



Metode și Algoritmi de Planificare (MAP)

2009-2010

Curs 10

Planificare folosind Algoritmi Imuni



Content

- Existing Algorithms
- Genetic Algorithms Overview
- Immune Algorithms
- Genetic Algorithm



Scheduling Algorithms

- List Algorithms
 - Heterogeneous Earliest-Finish-Time (HEFT)
 - Fast Critical Path (FCP)
 - Highest Level First with Estimated Times (HLFET)
- Duplication Based Algorithms
 - Task Duplication-based Scheduling Algorithm (TDS)
- Clustering Algorithms
 - Dominant Sequence Clustering (DSC)



Duplication Based Algorithms

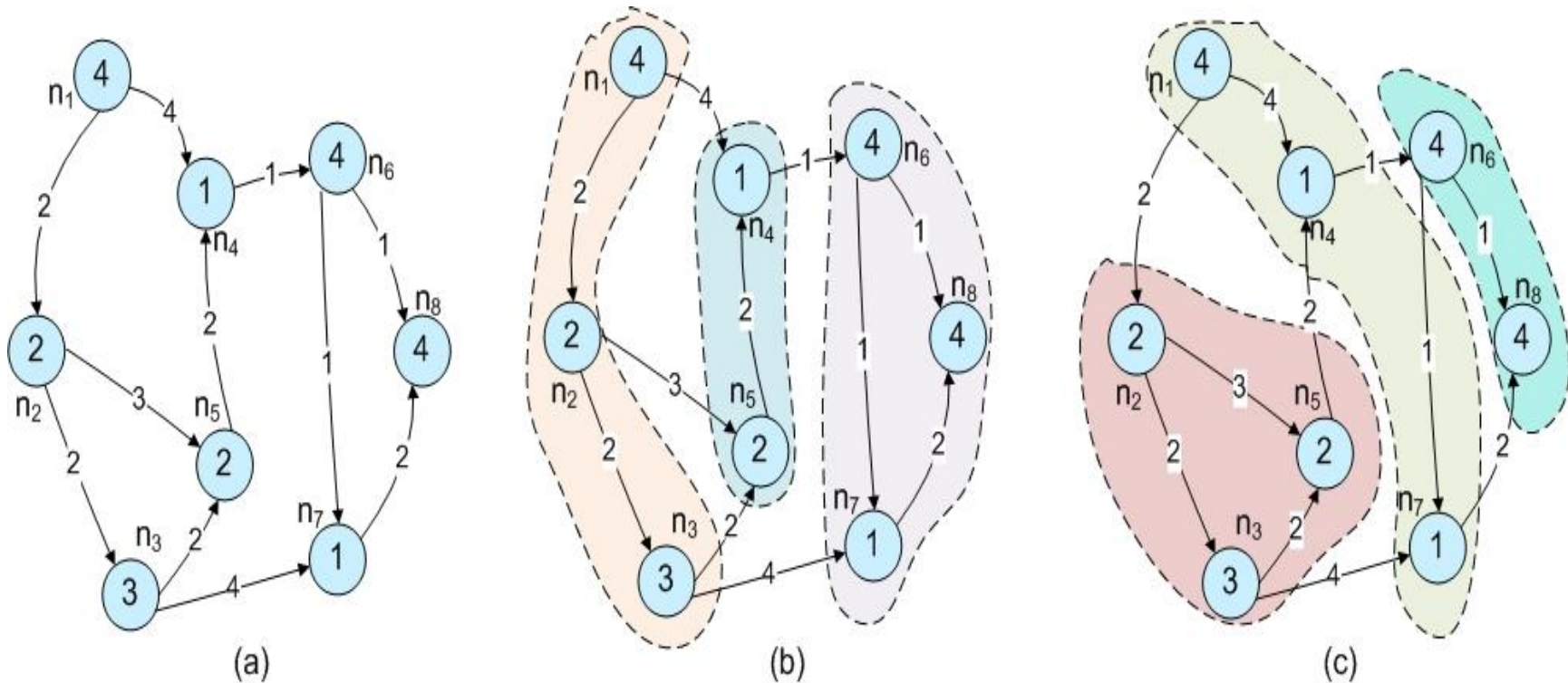
- Uses resources idle time for task duplication
- Parent task is duplicated
 - Reduction of communication time
- **Task Duplication-based Scheduling Algorithm (TDS)**
 - Favorite predecessor (if assigned to the same processor => Earliest Start Time is minimized)



