Whither Software

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Whither Software

Significant changes are on the way because:

- The nature of software we need to build will be different
- The `.com` collapse is partially a failure of software, especially programming language design, and we should fix it
- Security failures in Operating Systems are mostly failures of programming languages, and we should fix it
- A growing lack of confidence in the underpinnings of current computing models is forcing rethinking

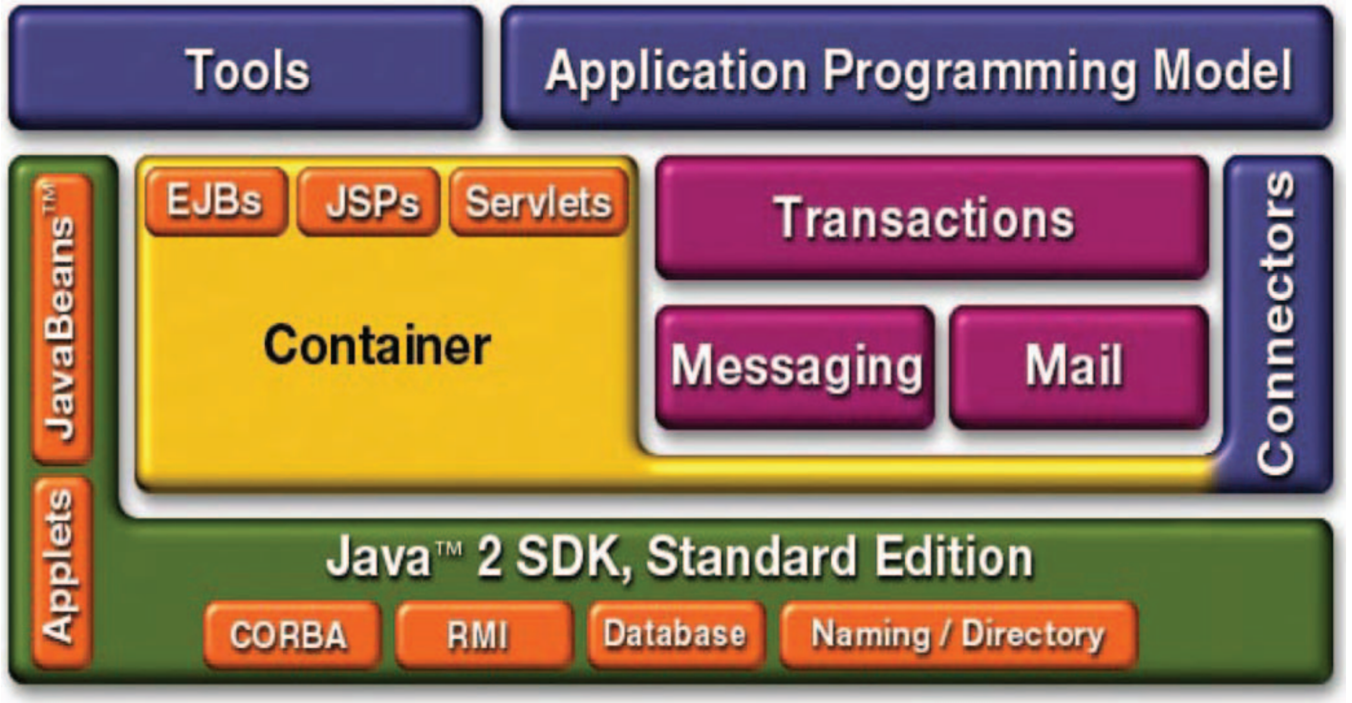
The Nature of Software

Nature of Future Software

Software will move from:

- Vertical to Horizontal Systems
- Programming Interface to Protocol/Language
- Monolithic to Distributed Architecture
- Monolithic to Mob Development

