CS 103 -04

AI Algorithms and Their Neurological Foundation

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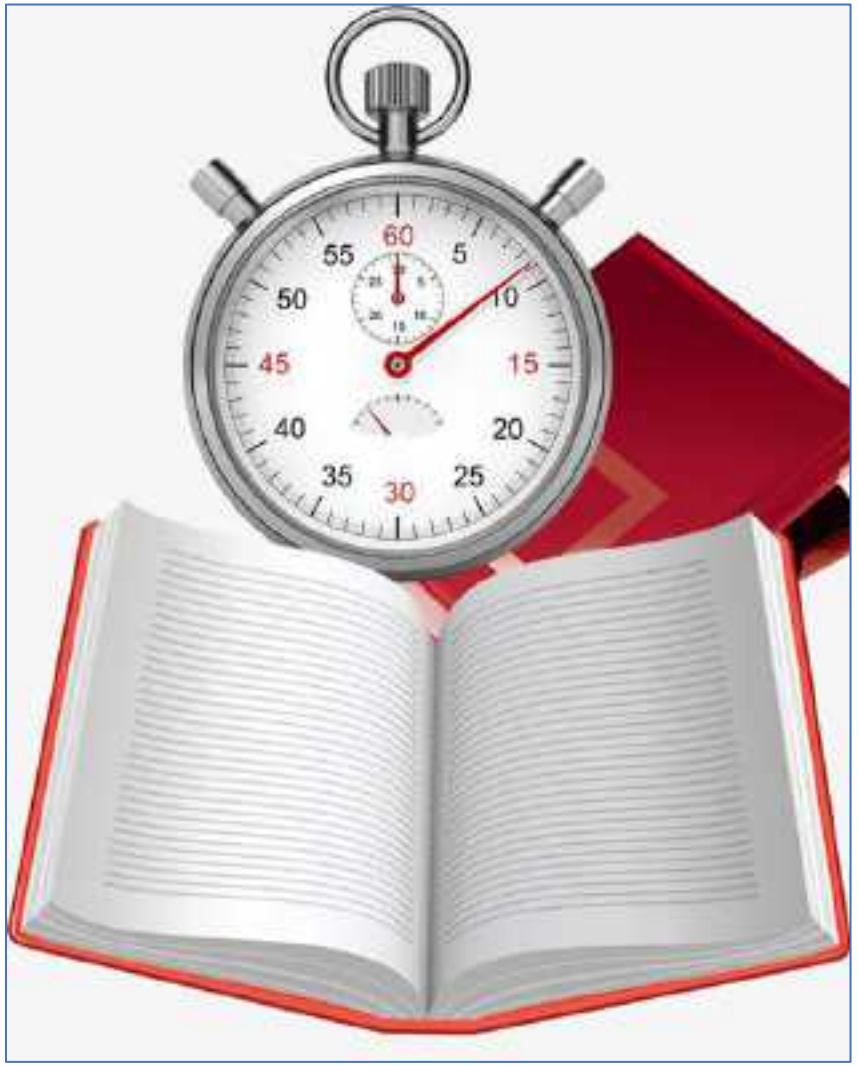
Lecture 03 Review



AI Applications - Survey

Now You have learnt more about AI:

- Name One AI Application You Currently Use in Your Daily Life and
- One AI Application You want AI to Empower You in the Future

Survey – Morning Class

Survey – Morning Class

Most Inspiring Answer For Morning

Survey – Afternoon Class

Survey – Afternoon Class

帮我上学

以图搜图

合成人声

已知应用：小冰唱歌
未来应用：高度定制化 AI Beings

机器臂手术

与人类结合实现人类功能扩展的 AI(外骨骼，外挂式大脑)

陪伴

帮忙解决形如楼上的冷场

学废了（

那全括号呢（）

半括号的含义：
基本含义：弱化语气，通常带有否定前面所说内容的意思，向对方表示自己所说的话是在开玩笑。
几乎所有使用半括号的场合都会有这一层意思：就其发展而言，最初括号内的文字说明说话人明确知道所说的内容会给人带来不快，借以用括号内的文字补充说明自己真正的想法，从而降低给人带来的不快。就以上面的例子来说：
你是猪吧（

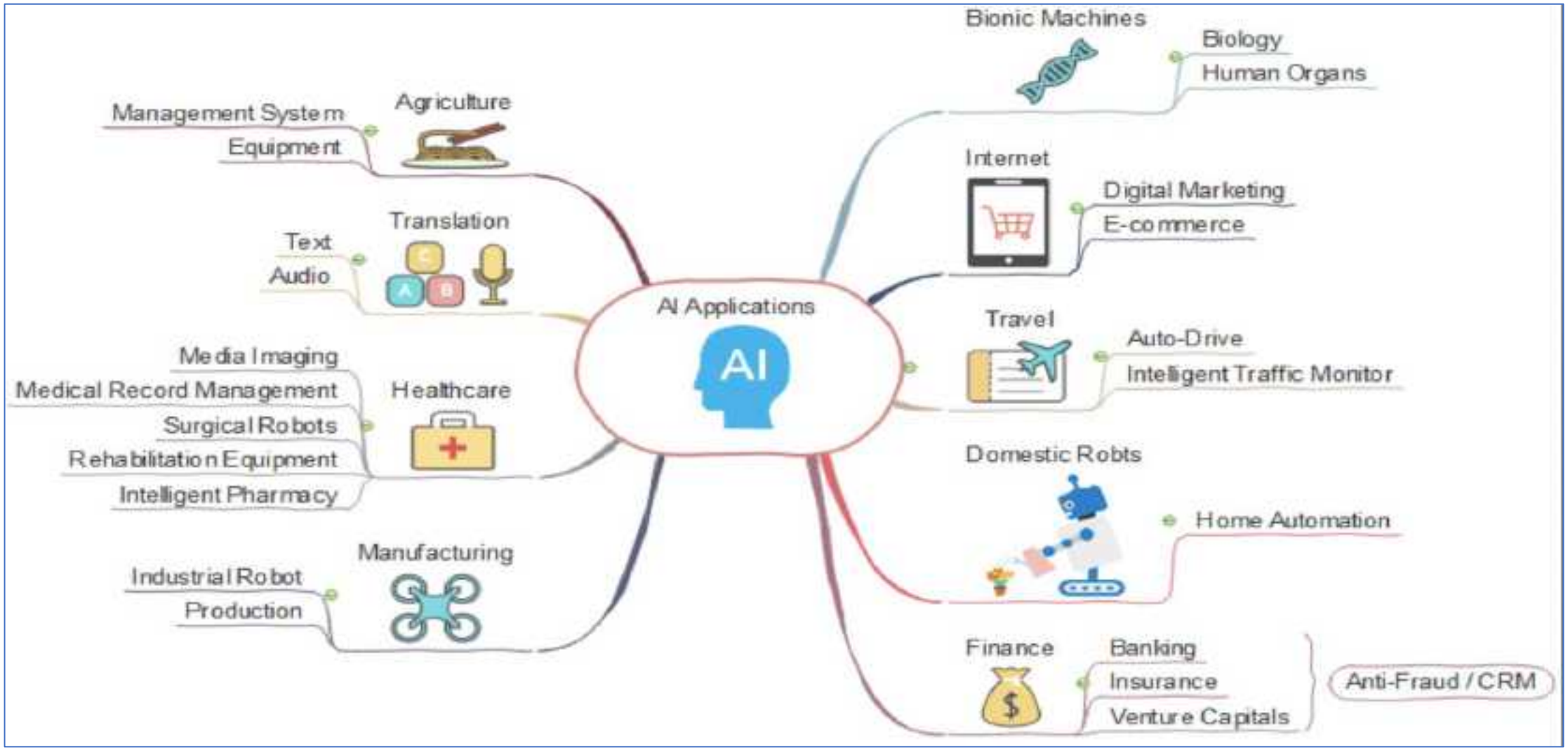
Most Inspiring Answer For Afternoon

其实你也想很人沟通，奈何完全不会说话但是又不想对方觉得自己很冷漠于是强行加入很多表情包，像手机中毒了一样！！！可以说是嘴笨+社交恐惧的最后的倔强了

不过最近社恐患者又发现了一个新的保护伞：（,化解尴尬烘托气氛，培养塑料姐妹情，和同事有效沟通，堵住别人质疑的嘴….“（”半括号成了社恐患者新宠。

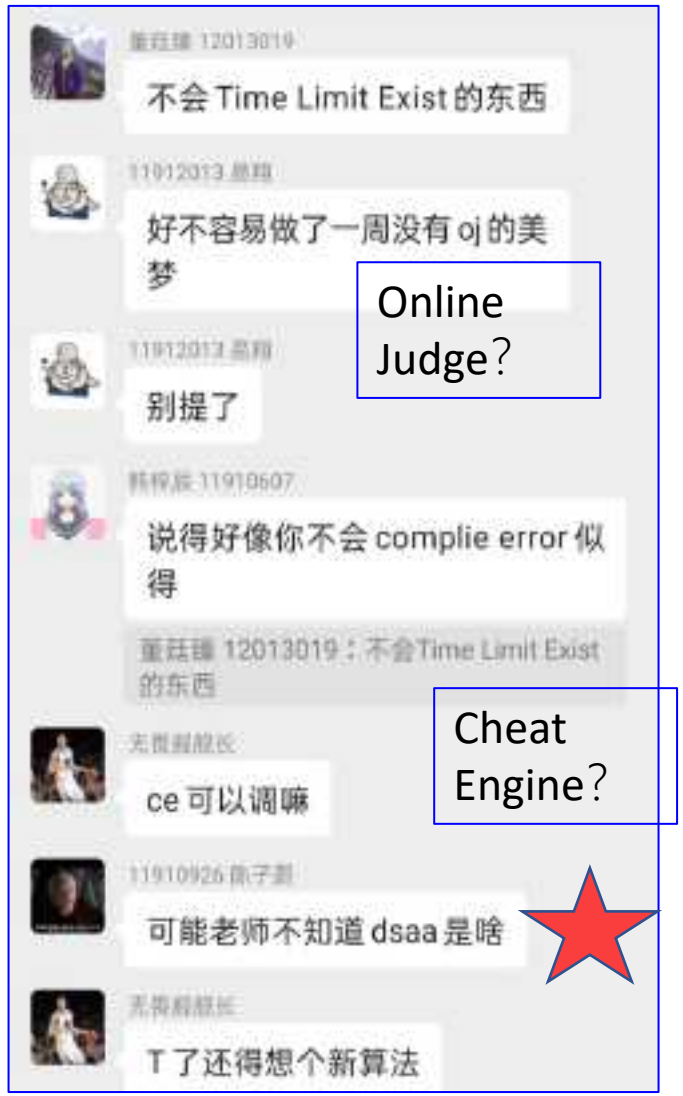
《半括号使用大全》请您一阅：

Some AI+ Industries

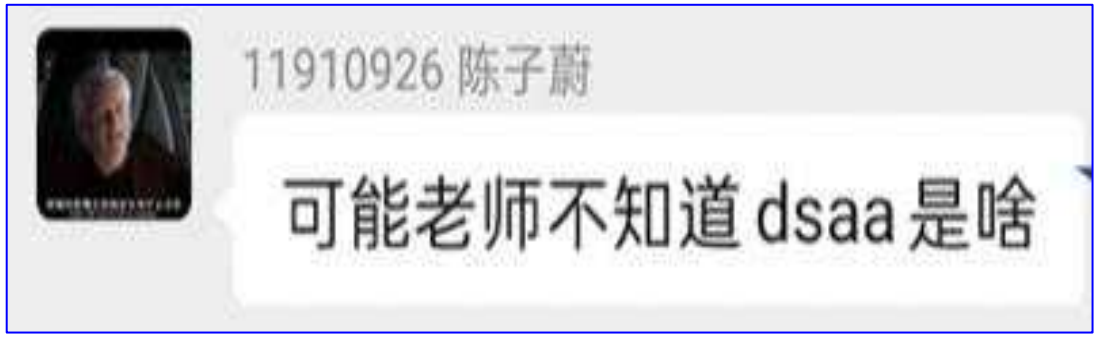


Survey: Name AI Algorithms You Like to Learn

Survey – Afternoon Class



Most Inspiring Answer For Afternoon

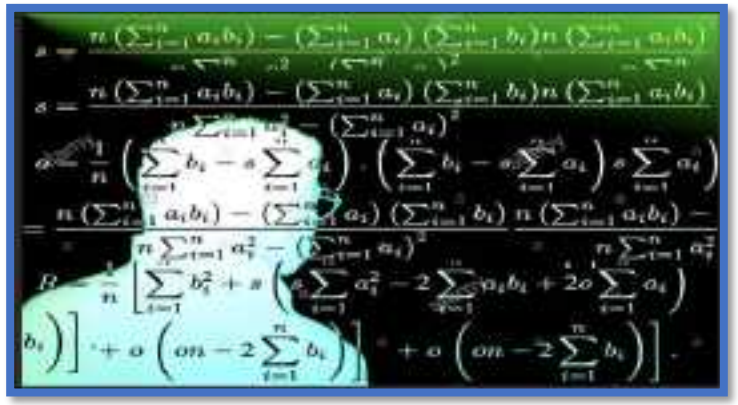


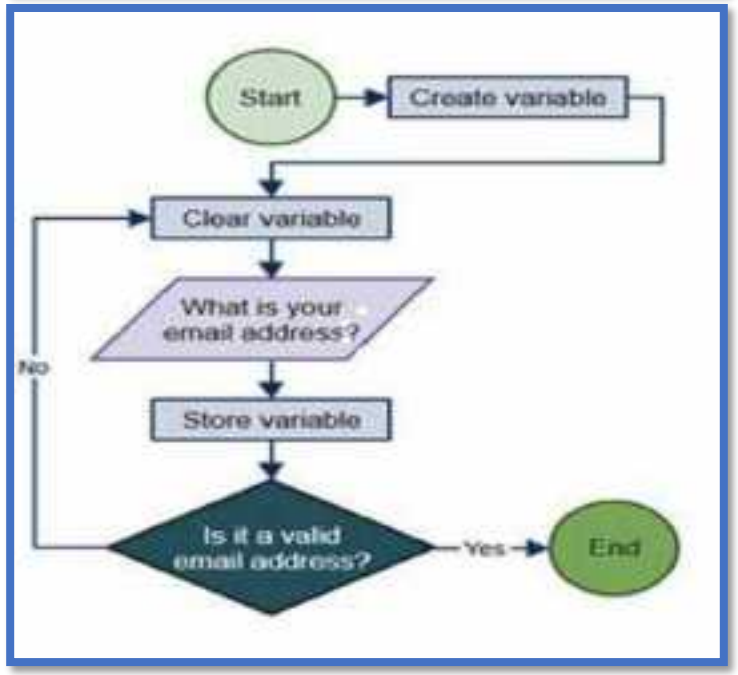
Computer Algorithm

Computer Algorithm:

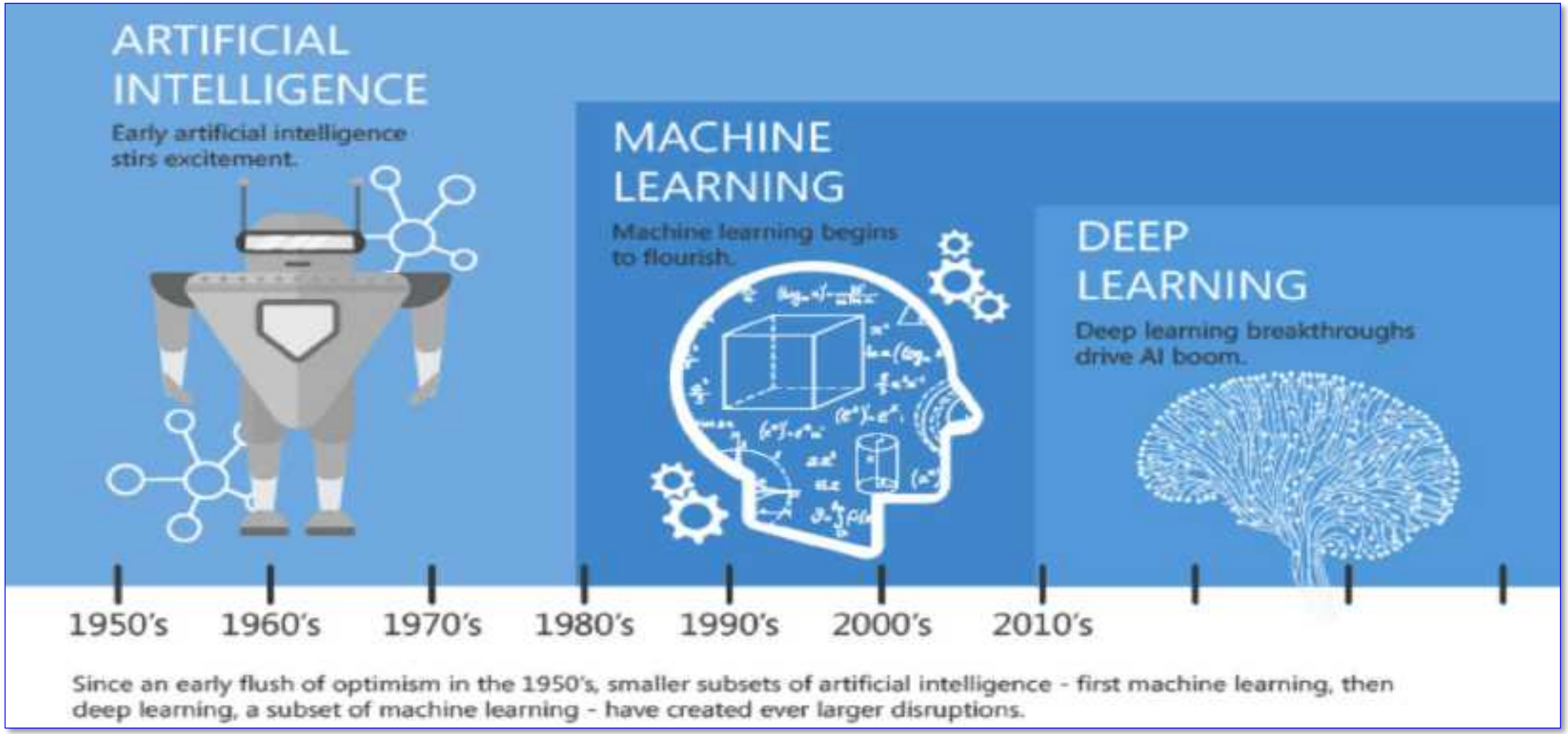
a well defined sequence of steps for solving a computational problem

- It produces the correct output
- It uses basic steps / defined operations
- It finishes in finite time

