software design & why it matters

Daniel Jackson · MIT CSAIL

Milan, Paris, Frankfurt · May 16-20, 2016

accenture

MIT PROFESSIONAL EDUCATION

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introduction

my background

PhD in Computer Science, MIT

MA in Physics,
Oxford University

Prof, MIT

Assistant Prof, CMU

other projects

Room:free : auto (number) | computed by formula

Formula: `sqFoot - sum[v : Occupant](v.role.allocSpace)` Save Cancel

Room

	name	sqFoot
•	text	number
•	Dungeon Five	480
•	Greenhouse Two	561

Occupant

	name	role	free
•	text	Role	number
•	Sirius	Grad. student	436
•	James	Post-doc	
•	Wormtail	Grad. student	
•	Bellatrix	Visiting Prof.	496
•	Lily	Post-doc	

Role

	title	allocSpace
•	text	number
•	Grad. student	12
•	Post-doc	20
•	Visiting Prof.	45

new programming paradigms

cyberphysical security

changes in how we live & work

growth of online activity

72% of millenials
research & shop online
before going to a store

27 metro areas in US

ORDER PLACED
May 30, 2013

TOTAL
$41.76

SHIP TO
Daniel Jackson

ORDER # 107-4962317-6190632
Order Details | Invoice

Goya Foods Inc Beans, Butter, 15.50-Ounce (Pack of 24)
Sold by: Amazon.com LLC
$41.76

