50+ Years of Digital Transformation

Mike Amundsen,
API Academy at CA
@mamund

API CONNECTION

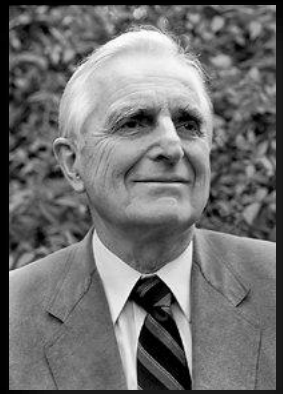
What concepts and ideas have influenced computing systems?

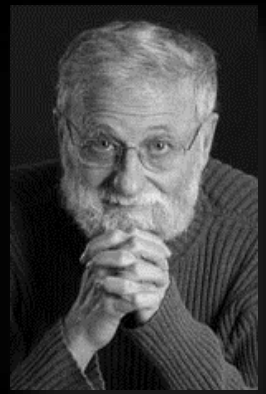
API CONNECTION

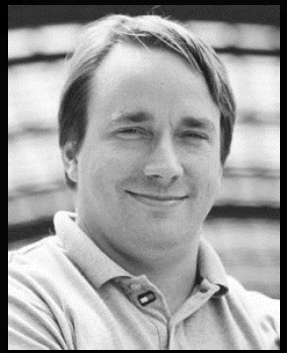
How have these ideas affected the way we think of the Web today?

API CONNECTION

There is much we can learn from our history…







API CONNECTION

Early Concepts

Vannevar Bush

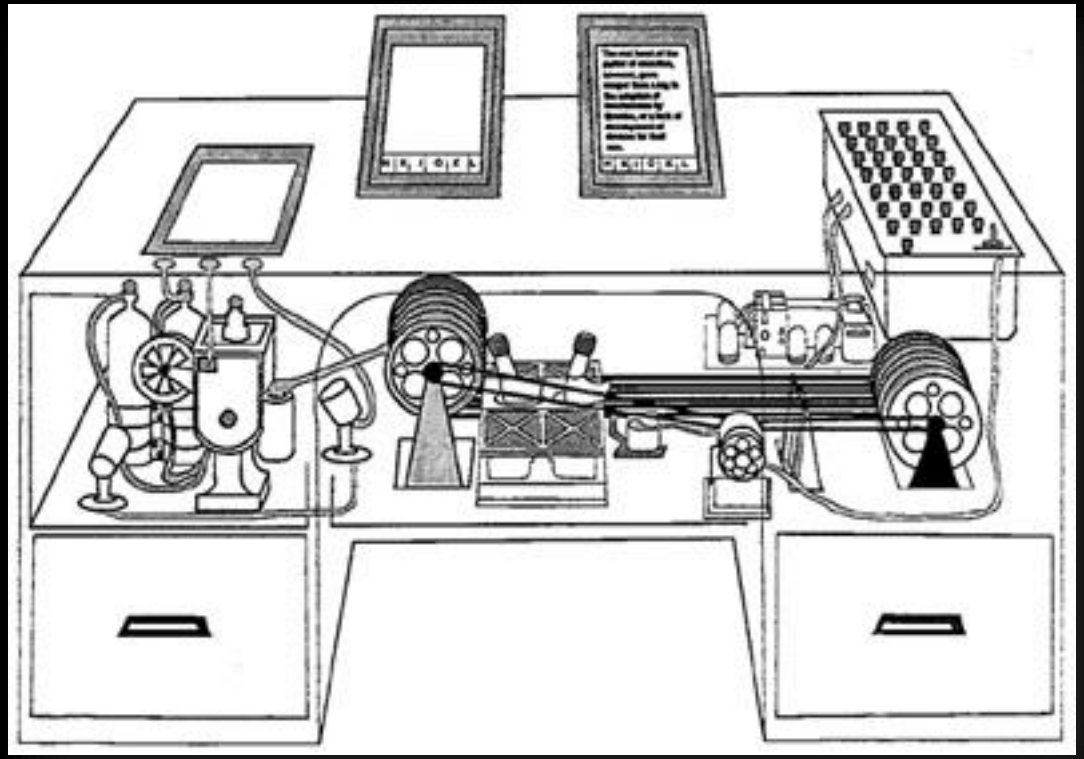
- *Memex, 1945*
- *Key project leader on the Manhattan Project to build the first nuclear bomb.*
- *“A memex …is an enlarged intimate supplement to … memory.”*

API CONNECTION

Vannevar Bush

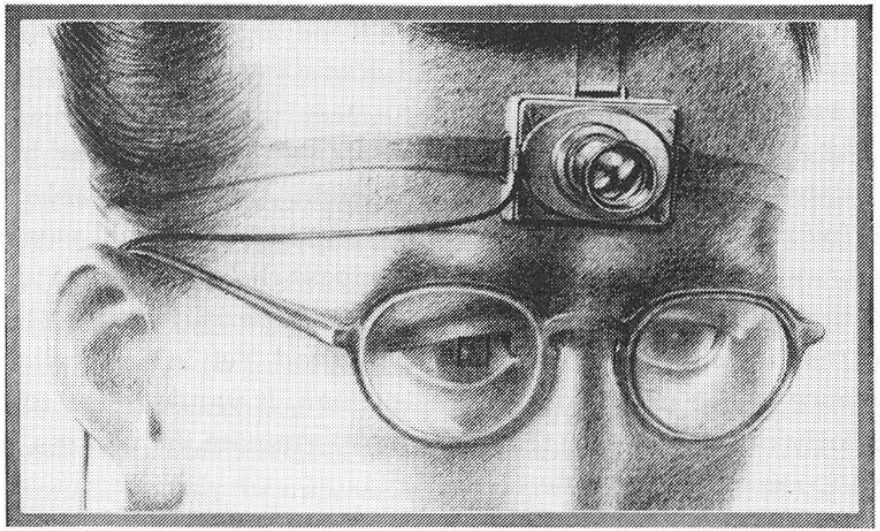
“With one item in its grasp, [the mind] snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain.”

Vannevar Bush - Memex



API CONNECTION

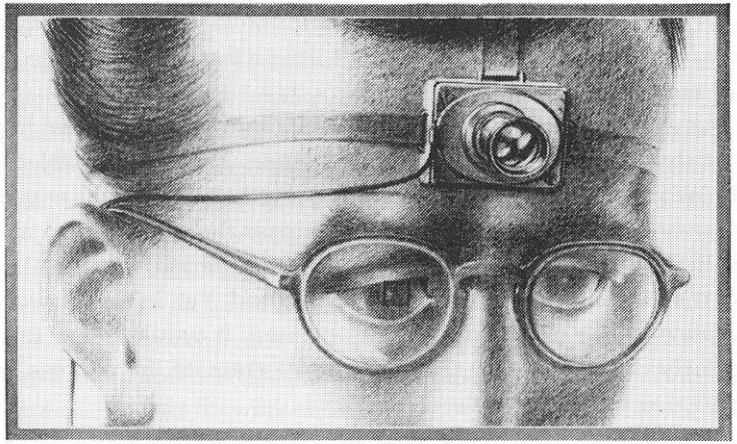
Vannevar Bush - Memex



A scientist of the future records experiments with a tiny camera fitted with universal-focus lens. The small square in the eyeglass at the left sights the object (*LIFE 19*(11), p. 112).

API CONNECTION

Vannevar Bush - Memex



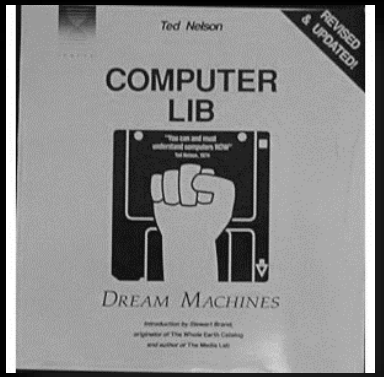
A scientist of the future records experiments with a tiny camera fitted with universal-focus lens. The small square in the eyeglass at the left sights the object (*LIFE 19*(11), p. 112).

Vannevar Bush

Mimic human linking using a machine

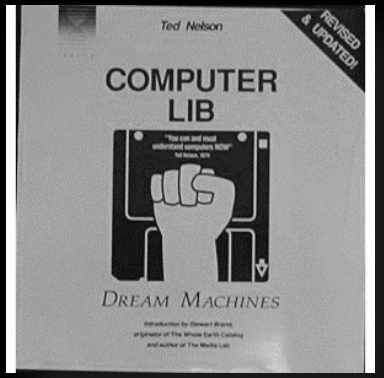
Ted Nelson

- *Hypertext, 1963*
- *Identified and popularized early “cyber-culture” in 1979 book “Computer Lib/Machine Dreams”*



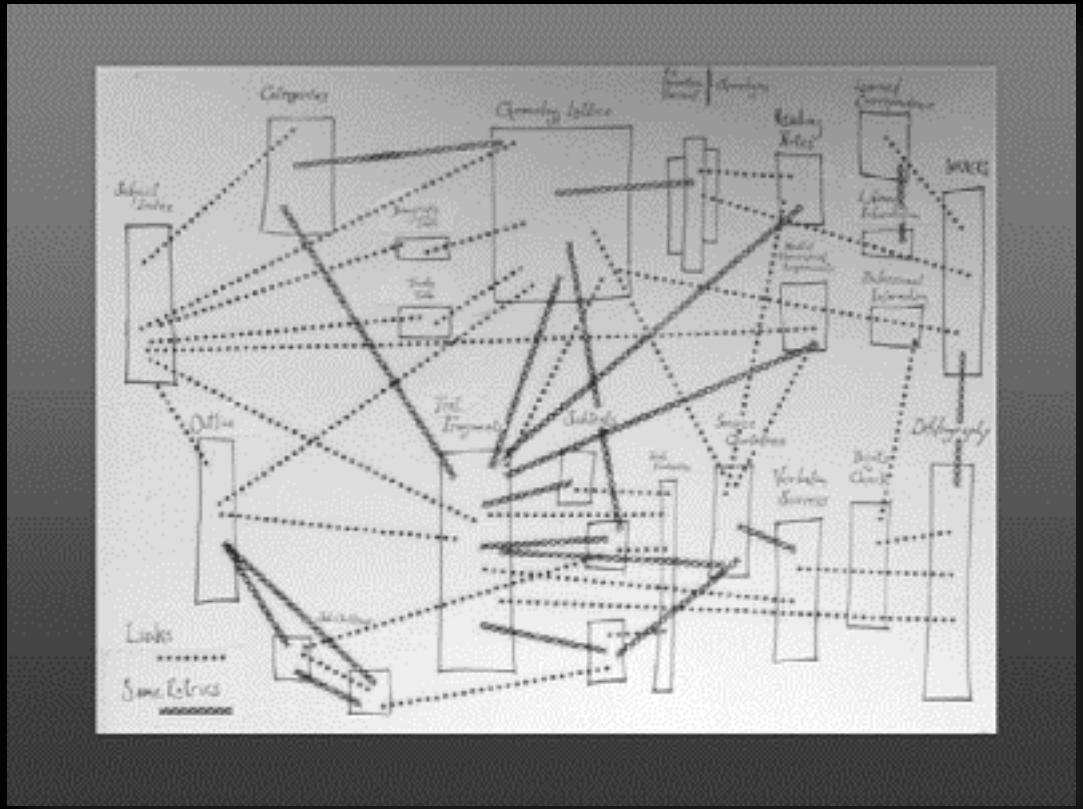
Ted Nelson

“If computers are the wave of the future, displays are the surfboards.”



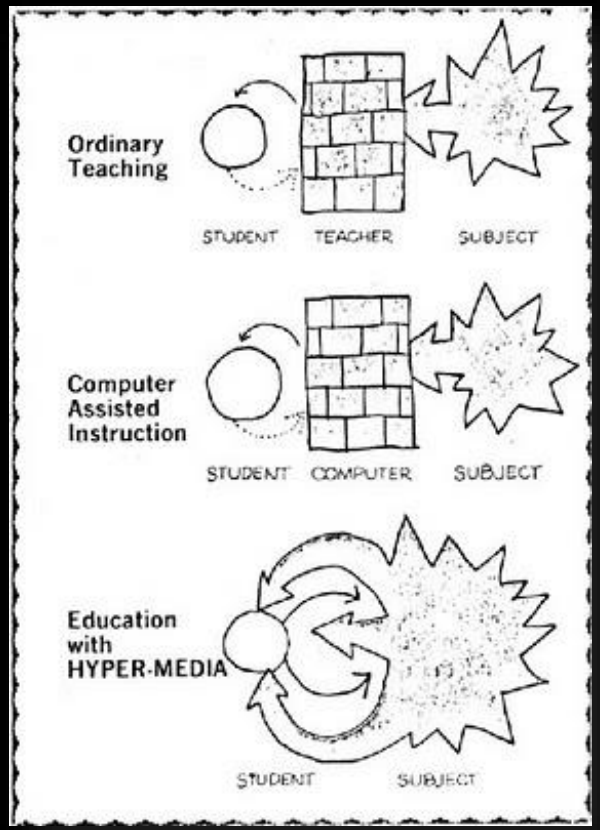
API CONNECTION

Ted Nelson - Hypertext



API CONNECTION

Ted Nelson - Hypertext



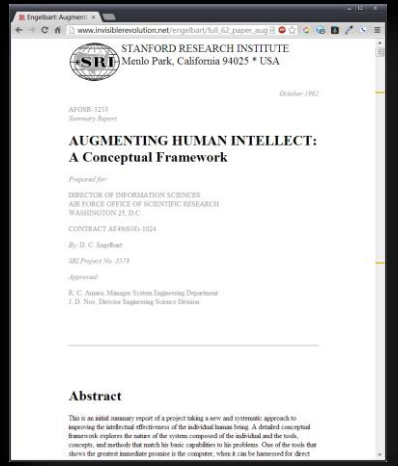
API CONNECTION

Ted Nelson - Hypertext

Describe how linking works in a network.

