Artificial Intelligence Challenges

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دانشگاه آزاد اسلامی واحد علوم و تحقیقات

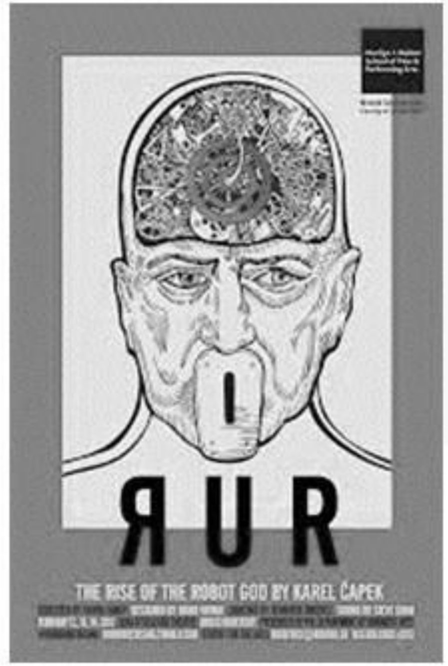
World War I

(28 July 1914 – 11 November 1918)

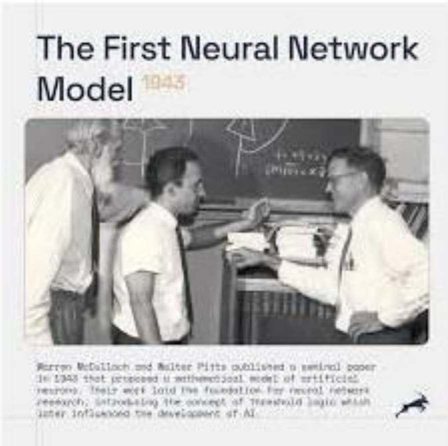
Imagination

1923

Karel Čapek's play named "Rossum's Universal Robots" (RUR) opens in London, first use of the word "robot" in English.

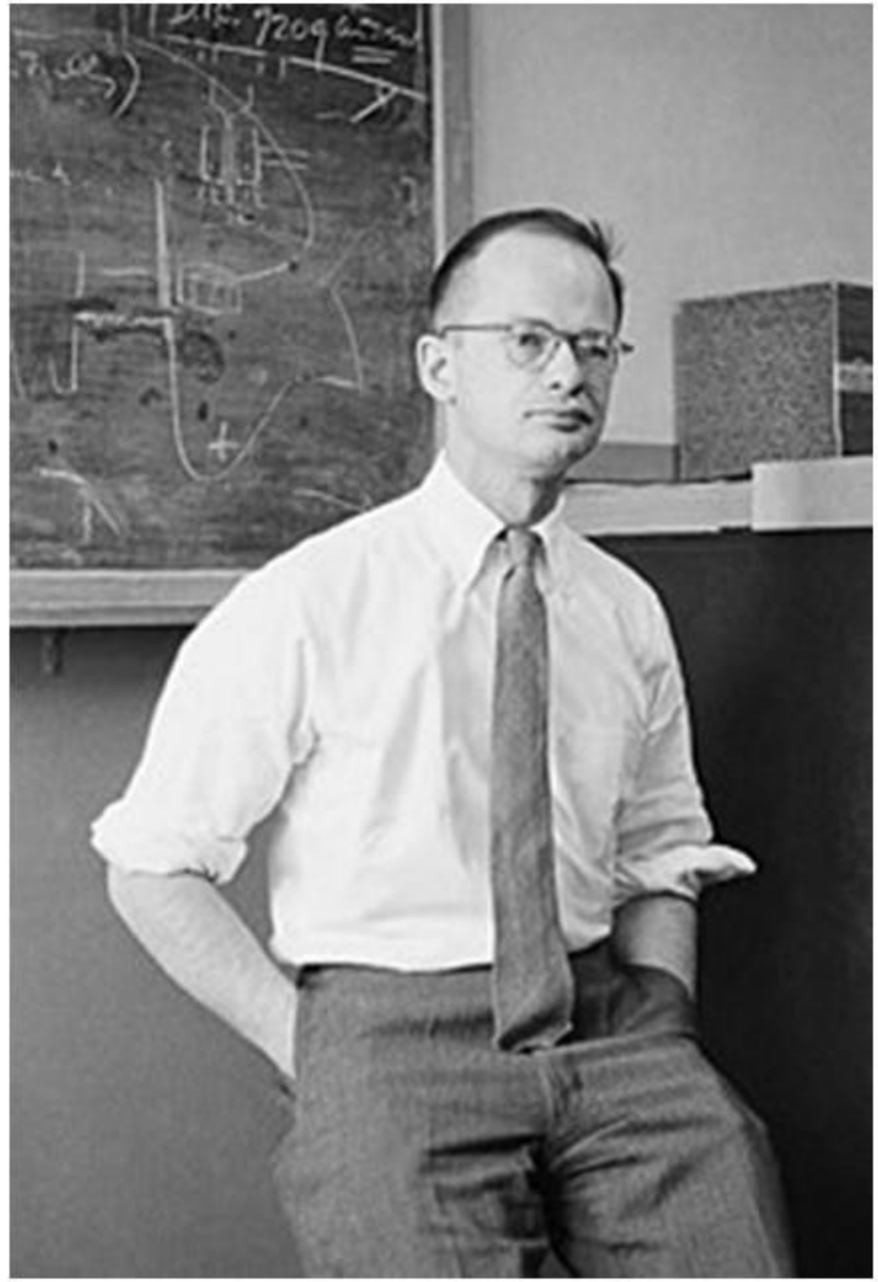


Inspiration



1943

Foundations for neural networks laid.



Walter Harry Pitts
American Logician
(23 April 1923 – 14 May 1969)

The rule of law

1945

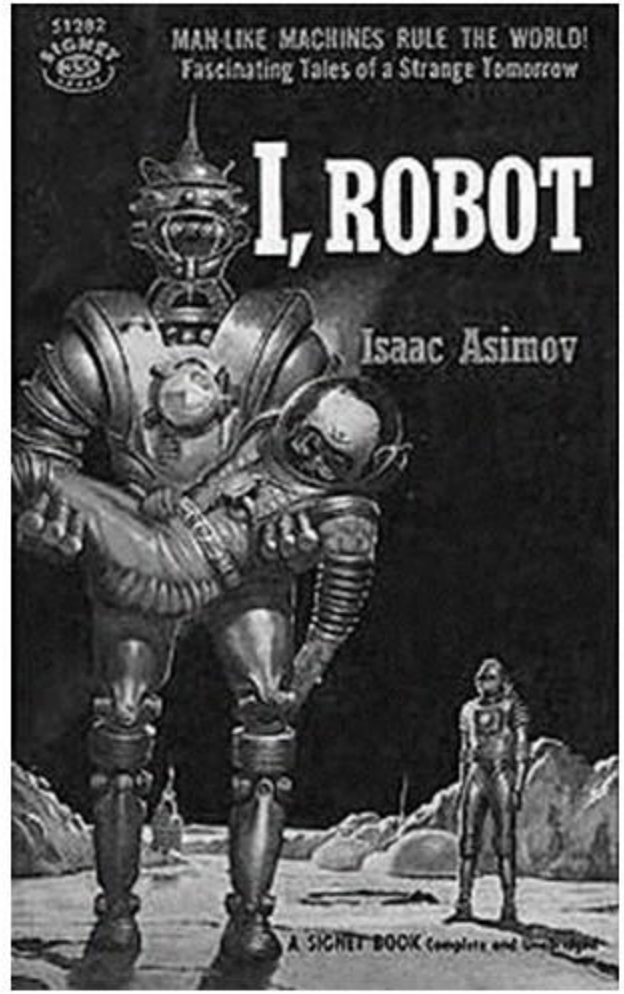
Isaac Asimov

a Columbia University alumni, coined the term Robotics.

