

# Innovation In Computers: And How Things Came About

by

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# Who Am I?

- Half Electrical Engineer, Half Computer Software, Half Business
- In the computer industry since 1969
  - Mainframes 5 years
  - Unix since 1980
  - Linux since 1994
- Companies (mostly large): Aetna Life and Casualty, Bell Labs, Digital Equipment Corporation, SGI, IBM
- Programmer, Systems Administrator, Systems Engineer, Product Manager, Technical Marketing Manager, Educator, Author
- *Extremely* large systems to *extremely* small ones
- Pragmatic
- Vendor *and* a customer



**Warning!**

Highly Opinionated Substance Follows!

# What Is Innovation?

“A New Idea, Method or Device”

# Where Does It Come From?

## USA

- ~ 86% of non-agriculture, non-govt GPD comes from small to medium business (SMB)
- ~90% of patents come from SMB
- ~2/3 of SMB only last two years
  - Bankruptcy
  - Grow
  - Bought out

# Patents

## Created To Allow Collaboration

- Bartolomeo Cristofori
  - 1703-1709
  - No music!
- Patent...or not?
- Eventually “samples” given
  - Bach
  - Mozart



# First Programmable Machines

- Music boxes
- Jacquard Loom

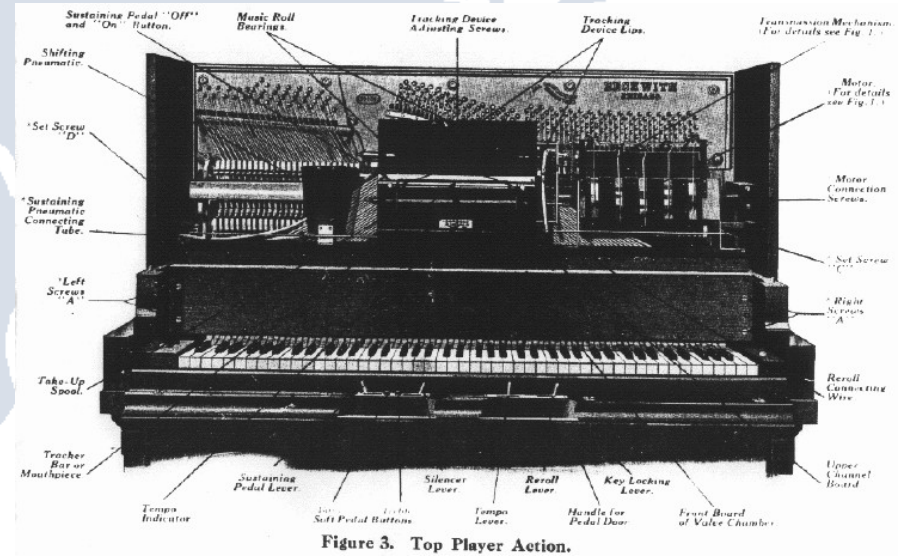
*WHY did they do THAT?*

# Jacquard Loom - 1801



# Player Pianos 1860-1880

- 61 notes
- No “standard”
- Few sold



# Player Pianos 1880-1929

- 88 note standard
  - 88 notes
  - Sustain hole
- 2.5 million pianos sold in USA alone
- “reproducers”

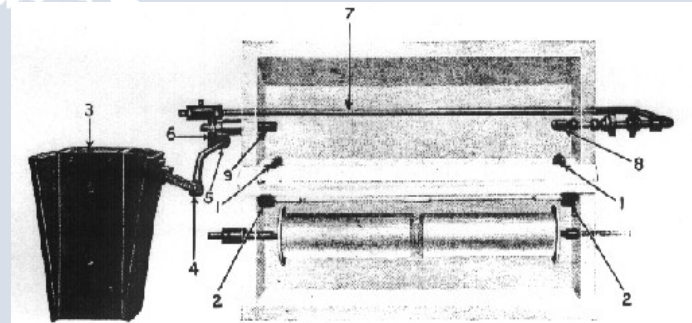


Figure 6.

