



In the name of wisdom

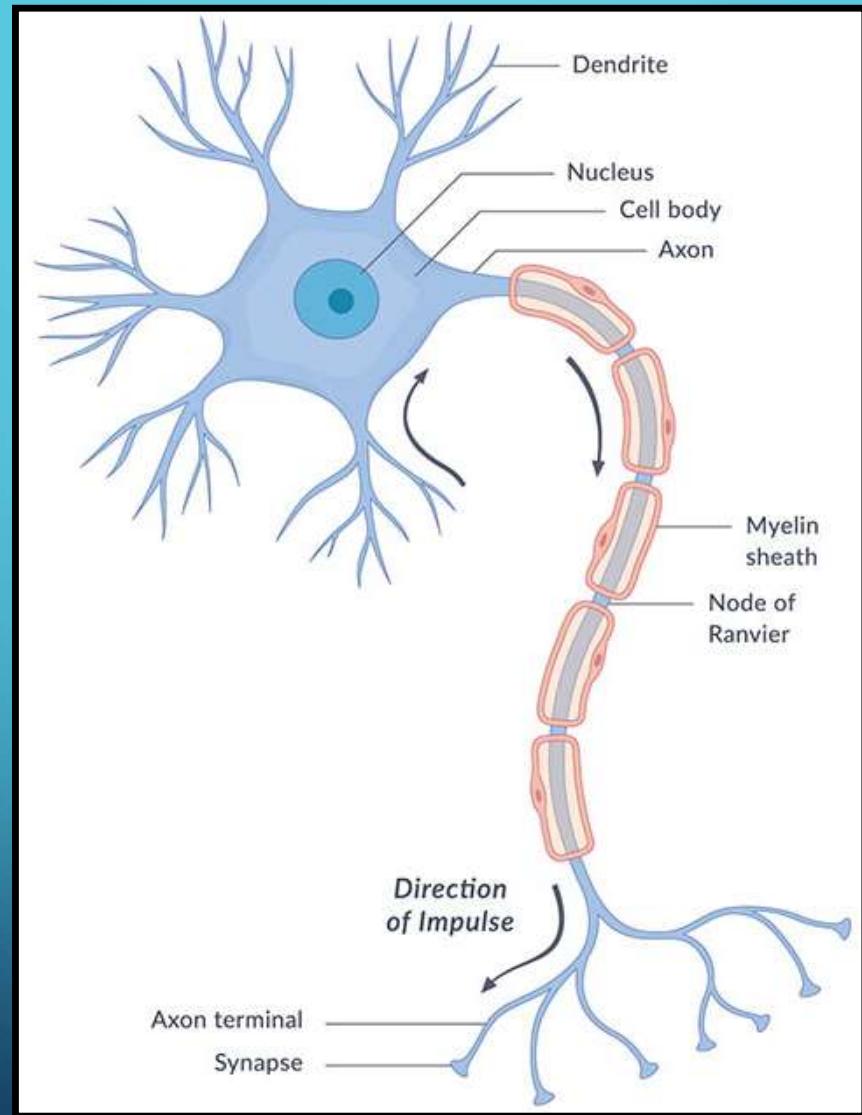
Neuroscience ,
Computational neuroscience &
relationships with AI

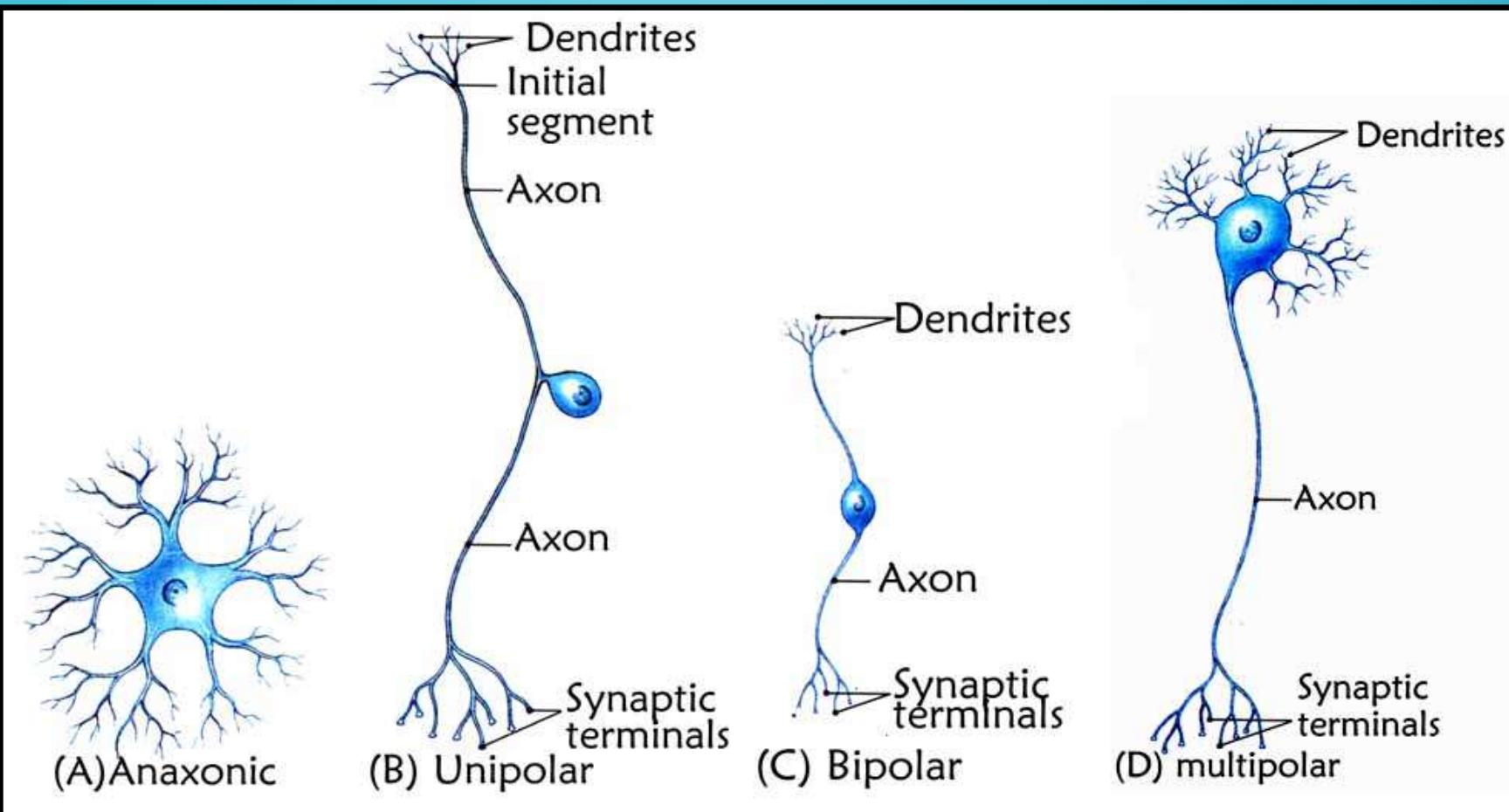
Lecturers:
Amirhossein rajabpour
Erfan miah
Ahmad mohammad alizadeh

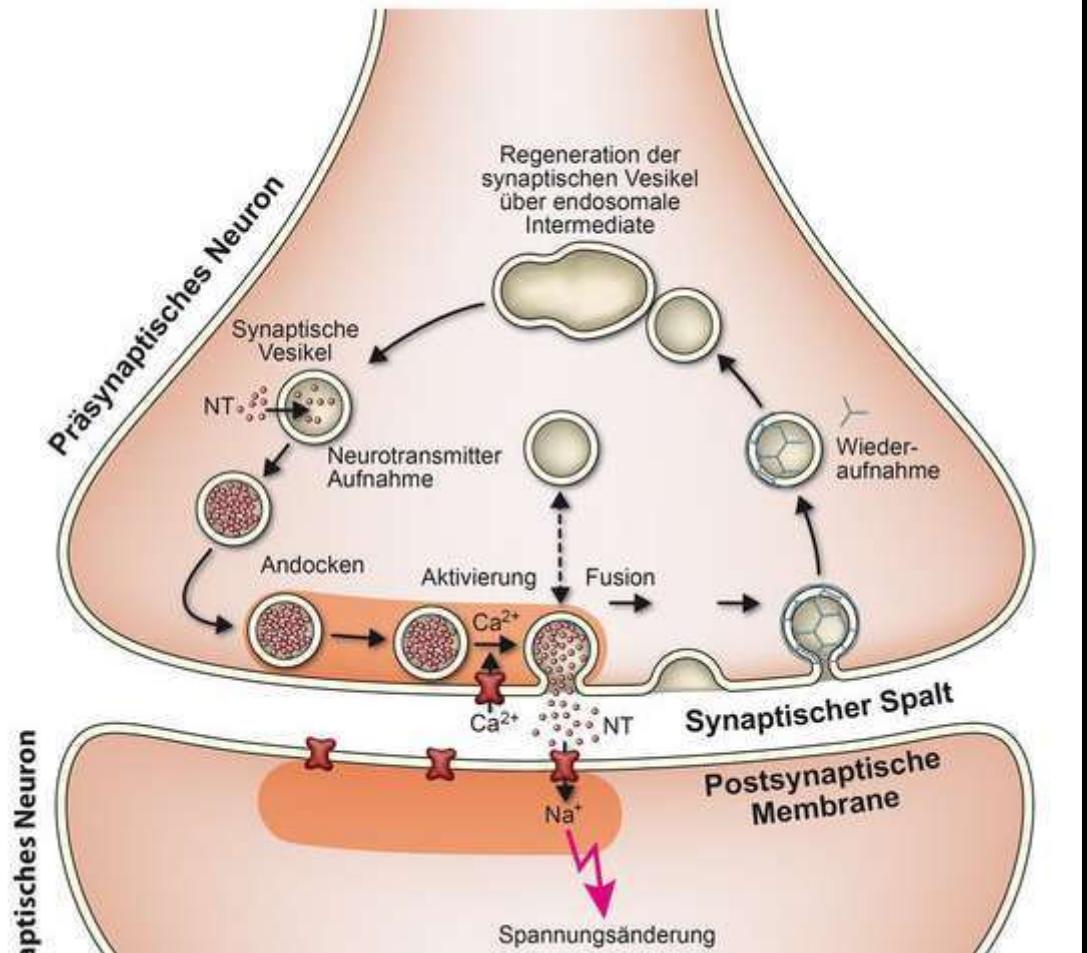
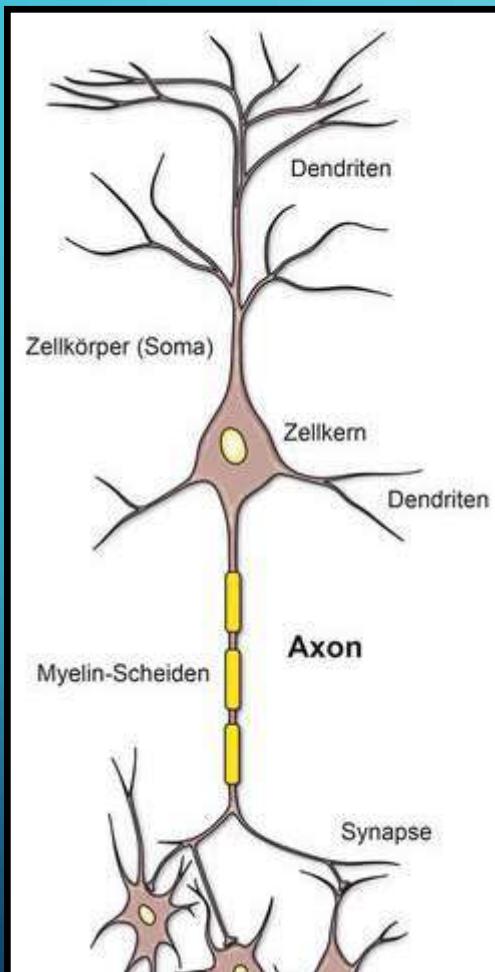


