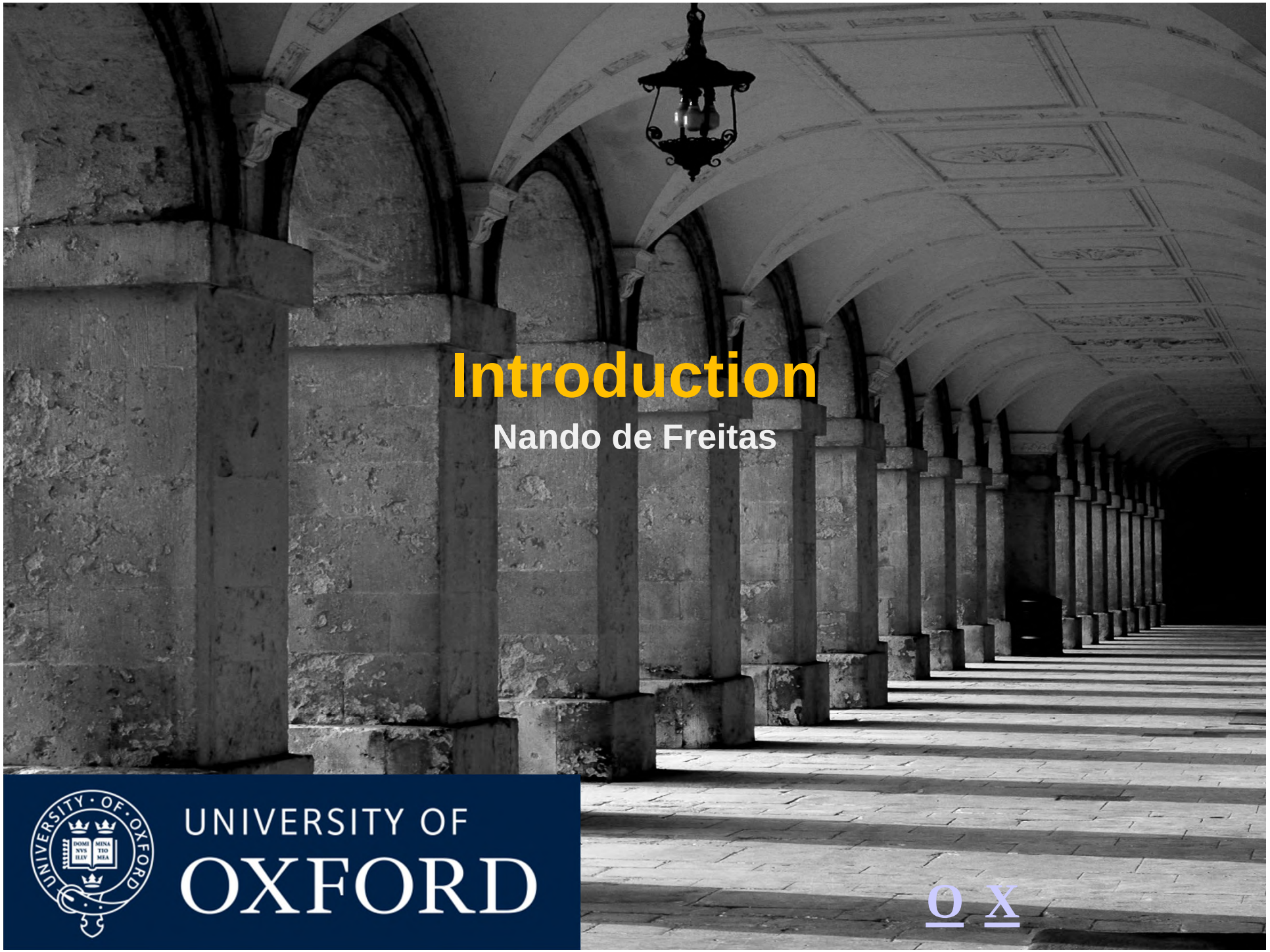
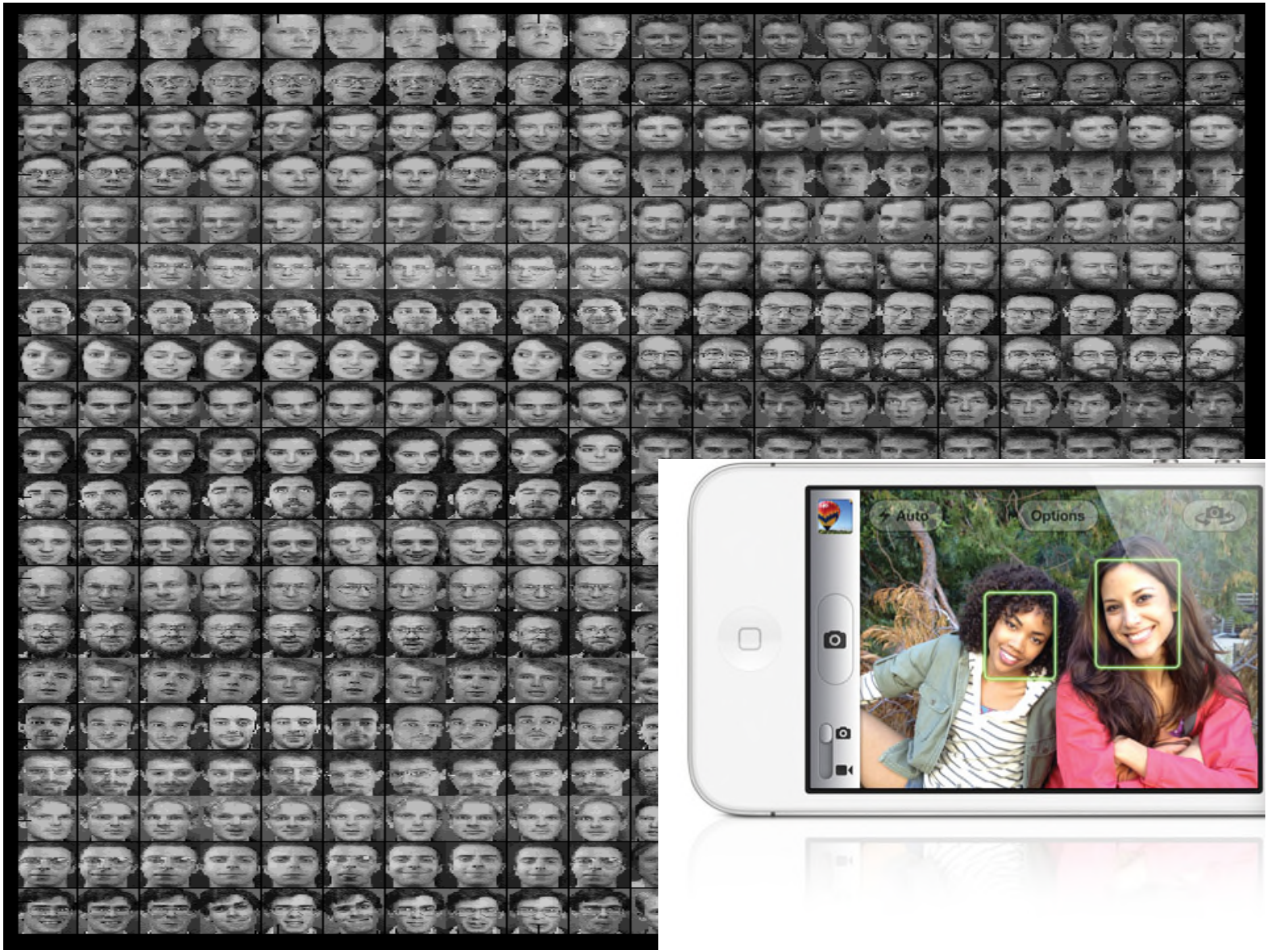
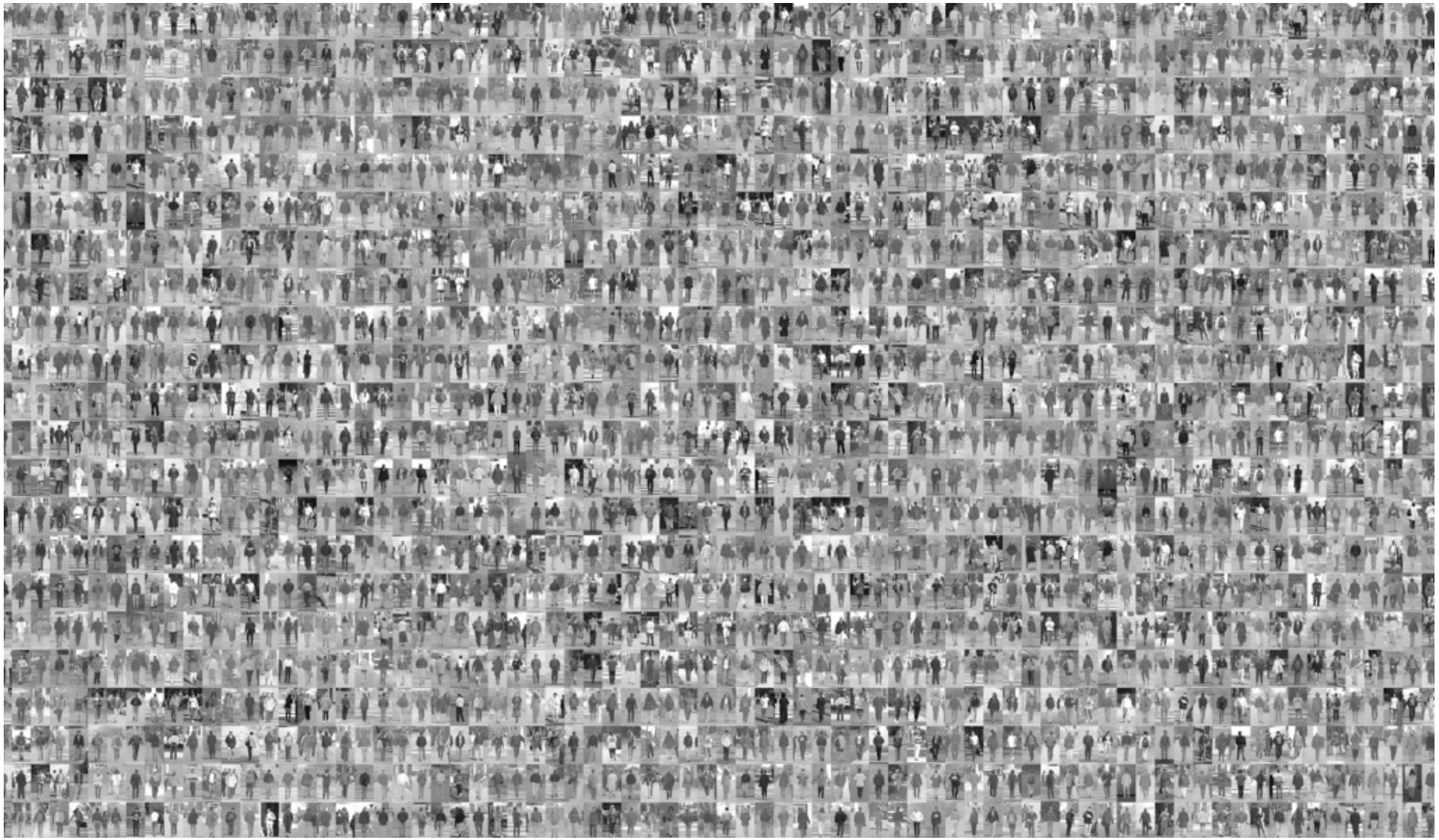

