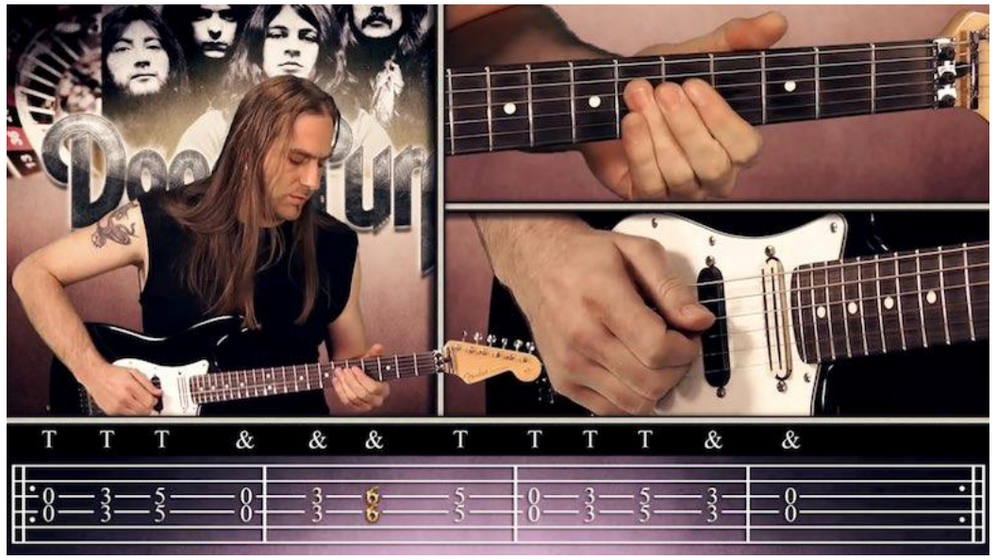
Projects

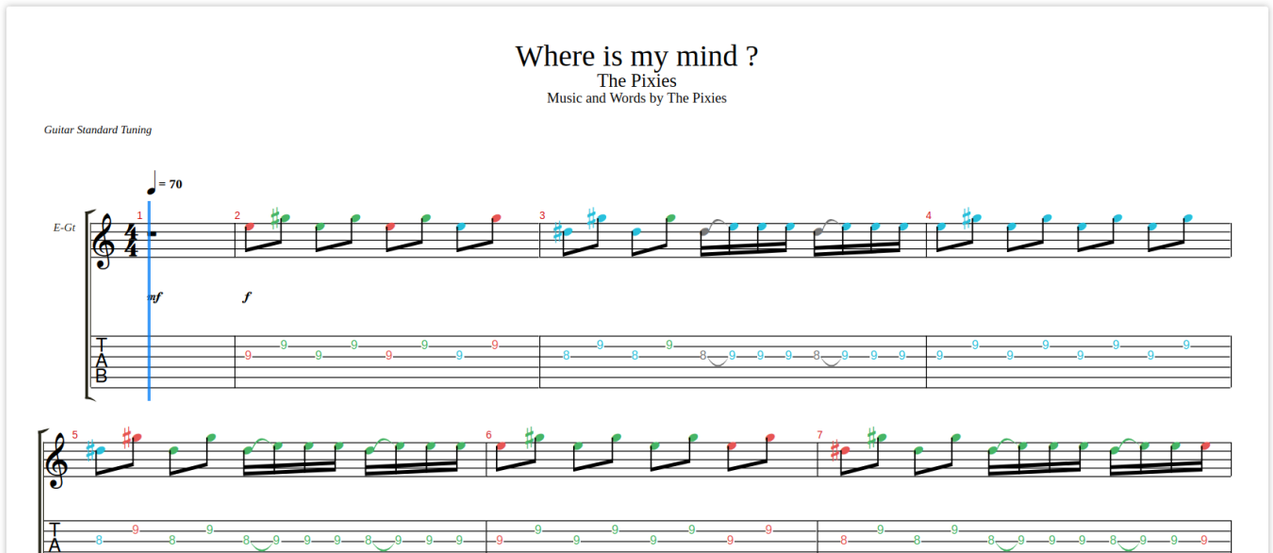
- @HES-SO
  - Human-Computer Interaction
    - Hguitar
    - Predict
    - ARAMIS
    - MAGI
    - EmoTV
  - Security
    - ADABeV
    - DEMIS
  - Biomedical application
    - SensiMed
    - VideoProtector
  - Web & information retrieval
    - NAMASTEE
  - Green Application
    - GreenMod
  - etc.

