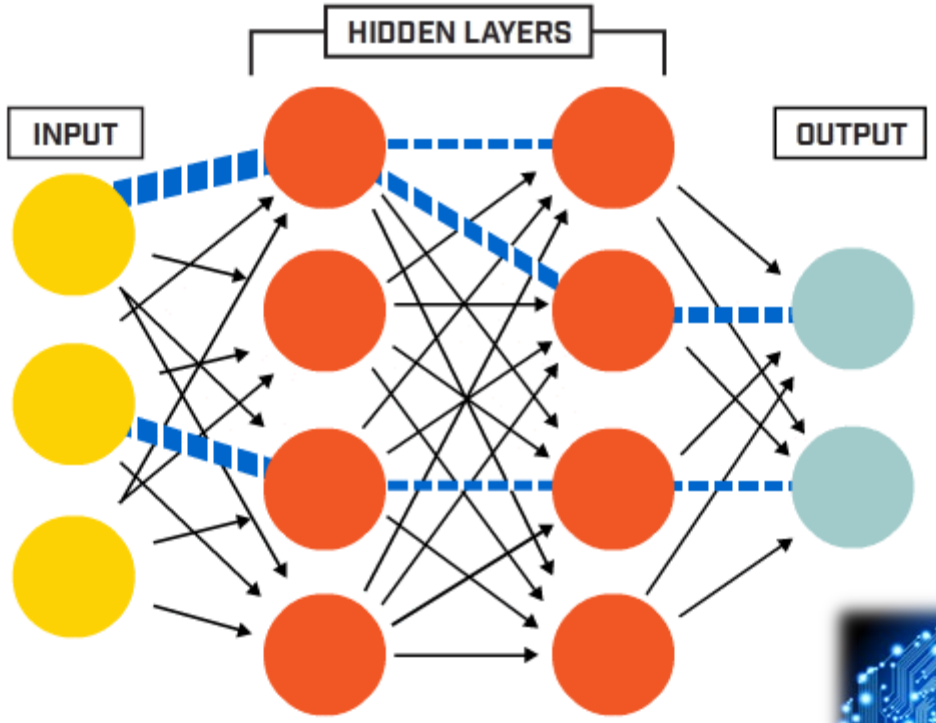
Mastering Automated Visual Inspection

Future Trends in Automated Inspection

- What is deep Learning ?
- How deep Learning will transform VI ?
- Key Milestones last decade
- 1st proof of concept with cracks and particles

Deep Leaning Vision



How Deep Learning will transform AVI?

Objective: Presentation of current trends in AVI and computer vision

1. Main function blocks of AVI
2. What can « see » a machine?
3. Historic milestones
4. Comparaison Man/machine
5. How is working « deep learning » ?
6. Some practical demos

