THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SDDP.jl

A Julia library for Stochastic Dual Dynamic Programming

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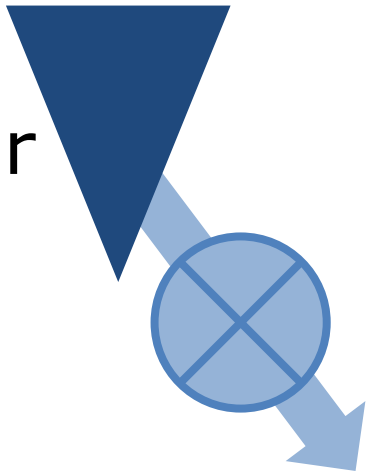
1. Hydro-thermal scheduling problem
2. Cow management problem

TWO PROBLEMS

HYDRO-THERMAL SCHEDULING

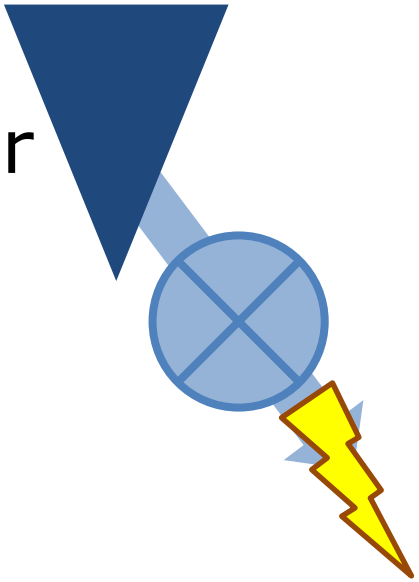
Reservoir

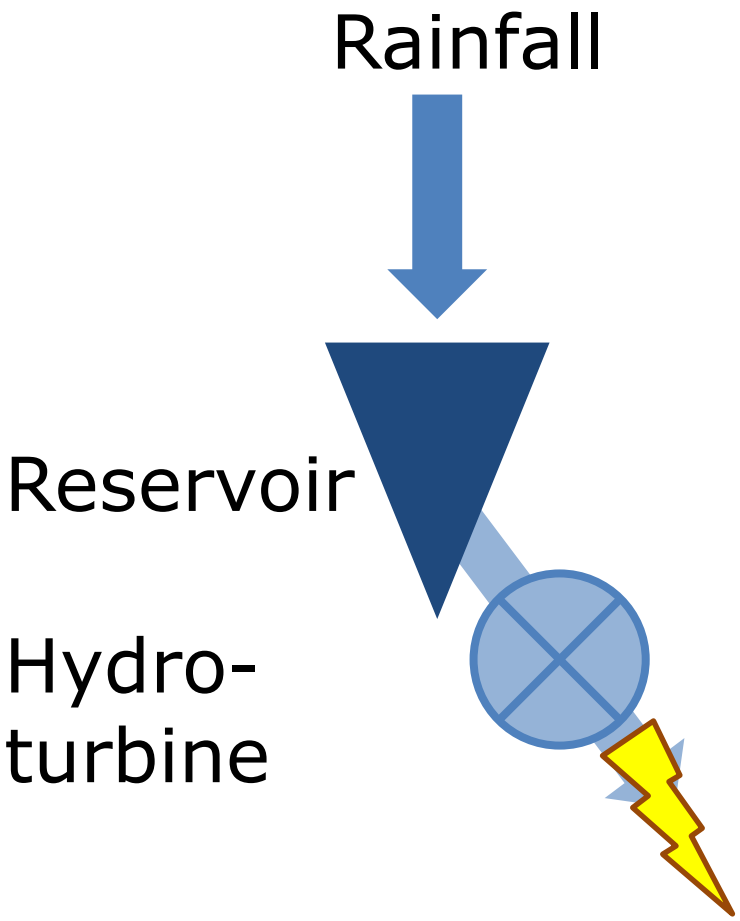
Hydro-
turbine

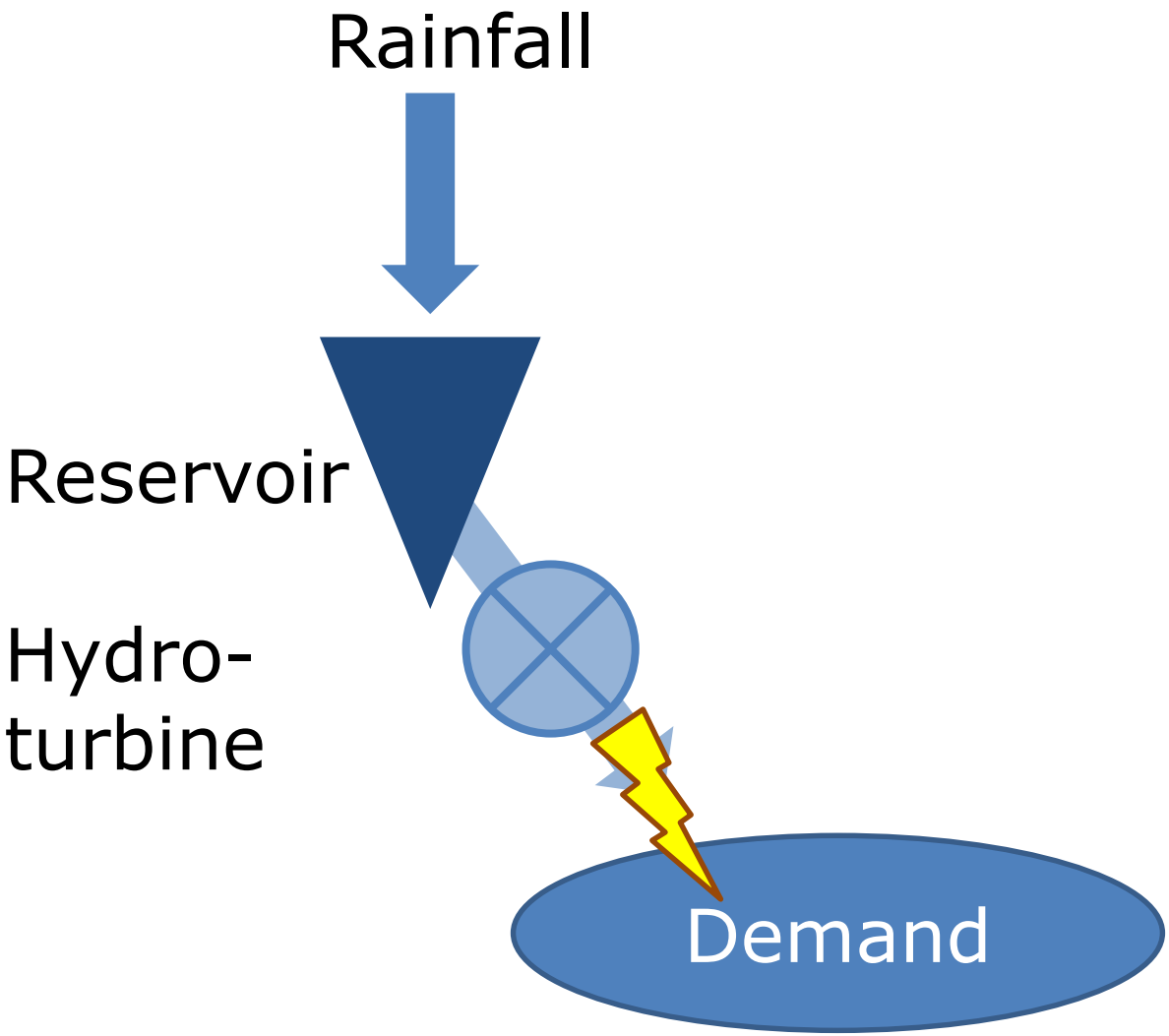


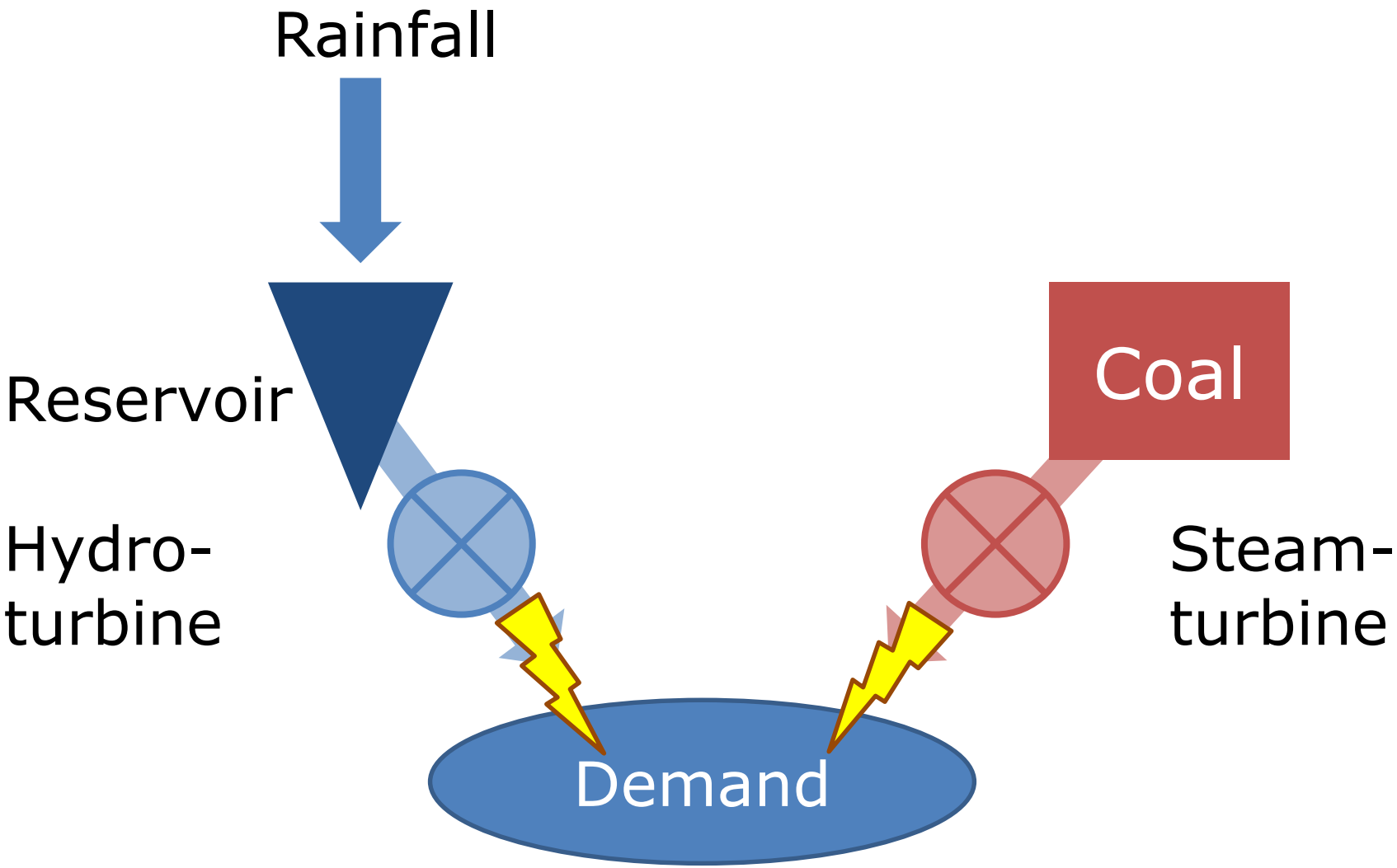
Reservoir

Hydro-
turbine




Rainfall
Reservoir
Hydro-
turbine


Rainfall
Reservoir
