CyberPhysical systems for Security and Services

UNIVERSITÀ DI SIENA 1240

MONTE DEI PASCHI DI SIENA
BANCA DAL 1472

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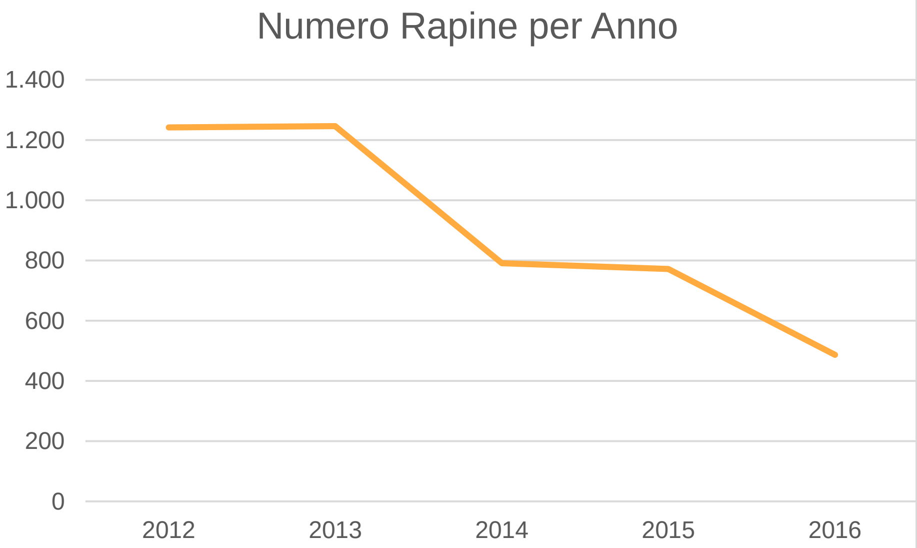
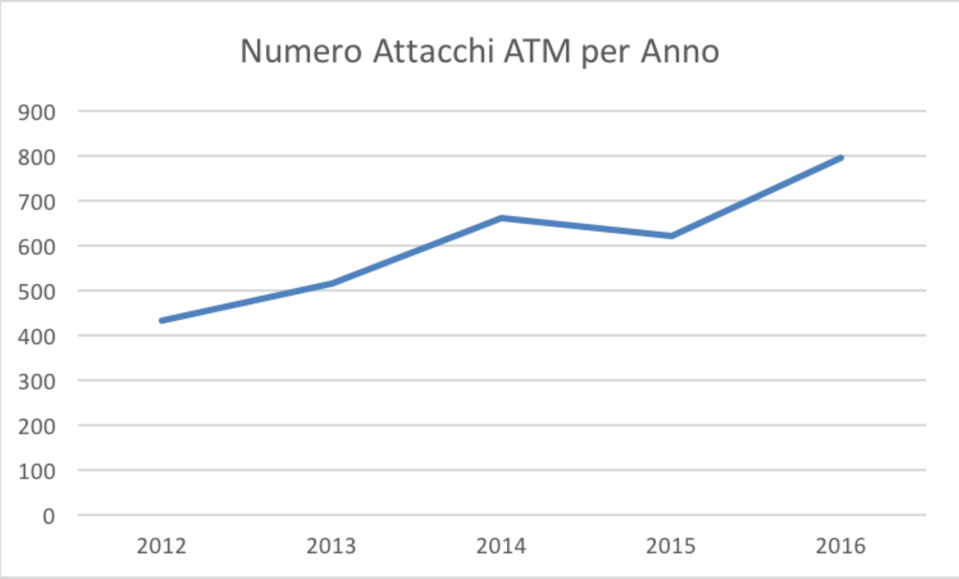
Siena, 14 Sett 2018

Case of study: ATM-Sense

TREND Rapine vs Attacchi ATM - Fonte ABI 2017





The evolution of **ATM Fraud**

1967

Introduction of the ATM

The cash dispenser is born.

1973

Lloyds Bank

(U.K.) deploys several networked devices.

1991

Five criminals

conduct a series of ATM robberies that involve intentionally causing a machine malfunction and physically attacking the technicians who attended the machine.

Late 1990s

Criminal groups

operating out of Japan improve ram-raiding by using a truck carrying heavy machinery to completely demolish/uproot ATM machines in order to physically steal cash.

2008

10,302 skimming incidents

are reported in Europe.

2009-2010

An unknown gang

of fraudsters make charges of 20 cents to $10 from over a million bank accounts throughout a period of several years.

2013

A group of international

thieves break into an Indian debit card system, lift customers' personal information and use it to steal $45M”

2014

Malware is installed

in a number of aging, European ATM machines.

2015

FICO reports a 546% increase

in ATM fraud cases in US since 2014

2016

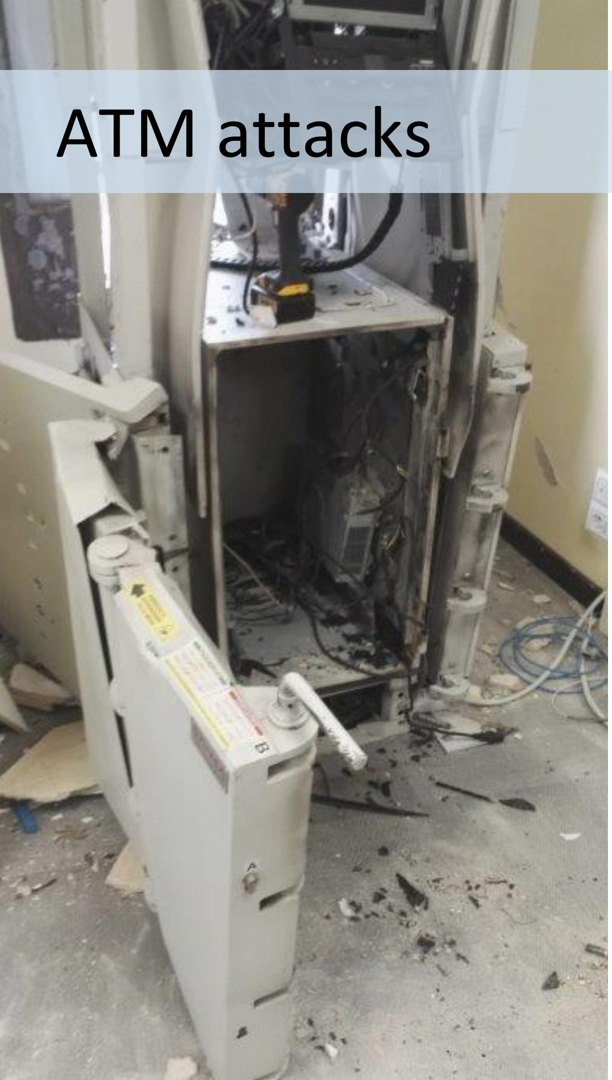
New age of ATM fraud

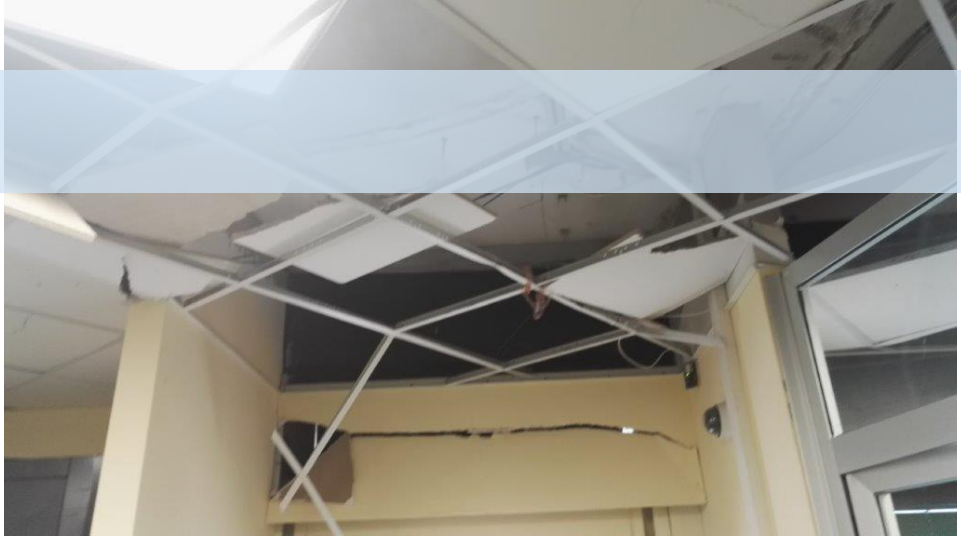
JUNE $13 million is stolen from South Africa's Standard Bank through 14,000 transactions.

