

# Syllabus

## *Evolutionary Robotics*

### Lingua di insegnamento

Italiano

Inglese

English

### Contenuti

Italiano

Inglese

- Foundations of Evolutionary Computation (EC).
  - High-level working scheme of an Evolutionary Algorithm (EA); terminology.
  - Generational model; selection criteria; exploration/exploitation trade-off; genetic operators with examples; fitness function; multi-objective optimization and Pareto dominance; debugging of an evolutionary search; EA issues (diversity, variational inheritance, expressiveness); fitness landscape.
  - Examples of common EAs: GA, GP, GE.
- Brief foundations of Artificial Neural Networks and EC
  - EA for neuroevolution
- Significant examples
  - Evolution of Soft Robots morphologies (body)
  - Evolution of robotic agents controllers (brain)
  - Simultaneous evolution of body and brain
- Simulation: tools and benchmark tasks

## Testi di riferimento

### Italiano

### Inglese

- Kenneth A. De Jong. Evolutionary computation: a unified approach. MIT press, 2006

## Obiettivi formativi

### Italiano

### Inglese

- Knowledge and understanding.
  - Know main kinds of problems which can be tackled with EC and ANN.
  - Know general working schemes of most common EAs.
  - Know design, development, and assessment phases of a EC-based system in the field of robotics.
- Applying knowledge and understanding.
  - Formulate a formal problem statement for simple practical problems of body/brain evolution of robotic systems in order to tackle them with EC techniques.
- Making judgements.
  - Judge the technical soundness of a ER system.
  - Judge the technical soundness of the assessment of a ER system.
- Communication skills.
  - Describe, both in written and oral form, the motivations behind choices in the design, development, and assessment of a ER system, possibly exploiting simple plots.
- Learning skills.
  - Retrieve information from scientific publications about ER techniques not explicitly presented in this course.

## Prerequisiti

### Italiano

### Inglese

- Basics of statistics: basic graphical tools of data exploration; summary measures of variable distribution (mean, variance, quantiles); fundamentals of probability and of univariate.

- Basics of programming and data structures: algorithm, data types, loops, recursion, parallel execution, tree.

## **Metodi didattici**

**Italiano**

**Inglese**

Frontal lessons with blackboard and slide projection.

## **Altre informazioni**

### **Modalità di verifica dell'apprendimento**

**Italiano**

**Inglese**

Written test with questions on theory and application with short open answers.