Hydro-
turbine
Demand


Rainfall
Reservoir
Hydro-
turbine
Coal
Steam-
turbine
Demand

*The milk **P**roduction **O**ptimizer incorporating*
***W**eather **D**ynamics and **E**conomic Risk*

POWDER

*The milk **P**roduction **O**ptimizer incorporating **W**eather **D**ynamics and **E**conomic Risk*

a.k.a. the shameless plug for Thursday morning.

POWDER

Paddocks are lakes of **Grass** and **Cows** are lakes of **Energy**

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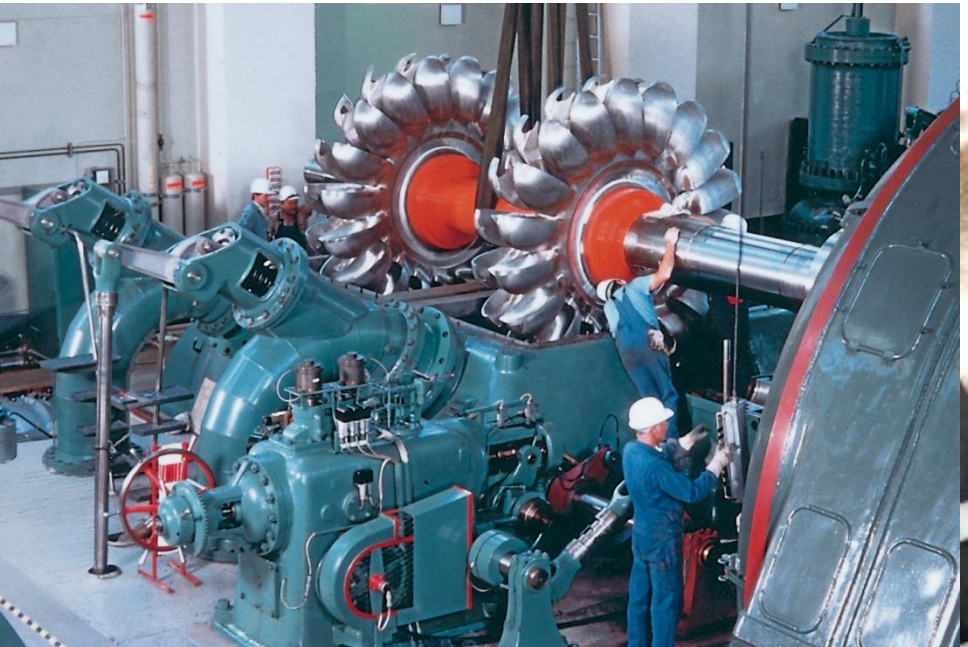
Turbine grass into the cow and **Turbine the cow to produce milk**