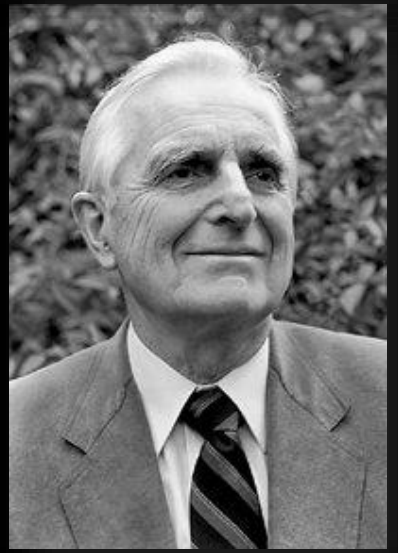
Douglas Engelbart

- *Computer mouse, 1965*
- *Key to creating the ARPANET while at Stanford Research Institue (SRI).*
- *“Augmenting Human Intellect”, 1962*


STANFORD RESEARCH INSTITUTE
Menlo Park, California 94025 * USA

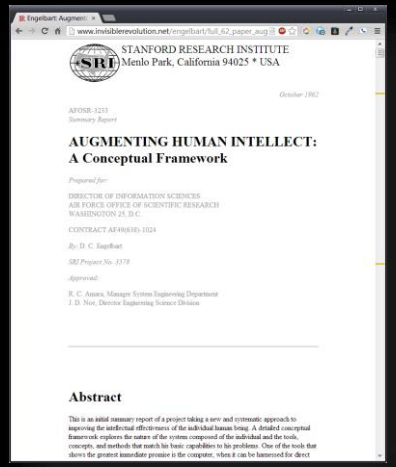
AUGMENTING HUMAN INTELLECT:
A Conceptual Framework

Abstract



Douglas Engelbart

“[A] new and systematic approach to improving the intellectual effectiveness of the individual human being … One of the tools that shows the greatest immediate promise is the computer.”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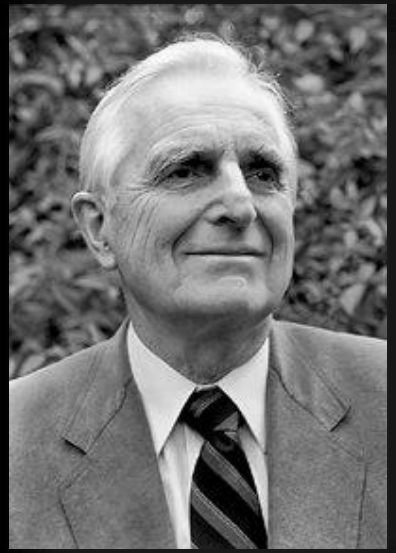
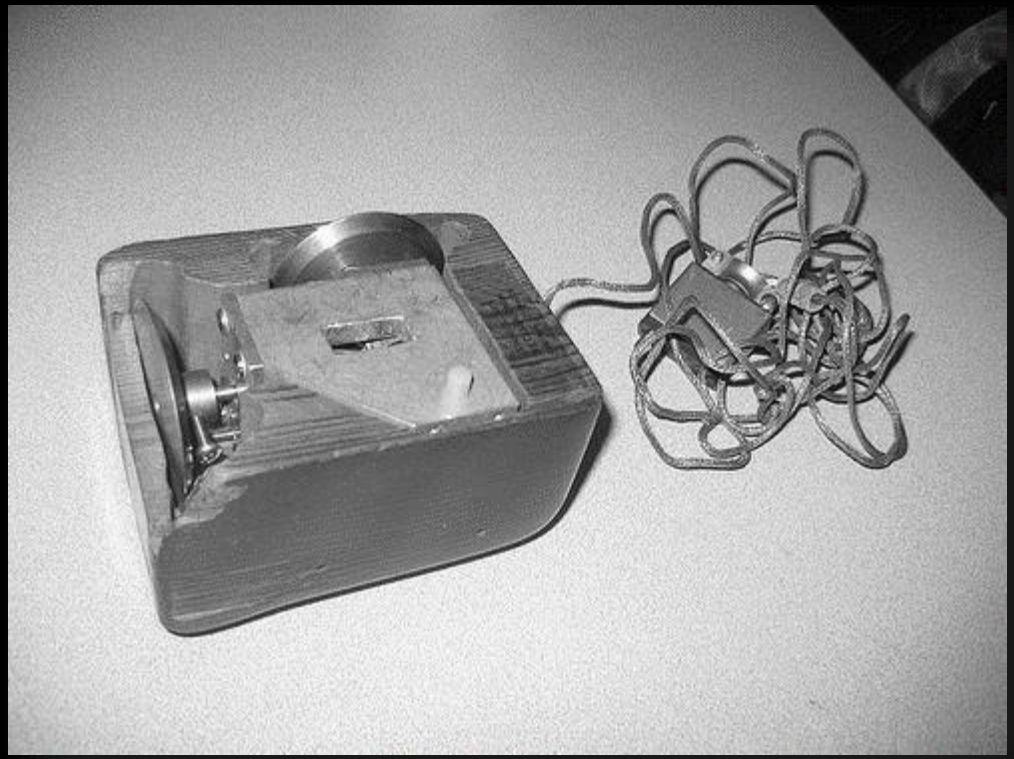
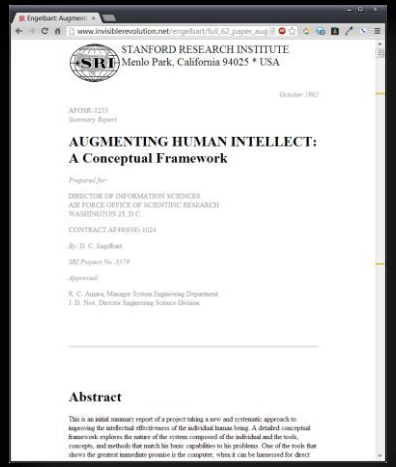


API CONNECTION

Douglas Engelbart - Mouse





STANFORD RESEARCH INSTITUTE
Menlo Park, California 94025 * USA

October 1962

APOSR-3233
Summary Report

AUGMENTING HUMAN INTELLECT:
A Conceptual Framework

Prepared for:

DIRECTOR OF INFORMATION SCIENCES
AIR FORCE OFFICE OF SCIENTIFIC RESEARCH
WASHINGTON 25, D.C.

CONTRACT AF49(638)-1024

By: D. C. Engelbart

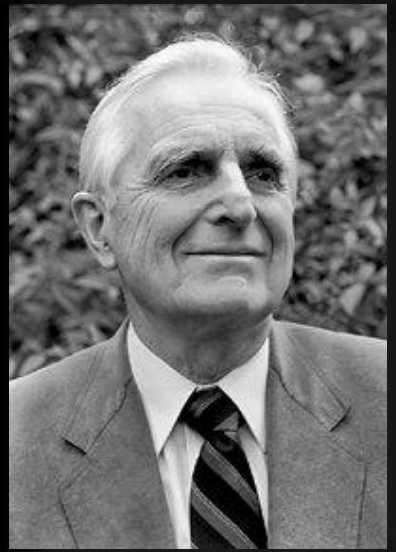
SRI Project No. 3578

Approved:

R. C. Amara, Manager System Engineering Department
J. D. Noe, Director Engineering Science Division

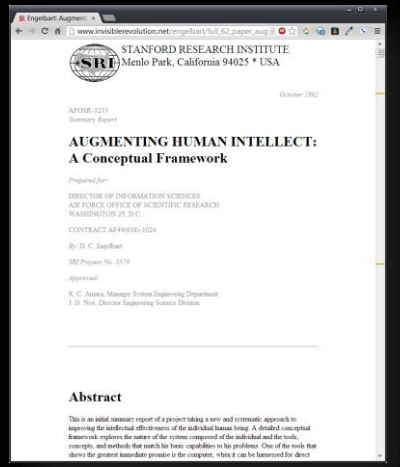
Abstract

This is an initial summary report of a project taking a new and systematic approach to improving the intellectual effectiveness of the individual human being. A detailed conceptual framework explores the nature of the system composed of the individual and the tools, concepts, and methods that match his basic capabilities to his problems. One of the tools that shows the greatest immediate promise is the computer, when it can be harnessed for direct



API CONNECTION

Douglas Engelbart - Mouse



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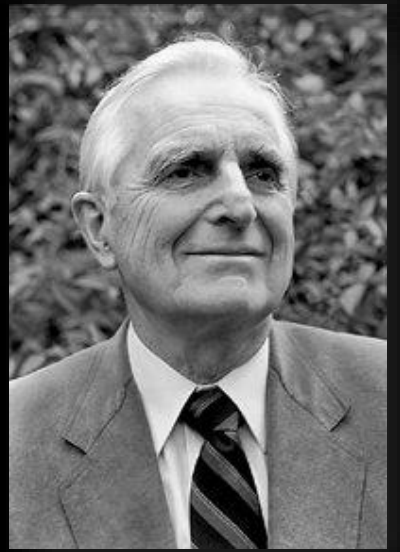
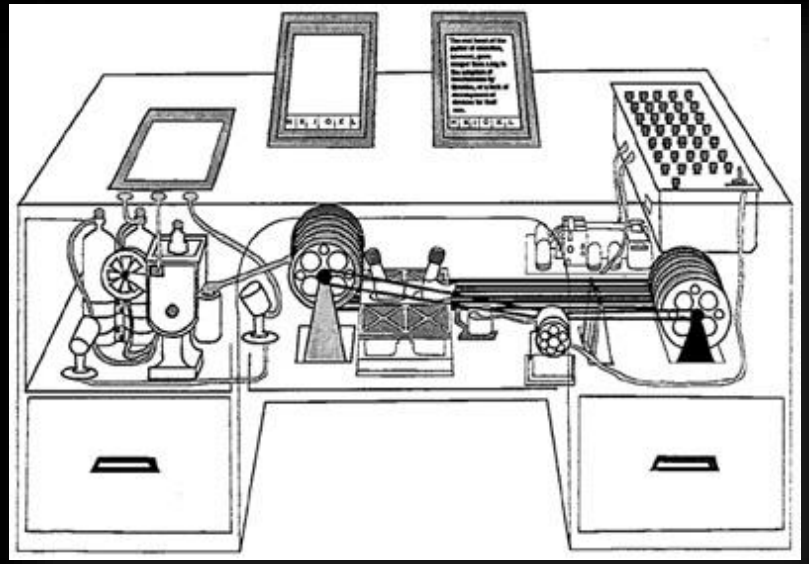
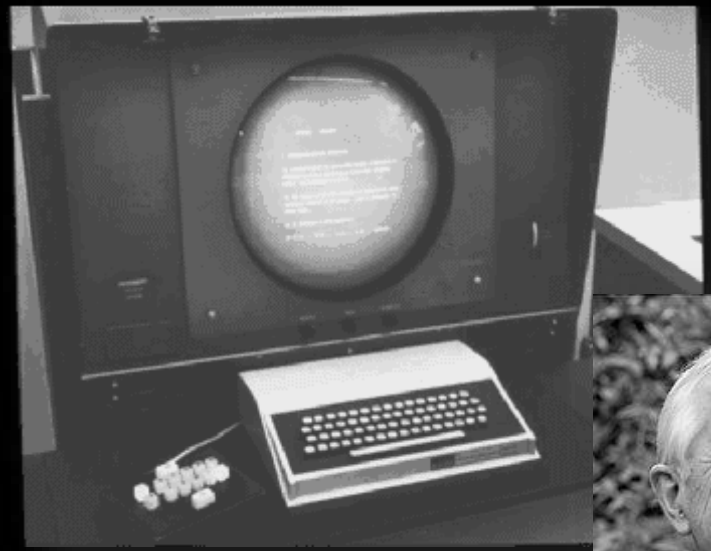
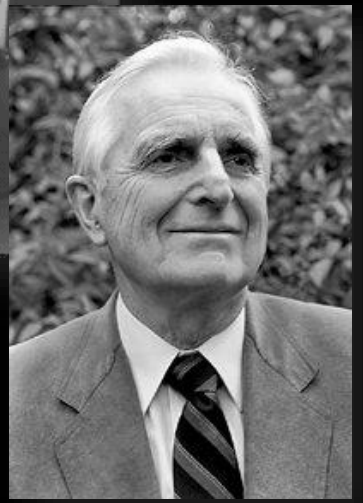


API CONNECTION

Douglas Engelbart - Mouse

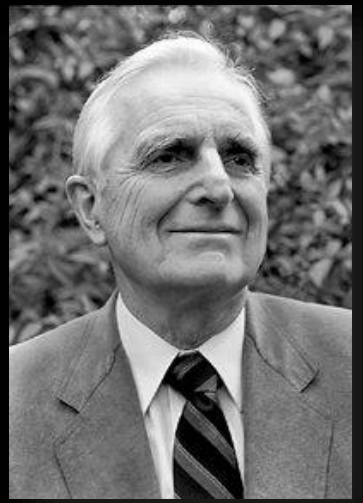






Douglas Engelbart - Mouse

Build the hardware that makes the linked network possible.