Deep Learning will impact Image computing + Defect Classification

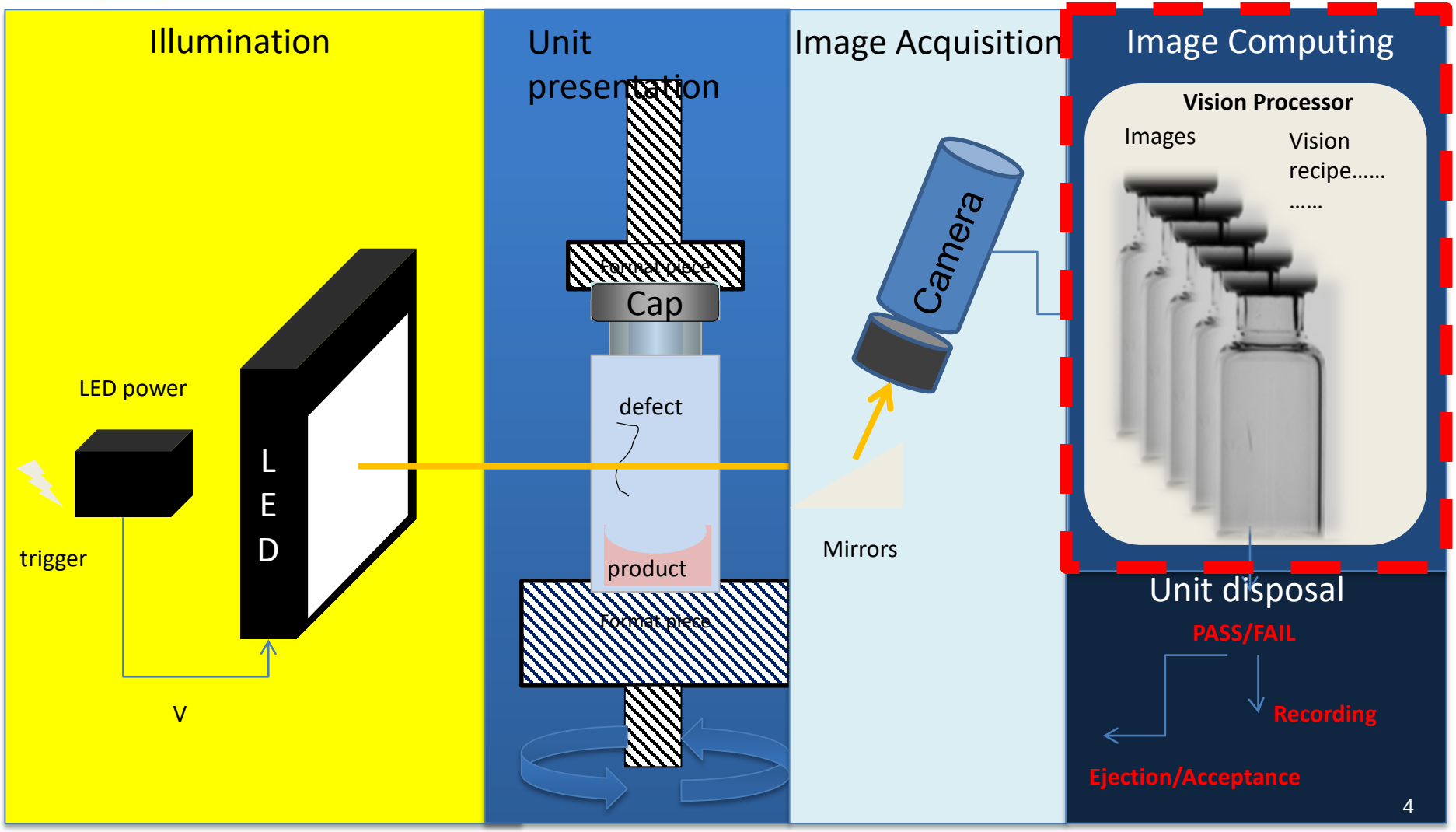
