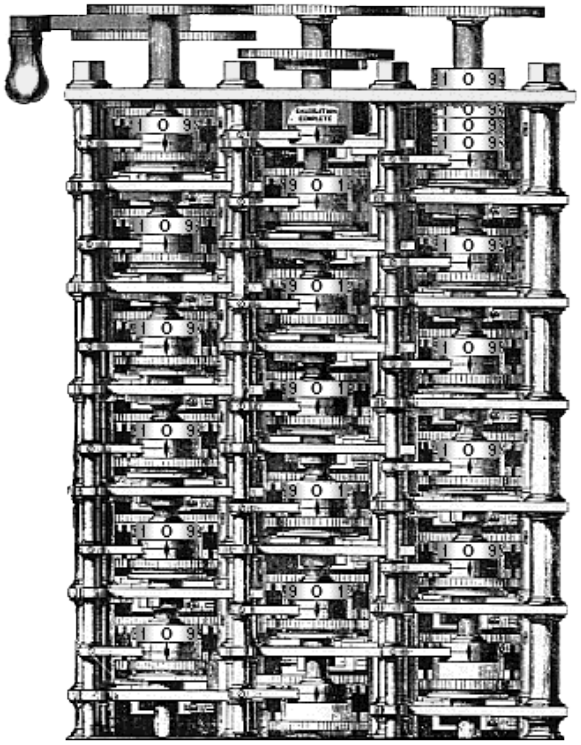
CS208E - Welcome!



Babbage Machine

Chris Gregg, based on slides by Eric Roberts

CS 208E

September 20, 2021

CS 208E—Topic Overview

Week 1	Introductions; course overview; Babbage machines; Ada Lovelace
Week 2	Karel the Robot / Bit the Robot; beginning JavaScript; algorithms
Week 3	Binary arithmetic; digital logic
Week 4	Stored-program machines; the Toddler machine
Week 5	Busy Beaver problem; undecidability
Week 6	Computational complexity; the P = NP question
Week 7	Cryptography; public-key cryptography; digital signatures
Week 8	Networking; networking algorithms; Artificial Intelligence
Week 9	Early Programming Languages / Reflections on Trusting Trust
Week 10	Historiography of Computing

Chris

Gaurab

Who is Chris Gregg?

- Career:
- Johns Hopkins University Bachelor's of Science in Electrical and Computer Engineering
- Seven years active duty, U.S. Navy (14+ years reserves)
- Harvard University, Master's of Education
- Seven years teaching high school physics (Brookline, MA and Santa Cruz, CA)
- University of Virginia, Ph.D. in Computer Engineering
- Three years teaching computer science at Tufts University
- Stanford! (arrived, Fall 2016)
- Book: *Your First Year Teaching Computer Science*
- Personal website: http://ecosimulation.com/chrisgregg

CS 208E—Logistics

Web page: https://web.stanford.edu/class/cs208e/

Textbook: Eric Roberts's *Great Ideas in Computer Science Reader* (available in the bookstore in hard copy, or online (see website) as a PDF

CS 208E—Requirements

Weekly assignments	50%
Final project	50%

Let’s Play a Game

Question 1

Q: Who invented the idea of the “difference engine,” in 1822?

Let's Play a Game

Question 1

Q: Who invented the idea of the "difference engine," in 1822?

A: Charles Babbage

Charles Babbage
(1791-1871)

Let’s Play a Game

Question 2

Q: Who is often described as “the first computer programmer?”

Let’s Play a Game

Question 2

Q: Who is often described as “the first computer programmer?”
A: Ada Lovelace, who was friends with Charles Babbage

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Question 3

Q: What does this symbol represent?

Let's Play a Game

Question 2

Q: What does this symbol represent?
A: Karel the Robot, used in CS 106A to introduce programming

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Question 4

Q: What British Mathematician worked at Bletchley Park during World War II, is a giant in theoretical computer science, and has the "Nobel Prize for computing" named after him?

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Question 4

Q: What British Mathematician worked at Bletchley Park during World War II, is a giant in theoretical computer science, and has the "Nobel Prize for computing" named after him?

