

# Image Processing and Machine learning With applications in governance.

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# Objectives

1. Brief : Artificial Intelligence, Machine learning and Deep learning
2. Image processing and deep learning (What is computer vision?)
3. Problem Statements in governance and proposed approaches.



# Artificial Intelligence

- The field that addresses complex problem solving. The universal set in Mathematics term.

## Machine Learning

- A subset of Artificial Intelligence that includes usage and discovery of data driven algorithms for computers to learn from past data.

## Deep Learning

- A subset of Machine learning, focused on Neural Networks (NN) able to learn the pattern in the system and to be able to classify and predict the outcome

# Human Stampede

- Kumbh Mela Stampede -February,2013 - 42 killed, 45 injured
- RajahMudry Stampede: The stampede on the banks of the Godavari River in Rajahmundry killed 27 pilgrims. The incident occurred when people tried to rush into the Puskhar ghat to take a holy dip. July 2015.
- Datia stampede, October 2013- Toll 115
- Junagadh stampede, February 2012 -Toll 6
- Kanchipuram temple stampede,July 18, 2019- Toll 4



# What can Computer vision do?

## *Flow Regulation & Monitoring*

- People tracking
- Crowd Density estimation
- Event Detection
- Validation and Simulation
- Public space design
- Intelligent environment



Ground truth=634, Proposed=640



- Regulating the rate at which the crowd builds up can be achieved through controlling crowd flow at the entry and exit points.
- Computer Vision has an ability to detect the number of people going in a particular direction.
- Event Detection : Automatic detection of anomalies and alert the authorities.
- Intelligent Environment : It can be used to decide how to split a crowd in a congregation based on their behaviours. For example, automatic monitoring of crowd exiting stadium and dense area could help detect the strangle points



Ground truth=634, Proposed=640



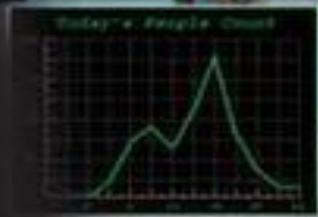
Slip and Fall

Graffiti Detected



Abandoned Object

Facial Recognition  
in a crowd



Counting

Loitering

# XLOONG AR glasses

Originally designed for sports purposes, China now is planning to make a database of its 1.3 billion people to recognise their faces from the crowd and make use of these glasses as a crowd patrolling tool.

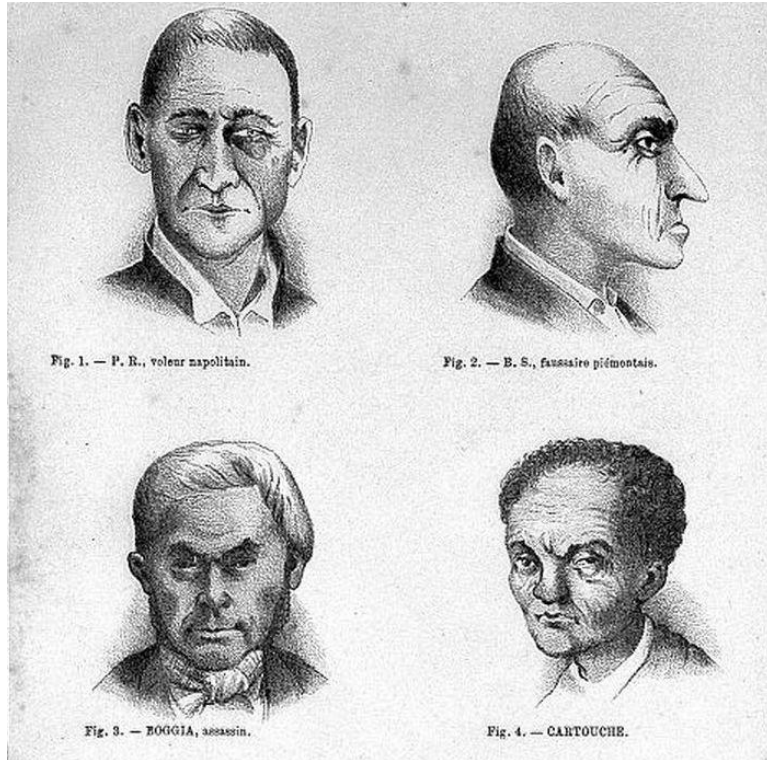




# Criminal activity identification- Vicomtech Project(Spain)



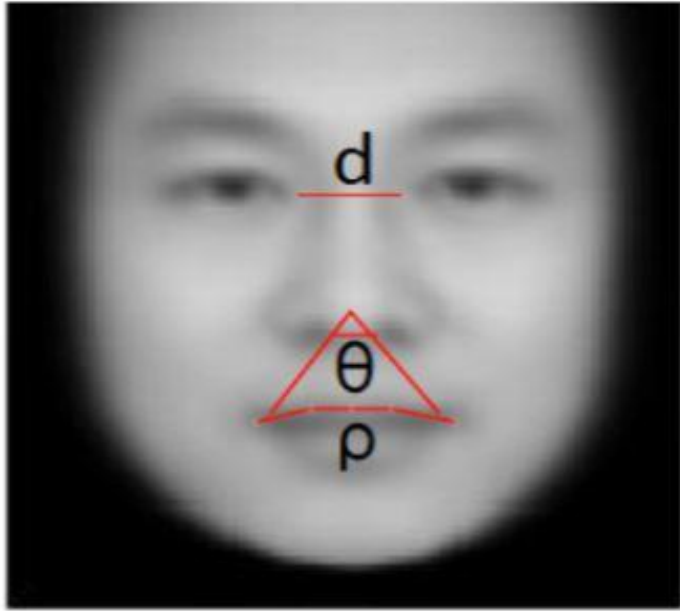
# Cesar Lambroso's Theory On Criminals



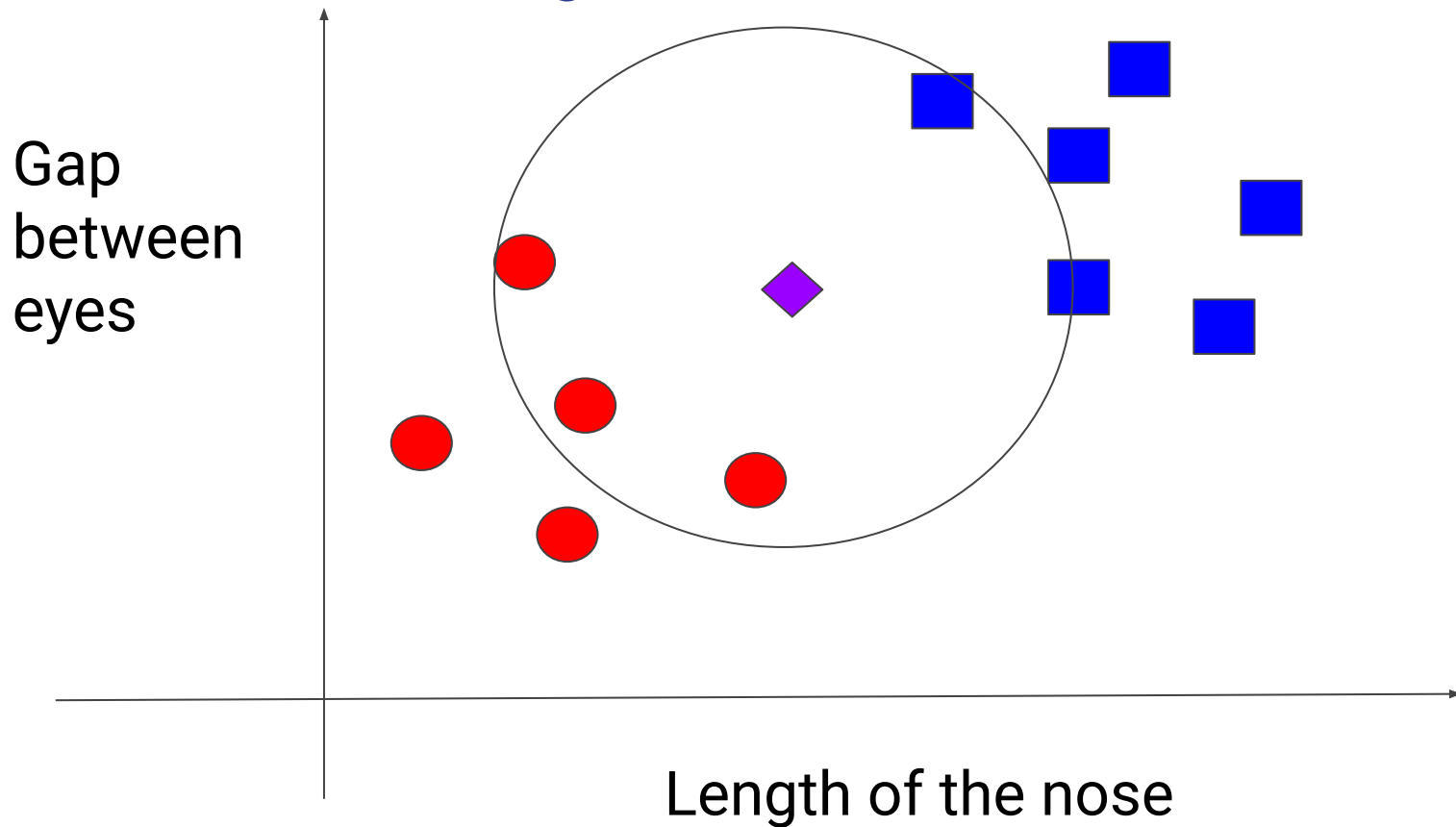
*“Criminals are born, And  
not made into them”*