HGuitar Project

MIR – Music Information Retrieval

- Goal
  - Automatically recognize guitar music performed by a learner
  - Provide suggestions on how to improve
  - In collaboration with www.hguitare.com





PREDICT Project

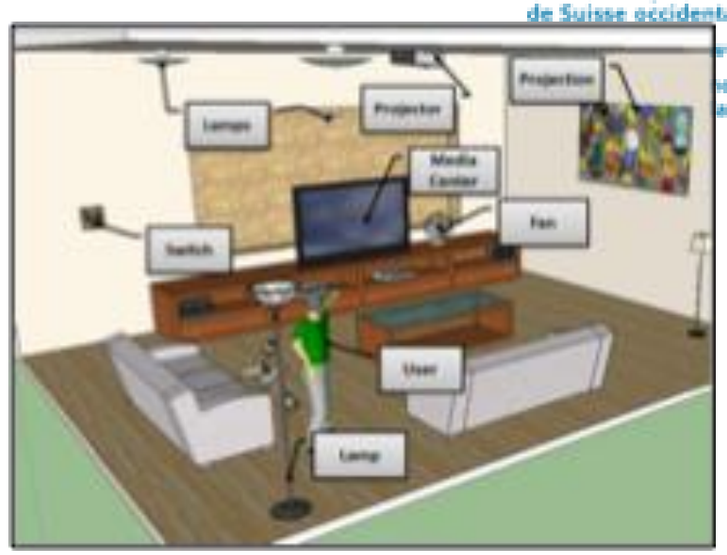
Prediction & Anomaly detection

- Goal
  - Predictive maintenance in a vehicle
  - Faults prediction
  - Remaining Useful Life (RUL) Estimation of Critical Components

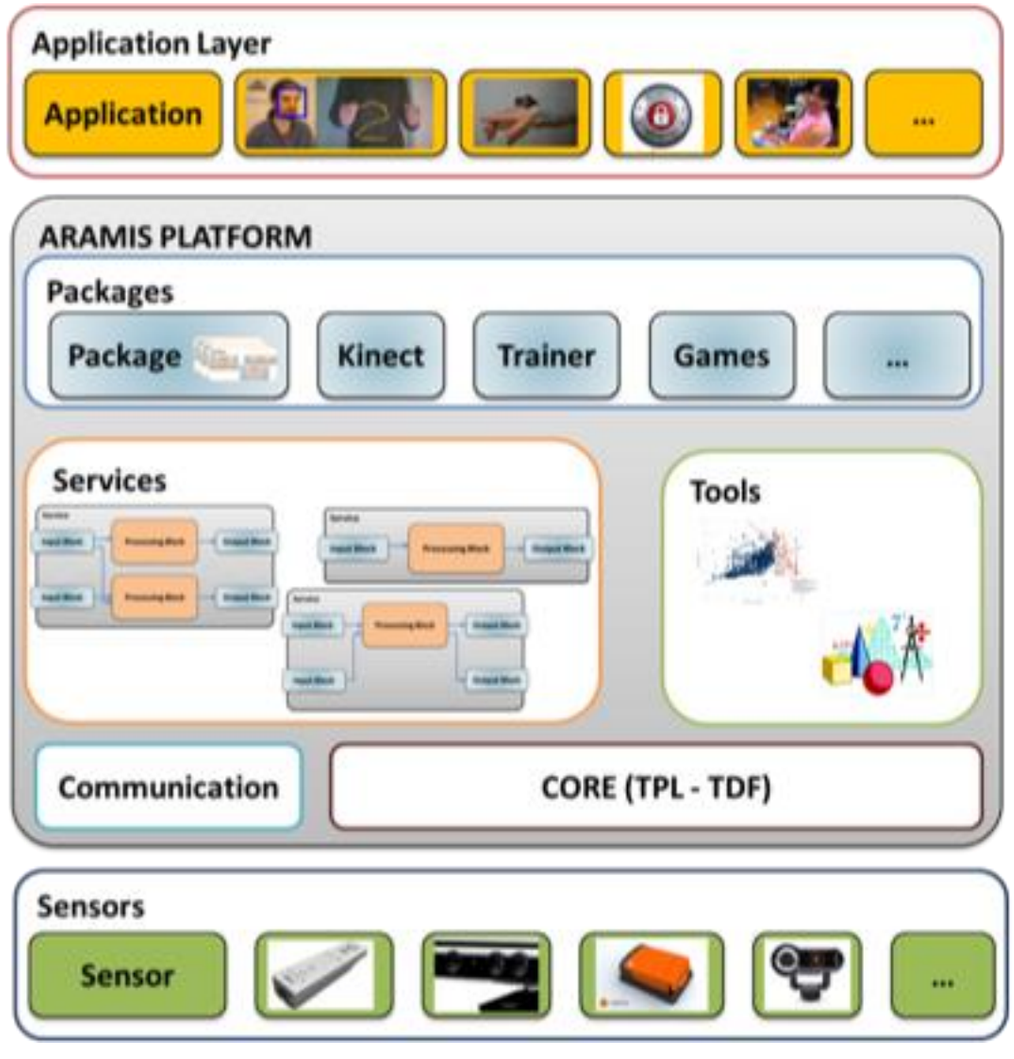
Image source: http://dataconomy.com/wp-content/uploads/2015/04/Predictive-Maintenance-Big-Data-on-Rails-1.png

