



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

Cows, Lakes, and a JuMP extension for multi-stage stochastic programming

Oscar Dowson

The University of Auckland

odow003@aucklanduni.ac.nz



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

Julia meats Daisy

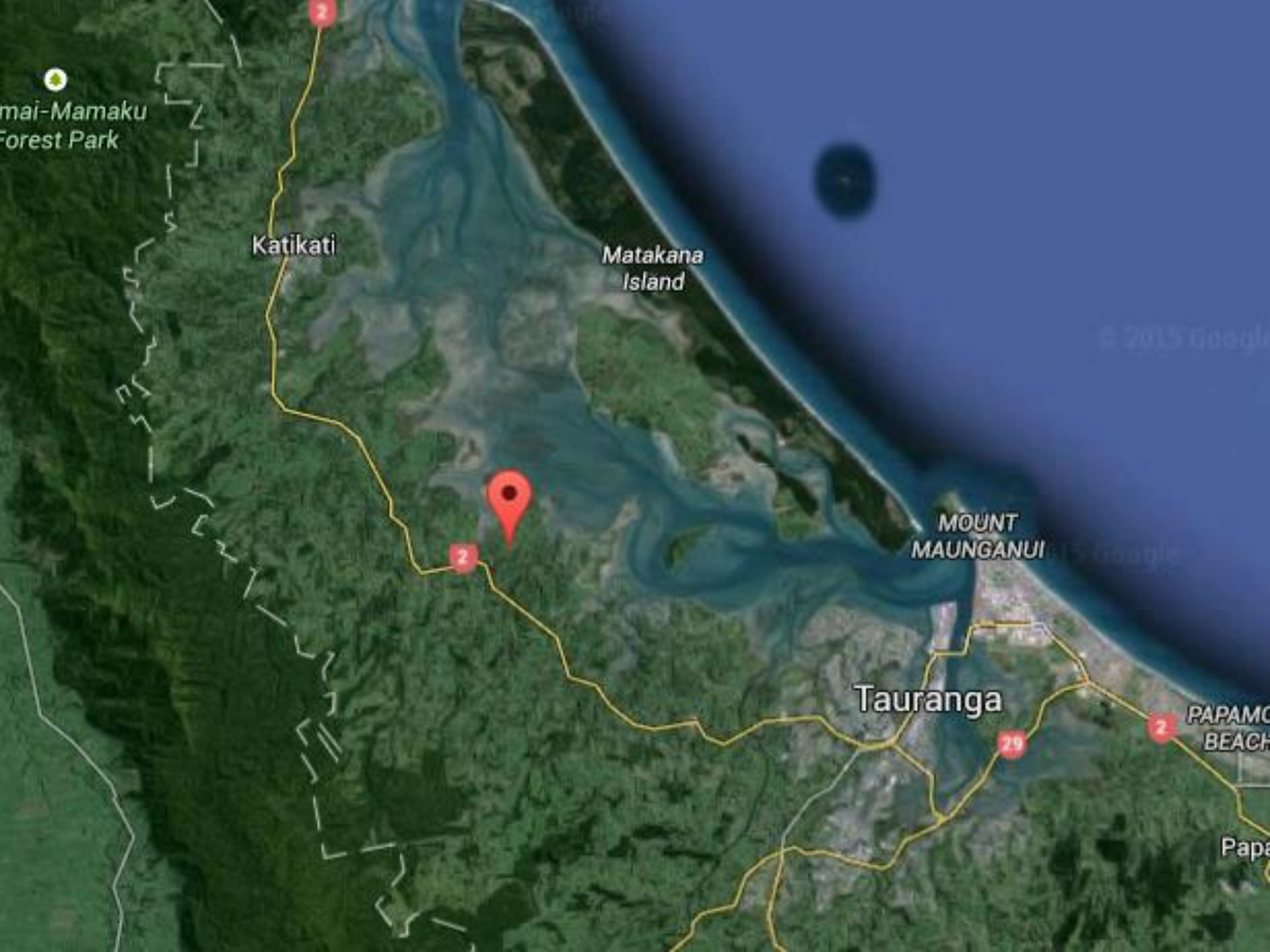
in the field of multi-stage stochastic optimisation

