



# CS 103 -05

## Pre-AI Vision and Neural Background

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2022-10-

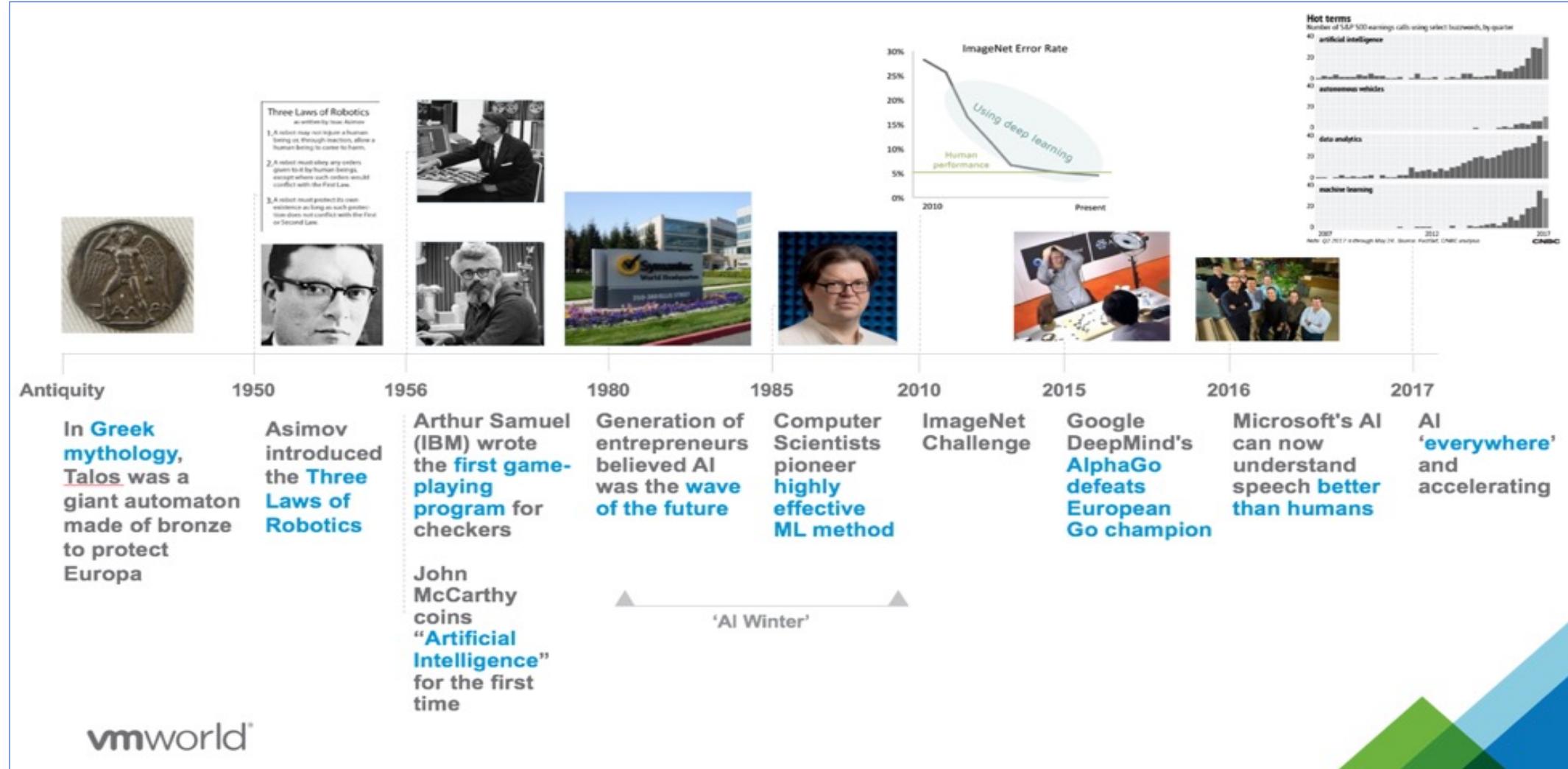
# What Will I Cover in Lecture 5?

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- Pre-AI and Psychoanalysis
- Human Retina Vision and AI
- Layered Visual Pathway Network
- Human Brain Neurology and AI
- Electronic Brain