JULY ATM machines in Taiwan are suspended after more than $2 million is stolen from 34 First Bank machines at 20 branches.

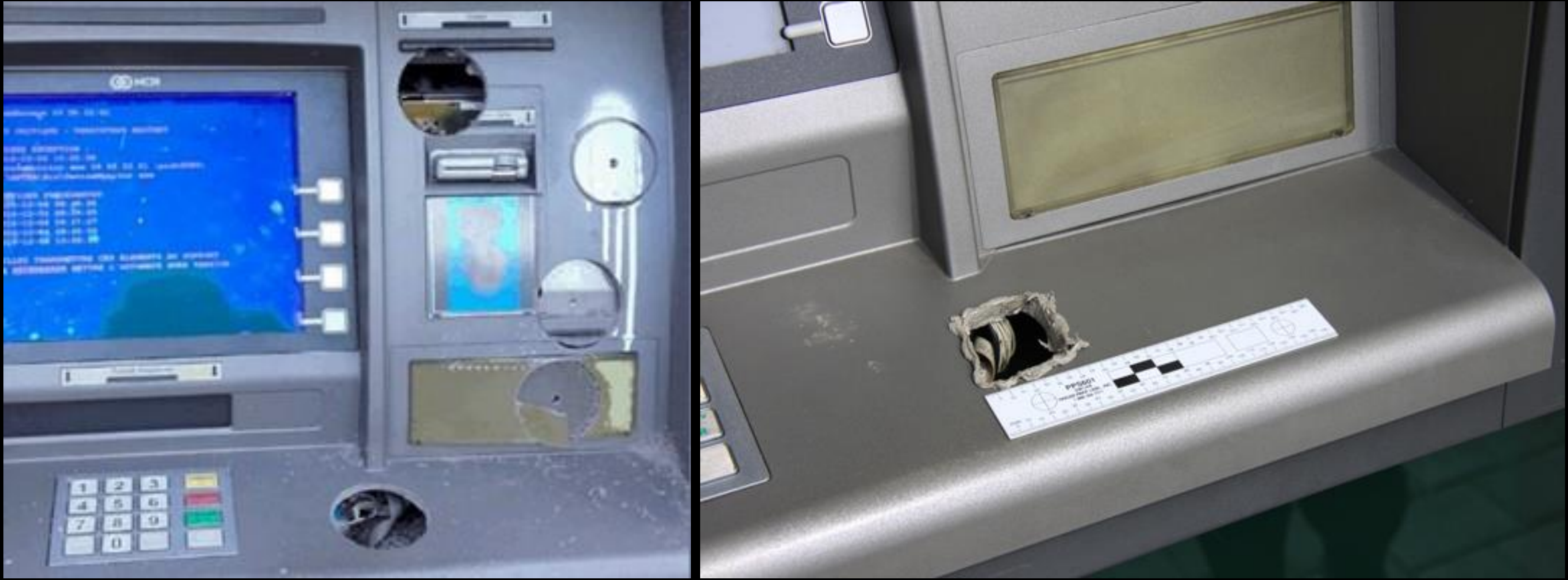
THETARAY

ATM attacks





New Attacks



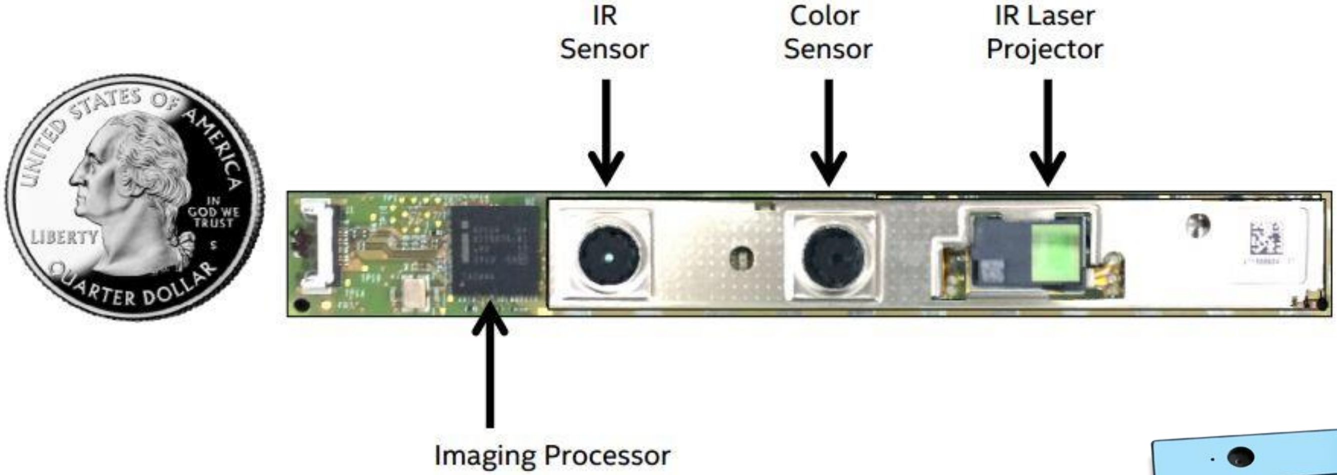
https://www.europol.europa.eu/newsroom/news/27-arrested-in-successful-hit-against-atm-black-box-attacks