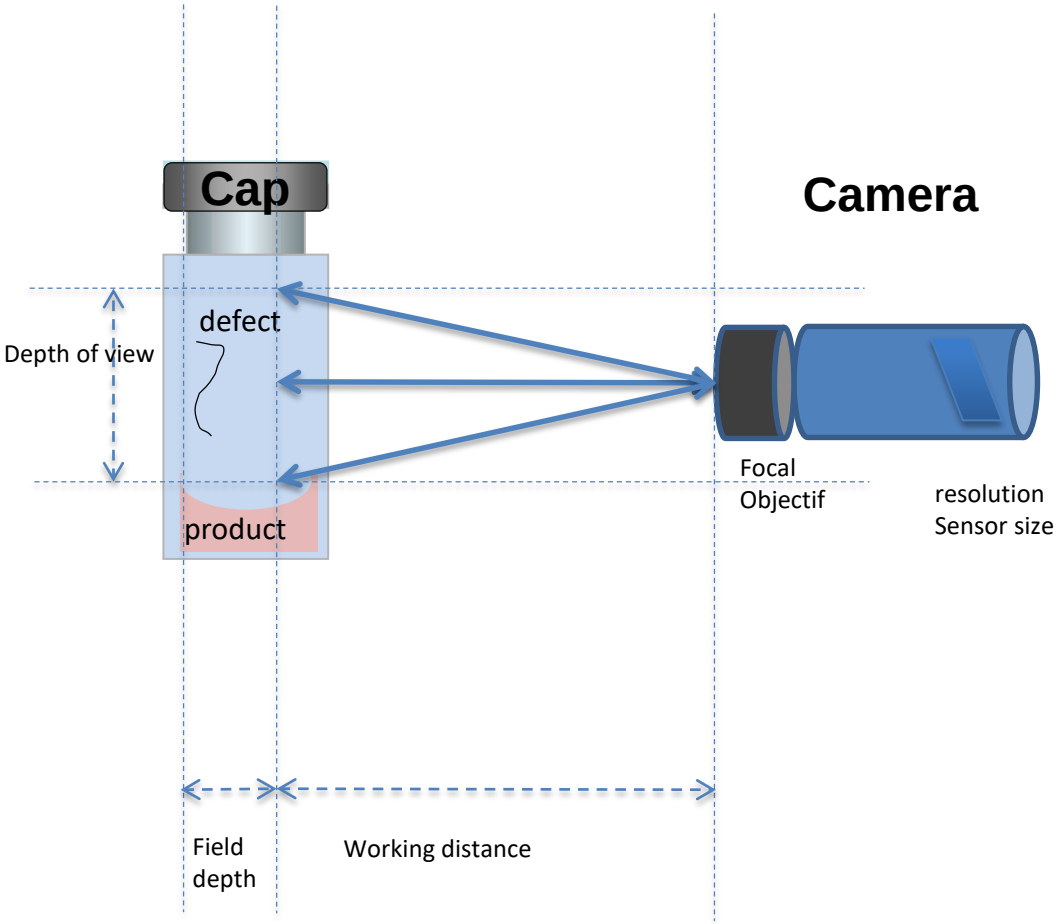
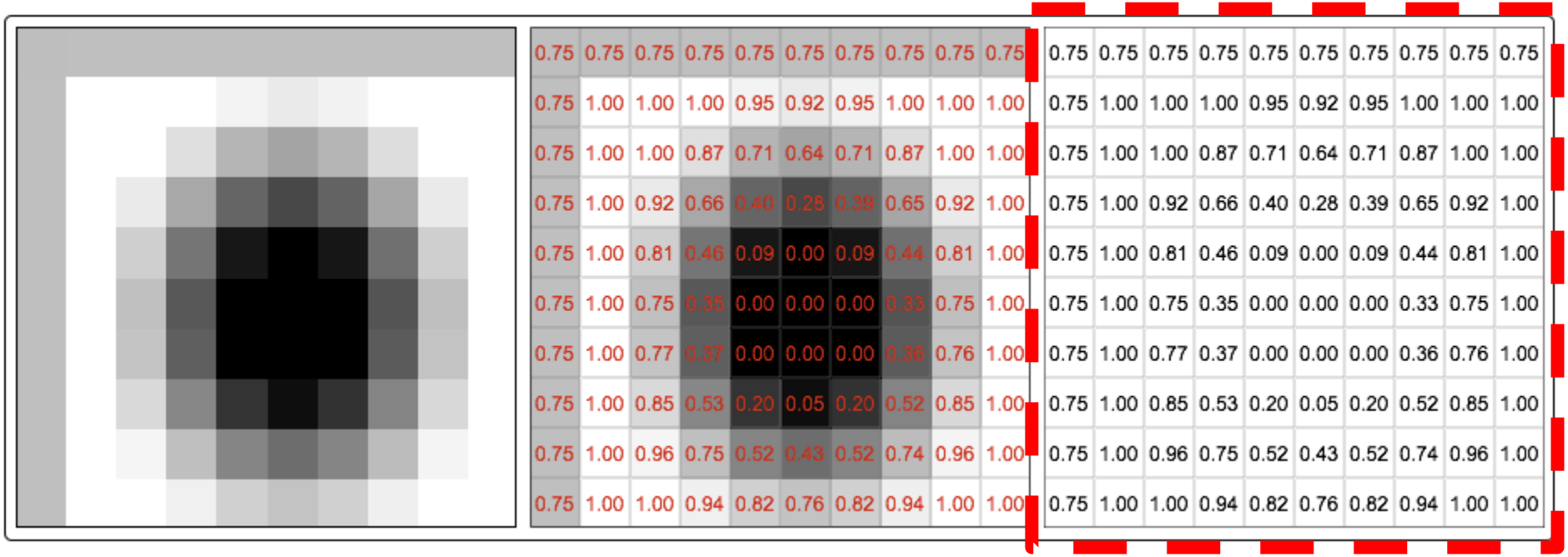


