Centrum Kompetencji
w Zakresie Rozproszonych Infrastruktur
Obliczeniowych Typu Gridowrgo – PLGrid Core

Parameter Sweep and Resources Scaling Automation in Scalarm Data Farming Platform

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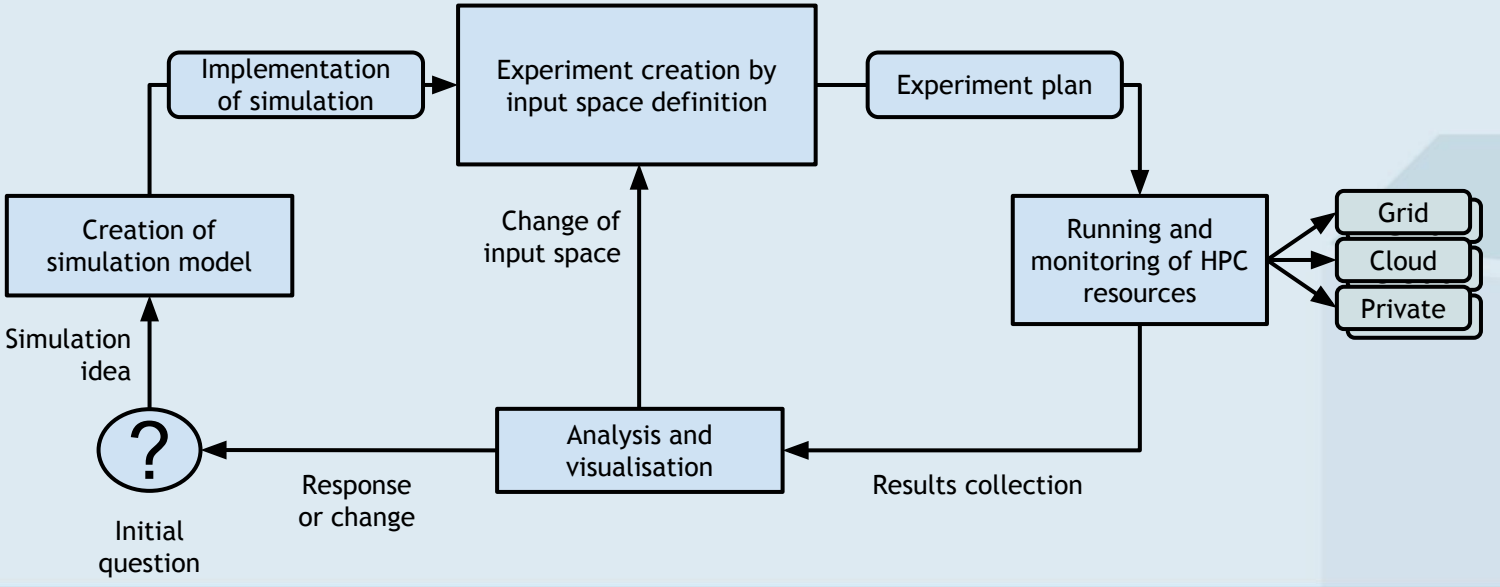
Agenda

- Data processing in modern science
- Problem description
- Scalarm overview
- Scalarm approach to automation
- Results
- Conclusions and future work

Data processing in modern science

- Scientific research methods often rely on executing numerous simulations each with different input parameter values
- One such approach is called data farming