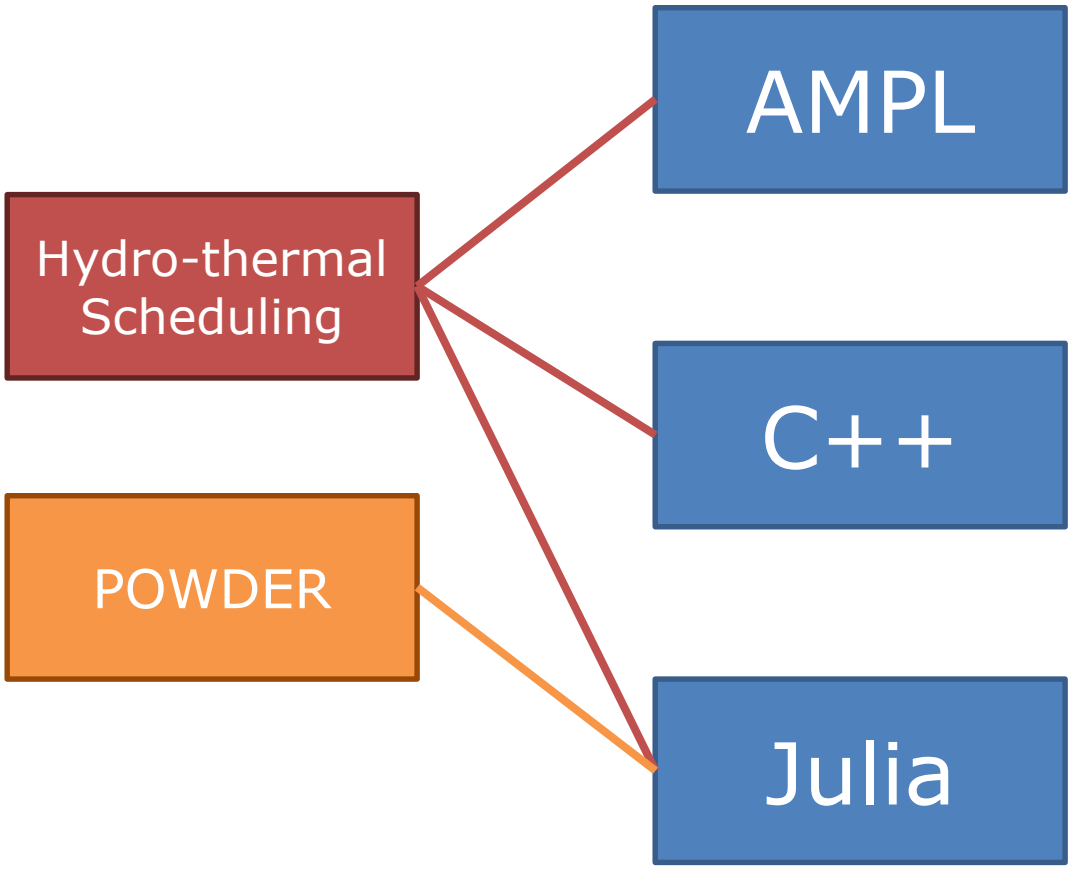

Random **grass growth** instead of **rainfall**

Random **grass growth** instead of **rainfall**

maize or palm kernel instead of **coal**

A complicated solution technique. The details need not concern us

STOCHASTIC DUAL DYNAMIC PROGRAMMING


Hydro-thermal Scheduling
POWDER
AMPL
C++
Julia

Why not make a generic solver?

THAT SEEMS INEFFICIENT

That’s exactly what people have done over the few years…

- FAST (Finally an SDDP Toolbox)
  https://github.com/leopoldcambier/FAST
- SDDP.jl
  https://github.com/odow/SDDP.jl
- StochDynamicProgram.jl
  https://github.com/JuliaOpt/StochDynamicProgram.jl
- StructDualDynProg.jl
  https://github.com/blegat/StructDualDynProg.jl
- PSR (Commercial)