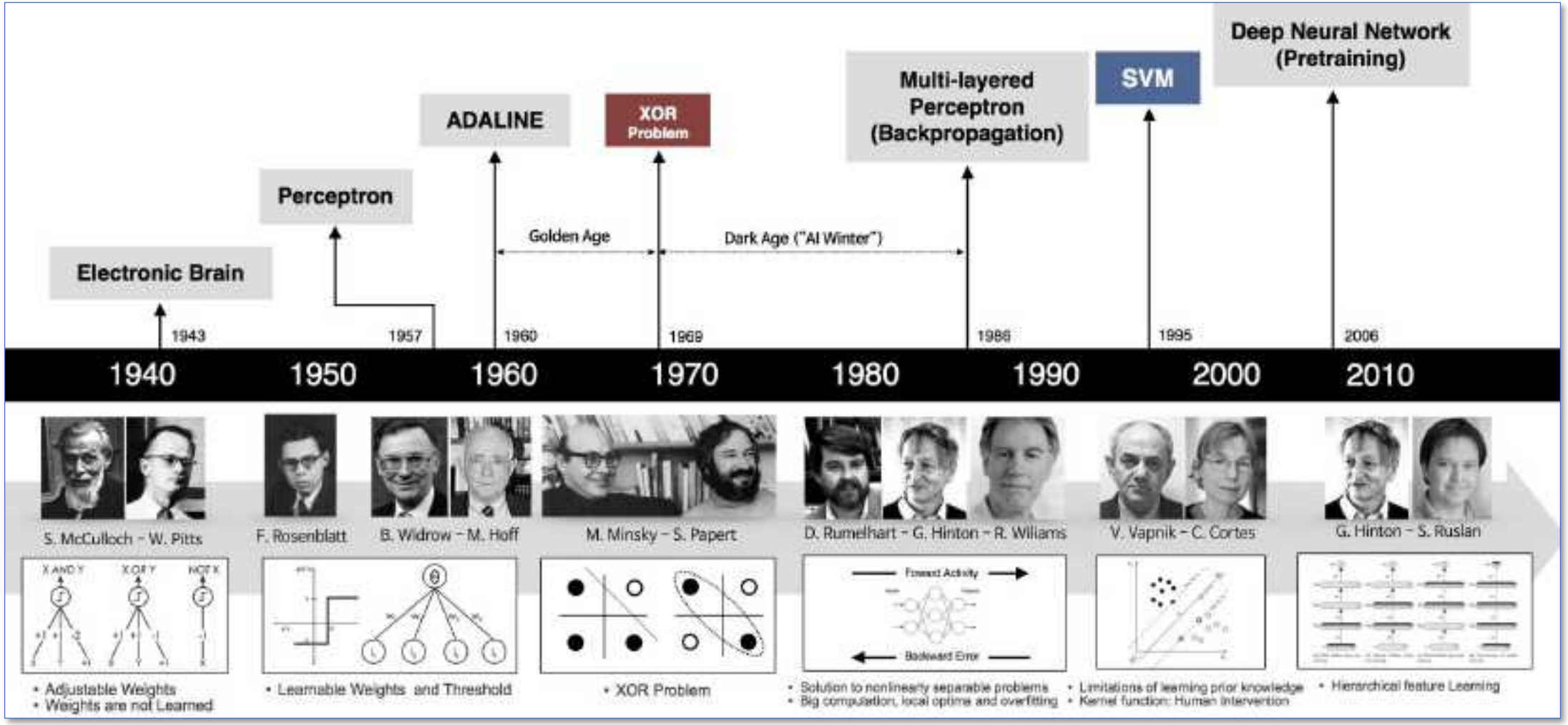




AI Algorithm Summary



AI algorithm Developments - A Closer Look



Lecture 2
Homework and Discussion – 学生提出项目

1. A识别并解决问题
2. 棋类竞技
3. A家用电器开关规划
4. A语言情感分析
5. 特定风格图像生成
6. 智慧城市，智能交通
7. 手写字识别
8. 识别不同姿势
9. 弹幕屏蔽
10. AI麻将
11. AI五子棋
12. 基于MRI扫描图像的阿尔茨海默症识别
13. 网络信息真伪判别
14. AI聊天机器人
15. 食堂排队拥挤进行优化
16. 疾病预测
17. 艾宾浩斯遗忘曲线
18. 医学图像分割
19. 语音翻译
20. 语音合成
21. 3D器官模型的构建
22. 推荐系统和隐私保护
23. 医学图像和中文病历
24. NLP方向的文本情感分析
25. 自然灾害预警与处理

Lecture 2
Homework and Discussion – Suggested Projects

① **预测AI+数学**：自动证明领域的应用
② **AI+物理**：物理模型构建的应用
③ **AI+化学**：化学分析的应用
④ **AI+生物**：生物药物研发的应用
⑤ **AI+金融**：金融模型的构建与应用，如股票预测
⑥ **AI+环境**：环境模型构建的应用
⑦ **AI+海洋**：海洋环境预测的应用
⑧ **AI+航天**：航空航天领域的应用
⑨ **AI+能源**：能源开采领域的应用
⑩ **AI+机械**：1.在机器人上的应用；2.机械故障预测

⑪ **AI+生医工**：在计算成像的应用
⑫ **AI+医学**：1.眼科OCT；2.脑科MRI；3.呼吸科肺部CT； 4.骨科X光； 5.心外科PET；5.艾宾浩斯遗忘曲线 （6人）；6.基于MRI扫描图像的阿尔茨海默症识别（3人）
⑬ **AI+人文**：1.自动写作；2.风景画合成
⑭ **AI+考古**：**1.瓷片拼接；2.动作模拟**
⑮ **AI+法律**：智能律师
⑯ **AI+心理**：智能心理辅导
⑰ **AI+商业**：智能推荐系统
⑱ **AI+物流**：智能配送

Lecture 3
Homework and Discussion – 学生提出项目 1

1	AI+斗地主	孙永康
		李怀武
		胡鸿飞
		吴一凡
		杨光
		张习之
		金肇轩
		于佳宁
2	五子棋+AI	周贤玮
		韩梓辰
		金冬阳
		赵云龙
		张坤龙
		陈茜
		夏星晨
3	AI application on diabetes	周钰奇
		李仪轩
		董叔文
		湛掌
		胡钧淇
		裴鸿婧
4	句子图片的文本情感分析	唐云龙
		刘叶充
		刘旭坤
		马卓远
		陈子蔚
		江欣乐

5	AI in lung cancer	夏瑞浩
		李悦明
		龚颖璇
		吴云潇潇
		姜欣瑜
		王英豪
6	基于MRI图像的阿尔茨海默症分类	董廷臻
		郑英炜
		李博翱
		朱嘉楠
		李杨燊
7	AI Applications in Breast Cancer Imaging	林文心
		翟靖蕾
		孙瀛
		林宝月
		陈帅名
		冀鹏宇
8	Applications of artificial intelligence in covid-19 patients	罗岁岁
		周雅雯
		肖雨馨
		程旸
		尹子宜
9	基于OCT图像的眼部多种疾病诊断和分析的调研	何忱
		郭煜煊
		朱寒旭
		赵子璇
		王子杰
		张晓新

Lecture 3
Homework and Discussion – 学生提出项目2

10	gesture recognition	车文心 张静远 张骥霄 杜鹏辉
11	AI in Lab	孙含曦 于松琦 罗西 唐家豪
12	人脸识别算法的发展与应用	易翔 陈俊滔 罗景南 胡泰玮 文颖潼
13	人工智能在无障碍设施领域中的使用调查	马子晗 陈沐尧 林小璐 任艺伟 王增义
14	identification of handwriting elements	刘通 谈思序 赵伯航 张皓淇
15	AI虚拟主播制作计划	王标 张倚凡 李康欣 何泽安
16	人工智能对白内障分级的算法综述	赵宇航 徐格蕾 陈星宇 祖博瀛 黄弋骞
17	人工智能技术在个性化推荐系统上的应用与研究	谭雅静 刘思岑 Ooi Yee Jing 孟宇阳 杨锦涛
18	High Score Gamer	易辰朗 许天淇 黄北辰 赵思源 朱佳伟
19	校园巴士路线优化	王祥辰 何鸿杰 吴子彧

Lecture 3
Homework and Discussion – 学生提出项目3

20	给线稿上色的强AI大的算法研究	韩晗	女	19级29班
		刘思语	女	19级29班
		赵晓蕾	女	19级9班
21	Utilizing the efficiency of the smart transport in campus	樊青远	男	18微电子科学与工程（深港实验班）
		方琪涵	女	18生物医学科学
		袁通	男	18微电子科学与工程（深港实验班）
22	人工智能应用于病理分析的前景与挑战	李修治		医学院
		刘宇欣		医学院临床医学系
		沈睿琦	男	19级2班
23	使用AI通过用电器不同的振动情况去识别它们的类型和功率等	陈松斌	男	18级20班
24	深度学习在自动驾驶中的应用	王晓轩	女	19级16班

尚未分组名单
Zhang Kenneth
吴杰翰
陈浩然
宛清源
孙杰欣
曾宇祺

人工智能导论项目分组汇总

1. **AI+斗地主**：孙永康、李怀武、胡鸿飞、吴一凡、杨光、张习之、金肇轩、于佳宁
2. **AI+五子棋**：周贤玮、韩梓辰、金冬阳、赵云龙、张坤龙、陈茜、夏星晨
3. **High Score Gamer**：易辰朗、许天淇、黄北辰、赵思源、朱佳伟
4. **AI application on diabetes**：周钰奇、李仪轩、董叔文、湛掌、胡钧淇、裴鸿婧
5. **AI in lung cancer**：夏瑞浩、李悦明、龚颖璇、吴云潇潇、姜欣瑜、王英豪
6. **基于MRI图像的阿尔茨海默症分类**：董廷臻、郑英炜、李博翱、朱嘉楠、李杨燊
7. **AI Applications in Breast Cancer Imaging**：林文心、翟靖蕾、孙瀛、林宝月、陈帅名、冀鹏宇
8. **Applications of artificial intelligence in covid-19 patients**：罗岁岁、周雅雯、肖雨馨、程旸、尹子宜
9. **基于OCT图像的眼部多种疾病诊断和分析的调研**：何忧、郭煜煊、朱寒旭、赵子璇、王子杰、张晓新
10. **人工智能对白内障分级的算法综述**：赵宇航、徐格蕾、陈星宇、祖博瀛、黄弋骞
11. **人工智能应用于病理分析的前景与挑战**：刘宇欣、李修治、沈睿琦
12. **句子图片的文本情感分析**：唐云龙、刘叶充、刘旭坤、马卓远、陈子蔚、江欣乐
13. **gesture recognition**：车文心、张静远、张骥霄、杜鹏辉
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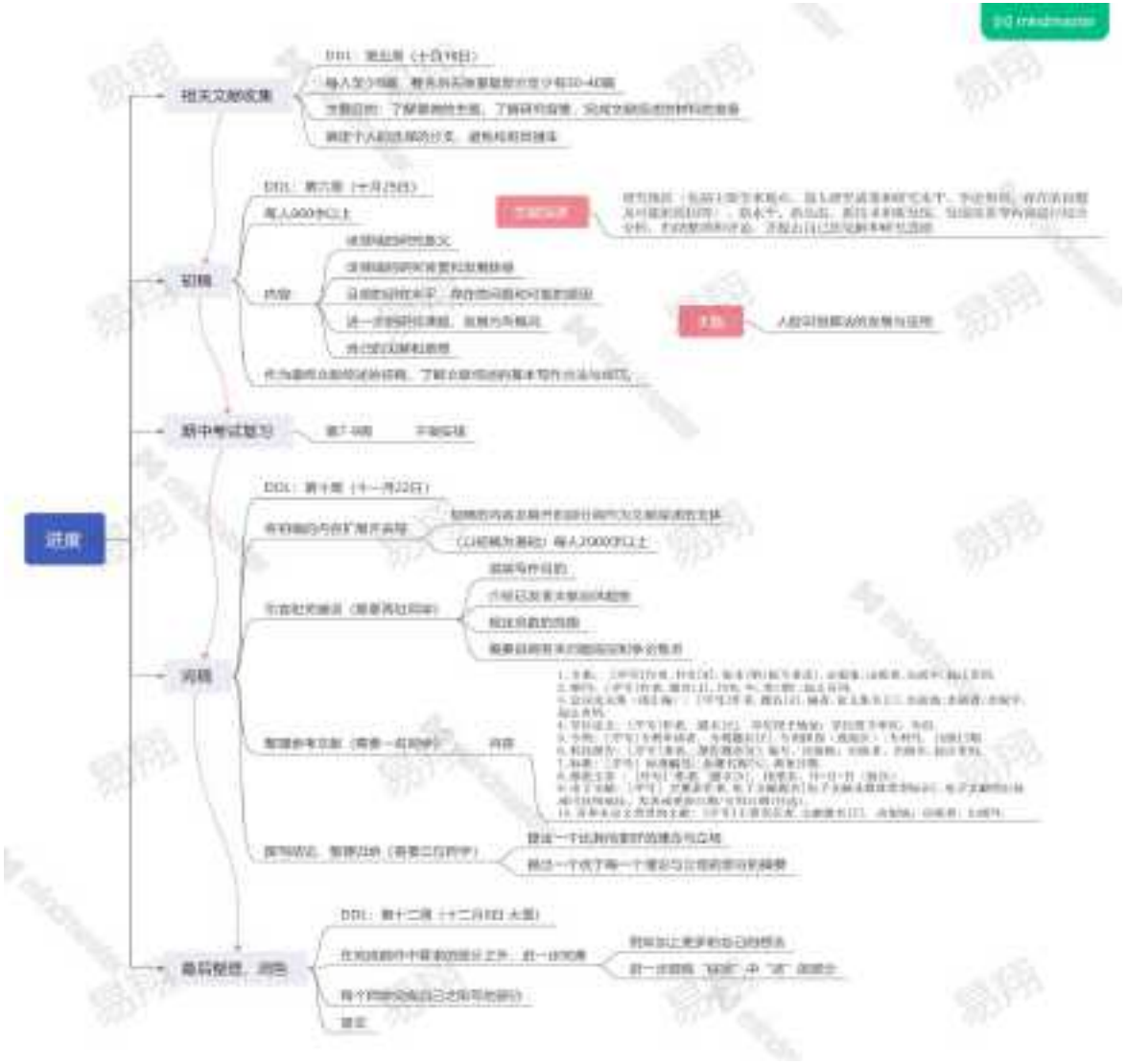
23. **深度学习在自动驾驶中的应用**：王晓轩
24. **不确定或未选择方向的**：Zhang Kenneth、陈浩然、宛清源、孙杰欣、曾宇祺
25. ***考虑到Presentation时间，小组数目限定为20个，有些小组合并一下谢谢！***

Some Group Project -1

人脸识别算法的发展与应用的规划



Some Group Project -2

Form Your Project Team. Finalize your Project Title. Record Why You Choose Such Topic for Your Project?
主题：深度学习在自动驾驶中的应用
选择原因：近年来，自动驾驶汽车技术取得了越来越快的进步，主要得益于深度学习的应用和人工智能的发展。深度学习是机器学习的一种，而机器学习是实现人工智能的必经路径。深度学习的概念源于人工神经网络的研究，含多个隐藏层的多层感知器就是一种主要的深度学习结构。深度学习通过组合低层特征形成更加抽象的高层表示属性类别或特征，以发现数据的分布式特征表示。随着硬件技术的成熟和人工智能中机器学习的不断发展，深度学习开始应用于自动驾驶领域使得自动驾驶汽车开始从实验室开发和测试条件转向在公共道路上驾驶，并开始被市场接受，逐渐成为社会热点。

Write a Project Plan Describing Intended Algorithms and Application You Want to Research for Your Project and Project Milestones.
10月1日至10月25日 查阅相关资料 阶段性成果：整理相关资料构建文献文档
10月26至11月1日 绘制综述的思维导图 阶段性成果：综述的思维导图
11月2日至11月29日 根据思维导图撰写论文 阶段性成果：论文
11月30日至12月8日 制作汇报ppt 阶段性成果：汇报ppt
算法：超像素采样网络、卷积神经网络、FCN-LSTM全卷积-长短期记忆网络的架构等等

Some Group Project - 3

主题：人工智能对白内障分级的算法综述
原因：我国白内障发病率极高，尤其在老年人当中更是如此。只有将白内障分级，才能更精准的诊断，并提供更有效的治疗。本组对白内障分级的现有算法进行调研，并形成综述，可以为白内障分级工作提供帮助。

Week5，6：查找白内障分级的不同标准，并对应算法。根据找到的算法数量具体分任务给每个人，对算法进行深入调研。
Week7，8，9，10：个人调研自己的任务，并形成综述。
Week11，12：小组结合分享讨论。

Some Group Project -4

项目名称：斗地主AI
原因：①斗地主是传统棋牌游戏，较有趣味性；②从搜集的资料来看，斗地主AI难度较为合适（不会太深奥但也有一定难度）；③小组内的一些同学“熟知”一些斗地主技巧。

Some Group Project -5

项目标题:
句子图片的文本情感分析
项目设立目的:
图片识别的人工智能与文本情感分析的人工智能，在学界已多有研究。可是很少有项目将两者合并。使用图片识别提取图片中的字符加以情感分析，能够扩宽文本情感分析的应用范围，为现代社会更为复杂的交往方式（图片中含有文字）提供一种新的分析方式。

Some Group Project -6

主题：

人工智能技术在个性化推荐系统上的应用与研究

调研目的：

在这个以信息作为主导的时代中，我们身边随处可见各类智能推荐系统，诸如网上购物的个性化推荐，音乐软件的偏好推送等等。在这些个性化推荐系统的背后，是人工智能与大数据分析的结合，它们为我们的生活带来了便捷贴心的服务，但同时我们的个人隐私也因此有了被泄露的风险。所以我们想要以个性化推荐系统作为切入点，研究人工智能与大数据的结合在信息爆炸的时代的意义与价值。

Some Group Project -7

项目名称：基于MRI图像的阿尔茨海默症分类

选题理由：

1. 网上有一定数量的阿尔茨海默症图片数据可供训练使用；
2. 阿尔茨海默症的分类有利于医学研究。

计划使用的算法：3DCNN/2DCNN/DNN（可能基于NVIDIA Clara Train SDK）

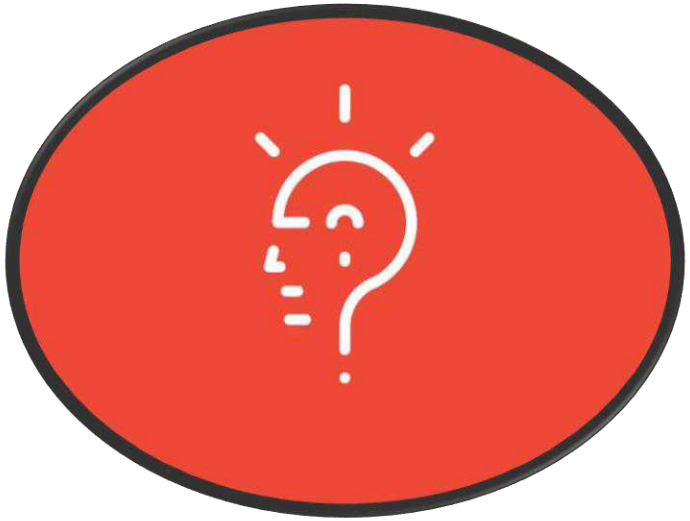
Roadmap：

10.20左右：完成框架选择和本地训练环境搭建，预处理数据集（OSIAS-3），完成对现有实现的调研；
11.10左右：实验各种思路并选定最终方案；
11.30左右：完成算法的调整和模型的训练，达到预想的准确率（80%以上）；
12.11之前：整理数据并完成综述报告和PPT。

Group Formation

Total 116 students, try to consolidate to 20 Groups

Any Question?