*Biased towards people's  
appearances?*

# Automated inference of criminality based on face images - Xiaolin Wu and Xi Zhang, 2016



# K- Nearest Neighbor Method

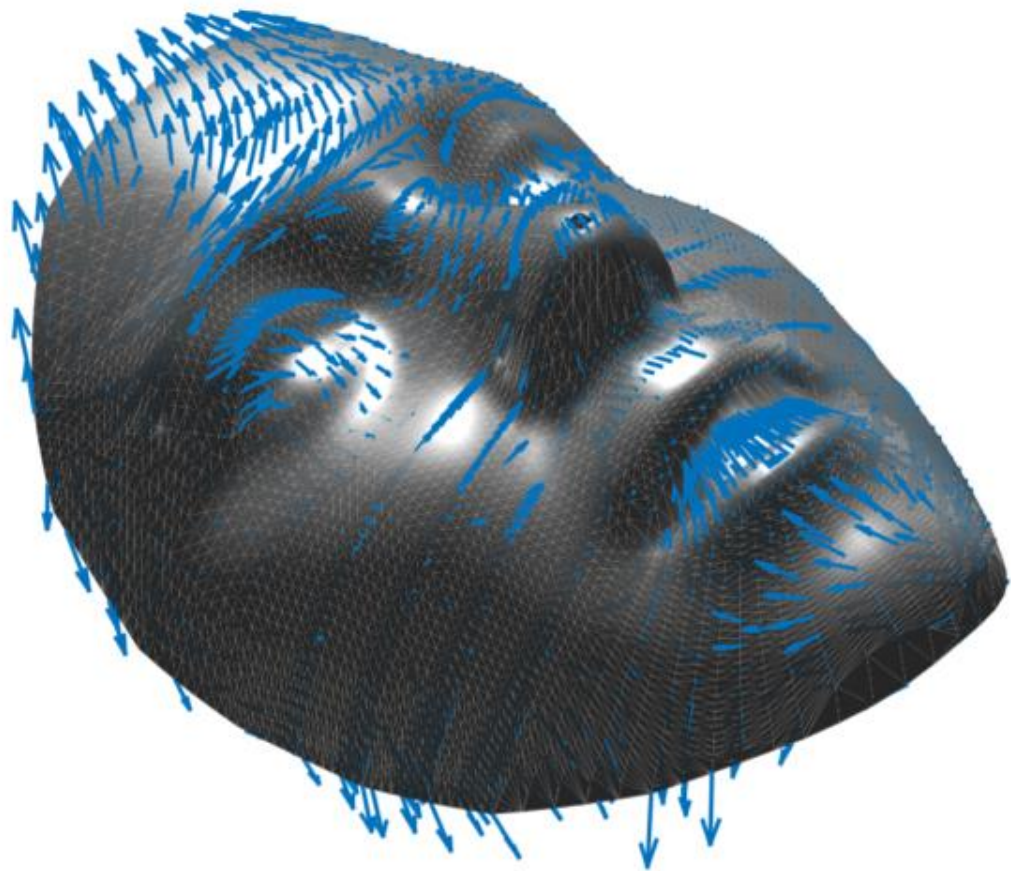
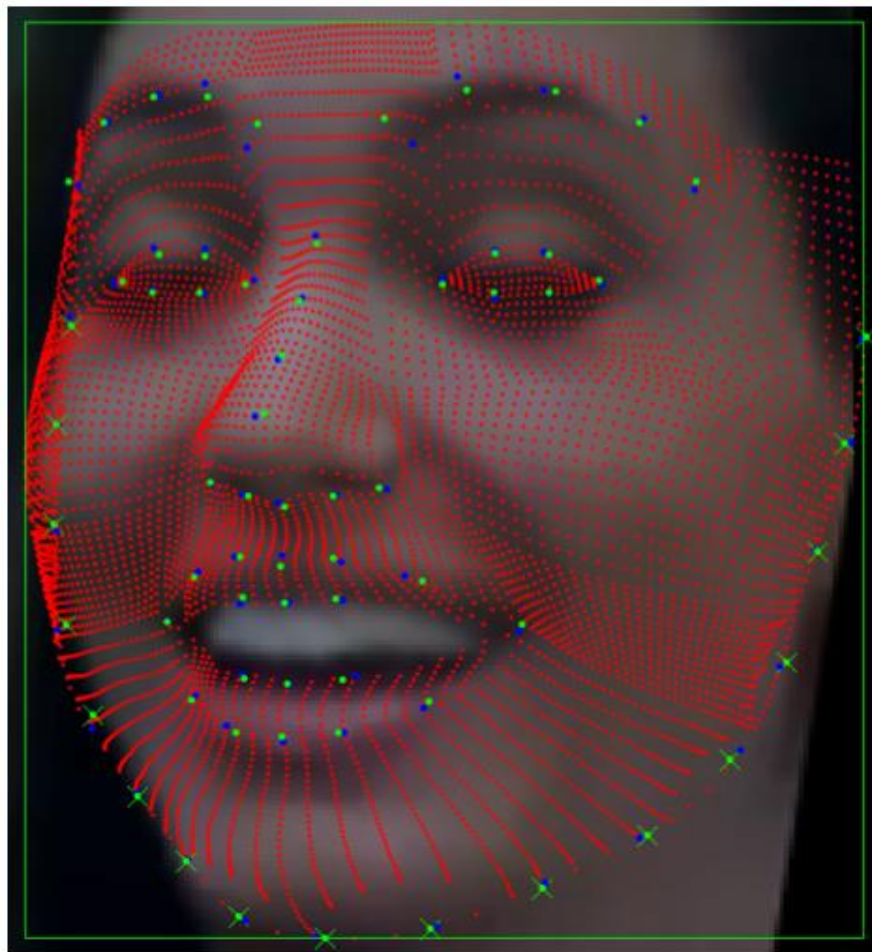


# Face Detection and 3-D visualization

- Can be used to detect criminals from the CCTV camera footage.( Limitations)
- Simple Algorithm detects the nose and outer edge of the face.Pulling the rest of the features out from the image in a contour.
- The machine can be trained with the different modeling of the same face and predicting the probability of the person in the image being the criminal.







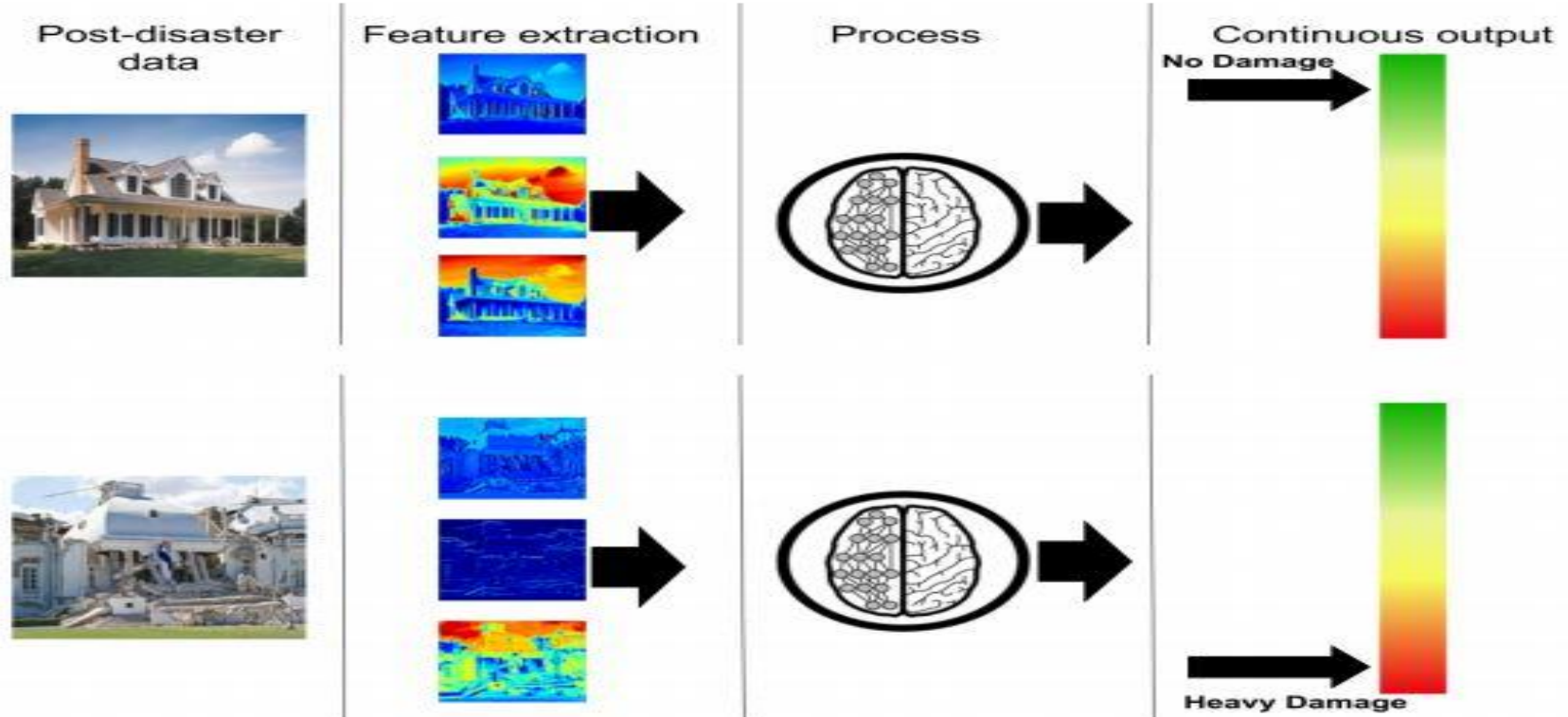
# Civil Structures inspection and monitoring

Traditional inspection can be time-consuming, laborious, expensive, and/or dangerous

Computer Vision techniques have been recognized in the civil Engineering field as a key component of improved inspection and monitoring.