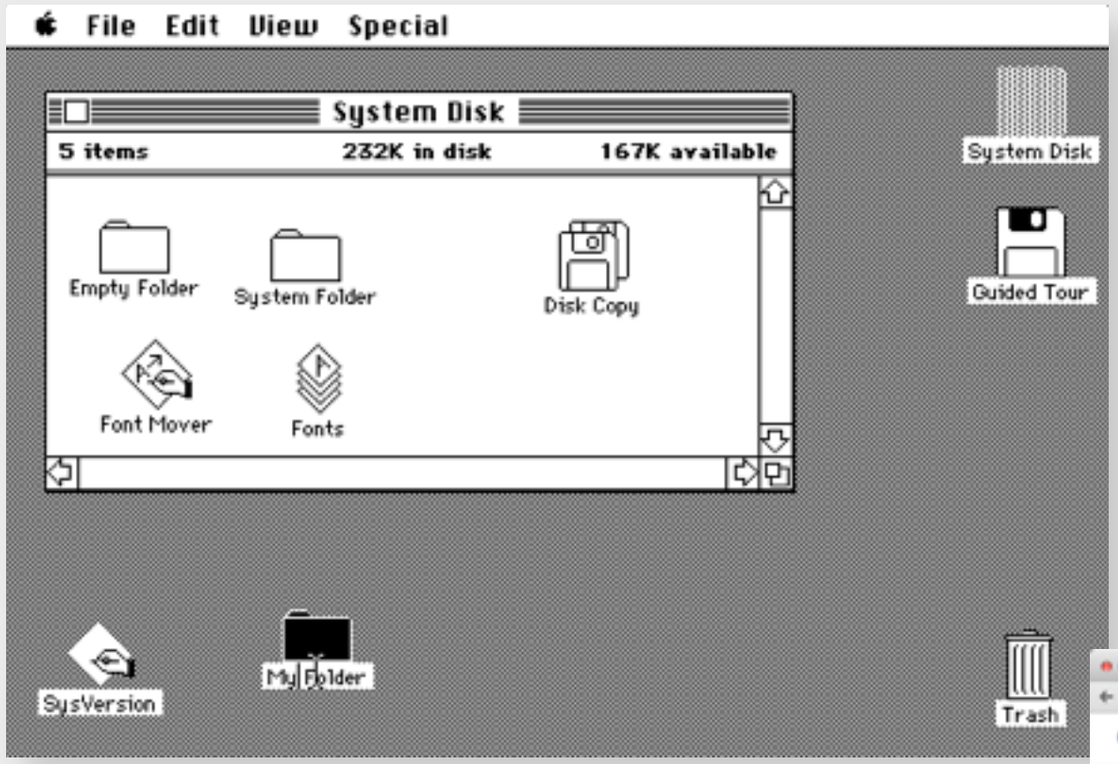
Buy it Again

Return or replace items

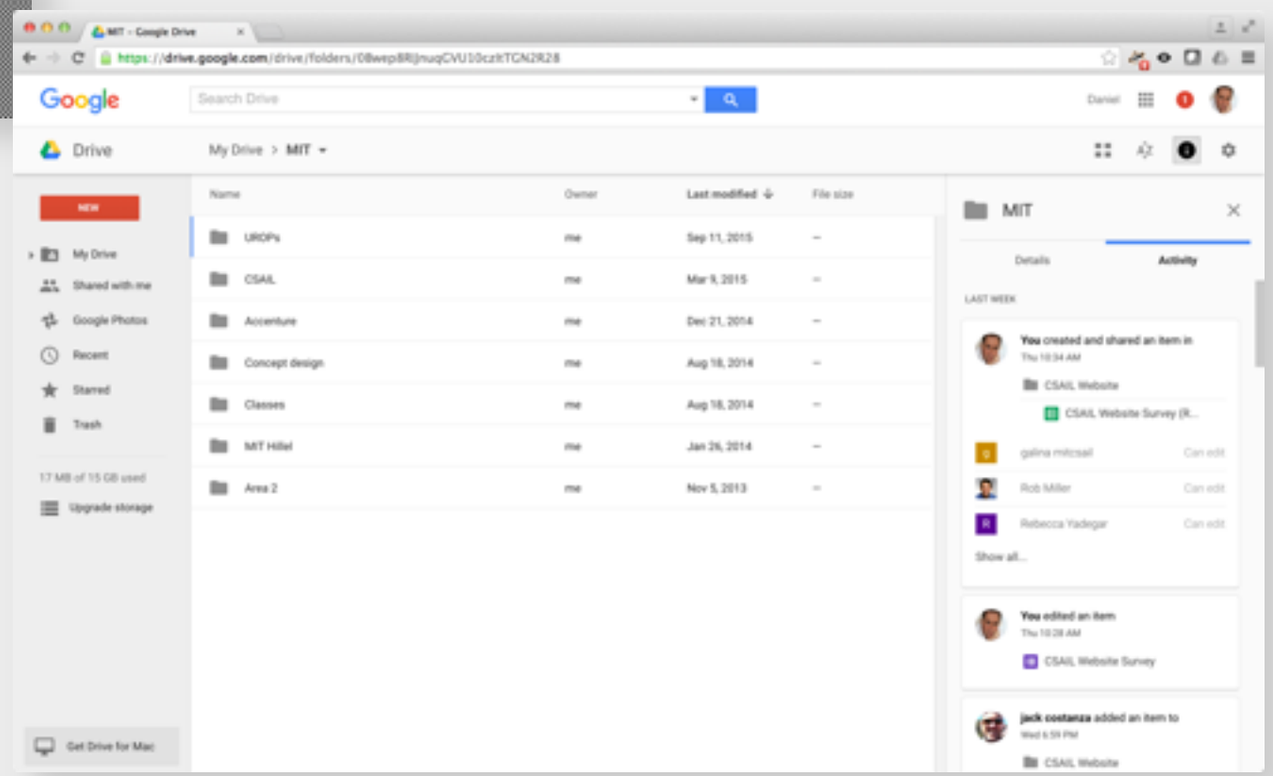
Write a product review

Archive order

connectivity

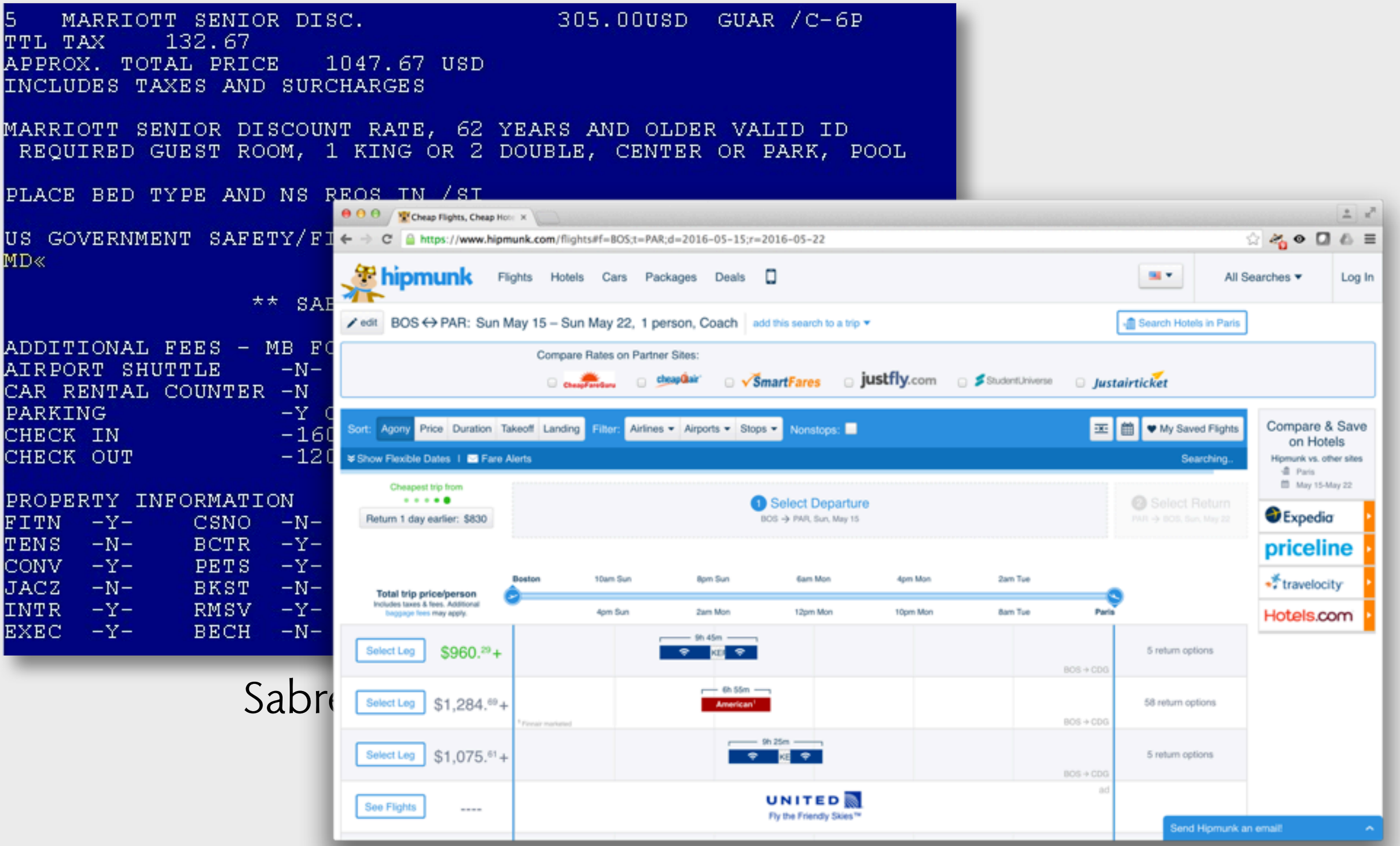


browser, 1986



browser, 2016

deprofessionalization



Sabre

hipmunk.com