A: Alan Turing

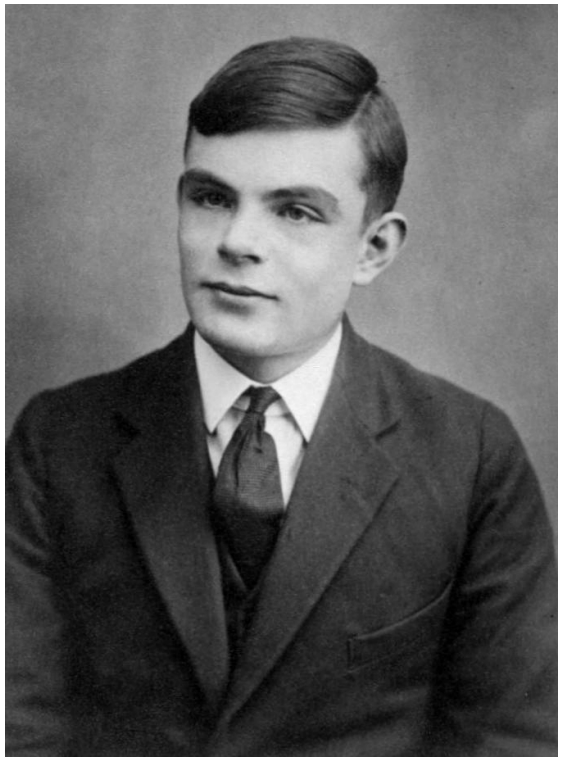
Just kidding on the picture (that is Benedict Cumberbatch, who played Turing in the 2014 film, *The Imitation Game*)

Let's Play a Game

Question 4

Q: What British Mathematician worked at Bletchley Park during World War II, is a giant in theoretical computer science, and has the "Nobel Prize for computing" named after him?

A: Alan Turing



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Question 5

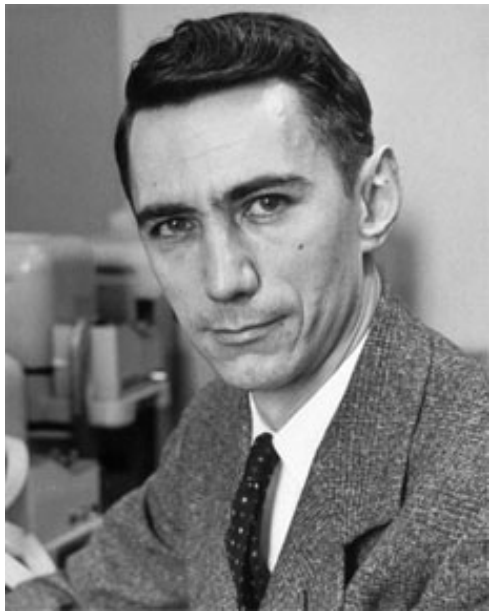
Q: Whose master's thesis, on digital circuit theory, has been called "possibly the most important, and also the most noted, master's thesis of the century"?

Let’s Play a Game

Question 5

Q: Whose master's thesis, on digital circuit theory, has been called "possibly the most important, and also the most noted, master's thesis of the 20th century"?

Q: Claude Shannon, who also invented information theory.



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Question 6

Q: Who is known as "the grandmother of COBOL" by popularizing the idea of machine-independent programming languages?

Let’s Play a Game

Question 6

Q: Who is known as "the grandmother of COBOL" by popularizing the idea of machine-independent programming languages?

A: Grace Hopper, who was also a Rear Admiral in the U.S. Navy

Let's Play a Game

Question 7

Q: In what decade were each of the following programming languages created?

1. Pascal
2. Python
3. BASIC
4. ALGOL
5. FORTRAN
6. Javascript
7. C
8. C++
9. Java
10. COBOL
11. LISP
12. Swift
13. Scratch
14. C#
15. Perl
16. Assembly Language
17. Ruby
18. PHP

Let's Play a Game

Question 7

Q: In what decade were each of the following programming languages created?

