Laboratory Class WORK Number 7: MULTILAYER NEURAL NETWORKS , TREE CLASSIFIERS and UNSUPERVISED Methods applied to PET and Magnetic Resonance BRAIN Images

The Database used in this practice has been provided by The “Institut d’Alta Tecnología PRBB, Hospital del Mar, Barcelona”:

www.prbb.org

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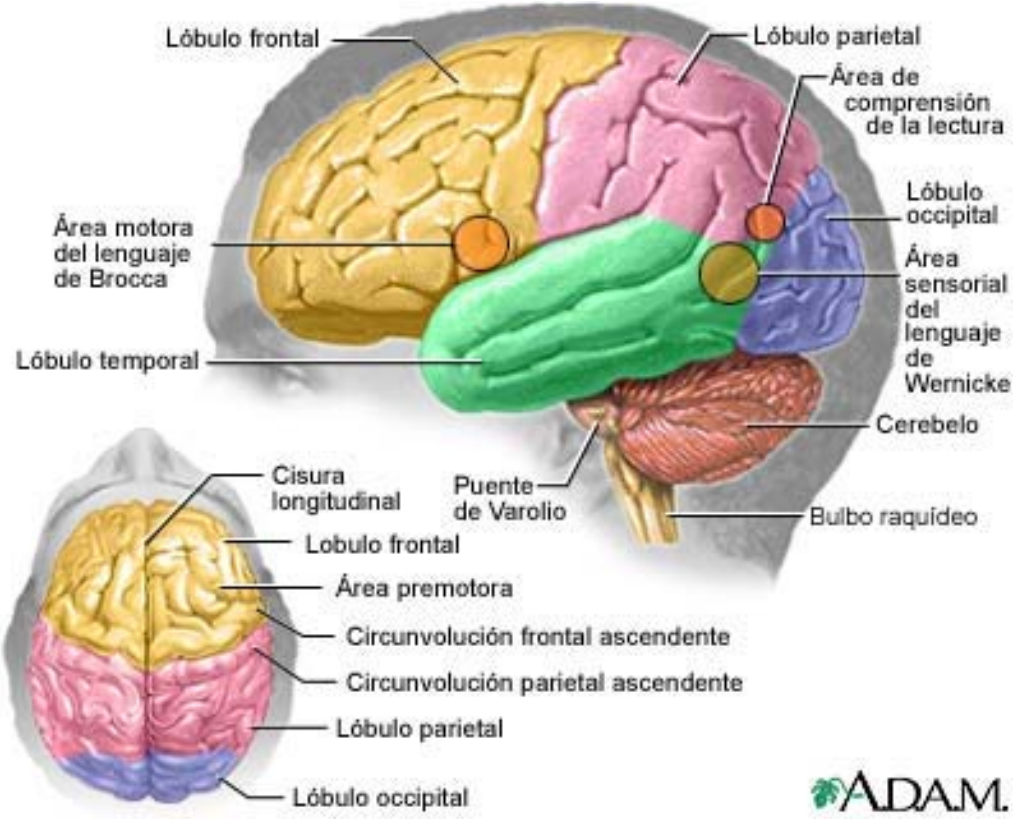
1 The Human Brain

The Brain:

