Deep Learning Lab Course 2016
(Deep Learning Practical)

Labs:
(Computer Vision) Thomas Brox,
(Robotics) Wolfram Burgard,
(ML for Automated Algorithm Design) Frank Hutter,
(Machine Learning) Joschka Boedecker

Machine Learning Lab
University of Freiburg

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Today...

- **Assignment:** I will quickly cover some questions regarding group assignments and handing in the first exercise
- **Lecture:** We will have a look at convolutional neural networks (CNNs)

Organizational

- **Group Assignment:** From next week on we will have two tracks with **overlapping exercises**:
  - Track 1: Computer Vision / Hyperparameter Optimization
  - Track 2: Robotics / Reinforcement learning
- decide now (until **Monday**) in which you want to be and send a mail to springj@cs.uni-freiburg.de
  - **Subject**: DL track assignment
  - **Content**: My name is [my name] I would like to be in Track [track number] and would like to work together with [one other student name]
- We will do our best to match up students to the tracks but no guarantees!
- You will get a mail with your assignment next **Wednesday**

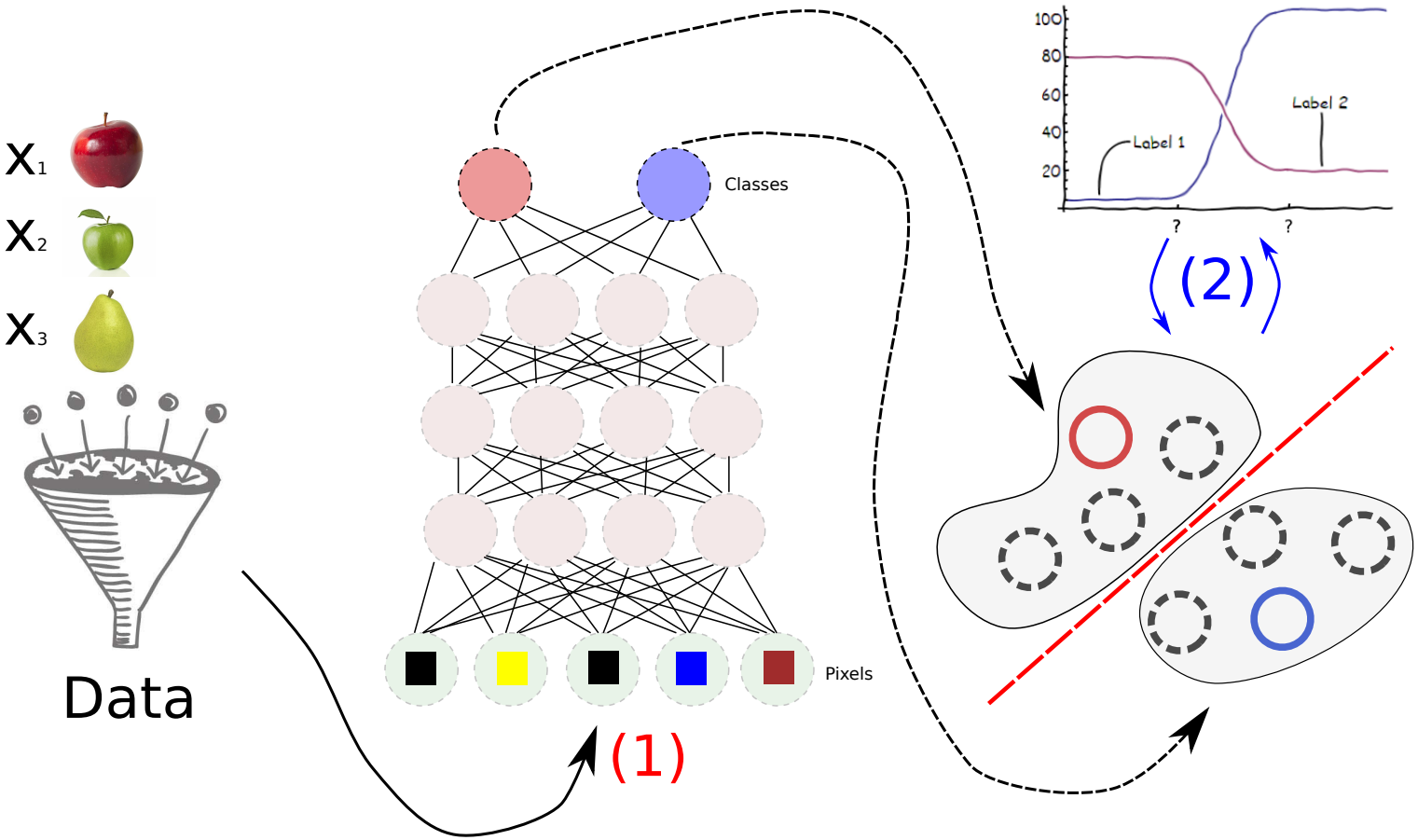
Organizational

- **Exercise 1:** Hand in your solution (zipped code or link to github repository) and short report via mail to one tutor **for your assigned track**
  - Track 1:
    Maxim Tatarchenko tatarchm@cs.uni-freiburg.de
    Ilya Loshchilov ilya@cs.uni-freiburg.de
  - Track 2:
    Jingwhei Zhang zhang@cs.uni-freiburg.de
    Andreas Eitel eitel@cs.uni-freiburg.de
    Jost Tobias Springenberg springj@cs.uni-freiburg.de
- **Next week:** mandatory meeting for next assignment, we meet in the lecture room and will split up

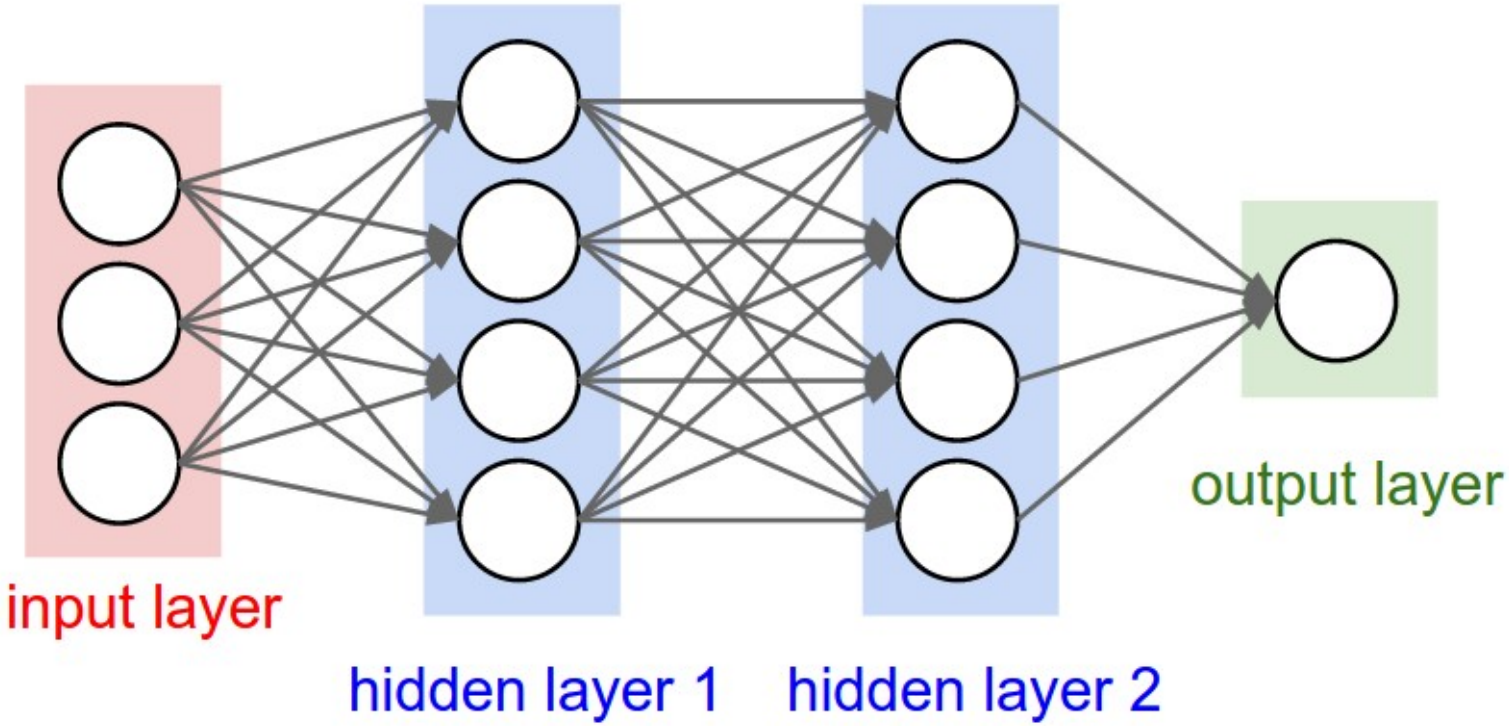
Where we are: Supervised Deep Learning Pipeline

