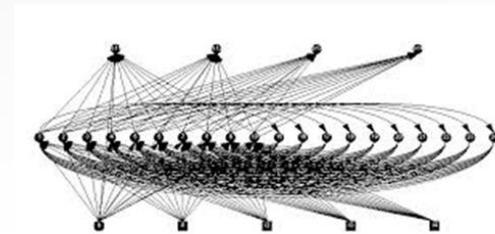


Intelligenza delle Macchine e Neural Computing

Elisabetta Binaghi

*Corso di Laurea in Informatica
Dipartimento di Scienze Teoriche e Applicate
Università degli Studi dell'Insubria - Varese*



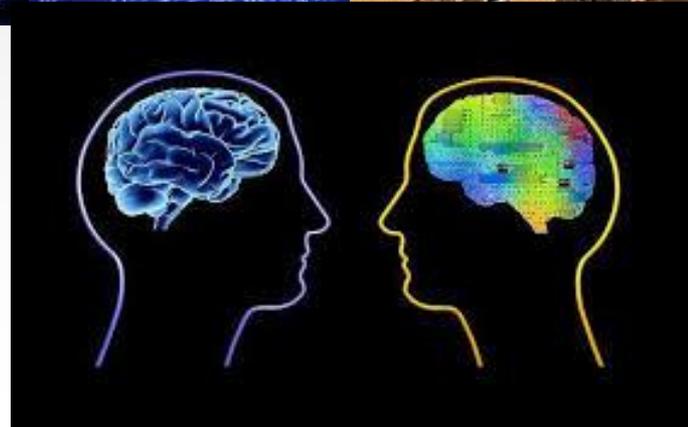
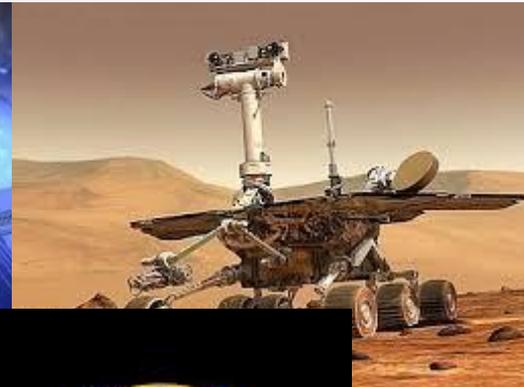
Intelligenza Artificiale

■ Obiettivo:

realizzare Agenti Intelligenti che ricevono percezioni dall'ambiente ed eseguono azioni

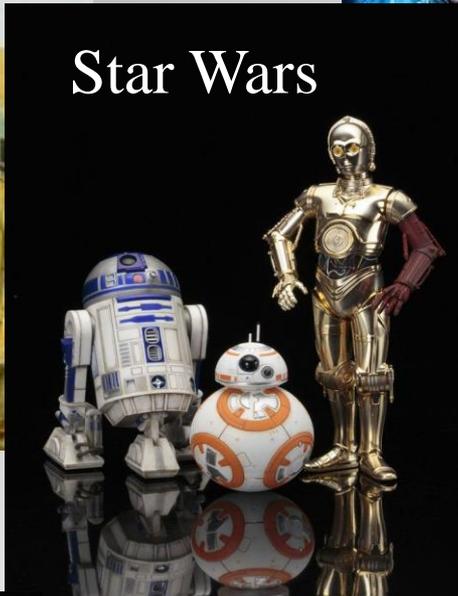
■ E' una disciplina

- Vasta
- Complessa
- Con elementi di conflitto





Lucas 1977



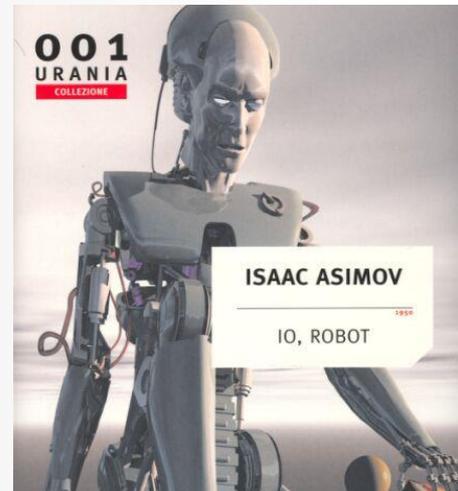
Star Wars



Ridley Scott
1982

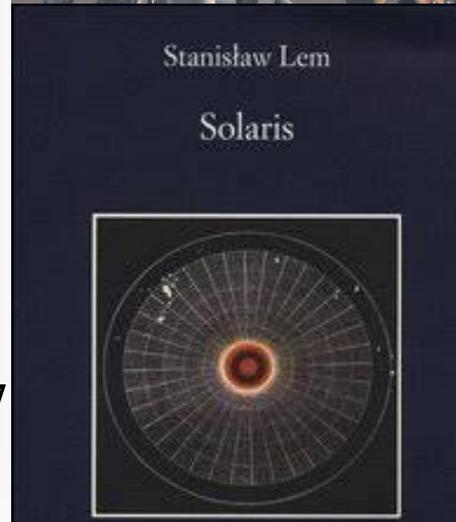


Alex Garland, 2015



ISAAC ASIMOV

IO, ROBOT



Stanislaw Lem

Solaris



UN FILM DI STANLEY KUBRICK

2001

odissea nello spazio

J.J. Abrams 2015



Fritz Lang 1927

Stanley Kubrick, 1968

Perché molto interesse per l'Intelligenza Artificiale in ambito scientifico

- Per l'Homo Sapiens sono fondamentali le facoltà mentali

- L'Intelligenza Artificiale studia tali facoltà contribuendo ad una loro comprensione, ma si pone un obiettivo ancora più ambizioso:

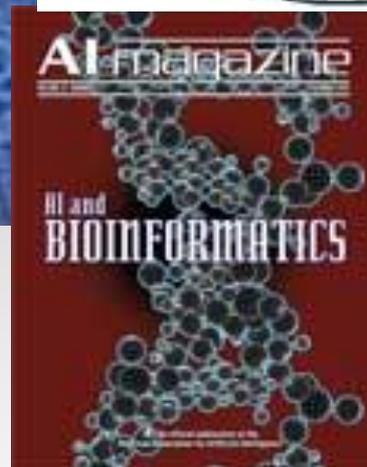
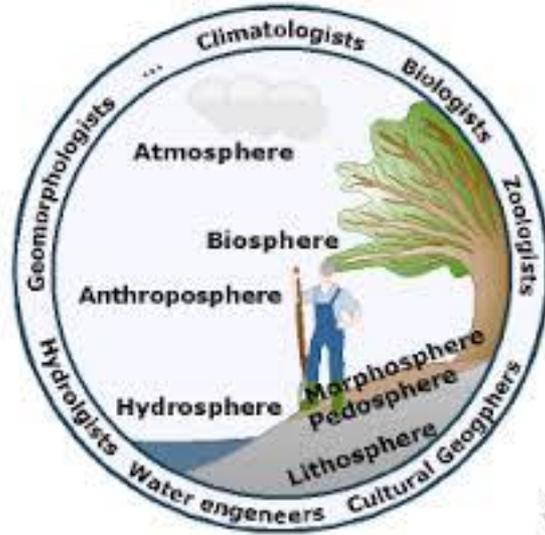
la costruzione di entità artificiali intelligenti





- L'Intelligenza Artificiale è tutt'ora un' ambito di ricerca
- molti risultati sono stati raggiunti ed applicati in vari ambiti **contribuendo al miglioramento della qualità della vita ed al progresso scientifico, culturale ed economico**





<http://www.aaai.org/home.html>



Topics

- ▶ AI Overview
- ▶ Applications
- ▶ Cognitive Science
- ▶ Education
- ▶ Ethics & Social Issues
- ▶ Games & Puzzles
- ▶ History
- ▶ Interfaces
- ▶ Machine Learning
- ▶ Natural Language
- ▶ Philosophy
- ▶ Representation & Reasoning
- ▶ Robots
- ▶ Science Fiction
- ▶ Speech
- ▶ Systems & Languages
- ▶ Vision
- ▶ Web & AI

Collections

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Top news this week

AI in the News

What DeepMind's



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UPCOMING AAAI EVENTS

March 2016

The [AAAI Spring Symposium](#) begins on March 21 in Palo Alto, CA USA.

May 2016

The [Tenth International AAAI Conference on Web and Social Media](#) will be held in Cologne, Germany, May 17 – 20.

October 2016

The [Twelfth AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment \(AIIDE-16\)](#) will be held October 8 – October 12, 2016 near San Francisco, California USA.



The AAAI Conference on Artificial Intelligence

WELCOME TO THE ASSOCIATION FOR THE ADVANCEMENT OF ARTIFICIAL INTELLIGENCE!

Founded in 1979, the Association for the Advancement of Artificial Intelligence (AAAI) (formerly the American Association for Artificial Intelligence) is a nonprofit scientific society devoted to advancing the scientific understanding of the mechanisms underlying thought and intelligent behavior and their embodiment in machines. AAAI aims to promote research in, and responsible use of, artificial intelligence. AAAI also aims to increase public understanding of artificial intelligence, improve the teaching and training of AI practitioners, and provide guidance for research planners and funders concerning



Miti antichi...

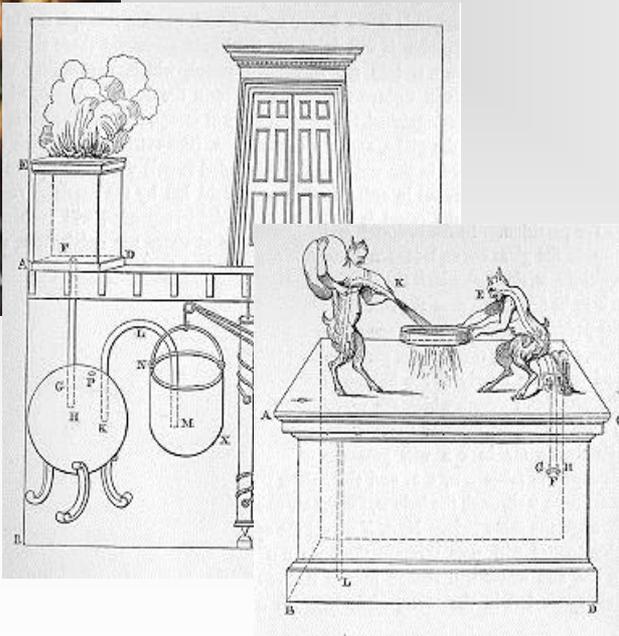
Nella Grecia classica



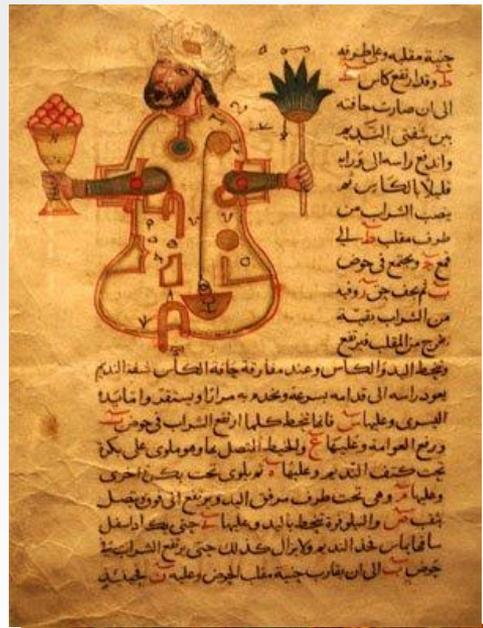
Servi meccanici nella fucina di Efesto



Nella tradizione cabalistica ebraica: Golem



macchine di Erone d'Alessandria I° secolo d.c.



Al Jazari 1206 automa umaoide

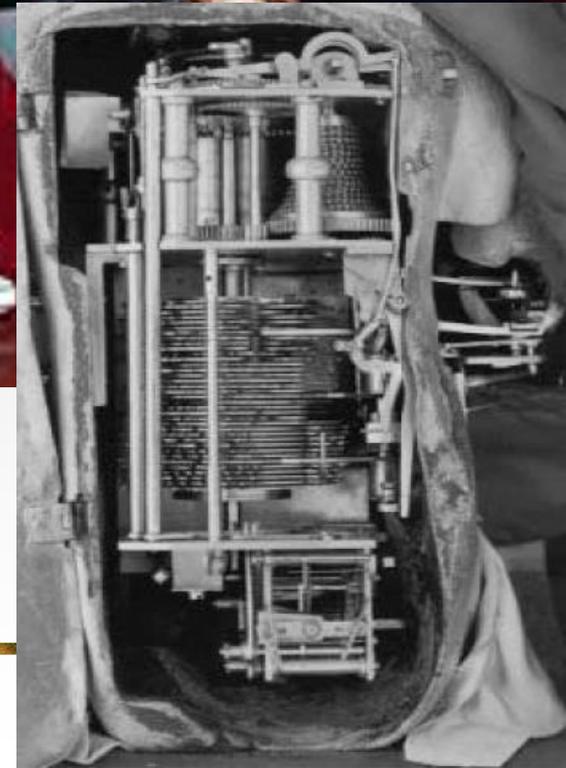
Nella cultura araba



*Leonardo: robot umanoide
concepito a Milano nel 1495*



Scrivani del XIX

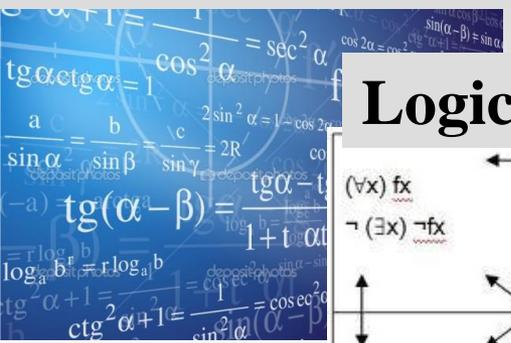


Realizzare Macchine Intelligenti: nel XX secolo un obiettivo possibile

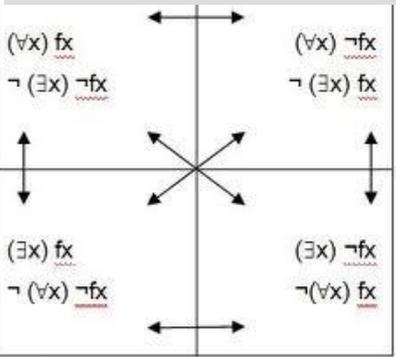
Filosofia



Matematica



Logica formale



Psicologia



NeuroScienze

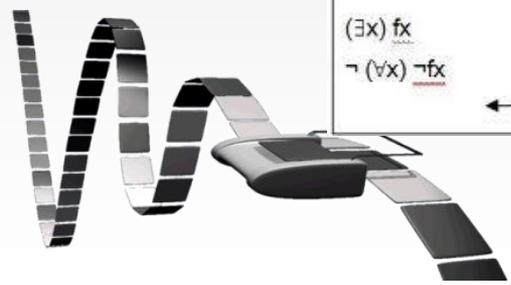
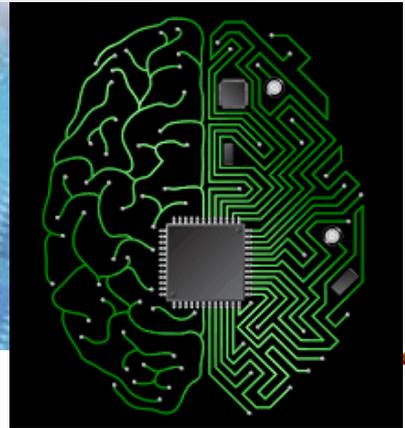


Cibernetica

Elettronica



Ingegneria Informatica





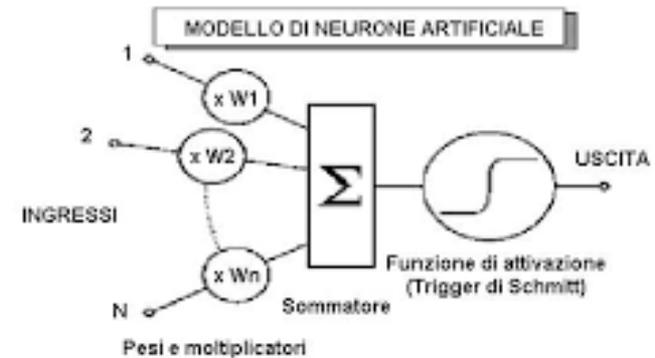
R5 robot candidato come primo esempio di astronauta metallico.

R5 è alto 1,90 centimetri, pesa circa 120 chili, ha un aspetto umanoide ed è stato costruito dalla NASA nel Johnson Space Center

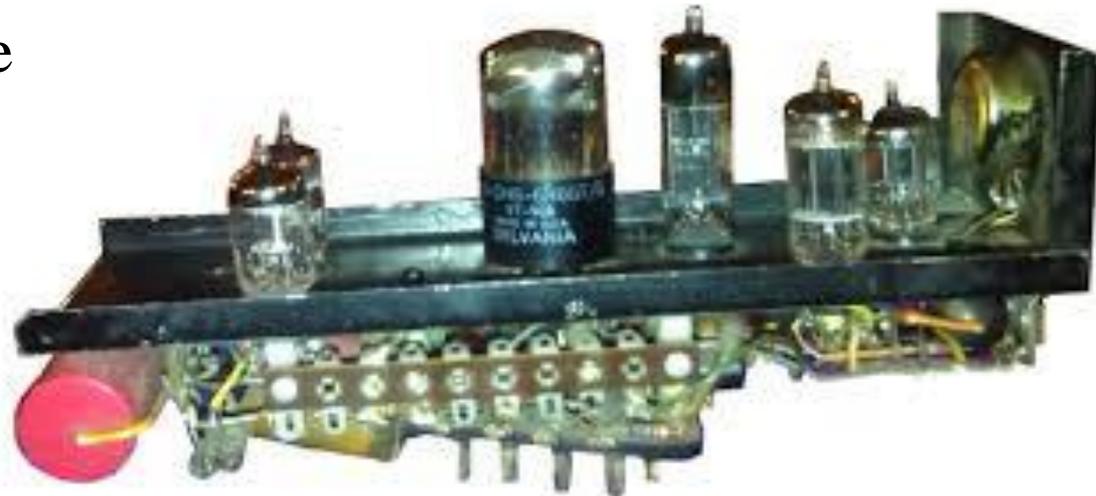
Un po' di Storia

1943-1955: Gestazione

Prima formalizzazione di un neurone artificiale ad opera di McCulloch e Walter Pitts



Primo computer a base neurale (40 neuroni) ad opera di Marvin Minsky e Dean Edmonds



1943-1955: Gestazione



A. M. Turing (1950) Computing Machinery and Intelligence. *Mind* 49: 433-460.

COMPUTING MACHINERY AND INTELLIGENCE

By A. M. Turing

1. The Imitation Game

I propose to consider the question, "Can machines think?" This should begin with definitions of the meaning of the terms "machine" and "think." The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words "machine" and "think" are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, "Can machines think?" is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

La sua nascita

A PROPOSAL FOR THE DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE

J. McCarthy, Dartmouth College
M. L. Minsky, Harvard University
N. Rochester, I.B.M. Corporation
C. E. Shannon, Bell Telephone Laboratories

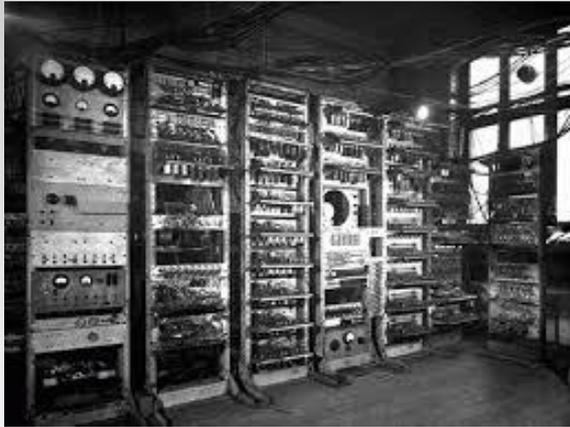
August 31, 1955

We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer. [...]