Vertical Systems

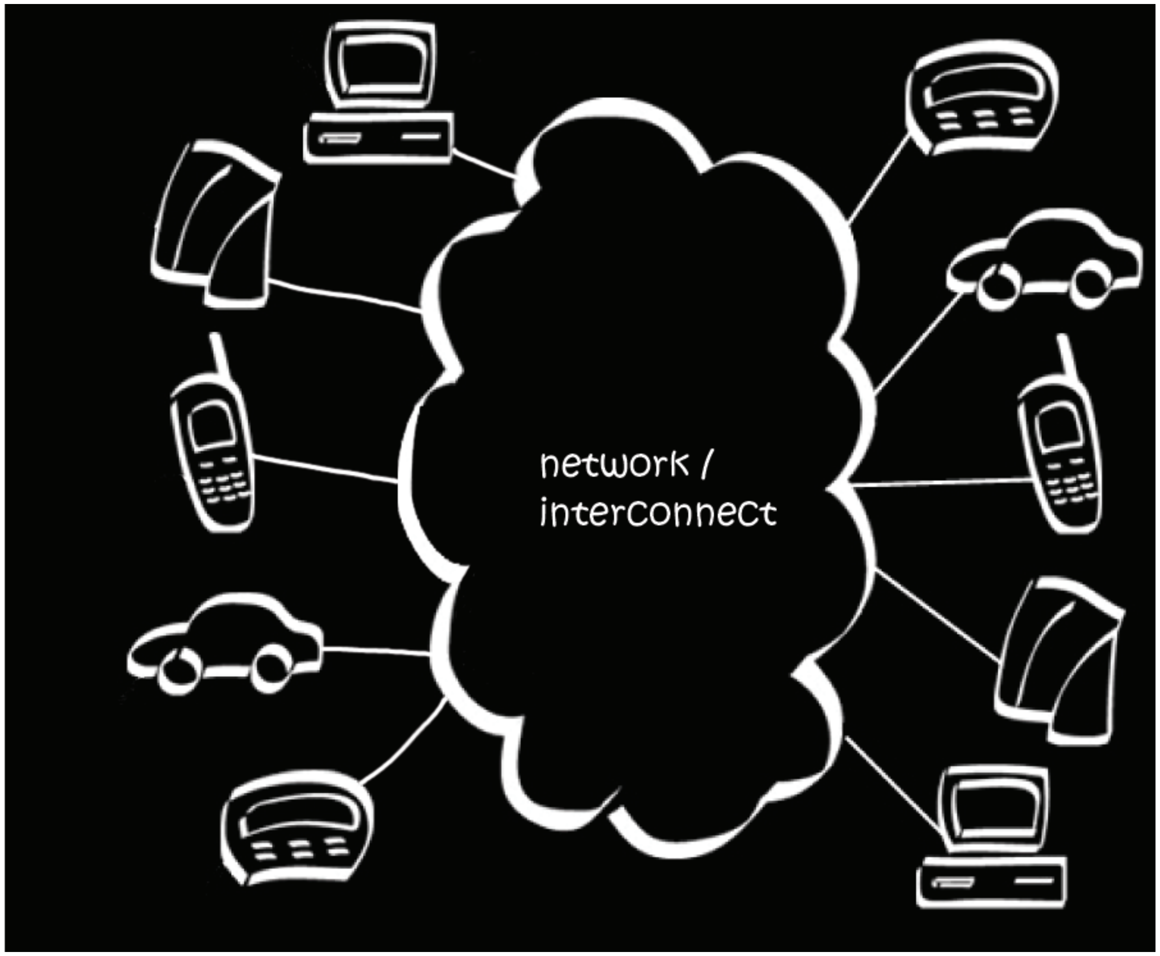


- Monolithic systems
- Client/Server
- N-Tier

Vertical Systems

- Hierarchical
- Deep interconnections based on programming interfaces (APIs)
- Deep interdependencies based on common assumptions, design, and architecture
- Deep dependency on underlying programming language and programming model
- Brittle because programming interfaces must match exactly, by position and type with no coercion or intelligent intermediaries
- Requires extensive testing or proof of correctness
- Uniform software development methodology is required to minimize human error (chosen from a plethora of such methodologies)
- Jigsaw puzzle

Horizontal Systems



- Distributed, peer-to-peer
- Edge computing, end-to-end

Horizontal Systems

- Heterarchical, polyarchical, fractal
- Shallow interconnections based on protocols
- Shallow interdependencies based on simple interconnect
- No dependency on underlying programming language and programming model
- Resilient because partial understanding of protocols is possible
- Requires only isolated testing or proof of correctness
- Variety of software development methodologies can be chosen according to local needs
- Collage