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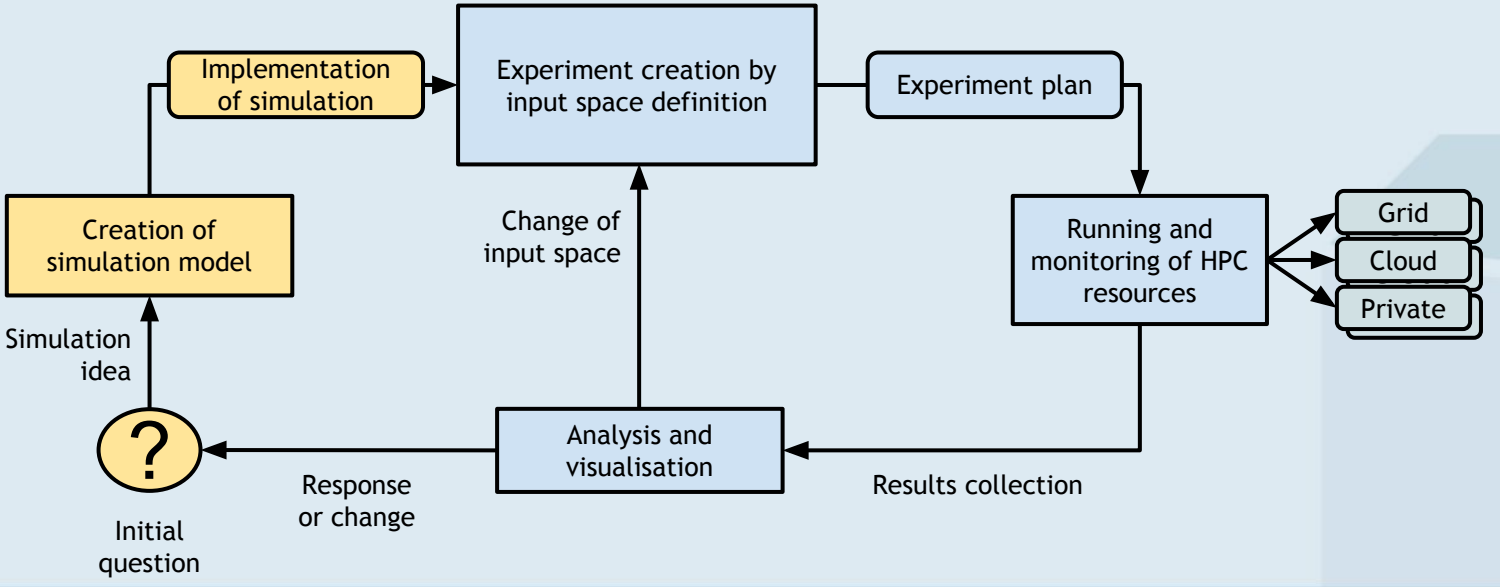

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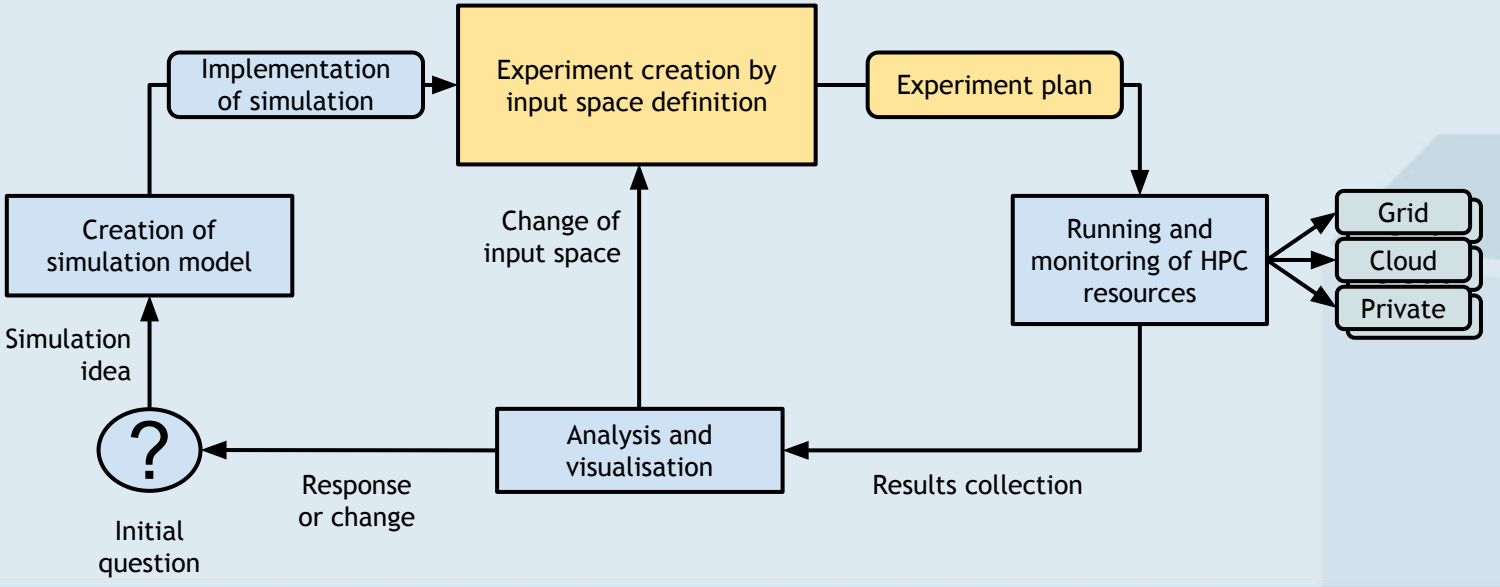