example: book publishing

design layout
Adobe Indesign

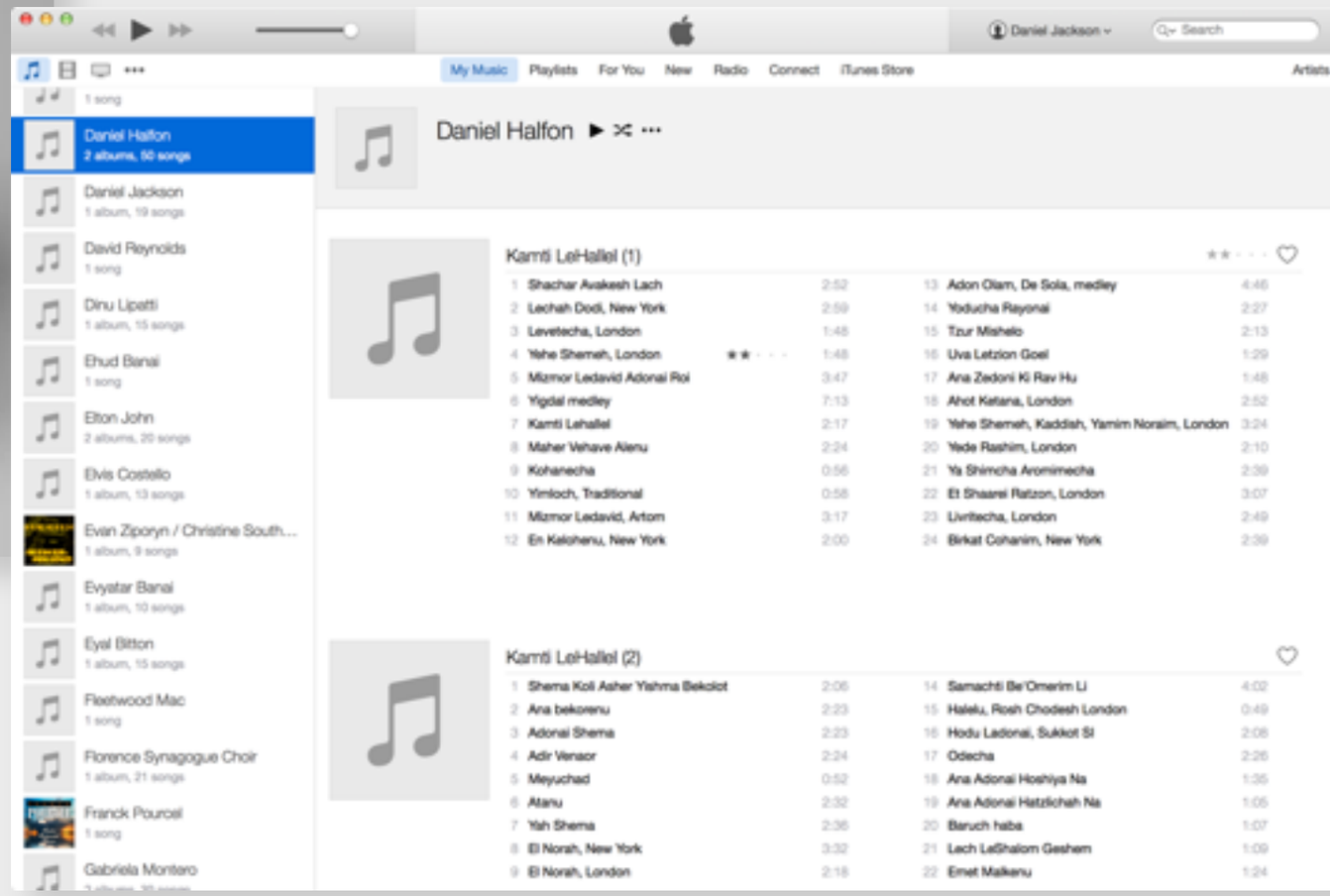
printing
Blurb

marketing
Facebook,
Twitter, etc

distribution
Amazon

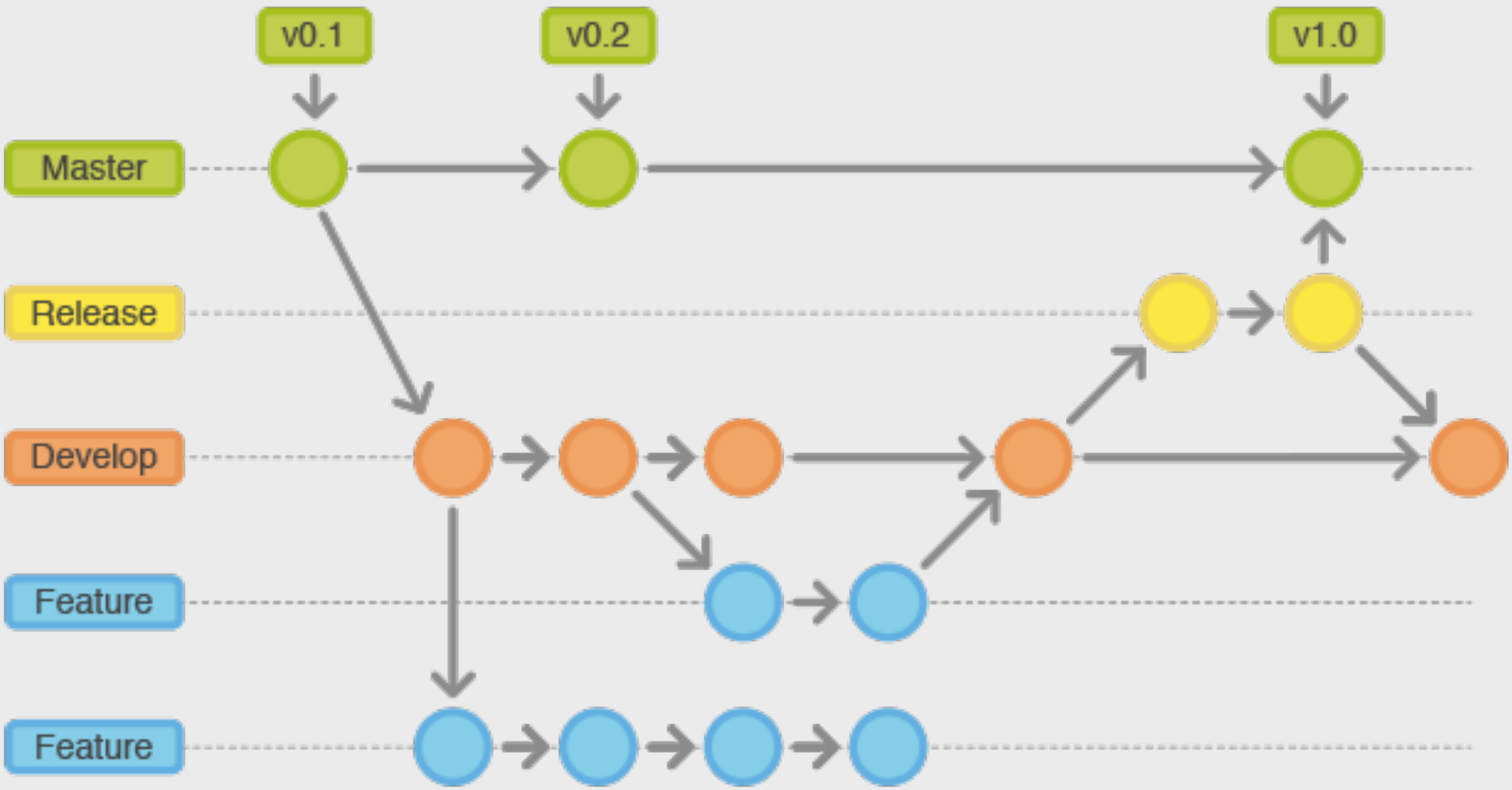
complexity

Braun SK4 by Dieter Rams (1957)



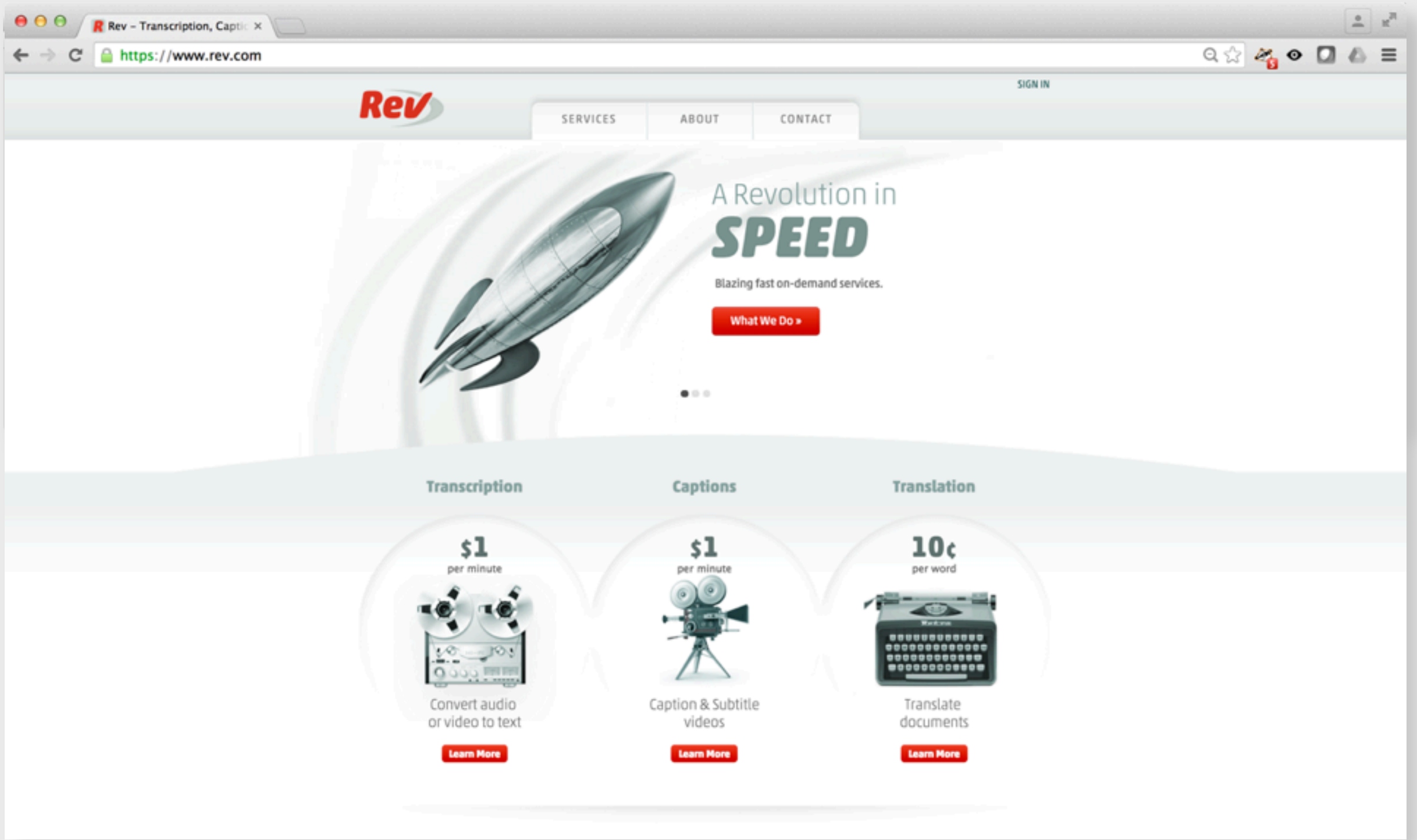
Apple iTunes (2016)