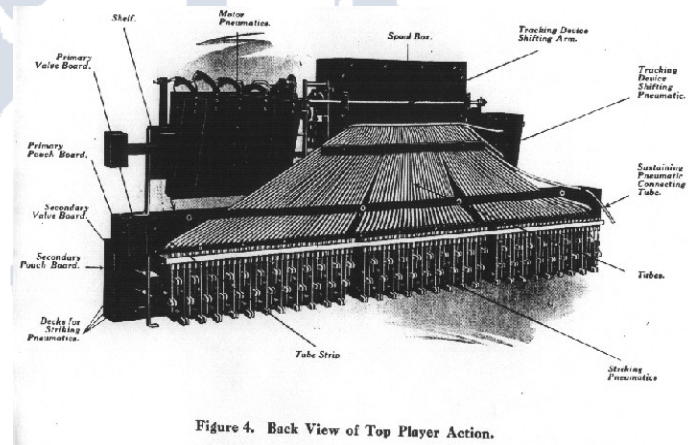


Figure 4. Back View of Top Player Action.

# Player Pianos 1880-1929

- 88 note standard
  - 88 notes
  - Sustain hole
- 2.5 million pianos sold in USA alone
- “reproducers”
  - FAILED

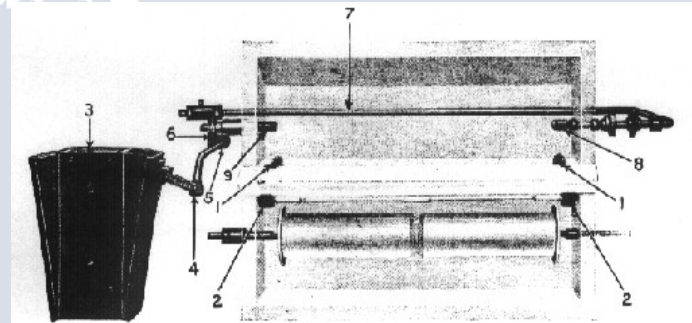


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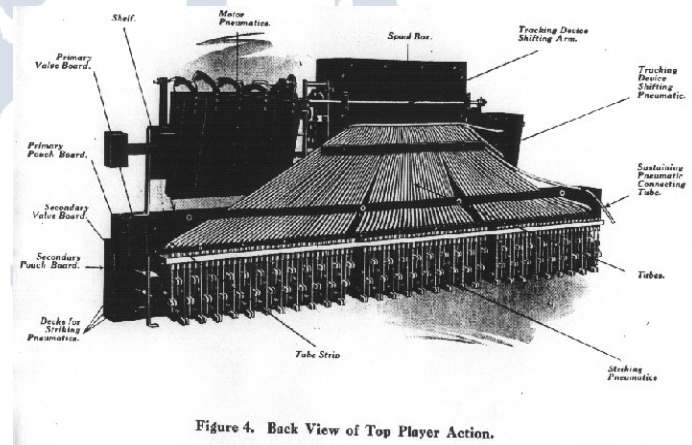


Figure 4. Back View of Top Player Action.

**WHY** did they do **THAT?**

# First Computers

- Charles Babbage (1791-1871)
  - Analytical Engine (and printer)
  - Difference Engine #2 (seven orders)
  - Augusta Ada (nee Byron) King (1815-1852) - Countess (Lady) Lovelace
- Georg (1785-1873) & Edvard (1822-1881) Scheutz
  - Three orders of difference
  - Two machines produced
    - First books of tables calculated and printed by machinery

# “On Computable Numbers”

## Alan Turing - 1935

- Alan Turing (1912-1954) interested in having a machine (a table of behavior) duplicate a human mind
  - A certain situation (state)
  - A certain input
  - Took you to a new situation (state)
- A finite set of states and inputs would get you to the same problem that a human might compute
- The “Turing Machine” - a state machine