Image Acquisition principle will remain the same



What a machine really sees, what is DIP?



0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
0.75	1.00	1.00	1.00	0.95	0.92	0.95	1.00	1.00	1.00
0.75	1.00	1.00	0.87	0.71	0.64	0.71	0.87	1.00	1.00
0.75	1.00	0.92	0.66	0.40	0.28	0.39	0.65	0.92	1.00
0.75	1.00	0.81	0.46	0.09	0.00	0.09	0.44	0.81	1.00
0.75	1.00	0.75	0.35	0.00	0.00	0.00	0.33	0.75	1.00
0.75	1.00	0.77	0.37	0.00	0.00	0.00	0.36	0.76	1.00
0.75	1.00	0.85	0.53	0.20	0.05	0.20	0.52	0.85	1.00
0.75	1.00	0.96	0.75	0.52	0.43	0.52	0.74	0.96	1.00
0.75	1.00	1.00	0.94	0.82	0.76	0.82	0.94	1.00	1.00

1 particle

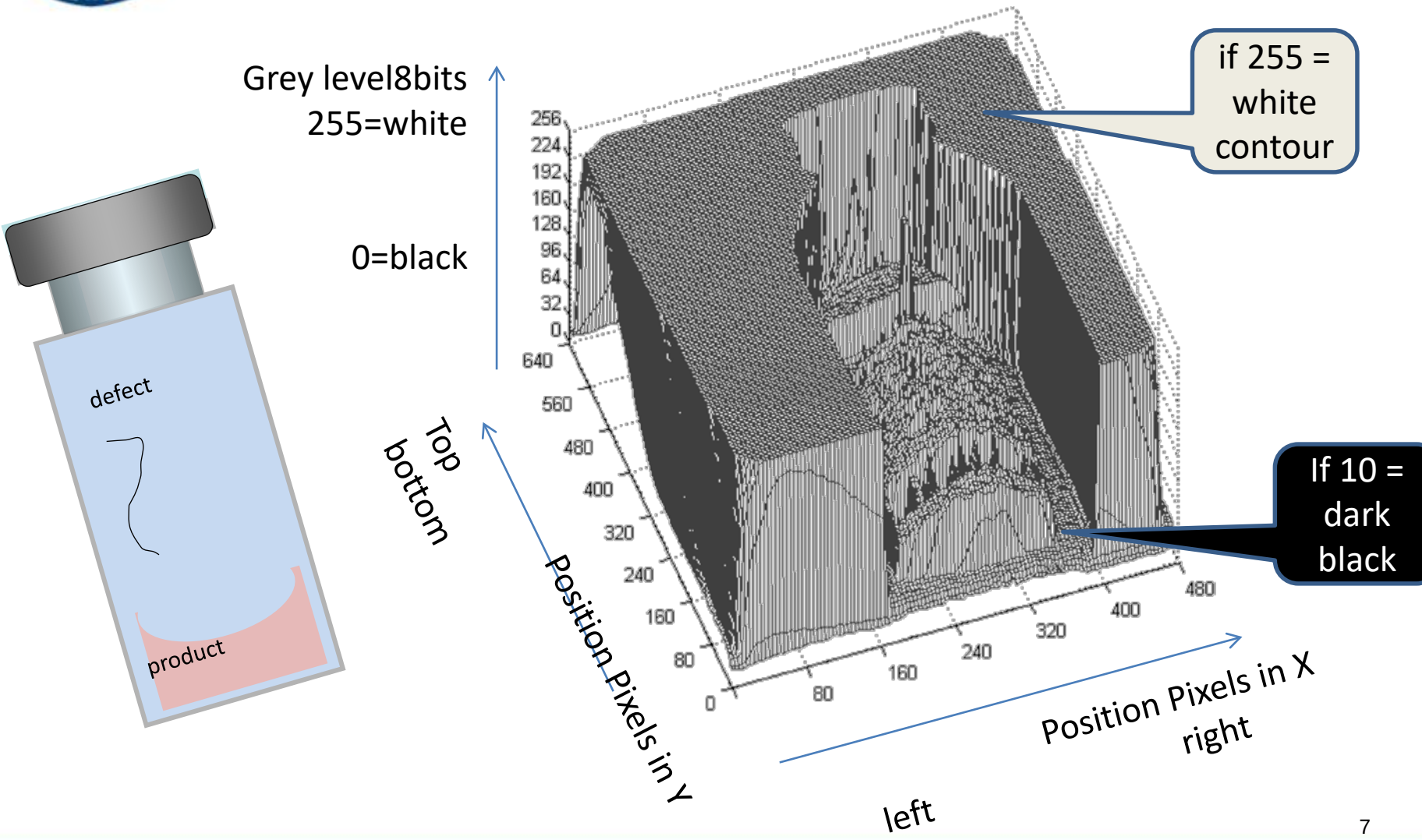
Image with grey level…

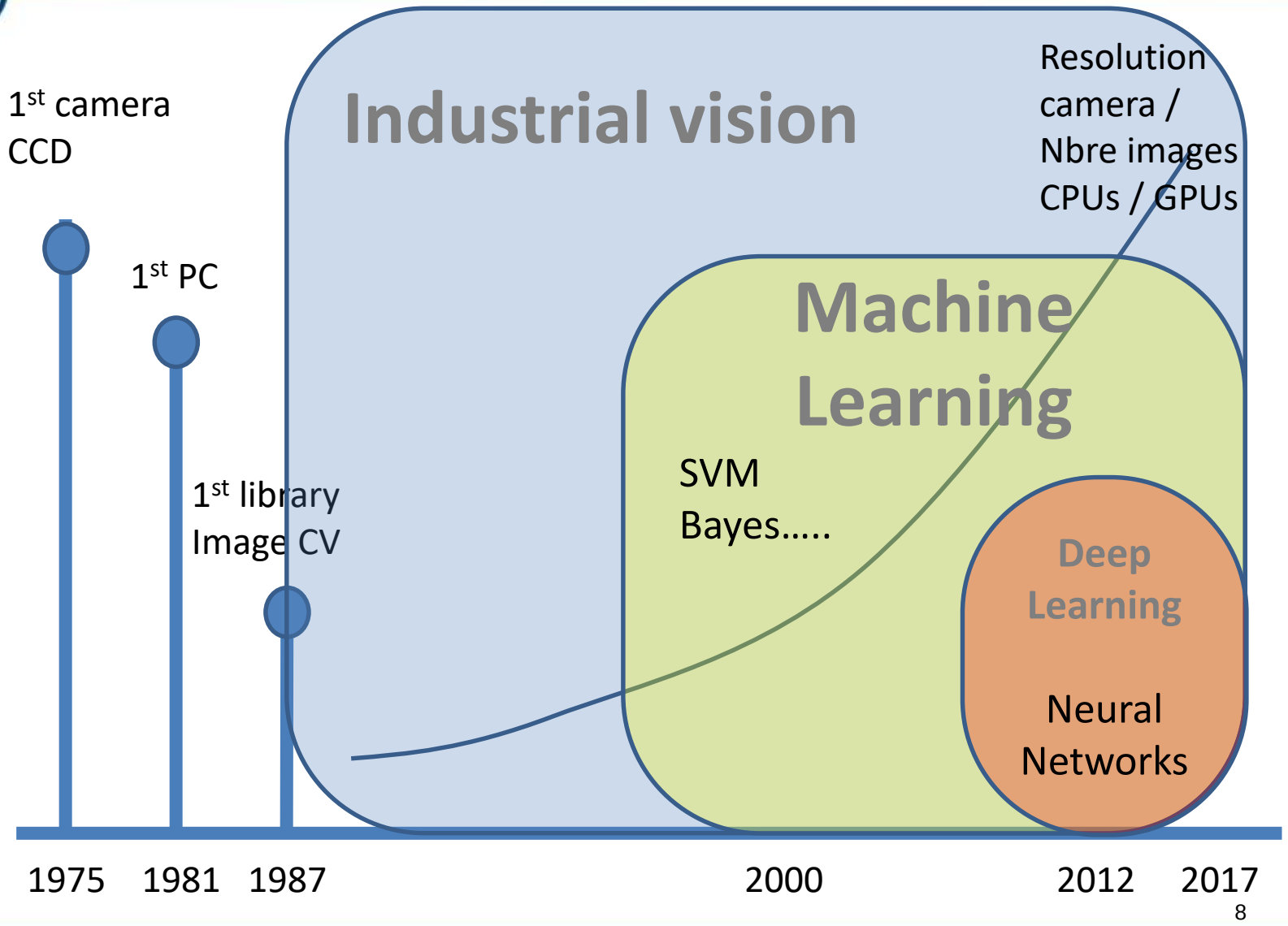
Digital Image = matrix grid of figures ☹