Programming Interface versus Protocol/Language

Programming Interface:

- Usually fixed, positional arguments
- Function-calling metaphor, though perhaps no value(s) returned
- Types must match exactly or by subsumption
- All communication is through programming language types—INTs, strings, arrays, etc.
- Full understanding or no understanding—all or nothing
- Usually not flexible or extensible
- Mathematically sound

Programming Interface versus Protocol/Language

Protocols or Languages:

- Parsing and meta-data are possible—in fact, any amount of automated reasoning can be applied to understand interactions
- Speech or interaction metaphor
- Types are manifest or constructed from descriptions
- All communication is through common representations—text for example
- Partial understanding through defaulting, deferral, or partial implementation
- Almost always flexible and extensible
- Goofy

Monolithic versus Distributed Architecture

Monolithic Architecture:

- Tight integration—requires planning to put parts together, and all changes move forward, rarely backward
- Programming language-based control and communication
- Requires a coördinated development methodology to get timing down ***or*** a highly incremental development methodology to minimize divergence—but the latter is generally despised by management
- Everyone uses the same language—uniformity
- Tempts people into master planning
- Dominated by resource concerns

Monolithic versus Distributed Architecture

Distributed Architecture:

- Loose coupling—parts can be added when ready and changes can be undone
- Protocol or language-based communication and, perhaps, some synchronization mechanisms
- No coördinated methodology required for the entire system—in fact, it would be nonsensical
- Anyone can use any language—diversity
- Forces people into piecemeal growth
- Can be dominated by timing and coördination concerns

Monolithic versus Mob Development

Monolithic Development:

- Master planning and control
- Chokepoints
- Integration planning
- Shared culture required
- Planned releases force misfits of time and effort—for some modules and components, developers are squeezed for time, for others, developers languish or move on prematurely
- Tends to exclude users from design
- Correctness
- No room for artistry

Monolithic versus Mob Development

Mob Development:

- Piecemeal growth and leadership
- Shared vision is desirable
- Few coördination points
- Can include users
- Comfort
- Can allow for artistry