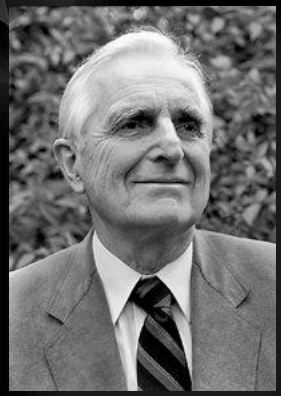


Early Concepts

- **Bush (1945)**
  Mimic human linking using a machine

- **Nelson (1963)**
  Describe how linking works in a network

- **Engelbart (1965)**
  Build the hardware that makes the linked network possible

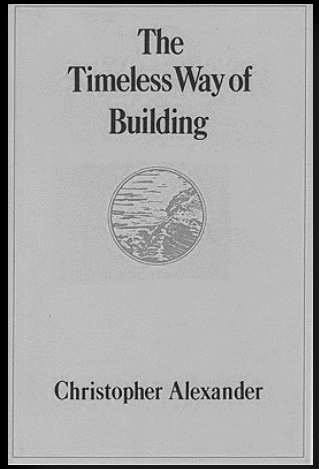


API CONNECTION

Affected Systems

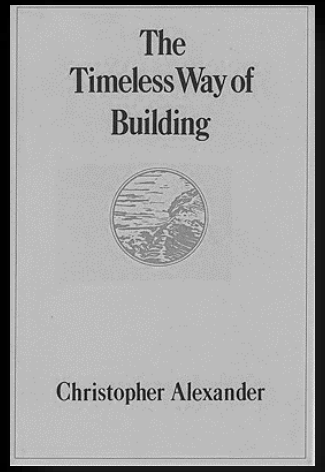
Christopher Alexander

- *The Timeless Way of Building, 1979*
- *Father of the "patterns" movement*
- *"Complexity is one of the great problems in design."*

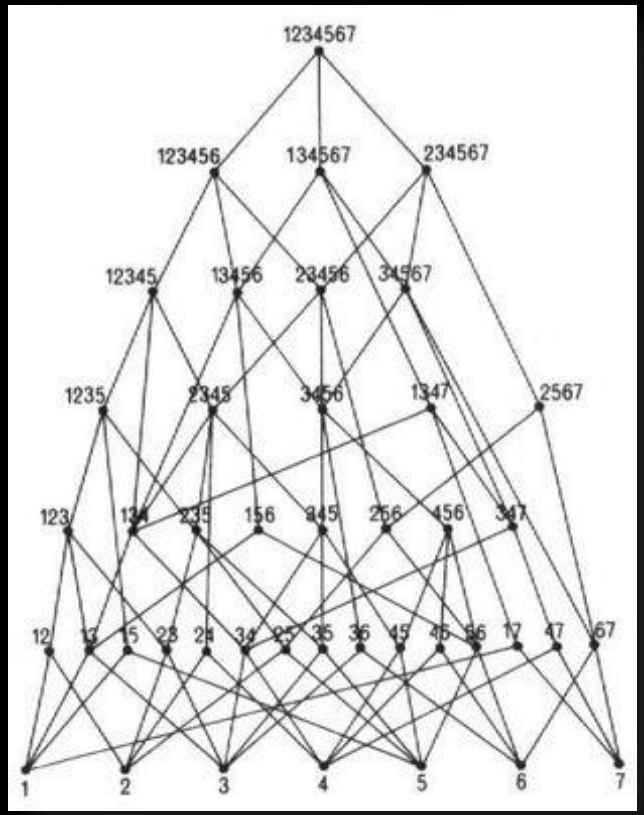


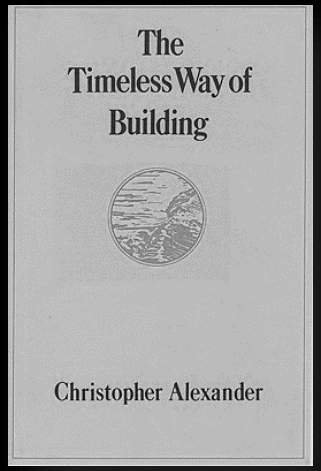
Christopher Alexander

“There is one timeless way of building. It is a thousand years old, and the same today as it has ever been. The great traditional buildings of the past, the villages and tents and temples in which man feels at home, have always been made by people who were very close to the center of this way.”



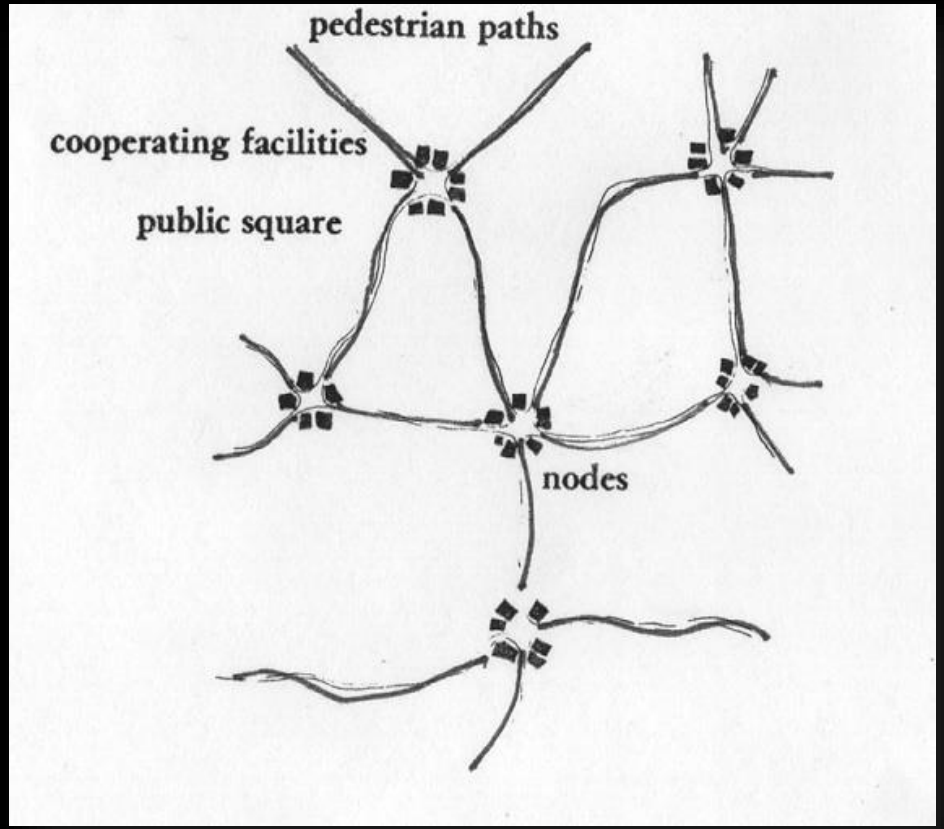
Christopher Alexander - Patterns

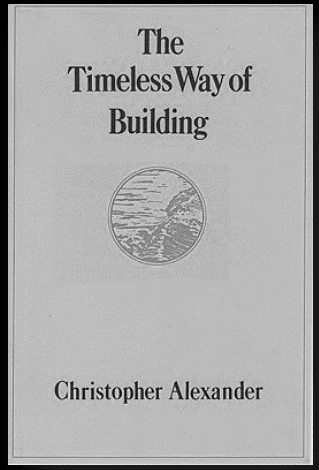




API CONNECTION

Christopher Alexander - Patterns





API
CONNECTION

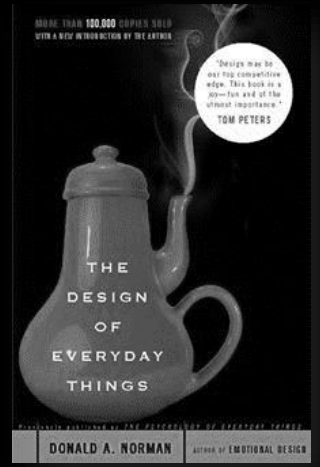
Christopher Alexander - Patterns

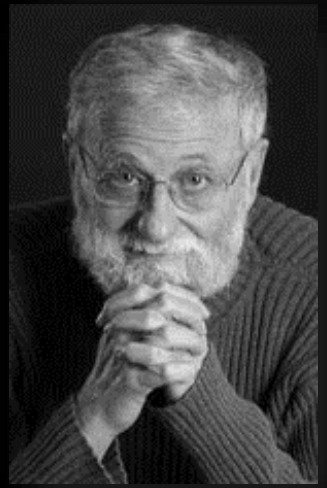
Recognize patterns for thinking and acting.

API CONNECTION

Donald Norman

- The Design of Everyday Things, 1988
- Action Lifecycle,
  Seven Stages of Action
- “In the world” and “In the head”

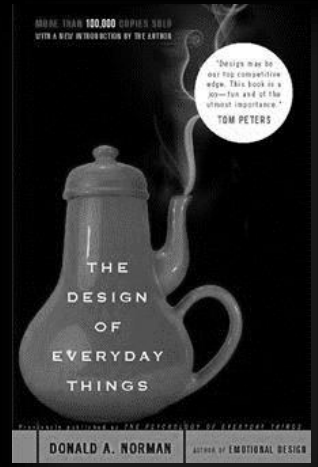


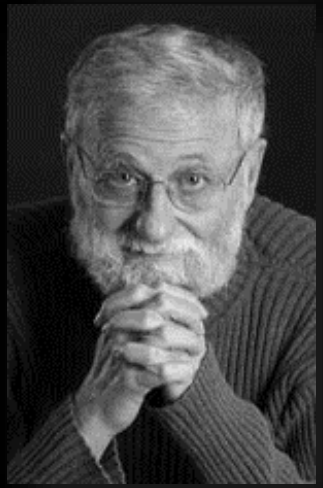


API CONNECTION

Donald Norman

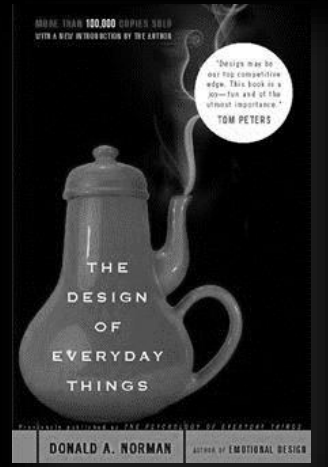
- *“Simplification is as much in the mind as it is in the device.”*
- *“Design is really an act of communication.”*
- *Human-Computer-Interaction (HCI)*