Clustering Algorithms

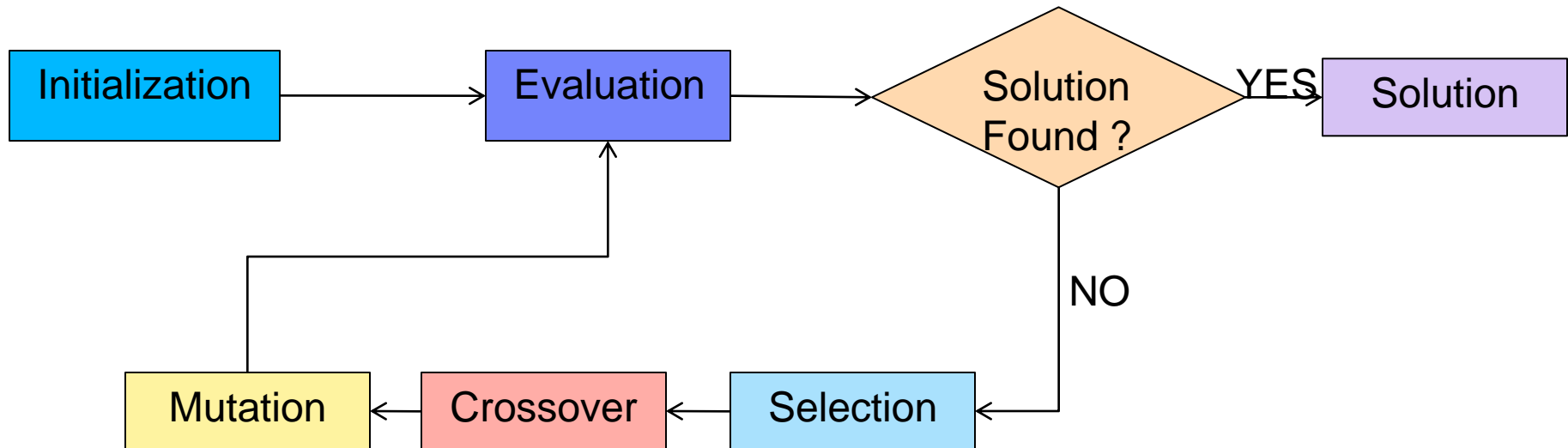
- Idea
 - Intensive communicating tasks assigned to the same processor
- Steps
 - Clustering phase
 - Original graph is partitioned into clusters
 - Post-clustering phase
 - Refines the previously generated cluster
 - Produces the final task-to-resource mapping

Clustering Algorithms



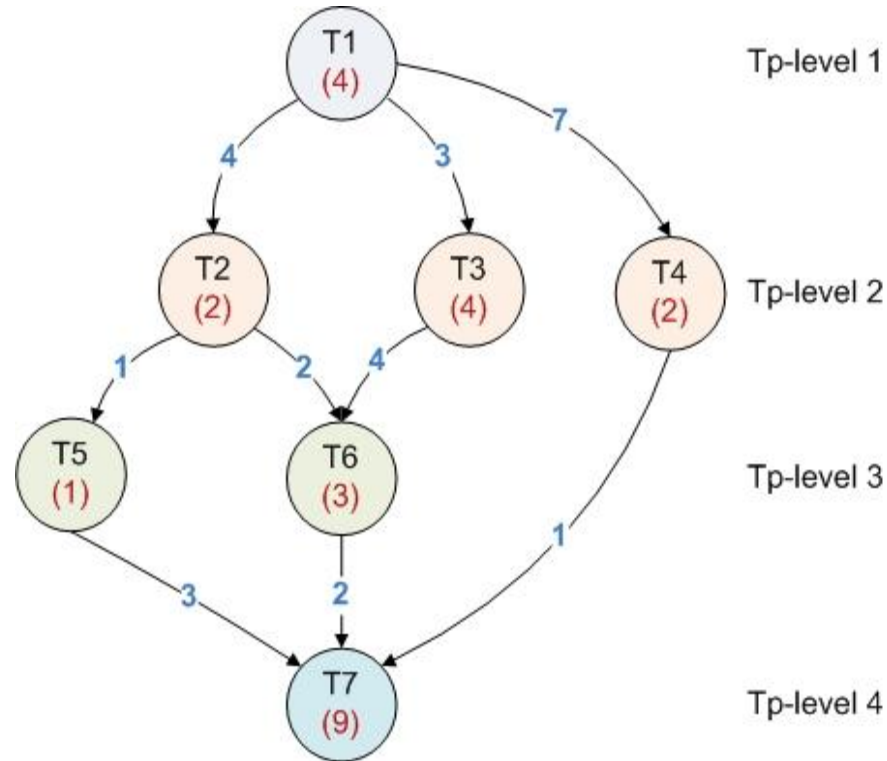
- (a) Initial graph
- (b) Linear clustering
- (c) Non-linear clustering

