DEEP LEARNING LESSONS

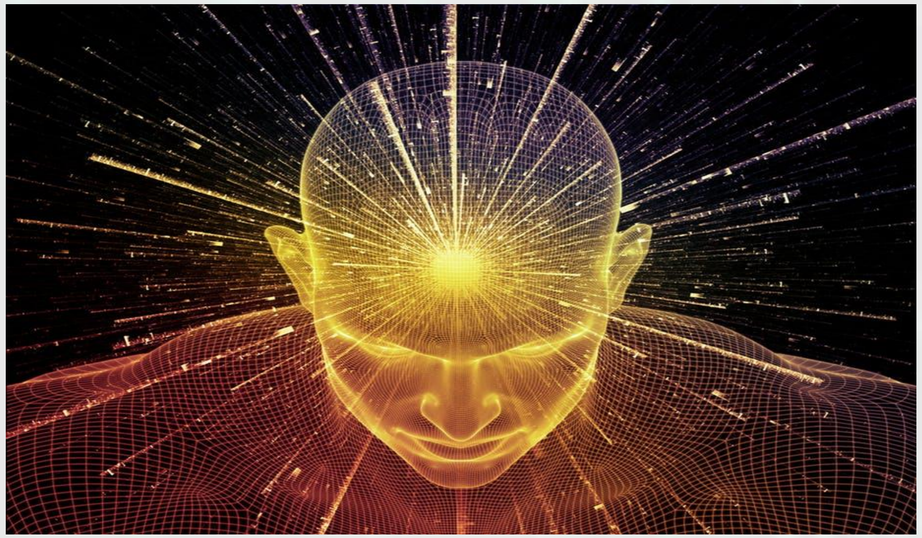
Deep, Consciousness and AI Learning

Francesco Pugliese, PhD

neural1977@gmail.com

Deep Learning, Consciousness and AI

WHAT IS CONSCIOUSNESS? WHAT IS THE SUBJECTIVE EXPERIENCE? NOBODY KNOWS

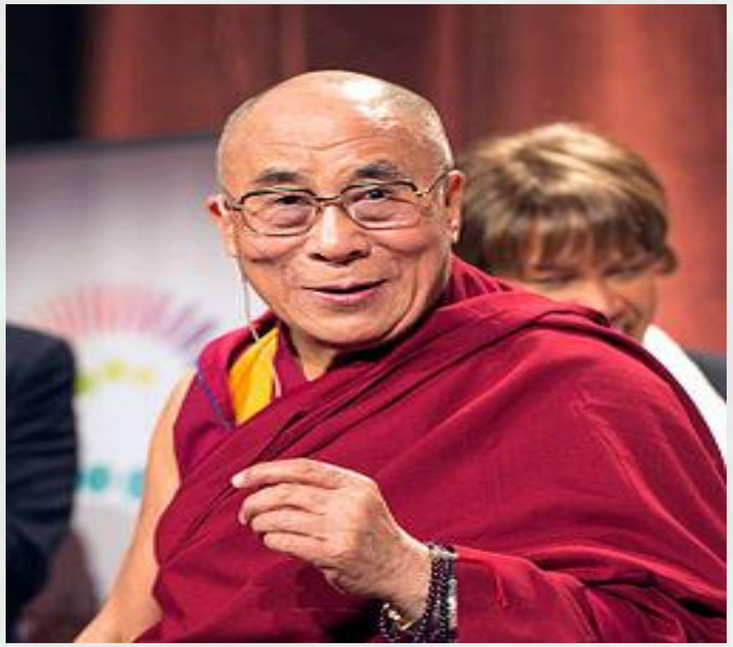


DISSOCIATION BETWEEN CORTICAL ACTIVITY AND COUSCIOUSNESS

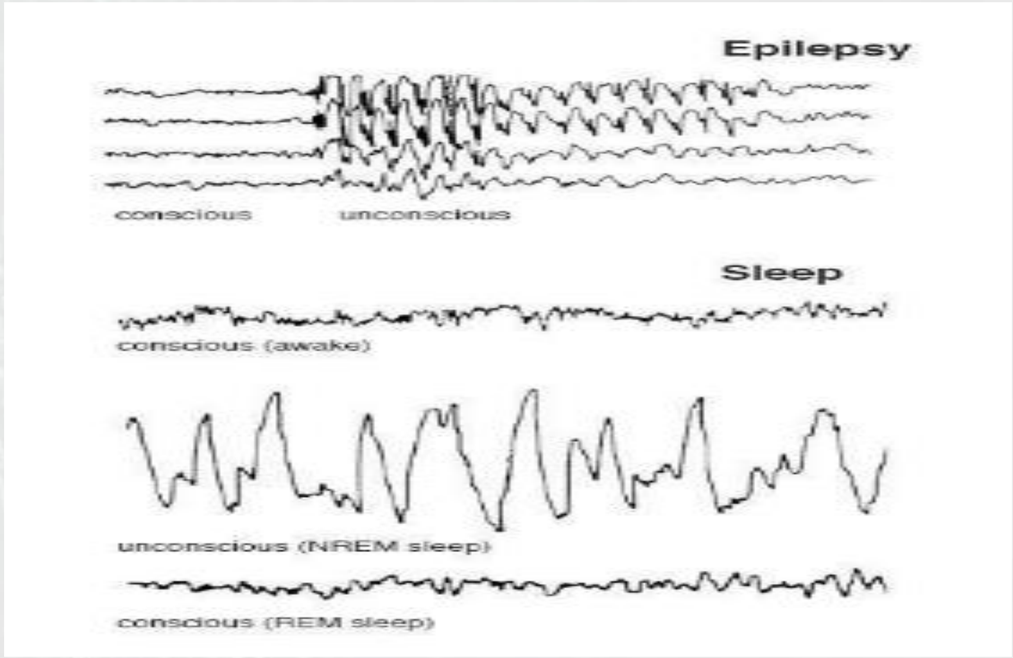
- During episodes of unconsciousness, the child's brain is by no means inactive; it is actually hyperactive.
- The observation of similar firing rates between waking and slow-wave sleep represents both the most striking dissociation between cortical activity and cousciousness.
- It indicates that the presence of "normal" firing levels in the cerebral cortex is not a sufficient criterion for consciousness.

Edelman, Gerald. A Universe Of Consciousness: How Matter Becomes Imagination

How Thoughts can change the Brain



Conscious Experience requires PATTERNS OF NEURAL ACTIVITY THAT ARE HIGHLY DIFFERENTIATED (Gerald Edelman