# Pre-AI Vision and Neural Background

# AI Algorithm History – A Simple One



# 3 Laws of Robotics

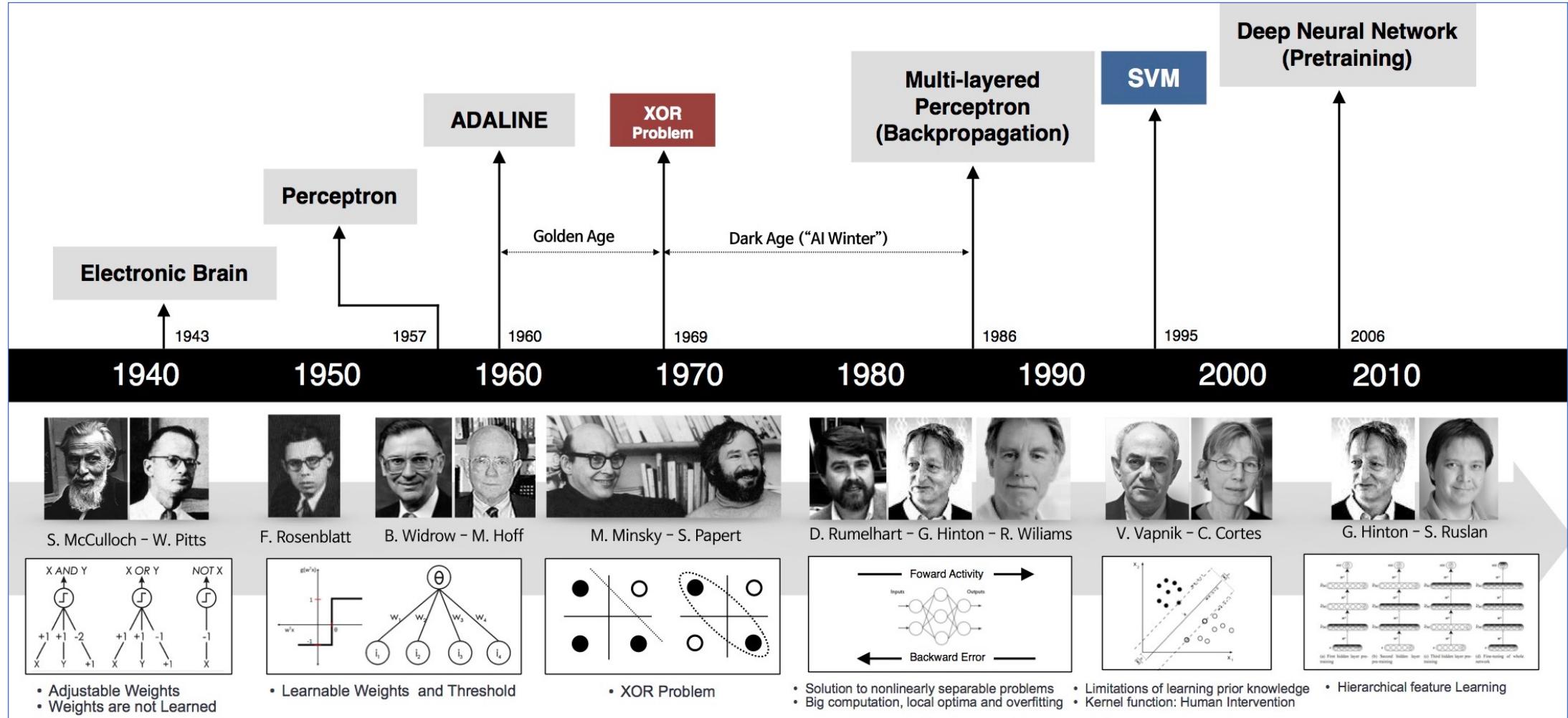
## Laws of Robotics

**The term *robotics* was coined in the 1940s by science fiction writer Isaac Asimov.**

### **Asimov's Laws of Robotics:**

- A robot may not injure a human being, or, through inaction, allow a human being to come to harm.
- A robot must obey the orders given it by human beings except where such order would conflict with the First Law.
- A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

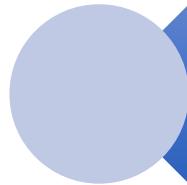
# AI algorithm Developments - A Closer Look



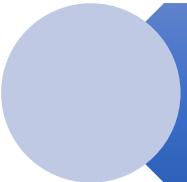
# Computer Algorithm

**Computer Algorithm:**

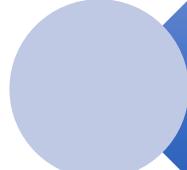
a well defined sequence of steps for solving a computational problem



It produces the correct output

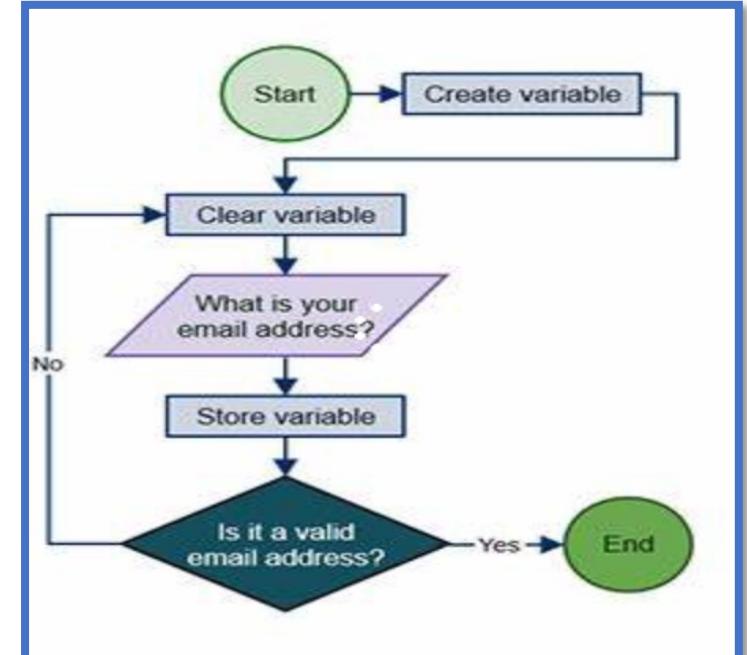


It uses basic steps / defined operations



It finishes in finite time

$$\begin{aligned}
 s &= \frac{n(\sum_{i=1}^n a_i b_i) - (\sum_{i=1}^n a_i)(\sum_{i=1}^n b_i)}{\sqrt{n}} \\
 s &= \frac{n(\sum_{i=1}^n a_i b_i) - (\sum_{i=1}^n a_i)(\sum_{i=1}^n b_i)}{\sqrt{n}} \\
 o &\stackrel{\text{def}}{=} \frac{1}{n} \left( \sum_{i=1}^n b_i - s \sum_{i=1}^n a_i \right) \cdot \left( \sum_{i=1}^n b_i - s \sum_{i=1}^n a_i \right) \\
 &= \frac{n(\sum_{i=1}^n a_i b_i) - (\sum_{i=1}^n a_i)(\sum_{i=1}^n b_i)}{n} \\
 R &= \frac{1}{n} \left[ \sum_{i=1}^n b_i^2 + s \left( \sum_{i=1}^n a_i^2 - 2 \sum_{i=1}^n a_i b_i + 2o \sum_{i=1}^n a_i \right) \right] \\
 &\quad + o \left( on - 2 \sum_{i=1}^n b_i \right) \\
 &\quad + o \left( on - 2 \sum_{i=1}^n b_i \right)
 \end{aligned}$$



# 2022 News Last Week

“已灭绝的人类基因组序列”为科学家赢得2022年首个诺贝尔奖

▷ 播报文章



@知识分子

打破矩阵乘法计算速度50年纪录，DeepMind新研究再刷Nature封面

▷ 播报文章



上图：斯万特·帕博的诺贝尔奖肖像。

发现DeepMind很会拿着榔头找钉子，而且是新钉子。这需要有勇气和专注到一个细分领域的精神。国内人工智能领域的科研团队可以好好学习一下。其实大家用的榔头都差不多，但我们可以接着敲别人找到并已经敲过的钉子：例如喜欢刷榜。国人喜欢榜上有名，但真正的科研讲独树一帜。在诺奖季，闲聊两句。希望对年轻人有些启发。

收起



DeepMind攻克50年数学难题！AlphaZero史上最快矩...

...