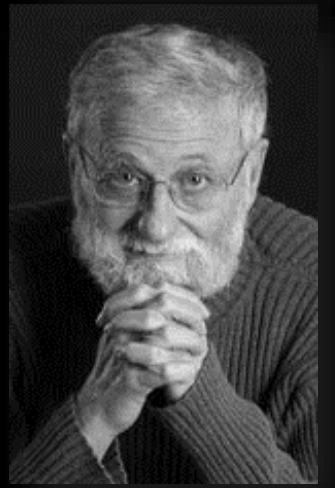




API CONNECTION

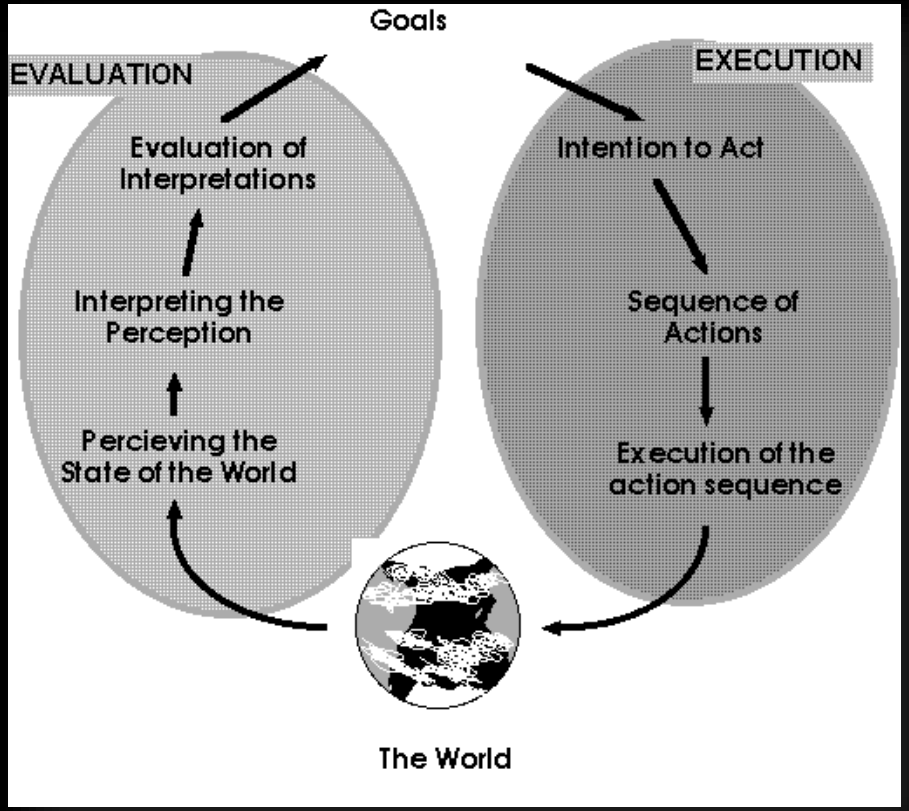
Donald Norman - HCI

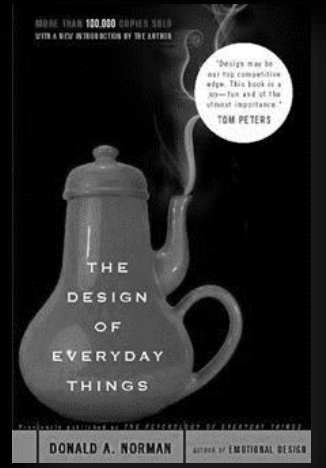


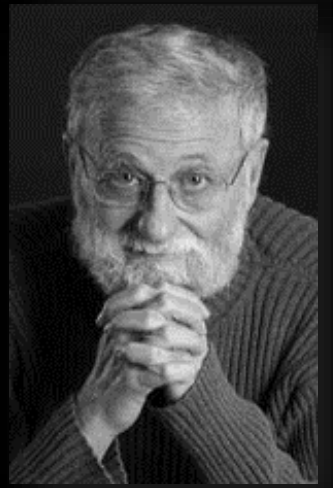


API CONNECTION

Donald Norman - HCI

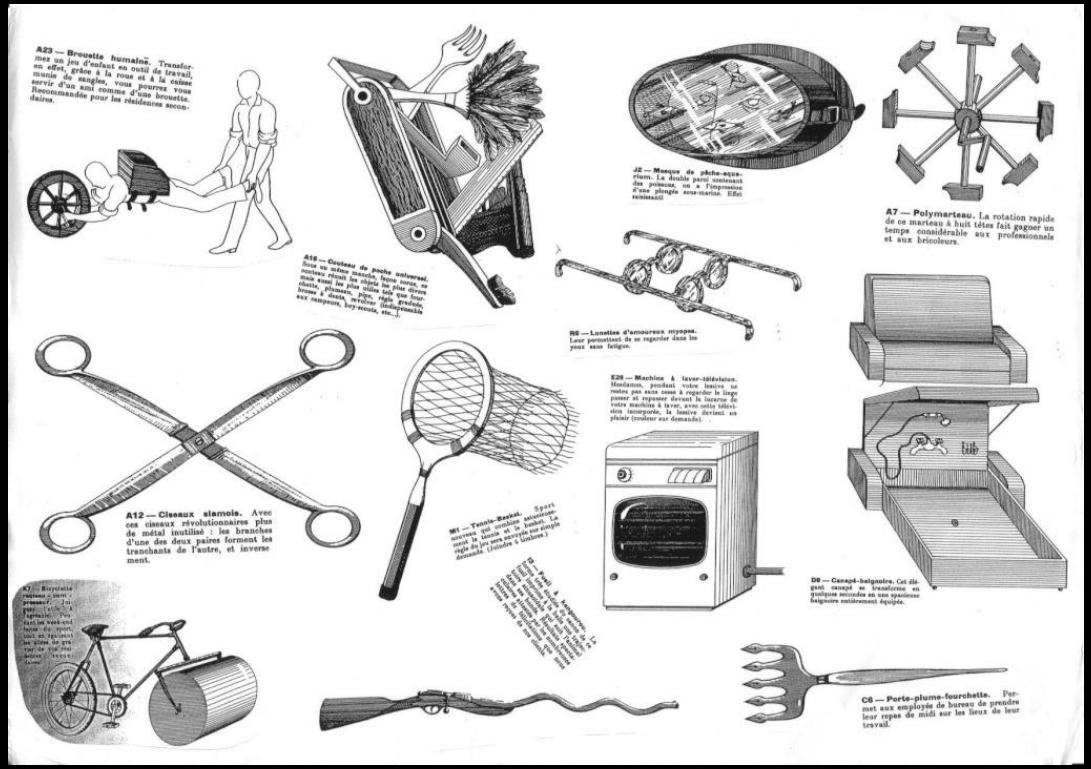


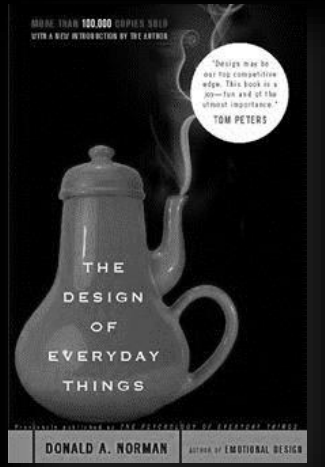


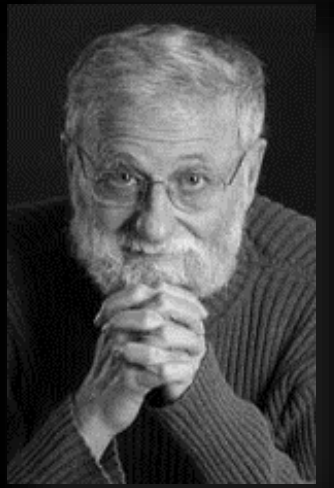


API CONNECTION

Donald Norman - HCI



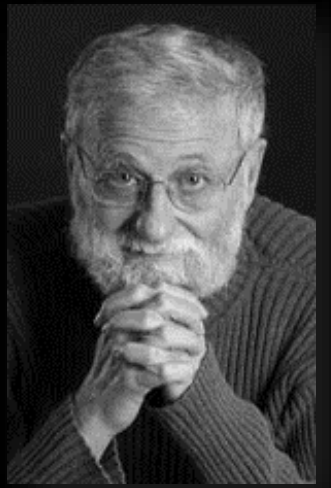




API CONNECTION

Donald Norman - HCI

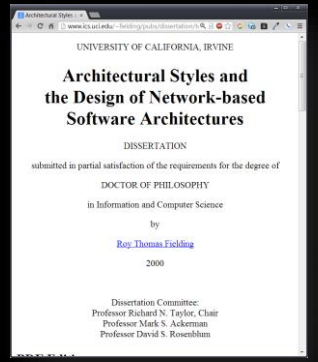
Describe the model we all use for interaction.



API CONNECTION

Roy Fielding

- *Architectural Styles for the Design of Networked-based Software, 2000*
- *Created “REST”*
- *Representations and Hypermedia*


UNIVERSITY OF CALIFORNIA, IRVINE

Architectural Styles and the Design of Network-based Software Architectures

DISSERTATION

submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in Information and Computer Science

by

Roy Thomas Fielding

2000

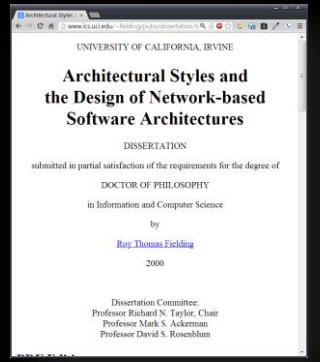
Dissertation Committee:
Professor Richard N. Taylor, Chair
Professor Mark S. Ackerman
Professor David S. Rosenblum

API CONNECTION

Roy Fielding

A resource is not the thing that is transferred across the wire or picked up off the disk or seen from afar while walking your dog.

Each of those is only a representation. Do I think of a different identifier every time I see my dog, or do I simply think of my dog as one identity and experience many representations of that identity over time (and on into memory and imagination)?


UNIVERSITY OF CALIFORNIA, IRVINE

Architectural Styles and the Design of Network-based Software Architectures

DISSERTATION

submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in Information and Computer Science

by

Roy Thomas Fielding

2000

Dissertation Committee:
Professor Richard N. Taylor, Chair
Professor Mark S. Ackerman
Professor David S. Rosenblum

API CONNECTION

Roy Fielding - REST

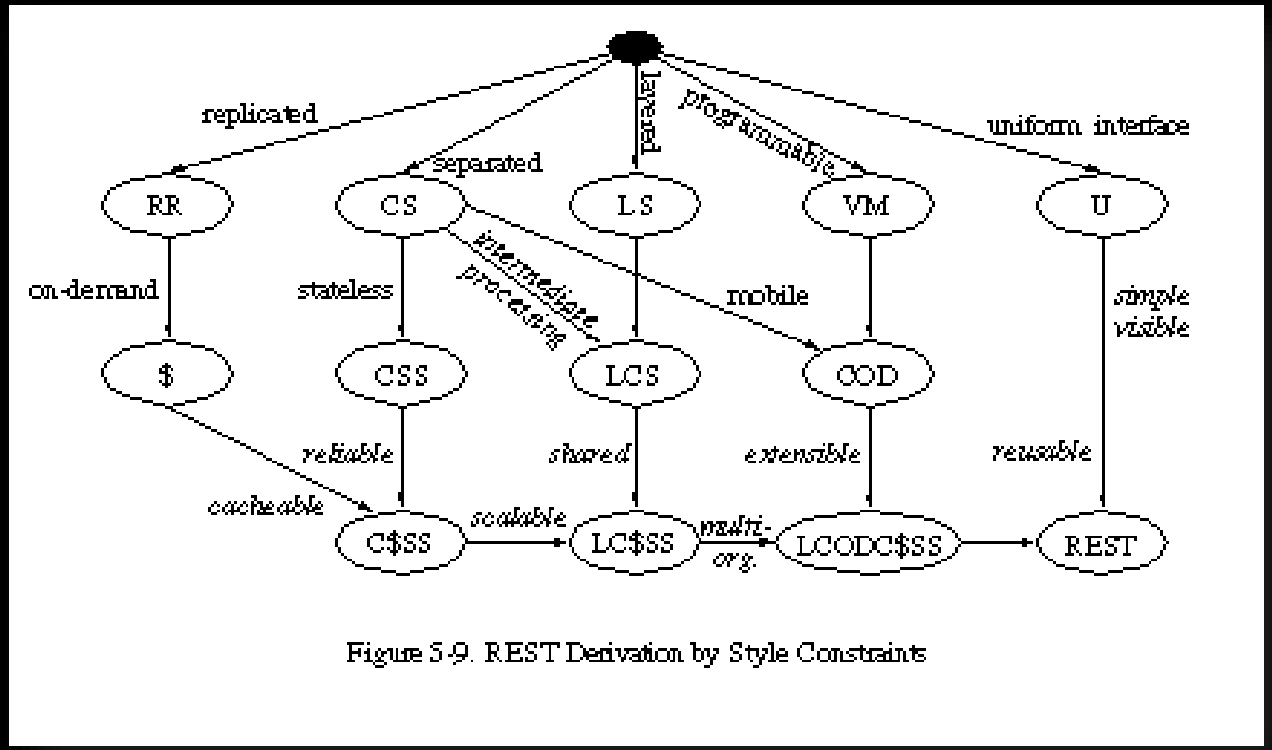
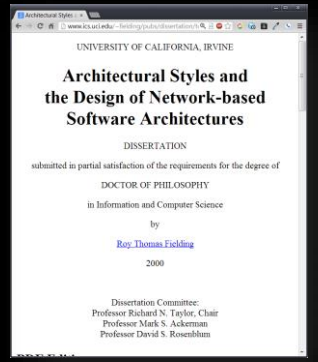