Tenzin Gyatso (Dalai Lama): “What if the brain comes from consciousness instead of consciousness coming from the brain?”

Why Deep Learning over-performed traditional statistics models?

- “Deep Learning” approaches can be **end-to-end trained** without a task-specific feature engineering.
- **These model are scalable**: adding GPUs they can be trained faster.
- ***“Deep Learning is killing every problem in AI”*** (Elizabeth Gibney, 2016)

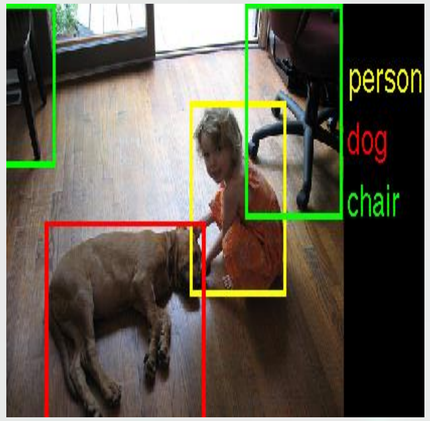
- Basically, **statistics is not able to deal with very high dimensionalities** of data as Deep Learning does.

Computer Vision: Where does Traditional Statistics fail?

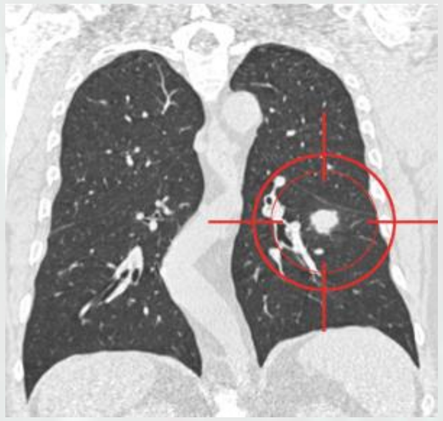
- **Computer Vision** is an interdisciplinary field that deals with the way algorithms can be made for gaining high-level understanding from digital images or videos.
- **Statistical methods** are not always welcome in computer vision.
- Statistical methods seem **not scaling up** to the challenges of computer vision problems (Chellappa, R., 2012).

Why does Computer Vision matter so much?

