MATSim tutorial 2

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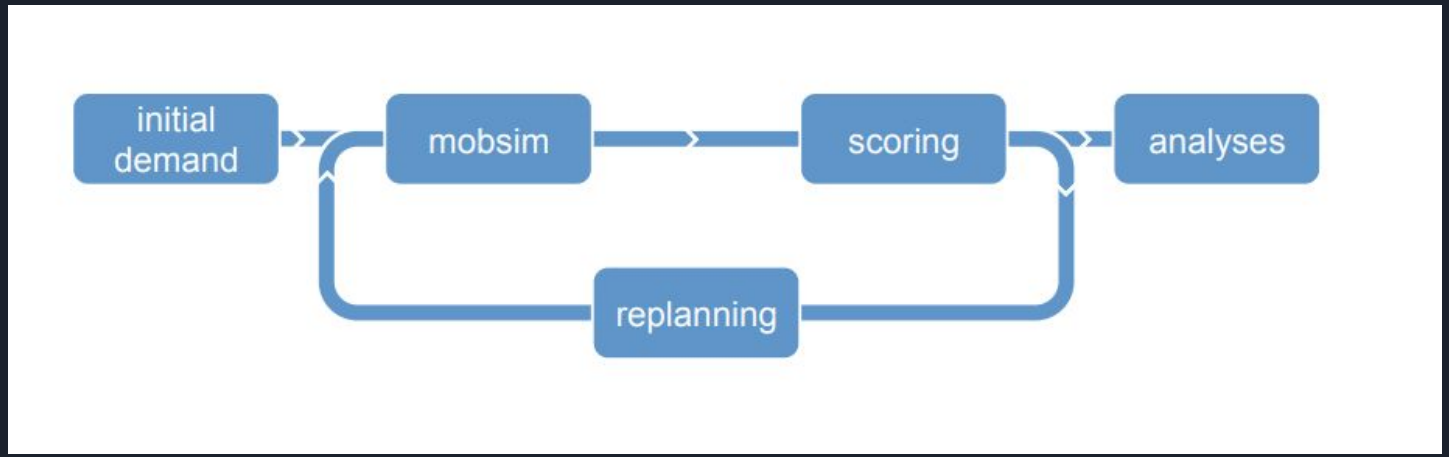
• Microscopic modeling of traffic: MATSim performs integral microscopic simulation of resulting traffic flows and the congestion they produce.

• Microscopic behavioral modeling of demand/agent-based modeling: MATSim uses a microscopic description of demand by tracing the daily schedule and the synthetic travelers' decisions. In retrospect, this can be called "agent-based".

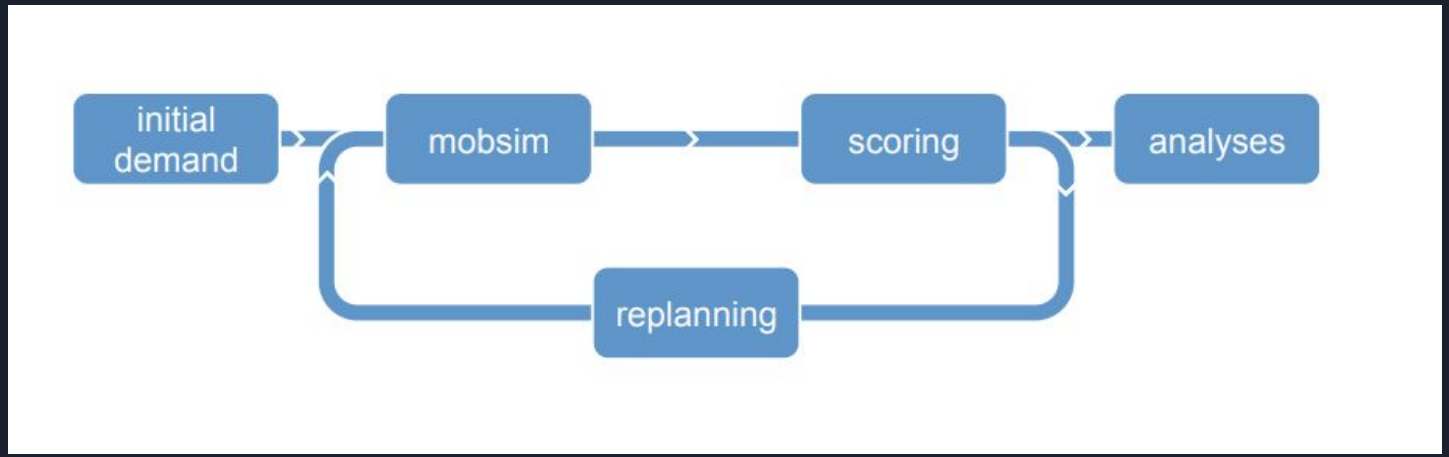
• Computational physics: MATSim performs fast microscopic simulations with 107 or more "particles"

