AlGorille: Algorithms for the Grid

Jens Gustedt

INRIA Lorraine & LORIA
AlGorille

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AlGorithmes pour la Grille

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Outline

Algorithmics

Within Algorithmics we investigate efficient algorithms and prove statements about their resource usage.

Algorithm: A concise description of a technique to solve a given problem.

Efficiency: Ensure that the resource usage of an algorithms is as low as possible.

Proof: May be a theoretical proof (*e.g* on the bound of the number of operations) or a reproducible experimental study of the behavior.

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The notion ‘Grid’ was introduced in 1998 by Foster & Kesselmann:

Idea: Use resources on the net

- computing power
- bandwidth
- storage

transparently, like we use electricity:

customer provider

anonymous

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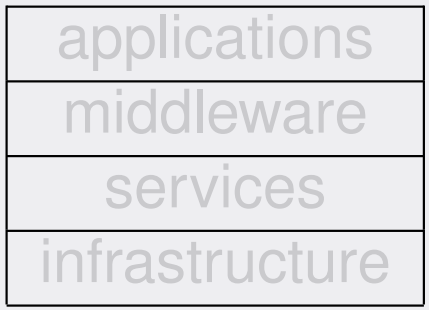

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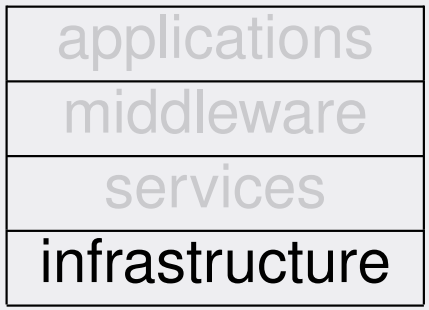

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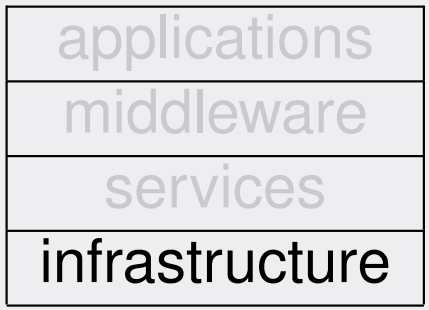

soft and hardware

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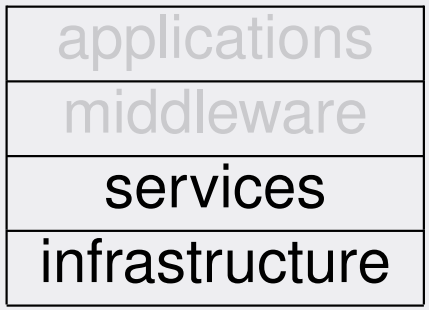

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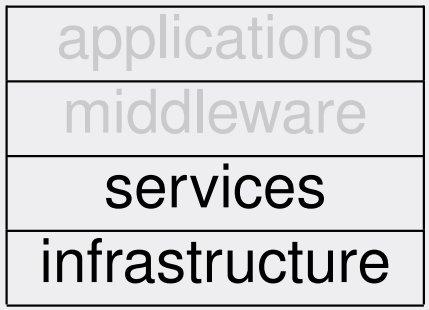

scheduling, data management...

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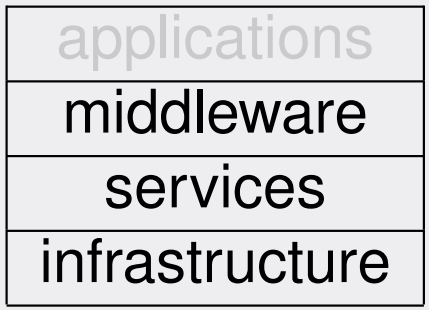

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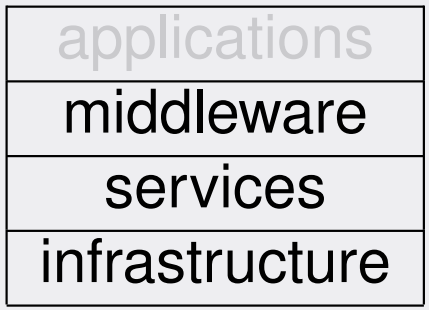

assemble service into platform API

Our Contribution

Layer model of a grid architecture:

applications
middleware
services
infrastructure

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External Collaborator:

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- Grid5000
- Alpage: ARA MDMSA
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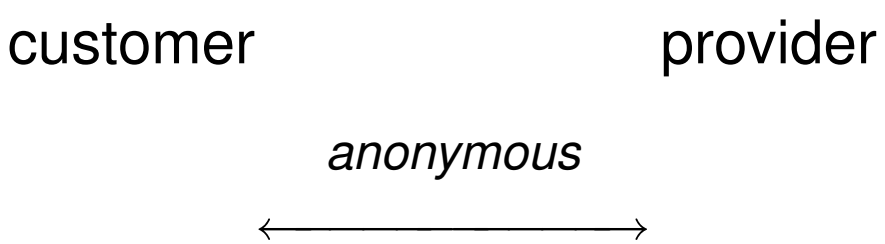

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customer broker provider

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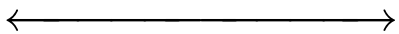

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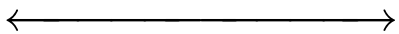

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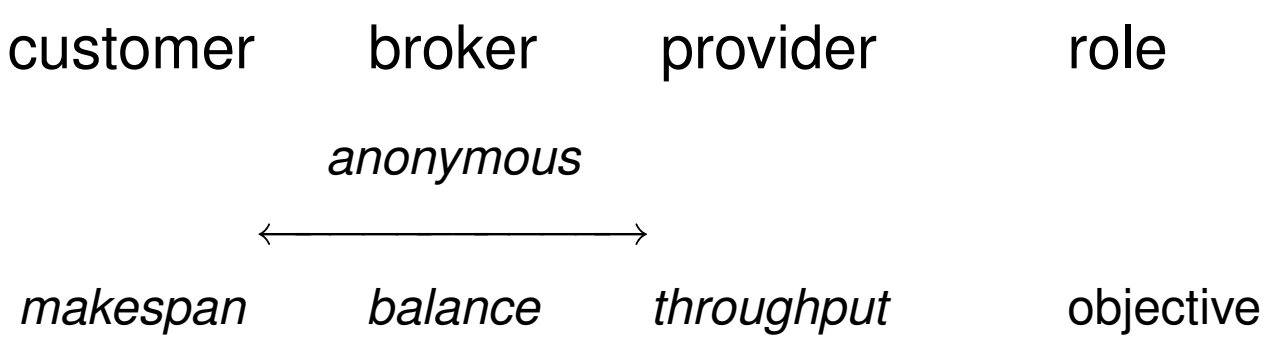

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The methodological challenge: performance evaluation

On top of all these difficulties: the problem of *performance evaluation*.

- Compare different algorithms in a reliable and reproducible way.
- Thereby demonstrate the progress our solutions provide.

We have to

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Models and algorithms for large scale computations

- Cellular Networks
- Matrix-based problems from Natural Science (Physics, biochemistry, ...)
- Graphs and other Dynamic Data Structures.

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Efficient algorithms for

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- Data exchange
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Experimental validation

- Simulation $\Longrightarrow$ SimGrid
- Emulation $\Longrightarrow$ Wrekavoc
- Large Scale Experiments $\Longrightarrow$ Grid5000
- Pilot Applications $\Longrightarrow$ parXXL

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cellular networks, neural networks, cristals

Large problems, some millions or billions of nodes.

Complex neighborhood structure and local functionality

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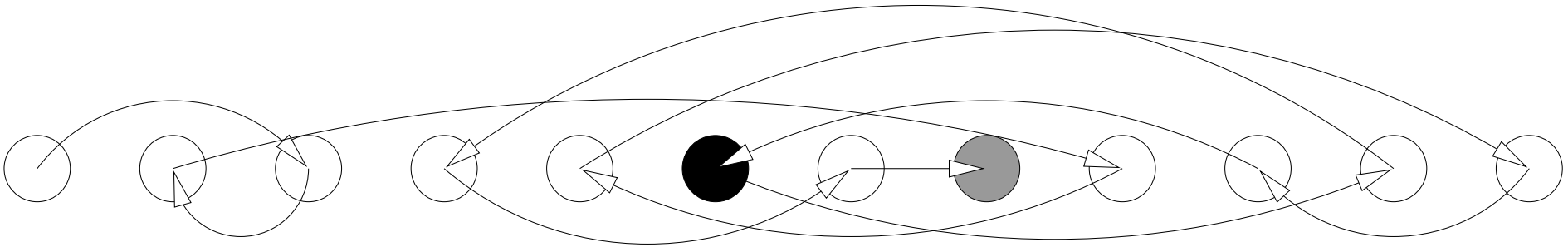

