Maplesoft
Mathematics • Modeling • Simulation
A Cybernet Group Company

How to Give Your Students Coding Experience Without Turning Your World Upside Down

More and more, students are looking for coding experience even when they are not studying computer science. They know that programming is an important aspect of an ever-growing number of technical careers, and is increasingly important even in non-technical fields. To prepare themselves for the future, students are demanding the opportunity to learn these skills, and educators at all levels are striving to help them do it.

But in a post-secondary institution, how do you give your students the exposure they need when they aren't taking a programming course? You can't simply sacrifice content from another course in order to make room for a programming unit, and even if you could, the new unit would still need to be relevant to that subject. How do you give your students the opportunity to code, and do it in a way that supports their overall learning, not detracts from it?

One answer is Maple™.

Maple is math software that combines the world's most powerful math engine with an interface that makes it extremely easy to analyze, explore, visualize, and solve mathematical problems. You might be surprised to hear Maple come up in the context of coding. After all, Maple is known for its Clickable Math™ approach, which enables students and teachers to solve problems and explore concepts *without* needing to learn any syntax or commands. But Maple *also* has a sophisticated programming language; in fact, the vast majority of its mathematics engine is written in the Maple language. This duality means you can get both styles of interaction from a single product – point-and-click problem-solving when you want it, and a programming environment when desired.

So instead of shoehorning in a programming unit where it doesn't belong, or doing without entirely, you can give your students coding experience by incorporating Maple into any of your math-based courses. And rather than coding being a largely separate topic, the programming work they do can actually help develop and reinforce the concepts they are learning throughout the course. In addition, you and your students get access to all the advantages of teaching and learning with Maple, and you don't even need to write code to get those benefits unless you want to.

Benefits of the Maple Language

While Maple enriches the classroom and enhances student learning in many different ways, here are some aspects of the Maple programming language in particular that make it a good choice for your students.

Designed for Mathematics

One of the strengths of the Maple language is that it is designed for mathematics. Mathematical objects, like matrices and polynomials, are fundamental data types in the language. This means that students can still think mathematically while they are coding, instead of having to operate at a much lower, more complicated level. They are reinforcing course concepts at the same time they are developing their coding skills. As a result, you don't need to choose between teaching your course and providing programming experience. You can have both, and each reinforces the other.

Maple:

```
A.A^(-1);
```

Python:

```
import numpy as np
np.dot(A,np.linalg.inv(A))
```

The code for multiplying the matrix A by its inverse, done in Maple and Python. The Maple language has a built-in understanding of mathematical objects, allowing students to develop coding skills while continuing to think mathematically.

Widely Used Programming Style

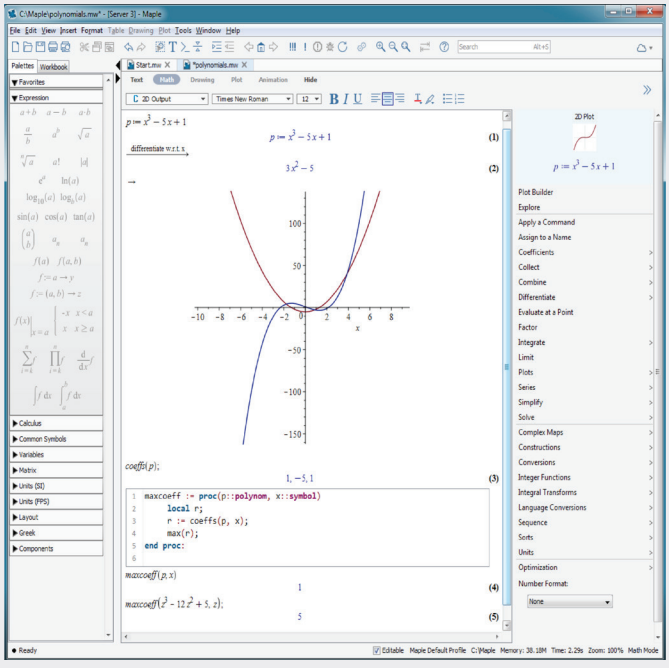
Maple has a procedural programming language, similar to Python®, C/C++, Java, and many others. If your students already have experience with another procedural language, they will find learning Maple's language straight-forward, while still getting important exposure to the differences that occur between languages. If they are new to programming, they will find Maple's logical structure and flow much easier to learn than other types, such as functional languages.

Experience with procedural programming such as Maple's can be easily transferred to the many other procedural languages in wide-spread use.