collaboration

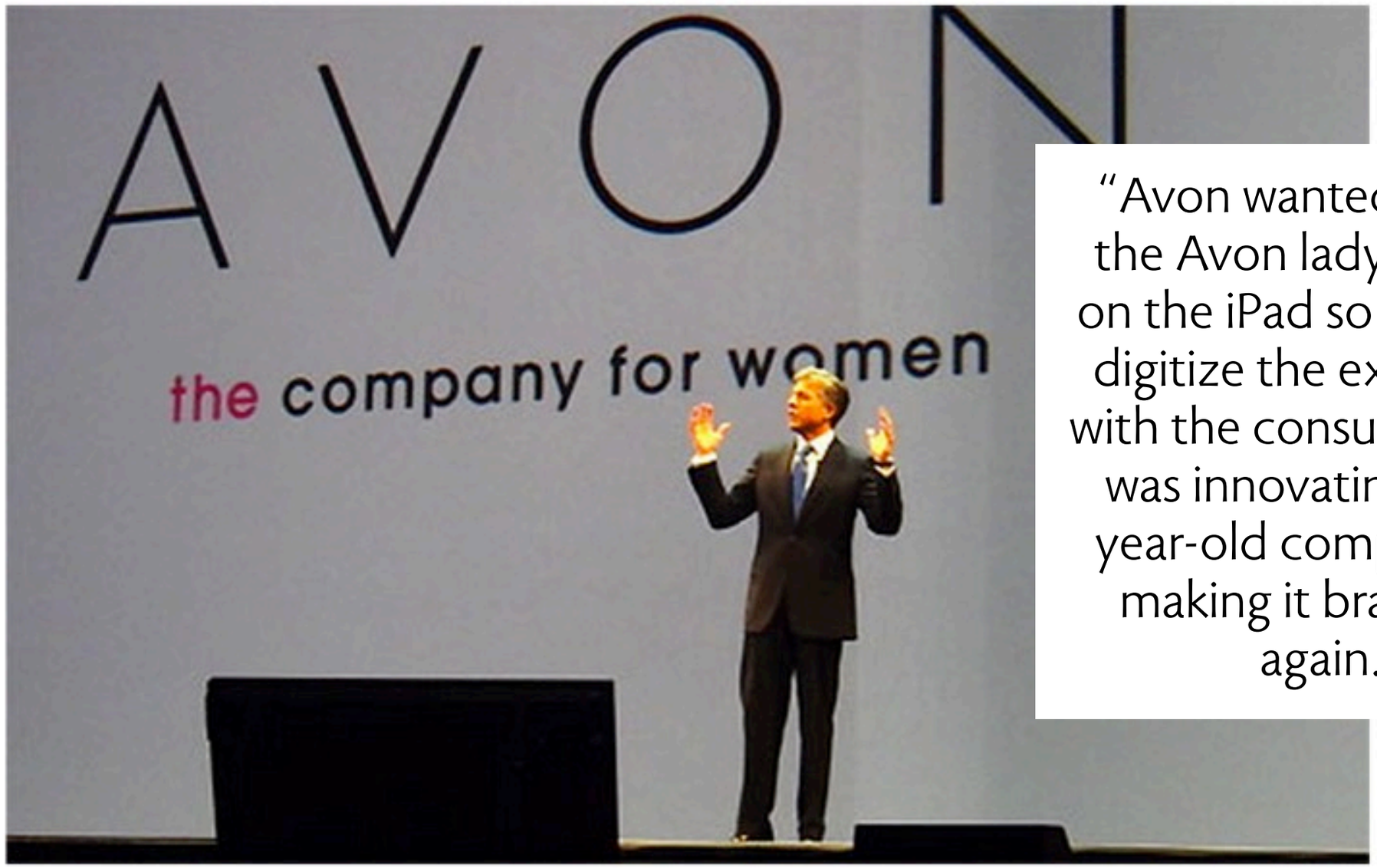


changes in how things are made

expectations of usability



an exciting launch



AVON plans to use mobile technology to connect better with customers

"Avon wanted to have the Avon lady enabled on the iPad so she could digitize the experience with the consumer... This was innovating a 100-year-old company and making it brand new again."

SAP Sapphire Event (2011)

what happened

"While the new system based on software supplied by SAP AG **worked as planned**, it was so **burdensome and disruptive** to the representatives' daily routine that they left in meaningful numbers."

Avon spokesperson

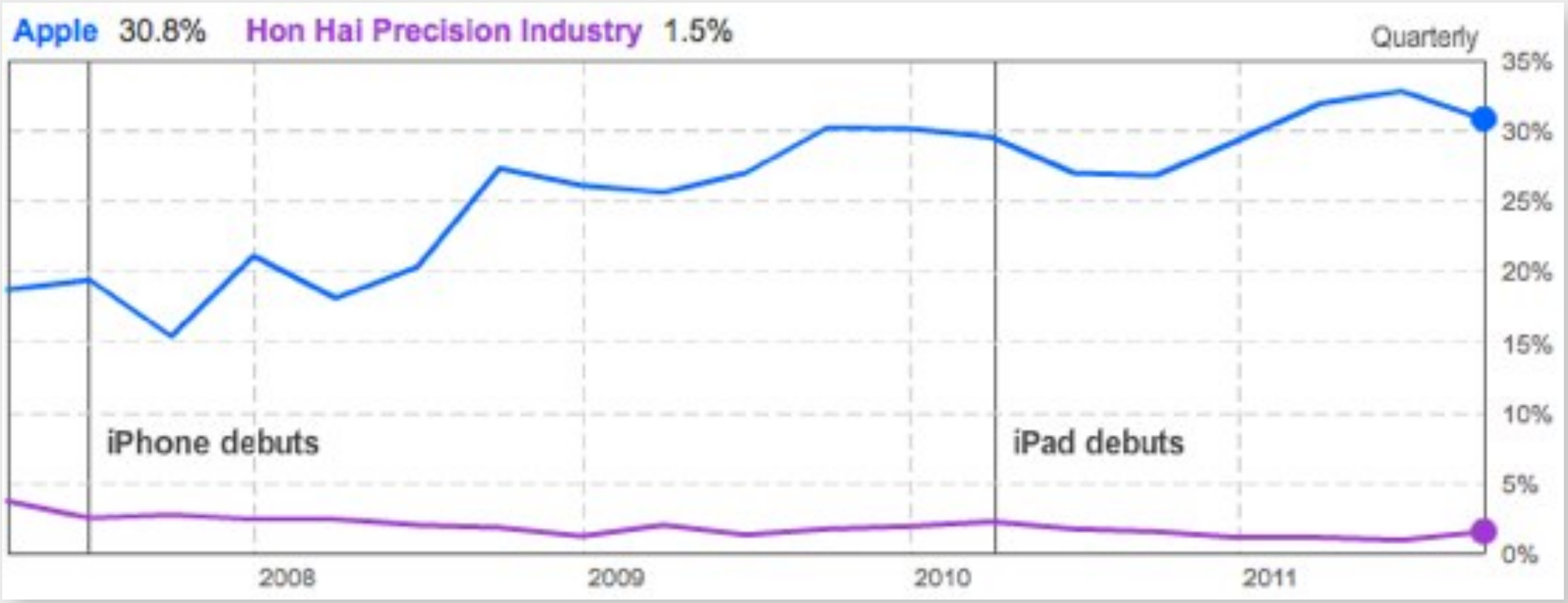
Avon is pulling the plug on a $125 million software system...

The failure is the latest – and perhaps most dramatic – example of how **usability has become a critical issue** in the workplace. People who are accustomed to using simple, well-designed applications in their personal lives have no patience for disappointing technology at work...

