The Evolution of IT

How Did We Get from THERE ….to HERE?

Why Look Back?

- “The long memory is the most radical idea in this country. It is the loss of that long memory which deprives our people of that connective flow of thoughts and events that clarifies our vision, not of where we're going, but where we want to go.”

- Bruce “Utah” Phillips (1935 – 2008) Itinerant story teller, singer, folklorist, and social activist

…and…

- “The only thing new in the world is the history you do not know.”

- Harry S. Truman (1884 – 1972) Failed haberdasher, Captain (U.S. Army) – WW I, Congressman, and President of the United States

Early Pioneers

– Charles Babbage (1791 – 1871) invented the "difference engine" and "analytical engine"

…and Another Early Pioneer….

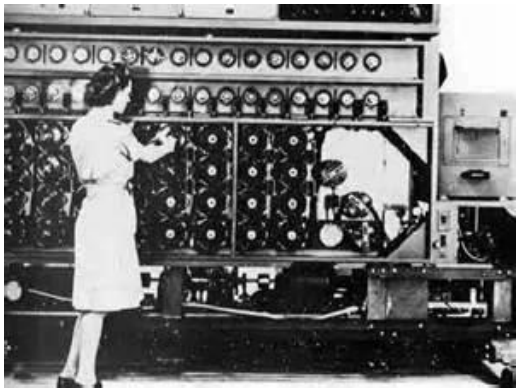
– Herman Hollerith (1860 – 1929)

- Adapted punchcard technology used to control weaving looms since 1725 to store and control the manipulation of data
- Cards first used for 1890 census
- Later combined four companies into the Computing Tabulating Recording Company - a tidy little operation later called “IBM”

The First Machines - WWII

- First British machine was “The Bombe”

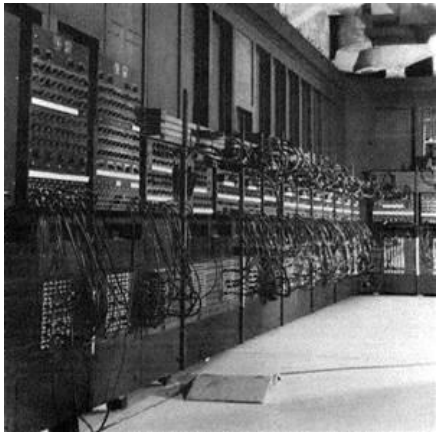
  Used to crack codes



- First American machine was the ENIAC

  Used to calculate

  artillery tables



…and the *other* machines….

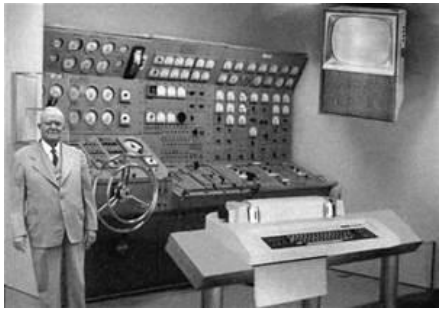
- Zuse Z3 (Germany, 1941) Wing flutter
- Colossus (UK, 1943) Code breaking
- Harvard Mk 1 (US, 1944) Nuclear fission
- Atanasoff-Berry (US, 1946) Binary, electronic
- EDSAC (UK, 1949) Prime numbers, squares
- Manchester Mk 1 (UK, 1949) Primes (Mersenne)
- CSIRAC (Australia - 1949) 1st digital music

Solid, Jackson! The 1940s

- Popular Mechanics® magazine makes two predictions:
  - One day there may be as many as seven or eight computers in the United States…
  - One day computers may be no larger than the average house…

- The end of WWII and the "Big Bands"…
- The birth of rock and roll
- Black & white TV (8" *round* screens), TV dinners, Mah Jong, and the atomic bomb…life is good….