AI Algorithms

3

1 3 Broad Questions and survey

2 AI Algorithm Development History

3 Pre-AI Algorithms

4 Early-AI Algorithms

Early AI Algorithms

3 3

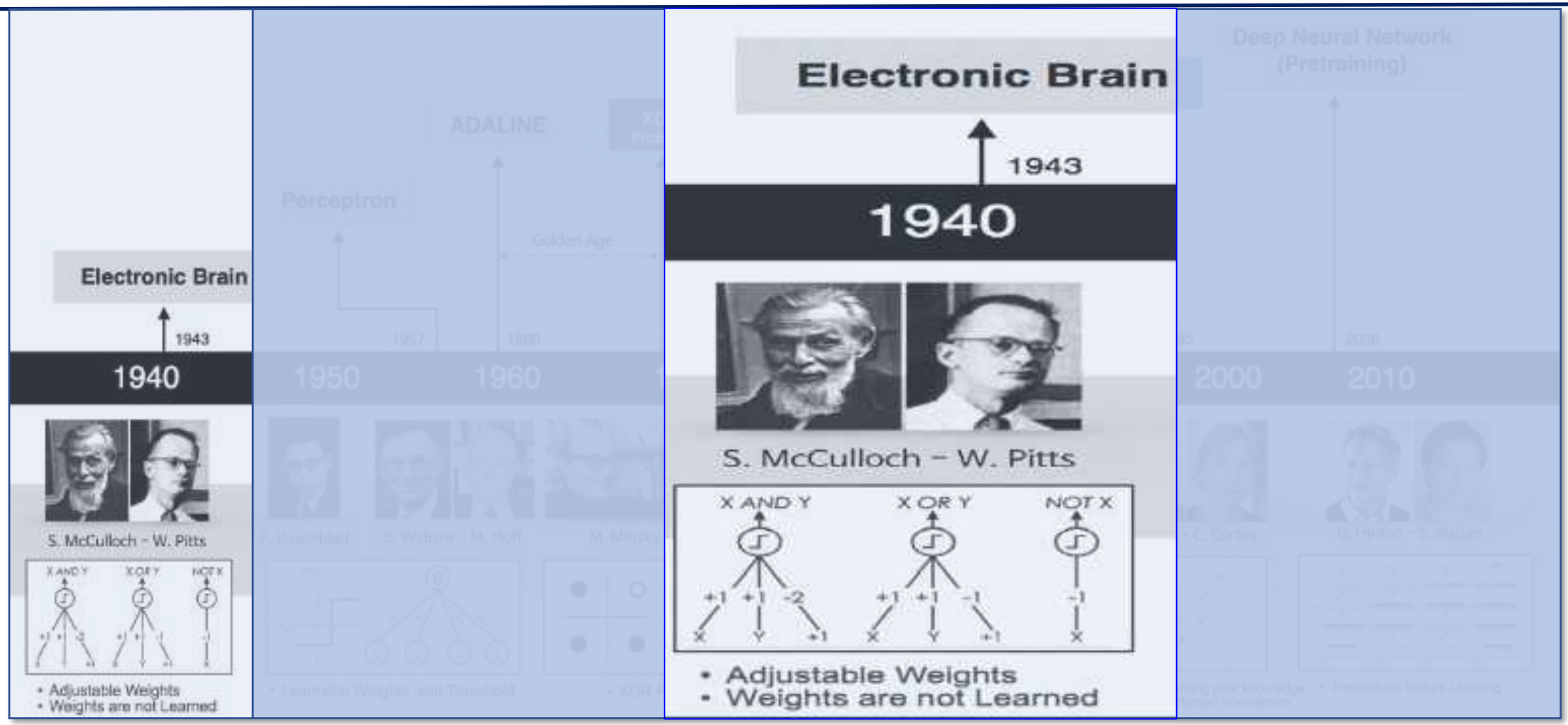
1 Early-AI Algorithms

2 Electronic Brain

3 Turing Test

4 Chinese （Card） Room

AI algorithm Developments - A Closer Look



Pre- AI Algorithms

3 3

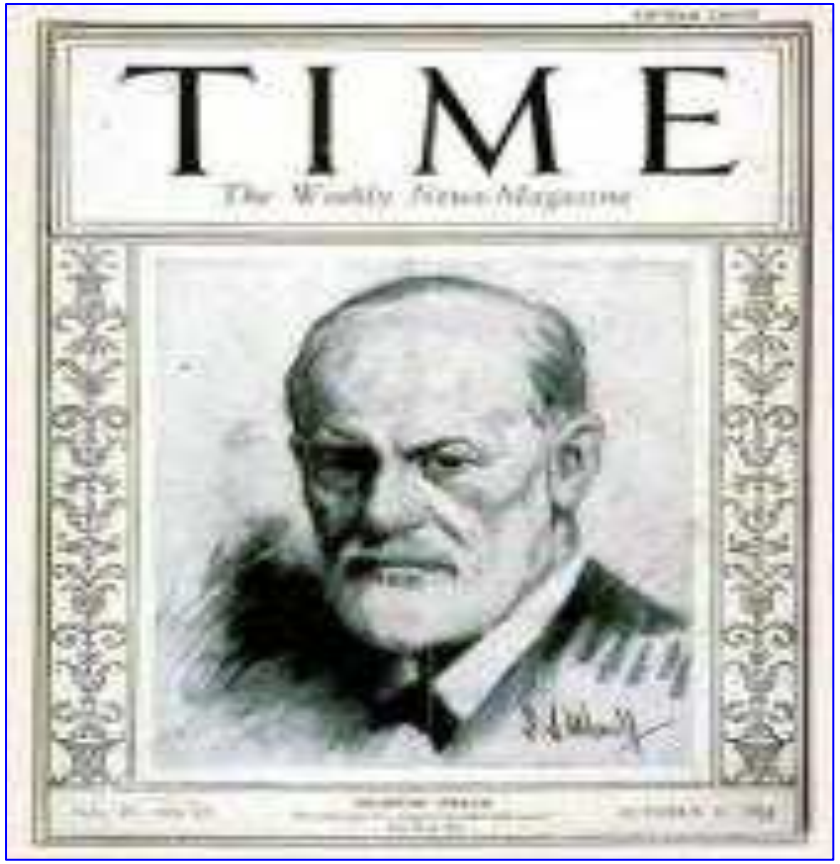
1 Pre-AI Algorithms

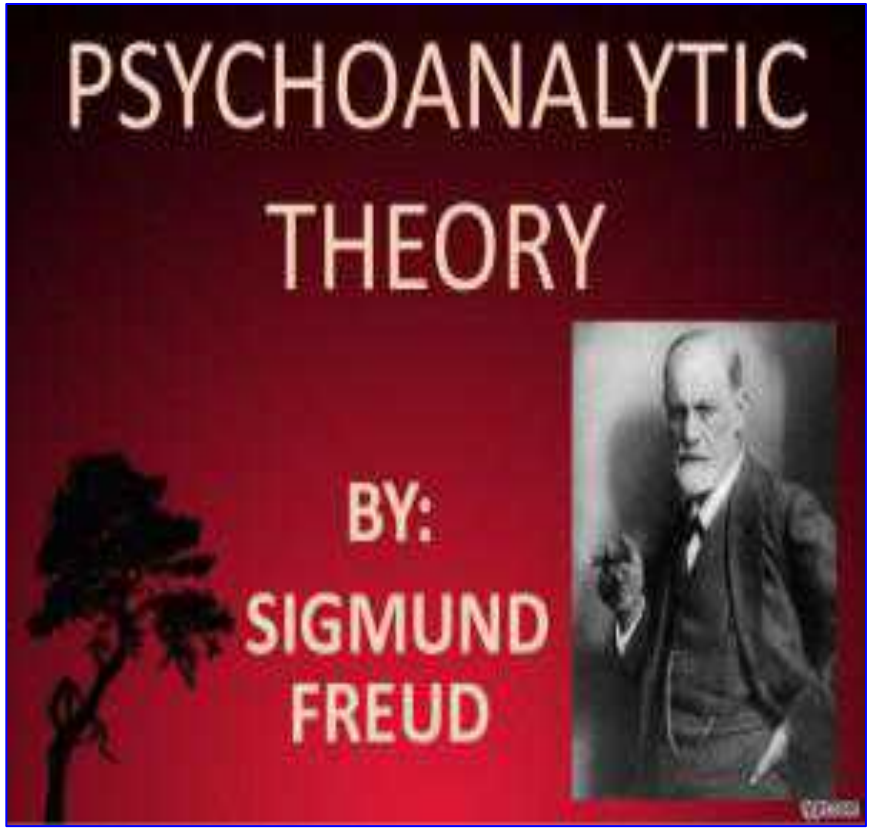
2 Electronic Brain

3 Turing Test

4 Chinese （Card） Room

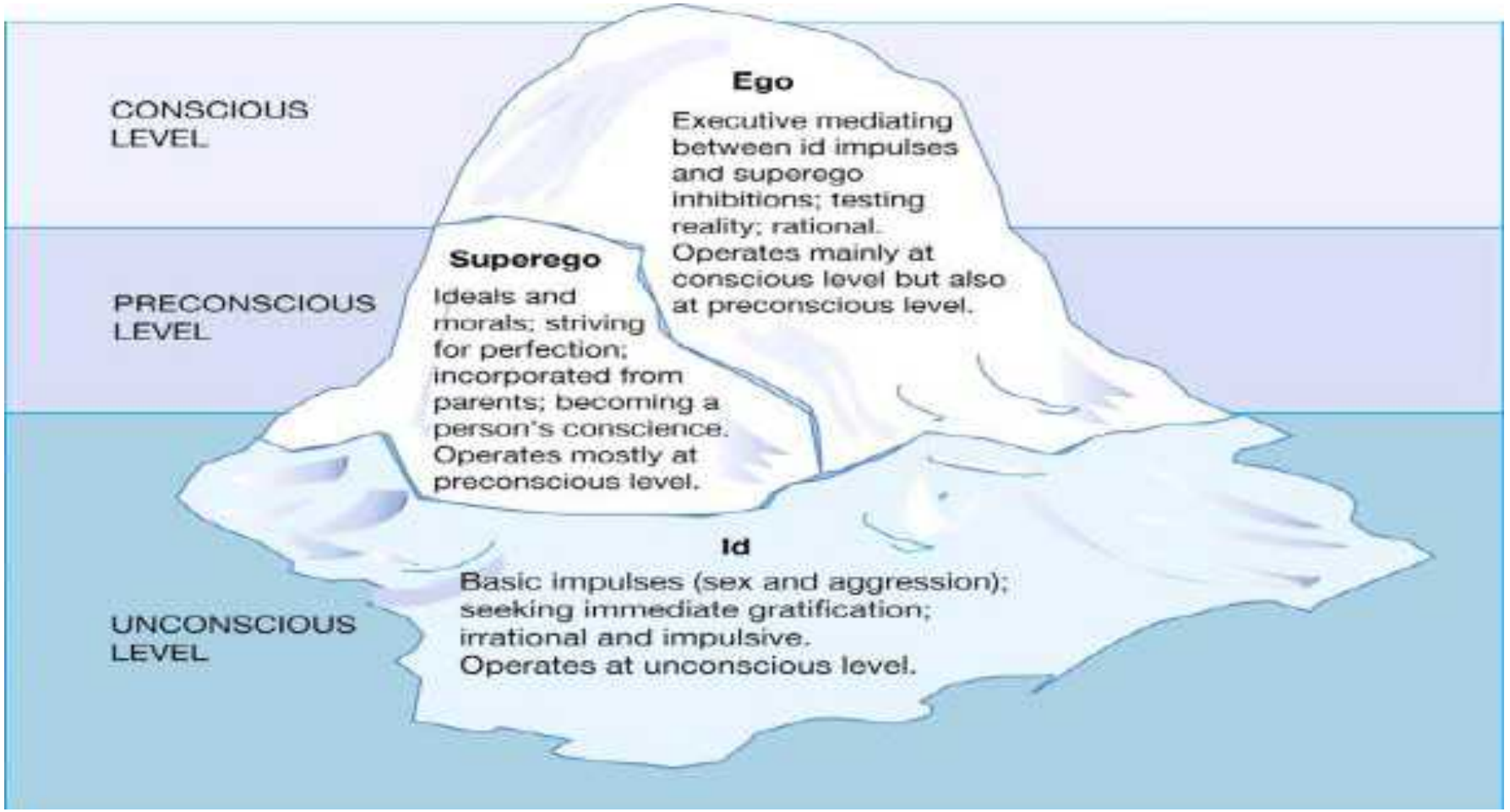
Dr. Sigmund Freud (1856-1939)





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.

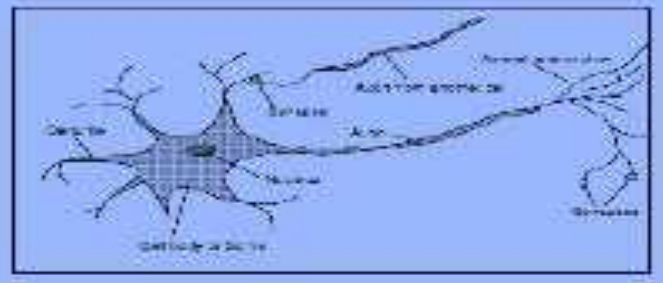
Human Mind from Freud

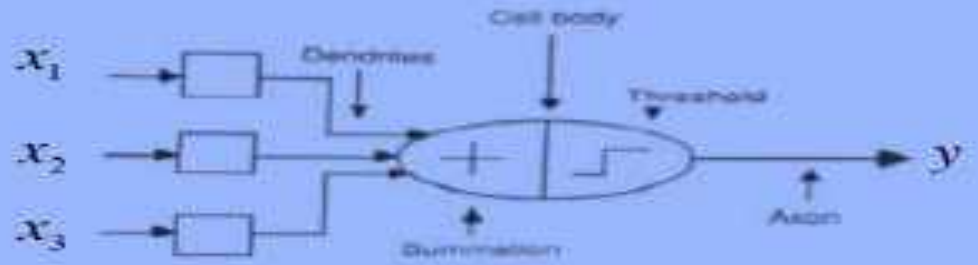


Electronic Brain from McCulloch and Pitts

Early Artificial Neurons (1943-1969)

- McCulloch- Pitts neuron

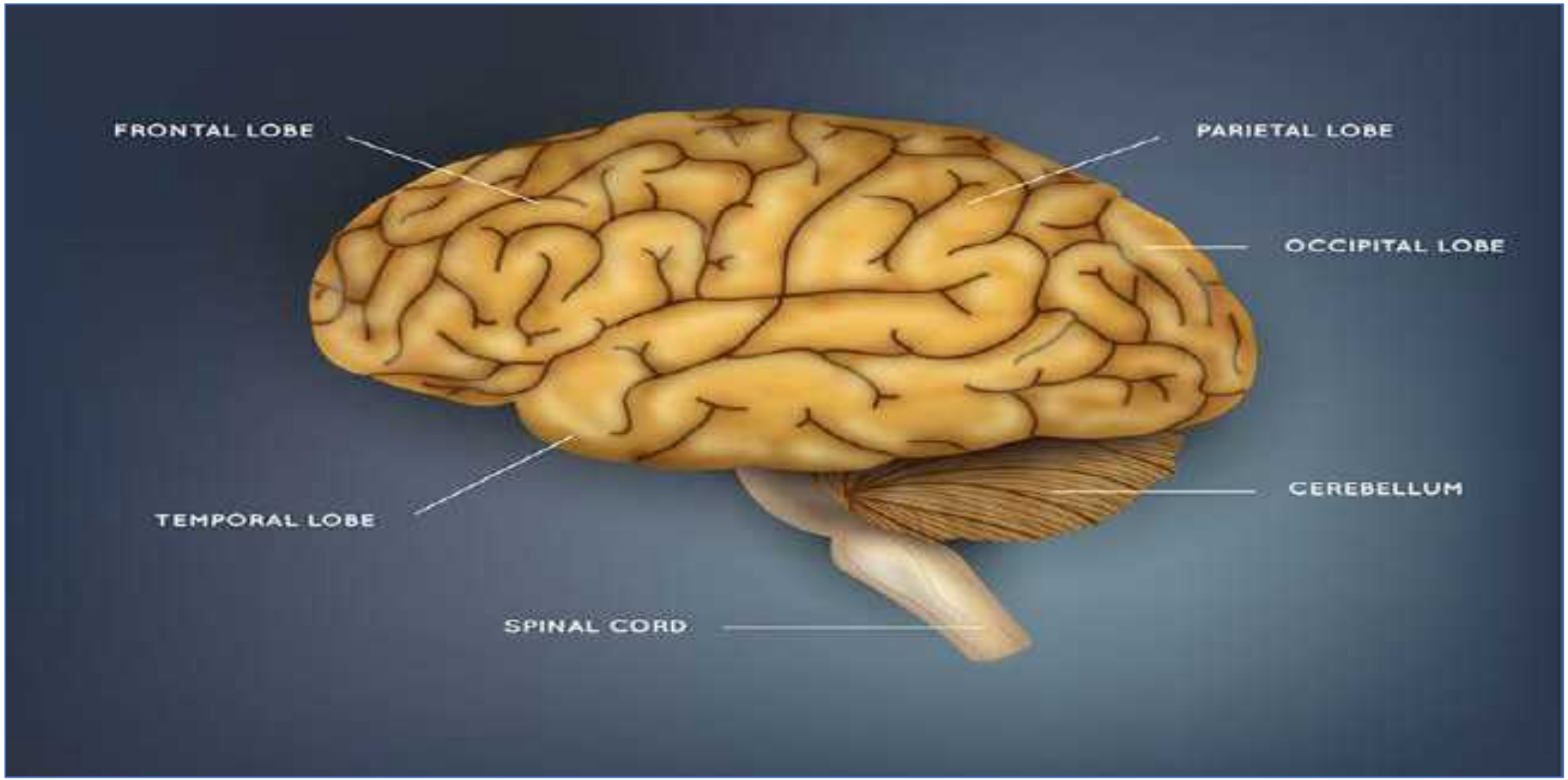




$$y = f\left(\sum_m w_m x_m - b\right) \qquad f(x) = \begin{cases} 1 & \text{if } x \geq 0; \\ 0 & \text{otherwise} \end{cases}$$

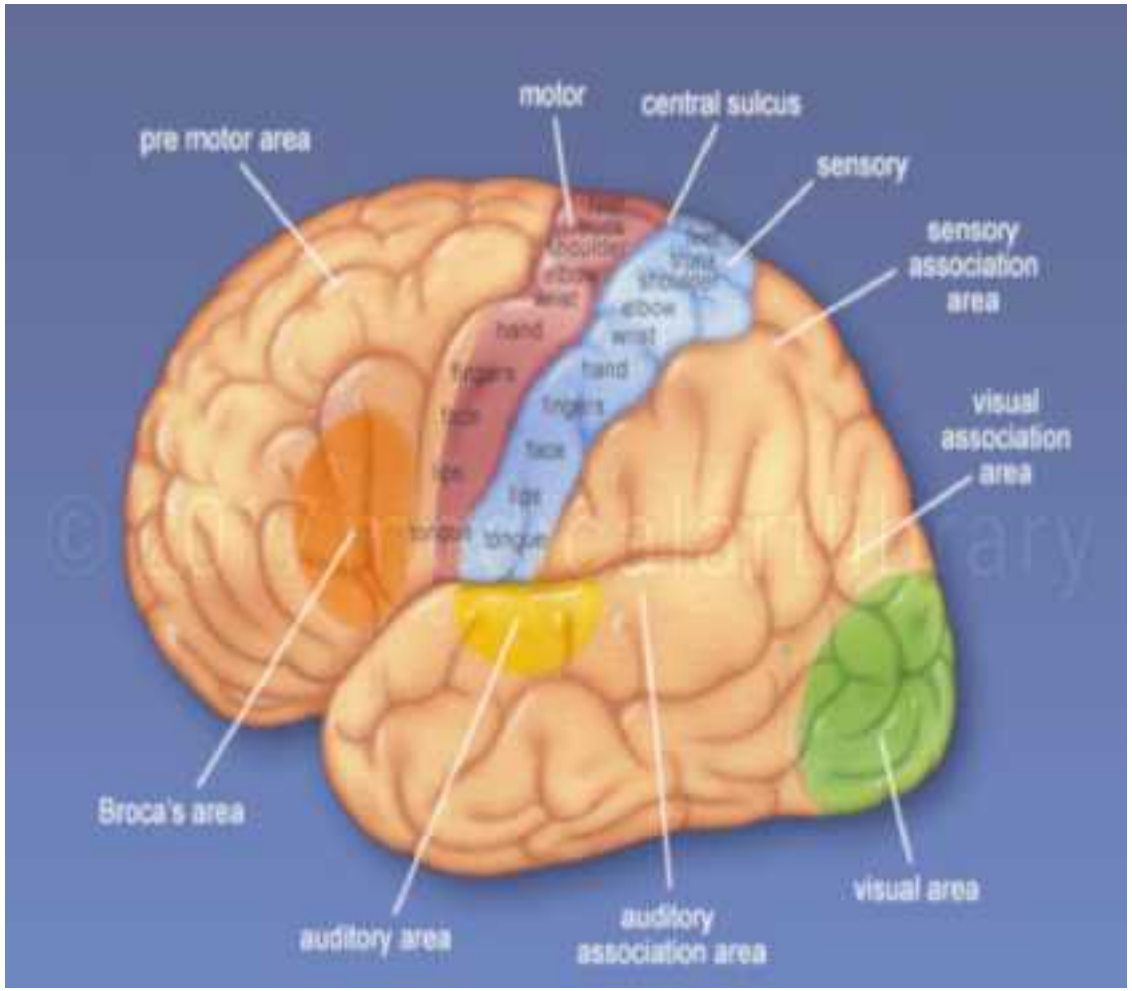
- McCulloch and Pitts [1943] proposed a simple model of a neuron as computing machine
- The artificial neuron computes a weighted sum of its inputs from other neurons, and outputs a one or a zero according to whether the sum is above or below a certain threshold