Oscar Dowson
The University of Auckland
odow003@aucklanduni.ac.nz



**New
Zealand**

Tasman Sea



Kaimānui-Mamaku
Forest Park

Katikati

Matakana
Island

MOUNT
MAUNGANUI

Tauranga

PAPAMO
BEACH

Papa











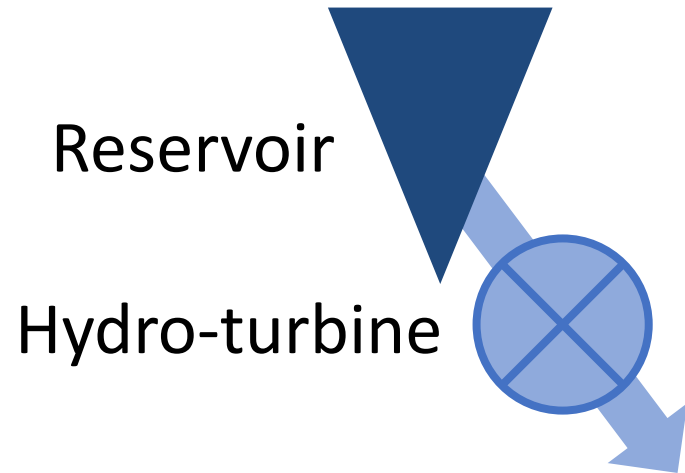


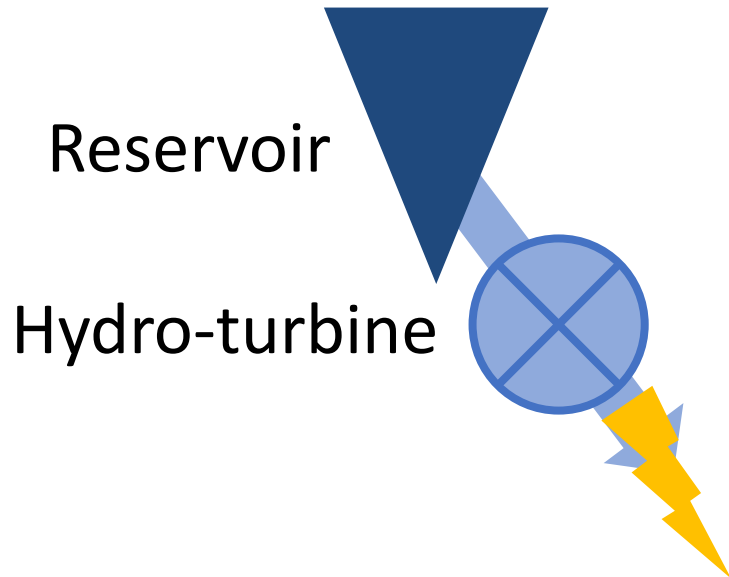
Help!

I don't know what multi-stage stochastic optimisation is!

