# Optimization/Rules Policy Editor

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# Outline

- Existing Optimization
- Rules vs. Optimization
- Vision: Integrated Rules and Optimization Policy
- This year’s plan
- Optimization Policy Demonstration

# Goal Programming

- Prioritized sequence of objectives and soft constraints
  - Highest priority: Move towards normal region
    - Flood control, minimum flows, etc
  - Lowest priority: In the normal region
    - e.g. Optimizing hydropower
- “Freeze” each objective.
- Use remaining solution space for other objectives.

# Common Policy Needs

- Get the most out of the system.
  - Both present and expected future benefits.
- Agreed upon method to balance purposes and locations.
  - Most systems: Prioritized policies that gradually reduce the solution space.
- Evolves over time
  - Flexible policy modeling.

# Optimization: Pros and Cons

+ Makes system and time tradeoffs easily.
+ Uses flexibility well.
+ Simultaneous solution of equations.
- Outcomes are less transparent.
- Some if-then logic is difficult.
- Some nonlinearities are difficult.
- Limited set of decision variables.

# Rules: Pros and Cons

+ Fits well with a legal environment.
+ Everyone knows what the rules are.
+ Handles nonlinearities well.
- Difficult to make informed tradeoffs.
- Might be very complex to handle all of the possibilities well.
- Usually some residual institutional flexibility.

# Long Term RiverWare Vision: Rules and Optimization

- Fits the broader policy need.
- Remove the existing need to choose.
  - Best of both tools.
  - Start with one and add the other.
- Shared interface.
- Shared underlying software.
- Short Term: share interface components, but separate controllers.

# Optimization and Rules: mixing a little of each into the other

- Optimization with a little Rules
  - If-then logic for which constraints and objectives to solve and what to do with the results.
  - This year.
- Rules with a little Optimization
  - Rules functions that contain an optimization problem.
    - e.g. Optimizing over future time steps to set values in the current time step.

# Sequential Rules and Optimization

- Rules have higher priority.
- Rule results would be “inputs” for optimization.
- Optimize “underdetermined” values.
- Might “refire” optimization as necessary.

# Mixed Optimization and Rules.

- Add time step control to the policy.
- Optimize in one case, fire a rule in another.
- A rule with higher priority can overwrite optimization and/or provide inputs.
- A rule with lower priority could be retained if it didn’t affect the optimal value of a higher priority optimization.

# Optimization and Rules Summary

- Optimization with If-then
- Rules with Optimization Functions
- Sequential Optimization and Rules
- Mixed Optimization and Rules

# This Year’s Minimum Plan

- Extend rules editor to optimization
- Reproduce existing optimization capability

# This Year's Ideal

- If-then logic
- For loops
- Visible For-all Object list - with grey-out
- Reusable Templates
  - e.g. daily average flow

# Shared Benefits

- Recent RPL enhancements for a variety of tasks have helped implementation of optimization.
  - RPL Applications
  - GUI to Qt
- Expect Optimization Enhancements to benefit Rules