The First Law: A robot may not injure a human being or, through inaction, allow a human being to come to harm.

The Second Law: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

The Third Law: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.



Three Laws of Robotics

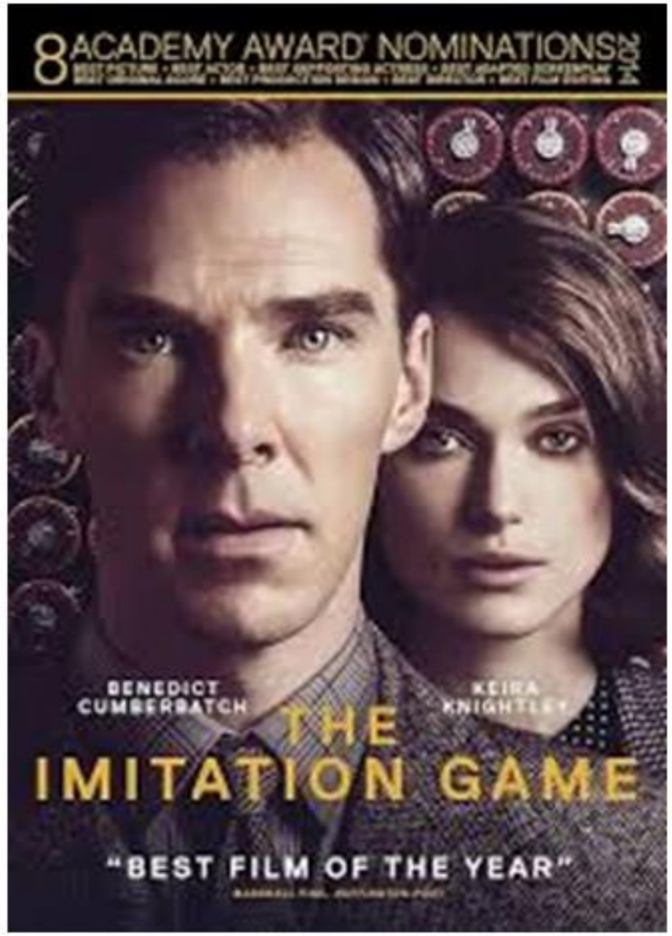
World **War** II

(1 September 1939 – 2 September 1945)

Mathematics

1950

Alan Turing introduced Turing Test for evaluation of intelligence and published Computing Machinery and Intelligence.



programming

language

LIS~~T~~P

1956

John McCarthy coined the term **Artificial Intelligence**. Demonstration of the first running AI program at Carnegie Mellon University.

Algebra

word problems

LISP

STUDENT

1964

Danny Bobrow's dissertation at MIT showed that computers can understand **natural language** well enough to solve **algebra word problems** correctly.

Interaction

1965

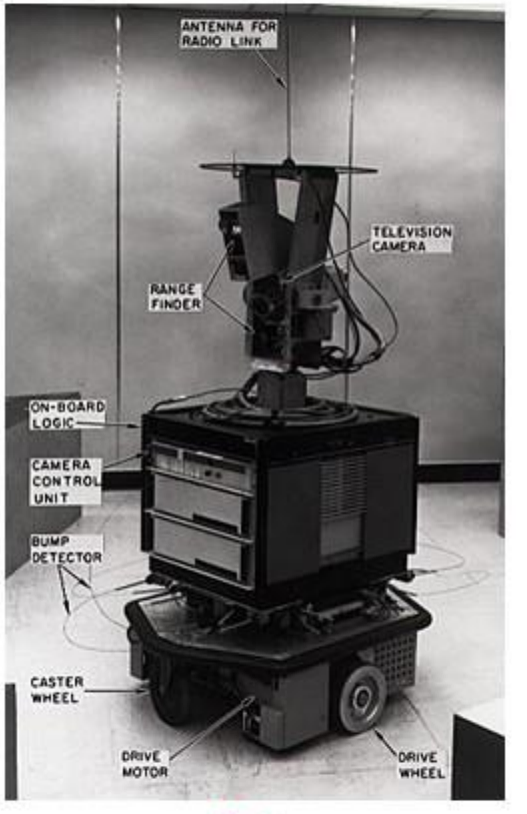
Joseph Weizenbaum at MIT built ELIZA, an interactive problem that carries on a **dialogue in English**.

Robot

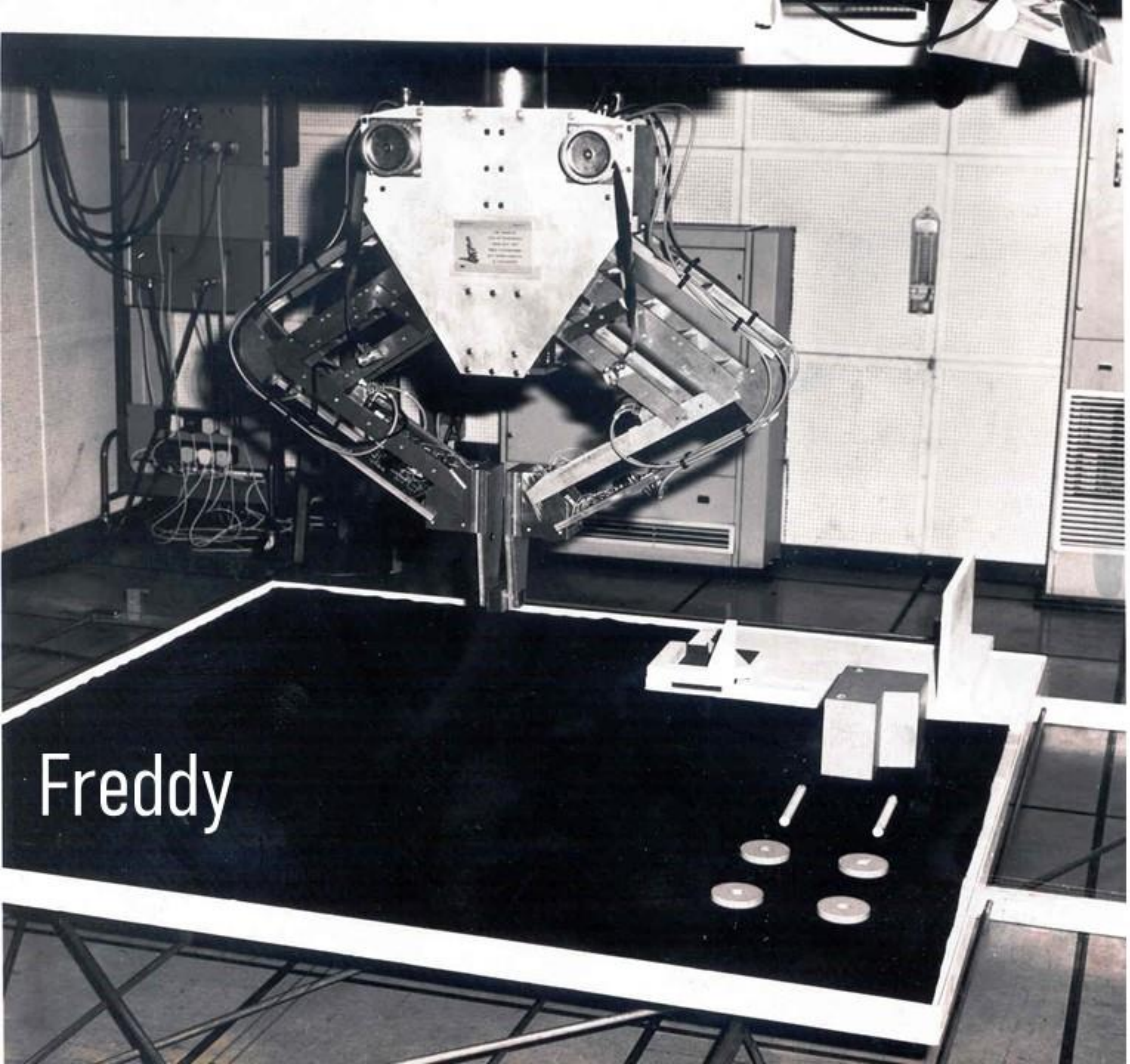
1969

Scientists at Stanford Research Institute Developed Shakey, a robot, equipped

LISP



Shakey



Industry

Assembly

1973

The Assembly Robotics group at Edinburgh University built Freddy, the Famous Scottish Robot, capable of using vision to locate and assemble models.