Video Surveillance Approach

Intel RealSense Depth Cameras

- **Powerful Open Souce SDK**
- **Easily Embeddable**

intel REALSENSE TECHNOLOGY

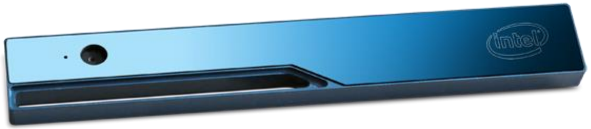


IR Sensor

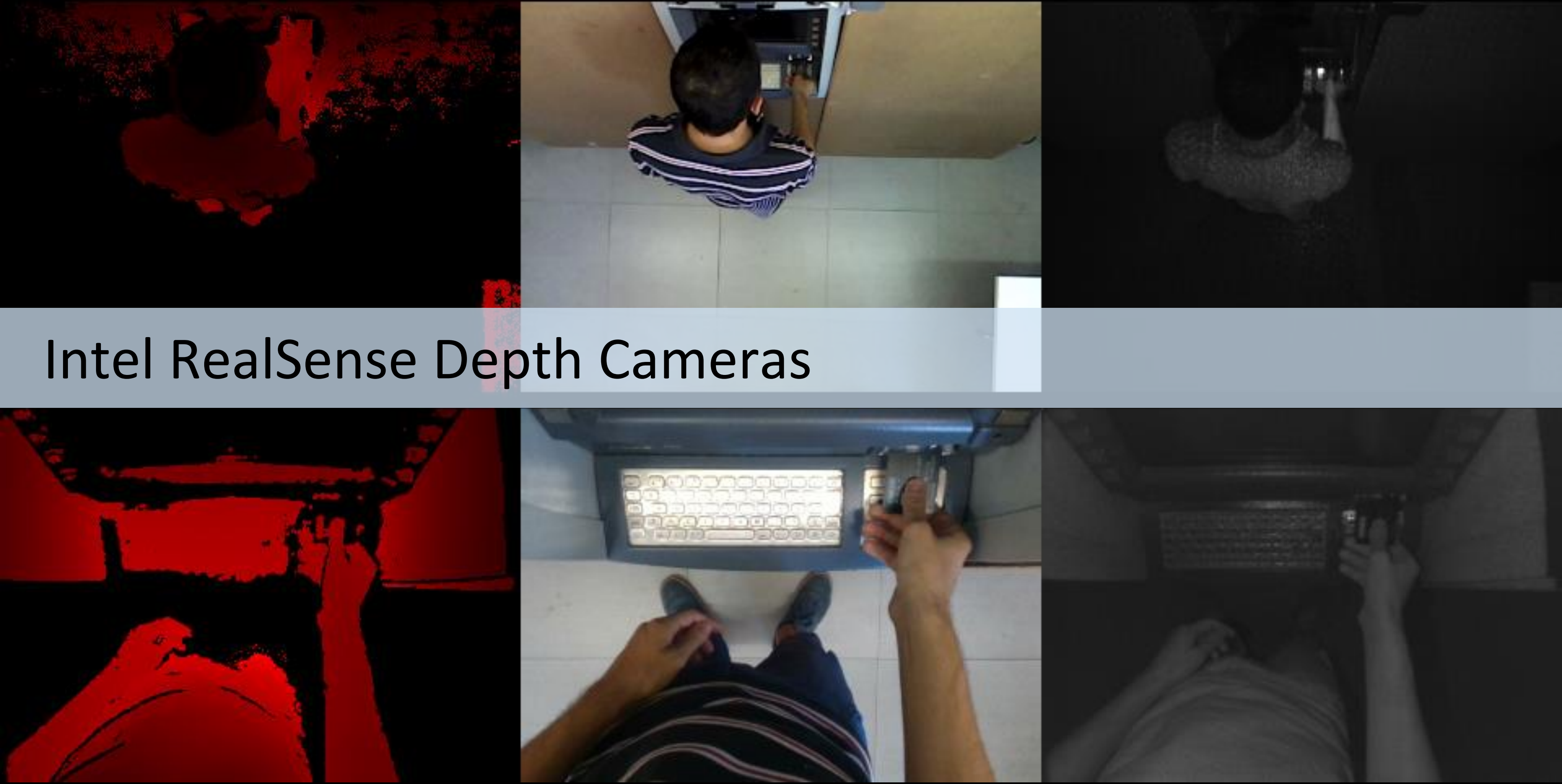
Color Sensor

IR Laser Projector

Imaging Processor



Intel RealSense Depth Cameras



Convolutional Neural Networks

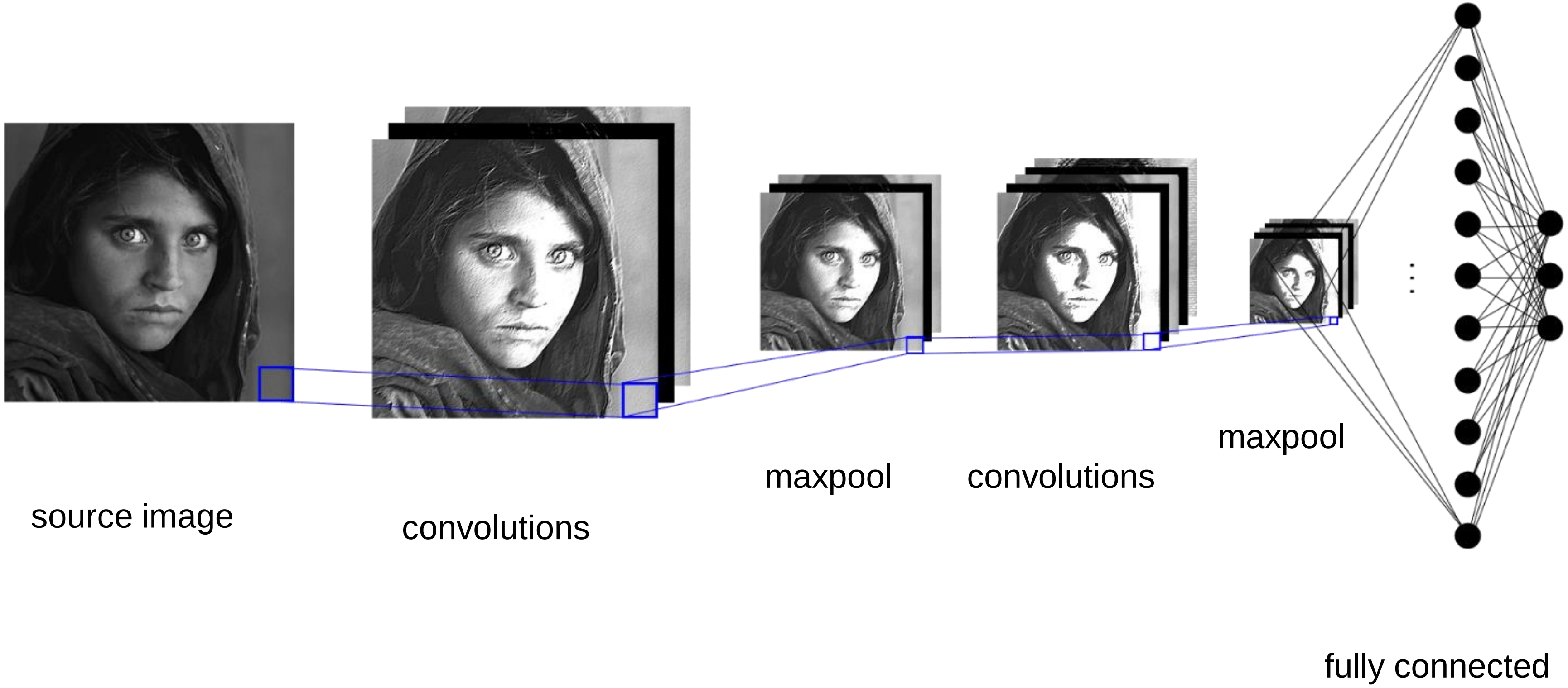
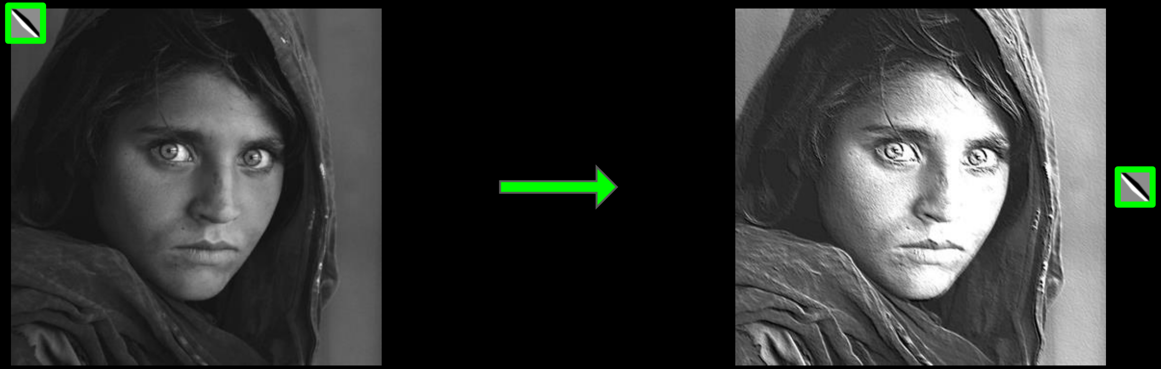


Image Convolutions



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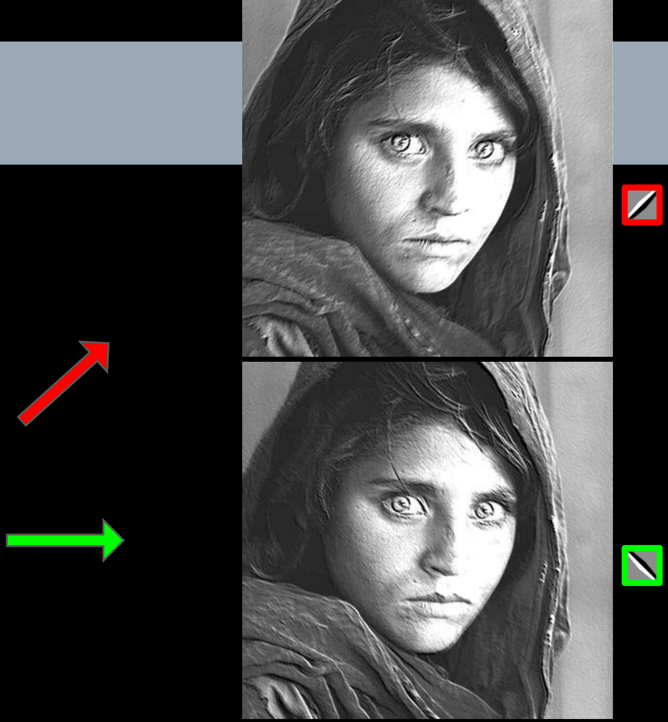