• Complex adaptive systems/co-evolutionary algorithms: MATSim optimizes the experienced utilities of the whole schedule through the co-evolutionary search for the resulting equilibrium or steady state

- Activity-based, extendable, multi-agent simulation framework
- open-source
- designed for large-scale scenarios
- queue-based model
- omitting very complex and computationally expensive car-following behavior
- model a single day scenarios
- co-evolutionary principle（Every agent repeatedly optimizes its daily activity schedule while in competition for space-time slots with all other agents on the transportation infrastructure.）



- Initial demand arising from the study area population's daily activity chains. The modeled persons are called agents
- Activity chains are usually derived from empirical data through sampling or discrete choice modeling.
- Every agent possesses a memory containing a fixed number of day plans where each plan is composed of a daily activity chain and an associated score. The score can be interpreted as an econometric utility
- Each individual has its plan with a score

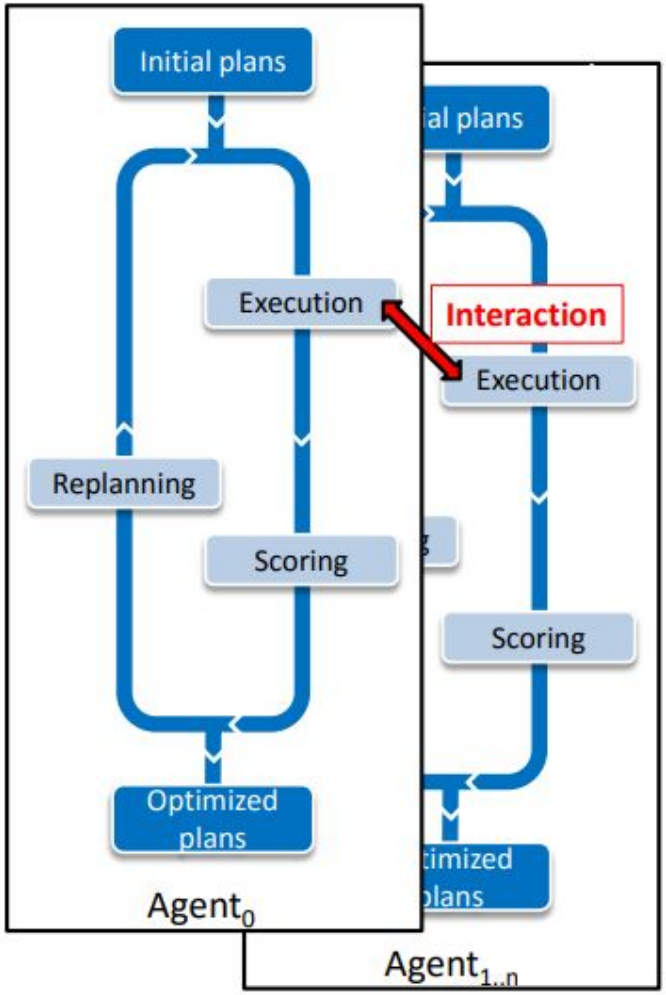


- Plan modification is performed by the replanning modules
- Four dimensions are usually considered for MATSim at this time: departure time (and, implicitly, activity duration), route, mode and destination
- Routing often is a best-response modification, while time and mode replanning are random mutations.
- The plan with the lowest score (configurable) is removed from the agent's memory.
- A model generating a logit distribution for plan selection is used.