ARAMIS Project

Human-Computer Interaction



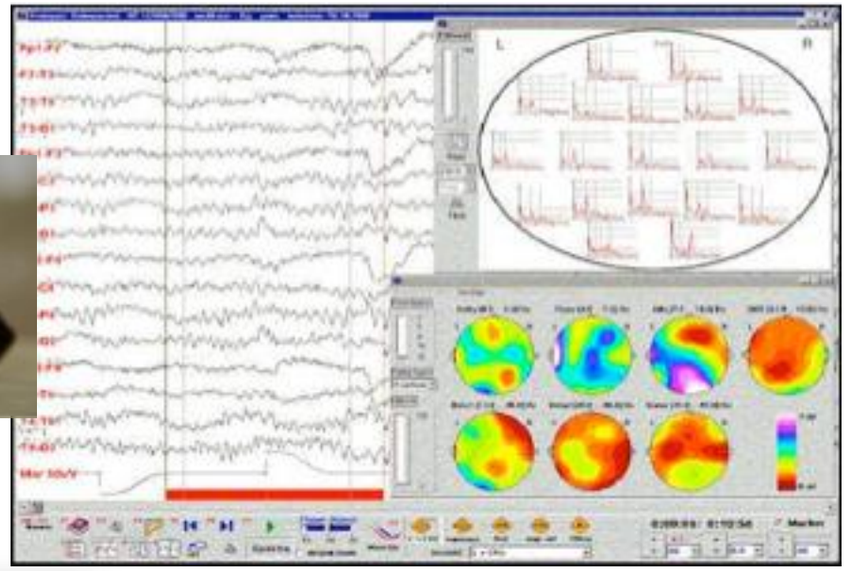
- Goal
  - Augmented Natural Interaction
  - Hybrid interaction approach combining wearable and environmental paradigm of interaction

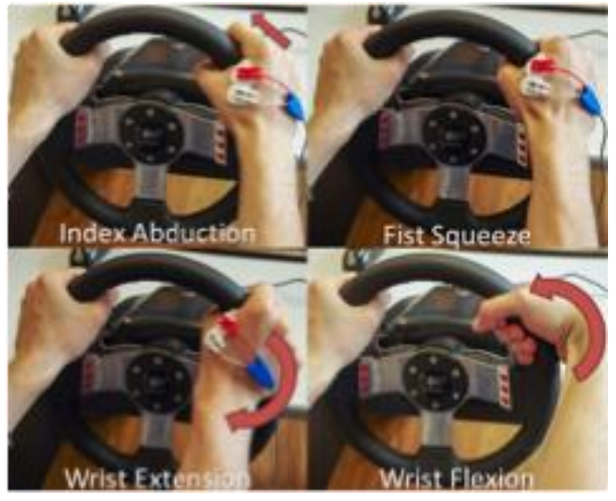


MAGI Project

Human-Computer Interaction

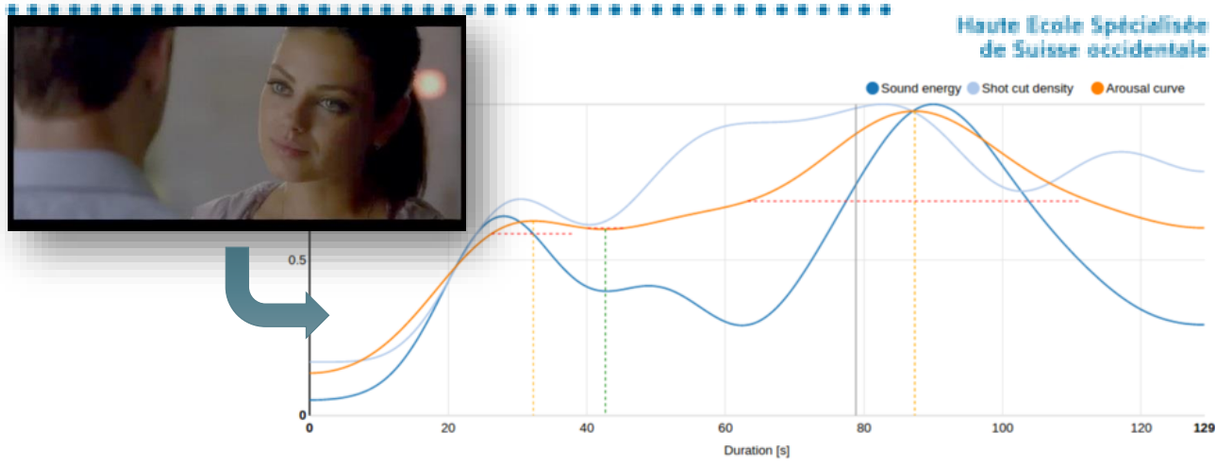
- Goal
  - Gesture recognition and segmentation based on psycho-physiological signals
    - EEG, EMG
  - Hybrid interaction approach combining wearable and environmental paradigm of interaction