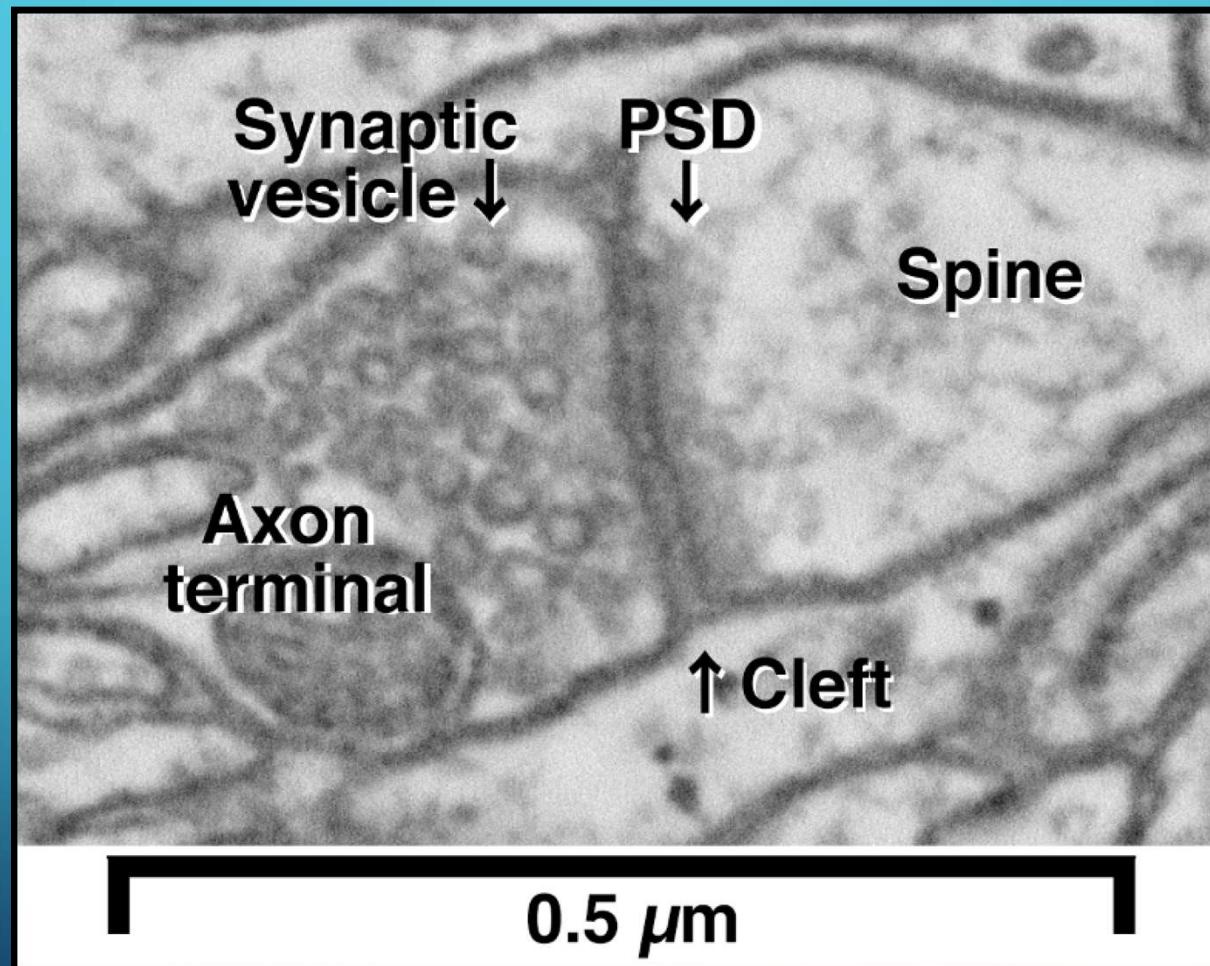
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NEUROSCIENCE

