

Autonomia ed intelligenza dell'artificiale

Animali, macchine e meccanismi
e la loro capacità di decidere

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MACHINE
LEARNING
LAB

EVOLUTIONARY
ROBOTICS
ARTIFICIAL
LIFE
LAB

Chi sono io?

- Professore associato al Dip. di Ingegneria e Architettura
 - <https://medvet.inginf.units.it/>
- Ricerca:
 - **Machine Learning** lab
 - **Evolutionary Robotics** and **Artificial Life** lab
- Insegno:
 - Programmazione avanzata
 - Introduction to machine learning and evolutionary robotics



Macchine che processano “cose”



grano → farina

Macchine che processano informazione



informazione → informazione

Macchine che processano informazione

Essere umano: **progettista**



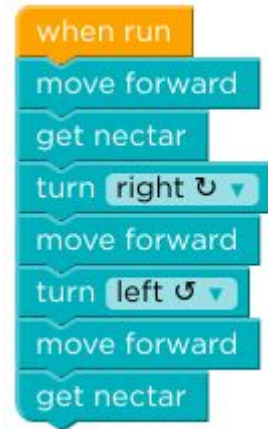
Computer: **esecutore**



Dare istruzioni all'esecutore

```
00000030 6E 69 74 3E 01 00 03 28 29 56 01 00 04 43 6F 64
00000040 65 01 00 0F 4C 69 6E 65 4E 75 6D 62 65 72 54 61
00000050 62 6C 65 01 00 04 6D 61 69 6E 01 00 16 28 58 4C
00000060 6A 61 76 61 2F 6C 61 6E 67 2F 53 74 72 69 6E 67
00000070 3B 29 56 01 00 0D 53 74 61 63 6B 4D 61 70 54 61
00000080 62 6C 65 01 00 0A 53 6F 75 72 63 65 46 69 6C 65
00000090 01 00 0E 47 61 75 73 73 54 65 73 74 2E 6A 61 76
000000A0 61 0C 00 09 00 0A 0C 00 06 00 07 0C 00 08 00 07
000000B0 01 00 19 6A 76 6D 67 6F 2F 62 6F 6F 6B 2F 63 68
000000C0 30 35 2F 47 61 75 73 73 54 65 73 74 01 00 10 6A
000000D0 61 76 61 2F 6C 61 6E 67 2F 4F 62 6A 65 63 74 00
000000E0 21 00 04 00 05 00 00 00 02 00 00 00 06 00 07 00
000000F0 00 00 00 00 08 00 07 00 00 00 02 00 01 00 09 00
00000100 0A 00 01 00 0B 00 00 00 2F 00 02 00 01 00 00 00
00000110 0F 2A B7 00 01 2A 03 B5 00 02 2A 04 B5 00 03 B1
00000120 00 00 00 01 00 0C 00 00 00 0E 00 03 00 00 00 03
00000130 00 04 00 04 00 09 00 05 00 09 00 0D 00 0E 00 01
00000140 00 0B 00 00 00 57 00 02 00 03 00 00 00 1D 04 3C
00000150 1B 10 64 A3 00 17 03 3D 1C 10 64 A2 00 09 84 02
00000160 01 A7 FF F7 84 01 01 A7 FF E9 B1 00 00 00 02 00
00000170 0C 00 00 00 12 00 04 00 00 00 07 00 08 00 08 00
00000180 16 00 07 00 1C 00 0A 00 0F 00 00 00 10 00 04 FC
00000190 00 02 01 FC 00 07 01 FA 00 0B FA 00 05 00 01 00
000001A0 10 00 00 00 02 00 11
```

```
@Override
public State<T1, T2, G1, G2, S1, S2, S, Q> init(P problem, RandomGer
    QualityBasedProblem<S1, Q> dummyProblem1 = QualityBasedProblem.cre
    QualityBasedProblem<S2, Q> dummyProblem2 = QualityBasedProblem.cre
    Collection<Individual<G1, S1, Q>> representatives1 = extractor1.se
    Collection<Individual<G2, S2, Q>> representatives2 = extractor2.se
    Collection<Individual<Void, S, Q>> evaluatedIndividuals = Collecti
    QualityBasedProblem<S1, Q> problem1 = QualityBasedProblem.create(
        s1 -> {
            List<S> solutions = representatives2.stream().map(s2 -> solu
            List<Q> qualities = solutions.stream().map(s -> problem.qual
            IntStream.range(0, solutions.size()).forEach(i ->
                evaluatedIndividuals.add(new Individual<>(null, solutio
            });
            return qualityAggregator.apply(qualities);
        },
        problem.qualityComparator()
    );
    QualityBasedProblem<S2, Q> problem2 = QualityBasedProblem.create(
        s2 -> {
            List<S> solutions = representatives1.stream().map(s1 -> solu
            List<Q> qualities = solutions.stream().map(s -> problem.qual
            IntStream.range(0, solutions.size()).forEach(i ->
                evaluatedIndividuals.add(new Individual<>(null, solutio
            });
            return qualityAggregator.apply(qualities);
        },
        problem.qualityComparator()
    );
};
```