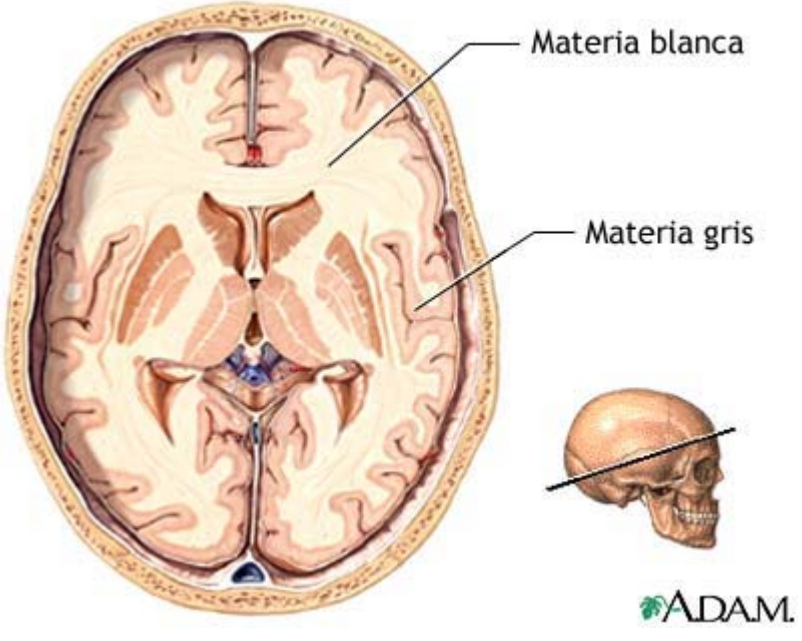
El cerebro es la parte antesuperior del encéfalo y el centro supervisor del sistema nervioso. Consta de la materia gris (parte superficial llamada corteza y el núcleo) y la materia blanca (partes profundas a excepción del núcleo). Las áreas principales del cerebro tienen una o más funciones específicas .