computer- controlled

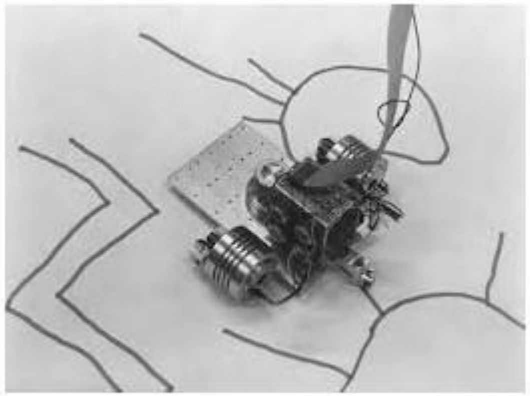
Autonomous

vehicle

1979

The first computer-controlled autonomous vehicle, Stanford Cart, was built.

Digital painting



1985

Harold Cohen created and demonstrated the drawing program, Aaron.

LISP

1990

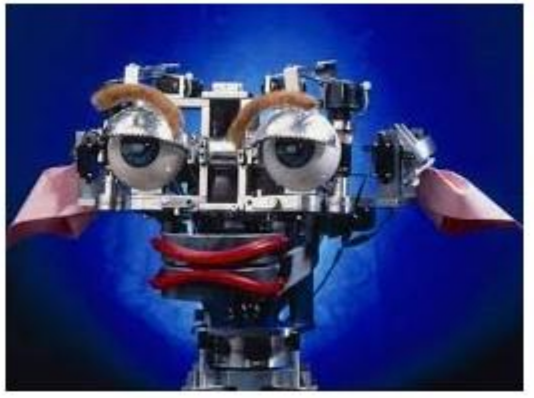
Major advances in all areas of AI:

- Significant demonstrations in machine learning
- Case-based reasoning
- Multi-agent planning
- Scheduling
- Data mining, Web Crawler
- natural language understanding and translation
- Vision, Virtual Reality
- Games


1997

The **Deep Blue Chess** Program beats the then world chess champion, **Garry Kasparov**.

Emotion



Remote

2000

Interactive robot pets become commercially available. MIT displays Kismet, a robot with a face that expresses emotions. The robot Nomad explores remote regions of Antarctica and locates meteorites.

AI is the simulation of human intelligence processes

AI is the **simulation** of human intelligence processes

Imitation of a situation or process

- Learning
- Reasoning
- Planning
- Self-correction
- Problem solving
- Knowledge representation
- Perception
- Motion
- Manipulation
- Creativity

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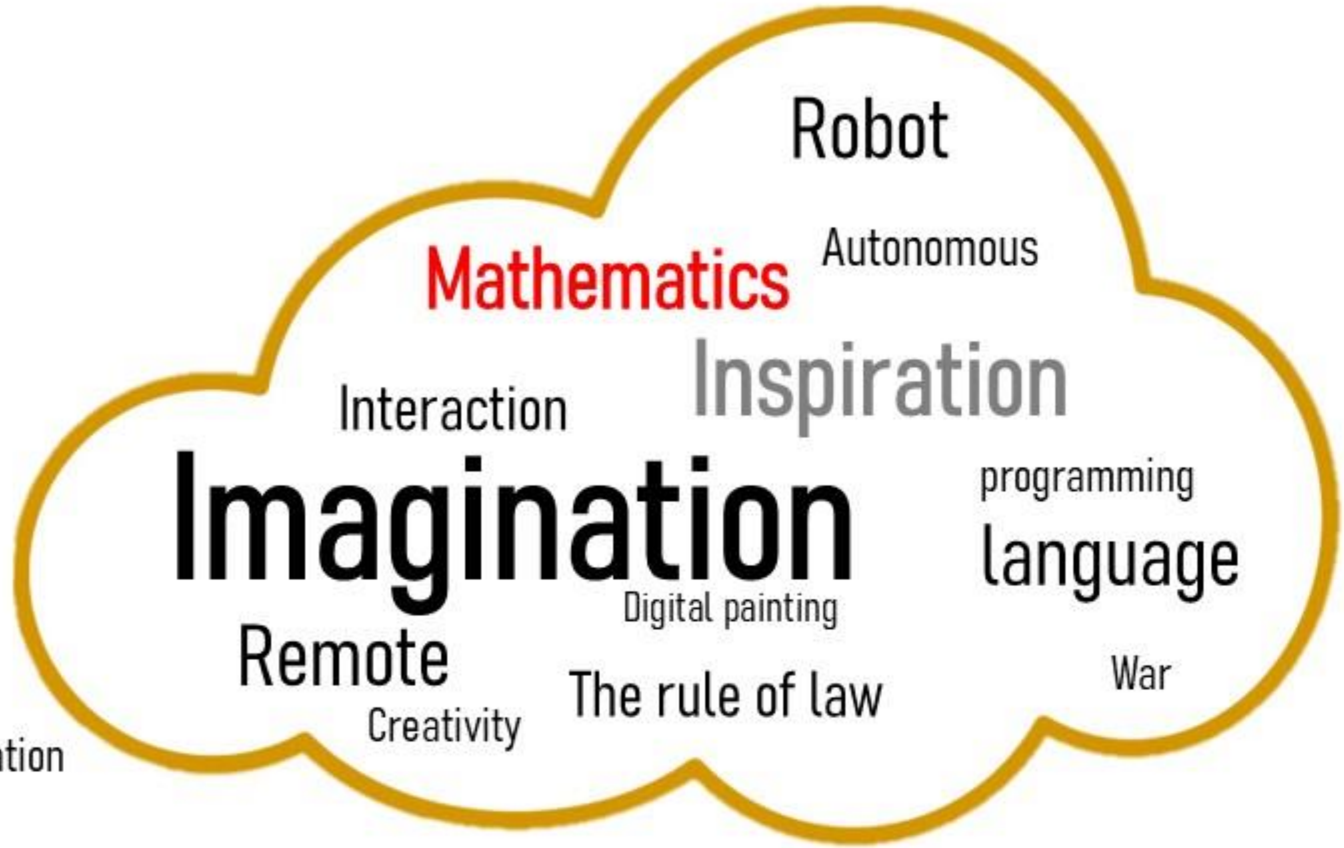
Imitation of a situation or process



