Modelling and Solving Energy Problems with SMS++

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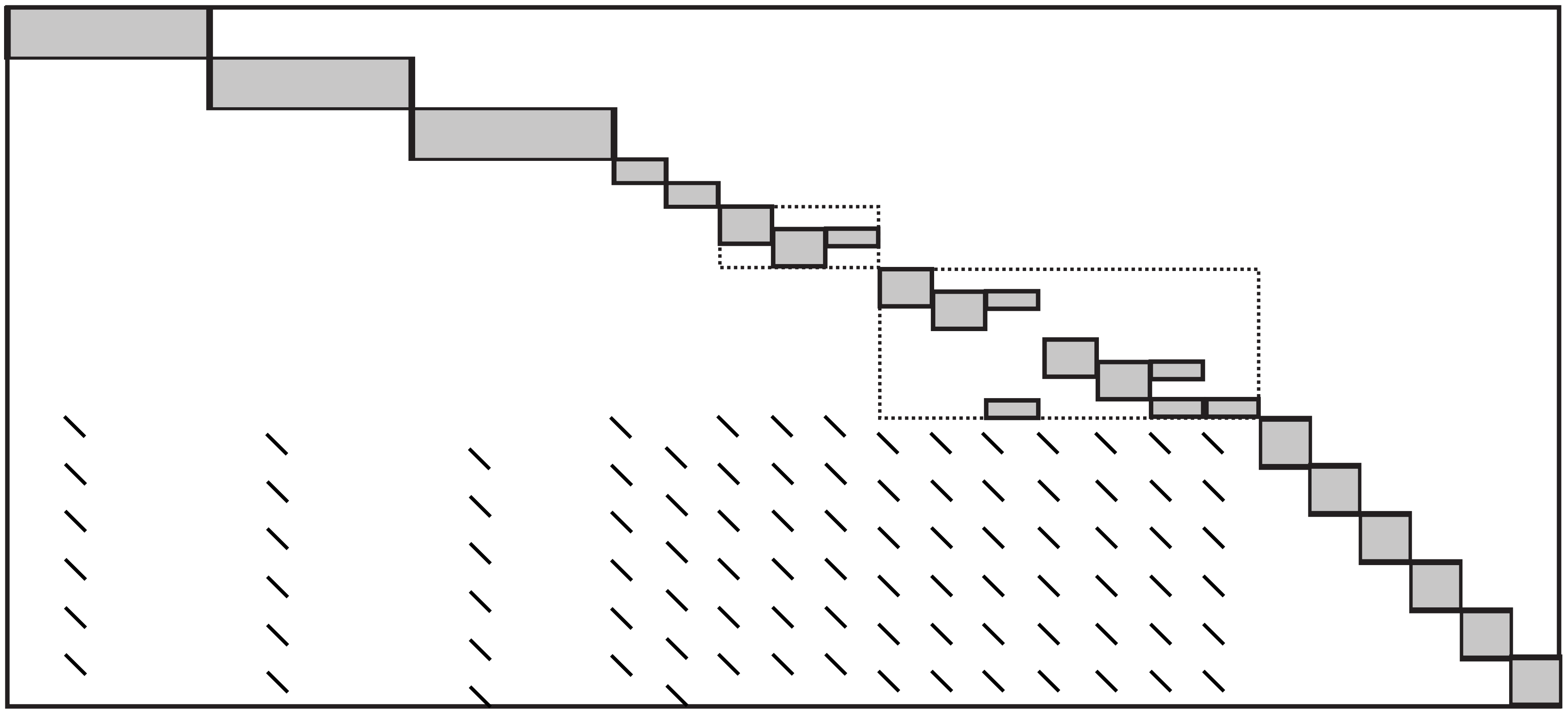
PGMO Days 2020