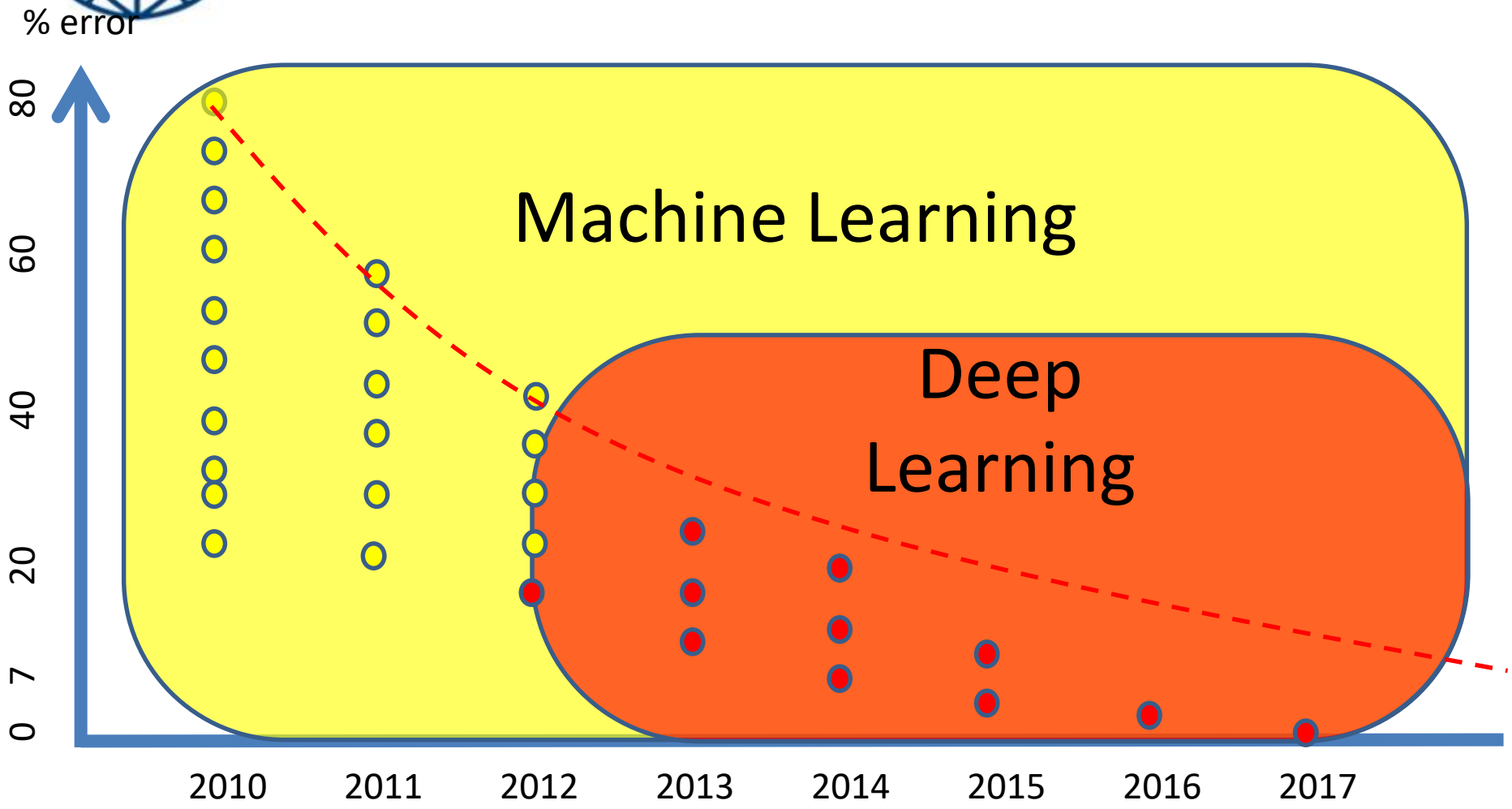
python:

```
np.zeros(img.shape, dtype=img.dtype
```

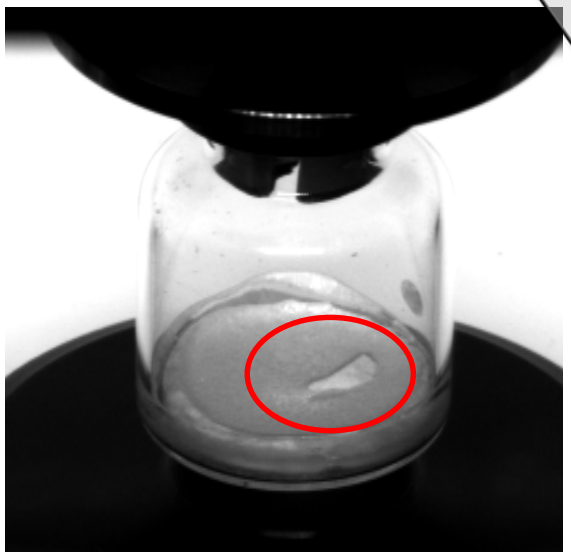
What a machine really sees, what is a Digital image?