Wall Street Journal (2013)

outsourcing

Apple vs Foxconn profit margins

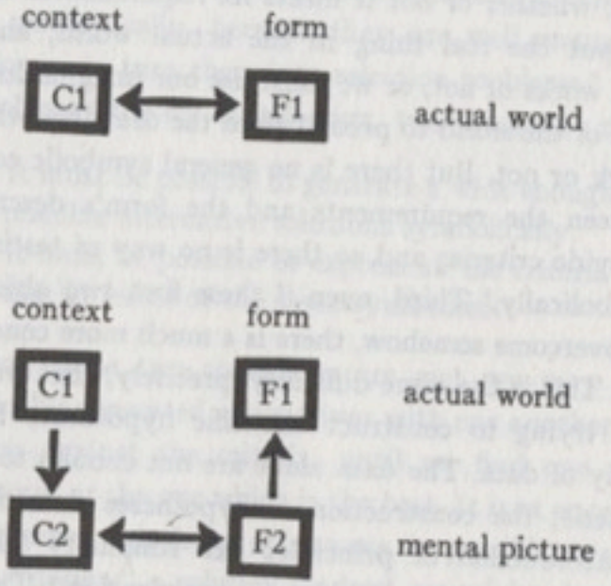


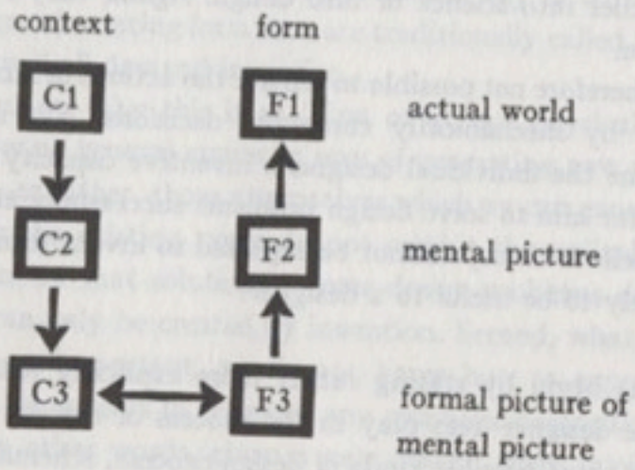
iPhone 5: where the money goes

foxconn
$8

the emergence of design

progression from craft





The first scheme represents the unselfconscious situation described in Chapter 4. Here the process which shapes the form is a complex two-directional interaction between the context C1 and the form F1, in the world itself. The human being is only present as an agent in this process. He reacts to misfits by changing them; but is unlikely to impose any "designed" conception on the form.

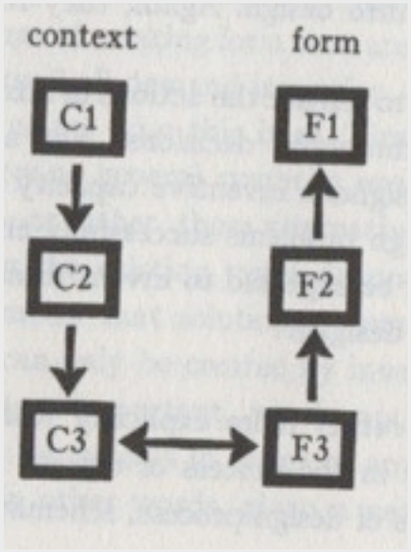
The second scheme represents the selfconscious situation described in Chapter 5. Here the design process is remote from the ensemble itself; form is shaped not by interaction between the actual context's demands and the actual inadequacies of the form, but by a conceptual interaction between the conceptual picture of the context which the designer has learned and invented, on the one hand, and ideas and diagrams and drawings which stand for forms, on the other. This interaction contains both the probing in which the designer searches the problem for its major "issues," and the development of forms which satisfy them; but its exact nature is unclear.[5] In present design practice, this critical step, during which the problem is prepared and translated into design, always depends on some kind of intuition. Though design is by nature imaginative and intuitive, and we could easily trust it if the designer's intuition were reliable, as it is it inspires very little confidence.

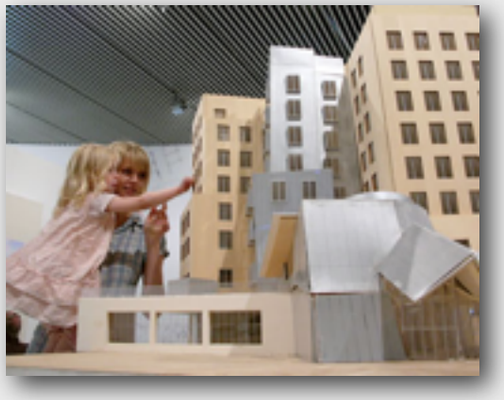
In the unselfconscious process there is no possibility of misconstruing the situation: nobody makes a picture of the context, so the picture cannot be wrong. But the selfconscious designer works entirely from the picture in his mind, and this picture is almost always wrong.

The way to improve this is to make a further abstract picture of our first picture of the problem, which eradicates

Christopher Alexander, Notes on the Synthesis of Form, Harvard, 1964

from http://www.environmentalgraffiti.com/featured/mud-structures-citadel/2227


context
form
C1
C2
C3
F1
F2
F3



Stata Center
Gates Building Elevation

Alfonso Bialetti, 1933
La Moka coffee maker

Leica, 1953
M3 rangefinder camera

Dieter Rams, 1958
pocket transistor radio T3

IBM, 1981
Personal computer

Jony Ive, 2002
Apple iPod

Fred Bould (2011)
Nest thermostat

from digital to physical

Fred Bould (2011)
Nest thermostat

Henry Dreyfuss (1953)
Honeywell T68 thermostat

Fuji (2013?)
Instax 90 film camera

iOS6 clock app

Swiss Federal
Railways
SBB clock

inclusive design

Bradley watch from Eone

design goes mass market

Michael Graves
(1934-2015)

Michael Graves (1985)
Alessi 9093 tea kettle

Michael Graves (1999)
Target spinner whistle tea kettle

design consultancies

IDEO

Frog
acquired by
Flextronics
(2004)

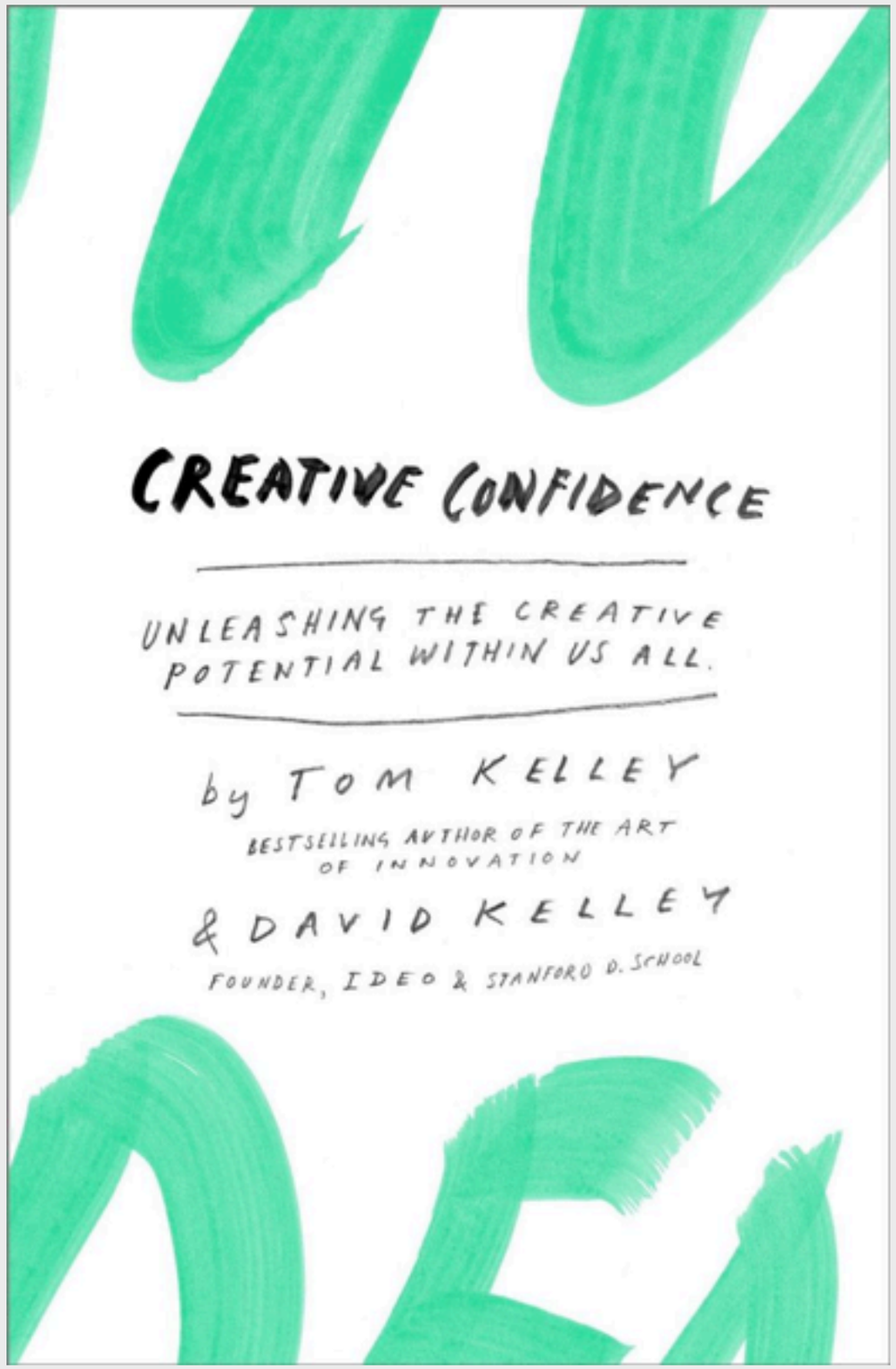
Fjord
acquired by
Accenture
(2013)