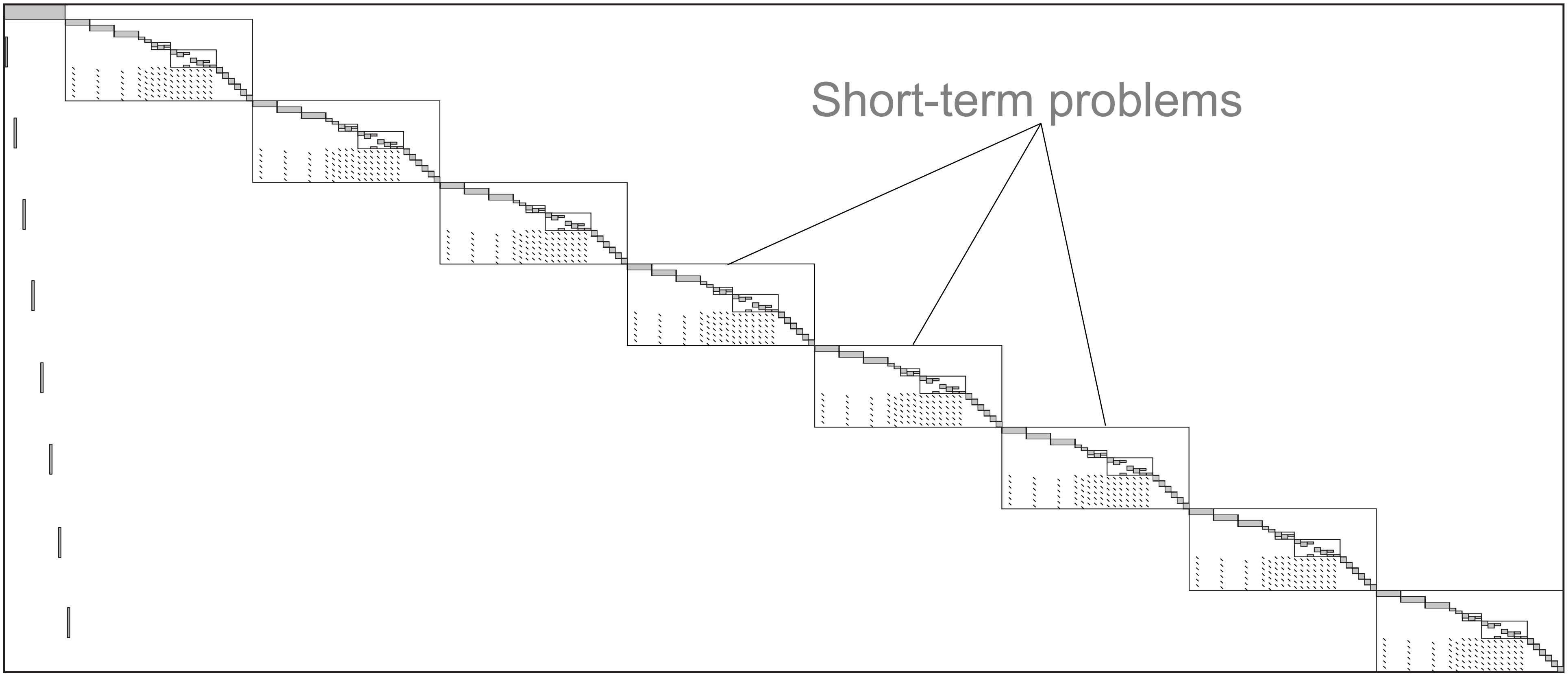

plan4res

Short-term problem: Unit Commitment (UC)