# Research from Simon Fraser University, Canada







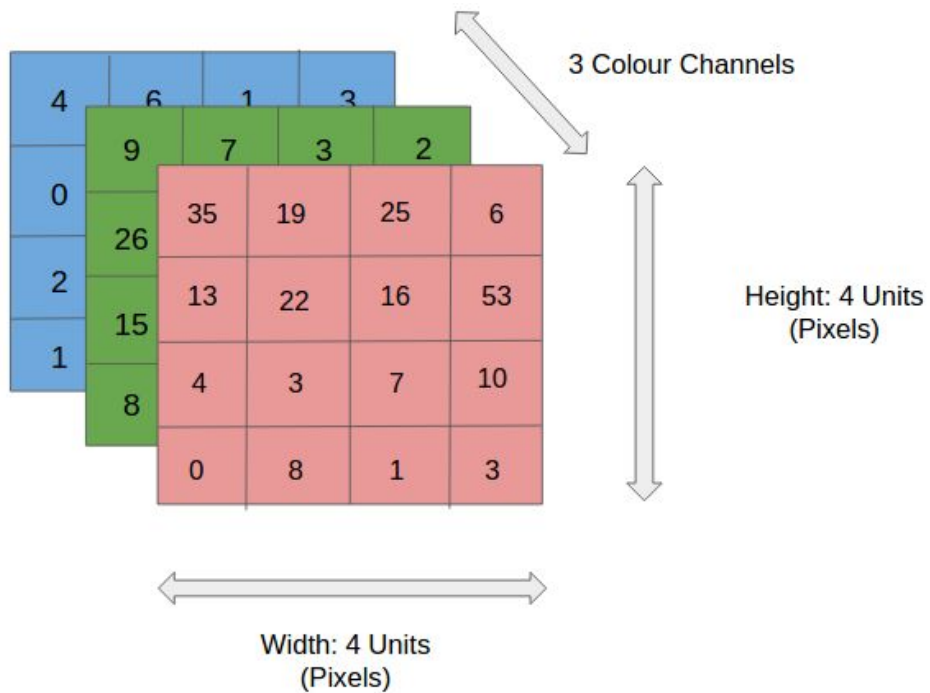

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255 254 253 .....3 2 1 0

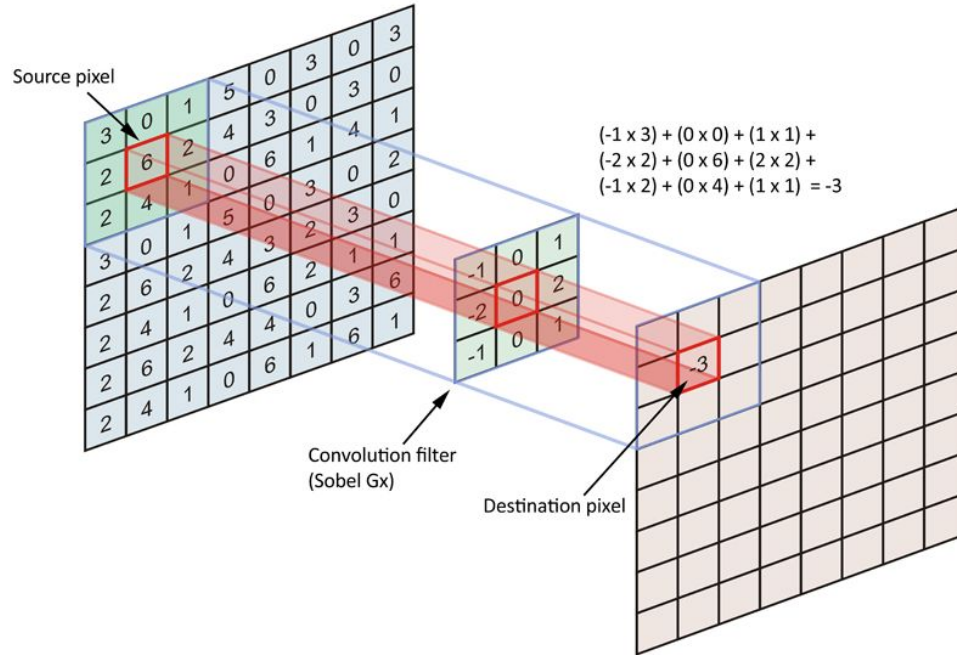


$(R, G, B) = (148, 0, 211)$





# Image Filtering --- Extracting features



1 <sub>x1</sub>	1 <sub>x0</sub>	1 <sub>x1</sub>	0	0
0 <sub>x0</sub>	1 <sub>x1</sub>	1 <sub>x0</sub>	1	0
0 <sub>x1</sub>	0 <sub>x0</sub>	1 <sub>x1</sub>	1	1
0	0	1	1	0
0	1	1	0	0

Image

4		

Convolved Feature



0.0625	0.125	0.0625
0.125	0.25	0.125
0.0625	0.125	0.0625



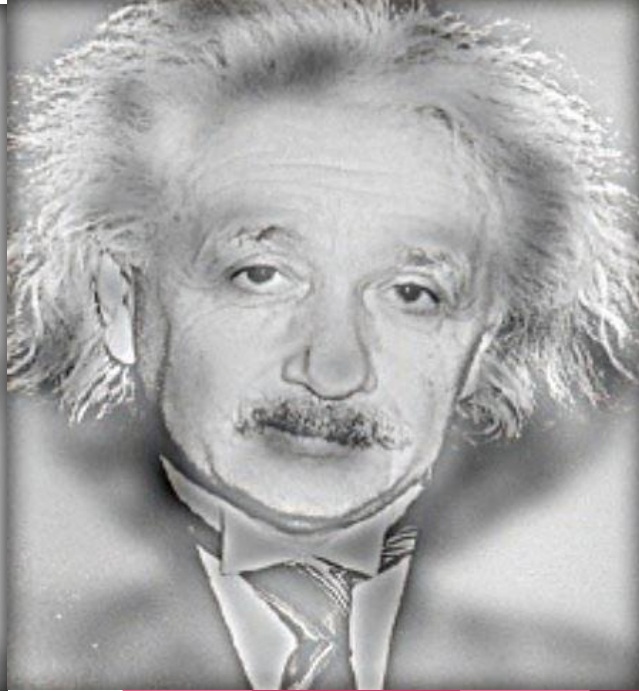
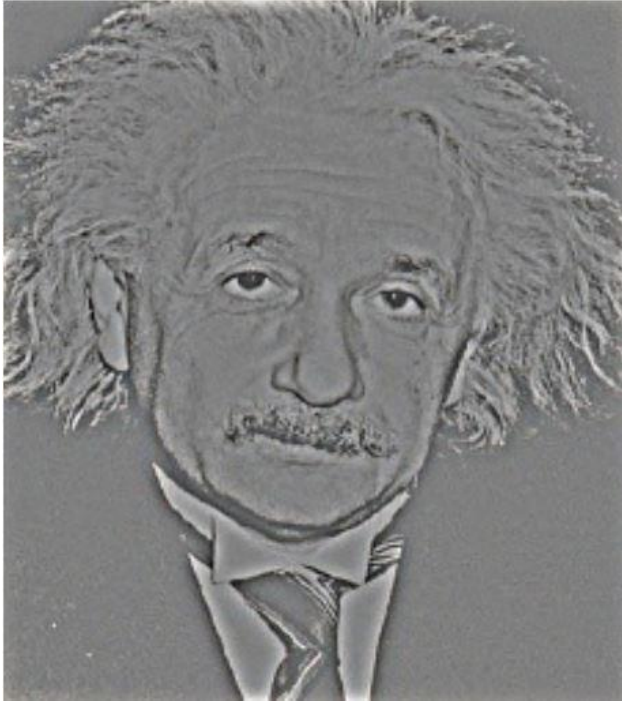
-1	-2	-1
0	0	0
1	2	1