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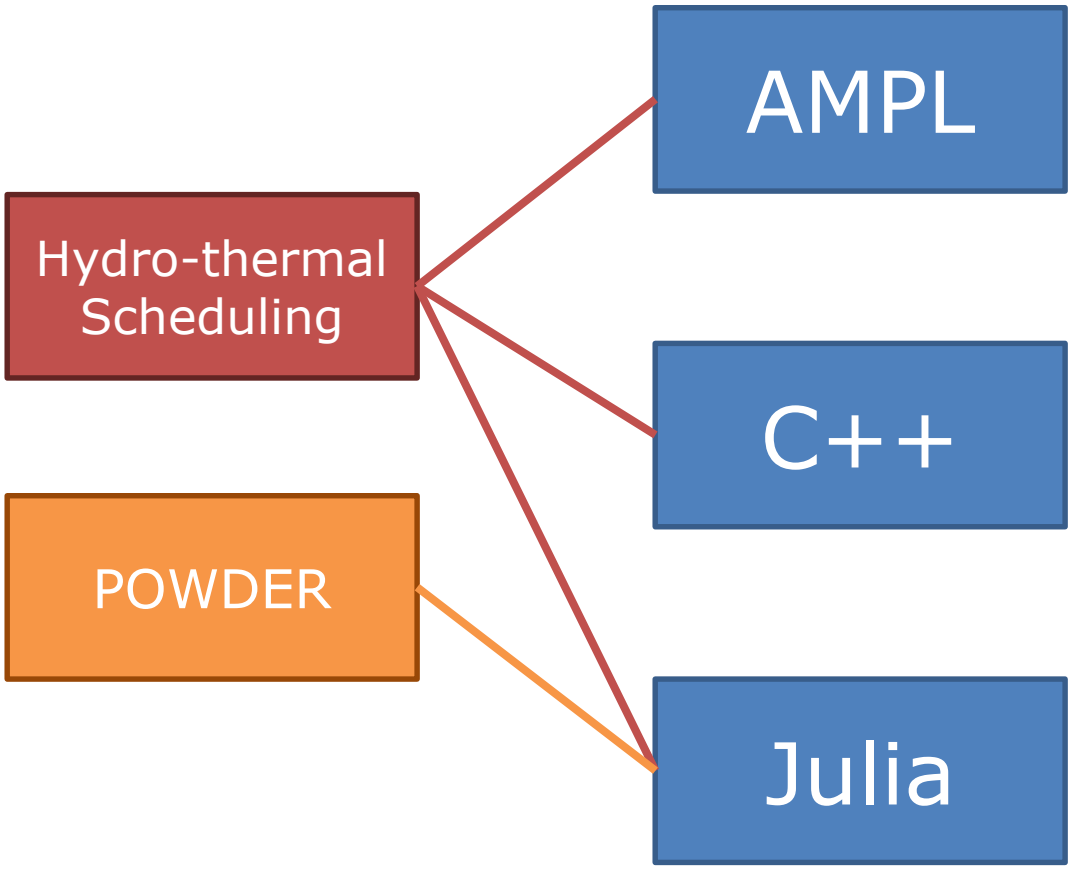
Hydro-thermal Scheduling
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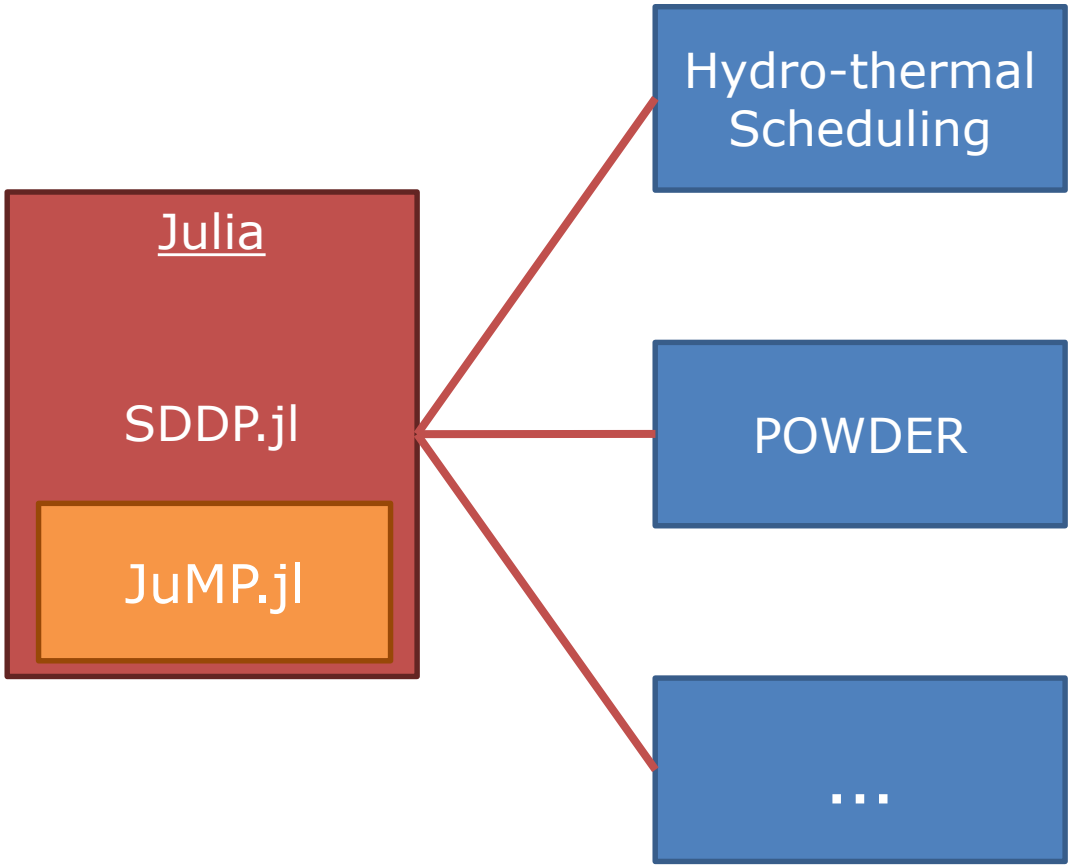

Julia
SDDP.jl
JuMP.jl
Hydro-thermal Scheduling
POWDER
...

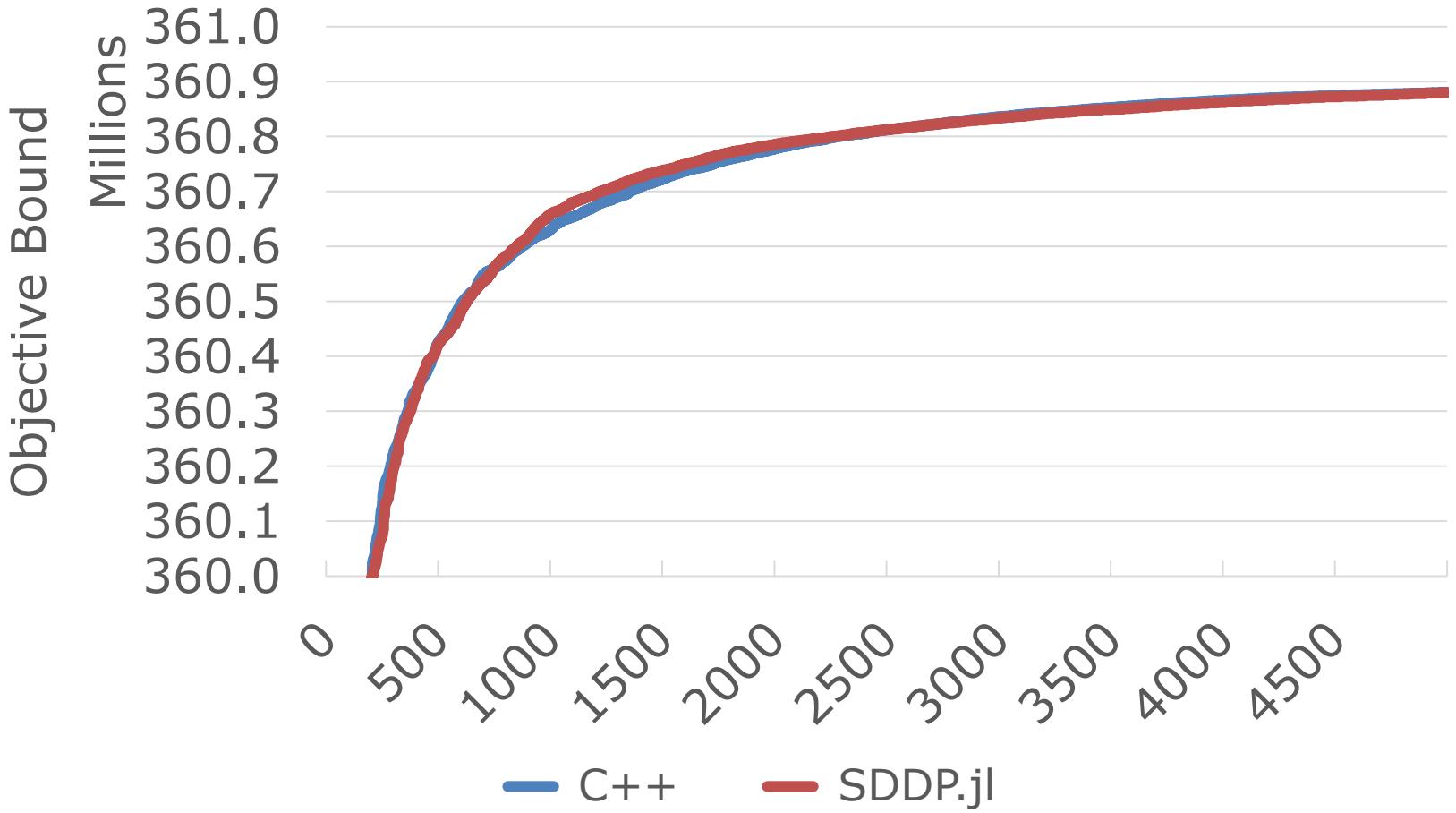
Benchmarking the NZ Hydro-Thermal Scheduling Problem

BUT IS IT ANY GOOD?

