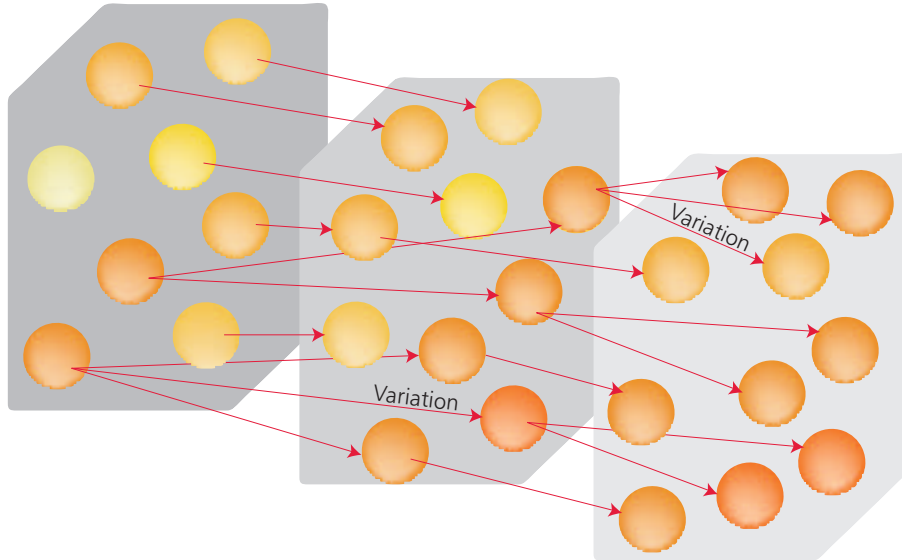


Evolutionary Algorithms



Evolutionary algorithms utilize the principles of biological evolution to solve computational problems. Such algorithms are based on a “population” of potential solutions; these solutions “reproduce” with some variation according to their quality (Figure 1) so that the resulting population will produce continually improving solutions. For problems in which the space of potential solutions is very large, evolutionary algorithms can often achieve excellent results (see Figures 2 and 3).

Figure 1: Evolutionary problem solving. Solutions to a computational problem are represented as individuals of a population (*left*). The better a solution (from light yellow to dark orange), the higher its chance of contributing offspring to the next generation of the population (*center*). Offspring solutions can contain slight variations relative to their parents; these variations are highlighted above. Gradually, good solutions are bound to accumulate in the population (*right*).

Although evolutionary algorithms offer an appealing general-purpose toolbox for solving complex computational problems, and therefore have become more and more important in commercial and industrial applications, their inner workings are still only poorly understood. IIASA’s ADN project is developing methods for analyzing the dynamics of such algorithms within the very high-dimensional search spaces in which they are set to operate. Results of this research allow for a better understanding of complex evolutionary processes in general and of the expected performance of evolutionary algorithms on specific problems in particular.

For more information, see IIASA’s ADN Web page www.iiasa.ac.at/Research/ADN/Algorithms.html.

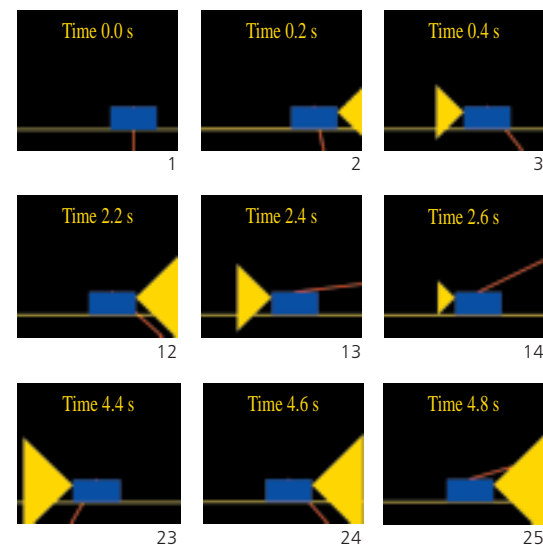


Figure 3: An evolutionary algorithm has automatically constructed a controller that brings a pendulum (red), mounted with a joint onto a cart (blue), into an upright position and keeps it balanced by moving the cart along a horizontal track (yellow). The forces exerted by the evolved controller are indicated by yellow triangles.

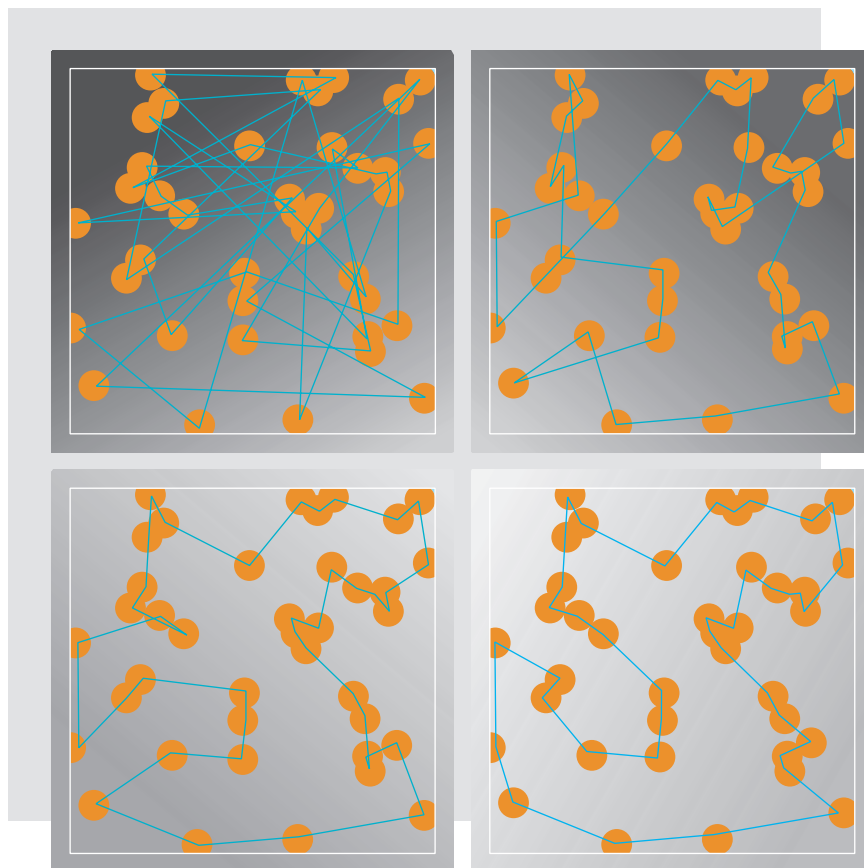


Figure 2: An evolutionary algorithm solves the Traveling Salesman Problem by finding one of the shortest itineraries through a given set of cities.