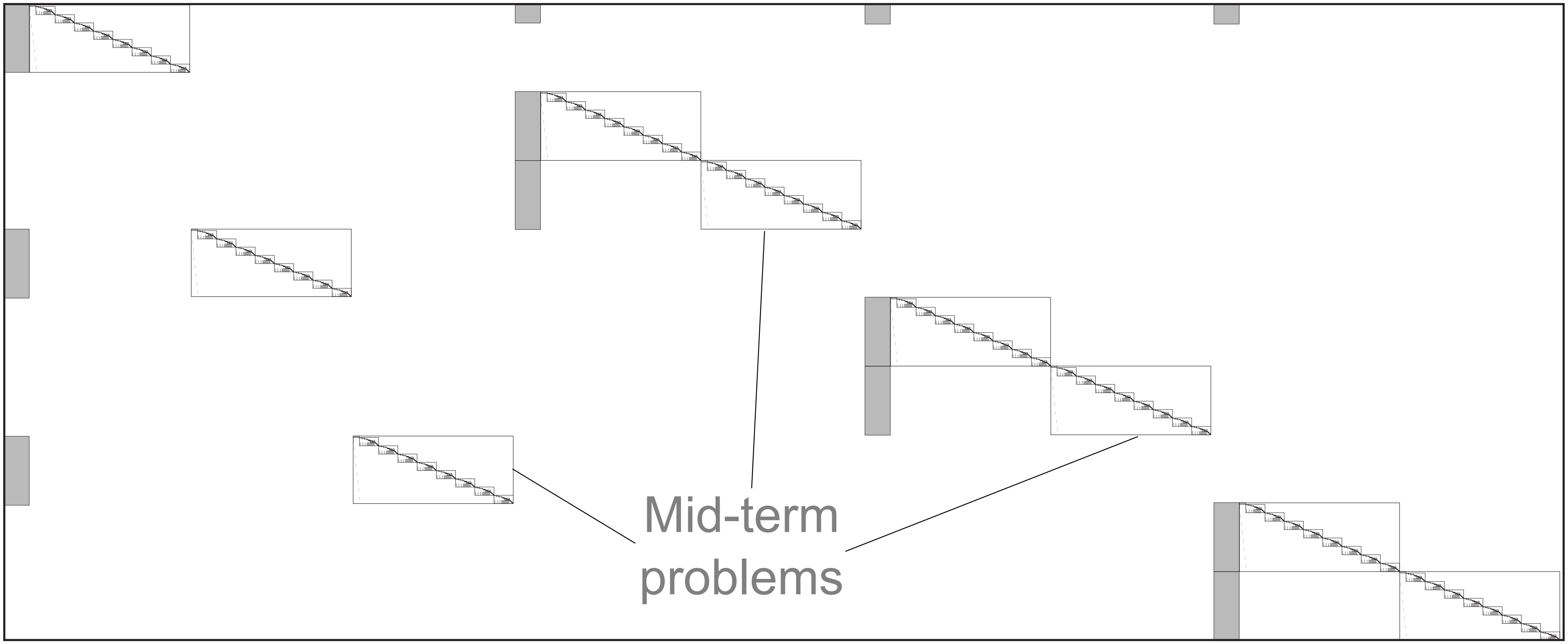
Mid-term problem: Seasonal storage valuation