Diversity, Distribution, Artistry, Users, Protocols, Piecemeal Growth

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    document.MM_pgW=innerWidth; document.MM_pgH=innerHeight; onresize=MM_reloadPage; }}
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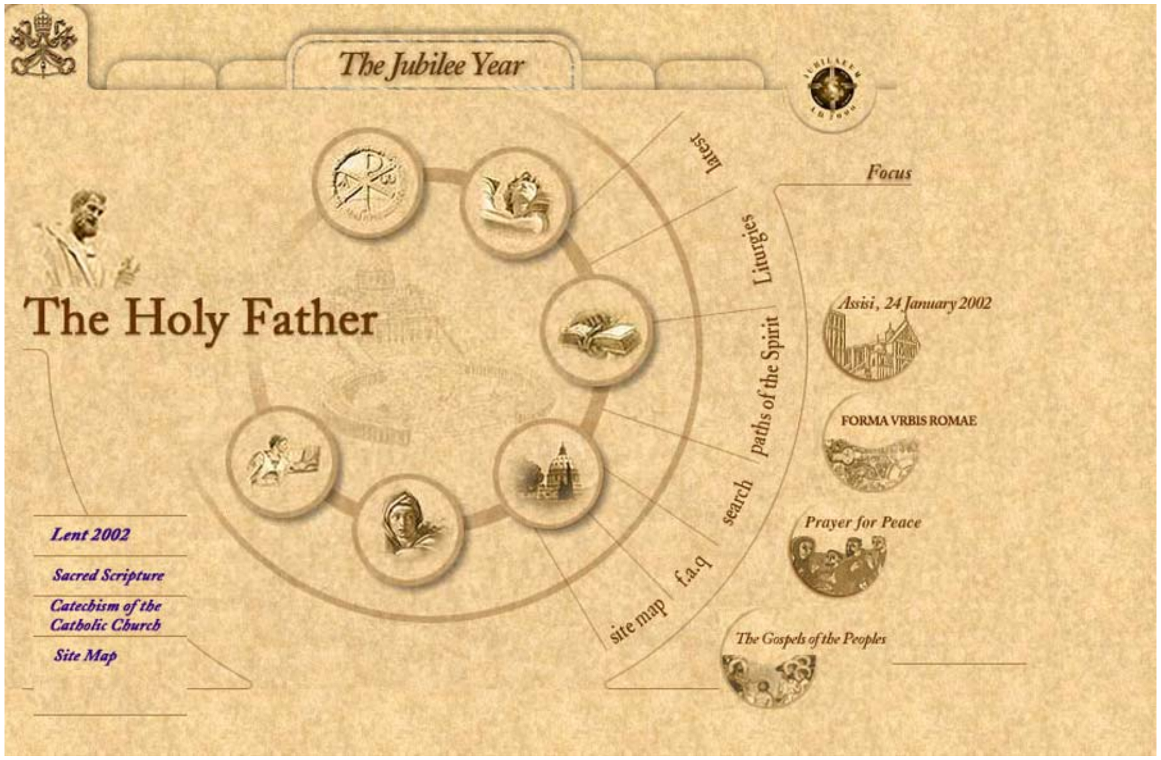
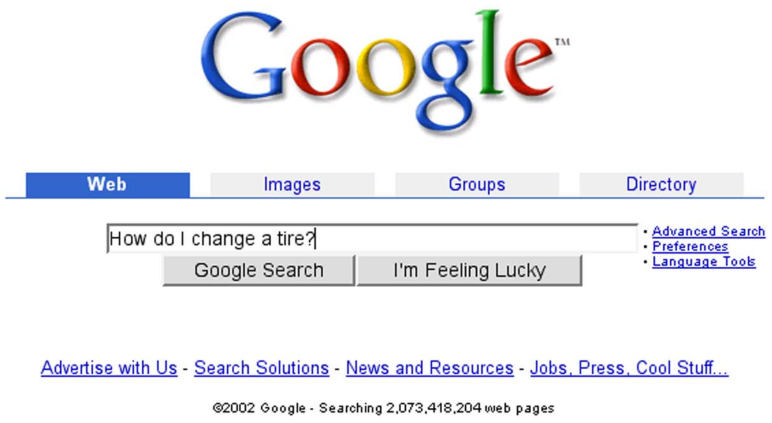
Diversity, Distribution, Artistry, Users, Protocols, Piecemeal Growth



What is the Effect of Mob Development?


Google™
Web
Images
Groups
Directory
How do I change a tire?
Google Search
I'm Feeling Lucky
• Advanced Search
• Preferences
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Advertise with Us - Search Solutions - News and Resources - Jobs, Press, Cool Stuff...
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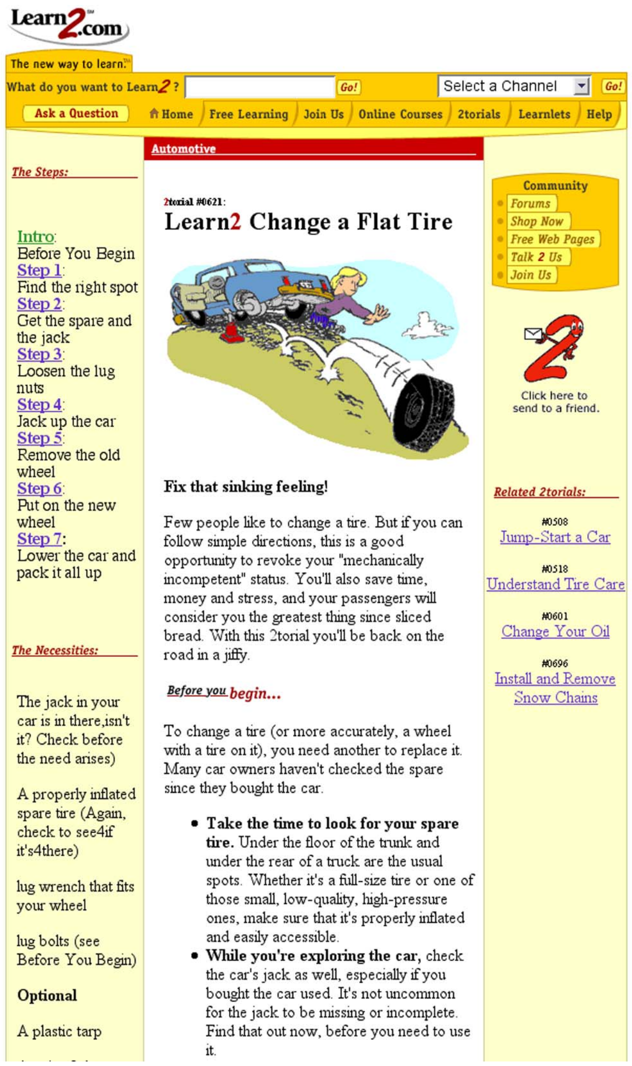
- Billions of Web pages, each a small program, written using a simple programming language, and relying on simple text-based protocols
- Does it solve the Turing Test?