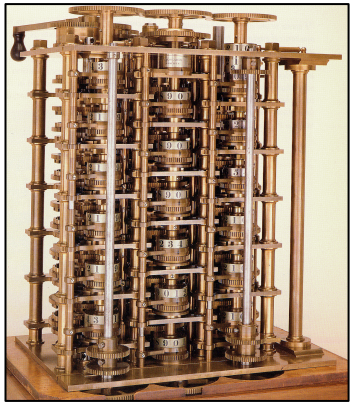
A:

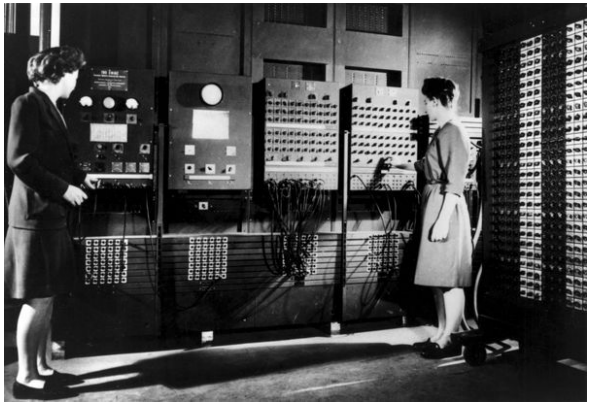
1. Pascal	1. 1960s	11.LISP	11.1950s
2. Python	2. 1990s	12.Swift	12.2010s
3. BASIC	3. 1960s	13.Scratch	13.2000s
4. ALGOL	4. 1950s	14.C#	14.2000s
5. FORTRAN	5. 1950s	15.Perl	15.1980s
6. Javascript	6. 1990s	16.Assembly Language	16.1940s
7. C	7. 1970s		
8. C++	8. 1980s	17.Ruby	17.1990s
9. Java	9. 1990s	18.PHP	18.1990s
10.COBOL	10.1950s		

Let's Play a Game

Question 8a

Q: Name the following computers:



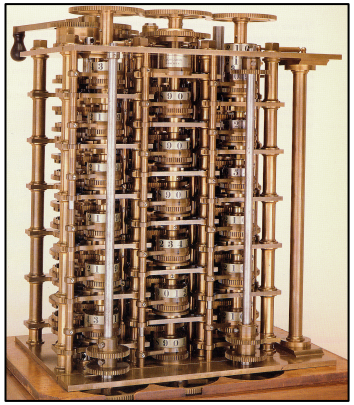


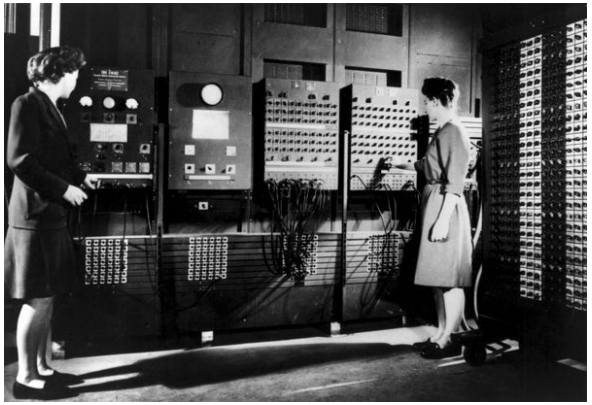
Let's Play a Game

Question 8a

Q: Name the following computers:

Babbage Difference Engine





ENIAC

Bombe from Bletchley Park

IBM System/360

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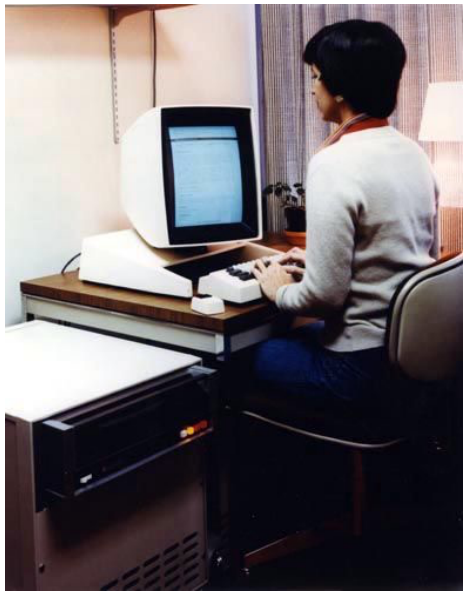
Question 8b