Easy Access

It is extremely easy to start writing code in Maple. Maple is an interpreted language. This means that your students don't need to worry about setting up compliers and complex programming environments that can make coding difficult before you even begin. Instead, all they need to do is start Maple.

Students run code directly inside Maple itself, in the same environment in which they can also use Clickable Math techniques to solve problems. In fact, they can mix and match approaches as they work, choosing whichever method bests suits their needs at that moment.



The Maple environment supports syntax-free point-and-click interactions as well as commands and programs.

Instant Results for Faster Learning

Because the Maple language is interpreted, it gives instant results, which makes Maple a particularly friendly environment for learning and experimenting with coding. You can run short scripts without having to define formal procedures, and see the results immediately. You can figure out your algorithm interactively, reviewing the results of each step as you go, identifying problems, and making changes on the fly. Once you are satisfied with the results, you can then combine these steps into a reusable procedure with minimal effort, if desired.

By contrast, compiled languages are more rigid in how you can interact with them, and cannot show instant results. This makes the standard iterative development process significantly more onerous, and experimentation more difficult. By using an interpreted language like Maple instead of a compiled language, your students can develop their fundamental coding skills faster, gaining the same knowledge and experience in less time.

Grows with Your Students

Mathematically, Maple has what your students need to support them in their future STEM education no matter how far they go, including graduate programs and even beyond into research.

Programmatically, Maple can take them from learning how to string commands together, to writing simple functions and procedures, all the way to large scale

Why Educators Use Maple

Maple offers much more than coding experience. Here are some other ways educators are using Maple in their math and math-heavy courses.

Illuminating Visualizations

Some topics in mathematics need to be seen to be understood. In Maple, you and your students can create illuminating 2-D and 3-D plots and animations instantly, with just a few clicks of the mouse. You can then zoom in and out, view 3-D plots from different angles, play animations, add additional curves to the same axes, and much more.

Focus on the Concepts

Even something as simple as a misplaced minus sign can derail an entire lesson or homework exercise, impeding understanding of the concept itself. When you let Maple deal with the mechanics, you and your students can focus on the important ideas without getting lost in the underlying calculations.

Interactive Learning

With Maple, your students can experiment with interactive explorations that give immediate feedback, so they can learn and reinforce concepts, and develop their mathematical intuition. It's much easier to understand slopes, or the difference between $\sin(a\,x)$ and $a\,\sin(x)$, or volumes of revolution, or many other concepts, if all you have to do is move a slider to see how the plot changes.

Motivating Examples

How often have you heard students grumble that what they are learning is useless? Maple enables you and your students to work with motivating examples and applications that would be much too difficult and time-consuming to work out by hand.

Going Beyond

Maple makes it easy for students to do mathematics on their own. Not only can they practice skills and build confidence, but Maple also enables them to explore beyond the confines of the lesson, experimenting with "what if..." questions that deepen their understanding and strengthen their interest in the subject.

Preparing for the Future

Computer algebra systems like Maple have become a basic tool of mathematical literacy. By introducing Maple now, you are giving your students the experience they need to pursue further studies and be effective in their professional careers.

advanced algorithm and application development. While students do not *need* to know about or use advanced features, if they want them, Maple provides an environment in which they can learn about objects and operator overloading, exception handling, parallel programming, and other advanced programming concepts.

Conclusion

To prepare themselves for future careers, students want coding experience. The challenge for educators, especially at the post-secondary level, is to find a way to provide this experience within the context of a non-programming course in a way that makes sense and adds value to the course itself.

For math courses, and courses that involve mathematics, such as science, engineering, and finance, Maple provides an effective solution to this problem. By introducing Maple into your math and math-based courses, you can give your students the coding opportunities they need, and do it in a way that actively supports their learning of the course material. You and your students can use Maple to explore concepts, visualize problems and solutions, apply abstract concepts to real-world problems, and much more, and you can do it using either an interactive point-and-click approach, or through commands and programming.

Whether you integrate Maple programming into your lectures, include programming questions on assignments, offer coding problems as an enrichment activity, or simply tell the self-motivated students that the programming language is there, by adopting Maple you will be providing your students with the opportunity to learn a valuable skill that will help prepare them for the future.

In other words, Maple lets you give your students coding experience without turning your world upside down.

Maplesoft
Mathematics • Modeling • Simulation
A Cybernet Group Company

www.maplesoft.com | info@maplesoft.com
Toll-free: (US & Canada) 1-800-267-6583 | Direct:1-519-747-2373