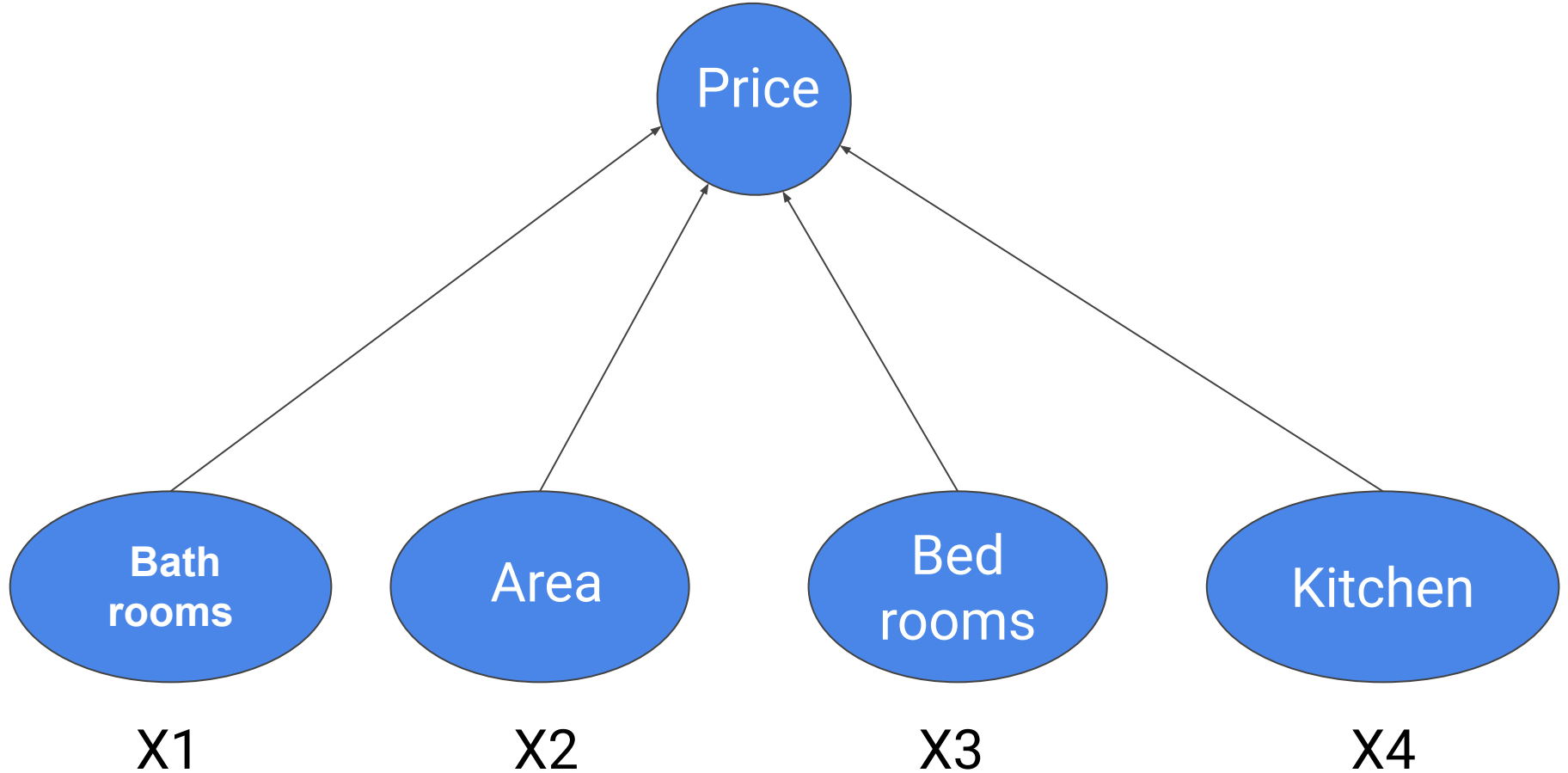
1	0	-1
2	0	-2
1	0	-1



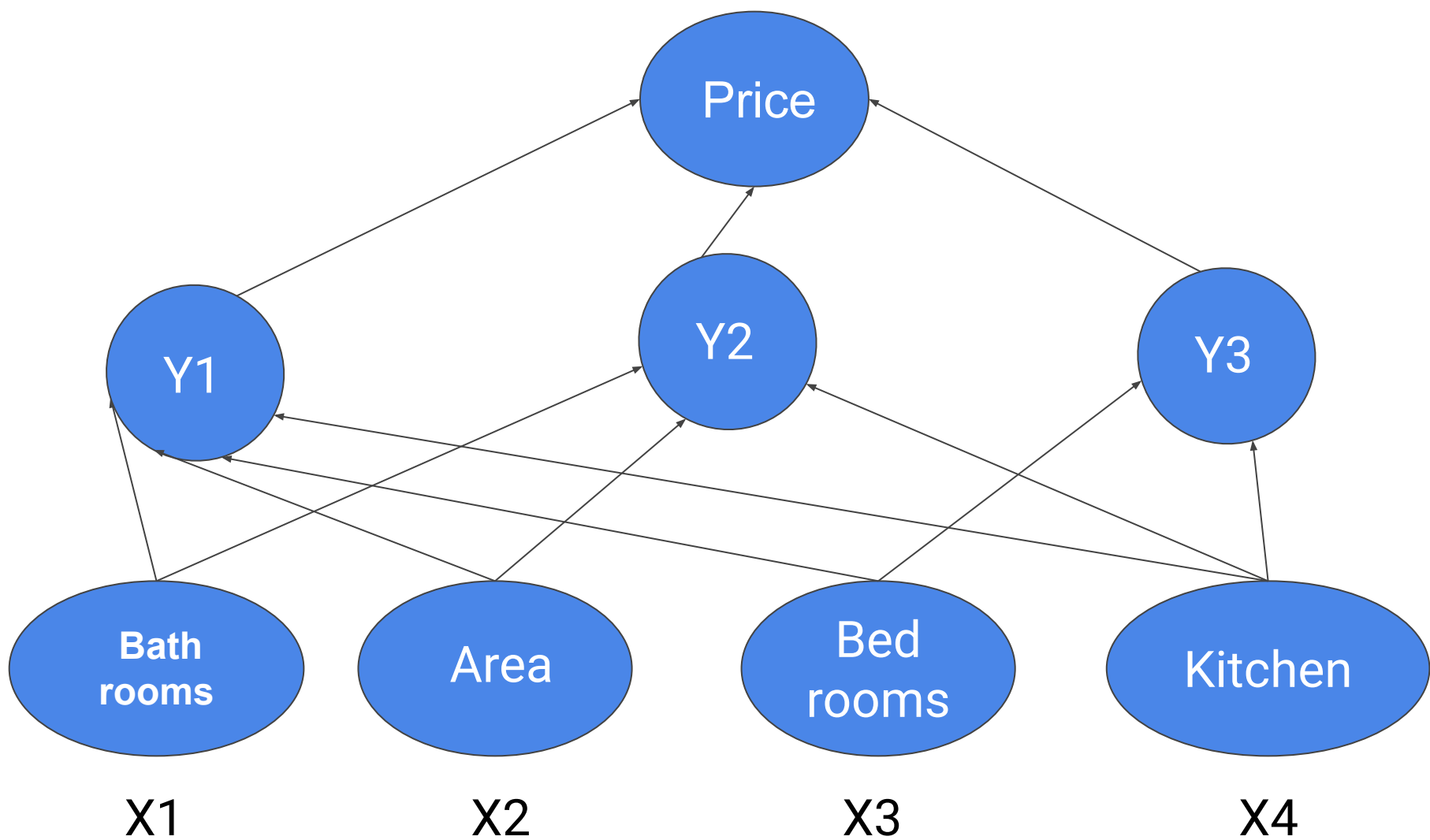
# High Pass Filter vs Low pass filter



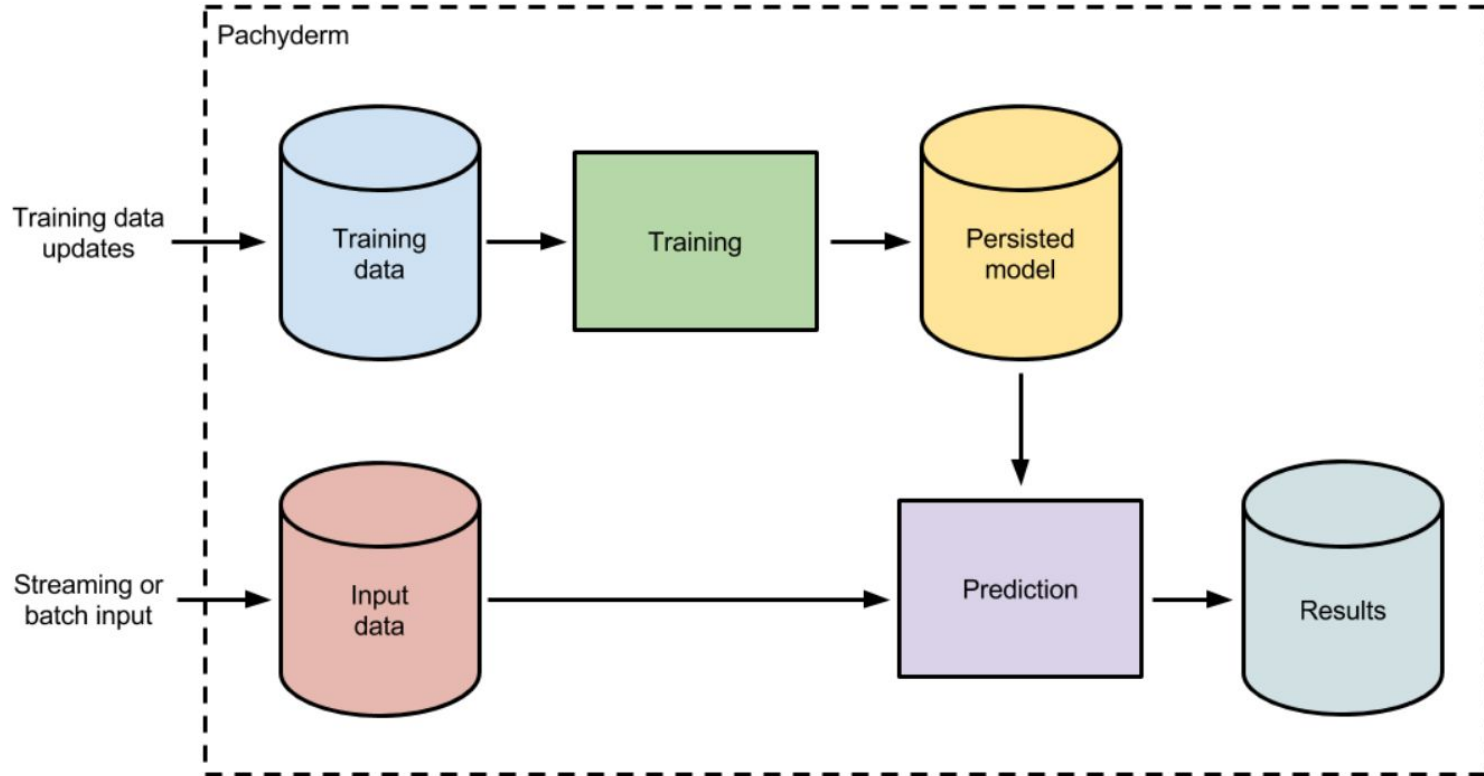
$$C1 X1 + C2 X2 + C3 X3 + C4 X4$$



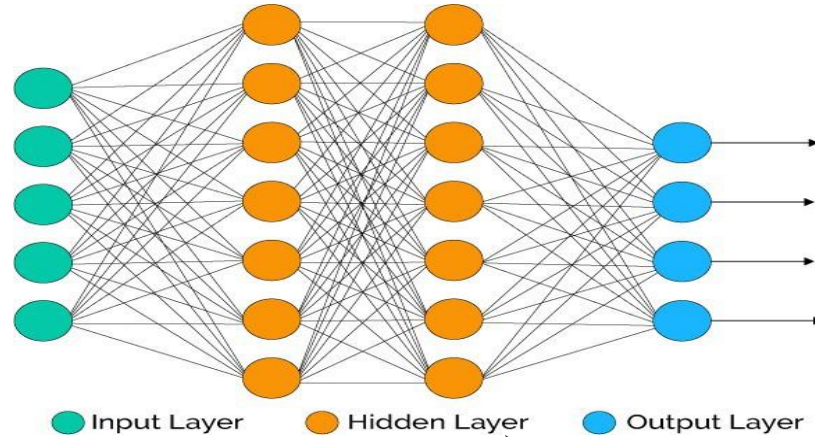




# Training of a Model

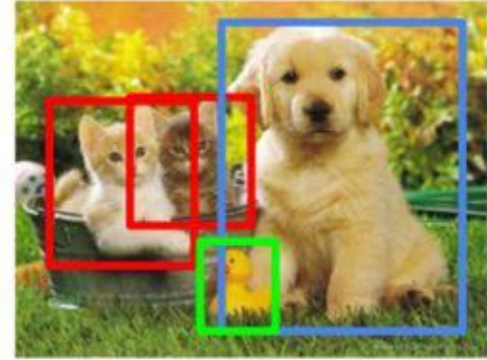


# Convolutional Neural Network



-1	-2	-1
0	0	0
1	2	1

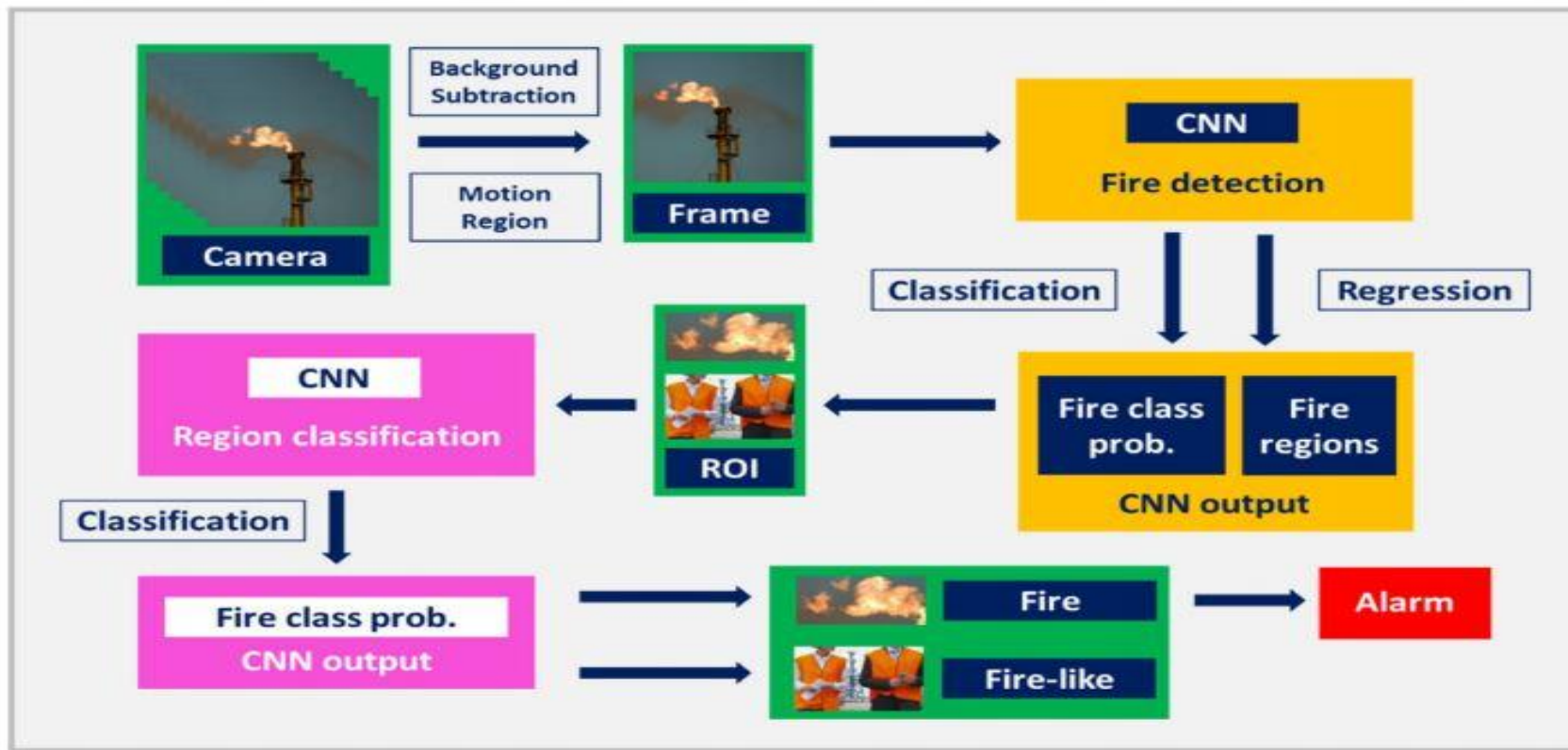
1	0	-1
2	0	-2
1	0	-1



# Traffic regulation



# Fire Hazards detection







(a) Positive images with fire.



(a) Positive images and fire regions.

# Aerial surveying of cropping fields

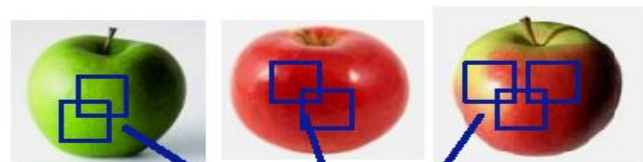


# Food quality Inspection

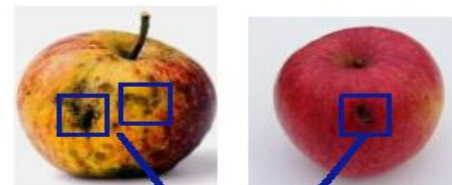
