The background features a central, semi-transparent human figure with a glowing blue energy core. Surrounding this figure are several rectangular frames, each containing anatomical diagrams of the human body, such as the muscular system and internal organs. A robotic hand is visible on the left side, and a human hand is pointing towards the center on the right side. The overall color scheme is a deep teal with glowing blue particles and lines, suggesting a high-tech, futuristic medical environment.

AI IN MEDICAL IMAGING

X Spring School
28th September 2022

Eng. Teresa Pace
O3 Enterprise, Italy

AI in medical imaging

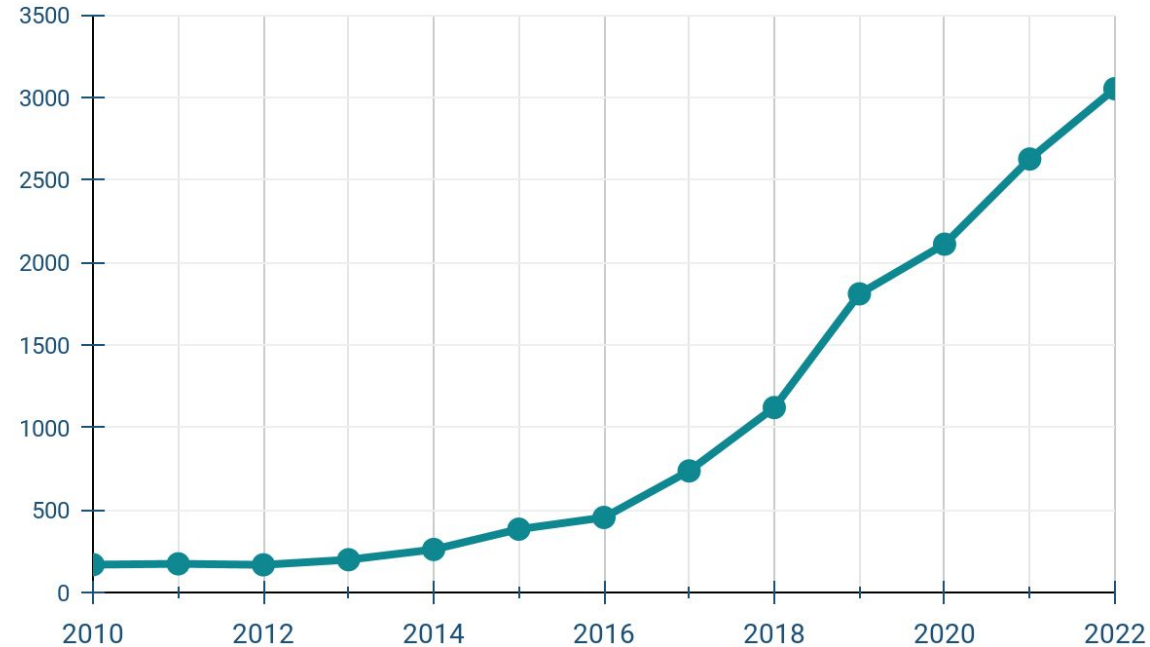
Overview

- Potential of AI in medical imaging
 - **Applications**
- **Theoretical concepts**
 - AI, Machine Learning, Deep Learning
 - Artificial Neural Networks
 - Convolutional Neural Networks
- **Practical example**
 - Classification of tissues in colorectal cancer histology



One of the most promising areas of health innovation is the application of artificial intelligence (AI) in medical imaging, including, but not limited to, image processing and interpretation

AI scientific publications



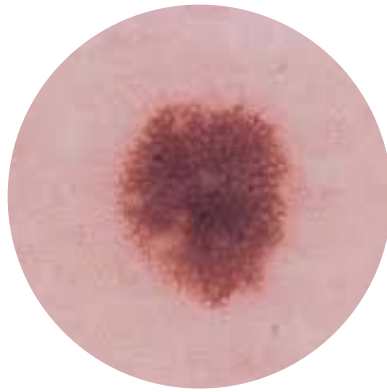
SUBJECT AREA (from Scopus)
Radiology, Nuclear Medicine and Imaging