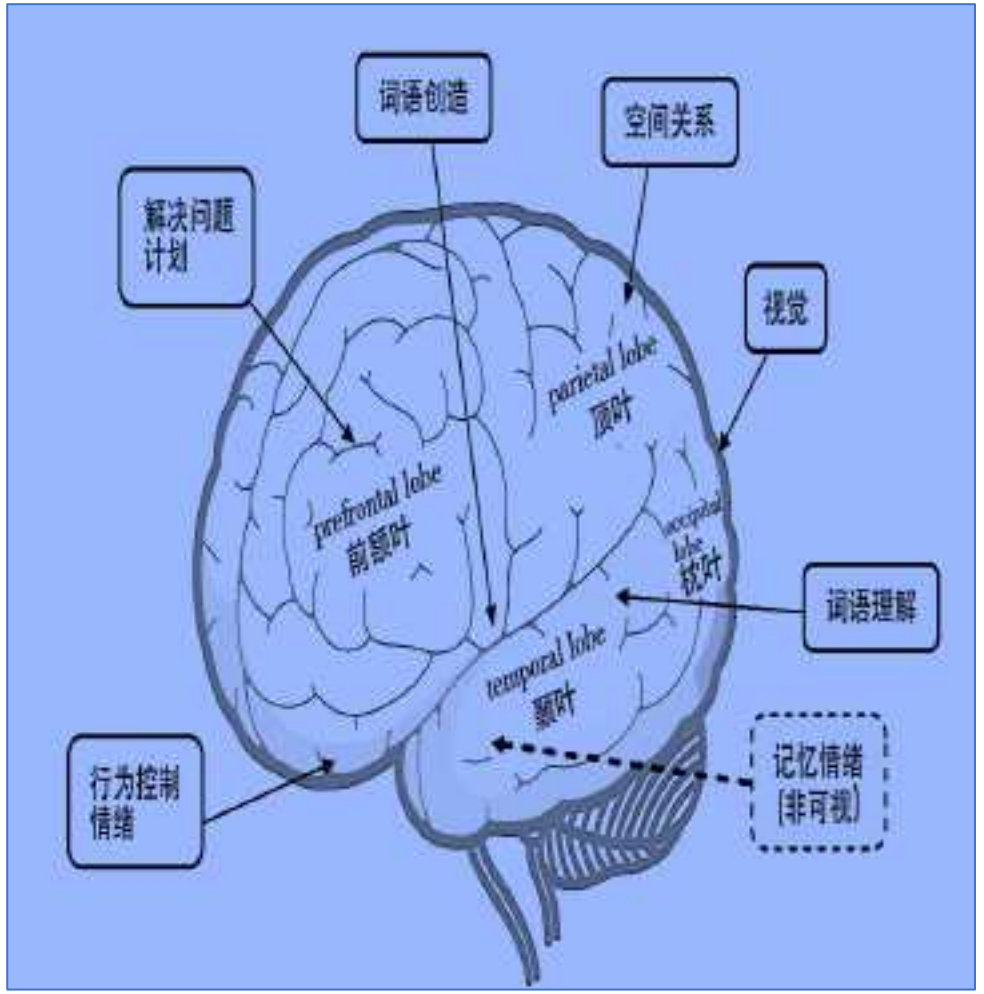
Human Brain


FRONTAL LOBE
PARIETAL LOBE
OCCIPITAL LOBE
CEREBELLUM
TEMPORAL LOBE
SPINAL CORD

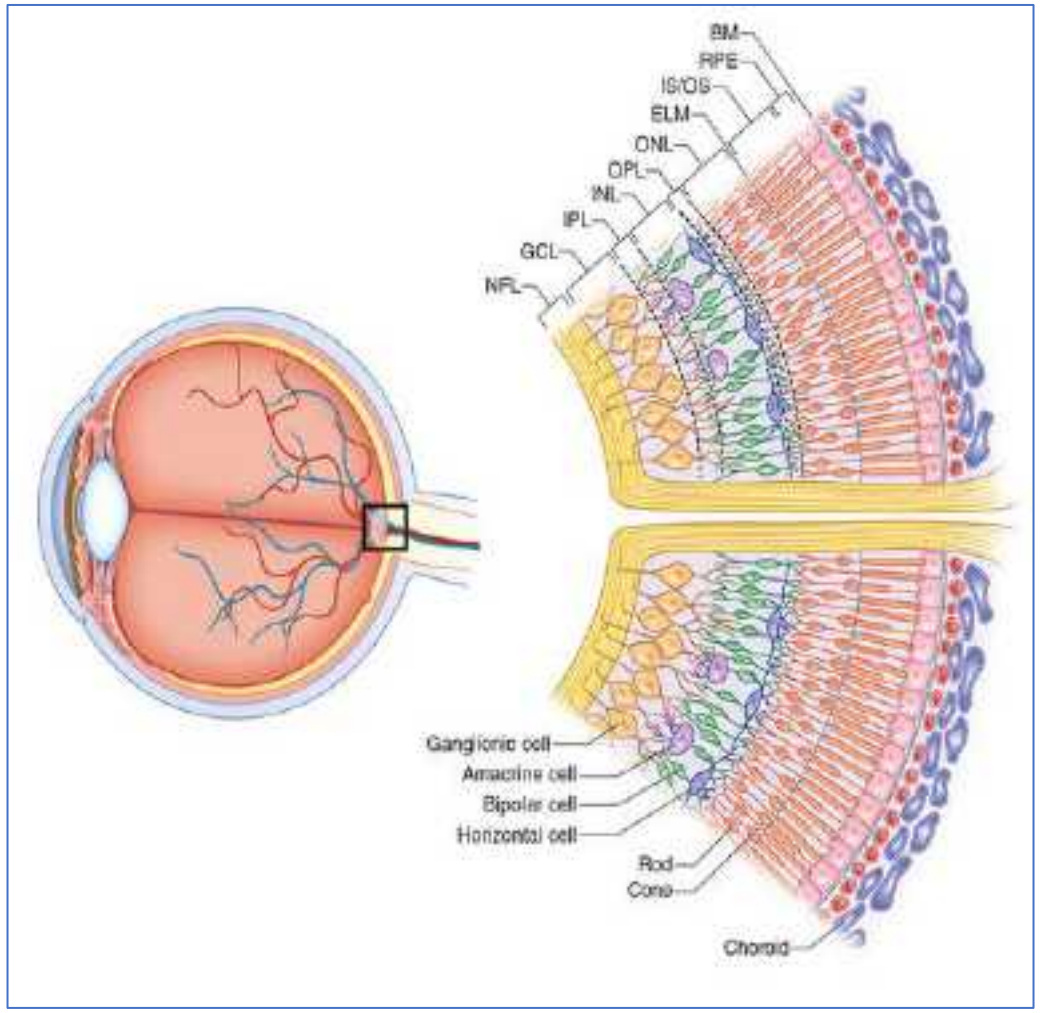
Human Brain – Simple Facts

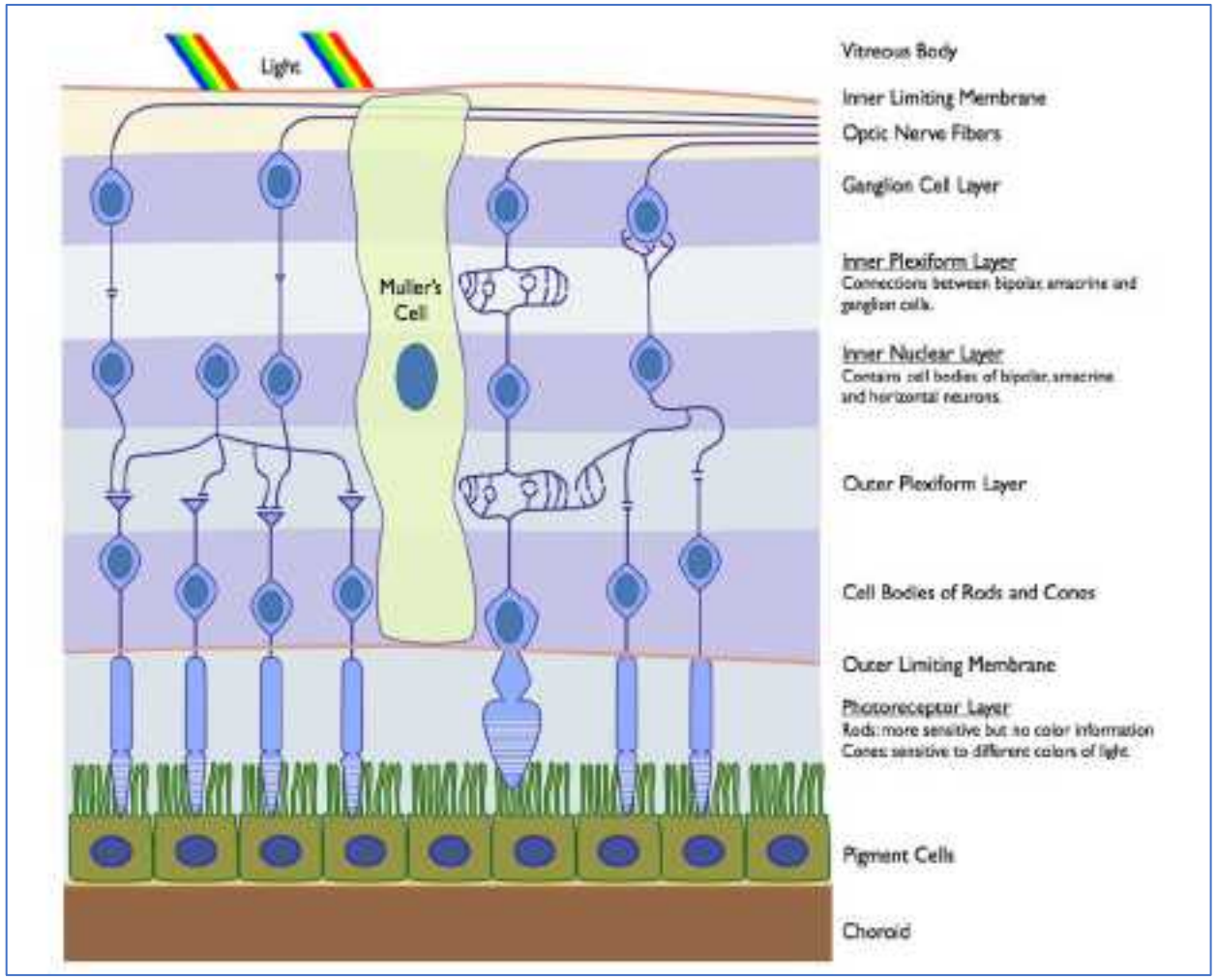
Human Brain - Areas



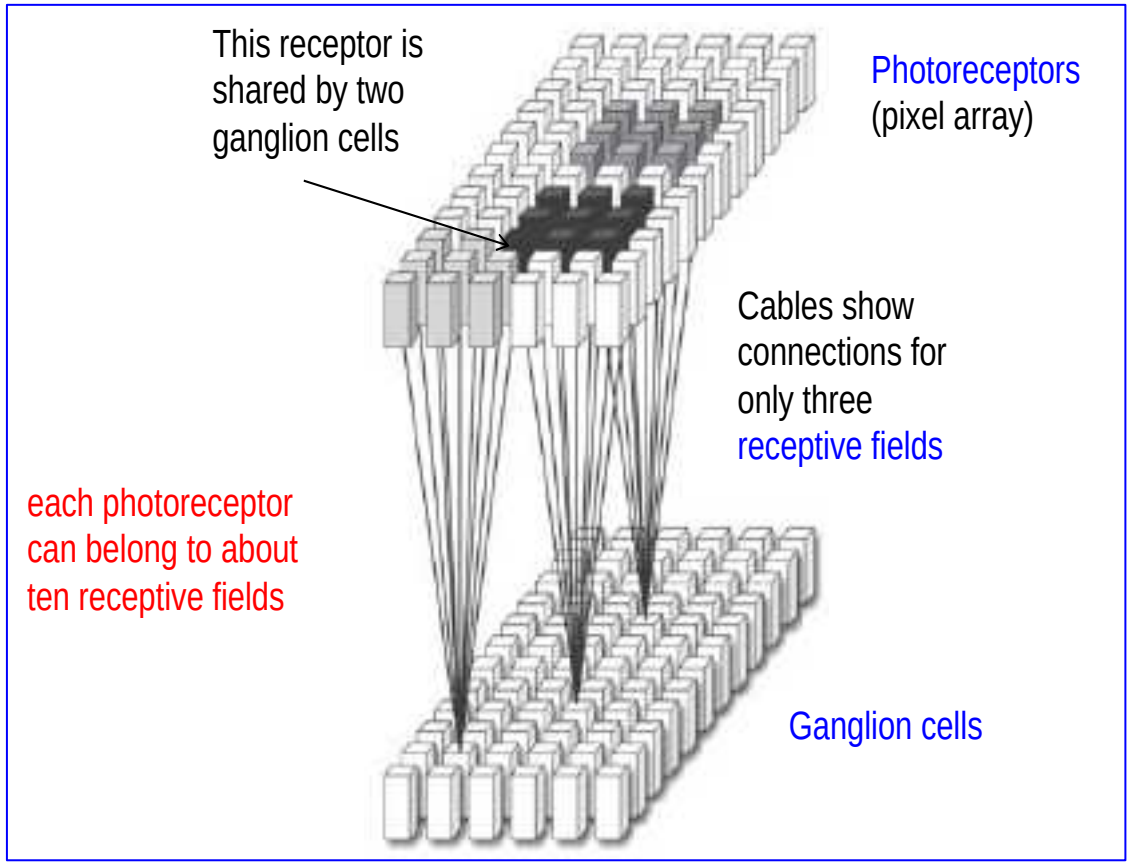


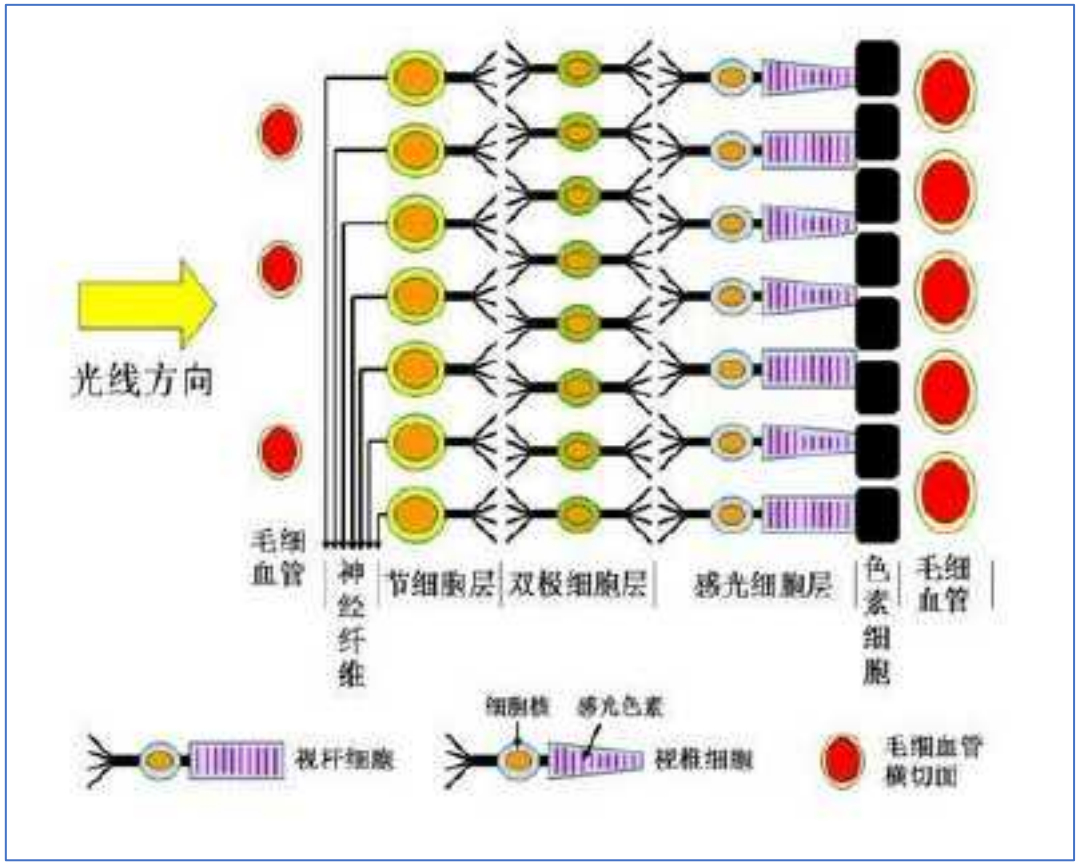
Major Input to Brain: Eye Retina Layer Structure



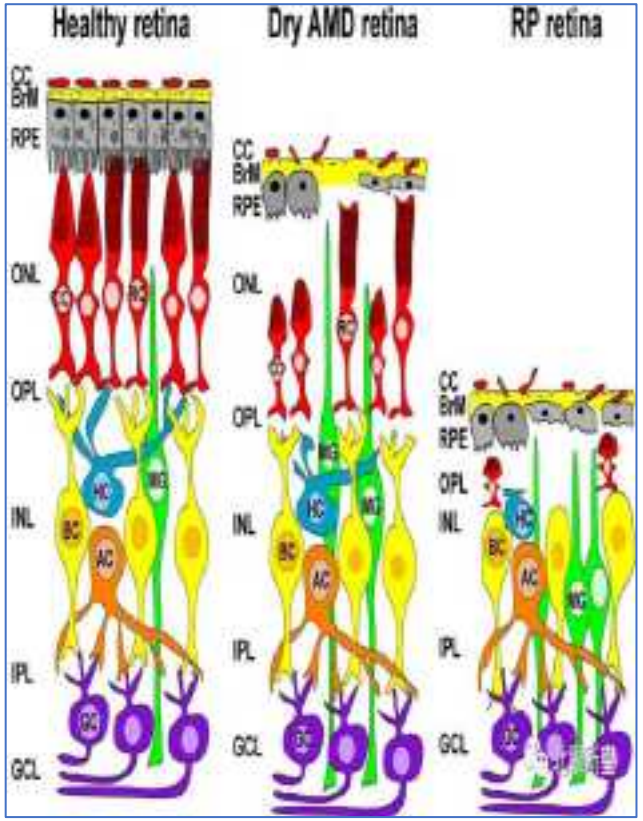


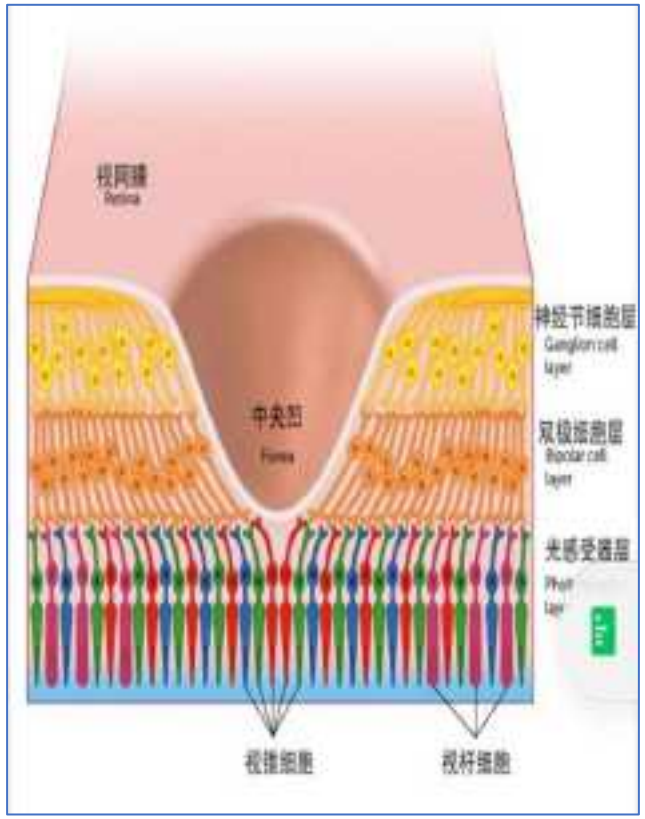
Major Input to Brain: From Eye Retina (126M photoreceptor cells –> 1M Ganglion cells)