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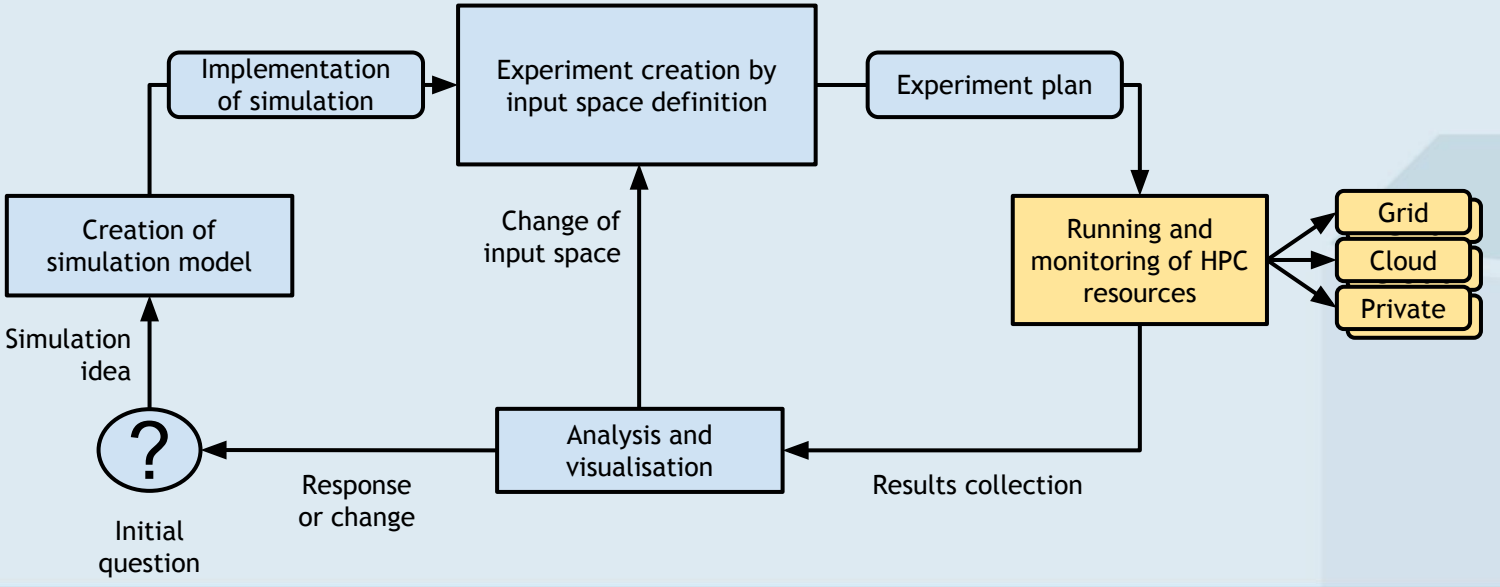

