

SISTEMI INTELLIGENTI

INTRODUZIONE

Riferimenti

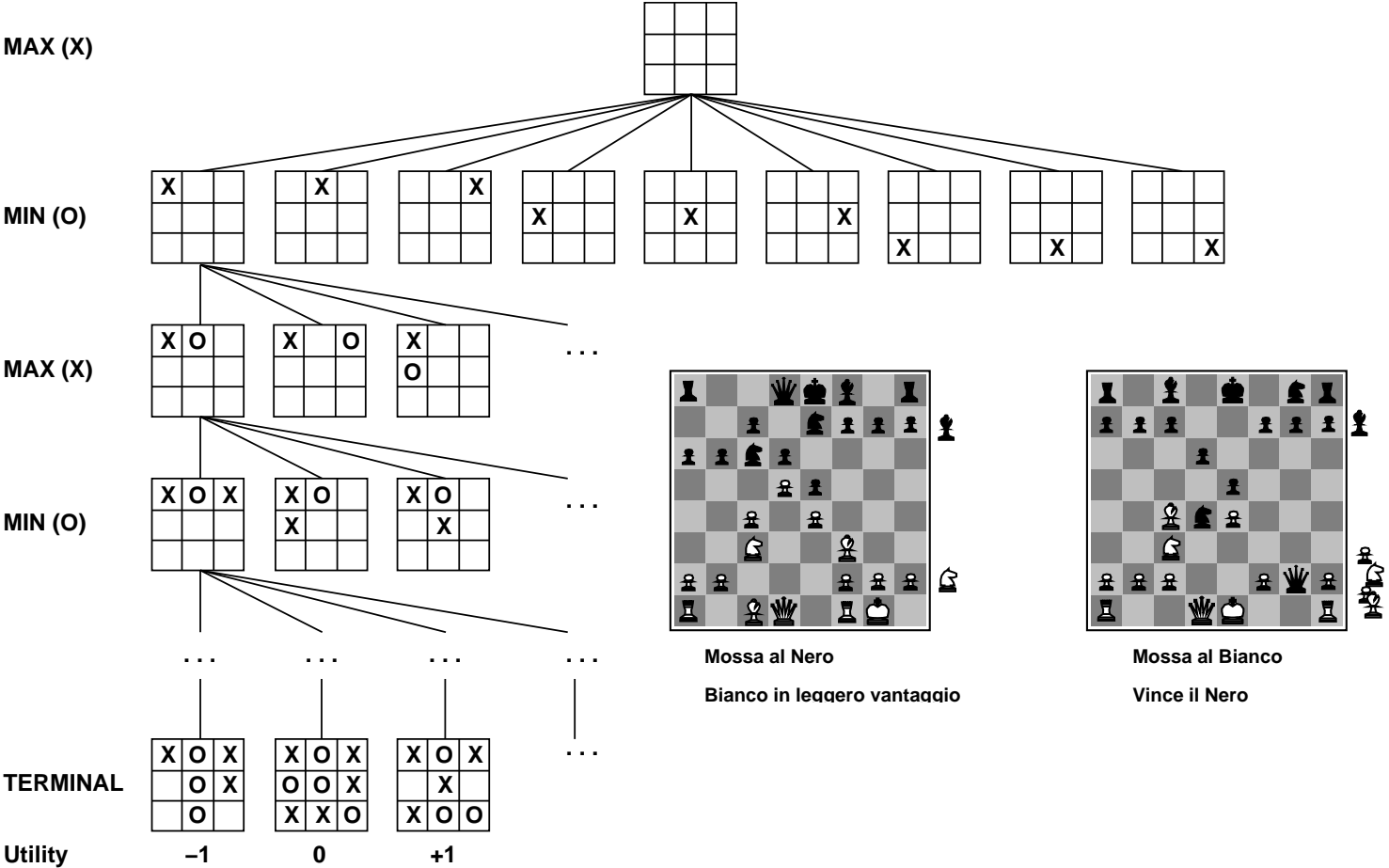
- ◇ S. Russell, P. Norvig, “Artificial Intelligence: a Modern Approach”, Prentice Hall, 2002 (II edizione)
- ◇ T. Mitchell, “Machine Learning”, McGraw Hill, 1998
- ◇ J. Shawe-Taylor, N. Cristianini, “Kernel Methods for Pattern Recognition”, Cambridge University Press, 2004.
- ◇ Lucidi (<http://www.math.unipd.it/~sperduti/si06.html>)