Genetic Algorithms Overview





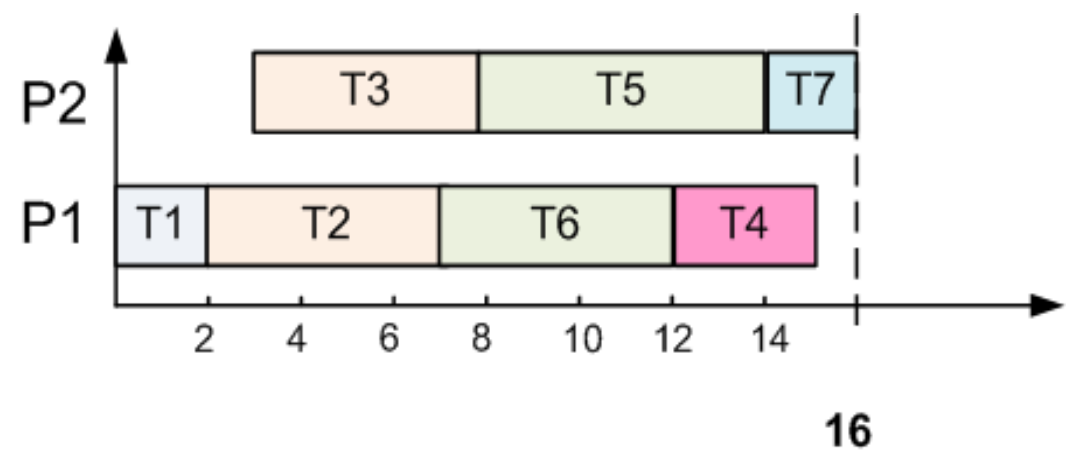
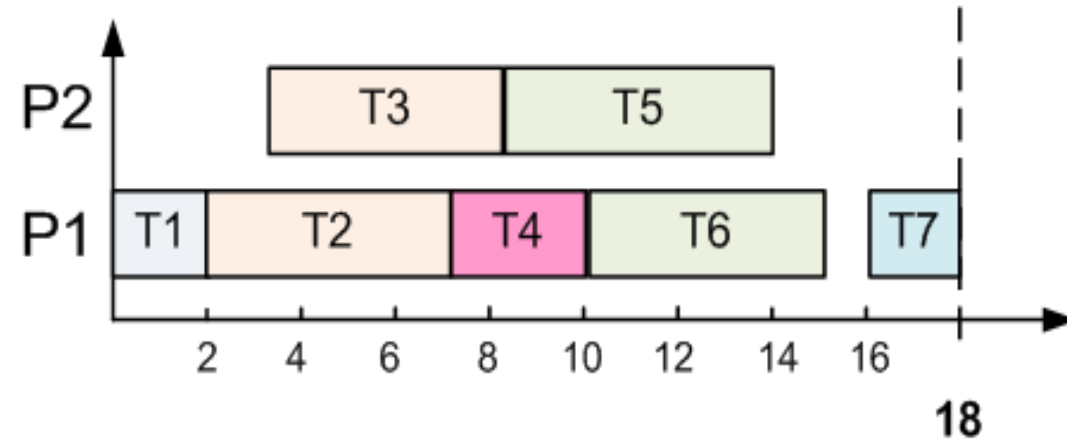
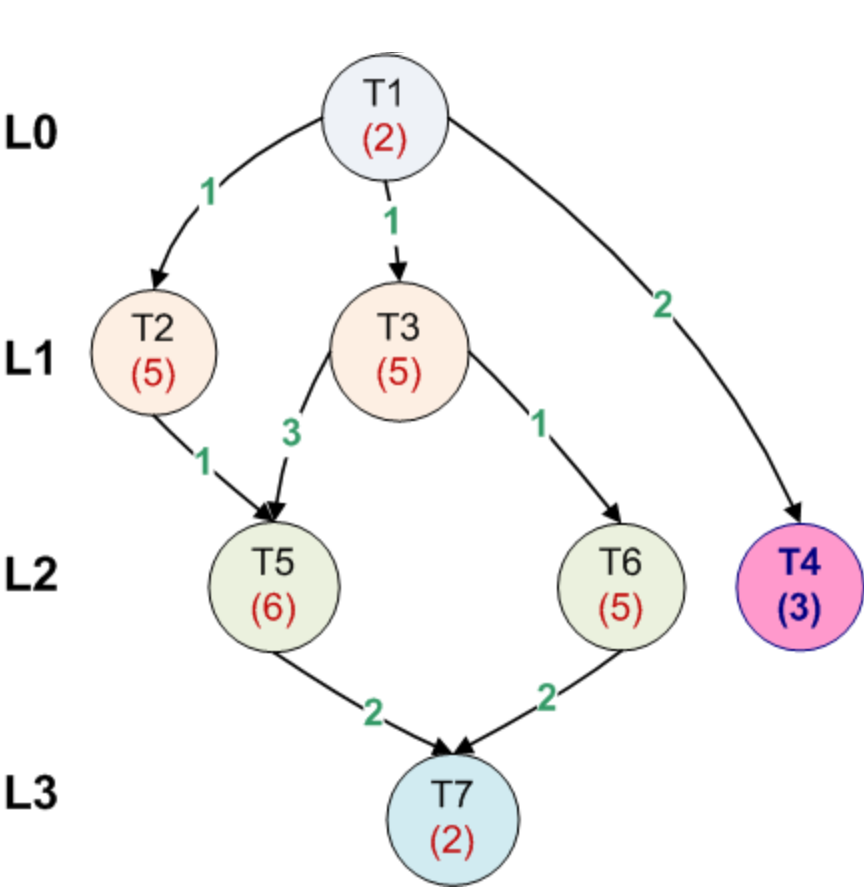
Chromosome Encoding



(T1,P1)	(T2,P1)	(T3,P2)	(T4,P3)	(T5,P1)	(T6,P3)	(T7,P2)
---------	---------	---------	---------	---------	---------	---------