I propose to consider the question "Can machines think?" This should begin with definitions of the meaning of the terms "machine" and "think."

—Alan M. Turing

What is the Effect of Mob Development?



The Steps:

Intro: Before You Begin
Step 1: Find the right spot
Step 2: Get the spare and the jack
Step 3: Loosen the lug nuts
Step 4: Jack up the car
Step 5: Remove the old wheel
Step 6: Put on the new wheel
Step 7: Lower the car and pack it all up

The Necessities:

The jack in your car is in there,isn't it? Check before the need arises)

A properly inflated spare tire (Again, check to see4if it's4there)

lug wrench that fits your wheel

lug bolts (see Before You Begin)

Optional

A plastic tarp

2torial #0621:

Learn2 Change a Flat Tire

Fix that sinking feeling!

Few people like to change a tire. But if you can follow simple directions, this is a good opportunity to revoke your "mechanically incompetent" status. You'll also save time, money and stress, and your passengers will consider you the greatest thing since sliced bread. With this 2torial you'll be back on the road in a jiffy.

Before you begin...

To change a tire (or more accurately, a wheel with a tire on it), you need another to replace it. Many car owners haven't checked the spare since they bought the car.

- **Take the time to look for your spare tire.** Under the floor of the trunk and under the rear of a truck are the usual spots. Whether it's a full-size tire or one of those small, low-quality, high-pressure ones, make sure that it's properly inflated and easily accessible.
- **While you're exploring the car,** check the car's jack as well, especially if you bought the car used. It's not uncommon for the jack to be missing or incomplete. Find that out now, before you need to use it.

Related 2torials:

#0508 Jump-Start a Car

#0518 Understand Tire Care

#0601 Change Your Oil

#0696 Install and Remove Snow Chains

The .com Collapse

.com Collapse

- eCommerce requires adaptable software to handle changing business conditions and models
- From January 2000–May 2001:
  - 374 companies were delisted from NASDAQ
  - on average $5–$10m was spent on computer infrastructure
  - of that, $1–$5m was spent on software development
  - in many cases, the software was not suitable and not adaptable enough for real business situations

.com Collapse

ZoZa.com is typical: the first proprietary apparel brand launched online selling high-fashion sportswear—hop off your mountain bike, pop into the Porsche, and off to the Pops.

- ATG Dynamo running on Solaris—eBusiness platform
- Oracle 8i
- Verity search tools
- A lot of custom, stand-alone Java glued everything together
- The bulk of the ATG work was outsourced to Xuma—an application infrastructure provider
- The production site:
  - 2 Sun Netras doing web services via Apache/Stronghold (web server/secure web server)
  - 4 Sun Netras providing an application layer and running Dynamo
  - 1 Verity server
  - 1 Sun Netra providing gateway services to fulfillment partners
  - 1 Sun Enterprise 250 running Oracle as a production database
  - Staging: 2 web boxes, 2 logic boxes, 1 Oracle box, 1 Verity box
  - Development: one big Sun Ultra 2

.com Collapse

The CTO of ZoZa says:

> *We built a good e-commerce platform, but unfortunately sales were slowly building just as the dot com economy collapsed. We had built a company to handle the promised phenomenal sales based on the Ziegler's self-promoted public profile. That never happened. The* ***costs of building our sales and fulfillment capabilities****, combined with ZoZa's lack of credit in the apparel manufacturing world caused us to go through SoftBank's $17 million quite quickly.*
>
> *Sizing was a terrible problem for ZoZa. Not only did the clothing get designed for ever smaller people, but even then the sizing was highly variable. Sometimes only a specific color of a product would be whacked out.*
>
> ***We ended up building a separate database table for sizing anomalies.***

.com Collapse

[The Zieglers were] *disappointed by the Web. Initially, they planned to use virtual-reality technology so customers could mix-and-match items and feel like they were trying on clothes. They also wanted to provide a personal assistant to shoppers who could recommend items based on an individual's coloring. But the Zieglers scrapped all that when they found that* ***the technology ruined the shopping experience*** *because it took too long to download. "****The medium is far more rigid than we imagined,****" says Mel* [Ziegler].

Patricia [Ziegler], *a former newspaper illustrator who designs many of the clothes, was* ***put off by the poor quality of colors on the Web****. And* ***she was really bummed to learn how complex it was to swap out items that weren't selling well****. "We have to change 27 to 32 different links to swap out just one style—from the fabric to sizing to color," she says.*

So the Zieglers have gone back to basics. ***Although it cost roughly $7 million to build, their Web site is, well, stark****—a picture of Zen minimalism. Navigation is simple and uncluttered. Nothing exists on the site that can't be optimally used with a standard 56k modem. The one concession to flash comes in the form of so-called mind crackers, which are Zen sayings about life hidden behind little snowflakes that have been sprinkled throughout the site.*

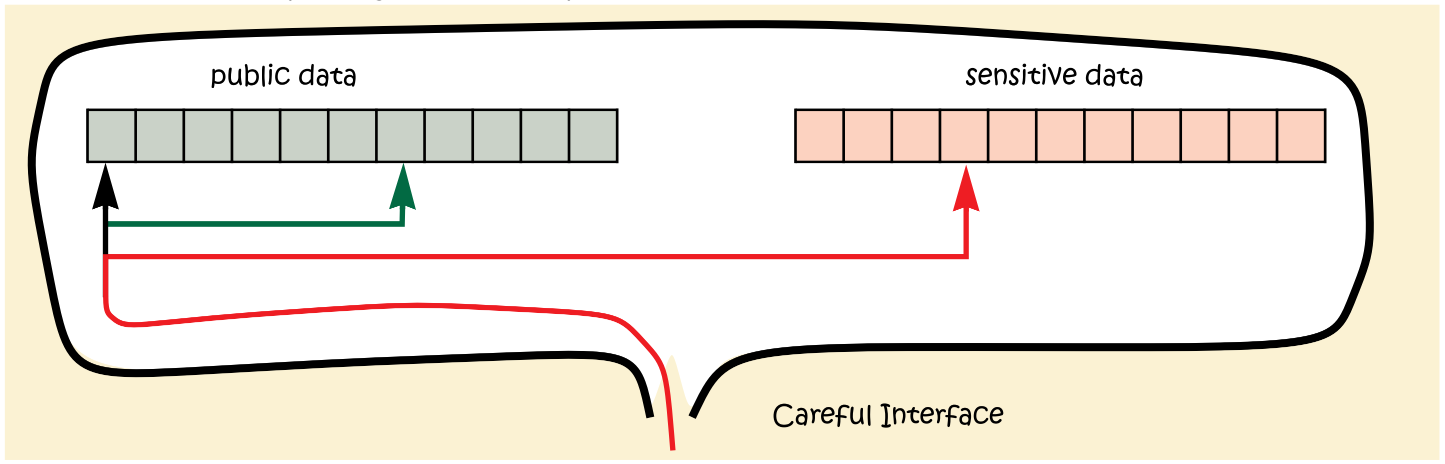
Security Failures

Security Failures

Security Expert$_1$: *Your typical buffer overrun costs a vendor on the order of $2,000. A system immune to buffer overruns would save the vendor about $20,000 a year. The cost to make a system immune to buffer overruns, using a technology such as Immunex™ would greatly exceed that.*