Hydro-Thermal Scheduling

The “lake” part of the talk





Rainfall

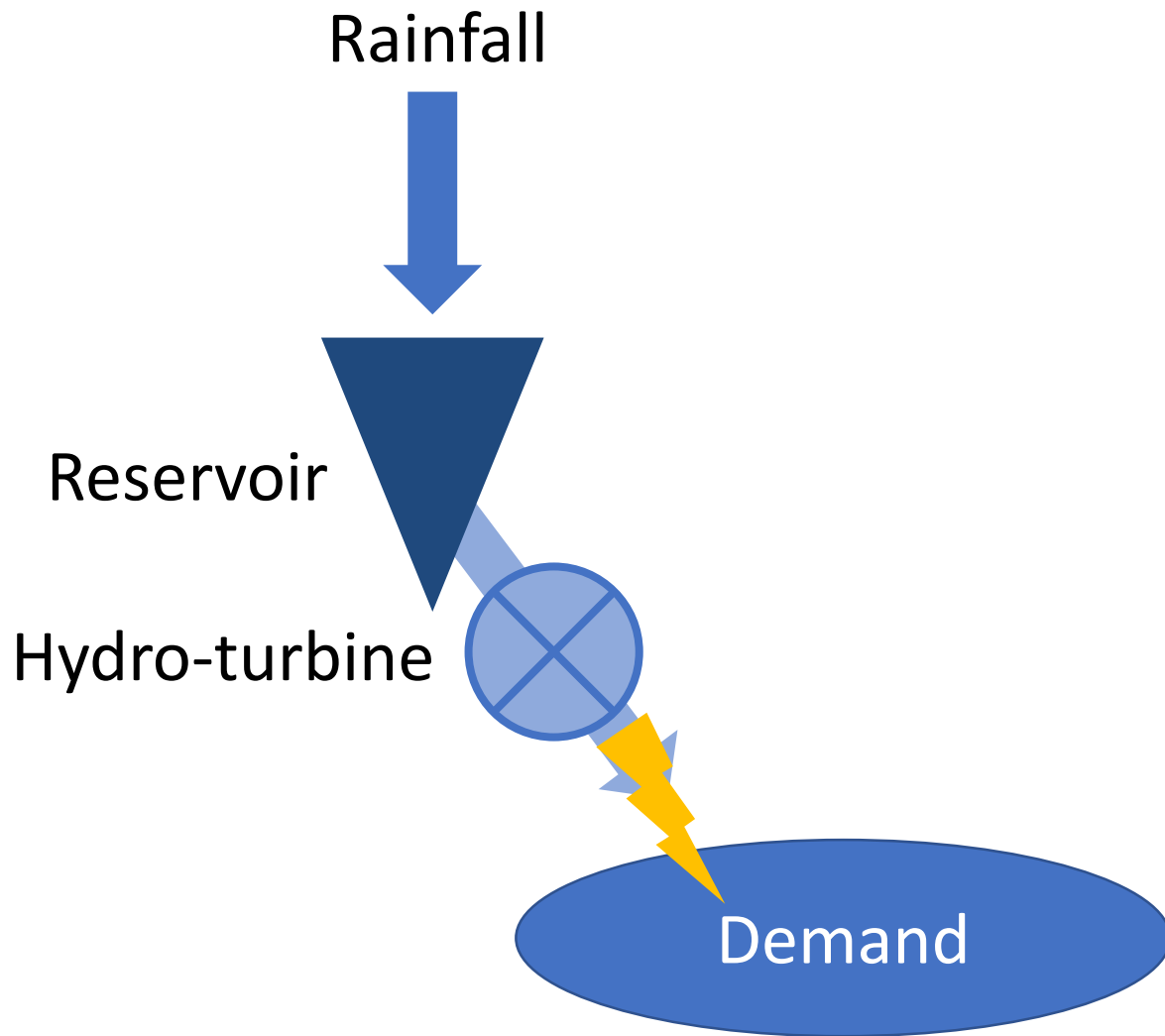


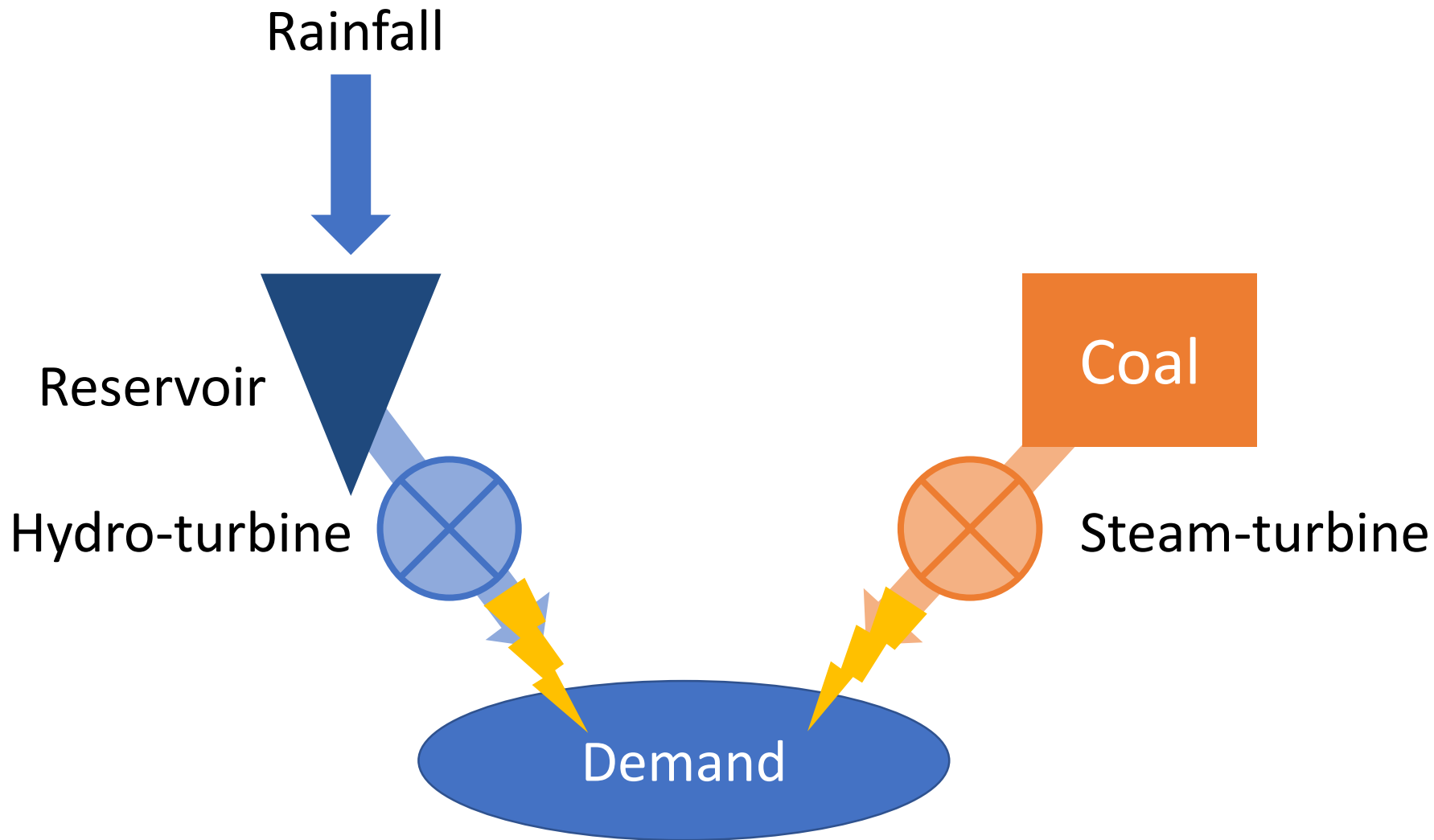
Reservoir



Hydro-turbine







The Milk Output Optimiser

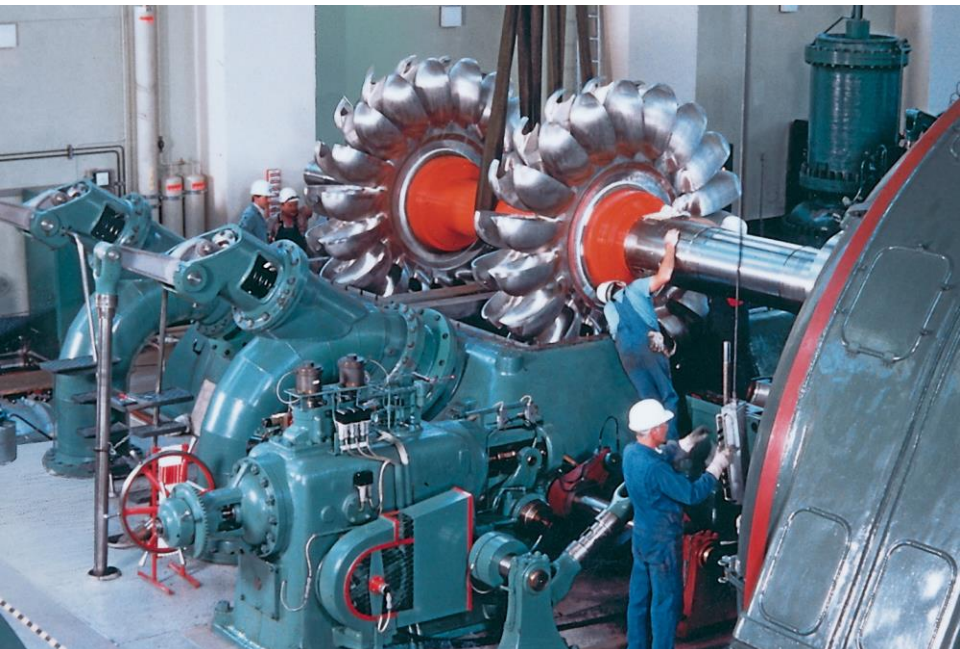