Introduction
Nando de Freitas
UNIVERSITY OF
OXFORD
O X

Application: Invariant recognition in natural images

[Thomas Serre 2012]


Auto
Options



Millions of labeled examples are used to build real-world applications, such as pedestrian detection

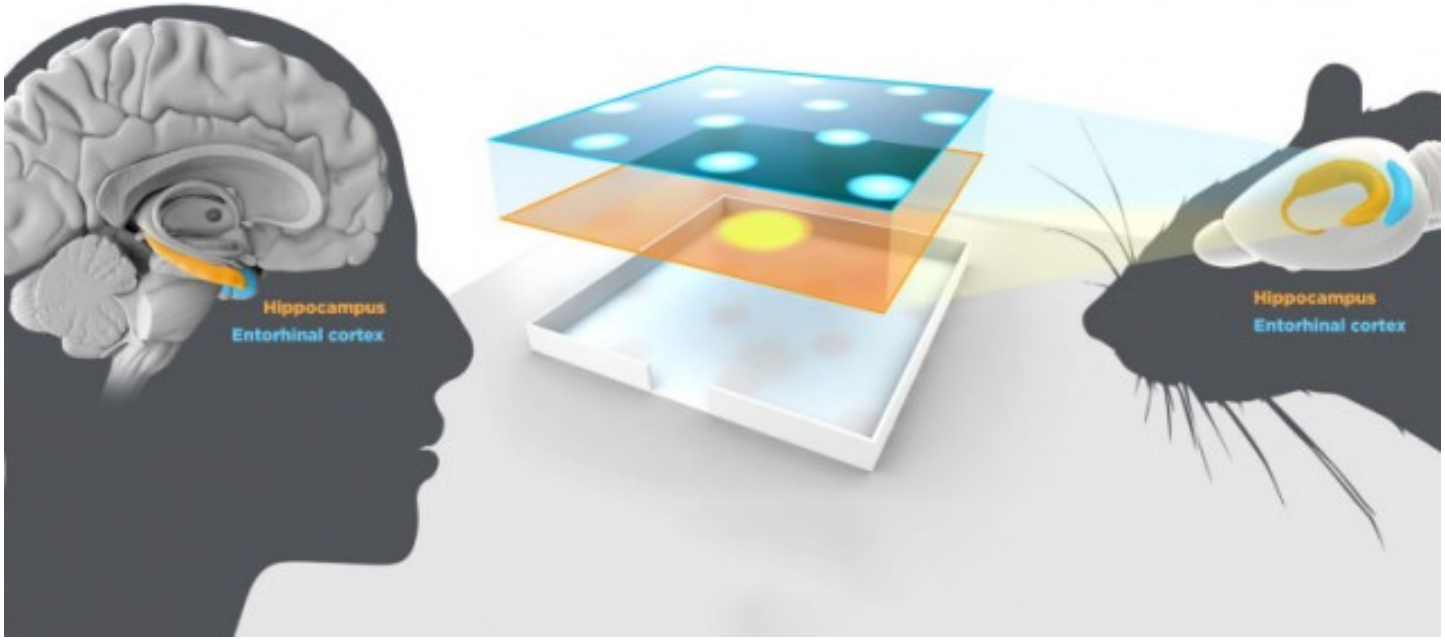
[Tomas Serre]

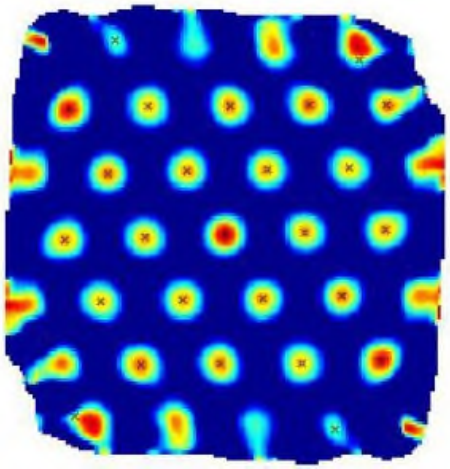
More applications of the same idea

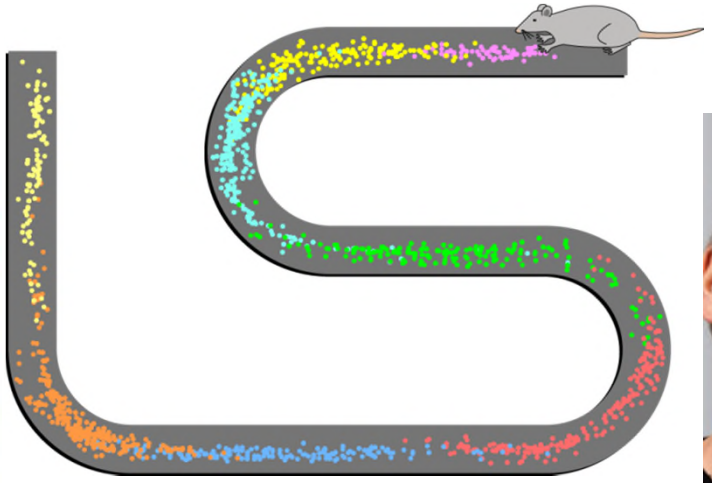
[Okuma, Taleghani, dF, Little, Lowe, 2004]