EVERYDAY LIFE

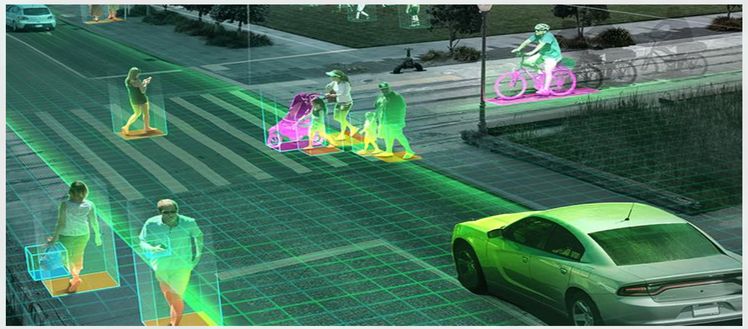


BIOMEDICAL IMAGES

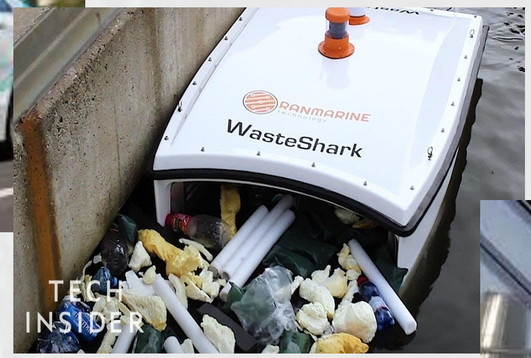


- A new study proves the **relationship** between **Vision capabilities and Intelligence** (Tsukahara et al., 2016).
- Seemingly, **human beings** have one of **the most complex vision systems** within the **animal realm** and this fact would have fostered **the evolution of human intelligence.**
- In other words, **Computer Vision** needs **human-like intellectual capabilities** in order to achieve the vision performances required by humans for every-day applications.

Why does Computer Vision matter so much?



- **A new generation of machines** might accomplish typical human tasks such as recognizing and moving objects, driving cars, cultivating fields, cleaning streets, city garbage collecting, etc.



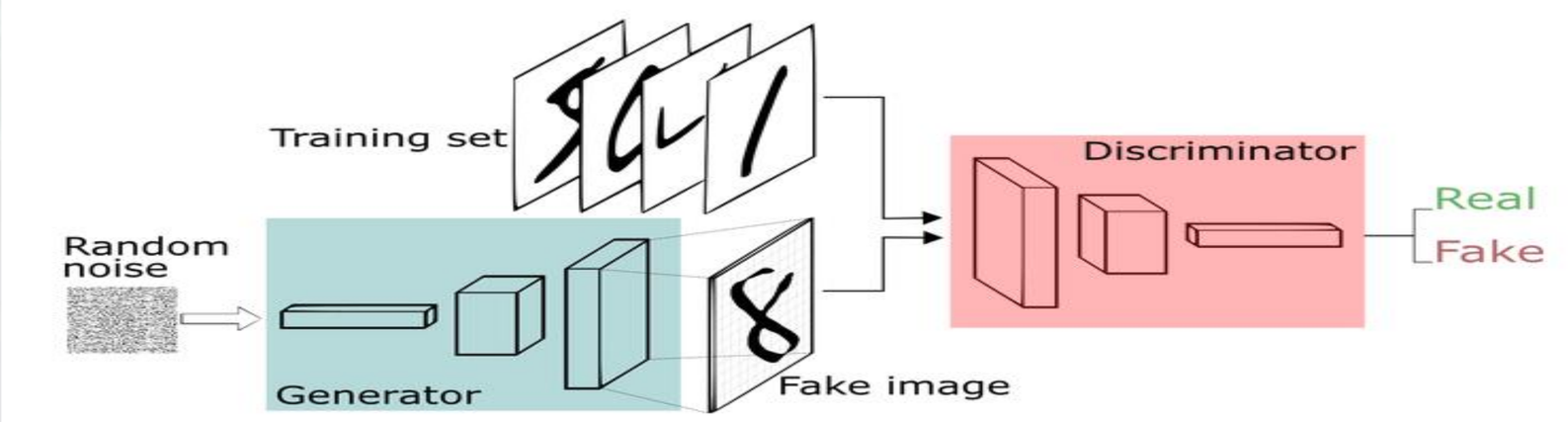
Computer Vision for Recycling

- **Smart Garbage Bins** could classify waste and differentiate it automatically. This might reduce the enormous impact of human errors.

