Exploring agent based models

From laptop to world class HPC

Arthur Brugière - *July 2020*

Who am I ?

Let me introduce myself

Arthur Brugiere

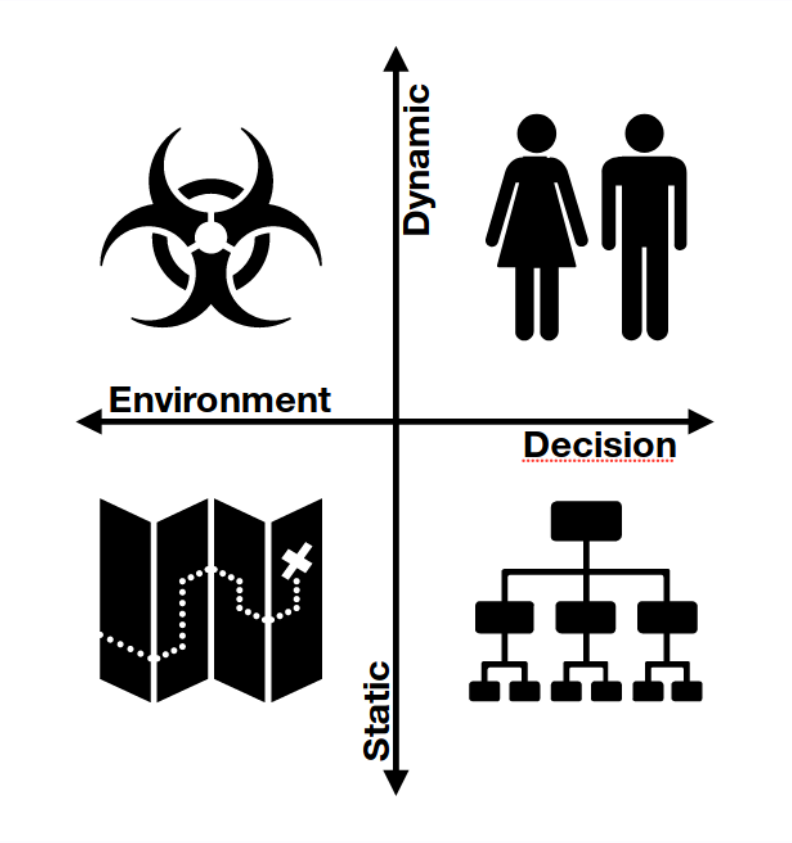
- Finished my Master at the USTH (Vietnam)
- Engineer on projects ANR ESCAPE & COMOKIT
- Working on GAMA for 2 years
- Mostly involved in *Big Data*, model exploration and *High Performance Computing* (HPC) usage
- Should start a thesis next year

What's ESCAPE

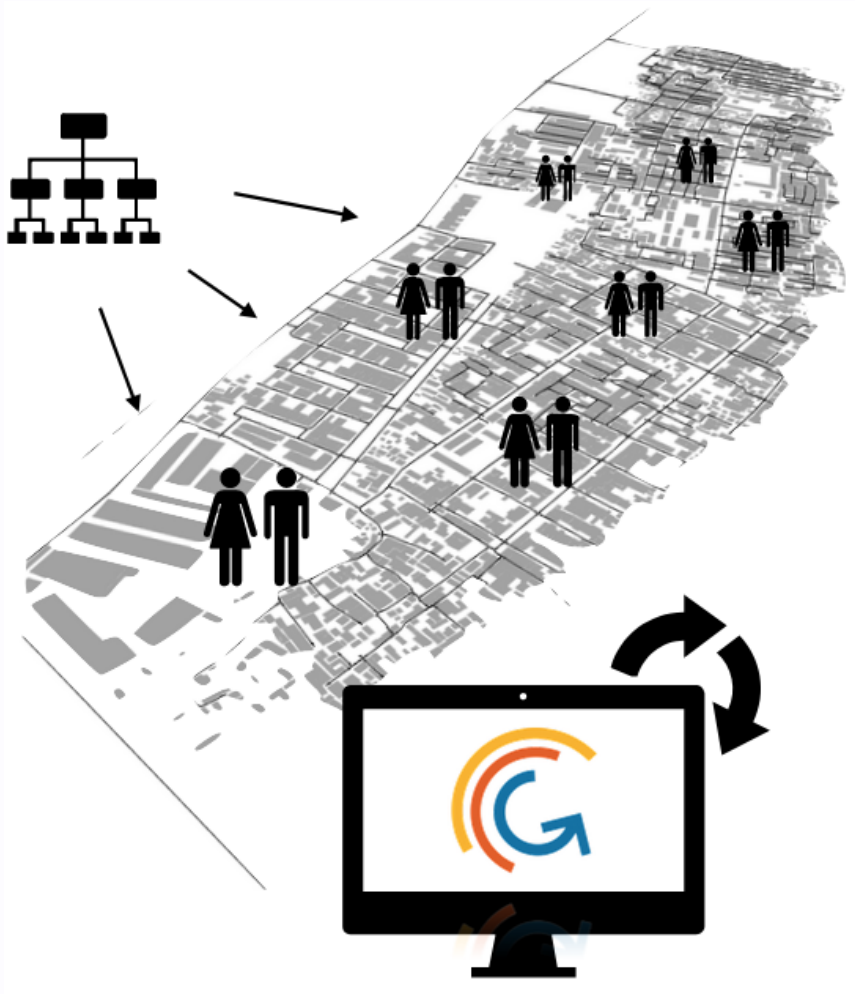
Exploring by Simulation Cities Awareness on Population Evacuation