(1) Jointly Learn everything with a deep architecture

(2) Inference e.g. classes of unseen data



Where we are: more detail



→ but what if the input is an image (say 32×32 pixels (RGB))

→ we would have $32 \times 32 \times 3$ weights **per neuron**

→ assuming only 100 units $\approx 300k$ weights in the first layer alone

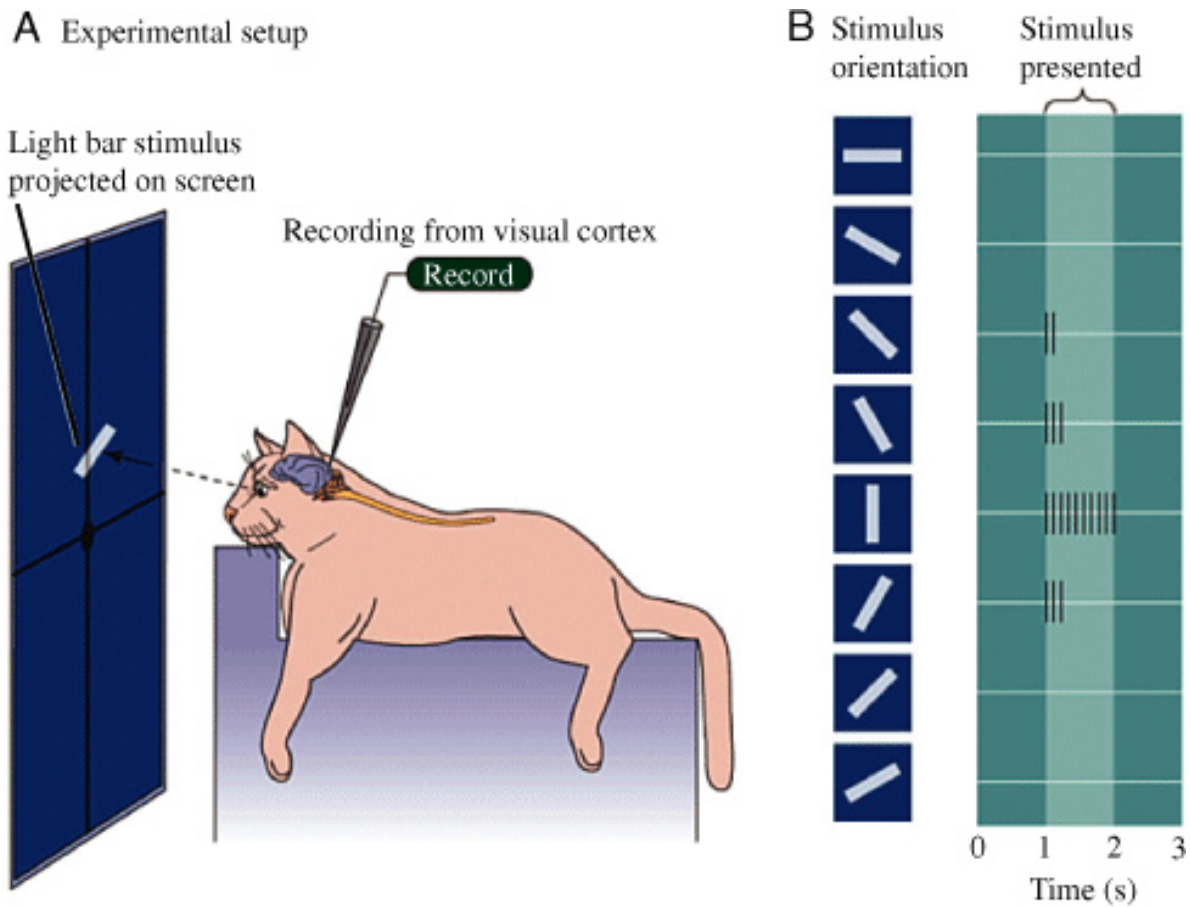
Where we are: a way forward ?