(Istruzioni per cosa? Regole di evoluzione dello stato nel tempo, sulla base dell'input, producendo l'output)

Computer: un mero esecutore

Non ha “buon senso”!

Non risolve le ambiguità!

(Cos'è il “buon senso”?)



Ambiguità, scelta, autonomia

Non risolve le ambiguità



non prende una decisione



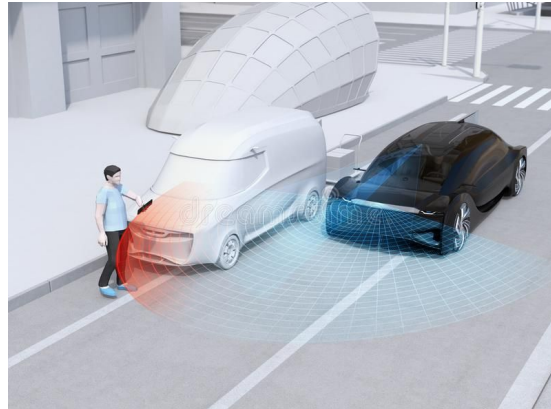
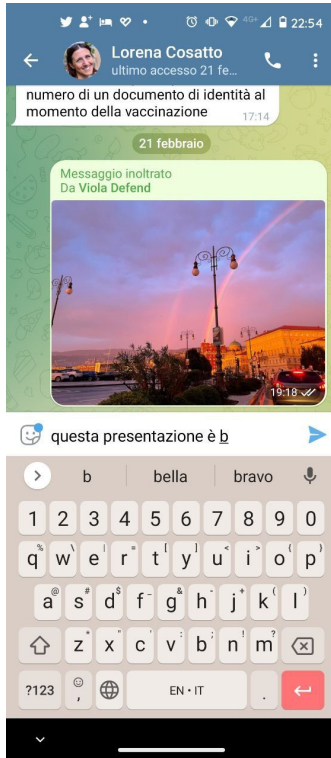
non è autonomo

Macchine che prendono decisioni al posto nostro

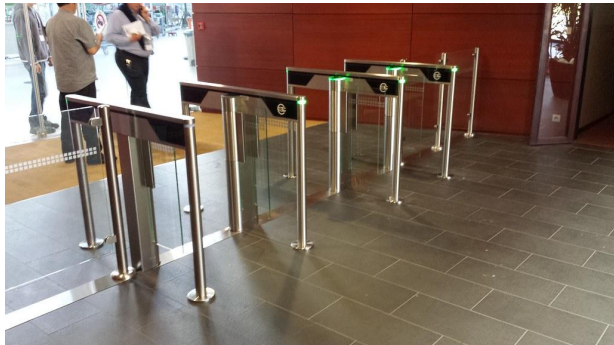
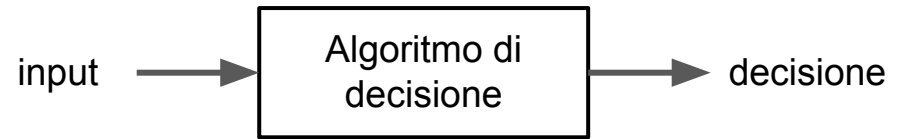
Perché?

- vanno prese velocemente o in grande quantità
- vanno prese neutralmente
- vanno prese in contesti pericolosi
- valgono poco
- non si sa secondo quale criterio vanno prese