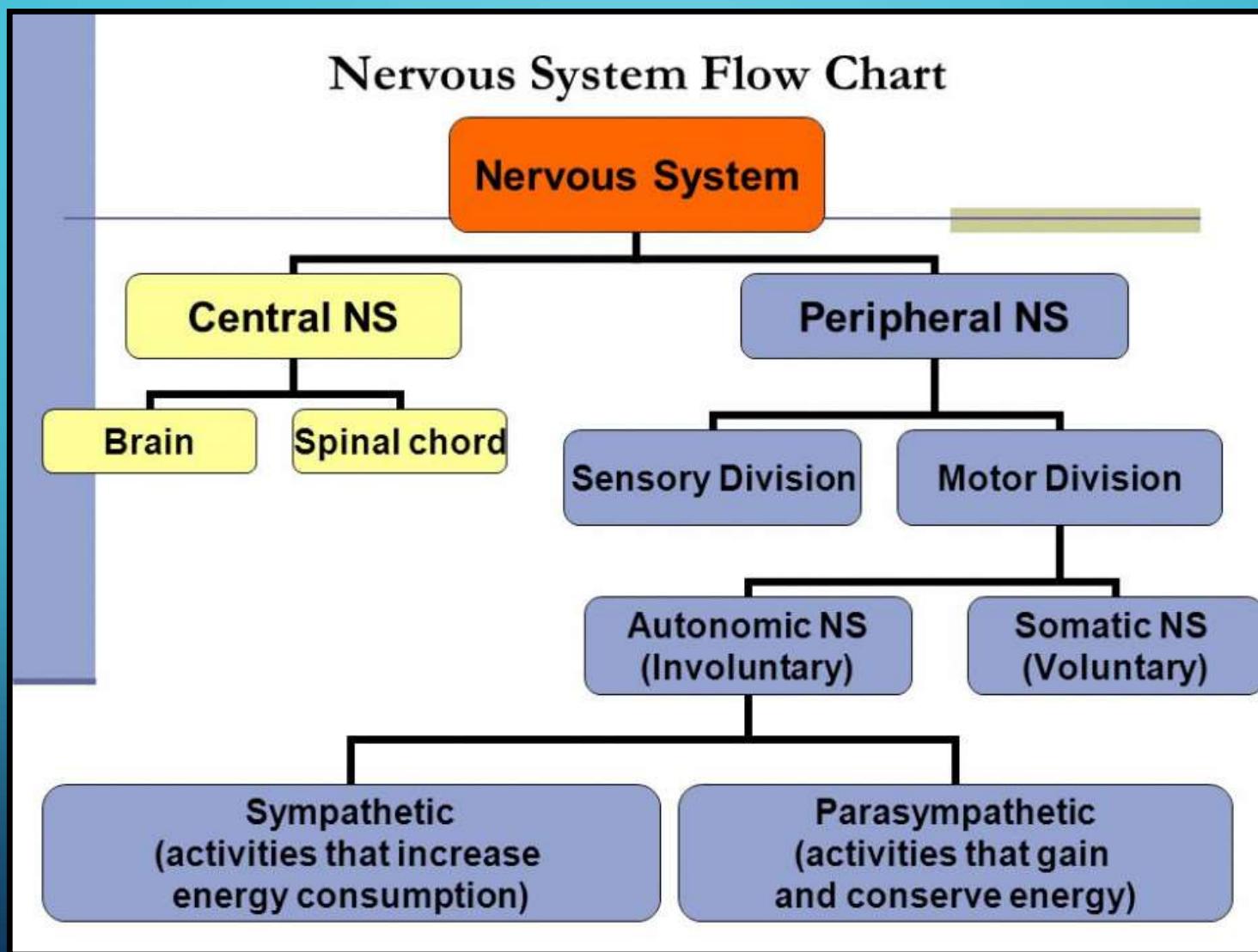




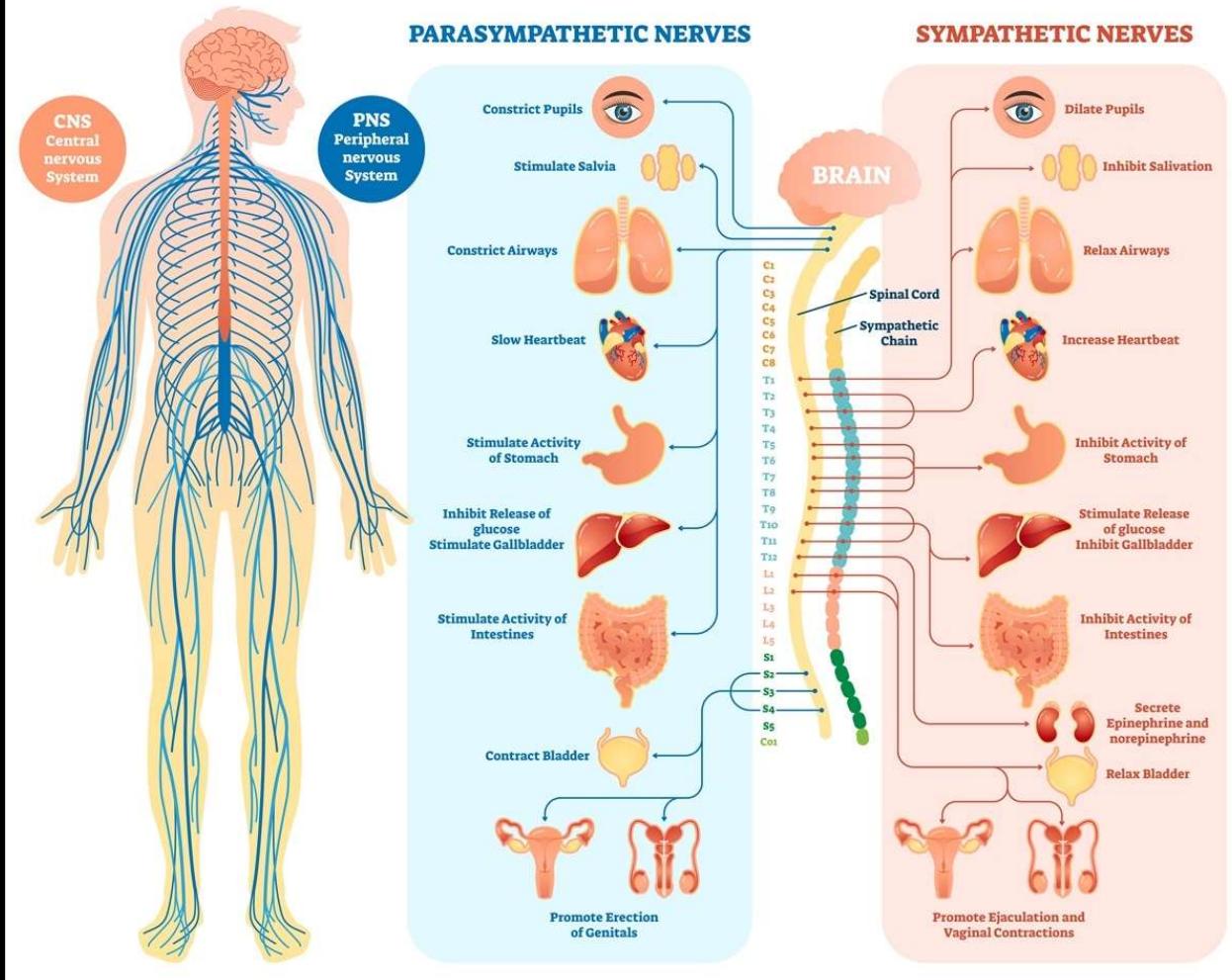


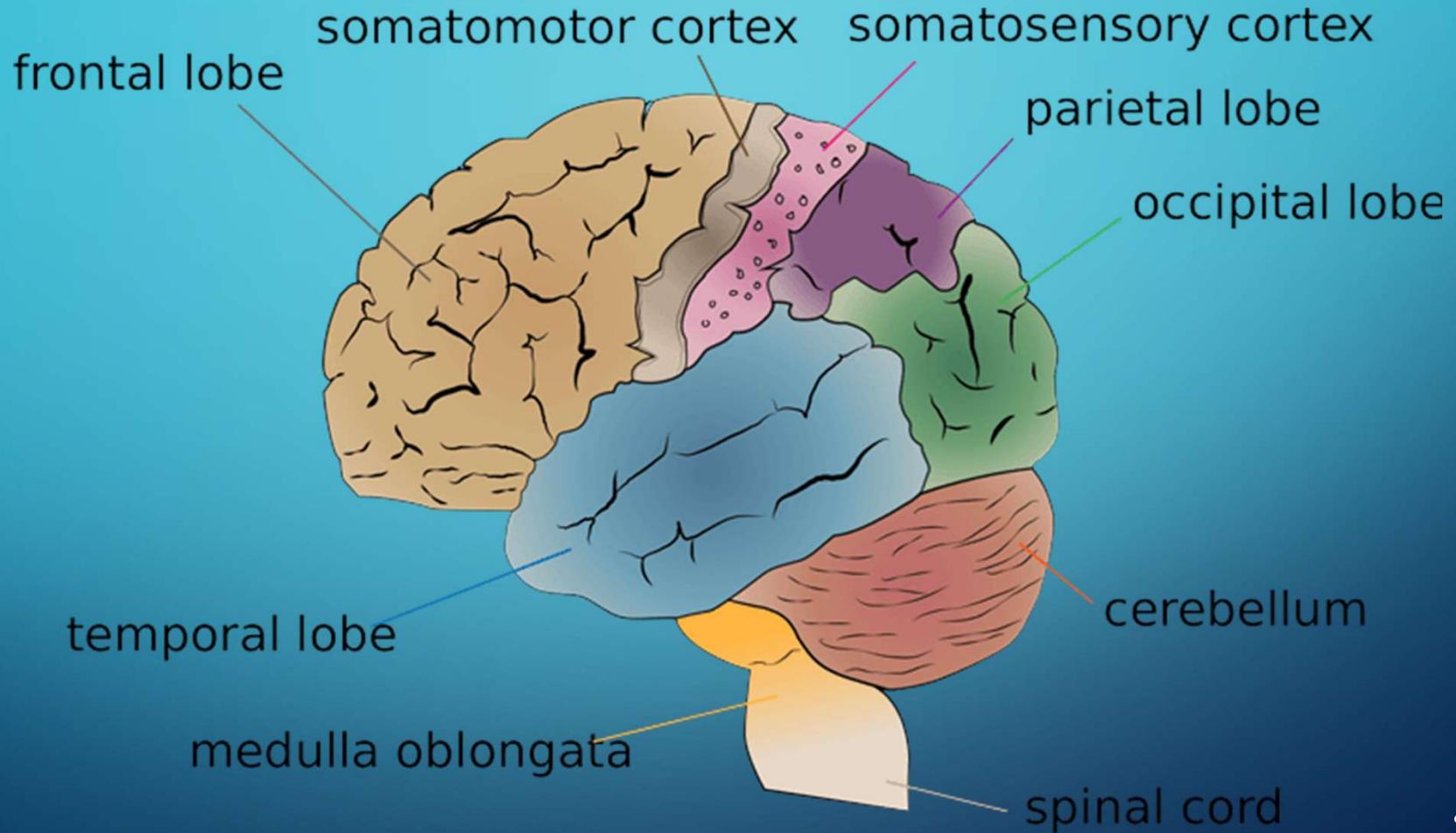


Nervous System Flow Chart



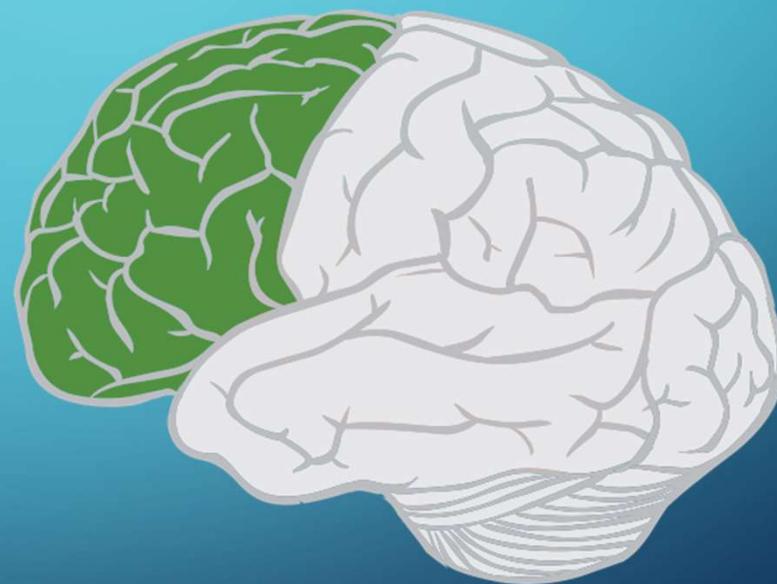
HUMAN NERVOUS SYSTEM





FRONTAL LOBE:

Motor activity
Problem solving
Judgement
Social behavior
Personality
Inhibition
Emotion traits
Language



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PARIETAL LOBE:

Processing sensory input
Sensory discrimination
Body orientation
Visual perception

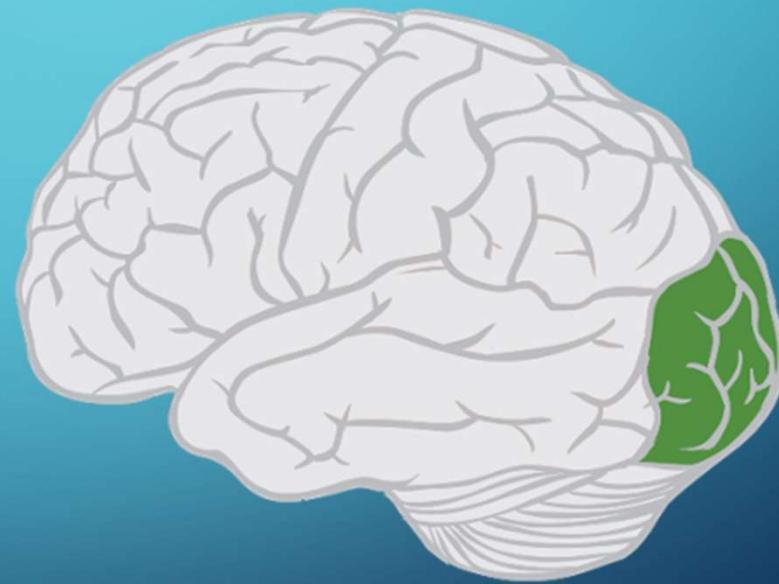


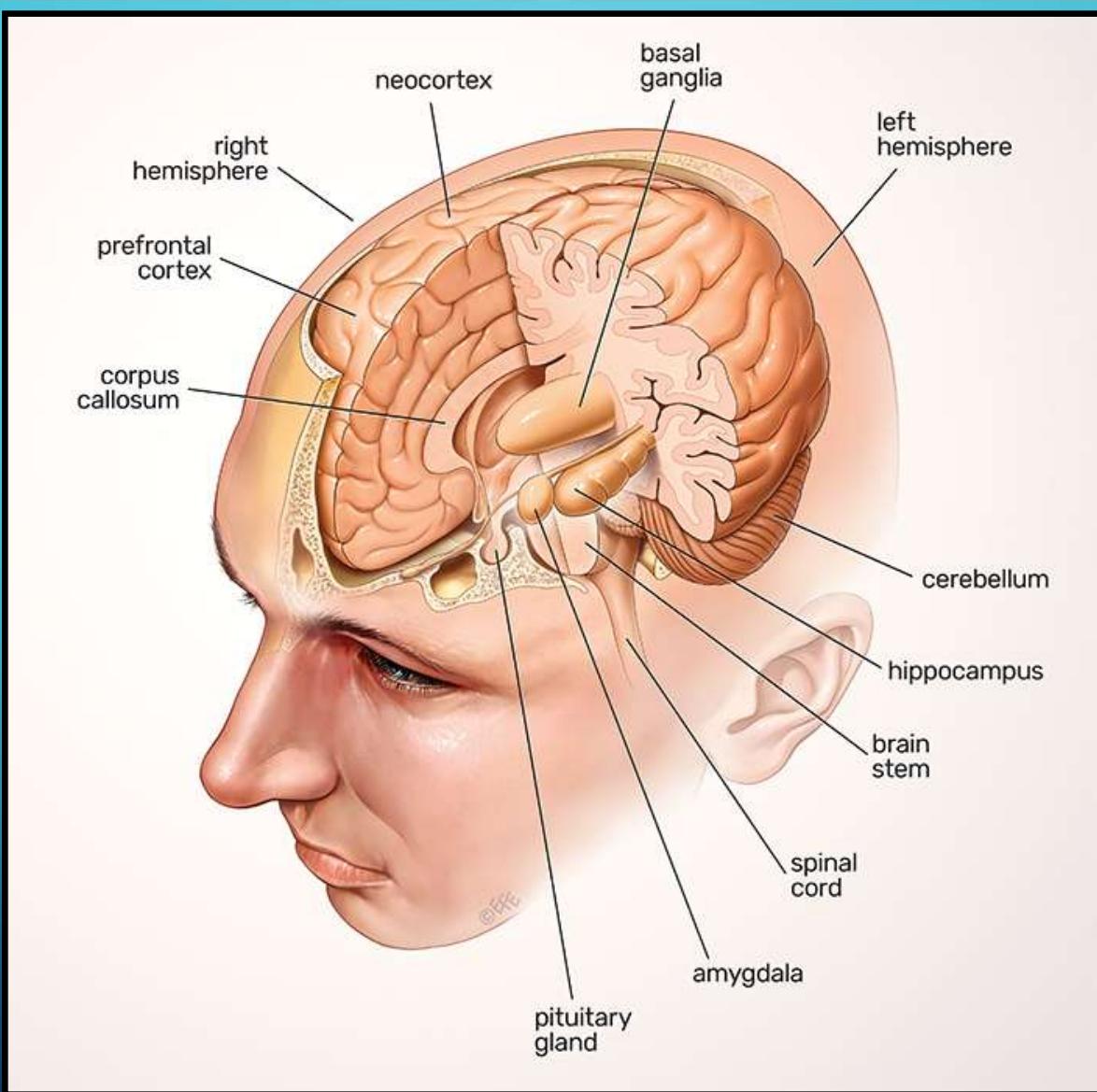
TEMPORAL LOBE:

- Auditory reception area
- Express behavior
- Information retrieval
- Language comprehension



OCCIPITAL LOBE:
Visual reception
Visual interpretation





Major branches of neuroscience:

- Cellular neuroscience
- Clinical neuroscience
- Cognitive neuroscience
- Developmental neuroscience
- Evolutionary neuroscience
- Behavioral neuroscience
- Computational neuroscience

What is computational neuroscience?