Applications in medical imaging

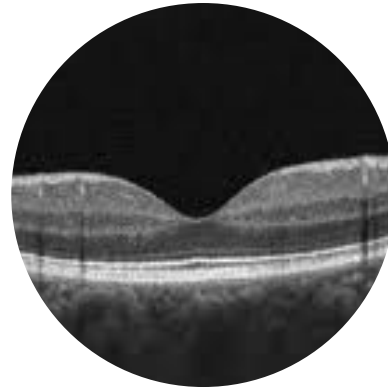
In medicine, AI systems have become dominant in all the main image-centric specialties



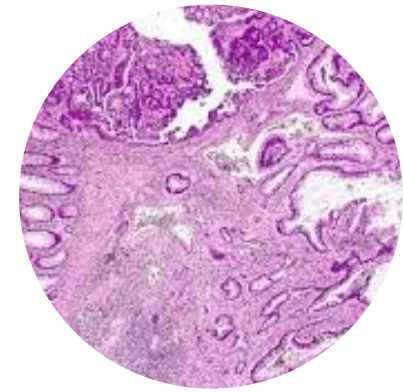
Radiology



Dermatology



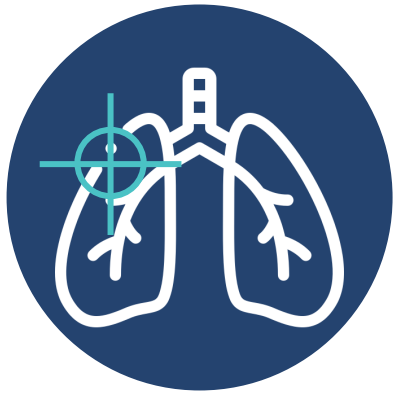
Ophthalmology



Pathology

Applications in medical imaging

AI applications within medical imaging could be divided into the following categories



Detection



Classification



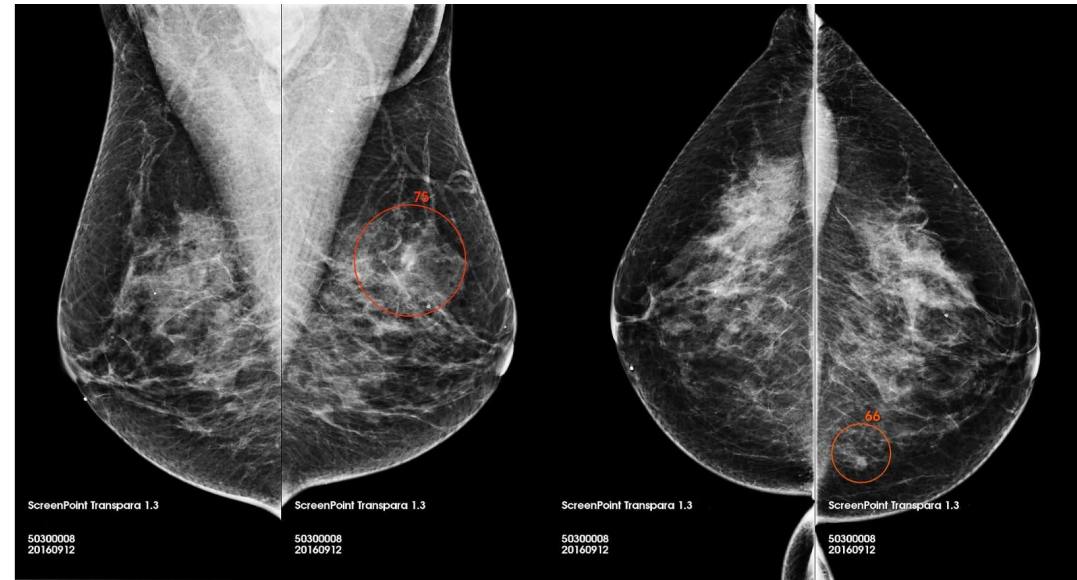
Segmentation

Applications in medical imaging

Detection

Detect potential abnormalities within images on the basis of changes in intensities or appearance of unusual patterns