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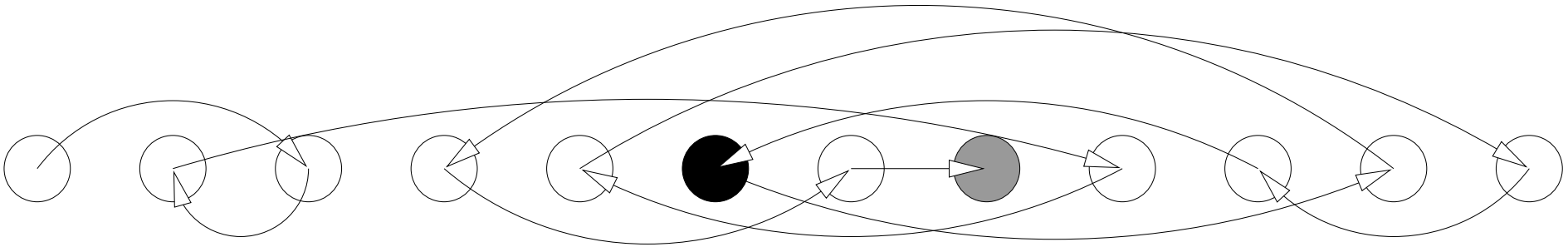

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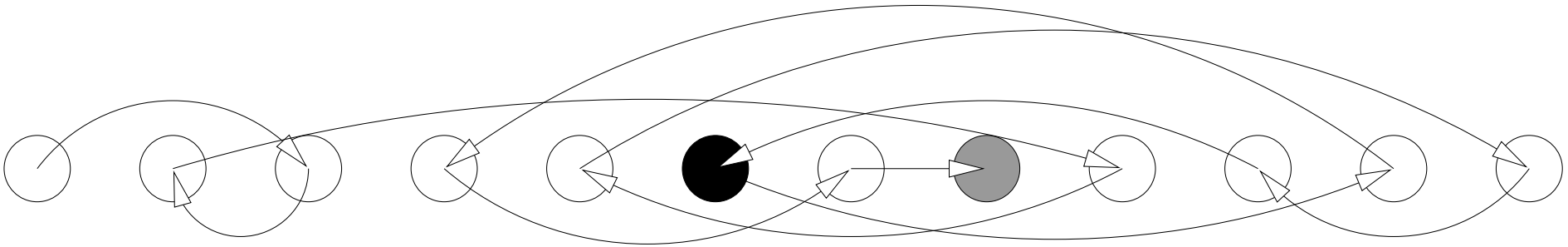

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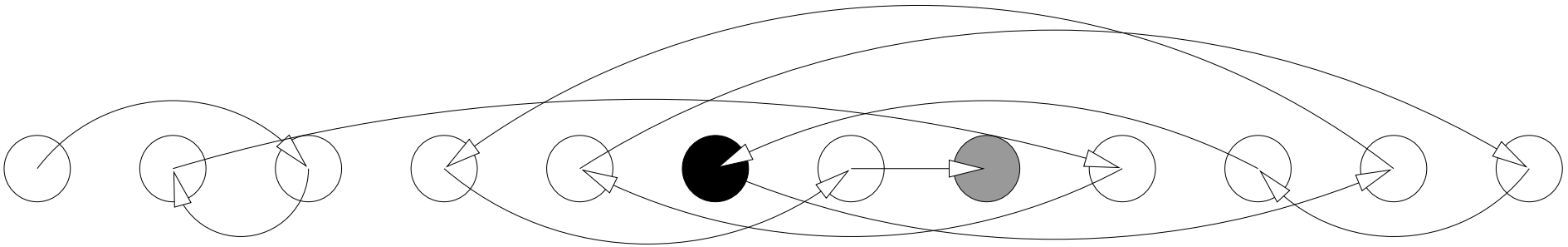

