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# Irrigation Expert Simulator (IES): a platform for training farmers and technicians in customized irrigation scheduling

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## ABSTRACT

A practical bottleneck for efficient use of irrigation water is the proper use of irrigation controllers. These devices undertake the automated execution of irrigation schedules but need to be programmed periodically to adapt to weather conditions and crop development. In this context, the Irrigation Expert Simulator (IES) is a web-platform for training farmers and technicians in using irrigation controllers and promoting the adoption of good irrigation practices. With this tool, they can define very particular irrigation scenarios, propose irrigation strategies for them and see how their proposals compare with those of an expert. The tool is backed by an expert system that uses a collection of irrigation examples to provide recommendations and simulations of how a given irrigation regime would perform. The tool will be accessible from RuralCat (www.ruralcat.net), the portal for the agricultural sector in Catalonia.

**Keywords:** Irrigation scheduling, expert-system, irrigation controller, e-learning, Catalonia.

## 1. INTRODUCTION

Efficient use of irrigation implies delivering the optimum amount of water depending on weather conditions, the state of the crop and the particular limitations and productive goals of each farm. In practice, irrigation uses to be automated with irrigation controllers, a type of electronic device that coordinates hydraulic parts, such as valves and pumps, in the execution of the schedules programmed by farmers or technicians. In this context, the main bottleneck for efficient irrigation appears to be the customization of irrigation schedules to particular cases and their update when weather or crop conditions change.

To deal with this problem, the project Irrigation Expert Simulator (IES) is developing a web-platform for practicing irrigation scheduling with the aims of improving the skills of farmers in programming their irrigation controllers and promoting the adoption of good irrigation practices. The final goal is to reduce the gap between the state of art in

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science and technology around irrigation and the common practices in farms. The idea is to use a methodology based on an Expert System to make available the knowledge accumulated by experts in the irrigation domain.

## 2. DESIGN OF THE TOOL

The IES platform is a learning tool addressed to any type of professional or student who wants to improve his/her skills in scheduling irrigation. It allows to define very specific cases of study and to ask how to irrigate them with a virtual irrigation controller. Then, the irrigation schedules proposed by students are evaluated by comparing their simulated performance with that of the irrigation recommended by an expert. Two internal tools act behind the scenes to undertake those tasks. The Expert Scheduler emulates a human expert on irrigation and produces tailored recommendations. The Virtual Crop simulates the effect of a given irrigation regime on the crop water balance and the development of yield. Both of them are supported by an Experience Database composed of a collection of good irrigation examples validated by experts. The workflow of IES is illustrated in Figure 1.

