Multi-agent systems

Andrej Lúčny

KAI FMFI UK

lucny@fmph.uniba.sk

http://www.agentspace.org/mas

Integration of methods of artificial intelligence via MAS

- GOFAI

- Machine learning

- Deep learning

Integration of GOFAI

- via BDI agents (so called Intelligent agents)
- called also strong agents
- What components can we use ?
- Distributed system – though compounded from intelligent agents is not equivalent to GOFAI system, e.g. it can resist to the frame problem.

Frame problem

- When we feed an inference mechanism with data, we forget semantics and manipulate the data at the syntax level.

- Thus when we feed all data into single system, the system is slowed down by checking relations among data which are not related at all. („Has the green color of walls and influence to explosion of bomb?")

- Frame problem: can we select the fed data, so that the system has enough data and their manipulation is not too slow?

Frame problem

- Solution: instead of single inference mechanism, we employ more specialized inference mechanisms.
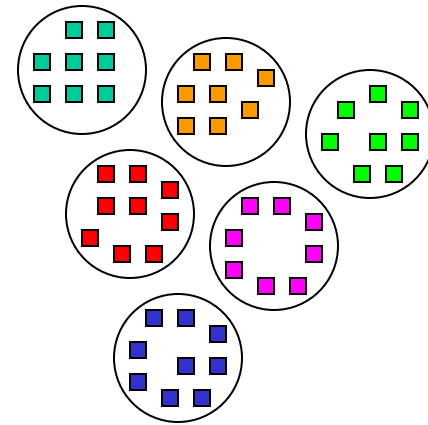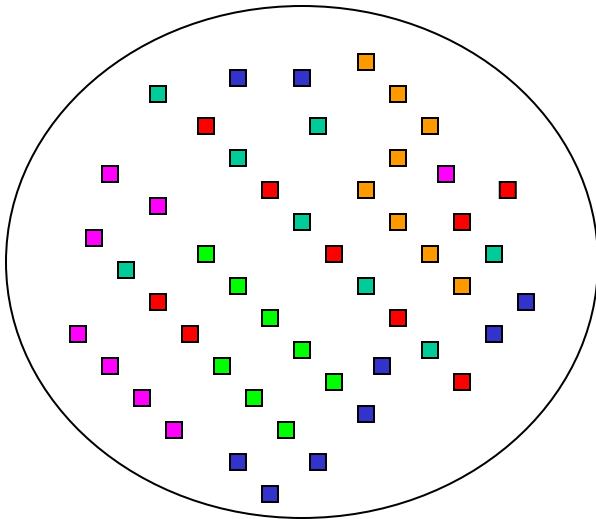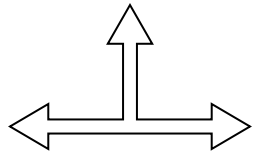
Reinforcement learning

- Simple method which provides impressive results

  - at each spot we toss a coin, each choice has a certain probability

  - the probabilities are initialized randomly

  - when we get positive reward, we increase probability of the last actions and decrease probability of the other choices accordingly.

Reinforcement learning is skinnerian but approximate Popperian behavior

Neural networks

- Feature vector of agent excites neurons in the input layer
- We select action which corresponds the most excited output neuron or sum of actions weighted by the network output
- Weights of the network are usually got by training performed offline using a dataset
- Feed-forward or recurrent (inner state)

Perceptron

- Neural network from at least two fully connected layers

- With non-linear activation it is an universal approximator, but it is less useful in practice

FC = fully connected
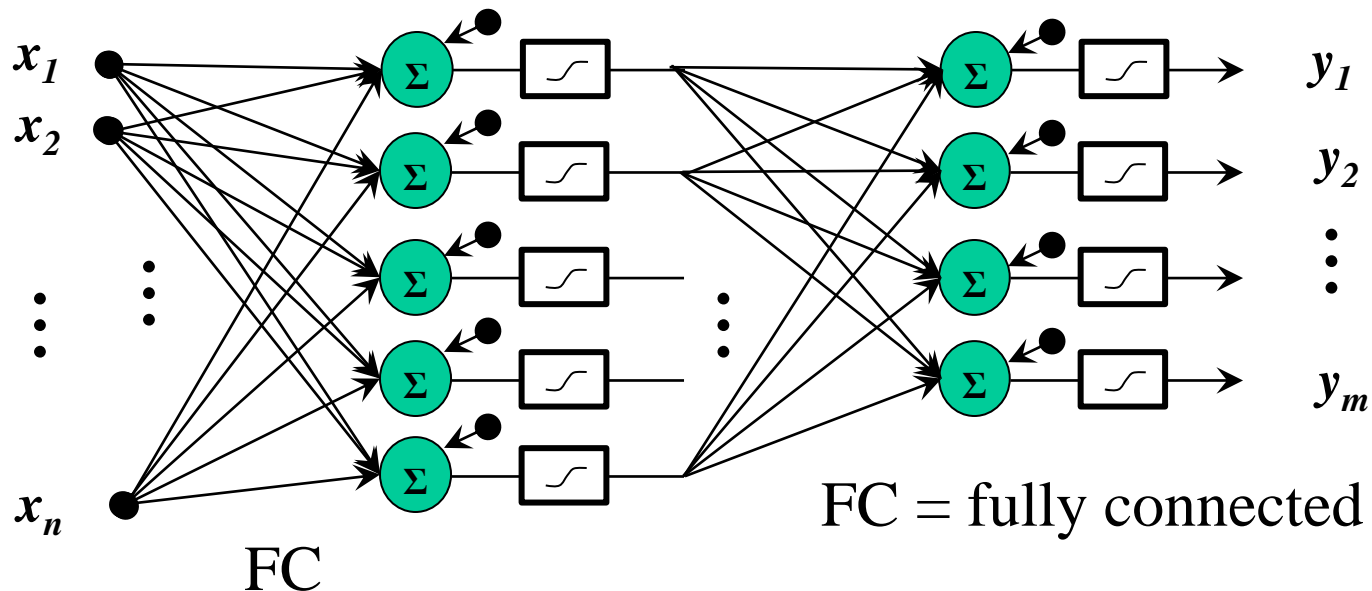
Planning via General Problem Solver

- World is represented by Horn clauses
- We have operators which manipulates the representation
- We have initial state and goal
- We aim to design plan – a sequence of operators which turn the initial state to a state where the goal is achieved