1956-1969: Primi entusiasmi grandi aspettative

- **Logic Theorist**
- **General Problem Solver**



1966-1973: Una dose di realtà – Anni di Crisi

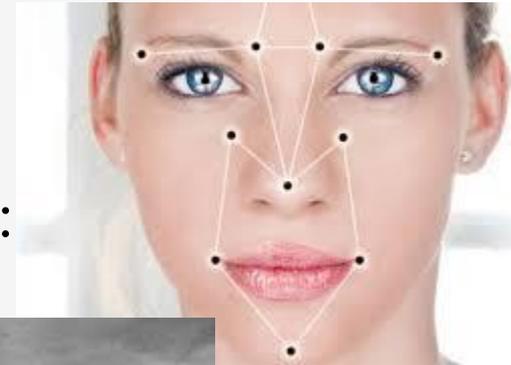
Eccessivi entusiasmi:

«In un futuro vicino il campo dei problemi che i sistemi di intelligenza artificiale potranno gestire avrà la stessa estensione di quello a cui è applicata la mente umana» –
Simon, 1957

Nascono difficoltà nell'affrontare problemi reali, quali:

Traduzione automatica

Riconoscimento Visuale e del Parlato..



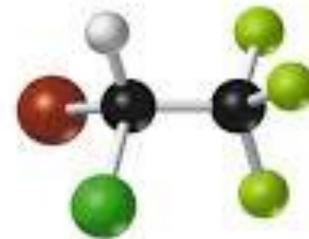
1973-1980: Sistemi basati su conoscenza

- Formalizzazione della conoscenza in un specifico contesto
- Trattamento dell'incertezza

Ripartono i finanziamenti per le ricerche in Intelligenza Artificiale



Applications of Expert Systems



DENDRAL:
Used to identify the structure of chemical compounds. First used in 1965

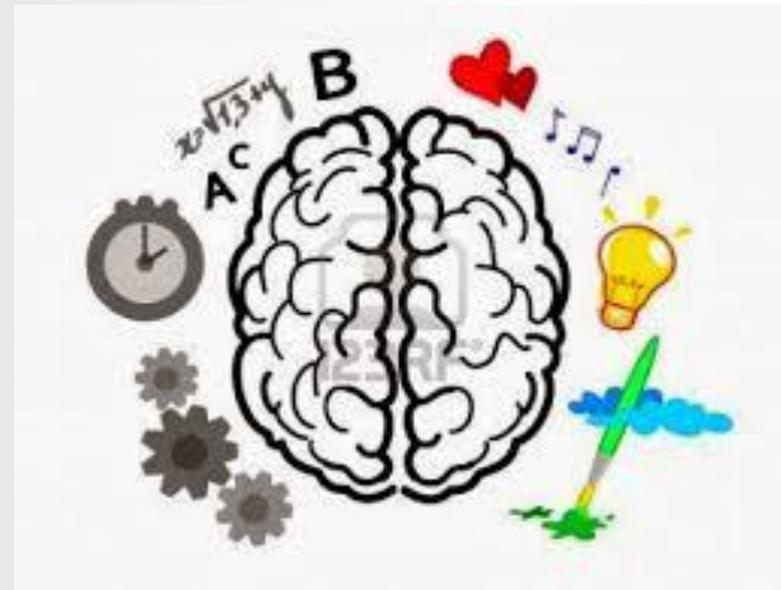


MYCIN:
Medical system for diagnosing blood disorders. First used in 1979

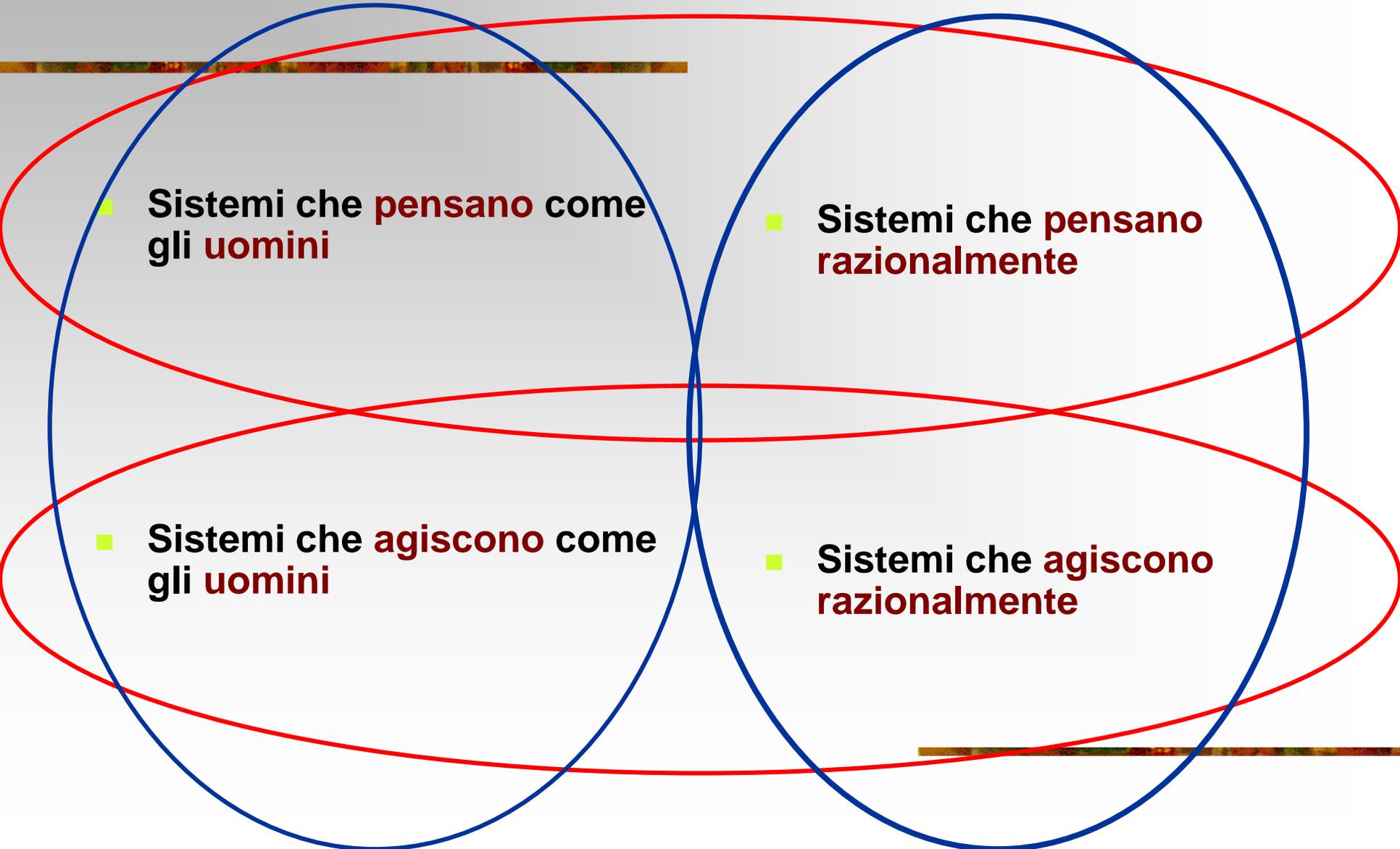
1980-Presente

Fattori di successo:

- Integrazione di approcci diversi
- Integrazione di aspetti percettivi e dell'agire nel concetto di comportamento intelligente
- Enfasi sull'Apprendimento, adattabilità come qualità di un comportamento Intelligente
- Enfasi sul concetto di Razionalità



Sistemi di Intelligenza Artificiale- Come definirli?



■ **Sistemi che pensano come gli uomini**

■ **Sistemi che pensano razionalmente**

■ **Sistemi che agiscono come gli uomini**

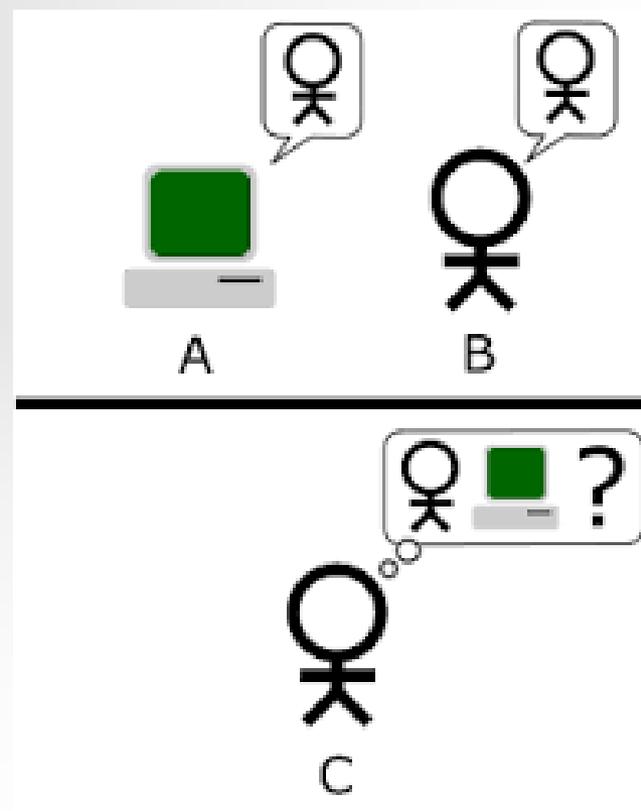
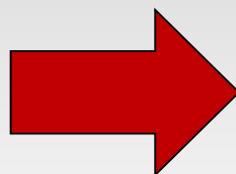
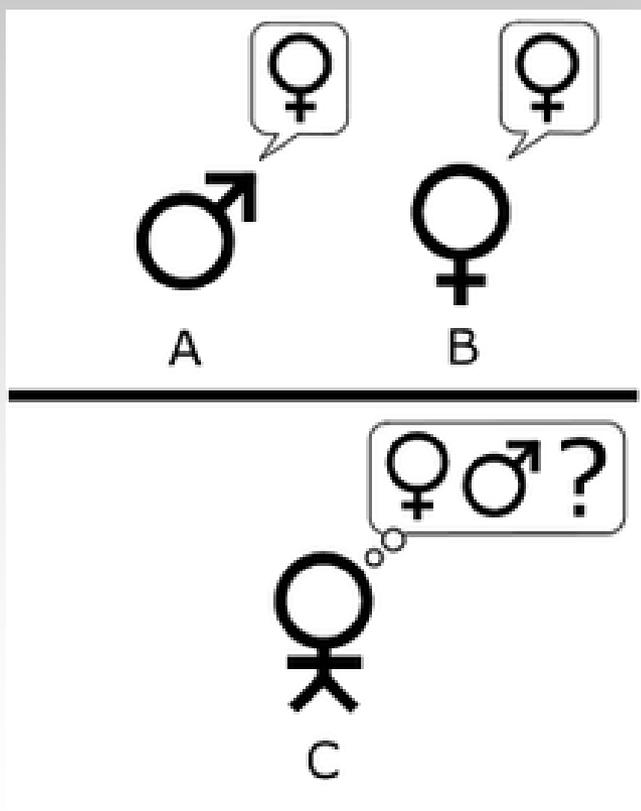
■ **Sistemi che agiscono razionalmente**

Agire come gli uomini: il Test di Turing

- Il **Test di Turing** è un criterio, introdotto da Alan Turing per determinare se una macchina ha un comportamento intelligente
 - La domanda
 - **possono le macchine pensare**
 - viene riformulata con
 - **può una macchina avere un “comportamento” (in un dialogo) indistinguibile da quello di un uomo**
-

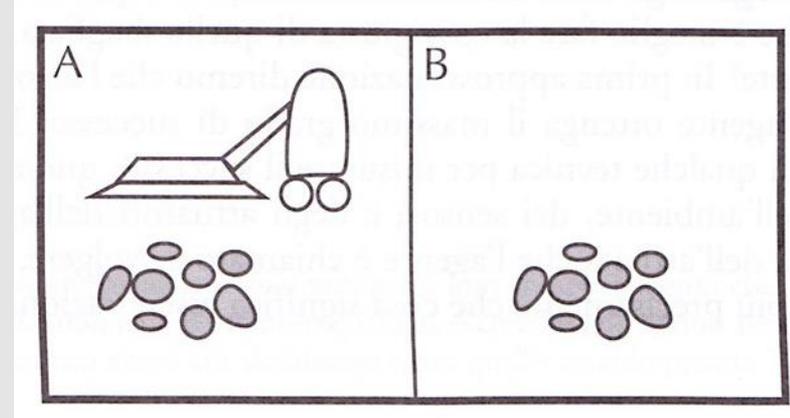
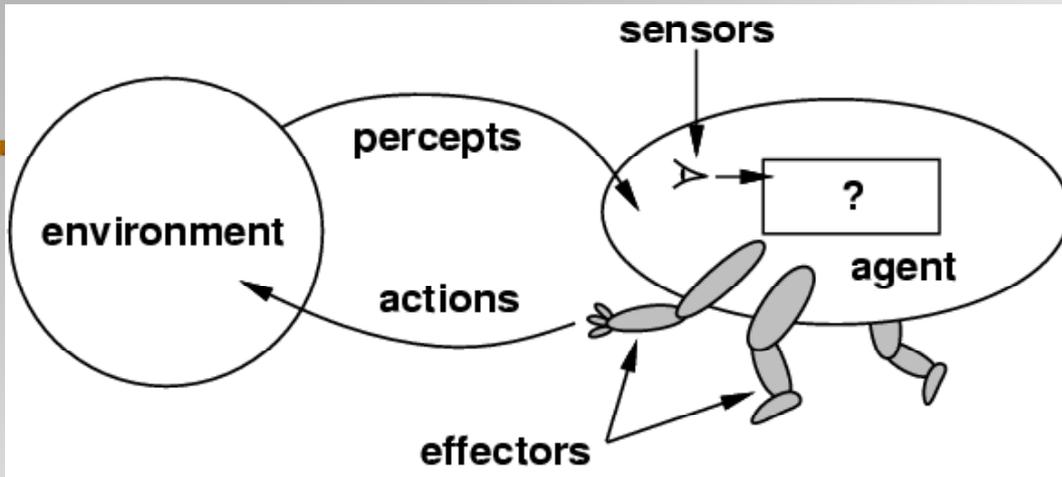
Agire come gli uomini: il Test di Turing

Imitation Game





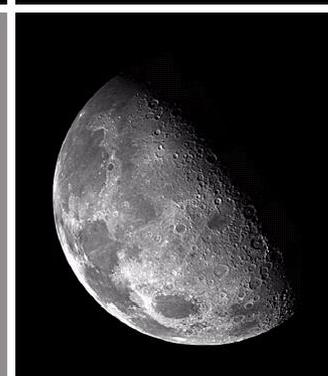
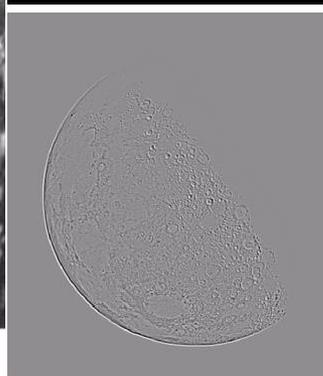
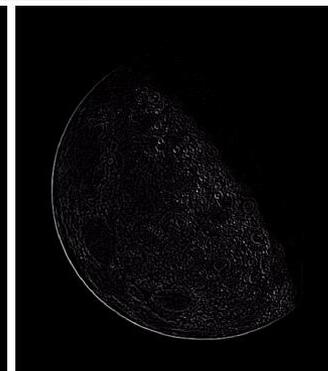
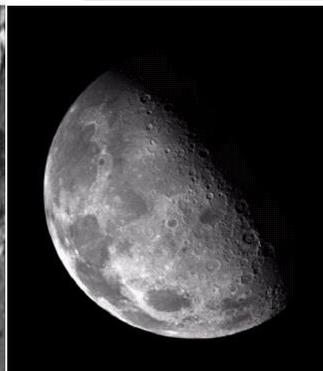
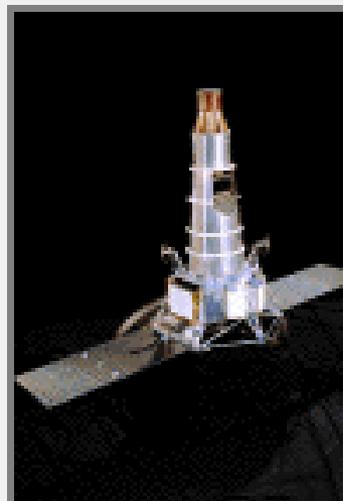
Agenti Razionali



- Agiscono in modo razionale, ovvero in modo da ottenere la **migliore performance rispetto agli obiettivi preposti**, sulla base di una propria conoscenza e dei dati acquisiti dal mondo esterno
- Imparano dall'esperienza
- Sono adattivi, flessibili al variare dell'ambiente e degli obiettivi

Cerchiamo con degli esempi di definire quando un programma al computer svolge un compito intelligente.

Ad esempio nell'Elaborazione delle Immagini Digitali quali procedure possono essere definite intelligenti e quali no?