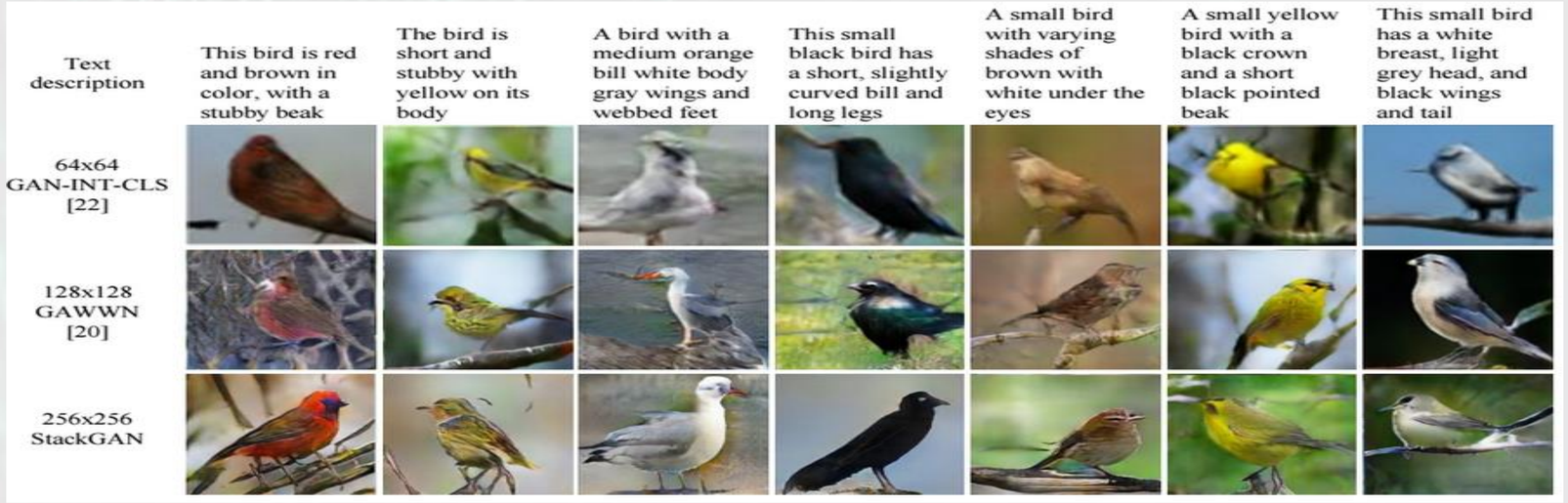
- As far as food **sustainability** is concerned, a first version of a classifier might enable a **restaurant** or a shop to recognize whether there is still a return of residual food from the production process. Afterwards, by exploiting other sub-classifiers we could catch the opportunity of regenerating this residual food saving resources.

- **AI applications** which can optimize all the **flow of interactions** with a **restaurant**, decreasing the process costs and increasing sustainability *(«Deep Learning al servizio del riciclo», Intervista su Wired, Pugliese, F.)*. Thanks to **Artificial Intelligence**, in one work, some researchers have generated menus of some restaurants analyzing all **non-structured data** from customers online comments.

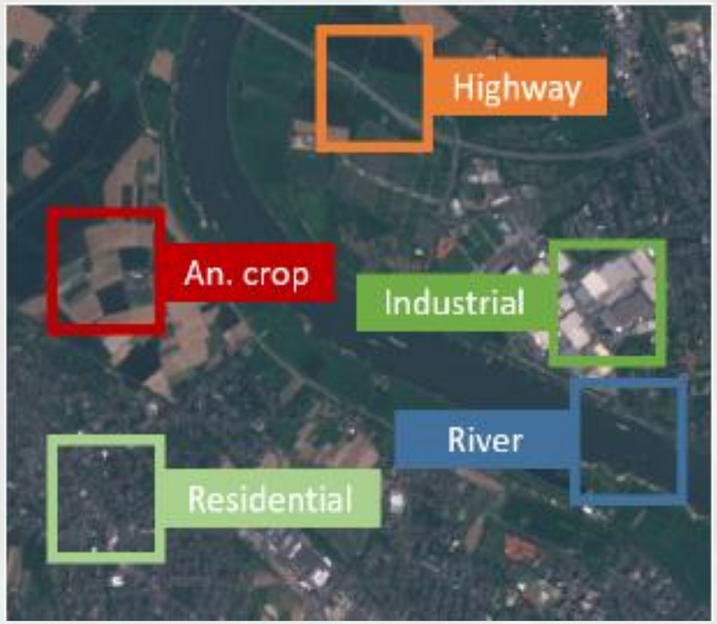
Generative Adversarial Networks (GAN) (Goodfellow, et al.,2014)



$$\min_G \max_D V(D,G) = \mathbb{E}_{\boldsymbol{x}\sim p_{\text{data}}(\boldsymbol{x})}[\log D(\boldsymbol{x})] + \mathbb{E}_{\boldsymbol{z}\sim p_{\boldsymbol{z}}(\boldsymbol{z})}[\log(1 - D(G(\boldsymbol{z})))].$$