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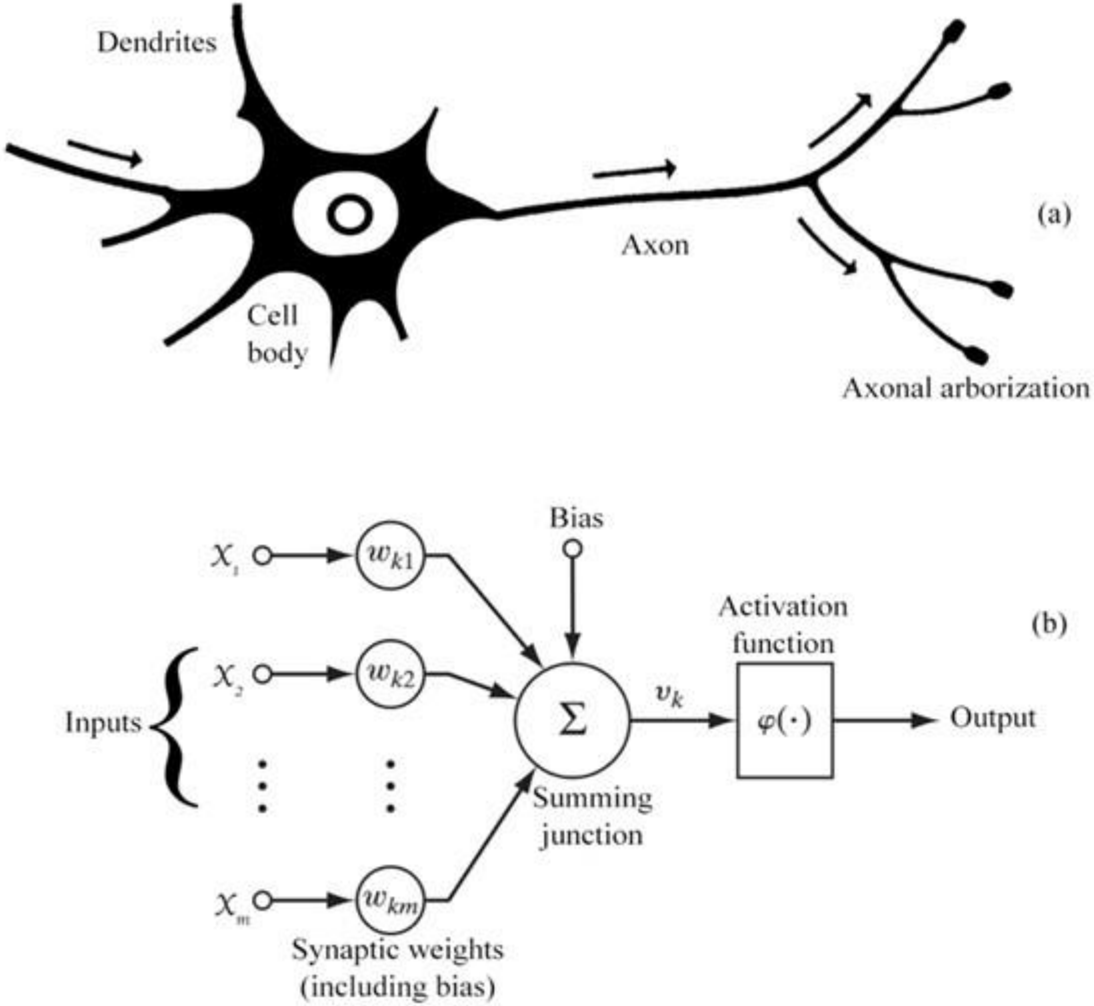

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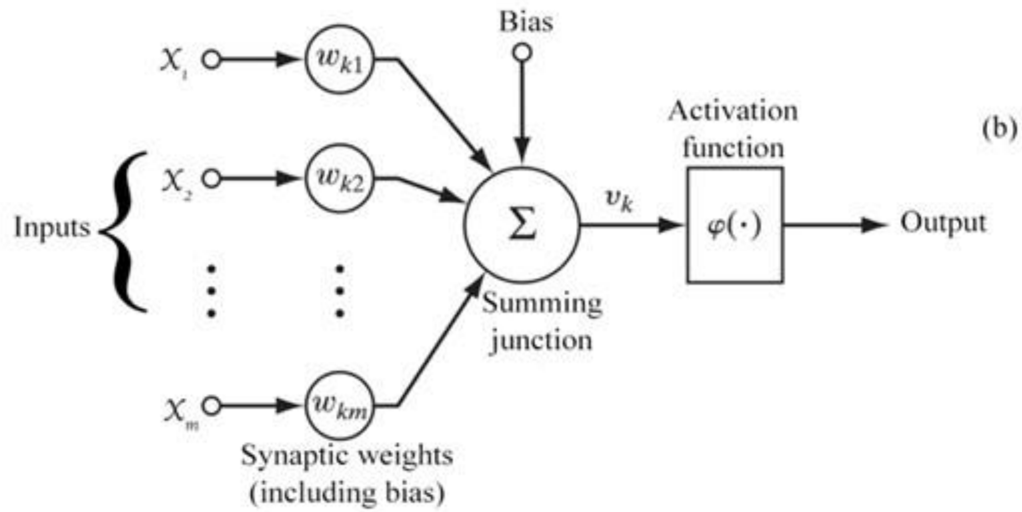
Imitation of a situation or process

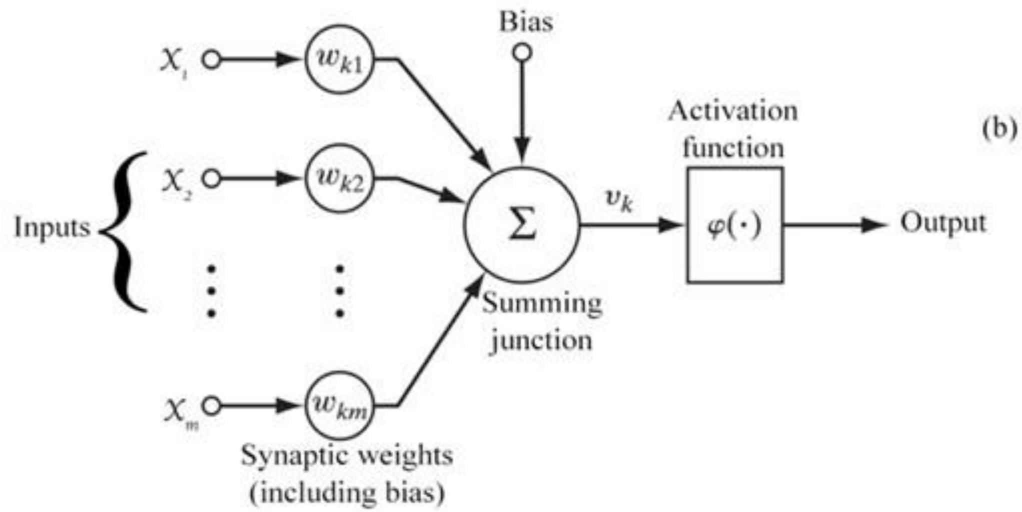
Biological and Artificial Neural Networks (ANN)

