The Next Fifty Years of Software

Nathan P. Myhrvold
Chief Technology Officer
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James Burke
Master of Ceremonies

Nathan P. Myhrvold, Chief Technology Officer, Microsoft Corporation: The Next Fifty Years of Software
The Next Fifty Years of Software

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Chief Technology Officer
Microsoft Corporation

Software: The Crisis Continues!

Nathan P. Myhrvold
Unrepentant Programmer &
Theoretical Physicist
A Brief History of the Universe
- Quantum gravitational fluctuation starts expanding
- Inflationary expansion grows exponentially
- Expansion slows and particles condense from quark plasma
- Radiation from initial fireball red shifts by expansion to 3 degrees K
- Matter condenses, ultimately into the San Jose Convention center

A Brief History of Information
- Writing is invented
- Johan Gutenberg invents moveable type and modern printing
- Von Neumann et. al invent the computer
- The microprocessor brings computing to everyone
- Networks hook us all together

Moore’s Law
- Price/performance
- 1,000,000X boost in last 20 years
- 1,000,000X more in the next 20 years
- Likely to continue for at least 40 years
Doubling time 964 days
Growth rate 30% per year

Doubling time 694 days
Growth rate 44% per year
Nathan’s 1st Law of Software

Software is a gas!
It expands to fit the container it is in!

Windows NT Lines of Code
Doubling time 866 days
Growth rate 33.9% per year

Browser Code Growth
Doubling time 216 days
Growth rate 221% per year

Nathan’s 2nd Law of Software
Software grows until it becomes limited by Moore’s Law
- Initial growth is rapid - like gas expanding (like browser)
Nathan’s 2nd Law of Software
Software grows until it becomes limited by Moore’s Law

- Initial growth is rapid - like gas expanding (like browser)
- Eventually, limited by hardware (like NT)
- Bring any processor to its knees, just before the new model is out

Nathan’s 3rd Law of Software
Software growth makes Moore’s Law possible

- That’s why people buy new hardware - economic motivator

- That’s why chips get faster at same price, instead of cheaper
- Will continue as long as there is opportunity for new software
Nathan's 4th Law of Software
Software is only limited by human ambition & expectation
- It's impossible to have enough
- New algorithms
- New applications and new users

The Software Crisis!
- Von Neumann had trouble

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The Software Crisis!
- Von Neumann had trouble
- Software is always in “crisis
- Is there some limit to complexity?
- Will software ever grow up?

The Perpetual Crisis
- Panacea solutions
  - High level languages
  - Object oriented programming
  - Component software, ...

Of course not!
The Perpetual Crisis

- Panacea solutions
  - High level languages
  - Object oriented programming
  - Component software, ...
- Benefits absorbed by rising expectations

The Perpetual Crisis

- Panacea solutions
  - High level languages
  - Object oriented programming
  - Component software, ...
- Benefits absorbed by rising expectations
- Software will never be easy
- Somebody will push the boundary

Synthetic Actors

Mommy, look at my T. rex!
Future Software Techniques

- Genetic programming
- “Software husbandry”
  - Tending virtual flocks
- How does software complexity compare to genetic complexity?

Which is Bigger?

Which is Bigger?

Madonna: The Genotype

Evita: The Motion Picture

Evita: The Motion Picture

The Movie Wins

Genetic Complexity

- Human Genome ~ 1 Gbyte
- Individual difference ~ 0.25%

Madonna: The Genotype

~1 Gbyte

4 Gbytes

0x0
Genetic Complexity
- Human Genome ~ 1 Gbyte
- Individual difference ~ 0.25%
- Loss less compression 2:1
- Individual ~ 1.2 Mbytes

Genetic Diversity?
- Human population < 3.7 Tbytes
- Compress relatives < 1 Tbytes
- Like a big web site!

The Ultimate Computer
- Learning more about the brain every day
The Ultimate Computer
- Learning more about the brain every day
- AI will happen
- Computers with same power in 20 to 30 years
- Brain has no Moore’s Law

Programming The Ultimate Computer
- When computers are as smart as humans, how do you program them?
- Human takes 20 years to boot!
- Must we teach them?
Humans as Software
Uploading to become a program

Operating Systems for Human Software
- Housing uploads
- Treat human upload as an application program
- Provide memory & other services
- Peripherals to deal with real world

Separated at Birth?
Windows 2.0 1987
Windows 2047

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Separation at Birth?

<table>
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<tr>
<th>Windows 2.0 1987</th>
<th>Windows 2047</th>
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<tr>
<td>Multitasking</td>
<td>Multiple personalities</td>
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<tr>
<td>Virtual memory</td>
<td>Virtual memory</td>
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Compatible with DOS applications
Compatible with meat based humans

> 640 Kilobytes
> 640 Petabytes

GUI
You & I

See you in 2047!

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See you in 2047!

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