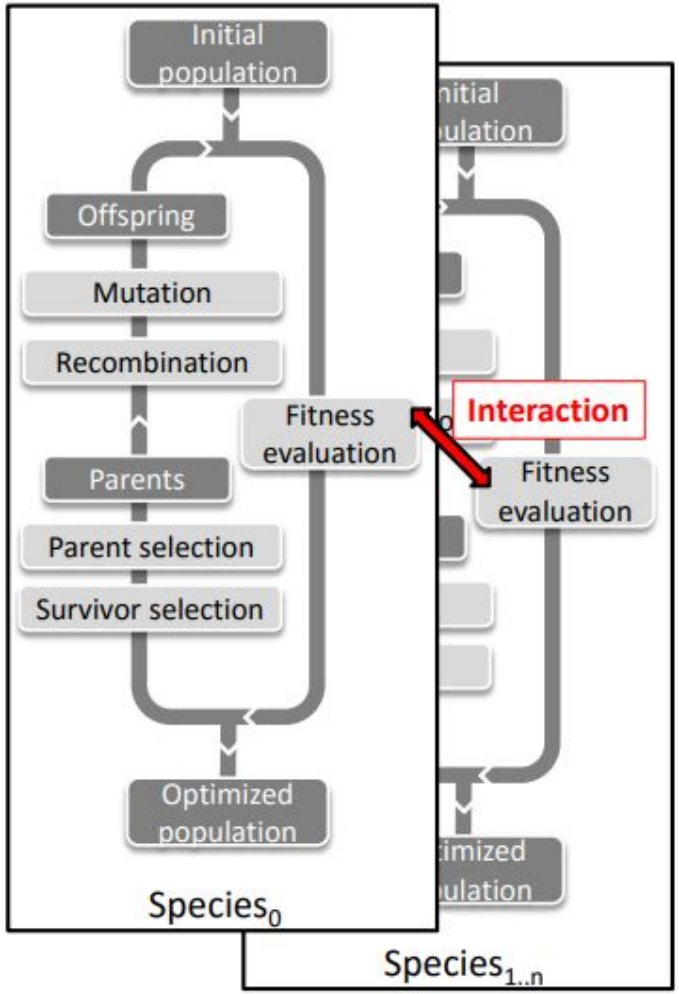
MATSim’s Traffic Flow Model

- mobsims

- physical simulations, featuring detailed car following models,
- cellular automata, in which roads are discretized into cells
- queue-based simulations, where traffic dynamics are modeled with waiting queues
- mesoscopic models, using aggregates to determine travel speeds, and
- macroscopic models, based on flows rather than single traveler units



MATSim



Co-Evolutionary Algorithm

MATSim's Co-Evolutionary Algorithm

These algorithms co-evolve different species subject to interaction (e.g., competition).

In MATSim, individuals are represented by their plans, where a person represents a species.

With the co-evolutionary algorithm, optimization is performed in terms of agents' plans,

i.e., across the whole daily plan of activities and travel.

It achieves more than the standard traffic flow equilibria, which ignores activities.

Eventually, an equilibrium is reached, subject to constraints, where the agents cannot further improve their plans unilaterally.

Evolutionary algorithm vs co-evolutionary algorithm

An evolutionary algorithm would lead to a system optimum, as optimization is applied with a global (or population) fitness function.

The co-evolutionary algorithm leads to a (stochastic) user equilibrium, as optimization is performed in terms of individual scoring functions and within an agent’s set of plans.