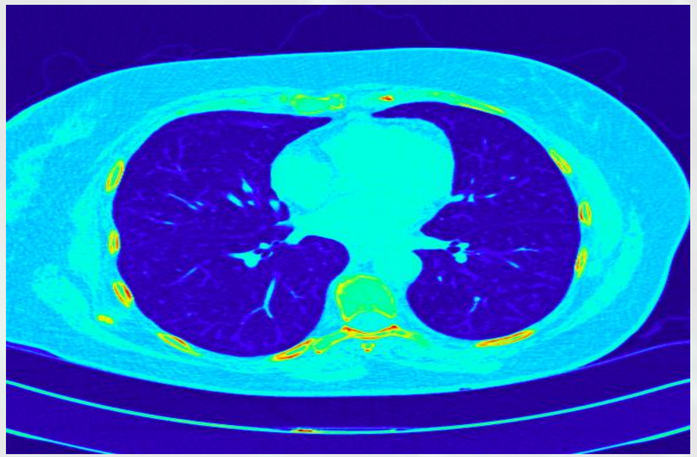
Automatic Extraction of Statistics from Satellite Imagery: Land Use and Land Cover Classification

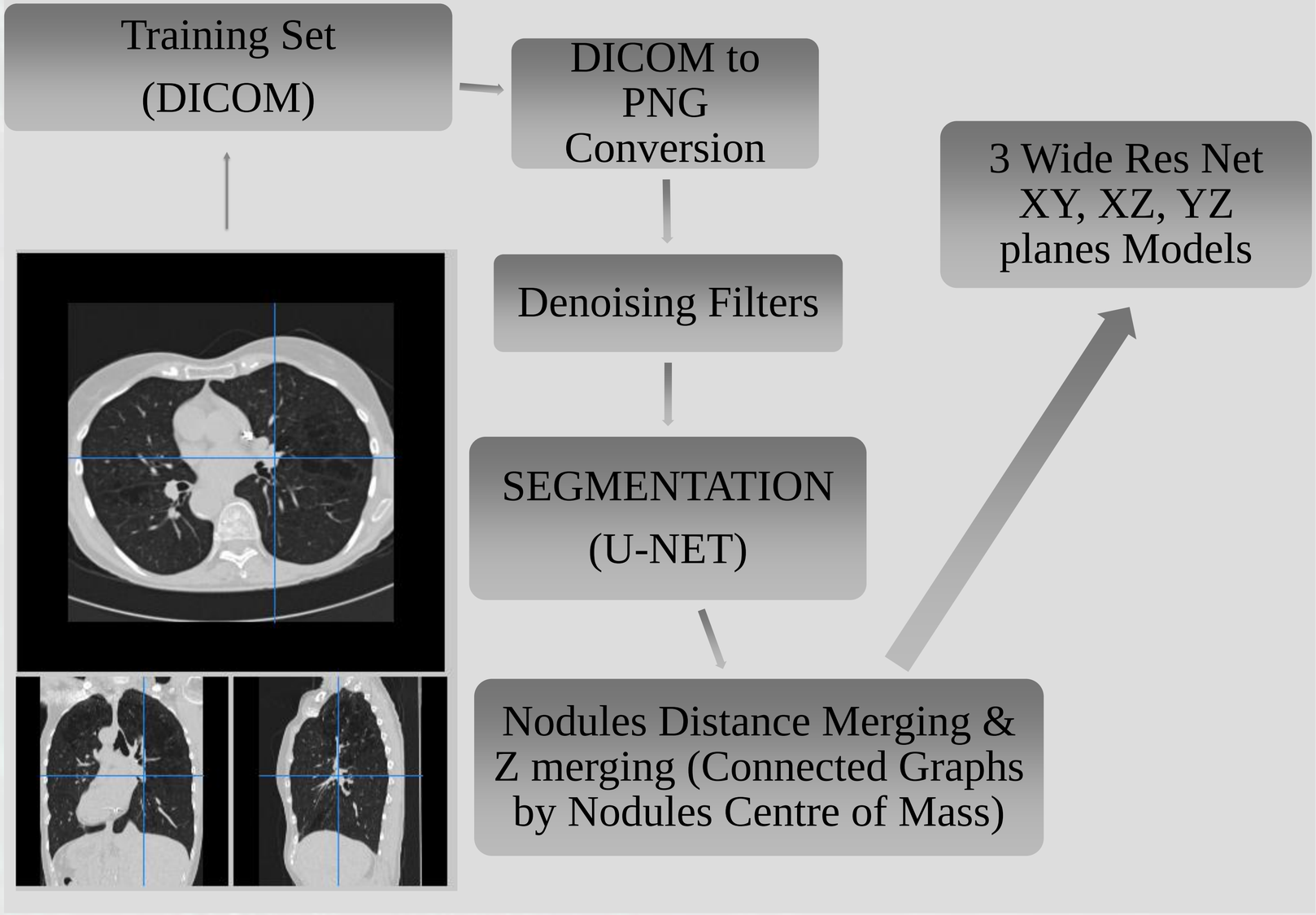


- Nowadays, more and more public and up-to-dated **satellite imagery** data for Earth observation are **available**.

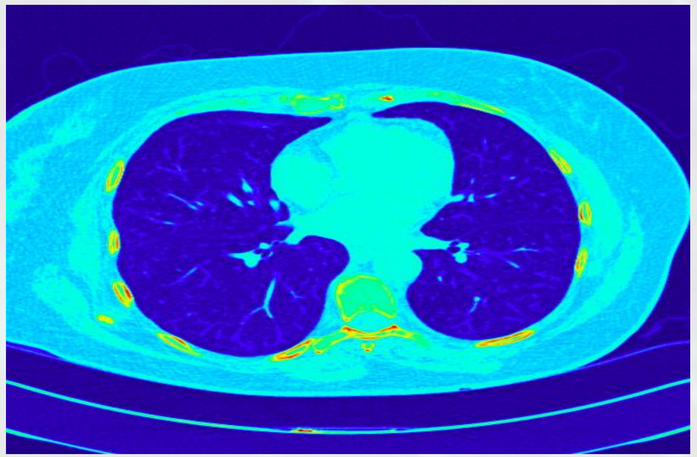
- However, to fully utilize this data, in order to automatically extract statistics, **satellite images** must be processed and transformed into **structured semantics**.