Computational neuroscience is a branch of neuroscience which uses computational approaches, to study the nervous system



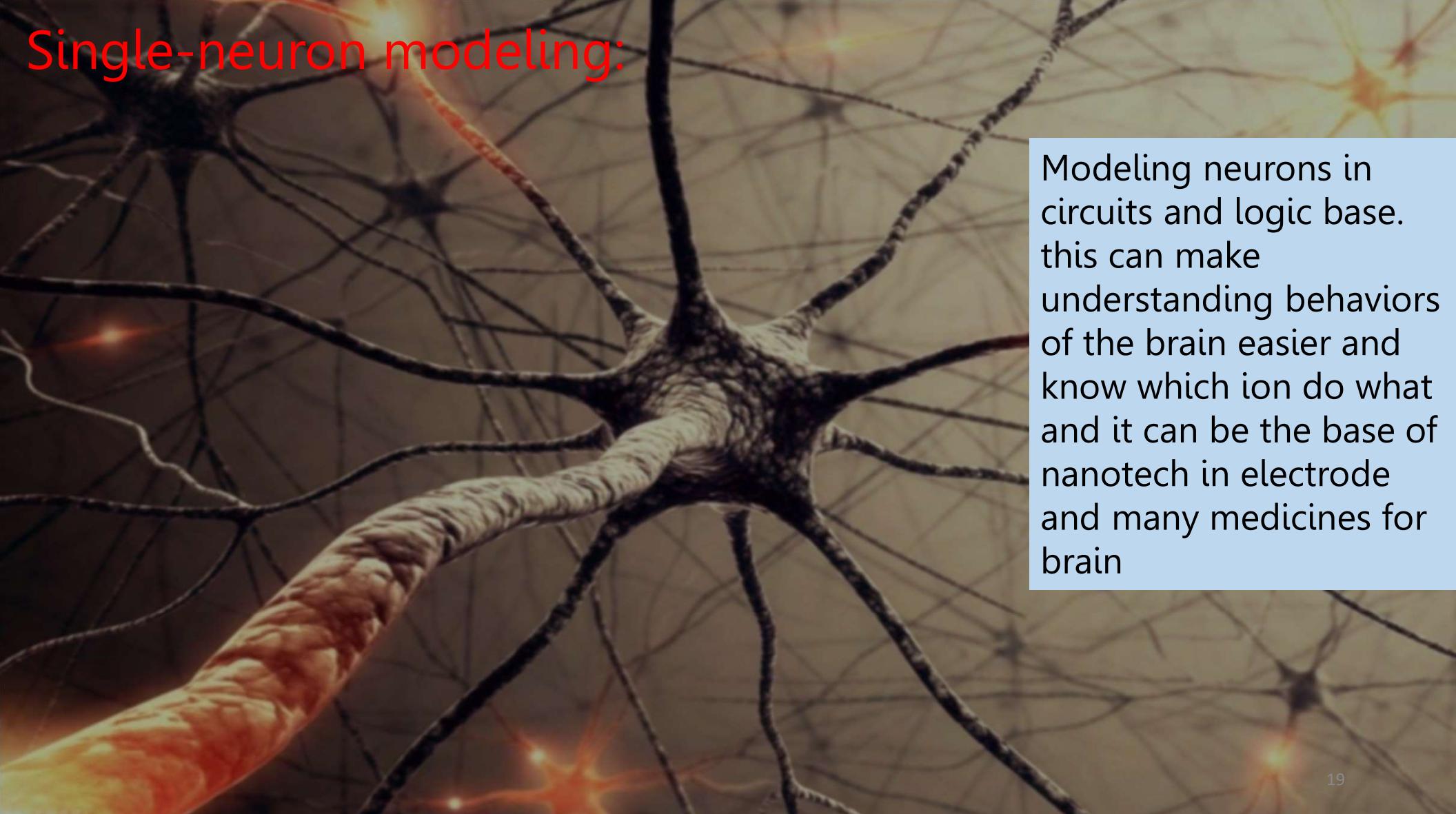
Where is the position of computational neuroscience among fields?

It is a multidisciplinary branch of neuroscience that combines Neurobiology and medicines, Theory/modeling, Philosophy, Applied physics, engineering and Computer science.

Some topics which Computational Neuroscience is working on:

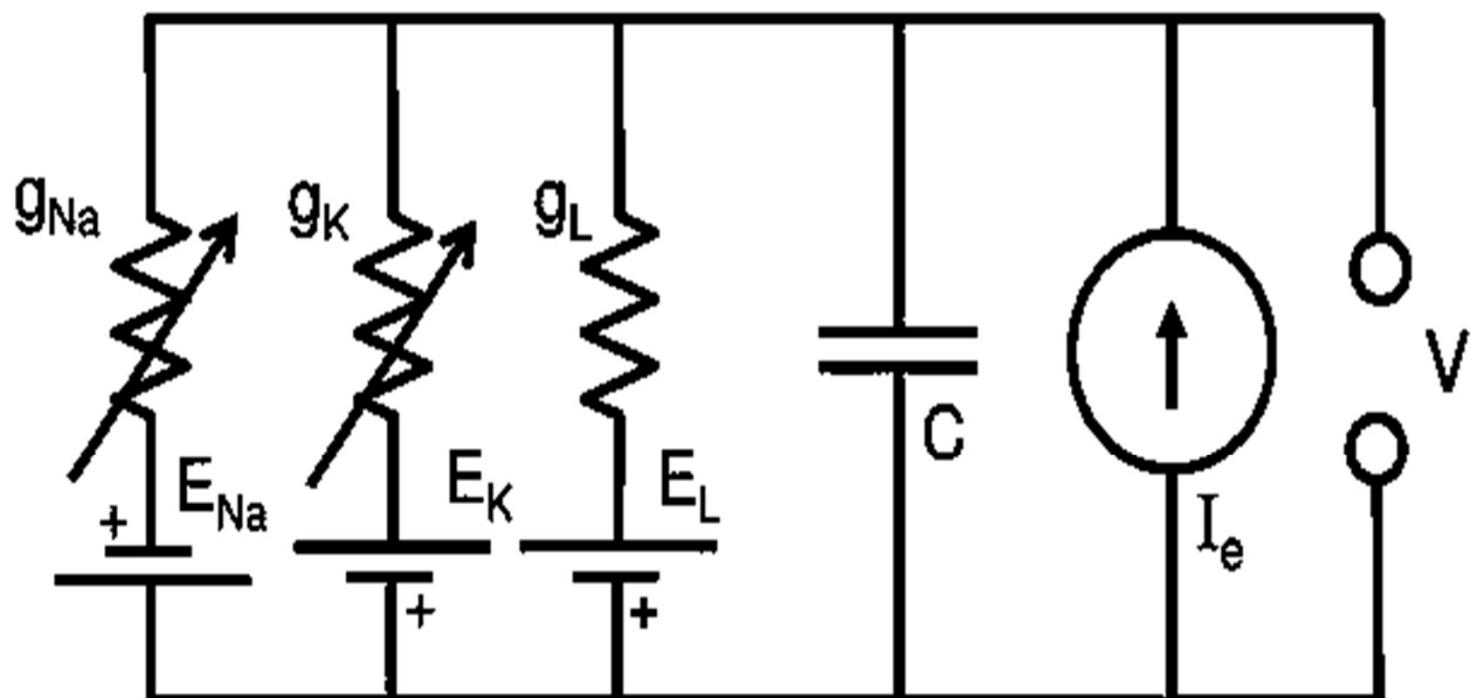
- Single-neuron modeling
- Memory and synaptic plasticity + vision
- Visual Attention, Identification, and Categorization
- Consciousness
- Reading thoughts
- Brain Machine Interface (BMI)
- Optogenetics
- Blue brain project
- Brainbow

Single-neuron modeling:

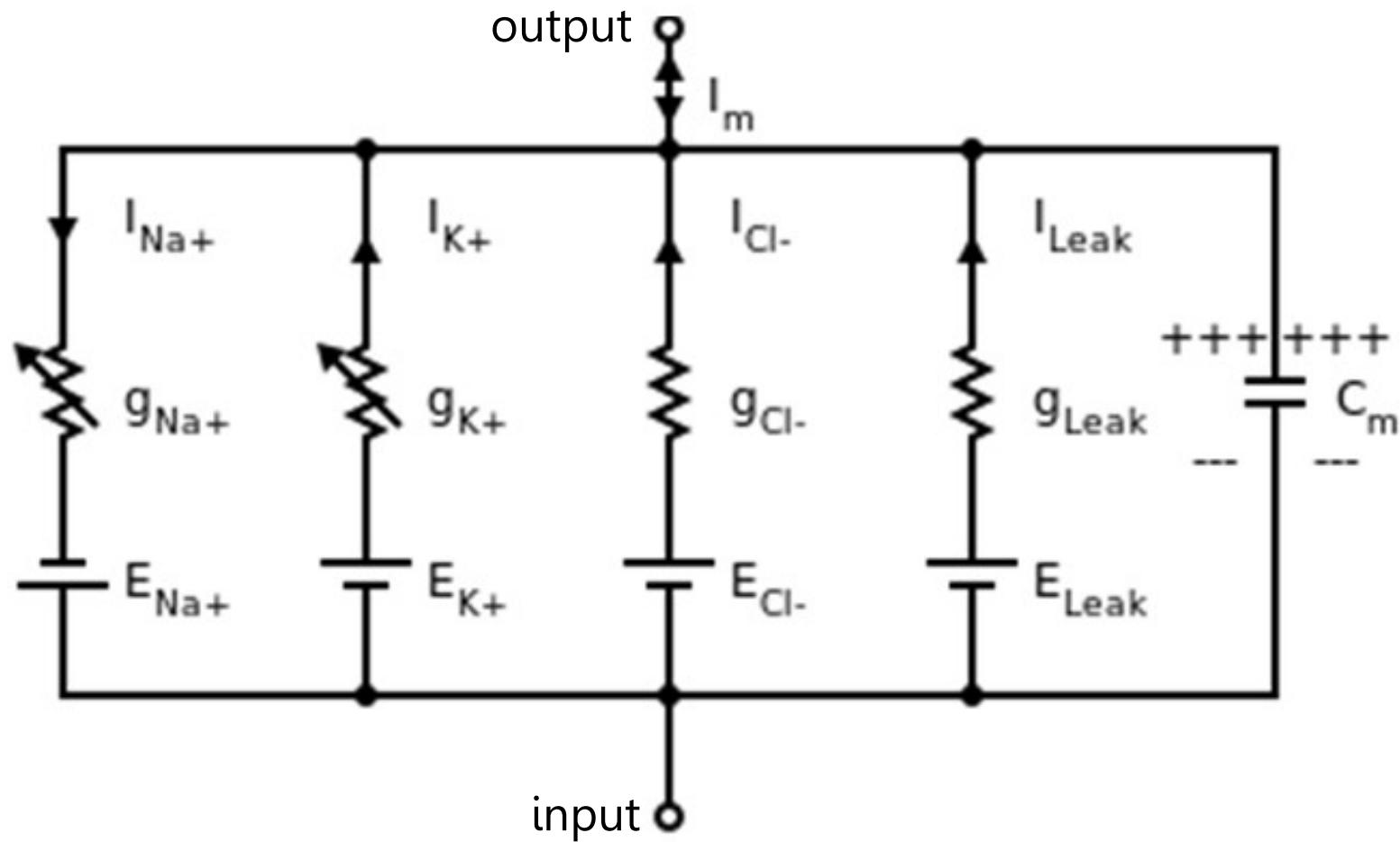


Modeling neurons in circuits and logic base. this can make understanding behaviors of the brain easier and know which ion do what and it can be the base of nanotech in electrode and many medicines for brain

