Advancing the neuroscience curricula, a computational thinking approach.

Daniel Zysman, MIT

We often hear that the brain is a marvelous and impressive computational device. Most of the current research efforts in the field of neuroscience are devoted in one way or another to broaden our understanding of how this organ actually works. This is, to disentangle how these computations are actually performed and how they continue to amaze us.

Despite this intimate and intricate connection between the brain and computational thinking, the way we teach undergraduate neuroscience does not necessarily showcase this fact. So, the natural question is: How we can bring this to the table?

At MIT we have reformed the undergraduate program to include a required subject in neural computation. The goal of this course is to give an introduction to the subject of computational neuroscience by exposing students to simple mathematical models of the brain computations and basic tools for data analysis.

Our pedagogical approach is to give context into specific aspects of neuroscience and brain functions to develop an algorithmic and computational thinking. For each concept or abstract representation, we move into implementing these models and data analyses in MATLAB.

In this way students can build conceptual connections that are applicable within a more rigorous and quantitative context.

As the course advances students overcome the initial difficulties of thinking quantitatively, and start to enjoy the opportunity to analyze and model real data.

Teaching such a course is challenging for a variety of reasons. First of all it requires well-crafted and engaging problem sets. Secondly it requires teaching personnel well trained in both areas (neuroscience and computation). Last and more importantly, we need to balance the focus on teaching programming (especially good programming practices) and teaching the subject matter.

However, this is a very rewarding experience both for the instructors and the students. After taking this course students feel more prepared for future coursework, research projects or even for the job market. They also come to understand that having these skills set is a prerogative for a successful career in the current scenario.

As instructors, we feel empowered, not only by advancing computational thinking, but also by paving the road for future neuroscientists. We hope that our students will be able to advance the fleld beyond the traditional view of neuroscience as a merely descriptive subject.