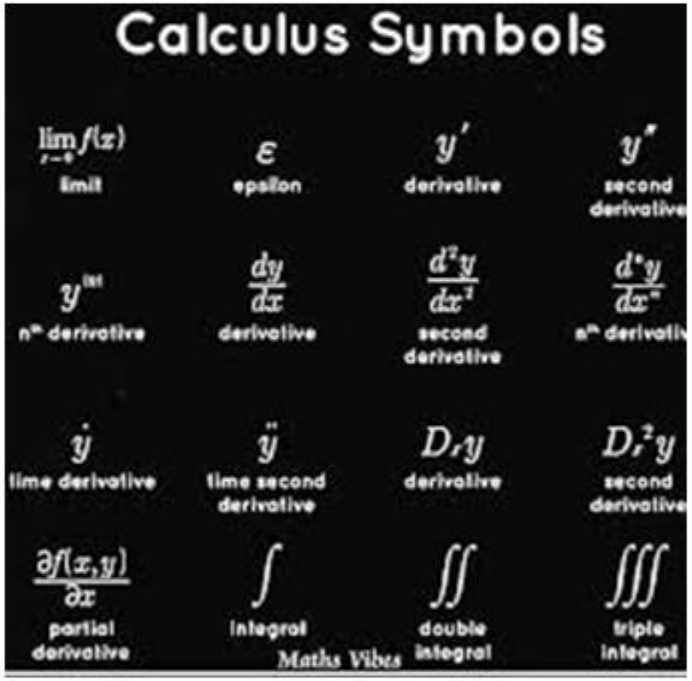
Algebra Symbols & Meanings

Symbol	Name	Meaning	Example
n	variable	unknown quantity	$18 - n = 7$
=	equal	the same as	$2 + 3 = 5$
≈	approximately equal	about the same as	$3 \div 8 \approx 0.38$
≅	congruent	same shape & size	squares A & B above
~	similar	same shape, different size	squares B & C above
≠	not equal	not the same as	$2 + 8 \neq 9$
<	less than	less than	$7 < 10$
≤	less than or equal to	less than or equal to	used to show a range of possible answers
>	greater than	greater than	$10 > 7$
≥	greater than or equal to	greater than or equal to	used to show a range of possible answers
( )	parentheses	These are organization symbols. Always start working with the innermost set, and then work out. These can also stand for multiplication.	
{ }	braces		
[ ]	brackets		
!	factorial	5!	5 x 4 x 3 x 2 x 1
e	Euler's number	2.71828 . . .	exponential growth & decay
Σ	sigma	*add or find the sum*	add a series of numbers
Δ	delta	*change in or find the difference*	slope of a line is Δ y / Δ x
π	pi	3.1415926 . . .	ratio between circumference & diameter of circle



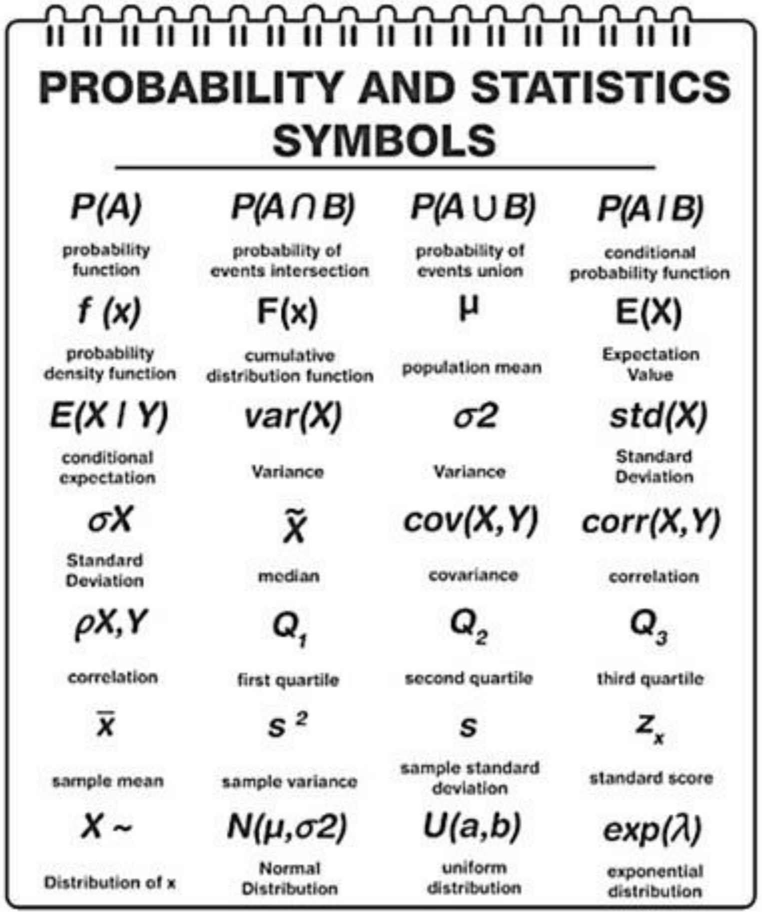
1. Linear Algebra: Understanding matrices and vector operations is crucial. ANNs involve a lot of matrix multiplications and additions. You'll need to be comfortable with concepts like matrix multiplication, transpose, and the dot product.

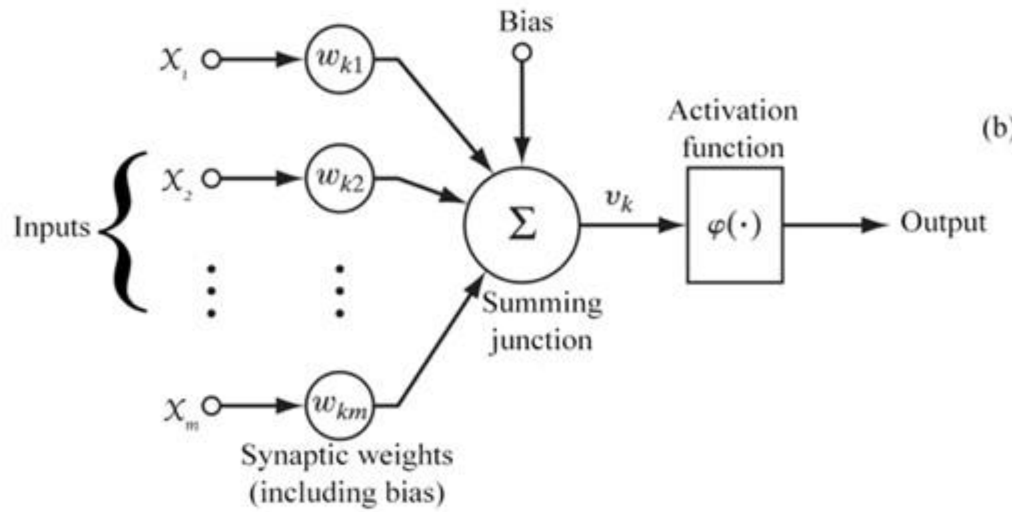




1.Linear Algebra

2.Calculus: Concepts from <u>calculus</u>, particularly <u>derivatives</u>, are essential. You'll use derivatives for training ANNs, such as gradient descent algorithms. Understanding how gradients affect weight updates is key.