Uncertainties: inflows, demand, outages, intermittent generation



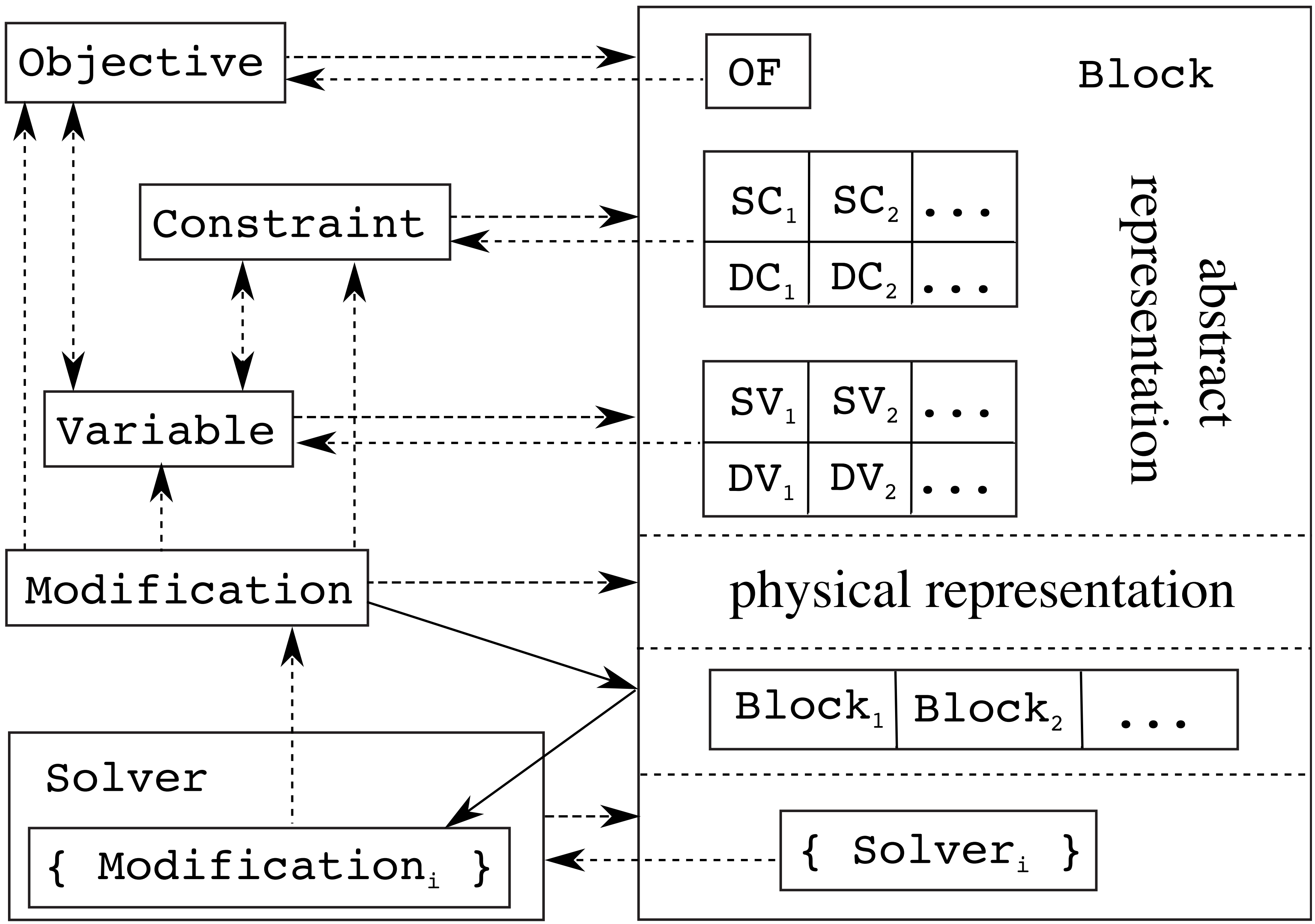
Long-term problem

Uncertainties in demand and production



SMS++

SMS++


Objective
OF
Block
Constraint
SC1 SC2 ...
DC1 DC2 ...
abstract representation
Variable
SV1 SV2 ...
DV1 DV2 ...
Modification
physical representation
Block1 Block2 ...
Solver
{ Modificationi }
{ Solveri }

Example: Capacitated Facility Location

$$\begin{aligned}
\min \quad & \sum_{i \in L} f_i y_i + \sum_{i \in L} \sum_{j \in D} c_{ij} x_{ij} \\
\text{s.t.} \quad & \sum_{i \in L} x_{ij} = 1, \forall j \in D \\
& \sum_{j \in D} d_j x_{ij} \leq u_i y_i, \forall i \in L \\
& x \geq 0, y \in \{0,1\}^{|L|}
\end{aligned}$$

$$\boxed{\begin{aligned}
\min \quad & f(x,y) \\
\text{s.t.} \quad & h_i(x) = 0, \forall i \in I \\
& g_j(x) \leq 0, \forall j \in J \\
& x \in X, y \in Y
\end{aligned}}$$

Abstract representation

$$\boxed{\begin{aligned}
& L \text{ and } D \\
& f_i, \ \forall i \in L \\
& c_{ij}, \ \forall\ i \in L, \ \forall j \in D \\
& d_j, \ \forall j \in D
\end{aligned}}$$

Physical representation

Solver

Wrappers for existing solvers: SDDPSolver, CPXMILPSolver, SCIPMILPSolver, ...

Native solvers: BundleSolver, LagrangianDualSolver, ...