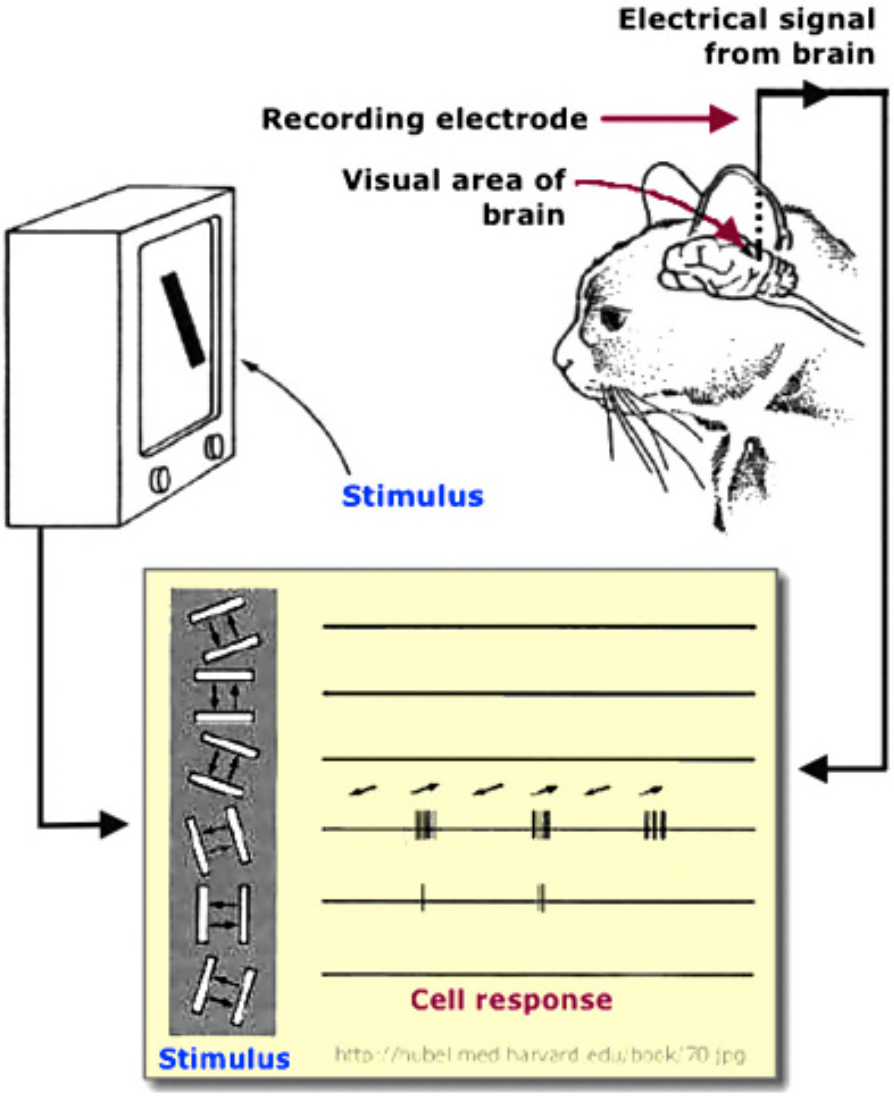
Best Cognitive Vision Paper- ECCV

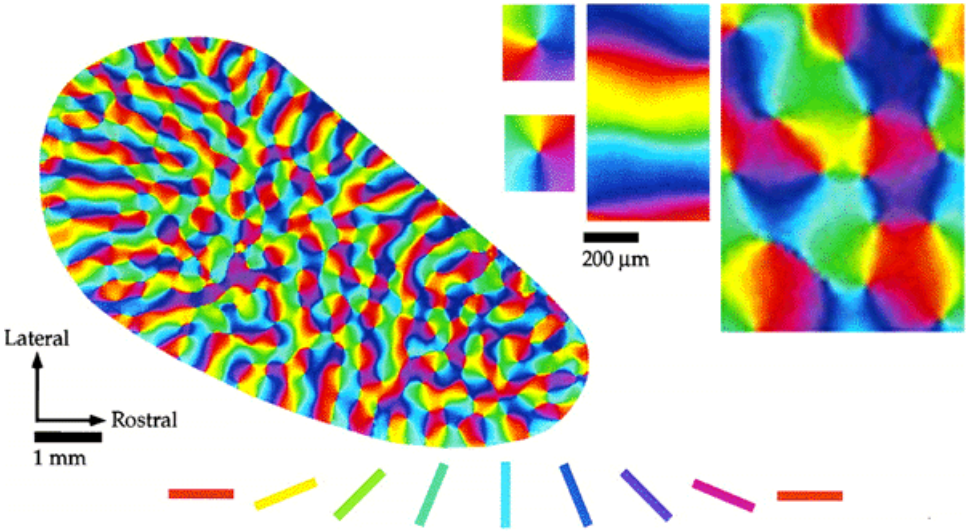
Place cells in the hippocampus and grid cells in the entorhinal cortex [John O'Keefe, May-Britt Moser and Edvard Mosel, NOBEL 2014]