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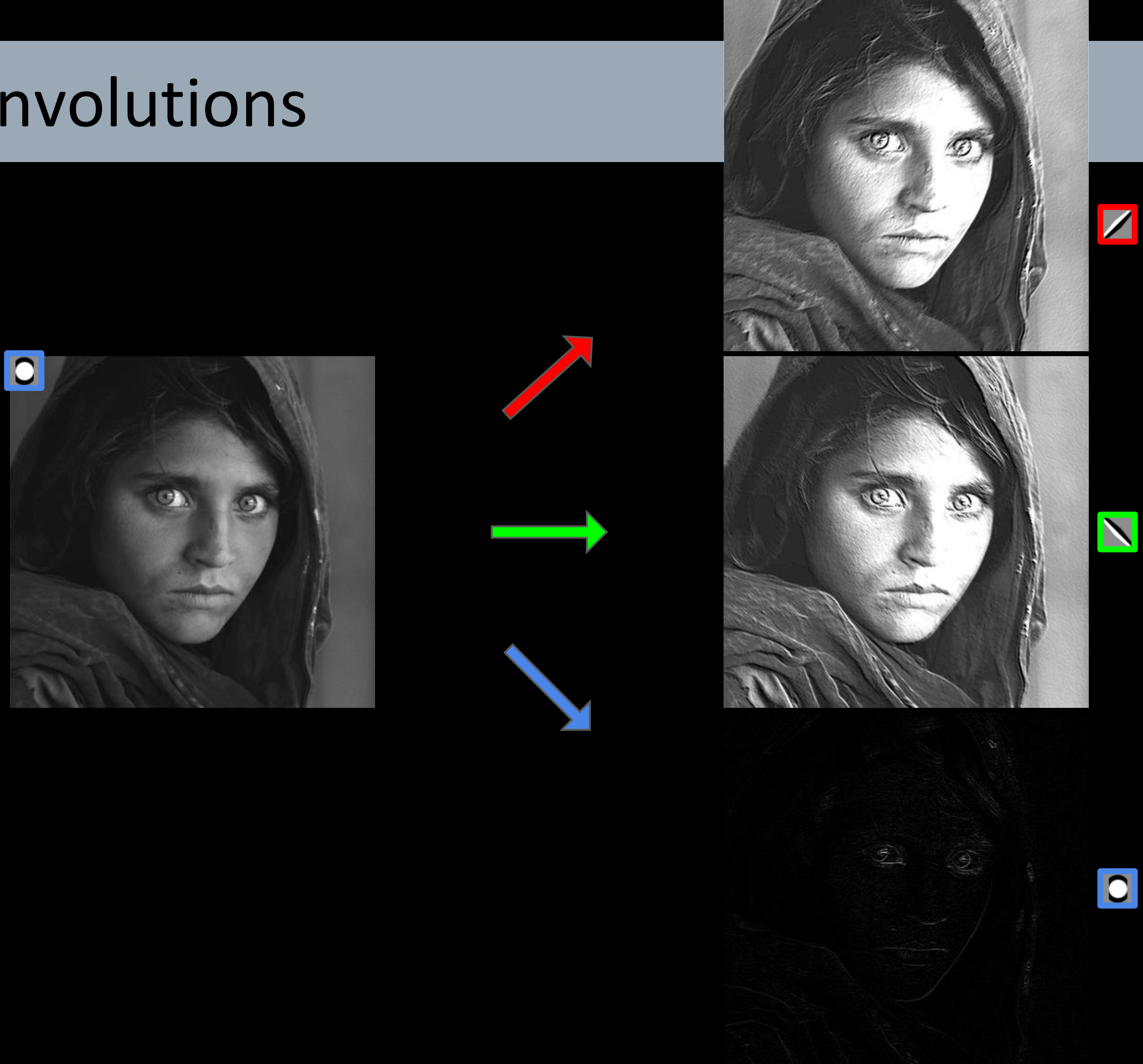
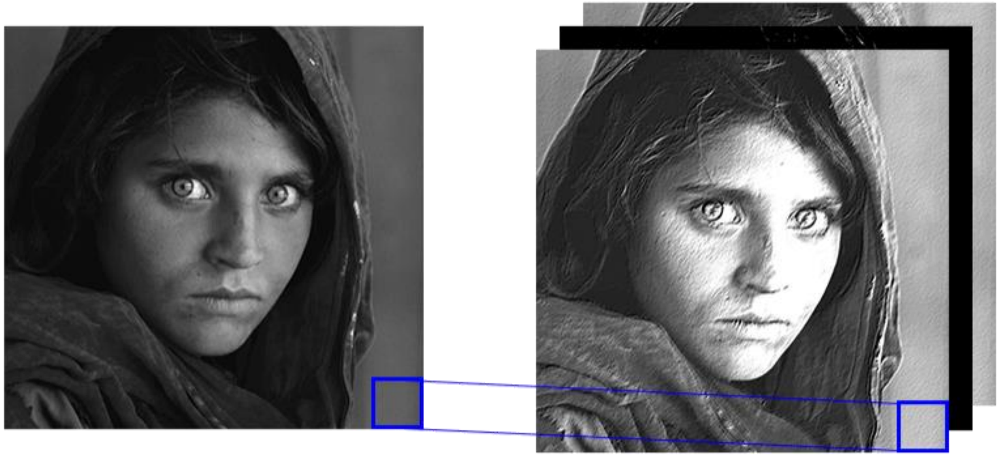
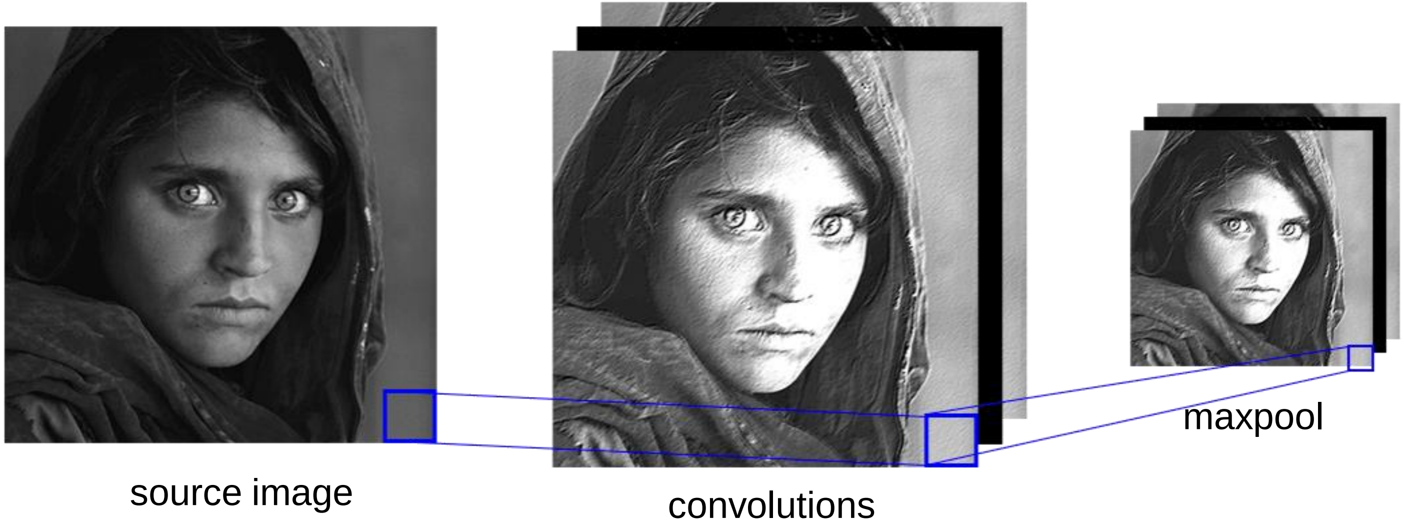