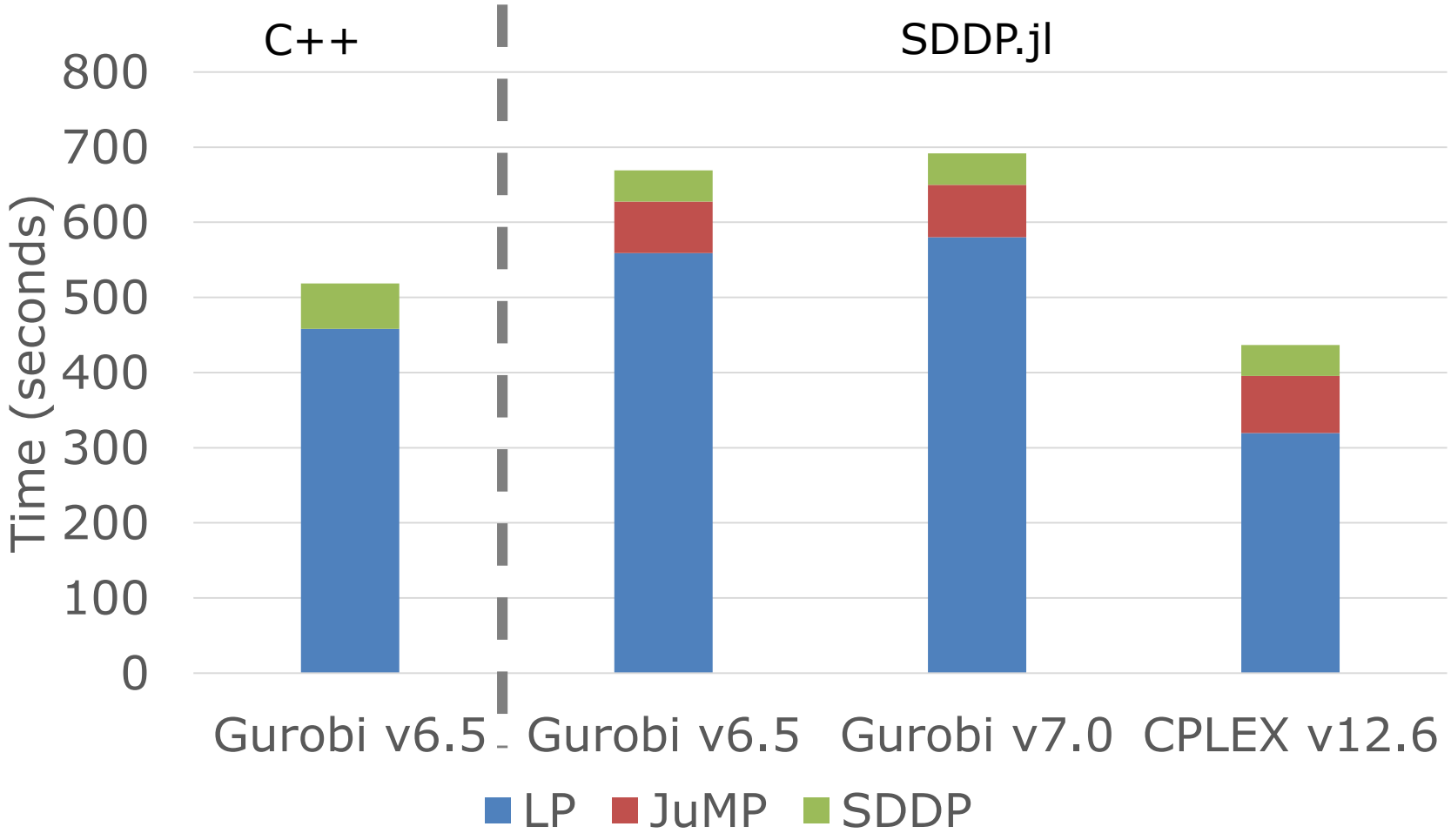
Correctness I

	C++	SDDP.jl
2005	$493,125,281	$493,125,281
2006	$423,420,729	$423,420,729
2007	$575,859,349	$575,859,349
2008	$446,507,222	$446,507,222
2009	$340,096,459	$340,096,459