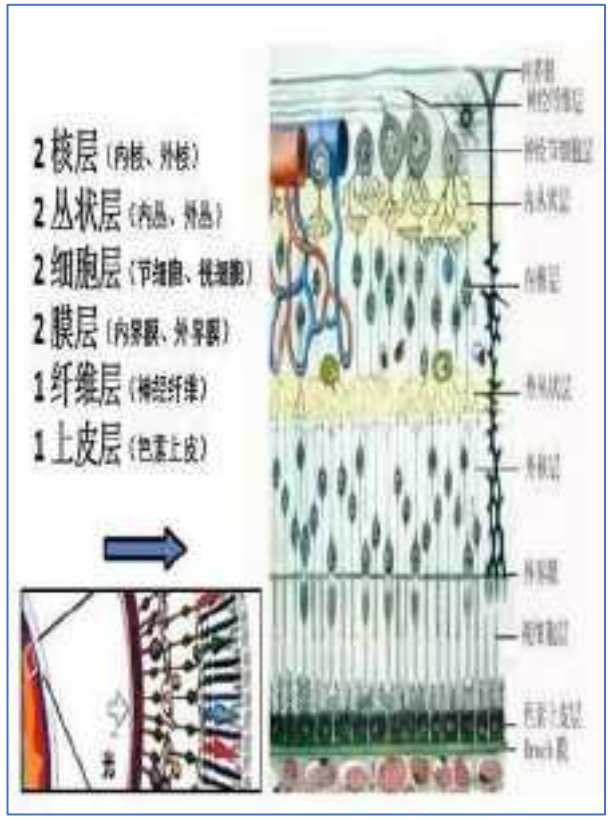




Major Input to Brain: Eye Retina Layer Structure



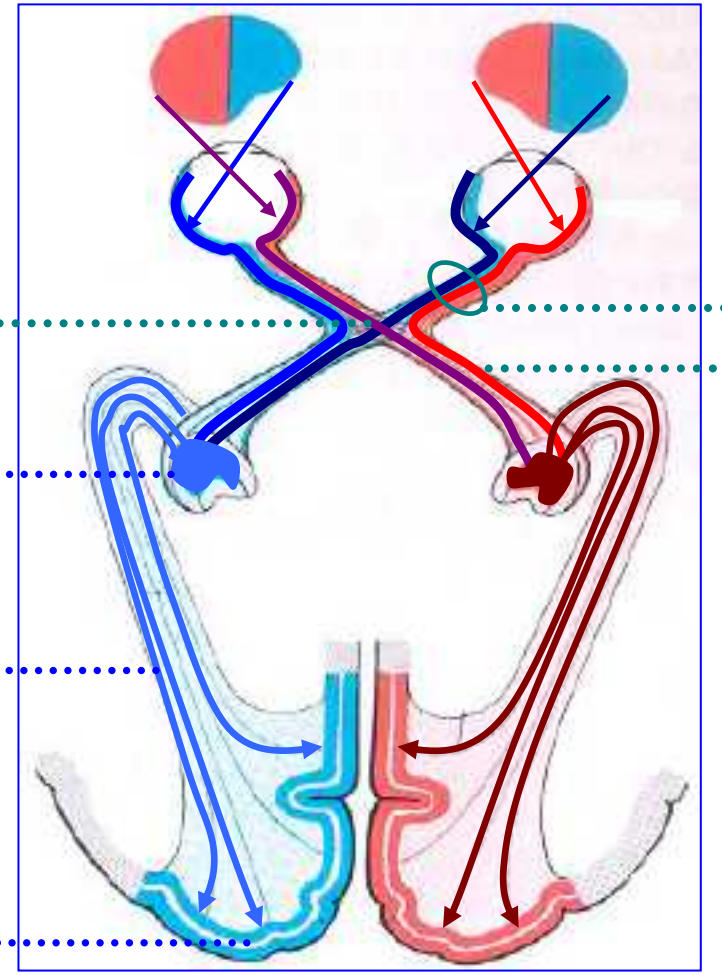


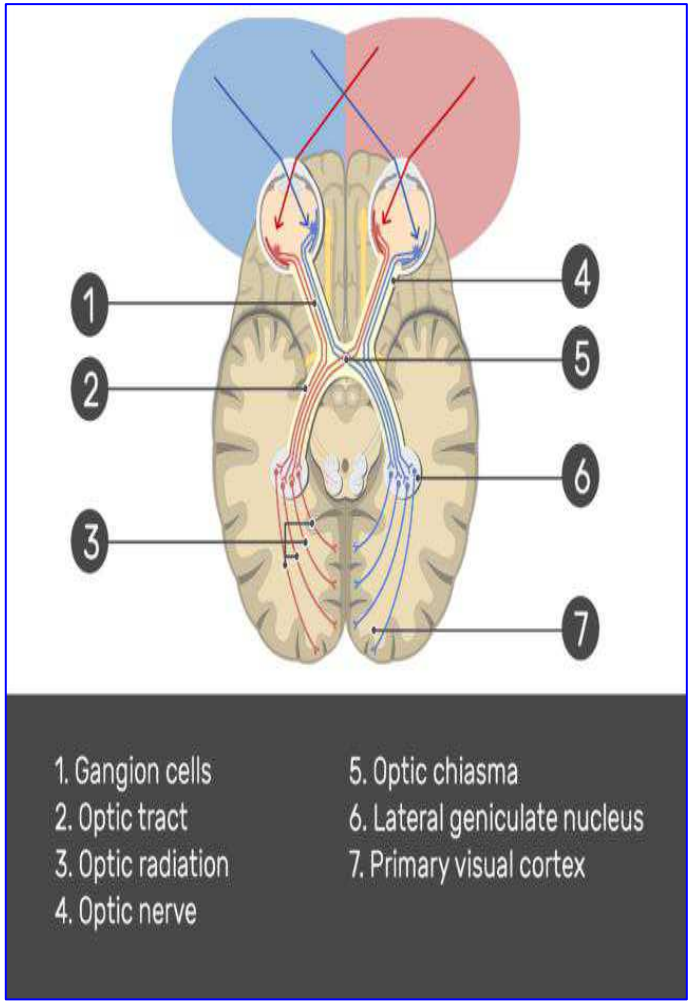


Visual Information From Eye to Brain

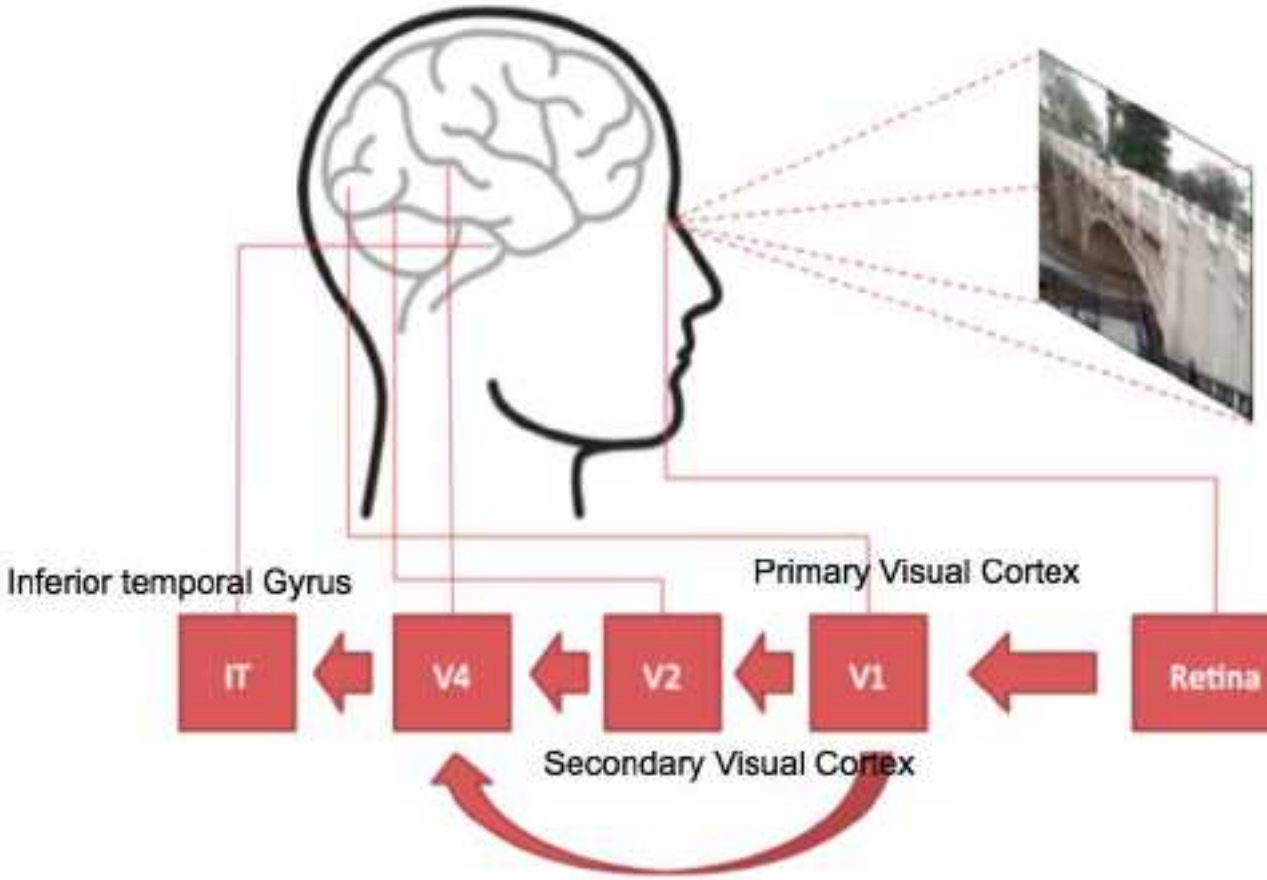
- The dumber the animal, the smarter the retina" (Denis Baylor of Stanford Medical School, in Montgomery, 1995).
- The human brain delays detailed analysis of the retinal image until after the information has left the retina via the optic nerve. While this is true, it is not the whole truth.
- The decomposition of the retinal image into key components, such as color and motion, begins at the retina.

Visual Input to Brain: Visual Information Process





Visual Input to Brain: Brain Computing



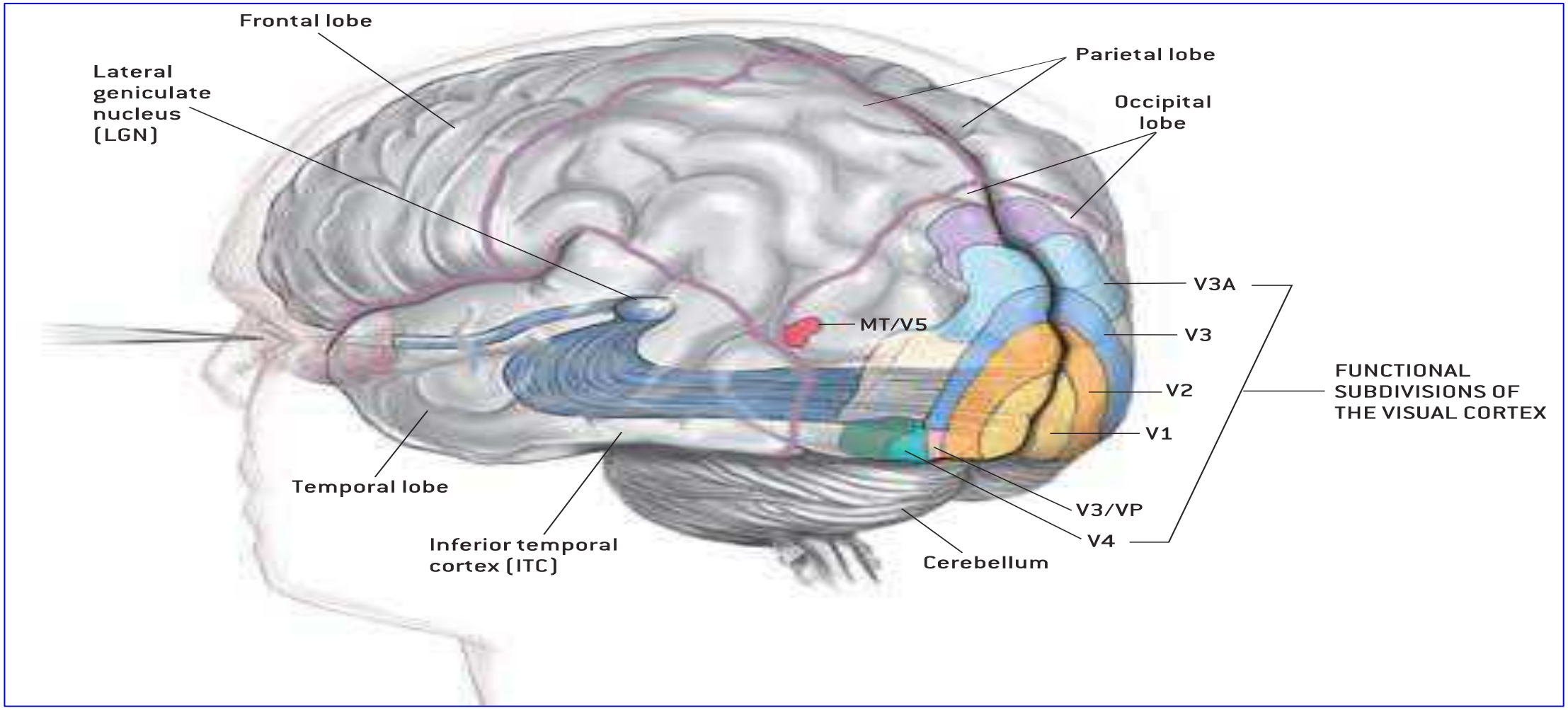
V1: Edge detection, etc.

V2: Extract simple visual properties (orientation, spatial frequency, color, etc)

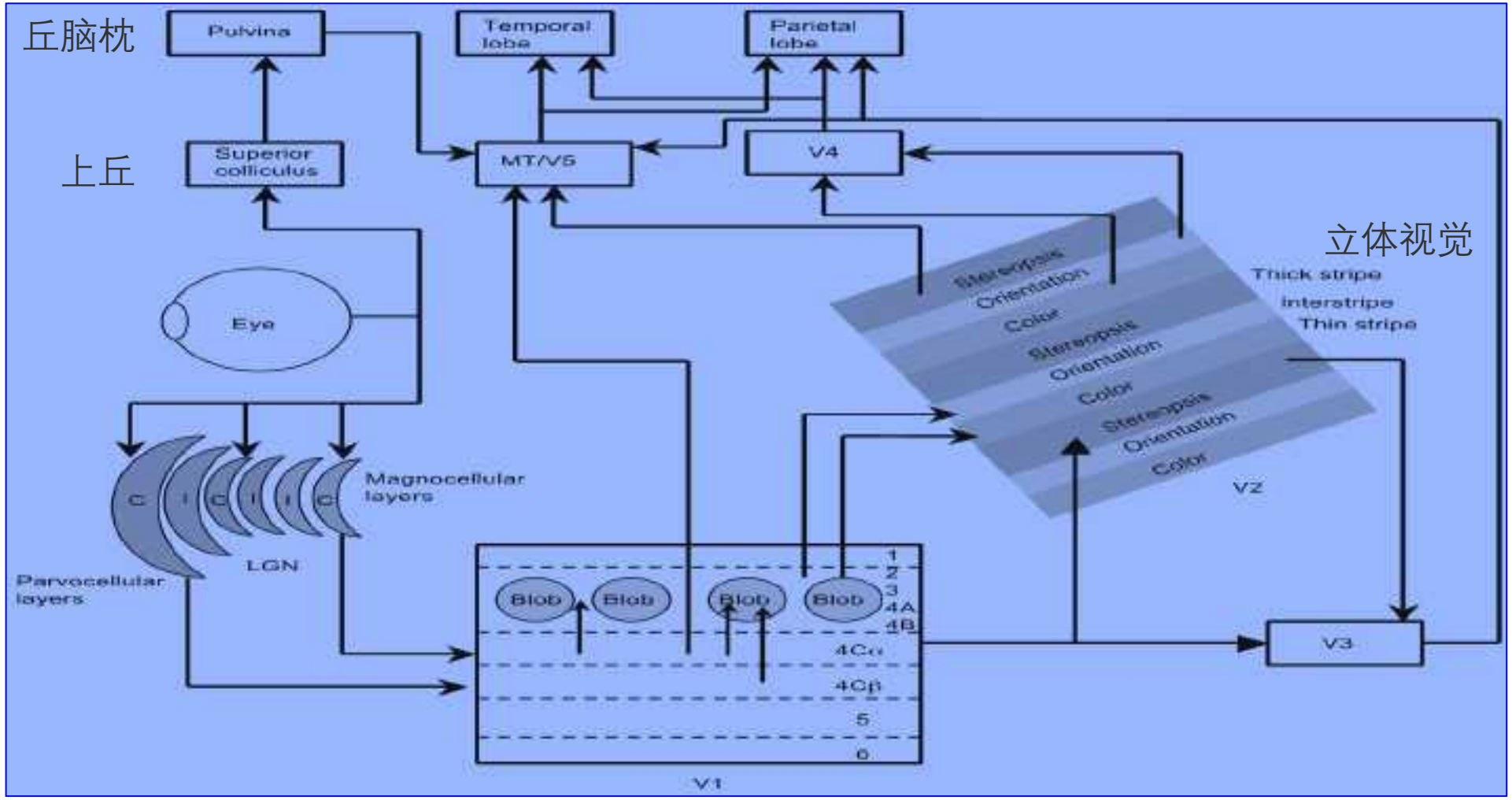
V4: Detect object features of intermediate complexity

TI: Object recognition.

