"The Innovators" The Age of the Digital Revolution

"How a Group of Hackers, Geniuses and Geeks Created the Digital Revolution."



Session 6













Session 6

- Software and about Software. We will discuss software as a product, but not ones and zeros.
- On-Line
- The *Innovators* chapters are silo'ed. The PC, the Internet, the Web, and online narratives run in parallel.
- Lets go back to the flow diagram!





In the minds of many, this is how software is made...

And how an errant computer is made to work again...



Software



- Microsoft/Bill Gates and Paul Allen
- Apple/Steve Jobs and Steve Wozniak
- Dan Bricklin and VisiCalc
- Microsoft developed IBM PC Operating System
- The graphic User Interface
- Windows
- Richard Stallman, Linus Torvolds and the free and open-source software movements

Software Types

- Operating Systems
- Applications [to those >60, Aps to others]

A Computer's Operating System

- An operating system, the software program that serves as the foundation for all of the other programs. Think skeleton and nervous system.
- An operating system handles the basic instructions that other application software uses
 - including such chores as deciding where data should be stored.
 - how memory and processing resources should be allocated.
 - how applications software interacts with the computer's hardware and peripherals.

Bill Gates and Paul Allen

- From MITS Basic to IBM: the Microsoft business model.
 - They license the use of their software on a nonexclusive basis; they do not sell it.
 - Thus, they are free to license it to others.
 - They control the source code, so a computer manufacturer can not tamper with it and make it exclusive to their hardware product.
 - Rumor: In the future you will have an annual license for the Windows operating system and Office.
 - Licensing is now the business model for most software.



Paul Allen (1953-) and Bill Gates (1955-) in the Lakeside school's computer room.

1977



The skinny kid makes good

The Microsoft Albuquerque Team



The Microsoft team, with Gates at bottom left and Allen at bottom right, just before leaving Albuquerque in December 1978.

Gates arrested for speeding, 1977.

- Steve Wozniak was a socially inept hardware engineer, who was a hacker, and was introduced to electronics as toys by his father.
 For fun he would read office equipment maintenance manuals.
- He was introduced to a neighborhood kid who shared his interest in electronics – Jobs.
 - "Woz was the first person that I met who knew more about electronics than I did."
- In 1971 their first venture was to build blue boxes, devices that emitted the right tones that spoofed the Bell phone system for free long distance calls.

- They scrounged parts, assembled them, and began to sell them locally in Pizza parlors and fast food restaurants near college campuses. Woz realized that he had more than a blue box, he had a business partner. If it hadn't been for the blue boxes, there would not have been an Apple.
- Jobs, between college and trips to see gurus, went to work for <u>Nolan Bushnell</u> at Atari and thus the torch was passed from the most creative entrepreneur of videogames to <u>Jobs</u>, the most creative entrepreneur of the personal computer.
- Atari taught Jobs some important lessons:
 - Most profound: keep interfaces friendly and intuitive.
 - Instructions should be insanely simple: Insert quarters, avoid Klingons.
 - Devices should <u>not need manuals</u>.



Steve Jobs (1955–2011) and Steve Wozniak (1950–) in 1976.



Jobs graphic on the original Macintosh in 1984.

- Bushnell taught him [1] that if you act like you can do something, then it will work. [2] Pretend that you are completely in control and people assume that you are.
- Jobs and Woz build a one man video game, *Breakout*, that he showed at a meeting of the Home brew Computing Club. No one cared. The hot news was the Altair. But someone passed around the spec for a new chip with a central processor on it.
- Woz was building an Altair, with an added keyboard and a screen. The new chip let him integrate all three. At 10 PM on June 29, 1975 Woz tapped a few lines on the keyboard and they appeared on the screen.
- Woz believe in the open forum concept and Xeroxed a few hundred copies of the design and passed them out at the next club meeting.

- Jobs saw this and pulled Woz back. Jobs then went about getting free samples from chip makers and started selling this new integrating computer board to local electronics stores.
- Woz, "Every time I designed something Steve found a way to sell it and make money for us." Jobs sold his VW bus and Woz sold his HP calculator and they went into business.
- At a Home Brew Club meeting Jobs met a local store manager who told him to keep in touch. The next day Jobs showed up bare foot and got an order for 50 of what would be the Apple I.
- They had to be fully assembled. No hobby kit.