Elaborare per migliorare la qualità visiva delle immagini

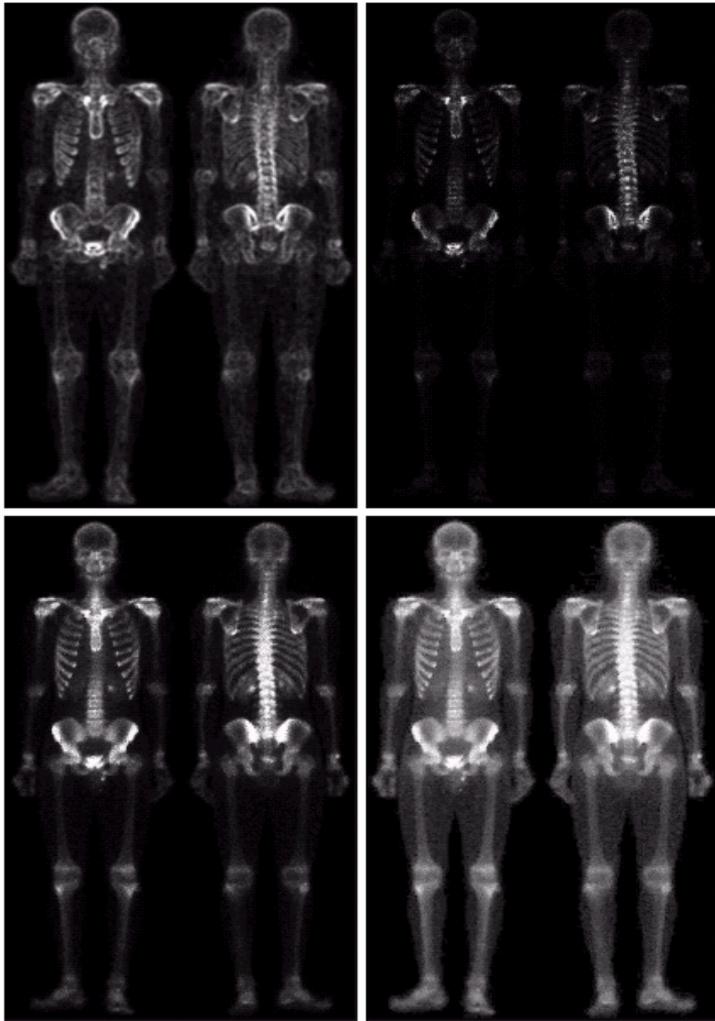
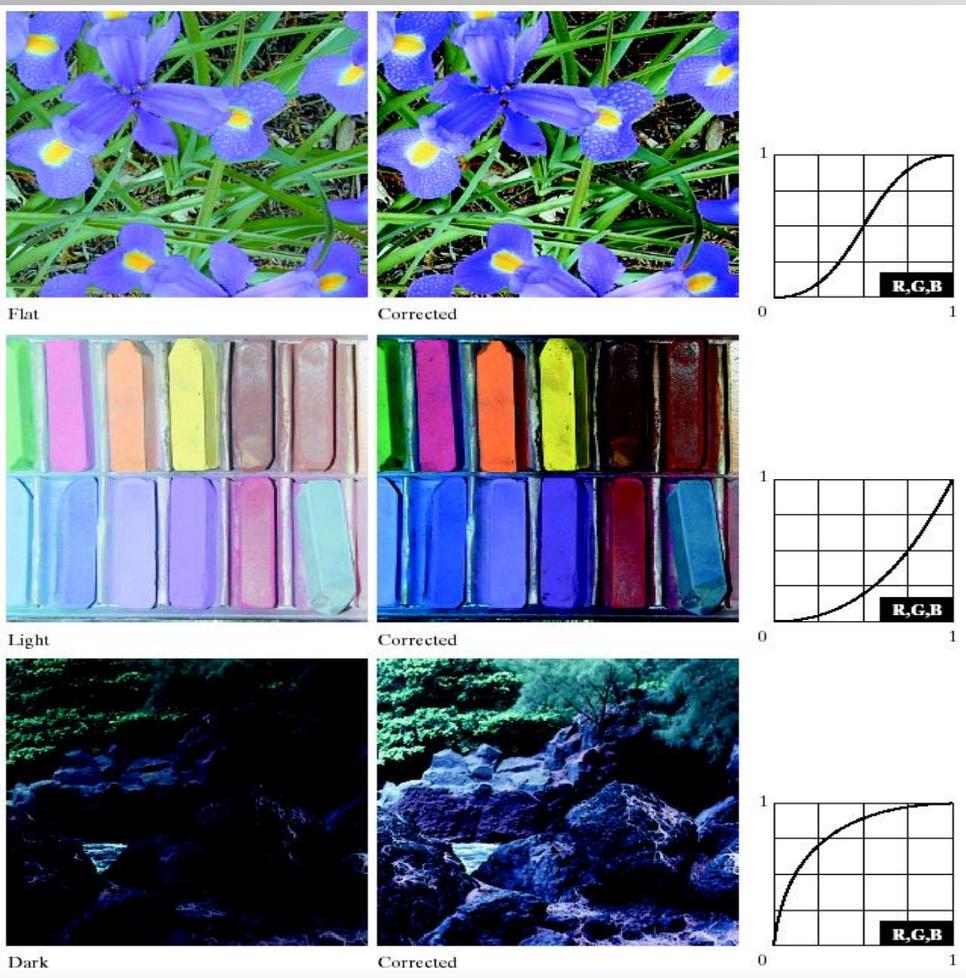
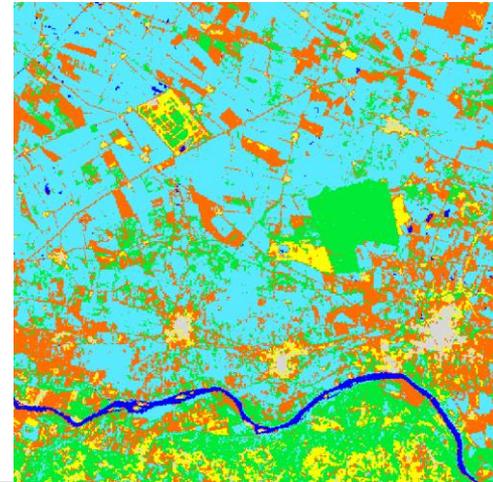
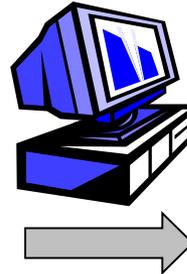
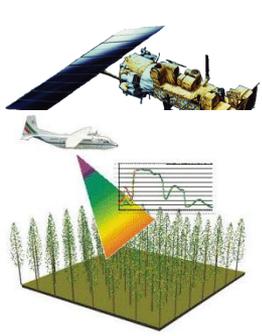
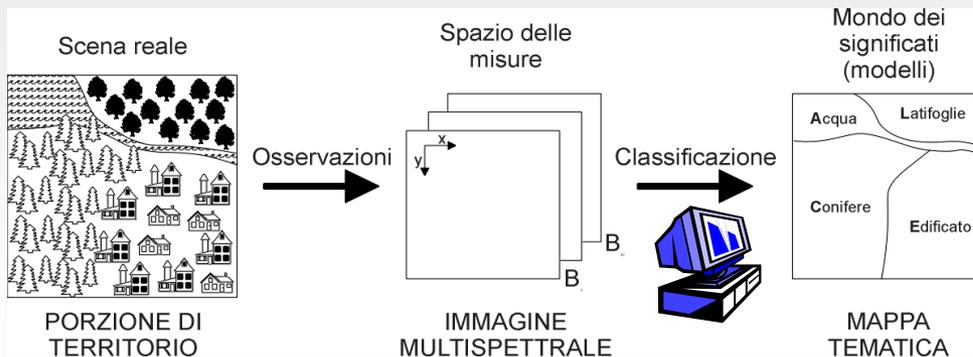


immagine → elaborazione → immagine migliorata

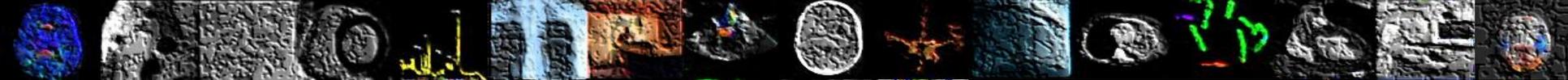
Elaborare per *riconoscere* il contenuto di un'immagine



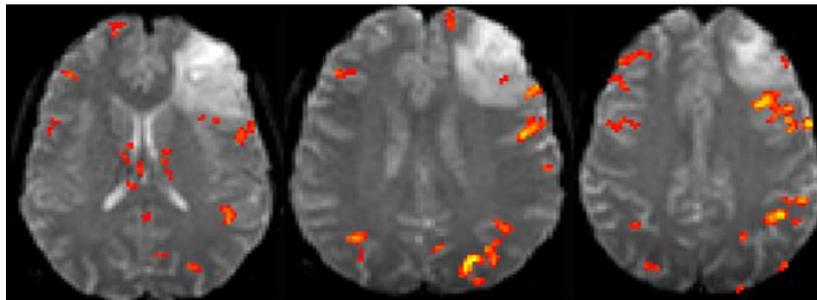
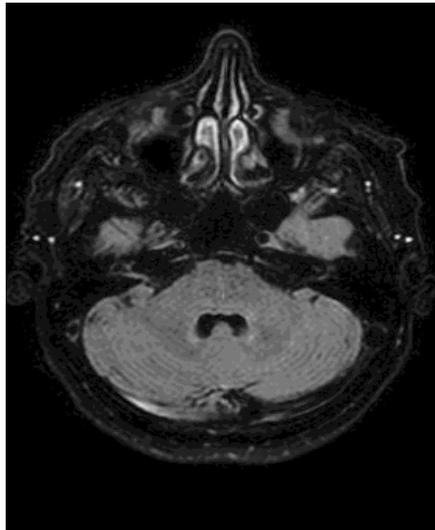
Scena → *immagine* → *elaborazione* → *categorie*

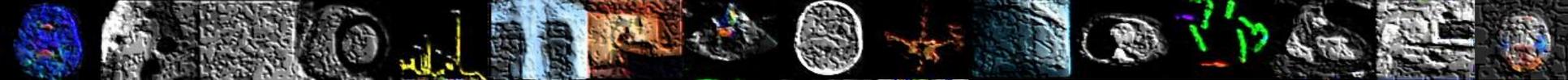


Riconoscere è un'attività che richiede Intelligenza



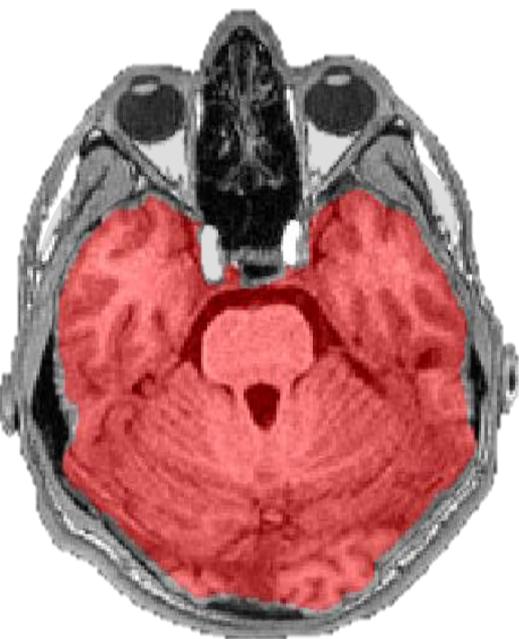
Elaborare per riconoscere il contenuto di un'immagine