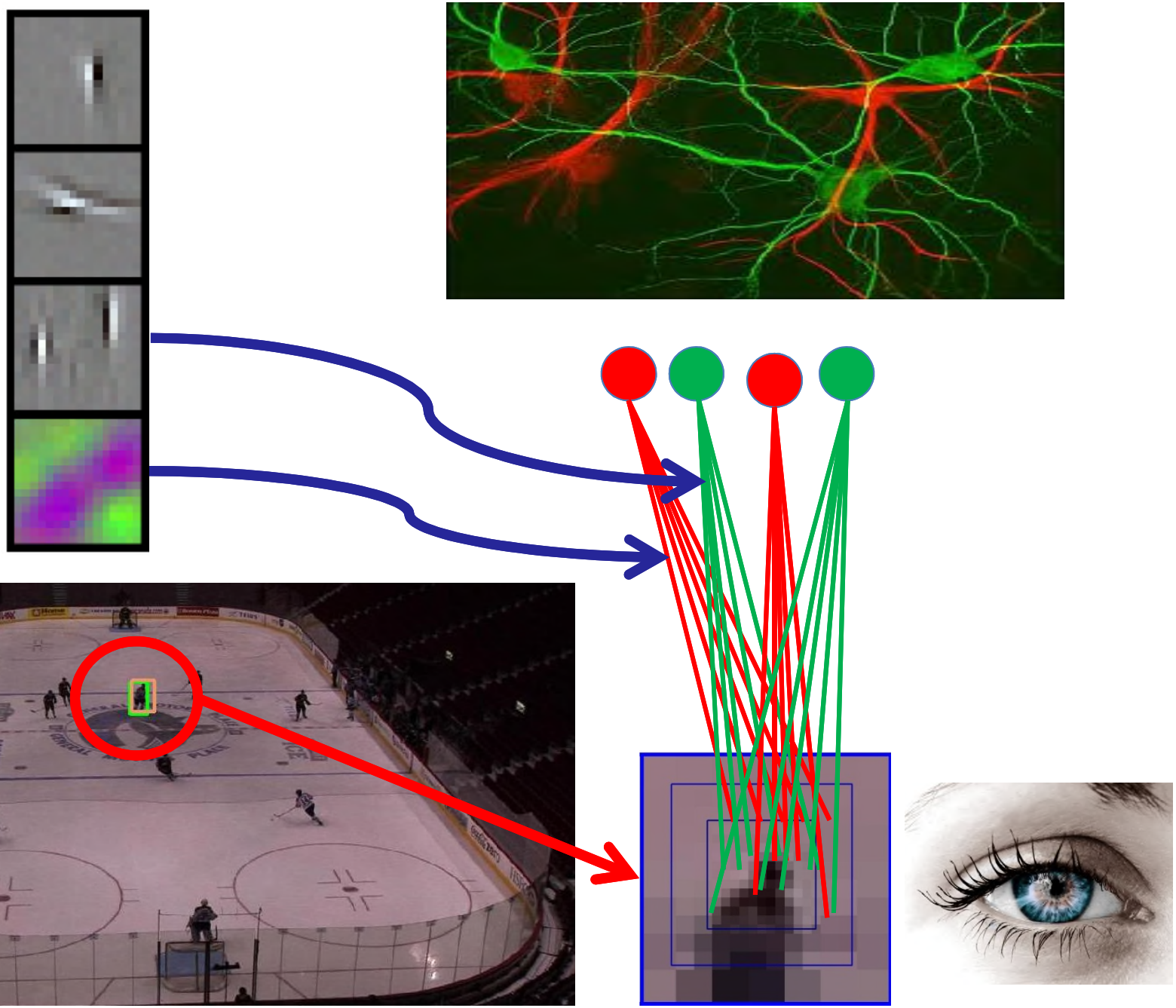




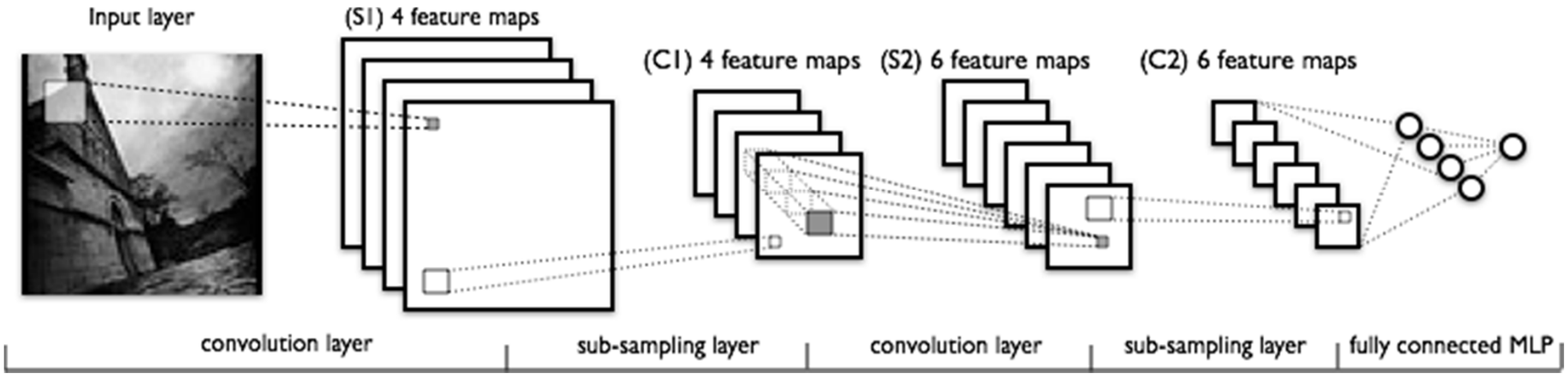


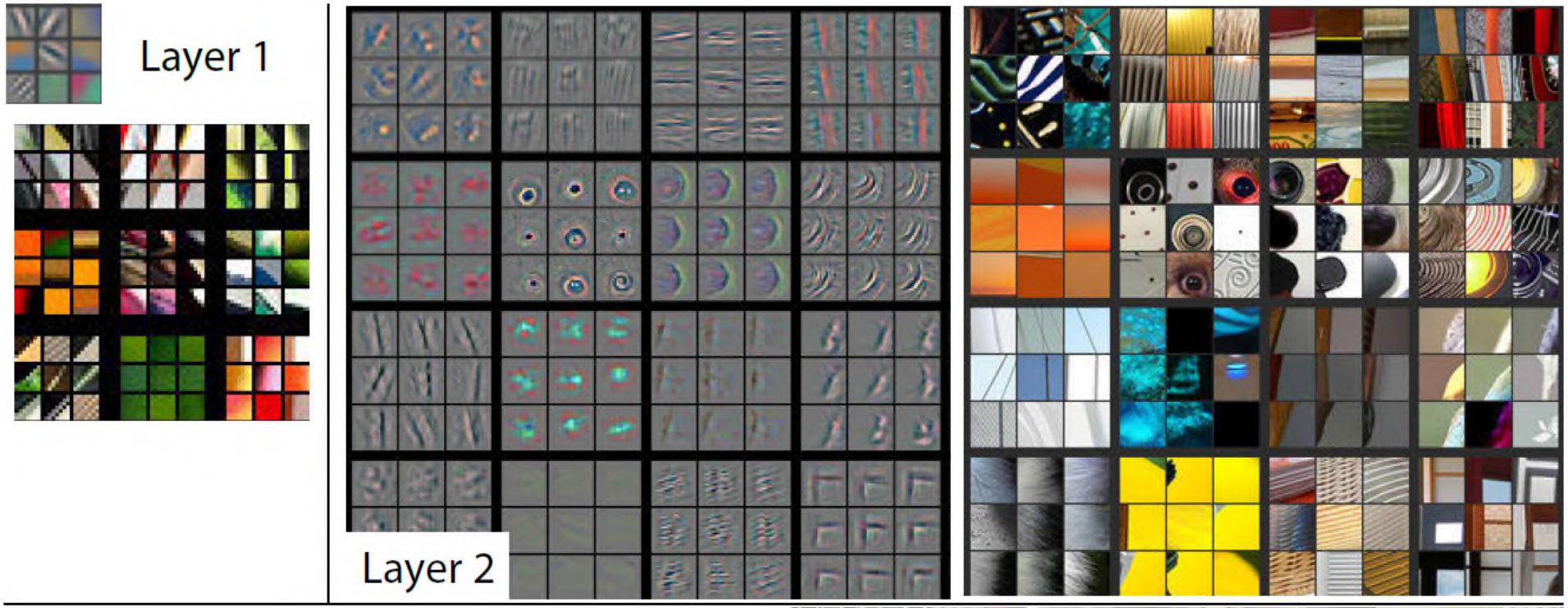

Electrical signal
from brain
Recording electrode
Visual area of
brain
Stimulus
Cell response
Stimulus
http://nobel.med.harvard.edu/book/70.jpg


200 µm
Lateral
Rostral
1 mm

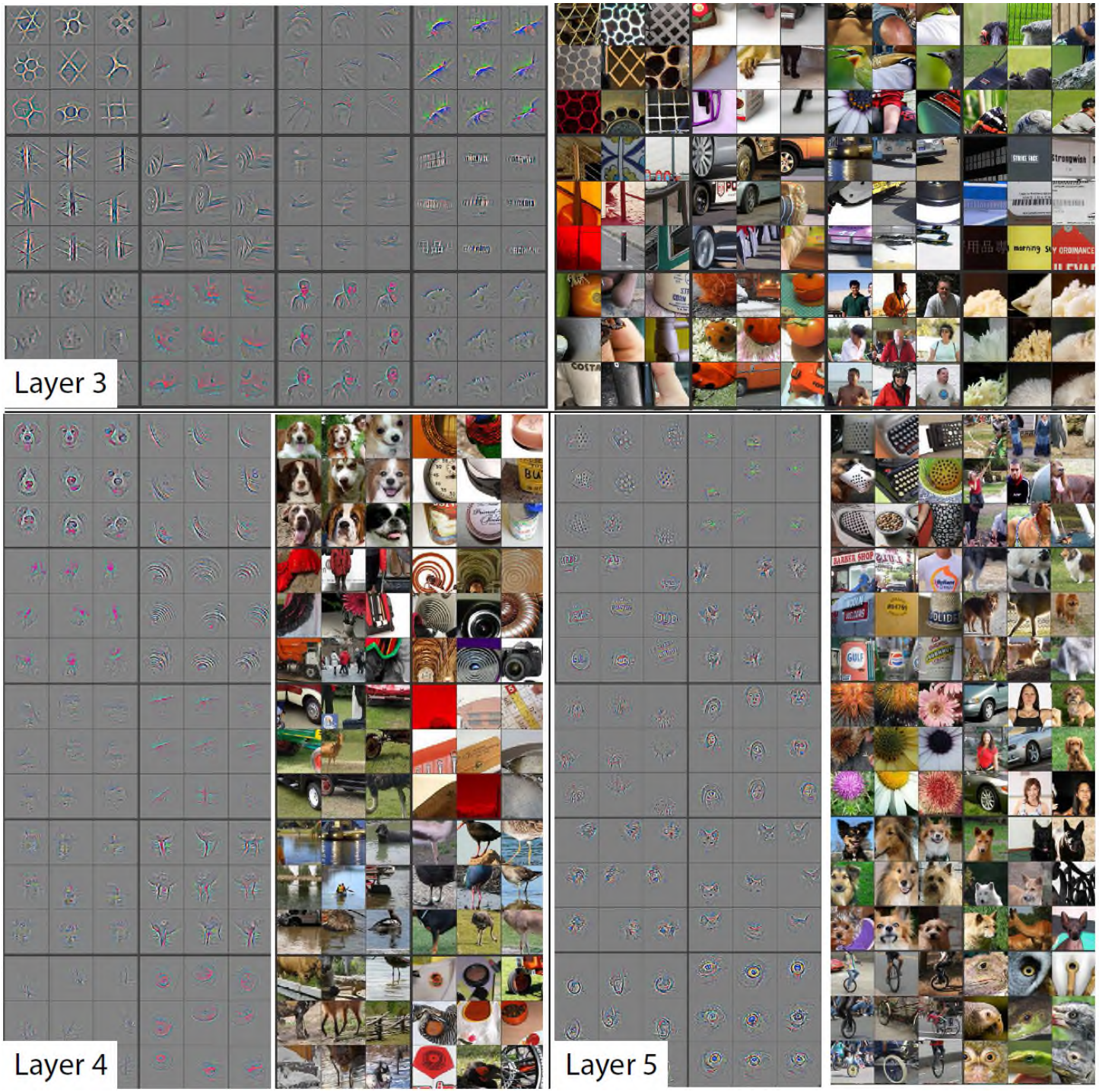


Convolutional networks

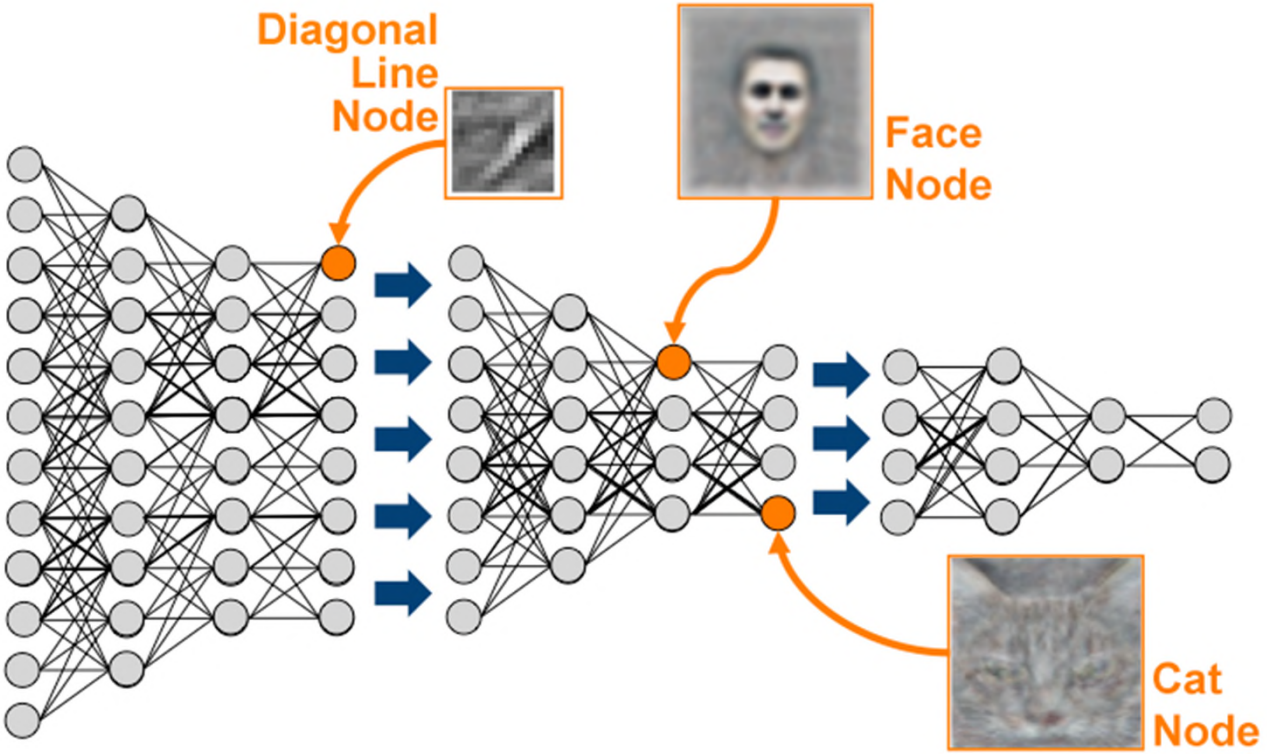


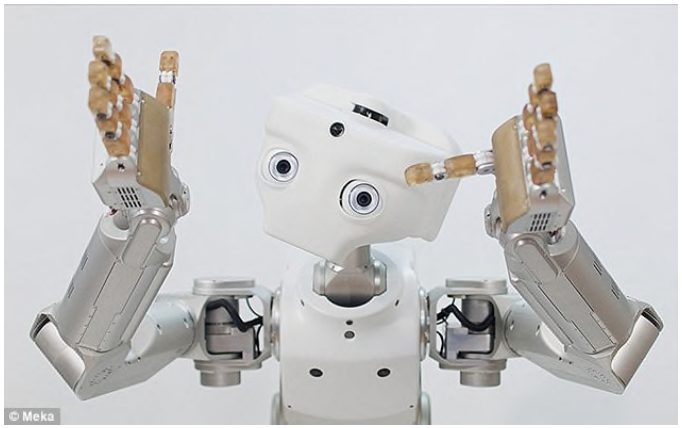


[Matthew Zeiler & Rob Fergus]