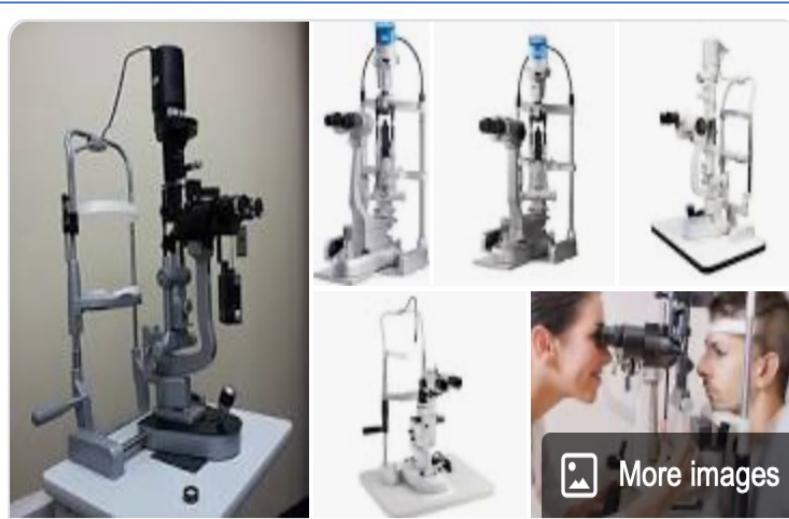
DeepMind每个重磅工作都是定义了一个极好的问题。定义问题很多时候比解决问题更有启发性

# Vision and Neurology Research Directly Inspire AI



# Ophthalmologist Allvar Gullstrand

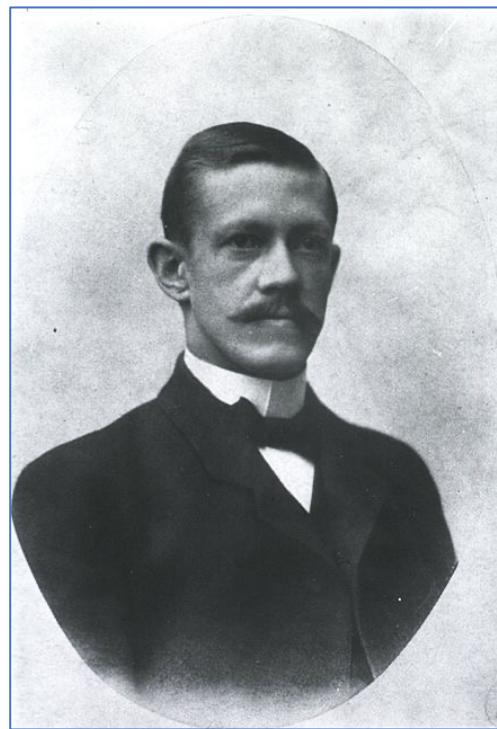
## - 1911 Physiology or Medicine Nobel Prize Laureate



### Slit lamp



A slit lamp is an instrument consisting of a high-intensity light source that can be focused to shine a thin sheet of light into the eye. It is used in conjunction with a biomicroscope. [Wikipedia](#)



### Reflexless ophthalmoscope

# Ragnar Granit, Haldan Hartline and George Wald - 1967 Physiology or Medicine Nobel Prize

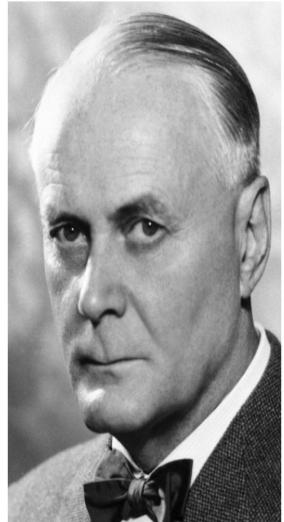


Photo from the Nobel Foundation archive.

Ragnar Granit

Prize share: 1/3

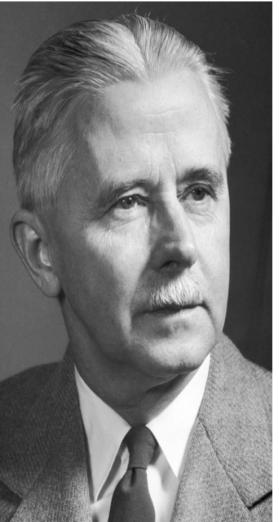


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Haldan Keffer Hartline

Prize share: 1/3

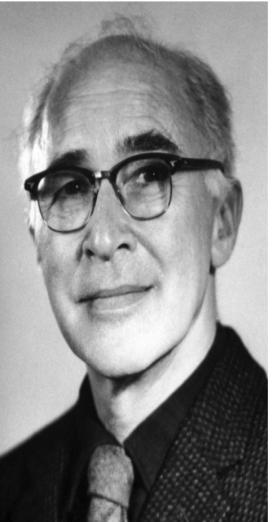


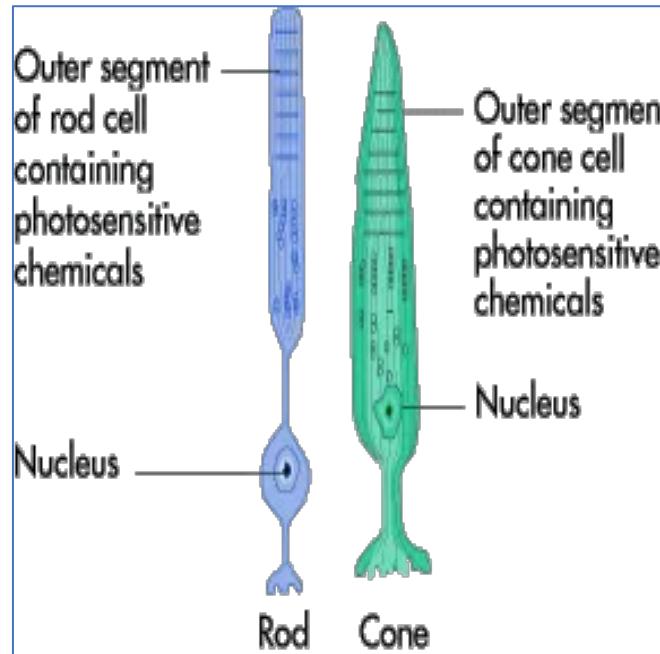
Photo from the Nobel Foundation archive.

George Wald

Prize share: 1/3

- "for their discoveries concerning the primary physiological and chemical visual processes in the eye."
- From studies of the action potentials in single fibres of the optic nerve, they formed “dominator-modulator” 优势器-调变器 theory of colour vision.