Technology in the 40s



- ENIAC and EDVAC led to the creation of UNIVAC, later acquired by Remington Rand
- IT limited to focused applications – defense, accounting, personnel administration
- The transistor (1947) will eventually eliminate relays and digging out bugs with florists' sticks
- Programming done via hard-wiring, paper tape, and Hollerith cards

Way out! The 1950s

- Science fiction movies with radioactive monsters running amok

- The Cold War
- TV's with 12" *rectangular* screens! (still b&w)
- Jet airplanes! (Look, Ma, no propellers!)
- Buddy Holly, Elvis Presley, and Pat Boone
- Howdy-Doody, '32 Ford flathead roadsters, poodle skirts, and the local drive-in

Technology in the 50s

- IT expands from the military and a few mega-corporations to large businesses and universities
- Ken Olson and friends leave MIT and found Digital Equipment Corp. using transistor technology
- Bill Norris of Sperry Rand and Seymour Cray of ERA start Control Data Corp.
- Burroughs buys Electrodata - it merges with Sperry Rand in the 1970s to form Unisys
- The prototype of the integrated circuit (IC)
- IT security was the lock on the door to the room where "…the near-sighted guy in the tie ran the Big I…BM…"

Groovy! The 1960s

- Woodstock, sex, drugs, mini-skirts, social unrest, and the “Twist”
- The Civil Rights movement
- The war in Viet Nam

- Color TV! Now you could watch Woodstock, the War, and Watts in living color right in your living room…thank you, RCA…
- Star Trek, Hee Haw, The Beatles, and The Who

Technology in the 60s

- IT development tended to be evolutionary and limited by hardware constraints (Memory!!!)
- Programs are either developed in-house by large organizations or provided by the major machine manufacturers
- The first prototype video game console
- LEDs, Lasers, UNIX, DRAMs, and the “mouse”
- Small scale integration ICs manufactured

Far out! The 1970s

- "Skyjack Sunday" – Sept. 6th, 1970
- Terrorists attack the 1972 Munich Summer Olympics
- End of the war in Viet Nam
- Disco balls and the "Hustle"
- Severe oil shortages in 1973 and 1979
- Soviet invasion of Afghanistan

Technology in the 70s

- The first personal computers (1977) ….and they were NOT IBMs …they were the TRS-80, the Sinclair, the Apple II, & the Commodore PET
- Pocket calculators (goodbye, slide rule…)
- The first general purpose microprocessor, the Intel® 4004 is developed
- Bright kids hacking the Dept. of Defense
- Large scale integration ICs (10k transistors)

Gnarly, dude! The 1980s

- Fall of the Berlin Wall and beginning of the break-up of the USSR and the Warsaw Bloc
- Mt. St. Helens erupts (May, 1980)
- Space shuttle *Challenger* blows up (1986)
- Global economic recession, with inflation in the U.S peaking at 14.76% in 1980 before falling back
- MTV is launched (another “blow up”?)
- Jamaica fields its first bobsled team at the 1984 Winter Olympics

Technology in the 80s

- Graphical User Interfaces (GUIs)
- The mobile phone - 11.8” x 3.5” x 1.7” and 1 ¾ lbs., talk time of 1 hour (called “bricks”)
- Widespread use of faxes (goodbye, Telex)
- VCRs, CDs, and the Sony Walkman®
- Very large/ultra scale integration ICs (100K+)
- Sophisticated IC design tools – “…the machine begins to design the next machine….”

Yo! The 1990s

- The Gulf War and the Balkans conflicts
- World Trade Center and Oklahoma City bombings
- The former Warsaw Pact countries move from one-party socialist structures to multi-party states with private economies
- Construction of the Int'l. Space Station begun
- Hubble Space Telescope launched
- NASA's *Pathfinder* spacecraft lands on Mars – no intelligent life found (same as on Earth)

Technology in the 90s

- Explosion of personal computing speed and power – the advent of the Intel Pentium® microprocessor
- Network capacity expanded through high speed cable, DSL lines, and massive telephone switch expansion
- The internet becomes a practical reality, developed and evolved from the military's ARPANET
- People get used to "being connected" through the introduction of personal portable devices, email, and 24-hour news networks
- GPS becomes fully functional