- The Model can be Trained to detect low quality fruits, vegetables and other bakery products based on their visual properties.
- The computational algorithms can be applied to classify between a good product and a bad product.



## Learning of color classifier



Positive samples: good skin color sampling regions

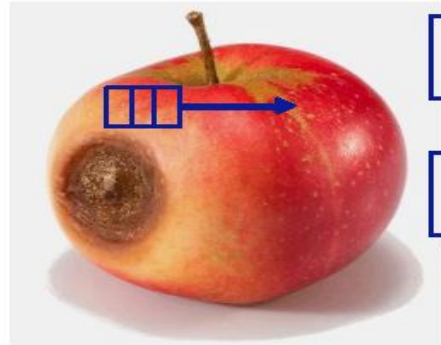


Negative samples: bad skin color sampling regions

Color histograms extraction for both positive and negative sampling regions

SVM training to get **color classifier**

## Detection of skin defects

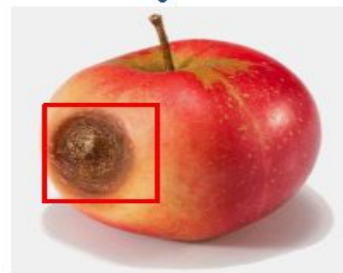


Slides a window to get local image patch

Extract the color histogram for each window image

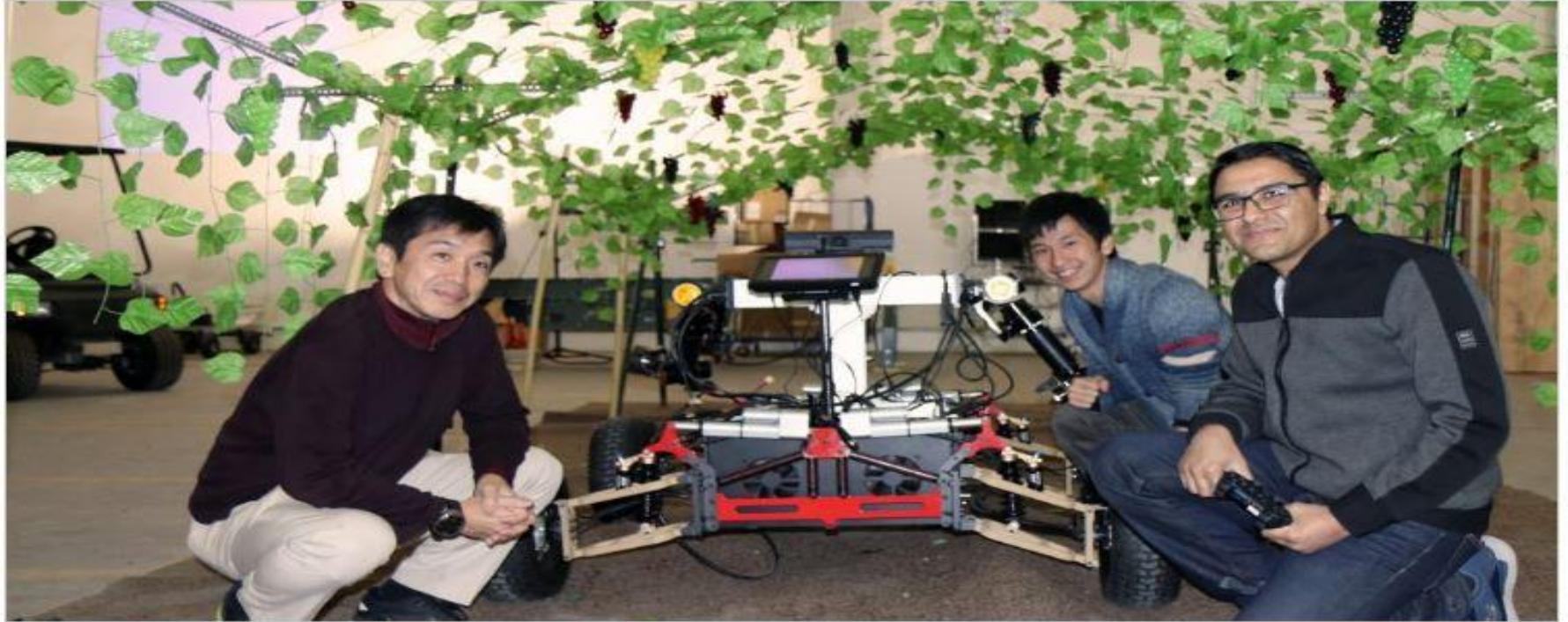
Use the **color classifier** to set a label to current window: Good or Bad skin?