Mainly used for Computer-Aided Diagnosis (CAD) systems



Transpara by ScreenPoint Medical: AI applied to CAD

Applications in medical imaging

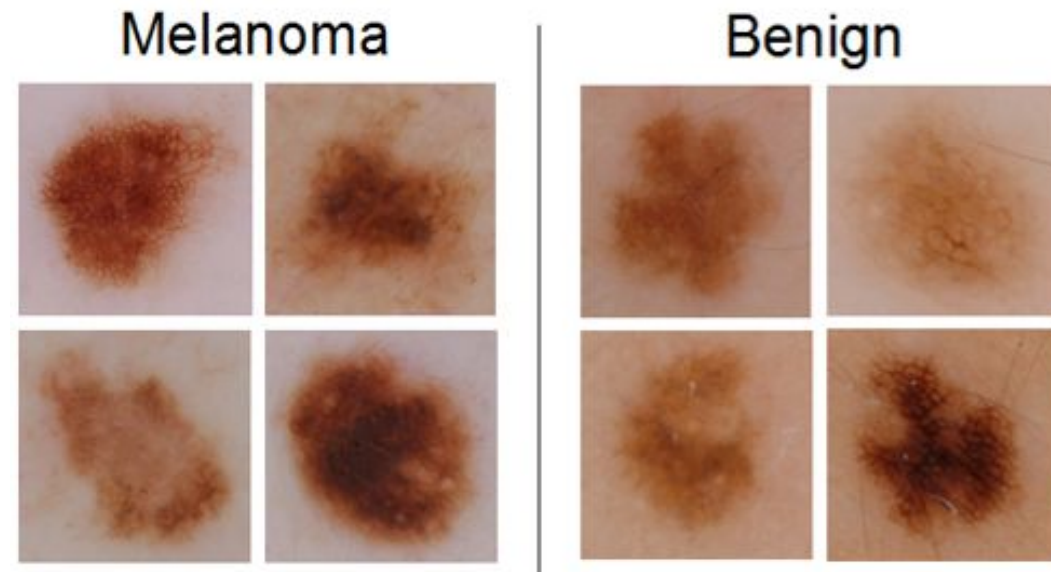
Classification

Diagnosis

Evaluate and classify abnormalities such as benign vs malignant

Staging

Classify abnormalities into multiple predefined categories such as the TNM classification of malignant tumors



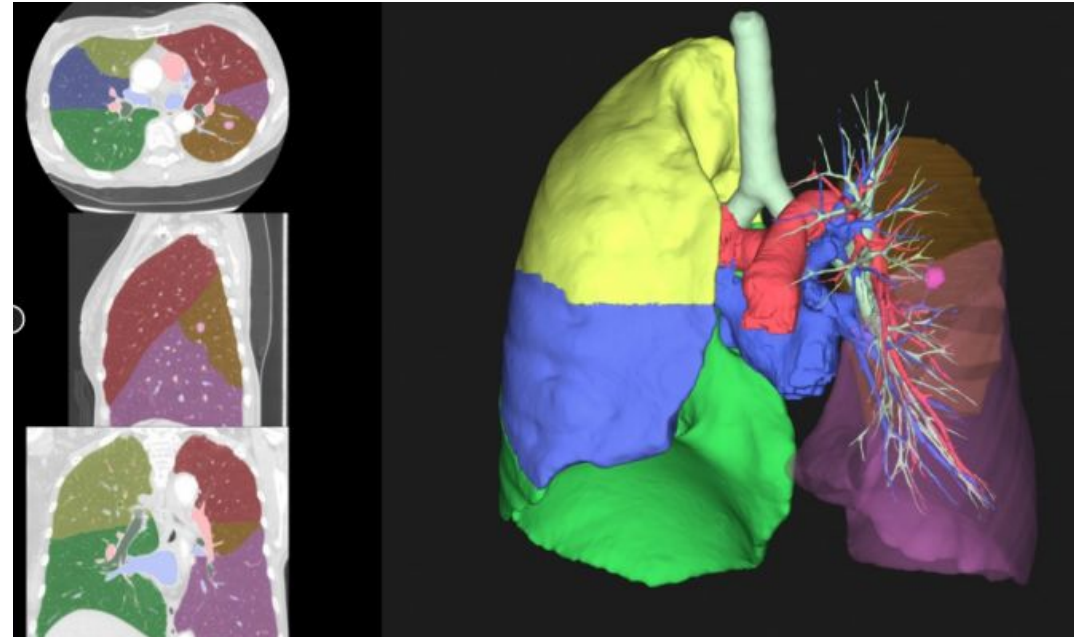
IEEE ISBI 2016 Challenge: Skin Cancer Classification Challenges