Contenuti del corso

- ◇ Ricerca con avversari: elementi della teoria dei giochi
- ◇ Richiamo dei concetti fondamentali dell'apprendimento automatico
- ◇ Apprendimento on-line: alcuni semplici algoritmi e loro analisi teorica
- ◇ Apprendimento di alberi di decisione
- ◇ Reti Neurali
- ◇ Apprendimento probabilistico
- ◇ Apprendimento in contesti strutturati: kernel per stringhe, alberi e grafi
- ◇ Elementi di pianificazione
- ◇ Apprendimento con rinforzo

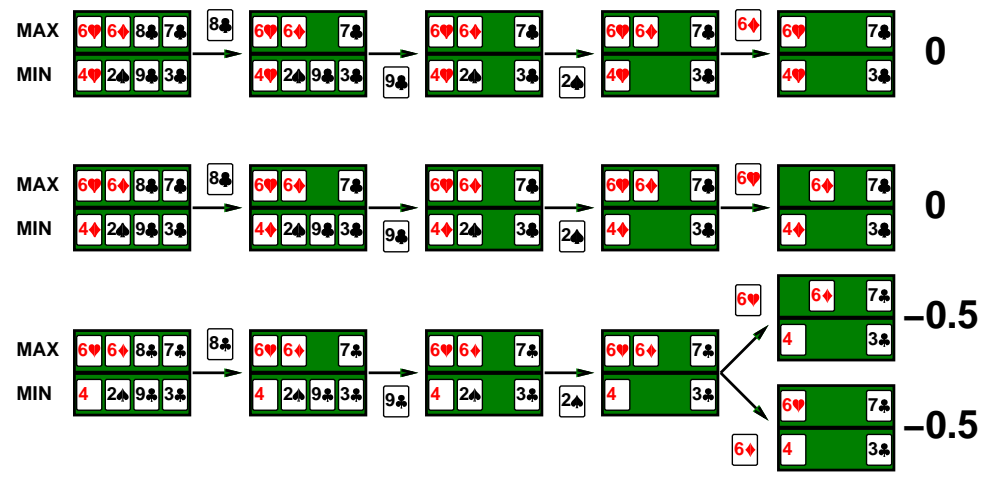
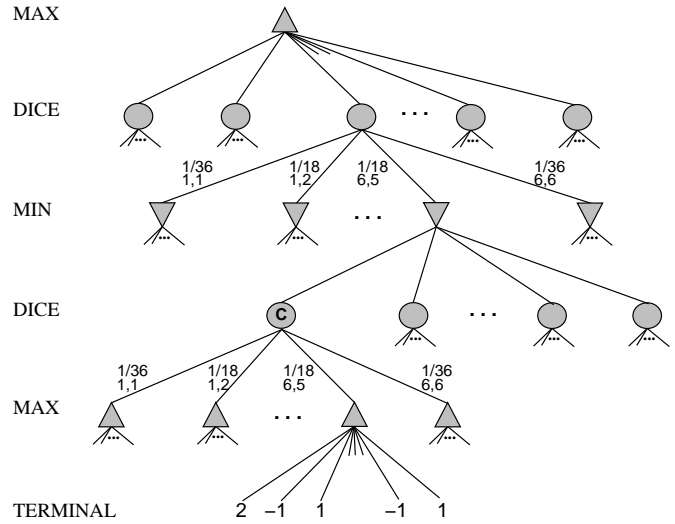
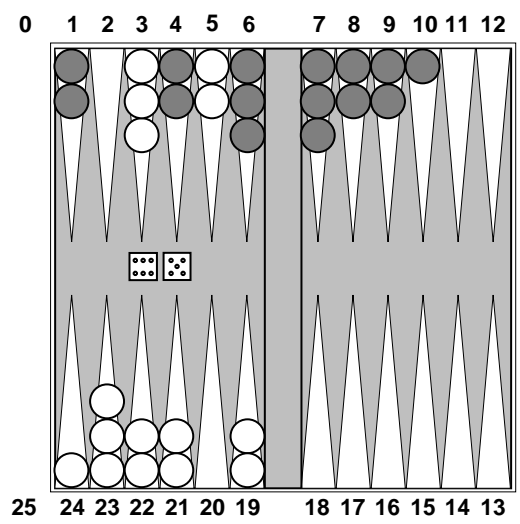
Ricerca con avversari: teoria dei giochi