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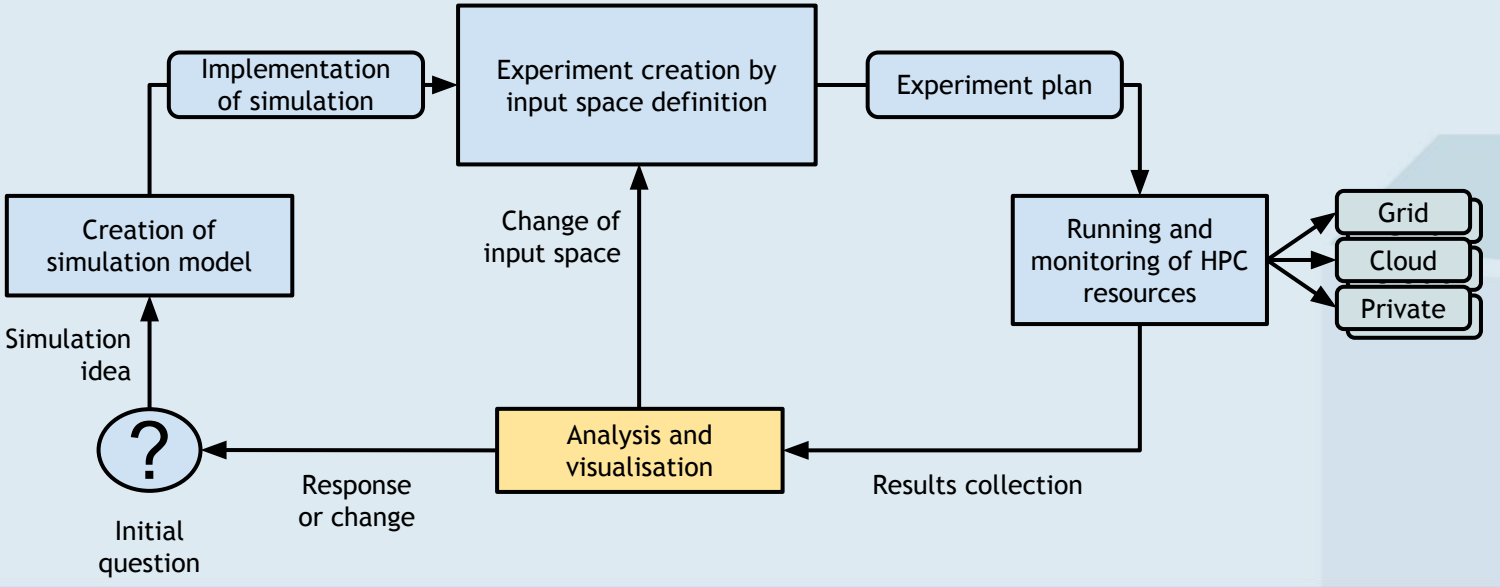
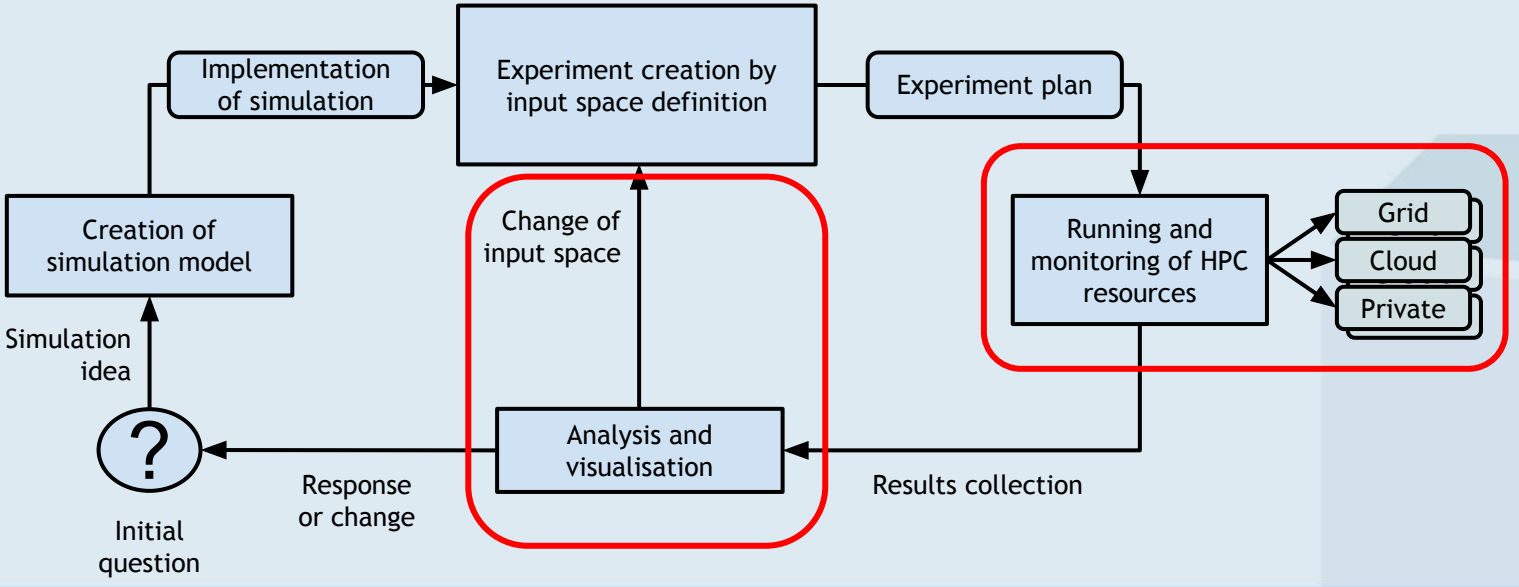


