CS207 Design and Analysis of Algorithms

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Algorithms: Introduction

Muhammad ibn Musa al-Khwarizmi

- Muhammad ibn Musa al-Khwarizmi
- Persian polymath; lived in al-Khwarizm c. 780 to c. 850 CE; known in the Western world as Algorithmi
- His Arabic works were translated into Latin
- "Algorithm" comes out of his name
- Main work: *al-Kitab al-Mukhtasar fi Hisab al-Jabr wal-Muqabalah* (The Compendious Book on Calculation by Completion and Balancing) known as *al-Jabr*
- "Algebra" comes out of "al-Jabr"
- al-Khwarizmi's books introduced many Indian/Arabic algorithms to the West

Algorithms

- Know
- Describe
- Define

Ancient civilisations *knew* algorithms

- Mesopotamian (3300 BCE to 750 BCE)
- Andean (3200 BCE to 1700 BCE)
- Indus Valley (3300 BCE to 1200 BCE)
- Egyptian (3000 BCE to 30 BCE)
- ... not to mention later civilisations
- ... ... all had sophisticated architecture, excavations show
- Must have had arithmetic and geometric algorithms

Ancient *descriptions* of algorithms

- Evidences of knowledge are aplenty; but descriptions are fewer
- Many clay tablets of Babylonians (c. 1800 BCE) bearing descriptions of arithmetic algorithms have been found. (D E Knuth, Ancient Babylonian Algorithms, CACM 15.7, 1972, 671-77.)
- Shulba Sutras, Vedic, describe geometric algorithms, after 800 BCE
- Euclid's Algorithm, c. 300 BCE
- Algorithm for computing the cube-root given by Aryabhata (c. 500CE)
- Chinese Remainder Theorem: statement c. 300 BCE by Sun-tzu, description of the underlying algorithm Aryabhata c. 500 CE
- Algorithms for computation of π and the sine function, Madhava (c. 1400 CE)

How do you *define* an algorithm?

- Should an algorithm be written in C language? Or Python?
- We want to say, "No, the langauge should not matter"
- So let us fix on some programming langauge L that is as expressive as any other
- Is an L-program an algorithm?
- An L-program has an algorithm built into it; but isn't one
- If we take an algorithm and change the name of a variable, do we get a new algorithm?
- We want to say, "No"; but it's not that easy
- There is a subjectiveness involved