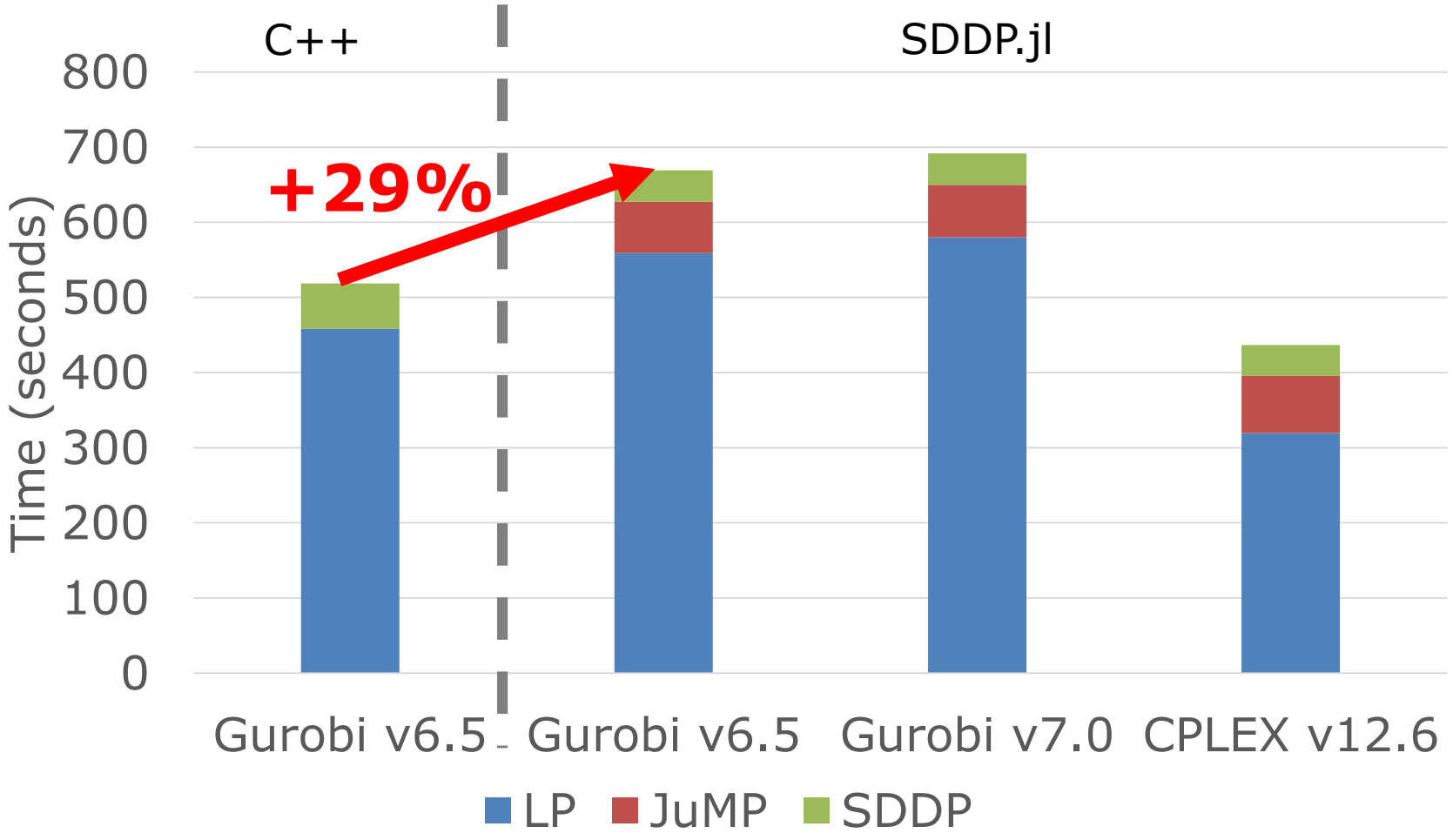
Correctness II



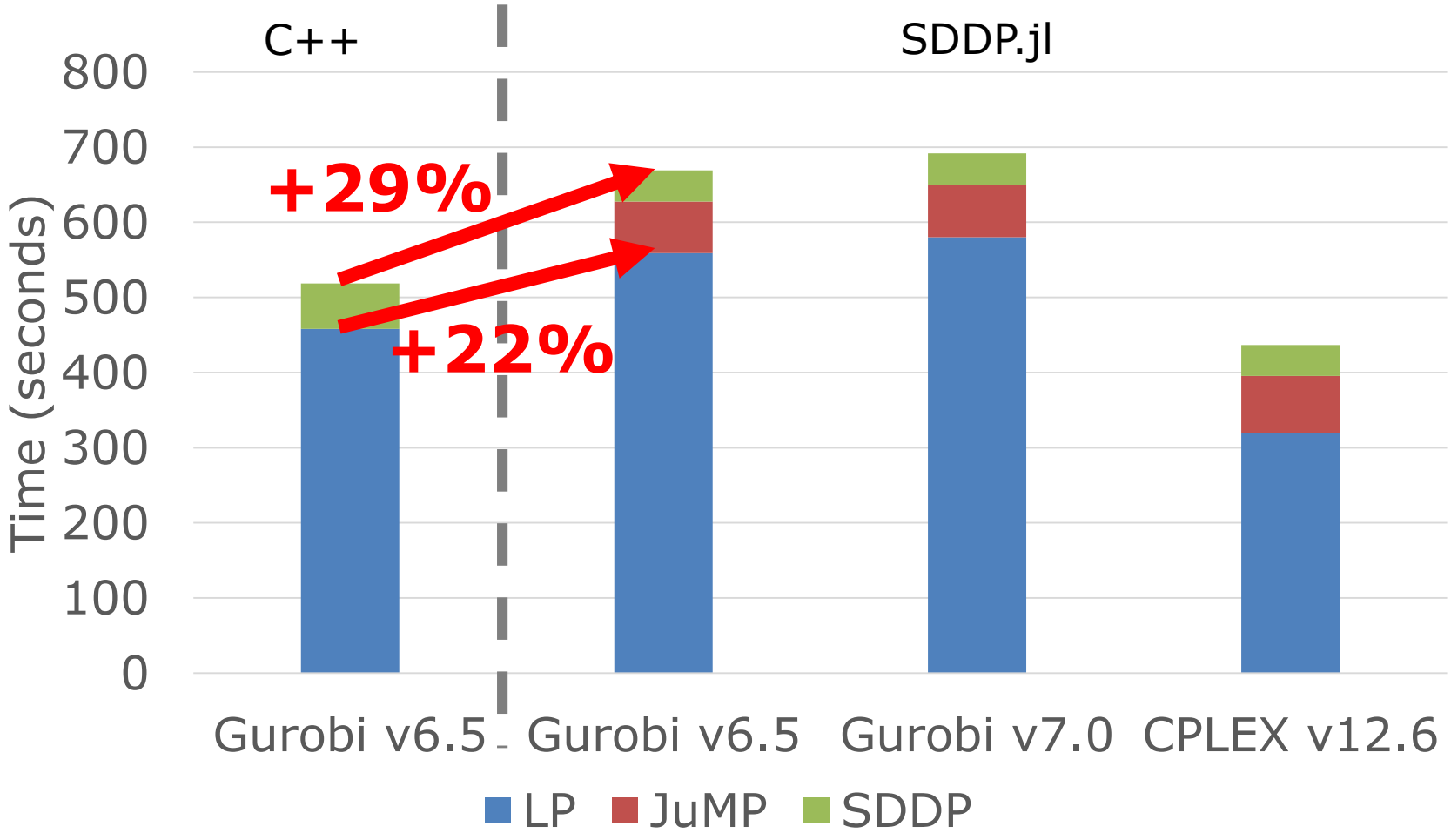
Performance



Performance



Performance