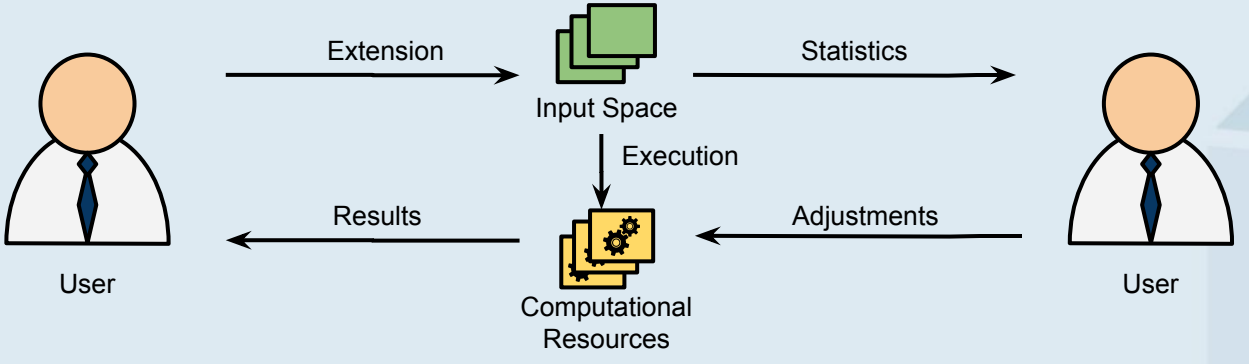
Problem description

- Data science computation often requires input space adjustments according to collected partial results
- Need of resources management according to changing computational power requirements



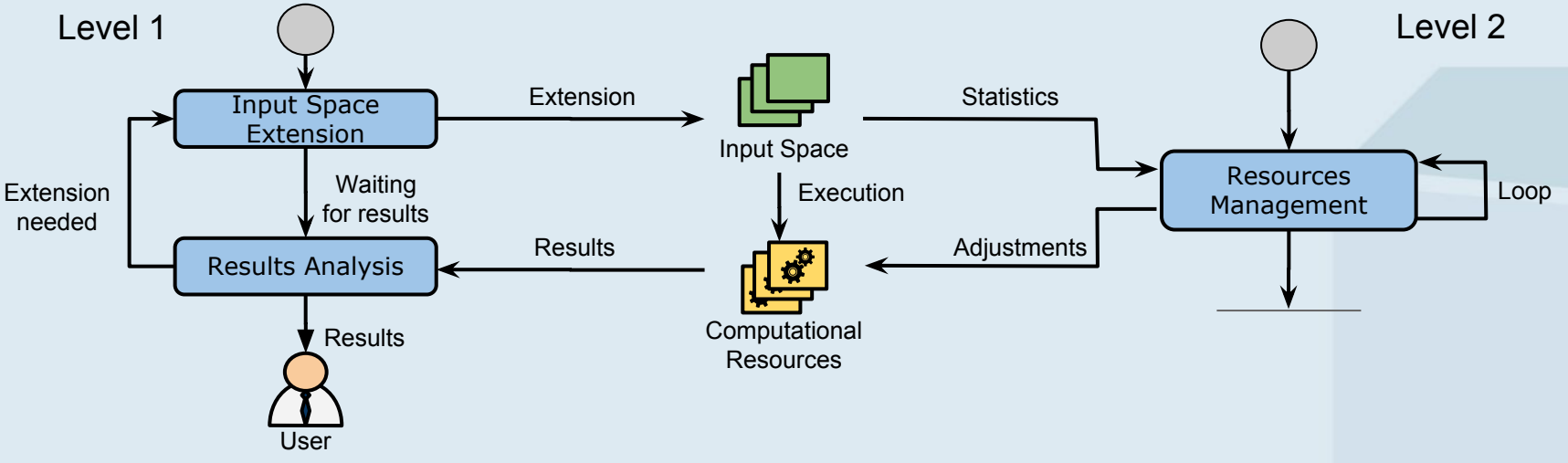
Scalarm overview

- Scalarm - a platform for data farming, allows user to execute experiments in convenient way
- Unified management of heterogeneous resources
- Partial results analysis with numerous methods
- Input space extension during experiment