Multistage Stochastic Optimization

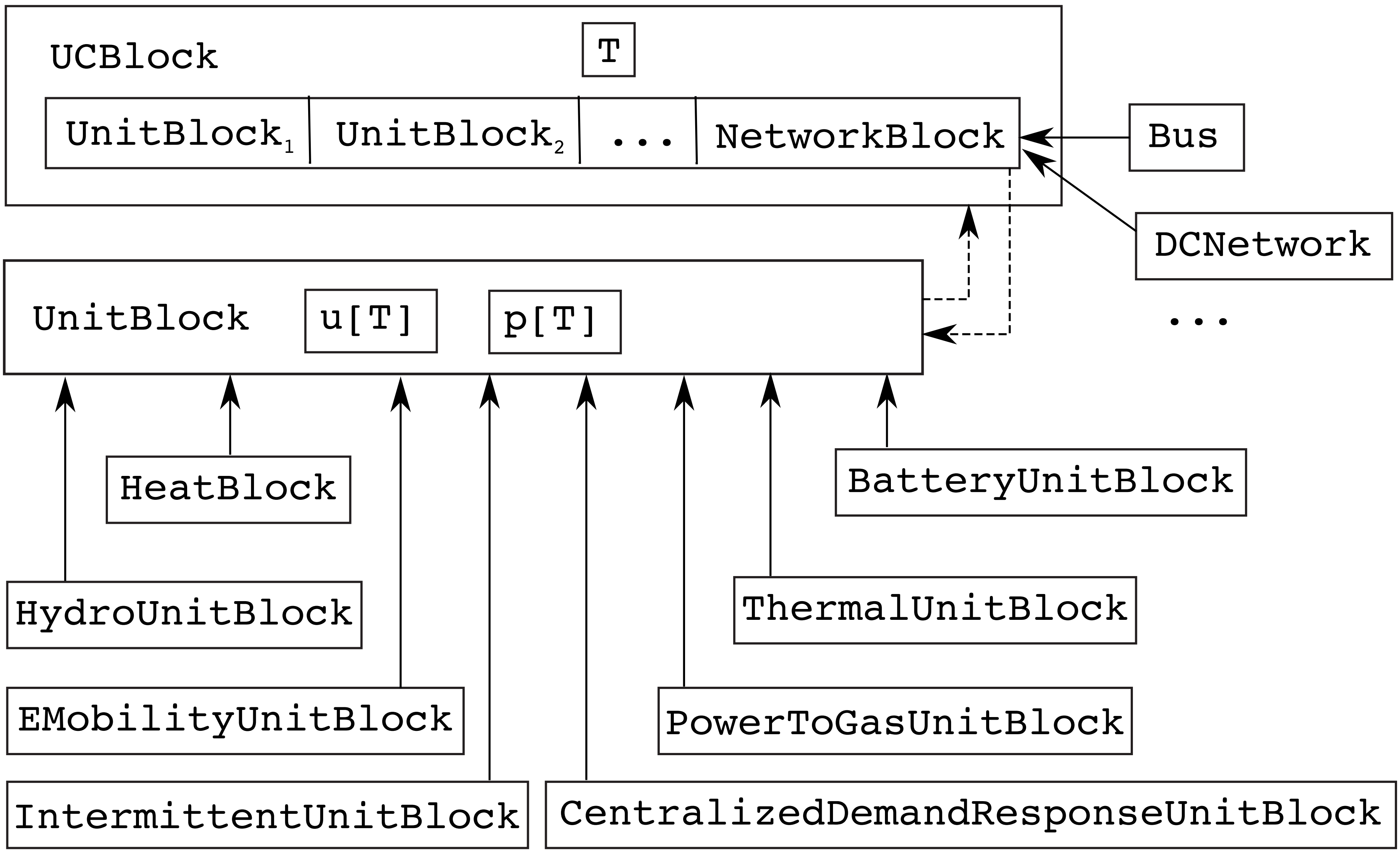
$$\begin{array}{cc}\min & f_1(x_1) \\ \text{s.t.} & x_1 \in X_1\end{array} + \mathbb{E}\left[\begin{array}{cc}\min & f_2(x_2;\xi_2) \\ \text{s.t.} & x_2 \in X_2(x_1,\xi_2)\end{array} + \mathbb{E}_{|\xi_{[2]}}\left[\cdots + \mathbb{E}_{|\xi_{[T-1]}}\left[\begin{array}{cc}\min & f_T(x_T;\xi_T) \\ \text{s.t.} & x_T \in X_T(x_{T-1},\xi_T)\end{array}\right]\right]\right]$$