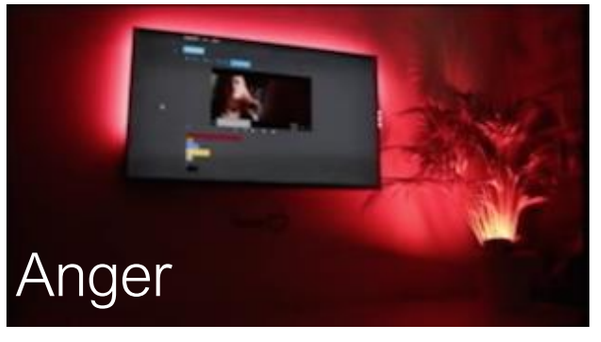


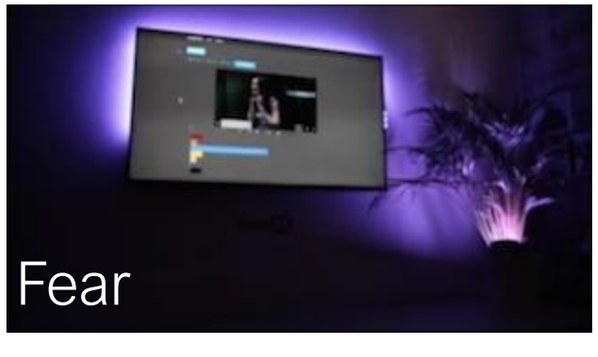
EmoTV Project

Human-Computer Interaction



- Goal
  - Emotion recognition in movies for empathic TV
  - Multimodal transmission of emotions
  - Dynamic lights
  - Smart watch/smartphone vibrations & emoticons
  - Dynamic subtitles
  - …





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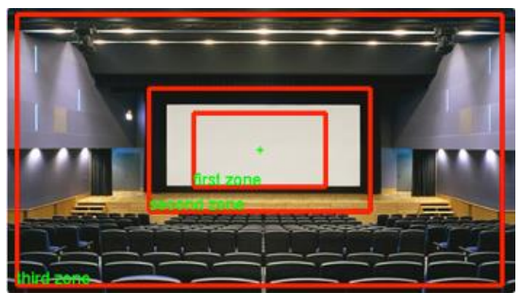
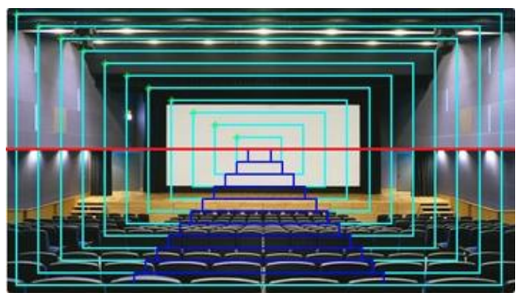
ADABeV Project

Security

- Goal:
  - Automatic Detection of Abnormal Behavior in Video-surveillance
  - Framework for event recognition in crowded scene surveillance videos to detect the abnormal human behaviour, automatically and in real time

