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An Object Oriented Programming Tool for Optimal Management of Water Systems under Uncertainty by use of Stochastic Dual Dynamic Programming

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We developed an Objective Oriented Programming (OOP) tool for optimal management of complex water systems by use of Stochastic Dual Dynamic Programming (SDDP).
OOP is a powerful programming paradigm. OOP minimizes code redundancies, making code modification and maintenance very effective. This is especially welcome in research, in which, often, code must be modified to meet new requirements that were not initially considered. SDDP is an advanced method for optimal operation of complex dynamic systems under uncertainty. SDDP can deal with large and complex systems, such as a multi-reservoir system.
The objective of this tool is making SDDP usable for Water Management Analysts. Thanks to this tool, the Analyst can bypass the SDDP programming complexity, and his/her task is simplified to the definition of system elements, topology and objectives, and experiments characteristics.
In this tool, the main classes are: Experiment, System, Element, and Objective. Experiments are run on a system. A system is made of many elements interconnected among them. Class Element is made of the following sub-classes: (stochastic) hydrological scenario, (deterministic) water demand scenario, reservoir, river reach, off-take, and irrigation basin. Objectives are used in the optimization procedure to find the optimal operational rules, for a given system and experiment. OOP flexibility allows the Water Management Analyst to extend easily existing classes in order to answer his/her specific research questions.
The tool is implemented in Python, and will be initially tested on two applications: the Senegal River water system, in West Africa, and the Seine River, in France.