$\{\xi_t\}_{t\in\{2,\ldots,T\}}$ is a stochastic process

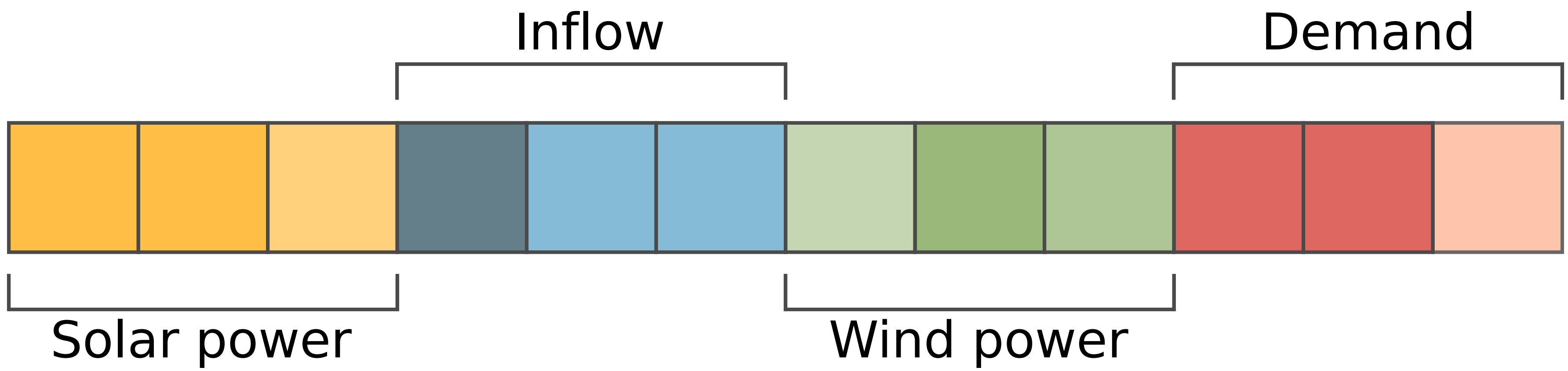
SDDPSolver: wrapper to StOpt

`http://gitlab.com/stochastic-control/StOpt`

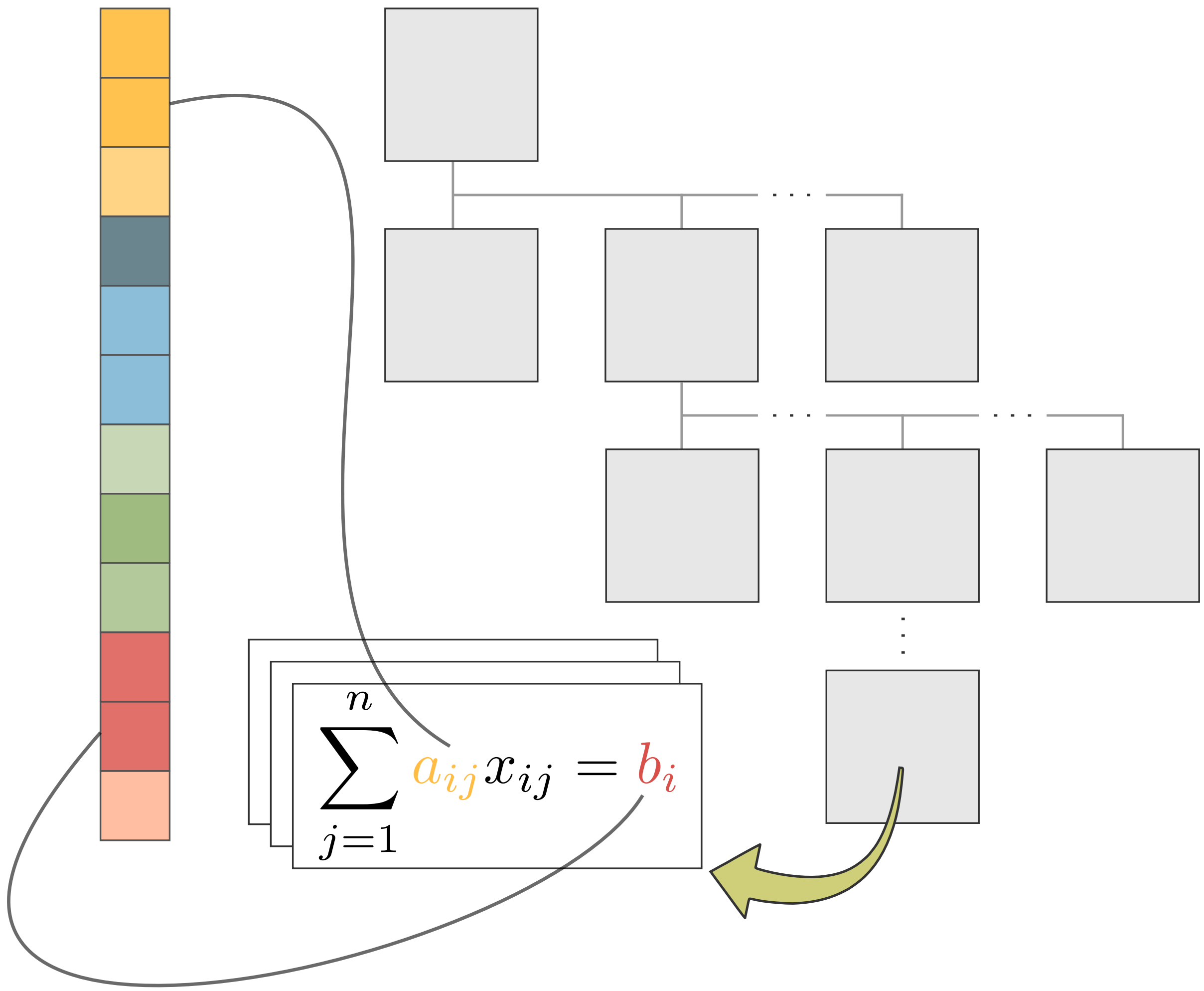
Unit Commitment



Random Variables



Update through abstract representation



Update through physical representation

Default method

```
void HydroUnitBlock::set_inflow(std::vector<double> inflow);
```