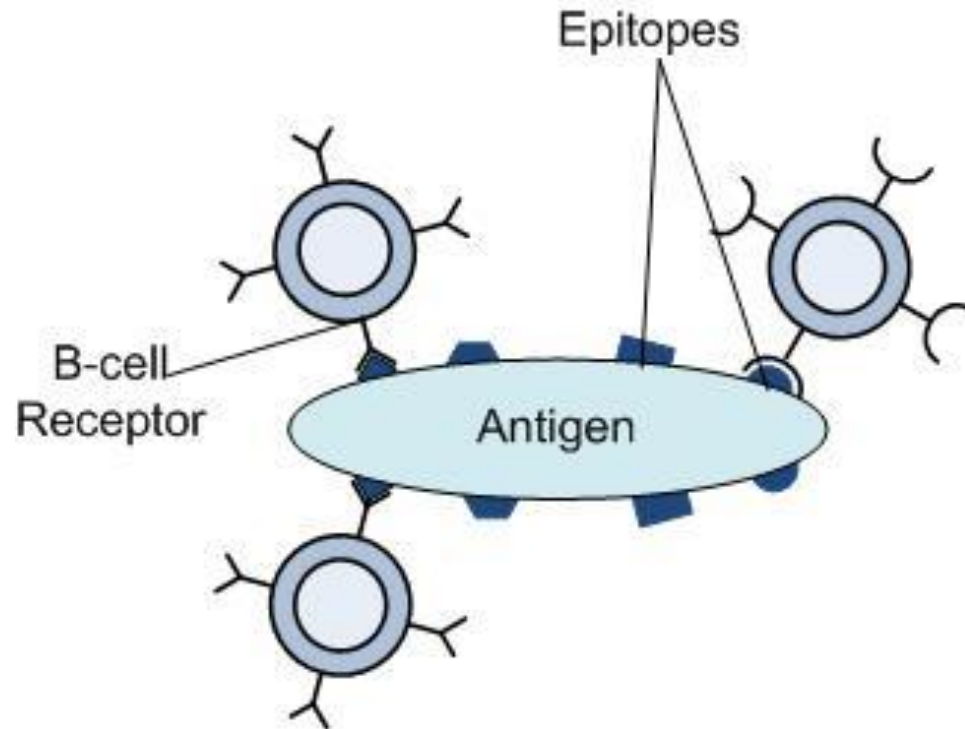


Floating Nodes

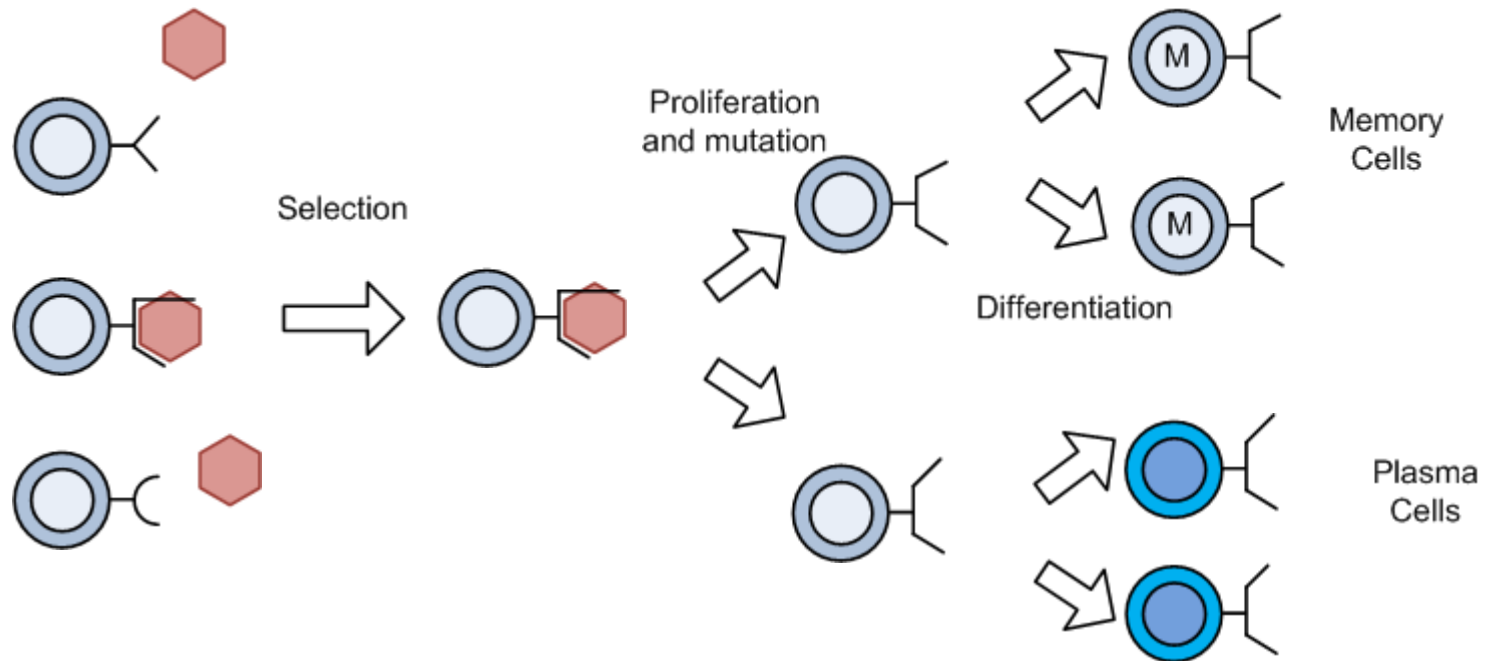


Initialization – Immune Systems

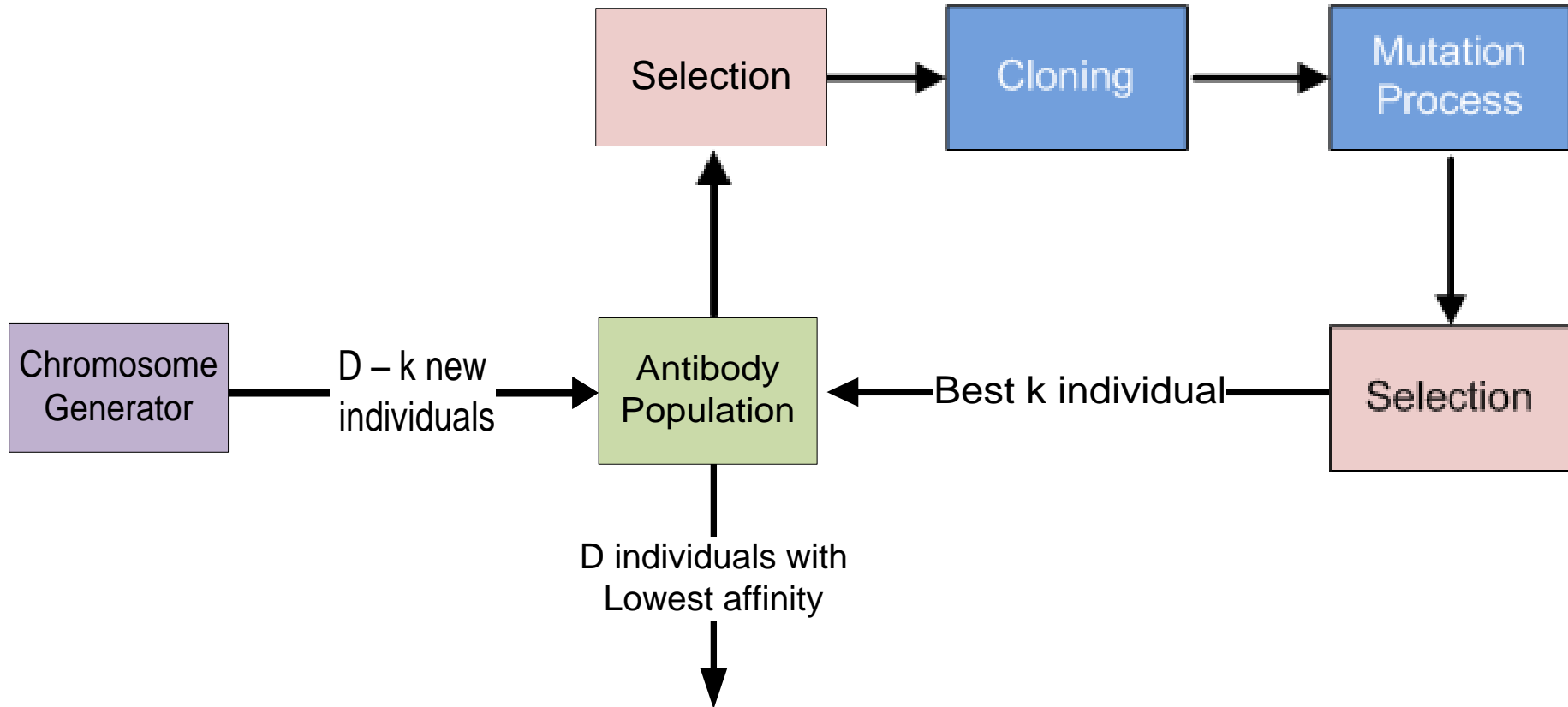
- Inspiration source: natural immune systems
- Components
 - Antigen
 - T-cells :helper, killer, suppression
 - B-cells
 - Antibodies
- Principles
 - Negative Selection
 - Clonal Selection
 - Immune Network