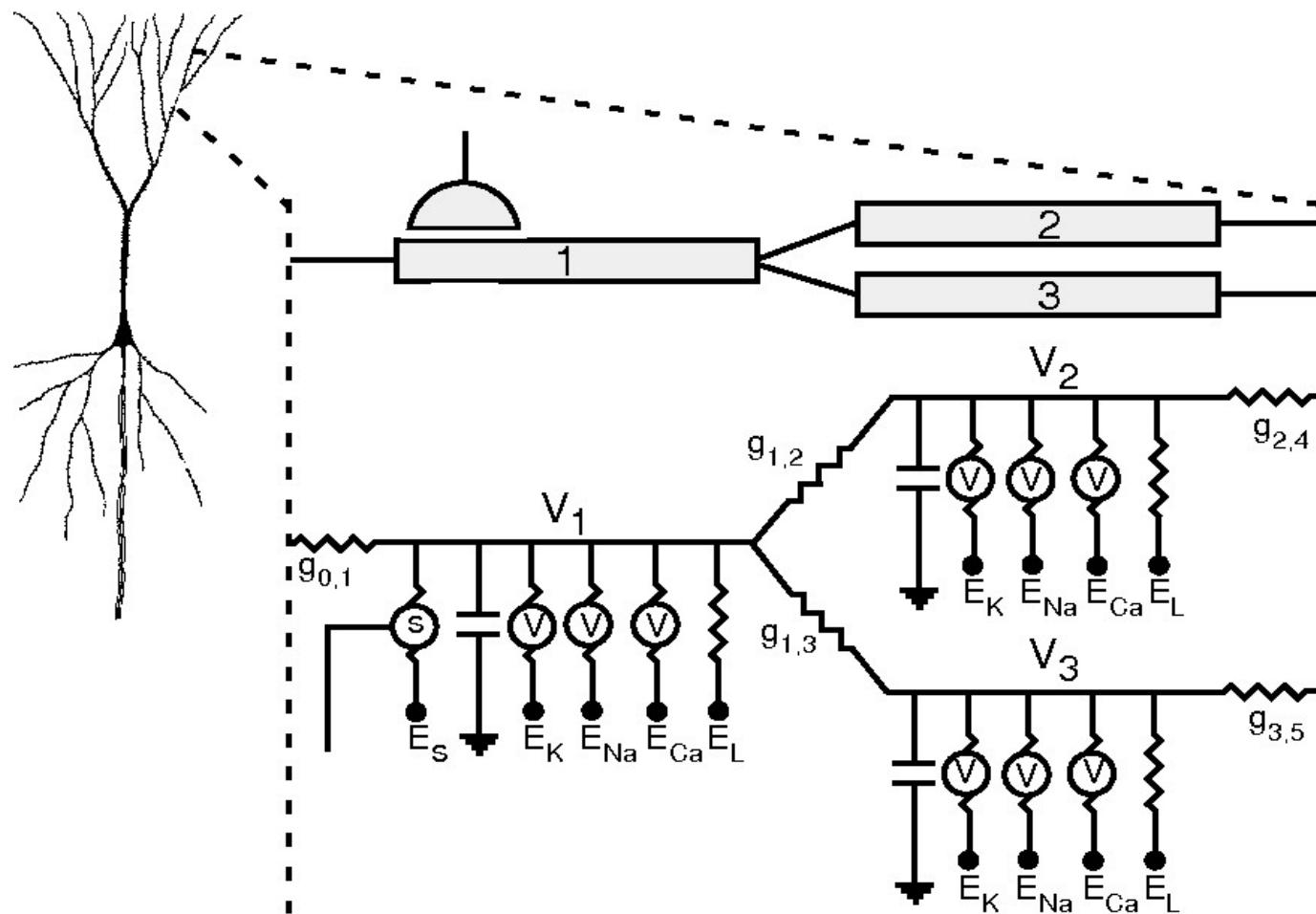
- Equivalent circuit model



Circuit model with potassium, Sodium and Chlorine ion channels:



Neuron connections as circuits:



Memory and synaptic plasticity + vision:

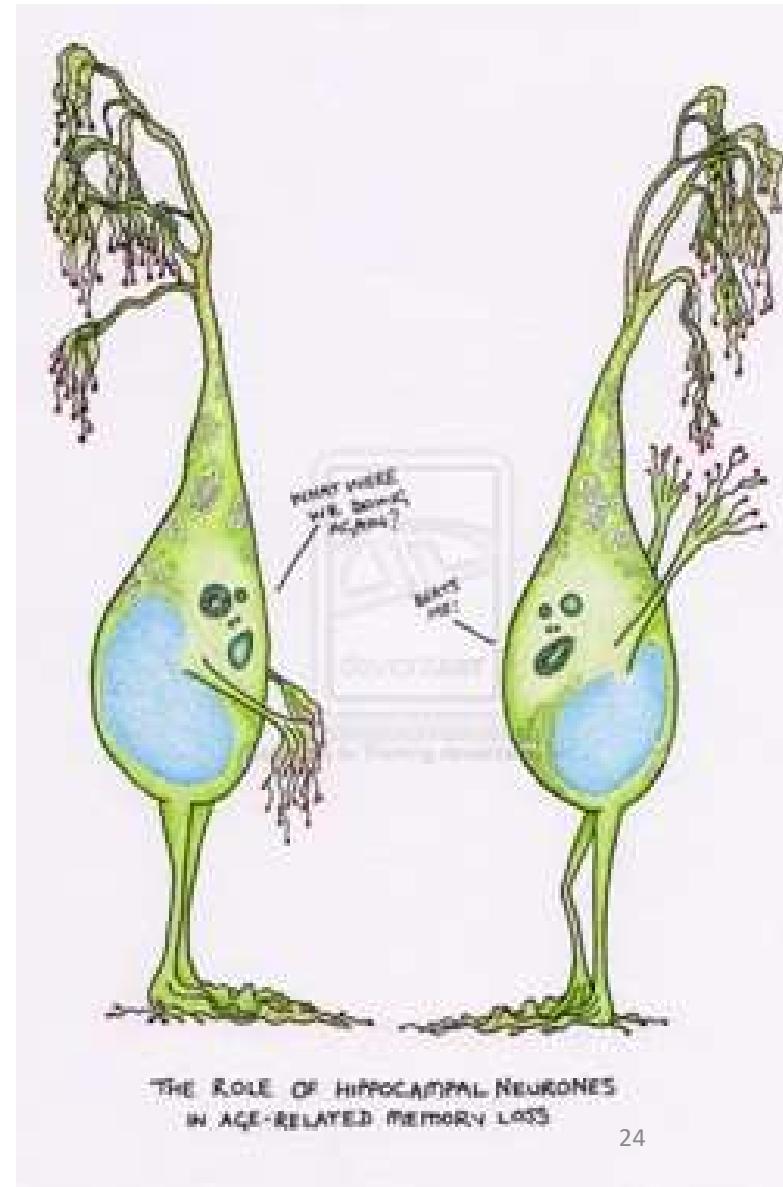
Our memory is much more different than computer memories and the art of recalling in our brain is very much different and it is vision base

One of the biggest challenges for this topic researchers is Alzheimer

In this topic

Researchers work on hippocampus and visual cortex more than others
And try to find solutions by researching and mining thousands of data.

[a nice paper about Combining computational neuroscience and body sensor networks to investigate Alzheimer's disease](#)



Visual Attention, Identification, and Categorization:

- identifying system
 - security
 - IOT
- Selling products
- Stuff managing
- Visual search

Computational Neuroscience of Vision

Edmund T. Rolls

University of Oxford
Department of Experimental Psychology
Oxford
England

Gustavo Deco

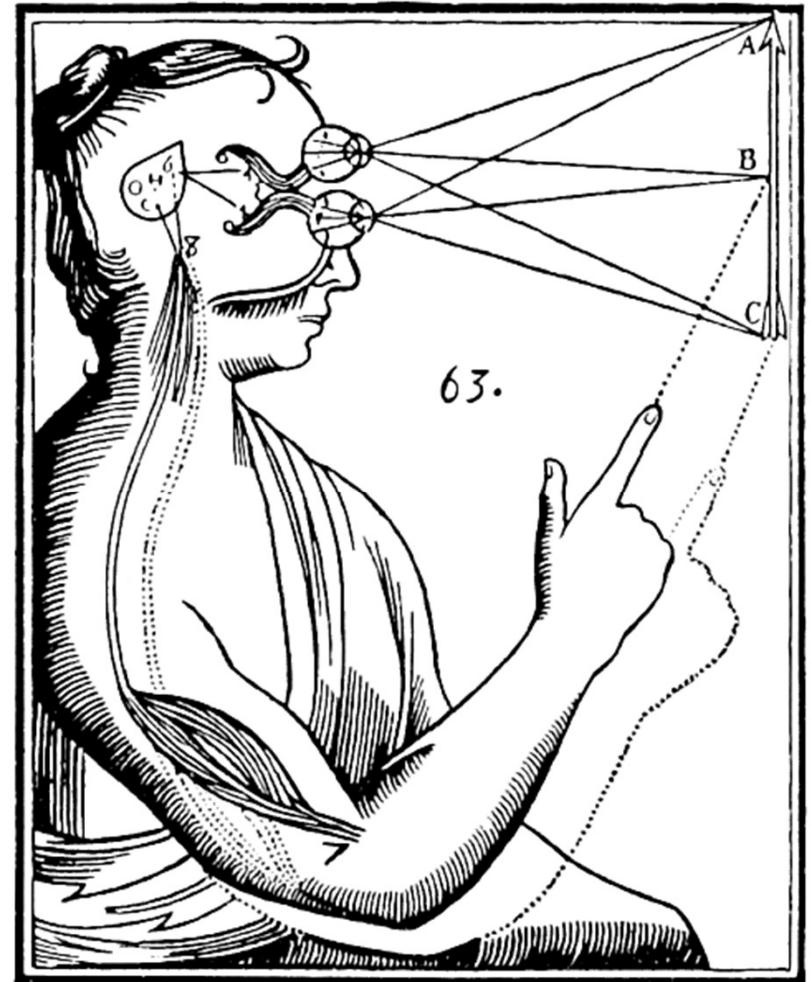
Siemens, Munich and
University of Munich

[computational neuroscience of vision pdf book](#)

