

# TURNING PLANT GROWTH MODELS INTO OBJECTS IN JAVA AND PARAMETERS IDENTIFYING USING A GENETIC ALGORITHM

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## Introduction

Software for agricultural production management, including plant growth models and model of the spread of disease and insect pests, has been developed by many researchers. Prior to several years ago, the problem of programming technology and the fact that network use was not yet widespread prevented the distribution of useful models. Developers often wrote programs several times for different runtime environments and had trouble reusing and maintaining programs. Users had to keep in mind that the model can be run on the user's computer and install the software on the user's computer. The situation changed with the spread of the Internet and the appearance of programming languages like Java. Java applets are well-suited for use on the WWW because Java applets can be downloaded from a Web server and run on your computer by a Web browser. And Java programs can be run on most computers because Java interpreters and runtime environments exist for most operating systems. Moreover Java is an object-oriented language. One of the advantages of object-oriented programming techniques is that they enable programmers to create modules that do not need to be changed when a new type of object is added. A programmer can simply create a new object that inherits many of its features from existing objects. It is now easy for model developers to disseminate their models and a model users can use models from anywhere in the world via the Internet.

## Methods

We are pushing forward on the construction of a database of models (Fig.1). The following work is to be performed:

1. Collect models that have been programmed in the past and data that will be used by these models.
2. Convert models to objects in Java.
3. Open models to the public via the Internet. Java applets and data can be distributed and can exist on several servers.

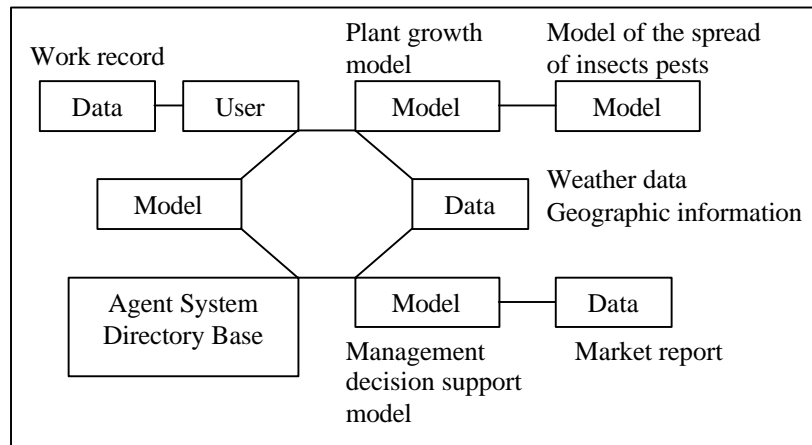


Fig.1. The concept of a model base.

The method of using the model base is as follows:

1. A suitable model for the producer's inquiry is selected from the model database.
2. Models are combined if no single model can determine a result.
3. The location of a database that includes data required by these models is indicated by a directory base.
4. The parameters of the model are adjusted according to cultivar and cultivation locale by a genetic algorithm.
5. The result of execution is displayed in tables or graphs according to the user's preference.