Customized method

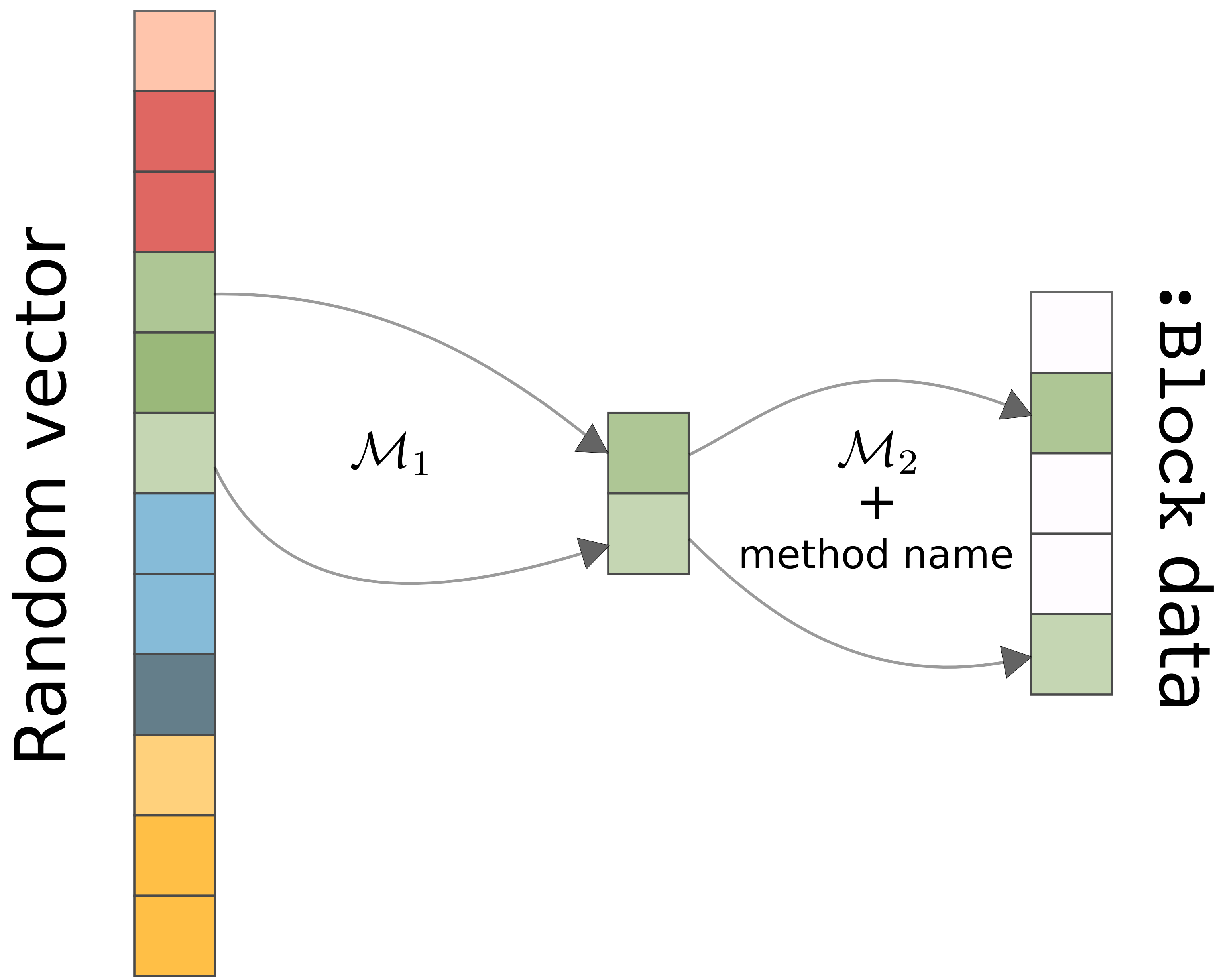
```
void customized_set_inflow(Block * block, ...) { ... }

Block::register_method
  ("HydroUnitBlock::customized_set_inflow",
   new Block::FunctionType<...>(customized_set_inflow));
```