Giochi deterministici



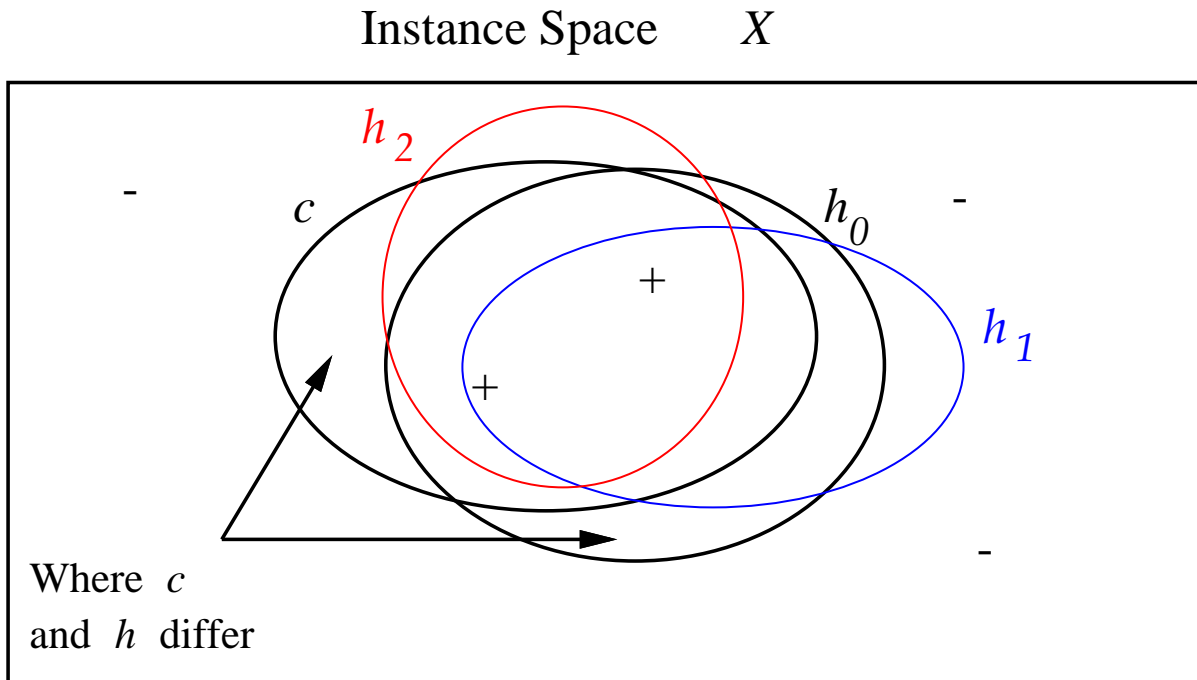
Ricerca con avversari: teoria dei giochi

Giochi nondeterministici (chance)