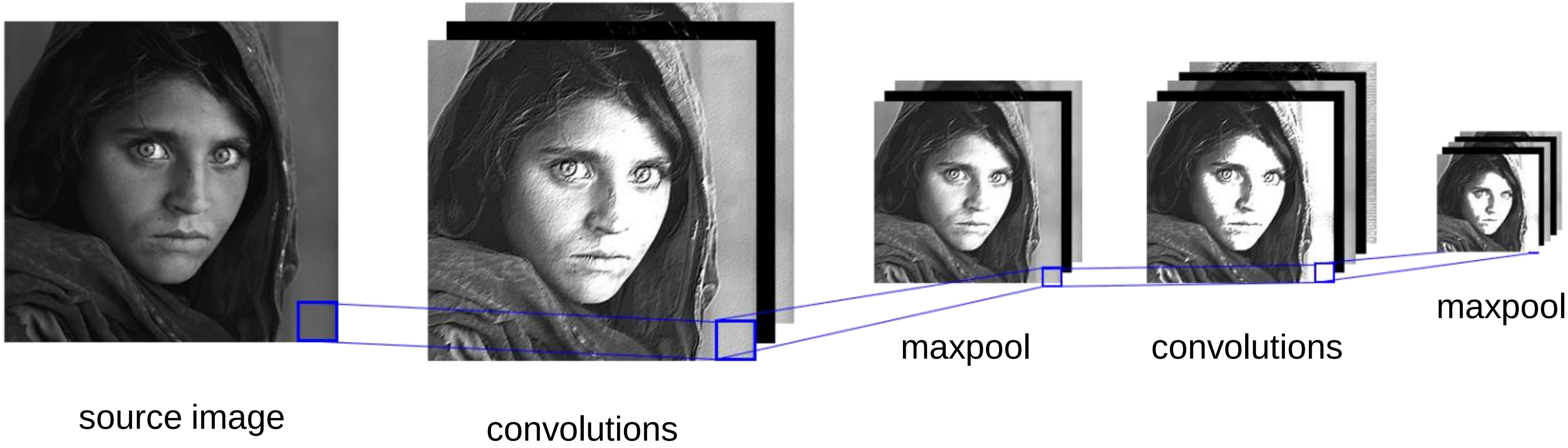
Convolutions



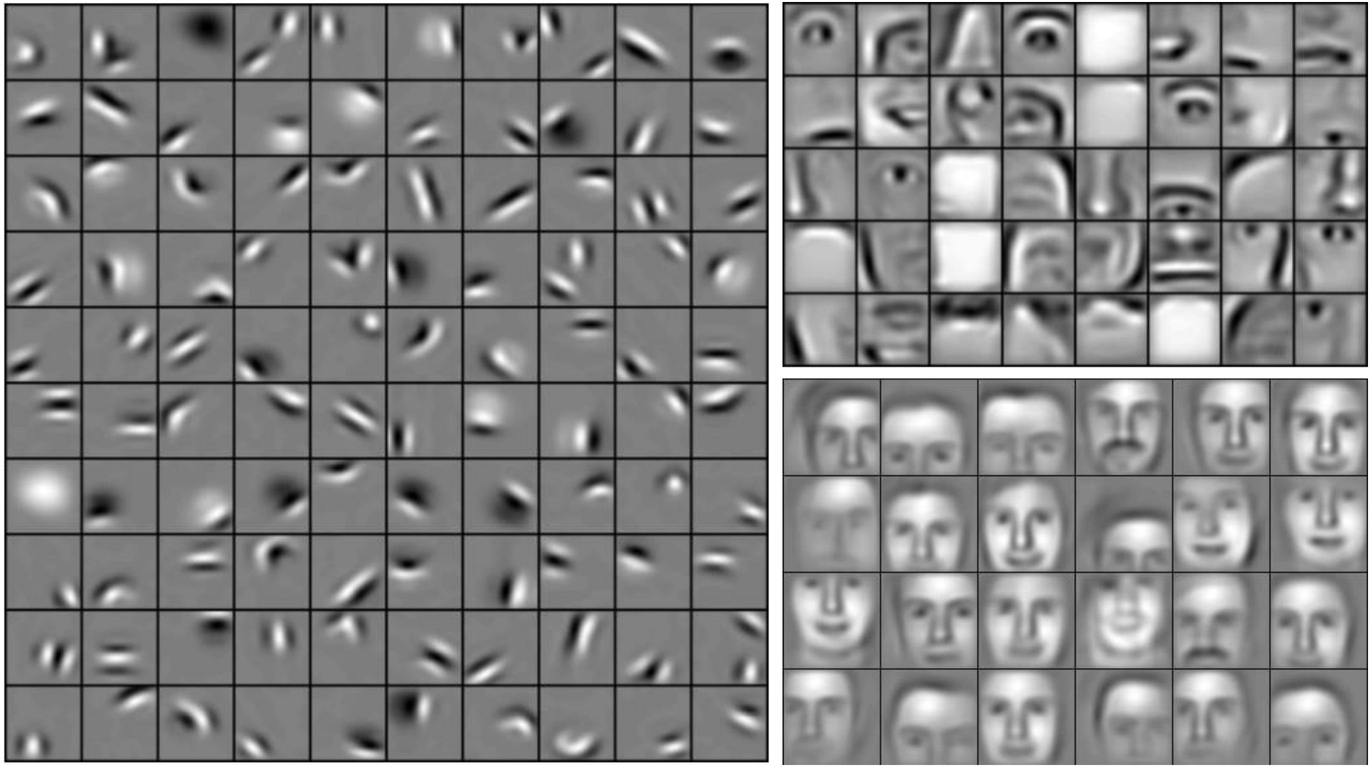
Max Pooling



More layers...