- When it came time for the Apple II, he did not study chips but went to Sears and studied the Cuisinart. The next Apple model would be like an appliance, no assembly required, sleek, all the parts would fit.
- No longer would they be aiming at hobbyists. For each hobbyist there were thousands of customers who just want to open the box and start computing.
- The Apple II went on sale in 1977 and sold 100,000 in three years.
- Apple had tightly integrated hardware and software. This did not turn out to be the <u>industry model</u>.
- Microsoft sold OSs to all sort of Hardware integrators.
 - The Apple II woke up the big companies, particularly IBM.

IBM's Wakes Up

- IBM had a lock on commercial mainframes. A comptroller would not be criticized for buying or leasing an IBM system.
 - They worked and were maintained.
 - But the likes of DEC and Wang were getting a lot of business.
 - Then, there was this new personal computer, which could expand into small business ventures.

Dan Bricklin and Visicalc

 In 1978 Dan Bricklin was in a Harvard Business school lecture, where the instructor had a very large completed matrix on the blackboard. It needed an <u>early</u> update, which affected virtually every entry down stream:



- There had to be a better, faster and more accurate way!
- He developed VisiCalc, the first financial package. It was available only on the Apple II and propelled Apple sales.
- It changed the minicomputer from a hobbyist's tool to a necessary business tool.
- It was the model for *licensed proprietary software* for computers. Think Word, PowerPoint, later Excel and now 100s of thousands more.



Albuquerque NM

The IBM PC OS and Microsoft

- The IBM PC was a vendor product based assembly effort. IBM's software centers did not think they could nor were structurally prepared to build a PC OS especially against a 9 month deadline.
- IBM knew of Gates/Microsoft and the Altair 8800 BASIC OS. They gambled that Microsoft could deliver. They did!
- But Gates negotiated the contract to read that he was giving IBM a non-exclusive license to use PC-DOS. He could sell MS-DOS to others. Ultimately making PCs a cost driven commodity.
- Gates is a programmer and a businessman. He doesn't think in terms of a product in the average user's hand in contrast to Jobs, who wanted product w/o manuals.
- Apple had a GUI that look like an office with stacked document. MS-DOS had prompts, c:\> and CTL+ALT+DEL.

Gates' Gamble

- When IBM approached Gates, Microsoft had about 40 employees.
- Gates believed accurately that if IBM uses his OS; it would become a de-facto OS in the industry.
- He personally coded most of MITS BASIC.
- Gates sold IBM that he could build the PC OS through several days of intense technical meetings where he overwhelmed them with his SW knowledge.
- Gates, Allen and now Steve Ballmer, as the new business manager, needed a platform on which to build their PC OS.
- Allen had an acquaintance in Seattle, who had a small software company, Seattle Computer Products, which had a product for Intel's newest microprocessor, dubbed the QDOS, the Quick and Dirty Operating System. QDOS could be modified and upgraded to be the PC OS.
- Allen buys exclusive rights to it for \$50,000 and PC-DOS springs from there....

The Graphic User Interface (GUI)— "Gooey"

The GUI allows users to interact through graphical icons [think Apple]and visual indicators versus text-based interfaces [think DOS], typed command labels or text navigation. → ↑



- GUIs were introduced in reaction to steep learning curve of command-line interfaces, which require commands to be typed on a keyboard.
- GUI actions are usually performed by clicking on an icon or click, drag and drop via a mouse developed primarily at PARC.

- PARC research devised the GUI; built on a process called bit mapping. Before bitmapping all that where available for display were letters and number on a single color TV screen.
- Bitmapping allowed each and every pixel to be turned on and off and in any color. This permitted all sorts of displays, fonts, designs, and graphics.
- When Jobs was briefed on this by PARC staff, "I could see what the future of computing could be."
- Jobs was accused of stealing GUI from PARC.

- Jobs quoting Picasso, "Good artists copy, great artists steal."
- Xerox was giving it away. Jobs: "They were copier-heads who had no clue of what a computer could do. They grabbed defeat from the greatest victory in the computer industry. Xerox could have owned the entire computer industry. " Xerox invests \$1M in Apple.
- Jobs was building his second computer model the LISA; it had many PARC ideas, but the GUI would revolutionize it.
- At this point Microsoft was building applications for the Apple I/II. Jobs briefed Gates on the LISA and the GUI and asked Microsoft to develop applications for the Mac. At that time Apple (at 70%) was Microsoft's largest customer.

- Jobs and Gates are both good business men. Jobs gives Microsoft a contract to build the Mac software interfacing with the Apple HW design and the GUI; with a five year exclusion from any other GUI product sales.
- Jobs believes with the LISA and the Macintosh, he will have an insurmountable commanding lead on every other computer maker.
- Microsoft is building GUI based applications for the LISA and the Mac, but the Mac roll-out is delayed. Gates seeing what the GUI can do, starts secretly building Windows for IBM PC and clone machines.