DataMapping

`DataMapping`
Pointer to a `Block` Mappings $\mathcal{M}_1$, $\mathcal{M}_2$ Method name

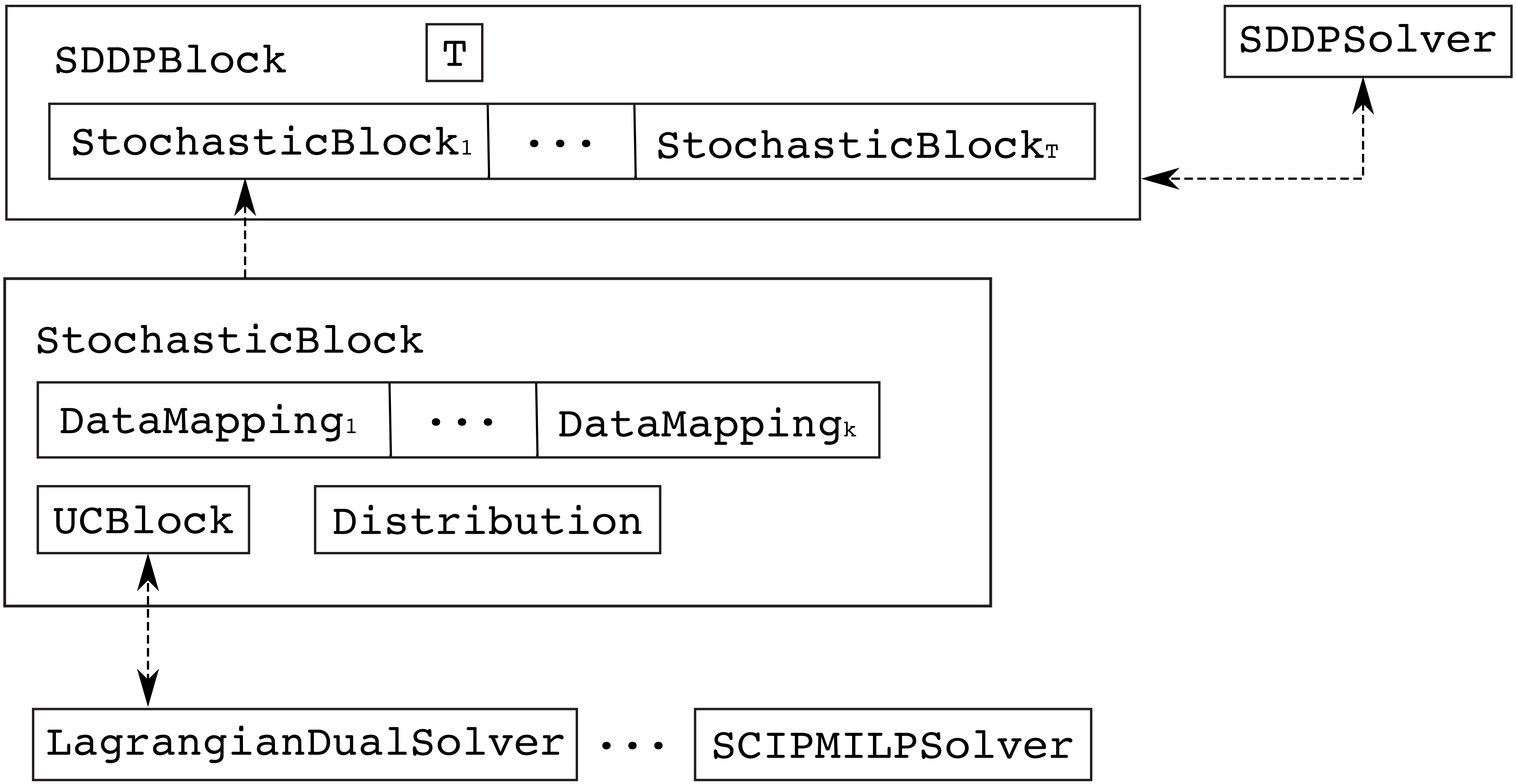
DataMapping



StochasticBlock

`StochasticBlock`
A sub-Block
A set of `DataMapping`
A probability distribution

SDDPBlock


SDDPBlock
T
StochasticBlock1
...
StochasticBlockT
SDDPSolver
StochasticBlock
DataMapping1
...
DataMappingk
UCBlock
Distribution
LagrangianDualSolver
...
SCIPMILPSolver

Acknowledgements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773897