ESCAPE: city scale evacuation

- **Hazard**: It never sticks to the plan
- **Environment**: *Roads* and *buildings* turn into enemies
- **Human behavior**: *People* do everything to make the plan fail
- **Evacuation plan**: *Organization(s)* spend resources to help people



ESCAPE Framework



- Geographical layers
- People decision and behavior
- Evacuation plans
- Hazard scenario

Why explore ?

Answer that kinds of questions

What If	**How To**
An exit point is closed	Evacuate as soon as possible
Explosion of a factory in the Rouen industrial area	Evacuate the most non-autonomous people under resource constraints

ABM* exploration is expensive and time consuming !

Let's do some maths :

For a simulation with 3 parameters with 10 values each

10^3 = **1.000 simulations** * *repetitions*

* Agent Based Model

Objective :

Explore the entire parameter space with a minimal number of simulations

How to explore these models easily ?

The full self-hosted solution

OpenMole

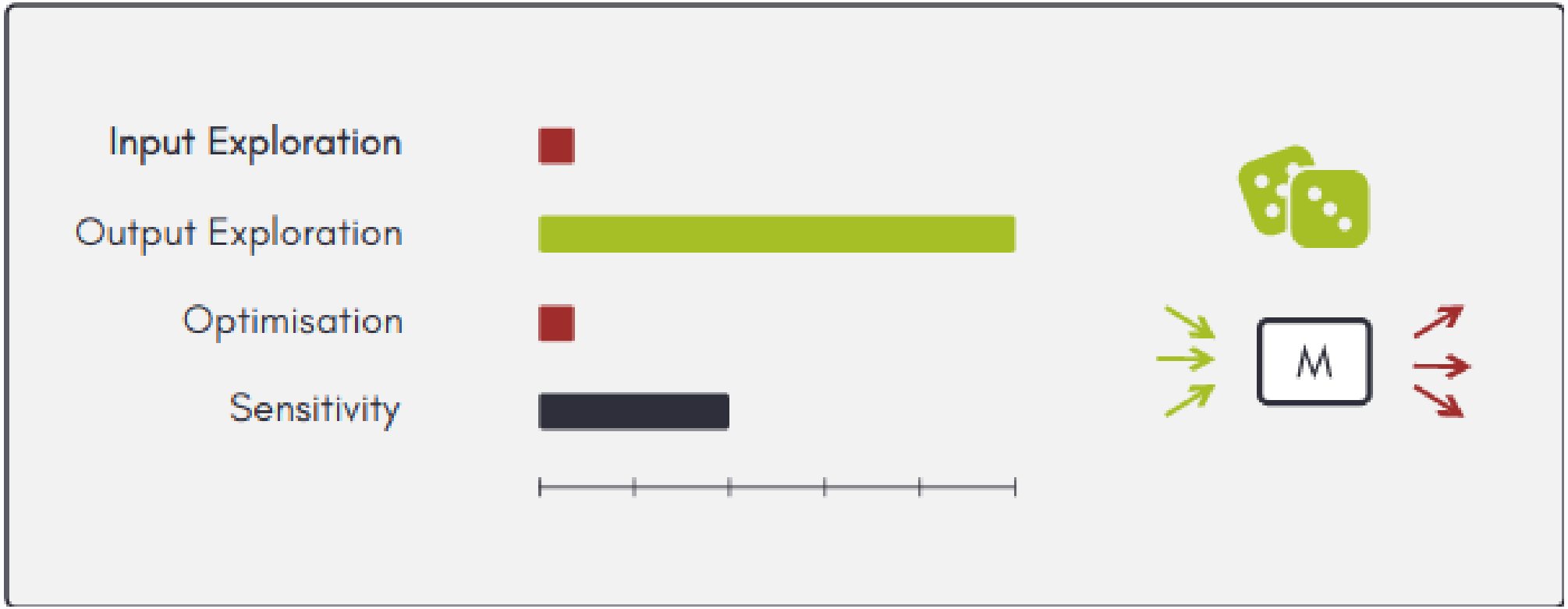
- Free and open-source platform
- Offers tools to run, explore, diagnose and optimize model
- Distributed computing environments
- Works with GAMA