Cogitoid
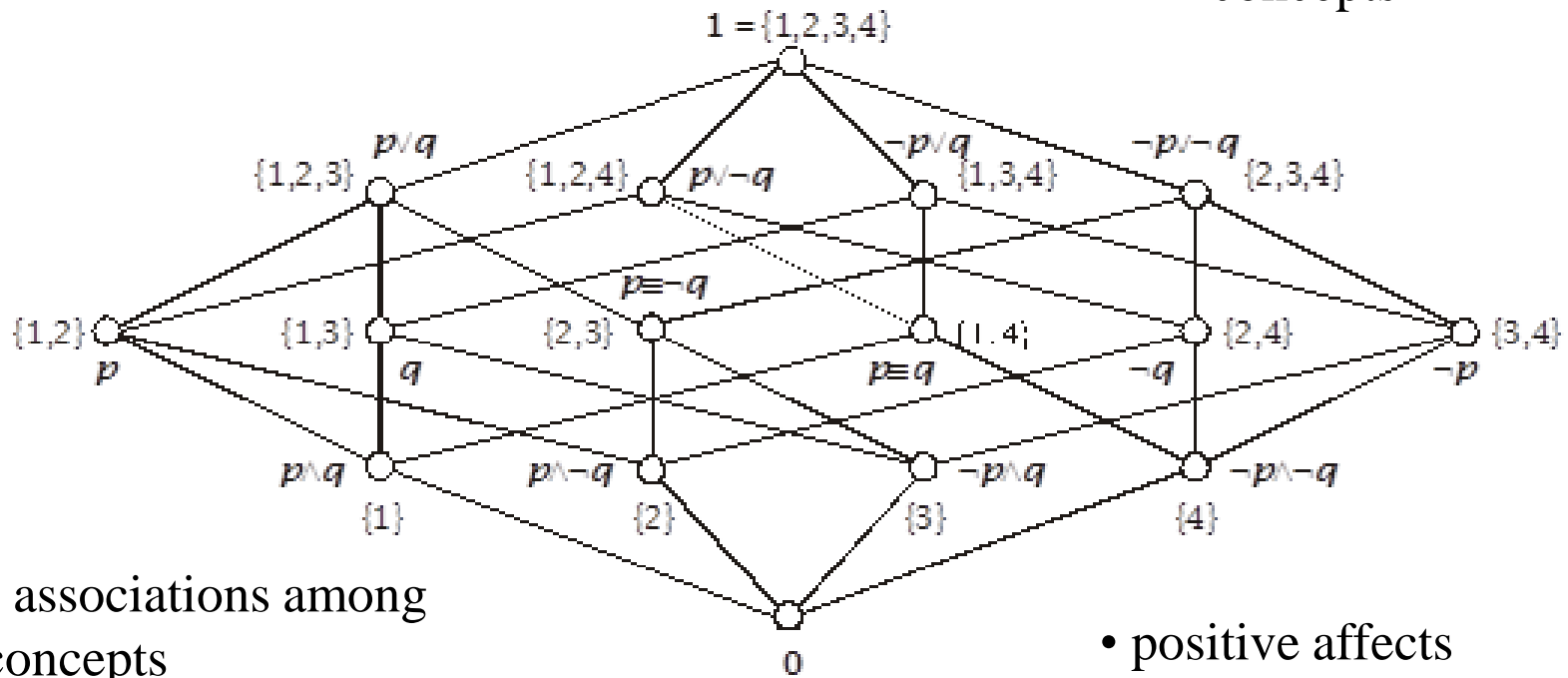
- features
- concepts
- associations among concepts
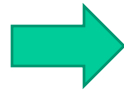- positive affects
- negative affects
- useful concepts have significant associations