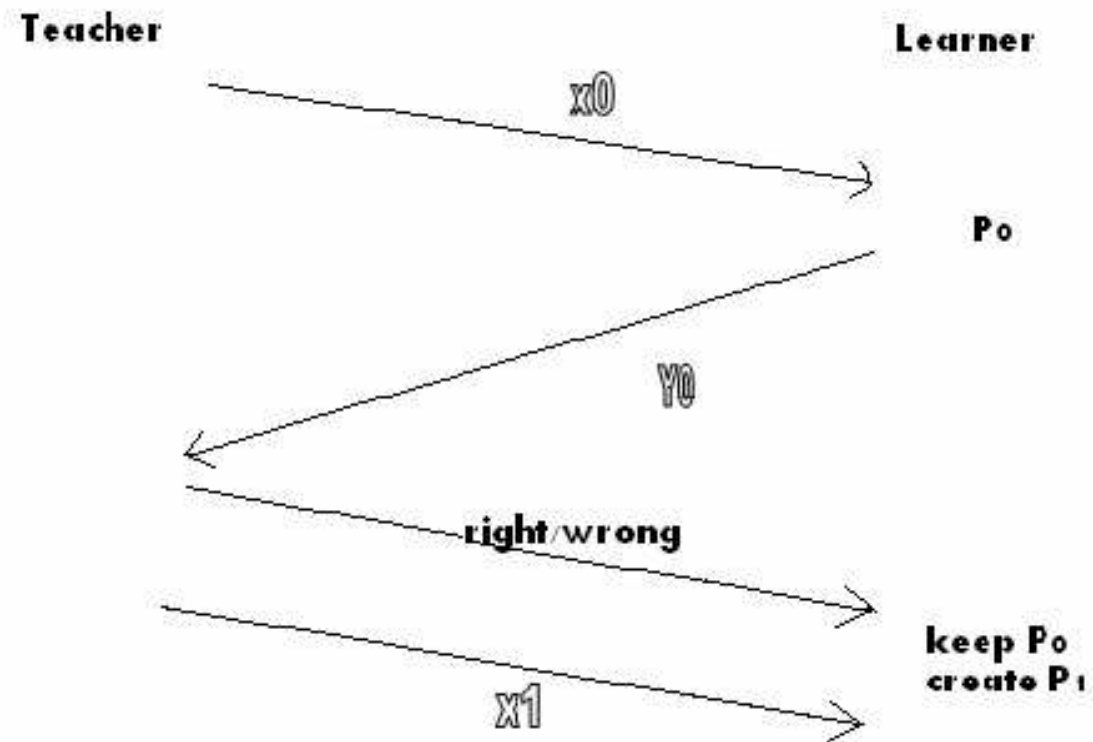
Richiamo concetti apprendimento automatico