Applications in medical imaging

Segmentation

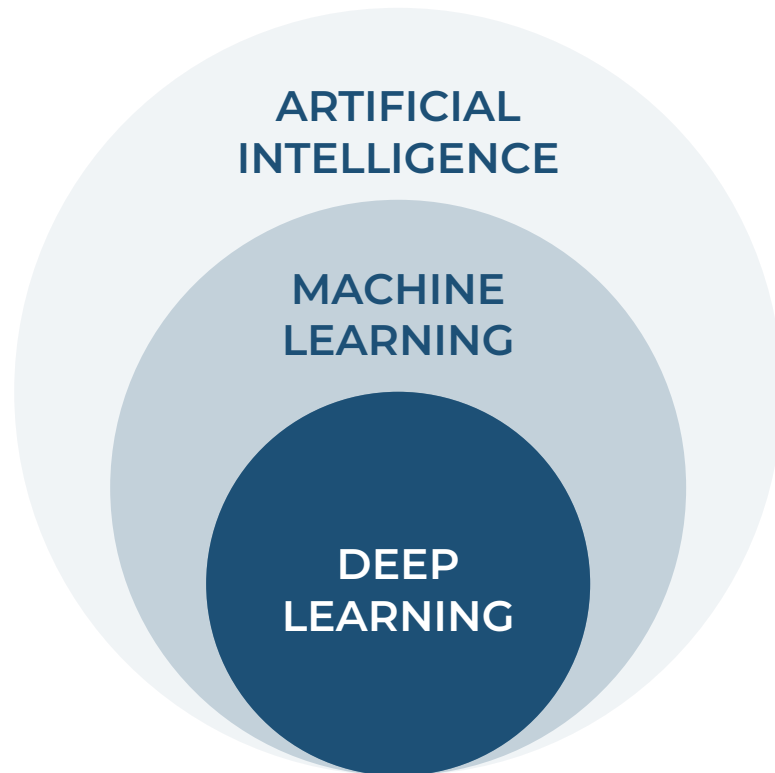
Define the boundary extend of organs, anatomical structures or abnormalities

Mainly used for quantitative evaluation of clinical parameters (organ volume and shape) for diagnosis and evaluating treatment response



REiLI by Fujifilm: Region Recognition AI technology

What is AI?