Machine learning

- Data are represented as point in multidimensional space (fixed number of dimensions)
- The space is reduced and transformed to easy distinguish e.g. data categories
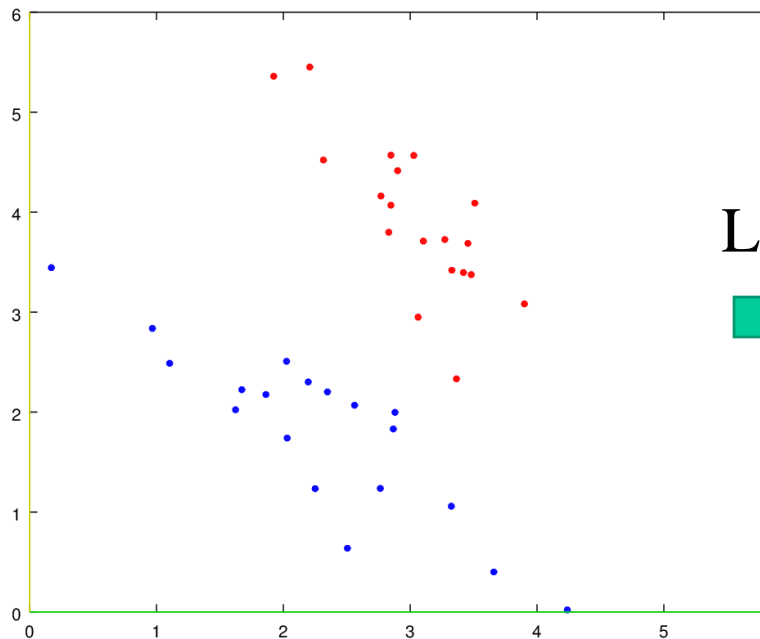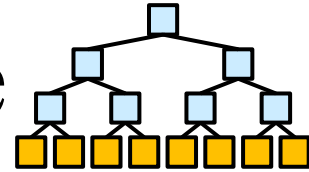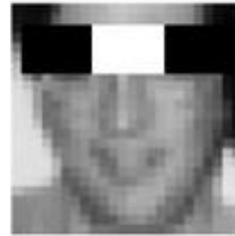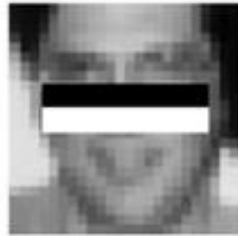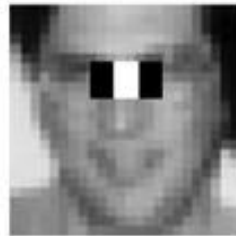
LDA
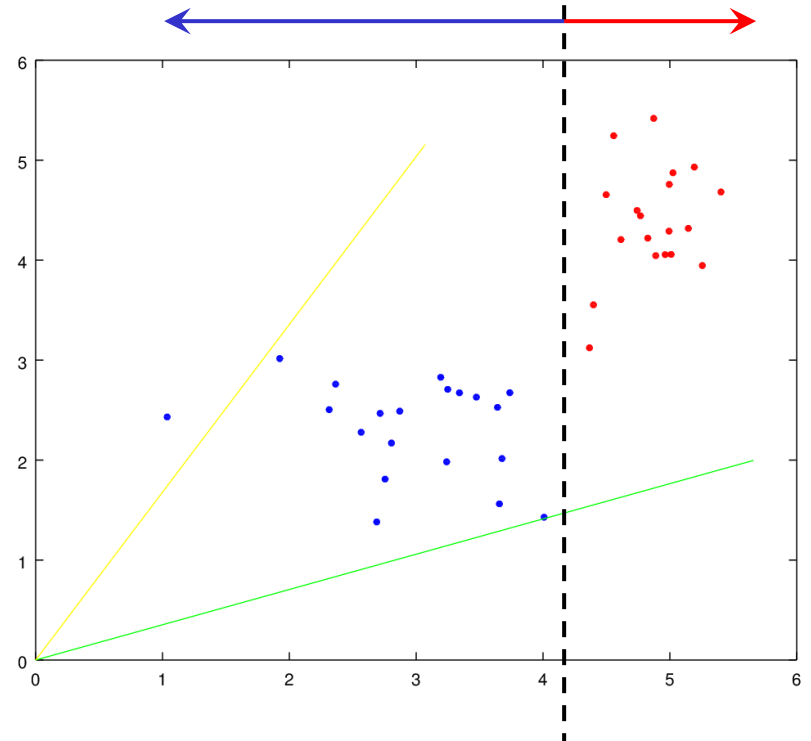
Viola Jones alg.
Haar Features → Decision tree
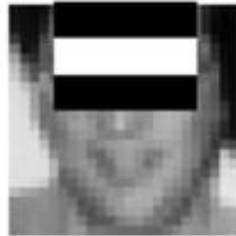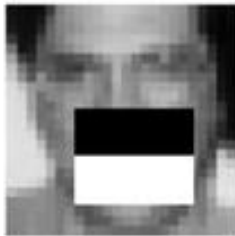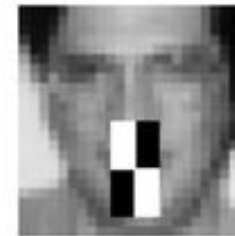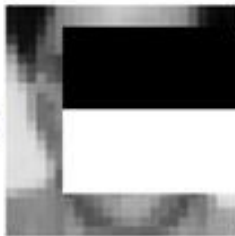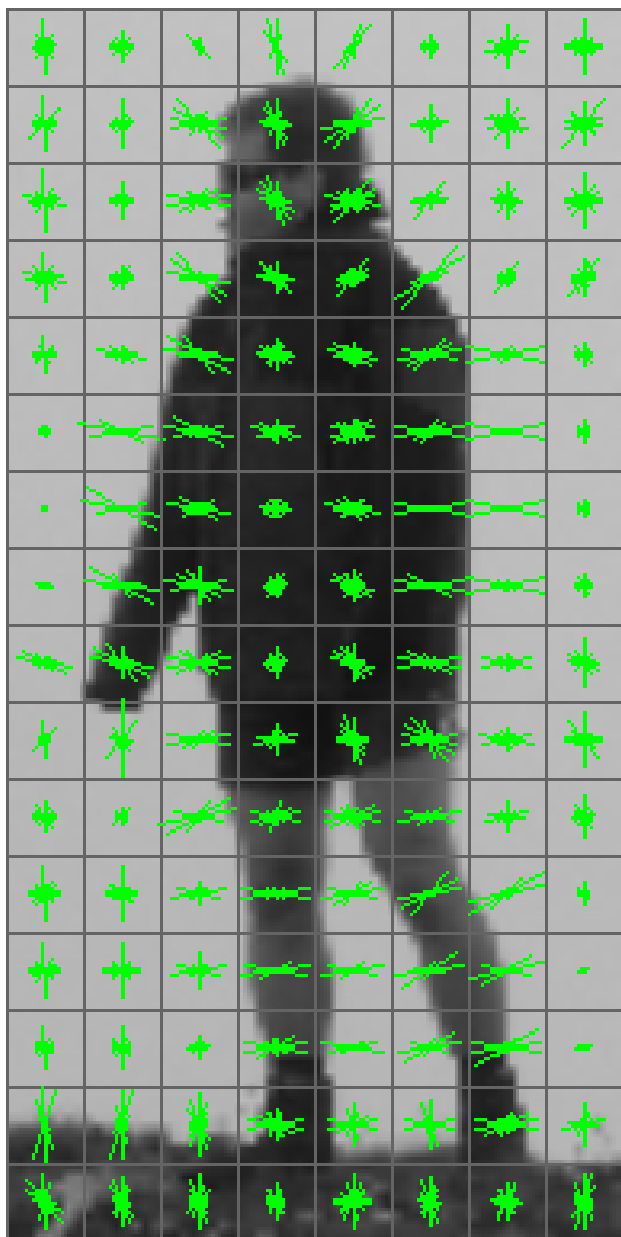
HOG features

$\downarrow$

LDA

Cascade classifier / regressor

estimated value **+** estimated error **+** estimated error of estimated error **+** estimated ... **+** estimated ...
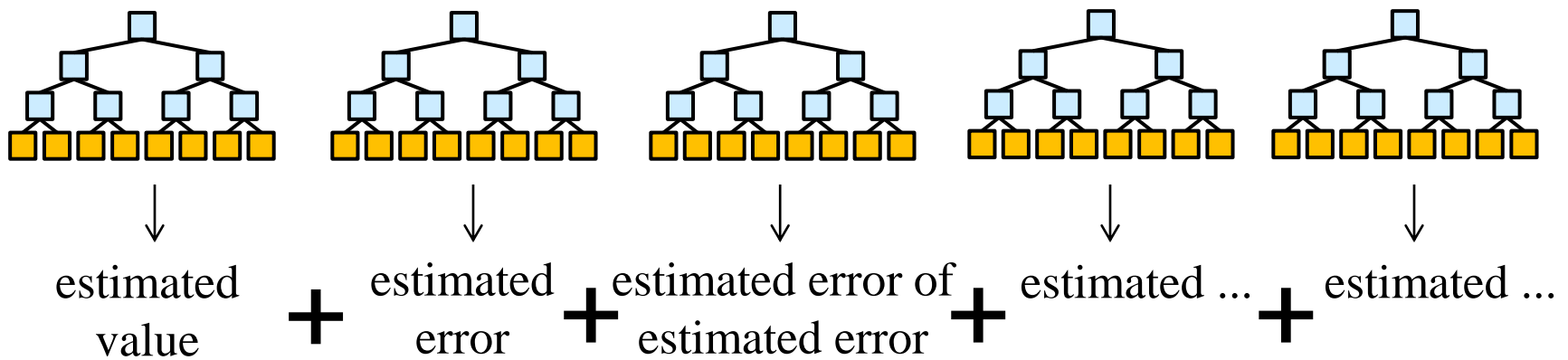
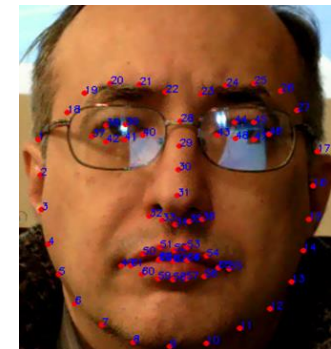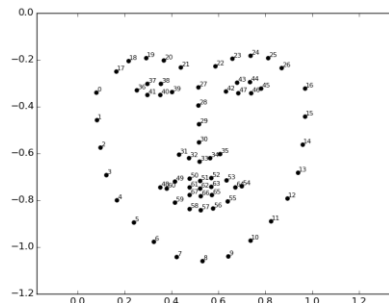We can join more weak classifier / regressors by gradient boosting method