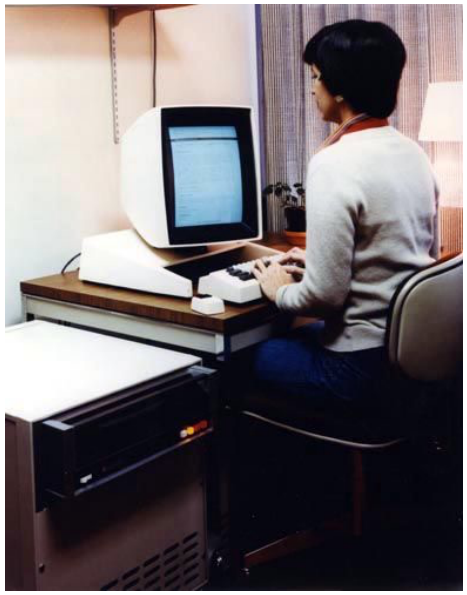
Q: Name the following computers:



Let's Play a Game

Question 8b

Q: Name the following computers:



Xerox
PARC Alto

Altair 8800

Osborne 1

Apple *II*

IBM PC

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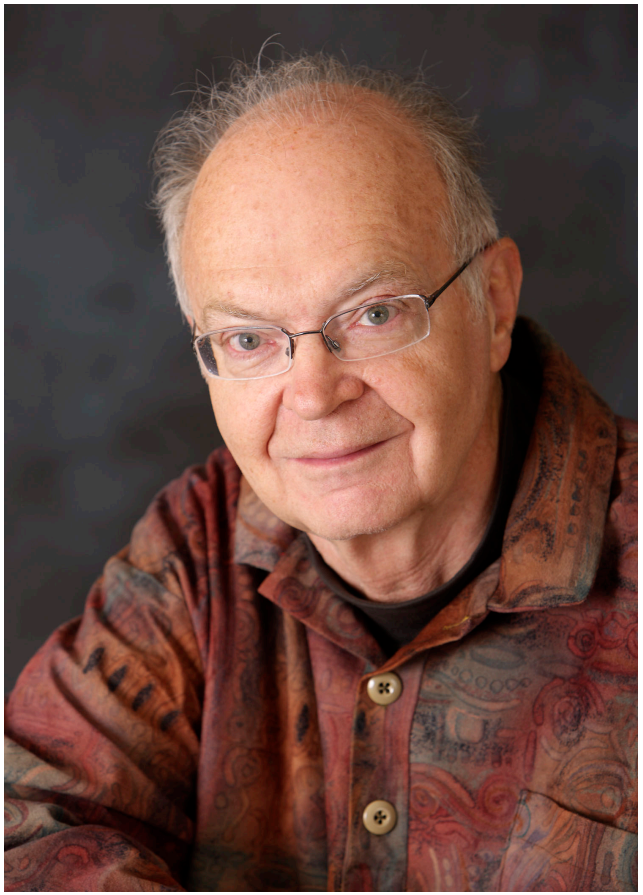
Question 9

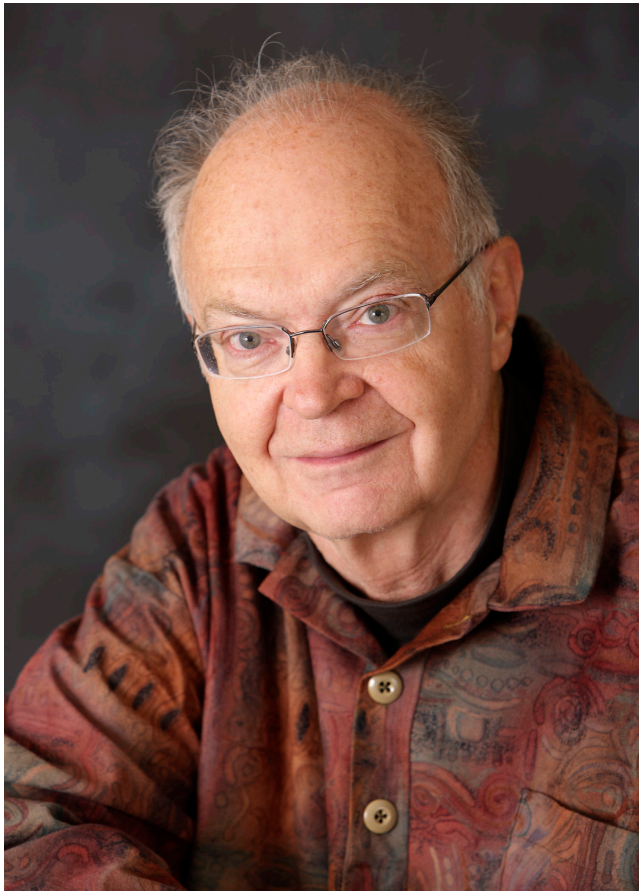
Q: Who is this?