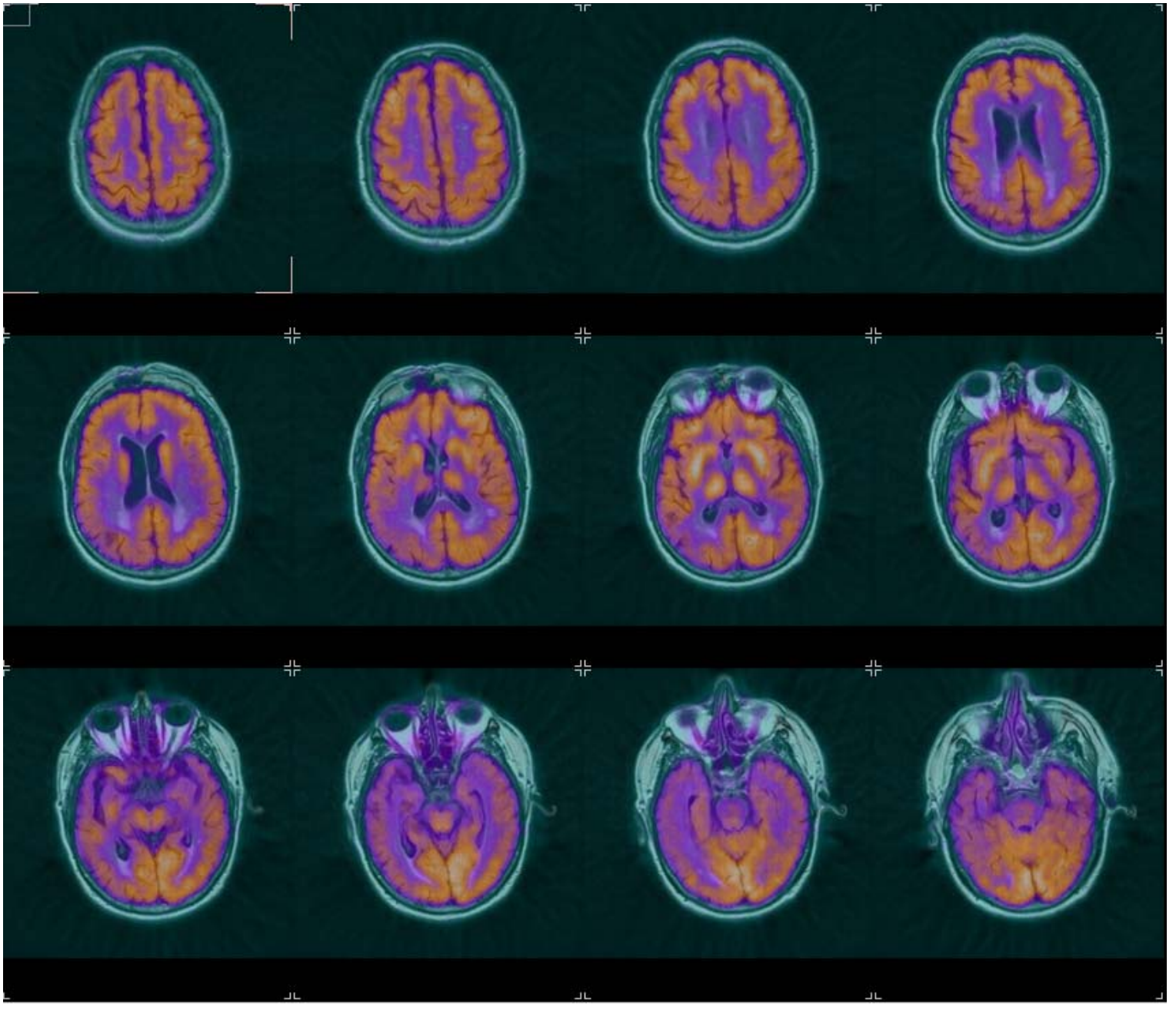
1 The Human Brain

Brain Images:

El tejido llamado "materia gris" presente en el cerebro y en la médula espinal es también conocido como sustancia grisácea y está compuesto por cuerpos celulares. La "materia blanca" o sustancia alba está compuesta por fibras nerviosas.



Typical Brain Cuts



2 PET Techniques

Positron Emission Tomography (PET)

is a method of nuclear medical imaging which allows displaying metabolic activity in a slice of the body by means of detecting radiation, emitted from a radio-isotope injected into the patient's body. PET is one of the most efficient tools for early detection and treatment monitoring of cancer as well as for neurological diseases such as Alzheimer's, Parkinson's and epilepsy.

Next Two slides have been obtained from:

http://visl.technion.ac.il/bron/works/

Lectured by Alexander Bronstein, Michael Bronstein, Michael Zibulevsky, Yehoshua Y. Zeevi from the TECHNION – ISRAEL INSTITUTE OF TECHNOLOGY

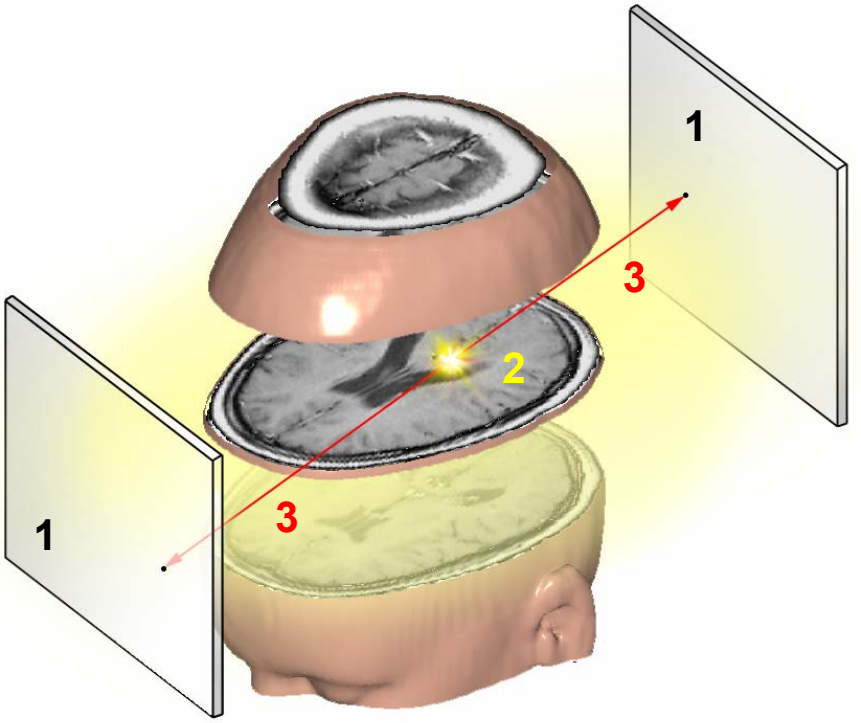
DEPARTMENT OF ELECTRICAL ENGINEERING

THE VISION AND IMAGE SCIENCE LABORATORY (VISL)

More Information on PET:

http://visl.technion.ac.il/bron/works/pet/SLIDES_nnpet.pdf

2 PET Techniques



1 – SCINTILLATION DETECTORS
2 – SCINTILLATION POSITION
3 – PHOTON PAIR LINE OF FLIGHT

DATA ACQUISITION:

PET utilizes the so-called coincident event imaging principle.