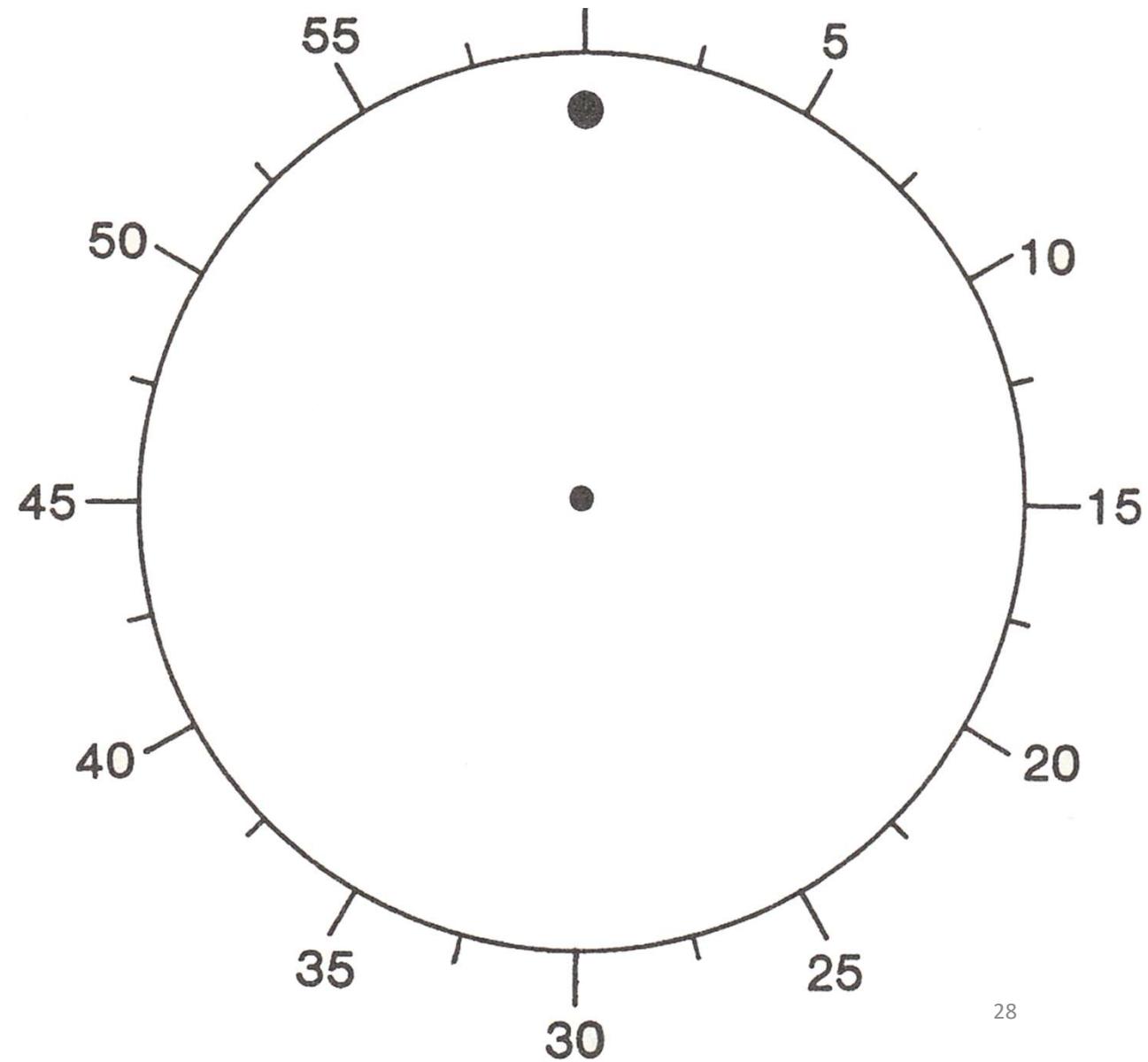
Consciousness:

The most philosophic part of neuroscience can be this.

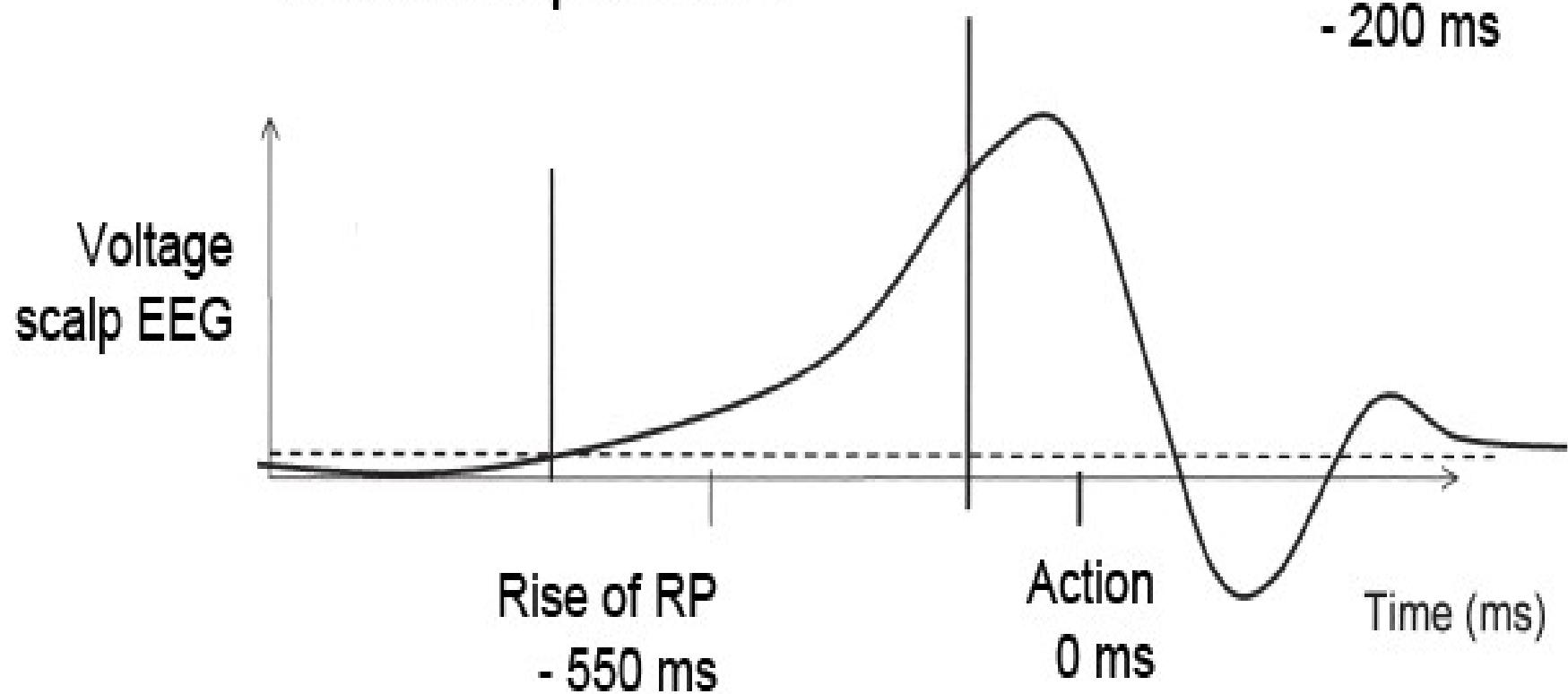
- Consciousness in animals
- Illustrations
- color existence
- Descartes mind and body
- Free will [benjamin libet experiment](#)



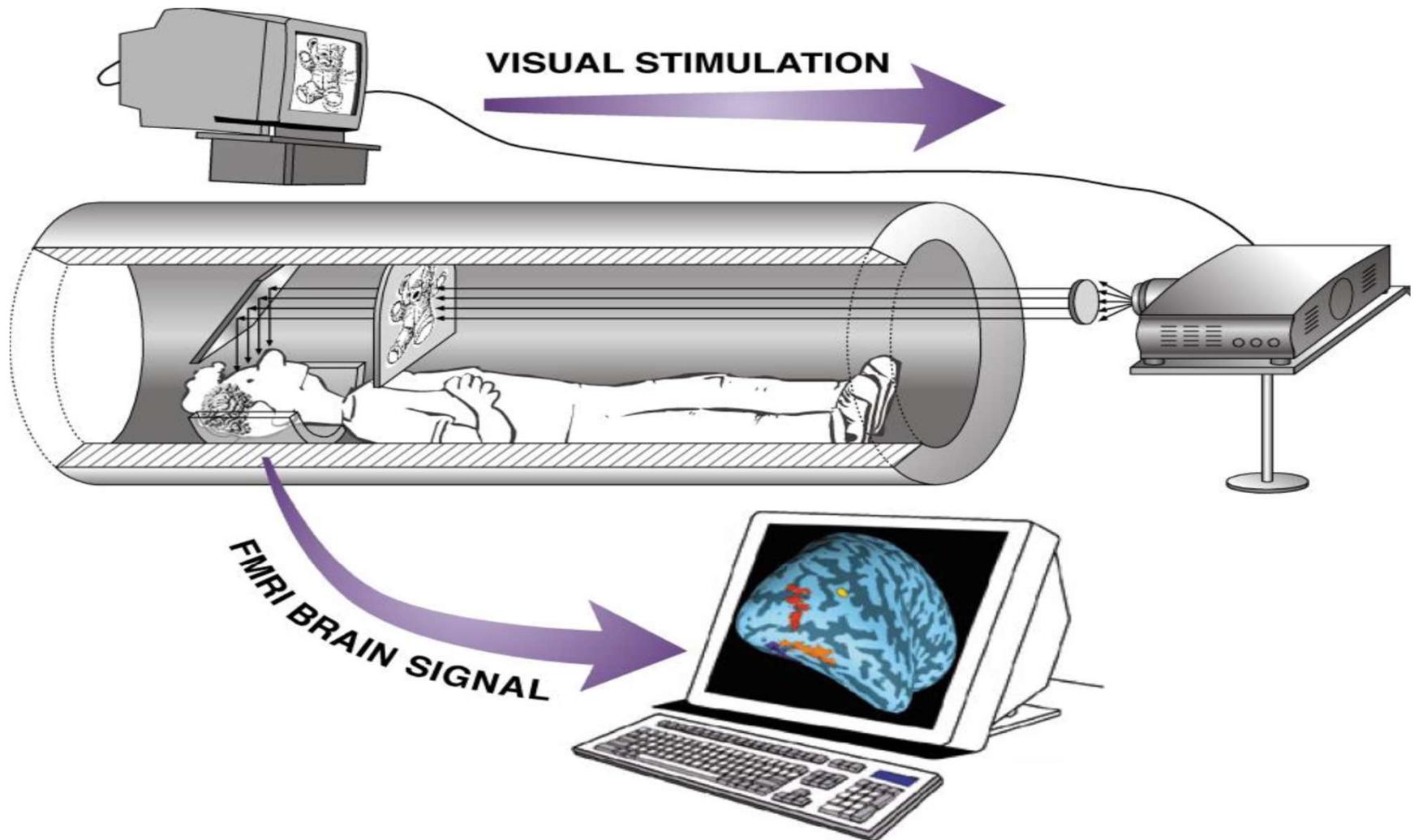
Benjamin Libet Wheel:



Libet's Experiment



Reading thoughts:





Some experiments:

- Beautifulness
- Face-related regions
- Speak with patients in coma
- Category specific regions





Some experiments:

- Beautifulness
- Face-related regions
- Speak with patients in coma
- Category specific regions

Category specific regions:



Abstract



Still life

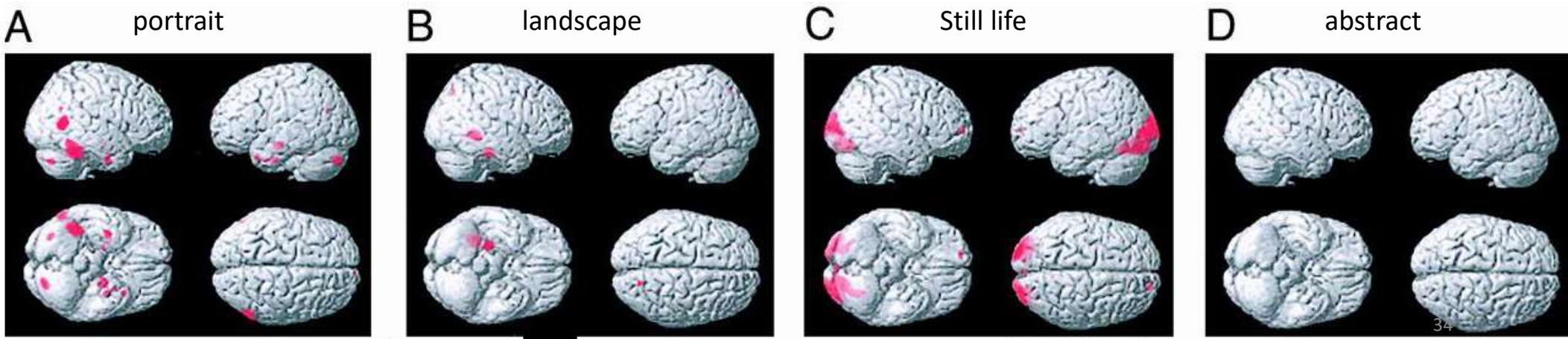


Portrait



Landscape

1-4: ugly | 5-6:neutral | 7-10:beautiful



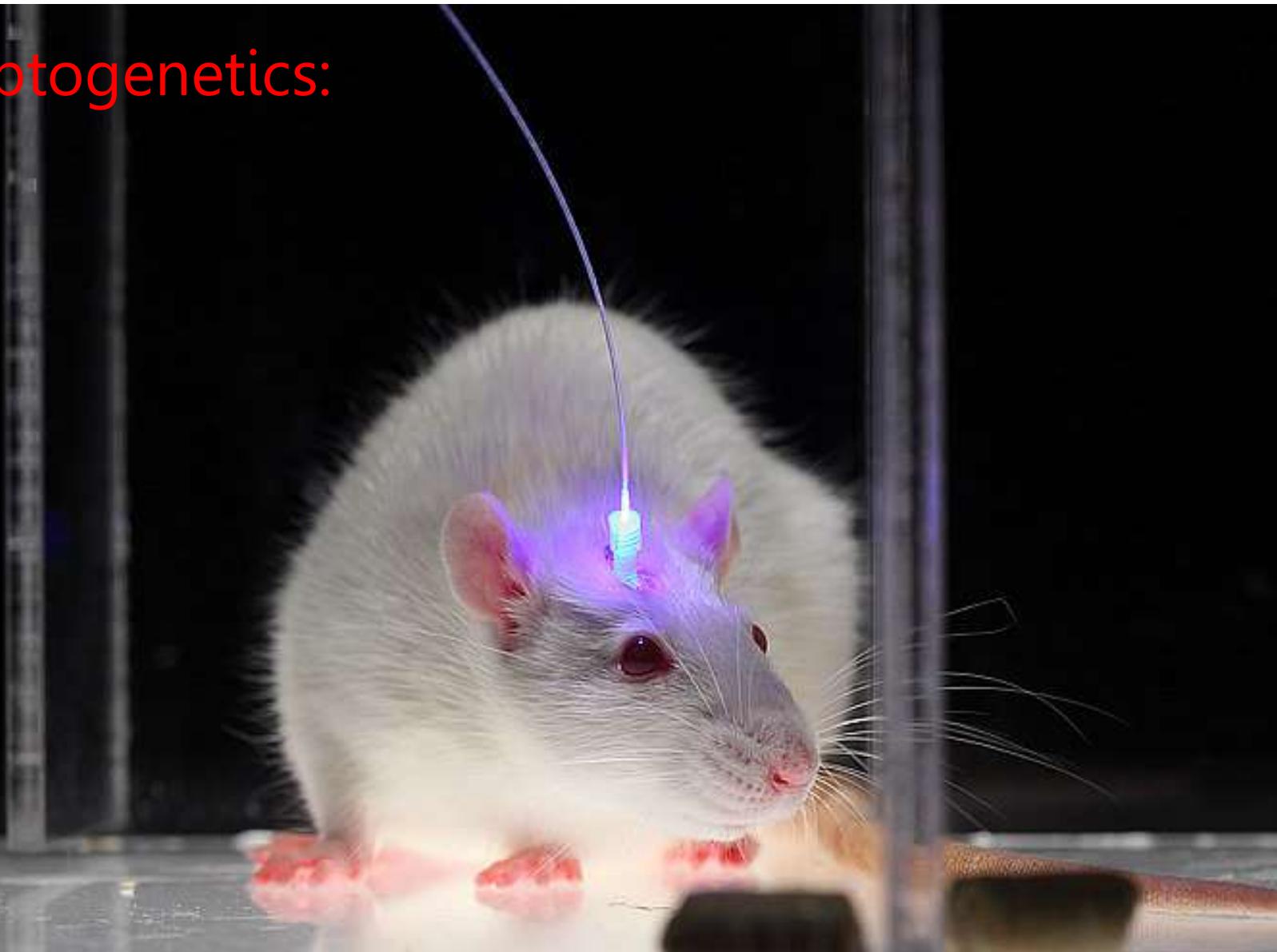
Brain Machine Interface (BMI):



A brain–machine interface (BMI) is a device that translates neuronal information into commands capable of controlling external software or hardware such as a computer or robotic arm. BMIs are often used as assisted living devices for individuals with motor or sensory impairments. [nature papers](#)

Brain Machine Interface (BMI):

Optogenetics:



Works with lighting in different frequencies. glint on different parts of brain and reactions to it or even control the brain.

Optogenetics:

Fiberoptic Control of Locomotion in ChR2 Mouse

Blue brain project by EPFL:

The **Blue Brain Project** is a Swiss brain research initiative that aims to create a digital reconstruction of rodent and eventually human brains by reverse engineering mammalian brain circuitry.

e.g.

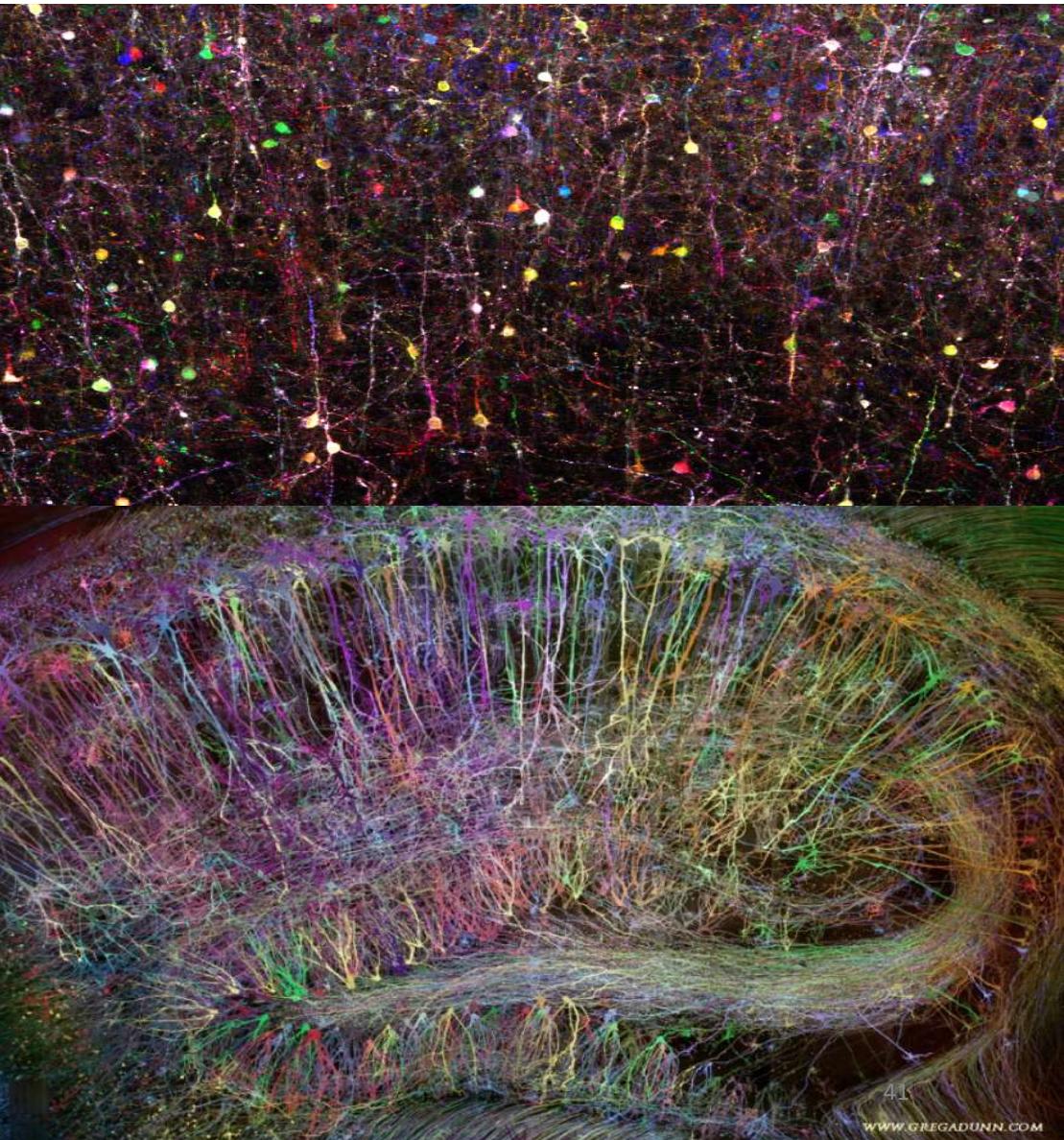
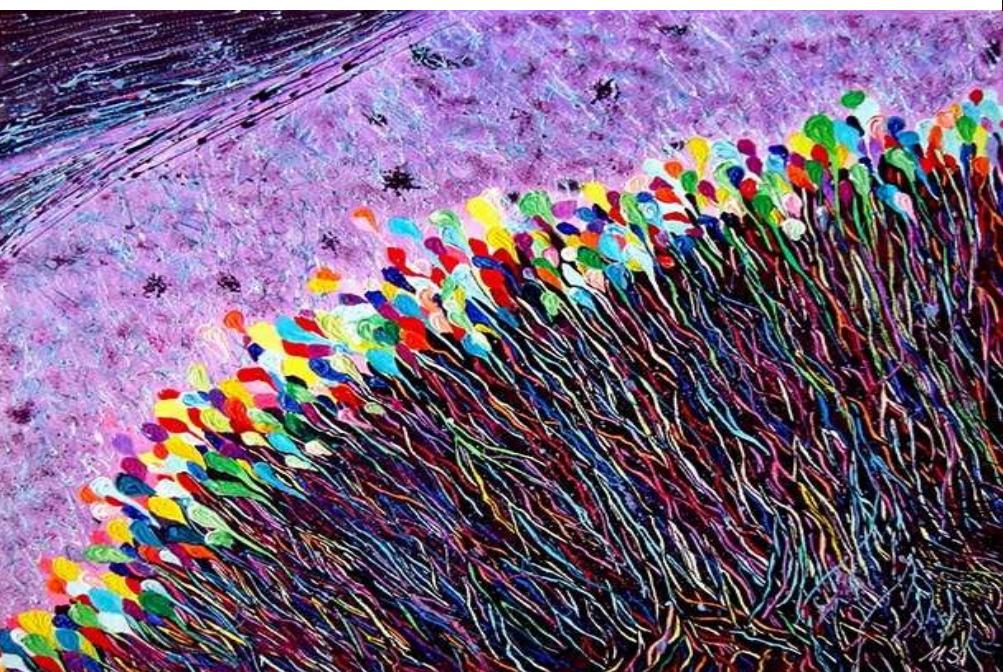
Kasparov against deep blue
Working on np math problems

...



