

Genetic algorithms

Metodický koncept k efektivní podpoře klíčových odborných kompetencí s využitím cizího jazyka ATCZ62 - CLIL jako výuková strategie na vysoké škole

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Genetic algorithm

- The heuristic process belongs to evolutionary algorithms
- It belongs to artificial intelligence
- Applying knowledge from evolutionary biology seeks to solve complex problems for which there is no exact algorithm
- It mimics the techniques of evolutionary biology
 - Heredity
 - Mutation
 - Natural selection
 - Crossover

Genetic algorithm

- Principle:

1. Initialization – generate 0th generation
2. Begining of cycle– Choose (randomly) several individuals from whole population based on fitness score
3. Make new generation
 - crossover - „swap“ parts of few individuals
 - mutation – randomly change some genes
 - reproduction – copy individuals without changes
4. Calculate fitness of new generation
5. Termination- Repeat from point 2 until the termination condition is reached

Genetic algorithm

- Terminology:
 - Phenotype – individual
 - Genotype, genome, chromosome - representation of phenotype
 - Chromosome - divided into individual linearly-ordered genes (i-th chromosome gene of the same type represents the same characteristic)
 - Alleles - Various gene values
 - Fitness value - ranging from 0-1, expresses the quality of each individual
- Individuals can be encoded (genetically described) in different ways
- By way of description, it may be important for the success or failure of solving a particular task

Genetic algorithm

- Example:
- 0th generation (fitness value = # of „1“):
 1. 0100011011 $f=0,5$
 2. 0101000100 $f=0,3$
 3. 1010110000 $f=0,4$
 4. 1110111000 $f=0,6$

Genetic algorithm

- Selection

- Weighted roulette: —

- Probability of being a parent

- Tournament method

- Random selection of groups from each parent group becomes the person with the highest fitness value

- Trimming

- We sort all the individuals according to the f value, cut the low value part, select the parents from the rest

- Random choose

- The simplest method, f value does not play a role in selecting a parent for parenting

Genetic algorithm

- Crossover

- Parents exchange parts of their code
- Simplest method– one point crossover
- Place for cutting – randomly chosen

- X: 010001|1011

- Y: 111011|1000

- P: 0100011000 $f=0,3$

- Q: 111011 1011 $f=0,8$

- Crossover at more points, more than two parents

Genetic algorithm

- Mutation

- Random change of the random gene in an individual
- Very low probability

1. 0100011011 \Rightarrow 0101011011
2. 0101000100 \Rightarrow 0101100100
3. 1010110000 \Rightarrow 1010110100
4. 1110111000 \Rightarrow 1010111000

- It is possible to reach properties which are not in the original generation

Genetic algorithm

- Termination

- This generational process is repeated until a termination condition has been reached. Common terminating conditions are:
 - A solution is found that satisfies minimum criteria
 - Fixed number of generations reached
 - Allocated budget (computation time/money) reached
 - The highest ranking solution's fitness is reaching or has reached a plateau such that successive iterations no longer produce better results
 - Manual inspection
 - Combinations of the above