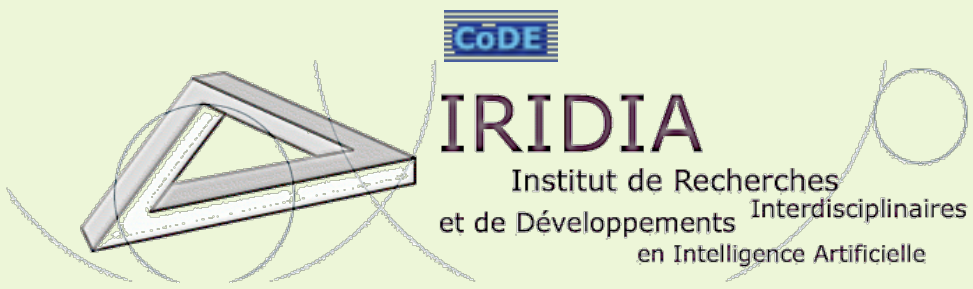


# Ant Colony Optimization Applied to Switch Engine Scheduling in a Railroad Yard

Jodelson A. Sabino<sup>1,2</sup>, Thomas Stützle<sup>2</sup>, Mauro Birattari<sup>2</sup>, José Eugênio Leal<sup>1</sup>



<sup>1</sup> Departamento de Engenharia Industrial, PUC-Rio, Rio de Janeiro, Brazil  
<sup>2</sup> IRIDIA, Université Libre de Bruxelles, Brussels, Belgium



## Improving railroad efficiency

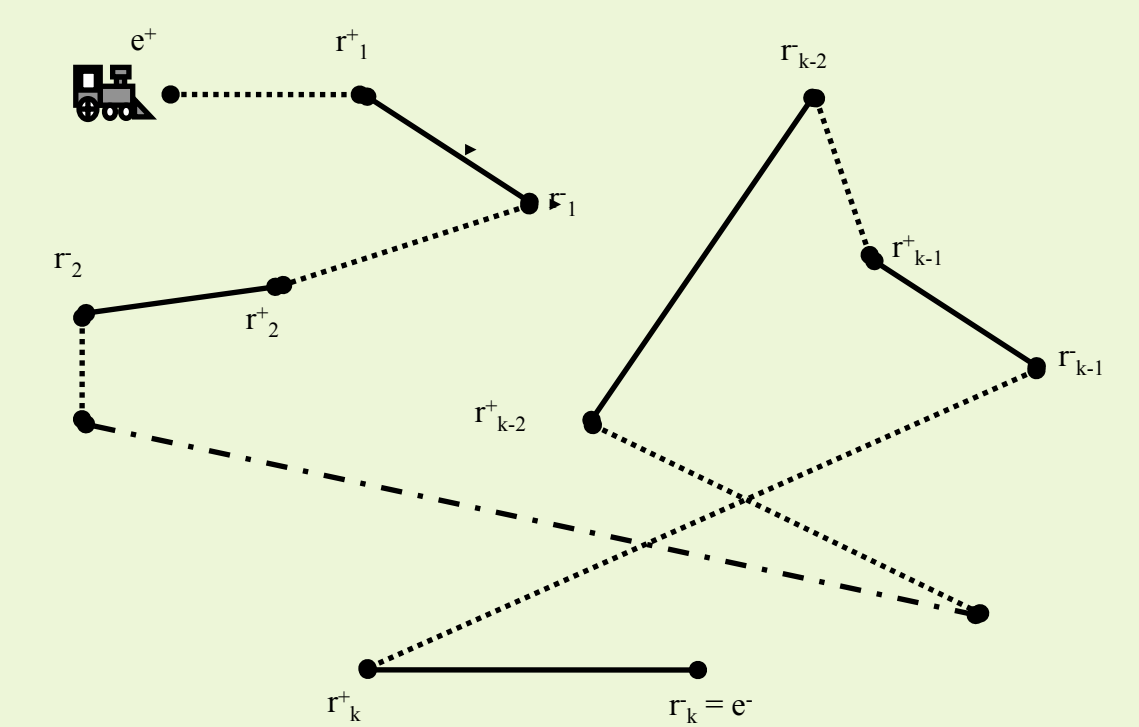
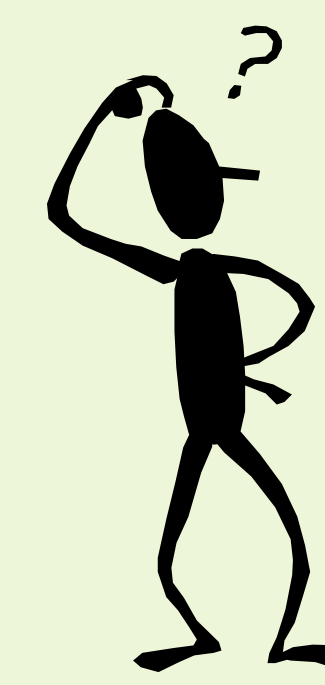
Many works on the ACO metaheuristic concern applications to rather strong abstractions of real-world problems. Differently, in this research we tackle a **real-life problem**: the railroad yard routine planning.



