Conclusion

Please take the time to complete the online course evaluation for all your Engineering Courses. For this course, completion of the evaluation is required and carries a weight of 1.

FINAL

Thurs, 13 May, 9:00-11:30AM, Barton Hall

8 review sessions next week.
See handout about the final for details.

You should have emailed Maria Witlox if you have a conflict!

0

Punch cards

Jacquard loom

Mechanical loom invented by Joseph Marie Jacquard in 1801.

Used the holes punched in pasteboard punch cards to control the weavinng of patterns in fabric.

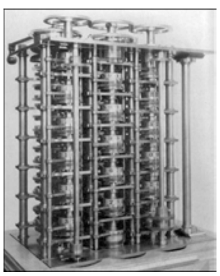
Punch card corresponds to one row of the design.

Based on earlier invention by French mechanic Falcon in 1728.

1

Charles Babbage designed a "difference engine" in 1822

Compute mathematical tables for log, sin, cos, other trigonometric functions.



The mathematicians doing the calculations were called computers

2

Oxford English Dictionary, 1971

Computer: one who computes; a calculator, rekoner. spec. a person employed to make calculations in an observatory, in surveying. etc.

1664: Sir T. Browne. The calendars of these computers.

1704. T. Swift. A very skillful computer.

1744. Walpole. Told by some nice computers of national glory.

1855. Brewster Newton. To pay the expenses of a computer for reducing his observations.

The mathematicians doing the calculations were called computers

3

Charles Babbage planned to use cards to store programs in his Analytical engine. (First designs of real computers, middle 1800s until his death in 1871.)

First programmer was Ada Lovelace, daughter of poet Lord Byron.

Privately schooled in math. One tutor was Augustus De Morgan.

The Right Honourable Augusta Ada, Countess of Lovelace.

Herman Hollerith.
His tabulating machines used in compiling the 1890 Census.
Hollerith's patents were acquired by the Computing-Tabulating-Recording Co.
Later became IBM.

The operator places each card in the reader, pulls down a lever, and removes the card after each punched hole is counted.

Hollerith 1890 Census Tabulator

Computers (mainly women), calculating the US census

6

History of computers

1935-38. Konrad Zuse - **Z1 Computer**

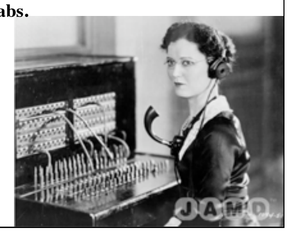
1935-39. John Atanasoff and Berry (grad student). Iowa State

1944. Howard Aiken & Grace Hopper **Harvard Mark I Computer**

1946. John Presper Eckert & John W. Mauchly **ENIAC 1 Computer** 20,000 vacuum tubes later ...

1947-48 The Transistor, at Bell-labs.

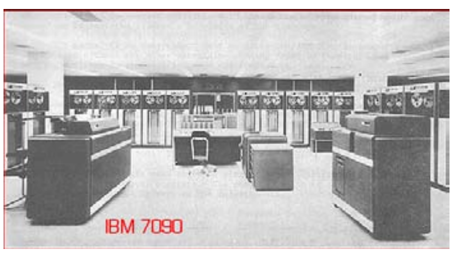
1953. IBM. the IBM 701.



How did Gries get into Computer Science?

1959. Took his only computer course. Senior, Queens College.

1960. Mathematician-programmer at the US Naval Weapons Lab in Dahlgren, Virginia.



8

How did Gries get into Computer Science?

1959. Took his only computer course. Senior, Queens College.

1960. Mathematician-programmer at the US Naval Weapons Lab in Dahlgren, Virginia.

Programmed in Fortran and IBM 7090 assembly language

```
          CLI   SEX,'M'     Male?
          BNO   IS_FEM      If not, branch around
          L     7,MALES     Load MALES into register 7;
          LA    7,1(,7)     add 1;
          ST    7,MALES     and store the result
          B     GO_ON       Finished with this portion
IS_FEM    L     7,FEMALES   If not male, load FEMALES into register 7;
          LA    7,1(,7)     add 1;
          ST    7,FEMALES   and store
GO_ON     EQU   *
```

if (SEX == 'M') MALES= MALES + 1;
else FEMALES= FEMALES + 1;

9

1960: Big Year for Programming Languages

LISP (List Processor): McCarthy, MIT (moved to Stanford).. First functional programming language. No assignment statement. Write everything as recursive functions.

COBOL (Common Business-Oriented Language). Became most widely used language for business, data processing.

ALGOL (Algorithmic Language). Developed by an international team over a 3-year period. McCarthy was on it, John Backus was on it (developed Fortran in mid 1950's). Gries's soon-to-be PhD supervisor, Fritz Bauer of Munich, led the team.