OpenMole provide functions to explore diversity in *input* or *output*

ESCAPE	**OpenMole**
How To	Pattern Space Exploration (PSE)
What If	Origin Space Exploration (OSE)

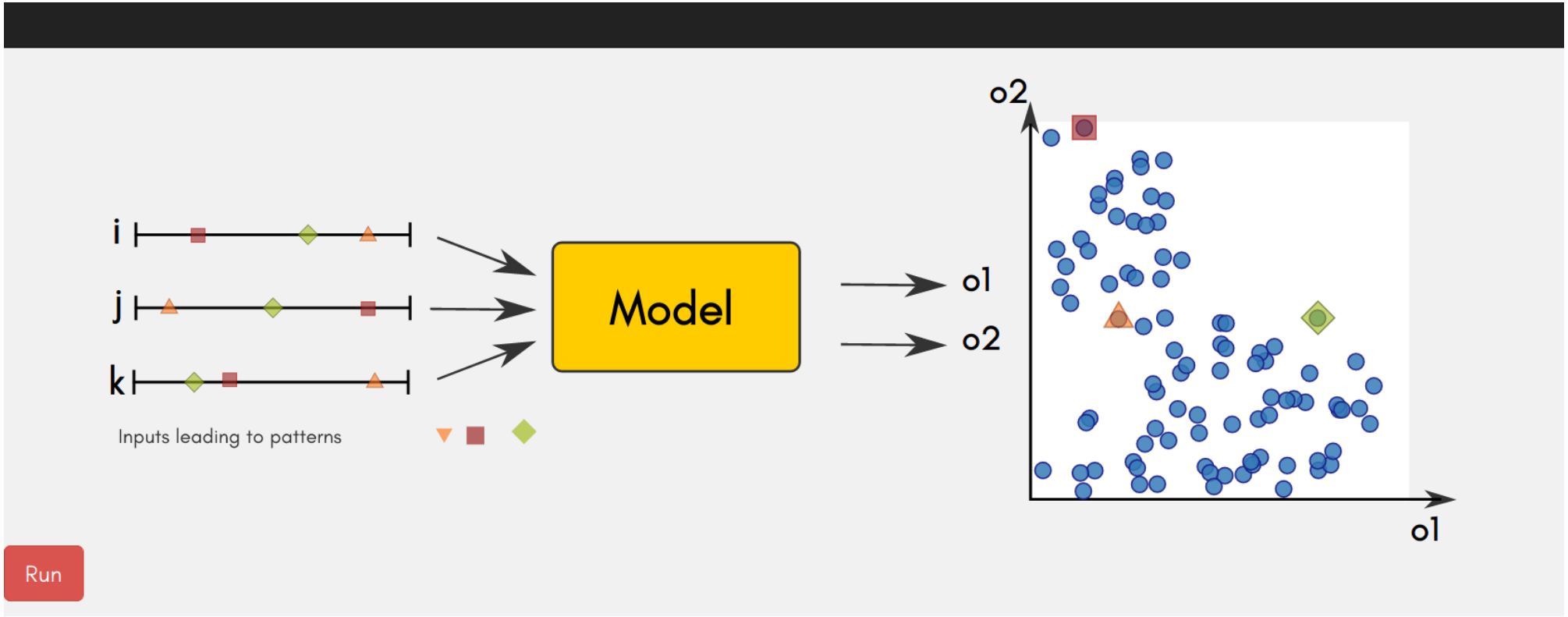
Explaination of the PSE

What the *Pattern Space Exploration* is for ?



