Introduction

Mathlets: An Introduction

Hello. My name is Haynes Miller. I'm a professor of mathematics at MIT. And I'd like to welcome you to this short online course on the use of technology in teaching university level mathematics.

Specifically, we'll be talking about a collection of computer tools developed here at MIT known as the MIT Mathlets. My involvement with this technology begin with my own frustration at being restricted to the use of Stone Age implements, that is chalk and slate, to try to explain mathematics to students. There are lots of reasons to use tools like the Mathlets in teaching mathematics. And I'll be pointing out many of these reasons as we go along in this course. But I think there two main ones.

First, many parts of mathematics are intrinsically visual and can be well presented using computer graphics. You can also use this technology to link the abstraction of the mathematics to the physical system from which it's derived. This linkage is important to your students and brings the subject to life.

The second big draw for me is this. You're always faced with a dilemma. You can write general formulas and the students don't understand what you're writing, or you can make special cases on the blackboard and you miss the general case. Students can't extrapolate easily from just one or two examples.

If you know the subject, you have in your mind a whole family of special cases. The general case is this family. You know what aspects of a particular example are shared by all examples and which are accidental to the chosen special situation. And Mathlets help by allowing you to show the student a continuously varying family of special cases. This gives meaning to the symbols used to express a general statement.

For these reasons, in the fall of the year 2000, we began to develop a set of applets for use in our courses. We began with our basic course on ordinary differential equations. But over time, we've created Mathlets useful in teaching calculus and linear algebra and also outside of mathematics. We collaborated with physics faculty to develop tools to teach mechanics and electromagnetism, and with mechanical engineers to help develop tools for their controls courses, and with aerospace engineering on tools to help students understand stability of numerical algorithms.

This short course will introduce you to the MIT Mathlets. We'll model their use in various contexts in lecture, in group work, and in homework. I'll show you decisions that I make in my own use of them in teaching. And we'll do some exercises to develop skills you need to use them in your own teaching.

This short course is designed to acquaint you with the MIT Mathlets and give you practice in designing learning activities, lectures, group work, and homework using the applets. This course should take you about four hours to complete. And the material consists of videos showing the use of the Mathlets in various styles of lecture, examples of their use in group work and in homework, colleague to colleague commentary sharing insights about the tricks and pitfalls of using this educational material, and exercises to help you develop the skill of integrating this work into your own teaching.

The course is broken into three modules illustrating three somewhat different uses of the Mathlets in lecture, in group work, and in homework. Each module contains two examples intended to model the use of an applet in one of these contexts. Each example is accompanied by a commentary discussing the choices I made in designing the activity and calling out some features to pay special attention to. Each module ends with some exercises for you. Since these Mathlets can be used in a variety of different contexts, many of the exercises invite you to make your own choice of Mathlet from the list. Now, let's look at the website housing the MIT Mathlets.

As of the fall of 2013, the main Mathlet library is written in Java. A project is under way to rewrite the Mathlets in JavaScript. And these will be added to the Mathlets website as they are completed. Navigate to http://Mathlets.org to find this page. We'll return to discuss the various features present on this site later in the course. For now, I want to show you where to find the actual Mathlets and how to execute them.

First, the applets button brings up a simple alphabetical listing of the Mathlets. Each Mathlet has a home page, which can be invoked by clicking on the name. Let's choose isoclines, since that will be the subject of the first module.

The home page contains a variety of material associated with this particular Mathlet. The Mathlet itself can be run in either the browser or in a Java window. Sometimes Java experiences conflict with the browser. If the Mathlet doesn't run smoothly, try running it in its own Java window. Of course, if a JavaScript version is available, that's a better choice.

Now, let's go back to the listing. Each line contains the name of a Mathlet and these three buttons. The button with the frame around it launches the Mathlet in the browser window. The button without the frame launches a new Java window. And this third button launches a help file containing a succinct description of the functionality of the applet.

If you run the Mathlet in your browser window, you can invoke this help file using a button at the top of that window. The Mathlets let's can also be accessed through this page, which organizes them according to the unit in a course in which they might be used. Each line here links to a Mathlet home page.

Before we go any further, I'd like to point out that many of these applets derive from the earlier collection of educational applets called interactive differential equations, or IDE. You can find that work on the web and use those tools as well as the MIT Mathlets. Creating good educational material is a cumulative effort.