Merge the neighboring bad skin windows to get bad area





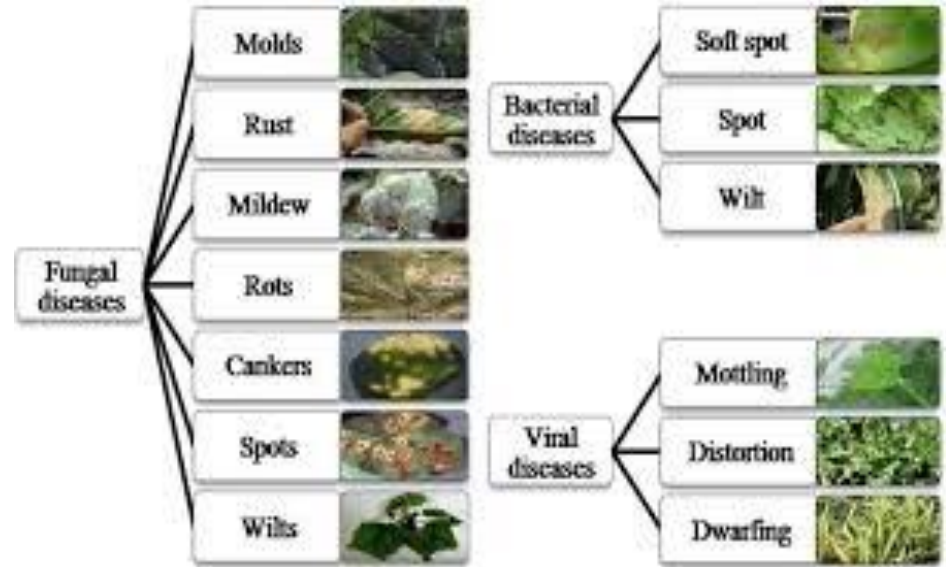
# Tabletop Grapes to Get Picked by Robots in India, With Help From Virginia Tech



# Crop disease identification

Farmers of the Country can benefit from the Computer vision by getting alerts about various diseases on their crop.

Why not investing on an app which detects the disease just by looking at the picture. A single platform for the farmers to use as their guiding system.





## Steps to Approach the issue:

### 1) Data Preparation:

- i) Data collection*
- ii) Labeling*
- iii) Pre-processing and augmentation*

### 2) Training

- i) Pre-Training*
- ii) Fine Tuning*

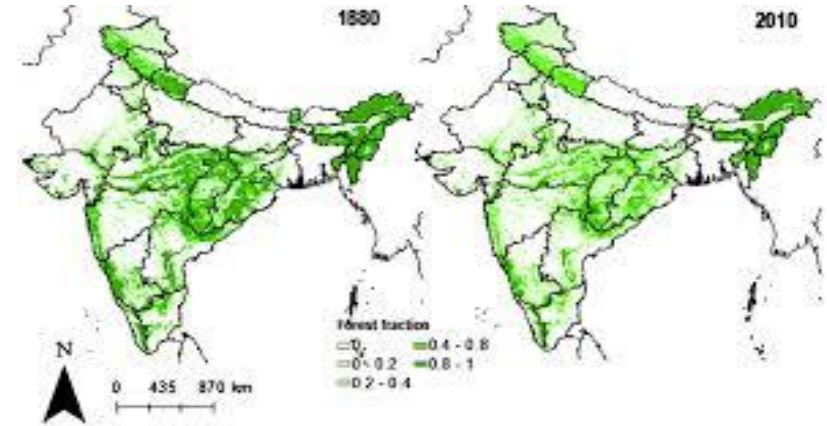
### 3) Deployment:

- i) Disease Classification*
- ii) Symptoms Detection and Visualization*

# Illegal Logging and deforestation

In 2009, India ranked 10th worldwide in the amount of forest loss., where world annual deforestation is estimated as 13.7 million hectares ( $34 \times 10^6$  acres) a year.

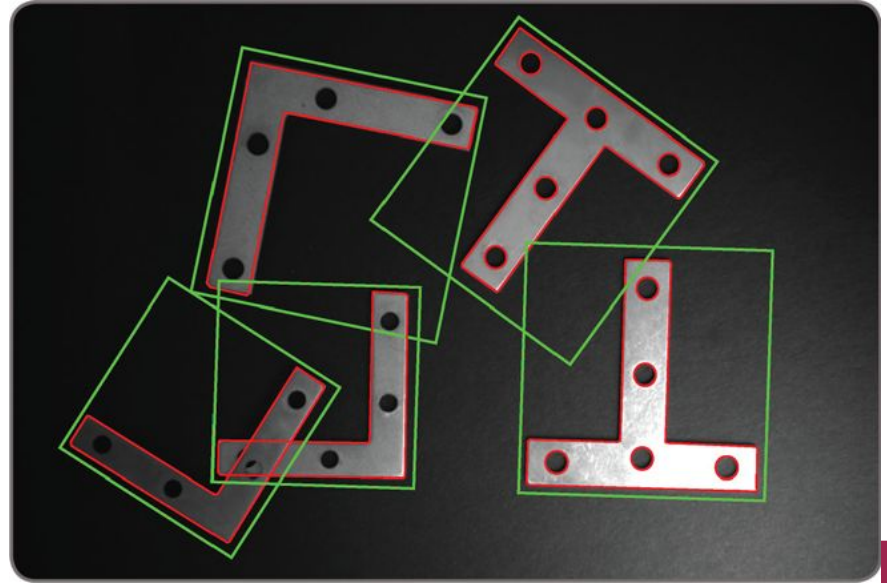
Machine learning with image data collected from drones can be used to detect such activities, Alert the authorities and keep a regulated environment.



# Correlation Pattern Matching and Geometric Pattern Matching

A simple Algorithm can match already existing patterns from the image to the saved image.

The limitation: it cannot detect the object if the position of the object changes.



# Road accidents prevention

In 2018, 1.47 lakh people died in road accidents. (11% of world road accidents.)

In 2017, 25 children below 18 were killed per day in the country.

Computer vision can detect emotions and It can also detect Tiredness/Exhaustion/Sleepiness from the image. Alerts the driver about the risks while driving.



# A Kinect-based RGBD+Time Dataset for Spontaneous and Non-Spontaneous Facial Expression Recognition - Dr.Lynn Abbott , Dr. Sherin Aly, Students- Andrea,Susan Amira

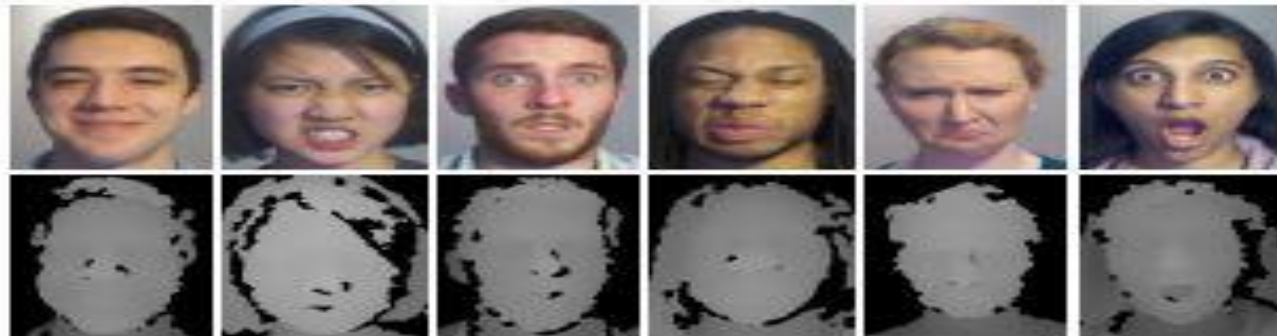
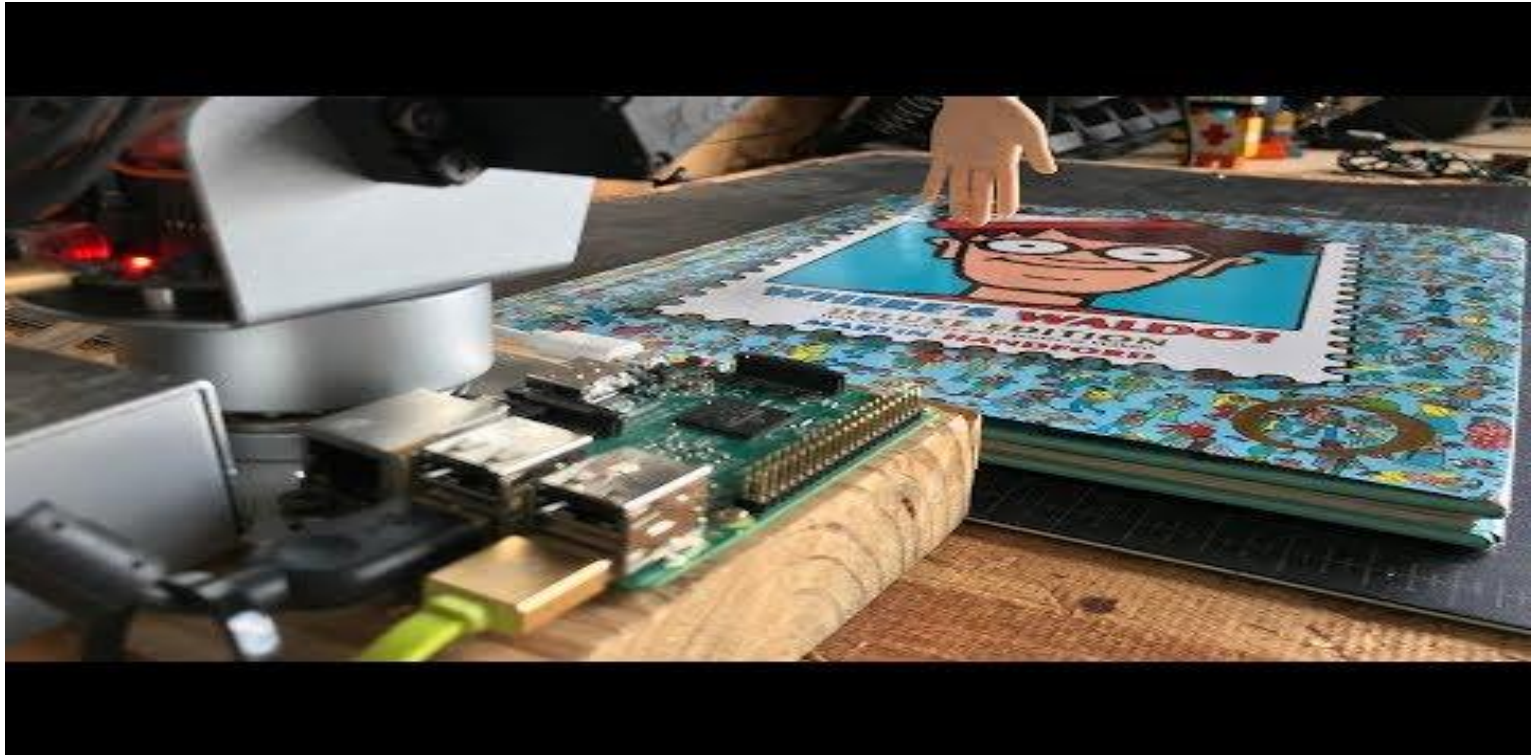