2011: GlobalLogic buys Method
2012: Google buys Mike and Maaike
2013: Facebook buys HotStudio

design schools & programs

Stanford D School founded 2004 by
David Kelley and George Kembel

design thinking for business



coworking + maker spaces

a startup whose founders met at RISD

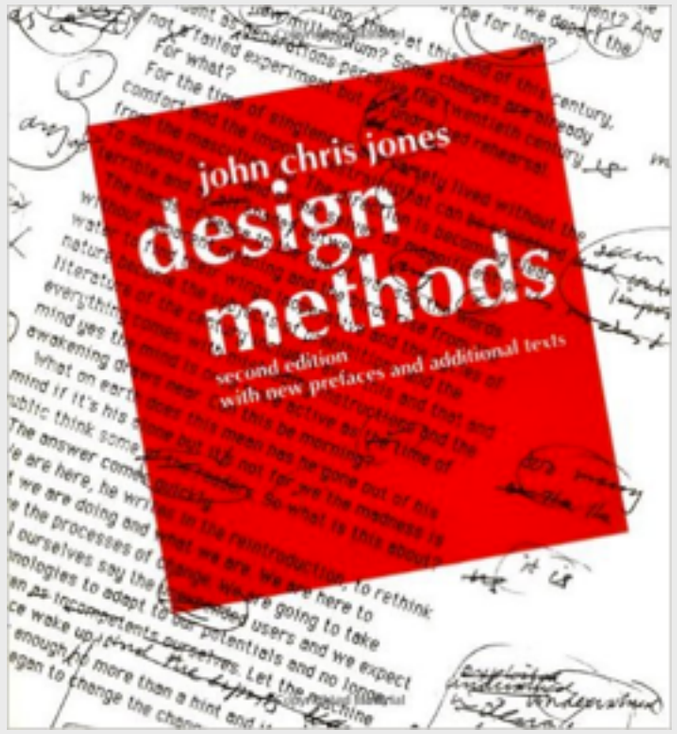
IBM (re)embraces design

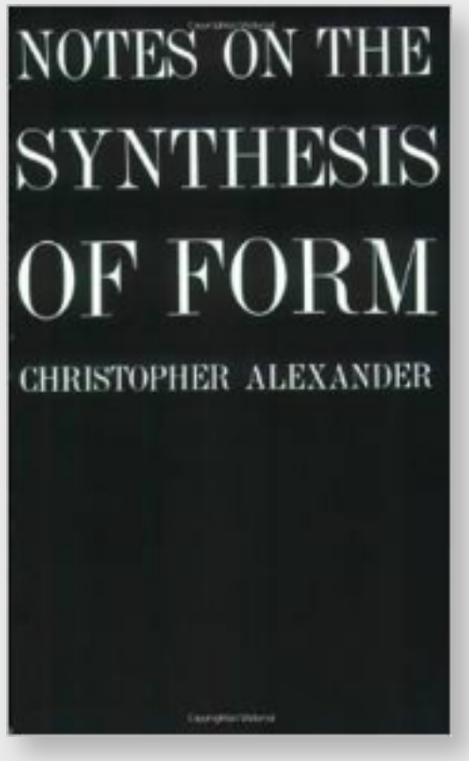
Eliot Noyes (1961)
IBM Selectric Typewriter

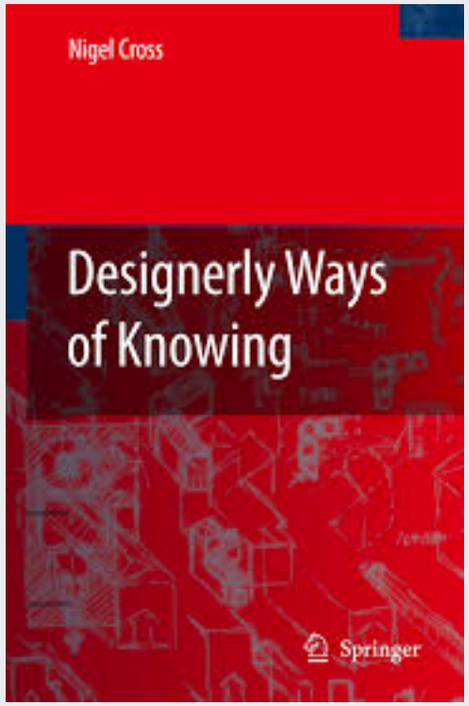
IBM's design studio in Austin, Texas

what is design thinking?

theories of design







what is design?

The central concern of Design is the conception and realisation of new things.

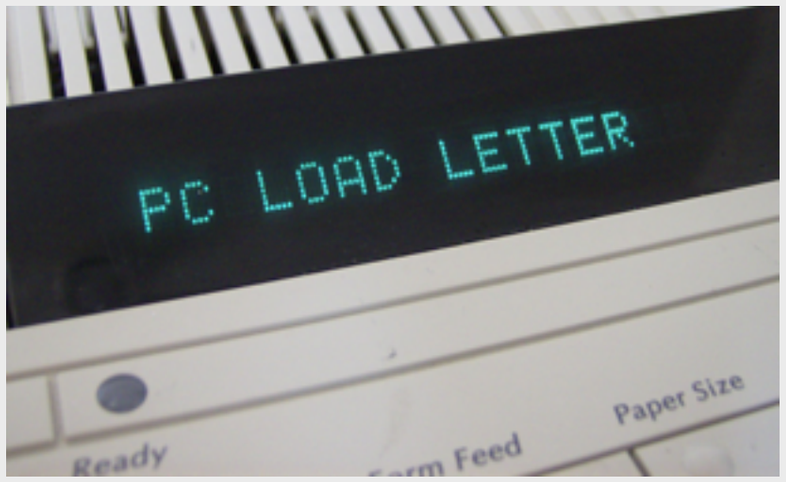
It encompasses the appreciation of material culture and the application of the arts of planning, inventing, making and doing.

At its core is the language of modelling... equivalent to aptitudes in the language of the sciences (numeracy) and the language of humanities (literacy).