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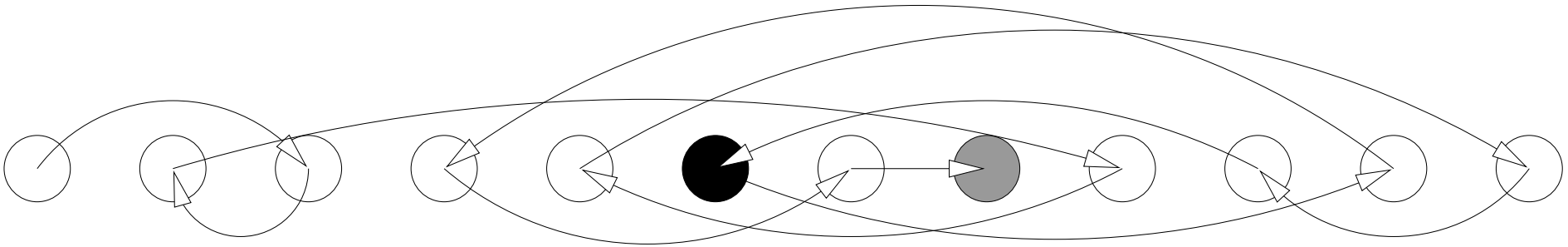

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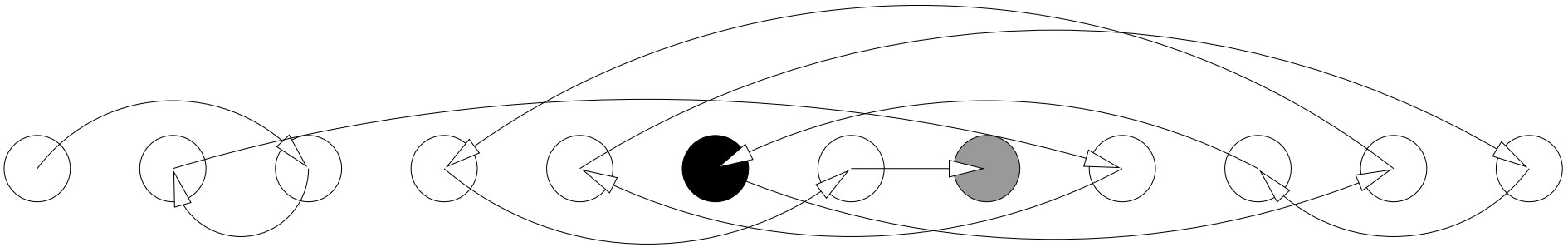

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Software

parXXL Algorithmic toolbox and testbed for fine grained computation on coarse grained architectures.

AdOC Communication compression on the fly.

SimGrid/GRAS Grid-simulator (SimGrid) and toolbox (GRAS) for service development, simulation, evaluation and deployment.

Wrekavoc Emulation of heterogeneity.

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GRAS (Grid Reality And Simulation)

Why: On simulator, one develops a prototype, not an application

What: Grid Research & Development Framework

- Study on simulator, produce real-world programs seamlessly
- Two implementations of the same interface
- Running to Linux, Mac OSX, Solaris, AIX, IRIX (Windows?)
- Communication speed almost comparable to MPICH
- Allow heterogeneous communications

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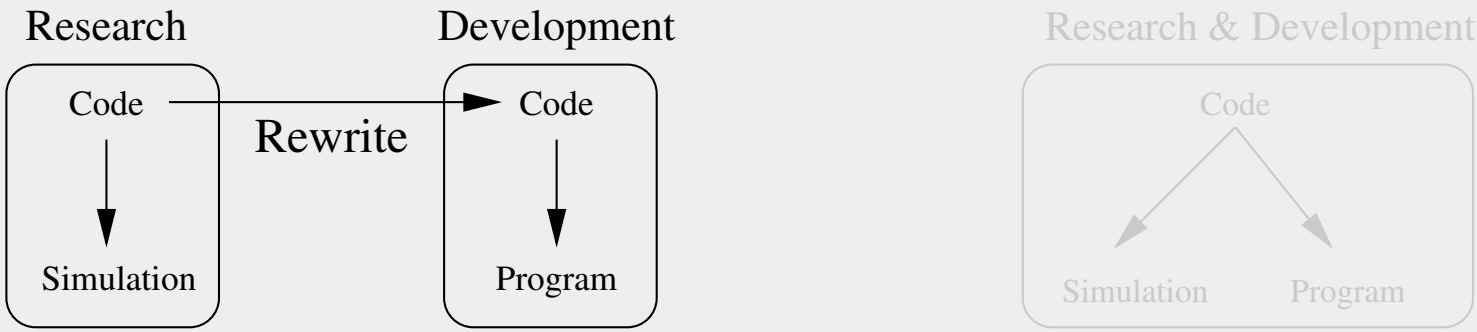