Kazemi detector provides facial landmarks

Face detector

Facial landmark detector

HOG

LDA

Cascade regresor

LBP

1	2	2
9	5	6
5	3	1

Threshold

0	0	0
1		1
1	0	0

Binary: 00010011
Decimal: 19

LBP

Face image

The face image is divided into blocks

LBP histogram from each block
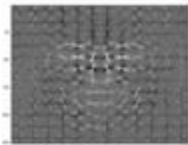
Feature histogram
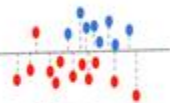
LDA
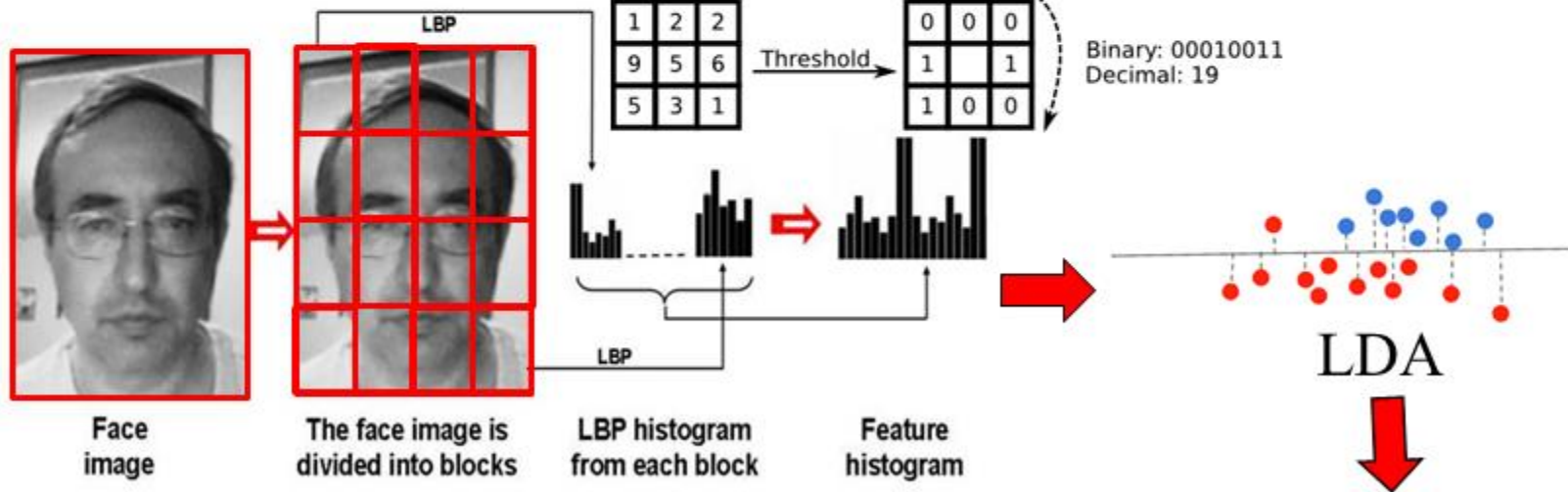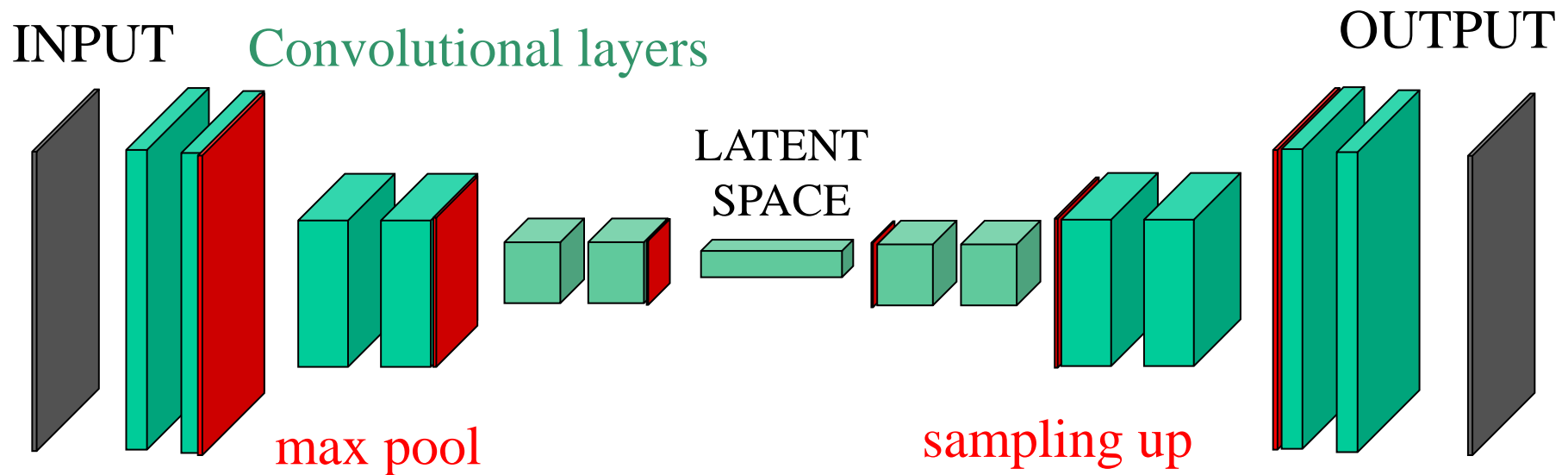
LBPH – Local binary pattern histogram

"Andy"

Classic approach (face recognition)