Let's Play a Game

Question 9

Q: Who is this?
A: Donald Knuth -- Turing Award winner, author of *The Art of Computer Programming*, creator of the TEX typesetting system, office in Gates.



Knuth is a giant in computer science, and you'll probably see him around campus!

There are at *least* **five** Turing Award winners who are still affiliated with Stanford, and there have been 17 Turing Award winners affiliated with Stanford.

Computer History Museum

http://www.computerhistory.org

As part of this class, we have the option to take a field trip (date TBD) to the museum, which is located in Mountain View.

Babbage's Machines

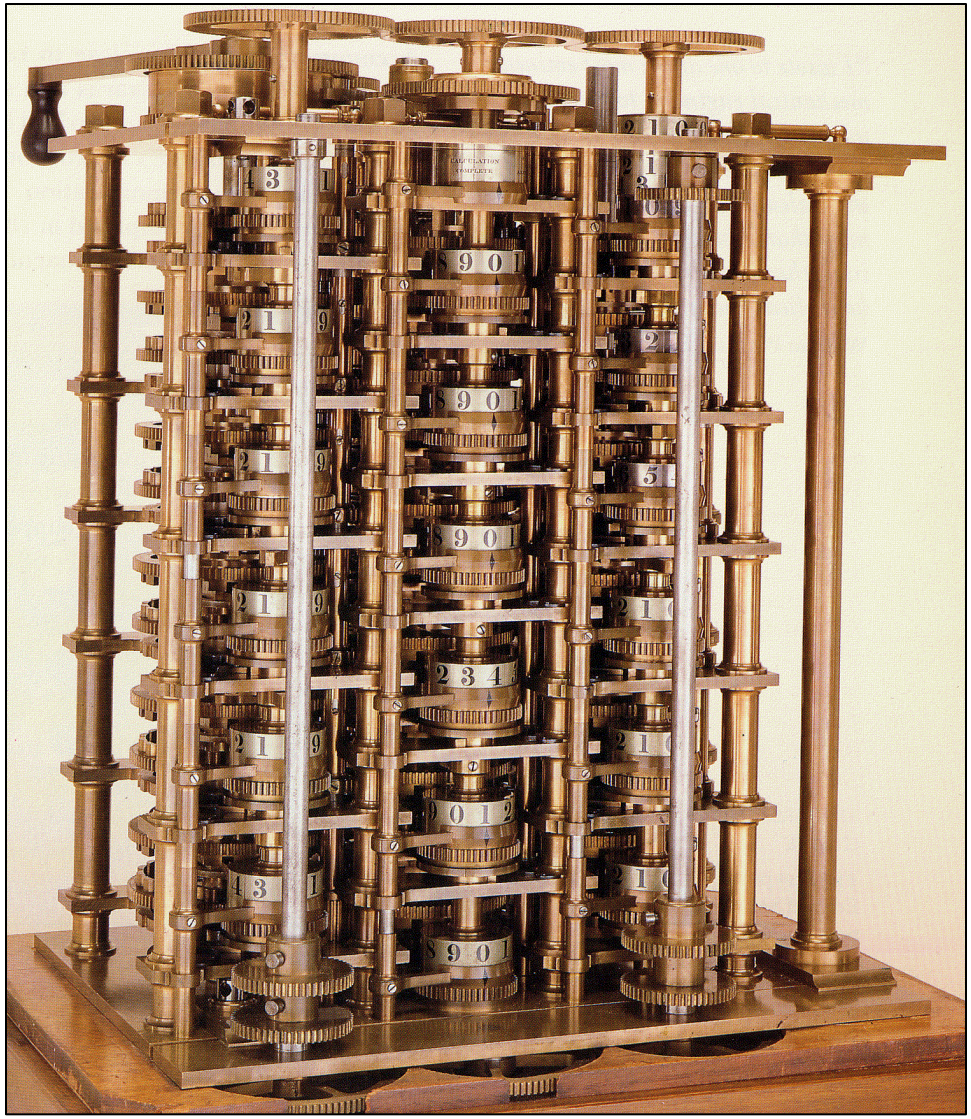
Charles Babbage (1791-1871)

Charles Babbage is one of the most fascinating figures in the history of computing.