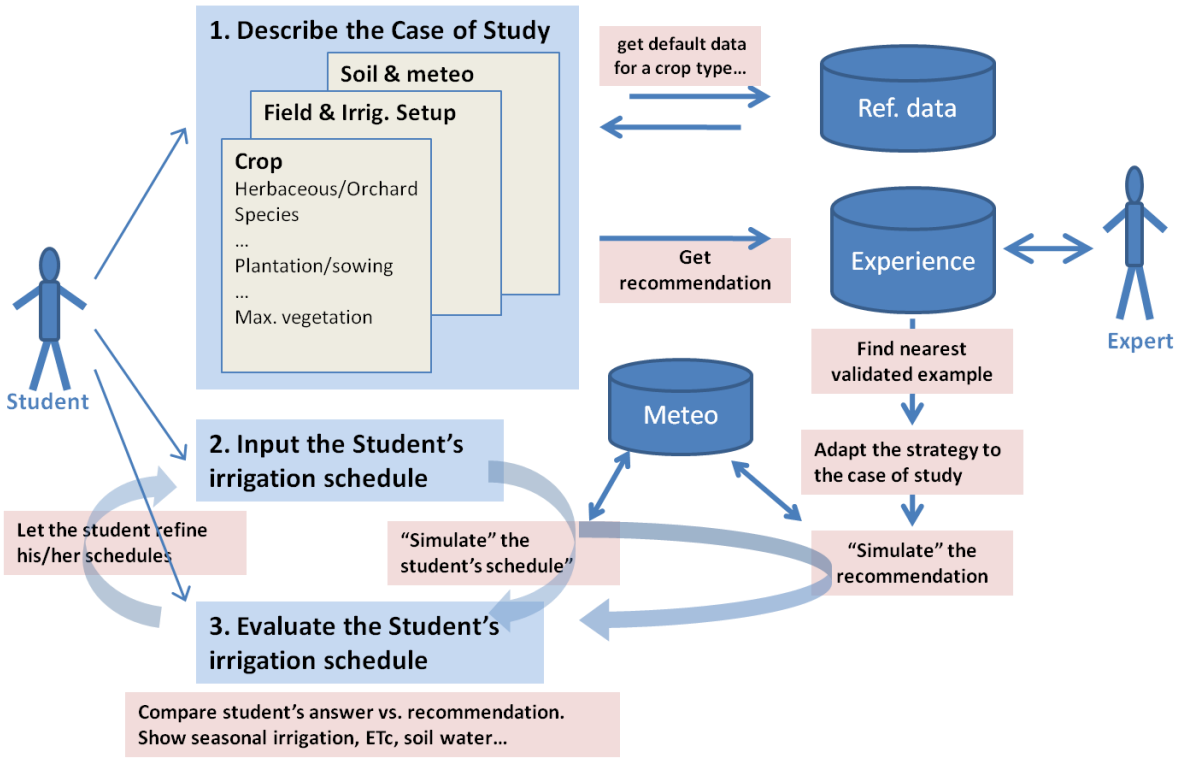


Figure 1. Overview of the main IES workflow.

First the student characterizes a new case of study by describing the properties of the crop, the irrigation setup, the soil and meteorological conditions. Once the case of study

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has been defined, the platform looks in the Experience Data Base for the most similar documented example, to do so; it uses an approach of instance-based learning (IBL) for finding the example that better suits for a specific case of study (Figure 2). Basically, this consists of finding the documented example most similar to the case of study. In general, applications of IBL consist of classifying problems in order to obtain a closer solution to the problem. This is exactly the usage of IBL in IES project: the Expert Scheduler searches the Knowledge Base for a similar example –in terms of crop, irrigation method, water allocation, etc. - from which it derives the irrigation strategy to follow. Later, the irrigation strategy applied in the example is slightly adapted to the details of the case of study and is used as the basis for the recommendations and simulations by IES.