# Ragnar Granit, Haldan Hartline and George Wald - 1967 Physiology or Medicine Nobel Prize



- In this theory they proposed that in addition to the three kinds of photosensitive cones—the colour receptors in the retina—which respond to different portions of the light spectrum, some optic nerve fibres (dominators) are sensitive to the whole spectrum while others (modulators) respond to a narrow band of light wavelengths and are thus colour-specific.
- They also proved that light could inhibit as well as stimulate impulses along the optic nerve.

# David H. Hubel and Torsten N. Wiesel - 1981 Physiology or Medicine Nobel Prize

## The Nobel Prize in Physiology or Medicine 1981

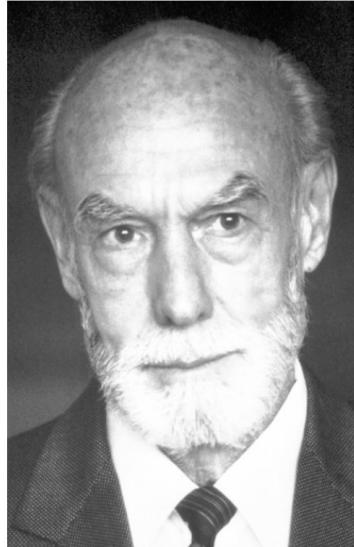


Photo from the Nobel Foundation archive.

Roger W. Sperry

Prize share: 1/2

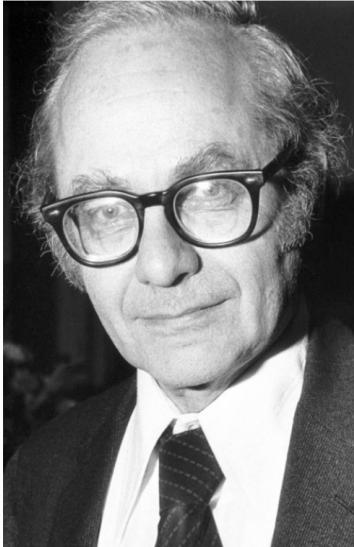


Photo from the Nobel Foundation archive.

David H. Hubel

Prize share: 1/4

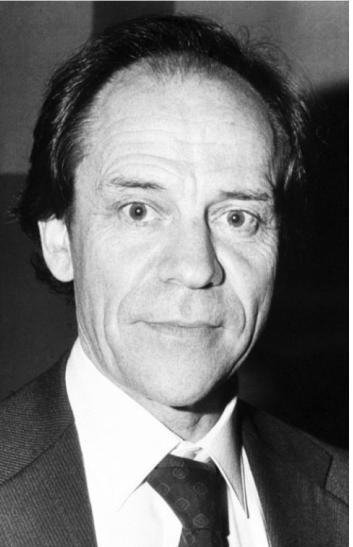


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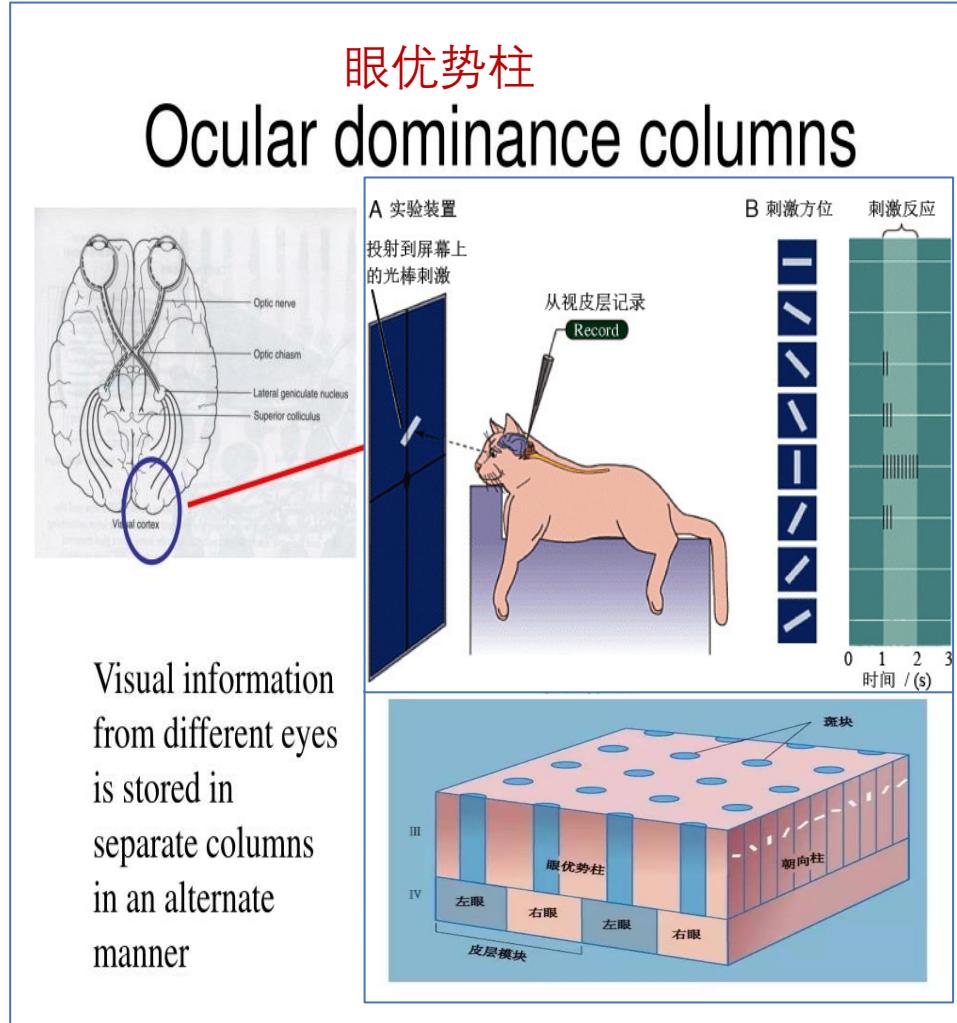
Torsten N. Wiesel

Prize share: 1/4

- The Nobel Prize in Physiology or Medicine 1981 was divided, one half awarded to Roger W. Sperry "for his discoveries concerning the functional specialization of the cerebral hemispheres"
- The other half jointly to David H. Hubel and Torsten N. Wiesel "for their discoveries concerning information processing in the visual system."