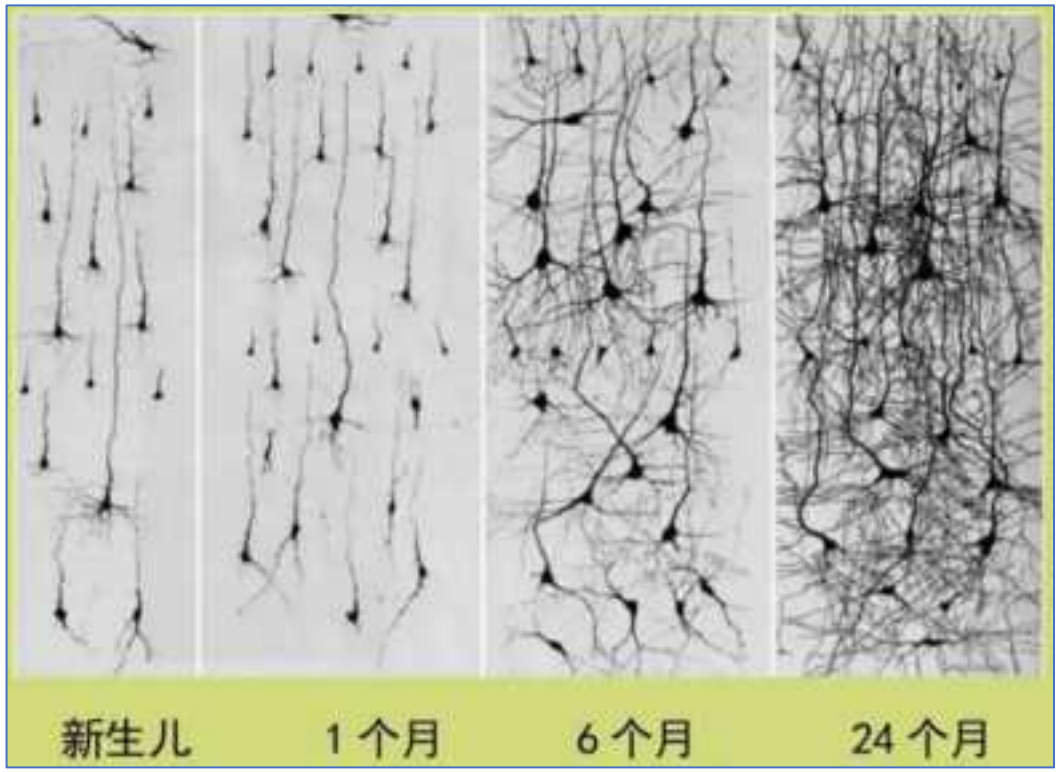
Visual Input to Brain: Brain Computing (1 M ganglion cells -> 10 B V1 cells)

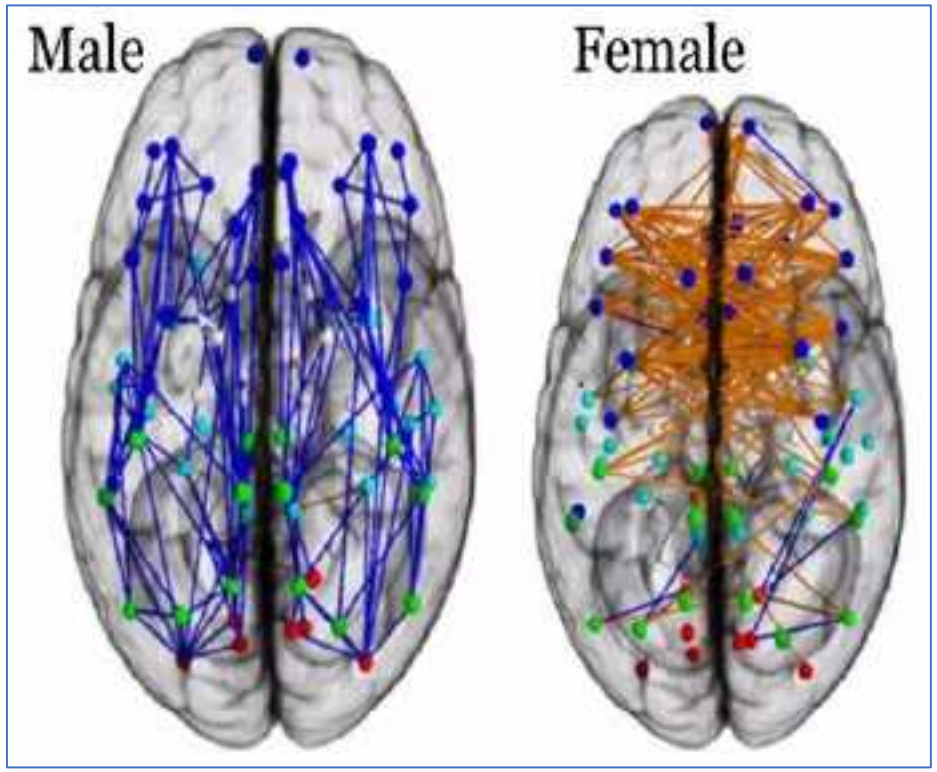


Visual Input to Brain: Brain Computing

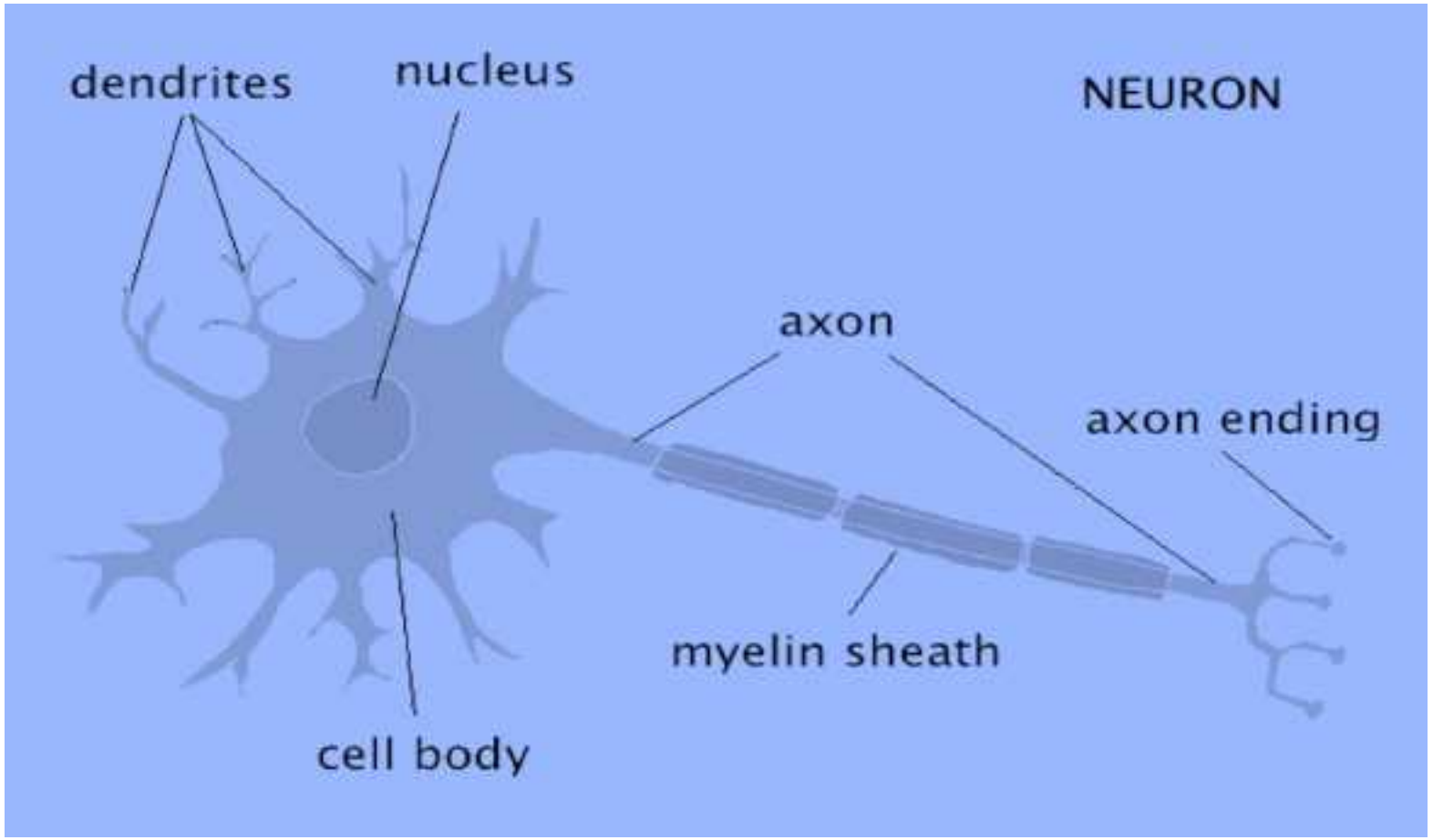


Human Neuron

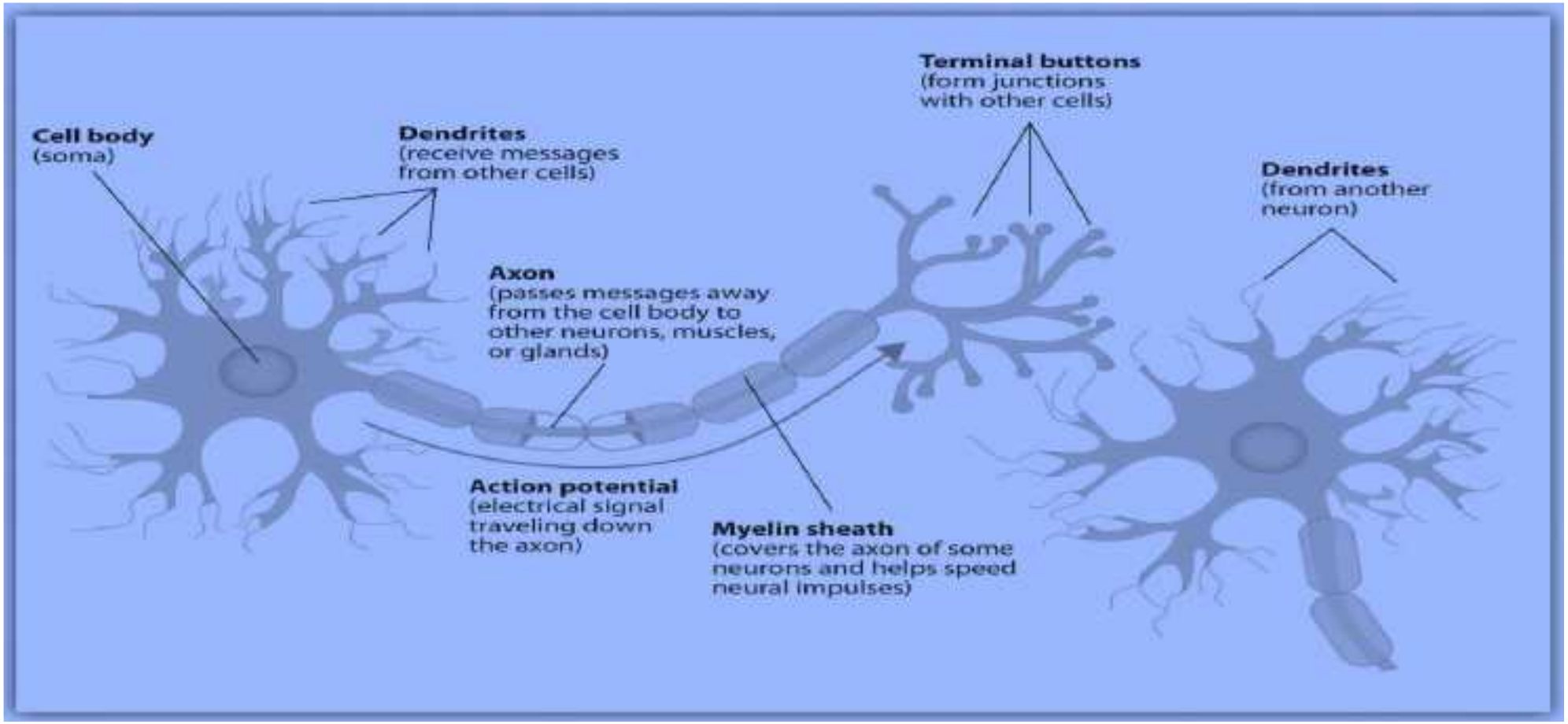




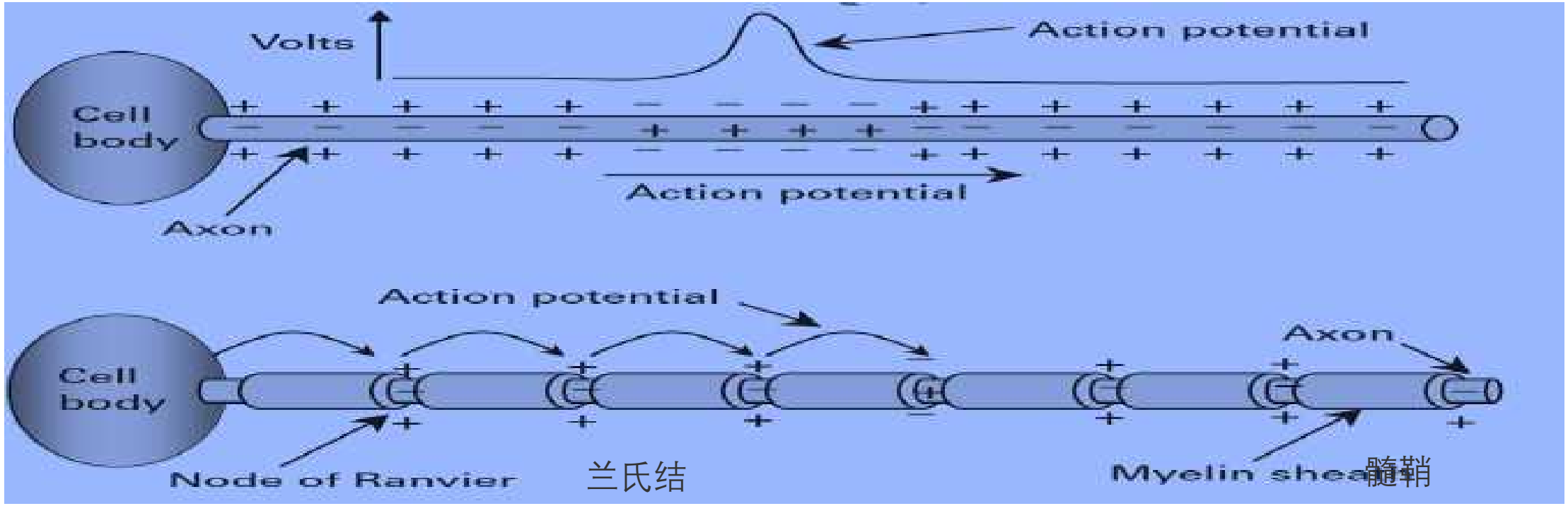
Single Neuron



What really happen in Neuron?

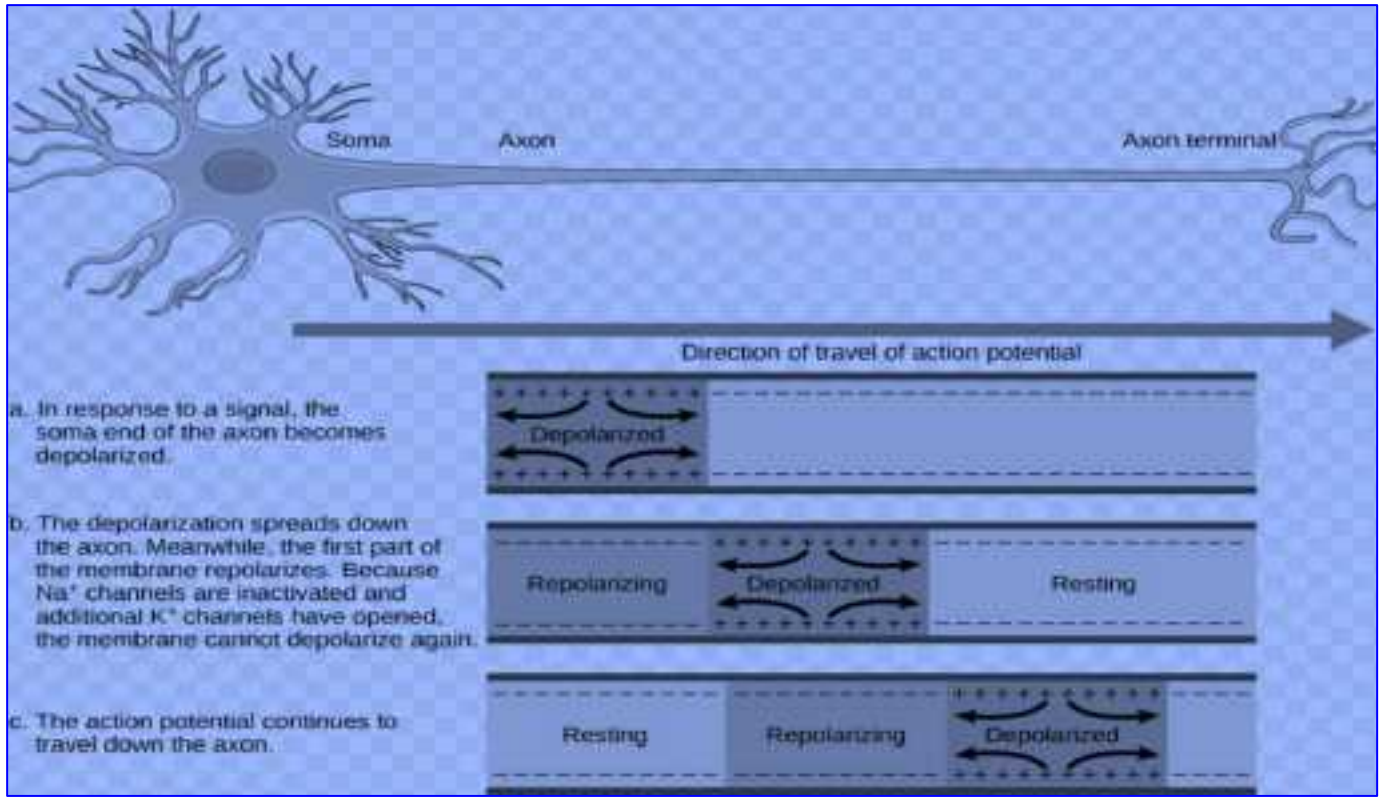


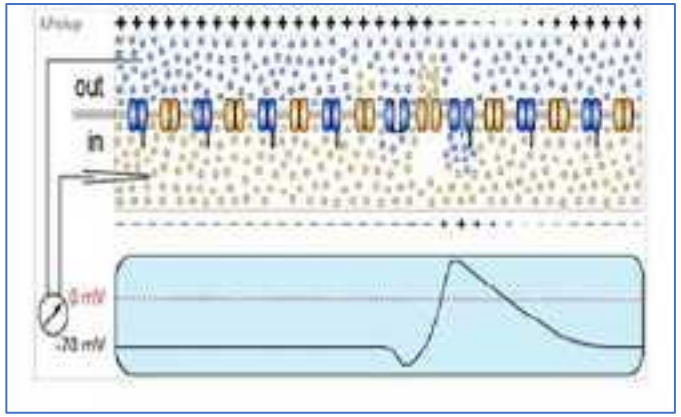
Myelin Sheath

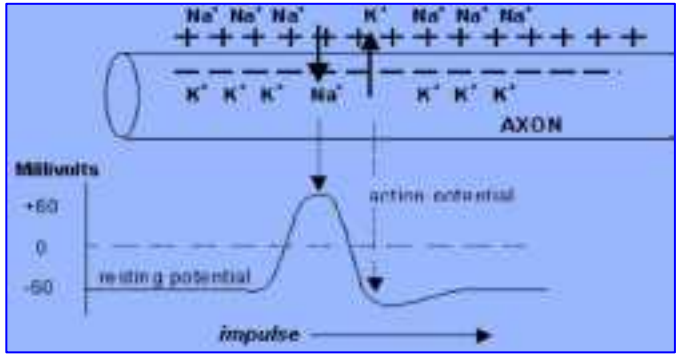


Spike travels at conduction velocities from 1 to 120 meters (3 to 380 feet) per second . If an insulating myelin sheath (signal booster) is wrapped around the axon then the action potential propagates by “jumping” between gaps in the myelin sheath, otherwise the action potential decays exponentially.

What really happen in Axon?