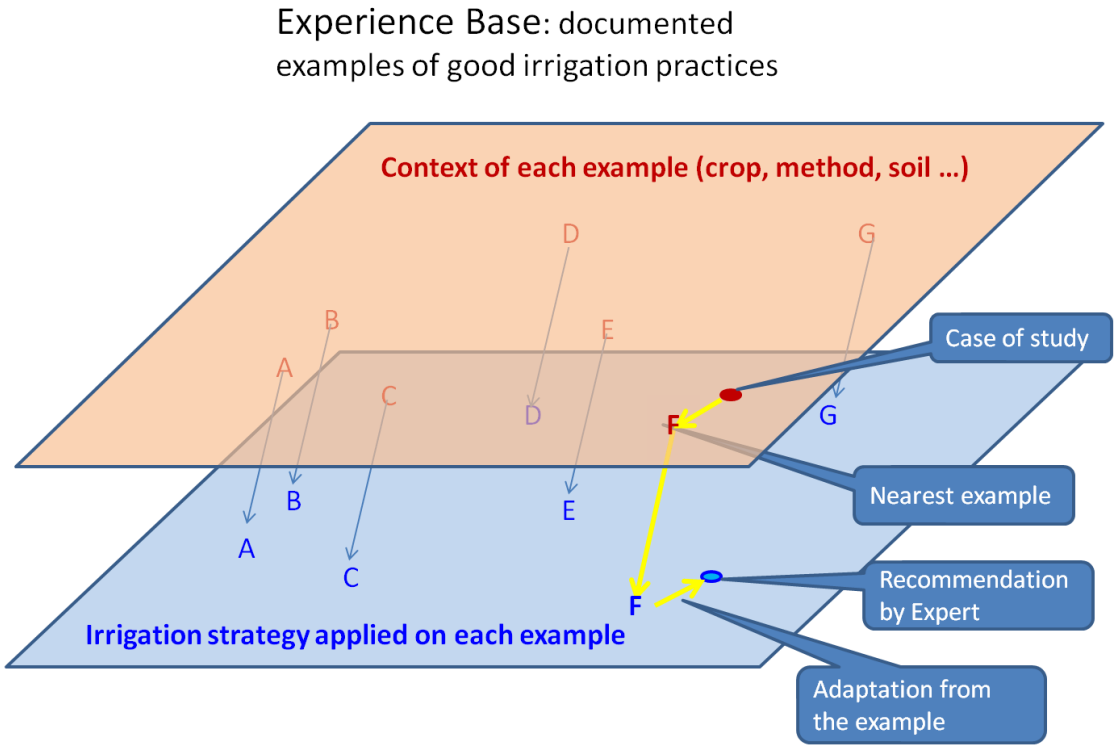


Figure 2. Search and adaptation of the nearest example

Second, the student is asked to irrigate the case of study (Figure 3). To do so, he/she has to fill in a form where to specify the timing and doses to apply during a certain period within the irrigation season. Then, the Expert Scheduler produces its recommended schedules for that period and the Virtual Crop simulates both, the schedules specified by the student and those recommended by the expert. Next, the tool shows the outputs of the simulation and the student shall propose the irrigation for a further period, iterating in this way until the end of the irrigation season.

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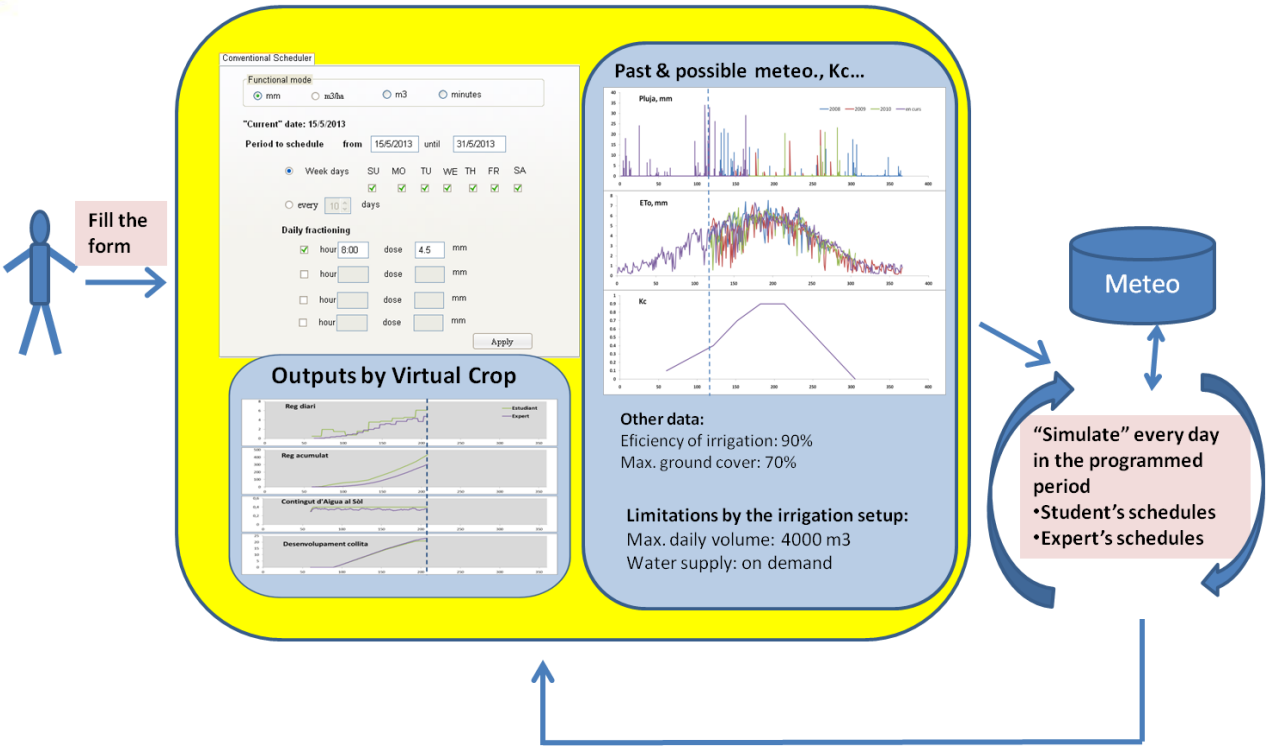


Figure 3. Loop of scheduling and simulation.