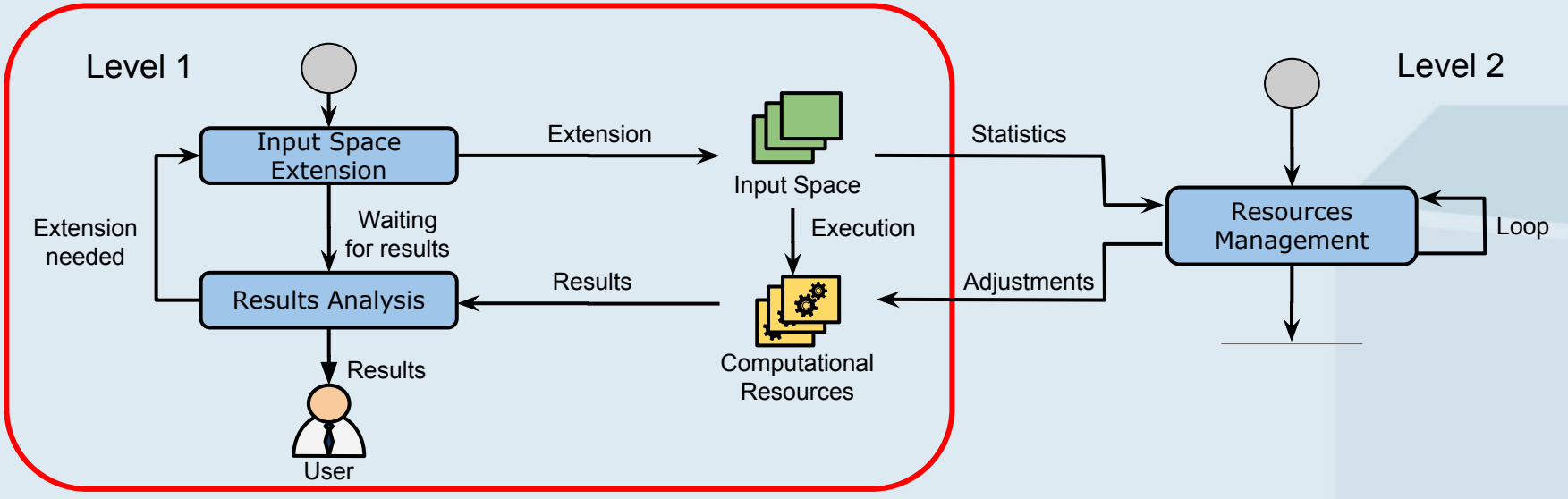
Scalarm approach to automation

- Two levels of experiment automation:
  - Input space adjustment
  - Resources management



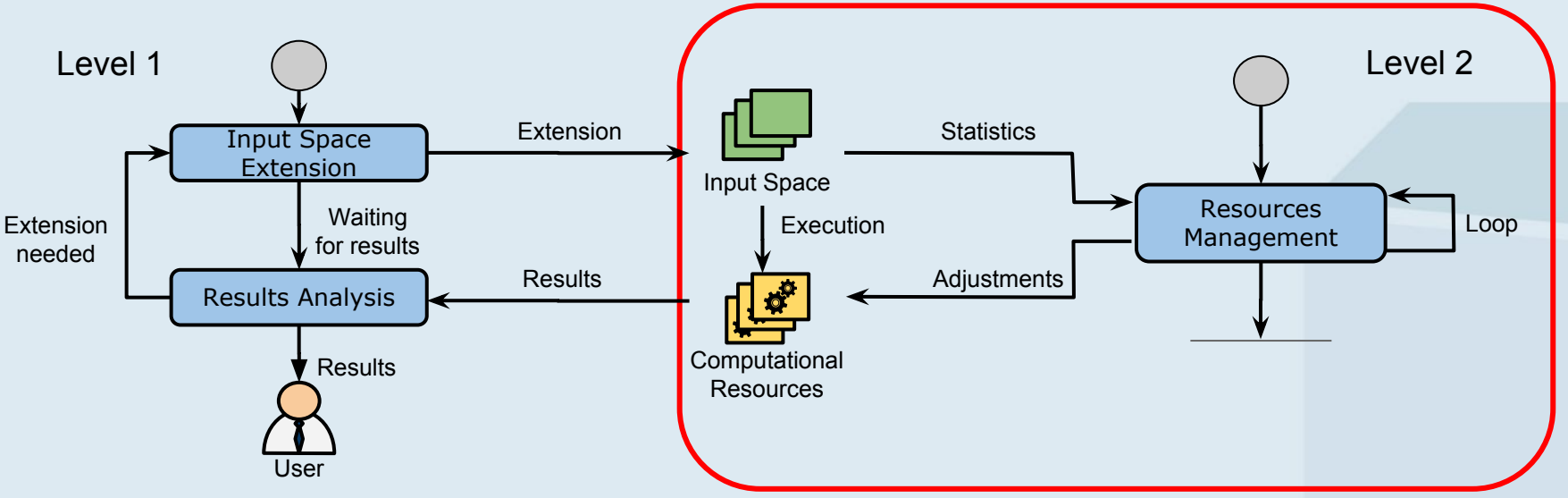
Input space adjustment

- Input space management algorithm:
  - Input space extension
  - Analysis of requested data
- Dedicated simulated annealing algorithm



Resources management

- Resources management algorithm:
  - Pulling metrics about current state
  - Metrics analysis
  - Increasing or decreasing amount of workers