10

1959. Took his only computer course. Senior, Queens College.

1960. Mathematician-programmer at the US Naval Weapons Lab in Dahlgren, Virginia.

1962. Back to grad school, in Math, at University of Illinois

Graduate Assistantship: Help two Germans write the ALCOR-Illinois 7090 Compiler.

John Backus, FORTRAN, mid 1950's: 30 man years

This compiler: 6 ~man-years

Today, CS compiler writing course: 2 students, one semester

1963-66 Dr. rer. nat. in Math in Munich Institute of Technology

1966-69 Asst. Professor, Stanford CS

1969- Cornell!

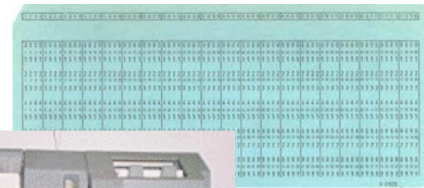
11

Late 1960s

Write programs on IBM "punch cards. Deck of cards making up a program trucked to Langmuir labs by the airport 2-3 times a day; get them back, with output, 3-4 hours later

IBM 360 Mainframes

12



Gries's 1971 compiler construction book was punched on IBM cards. They are now on display at Stanford

http://infolab.stanford.edu/pub/voy/museum/pictures/display/floor5.htm

13

The text for the book was punched onto ~12,000 computer data-processing (IBM) cards. Many figures also created using characters.

Each card: 12 rows of 80 cols. 72 cols for characters of text, 8 cols for identification.

14

About 1973. BIG STEP FORWARD

1. Write program on punch cards.
2. Wait in line (20 min) to put cards in card reader in Upson basement
3. Output comes back in 5 minutes

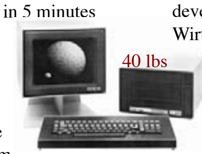
About 1973. BIG STEP FORWARD

Switched to using the programming language Pascal, developed by Niklaus Wirth at Stanford.

About 1979. Teraks

Prof. Tim Teitelbaum sees opportunity. He and grad student Tom Reps develop "Cornell Program Synthesizer". Year later, Cornell uses Teraks in its prog course.

40 lbs



November 1981, Terak with 56K RAM, one floppy drive: $8,935.

Want 10MB hard drive? $8,000 more

15

1983-84

Switched to Macintosh in labs

1980s

CS began getting computers on their desks.

Late 1980s

Put fifth floor addition on Upson. We made the case that our labs were in our office and therefore we need bigger offices.

Nowadays

Everybody has a computer in their office.

16

Programming languages. Dates approximate

Year	Major languages	Teach at Cornell
1956's	Fortran	
1960	Algol, LISP, COBOL	
1965	PL/I	PL/C (1969)
1970	C	
1972	Pascal	
1980's	Smalltalk (object-oriented)	Pascal (1980's)
1980's	(late) C++	
1996	Java	C and C++
1998		Java / Matlab

17

Software Engineering Conference, 1968

18

During 1970s, 1980s, intense research on
How to prove programs correct,
How to make it all practical,
Methodology for developing algorithms

The way we understand recursive methods is based on that methodology.
Our understanding of and development of loops is based on that methodology.

Throughout, we try to give you thought habits to help you solve programming problems for effectively

Mark Twain: Nothing needs changing so much as the habits of **others**.

19

Late 1960's — Early 1980's

Niklaus Wirth
stepwise refinement

Edsger W. Dijkstra
Structured Programming

A Discipline of Programming

Tony Hoare
Axiomatic basis for computer programs

David Gries
1973 text (with Conway) uses invariants

The Science of Programming

20

Throughout, we try to give you thought habits to help you solve programming problems for effectively

Simplicity is key:
Learn not only to simplify, learn not to complify

Don't solve a problem until you know what the problem is

Separate concerns, and focus on one at a time.

Specify methods before writing them

Develop and test incrementally

Read a program at different levels of abstraction

Define variables before using them (e.g. class invariant, loop invariant)

Use methods to avoid duplication, keep program simple

21

Simplicity and beauty: keys to success

CS has its field of computational complexity.
Mine is computational simplicity,

David Gries

CS professor's non-dilemma
I do so want students to see
beauty and simplicity.
A language used just has to be
one only with that property.
Therefore, and most reasonably,
I will not and do not teach C.
David Gries

Inside every large program is a little program just trying to come out. **Tony Hoare**

Bugs
Your
testing
shows presence
but never absence

Admonition
a little Grook
In correctness concerns
one must be immersed.
To use only testing
is simply accursed.

22

On Science and Engineering

Science explains why things work in full generality by means of calculation and experiment.
Engineering exploits scientific principles to the study of the specification, design, construction, and production of working artifacts, and improvements to both process and design.

Science asks: WHY?   Engineering asks: WHY NOT?

23