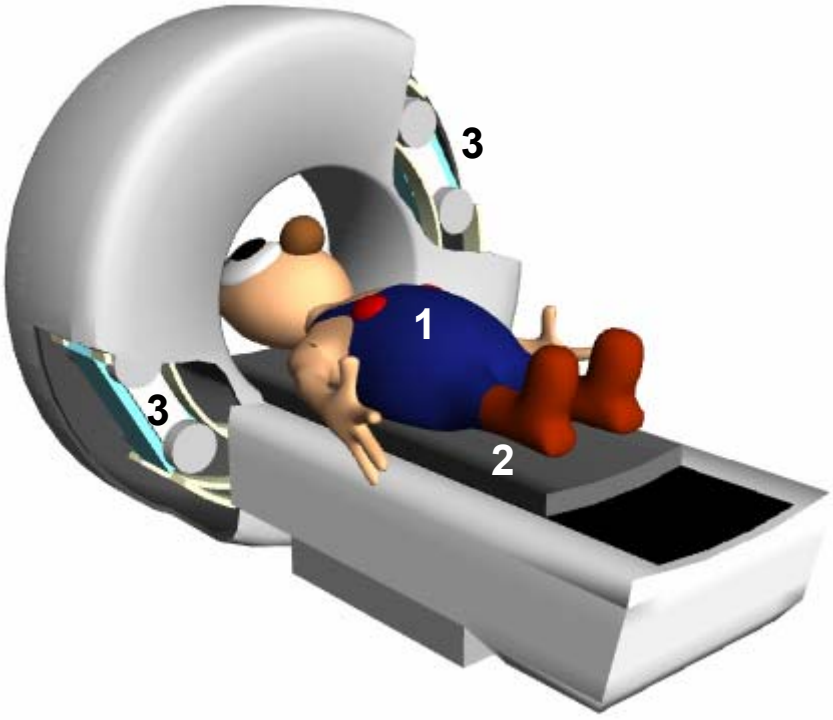
Both photons of the produced pair must be detected by a pair of opposite scintillation detectors in order to record an event.

Detector readouts are used to reconstruct the line of flight of the photon pair, i.e. the line, on which the annihilation has occurred.

A reconstruction algorithm produces an image from the acquired data.

During a typical PET scan 1-100 millions of events are recorded.

2 PET Techniques



1 – PATIENT'S BODY,
2 – SLIDING BED,
3 – ROTATING PAIR OF SCINTILLATION DETECTORS

PET SCANNER CONSTRUCTION

Typical PET scanner configuration includes a large ring with an aperture of circular form into which the patient's body is inserted on a sliding bed.

The detectors are either static (full-ring) or rotating around the object and collecting the emitted radiation.

The acquired information is processed using a digital computer to reconstruct the image.