Computational Neuroscience –HH Model

产生的电流脉冲

相当于 电量=电容*电压 $Q = C \times V$

附加电流，表示神经元受到的刺激

$$I = C_m \frac{dV_m}{dt} + \bar{g}_K n^4 (V_m - V_K) + \bar{g}_{Na} m^3 h (V_m - V_{Na}) + \bar{g}_l (V_m - V_l) - I_{App}$$

钾离子诱导的脉冲（非线性）

钠离子诱导的脉冲（非线性）

两种离子共同诱导的脉冲（线性）

$$\frac{dn}{dt} = \alpha_n(V_m)(1-n) - \beta_n(V_m)n$$

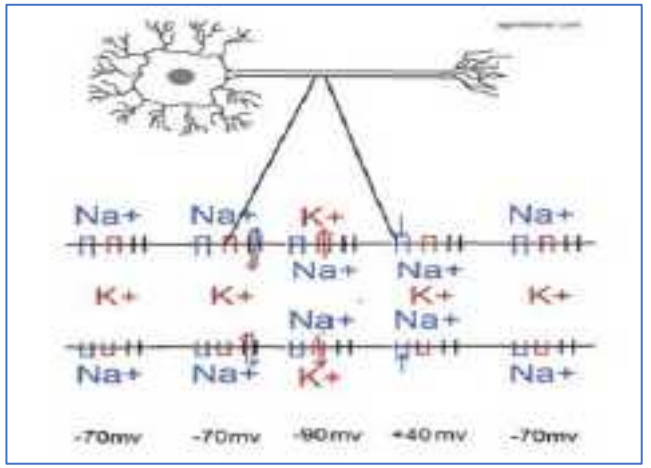
$$\frac{dm}{dt} = \alpha_m(V_m)(1-m) - \beta_m(V_m)m$$

$$\frac{dh}{dt} = \alpha_h(V_m)(1-h) - \beta_h(V_m)h$$

- m, n和h的不同表示钠通道和钾通道有不同结构
- 它们三个变量介于0和1之间，分别表示几个不同通道大门的开关概率
- α和β表示大门开关两状态之间的转化率

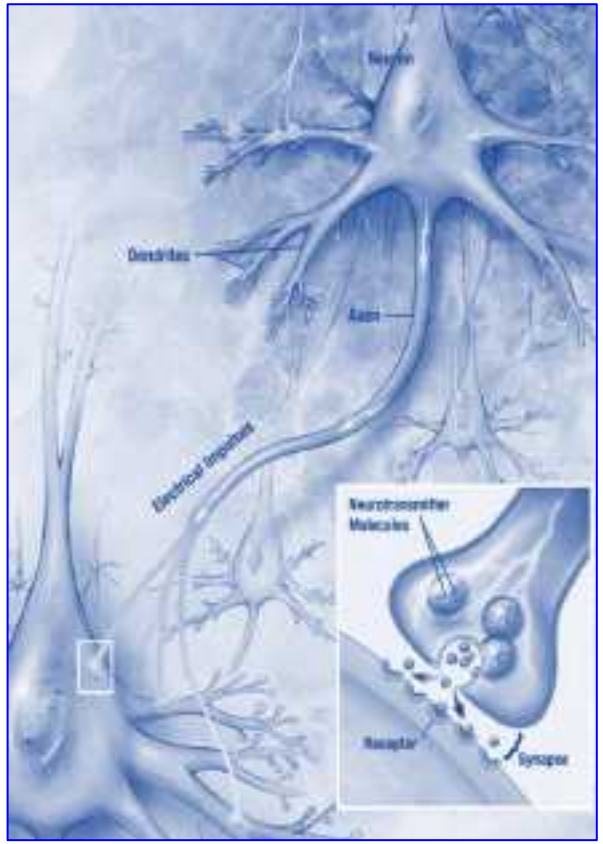
Hodgkin

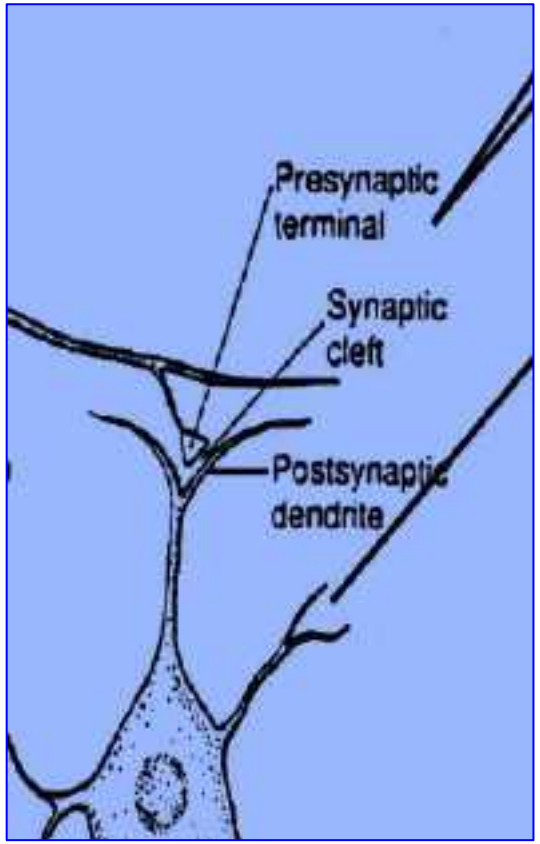
Huxley



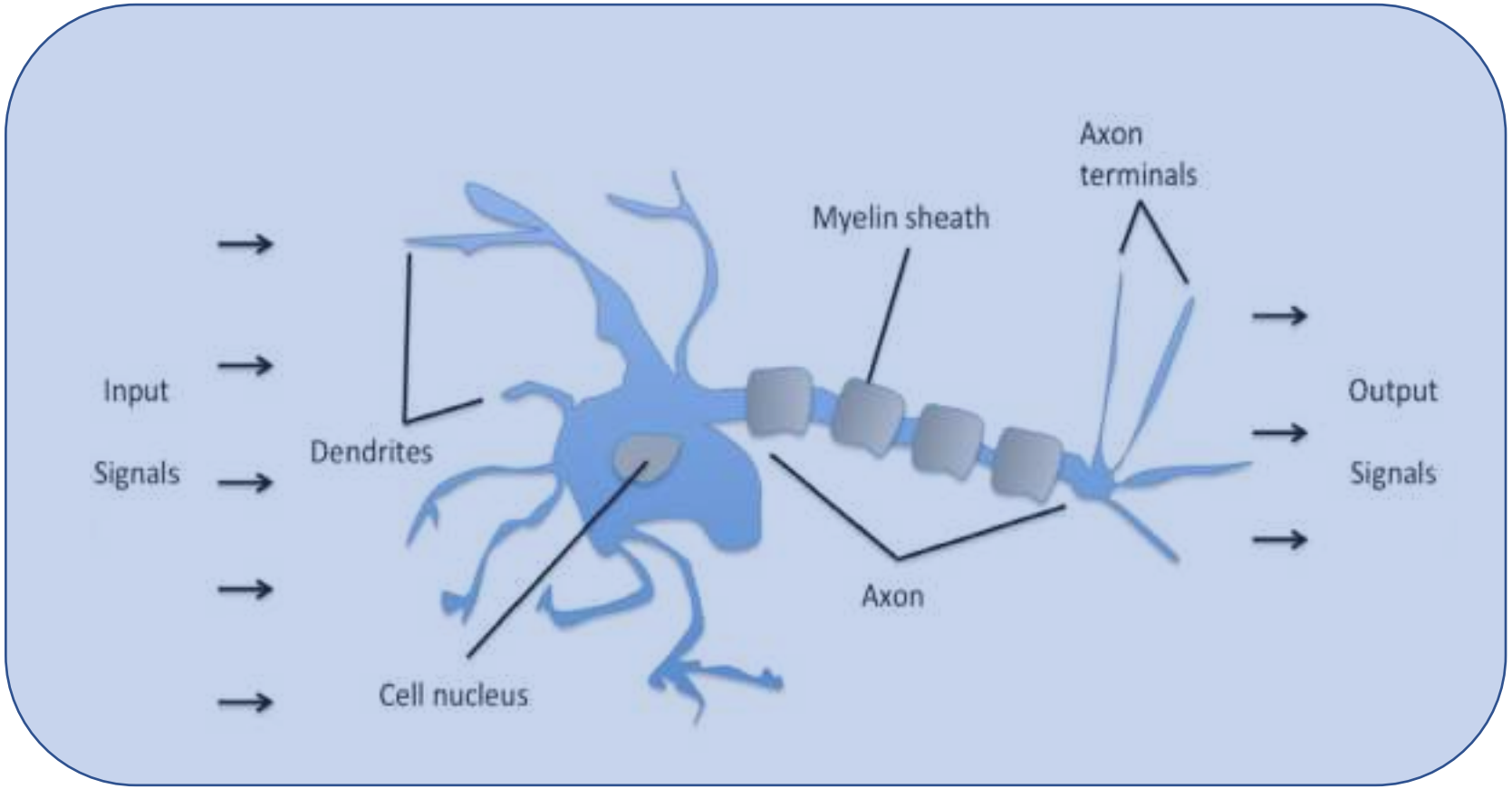
Synapses (神经元的) 突触

- Each neuron receives inputs via its dendrites.
- If these inputs are sufficiently large then an output in the form of an action potential appears in the neuron's axon.
- This causes chemical neurotransmitter to be released at the synapses to other neurons.





Schematic of a Biological Neuron



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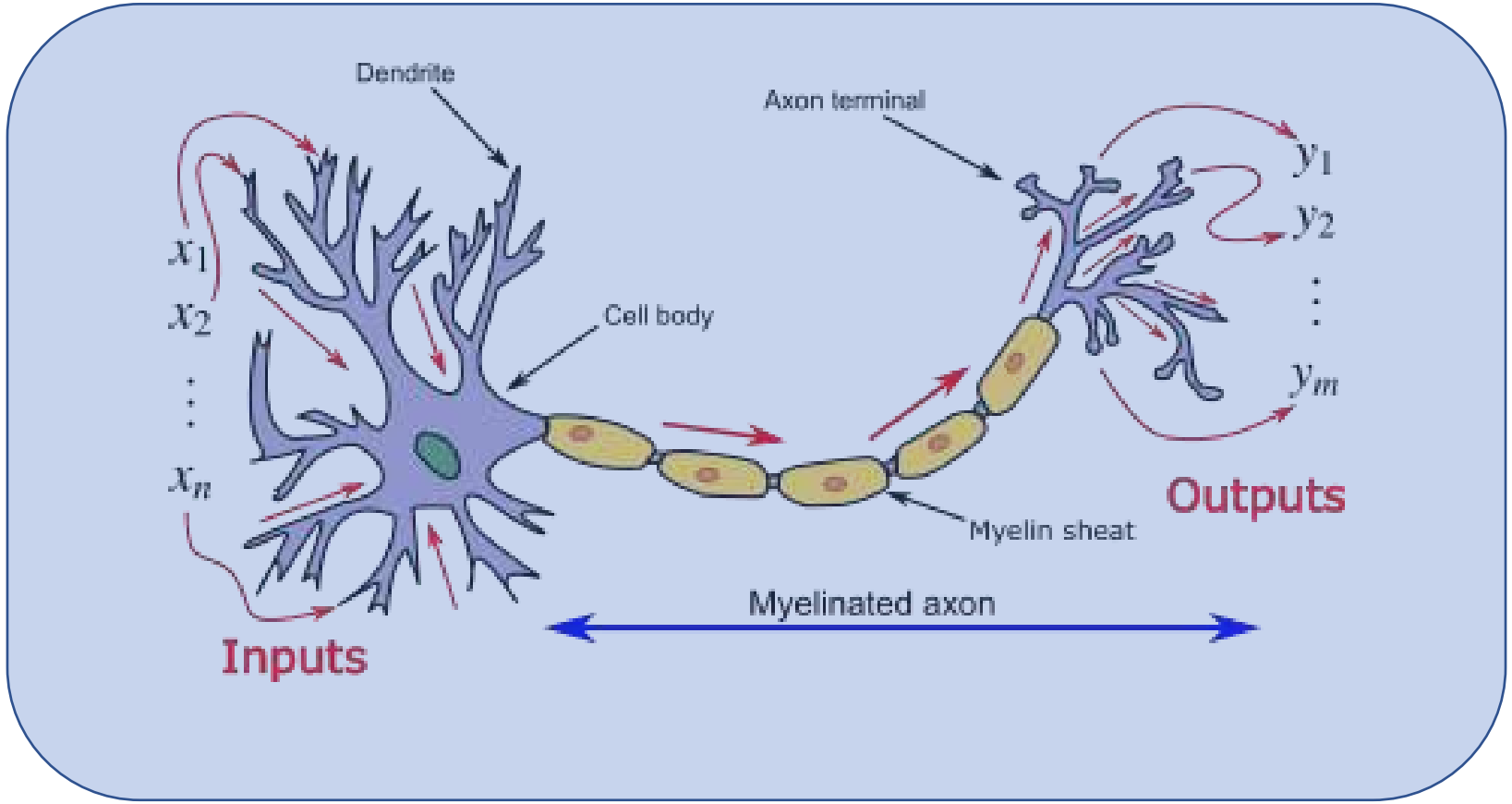
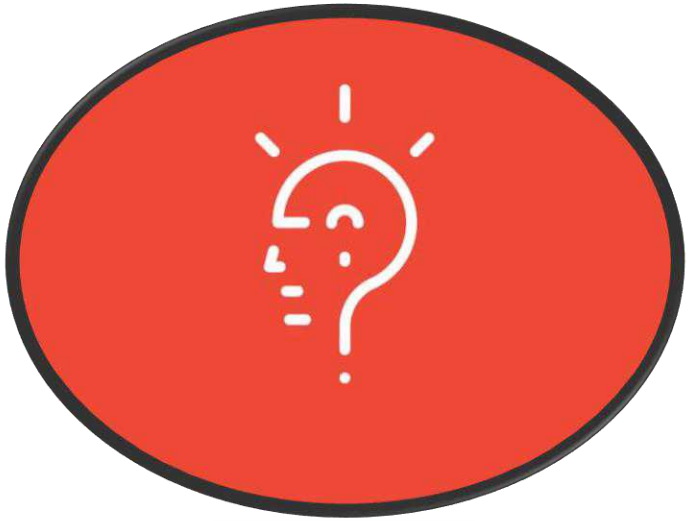
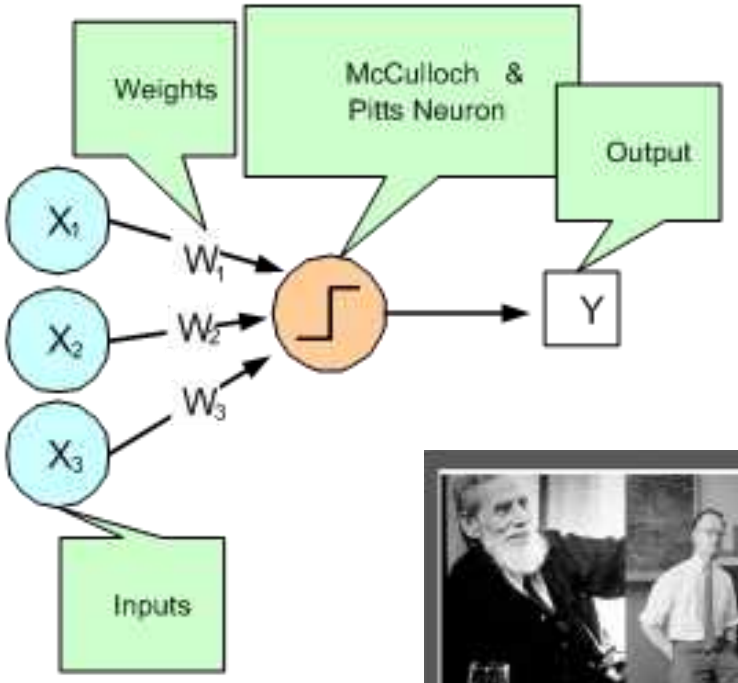


Any Question?



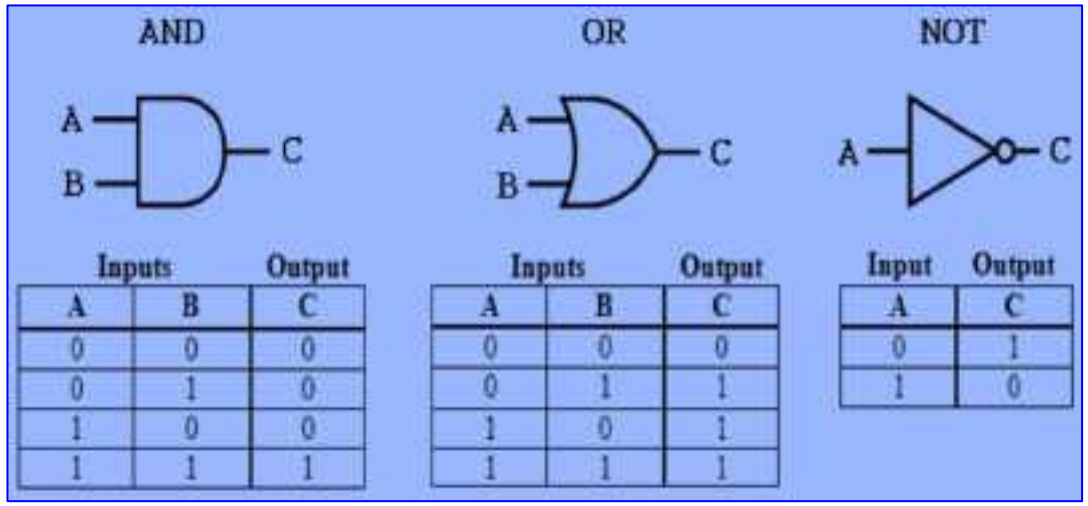
MCP (McCulloch and Pitts) Neuron – Weights Are Adjusted But Not Learnt

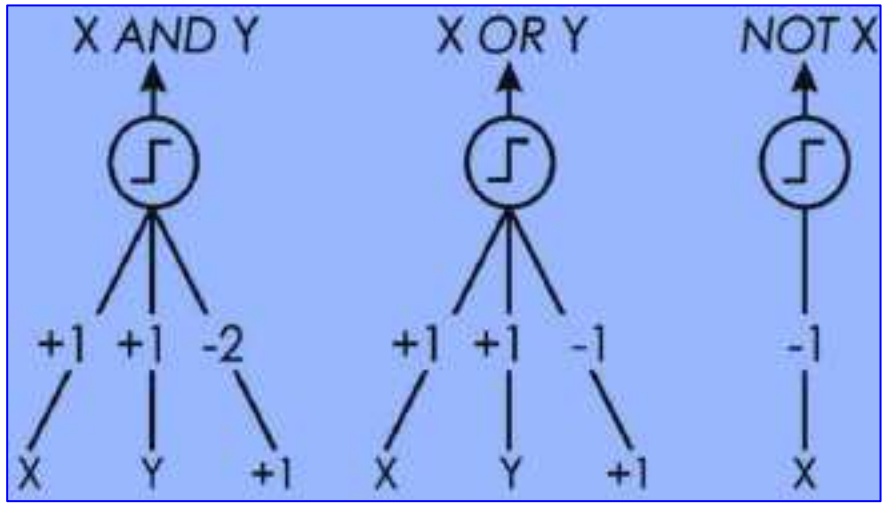
- Tried to understand how the brain could produce highly complex patterns by using many basic cells that are connected together.
- These basic brain cells are called neurons, and McCulloch and Pitts gave a highly simplified model of a MCP neuron in their paper.