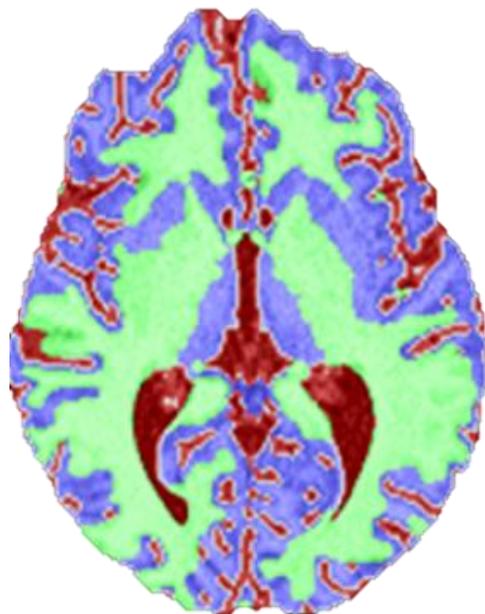


MRI Brain Segmentation

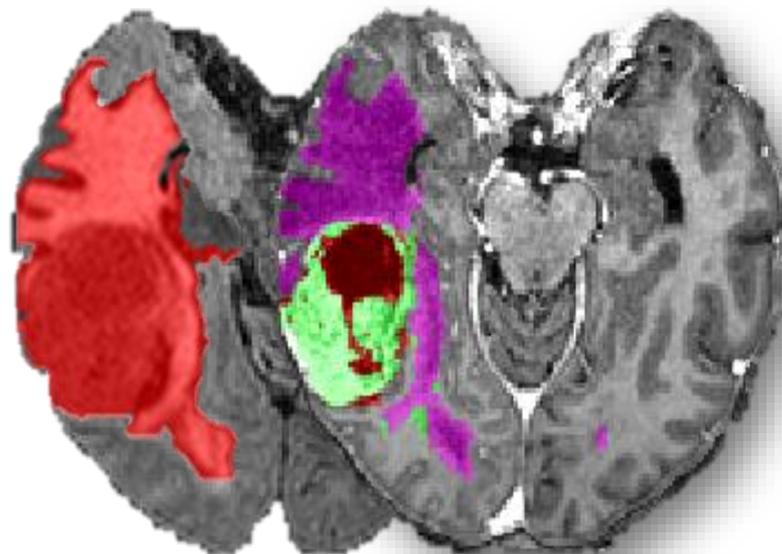
Brain Segmentation

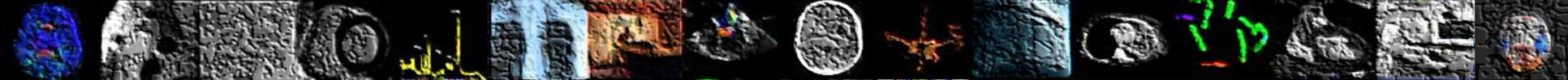


Tissues Segmentation

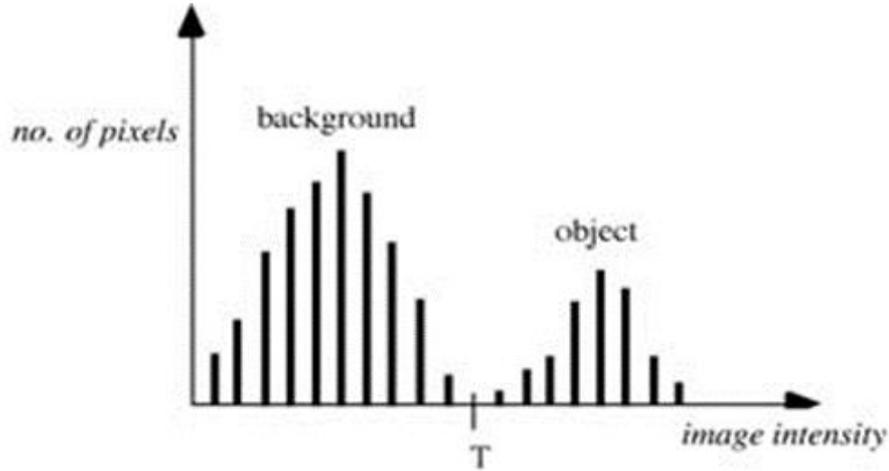


Tumor Segmentation



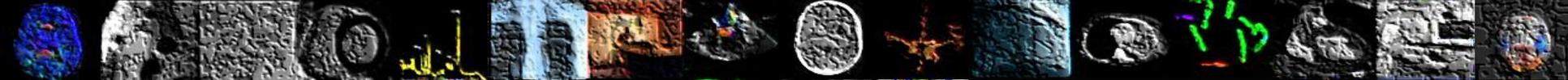


Approcci convenzionali alla segmentazione

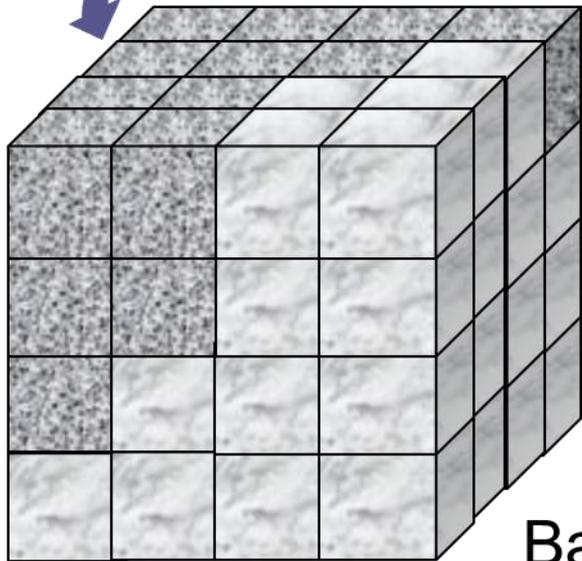


Arbitrary tresholding





Object

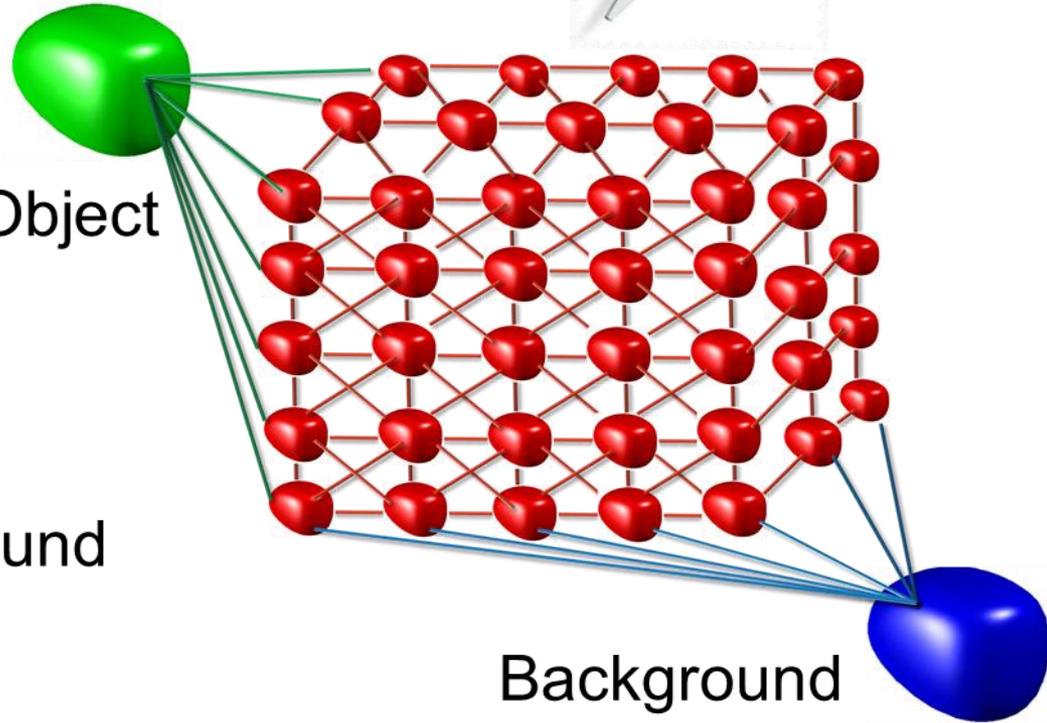


Volumetric Data

Background

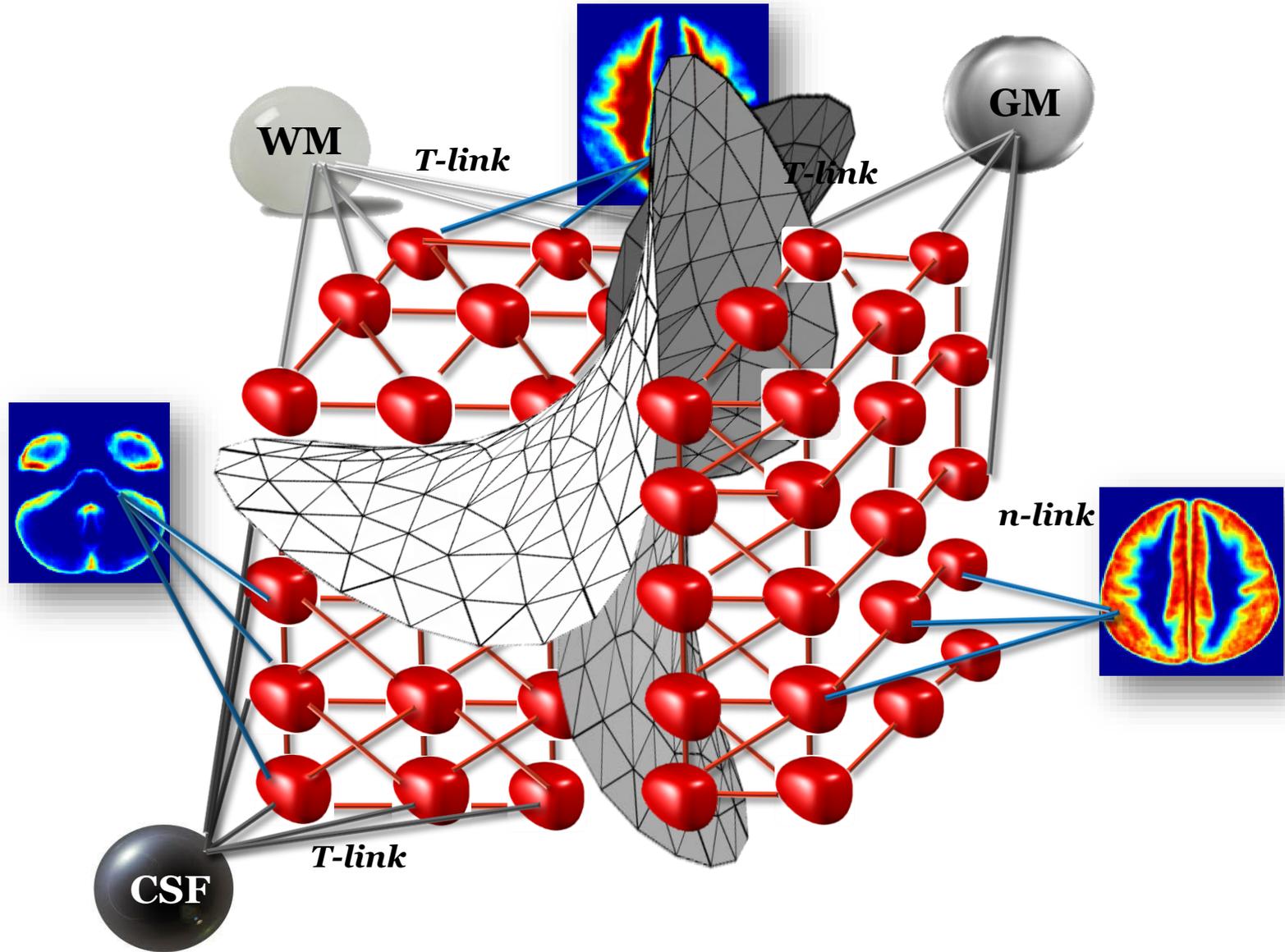
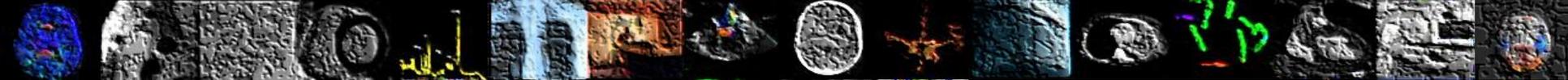


Object



Background

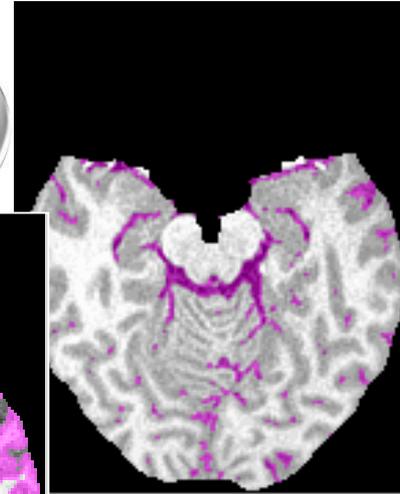
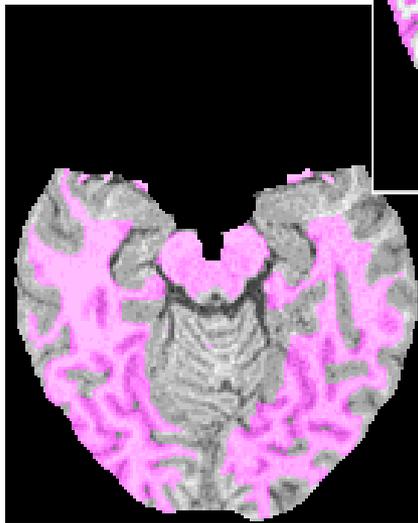




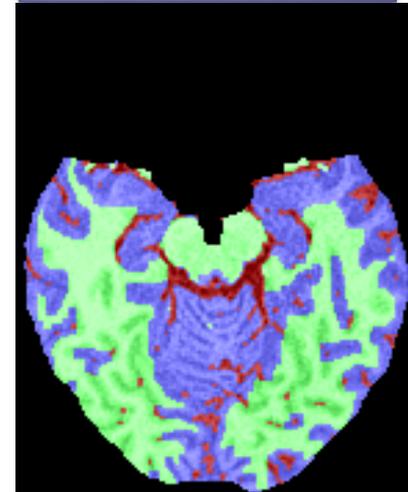
White Matter/Gray Matter/Cerebral Spinal Fluid Segmentation



Skull Stripped
MRI



Tissues
Segmentation



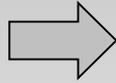
Ricerca di Immagini nel Web ..un compito che richiede Intelligenza



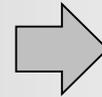
Ricerca di immagini per contenuto



query

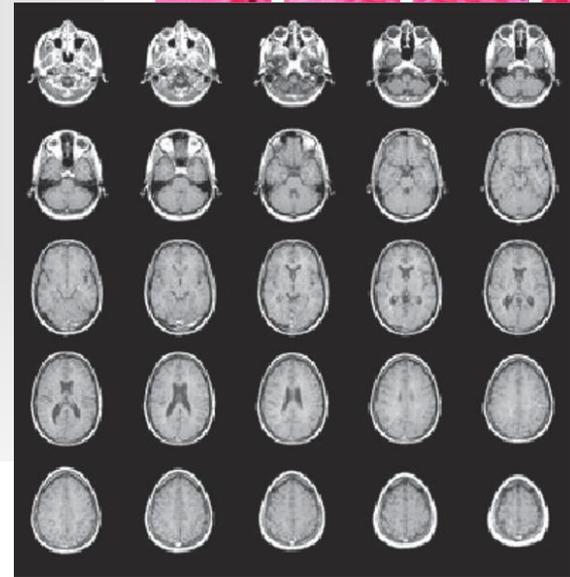
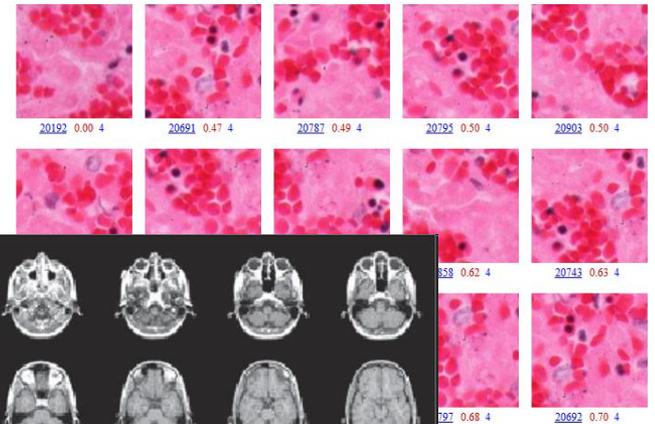
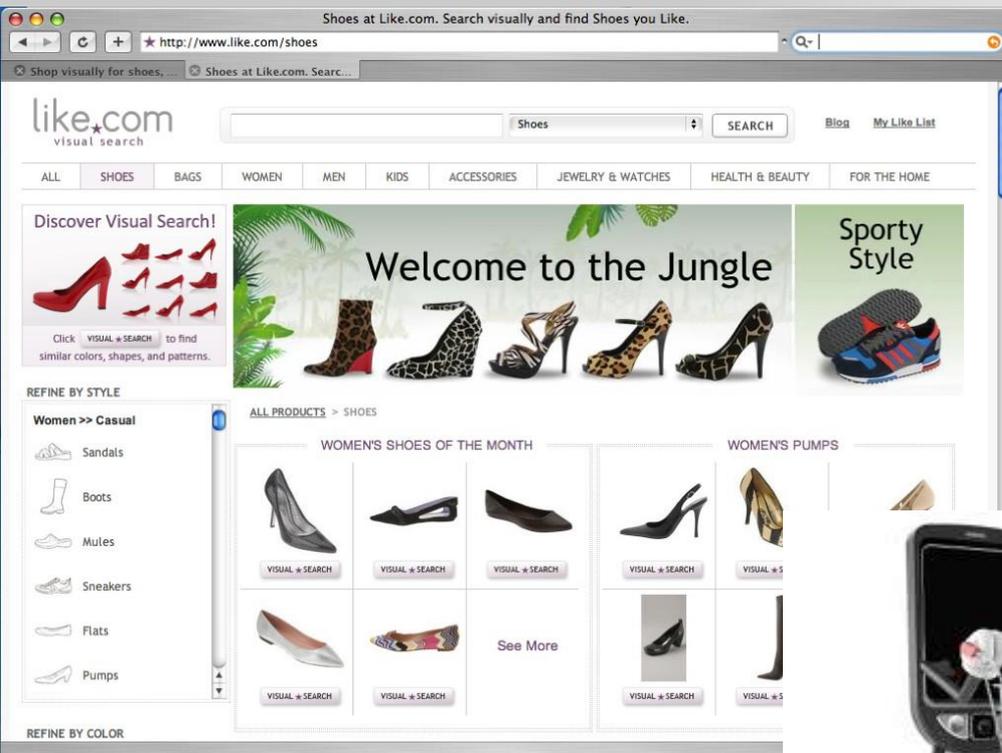


**Agente
intelligente**



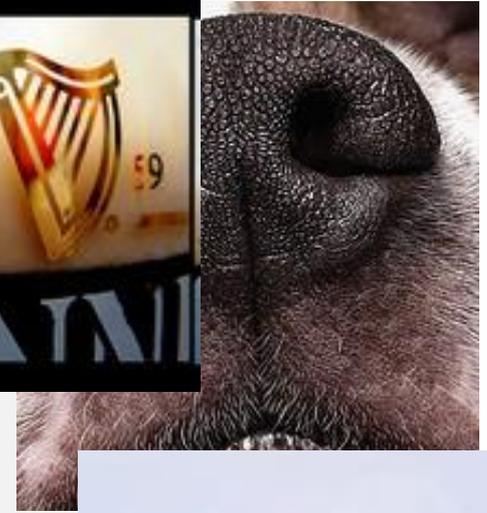
Applicazioni Biomediche

Online Mobile Shopping

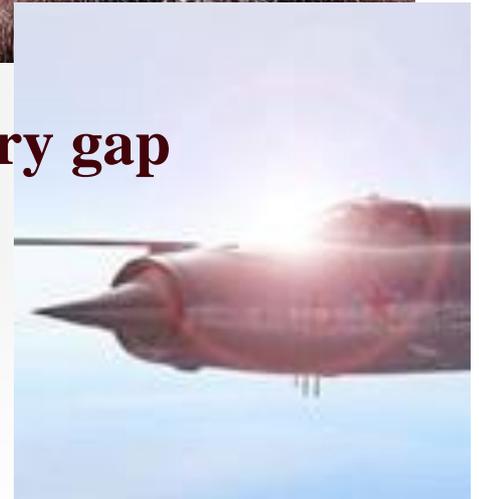




Simili?

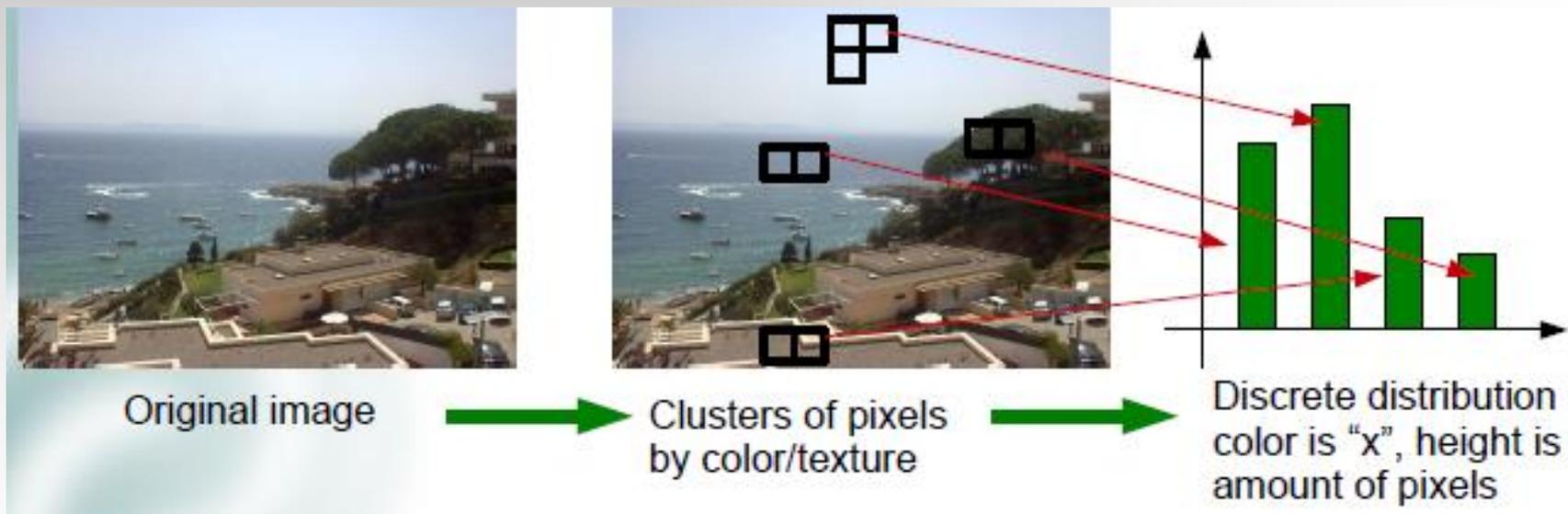


Sensory gap

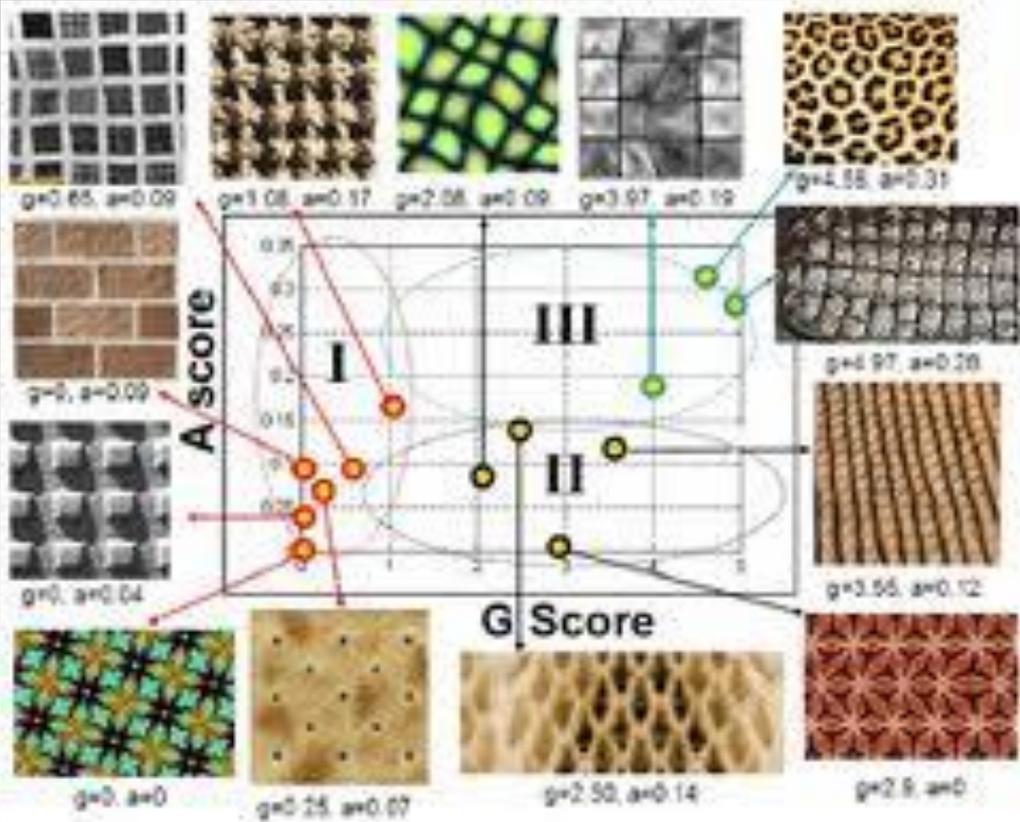


Per riconoscere e confrontare le immagini debbo estrarre da esse attributi visuali