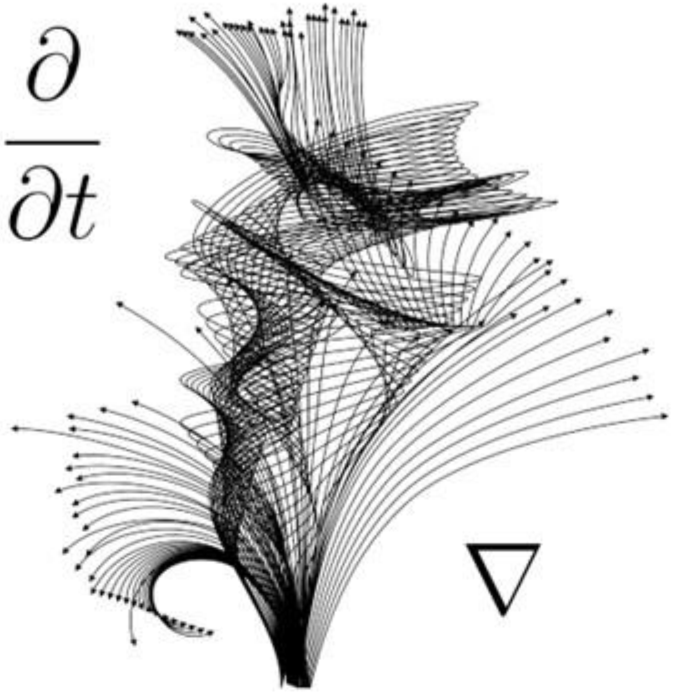


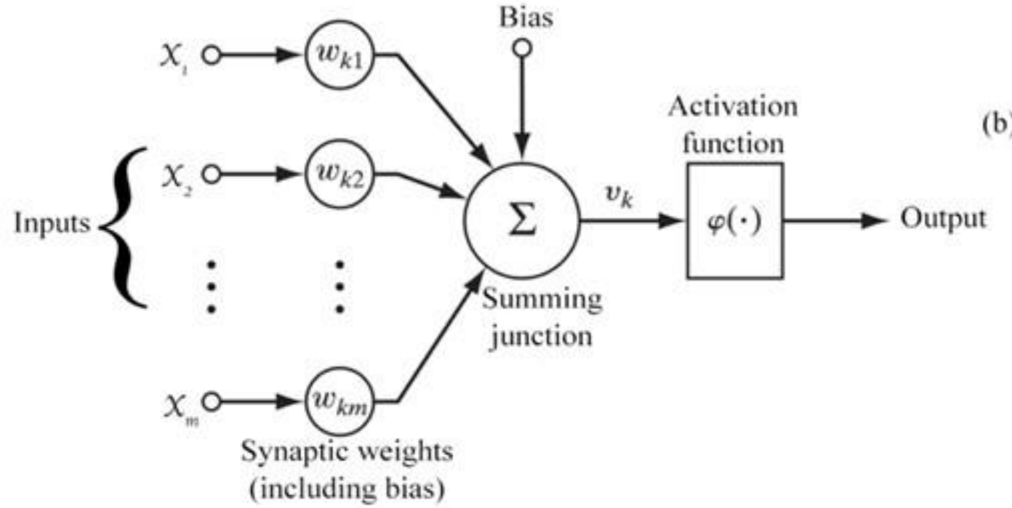


1. Linear Algebra

2. Calculus

3. Probability and Statistics: You'll encounter probability and statistics when dealing with tasks like classification and regression. Concepts like probability distributions, mean, variance, and statistical tests are valuable.



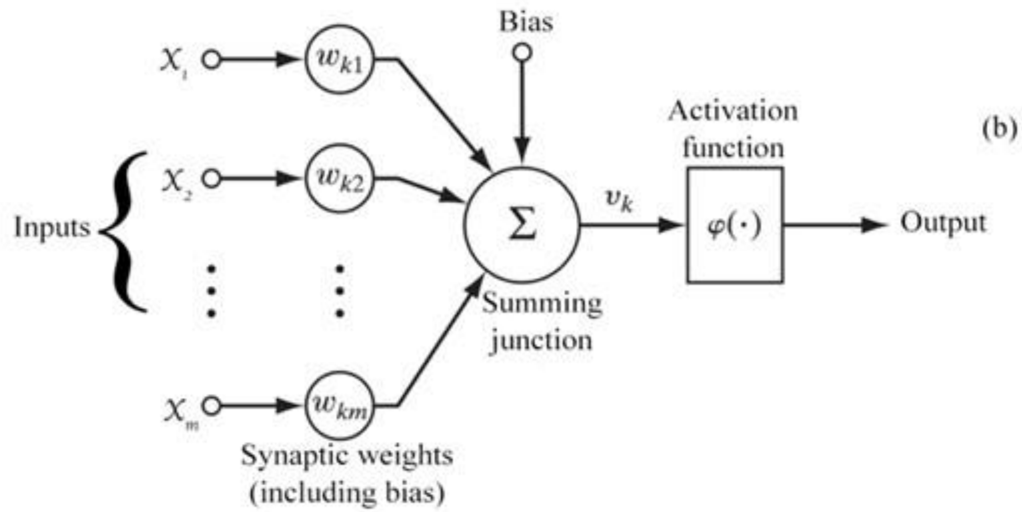


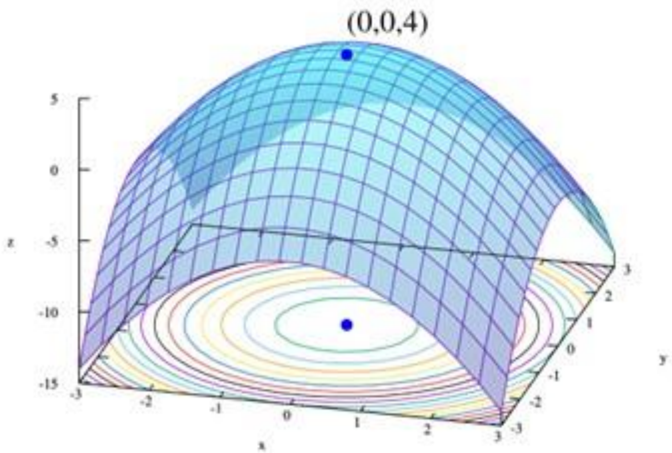
1. Linear Algebra

2. Calculus

3. Probability and Statistics

4. Differential Equations: Deep learning models, including ANNs, often involve solving differential equations. Understanding the basics of differential equations will be beneficial for understanding the training process.