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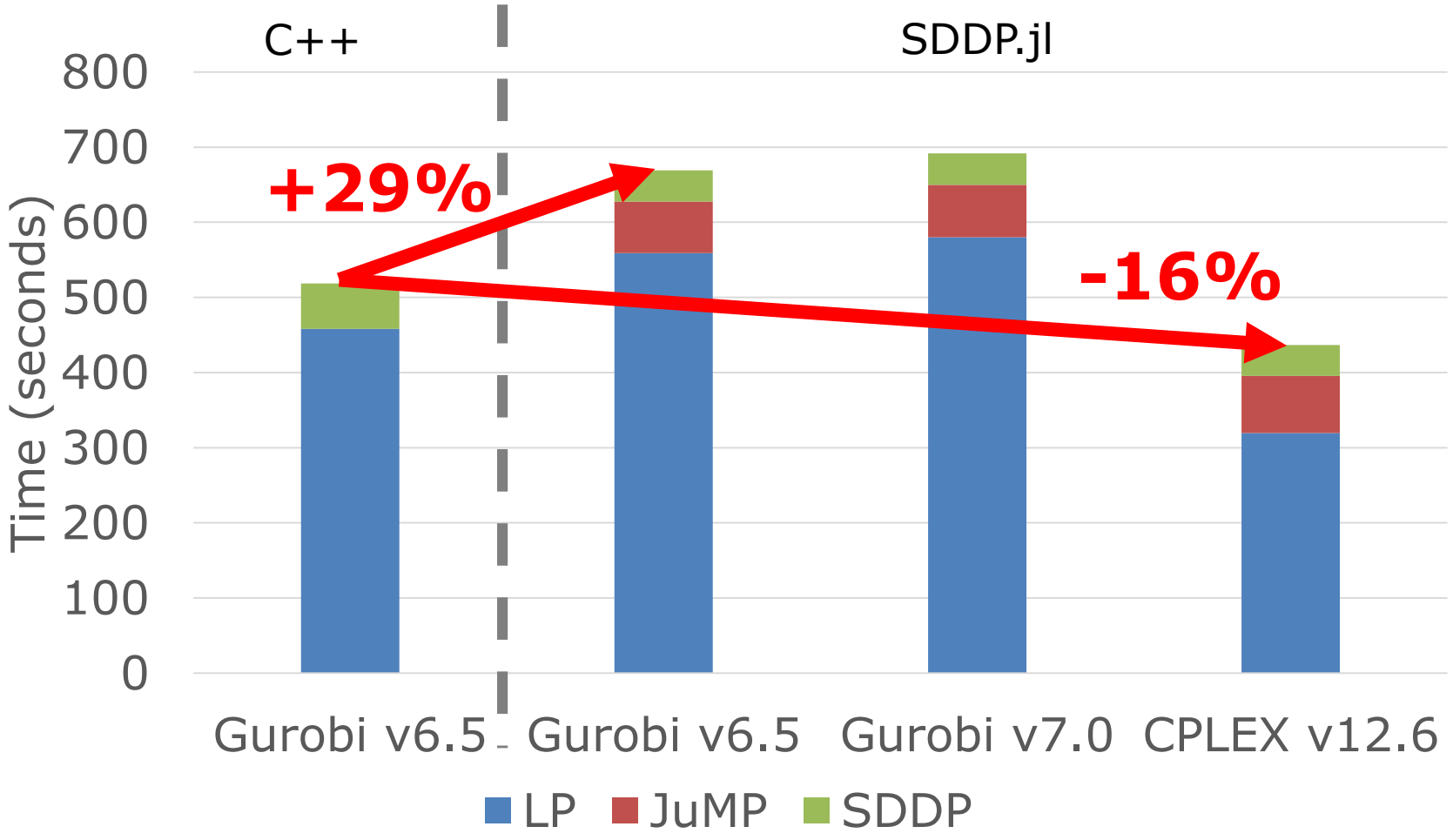
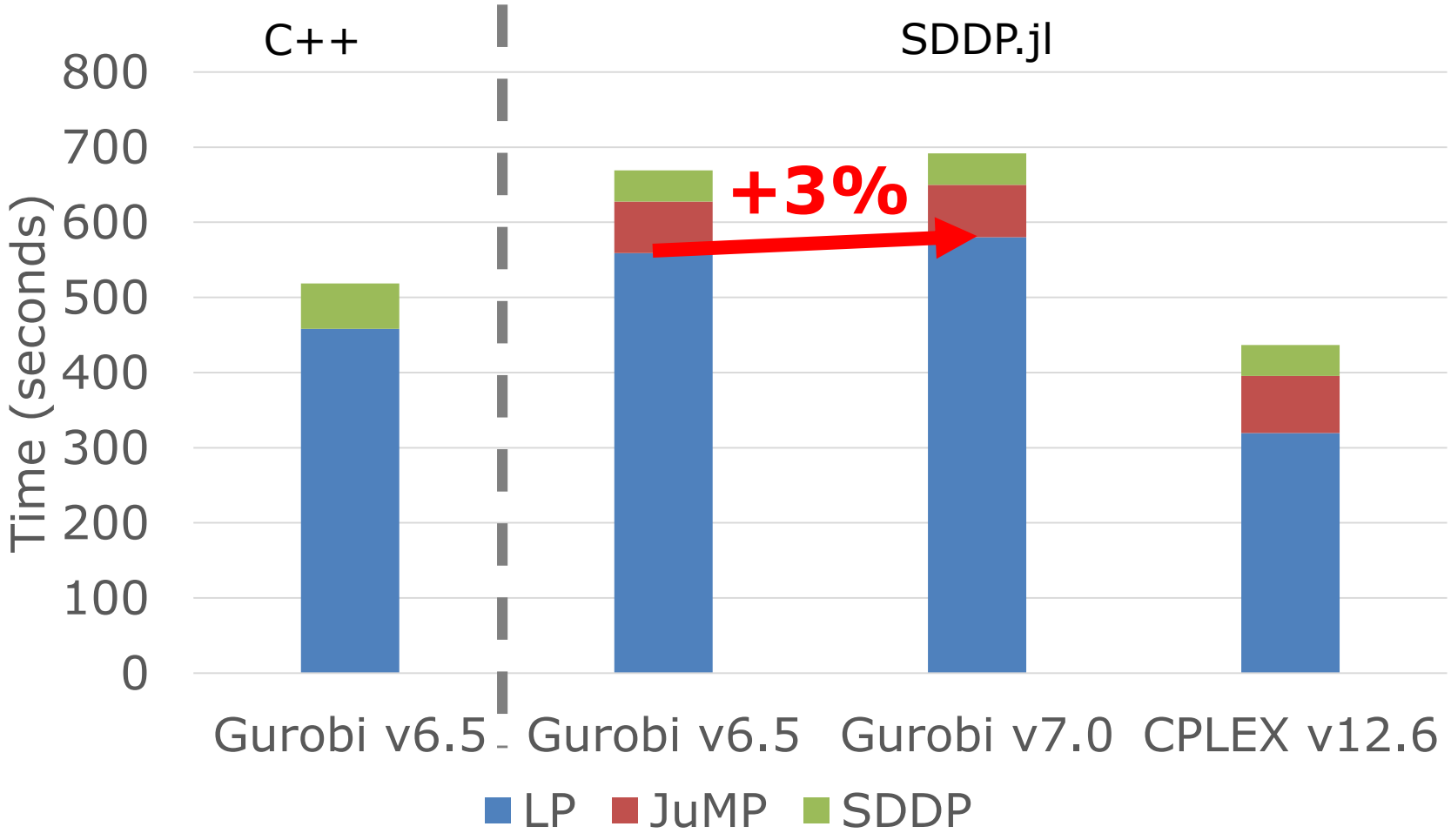
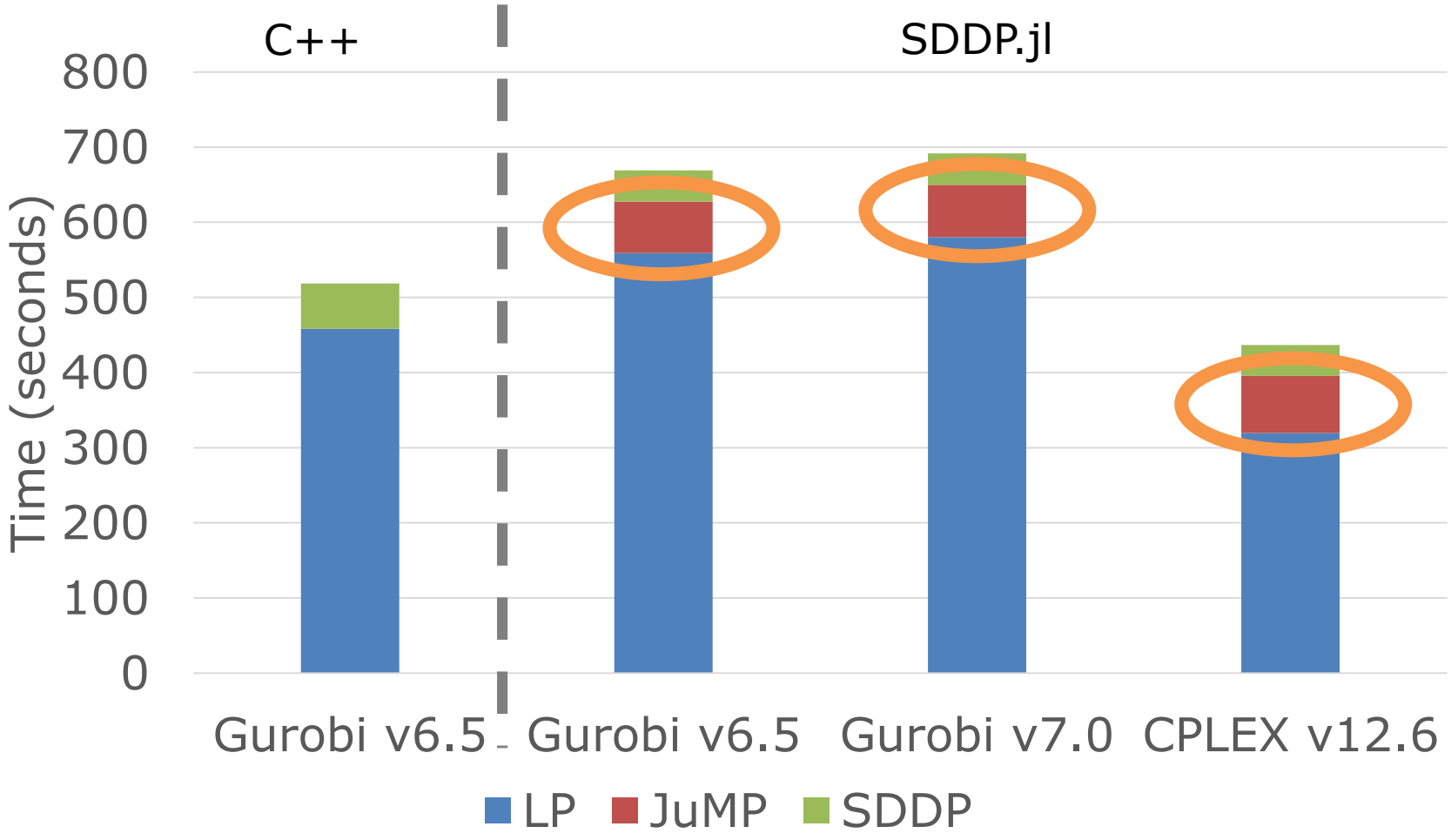