Resources management metrics

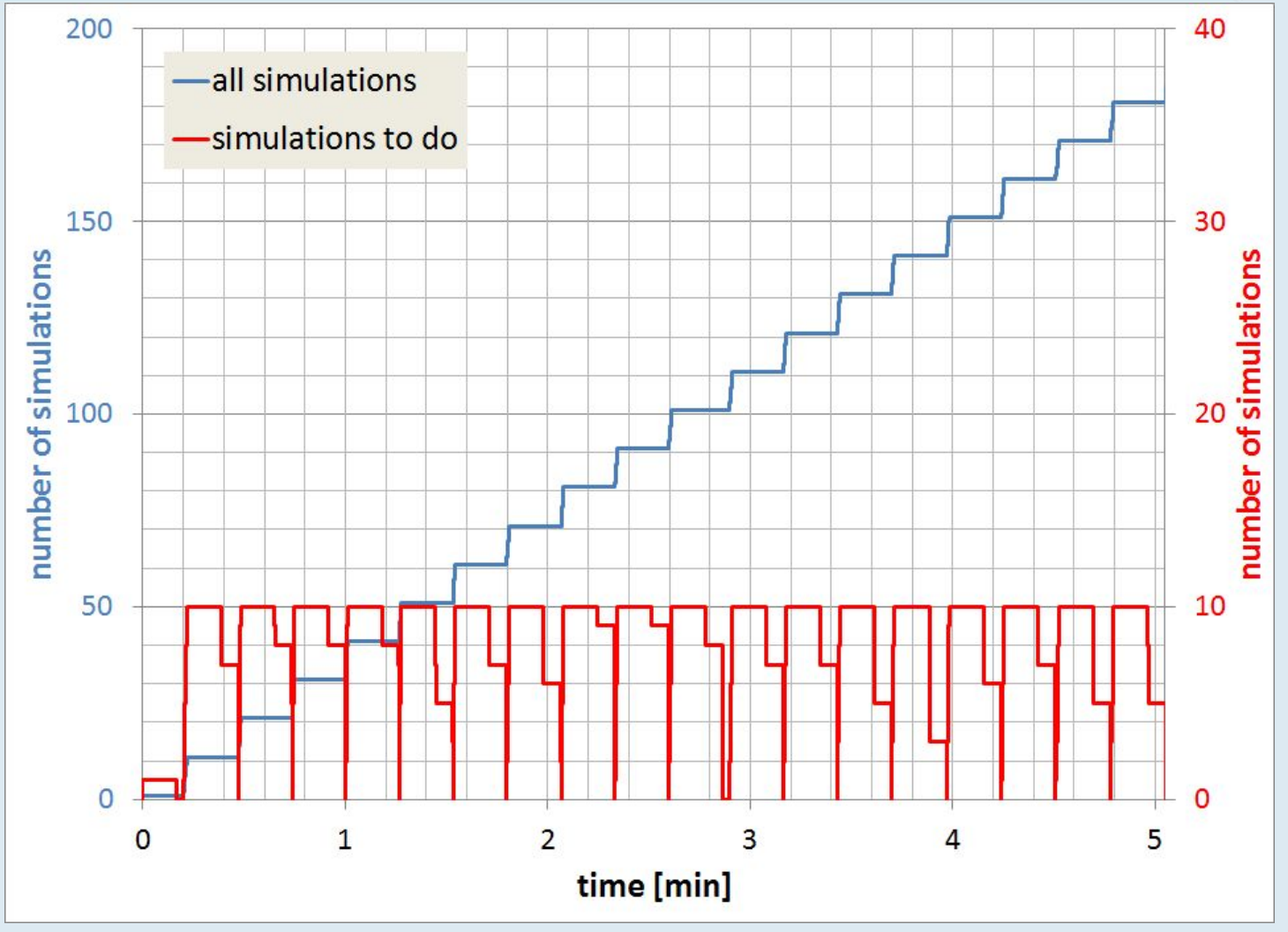
- Metrics used during resources management
  - workers throughput $T_W = \frac{done\ simulations}{execution\ time}$
  - system throughput $T_S = \sum T_W$
  - target throughput $T_T = \frac{simulations\ to\ run}{time\ left}$
  - makespan [time] $M = \frac{simulations\ to\ run}{T_S}$