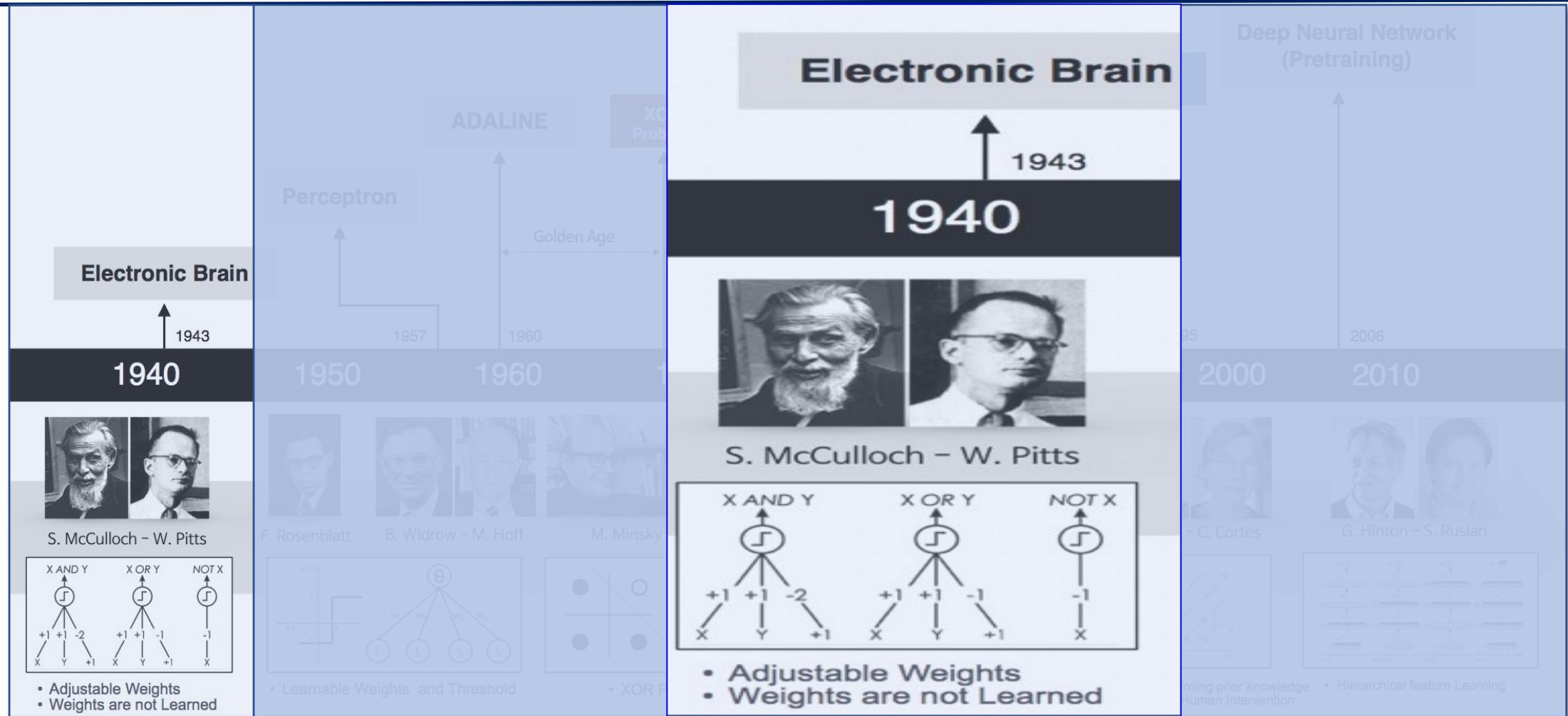
# David H. Hubel and Torsten N. Wiesel

## - 1981 Physiology or Medicine Nobel Prize

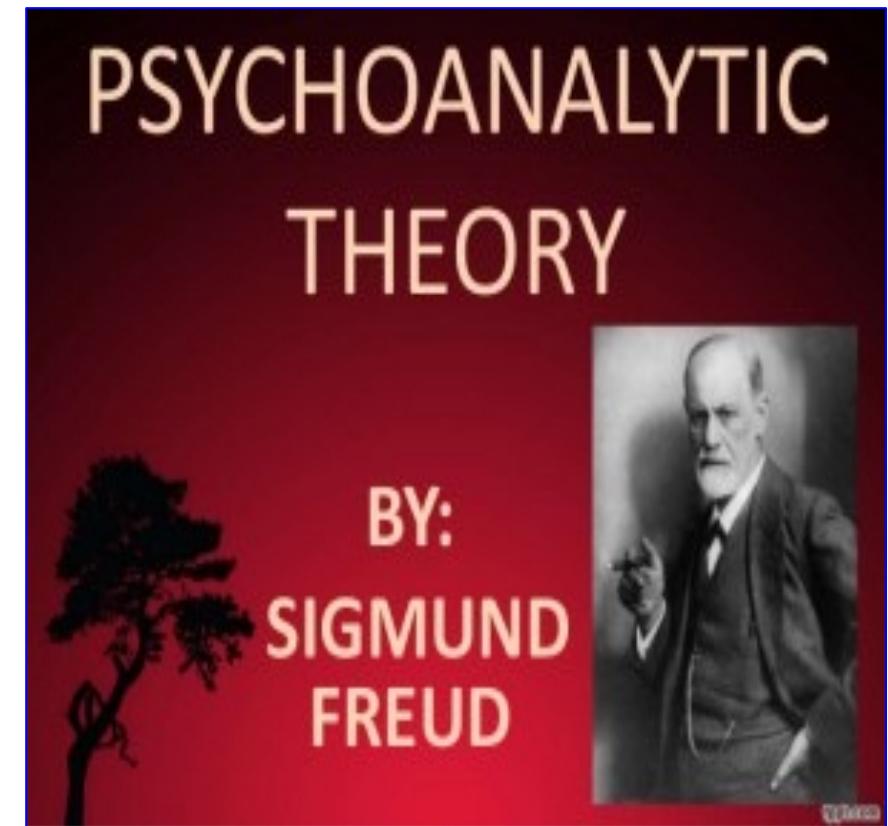


- Hubel and Wiesel described ocular dominance columns in the early 1960s, noting that in the cat primary visual cortex, cells with similar eye preference were grouped together into columns, and eye dominance shifted periodically across the cortex.
- They distinguished between the innate mechanisms guiding the initial formation of cortical functional architecture, and the experience-dependent, competition-based mechanisms responsible for later modification during the critical period.