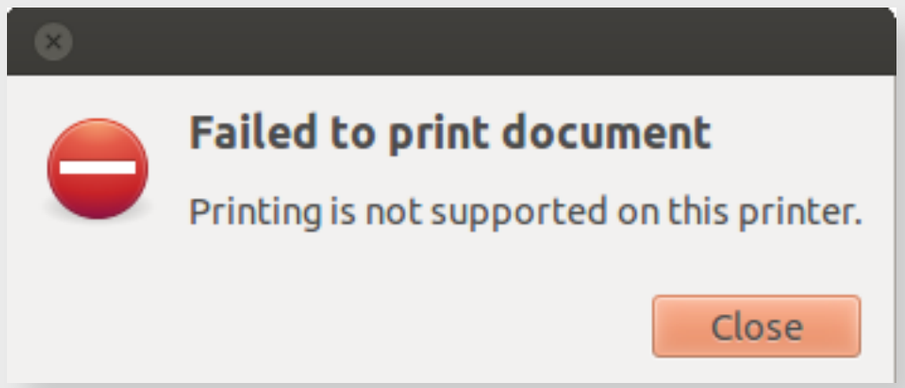
Design has its own distinct things to know, ways of knowing them, and ways of finding out about them.

Nigel Cross (1982)
Designerly Ways of Knowing
excerpted from RCA report

user centeredness

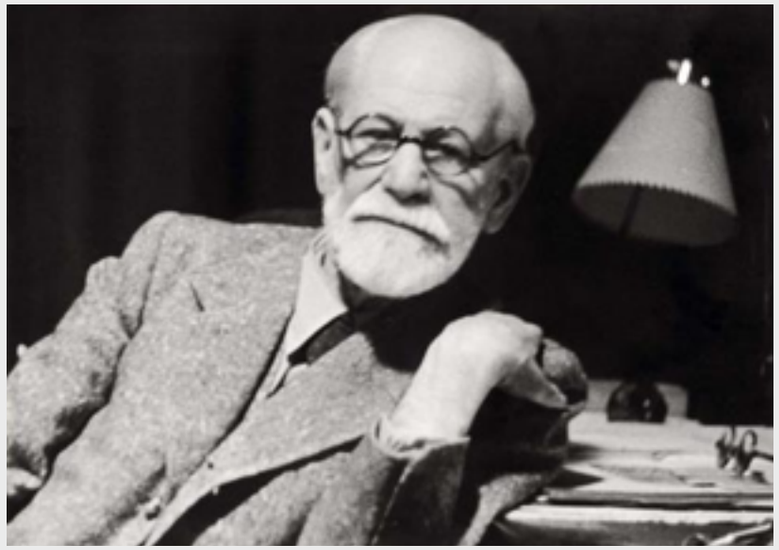


translation:
"please load letter-sized paper
into paper cassette"

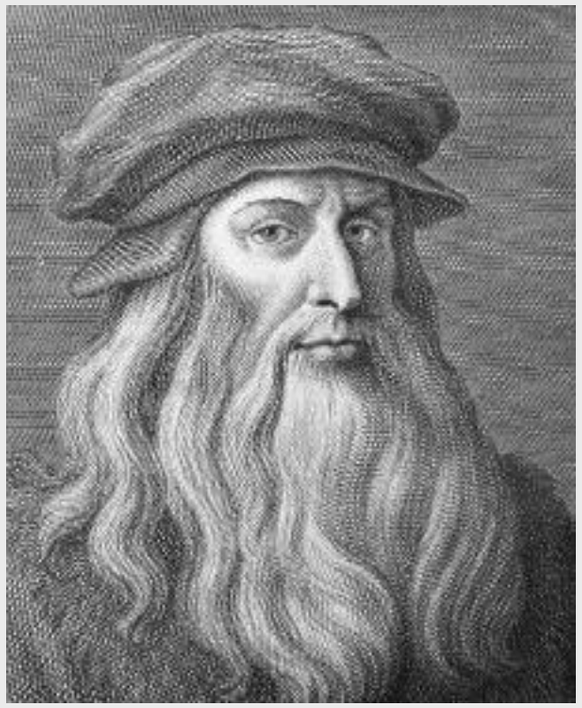


diversity of contributors

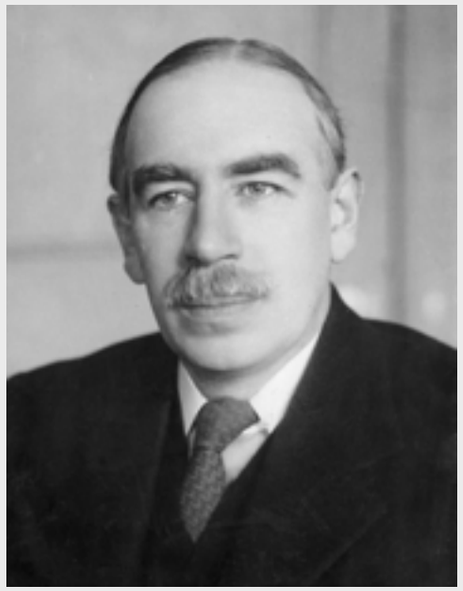
anthropology



psychology



art



economics

attention to detail

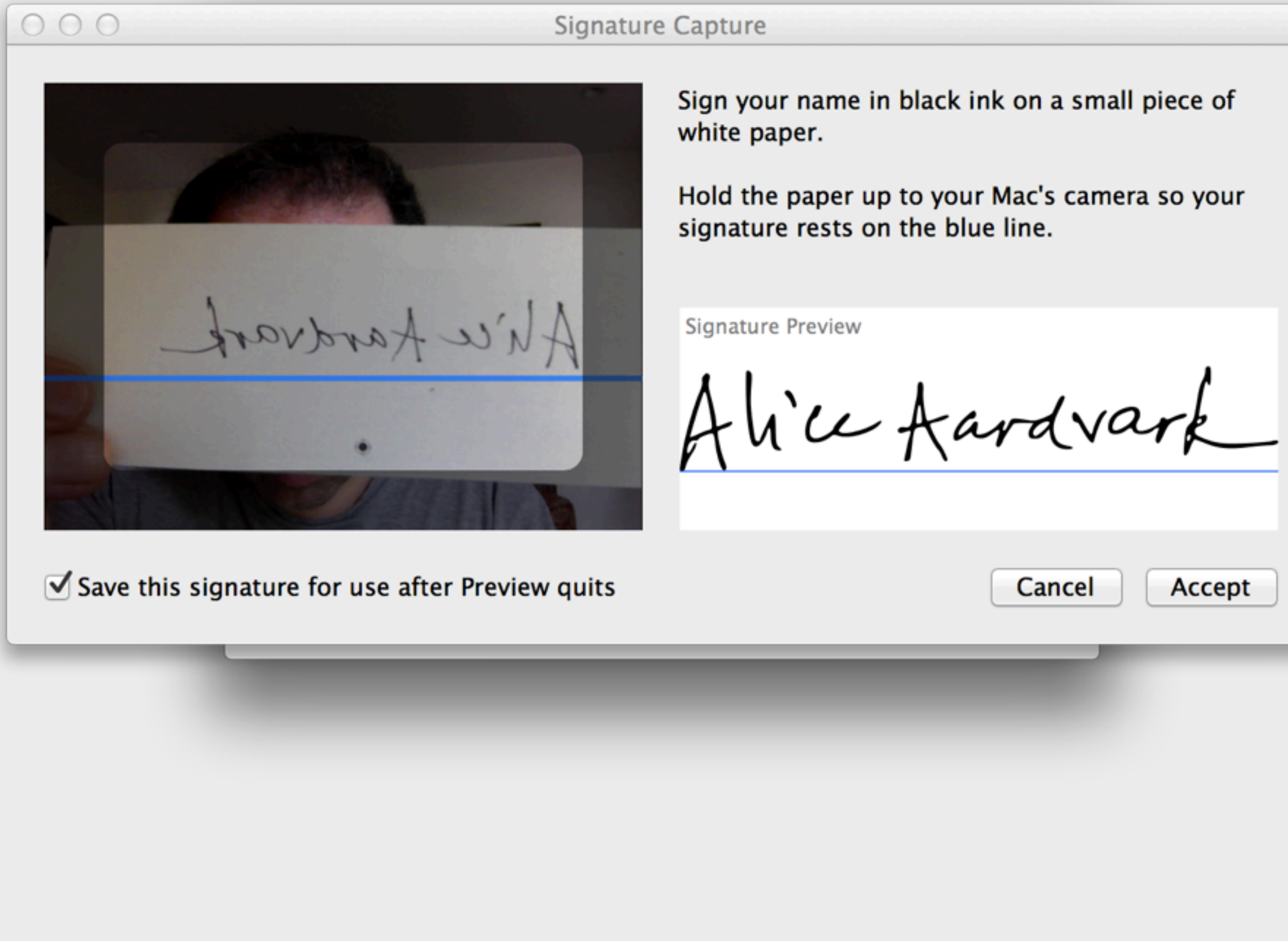
That's quite obsessive, isn't it?