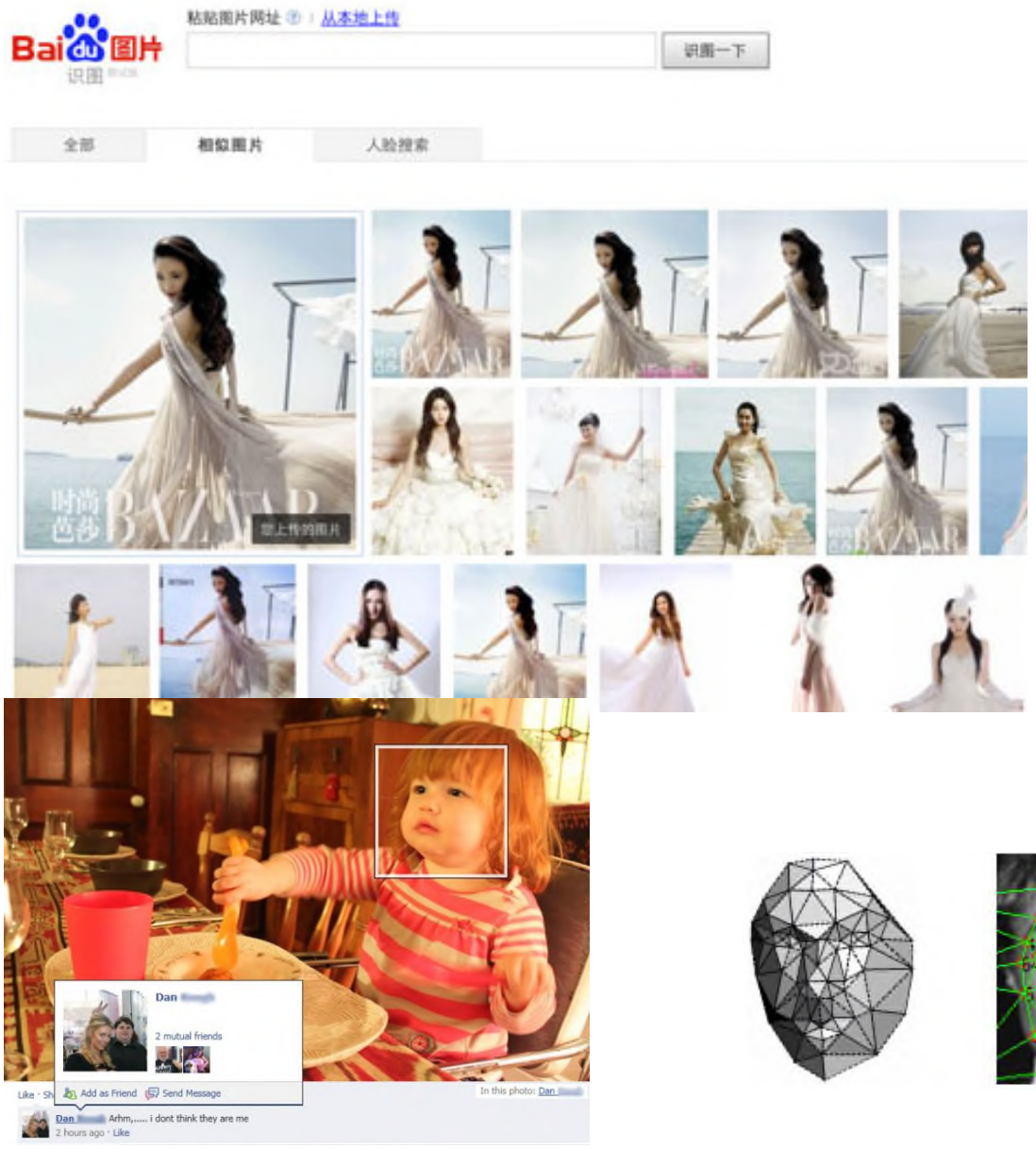

Layer 3
Layer 4
Layer 5

Google’s neural net learns just by watching youtube videos





Machines that learn to recognise what they see and hear are at the heart of Apple, Google, Amazon, Facebook, Netflix, Microsoft, etc.

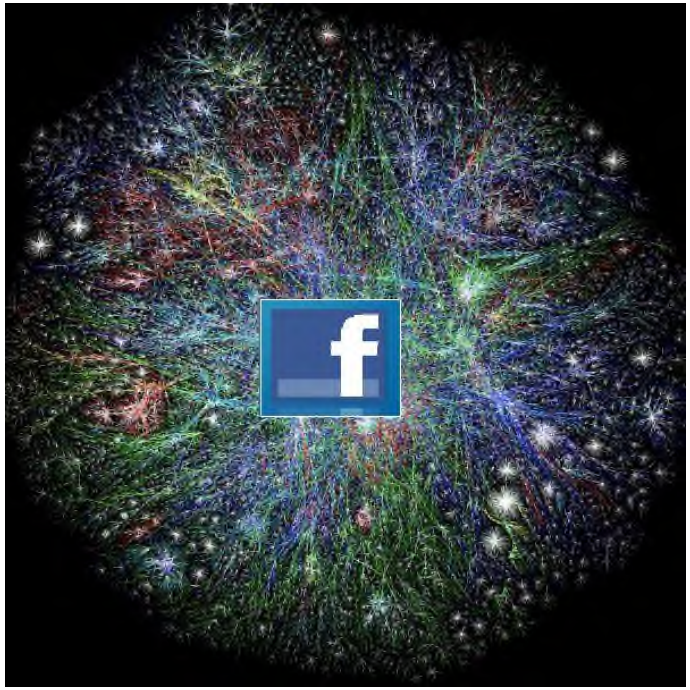


Review sentiment and summarization

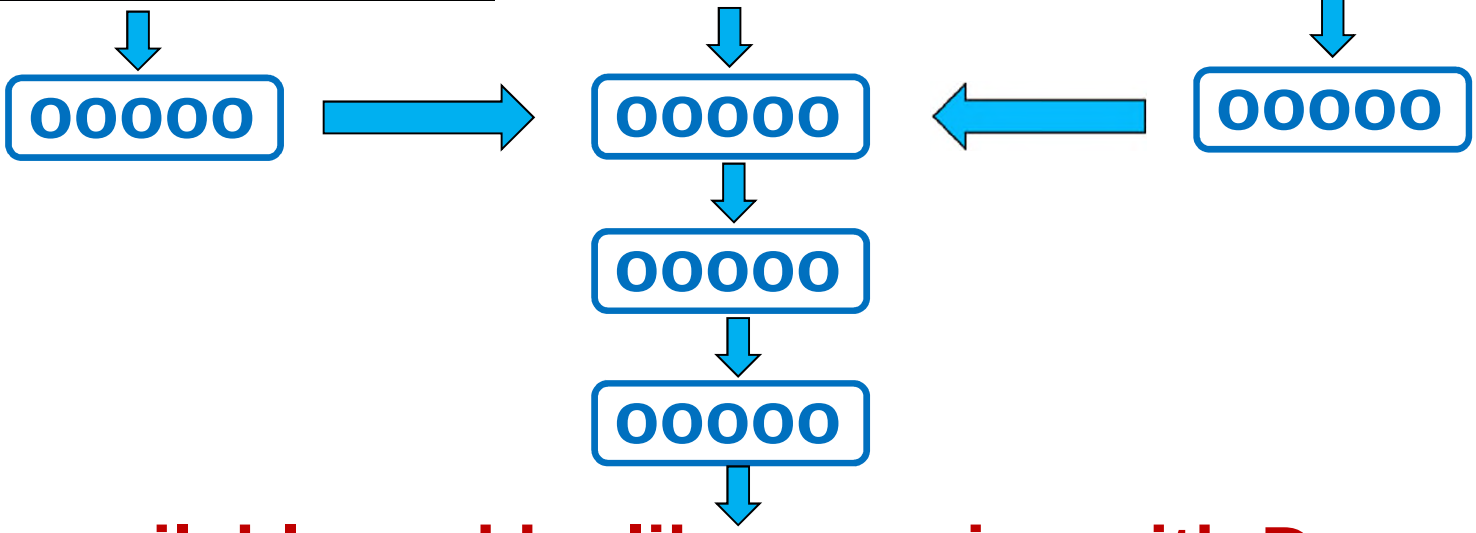
Paul Bettany did a great role as the tortured father whose favorite little girl dies tragically of disease.
For that, he deserves all the credit.
However, the movie was mostly about exactly that, keeping the adventures of Darwin as he gathered data for his theories as incomplete stories told to children and skipping completely the disputes regarding his ideas.
Two things bothered me terribly: the soundtrack, with its whiny sound, practically shoving sadness down the throat of the viewer, and the movie trailer, showing some beautiful sceneries, the theological musings of him and his wife and the enthusiasm of his best friends as they prepare for a battle against blind faith, thus misrepresenting the movie completely.
To put it bluntly, if one were to remove the scenes of the movie trailer from the movie, the result would be a non descript family drama about a little child dying and the hardships of her parents as a result.
Clearly, not what I expected from a movie about Darwin, albeit the movie was beautifully interpreted.