The “cow” part of the talk



Paddocks are Lakes of grass and **Cows are Lakes of energy**



Paddocks are Lakes of grass and **Cows are Lakes of energy**
Turbine grass into the cow and **Turbine the cow to produce milk**





Random grass growth instead of rainfall



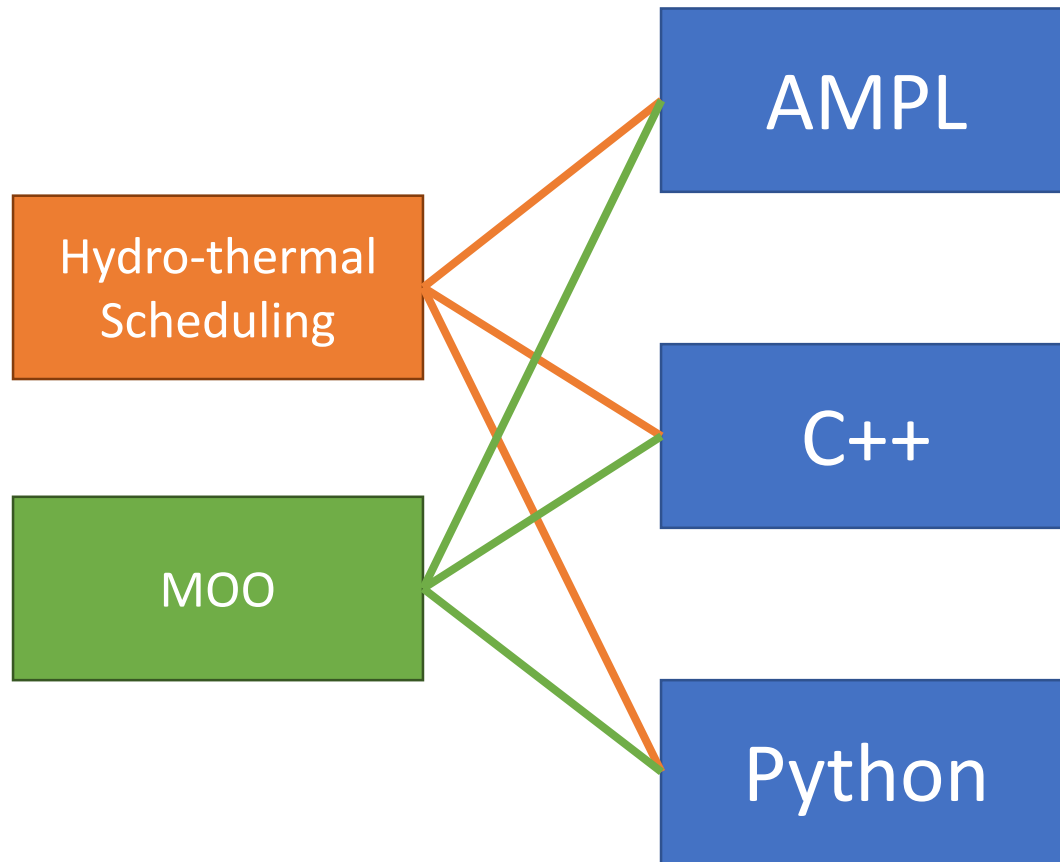
Random grass growth instead of rainfall

Make up the difference with maize instead of coal



Solution Technique

Stochastic Dual Dynamic
Programming



This seems inefficient

Why not do it in Julia?