- Applying NNs naively to high dimensional images is not going to work
- How can we improve on this ?

$\rightarrow$ Let us try to exploit domain knowledge

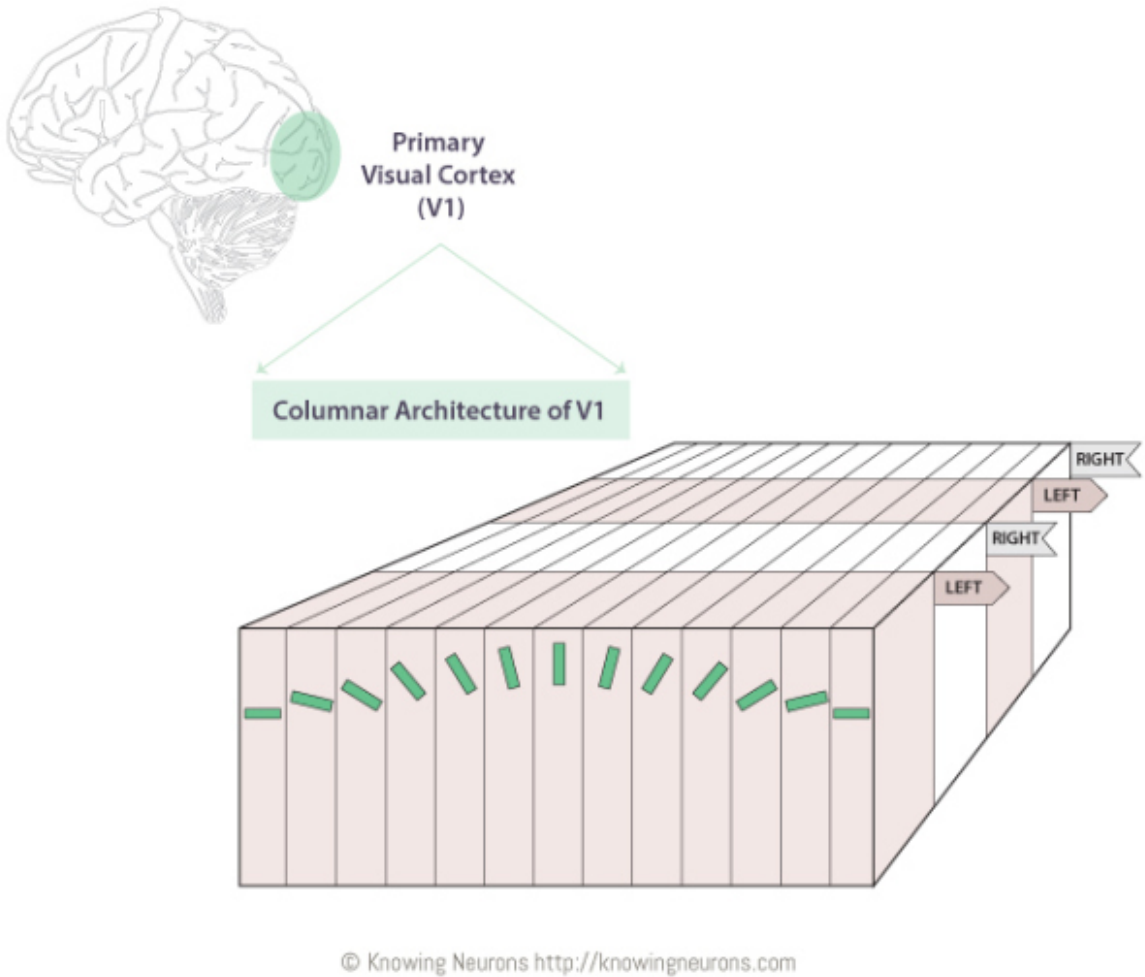
Where we are: a way forward ?