Captivated by the idea that he could produce mathematical tables "by steam," Babbage designed two early computing machines—the ***Difference Engine*** and the vastly more powerful ***Analytical Engine***—that anticipated many of the features found in modern computers.

Neither machine was completed within Babbage's lifetime. The Science Museum in London made a full-scale replica of the Difference Engine for the bicentennial of Babbage's birth in 1991.

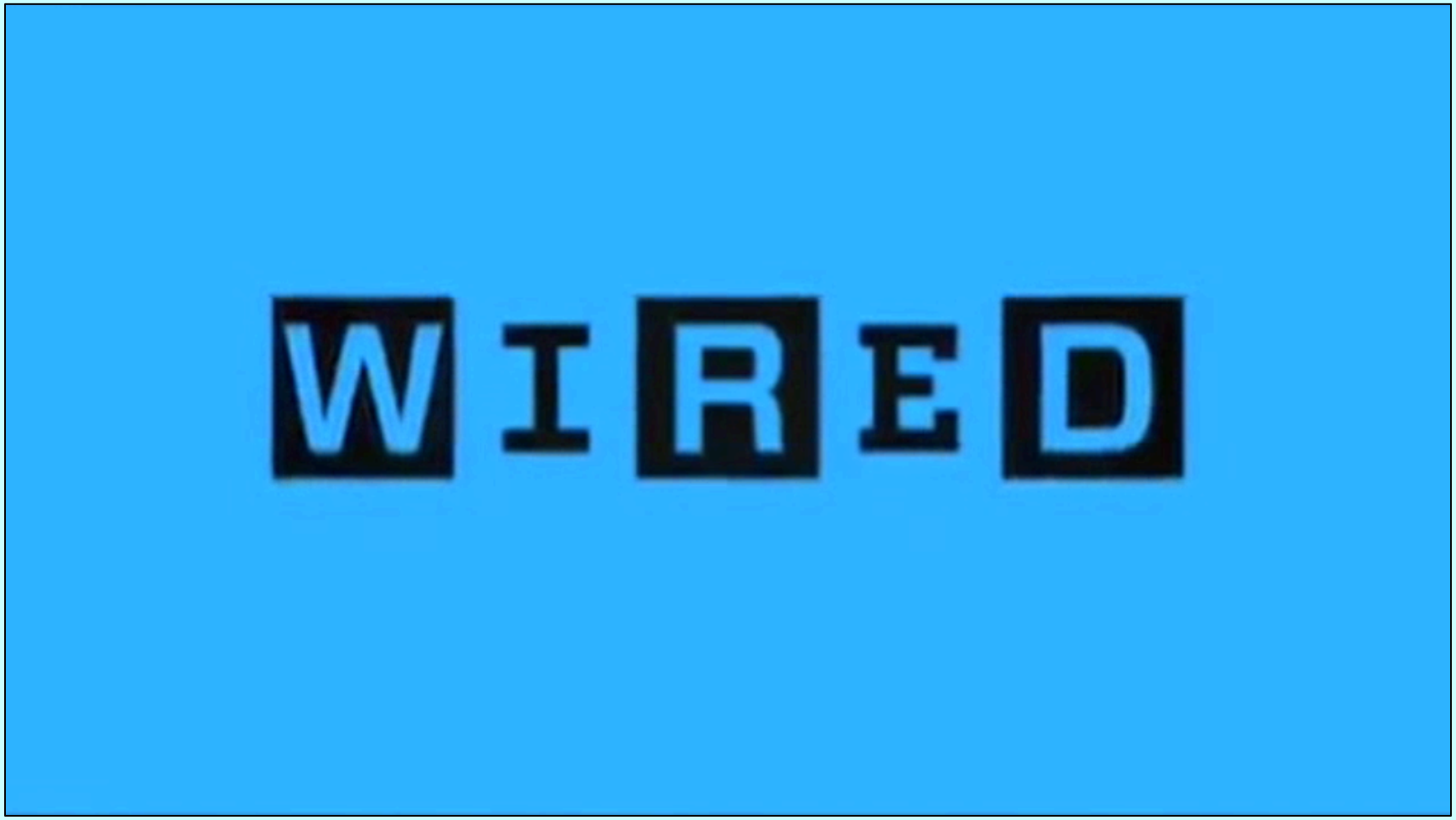
The Difference Engine Prototype



Babbage completed a working model of his Difference Engine, which he had on display at his popular soirées in London.