Security Expert$_2$: *Why not just funnel all array writes through a routine that checks the bounds? If there are a few for which this results in too great an impact on performance, those can be analyzed individually.*

Security Expert$_1$: *This is non-trivial to do in C (because you rely on the programmer correctly determining the bounds for the funneled writes* ***and*** *you have to modify large amounts of libc).*



Redefining Computing

Redefining Computing

While it is perhaps natural and inevitable that languages like Fortran and its successors should have developed out of the concept of the von Neumann computer as they did, the fact that such languages have dominated our thinking for twenty years is unfortunate. It is unfortunate because their long-standing familiarity will make it hard for us to understand and adopt new programming styles which one day will offer far greater intellectual and computational power.

—John Backus, 1981

Programming Languages

Millions for compilers but hardly a penny for understanding human programming language use. Now, programming languages are obviously symmetrical, the computer on one side, the programmer on the other. In an appropriate science of computer languages, one would expect that half the effort would be on the computer side, understanding how to translate the languages into executable form, and half on the human side, understanding how to design languages that are easy or productive to use.... The human and computer parts of programming languages have developed in radical asymmetry.

—Alan Newell & Stu Card, 1985

Computing Paradigms

...the current paradigm is so thoroughly established that the only way to change is to start over again.

—Donald Norman, The Invisible Computer

Paul Feyerabend

...one of the most striking features of recent discussions in the history and philosophy of science is the realization that events and developments ... occurred only because some thinkers either decided not to be bound by certain 'obvious' methodological rules, or because they unwittingly broke them.

This liberal practice, I repeat, is not just a fact of the history of science. It is both reasonable and absolutely necessary for the growth of knowledge. More specifically, one can show the following: given any rule, however 'fundamental' or 'necessary' for science, there are always circumstances when it is advisable not only to ignore the rule, but to adopt its opposite.

—Paul Feyerabend, Against Method

Feyerabend Project

Computing theory was first developed as a branch of computability theory based on a particularly inexpressive set of mathematical constructs.

The proofs of their universality under certain assumptions and equivalences to other mathematical constructs under others have irreparably boxed us into a realm of almost blinding inexpressiveness.

Feyerabend Project

Early computing practices evolved under the assumption that the only uses for computers were military, scientific, and engineering computation—along with a small need for building tools to support such activities.

We can characterize these computational loads as numeric, and the resulting computational requirements as Fortran-like. Early attempts to expand the realm of computing—such as John McCarthy's valiant attempt with Lisp and artificial intelligence, Kristen Nygaard's similarly pioneering attempt with Simula, Doug Englebart's intriguing attempt to expand our usage options, Alan Kay's later attempt with Smalltalk, and Alain Colmerauer's attempt with Prolog—were rebuked.

Feyerabend Project

The architecture of almost every computer today is designed to optimize the performance of Fortran programs and its operating-system-level sister, C.

Further, attempts to consider neuron-based, genetic, or other types of nonstandard computational models were soundly rejected, snubbed, and even ridiculed until the late 1980s.

Feyerabend Project

Programming languages have hardly shown one scintilla of difference from the designs made in the first few years of computing.

All significant programming languages are expressively, conceptually, and aesthetically equivalent to Fortran and assembly language—the direct descendants of Turing computability based on Von Neumann machines. Programming today is the intellectual equivalent of picking cotton, with the same overtones of class structure. For example, it is currently not permitted for a developer to refuse to implement a faulty or unsafe program unless he or she is willing to be fired. Lawyers are provided more avenues for ethical and moral behavior than programmers.

Feyerabend Project

Software development methodologies evolved under a mythical belief in master planning.

Such beliefs were rooted either in an elementary-school-level fiction that all great masterpieces in every discipline were planned, or as a by-product of physicists shovelling menial and rote coding tasks to their inferiors in the computing department. Christopher Alexander has run into the same set of beliefs in the building trades, and this uniquely Cartesian view of the world is currently setting back progress at an alarming pace.

Feyerabend Project

High-octane capitalism has created a nightmare scenario in which it is literally impossible to teach and develop extraordinary software designers, architects, and builders.