What domain knowledge do we have ?



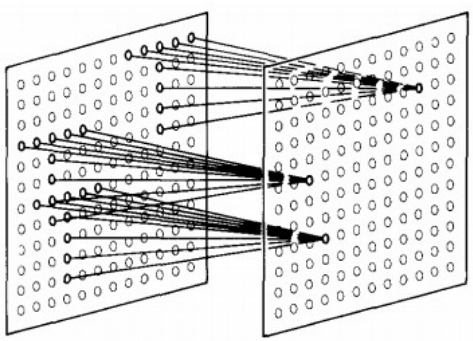
Where we are: a way forward ?

What domain knowledge do we have ?

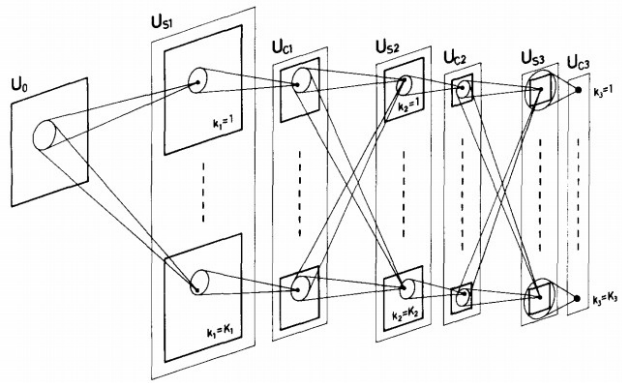


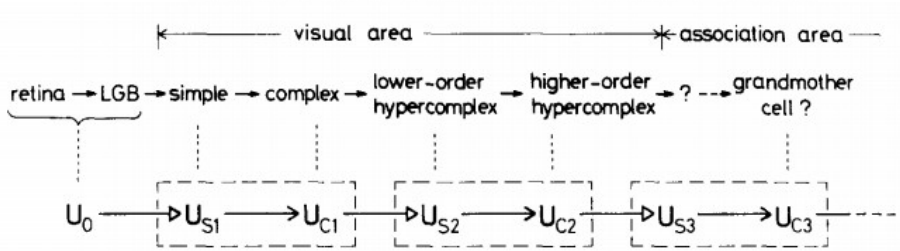
Towards Convolutional Neural Networks

Neurocognitron
[Fukushima 1980]



