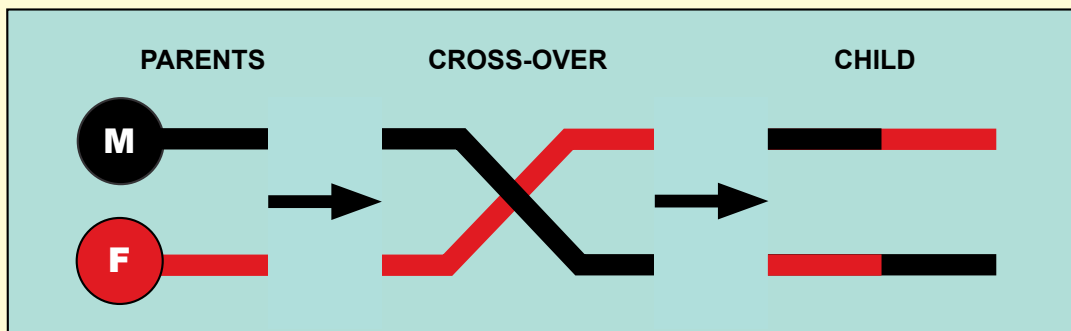


Genetic Algorithms

Based on Darwin's theory of natural selection, a genetic algorithm essentially replaces the selective breeding process of plants and animals with a learning algorithm and reduces the time between generations to a few seconds of computer time. It was recognized early on in the development of genetic algorithms that such a learning algorithm should incorporate a mechanism that simulates sexual reproduction. In reproduction two new chromosomes are produced; one consisting of the mother's chromosome before and the father's after reproduction and the other consisting of the father's chromosome before and the mother's after reproduction.



Based on a fitness function the genetic algorithm creates variations that can be evaluated according to meeting the fitness goal. Similar to the way that in nature DNA encodes an organism as a sequence of chromosome pairs, the genetic algorithm uses a string of bits. During each generation the algorithm creates the fittest cases in the data by crossing over their bit strings at a random point in time. In this virtual computational world, each mutated case receives a fitness score, with the result that each computed generation is fitter than the previous one. The process terminates when either the desired fitness level has been reached or time runs out.

This original concept took a major step forward in the early 1990s with the replacement of the bit strings in genetic algorithms with software code. It was argued that a computer program is really a tree of subroutines. Using crossover and mutation to swap subroutines between program trees it was shown that genetic programs can include a wide range of programming constructs such as if-then comparisons, loops, and recursion.

Genetic programming's first major success in the mid-1990s was in the design of electronic circuits, when a genetic program was able to reinvent a previously patented design for a low-pass filter that could be used to selectively enhance a particular frequency band in a musical recording. In 2005, the US Patent Office awarded a patent to a factory optimization system that was designed using genetic programming.