Evaluation

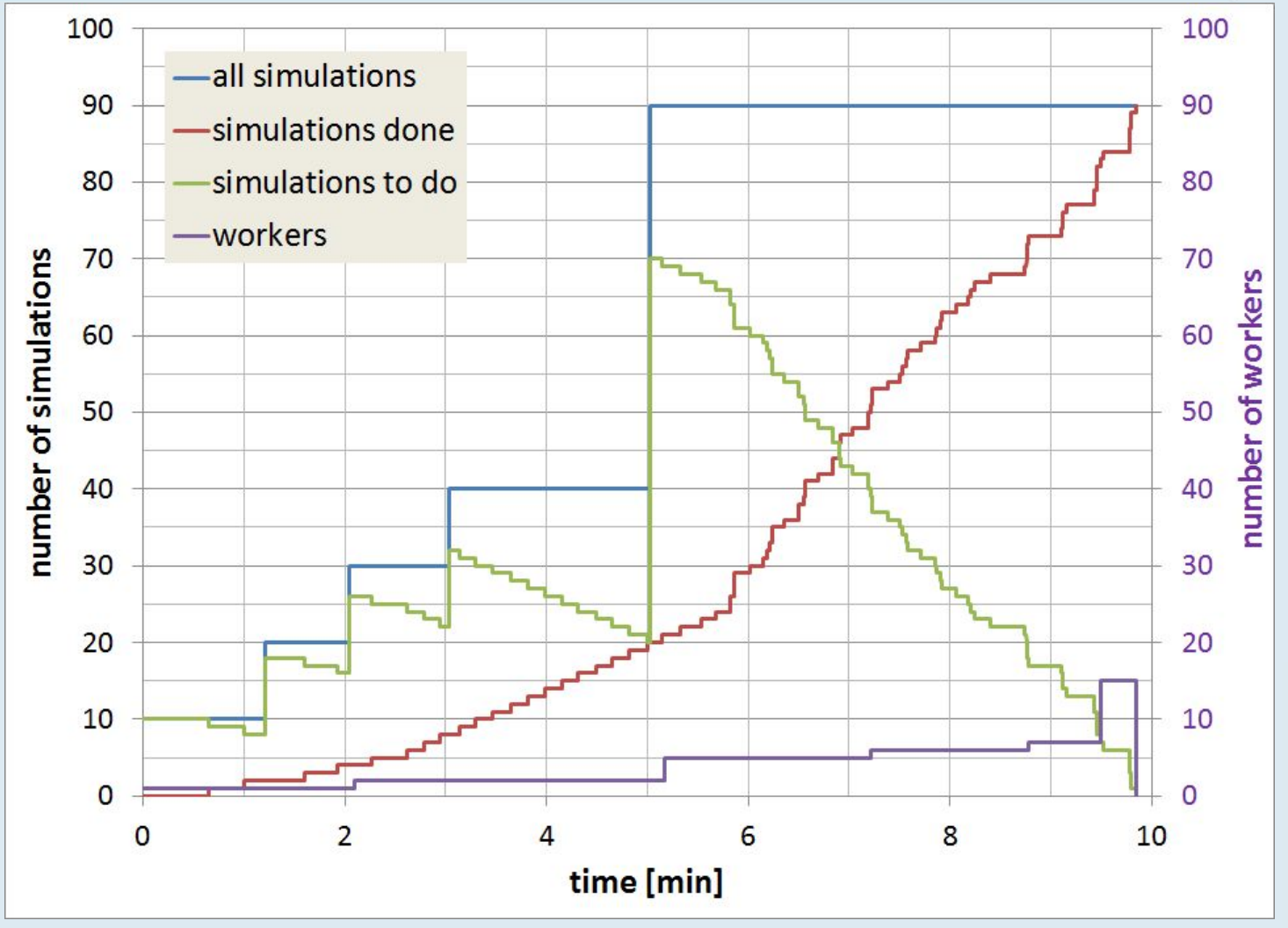
Test 1: Automated input space extension evaluation
- Input space controlled by simulated annealing algorithm
- Fixed time of simulation execution - 10 seconds
- Fixed number of workers - 10

Test 2: Automated resources management evaluation
- Resources controlled by our resources management algorithm
- Fixed time of simulation execution - 20 seconds
- Manual input space extensions
- Experiment execution time constrained to 10 minutes

Automated input space extensions



Automated resources management



Conclusions

- Two levels of automation - input space adjustments and resources management
- Plugin-based architecture allows an easy extension with new algorithms
- Integration of these levels of automation is challenging
  - Automated input space extension requires calculation of all simulation from ‘bundle’ before scheduling next one
  - Resources management algorithm must take into account input space extension by bundle of simulations

Future Work

- Resources management algorithm better suited to data farming experiments
  - Predicting amount of simulation yet to be scheduled based on available data
  - Metrics extension
- Additional dedicated input space management algorithms, e.g. genetic algorithm