Decisioni delle macchine

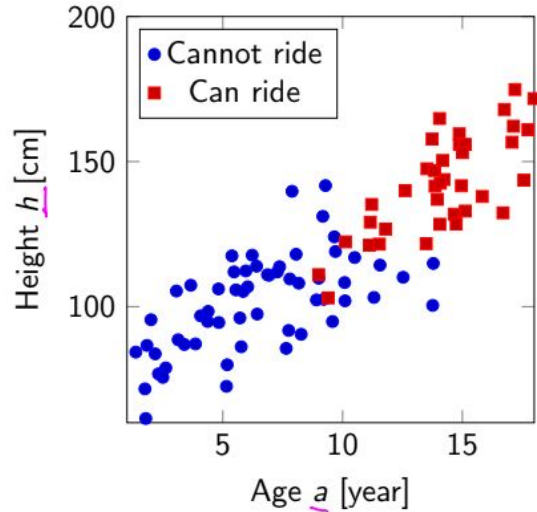


Algoritmo di decisione

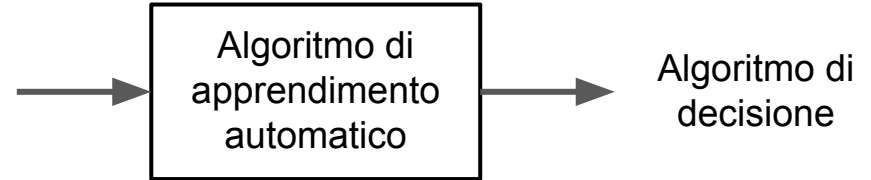


Machine learning

Algoritmo che scrive l'algoritmo di decisione



(input, decisione)
(input, decisione)
(input, decisione)
(input, decisione)
...
(input, decisione)



Algoritmo di “decisione”

Essere umano scrive algoritmo di apprendimento

Algoritmo di apprendimento “scrive”, dai dati, algoritmo di decisione

Macchina esegue algoritmo di decisione

È **autonoma**? Può scegliere?

È **responsabile**? È **intelligente**?

La facoltà di scegliere



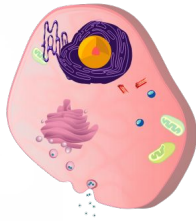
La pianta



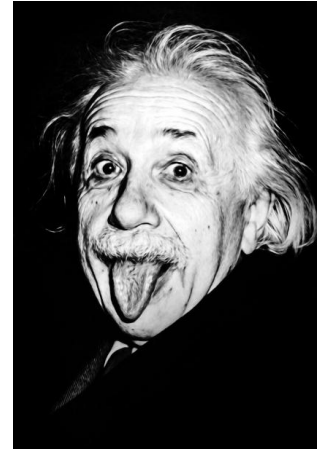
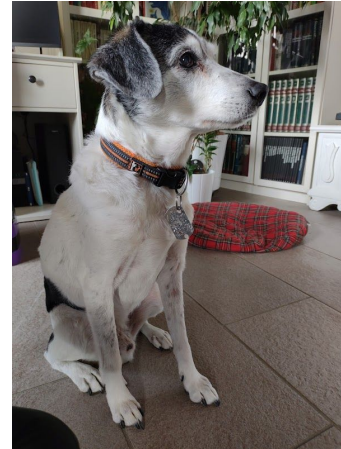
La scimmia



Complessità e intelligenza



...

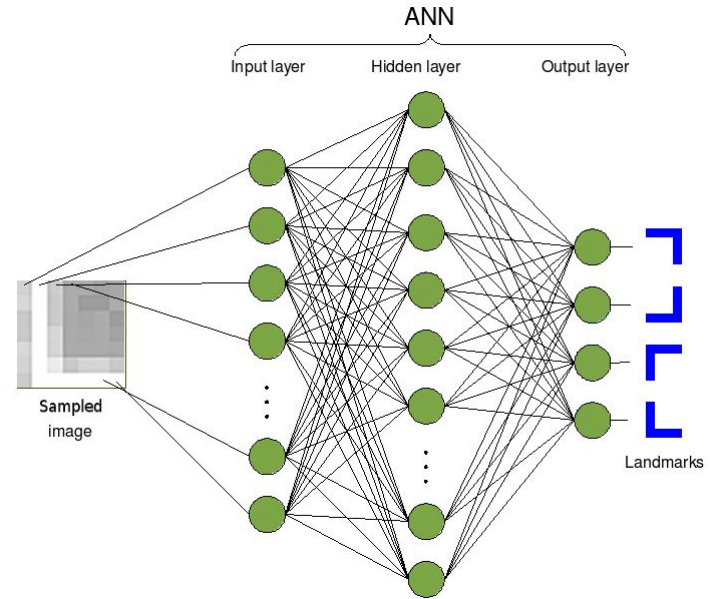
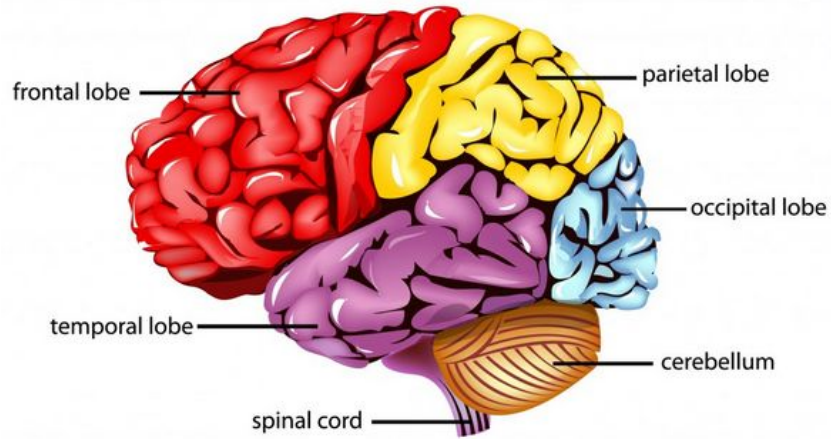