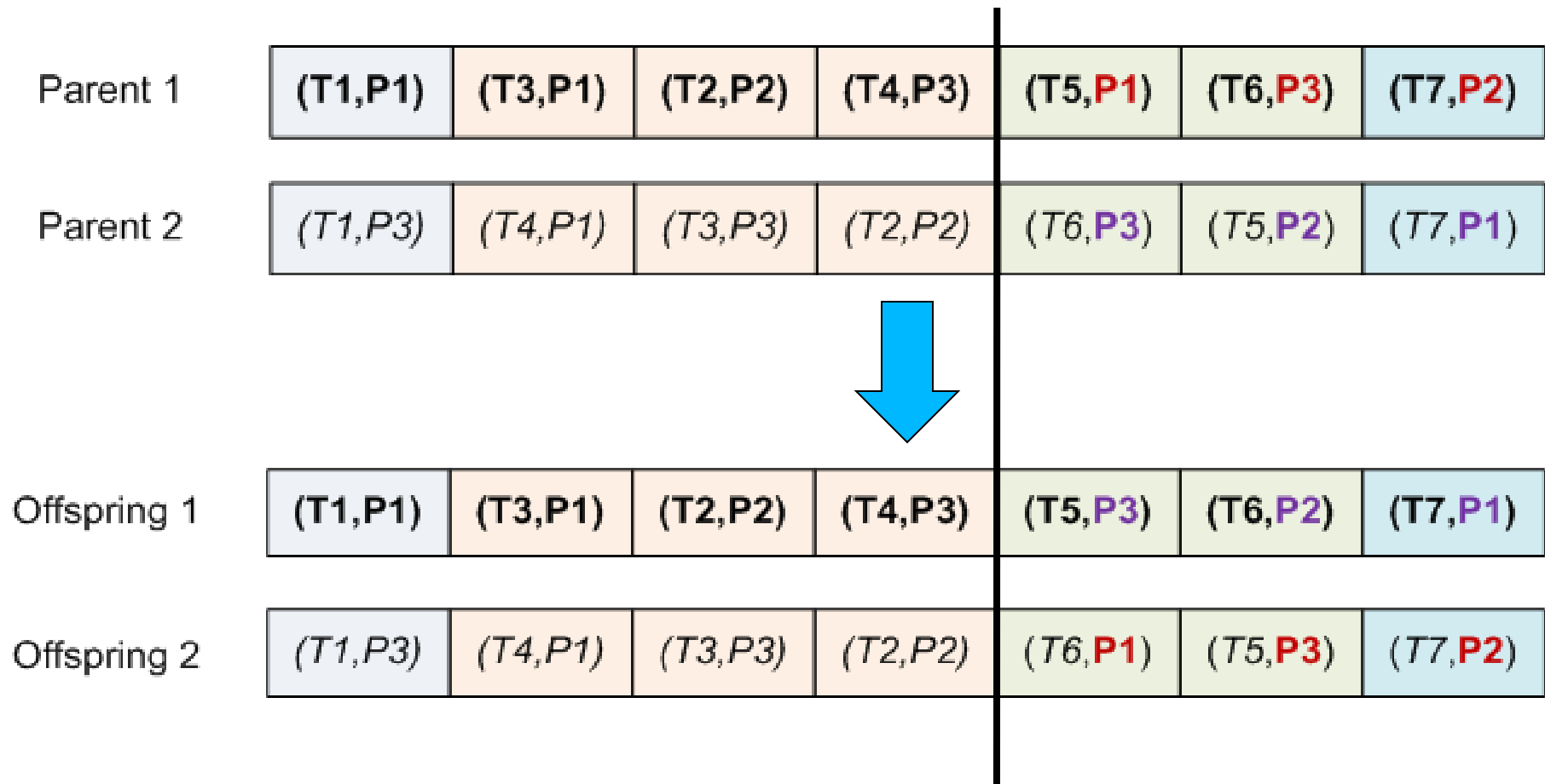
Initialization – Clonal Selection



Initialization – The Immune Algorithm

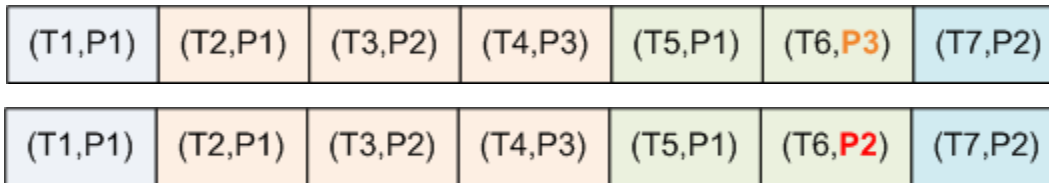


Genetic Operators - Crossover

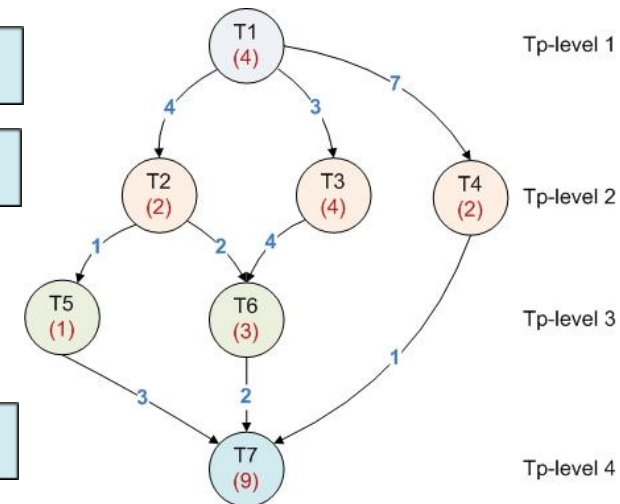
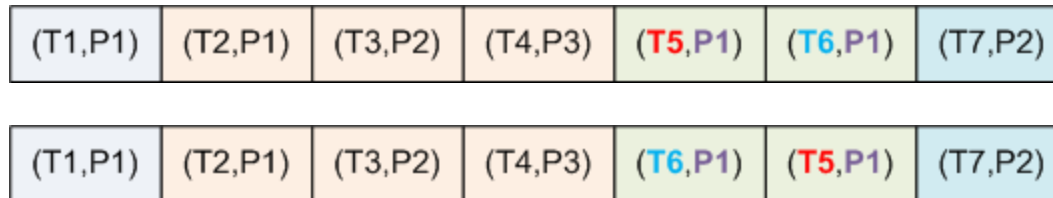


Genetic Operators – Mutation(1)