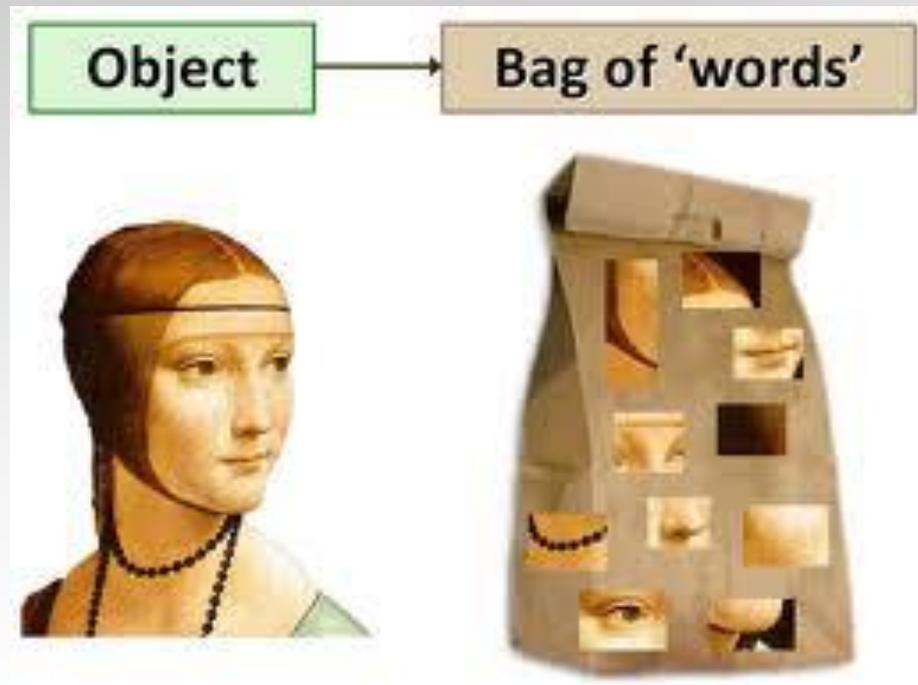
Colore



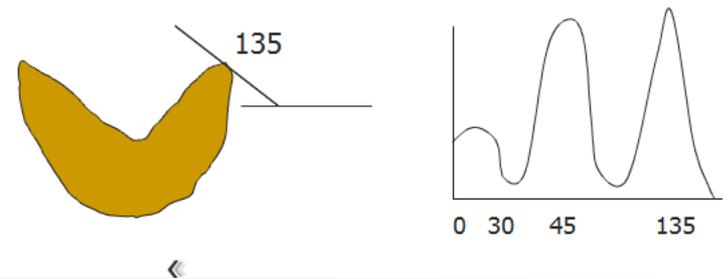
Tessitura



Forma



Tangent-Angle Histograms





Colori simili tessiture diverse



Colori tessiture simili forme diverse

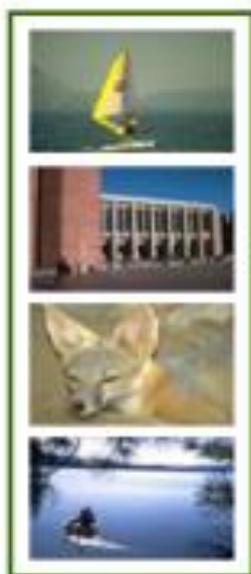
Query Image

Retrieved Images

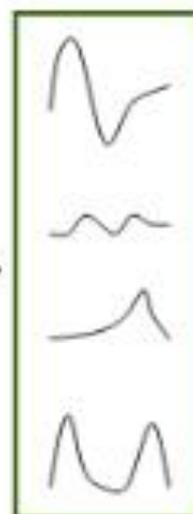
User



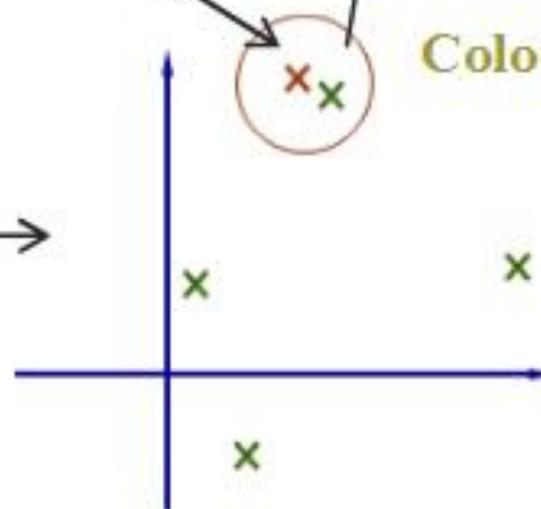
Image Database



Images



Histogram



Colour Measure

Comparison



[27871](#) 0.00 6



[27887](#) 17.23 8



[44925](#) 19.41 7



[27832](#) 19.98 6



[27894](#) 20.30 8



[27842](#) 20.87 6



[27818](#) 21.29 7



[44651](#) 21.40 5



[44929](#) 22.07 8



[52298](#) 22.12 8



[27862](#) 22.40 4



[27829](#) 22.66 8



[27826](#) 22.99 6



[19468](#) 23.35 16



[27809](#) 23.47 6



[25220](#) 23.61 7



[27834](#) 23.62 4



[3904](#) 23.76 7



[26353](#) 23.88 7



[16585](#) 23.90 10



[27874](#) 24.31 5



[34192](#) 24.36 6



[9797](#) 24.46 9



[27803](#) 24.50 4



[25253](#) 24.57 7



[43872](#) 24.69 5



[27869](#) 25.02 5



[15665](#) 25.03 6



[7191](#) 25.04 10



[27849](#) 25.21 4



[44620](#) 25.26 6



[52296](#) 25.28 6



[39435](#) 0.00 10



[25337](#) 16.08 8



[46819](#) 18.12 8



[39430](#) 18.27 7



[2601](#) 18.29 10



[2013](#) 18.61 5



[39410](#) 18.61 8



[14133](#) 18.64 11



[39399](#) 18.66 7



[14141](#) 18.71 12



[39473](#) 18.77 8



[56180](#) 18.91 7



[14165](#) 18.92 9



[41420](#) 18.93 8



[39436](#) 19.00 10



[47315](#) 19.01 10



[18025](#) 19.11 8



[39481](#) 19.12 7



[16263](#) 19.20 13



[26376](#) 19.35 6



[15748](#) 19.40 10



[29869](#) 19.44 9



[39398](#) 19.46 8



[28471](#) 19.50 5



[26851](#) 19.55 7



[39450](#) 19.60 8



[15437](#) 19.64 7



[39493](#) 19.70 6



[53944](#) 19.73 6



[39462](#) 19.76 9



[59781](#) 19.78 11



[7267](#) 19.79 6

On-Site Composition and Aesthetics Feedback through Exemplars for Photographers

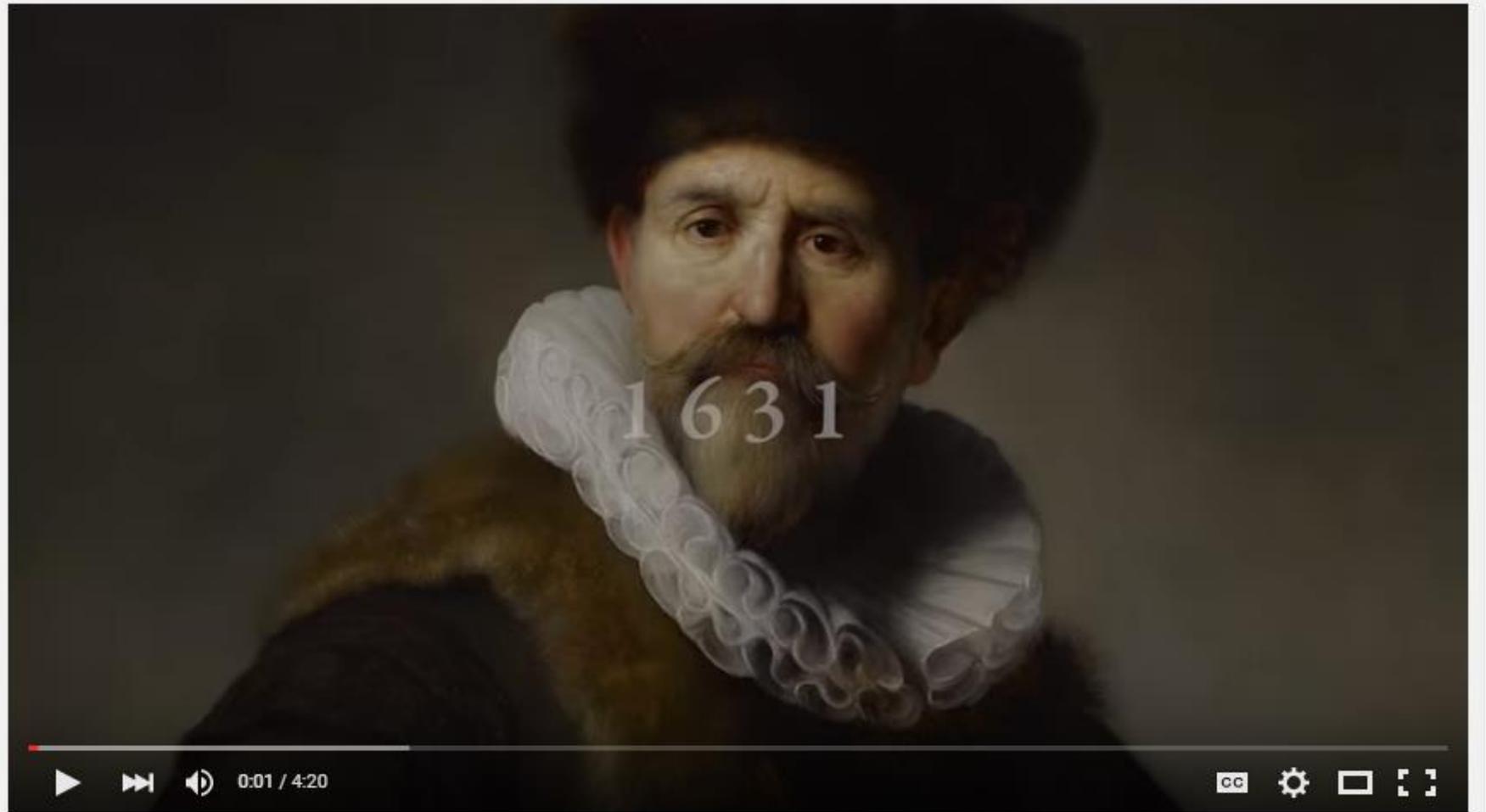
OSCAR



Color Confidence: 55.5%

Rating: **73** / 100

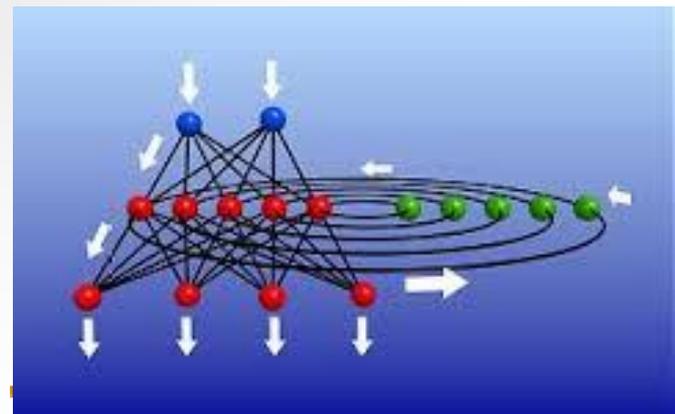
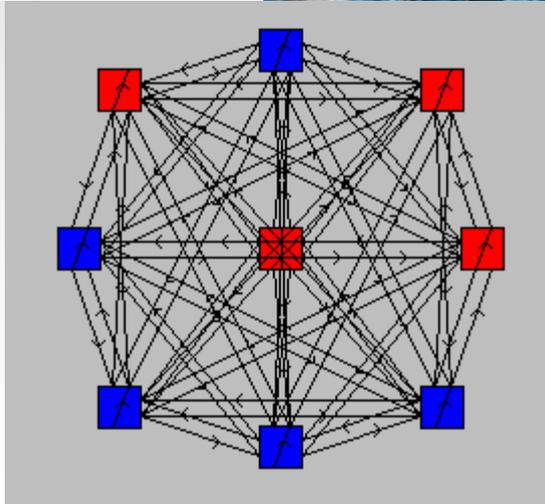
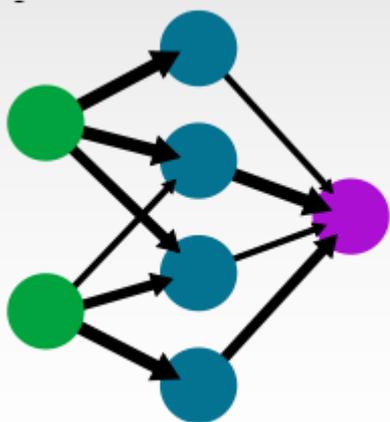
SIMPLcity	S+Composition	S+C+Aesthetics
		
		
		



The Next Rembrandt

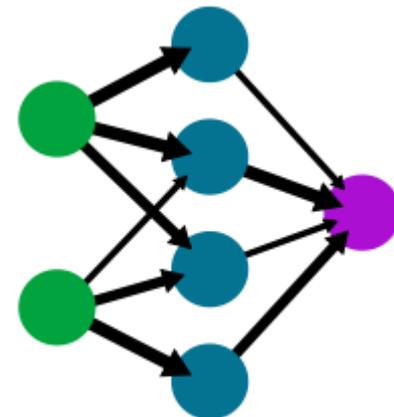
Reti Neurali Artificiali

Algoritmi ispirati a modelli biologici per realizzare sistemi intelligenti

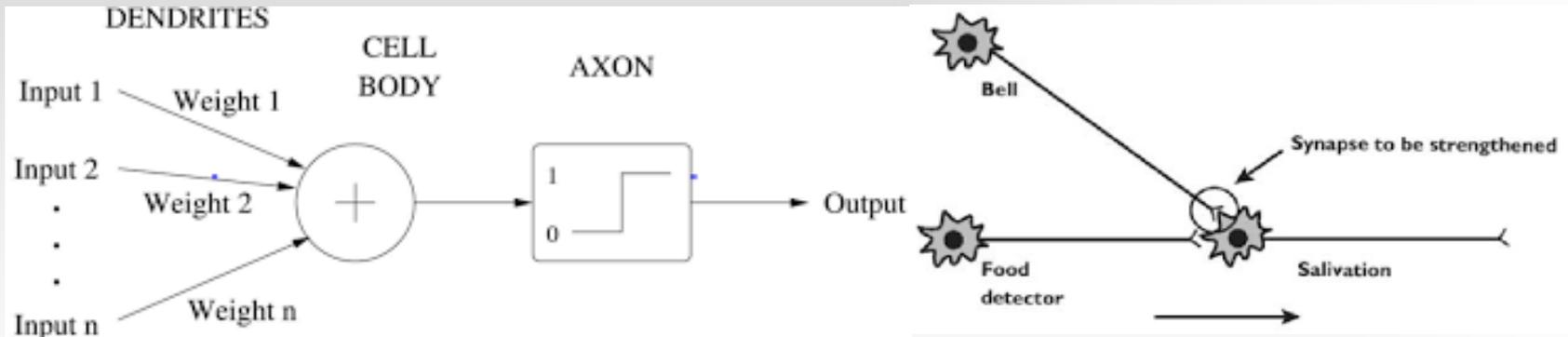


Motivazione agli studi sulle reti neurali

- Interesse sempre crescente per meccanismi in grado di svolgere compiti di riconoscimento complessi caratterizzati da
-
- **Valutazione di una moltitudine di fattori eterogenei interagenti**
- **Imprecisione, incertezza nei dati**
- Si rinforza la convinzione che il cervello umano debba le sue capacità alle caratteristiche della sua struttura interna.

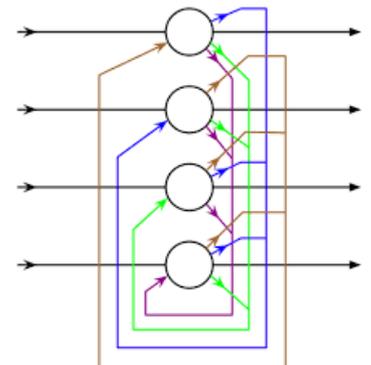
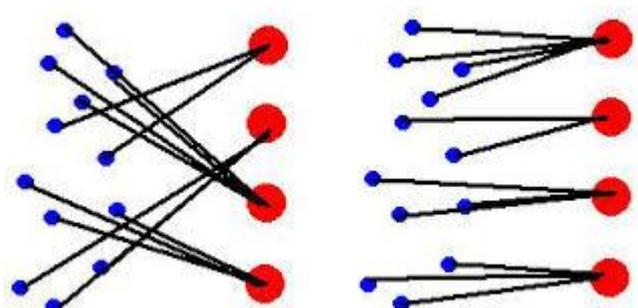
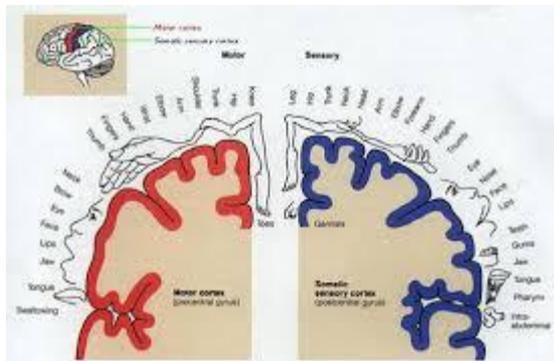


- **1943**: studi di McCulloch (neurofisiologo) e Pitts (matematico): nasce il primo modello di neurone formale
- 1949: Hebb: formalizza per i neuroni artificiali le capacità di apprendimento introduce i concetti di learning by reinforcement or association



- **1962**: Rosenblatt: learning machines basate su un nuovo modello di neurone capace di apprendere mediante esempi

- **1969-1984**: critica sempre più radicale dell'approccio neurale
- **1980-**, nuovi sforzi di ricerca
 - 1982 Hopfield, propone modelli di rete associative
 - 1982 Kohonen, reti auto-organizzanti (mappe recettive)
- **1986**, Rumelhart, Hinton and Williams formalizzano un modello di rete multistrato superando i limiti dei modelli di apprendimento precedenti
- **1990-....** grandissima evoluzione della ricerca di base ed applicata

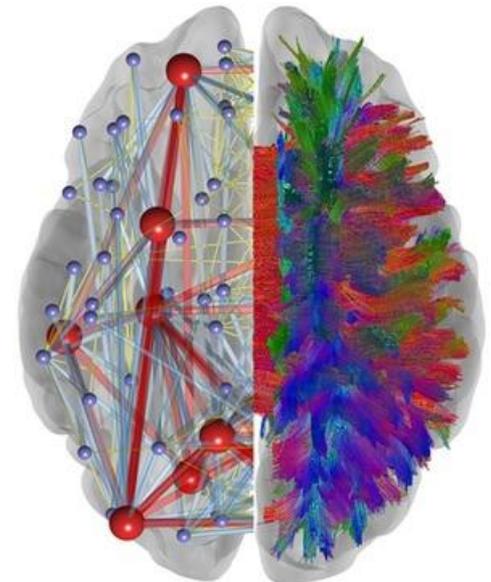


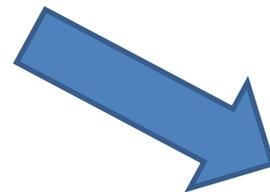
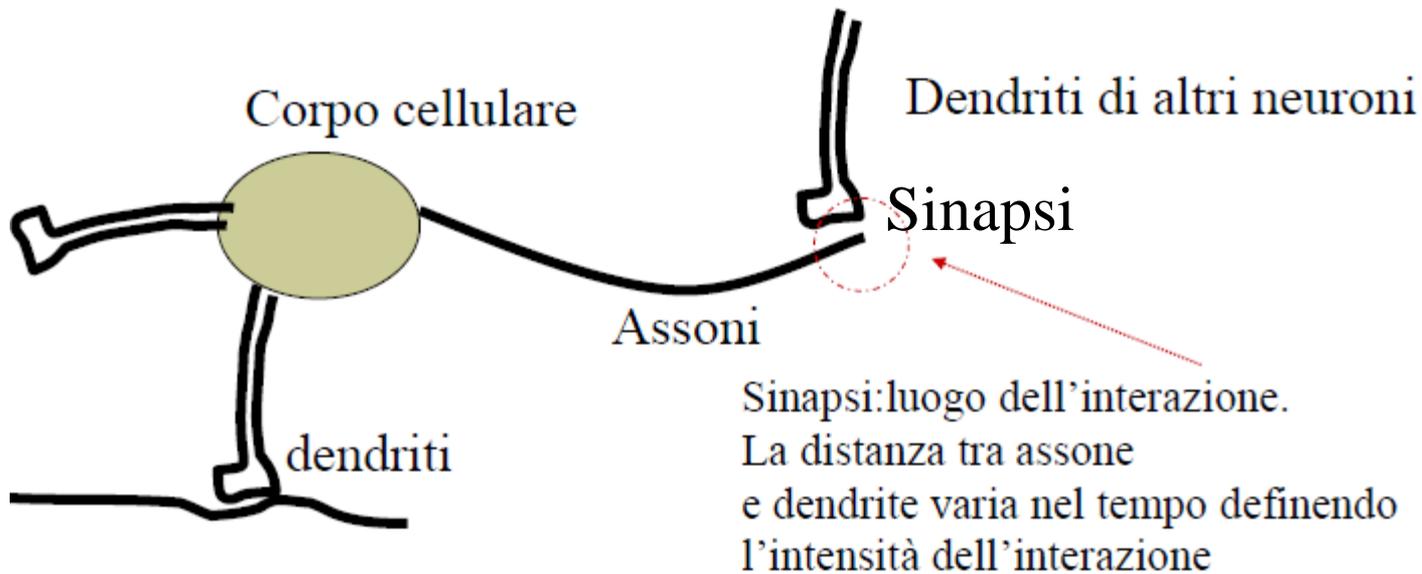
Nasce un nuovo approccio al calcolo basato sul concetto di *Connessionismo*