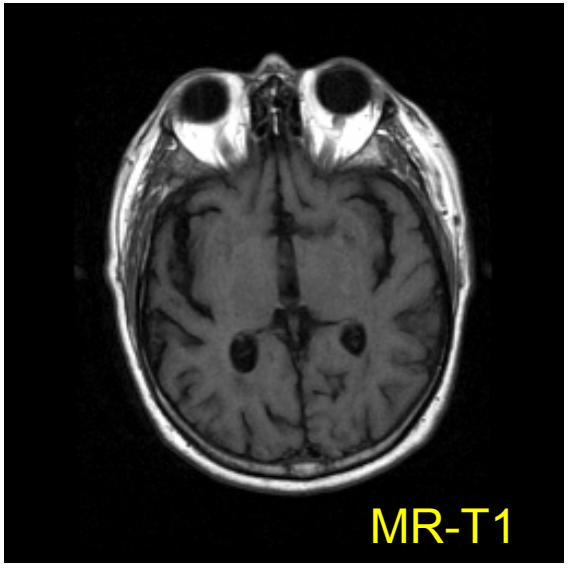
3 The DataBase: PRBB_Brain

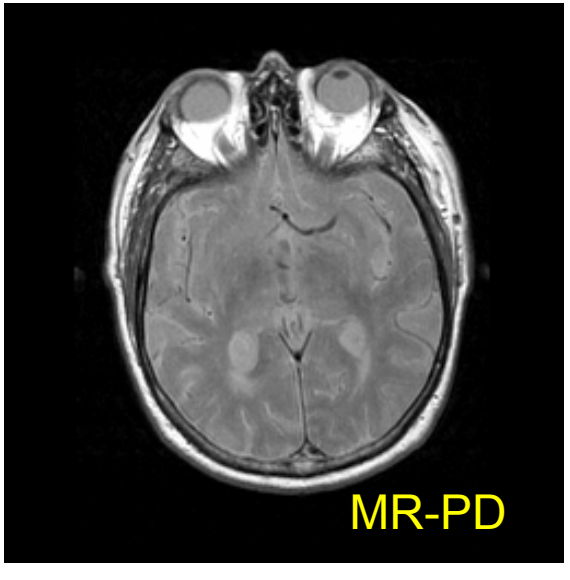
The database is formed by 8 Images. All of them correspond to a single Human Brain Cut

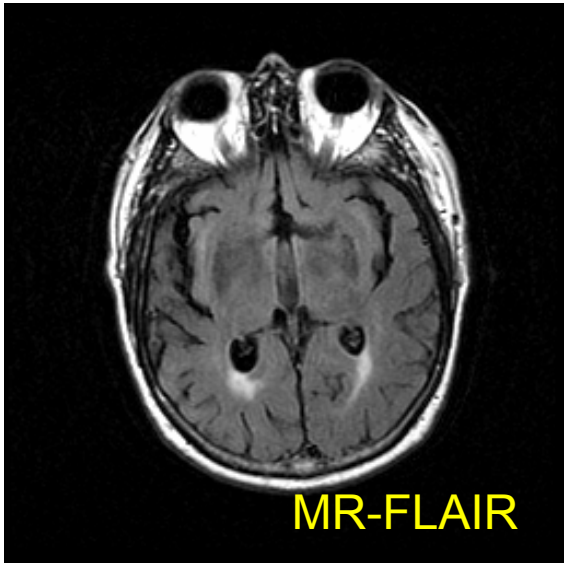
- Images 1..4: Obtained by Magnetic Resonance
- Images 5: Positron emission tomography (PET)
- Images 6:8: Probabilities for each pixel to be in one of the three classes:
  - White (Materia Blanca) Class 2
  - Grey (Materia Gris) Class 1
  - LCR (Líquido Cefaloraquídeo) Class 3
- Each Image has 256x256 pixels = 65536 = N patterns
- Feature Vectors are formed taking d=5 pixels. Each feature “j” in a vector is obtained from the same horizontal-vertical pixel at the “j” image.

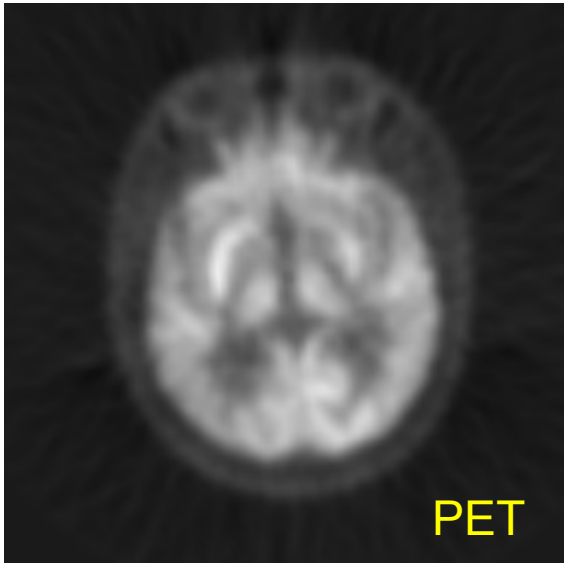
3 The DataBase:
PRBB_Brain

Images 1:5









3 The DataBase: PRBB_Brain Images 6:8