(Dove mettiamo un computer? Un robot?)

Complessità

Dov'è l'intelligenza?

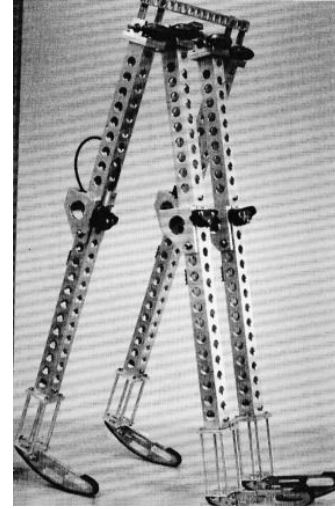
Parts of the Human Brain



Embodied (A)



Macchina senza cervello



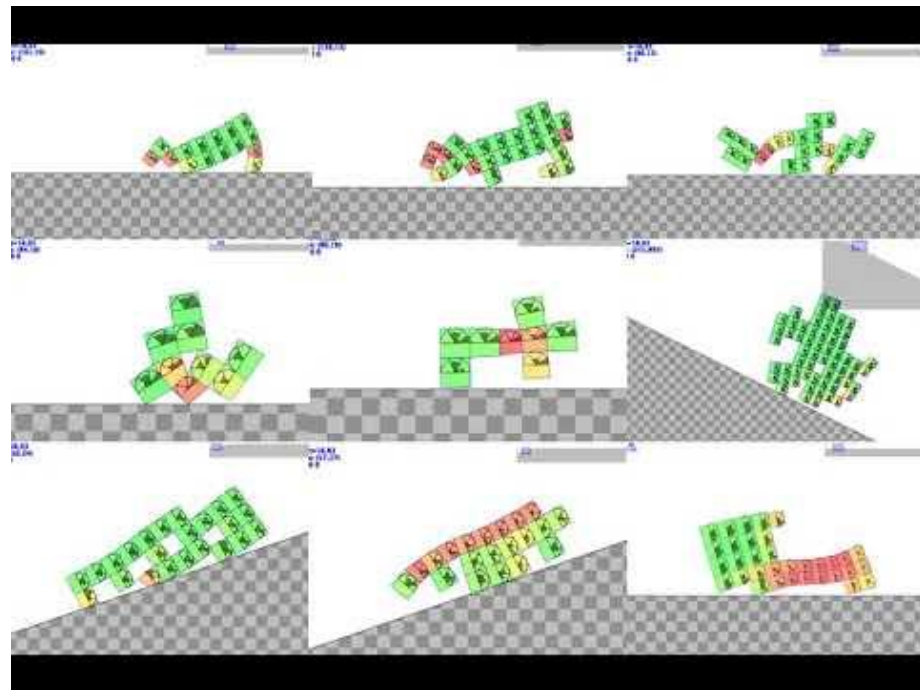
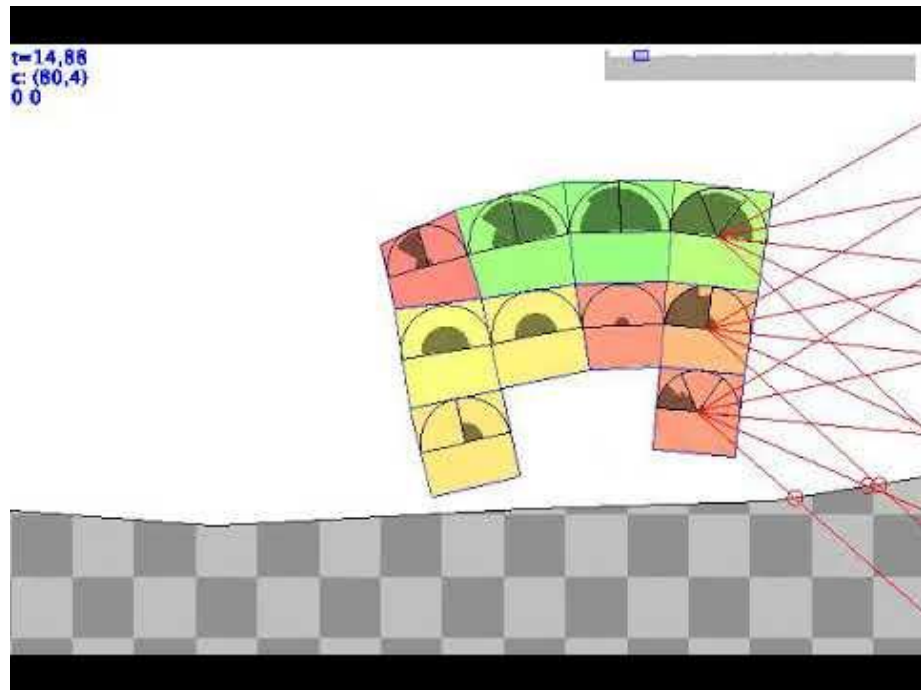
È autonoma? Può scegliere?