Errore

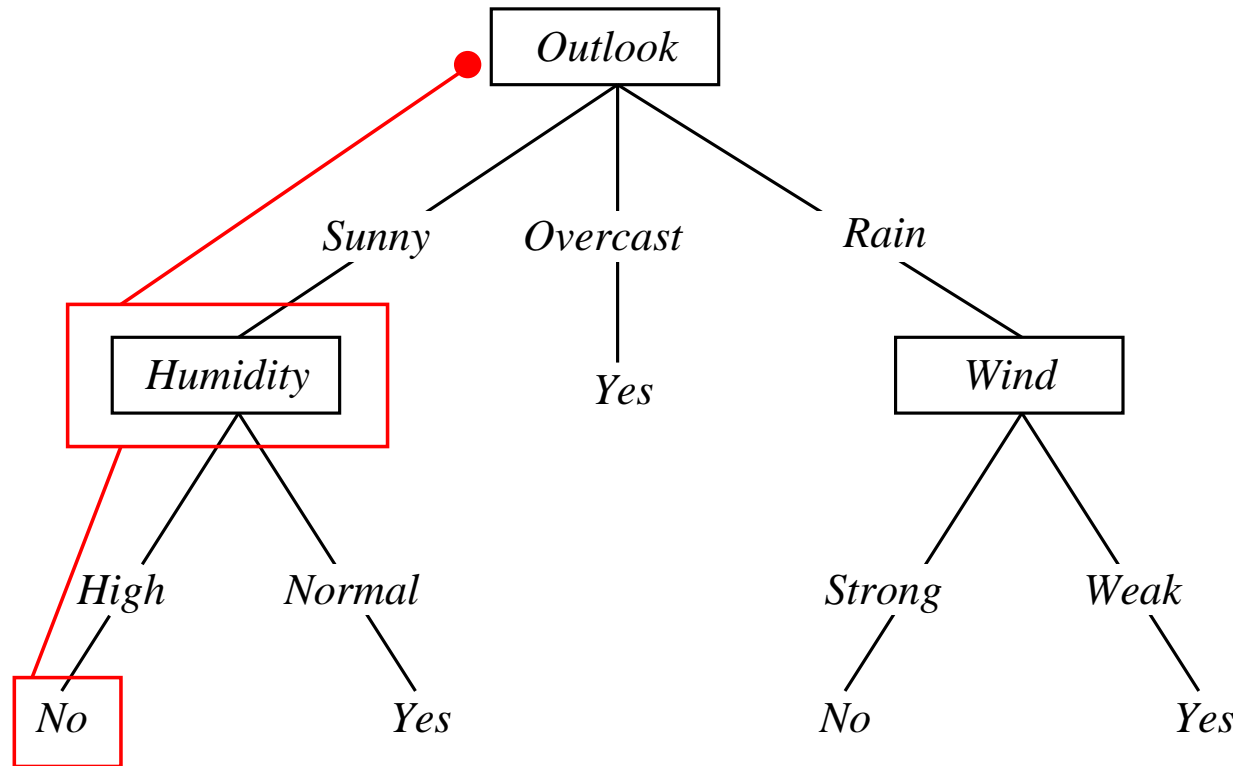


Apprendimento on-line

Schema generale

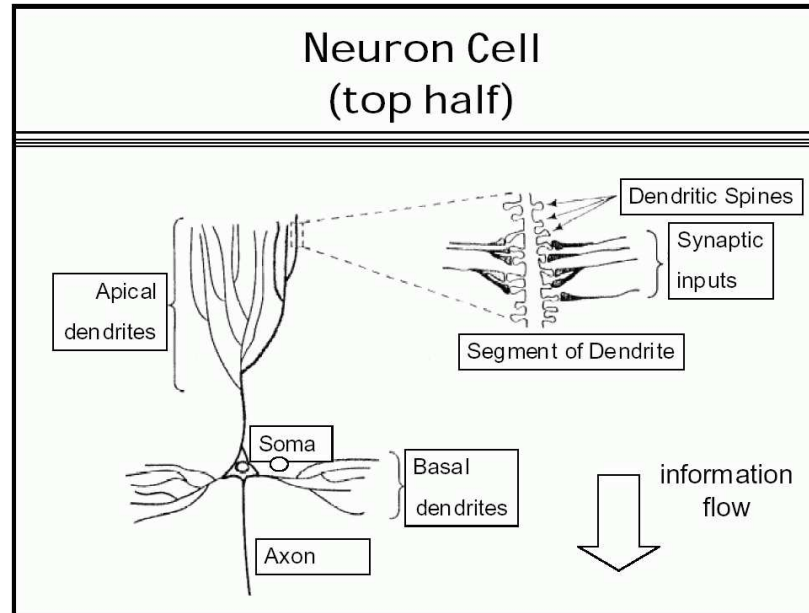


Apprendimento alberi di decisione

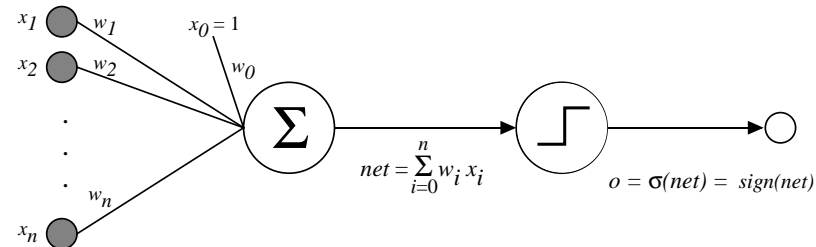