- Adaptive mutation
- Mutation operators
 - *Partial-gene Mutation*

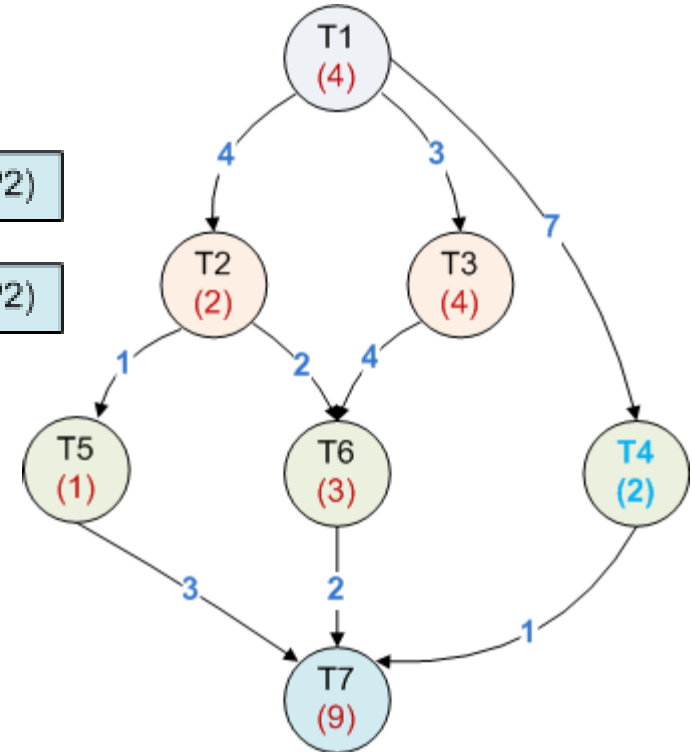
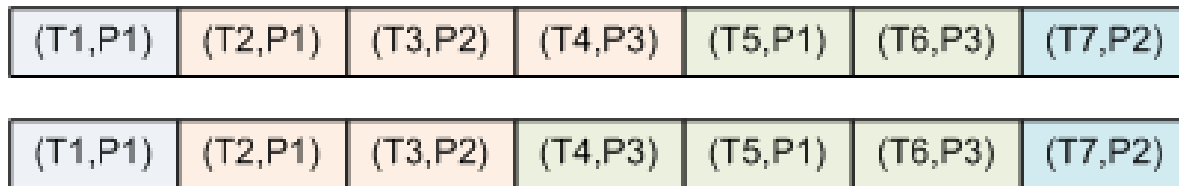


- *Swap-gene Mutation*



Genetic Operators – Mutation(1)

- Topological Hyper-mutation
 - Select one free floating node
 - Increase its current topological level
 - Find new free floating nodes




Selection & Fitness Function

- Selection
 - Roullet Wheel Selection


$$p(i) = \frac{fitness(i)}{Ft} \quad Ft = \sum_{i=0}^{|P|} fitness(i)$$

- Fitness Function


$$F(ch) = \left(\frac{t_m}{t_M} \right) \times \left(\frac{1}{n} \sum_{i=0}^n \frac{t_i}{t_M} \right) \times \left(\frac{T_S}{T} \right) \times \left(\frac{T_M}{SL(ch)} \right)$$




Load
balancing



Average idle
time



Deadline
violation



Schedule
length

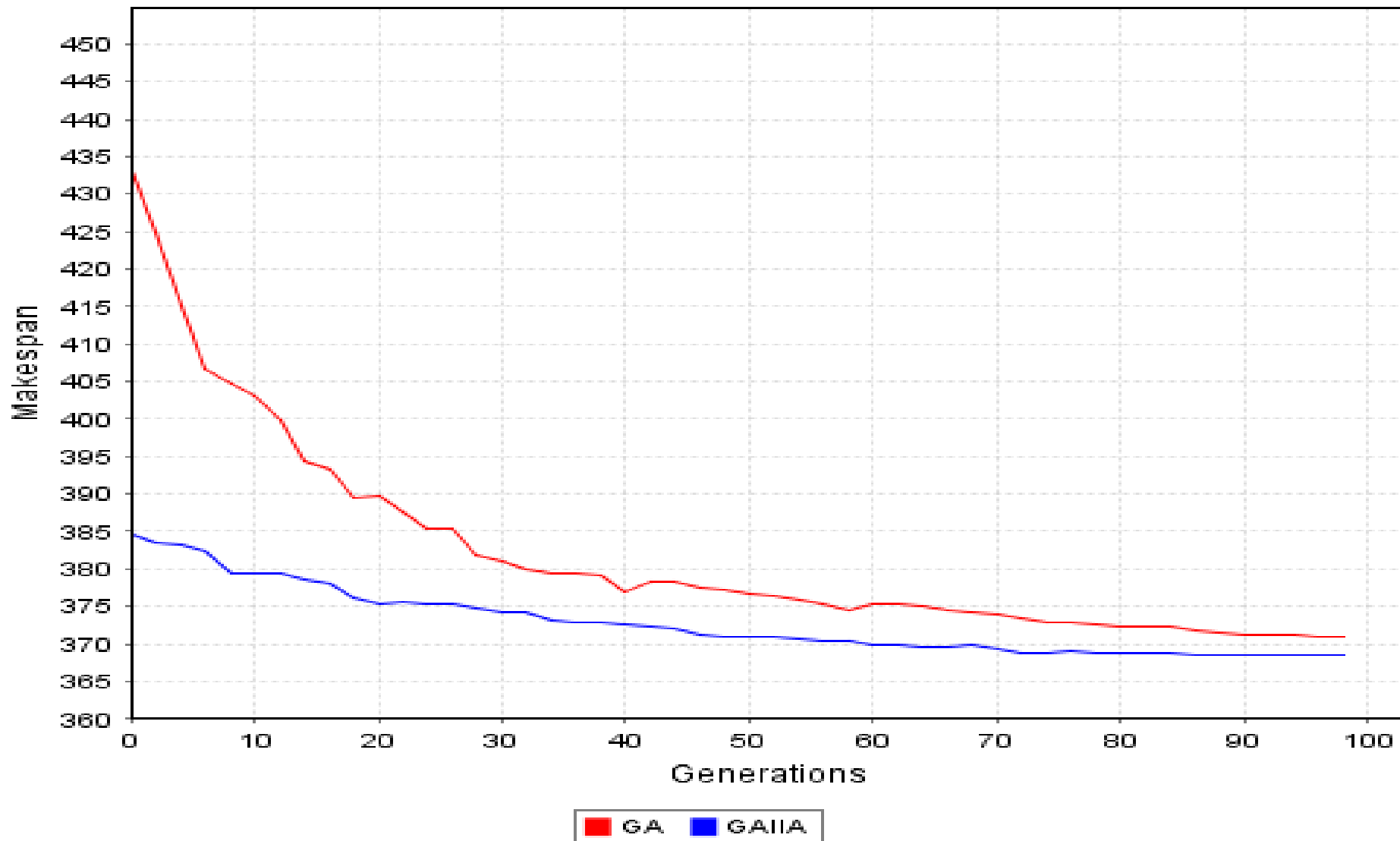


GA vs. GAIIA – Makespan

- 8 processors
- 90 tasks
- Population
 - 2 with Migration
 - 64 individuals
- 100 generations