	Brain	Computer
Processore	lento, numerose unità	veloce, limitate unità
Memoria	intra-processore, indirizzabile dal contenuto	extra-processore, non indirizzabile dal contenuto
Elaborazione	Distribuita e parallela	Centralizzata e sequenziale
Tolleranza errori	Si	No

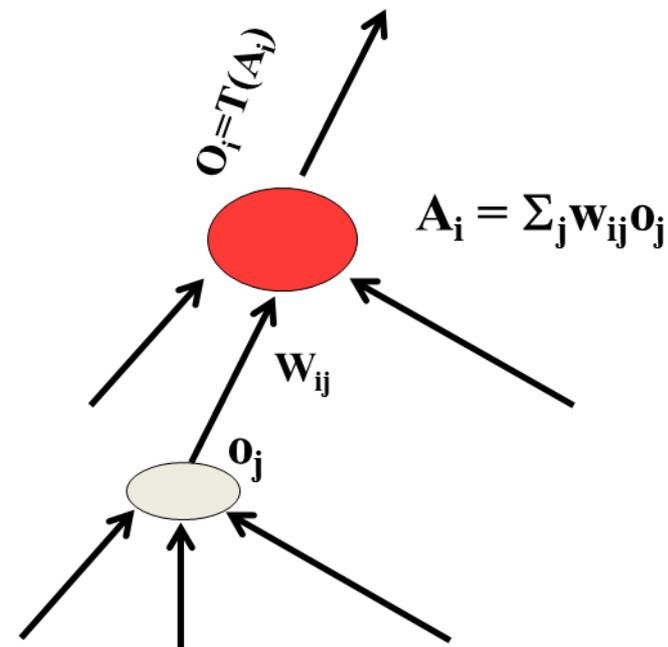
Non si vuole riprodurre il cervello ma ispirarsi alla sua struttura e funzionamento!

- Le **cellule nervose** sono circa 100 miliardi (10^{11})
- Le loro **interconnessioni** sono circa 1 milione di miliardi (10^{15})

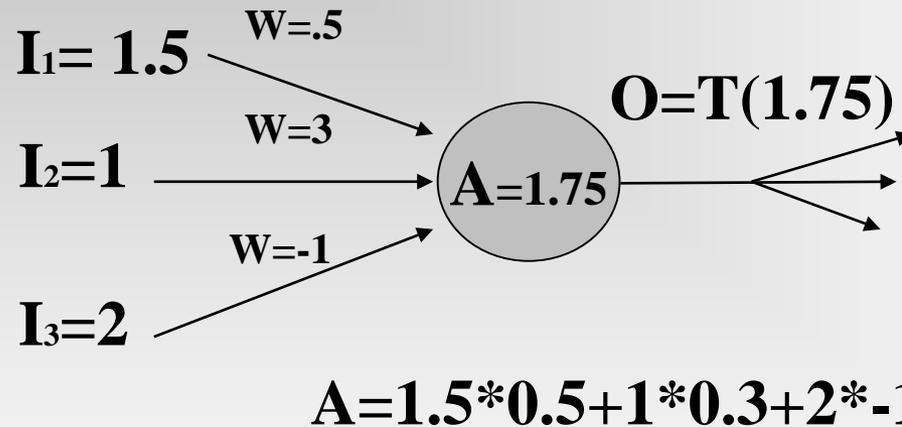




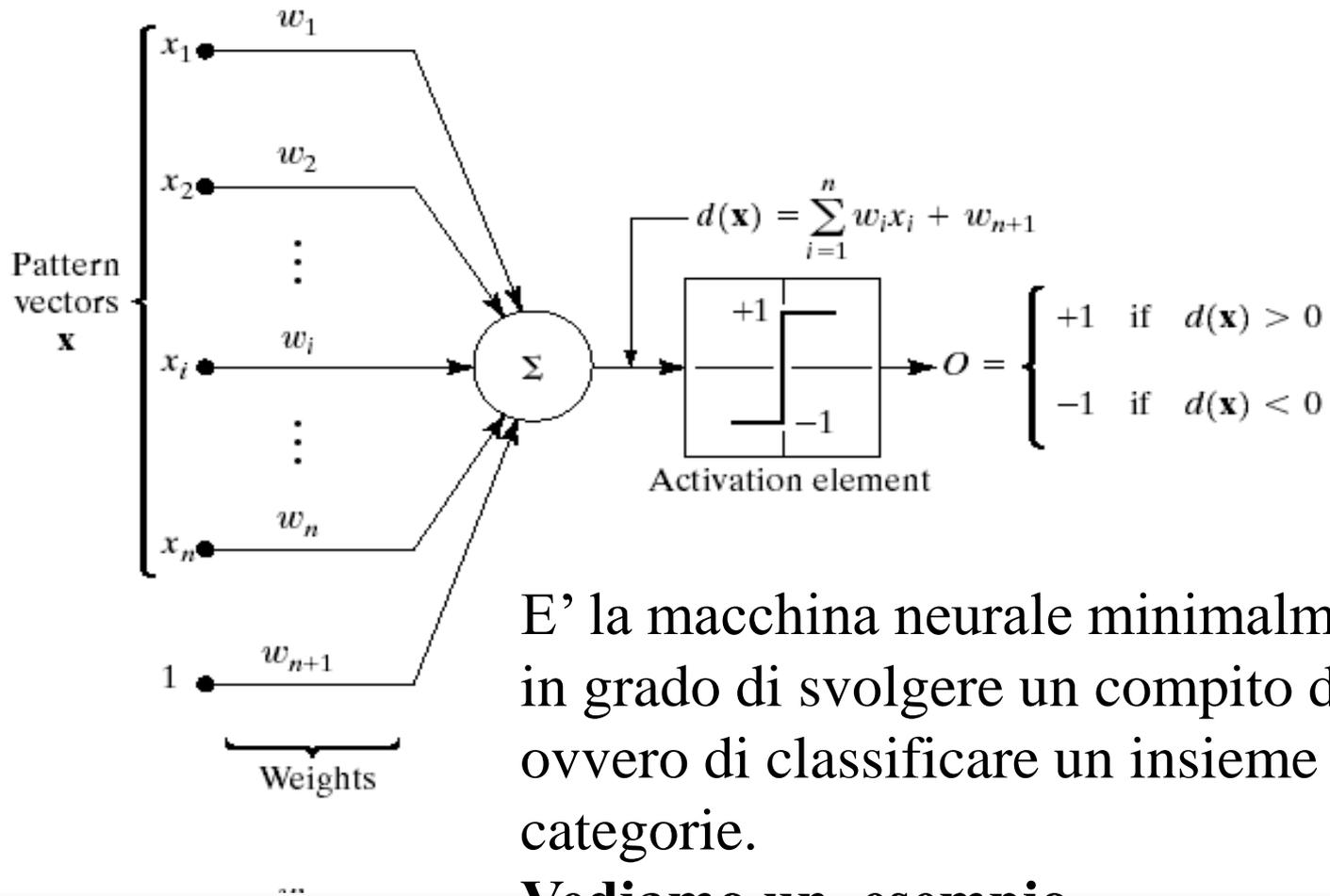
- Neurone
- Dendriti, assoni → Input/Output
- Polarizzazione → Attivazione
- Scarica → Funzione di Trasferimento
- Sinapsi → Peso delle Connessioni



Calcoliamo con un esempio la funzione svolta da un neurone

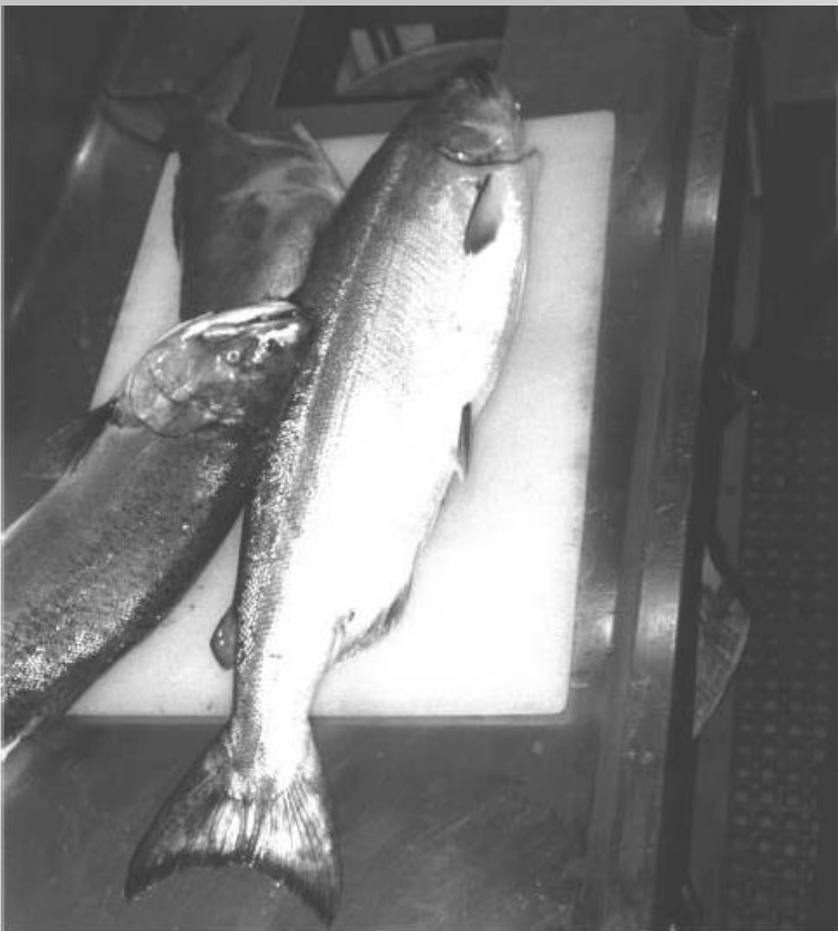


Il perceptrone



E' la macchina neurale minimalmente complessa in grado di svolgere un compito di riconoscimento, ovvero di classificare un insieme di dati in due categorie.

Vediamo un esempio.....



L'esempio può riferirsi ad un software real time connesso ad una videocamera in una catena di convogliamento di un'industria ittica col quale riconoscere due classi di prodotti:

- 1)Salmone**
- 2)Pesce Azzurro**

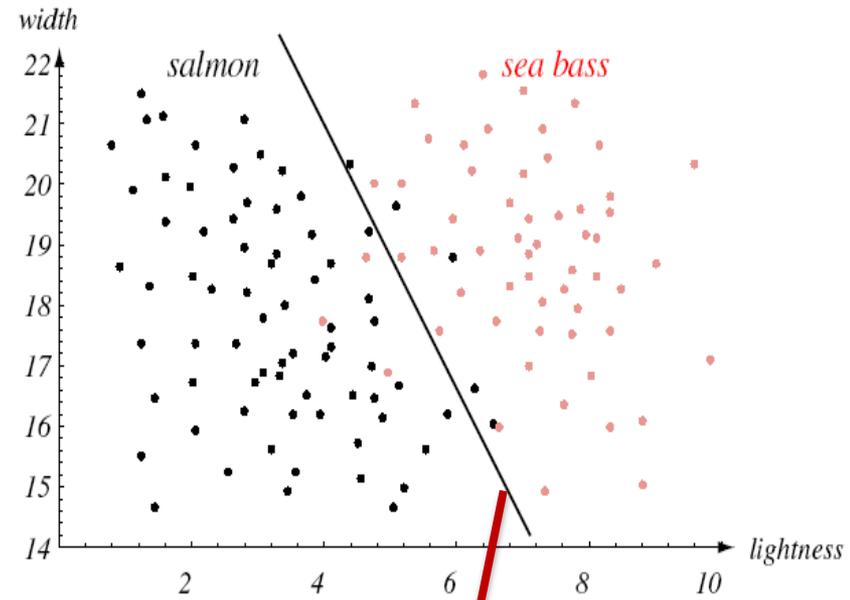
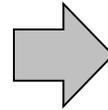
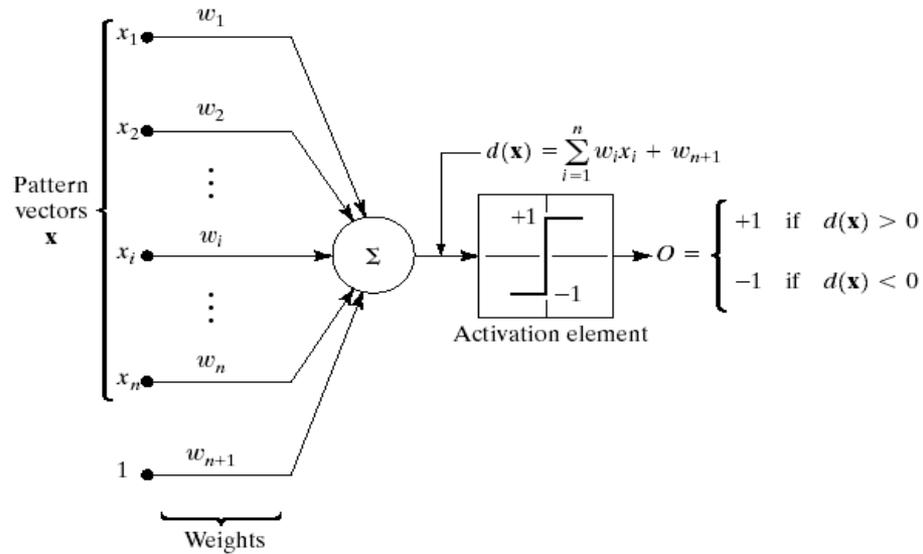


Supponiamo di avere un insieme di immagini campione

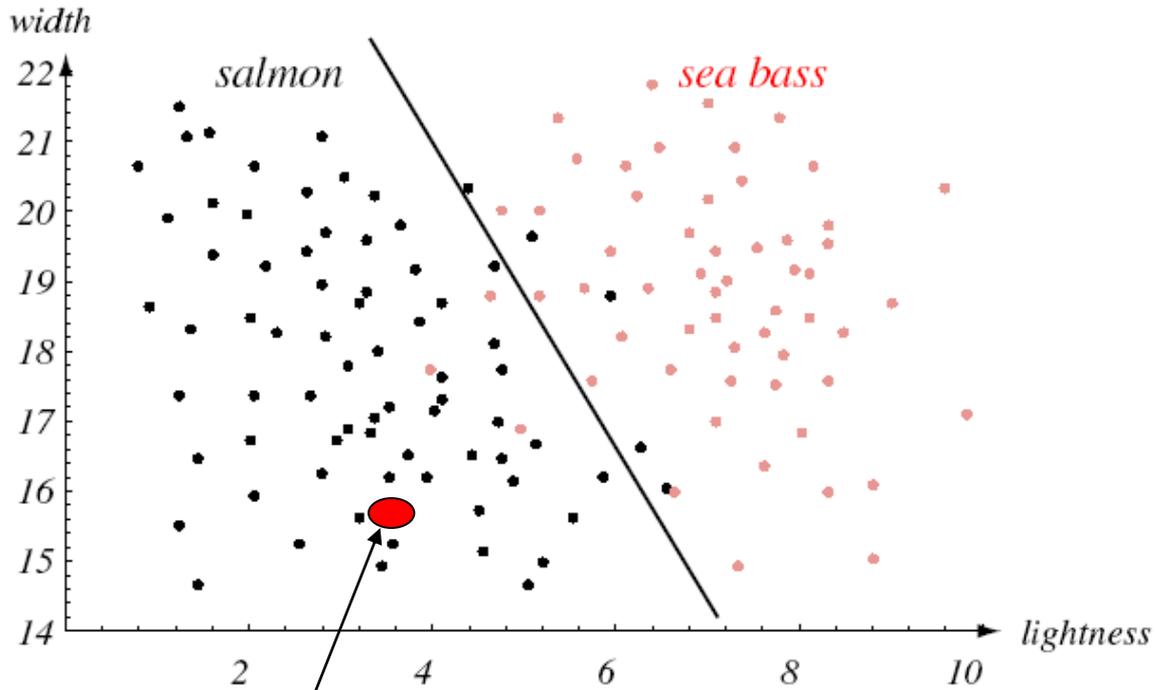
Le proprietà che permettono di discriminare le due tipologie sono:

