Foundations of Computer Science
Lecture #1: Introduction

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Getting Started

• Course Home: https://www.cl.cam.ac.uk/teaching/2324/FoundsCS/

• Interactive online notebook: https://hub.cl.cam.ac.uk/

• This notebook corresponds to the printed notes that you should all have. If you cannot login, email me (avsm2) or Jon (jjl25) immediately.

• At the end of this lecture, will also explain the practicals: https://www.cl.cam.ac.uk/teaching/2324/OCaml/
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• We can master complexity through *levels of abstraction*

• Focus on 2 or 3 levels at most!
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• **Recurring issues:**
  
  • *what services* to provide at each level
  
  • *how to implement them* using lower-level services
  
  • *the interface* by which two levels should communicate
• **Computers**: a child can use them; but nobody can fully understand them!
Example: Dates

- **Abstract level**: dates over a certain interval

- **Concrete level**: typically 6 characters: YYMMDD
  - (where each character is represented by 8 bits)

- Date crises caused by inadequate internal formats:
  - *Digital’s PDP-10*: 12-bit dates (good for at most 11 years)
  - *Y2K crisis*: 48-bits could be good for lifetime of universe!

- Our choices of representations within a computer has long-ranging consequences.
Example: Floating Point Numbers

- Computers have integers (like 1066) and floats (like $1.066 \times 10^3$).

- A floating-point number can be represented by two integers.

- The concept of a **data type** involves:
  
  - how a value is represented inside the computer
  
  - the suite of operations given to programmers
  
  - valid and invalid (or exceptional) results, such as “infinity”

- Computer arithmetic can yield incorrect answers due to **finite precision**!
Goals of Programming

• to describe a computation so that it can be done mechanically:
  • expressions compute values
  • commands cause effects

• to do so efficiently and correctly, giving right answers quickly

• to allow easy modification as our needs change
  • through an orderly structure based on abstraction principles
  • programmer should be able to predict effects of changes
Why Learn to Program in OCaml?

• It is interactive.

• It has a flexible notion of data type.

• It hides the underlying hardware: no crashes.

• Programs can easily be understood mathematically.

• It distinguishes naming from updating memory.

• It manages storage in memory for us.
The Practical Classes

https://www.cl.cam.ac.uk/teaching/2324/OCaml/

- Executed online in the hub.cl.cam.ac.uk server

- There are 5 ticks, each of which have a deadline for submission 10 days after they are issued (except last tick, which goes into Lent term).

- Exact dates for the first tick will be announced later today / over weekend by email.

- Some of you will be selected for in person "ticks" in the Lab to explain your workings.