

Logic and Computation – CS 2800

Fall 2019

Lecture 1

Introduction

Stavros Tripakis



Northeastern University
Khoury College of
Computer Sciences

Outline

- First assignment
- Round of introductions
- What is this class about? In a nutshell:
 - **Computation**: writing programs
 - **Logic**: reasoning about programs
 - Writing properties about programs
 - Proving those properties
- Thanks to Prof. Manolios for ACL2s, lecture notes, slides, etc.

Your first assignment

- Course contract: read, sign, upload on Blackboard
- Piazza: enroll
- Homework groups:
 - Find team mates
 - Create group on Blackboard

Also: try to install ACL2s **before** Friday's lab

- See instructions on course web page:
<https://course.ccs.neu.edu/cs2800f19/>
- If you don't manage, go to the lab on Friday
 - Download all packages **before** going to the lab (virtual box, extension pack, vagrant)
 - These are hundreds of Mbytes so you don't want to leave it for the lab

Introductions

- Come to the front and introduce yourselves
 - Your name
 - Where are you from?
 - Your major
 - Why are you interested in CS
 - What are you expecting from this course
 - Is it a mandatory course for you?
 - Some fun/cool thing about you/that you do/did this summer

The science of software

What is science?

- Science = knowledge that helps us make **predictions**
- The stronger the science, the stronger / less trivial the predictions it can make

Prometheus and Epimetheus

- **Epimetheus** (/ɛpɪ'miːθiəs/; Greek: Ἐπιμηθεύς, which might mean "hindsight", literally "afterthinker")
- **Prometheus** (/prə'miːθiːəs/ ; Greek: Προμηθεύς, pronounced [promɛ:tʰéus], possibly meaning "forethought")
- Quote: *"It is hard to make predictions, especially about the future"*

Think of other sciences you know

- What predictions can they make?
 - Physics
 - Chemistry
 - Biology
 - Geology
 - Weather forecasting
 - Medicine
 - Psychology
 - Sociology
 - Economics
 - Theology
 - ...
- Is math a science?

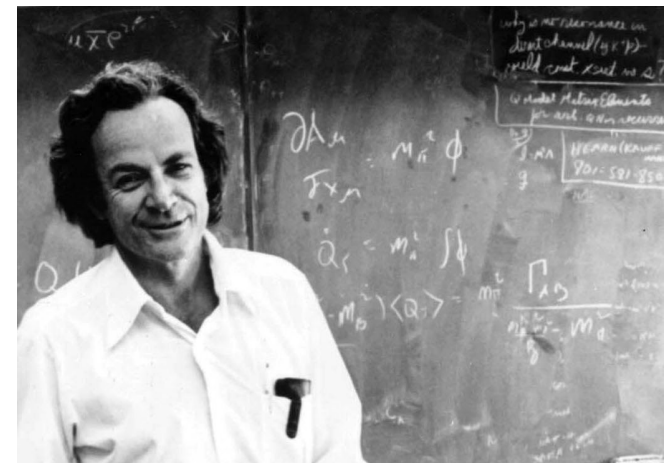
Physics: looking for the laws of nature

- *"In general, we look for a new law by the following process. First, we guess it (audience laughter), no, don't laugh, that's really true. Then we compute the consequences of the guess, to see what, if this is right, if this law we guess is right, to see what it would imply and then we compare the computation results to nature, or we say compare to experiment or experience, compare it directly with observations to see if it works.*

If it disagrees with experiment, it's wrong. In that simple statement is the key to science. It doesn't make any difference how beautiful your guess is, it doesn't matter how smart you are who made the guess, or what his name is... If it disagrees with experiment, it's wrong. That's all there is to it."

- Videos available at <https://www.presentationzen.com/presentationzen/2014/04/richard-feynman-on-the-scientific-method-in-1-minute.html>

Richard Feynman



Physics vs math

- Physics:
 - Guess laws of nature
 - Write laws down using math: now you can “compute consequences” => make predictions
 - Check whether predictions match reality/experiment
 - Revise, until ... : Aristotle revised by Newton revised by Einstein revised by ...

- Math:
 - Theorems are forever
 - Pythagorean theorem is never going to change
 - The ultimate predictions

What is computer science?

- Computer science is many things (sciences)
- One is the **science of computation** (*computability theory*):
 - What is computation? What's a computer? What's an algorithm?
 - Which problems are computable? Which ones are not?
 - Which problems are hard to compute? Which ones are easy? (*complexity theory*)
 - How difficult exactly are the problems? Time complexity, space (memory) complexity, ...
 - ...

What is software science?

- What predictions can we make about the programs (software) that we write?
- Can we predict:
 - Whether our program will terminate?
 - That it will not crash? Never? In some cases? Under which conditions exactly?
 - That it will produce the correct result? What exactly is the correct result?
 - That it will never attempt to divide by zero?
 - That it will not access forbidden parts of the memory?
 - That it will not leak private information?
 - ...

Next time

- Software science continued
- Course web pages
- Designing programs
- Intro to ACL2s
 - **Install ACL2s and experiment with it!**
 - **Try to finish your installation before Friday's lab**
 - **At the very least you should download everything before the lab (many hundreds of MBs of downloads, you won't have time to do it during lab)**
- Skim the lecture notes
 - Available on <https://course.ccs.neu.edu/cs2800f19/>