Figure 6: Part of an unscripted sequence for a subject while disgust stimuli images were displayed.



What humans cannot see..



# Models for Weakly Supervised Cyberbullying Detection

Virginia Tech Research by Dr. Bert Huang and Dr. Elaheh Raissi, Computer Science Department

## Social Media Analysis With Machine learning

Virginia Tech Research Article by Tanushree Mishra

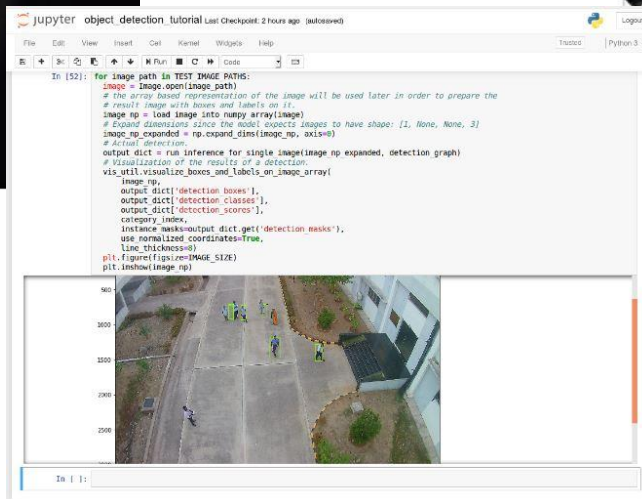
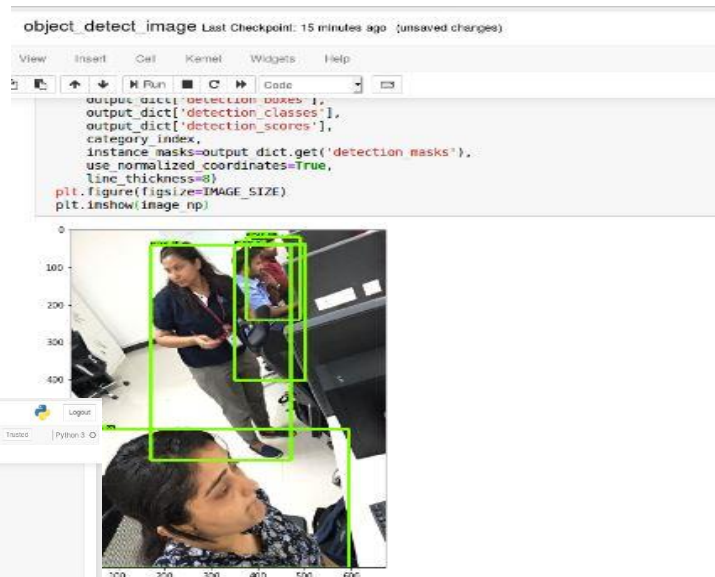
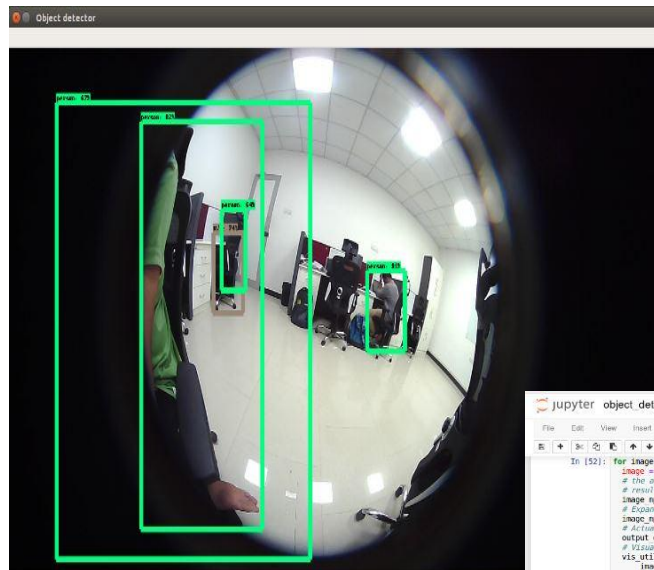
## Multi-source models for civil unrest forecasting

Research by Dr. Naren Ramakrishnan, Computer Science, Virginia tech.

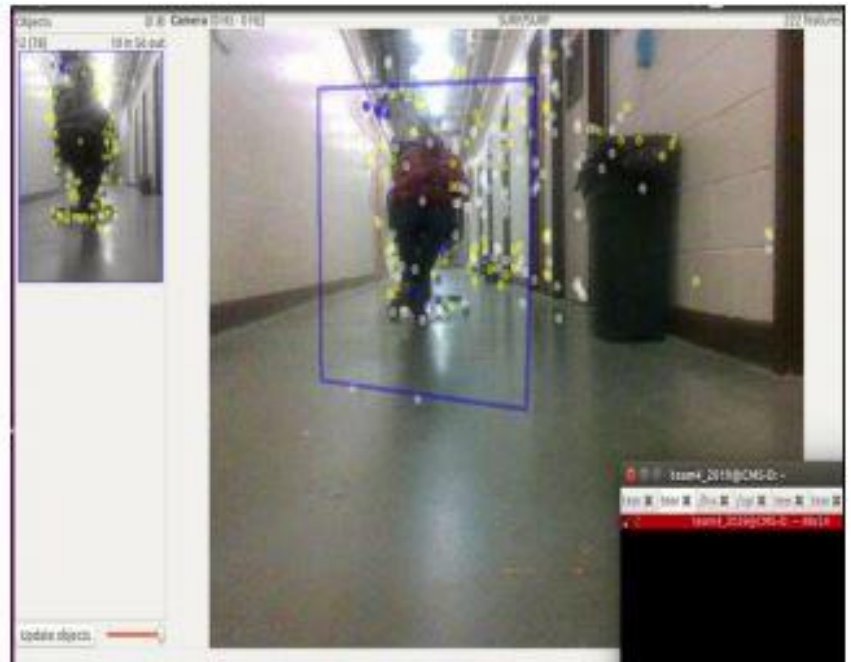
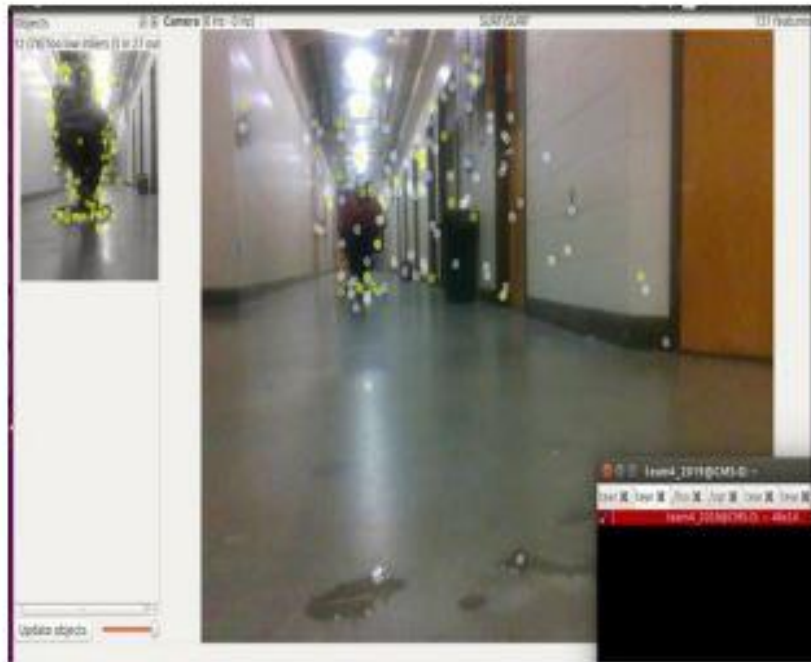