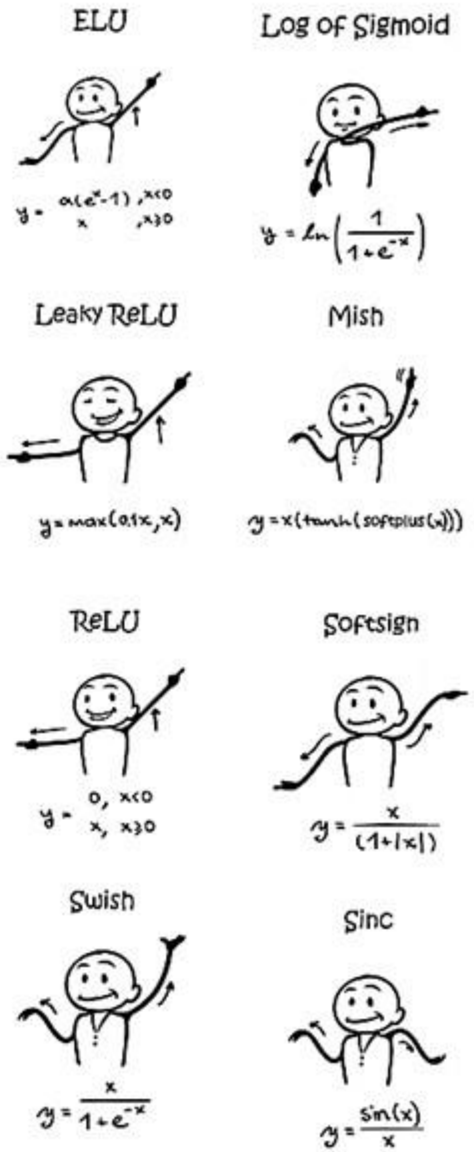
1. Linear Algebra

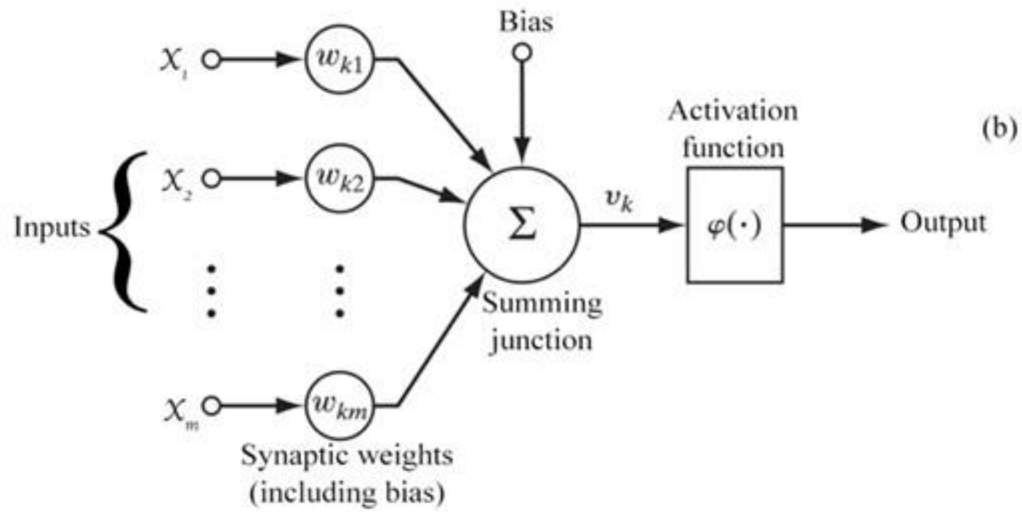
2. Calculus

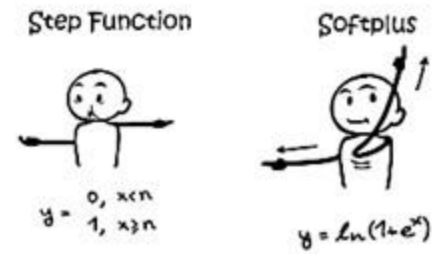
3. Probability and Statistics

4. Differential Equations

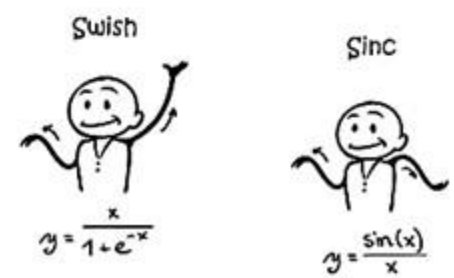
5. Optimization: Knowledge of optimization techniques, such as gradient descent and its variants (e.g., stochastic gradient descent), is important for training ANNs effectively.







1. **Linear Algebra**
2. **Calculus**
3. **Probability and Statistics**
4. **Differential Equations**
5. **Optimization**
6. **Activation Functions:** Understanding how activation functions (e.g., sigmoid, ReLU) transform input data mathematically is vital for comprehending how information flows through ANNs.

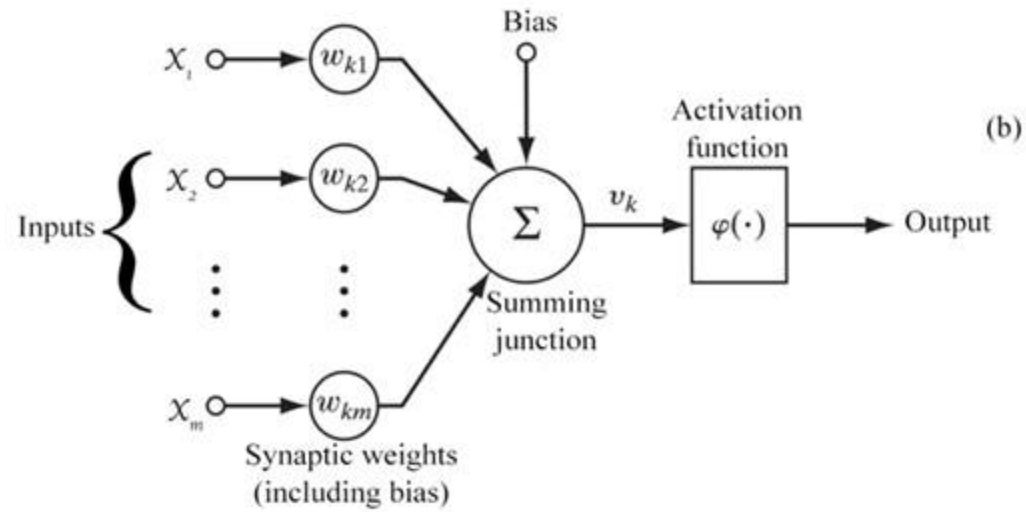


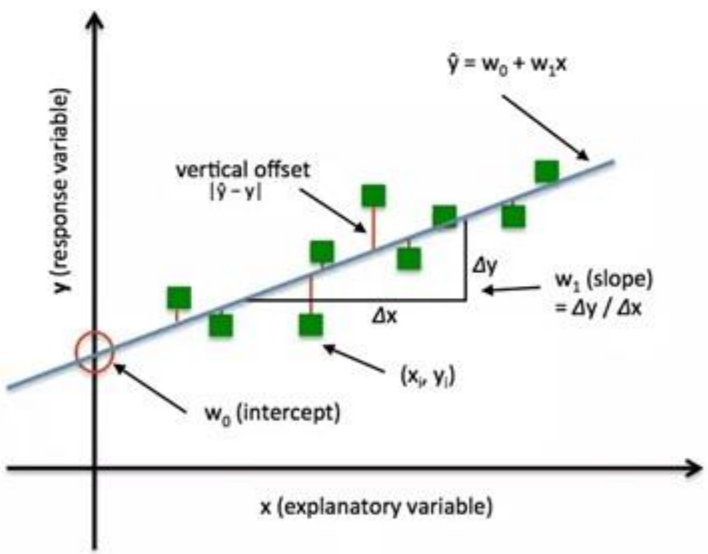
Log loss

$$L(y-\hat{y}) = \frac{1}{n}\sum_{i=1}^{n} y_i \log(\hat{y}_i)$$

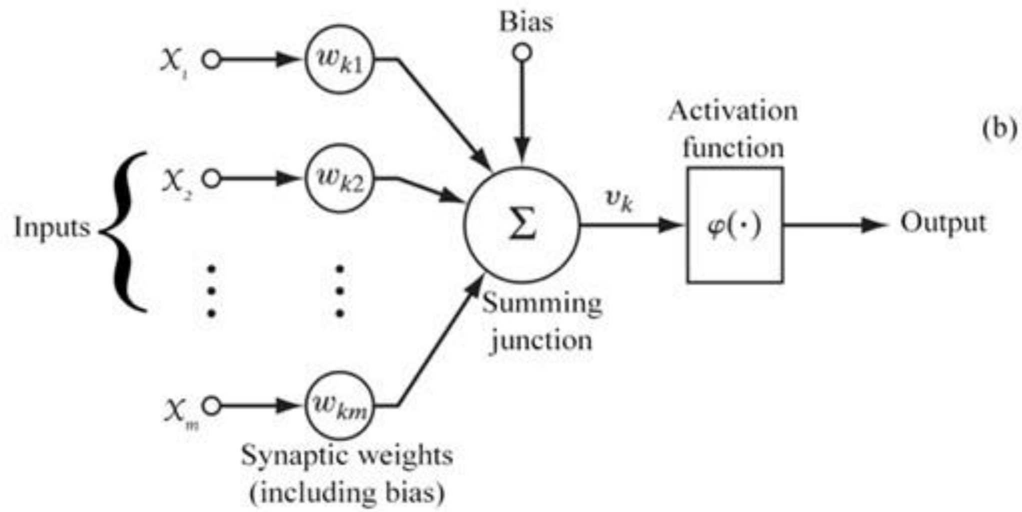
Mean Squared Loss

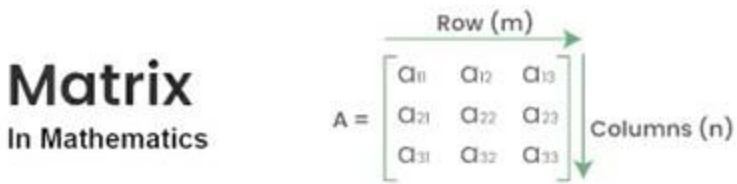
$$L(y-\hat{y}) = \frac{1}{n}\sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$