# Unix - 1969

## PDP-7

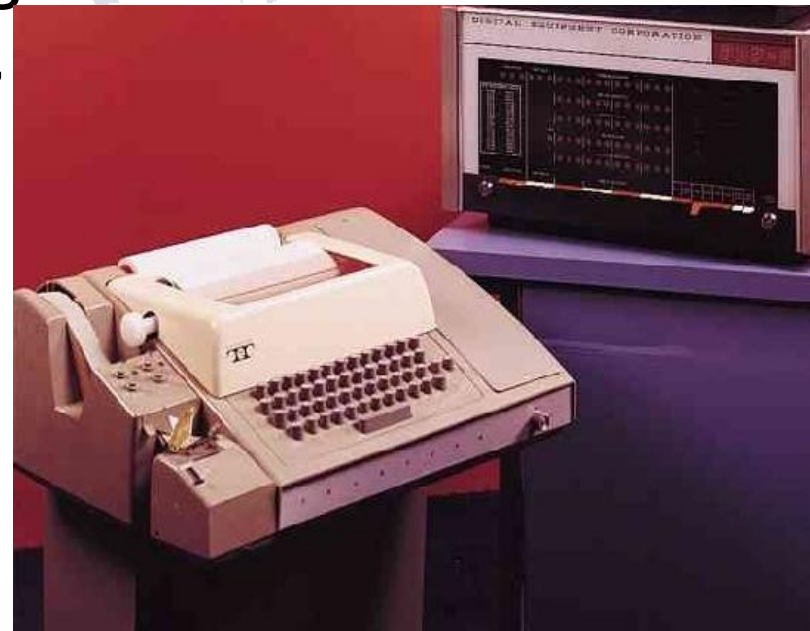
- Ken Thompson – Multics and Space Travel
  - Dennis Ritchie
  - Douglas McIlroy
  - Brian Kernighan
  - Joe Ossanna
- Assembly language
- Ported to PDP-11 in 1970
- Rewritten in “C” in 1972

# Also In 1969

ARPANET was started

## Also in 1969

- A university student
- Cost of software was high
  - No “shrink-wrap”
  - No “computer stores”
  - No “bulletin boards”
- User groups
  - Share
  - DECUS



# Unix Escaped

- Universities
- Large government labs
- Some commercial companies
  - DEC – support of hardware
  - Sun Microsystems

# Unix Features

- Time sharing
  - Security
- Multi-processing
  - Stability
- Lightweight processes
- Portable across hardware vendors

# Various Other Systems

- Atari
- Kim -1 – 1976 – about 500 USD
- Commodore PET - 1977
- Tandy (Radio Shack) TRS-80 – 1977 – 600 USD
- CP/M

# Apple

- 1976 Apple I – 666.66 USD
- 1977 – Apple II

# IBM 5150 - August 1981

## Charlie Chaplin for 20K USD

- 5.25 Floppy disks
- Mostly for “professional” work
- clones

# Software Overtook Hardware In Cost

- Software by contract
  - Meet with customer
  - Write software to customer's needs
- Software as a product
  - Design to “average” needs
  - Print on “printing press”
    - No such thing as “commodity problem”
    - Readers of books assumed intelligent

# Unix In 1981

- Many universities using it on mini-computers
  - Expensive for non-research entities
- Sun Microsystems
  - Binary version
- DEC and others followed

# Nothing GNU - 1984

## rms started GNU project

- Completely free OS
  - Started with emacs
- Portable code ran on many OS
- Distributed development
- Free Software Foundation

# Computer Stores (Microwave Oven Stores)

- Apple II and IBM PC (and DEC Rainbow)
- Three software programs
  - Word processor
  - Spreadsheet
  - Modem program
- Binary software lowered costs for a while