Involvement of deep learning

(Convolutional) autoencoder

INPUT   Convolutional layers   OUTPUT

LATENT
SPACE

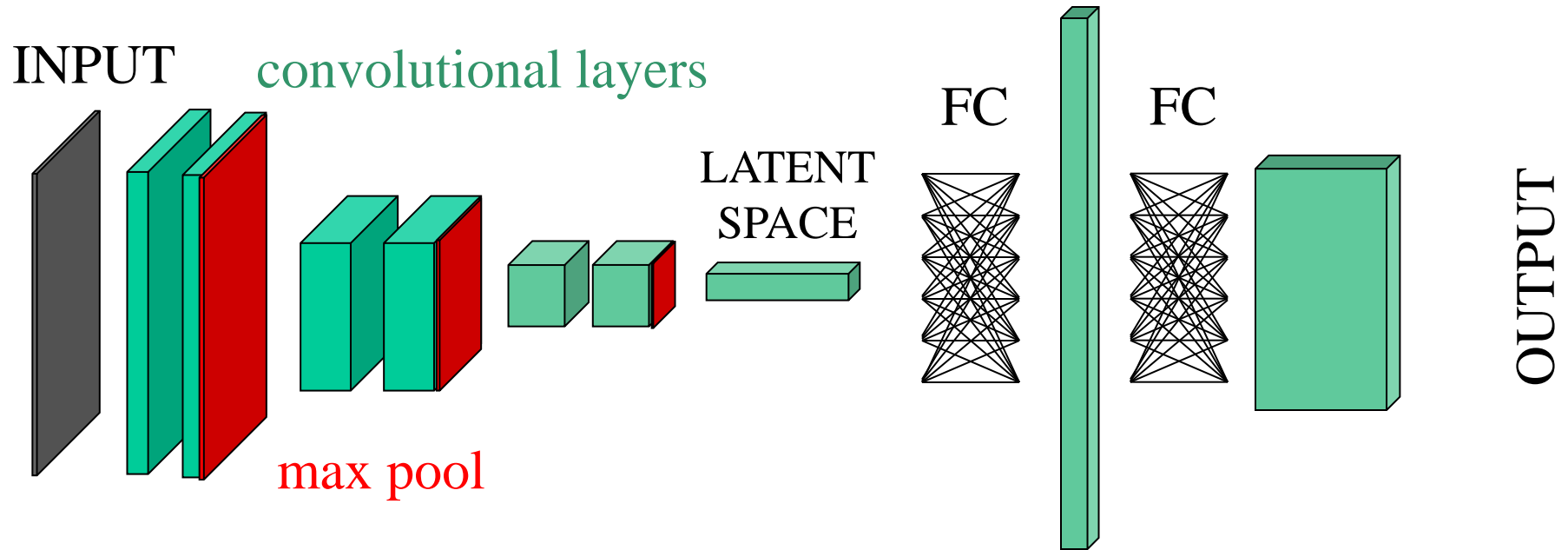max pool   sampling up

Encoder transforms image into feature vector ...

Classifier
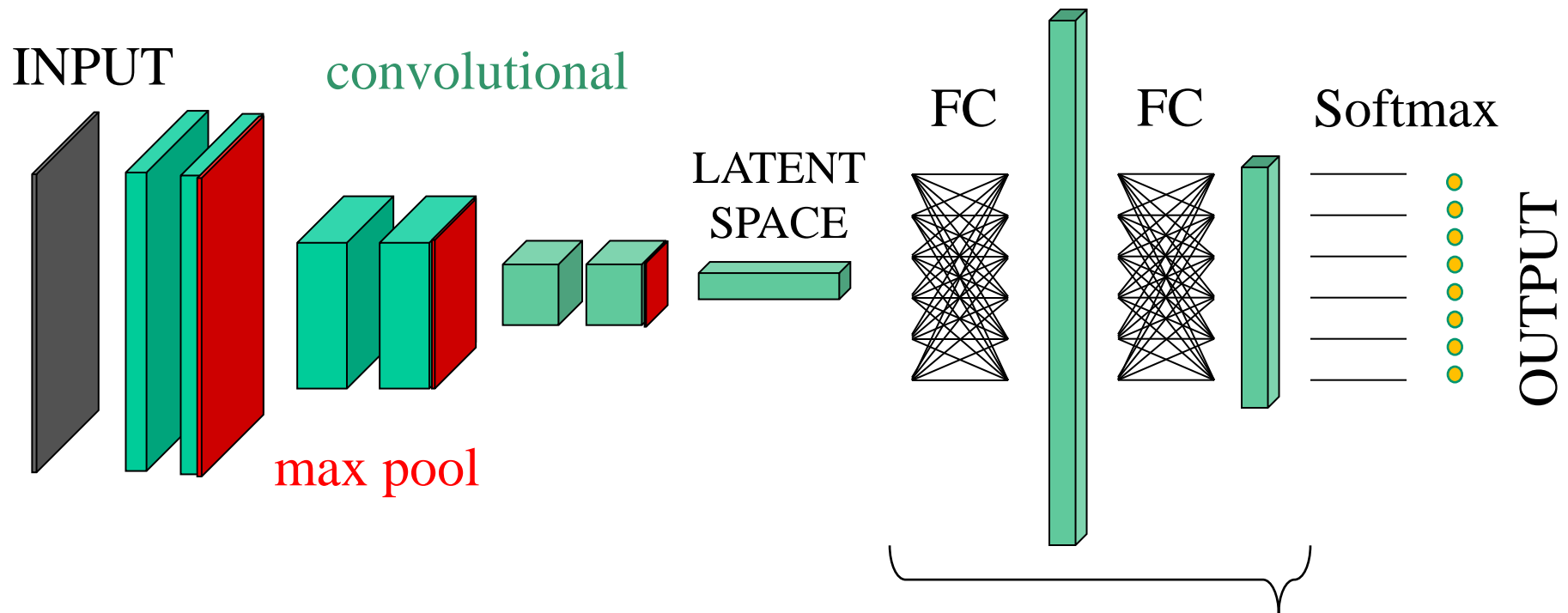
... and the feature vector can be treated by perceptron also in practice