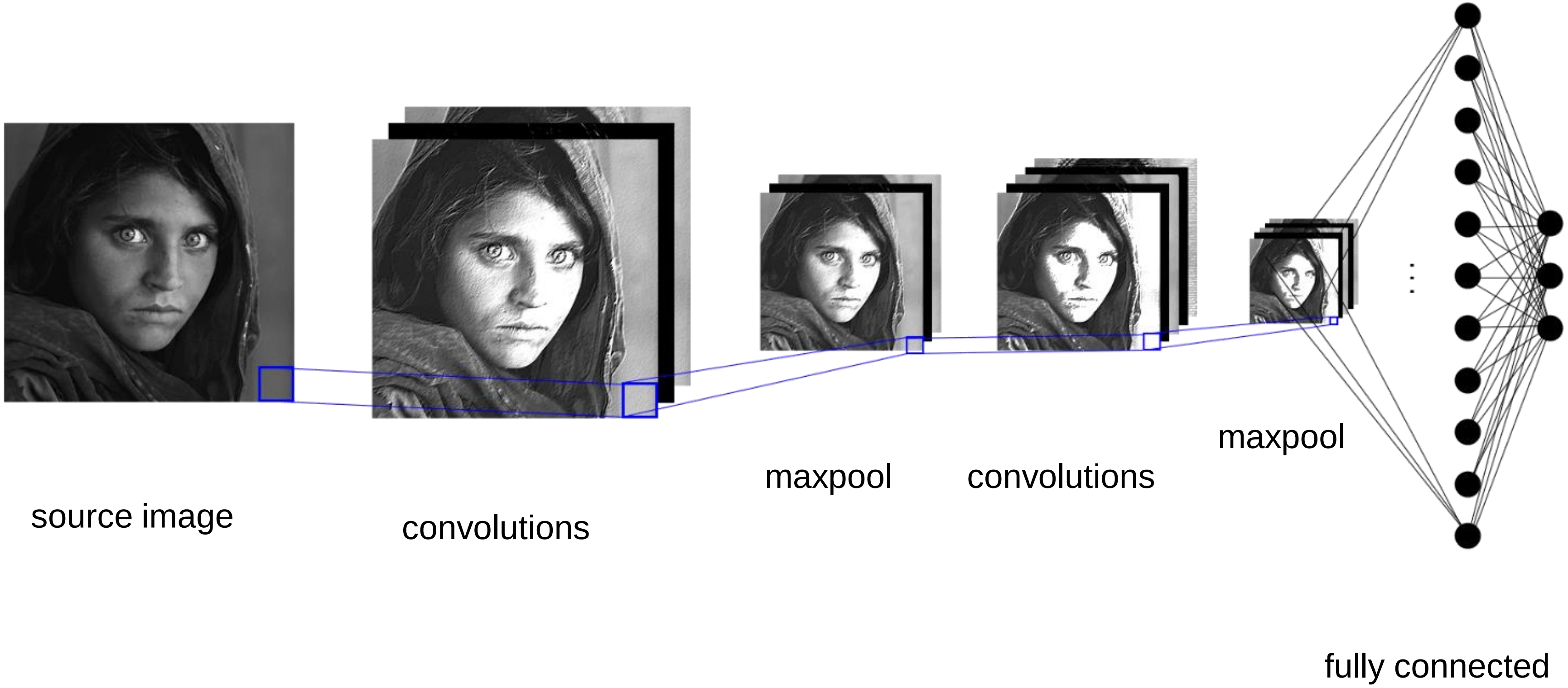
Visualizing Convolutional Layers



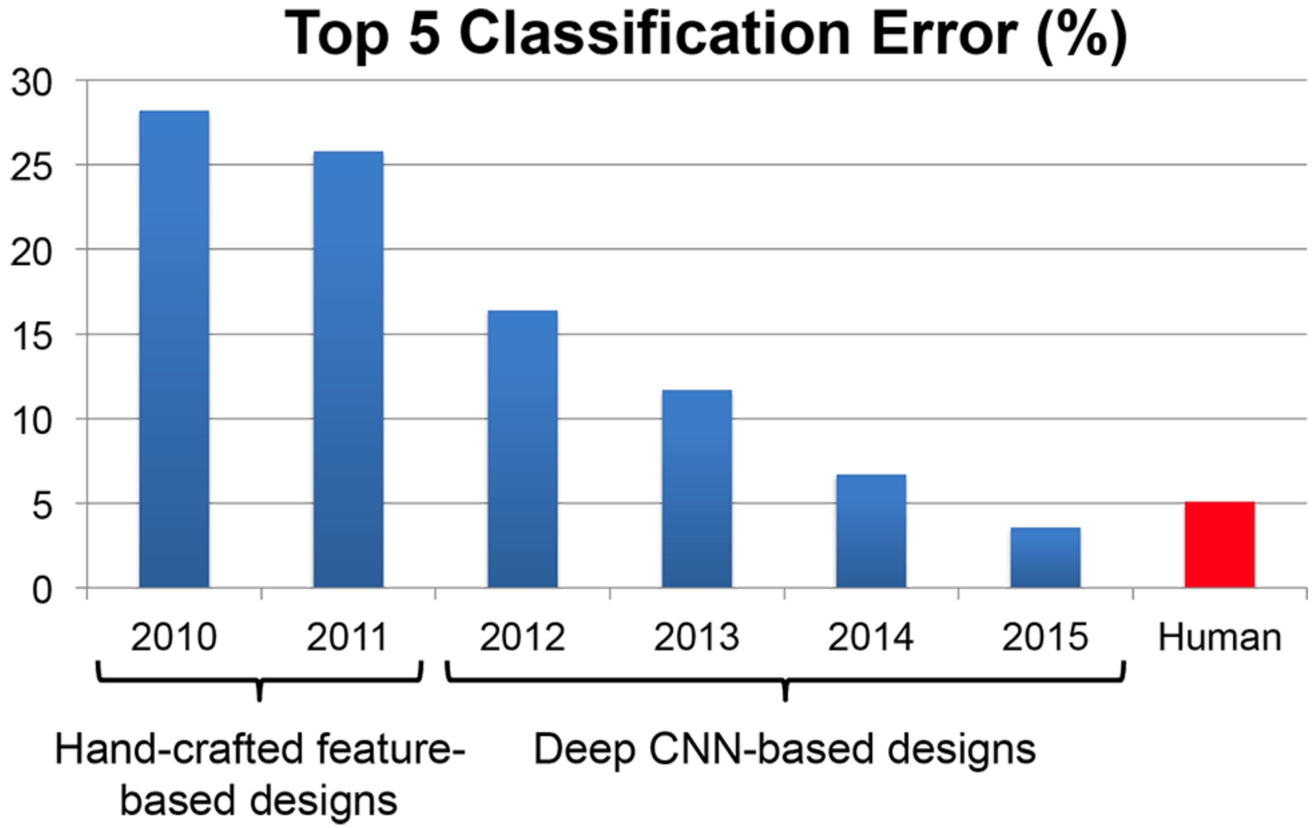
References:

- Lee, H., Grosse, R., Ranganath, R., & Ng, A. Y. (2009, June). Convolutional deep belief networks for scalable unsupervised learning of hierarchical representations. In Proceedings of the 26th annual international conference on machine learning (pp. 609-616). ACM.

Convolutional Neural Networks



CNN: ImageNet Classification Error



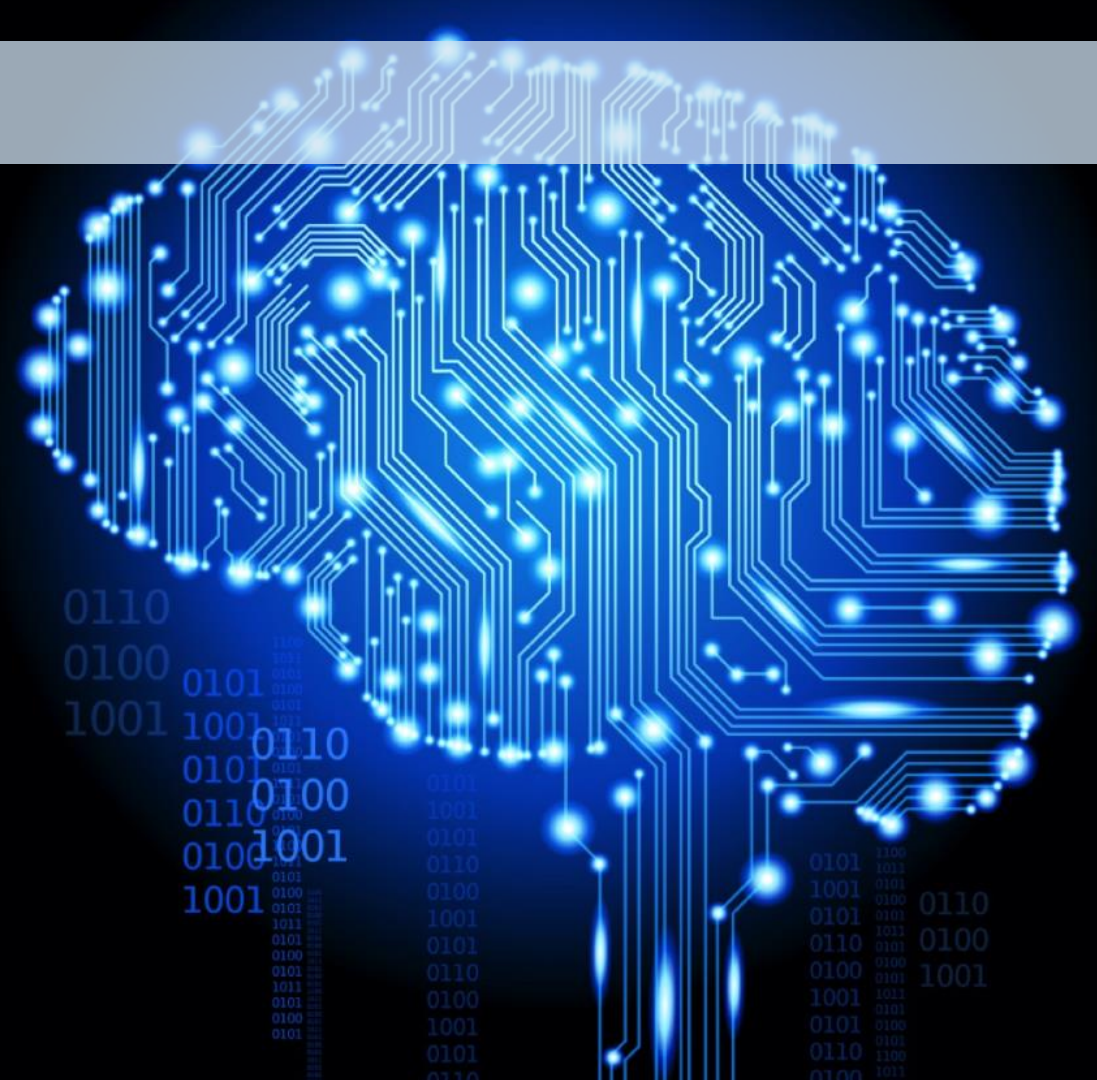
References:

- Russakovsky, Olga, et al. "Imagenet large scale visual recognition challenge." International Journal of Computer Vision 115.3 (2015): 211-252