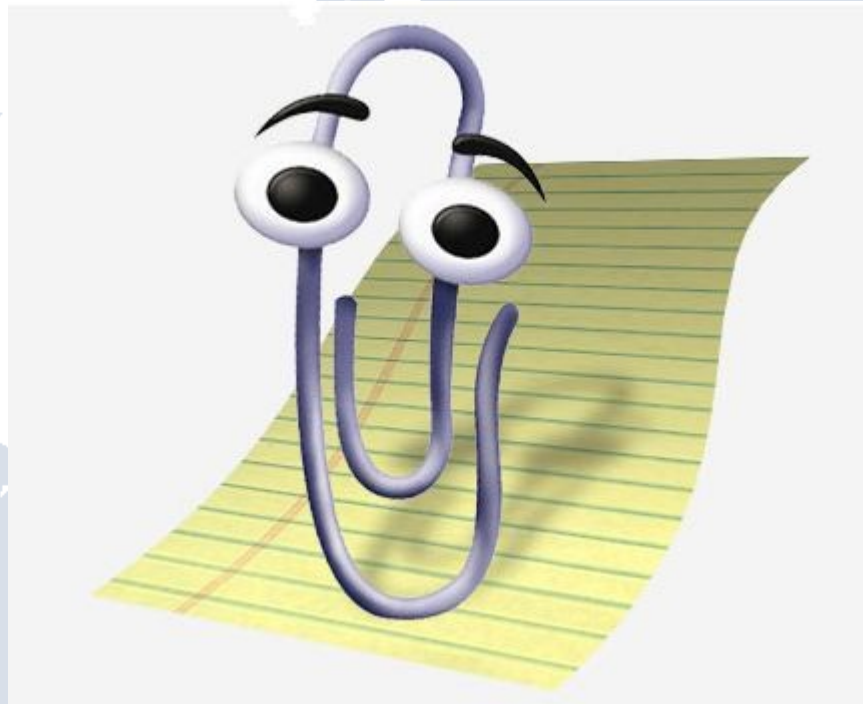
# Copyrights and Patents applied to software 1983-1986

What Was Developed Before That Time?

# Before Software Copyright And Patents

- Computer theory itself
- Real time
- Time sharing
- Batch
- Language Theory
- Client-Server Computing
- Graphics
- Mouse
- Word Processing
- Databases
- Internet (but not WWW)
- High Level Languages
- Unix

# After Software Patents and Copyrights



# And “Clippy” Is Coming Back!

Sometimes I watch you sleep



# Innovation Is More Than “Just” Genius: Technology and Balance

- Capability vs cost
  - Is it *affordable*?
  - Is it *worthwhile*?
- Speed of CPU vs
  - I/O speeds
  - Memory size
  - Bus speeds
- Network capability (including cost)
- What are the barriers to innovation?

# Barriers

- Lack of information
- Cost of Development systems

# Standards And Their Importance

- Standard interfaces
  - Improve above
  - Improve below
- What if Apple designed a bathroom?





# Ken Olsen

“Standards are as interesting as a Russian truck.”

# What He Meant

- I am an engineer
- I get bored arguing about standards
- I know they are important
- Once developed, I implement them:
  - faster
  - smaller
  - more scalable
  - for less money

# Sony Betamax vs VHS

- Betamax “better” but proprietary
- VHS licensed out

# Sony Walkman

- Audio used to be:
  - AM stationary radio
    - AM portable radio
  - FM stationary radio
    - FM portable radio
  - Recording definitely stationary
- Sony Walkman changed that
  - Sony “lost” to “clones”
- Apollo, Wang, DEC, Compaq, Nortel, RIM

# Inertia and Marketplace

## Apple vs Microsoft (and Android)

- Takes time to change
- Volume is everything
  - Attracts application development
  - Attracts services
- Apple may be very successful at high end market

# Marketplace Today

- 2.0 billion desktops
  - 7.3 billion people
- 90% desktops – Microsoft
  - Apple 8%
  - Linux 2-3%
- Linux outselling Apple on Desktop
- Apple iPhone more installed base
  - Andoid outselling iOS on devices

# View Of Computers Changing

- High Performance Computing becoming more prevalent
  - Computing itself demystified
- Embedded computing more prevalent
  - Not just specific purpose “controllers”
- “Cloud”, “Wireless”, IoT computing are buzzwords of the day
- Your smartphone may also be your laptop AND your desktop

# Small, Cheap Computers Allowing the Other 99% to Innovate

- Worldwide collaboration is now possible
  - 15 year old entrepreneurs
- Free Software means you do not start at zero
- Business models are changing
- Marketing models are changing
- Distribution models are changing
- Time to market and volume market now more critical

# Innovation



May be as much or more in the Financing, Development, Marketing, Distribution and Support models as in the product itself.

# Summary

- Volume is (almost) everything
- Nothing is forever
- High end markets can be very lucrative, but low-end volume markets even more lucrative
- Portability and Standards are key to survival as a customer
- Innovation is important, but widespread collaboration is also important

# Questions?



***“Genius is 1% inspiration and 99% perspiration” -  
Thomas Edison***