The effect of ownership imperatives has caused there to be absolutely no body of software as literature. It is as if all writers had their own private "companies" and only people in the Melville company could read **Moby-Dick** and those in Hemingway's could read **The Sun Also Rises**. Can you imagine developing a rich literature under these circumstances? There could be neither a curriculum in literature nor a way of teaching writing under such conditions. And we expect people to learn to program in exactly this context?

Feyerabend Project

Distributed systems—the gold standard of computing today—requires that vastly diverse, dispersed, and different-minded people—and massive numbers of them—contribute to each large software system.

Each such system never goes down, it can't be recompiled from scratch, it can never be in total version coherence, it must have parts that depend on everything that has ever been developed. Even in a monolithic system we find the same thing. For every major operating system, there are people who absolutely demand and rationally require the newest backwardly incompatible features, and others who absolutely and rationally require the oldest features to remain as they are forever. Every single programming language we have is predicated on the physicists' model of figure it out, code it up, compile it, run it, throw it away. All our computing education is based on this, all our methodologies, all our languages, environments, tools, attitudes, mathematics, prejudices, and principles are based as solidly and firmly on this rock as Gibraltar is based on the stone it rests on. Many if not most development headaches come from precisely this problem, one that programming language theorists ridicule. Every attempt to define a language to handle this or a computing device to make it simpler is met with laughter and rejection. And all this in the face of the fact that the reality of programming must be based on precisely the opposite assumptions: Everything changes, every version is necessary, evolution happens.

Feyerabend Project

Computing practice and theory is based on the very hidden and hard-to-reveal assumption that engineers, mathematicians, and computer scientists are the only ones who will write a program or contribute to a software system.

When computing started, no one but scientists and the military even remotely conceived of the utility of programs and programming. Today, almost every business and human pursuit is built on computing and digital technology. Artists, craftspeople, writers, fishermen, farmers, tightrope walkers, bankers, children, carpenters, singers, dentists, and even some animals depend on computing, and most of the people I mentioned want to have a say in how such software works, looks, and behaves. Many of them would program if it were possible. The current situation might feel fine to some of you, but suppose all computing were based on the needs of tightrope walkers? Hard to imagine. What we've created is hard to imagine for them.

Feyerabend Project

Computing is based on utility, performance, efficiency, and cleverness.

Where are beauty, compassion, humanity, morality, the human spirit, and creativity?

Feyerabend Project

- Understand the limitations of our current computing paradigm
- Understand the limitations of our current development methodologies
- Bring users—that is, people—into the design process
- Make programming easier by making computers do more of the work
- Use deconstruction to uncover marginalized issues and concepts
- Looking to other metaphors
- Three workshops so far, four more planned—using a tipping-point approach

Feyerabend Project

- Homeostasis, immune systems, self-repair, and other biological framings
- Physical-world-like constraints—laws, contiguity
- Blackboards, Linda, and rule-systems—use compute-power
- Additive systems—functionality by accretion not by modification
- Non-linear system-definition entry—instead of linear text
- Non-mathematical programming languages
- Sharing customizations
- Language co-mingling and sustained interaction instead of one-shot procedure invocation in the form of questions/answers or commands
- Piecemeal growth, version skews, random failures
- Artists' understanding, ambiguous truth

Farewell

Few people who are not actually practitioners of a mature science realize how much mop-up work ... a paradigm leaves to be done or quite how fascinating such work can prove in the execution.... Mopping-up operations are what engage most scientists throughout their careers. They constitute what I am here calling normal science. Closely examined, whether historically or in the contemporary laboratory, that enterprise seems an attempt to force nature into the preformed and relatively inflexible box that the paradigm supplies. No part of the aim of normal science is to call forth new sorts of phenomena; indeed, those that will not fit the box are often not seen at all. Nor do scientists normally aim to invent new theories, and they are often intolerant of those invented by others....

Perhaps these are defects. The areas investigated by normal science are, of course, miniscule....

—Thomas S. Kuhn

Confusionists and superficial intellectuals move ahead *while the 'deep thinkers'* descend *into the darker regions of the status quo or, to express it in a different way, they remain stuck in the mud.*

—Paul Feyerabend

Where I'm from the birds sing a pretty song

and there's always music in the air

—The Little Man