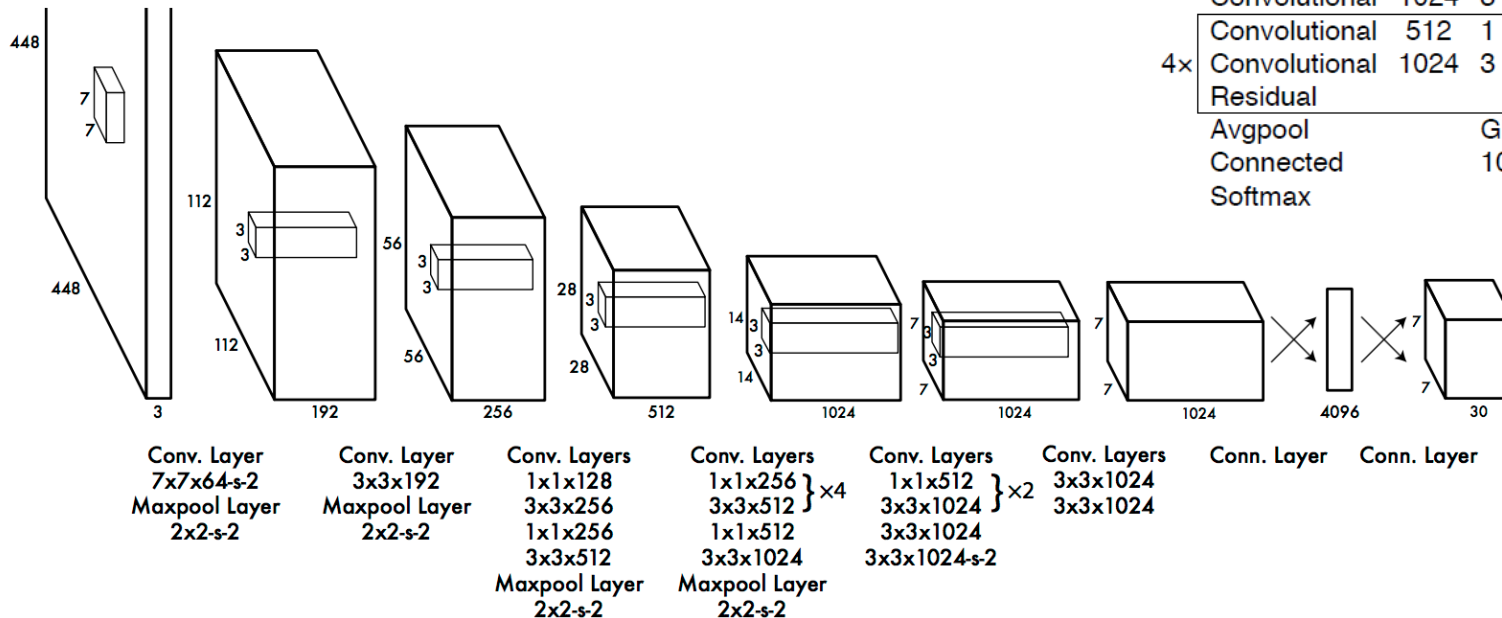# Detector YOLO (you only look once)

Objects positions and size can be also coded as a tensor calculated by a deep neural netwotk
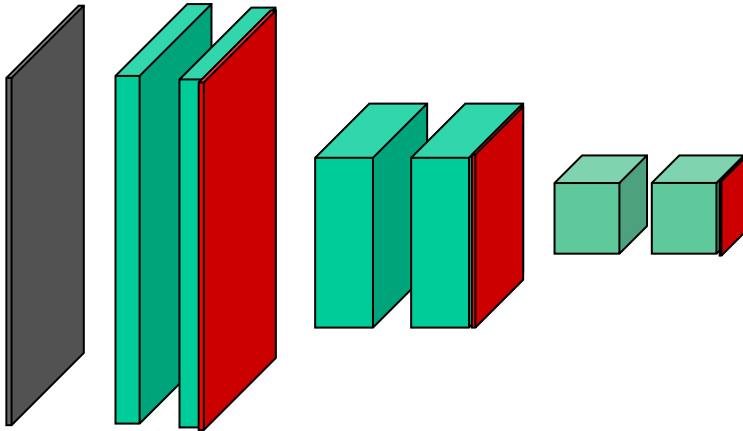
You Only Look Once
deep detector based on DarkNet

Type	Filters	Size	Output
Convolutional	32	3 × 3	256 × 256
Convolutional	64	3 × 3 / 2	128 × 128
1× Convolutional	32	1 × 1	
Convolutional	64	3 × 3	
Residual			128 × 128
Convolutional	128	3 × 3 / 2	64 × 64
2× Convolutional	64	1 × 1	
Convolutional	128	3 × 3	
Residual			64 × 64
Convolutional	256	3 × 3 / 2	32 × 32
8× Convolutional	128	1 × 1	
Convolutional	256	3 × 3	
Residual			32 × 32
Convolutional	512	3 × 3 / 2	16 × 16
8× Convolutional	256	1 × 1	
Convolutional	512	3 × 3	
Residual			16 × 16
Convolutional	1024	3 × 3 / 2	8 × 8
4× Convolutional	512	1 × 1	
Convolutional	1024	3 × 3	
Residual			8 × 8
Avgpool		Global	
Connected		1000	
Softmax			

Encoder - decoder

VGG

3x3 conv, 64	3x3 conv, 64	*pool/2*	3x3 conv, 128	3x3 conv, 128	*pool/2*	3x3 conv, 256	3x3 conv, 256	3x3 conv, 256	*pool/2*	3x3 conv, 512	3x3 conv, 512	3x3 conv, 512	*pool/2*	3x3 conv, 512	3x3 conv, 512	3x3 conv, 512	*pool/2*	fc 4096	fc 4096	fc 4096