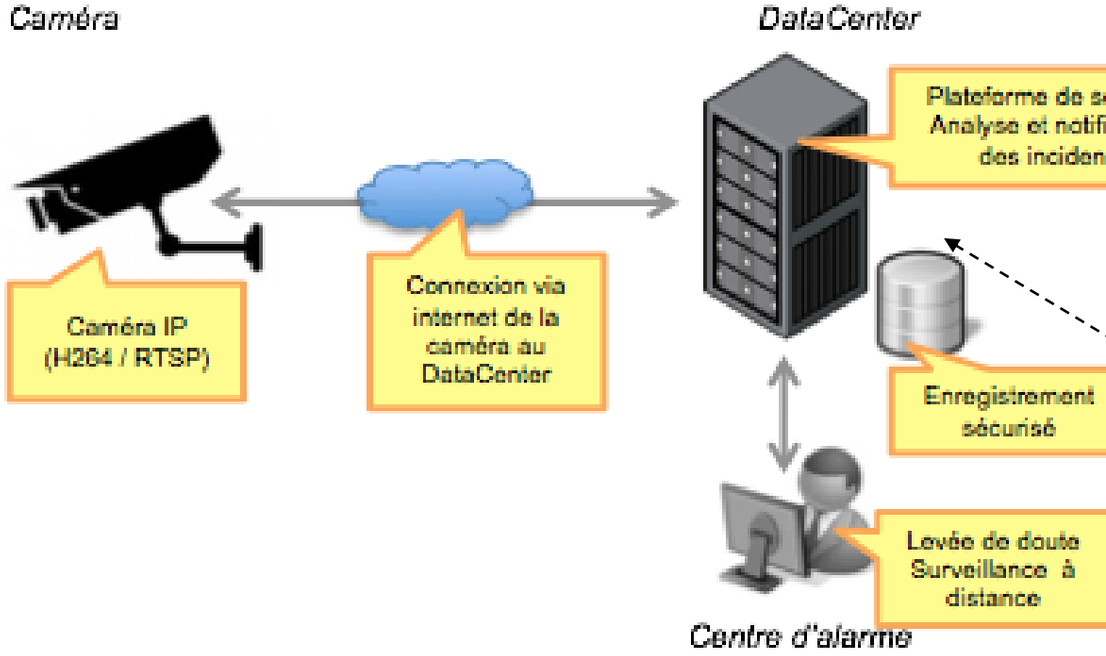


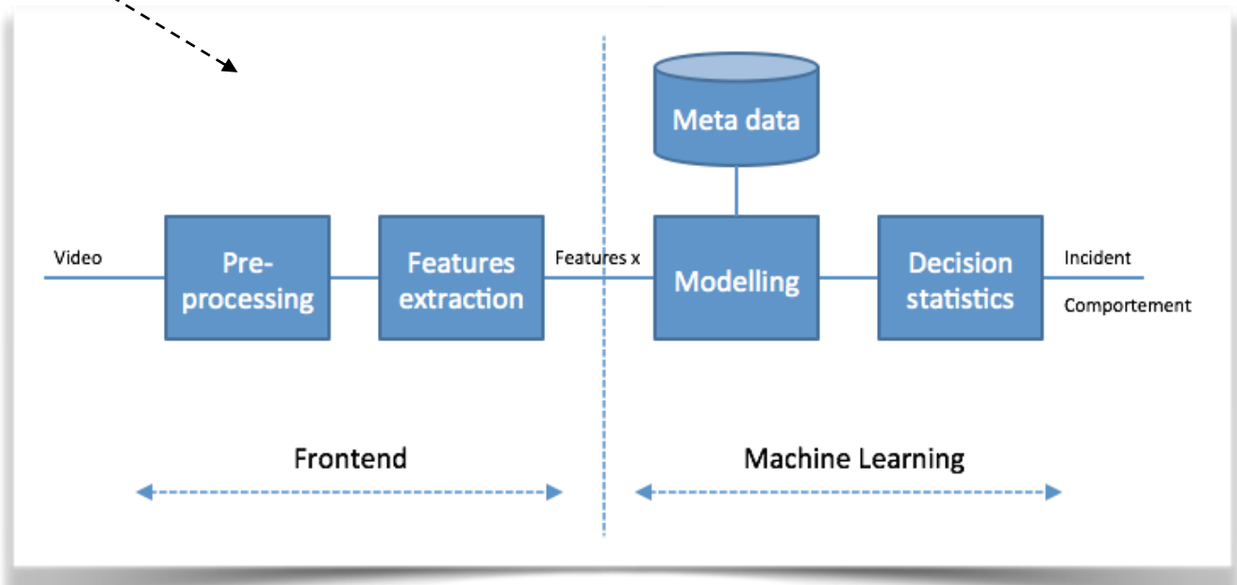


Morphean VideoProtector

Biomedical application

- Fonds de Soutien à l'Innovation, Fribourg
- Machine learning applied to the detection of events in video streams