Brainbow:

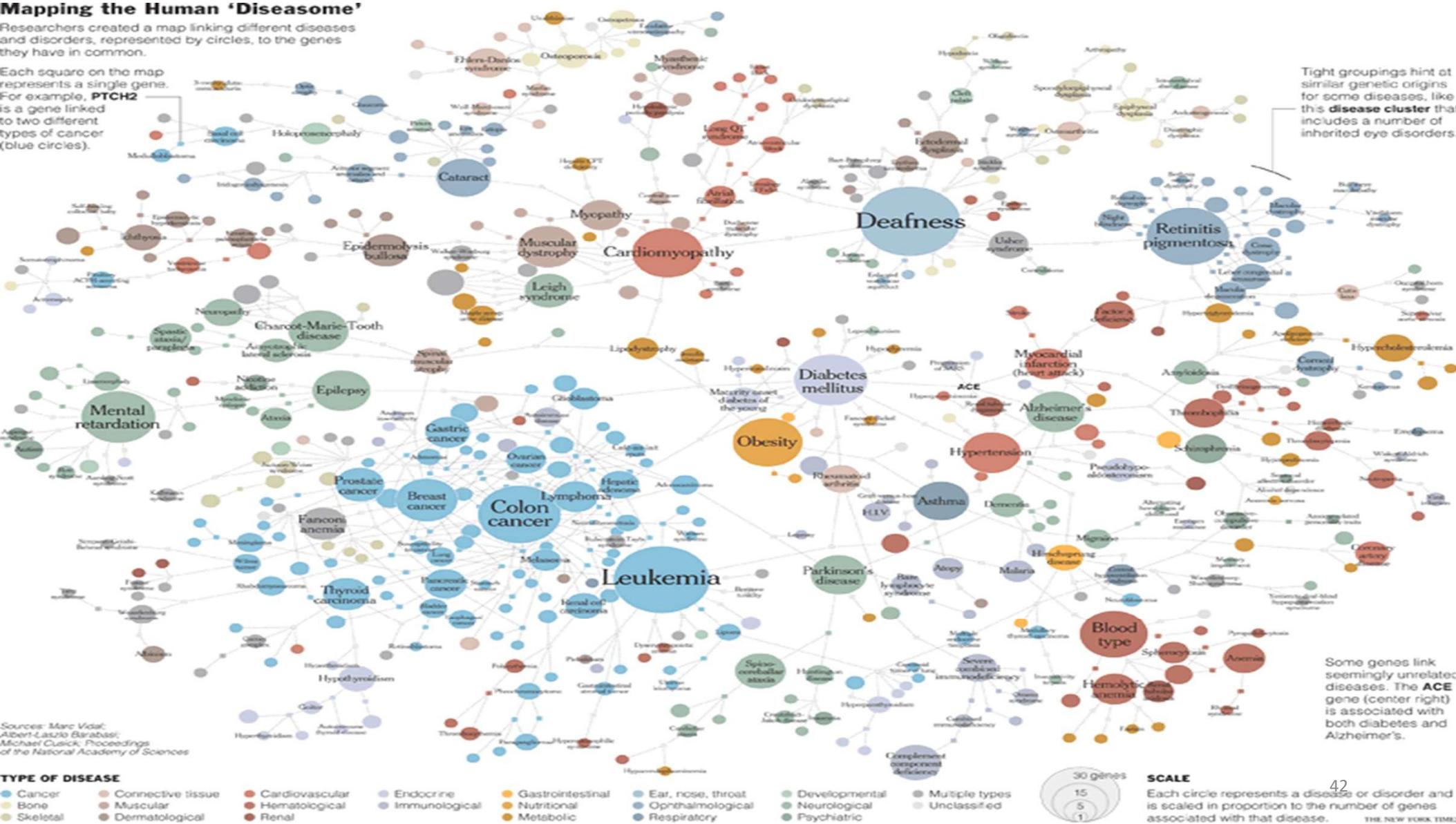
coloring different parts and cells of brain to differentiate them using AI and image processing and it is making recognition a lot easier and faster



Mapping the Human ‘Diseasome’

Researchers created a map linking different diseases and disorders, represented by circles, to the genes they have in common.

Each square on the map represents a single gene. For example, PTCH2 is a gene linked to two different types of cancer (blue circles).



Sources: Marc Vidal;
Albert-László Barabási;
Michael Cusick; Proceedings
of the National Academy of Sciences

TYPE OF DISEASE

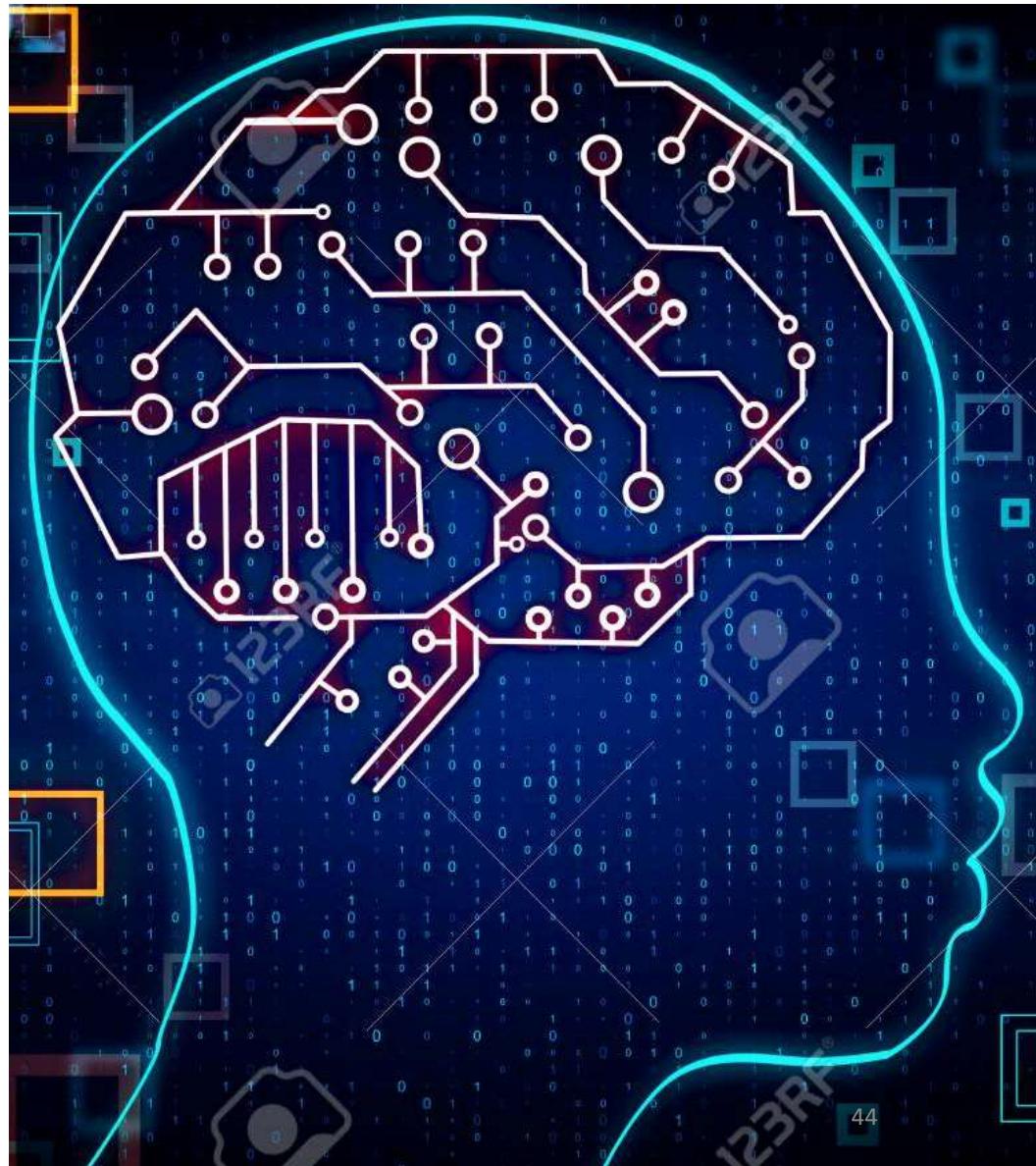
- Each circle represents a disease or disorder and is scaled in proportion to the number of genes associated with that disease.

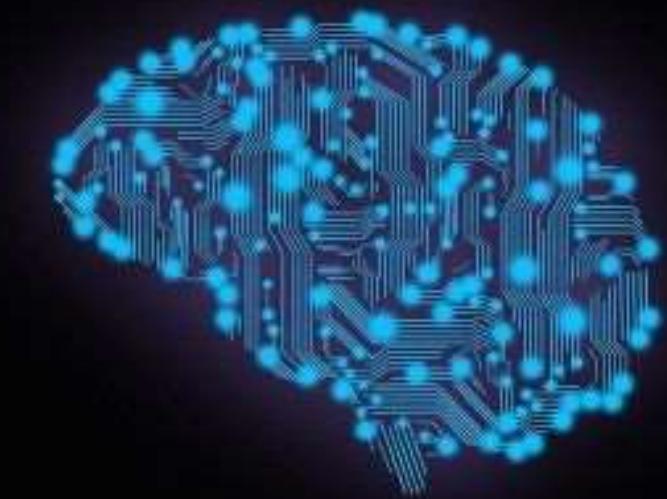
SCALE 42
Each circle represents a disease or disorder and is scaled in proportion to the number of genes associated with that disease. THE NEW YORK TIMES

Computational Neuroscience & Machine Learning

future of computational neuroscience:

This field will stay with us until we make something more creative than brain





Neuralink







پژوهشگاه روان



نوروسافاری

NEUROSAFARI

What can I do with this degree :

It is completely based on your background and your works like electrical background, programming, philosophy and etc. But most of it is research and optimization



[coursera course](#) by idan segev university of Hebrew

[website of the Computational Biology Lab](#)

[stanford neuroAI lab](#)

[Learning in Neural Circuits \(LiNC\) Laboratory](#)

[Comprehensive info about neurons from electronic point of view](#)

[Humanbrainproject](#)

[Center for Brains, Minds and Machines](#)

[Center for Theoretical Neuroscience](#)

[Unsupervised Thinking](#)

[Neurosciencenews](#)

[neurosafari](#)