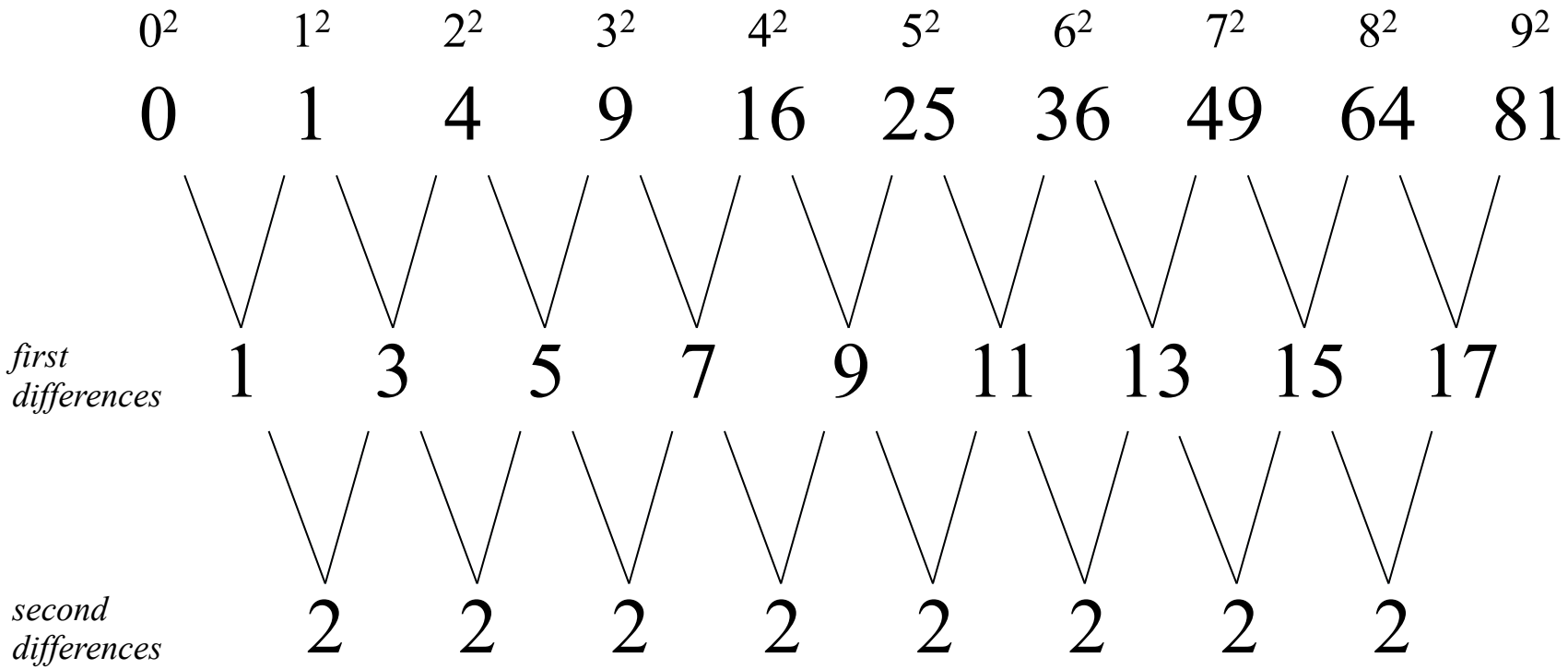
The model on the left was given to the London Science Museum by Babbage's son.