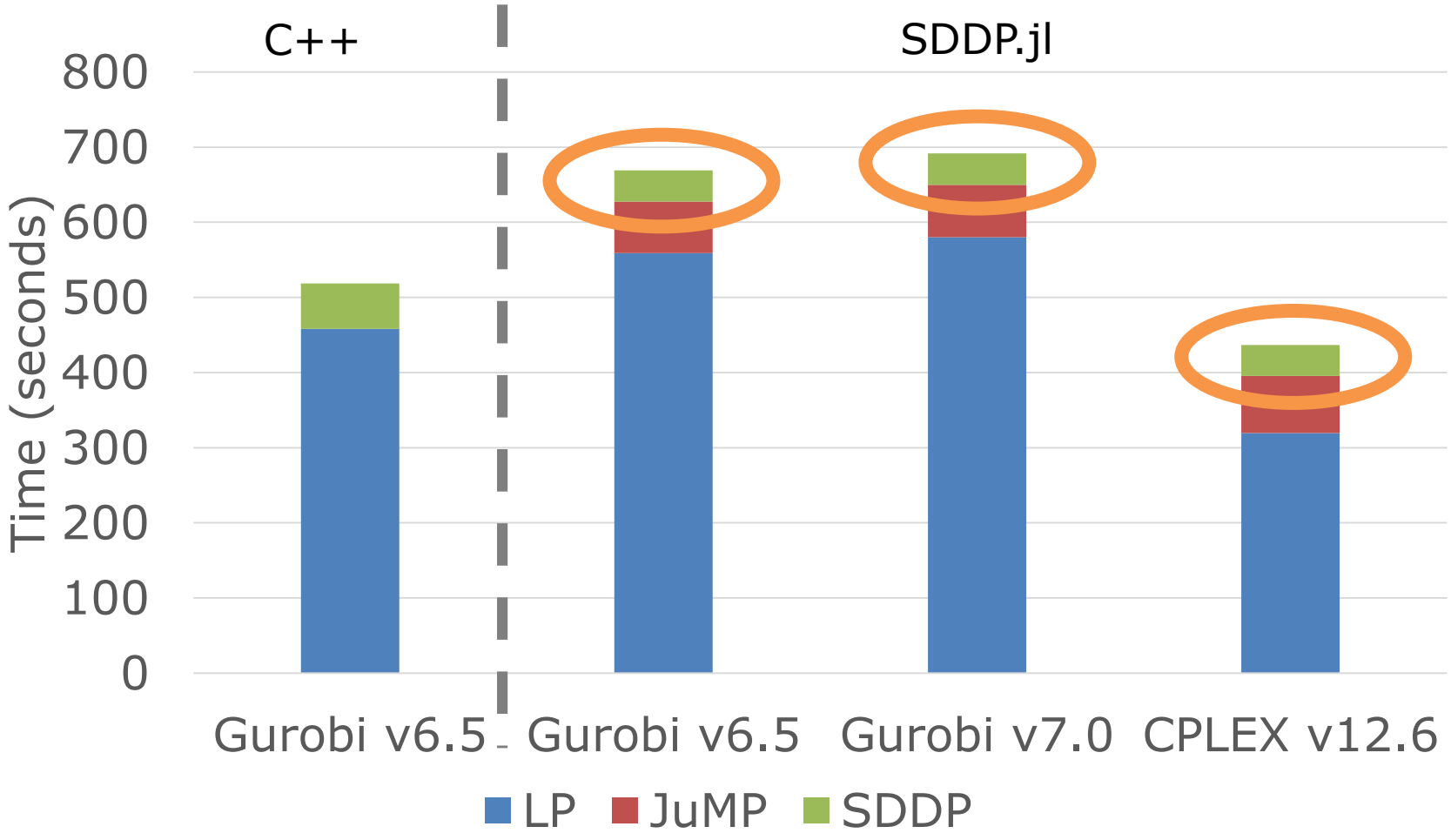
Performance



Performance



Performance



SDDP.jl is

- generic
- open-source
- easy to use
- competitive with hard-coded C++ implementations
- correct

CONCLUSIONS