Size:224 *Size:112* *Size:56* *Size:28* *Size:14* *Size:7*
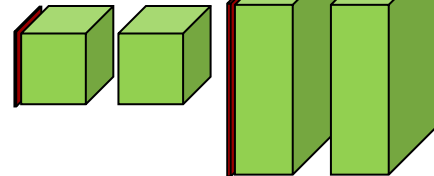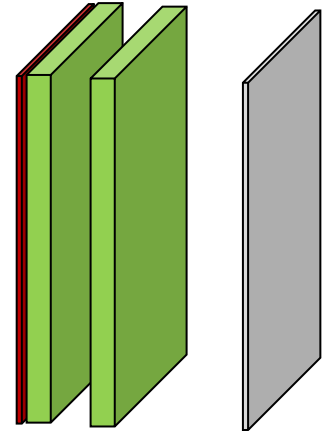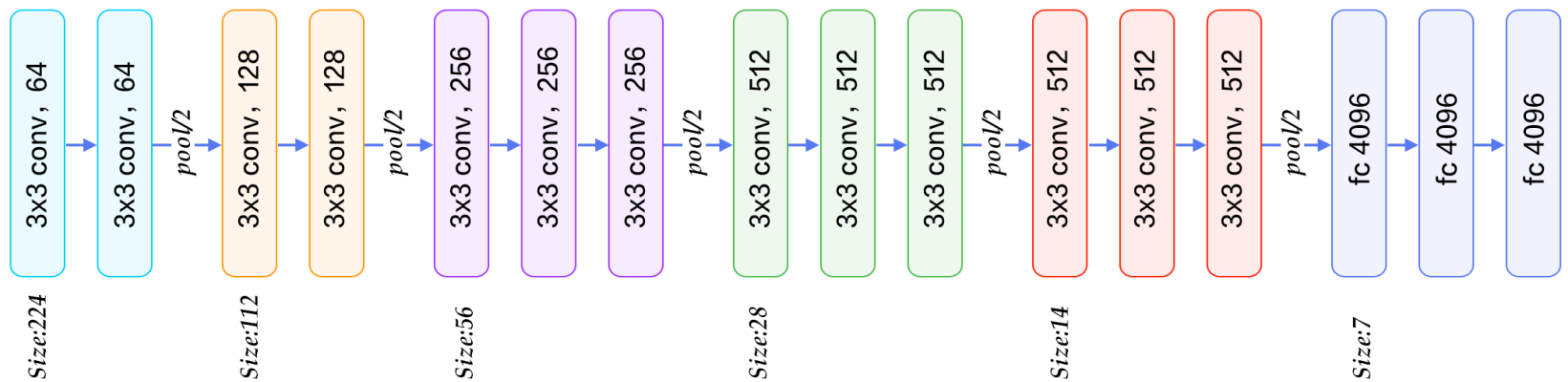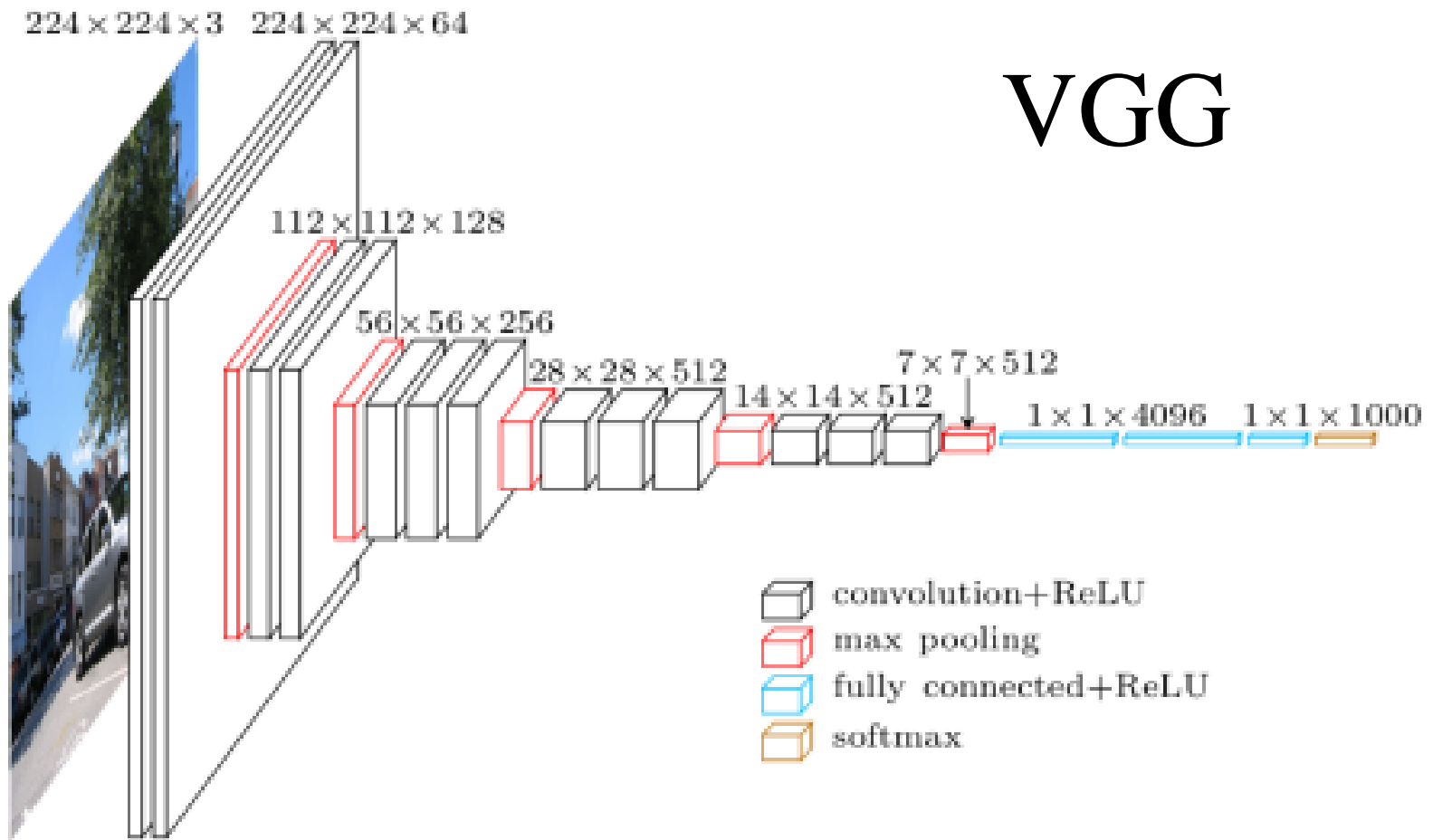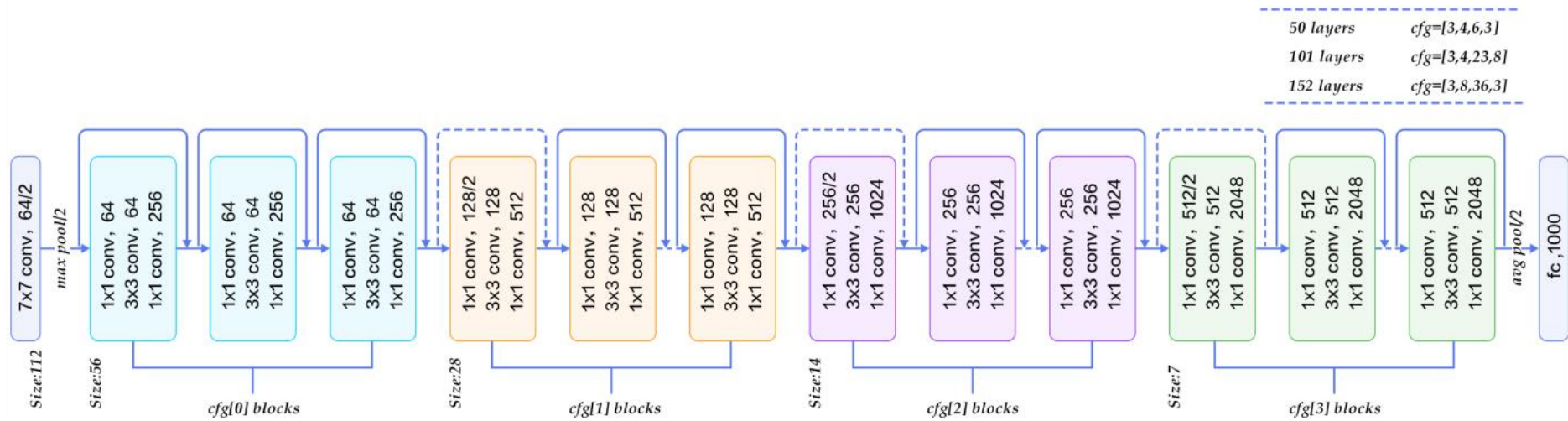
ResNet

Face detector

Facial landmark detector

ResNet

Cascade regresor

ResNet

Descriptor
(0.453,0.122,0.998,...)