Reti Neurali

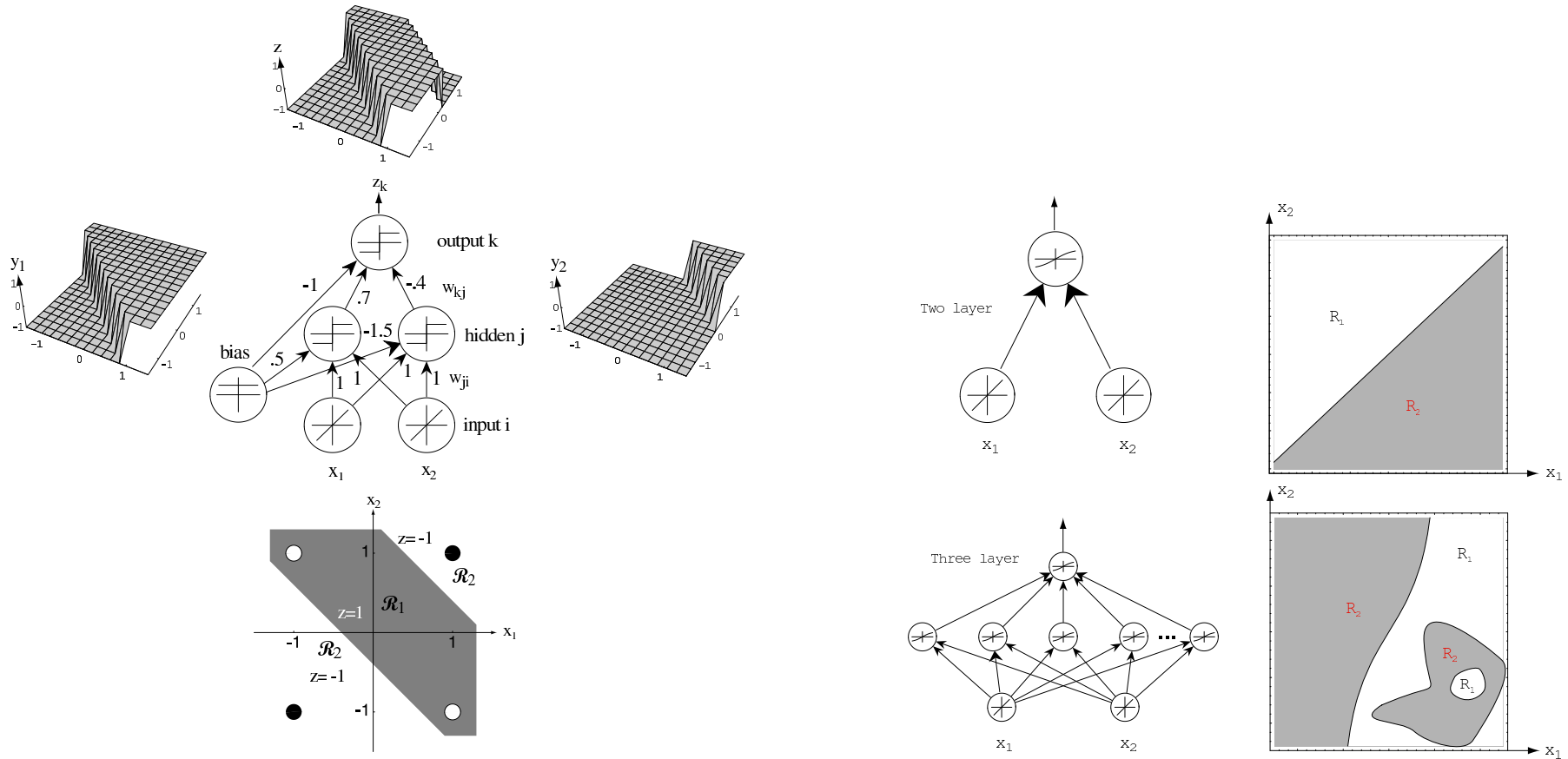
Neurone biologico



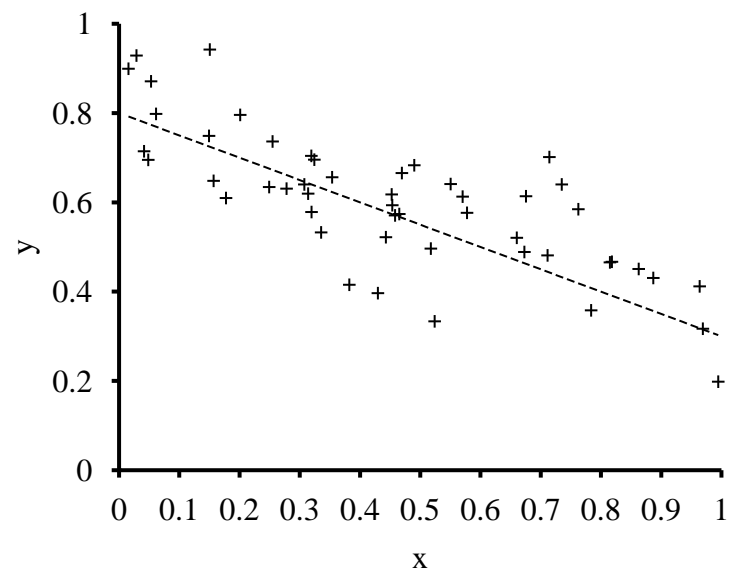
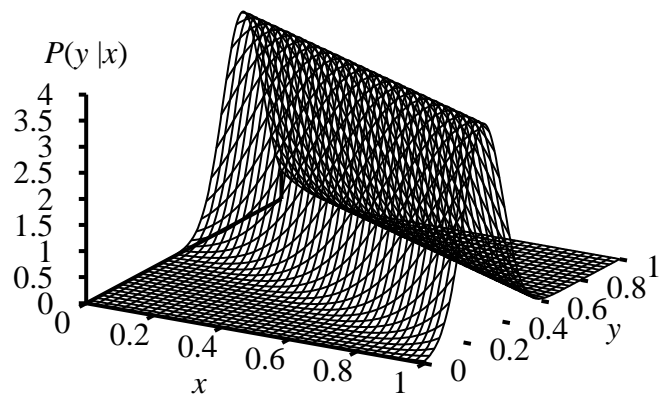
Neurone artificiale