Sensimed Plus Project

Biomedical application

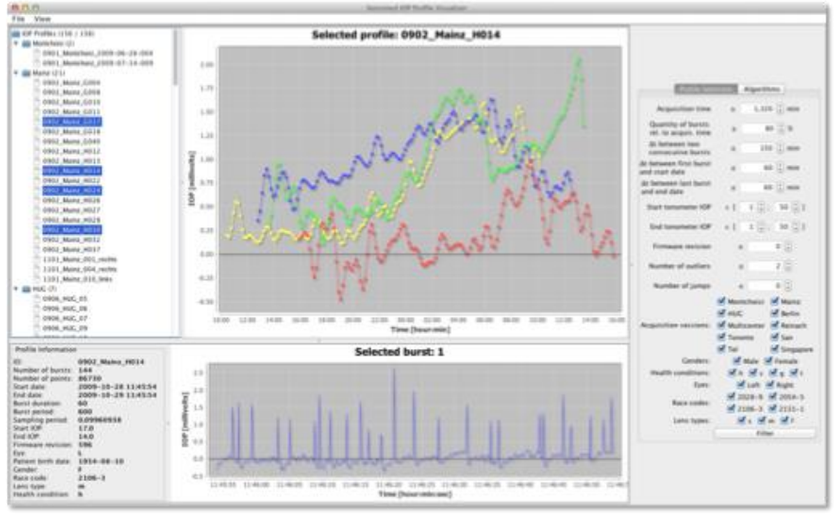
From sensors to cloud to intelligence

Patient

Embedded system

Visualisation and basic analysis
(PC of the doctor)

Scalable server architecture $
(private at Sensimed)

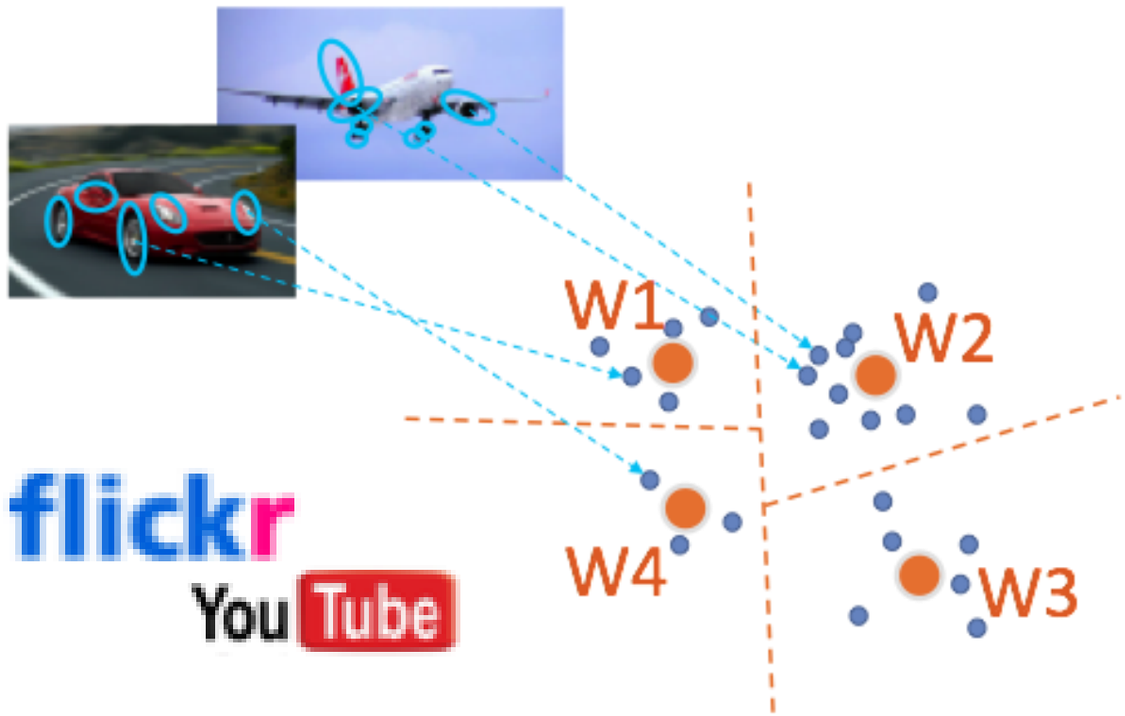


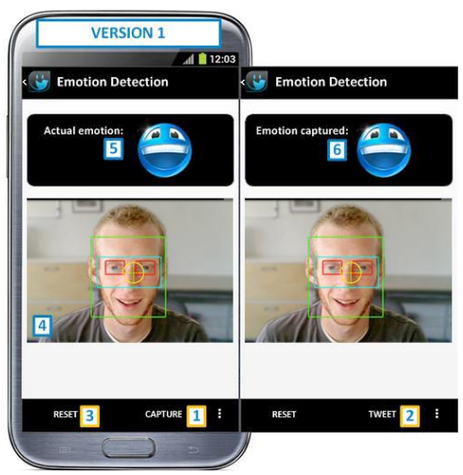
Automated aid for the diagnostic
/ indexation of similar cases (at Sensimed)