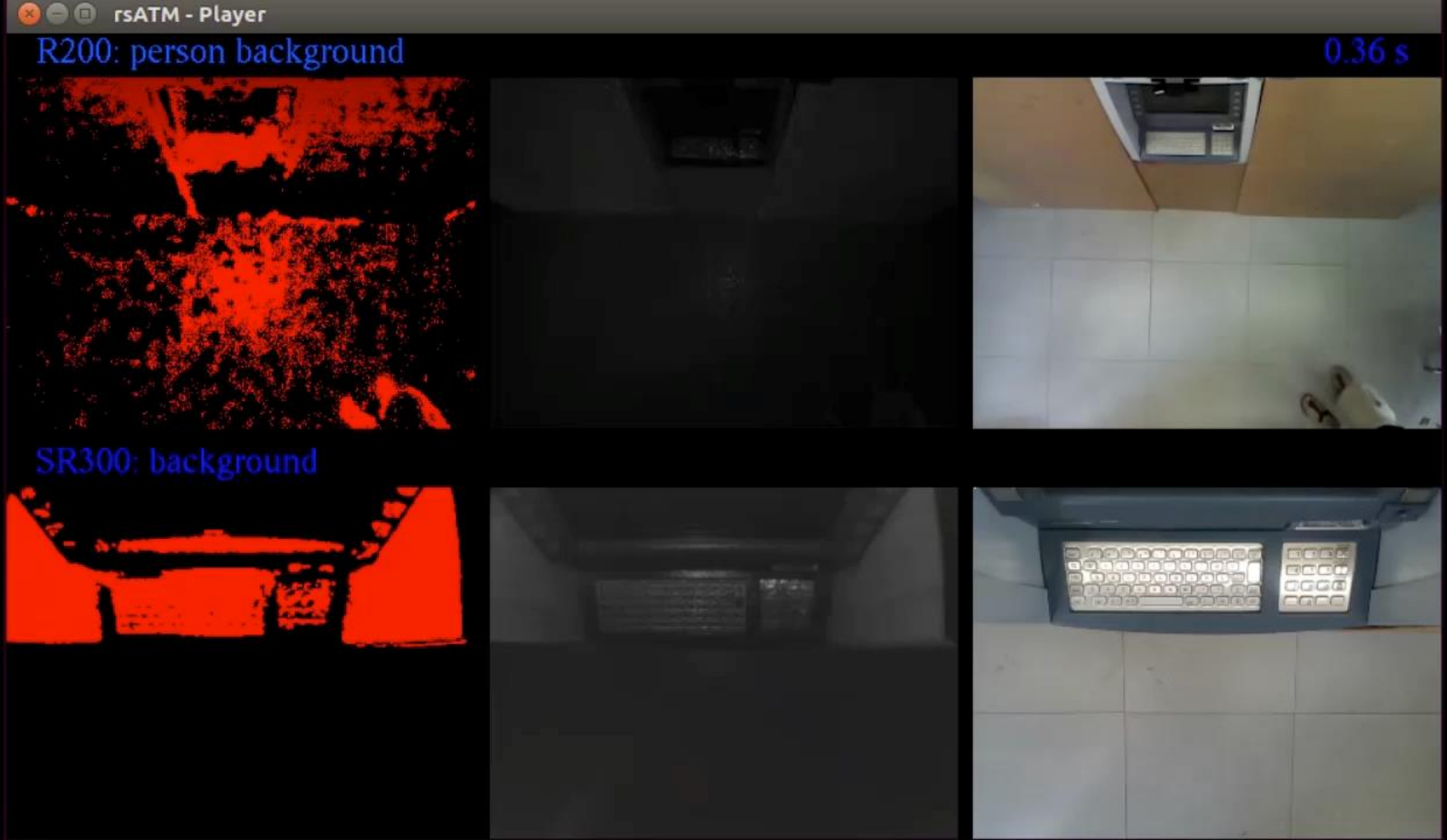
- Hardware Architectures for Deep Neural Networks, ISCA Tutorial, MIT

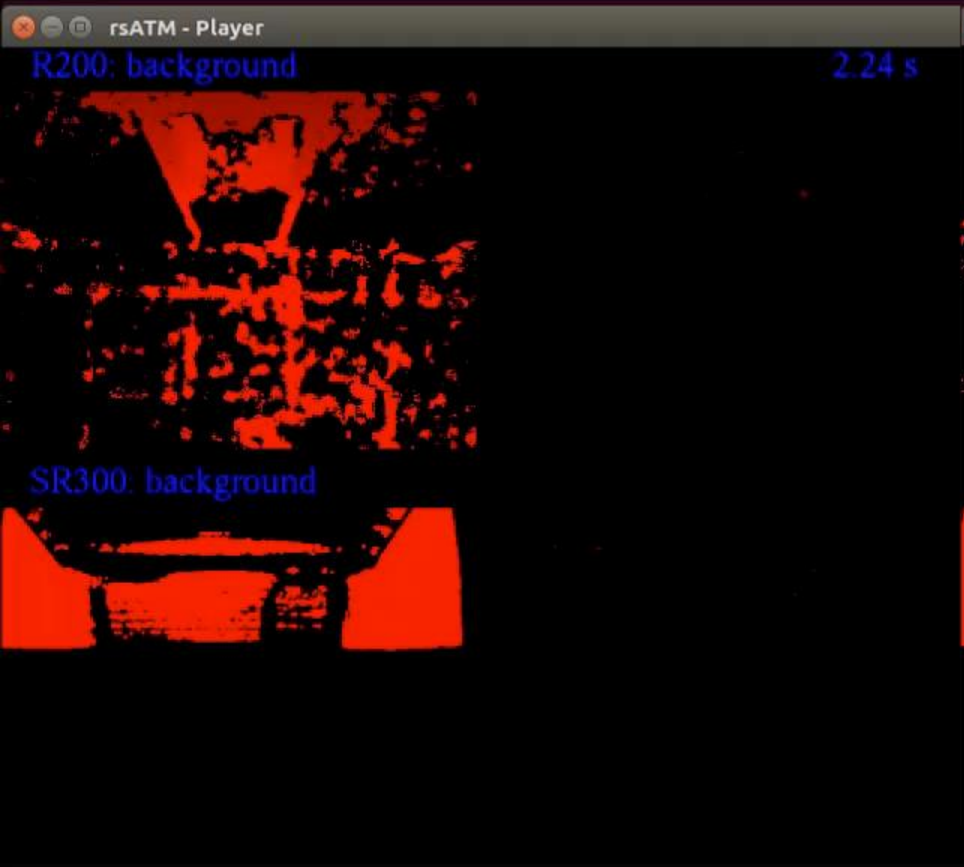
Machine Learning Process

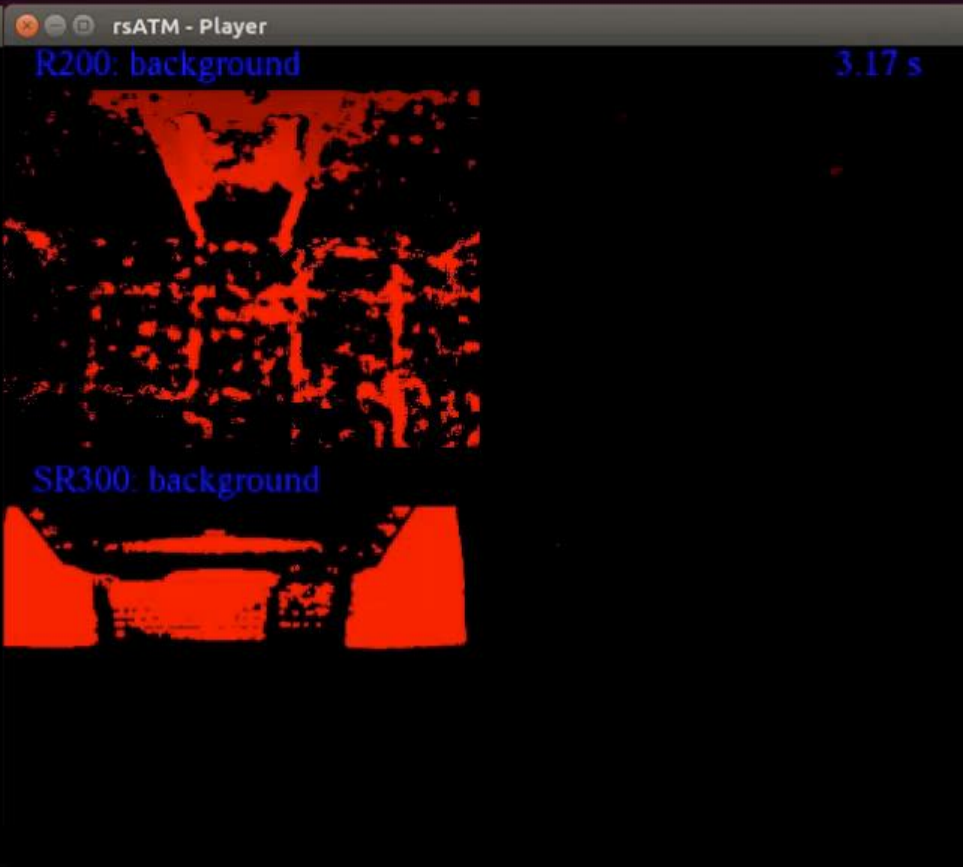
1. Get a dataset
2. Define the network architecture
3. Train and Test the model