Whatever…the 2000's

- 9/11
- Terrorist bombings: London, Madrid, Bali, and Istanbul
- AOL/Timer-Warner merger, the largest merger in American history, later called "…the biggest corporate mistake…." by the Time-Warner CEO
- Dot.com bust (2000) and real estate meltdown (2008)
- Astrophysicists confirm age of universe as 13.7 billion years – the universe files for Social Security
- CERN large hadron collider completed

Technology 2000

- New technologies drastically reduce power usage and “footprint”
  - Wafer Scale Integration and 3D ICs
  - System-on-a Chip/Computer-on-a-Chip
  - Continued geometric growth of memory capacity
- Data storage costs go from $7.00/Meg (2000) to $0.07/Meg (2008)
- Solid state flash drives replace mechanical floppy disks
- 24/7 full function connectivity, rise of social media, and personal devices combining multiple functions – voice, data, camera, GPS
- Physical security barriers – including many firewall structures – cease to have any real meaning…or effect….
- IT security and security breaches become everyday headlines

Hardware Historically was the Constraint

- PWBs
  - 1/8” Phenolic, one-sided, through-hole (with splinters)
  - Double-sided rigid, through-hole
  - Multi-layer, plated through-hole technology
  - Daughter boards/Flex boards/?
- Component Mounting
  - Thru-hole, bend and hand solder wire leads
  - Mechanical wave solder wire leads
  - Square pin through-hole conductor displacement
  - Solder ball/surface mount
  - Solder mask/surface mount
  - Friction weld
- Component Packaging
  - Discrete components – Multiple package designs
  - DIPs (8-pin, 16-pin, and larger) and tabs
  - SIPPs, SIMMs, and everything else
  - Surface mount flat cases
- Microprocessors, Memory, and Data Storage - See the next 3 slides

Look What Happened with Micro-Ps

Processing Speed Based on Intel Micro-P's (Ref: Typing paper is about 0.1 mm = 1,000 um = 100,000 nm)

Year	Model	Op Speed	Transistors	Path Width
1971	4004	.1 MHz	2,600	10,000 nm
1972	8008	.8 MHz	3,500	10,000 nm
1974	8080	2 MHz	4,500	6,000 nm
1978	8086	5 MHz	29,000	3,000 nm
1982	80286	6 MHz	134,000	1,500 nm
1985	80386	16 MHz	275,000	1,500 nm
1989	80486	25 MHz	1,200,000	1,000 nm
1993	Pentium®	66 MHz	3,100,000	800 nm
1995	Pentium Pro®	200 MHz	5,500,000	600 nm
1997	Pentium II®	300 MHz	7,500,000	250 nm
1999	Pentium III®	500 MHz	9,500,000	180 nm
2001	Pentium 4®	1,500 MHz	42,000,000	180 nm
2002	Pentium M®	1,700 MHz	55,000,000	90 nm
2005	Pentium D®	3,200 MHz	291,000,000	65 nm
2007	Xeon Penryn®	3,000 MHz	820,000,000	45 nm

…and some real world news…

(From the *Omaha World-Herald* July 13, 2015)

San Jose, Calif. – "IBM has pulled ahead of its rival Intel…the company's scientists have created a "test" chip with transistors 7 nanometers thick…in comparison, a strand of DNA is 2.5 nanometers in width and a human hair is 80,000 to 100,000 nanometers wide."