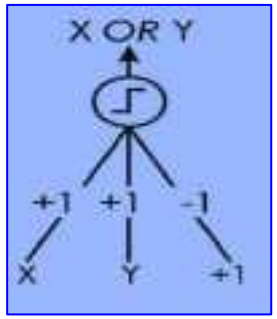
Warren S. McCulloch, a neuroscientist, and Walter Pitts, a logician, "A logical calculus of the ideas immanent in nervous activity", the Bulletin of Mathematical Biophysics 5:115-133. 1943

MCP (McCulloch and Pitts) Neuron – Weights Are Adjusted But Not Learnt





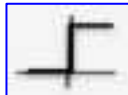
Prove “OR” MCP (McCulloch and Pitts) Neuron



A	B	Bias	W1	W2	W3	Transfer
0	0	1	1	1	-1	G(z)
0	1	1	1	1	-1	G(z)
1	0	1	1	1	-1	G(z)
1	1	1	1	1	-1	G(z)

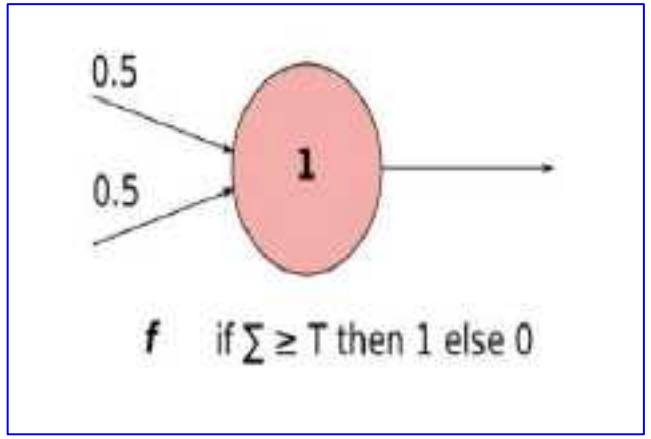
$Z = \sum$ = A*W1+B*W2+ Bias*W3	Output F=G(Z) (Z>=0)	A OR B
0*1 + 0*1 + 1*(-1) = (-1)	0	0
0*1 + 1*1 + 1*(-1) = 0	1	1
1*1 + 0*1 + 1*(-1) = 0	1	1
1*1 + 1*1 + 1*(-1) = 1	1	1

Transfer Function is G(z)



$$g(z) = \begin{cases} 1 \text{ if } z \geq 0 \\ 0 \text{ otherwise.} \end{cases}$$

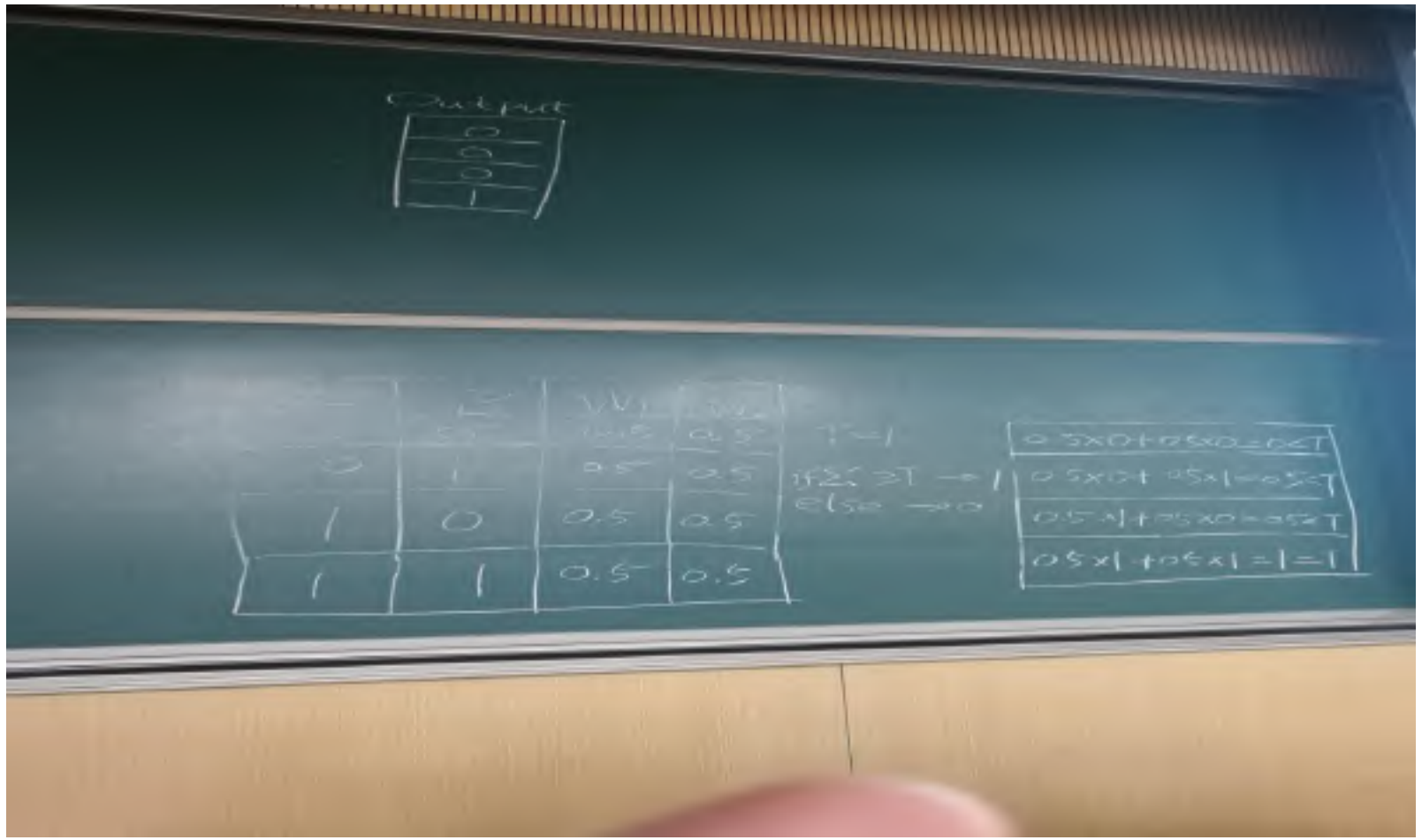
Prove "AND" MCP (McCulloch and Pitts) Neuron



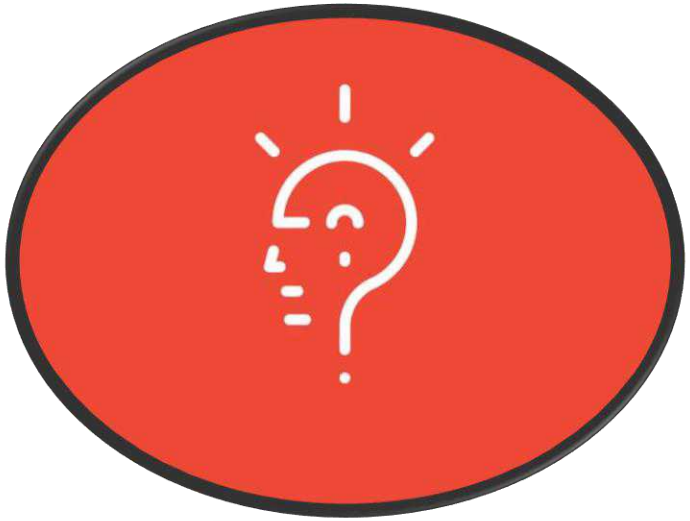
Inputs		Output
A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

Transfer Function is G (SUM-T)

Answer From 巫晓 Last Year



Any Question?



Early AI Algorithms

3 3

1 Pre-AI Algorithms

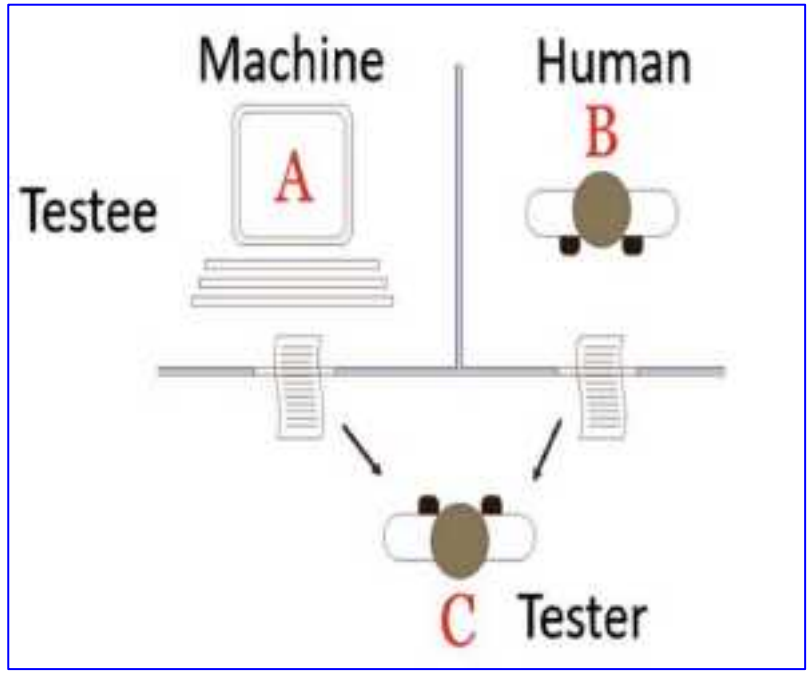
2 Electronic Brain

3 Turing Test

4 Chinese （Card） Room

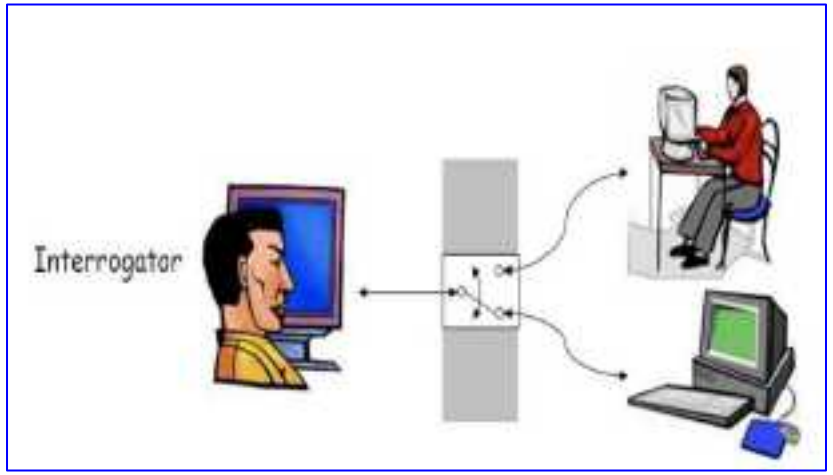
Turing Test

1. The 1943 Turing Test was designed to provide a satisfactory operational definition of intelligence.
2. The test is conducted with two people and a machine
3. One person plays the role of an interrogator/tester and is in a separate room from the machine and the other person
4. The interrogator C cannot see the machine and person, he only knows the person and machine as A and B.



Turing Test - Intelligence

1. The aim of the machine is to fool the interrogator into thinking that it is a person.
2. The interrogator's task: to find out which candidate is the machine or human, only by asking them questions.
3. If the machine can fool the interrogator 30% of the time, the machine is considered intelligent



Turing Test – Operational Definition

1. If the Turing Test was passed, Turing would conclude that the machine was intelligent.
2. Suggested as a way of saying when we could consider machines to be intelligent, or at least act intelligently
3. A satisfactory operational definition of intelligence

Turing Test –Passed?

Turing predicted the machines will be able to pass the test by the year 2000.

Turing Test –Passed

1. Turing predicted the machines will be able to pass the test by the year 2000.
2. In 2014, the chatbot "Eugene Goostman" passed the Turing test
3. With 33% of the event's judges identified Goostman as human

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4 Chinese (Card) Room

Chinese Room?

Chinese Room

The Chinese room argument holds that a digital computer executing a program cannot be shown to have a "mind", "understanding" or "consciousness", regardless of how intelligently or human-like the program may make the computer behave. The argument was first presented by philosopher John Searle in his paper, "Minds, Brains, and Programs", published in Behavioral and Brain Sciences in 1980. It has been widely discussed in the years since. The centerpiece of the argument is a thought experiment known as the Chinese room.

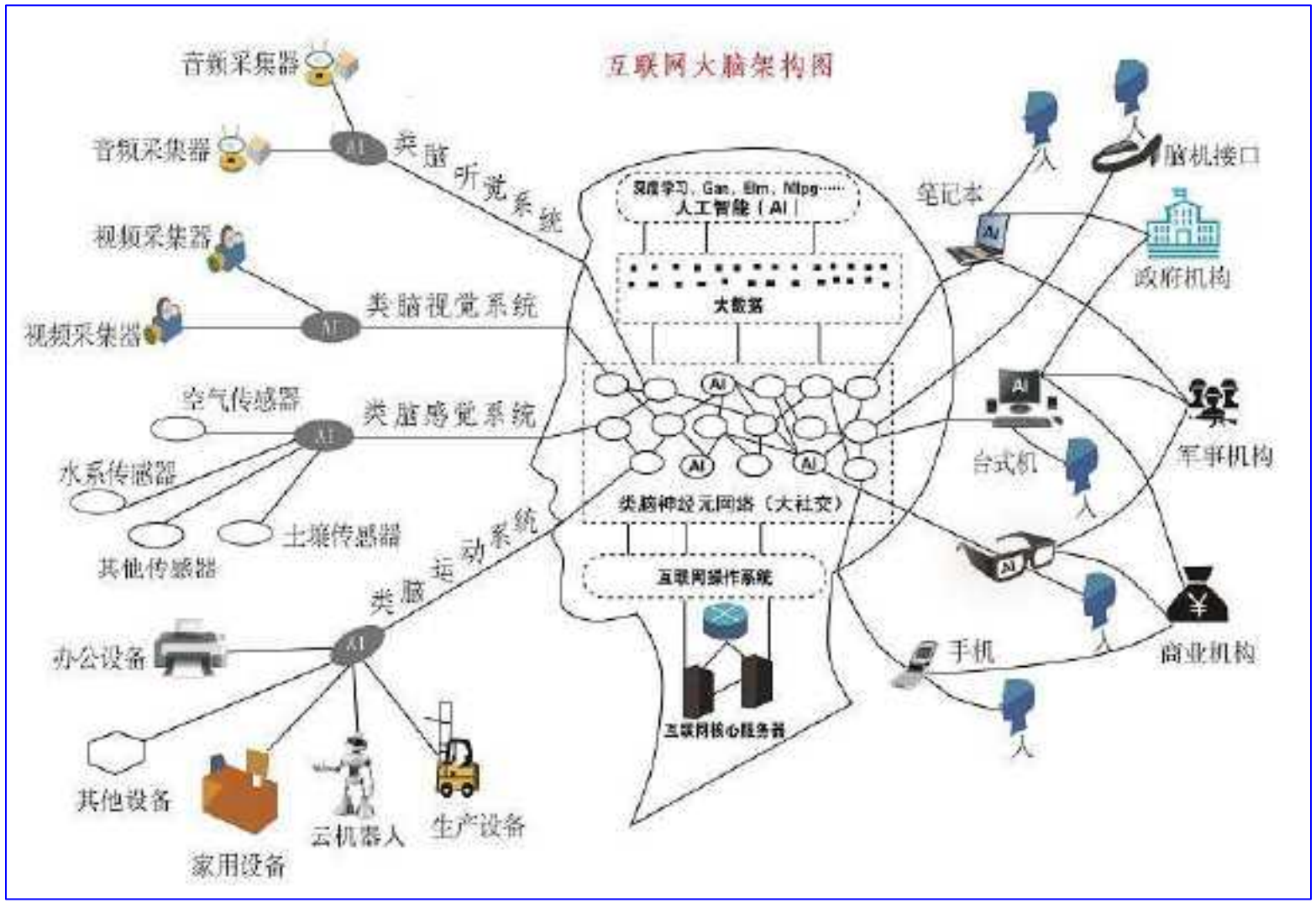
Chinese Card Room

Chinese Room and Turing Test

The Chinese Room thought experiment is an analogy to artificial intelligence. A person who can't speak Chinese is sitting in a room text chatting in Chinese. They have a book that gives them an appropriate response to each series of symbols that appear in the chat. The person on the other side of the chat can't tell that they are speaking to someone who can't speak Chinese. The person in the room doesn't understand anything about the conversation and is simply looking up symbols in a book.

The Turing test, a common way to define and test artificial intelligence, involves a computer imitating a human on a chat. According to the test, if a machine can convince people that it's human, it's intelligent. The Chinese Room analogy shows that by this definition of machine intelligence that computers need not understand the conversation to pass.

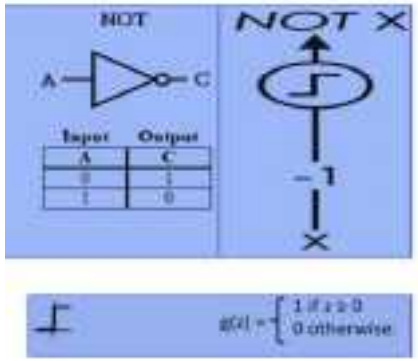
类脑（Brain-Inspired Intelligence）



Homework 04

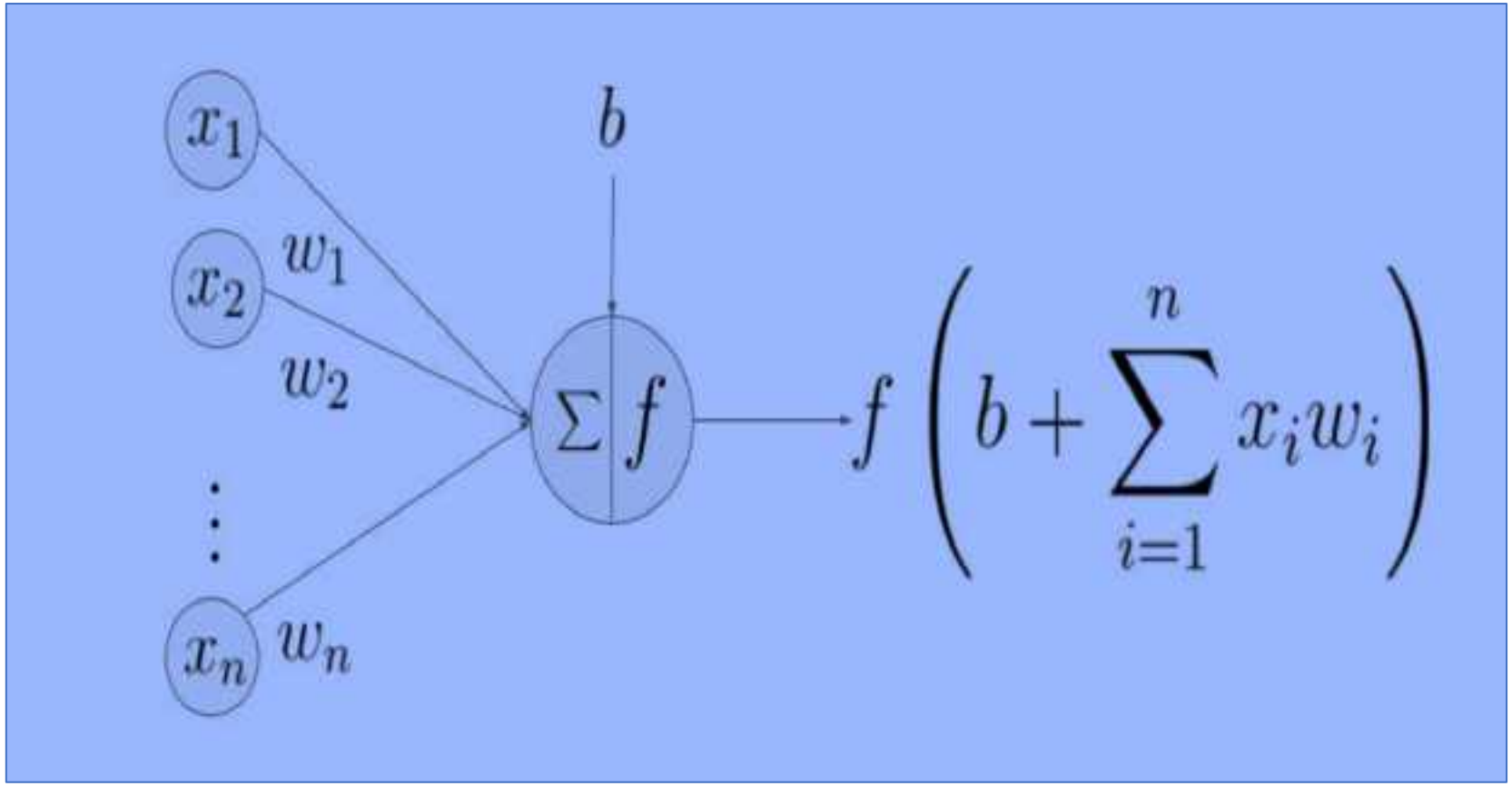
1. Watch: Turing and Turing Award
   https://v.qq.com/x/page/h0355eutfis.html?

2. Prove “NOT X” Artificial Neuron



3. Fix Your Project Topic and Project Group Leader /members

Next Lecture : Perceptron



CS 103 -04

AI Algorithms and Their Neurological Foundation

Jimmy Liu 刘江

2020-10-09