# AI algorithm Developments - A Closer Look

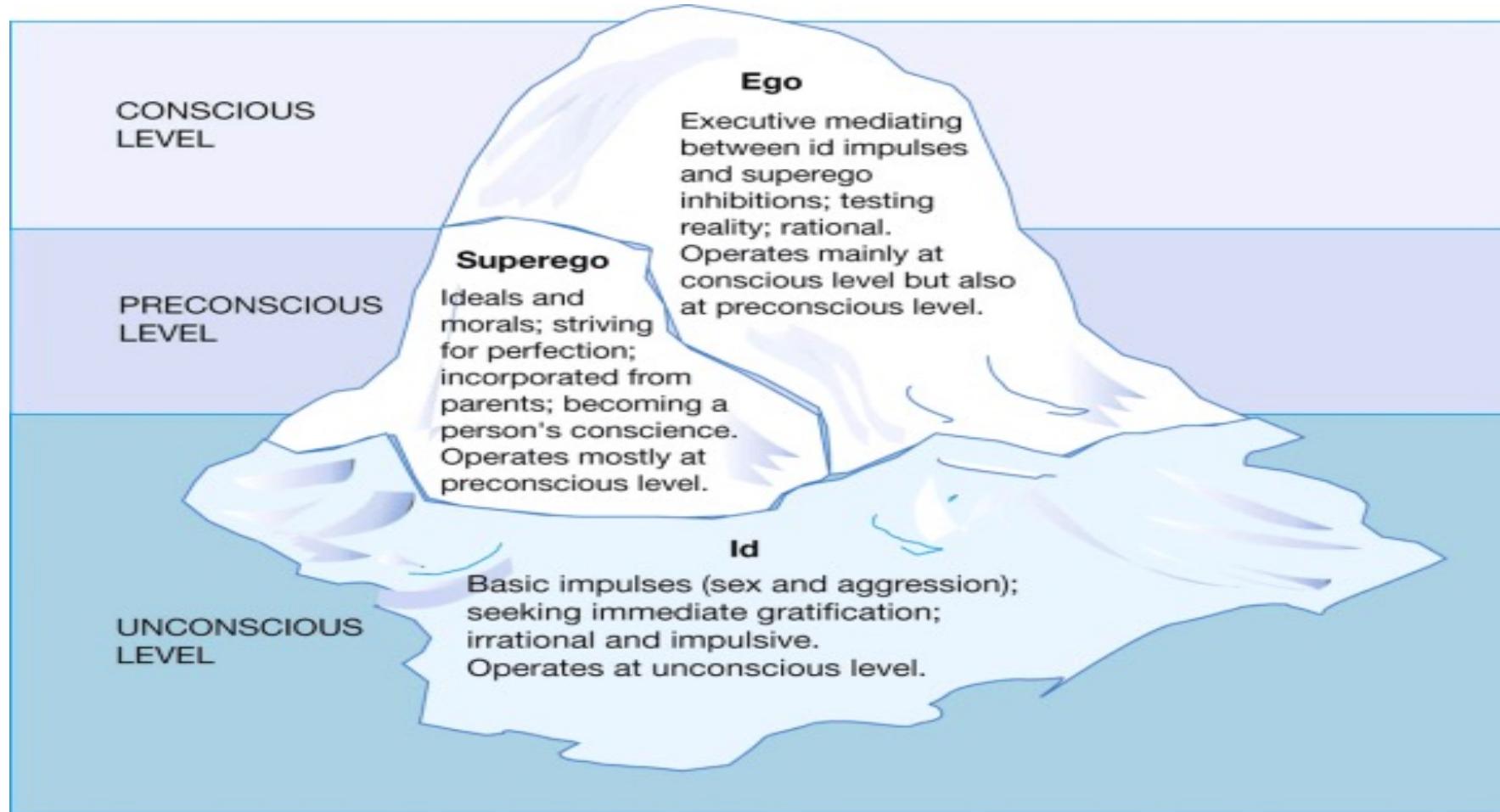


# Dr. Sigmund Freud (1856-1939)

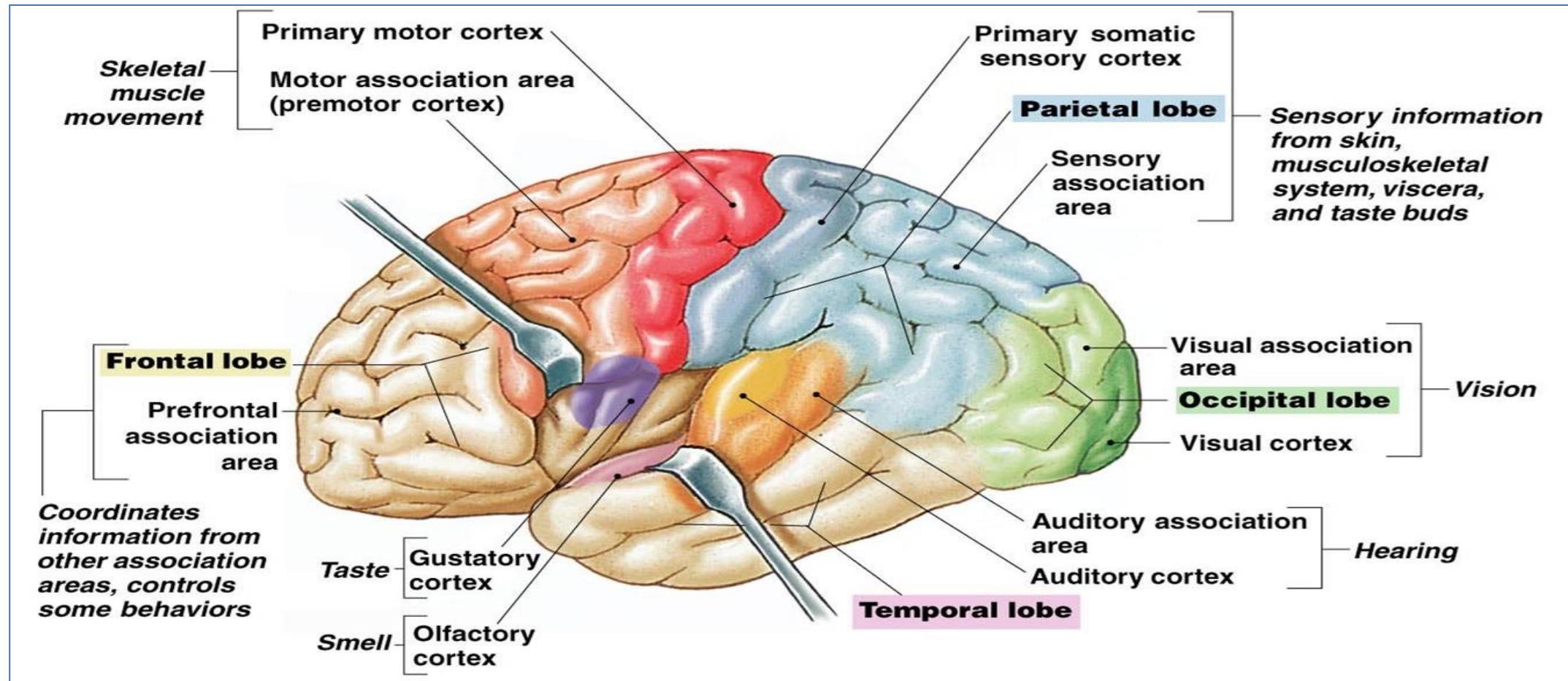


Sigmund Freud was an Austrian neurologist and the founder of psychoanalysis, a clinical method for treating psychopathology through dialogue between a patient and a psychoanalyst.