Figure 5-9. REST Derivation by Style Constraints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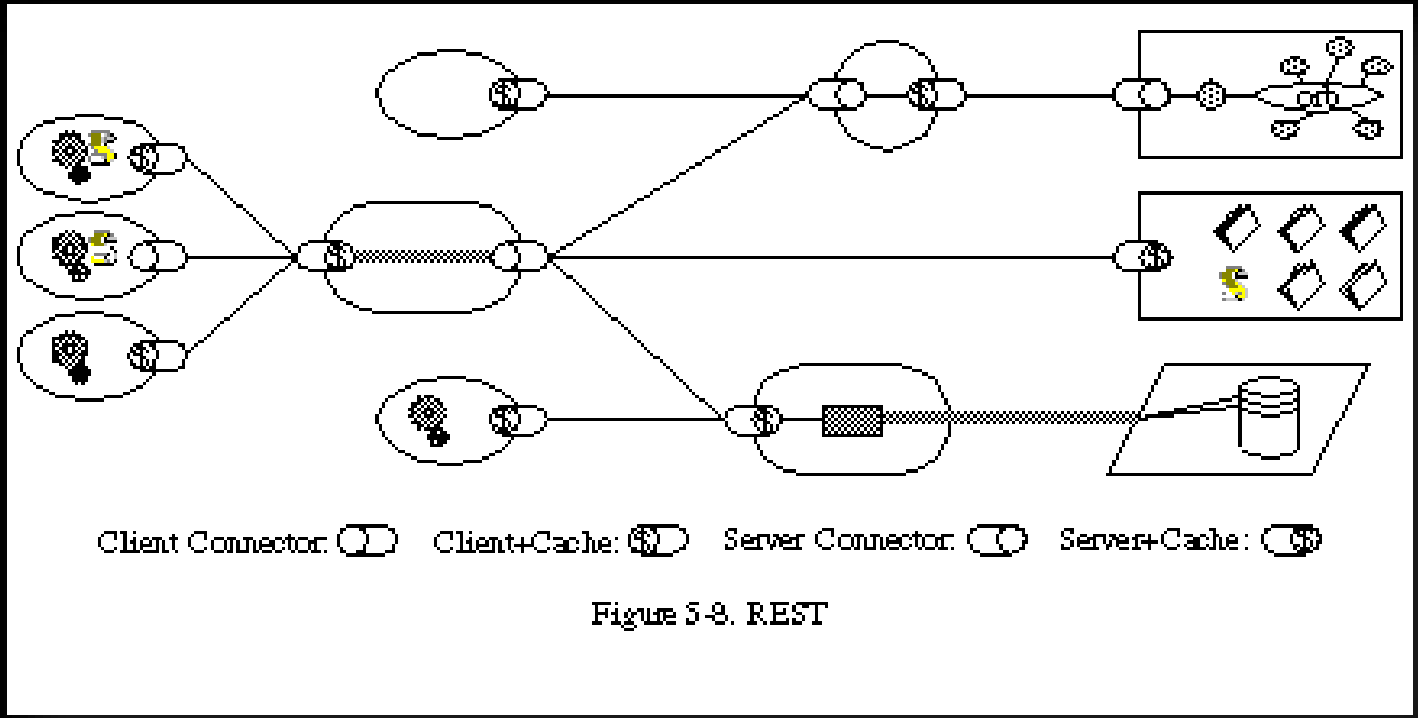
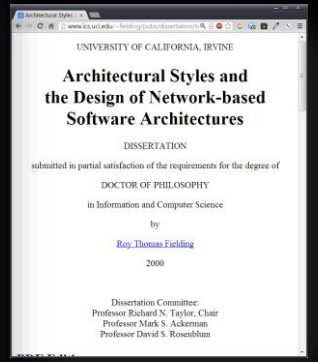


Figure 5-8. REST



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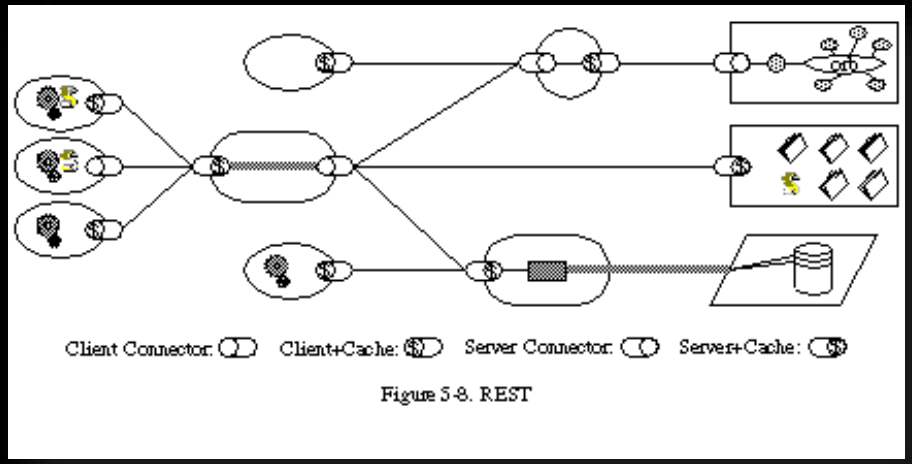
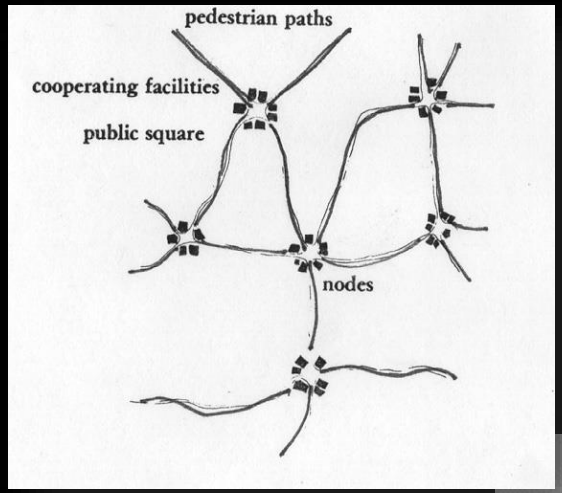


Figure 5-8. REST



API CONNECTION

Roy Fielding - REST

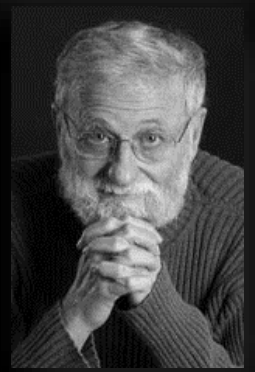
Identify a formula for creating new systems at planetary scale.

Affected Systems

- **Christopher Alexander (1979)**
  Recognize patterns for thinking and acting

- **Donald Norman (1988)**
  Describe the model we all use for interaction

- **Roy T. Fielding (2000)**
  Identify a formula for creating new systems at planetary scale.



API CONNECTION

Futures

API CONNECTION

Linus Torvalds/Github

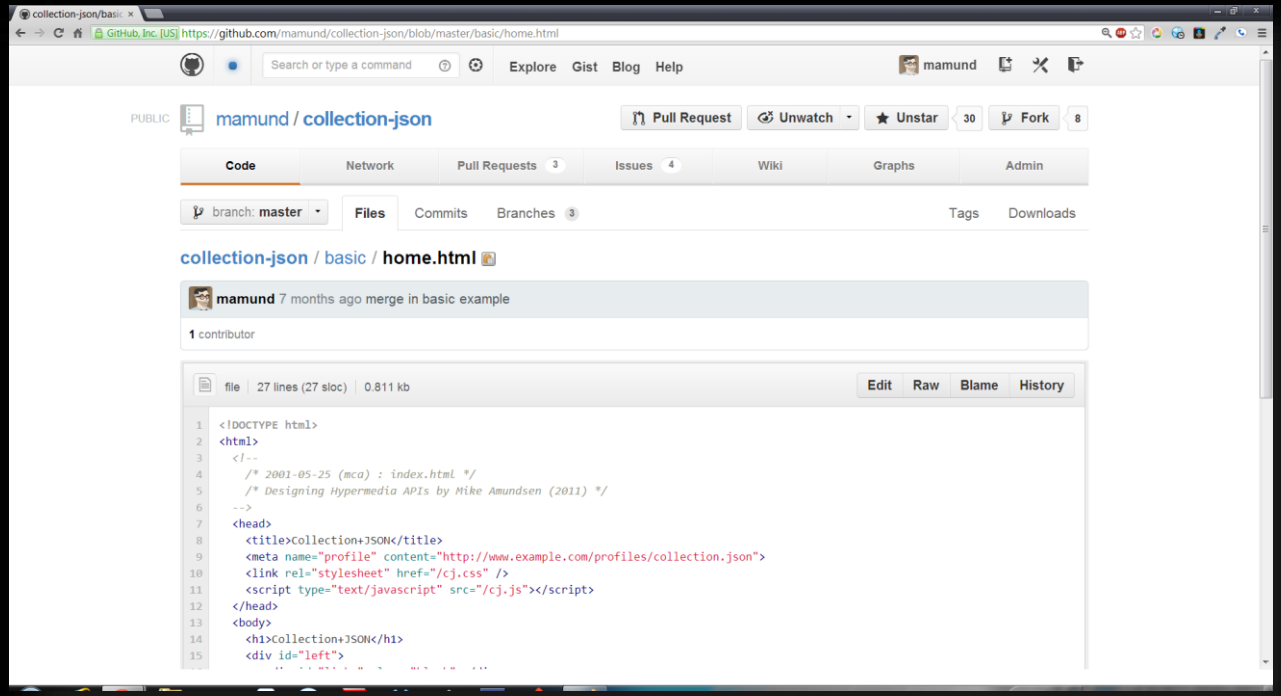
- *Github Launched in 2008*
- *A web-based hosting service for software development projects that use the Git revision control system.*

Linus Torvalds/Github

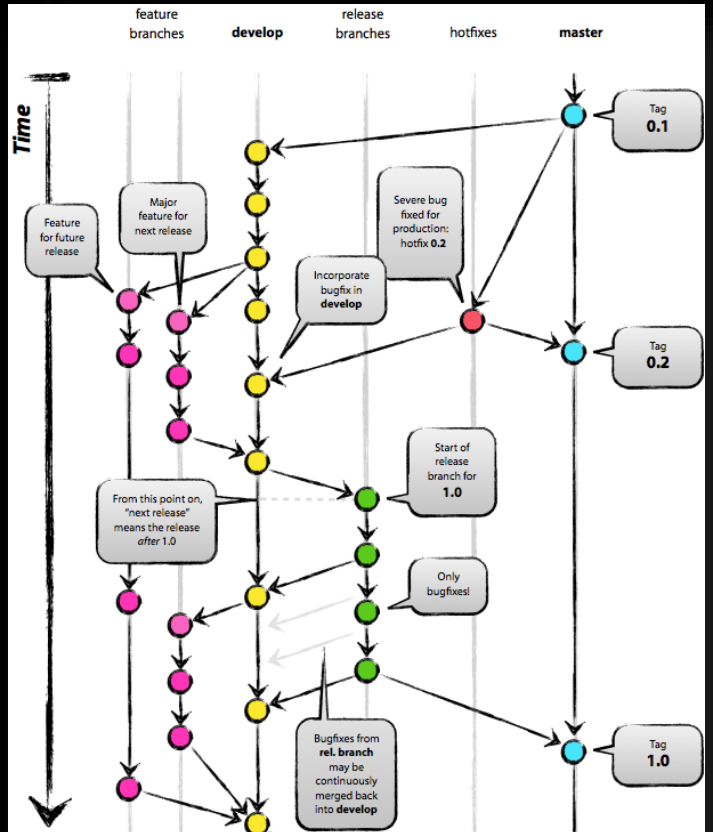
“Bad programmers worry about the code. Good programmers worry about data structures and their relationships.”

API CONNECTION

Linus Torvalds/Github – Social code



Linus Torvalds/Github – Social code



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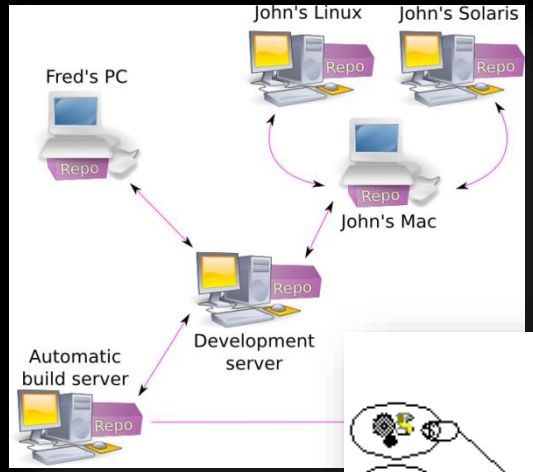
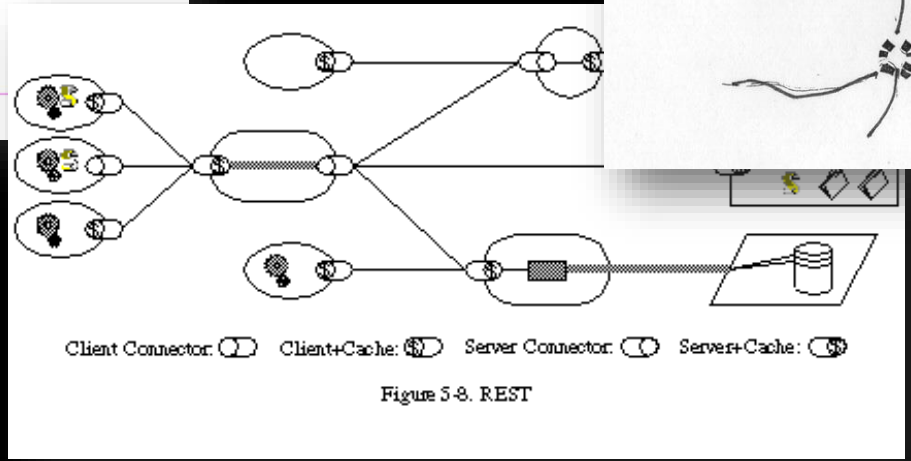
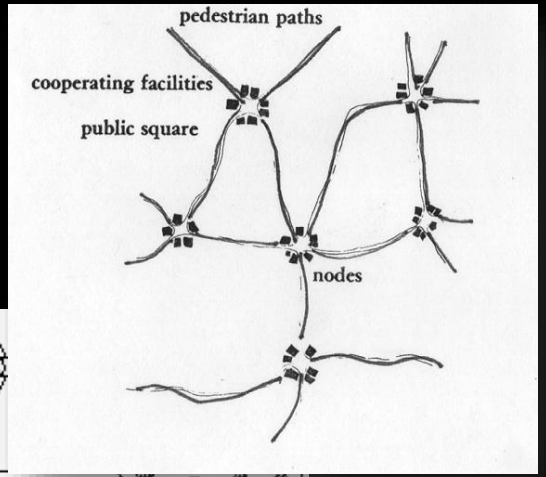
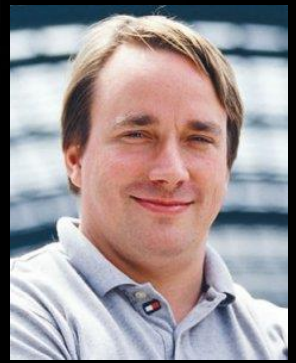
Linus Torvalds/Github – Social code