Lunghezza
Luminosità

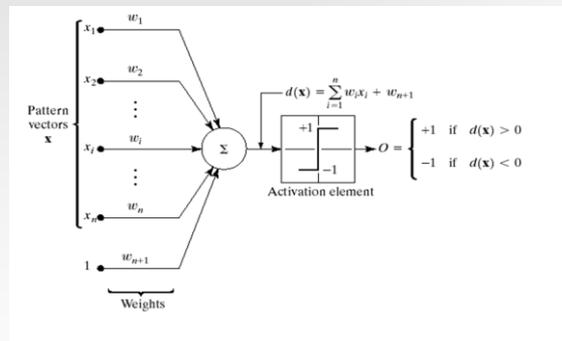
Perceptrone



$$d(x_1, x_2) = w_1 x_1 + w_2 x_2 + w_3 = 0$$



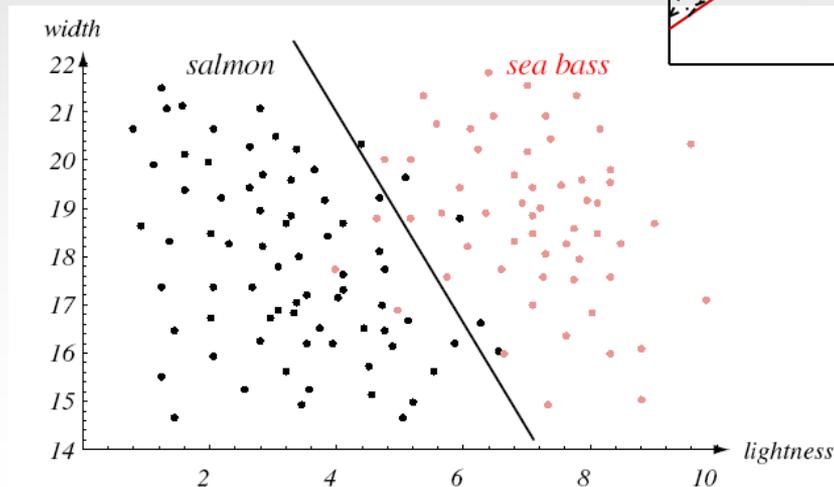
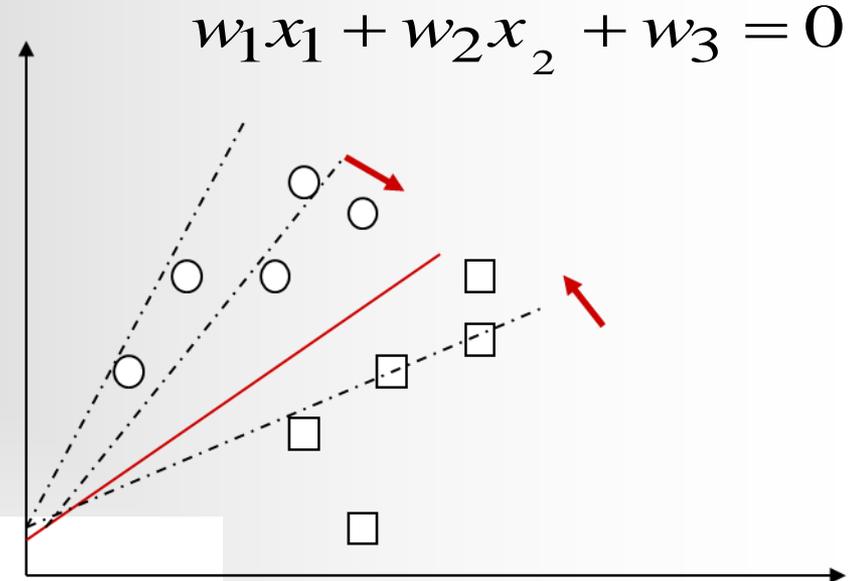
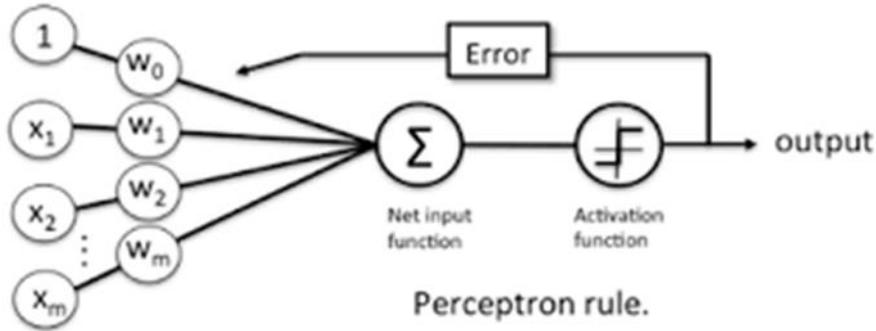
?



Salmone

Output del percettrone **-1**

I pesi w_1 w_2 w_3 che definiranno una retta di separazione nel piano delle misure vengono appresi durante una fase di apprendimento



Demo Percettrone

<http://neuron.eng.wayne.edu/java/Perceptron/New38.html>

<http://lcn.epfl.ch/tutorial/english/perceptron/html/>

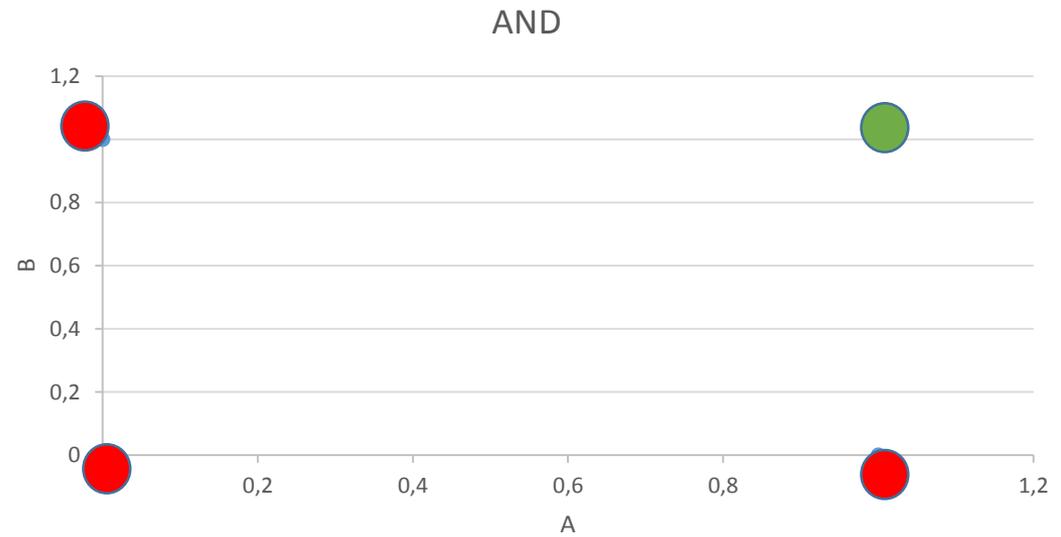
The screenshot shows a Java-based Perceptron simulation interface. At the top, there are several controls: a "Train" button, a dropdown menu set to "FULL", a "Clear" button, a "Step" button, and a radio button labeled "X". To the right of these controls is a "Weights" button. Below the controls is a large empty rectangular area, likely for displaying training data or results. To the right of this area is a diagram of a single neuron. The diagram shows three input lines on the left, labeled "X1", "X2", and "1". Each input line is connected to a central circular neuron. The connections are labeled with weights: "W1" for X1, "W2" for X2, and "W3" for the bias input "1". An output line on the right is labeled "Y". Below the neuron diagram is a "Graphics Speed" slider, currently set to "1".