Explaination of the PSE

How the *Pattern Space Exploration* works ?



GAMA  HPC

COMOKIT use-case

* HPC == High Performance Comuter

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Context: OpenMole need a specific virtualizator (*Singularity*) to run GAMA

Problem: That virtualizator is not install on the HPC

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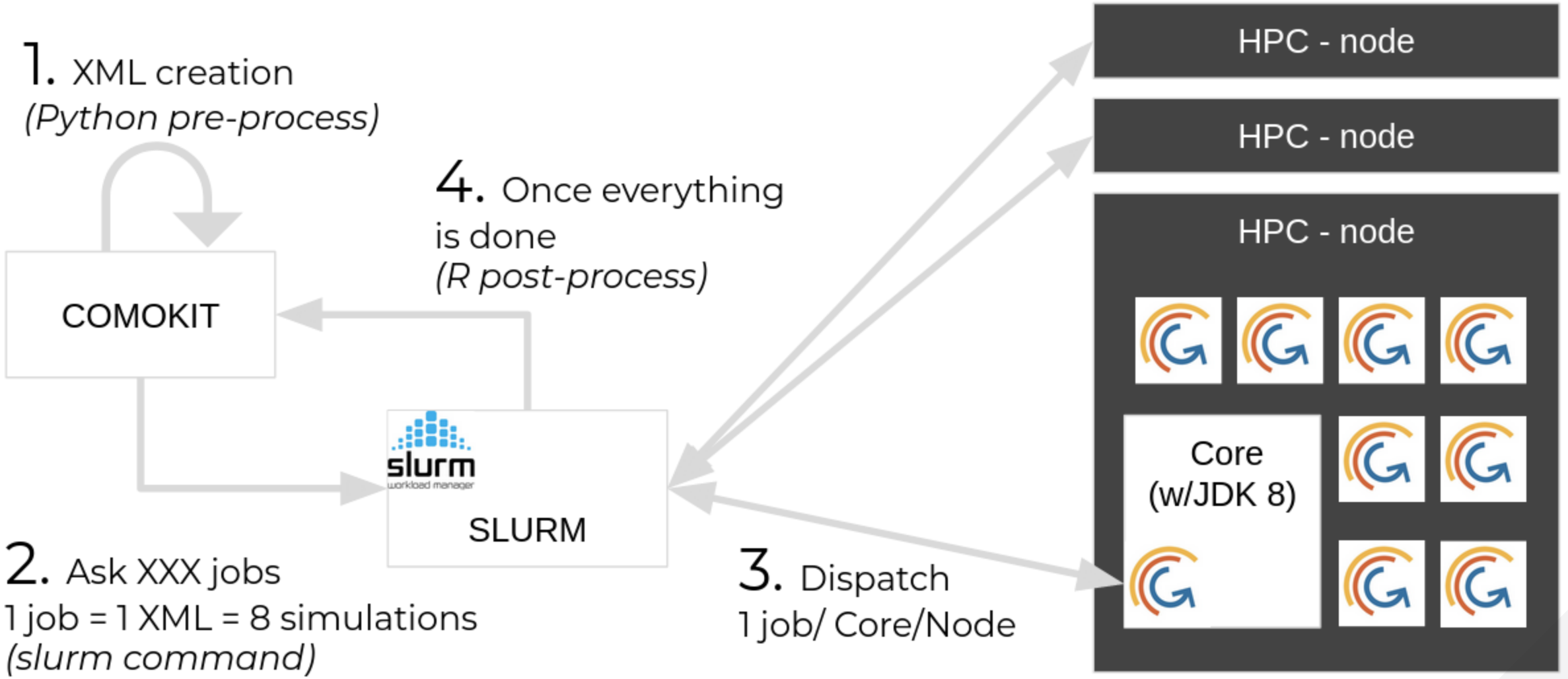
Solution: Use a custom setup to optimize parallelization run with GAMA's headless tools