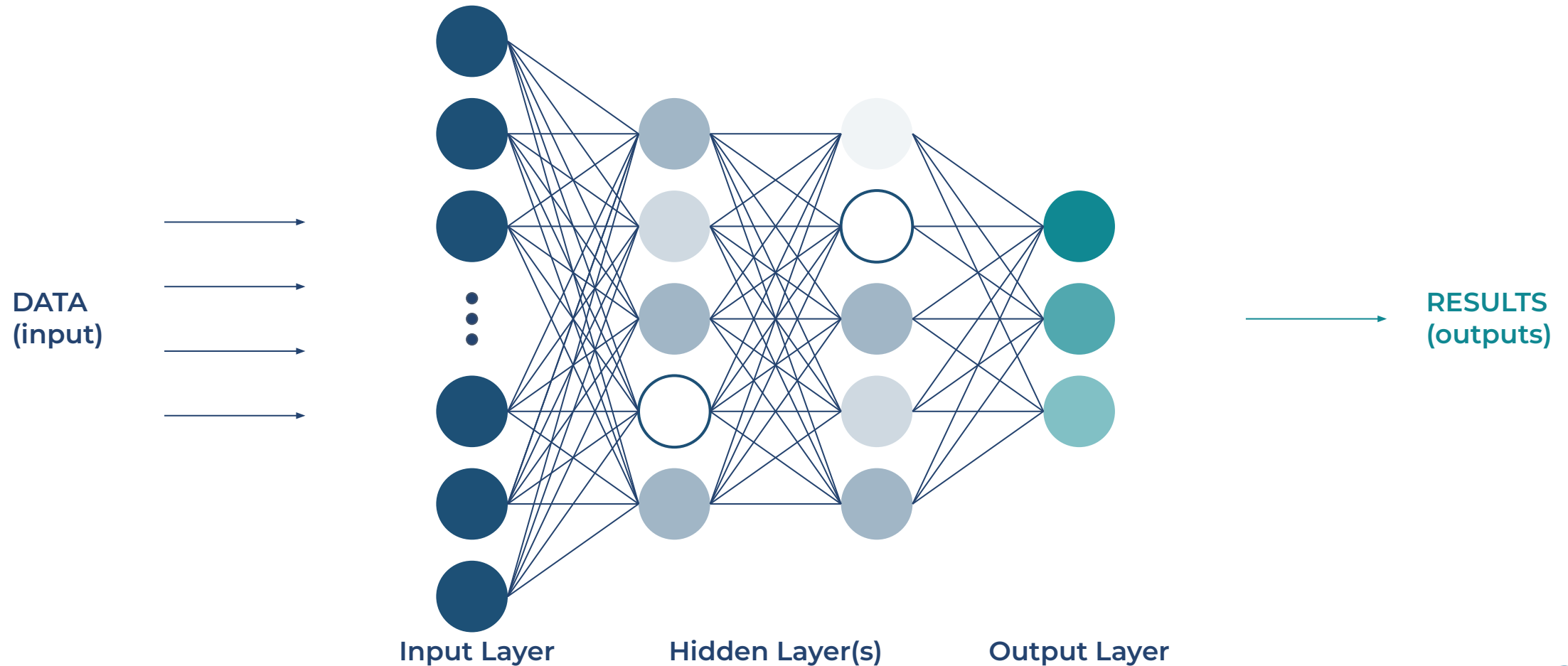


ARTIFICIAL INTELLIGENCE Effort to automate intellectual tasks normally performed by humans

MACHINE LEARNING Algorithms which use statistical methods to enable machines to improve at tasks with experience