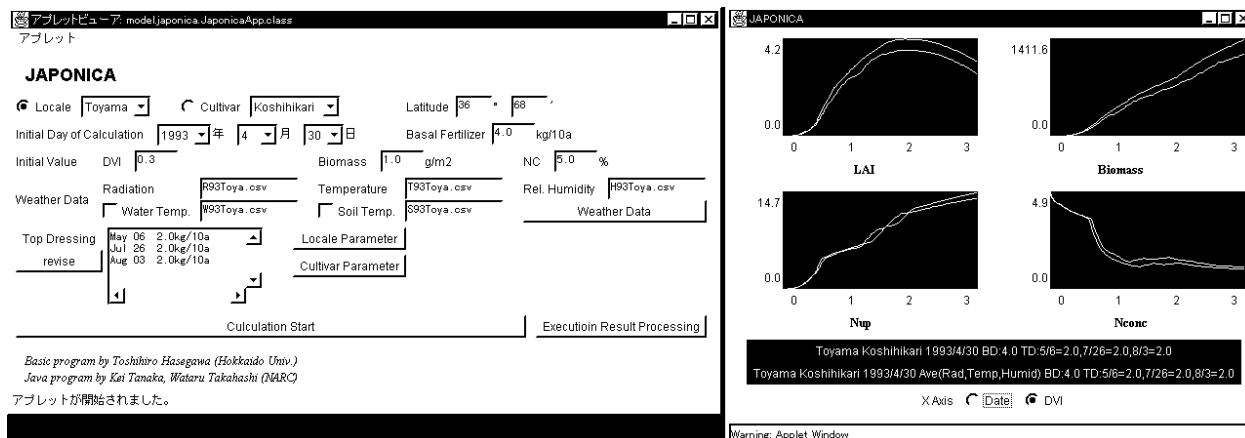


Fig.2. Example of a Java applet: JAPONICA (rice growth model)

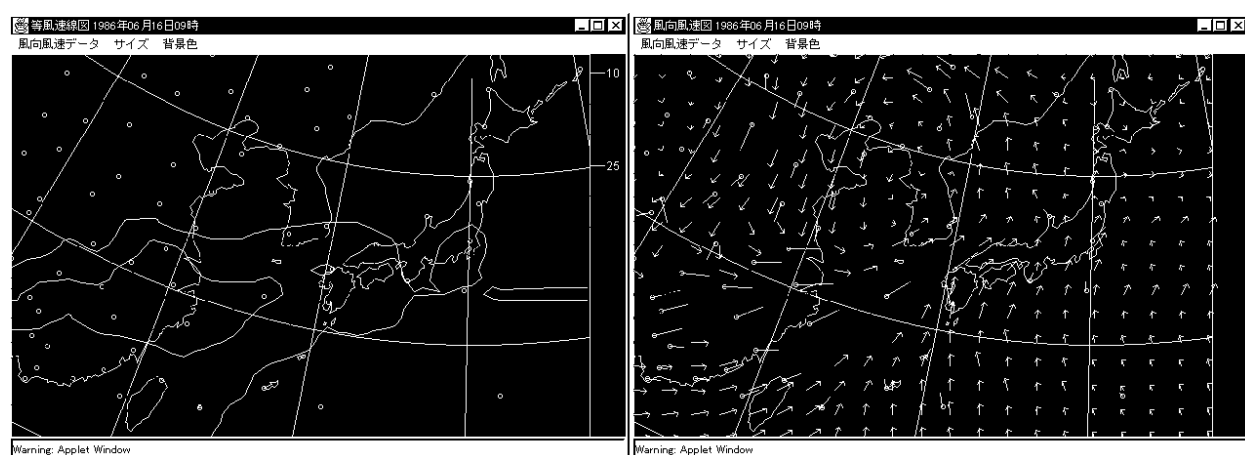


Fig.3. Example of a Java applet: LLJET (a model of the spread of insects pests)

## Results

We have programmed JAPONICA (rice growth model, Fig.2), LLJET (model of the spread of insects pests, Fig.3), etc. in Java. These can be run on computers anywhere in the world via the Internet. By adopting a GUI, it becomes easy to operate applications. Moreover, since Java excels in extendability and maintenance, productivity is increased. Users may not notice that they are running the latest version of a model, revised with respect to software bugs, because Java applets are downloaded at the time of execution.

## Conclusions

Some models were translated into Java applets. The feature of Java applets that they can be run on most computers anywhere in the world via the Internet shows possibilities for model use. Moreover, object-oriented technology increased productivity, through its extendability and maintenance, and made it easy to make more complicated models by integrating several simpler ones. We are currently improving the mechanism of model integration and parameter identification.

## References

Tanaka, K., et al. 1998. Finding Formula Equation for Dynamic Change in Complex System and System Identification by Genetic Algorithm. Intelligent System Symposium. pp.31-34.