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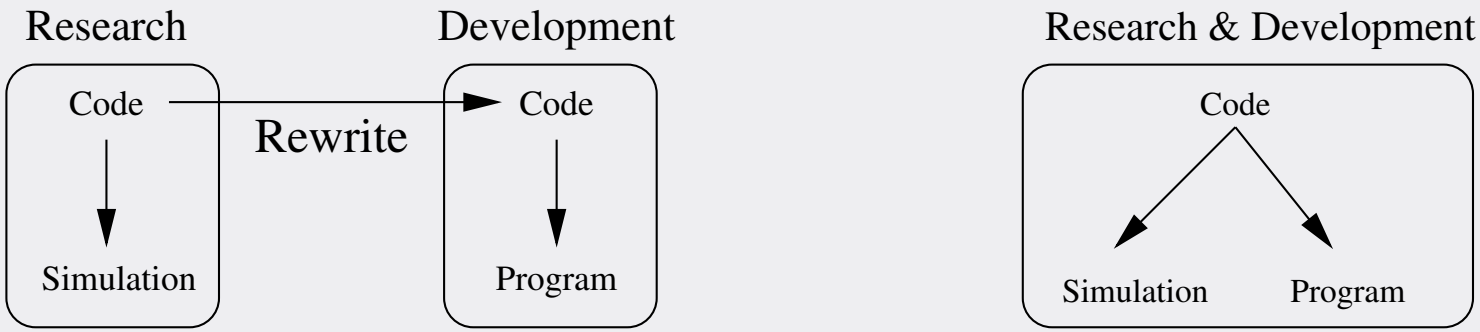

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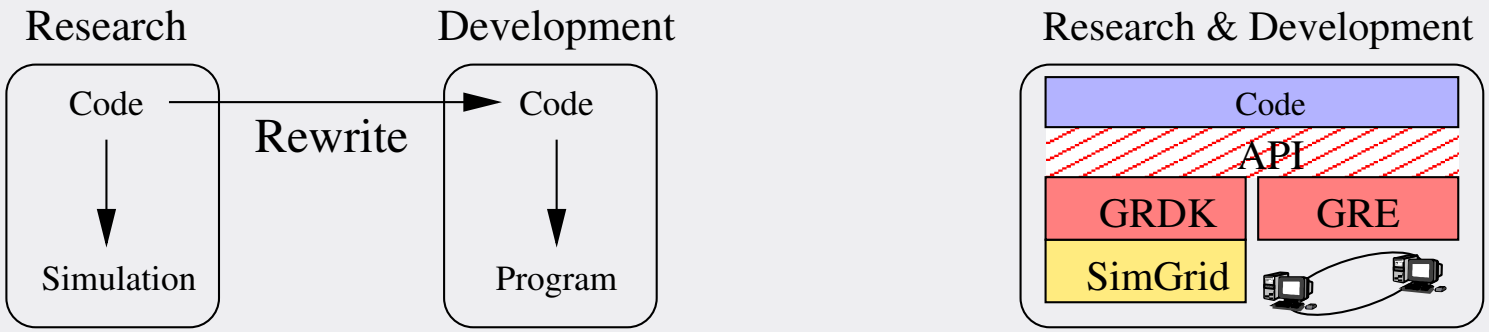

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Conclusion

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Algorithms for the Grid

Layer model of a grid architecture

Experi-mental valida-tion

applications
middleware
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⟸ Structuring applications for scalability

⟸ Transparent resource management

A lot of Software

parXXL AdOc SimGrid Wrekavoc

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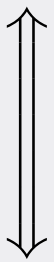
Experi-mental valida-tion



applications
middleware
services
infrastructure

⟸ Structuring applications for scalability

⟸ Transparent resource management

A lot of Software

parXXL AdOc SimGrid Wrekavoc

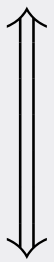
Conclusion

AlGorille

Algorithms for the Grid

Layer model of a grid architecture

Experi-mental valida-tion



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