Perceptrone (2) – AND

A	B	AND
0	0	0
0	1	0
1	0	0
1	1	1

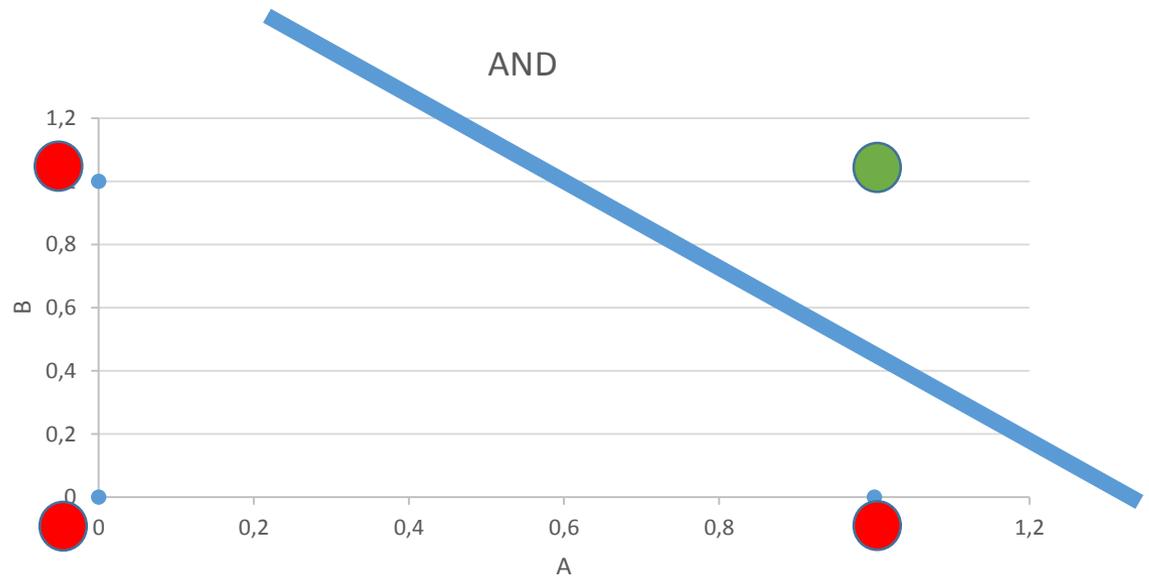
Perceptrone (2) – AND

A	B	AND
0	0	0
0	1	0
1	0	0
1	1	1



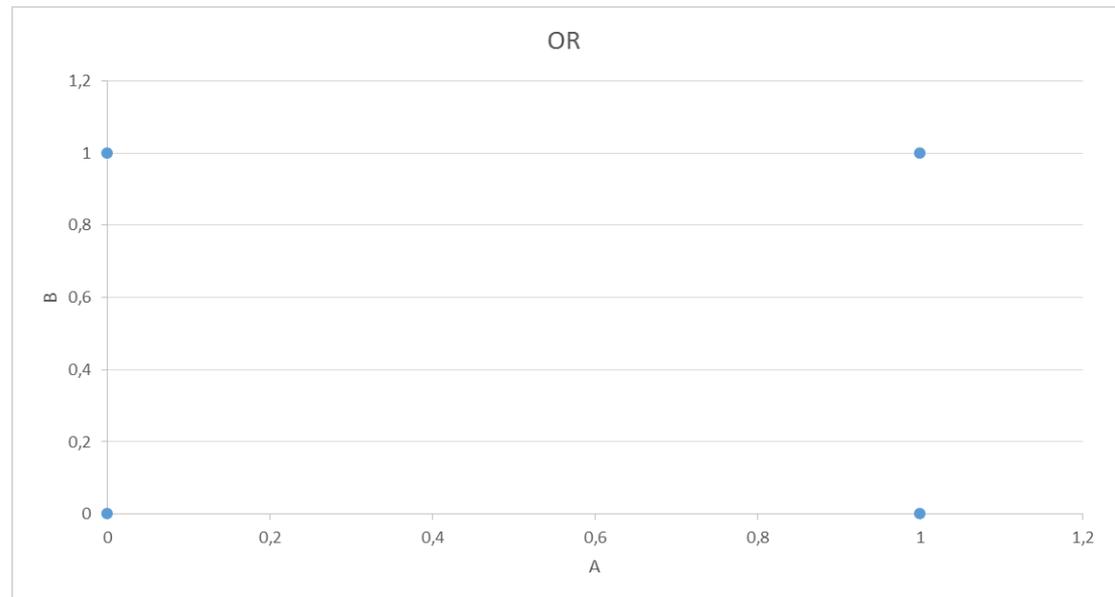
Perceptrone (2) – AND

A	B	AND
0	0	0
0	1	0
1	0	0
1	1	1



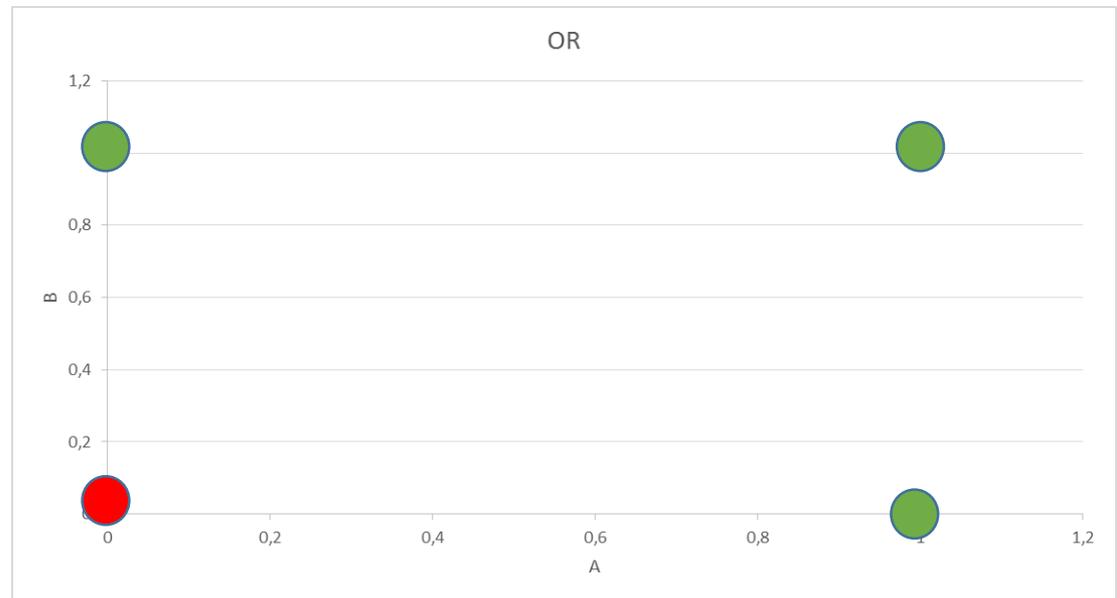
Percettore (2) - OR

A	B	OR
0	0	0
0	1	1
1	0	1
1	1	1



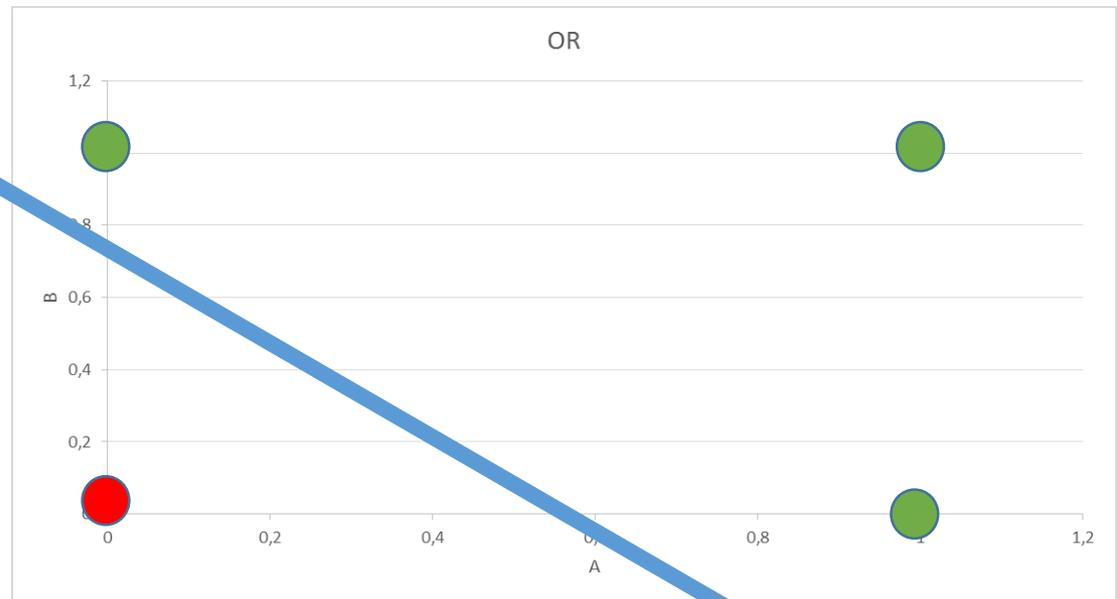
Percettrone (2) - OR

A	B	OR
0	0	0
0	1	1
1	0	1
1	1	1



Percettrone (2) - OR

A	B	OR
0	0	0
0	1	1
1	0	1
1	1	1



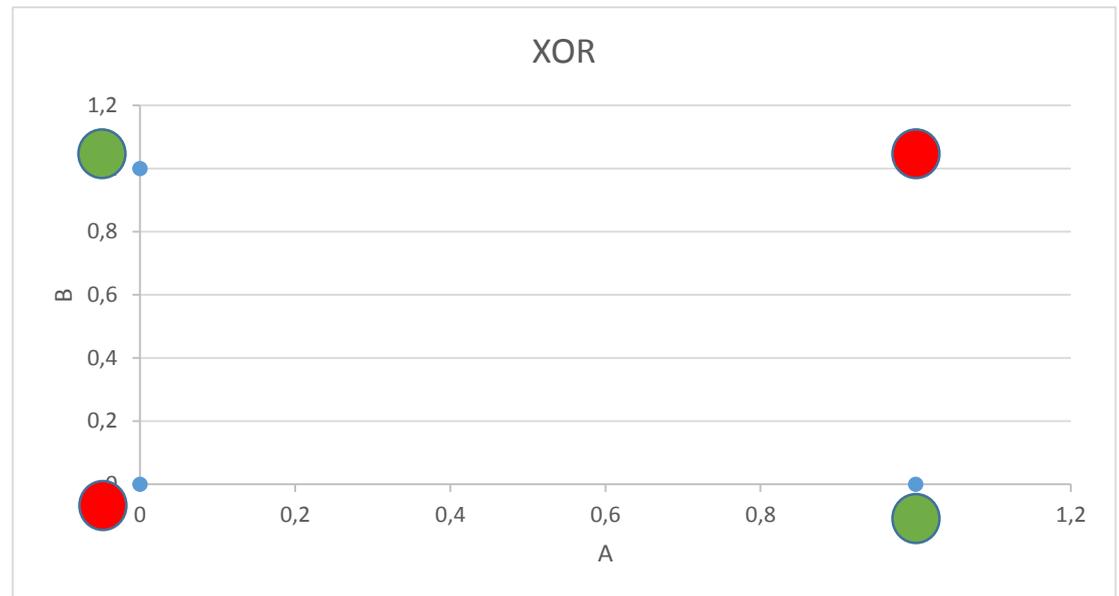
Perceptrone (2) - XOR

A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0



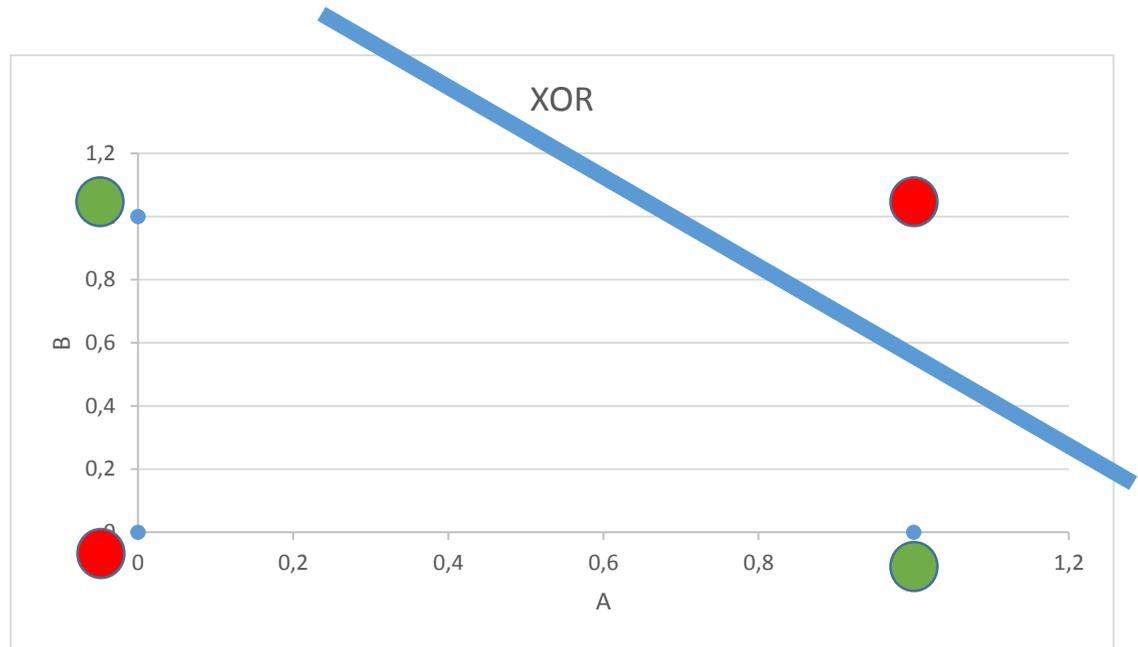
Perceptrone (2) - XOR

A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0



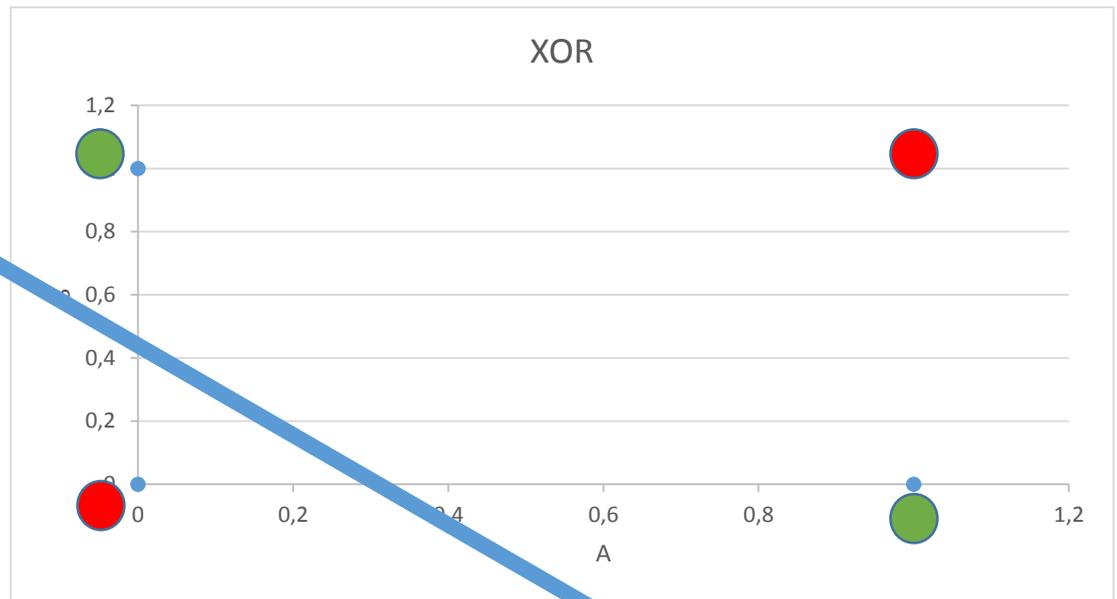
Perceptrone (2) - XOR

A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0



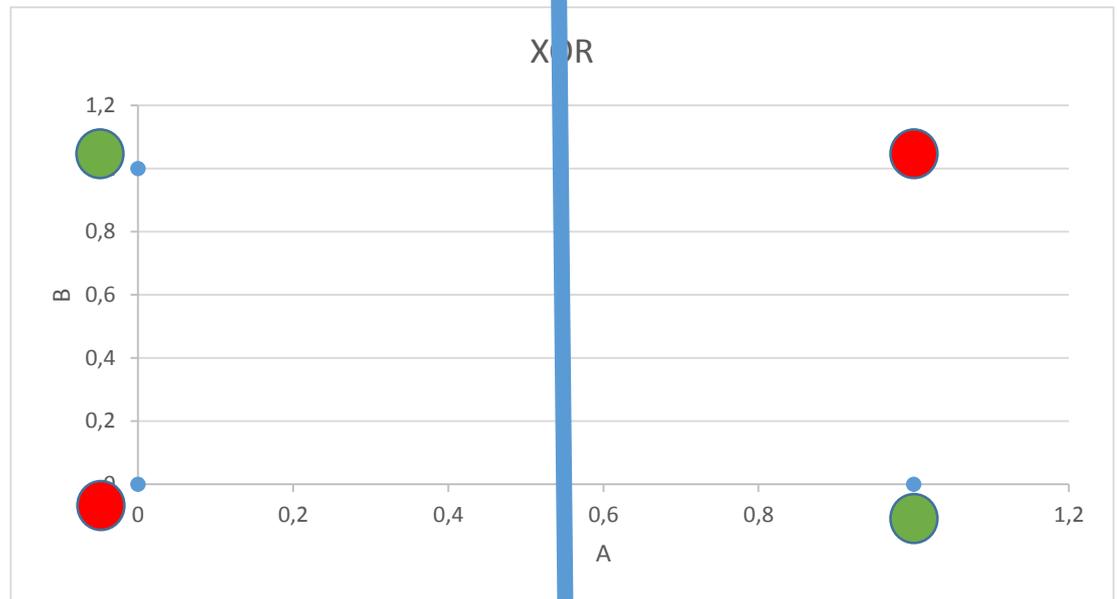
Perceptrone (2) - XOR

A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0



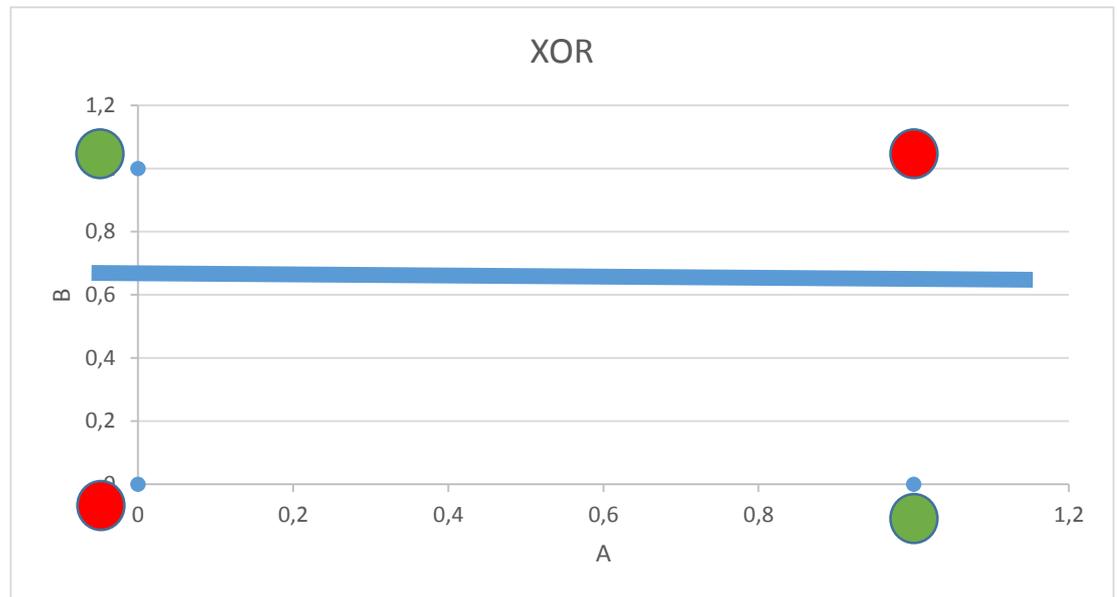
Perceptrone (2) - XOR

A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0



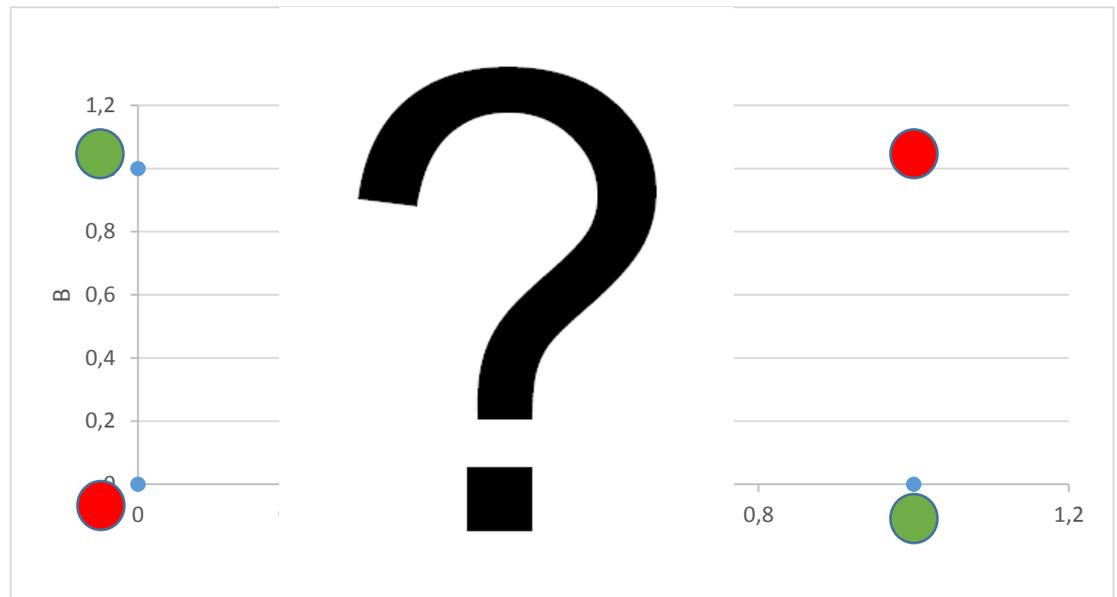
Perceptrone (2) - XOR

A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0



Percettrone (2) - XOR

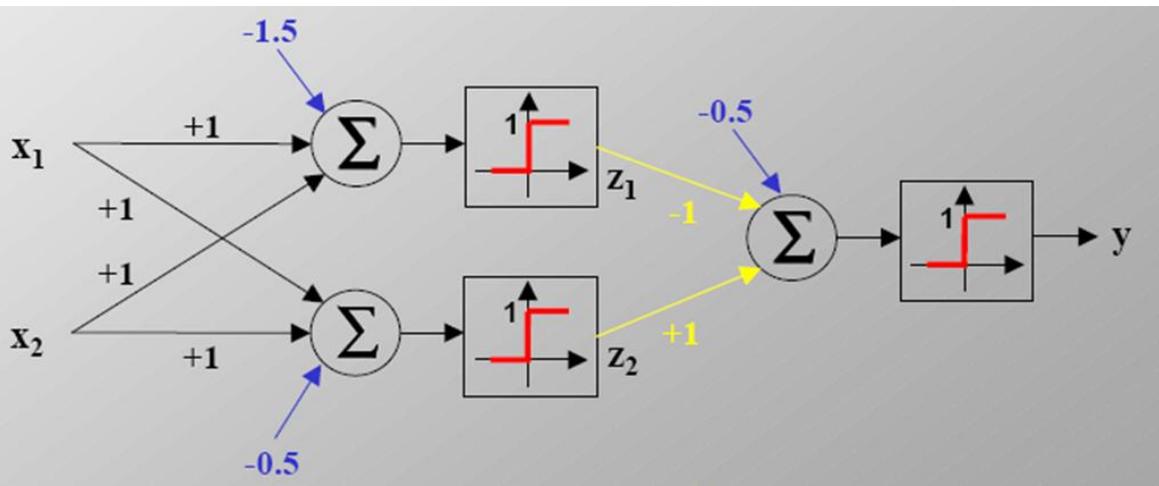
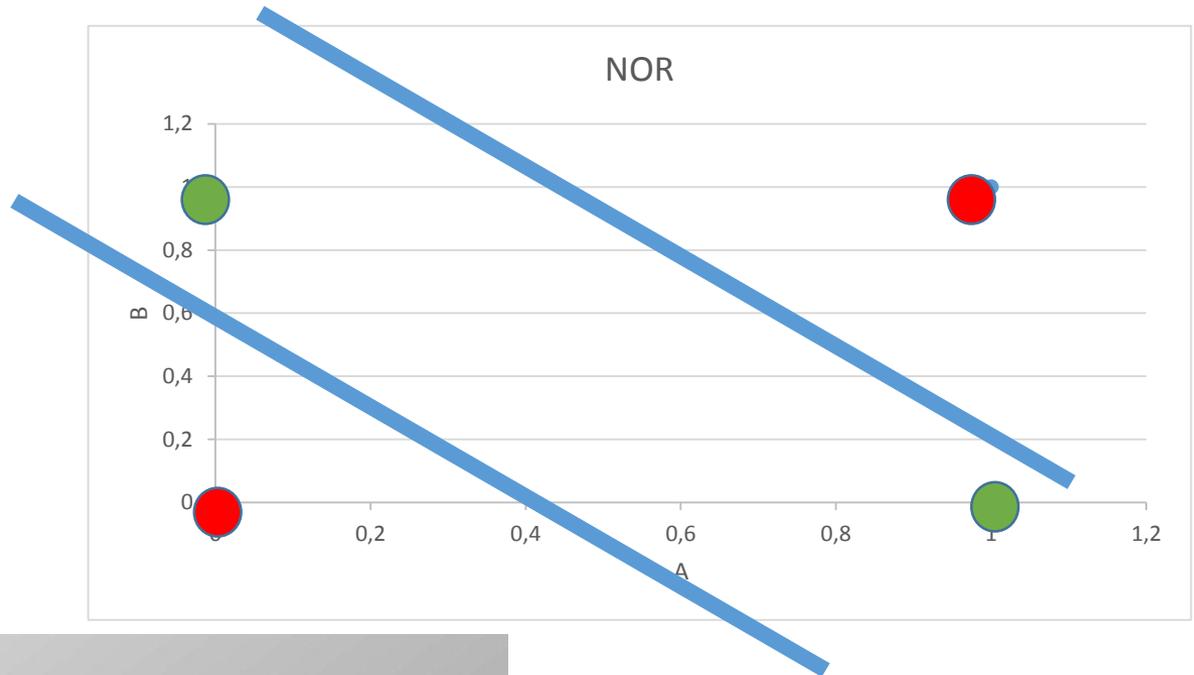
A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0

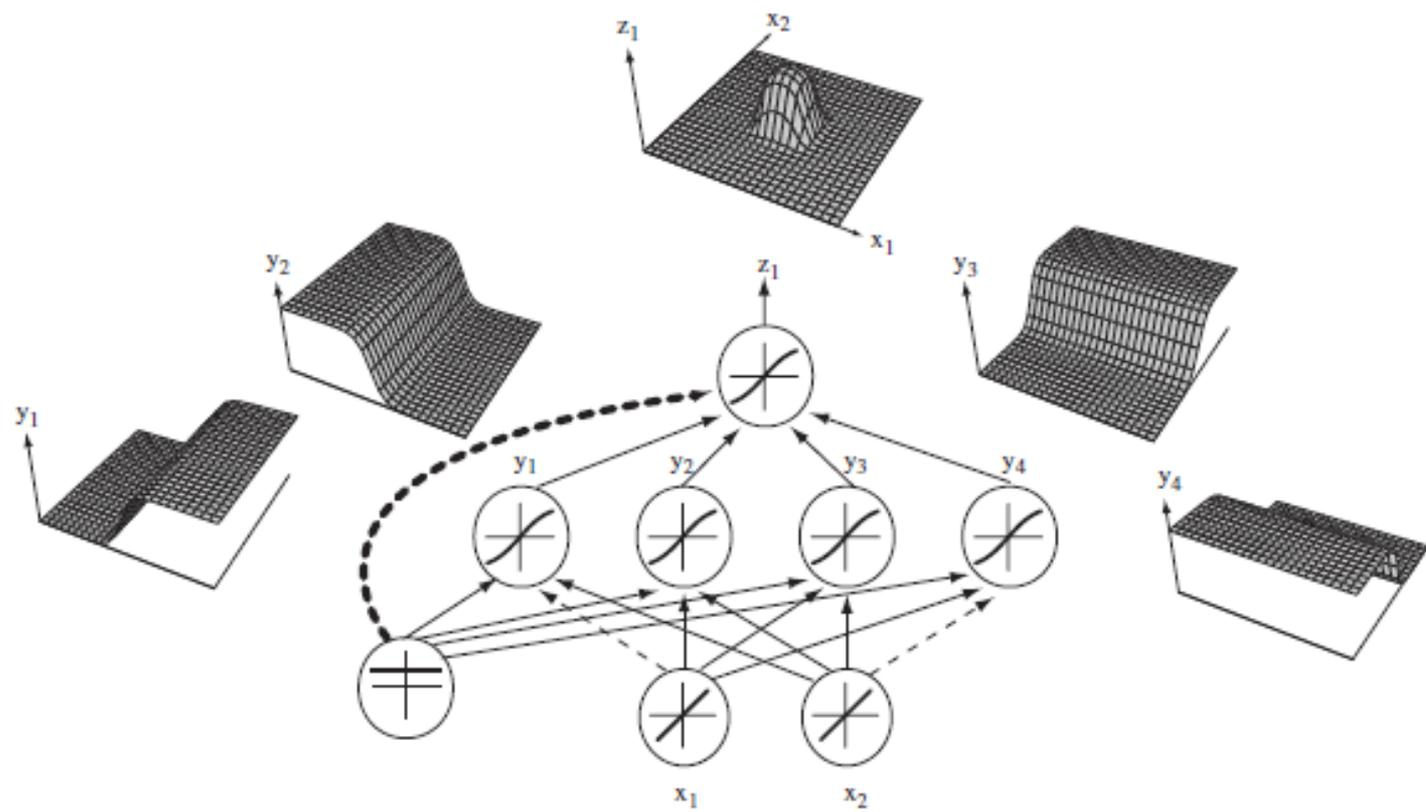


Come separare completamente il risultato di un operazione XOR?

Percettrone (2) - XOR

A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0





<http://www.sund.de/netze/applets/bpn/bpn2/ochre.html>

pn2/ochre.html Accedi a Hotmail, Messenger, ... Java Program OCHRE- Optical Character ...

The OCHRE applet

Optical CHaracter REcognition. Documentation is included below.

OCHRE
A Backpropagation Neural Network Demo Applet

test0 test1 test2 test3 test4 test5 test6 test7 test8 test9



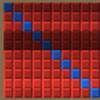
clear blur sharpen test

Start training training epochs:

Stop training sum squared error:

Reset network input neurons:

Reset inputs hidden neurons:



network output

by Jason Tiscione



Come progettare Reti neurali variamente complesse?

**La rispostaal Corso Sistemi Intelligenti della Laurea
Magistrale in Informatica.**

Grazie per l'Attenzione e Arrivederci!!