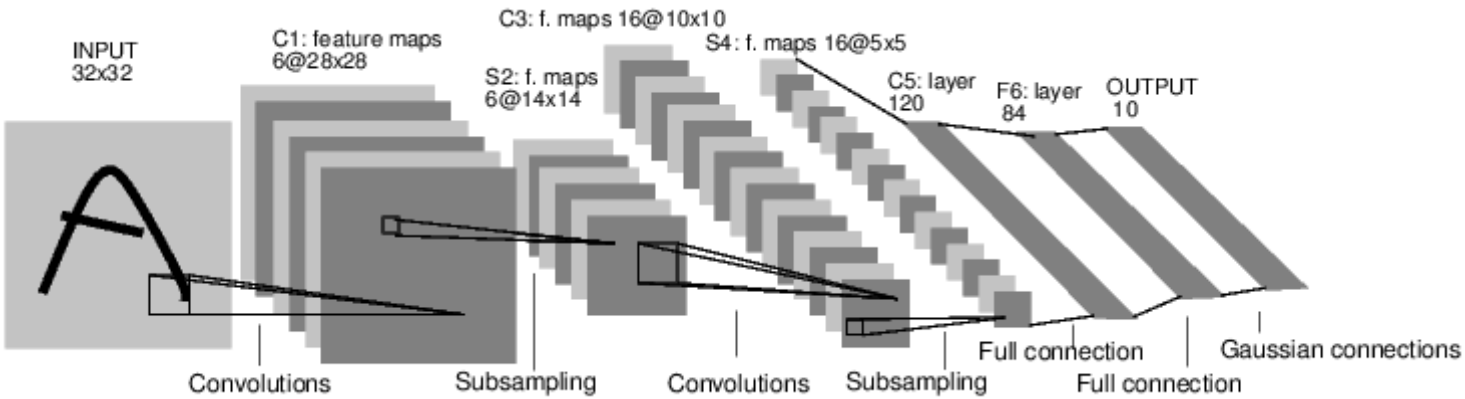
"sandwich" architecture (SCSCSC…)
simple cells: modifiable parameters
complex cells: perform pooling