Reti Neurali



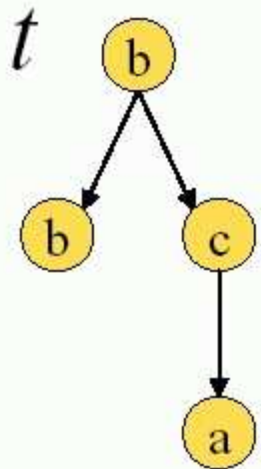
Apprendimento Probabilistico



Apprendimento in domini strutturati

Kernel per strutture

$$k(t, t') = \langle \phi(t), \phi(t') \rangle$$



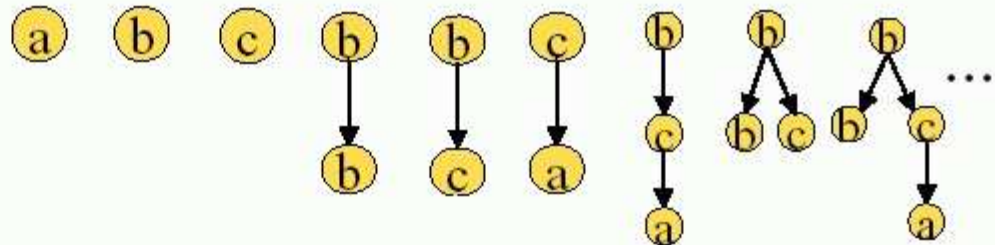
$$\phi(t) = \tau_E(t)$$



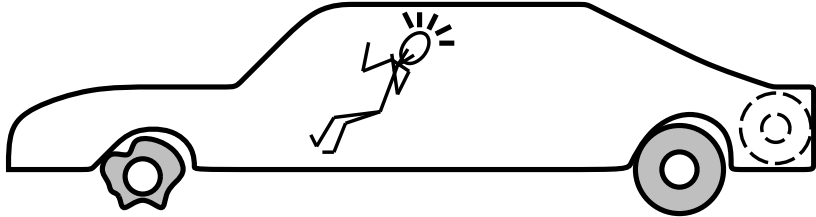
Encoding into feature space

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|------|
| 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

$\phi_i(t)$



Pianificazione



START

*~Flat(Spare) Intact(Spare) Off(Spare)
On(Tire1) Flat(Tire1)*

On(x) ~Flat(x)