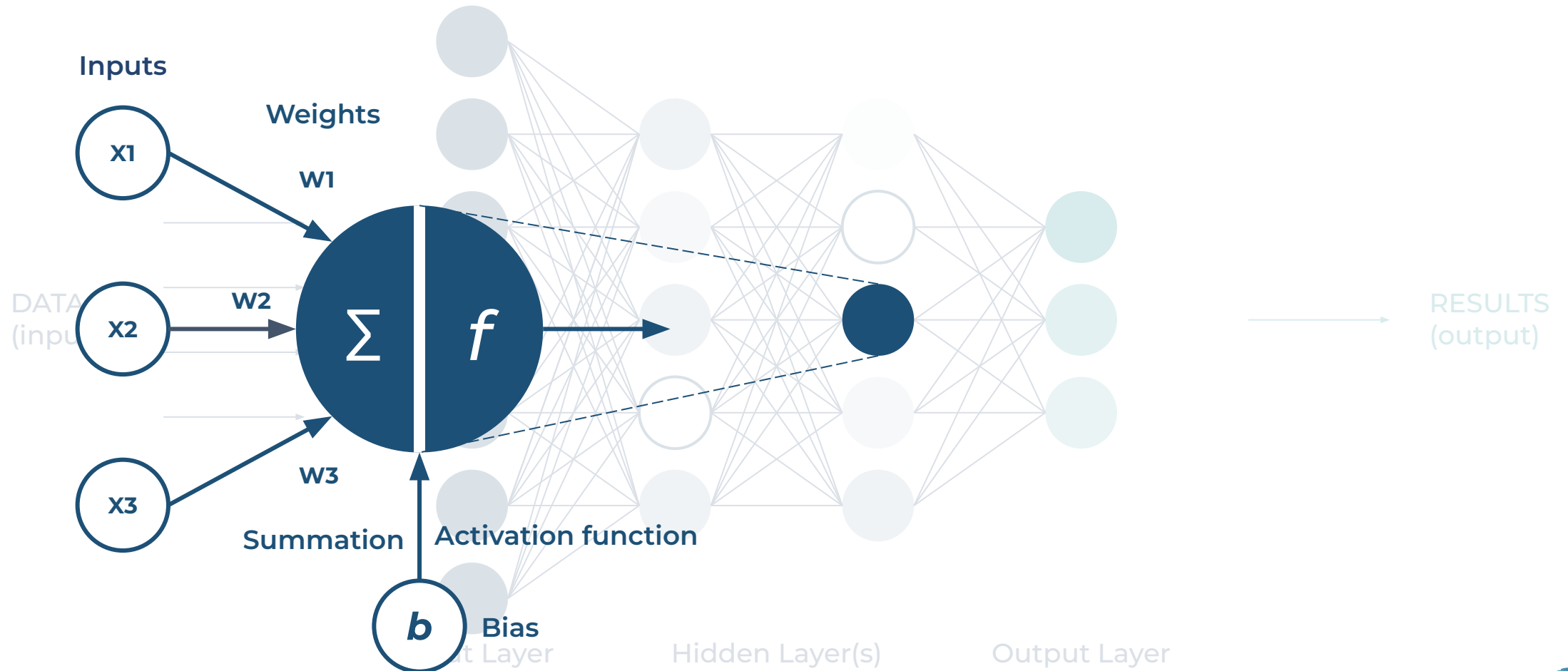
DEEP LEARNING Subset of machine learning in which algorithms with brain-like logical structure adapt and learn from vast amounts of data