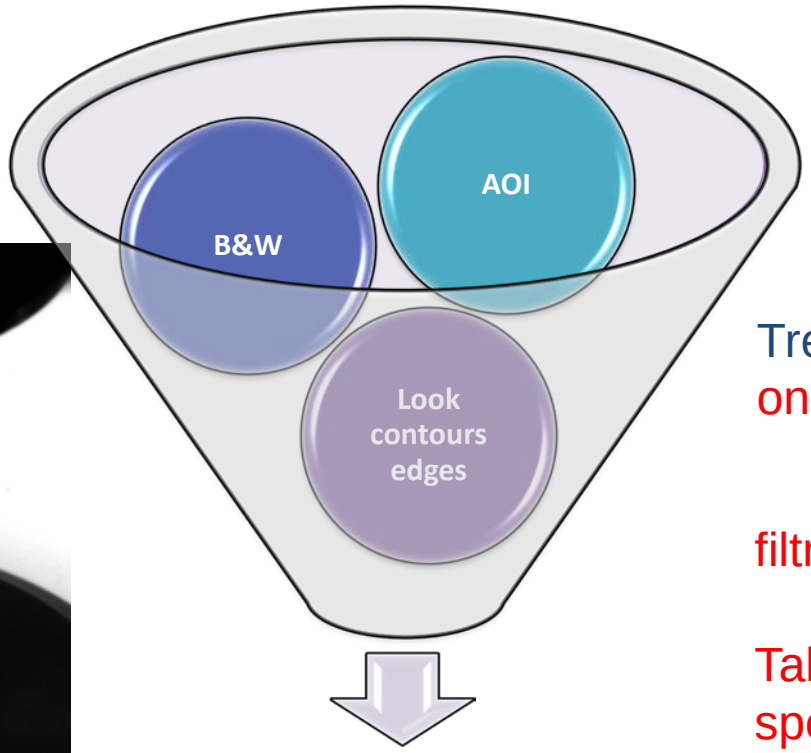



1st camera CCD
1st PC
1st library Image CV
Industrial vision
Resolution camera / Nbre images CPUs / GPUs
Machine Learning
SVM Bayes…..
Deep Learning
Neural Networks
1975
1981
1987
2000
2012
2017


% error
80
60
40
20
7
0
Machine Learning
Deep
Learning
2010
2011
2012
2013
2014
2015
2016
2017

Why ? Too much useless infos in images

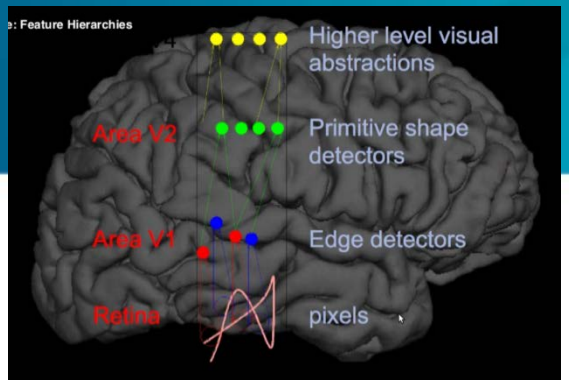


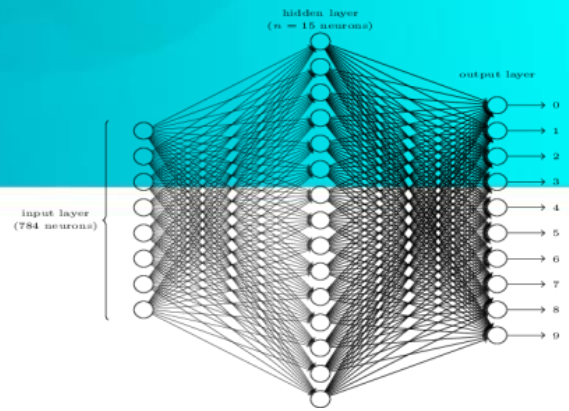


Treatment = focus on essential info

filtre

Take decision specific on key attributes





HUMAN MVI

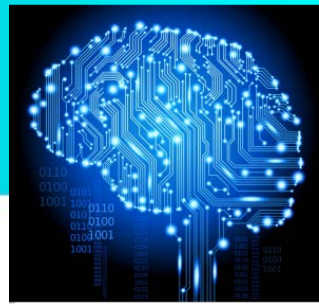
- ✓ 1 real object object that was teatched to the machine = supervised learning
- ✓ Observation; concentration / light/ fatigue….
- ✓ Cones in retina activated
- ✓ Image projected in V1 area of brain for detection angles/ edges /contours
- ✓ Area V2 of brain to detect gross forms/shapes
- ✓ Area V4 -V5 for forms more abstract
- ✓ Activation memory area