Lung Cancer Detection

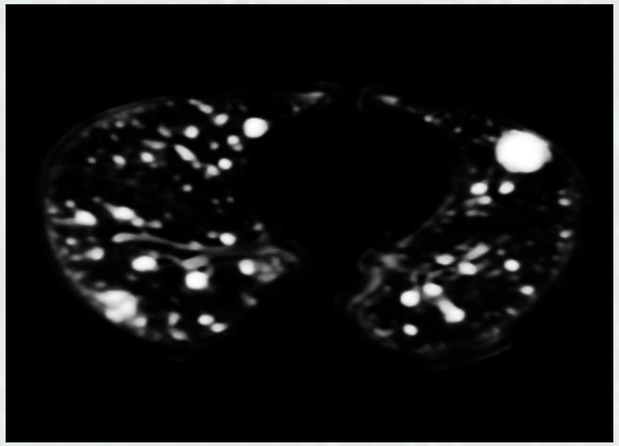




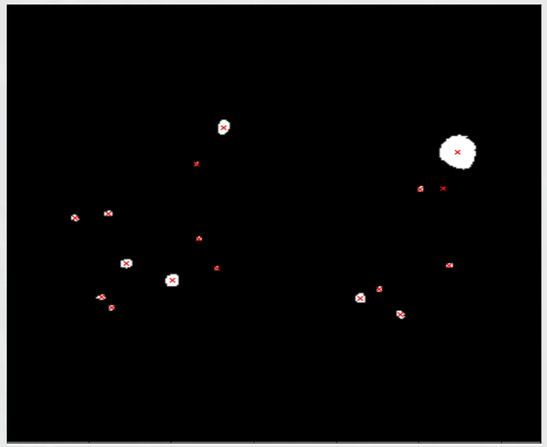
Lung Cancer Detection



Candidate Nodule Selection via UNET



Dilation, Erosion, Nodules Distance Merging



False Positive Reduction via WideResNet

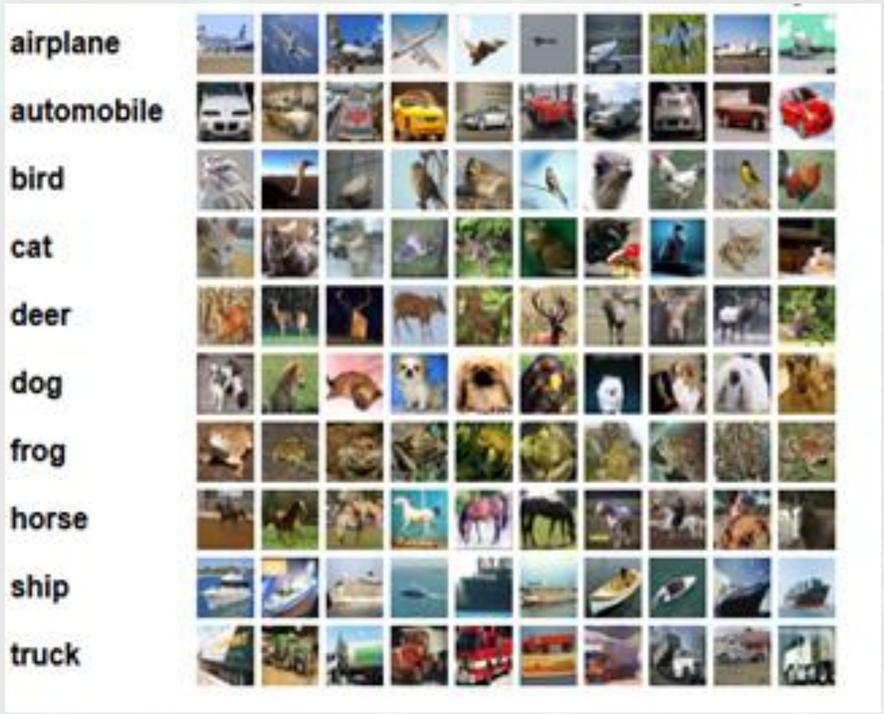
Cancer / Non cancer

Computer Vision Datasets and Competitions

- **Kaggle**: In 2010, Kaggle was founded as a platform for predictive **modeling** and **analytics competitions** on which companies and researchers post their data.
- Statisticians and data scientists from all over the world compete to produce the best models.