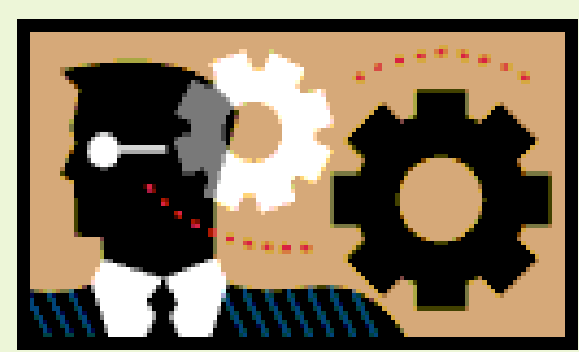
## The real world problem

### GIVEN

- ◆ The information about the railroad yard layout
- ◆ The switch engines currently located in it
- ◆ A list containing all pending planned operations

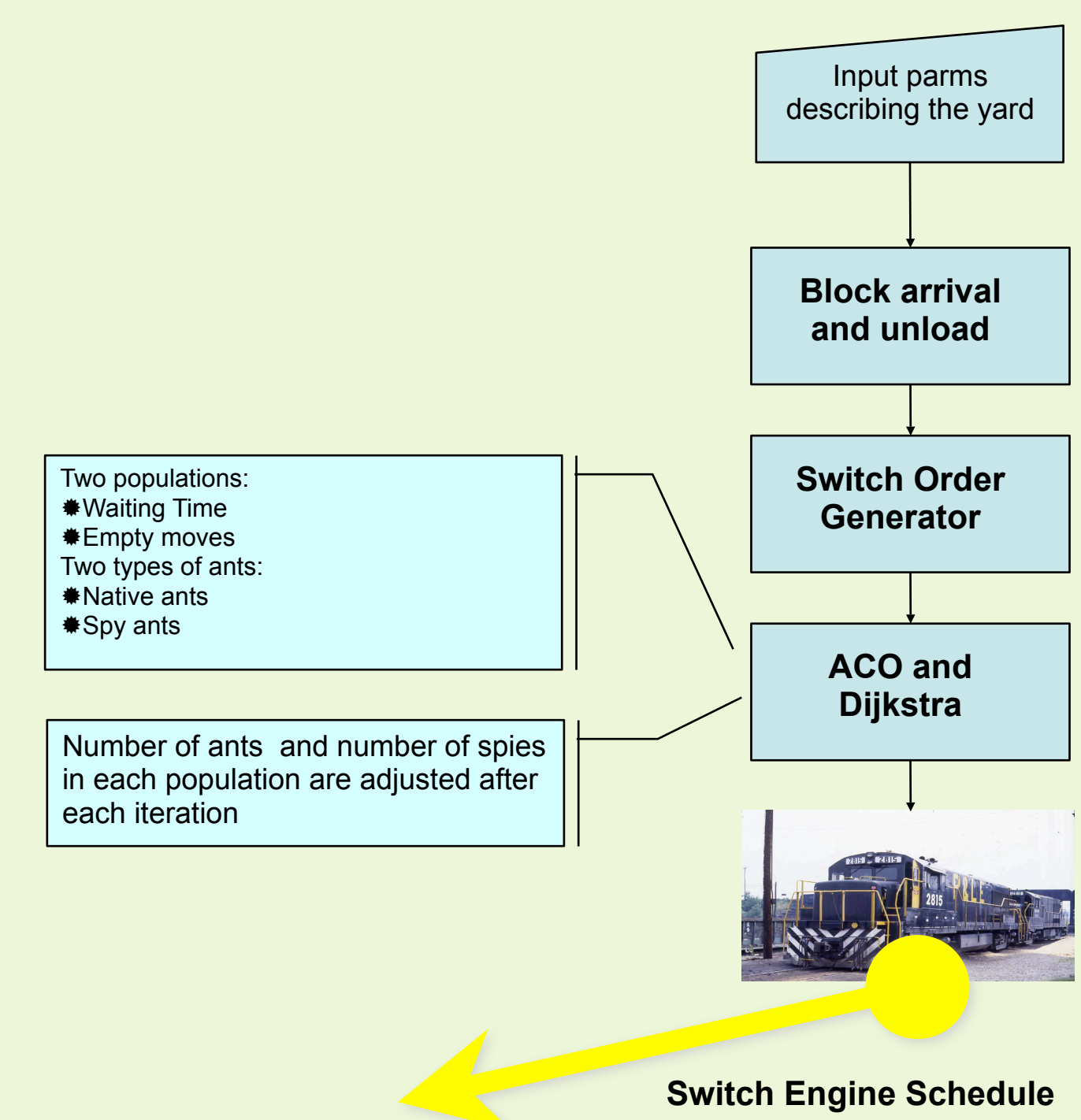


The **GOAL** is to determine an assignment of switch engines to switch orders, and a sequencing of these such that none of the operational constraints are violated and the costs are minimized.



## The Solution

- ◆ The problem was modeled as a pickup and delivery problem with time windows and capacity and ordering constraints;
- ◆ Objective function: weighted sum of fixed and variable costs;
- ◆ The CompetANTS algorithm was adapted to the solution of this problem;
- ◆ A railroad yard simulator was built to generate a large set of real-life like instances to allow for a detailed computational analysis of the algorithm.



## Results up to now

- ◆ First real-world instances showed that the algorithm might produce huge savings;
- ◆ CompetANTS pheromone update rules proved to give better results than the ones taken directly from rank-based AS;
- ◆ The computational results achieved so far confirm that the switch engine scheduling problem can effectively be tackled in practice.



## Work in progress ...

The switch engine routing problem is being tackled now: How to determine the best route at a certain moment to go from the pickup to the delivery location such that delays due to the concurrent need for a specific track are minimized. The next step will be the implementation in the largest railroad yard in Latin America, located in Vitória (ES), Brazil.