È responsabile? È intelligente?

È viva?

(Ci sono delle istruzioni? Chi l'ha programmata? Qual è la forza motrice?)

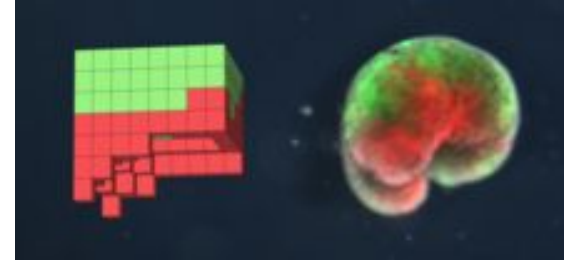
Robot che camminano (e perché camminano?)



Il parere dell'esperto

Miti da sfatare:

- Machines Are Independent: Life Is Interdependent
- Machines Are Predictable: Life Is Unpredictable
- Machines Are Designed by Humans: Life Is Evolved
- Life Is Hierarchical and Self-Similar: Machines Are Linearly Modular
- Life Is Capable of Intelligence (And Free Will, Subjectivity, Consciousness, Agency, and Metacognition): Machines Are Not; Indeed, They Never Will
- Machines Can Be Studied in a Reductionist Framework: Life Cannot
- Life Is Embodied: AIs Are Not
- Machines Have Clear Hardware/Software Distinctions: Life Does Not



Bongard, Joshua, and Michael Levin. "Living things are not (20th century) machines: updating mechanism metaphors in light of the modern science of machine behavior." *Frontiers in Ecology and Evolution* 9 (2021): 650726.

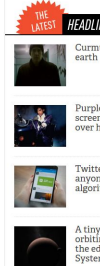
Macchine autonome, complesse, vive

- Imparano da noi
- Agiscono per raggiungere degli obiettivi fissati da noi
- Siamo i loro educatori, il loro esempio, la loro “divinità”

Lo facciamo bene?

Google's AlphaGo AI beats Lee Se-dol again to win Go series 4-1

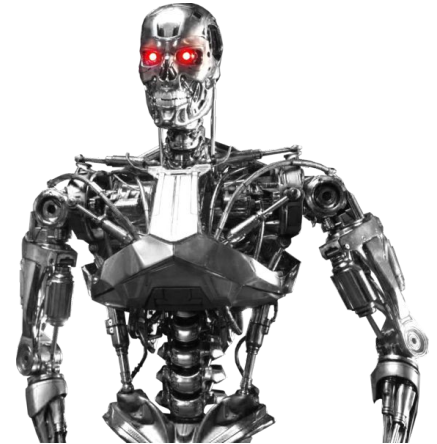
By Sam Byford on March 15, 2016 05:00 am Email @s4triangle



TL;DR MICROSOFT WEB

Twitter taught Microsoft's AI chatbot to be a racist asshole in less than a day

By James Vincent | @jvincent | Mar 24, 2016, 6:43am EDT



Grazie!

EVOLUTIONARY
EROBOTICSERA
ERARTIFICIAL
ERALLIFEERALL
ERALLABERALL



Giulia, Giorgia, Francesco, Eric, Simone, Giulia, Jessica