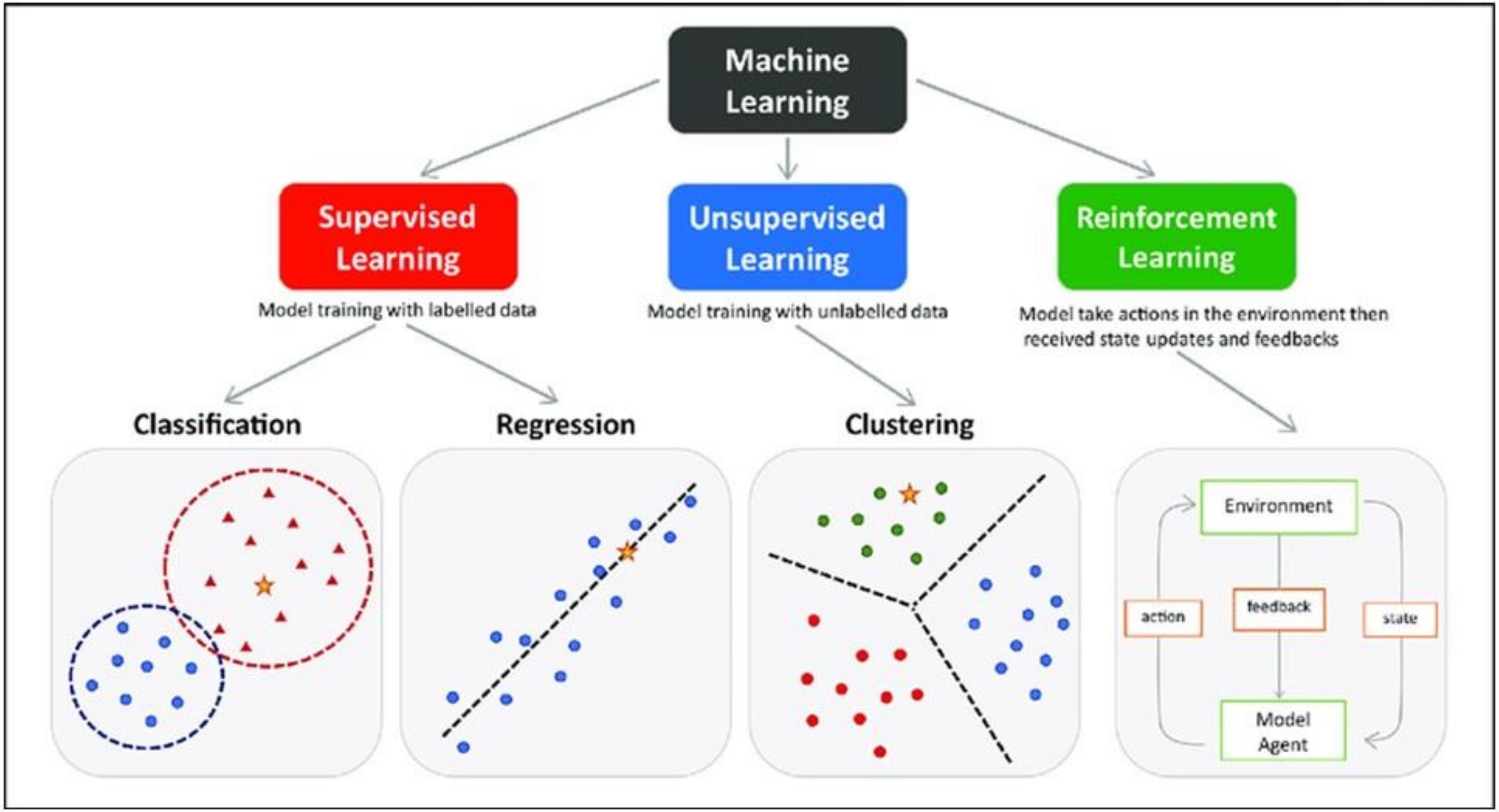


1. **Linear Algebra**
2. **Calculus**
3. **Probability and Statistics**
4. **Differential Equations**
5. **Optimization:**
6. **Activation Functions**
7. **Loss Functions:** Familiarity with various loss functions (e.g., mean squared error, cross-entropy) used to quantify the difference between predicted and actual values is essential for training ANNs.





1. Linear Algebra
2. Calculus
3. Probability and Statistics
4. Differential Equations
5. Optimization:
6. Activation Functions
7. Loss Functions
8. Matrix Calculus: A deeper understanding of matrix calculus can be helpful, especially for advanced deep learning concepts like backpropagation through time (BPTT) in recurrent neural networks.



Machine learning

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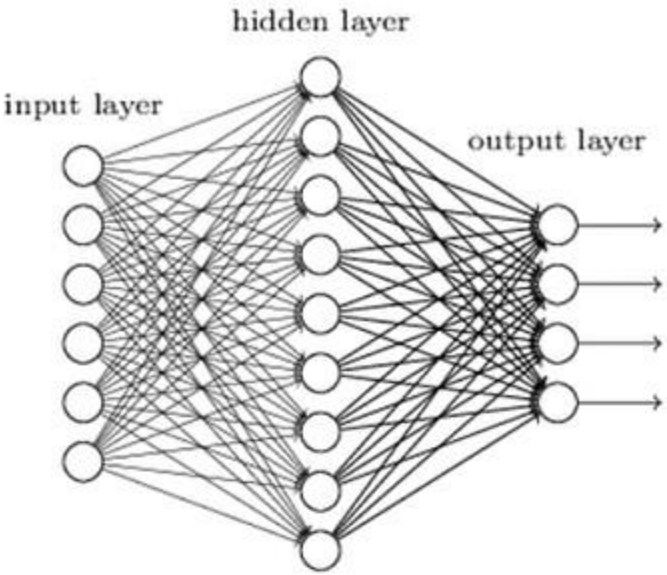
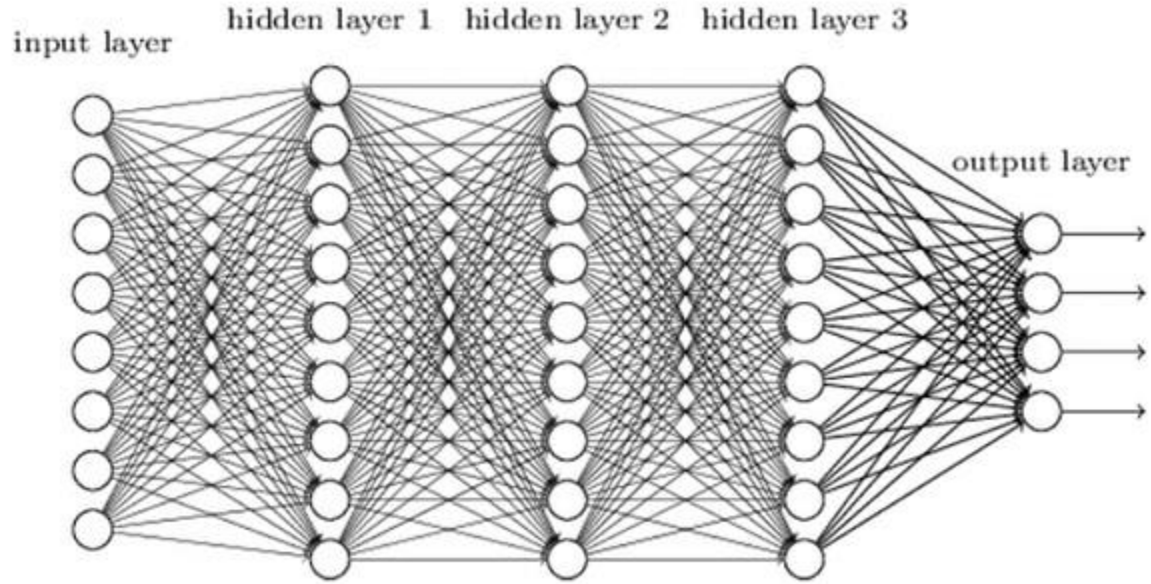
"Non-deep" feedforward neural network



Deep neural network



Machine learning **and Deep learning**

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