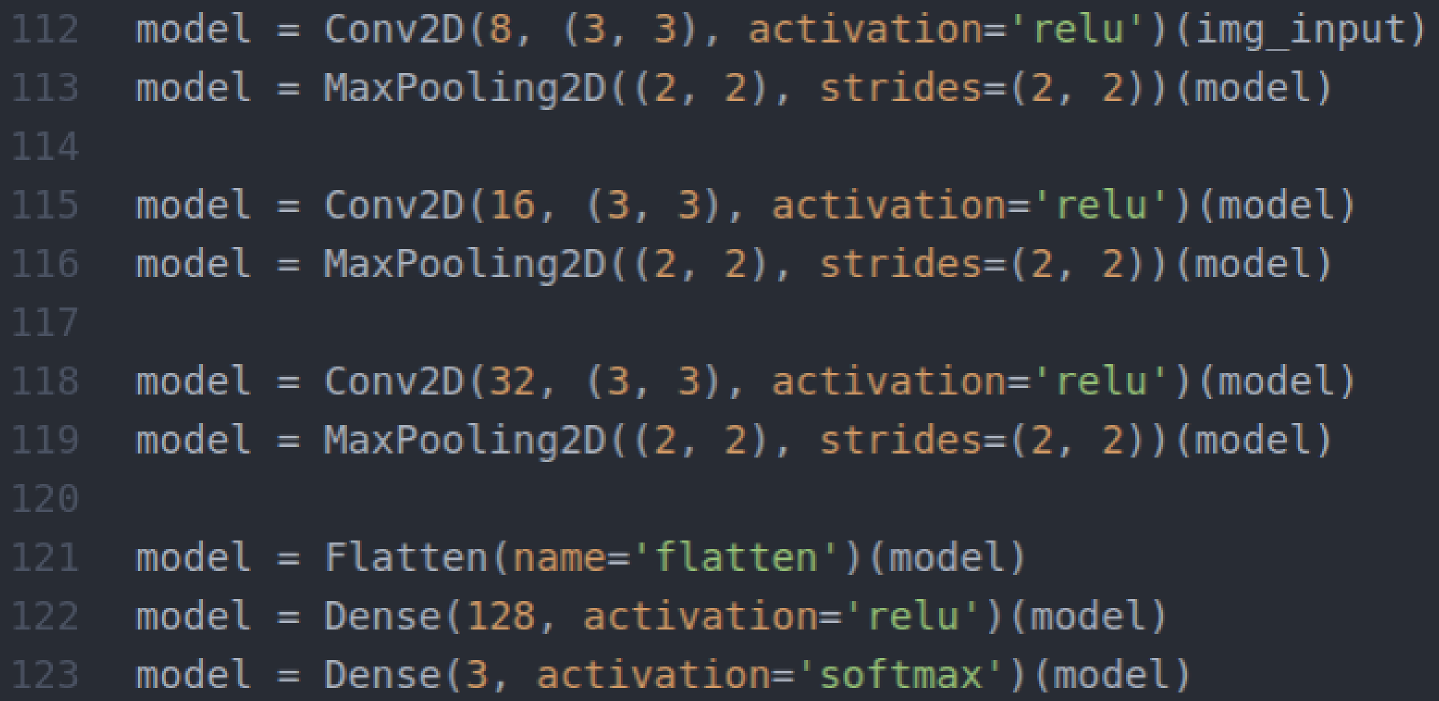
1. Get a Dataset


rsATM - Player
R200: person background
0.36 s
SR300: background


rsATM - Player
R200: background
2.24 s
SR300: background


rsATM - Player
R200: background
3.17 s
SR300: background

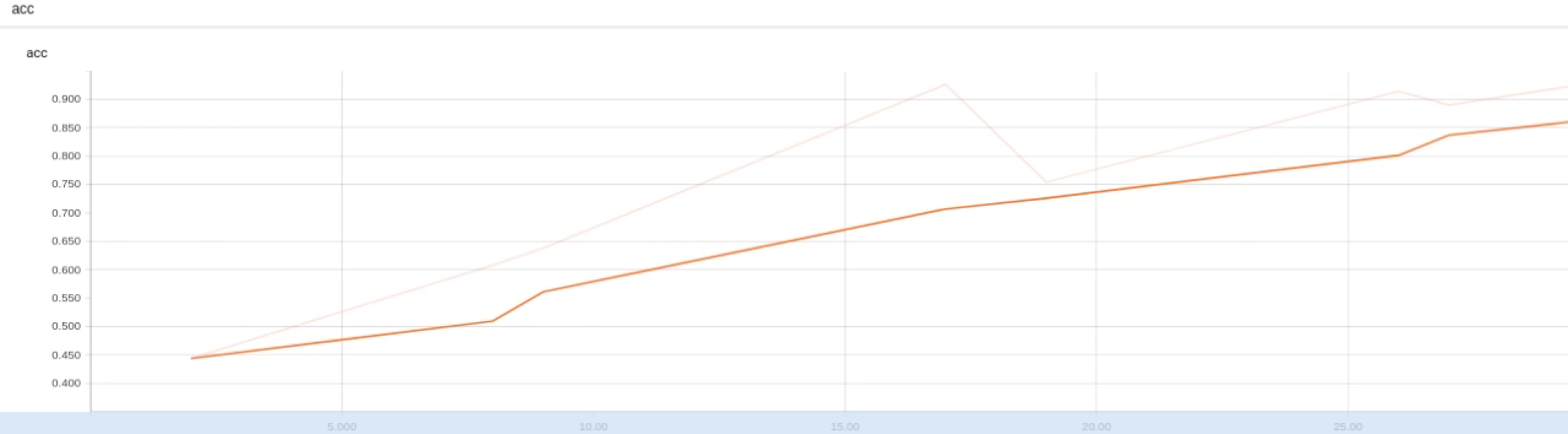
2. Define the Network Architecture

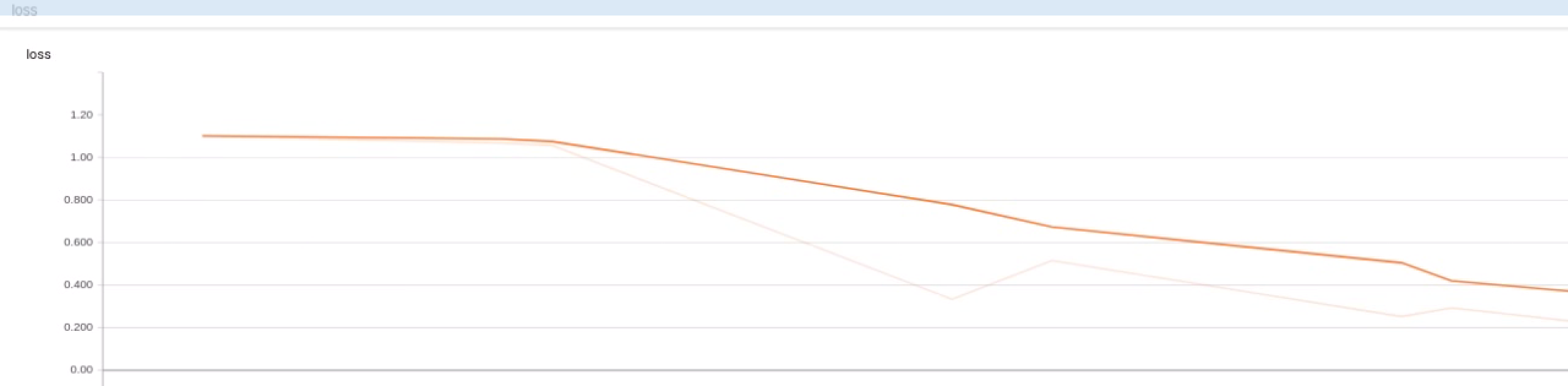


```
model = Conv2D(8, (3, 3), activation='relu')(img_input)
model = MaxPooling2D((2, 2), strides=(2, 2))(model)

model = Conv2D(16, (3, 3), activation='relu')(model)
model = MaxPooling2D((2, 2), strides=(2, 2))(model)

model = Conv2D(32, (3, 3), activation='relu')(model)
model = MaxPooling2D((2, 2), strides=(2, 2))(model)

model = Flatten(name='flatten')(model)
model = Dense(128, activation='relu')(model)
model = Dense(3, activation='softmax')(model)
```

BSC
Barcelona
Supercomputing
Center

3. Train and Test the Model





Results

Single Frame analysis:

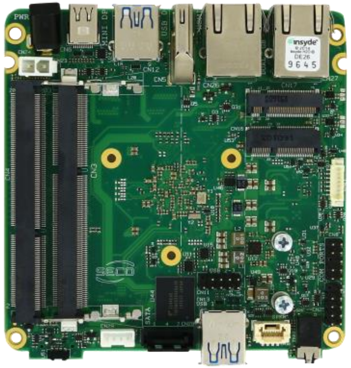
Test Dataset Classification Accuracy	
Background	98.19%
Withdrawal	97.05%
Attack	98.32%
Average	97.85%

- mean: 0.5 sec

Model Running on SECO SBC–A80 with Intel Braswell CPU

Five Frames analysis:

- No false alarms
- No undetected attacks
- Attack detection time:
  - mean: 2.4 sec
  - max: 3.3 sec



Predicting Security

Thank You