[Kotzias, Denil, Blunsom & NdF, 2014]

Structured queries and outputs

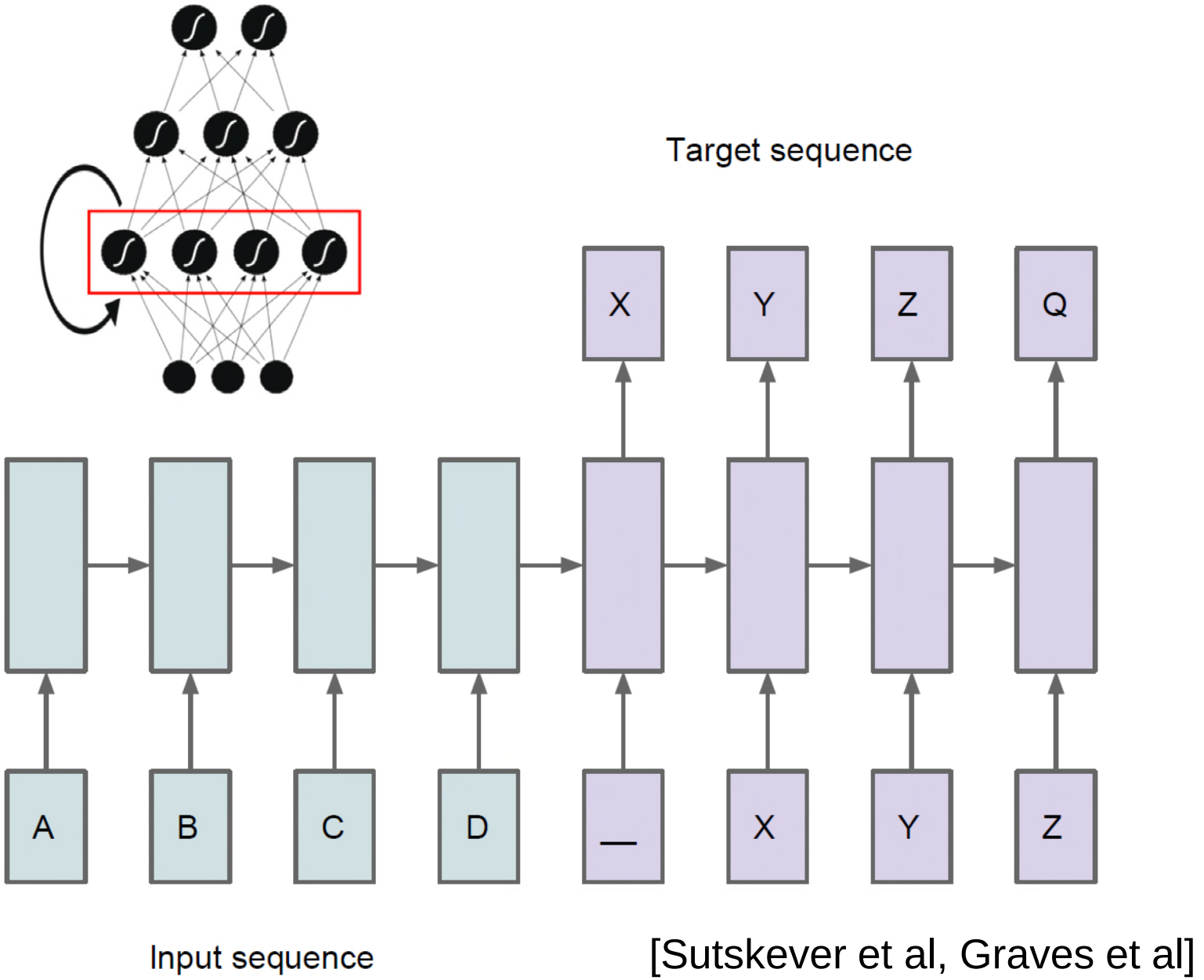


Who's likely to want to watch this movie with me on Friday?



Phil is available and he likes movies with Downey JR

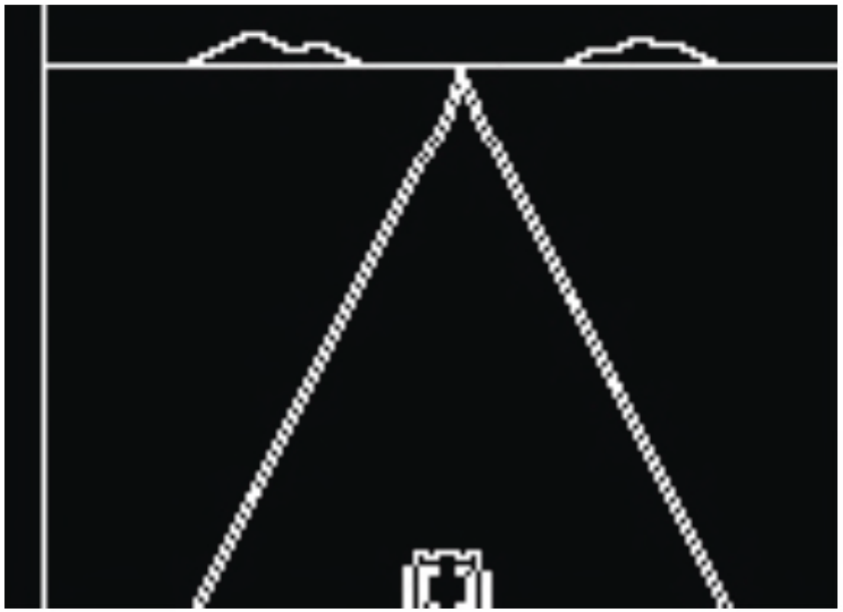
Sequence learning and recurrent nets



[Sutskever et al, Graves et al]