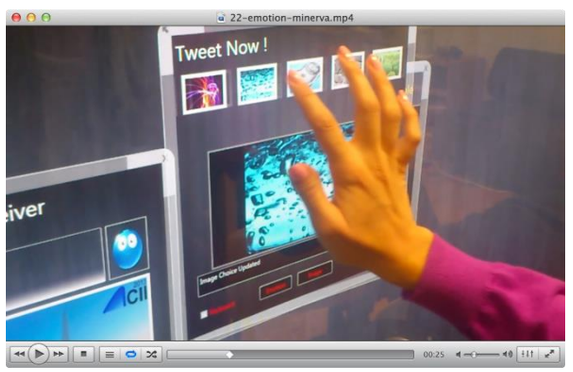
NAMASTEE Project

Web & information retrieval

- Goal
  - Novel Automatic Multimedia Annotation System for Television Experience Enhancement
  - Improve the automatic multimedia content enrichment process
    - visual search on the web
    - user emotion recognition



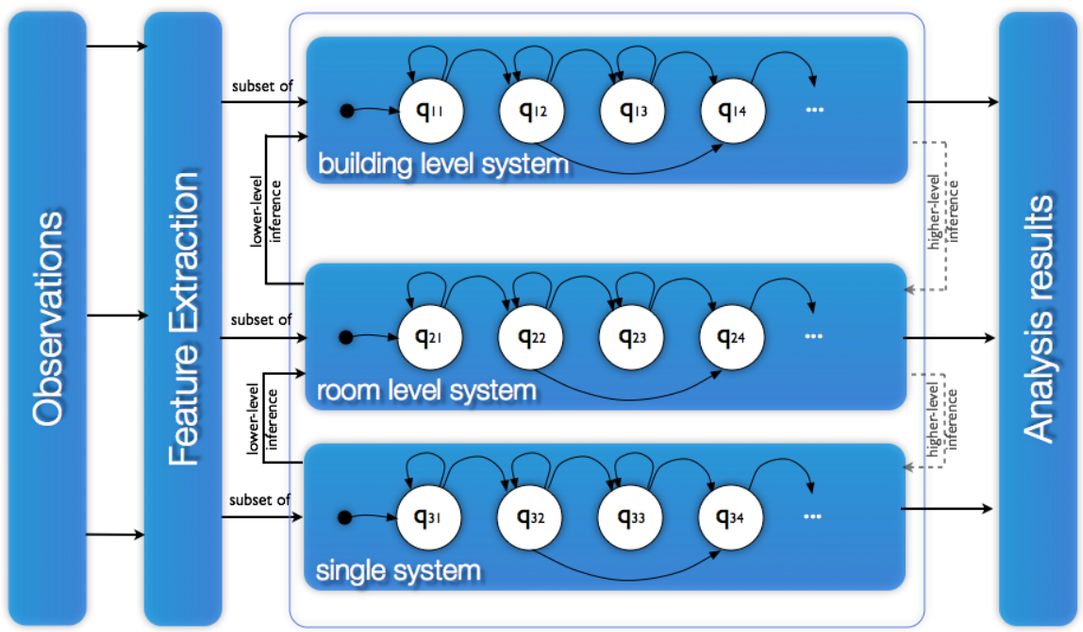




Hasler Smart Living Green-Mod

Green application

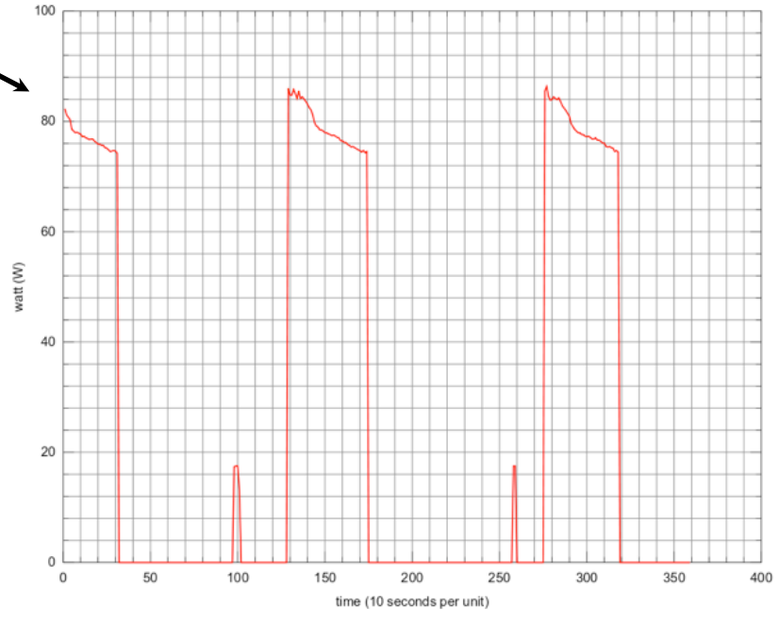
- Hasler **Green-Mod** project, 2012-2015
  - Machine learning applied to the maximization of energy efficiency in buildings
    - Identification of electric appliances from their load traces
    - Identification of activities, modeling the behavior of building users