Artificial Neural Networks

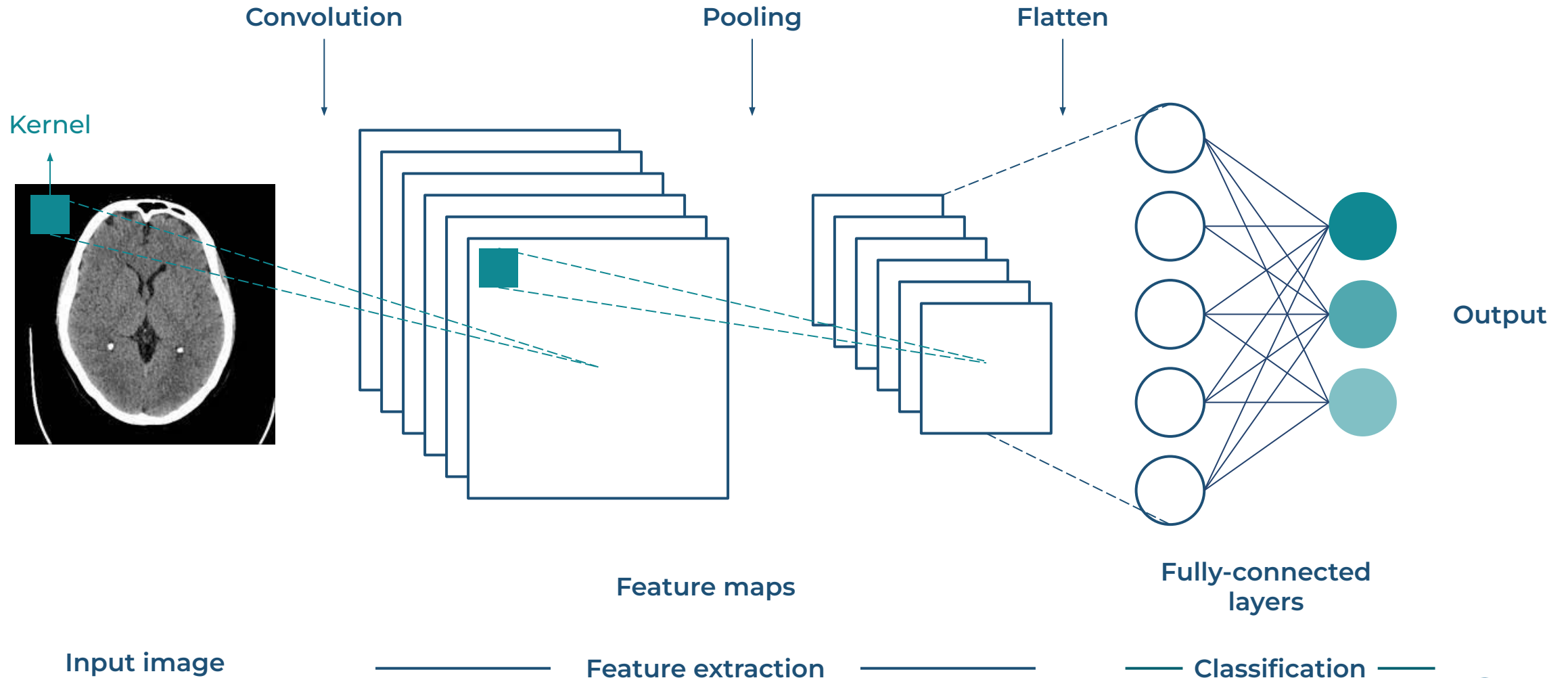


Artificial Neural Networks

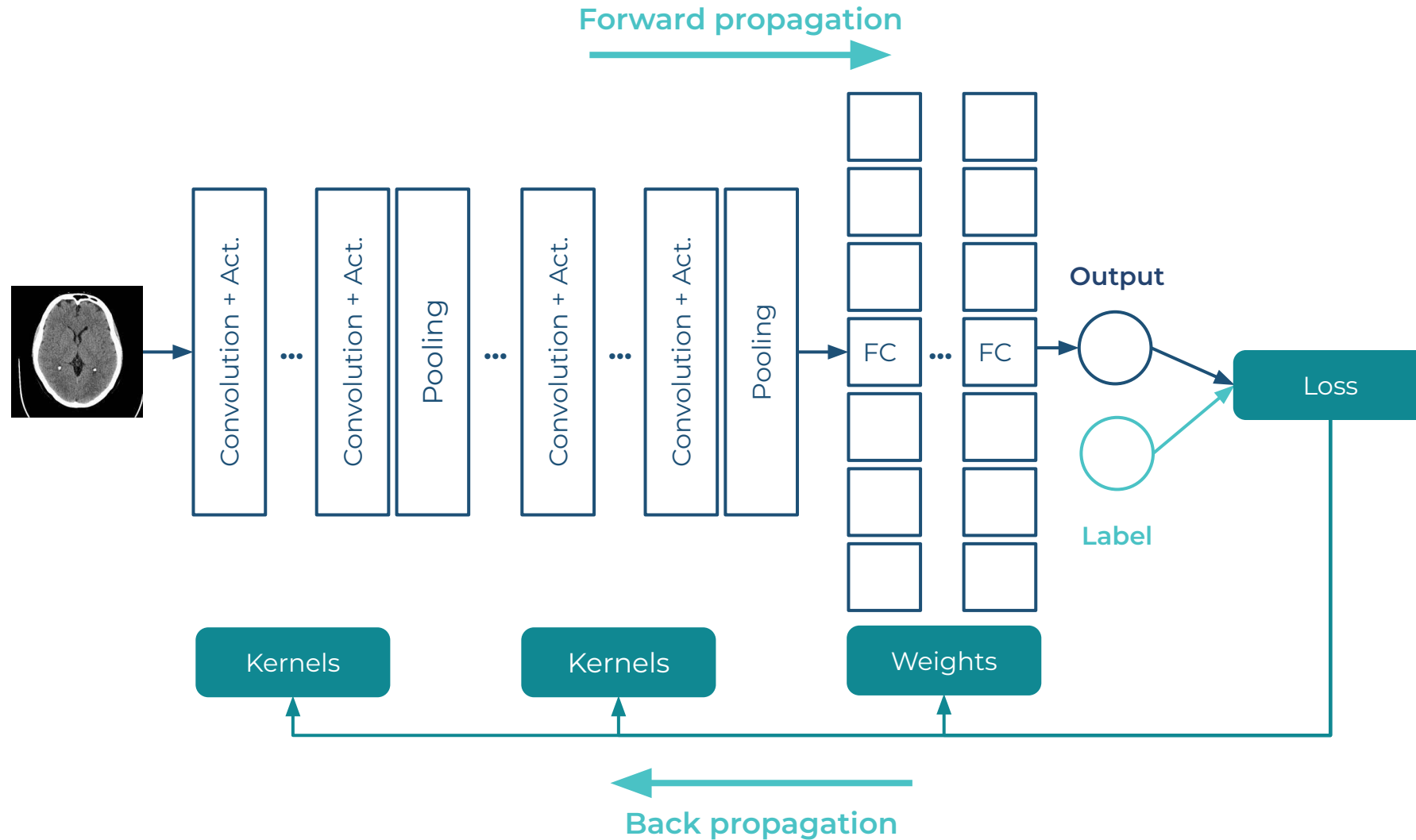
Artificial Neuron



Convolutional Neural Networks



Training a network



A practical example

The screenshot shows a Jupyter Notebook titled "X Spring School Trieste 2022.ipynb". The notebook content is organized into sections:

- AI in medical imaging: a practical example**
 - The goal of this practical example is to build a simple deep learning classifier to differentiate tissue in histology tiles from patients with colorectal cancer.
 - The source of images is the ready-to-use [colorectal histology](#) dataset provided by **TensorFlow Datasets**.
 - The dataset consists in 5000 histology image tiles of size (150x150x3) divided in 8 classes of tissue.
 - How to enable the GPU:** *Runtime > Change Runtime Type > GPU*
 - ```
[] import tensorflow as tf
import tensorflow_datasets as tfds
import matplotlib.pyplot as plt
import numpy as np

import sklearn.metrics
```
- Collect the data**
  - Download the dataset into a [tf.data.Dataset](#) and split the data into training, validation, and test sets.
  - The model will be trained on the training data and evaluated on the validation data. Once ready, it will be tested one final time on the test data.
  - ```
[ ] (train_ds, val_ds, test_ds), info = tfds.load('colorectal_histology', split=['train[:80%]', 'train[80%:90%]', 'train[90%:]'], as_supervised=True, shuffle_files=False, with_info=True)
```

The interface includes a top navigation bar with "File", "Edit", "View", "Insert", "Runtime", "Tools", and "Help" menus, and a status bar showing "RAM" and "Disk" usage, "Editing" mode, and a "T" icon.