The form where the student specifies his/her proposal of irrigation emulates the interface of a typical irrigation controller and it is complemented with panels providing useful information. Among these are historical weather data, reference data for that crop and the most significant traits of the study case. The outputs of the simulations are also shown, which should help the student appreciate how he/she may improve his/her practices.

The workflow for evaluating the irrigation schedules proposed by the student is shown in Figure 4. IES simulates in parallel both the schedules specified by the student and those proposed by the expert. In the case of the Expert Scheduler, the estimation of irrigation needs are based on the adapted example and refined with feedback from the simulation.

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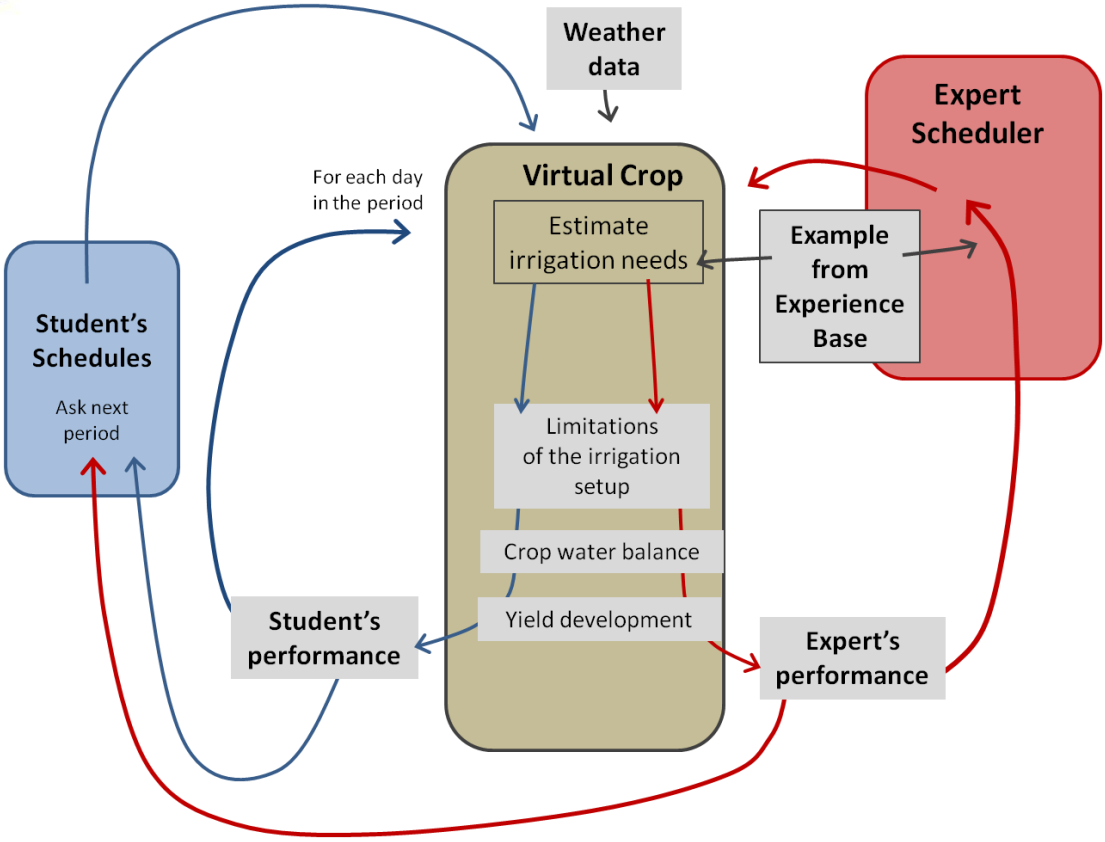


Figure 4. Workflow of the simulations for evaluating the performance of the irrigation schedules proposed by the student.

## 3. RESULTS / CONCLUSIONS

The IES platform offers farmers and technicians the opportunity for practicing and analysing the impact of different scheduling practices on the expected yield and water productivity of a particular plot. With this tool, farmers and technicians can learn to apply more efficient irrigation strategies and program their irrigation controllers as would do an expert.
The expert system behind IES, based on instance-based learning, allows a great simplification of the algorithms required for producing case-specific recommendations and for simulating the performance of different irrigation regimes.

## 4. ACKNOWLEDGMENTS

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