

Machine Learning applications in Communication Networks

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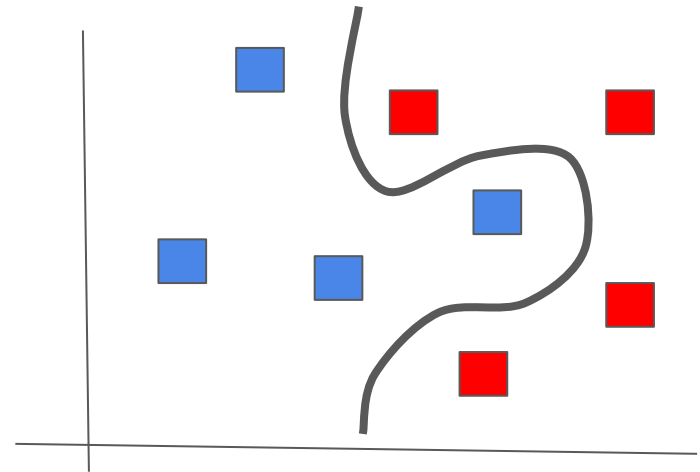
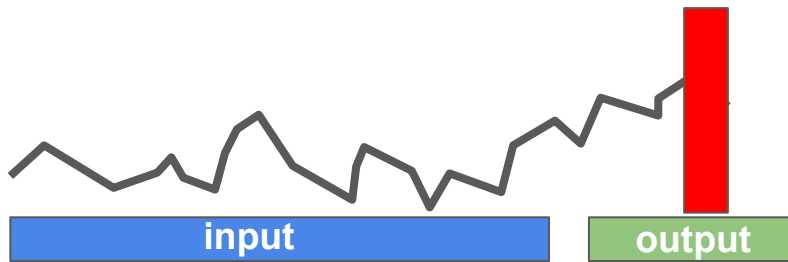
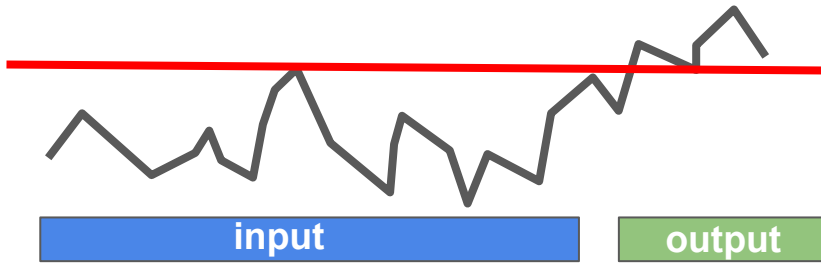
Flight schedule...

1. Introduction: Machine Learning vs. Networks
2. Predicting...
 - a. IoT traffic... for quality of service applications
 - b. Failures... for the VM placement problem
3. Using wireless to find patterns in crowd movement
 - a. Based on WiFi localization data
 - b. In areas with only one “base station/access point”
4. Conclusions

Introduction

- **Machine (Deep!) learning** research has been focused **mainly** in problems with “structure” (**images, audio, video, language**), and **not in networks** problems
- ML is a **rapidly changing** field: “hot” techniques come and go **faster than their applications**.
- Optimization is usually used to train ML models. **Great opportunities** to use **predictive data as input for optimization** models.

Predicting...



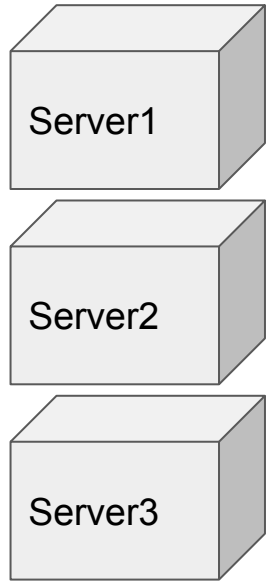
Somewhere, over the.. Representation space

Predicting: Traffic of IoT

- IoT communication standards are **still being defined**. ,:/
- Work in collaboration with Filippo Malandra, who will be generating **simulations**.
- **Quality of Service** from the perspective of the Things (**not for people**)
- Can we predict and control bad quality regimes?