Enrollment

"Andy"

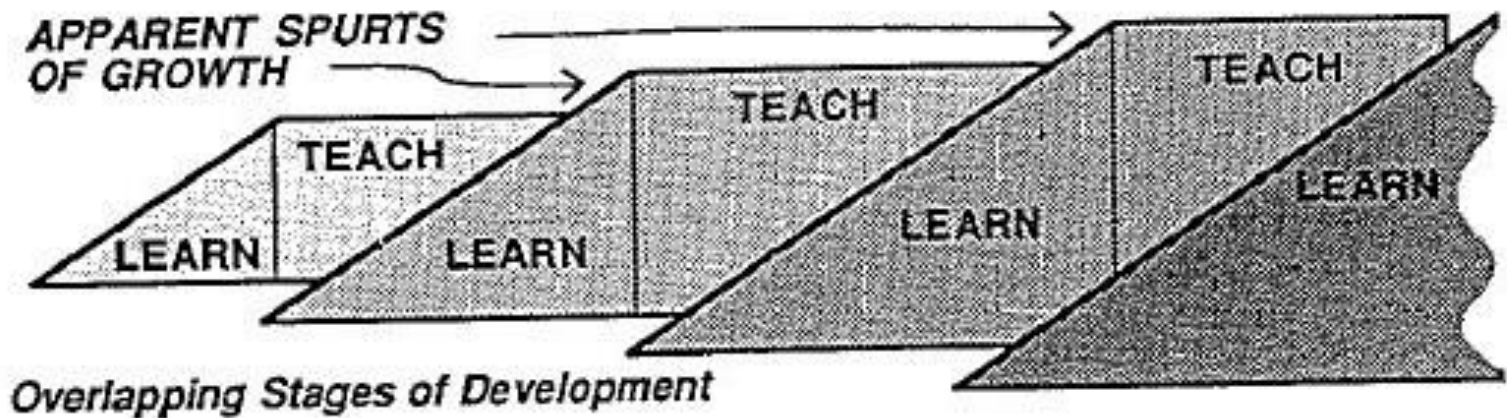*A modern appraoch to face recognition*

Integration of cloud services

Voice recognition from Android

https://github.com/andylucny/Recognize4PC
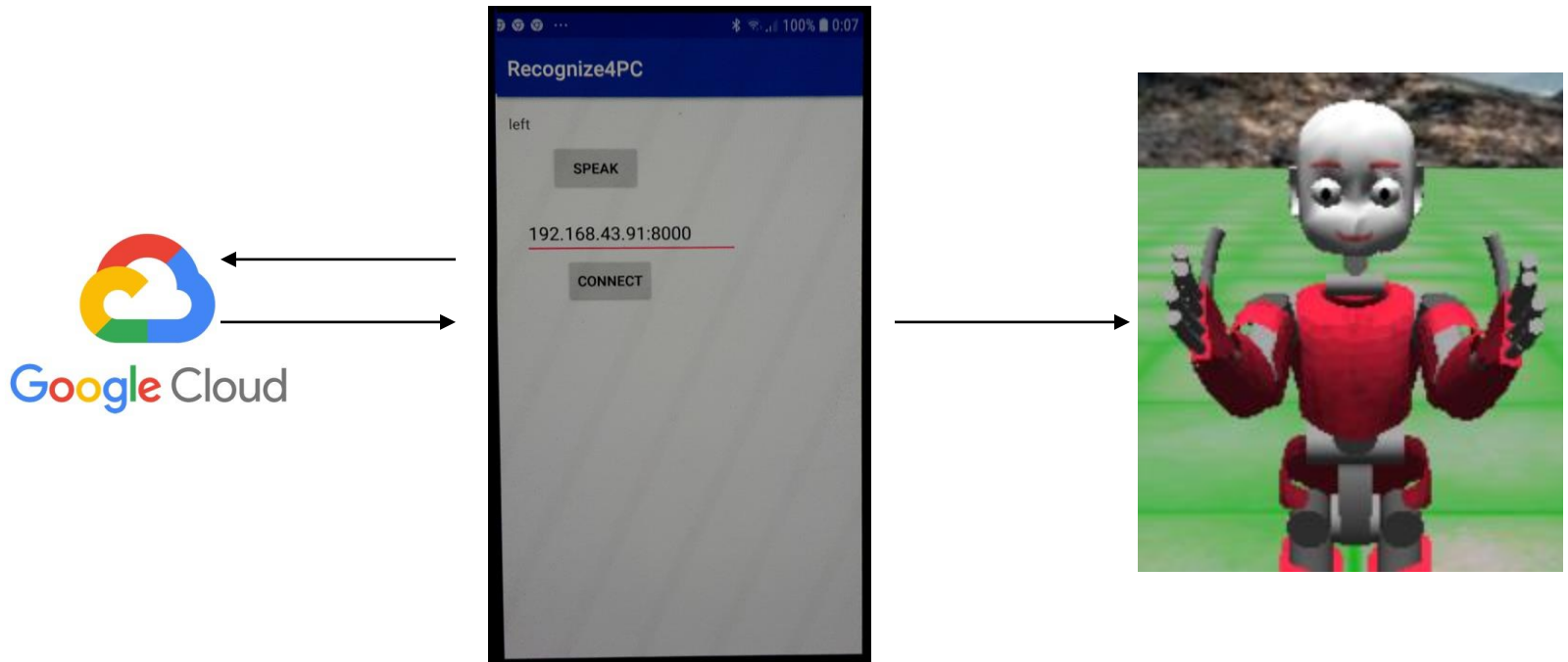
Overlapping stages of development

17.1 SEQUENCES OF TEACHING-SELVES

Overlapping Stages of Development

https://youtu.be/-KyS7_Xu3RQ

Thanks for paying attention!