API CONNECTION

Linus Torvalds/Github – Social code

Enable collaborative interaction at distances (of time and space)

API CONNECTION

Ryan Dahl

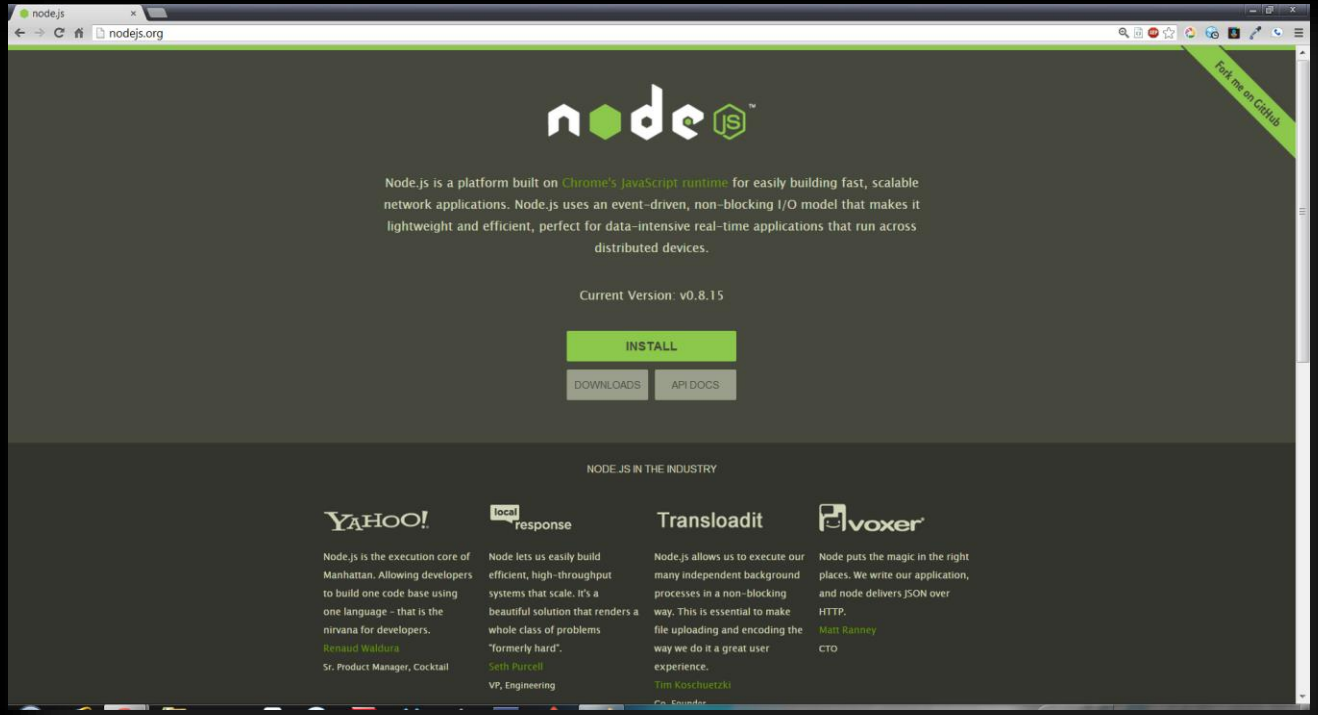
- *Node.js, 2009*
- *Makes network latency “a feature”*
- *“Node.js [is] perfect for data-intensive real-time applications that run across distributed devices.” – Ryan Dahl*

API CONNECTION

Ryan Dahl

- *“Node is more like C than it is like Python, and that is by design.” – Isaac Schlueter*

Ryan Dahl - NodeJS



API CONNECTION

Ryan Dahl - NodeJS

IO

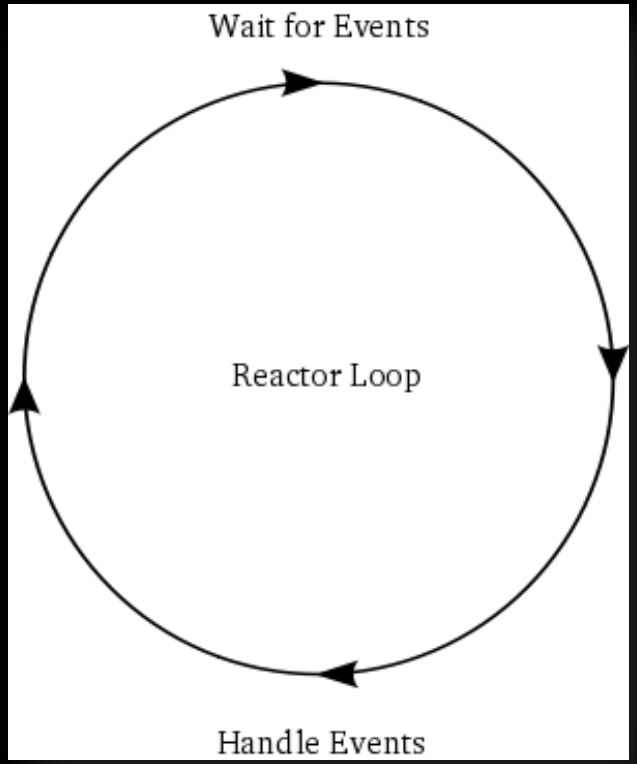
You're Doing It Wrong

API CONNECTION

Ryan Dahl - NodeJS

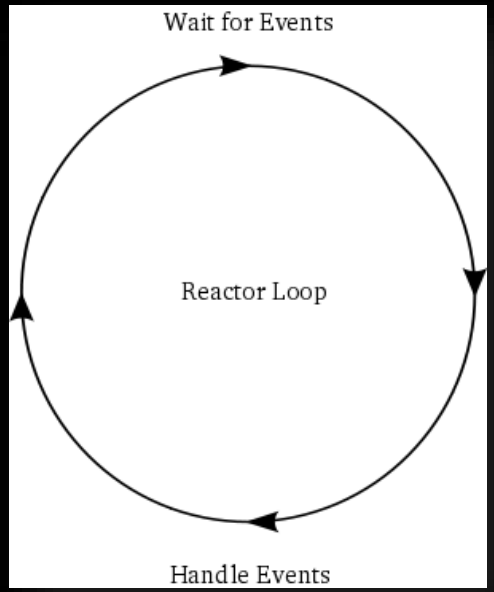
API CONNECTION

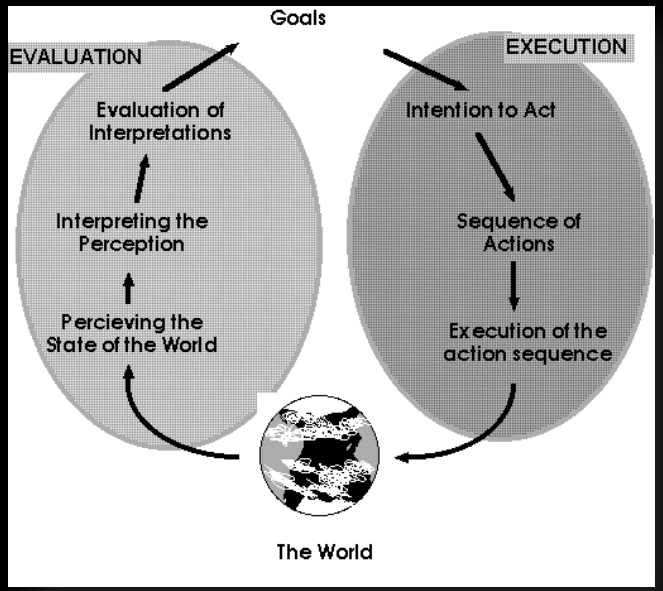
Ryan Dahl - NodeJS



API CONNECTION

Ryan Dahl - NodeJS





API CONNECTION

Ryan Dahl - NodeJS

Embrace latency as a feature of the network.

API CONNECTION

Rich Hickey

- *Clojure 2007, Datomic, 2010*
- *“Code is data”*
- *“The past doesn’t change”*

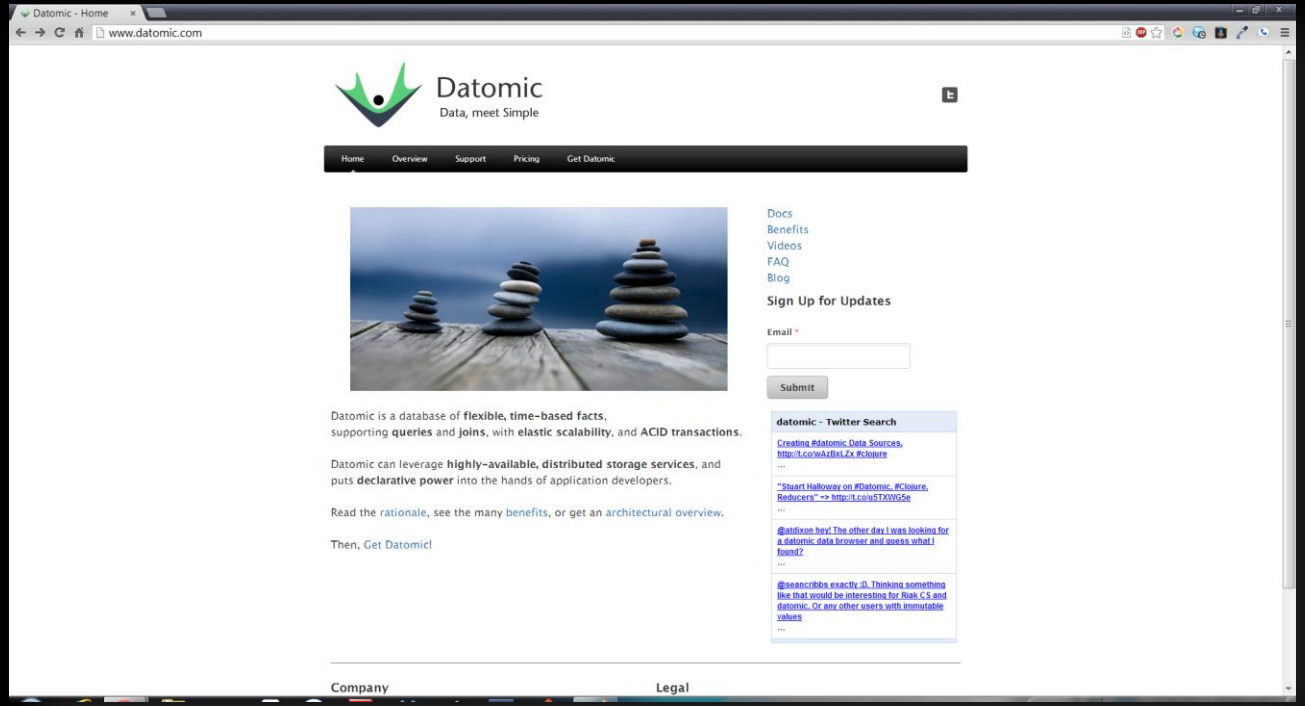
Rich Hickey

“Clojure is a functional language that explicitly supports programs as models and provides robust and easy-to-use facilities for managing identity and state in a single process in the face of ***concurrency****.”*

“We need to move away from a notion of state as ‘the content of this memory block’ to one of ‘the ***value*** *currently associated with this identity’”*