Sequence learning and recurrent nets

Real



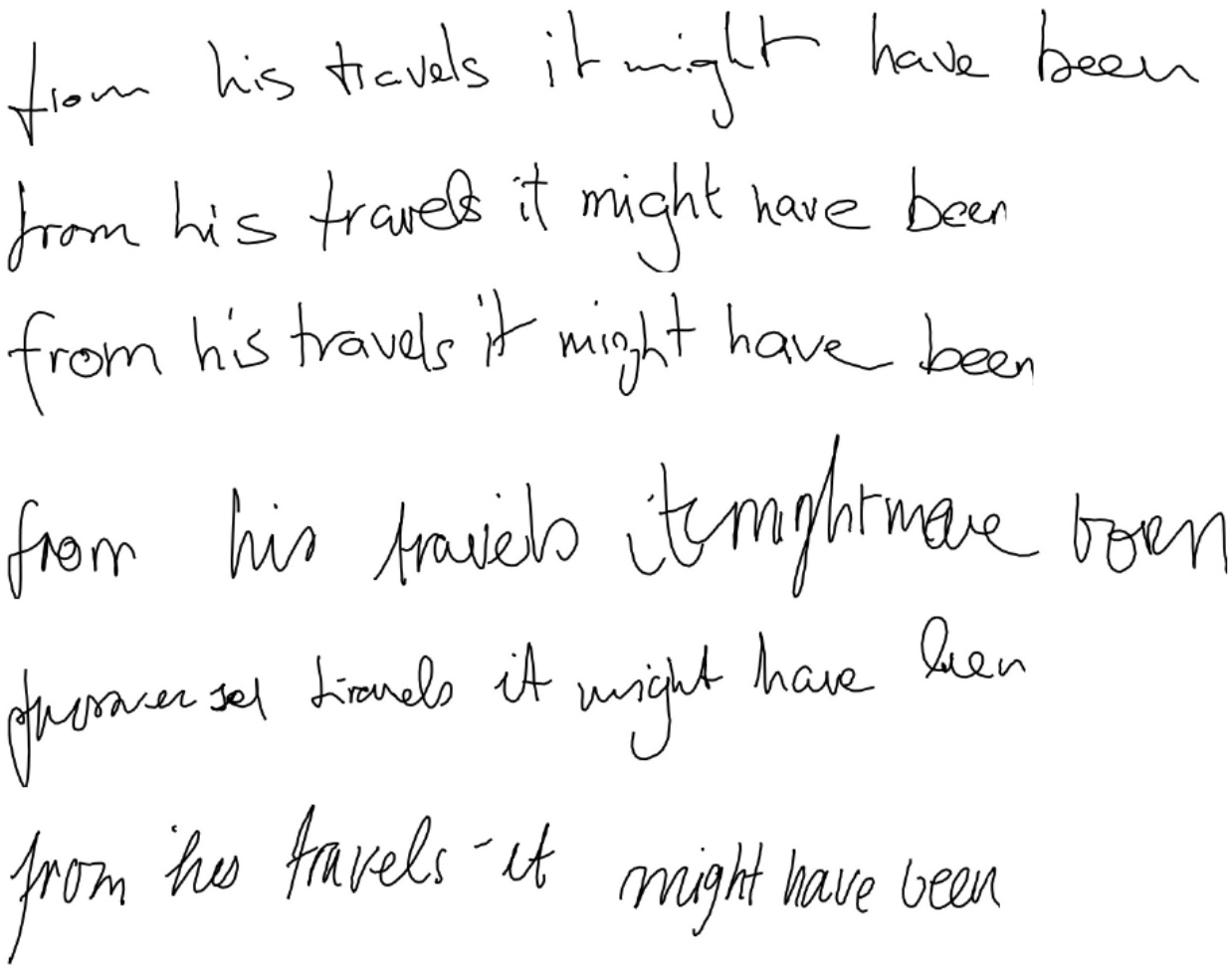
Generated

Karol Gregor, Ivo Danihelka, Andriy Mnih, Daan Wierstra…

Google DeepMind

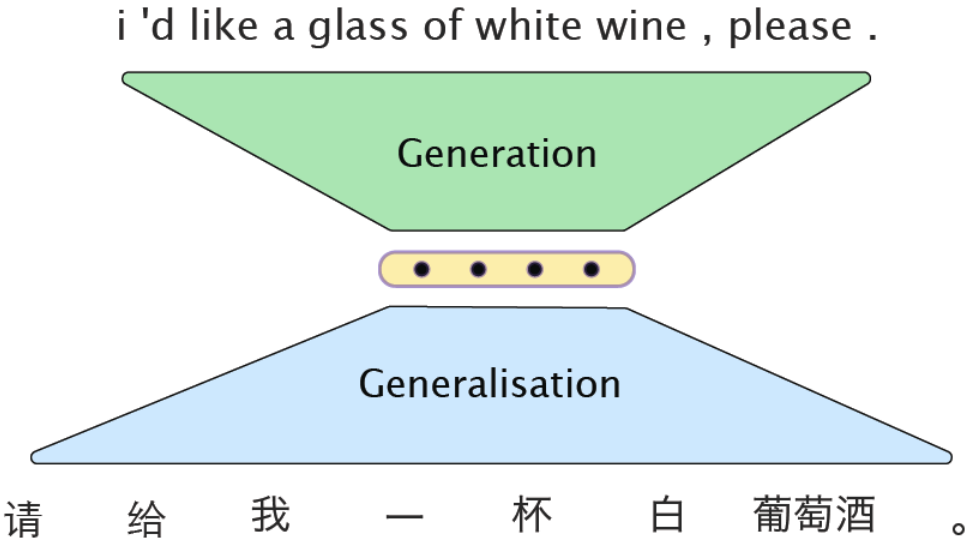
Sequence learning and recurrent nets

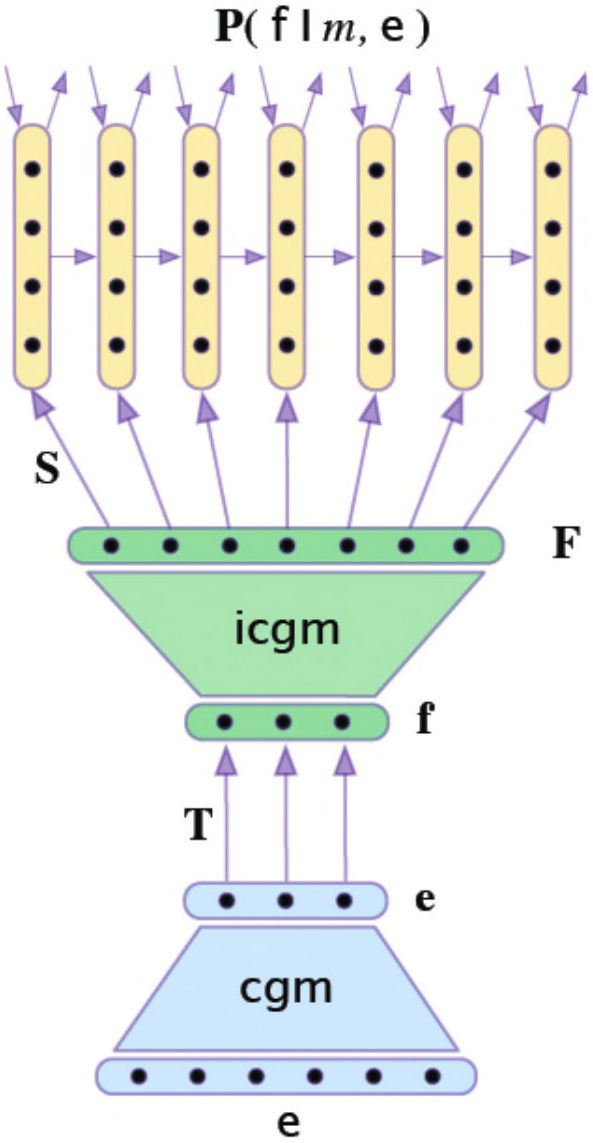
Which is Real?



[Alex Graves]