HCP pipeline



My PhD subject 🎓

Two main points in it

Co-modeling

Continue thesis subject from Dr. Huynh Quang Nghi*

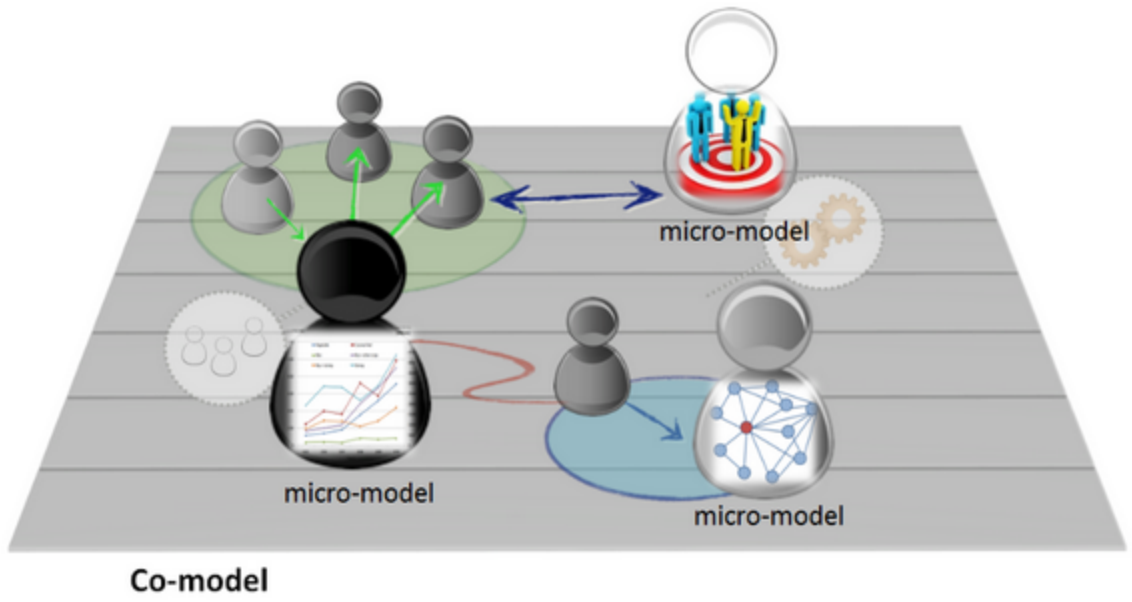


Figure 3.1: Co-models extend the base concepts of agent-based modeling formalism by allowing agents to be models themselves

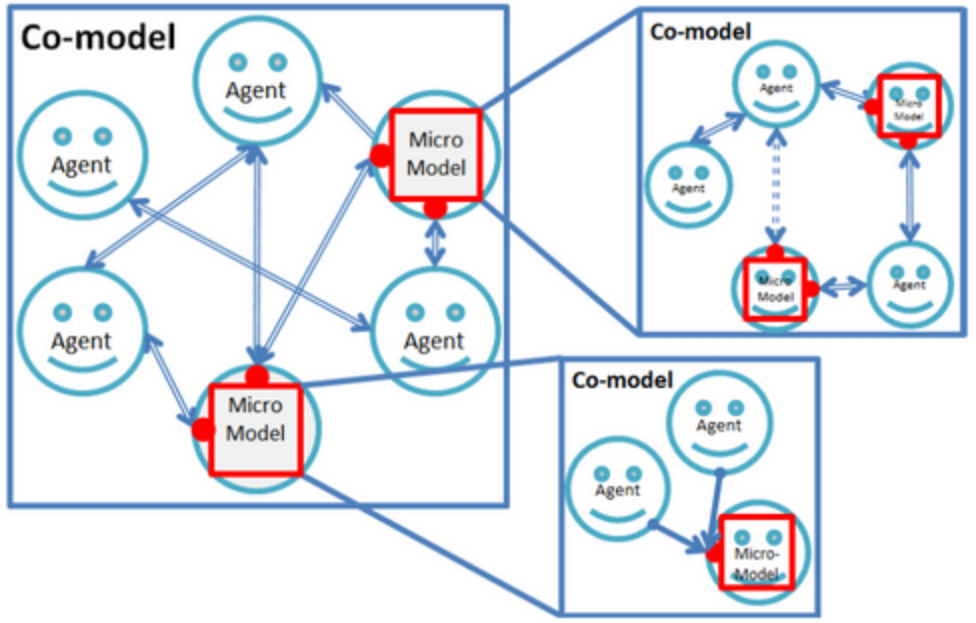


Figure 3.2: Micro-model can be co-models too

* Huynh, Quang-Nghi. CoModels, engineering dynamic compositions of coupled models to support the simulation of complex systems. Diss. Université Pierre et Marie Curie-Paris VI, 2016.

Parallelization of simulation processing

Working on parallel multi-scale calculation, which may be appliable on HPC environments

Thanks for your attention

Feel free to ask any questions you might have