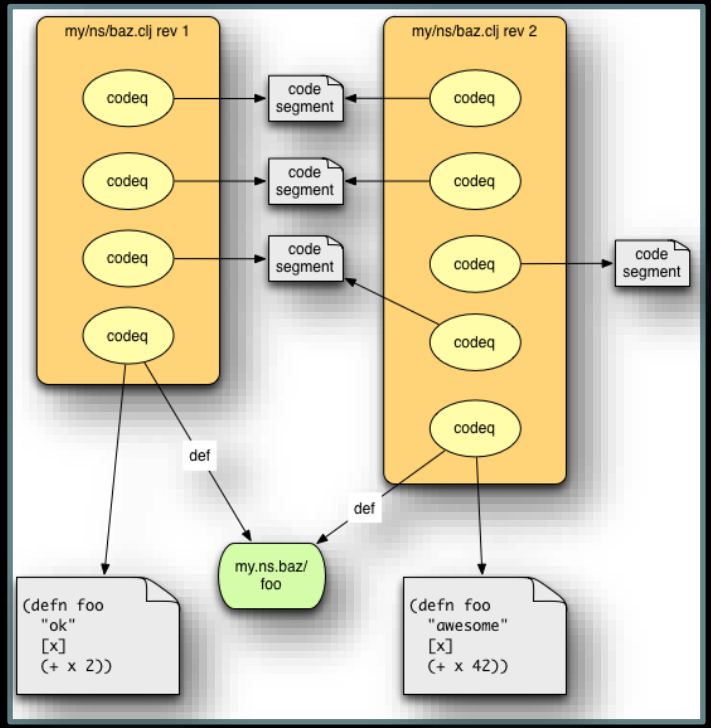
API CONNECTION

Rich Hickey - Datomic



API CONNECTION

Rich Hickey - Datomic



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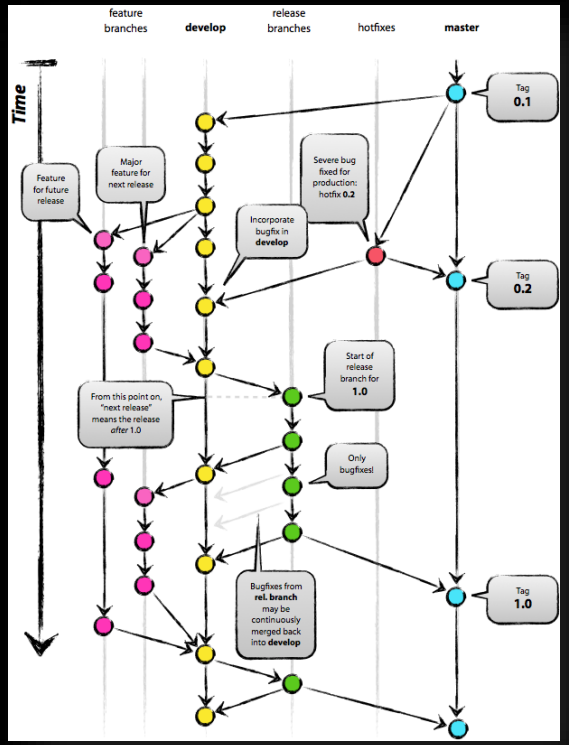
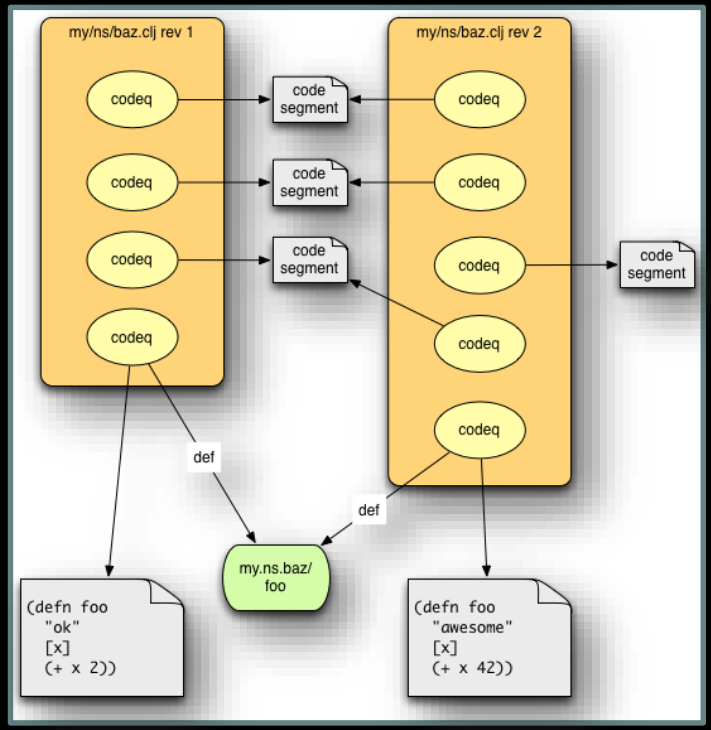
Rich Hickey - Datomic





API CONNECTION

Rich Hickey - Datomic

*Recognize that all data is **immutable**,*
we just have lots of copies w/ shared identity

API CONNECTION

Eric Schweikart

- *Cubelets, 2012*
- *PhD in Architecture at Carnegie Mellon University*
- *“People have a hard time thinking about complex problems.”*

Eric Schweikart

“Unlike contemporary robots in which a single “brain” controls the entire robot, robots formed with [Cubelets] are made up of individual parts that have different functions, yet work in unison to form the entire model.”

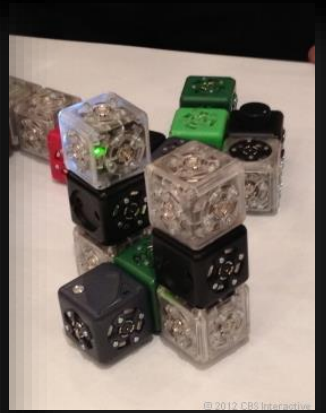
Eric Schweikart – Microbots

API CONNECTION

Eric Schweikart - Microbots

API CONNECTION

Eric Schweikart - Microbots



API CONNECTION

Eric Schweikart - Microbots

API CONNECTION

Eric Schweikart - Microbots

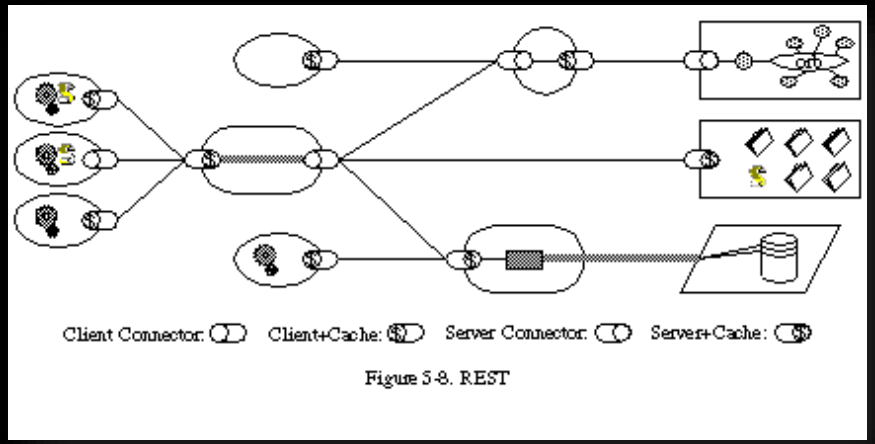


Figure 5-8. REST

API CONNECTION

Eric Schweikart - Microbots

Design systems to enable emergent behaviors.

Futures

- **Linus Torvalds**
  Enable collaborative interaction at a distance

- **Ryan Dahl**
  Embrace latency as a feature in networks

- **Rich Hickey**
  Recognize that all data is immutable, we just have lots of copies with shared identity.

- **Eric Schweikardt**
  Design systems to enable emergent behaviors

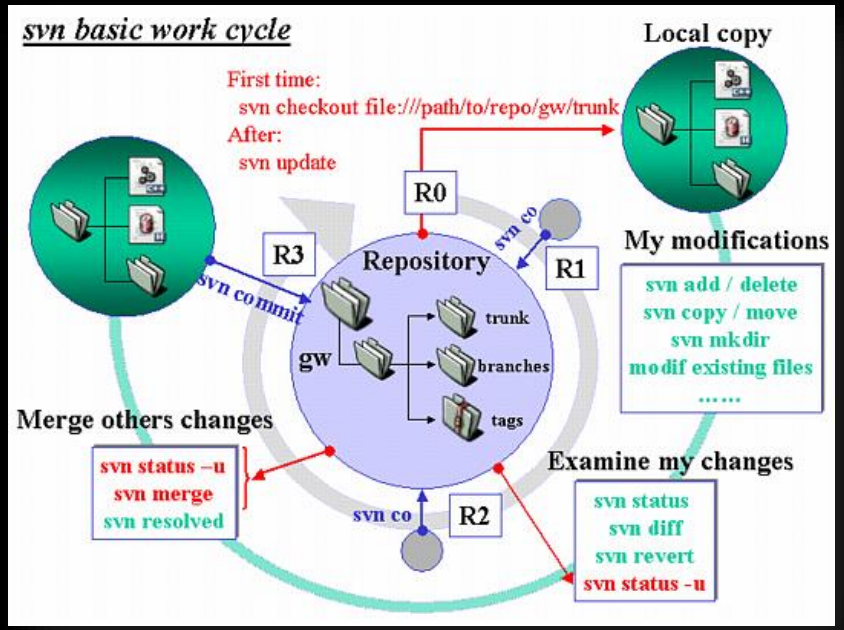
API CONNECTION

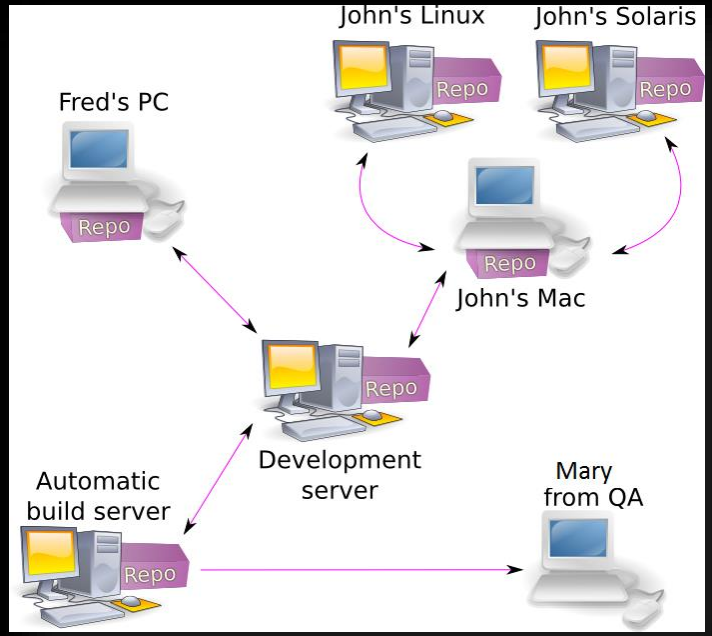
Transformation

Transformation

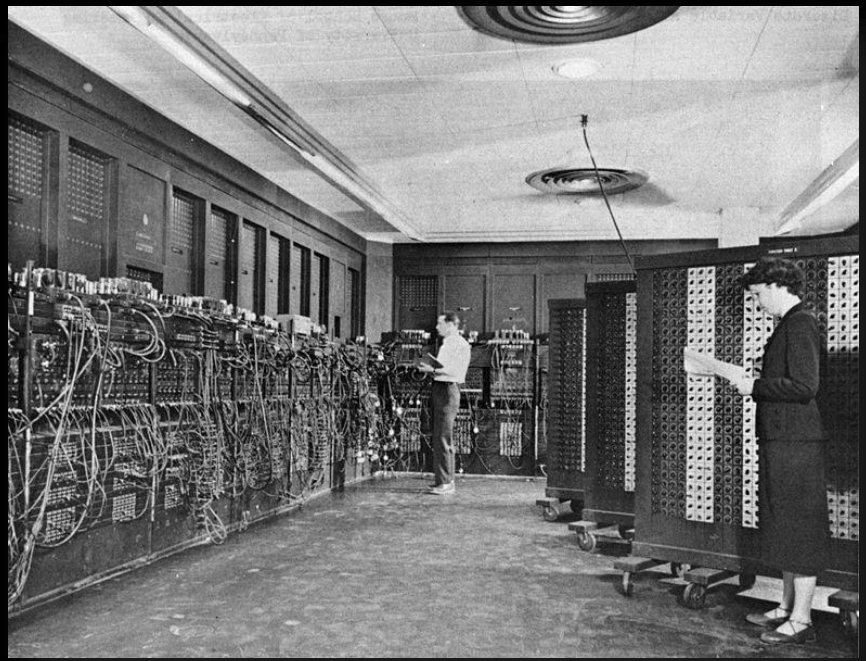
Transformation

Imperative vs. Declarative





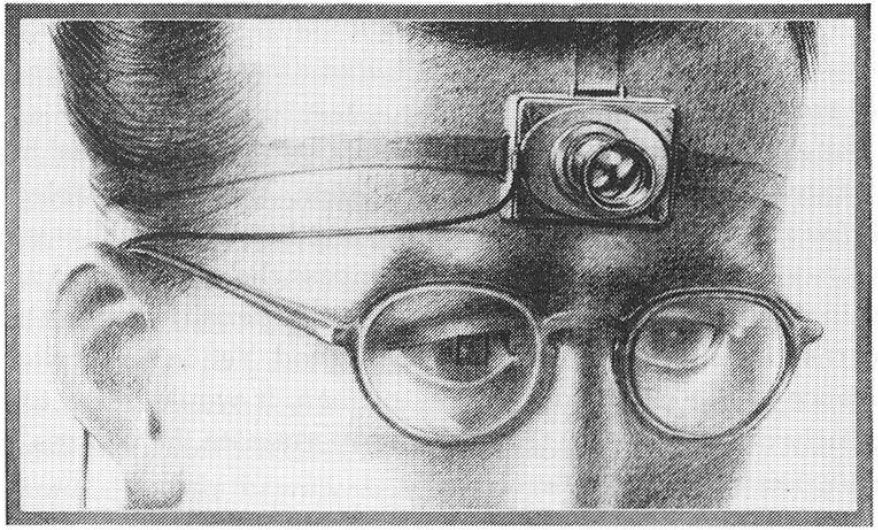
Big (“smart”) vs. Small (“dumb”)



API CONNECTION

Central control vs. Collaborative

One possible transformation…



A scientist of the future records experiments with a tiny camera fitted with universal-focus lens. The small square in the eyeglass at the left sights the object (*LIFE 19*(11), p. 112).