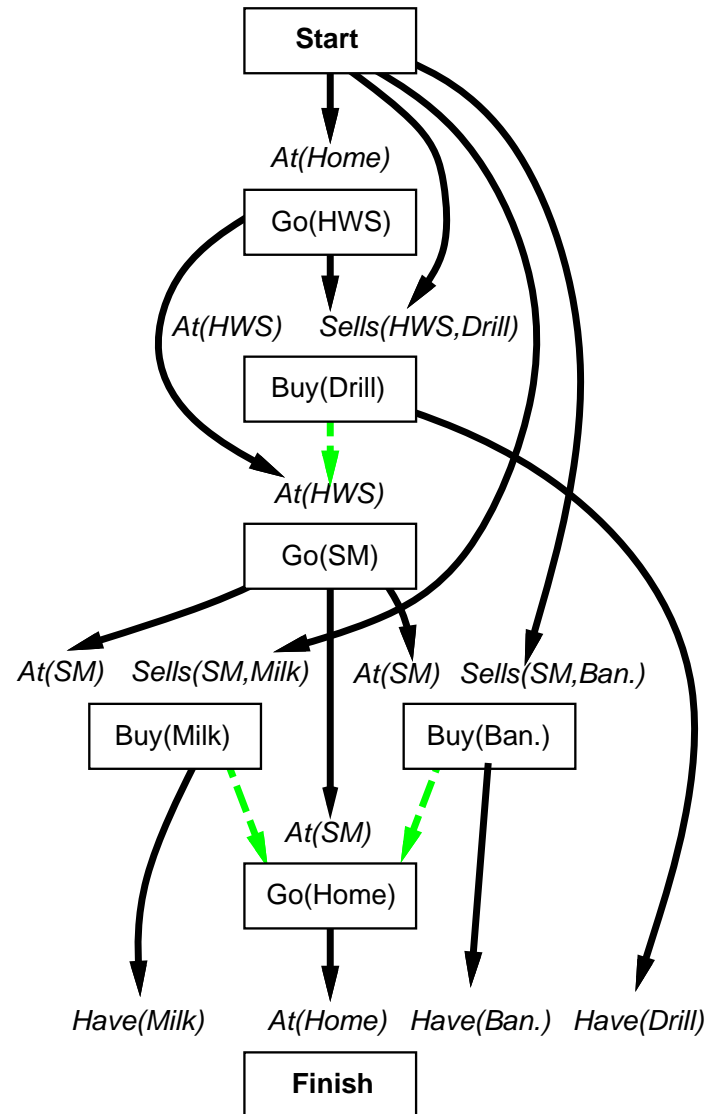
FINISH

On(x)
Remove(x)
Off(x) ClearHub

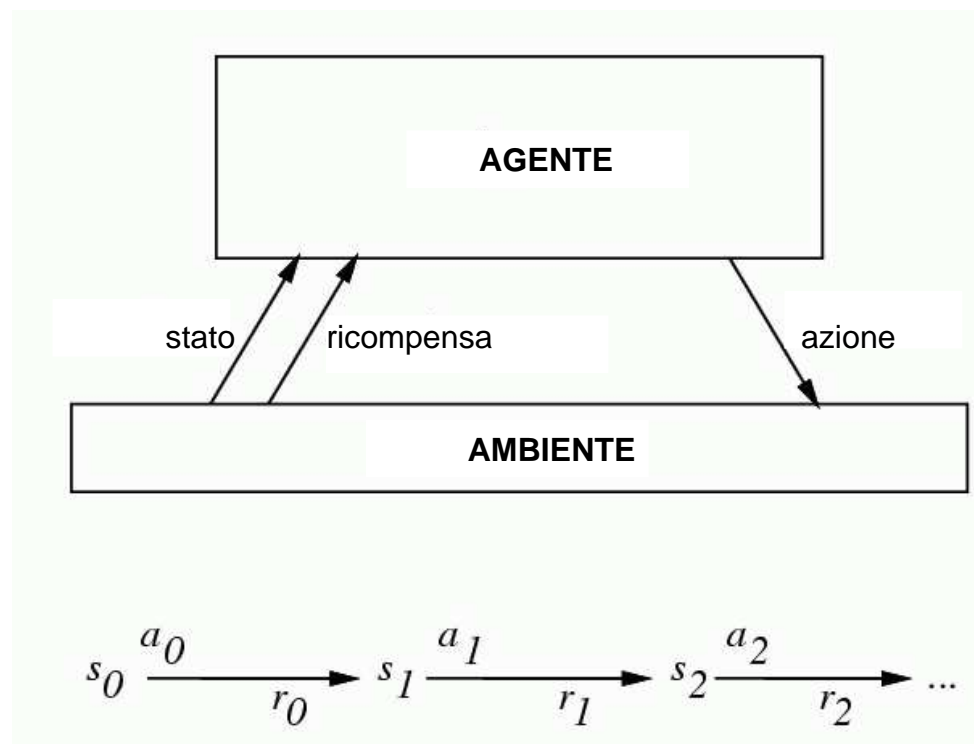
Off(x) ClearHub
Puton(x)
On(x) ~ClearHub

Intact(x) Flat(x)
Inflate(x)
~Flat(x)

Pianificazione



Apprendimento con rinforzo



Goal: apprendere le azioni che massimizzano
 $r_0 + \gamma r_1 + \gamma^2 r_2 + \dots$, dove $0 \leq \gamma < 1$