GA vs. GAIIA – Makespan algorithm results



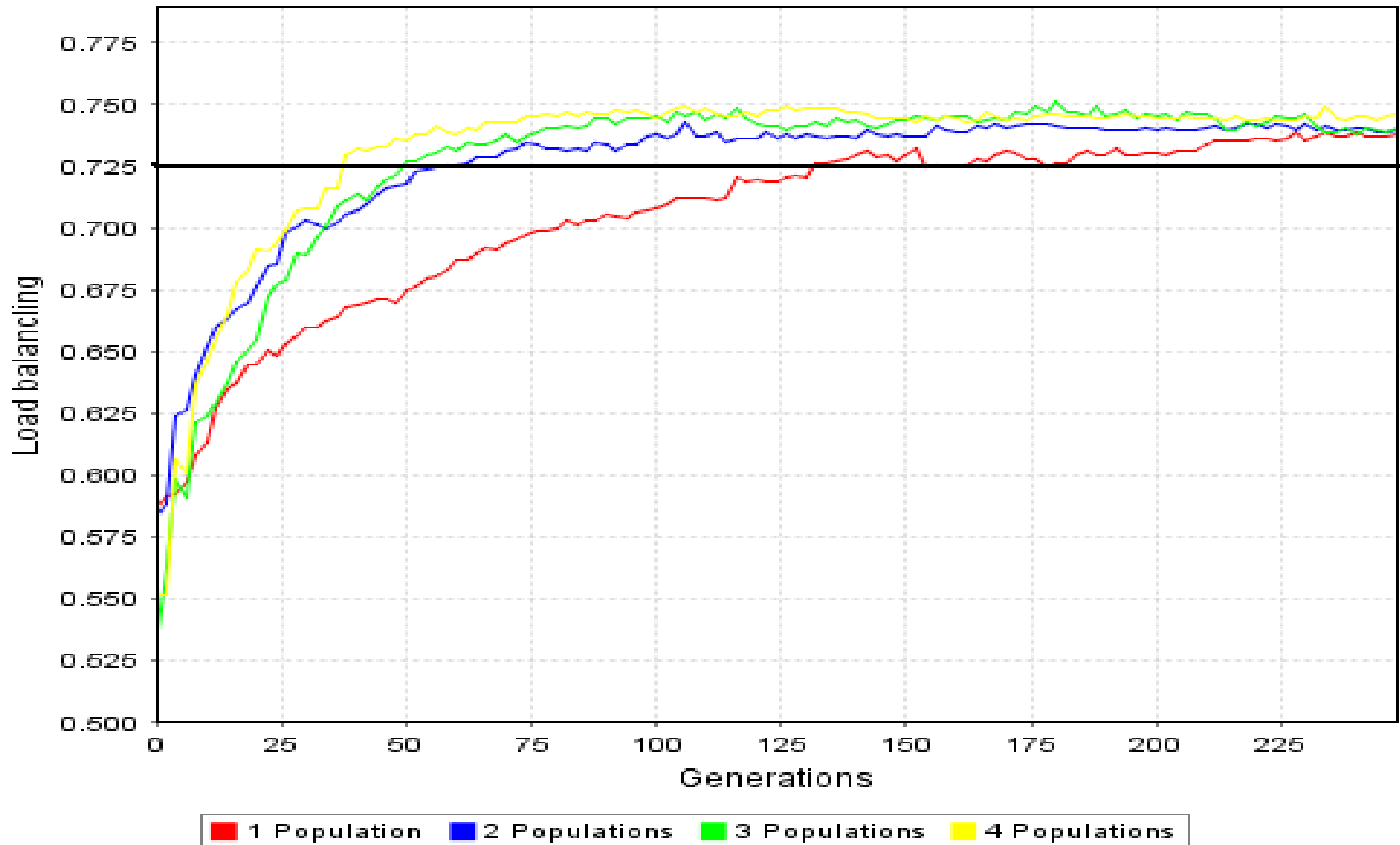


Multi-population GA

- Multiple populations evolve in parallel
- After a certain number of generations
 - Best individuals are interchanged
- Improves the convergence of the algorithm
- Proper for distributed systems

Multi-population GA

Multipopulation GAIIA





Exam's quizzes

- **1.** Descrieți modelul de planificare folosit de clasa “Duplication Based Algorithms”.
- **2.** Care sunt diferențele dintre algoritmi imuni și algoritmi genetici?
- **3.** Care sunt beneficiile de utilizare ale algoritmilor imuni pentru faza de inițializare a unui algoritm genetic de planificare?
- **4.** Descrieți modelul de planificare folosit de clasa “Clustering Algorithms”.