Gates/Jobs Clash-1

- Gates is at the Apple plant the day of IBM PC release in 1981.
- Jobs shows Gates the GUI. Apple and Microsoft sign a secret agreement for Microsoft to develop GUI based applications for the Mac exclusively through 1984.
- Jobs believes that he can get the Mac out in 1982 and can corner the market.
- The Mac rollout is delayed to 1984.
- Microsoft begins a secret development of a GUI based OS for IBM and clones called Windows; it is finally shipped in 1985.

- Five years expire; the Mac is now on the market. But Microsoft brings out Windows 1.0. <u>It is a dog</u>. Apple designed their HW to work seamlessly with the OS.
- Microsoft has to adapt the OS to the IBM hardware envelope. IBM still thinks like a main-frame builder.
- Jobs and Gates have a major falling out. Apple develops it own software. Jobs takes his dislike to his grave.
- Microsoft Windows following their business model of selling to everyone now has 90⁺% of the OS market. You can still buy Microsoft Office for the Mac.
- The Mac is still an elegant, intuitive, powerful computer; but costly. *It has its cult following.*

Gates/Jobs Clash-2

- Jobs and Gates meet at an open meeting to discuss the Microsoft GUI efforts. Jobs goes ballistic and Gates gets cooler and cooler.
- Gates finally states; "Well Steve, there is more than one way of looking at it. I think that it is more like this, we both have this rich neighbor, Xerox, and I broke into his house to steal the TV set and discovered that you had already stolen it."
- Apple/Microsoft agreements were legally unenforceable.

Steve Jobs and NeXT



- Steve Jobs founded NeXT in 1985, after he was forced out of Apple. A few of his co-workers moved with him.
- NeXT developed and manufactured a series of computer workstations intended for the higher education and business markets.
- The first NeXT Computer was delivered in 1988, and the smaller NeXTstation in 1990, both selling about 50,000 units. Considered small volume, nevertheless, their innovative object-oriented NeXTSTEP operating system and development environment were highly influential.
- NeXT later released much of the NeXTSTEP system as a programming environment standard called OpenStep.
- NeXT withdrew from the hardware business in 1993 to concentrate on marketing OPENSTEP for the Mach kernel, its own OpenStep implementation, for several OEMs.

Steve Jobs and NeXT

- NeXT also developed WebObjects, one of the first enterprise web application frameworks. WebObjects never became very popular because of its initial high price of \$50,000, but it remains a prominent early example of a
 web server based on dynamic page generation rather than on static content.
 - Apple purchased NeXT in 1996, for \$429 million and 1.5 million shares of Apple stock. As part of the agreement, Steve Jobs returned to Apple, the company he had co-founded in 1976.
 - The merger married NeXT software with Apple's hardware platforms, eventually resulting in OS X and iOS.
 Parts of these operating systems incorporated the OPENSTEP foundation.

30 Second In-Place Stretch

3PG Preview

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No Free Use Allowed

Richard Stallman, Linus Torvolds, the free and open-source software movements and LINIX

- Richard Stallman was a child mathematics genius. He blew through Harvard and in 1972 went two Tstops away to MIT for graduate work.
- He was a lead member of the MIT Model Train club and implemented a PDP-10/11 based control in upgrading the main track of the club's train networks.
- He ended up in the Artificial Intelligence Lab.
- He profoundly believed that all software should be collaboratively created, be free, open and collegially be upgraded and improved.
- But MIT was obtaining larger numbers of more powerful computers that came with proprietary software and required non-disclosure agreement to use. The AI labs began to lose its free soft ware zealots to the lure of \$\$ and many went to a spinoff call Symbolics, Inc.

Richard Stallman, Linus Torvolds, the free and open-source software movements and LINIX

- In 1985 Stallman decided to build an operating system that was free and open. It would be similar to and compatible with Bell Lab's 1971, UNIX. UNIX was the standard for most Universities and Hackers. He created a recursive acronym for the new OS. GNU, which stood for GNU's Not UNIX.
- For him free software was a moral imperative. He came up with a GNU General Public License and the concept of copyleft. The license gave anyone the right [or the left] to use and modify but not the right to impose restrictions on it.
- He left MIT In 1986 so it could not lay claim to his work. Stallman wrote most of the components for the GNU. But it came clear that he needed a kernel.

What is A Kernel?