What I would hope to see in our future…

API CONNECTION

The kinds of systems I'd like to be using…

API CONNECTION

The future I want to help build…

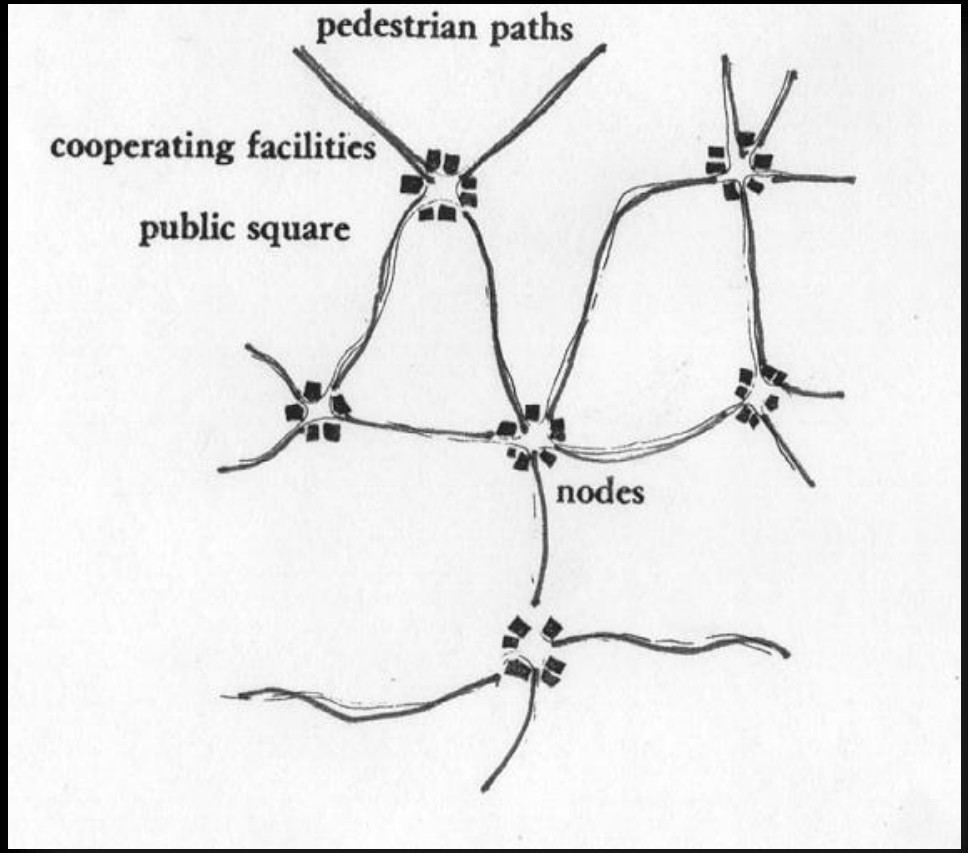
API CONNECTION

Means transforming our organizations into…

API CONNECTION

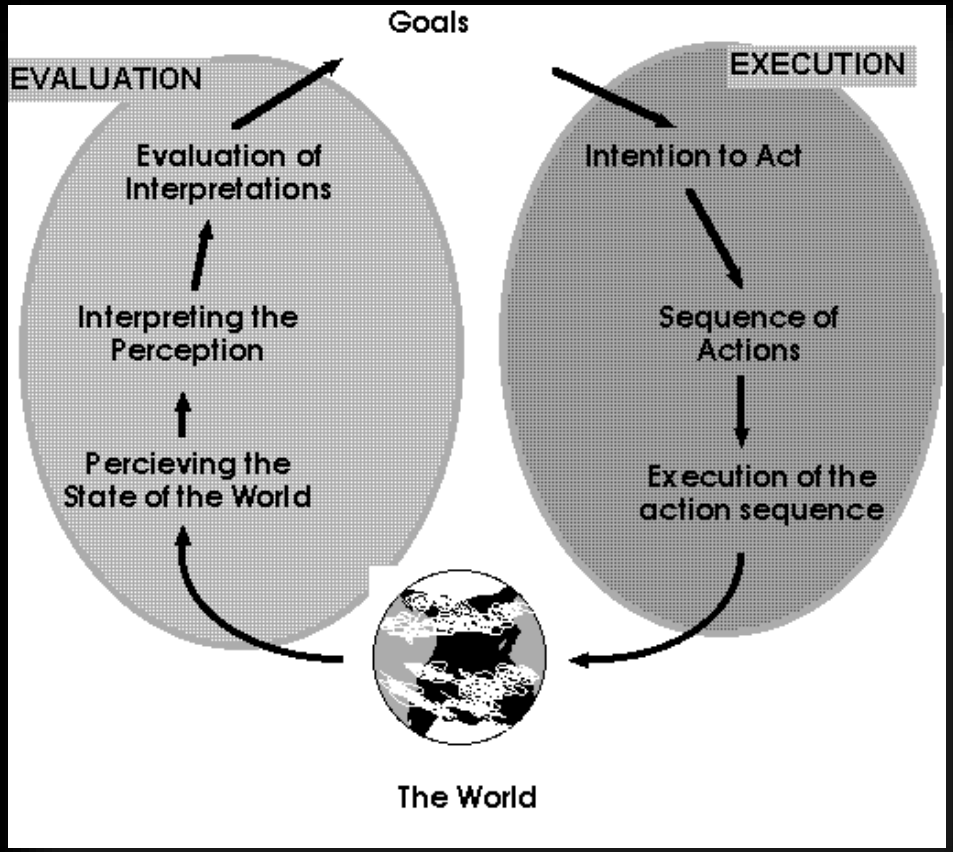
Systems composed of small independent units..

API CONNECTION



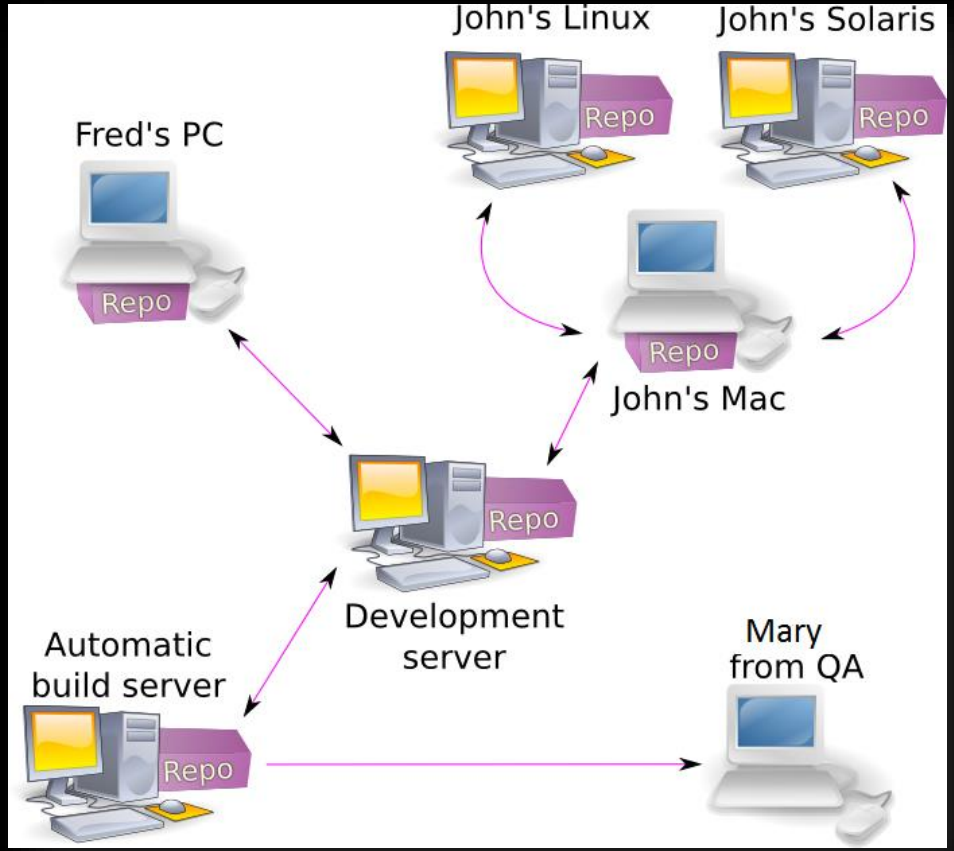
Each unit based on timeless patterns…

API CONNECTION



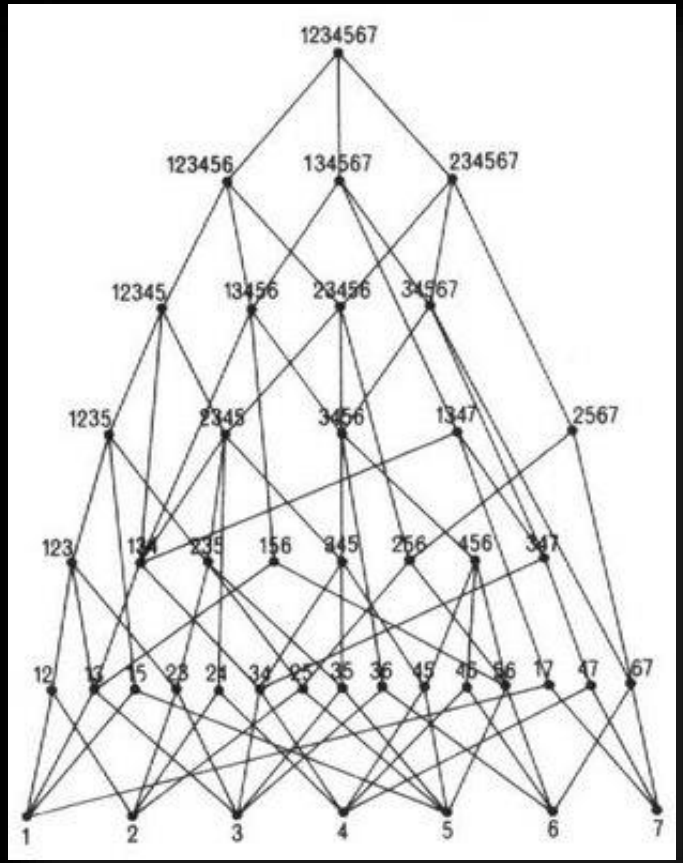
Able to bridge the gulfs of evaluation and execution

API CONNECTION



All widely distributed…

API CONNECTION



Capable of operating as a collective…

API CONNECTION

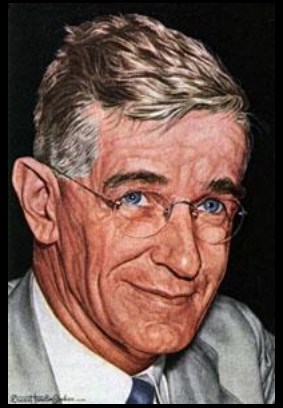
In order to augment human intelligence.

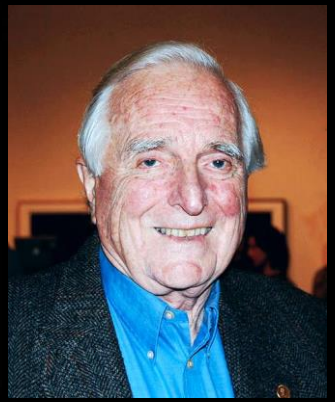
API CONNECTION

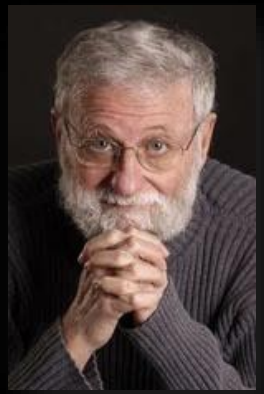
There is no one, single future…

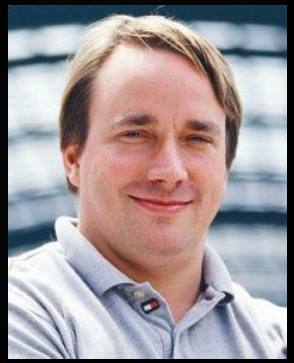
API CONNECTION

But we have many minds to guide us forward…









API CONNECTION

The question we must ask is…

API CONNECTION

Who will we add to this list?

API CONNECTION

50+ Years of Digital Transformation

Mike Amundsen,
API Academy at CA
@mamund

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