Convolutional Neural Networks

LeNet for digit recognition

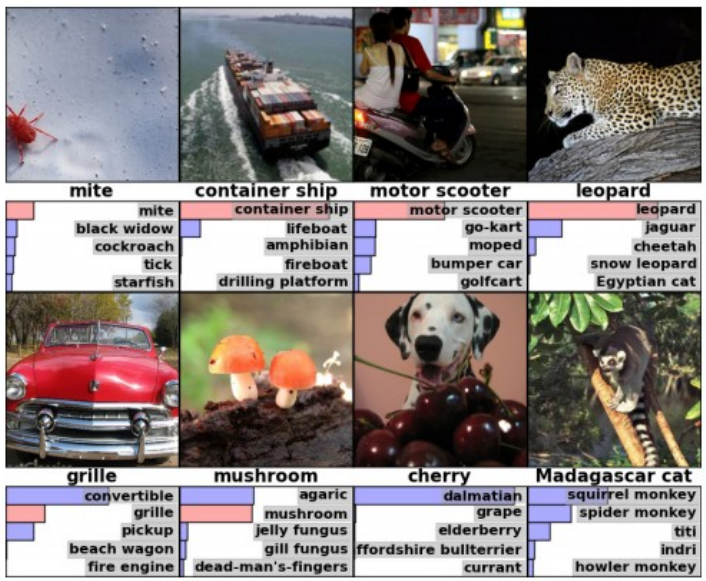


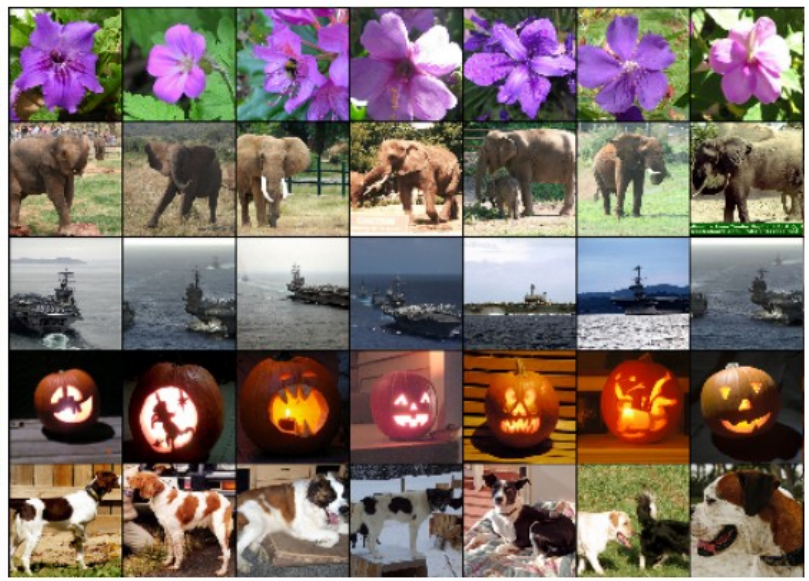
[LeCun et al. 1998]

CNNs in the wild

Classification

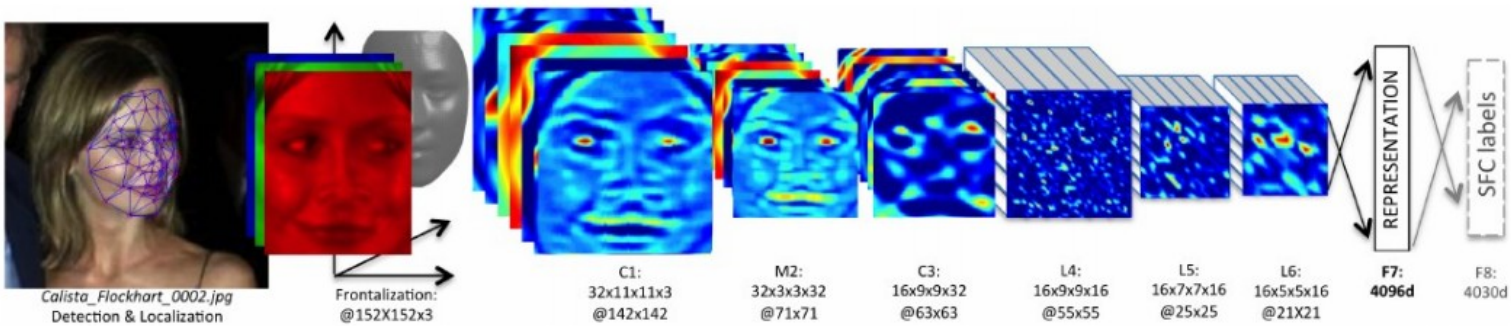
Retrieval



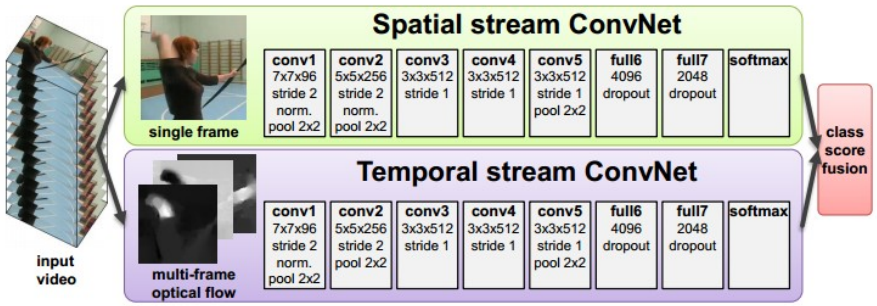


[Krizhevsky 2012]

CNNs in the wild



[Taigman et al. 2014]



[Simonyan et al. 2014]

CNNs in the wild

[Toshev, Szegedy 2014]

[Mnih 2013]

CNNs: a change in perspective

Let us take things slowly, one a t a time