That's exactly what people have done over the last year or so...

- 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)
- A few other private research codes

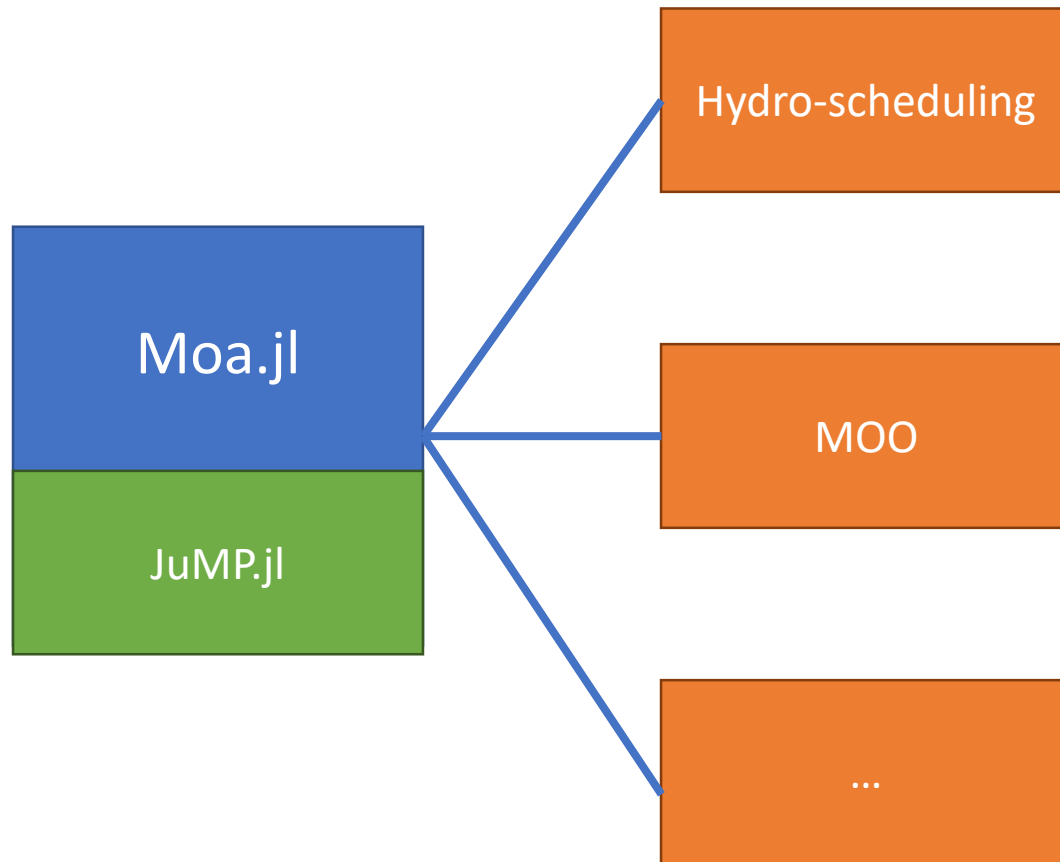
That's exactly what people have done...

- 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)
- A few other private research codes

Moa.jl

Multi-stage Optimisation
Application





But is it any good?

But is it any good?

Yes.

Is it any good?

- Similar performance to problem-specific C++
- Much easier to apply to new problems
- Much easier to modify old problems
- Easier to code (and test) new heuristics which significantly improve performance

What should I take away from this talk?

I know what SDDP is:

Let's talk.

What should I take away from this talk?

I know what SDDP is:

I don't know what SDDP is:

Let's talk.

New Zealand dairy farmers may someday use Julia to help them make better decisions under uncertainty.