- **Data Science Bowl 2017** was the biggest competition focused on "Lung Cancer Detection". The competition was founded by **Arnold Foundation** and awarded **$1 million in prizes** (**1st** ranked **$500,000**).

- **Train Set:** around 150 CT labelled scans images per patient from 1200 patients encoded in **DICOM** format.
- **Stage 1 test set:** 190 patients CT scans.
- **Stage 2 test :** 500 patients CT scans.

Computer Vision Datasets and Competitions

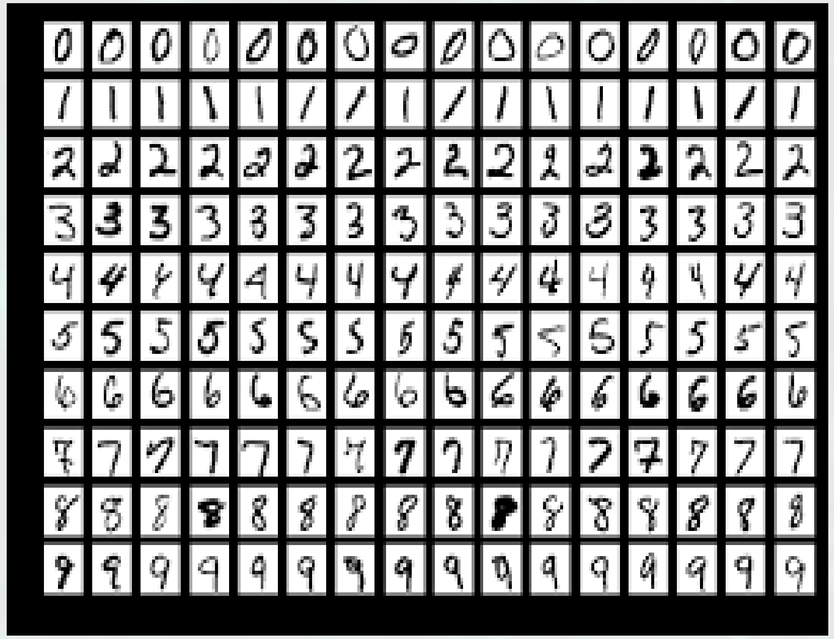


- The **CIFAR-10** dataset consists of **60,000 32x32** coloured images divided into **10 classes**, with **6000 images per class**. There are **50,000 training** images and **10,000 test** images.

