BYTES AND BEATS
An Introduction to Programming with MATLAB

Instructor Guide

Module 2: What is Programming?

Prerequisite Domain Knowledge: None

Expected Completion Time: 50 minutes

Note: This module does not require the use of MATLAB® for students, and may be best suited as an introduction or for younger groups.

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What is Programming?

Expected Duration: 5 minutes

Learning Objectives

- Discuss what programming is at a high level.
- Talk about examples of programming applications.
- Introduce MATLAB.

Motivation

How do we make our computer create and play music? What is MATLAB?

Steps

Introduce programming

- Tell the students that one part of the course is about music and the other part is about programming. We will be making music using computer programs.
- Ask the students what they think programming is.
- Essentially, programming is a way to communicate with the computer and instruct it to perform tasks.
- Human beings can make mistakes when doing large calculations. We also become bored or distracted when doing repetitive things, which makes us more error-prone. Computers, on the other hand, are very quick at doing math and logic operations. They are also good at doing repetitive things (e.g. changing traffic lights every 30 seconds) as they don't have feelings like boredom. This makes computers especially useful. But computers can't think for themselves and need instructions for doing things, so they need humans to program them.

Discuss examples of programming and code applications (ask student for examples):

- Apps: TikTok® or Instagram®
- Videogames: Minecraft®
- Websites: YouTube®
- Digital watches: Ask if anyone is wearing a digital watch and ask if it has code in it (it does)

Get the students to realize that they are surrounded by code and programming applications.

MATLAB is a programming language and platform. Just like we have different human languages to talk to one another, we give instructions to the computer using a programming language. MATLAB is used for many different applications.

- Some examples are: Mars rover, airplanes, car monitoring systems, biotechnology, AI.

Acting Out Programming

Expected Duration: 20 minutes

Learning Objectives

To run a program at the very minimum you need:

- Human programmer – to write commands
- Computer – to process or execute the commands
- Output Device – (attached to the computer) to show tangible outputs or results

A computer needs extremely specific instructions.

Motivation

We must understand what programming is before we start writing code.

Steps

Divide the students into groups of five.

Tell the students we are going to act out programming and have a mini concert.

Each group should have:

- 1 Programmer (music composer)
- 1 Computer (conductor)
- 3 Output Devices (musicians)

In each group, ask them to decide who will be the programmer and the computer. The other three will be output devices.

For the Output Devices:

- Find items in the classroom or gather materials that the students can use to make different sounds with. For example: cans, spoons, knock on the desk, rulers, aluminum trays or even snapping their fingers.
- From each group, the three students acting as output devices should choose ONE sound each and name it – ask them to think of a word to describe their sound. For example, TING, BOOM, CLAP, SNAP, etc.
- Ask them to use a sticky note or index cards to tape the sound names they came up with on their clothes.
- These names will become the commands that the programmer in their group can use. A command is a piece of code or instructions that the programmer writes for the computer.

For the Programmers:

- Ask the programmers in each group to write out a sequence of sound names or commands on a piece of paper that sounds like a rhythm. For example, if a group has three sound names - TING, BOOM, CLAP – the sequence can be something like:
- TING
- BOOM
- BOOM
- CLAP
- TING
- BOOM
- BOOM
- CLAP
- This becomes a list of commands which the programmer then hands to the computer. The computer reads the commands, and then does whatever tasks it is told to do.

For the Computers:

- The Computers will then execute the commands line by line by pointing their hand at the corresponding output devices.

Output Devices:

- The output devices now play their sound when the computer points at them.

Congratulate the class on writing and executing their first program!

Ask them what will happen if the programmer uses a fourth sound in his/her sequence which is not available in the group? (Ans: The computer will execute all the lines up until it reaches the fourth sound and then it won't know who to point to. Basically, it will give an error saying, "I don't know what you would like me to do here.")

Concepts Learned

- The programmer needs to use a valid set of keywords and syntax that the computer understands and can execute.
- A command is a piece of code or instructions that the programmer writes for the computer.
- The computer reads the commands, and then does whatever tasks it is told to do.
- The computer cannot think for itself and guess what the programmer is trying to do.

Drawing a Picture of a Guitar

Expected Duration: 25 minutes

Learning Objectives

- Demonstrate the need for specificity when programming
- Provide an interactive way for students to debug a "program"

Motivation

It is necessary to be very literal and specific with computers and programming!

Materials

- Whiteboard
- Whiteboard markers
- Paper (for students)
- Pencils/Pens (for students)

Note: If you do not have a whiteboard, you can also just use a piece of paper for this activity.

Steps

To demonstrate how clear and exact you must be with computer programming, you will task the students in coming up with instructions for you to draw a picture of a guitar. At first, this may seem simple, with steps such as

- Pick up marker
- Draw body of guitar
- Draw head and neck of guitar
- Draw strings of guitar

but consider that computers need more specific information than this.

- How should you hold the marker?
- Does the marker need to be uncapped first?
- Where should the marker start on the whiteboard?
- What drawing movements will create a guitar shape? *(A computer does not know what a guitar looks like!)*

Split the students into small groups or pairs and have them create their "program" on paper for you to test for them. The more literal and frustrating you are with your movements, the more the students will see how specific they need to be with their program. Allow them to try as many iterations with you as time allows.