Green-Mod Identification of electric appliances

Plug-based measurement device

Appliance



This is a :

"heating cycle machine"

"coffee machine"

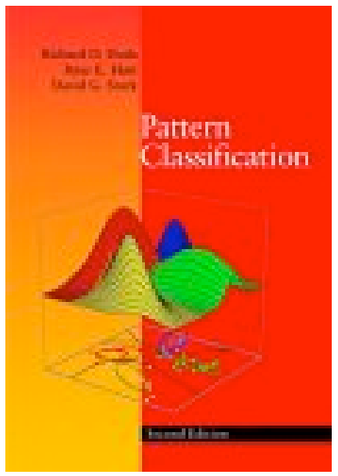
"nespresso machine"

"machine in standby"

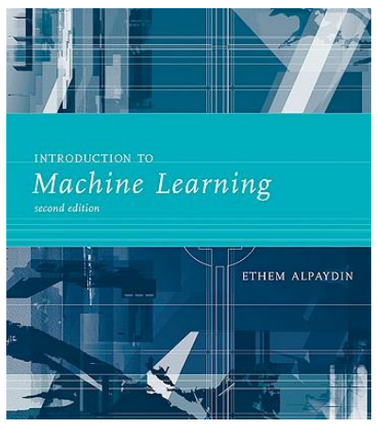
Category recognition
Appliance recognition
Brand recognition
State recognition

http://www.youtube.com/watch?v=Xr662k3fz00

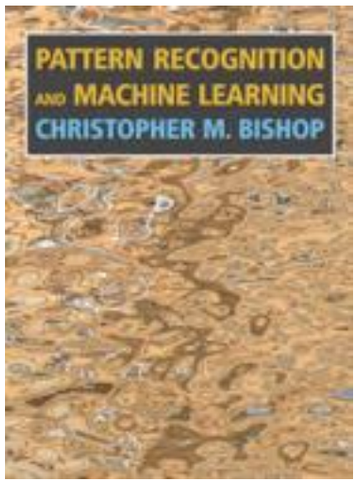
References



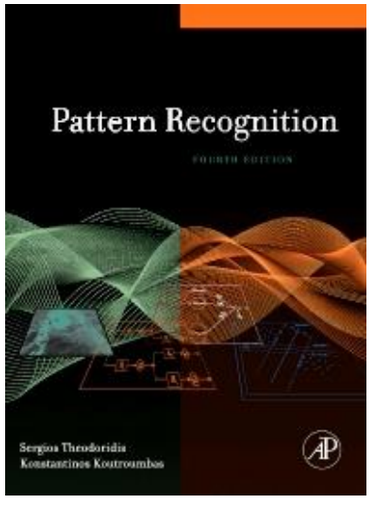
R. O. Duda, P. E. Hart and D. G. Stork
Pattern Classification



E. Alpaydin
Introduction to machine leaning

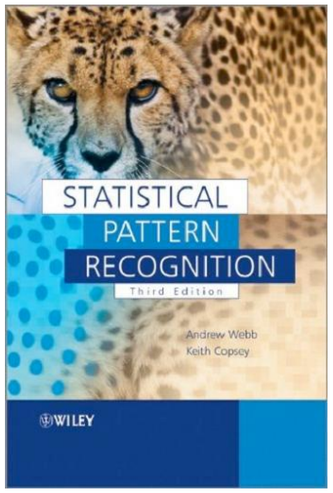


C. M. Bishop
Pattern Recognition and Machine Learning

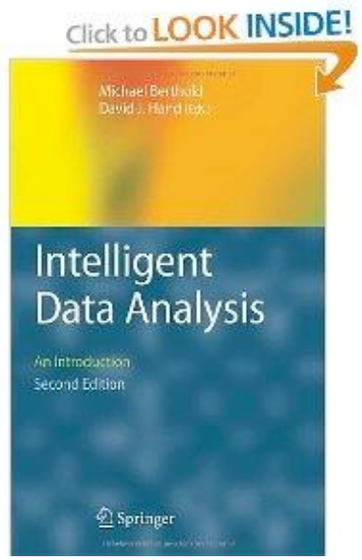


S. Theodoridis and K. Koutroumbas
Pattern Recognition

References



A. R. Webb & K. D. Copsey statistical Pattern Recognition



Berthold et al., Intelligent Data Analysis