- The dataset is divided into **five training batches** and one test batch, each with **10,000** images. The test batch contains exactly 1,000 randomly-selected images from each class. The training batches contain the remaining images in random order, but some training batches may contain more images from one class than another. Between them, the training batches contain exactly 5000 images from each class.

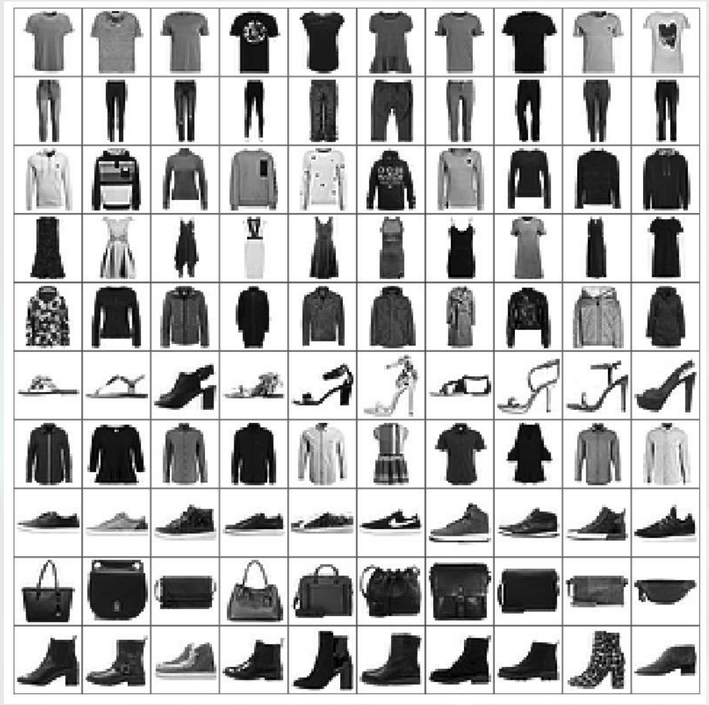
- The classes are completely **mutually exclusive**. There is **no overlap** between **automobiles** and **trucks**. "Automobile" includes sedans, SUVs, things of that sort. "Truck" includes only big trucks. Neither includes pickup trucks.

Computer Vision Datasets and Competitions



- The **MNIST** database of handwritten digits, available from this page, has a training set of **60,000** examples, and a test set of **10,000** examples.
- It is a subset of a larger set available from **NIST**. The digits have been size-normalized and centered in a fixed-size image.
- It is a good database for people who want to try learning techniques and pattern recognition methods on real-world data while spending minimal efforts on **preprocessing** and **formatting**.
- The images contain **grey levels** as a result of the **anti-aliasing technique** used by the normalization algorithm. The images were centered in a **28x28** image by computing the center of mass of the pixels, and translating the image so as to position this point at the center of the **28x28** field.

Computer Vision Datasets and Competitions



- **Fashion MNIST** is a dataset of **Zalando's** article images consisting of a training set of **60,000** images and a test set of **10,000** examples.

- Each example is a **28 x 28** grayscale image associated with a label from **10 classes**.

- Reasons for replacing MNIST according to **Zalando** opinions:

  - **MNIST is too easy.** Convolutional nets can achieve 99.7% on **MNIST**. Classic machine learning algorithms can also achieve 97% easily.

  - **MNIST is overused and cannot represent modern CV tasks**, as noted by deep learning **expert/Keras** author **François Chollet**.

References

Bengio, Y. (2009). Learning deep architectures for AI. Foundations and trends® in Machine Learning, 2(1), 1-127.

Hinton, G. E., & Salakhutdinov, R. R. (2006). Reducing the dimensionality of data with neural networks. *science*, *313*(5786), 504-507.

Chellappa, R. (2012). Mathematical statistics and computer vision. Image and Vision Computing, 30(8), 467-468.

Tsukahara, J. S., Harrison, T. L., & Engle, R. W. (2016). The relationship between baseline pupil size and intelligence. Cognitive Psychology, 91, 109-123.

Francesco Pugliese - Deep Learning al servizio del Riciclo https://www.wired.it/attualita/tech/2018/09/20/party-cloud-ibm-deep-learning/

Srivastava, N., Hinton, G. E., Krizhevsky, A., Sutskever, I., & Salakhutdinov, R. (2014). Dropout: a simple way to prevent neural networks from overfitting. Journal of Machine Learning Research, 15(1), 1929-1958.

DEEP LEARNING LESSONS

Deep, Consciousness and AI Learning

Francesco Pugliese, PhD

neural1977@gmail.com

Thank You