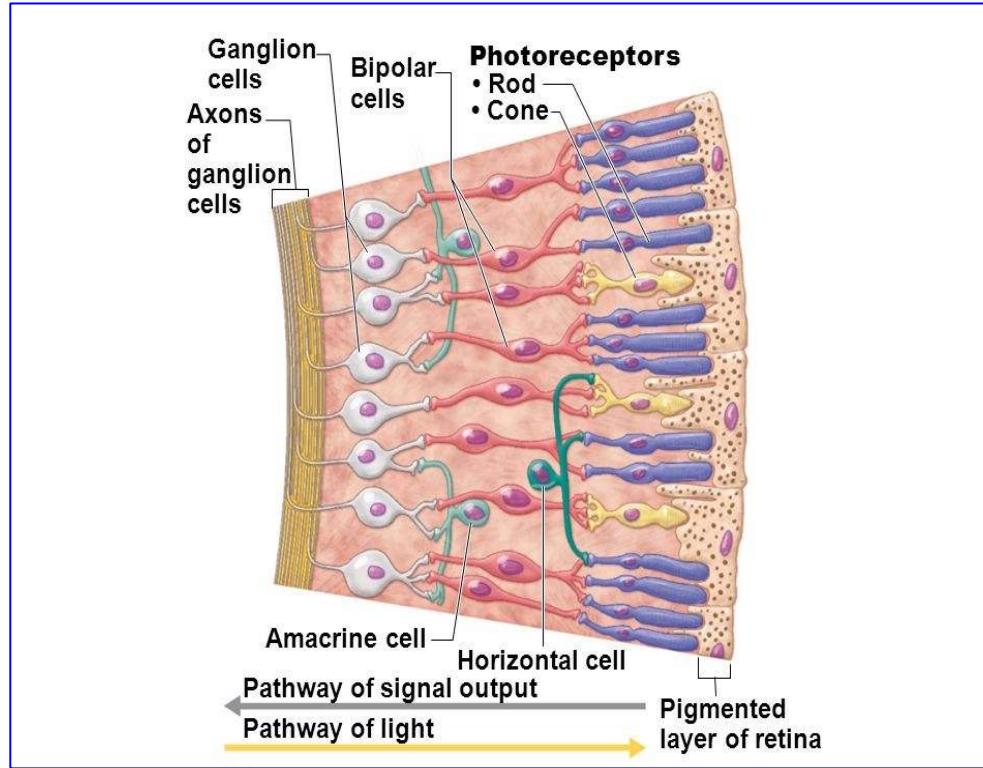
# Human Mind from Freud



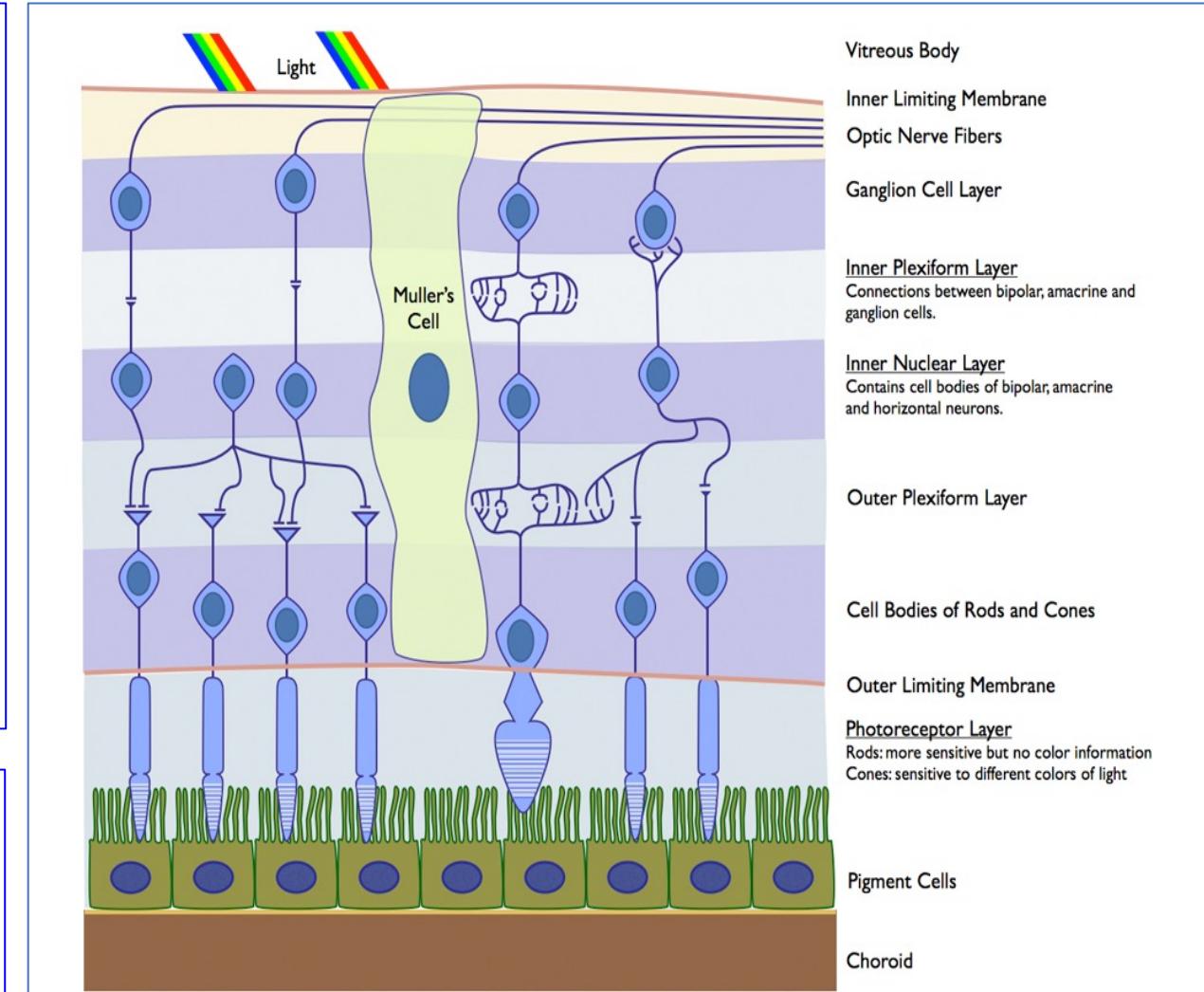
# Human Brain – Lobes and Functions



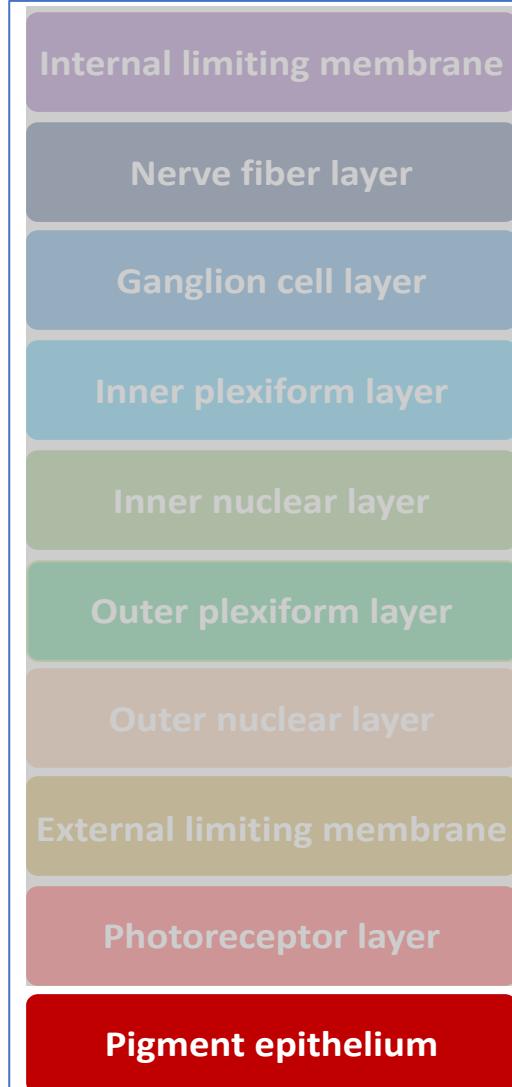
# Major Input to Brain: Eye Retina Layer Structure



The light rays that contribute to the retinal image have to pass through layer of **nerve fibers** and the **blood vessels** before reaching the light-sensitive **photoreceptors**.

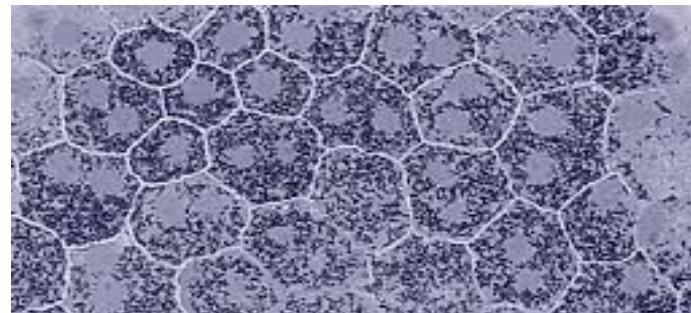


# Retina Detailed Histology 6

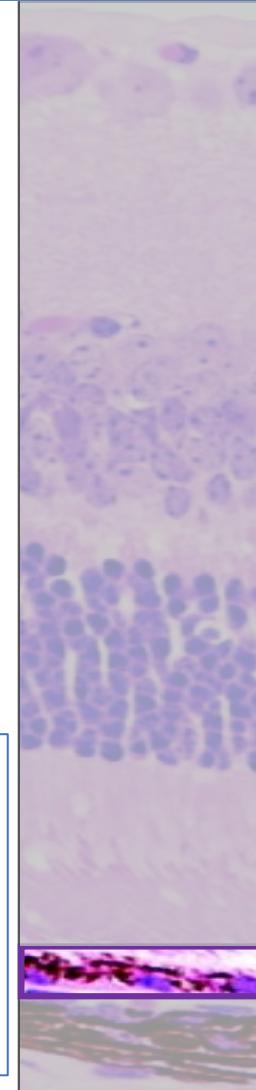


## RPE 保持视网膜健康

- 吸收光
- 吞噬感光细胞的代谢产物
- 屏障作用



- 内界膜
- 神经纤维层——主要为神经节细胞的轴突
- 神经节细胞层——这个层含有神经节细胞的细胞核，视神经从这里开始
- 内丛状层——主要由双极细胞的轴突及神经节细胞的树突组成，并以突触形式相接触
- 内核层——又称内颗粒层，由双极细胞、水平细胞、无长突细胞、Muller细胞的胞核组成
- 外丛状层——由光感受器细胞的轴突及双极细胞树突水平细胞突起组成，它们之间的接触称为突触
- 外核层——又称外颗粒层，由光感受器细胞核组成
- 外界膜——这个层隔开感光细胞的内部与其细胞核
- 感光层——包括视杆细胞及视锥细胞
- 视网膜色素上皮



# Homework 05

1

For Project Teams, Discuss Among Your Group on What kind of Algorithm Development Tools Your Project Intend to Use, and the Reasons Behind Your Choice.  
For People Doing “Survey” , Please List 15 Papers You Intend to Read

2

Analysis How CNN Borrow Idea from Human Vision System



# CS 103 -05

## Pre-AI Vision and Neural Background

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