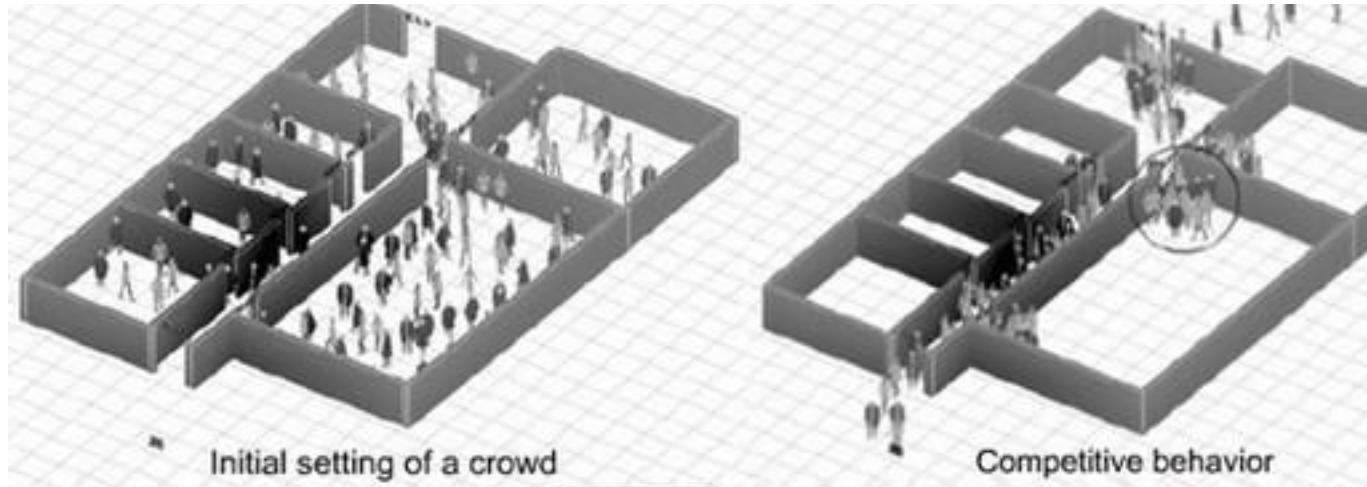


Predicting: Machine/jobs failures for VMPP



- Assigination problem important for **Cloud Computing**
- Multi-objective: energy, cost, quality of service,...
- **New inputs** from Deep Learning: info about the future
 - Probability of failure of a server
 - Probability of failure of a task or job

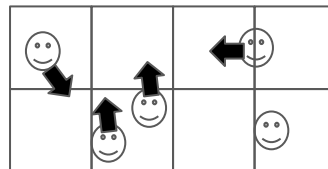
Patterns in crowds



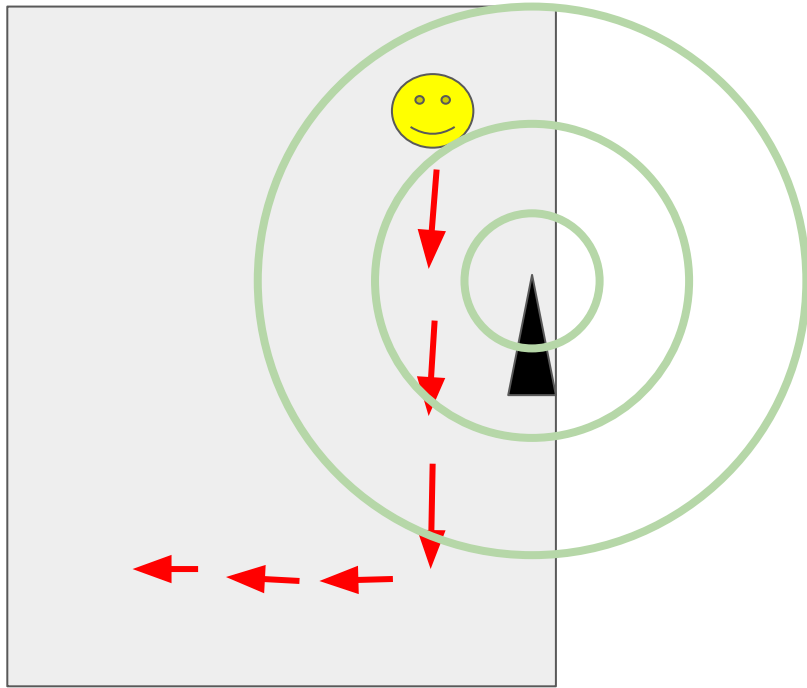
Taken from <http://www.eoht.info/page/Human+physics>

Patterns in crowds: WiFi localization

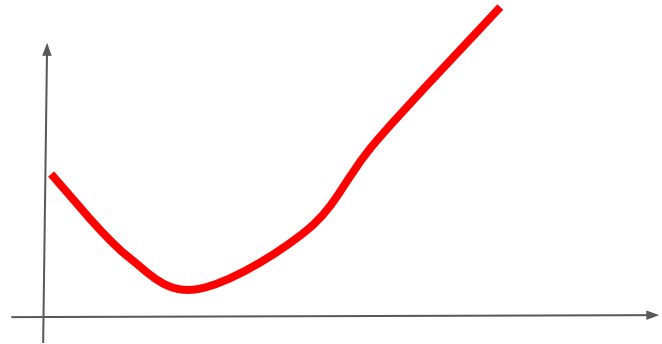
- **Indoors** facilities with general WiFi availability (many AP), can **provide location of WiFi-capable devices**.
- **ConvNets** excel at capturing patterns with **spatial structure** (images). **RNNs** excel at patterns in **sequences**.
- What if we **partition a building as pixels** and apply ConNets to represent a small period of “device flows”?
- **Colors of a building ‘pixel’** would be:
 - Density
 - Statistics of flow
- RNNs can (and will!) be used to study change of the scenario through time.
- The big questions: **Is there an emergency? Where? (not who!!)**



Patterns in crowds: only one AP/BS



Will Deep Learning help in finding **emergency patterns** in the **variation of distance from an AP/BS**, from a crowd of users of mobile devices?



Conclusion

- Much to do!
 - Data to collect (companies tend to be mean in giving data away)
 - Lots of algorithms to try, and ensemble (they are now more like Legos!)
 - Lots of opportunities

Questions... and a few cats

Let's not finish without cats from the internet... but lets
Look at a Deep Network dreaming about them :)

Deep Dream processing provided [by Host Duplex XenServer Cloud Hosting](#).

Taken from: <http://psychic-vr-lab.com/deepdream/pics/729246.html>