Difference Engine #2



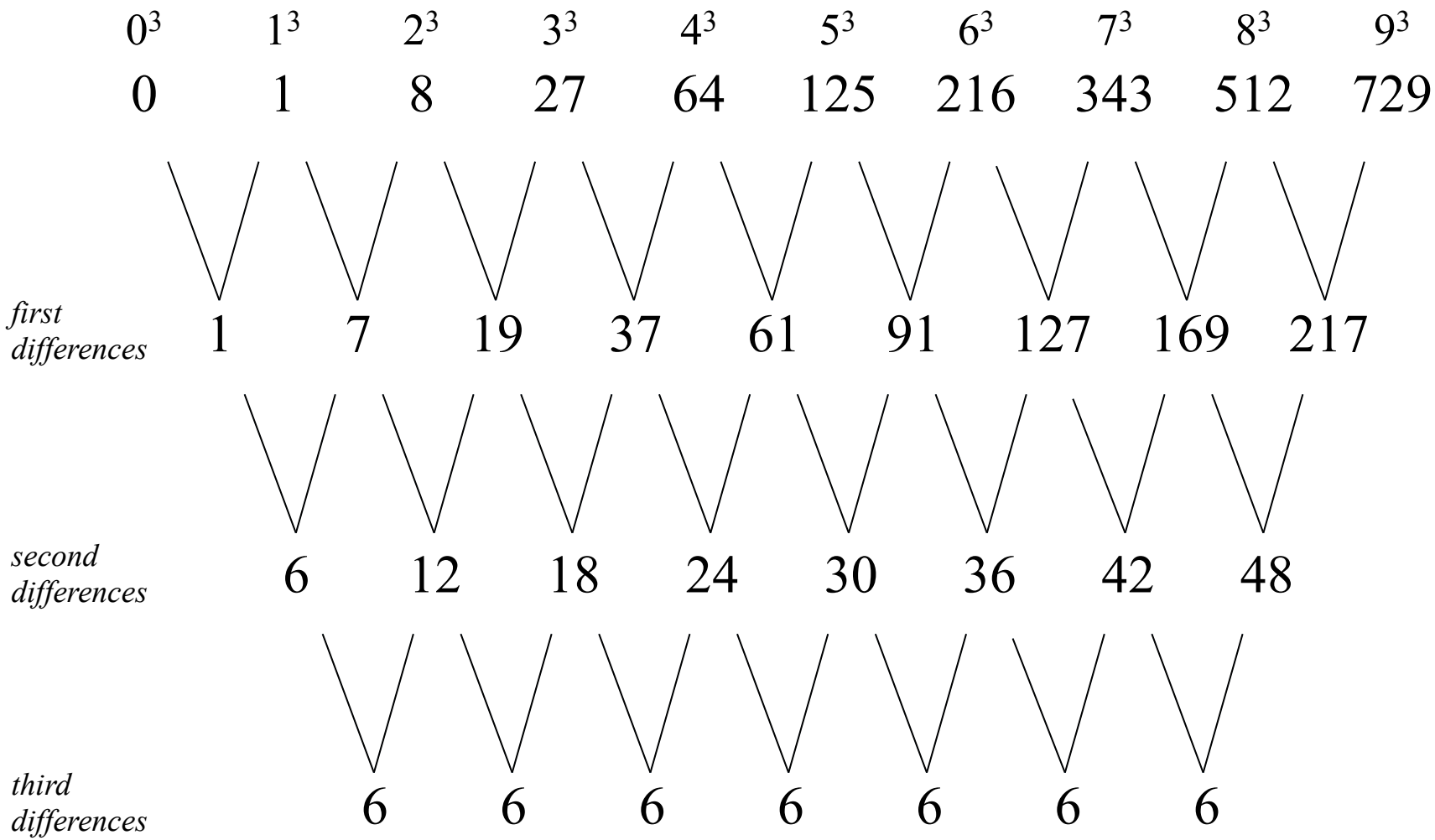
Calculating with Differences

Suppose that you want to produce a table of squares:



Note that the second differences are constant.

Exercise: Do the Same for a Table of Cubes



Exercise: Polynomial Calculation

How would you program the Difference Engine to calculate the terms in the sequence generated by the following polynomial:

$$f(x) = x^2 - 5x + 10$$

Exercise: A Table of Trigonometric Sines

Consider the following table, which shows the value of sin(θ) for values of θ between 30 degrees and 31 degrees in increments of 0.1 degree:

θ	sin(θ)
30.0	0.500000000
30.1	0.501510737
30.2	0.503019947
30.3	0.504527624
30.4	0.506033764
30.5	0.507538363
30.6	0.509041416
30.7	0.510542918
30.8	0.512042865
30.9	0.513541252
31.0	0.515038075

How would you code this calculation on the Difference Engine?

The End