➔ **Object Identification +classification**

DEEP LEARNING

- ✓ 1 real object that was taught to the machine = supervised learning
- ✓ Image camera capture
- ✓ Presentation of image in 1st layer of neuron = nbre pixels
- ✓ Each part of image is sent to other layers of neuron that are interconnected, adjustment of coefficients to match elements as best
- ✓ Last neron layer to classify object

➔ **Object Identification=classification**



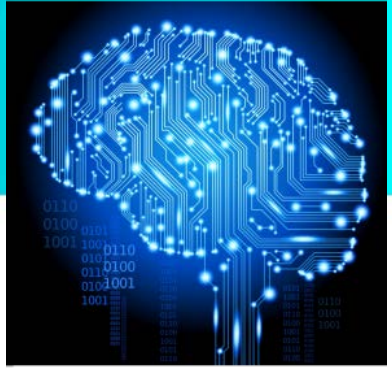
Industrial vision

- ✓ Ajustement light
  + optic + image
- ✓ Image Capture
  Images confoirming units (kits)
  + defect images (kits)
  + identification defects (logbooks)
- ✓ Preparation of image treatment
  for each camera
  - click and drag software
  - opened computing or hard coding
  Optimization processing time
- ✓ Adjustement on images / auto ajust.
- ✓ Evaluation on machine
- ✓ Validation (PQ)
- ✓ Go Live to production

Deep Learning

- ✓ Ajustement light
  + optic + image
- ✓ Image Capture
  Images confoirming units (kits)
  + defect images (kits)
  + identification defects (logbooks)
- ✓ Construction of 2 data bases of image:
- ✓ learning (training_set)
- ✓ Evaluation (Prediction_set)
- ✓ Programmation neural network
- ✓ Evaluation & adjustements
- ✓ Optimisation processing time
- ✓ Validation (PQ)
- ✓ Go live to production

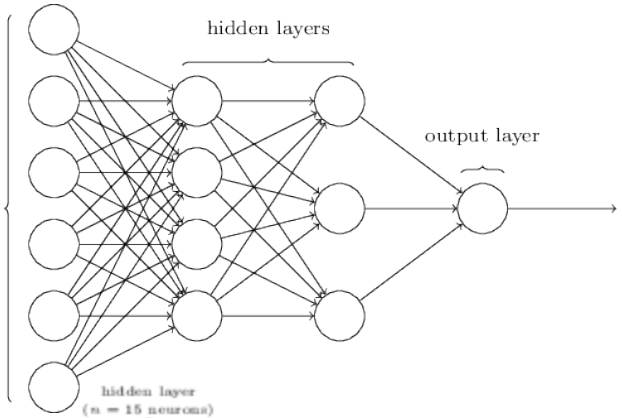
Lets give it a try?



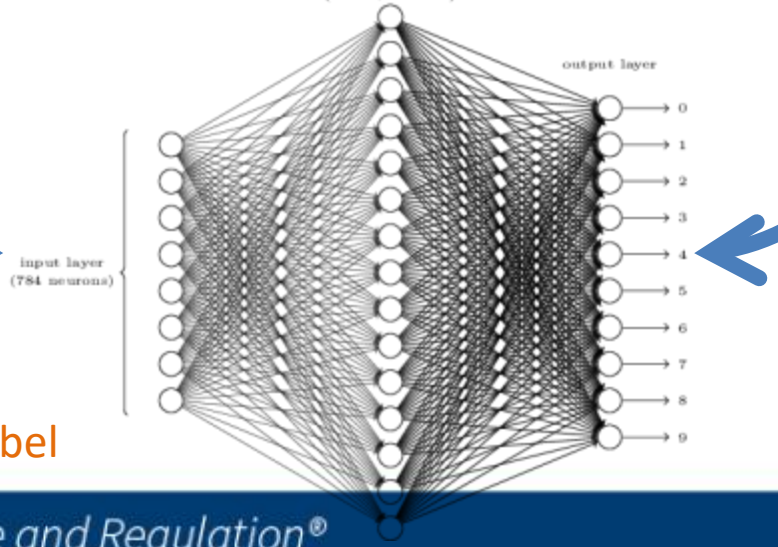
1 Transversal Learning

440images of syringes (Conform/Crack/Particle)
+ corresponding labels

neural network pretrained (Lenet.org)



2 Evaluation



96.3% of labels found OK
3.7% « error » or just

Submit new images
never show without label

What you need ?

- ✓ 1 PC Linux
- ✓ Python + OpenCV
- ✓ Scikit-learn
- ✓ TensorFlow + Keras
- ✓ Some images

OpenCV

python

Deep Learning

K + TensorFlow