# My Projects so far.

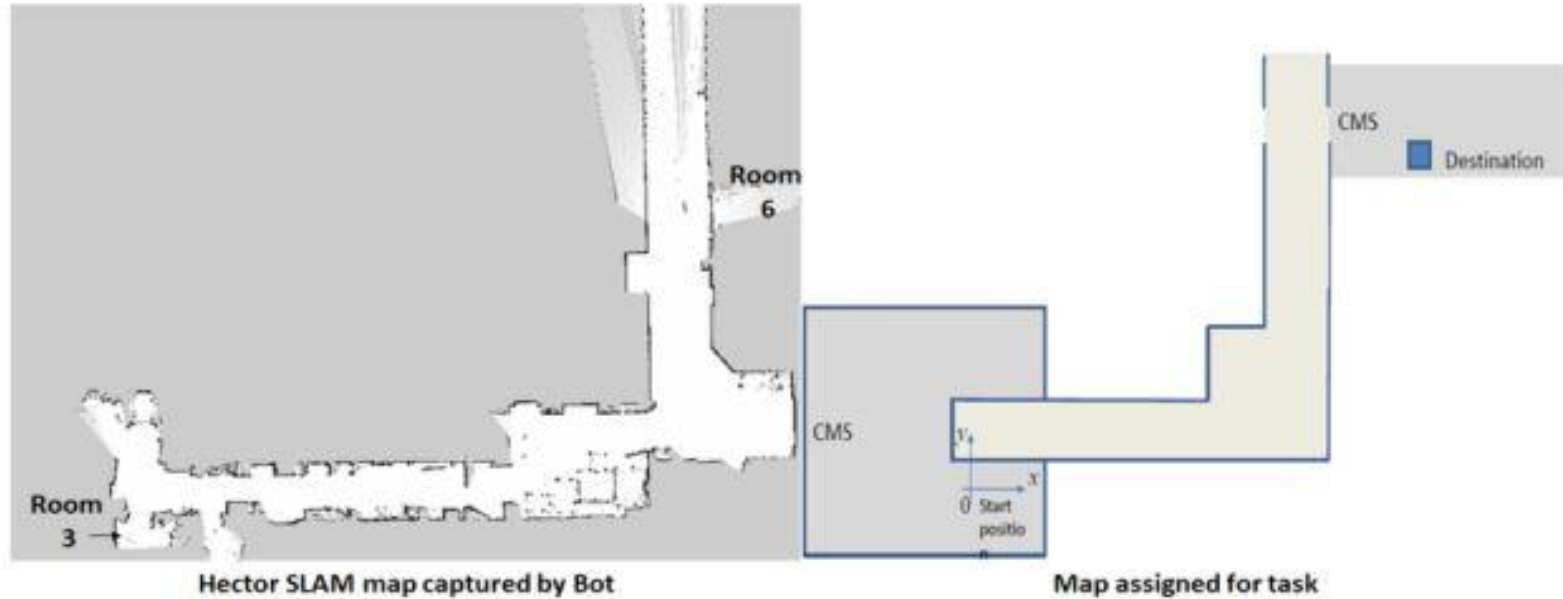


# ROS 2D detector

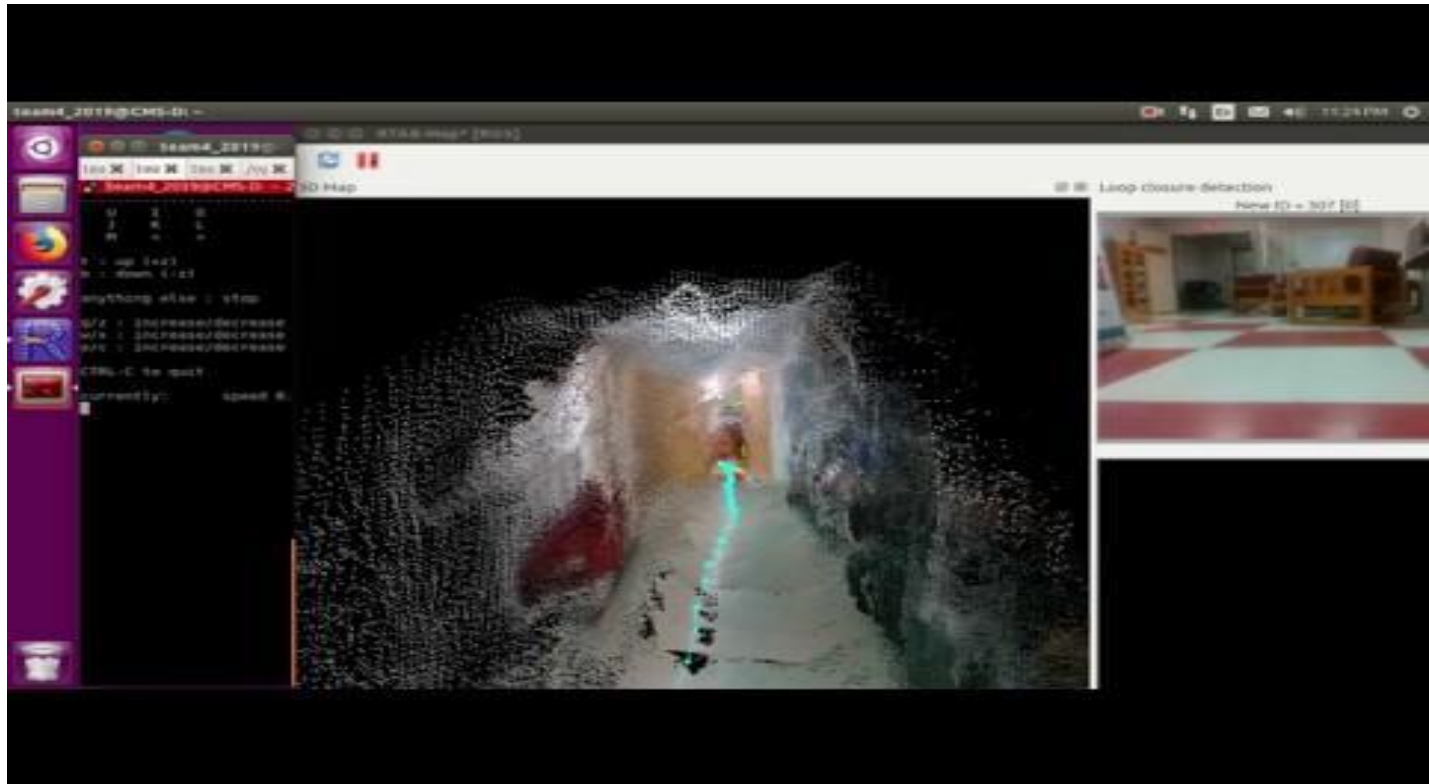




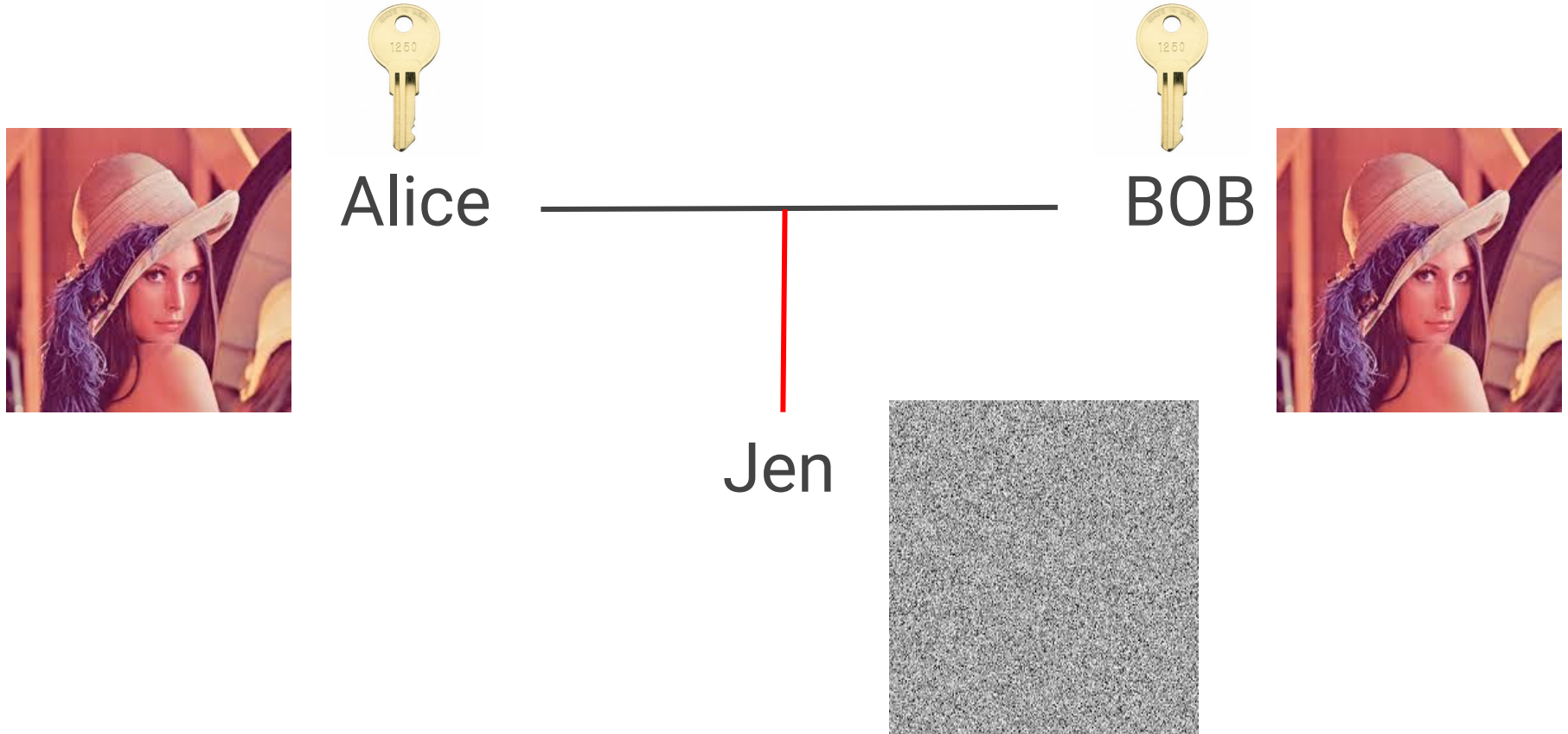
# SLAM - Simultaneous localization and mapping



## 3-D Mapping of the room



# Image Encryption- Decryption:



Thank you so much.

Questions.