Look What Happened to Memory

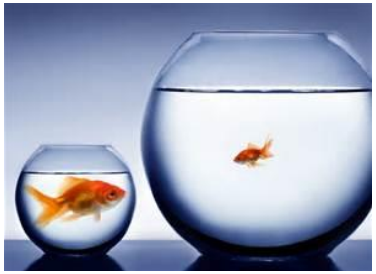
DRAM On-Line Spreadsheet “Memory Prices Through Time (1957-2015)” jcmit.com

Year	Size	Cost	Mfr/Vendor
1971	1 kB	$?	Intel 1103
1977	16 kB	$ 575.00	TDL
1979	64 kB	$ 419.00	SD Sales
1986	256 kB	$ 495.00	Cal. Digital
1985	512 kB	$ 210.00	Do Kay
1985	2,000 kB	$ 599.00	Jade
1989	4,000 kB	$ 753.00	Unitex
1990	8,000 kB	$ 662.00	Unitex
1999	64,000 kB	$ 54.99	Tiger Direct
2001	256,000 kB	$ 69.00	iMemoryM
2002	512,000 kB	$ 99.00	Star Surplus
2005	1,000,000 kB	$ 119.00	NewEgg
2009	2,000,000 kB	$ 41.99	NewEgg
2013	8,000,000 kB	$ 69.99	NewEgg

Look What Happened to Data Storage

- Punched Paper Cards (1890) – 1st used for census
- Punched Paper Tape (1897) – Input AND output
- Magnetic Drum (1932) – 10 kB/16”/12.5K rpm(1950s)
- Selectron Tube (1946) – 512 B (10” x 3”)
- Magnetic Tape (1951) – 1,200’, 7,200 cps (metal)
- Hard Disk (1956) – 50 24” disks, 5M
- Floppy Disk (1971) – 8”, 79.7 kB (later 3.5”)
- Hi-Cap Hard Disk (1980) – 2.5 GB, 550 lbs., $142,000
- Flash drives (2001) – IBM 8 Mbyte “Memory Key”
- Cloud

A Little Comparison



- 1969 IBM 360 (multiple) 16 MHz 7 MFLOPS
  Used by NASA to put men on the moon

- 1975 Cray 1 80 MHz 80 MFLOPS
  Used to do the graphics in the film *Tron*

- 1997 Deep Blue 120 MHz 11,380 MFLOPS
  Used to defeat Garry Kasparov at chess

- 2013 iPhone 5s 1,300 MHz 76,800 MFLOPS
  Used to call Mom while doing video games

Capability, Complexity, and Connectivity Combined to Bring Disruption…

- Creeper (ARPANET) 1971

  Bob Thomas' proof of von Neumann model

- Rabbit (Wabbit) 1974

  Replicated on a machine until it clogged it

- Animal (UNIVAC) 1975

  First documented Trojan Horse

- Friday 13th Ten-Line 1979

  Replicating code (Millersville U. of PA - UNIVAC)

- Elk Cloner 1981

  First documented large-scale virus

- BRAIN 1986

  Displayed a message and phone number (to clean it off)

…and then…Danger….

- Vienna/Jerusalem/etc. 1987

  First year of multiple identifiable recognized outbreaks
- ILOVEYOU worm 2000

  The human need for contact – social engineering works….
- Code Red 2001

  Re-written and used again later (a common theme)
- BOTNETs 2007

  Mechanized proliferation
- CryptoLocker 2013

  First true ransomware
- Ashley Madison hack 2015

  Hot sex meets high tech hi-jinx…the stakes go up…

So, What Does All This Mean?

- To know where you are going, it is good to know where you came from.
- Your manager may have come out of this historical background and may still think this way!
- I think the government STILL operates in the historical past!

…And More Importantly….

- The impact of the change is not evident until you standardize the units of measure and aggregate results.

- Many of the technological waves of the past – the steam engine, heavy manufacturing, the telegraph, and even the airplane – were socio-economic paradigm shifts that were kept at arm's length from people.

- However, you carry *on your person* the technological innovations of a camera (1840), a telephone (1875) , a radio (1894), an audio recorder (1895), a television (1927), a video recorder (1951), and a computer (1941) – all in the same device.

- The impact of having all those technologies in your hand, coupled with a dynamic world-wide network, makes an IT professional's worst nightmare inadequate to the reality.

C.M. Zelhart 10-15-15