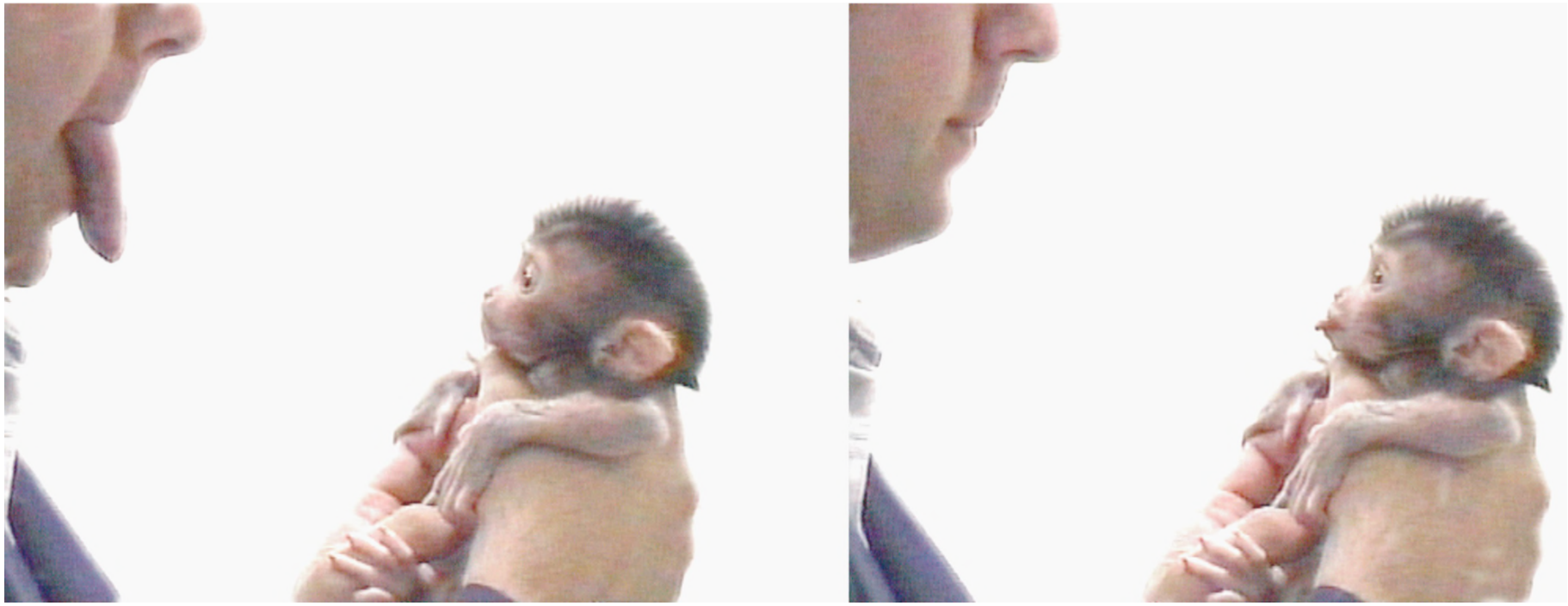
Siamese nets, machine translation



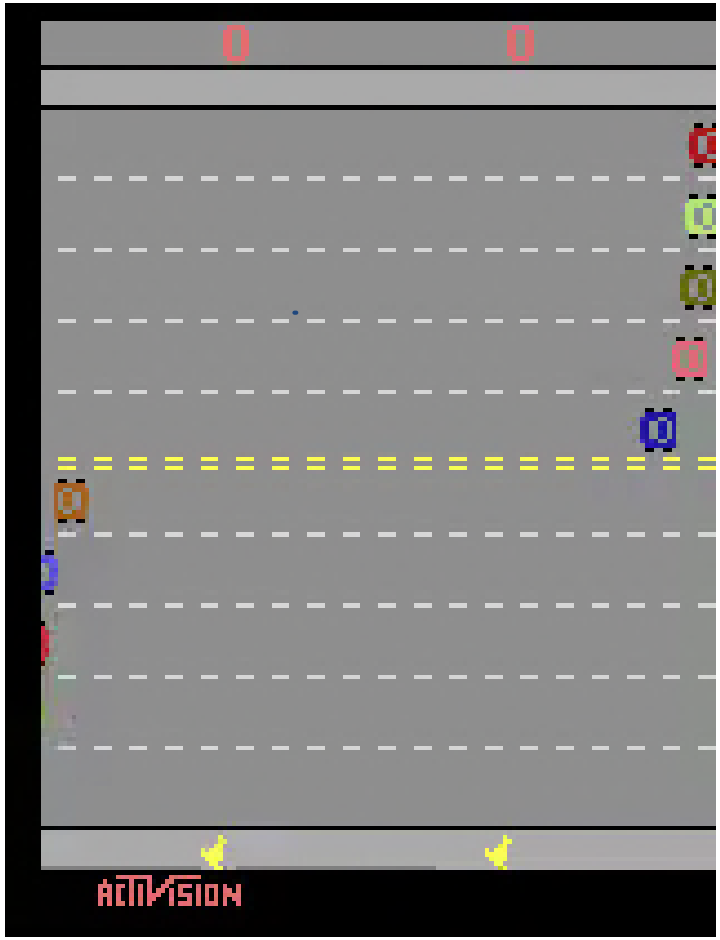


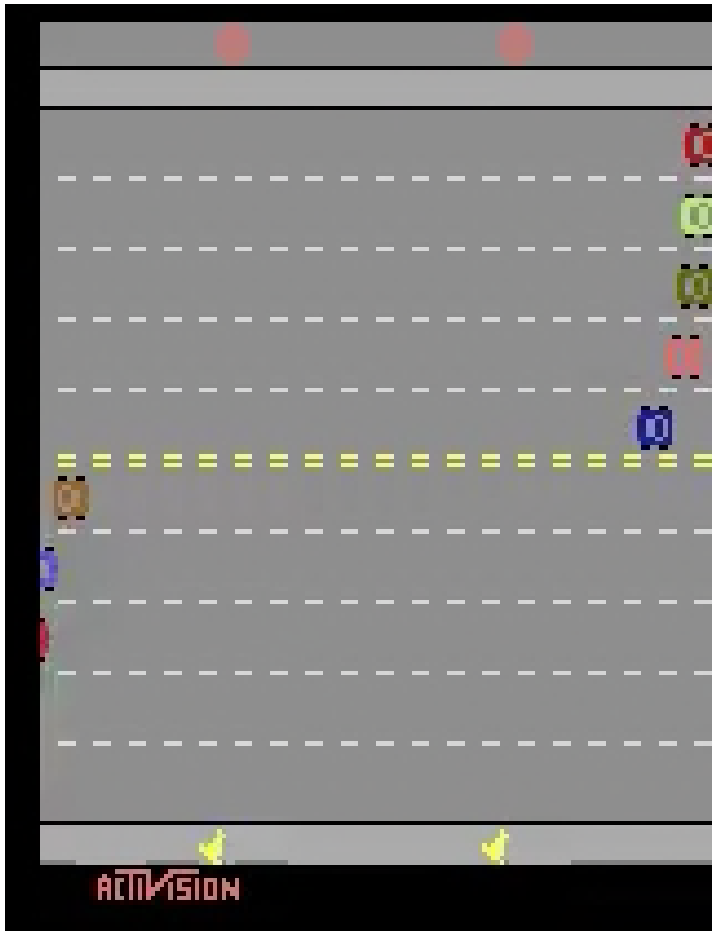
[Le Cun et al, Blunsom et al]

Imitation learning & mirror neurons



Imitation learning for Atari



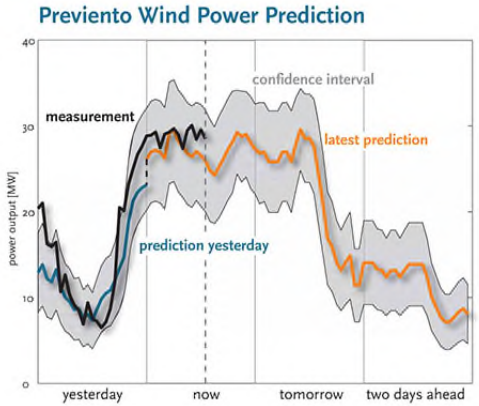


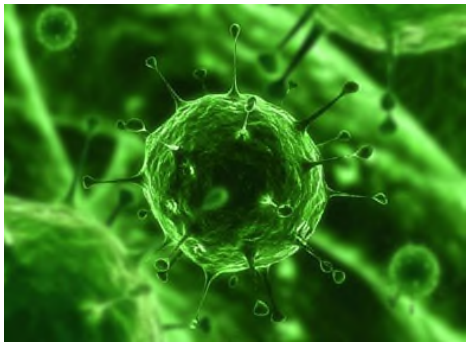
[Dejan Markovikj, Miroslav Bogdanovic, Misha Denil, NdF 2014]

Machine learning

Machine learning deals with the problem of extracting ***features*** from data so as to solve many different ***predictive*** tasks:

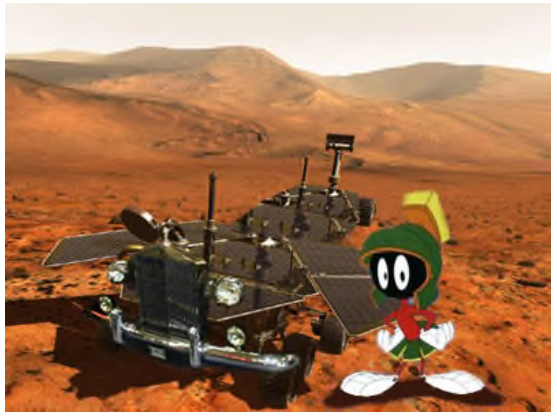
- ❑Forecasting (*e.g. Energy demand prediction, finance*)
- ❑Imputing missing data (*e.g. Netflix recommendations*)
- ❑Detecting anomalies (*e.g. Security, fraud, virus mutations*)
- ❑Classifying (*e.g. Credit risk assessment, cancer diagnosis*)
- ❑Ranking (*e.g. Google search, personalization*)
- ❑Summarizing (*e.g. News zeitgeist, social media sentiment*)
- ❑Decision making (*e.g. AI, robotics, compiler tuning, trading*)

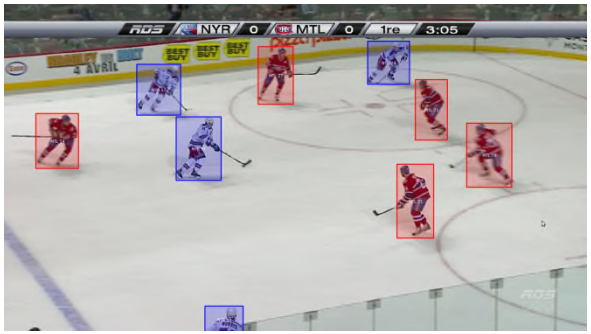




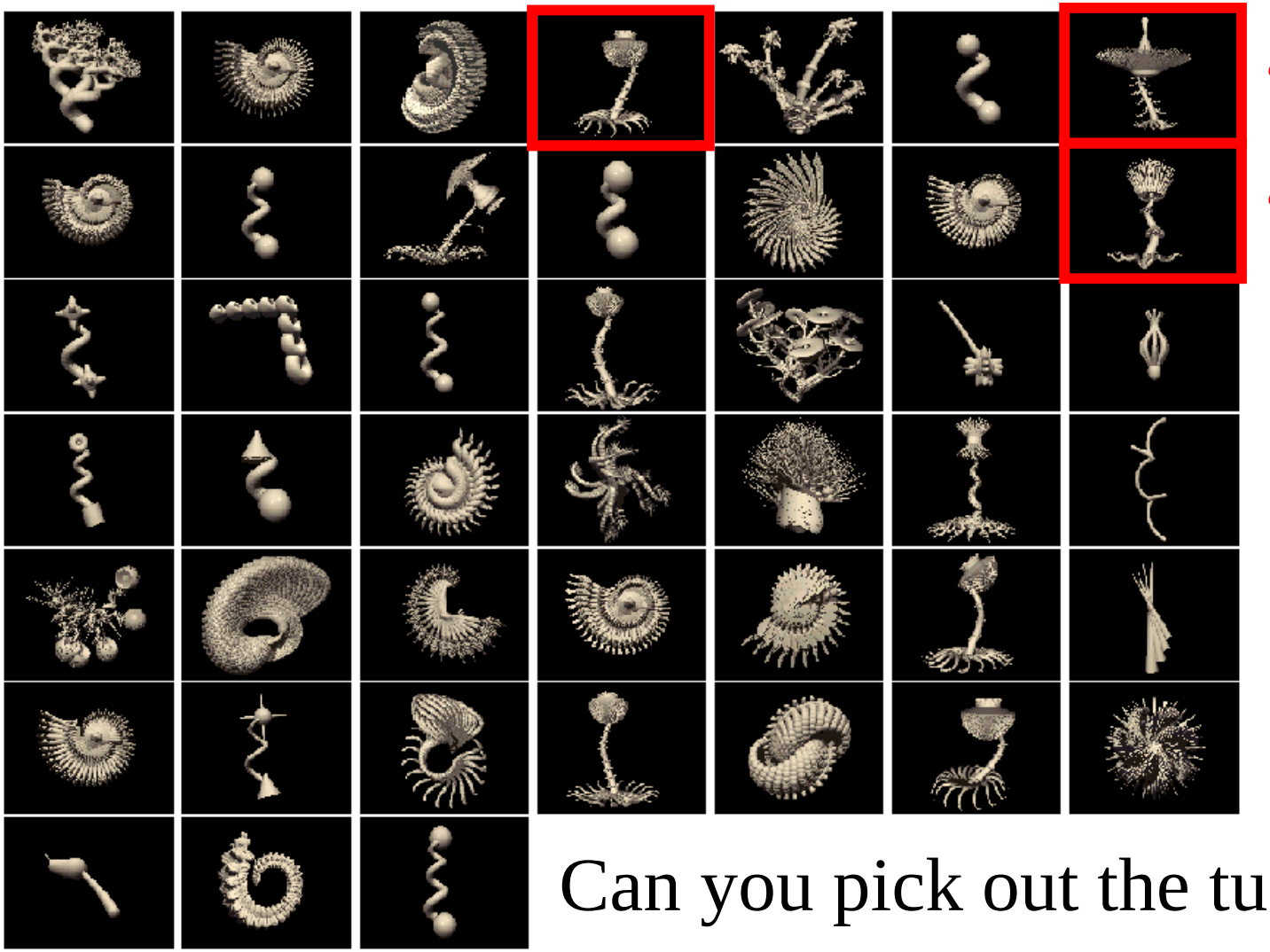
When to apply machine learning

- Human expertise is absent (*e.g.* *Navigating on Mars*)
- Humans are unable to explain their expertise (*e.g.* *Speech recognition, vision, language*)
- Solution changes with time (*e.g.* *Tracking, temperature control, preferences*)
- Solution needs to be adapted to particular cases (*e.g.* *Biometrics, personalization*)
- The problem size is to vast for our limited reasoning capabilities (*e.g.* *Calculating webpage ranks, matching ads to facebook pages*)





Challenge: One-shot learning



Can you pick out the tufas?

Josh Tenenbaum

Other challenges

- Multi-task & transfer learning (generalization)
- Scaling and energy efficiency
- Ability to generate data (e.g., vision as inverse graphics)
- Architectures for AI

Next lecture

In the next lecture, we look at the simplest model in machine learning: Linear regression.