- Tech Note here: a kernel is logic or code that manages the requests from software programs and turns them into instructions for the computer's central processing unit.
- Stallman lacked a kernel and had difficulty completing his GNU. One became available not from his free software society but from a 22 year old toothy boyish Swedish speaking Finn at the University of Helsinki named Linus Torvalds.

Linus Torvolds and the GNU Kernel



- Torvalds came from a family that had a Finnish communist father and radical journalist mother. By his own admission he was "good at math, good at physics and with no social grace whatsoever." This was before being a nerd was a good thing, even in Finland.
- When he was 11 his grandfather gave him a used Commodore Vic 20, which had BASIC.
- He graduated to an IBM clone, an AT-360 with BASIC. He didn't like BASIC; he used UNIX [Bell Labs] at school, but a UNIX license was \$5,000. There was a Dutch educational product called MINIX for \$159.
- He began to tinker and after about a year placed his updated product, with a Kernel, on the MINIX users site and offered it up for use, only asking for comments on how to improve it.

There Ensued a Flow of Comments and Improvements

- Torvolds decided to use the GNU General Public License. Not that he embraced Stallman's freesharing ideology or his parents' political theology. He was lazy; he thought that if other hackers used and improved his source code in an open collaborative effort— then it could only get better.
- "My reasons for putting LINIX out there was selfish; I didn't want to do all the 'crap' work."
- By 1992 the LINIX users group had 10s of thousands of users.

EVIEEK LINUX Opportunities

March 10, 2015/April 27, 2015

- Demand for skilled Linux professionals continues to outpace the supply of qualified candidates, according to the Linux Foundation, which on March 4 released its **2015 Linux Jobs report**, produced by career Website Dice.
- While 92 percent of hiring managers plan to hire Linux pros in the next 6 months, 88 percent said it's very or somewhat difficult to find qualified candidates.
- The year-over-year data really underscores the trends we've all been witnessing: Linux has become the world's most ubiquitous operating system, and companies need more talent to support it. 37

The Forbes 2013 Top 10 Companies in the "Software & Programming" Industry

Rank	Company R	levenue (\$B	8) FY	Market Cap (\$B)	Headquarters
1	Microsoft	\$86.83	2014	\$385.4	Redmond, Washington, USA
2	Oracle	\$38.27	2014	\$194.7	Redwood City, CA, USA
3	SAP	\$22.30	2013	\$85.9	Walldorf, Germany
4	Symantec	\$6.80	2013	\$17.7	Mountain View, CA, USA
5	VMware	\$5.20	2013	\$35.3	Palo Alto, CA, USA
6	Fiserv	\$4.80	2013	\$17.2	Brookfield, WI, USA
7	CA Technologies	\$4.60	2013	\$13.7	Islandia, NY, USA
8	Intuit	\$4.20	2013	\$26.0	Mountain View, CA, USA
9	Salesforce.com	\$4.10	2014	\$37.4	San Francisco, CA, USA
10	Amadeus IT Grou	ıp \$4.10	2013	\$17.7	Madrid, Spain

Excludes manufacturers, consumer electronics companies, conglomerates, IT consultancy, and computer services companies.

Parallel Worlds

- The internet, the personal computer and being "online" were all born in the early 1970s, but they developed apart from each other.
- There was the mind set of those who embraced networking and the mind set of those who wanted to use the PC on their own.
- There were also policy and regulatory blocks and corporate protectionism that erected walls.
 - The ARPANET was closed to all but "select" researchers.
 - — Second Second
 - There was no one in charge to dictate a comprehensive solution or approach.

What Hath Wrought!



(With Apologies to Numbers 23:23)

- The ARPANet was intended to link Government funded expensive computers to minimize idle time and thus maximize research time.
- In this, it was only marginally successful. The large stand-alone computer was over taken by technology and entrepreneurship. Computer capabilities, fueled by the microchip and new memory schemes, expanded exponentially as costs plummeted.
 - Fueled by mid-size products from DEC, Wang, others
- In the background, researchers were beginning to use the ARPANet for communications.

@

- One aspect of the digital age is the desire to communicate, to collaborate, to connect, to form communities and in doing so create "killer" applications [to those >60] and Aps to others.
- In 1972 the ARPANet got its first: email
- Researchers on time-sharing computers were already communicating locally with a SENDMSG tool.
- In late 1971 <u>Ray Tomlinson</u> an MIT engineer working at BBN concocted a tool that linked SENDMSG with an experimental file transfer program [CYPNET] to exchange files with distant computers.
- The ingenuity was instructing the message to go to a file on the remote computer by using the @ and addressing username@hostname.
 @ was a typewriter carry over.



 In less than two years after it became operation 75% of ARPANet's traffic were emails.