Jonathan Ive in "Objectified"

The details are not the details.
These make the design.

attributed to Charles Eames by Garrett

example: signatures in Apple Preview



needfinding

The need itself is a perceived lack, something that is missing. Needfinding is thus a paradoxical activity—what is sought is a circumstance where something is missing. In order to find and articulate a need, this missing thing must be seen and recognized by someone.

Rolf A. Faste, Perceiving Needs (1987)

users don't know what they want

new recipe won
blind taste tests

Aeron office chair
low ratings in early tests

brainstorming

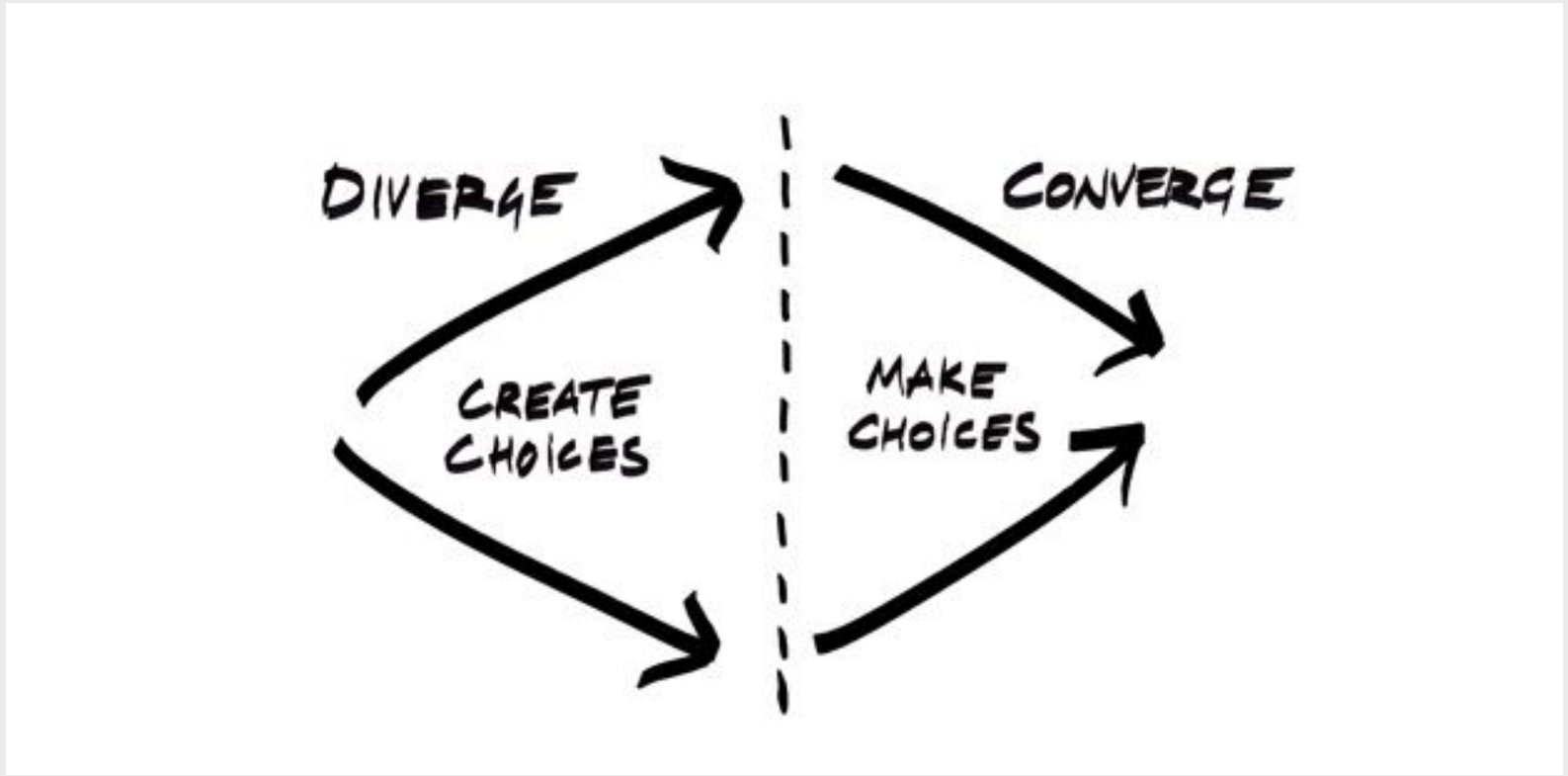
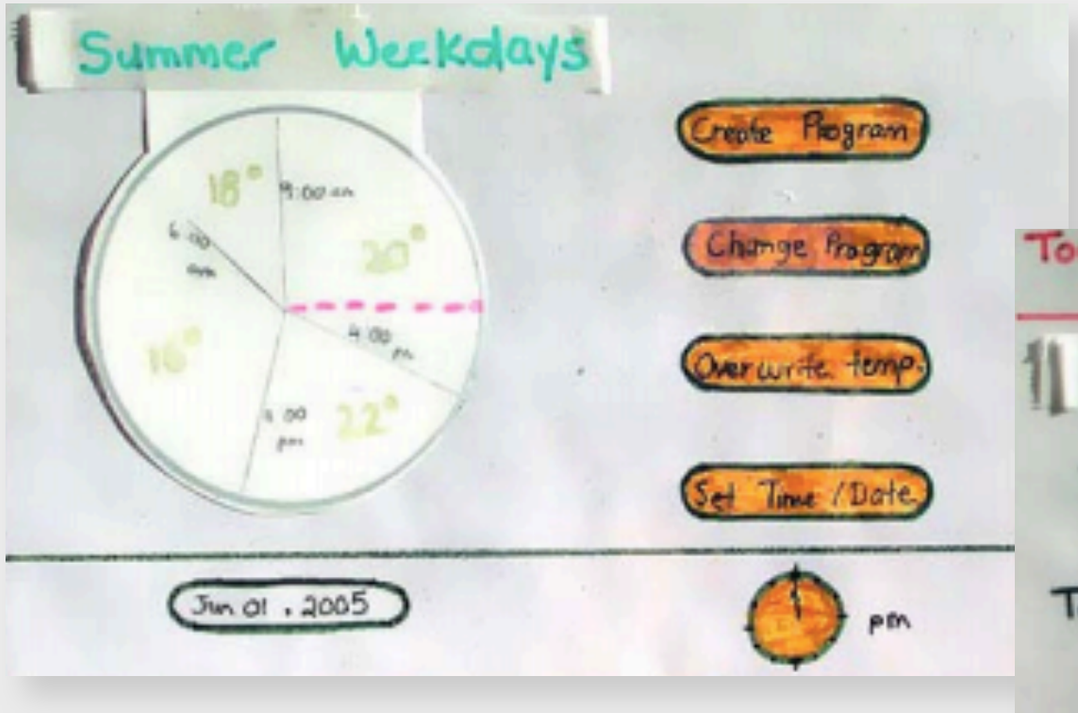
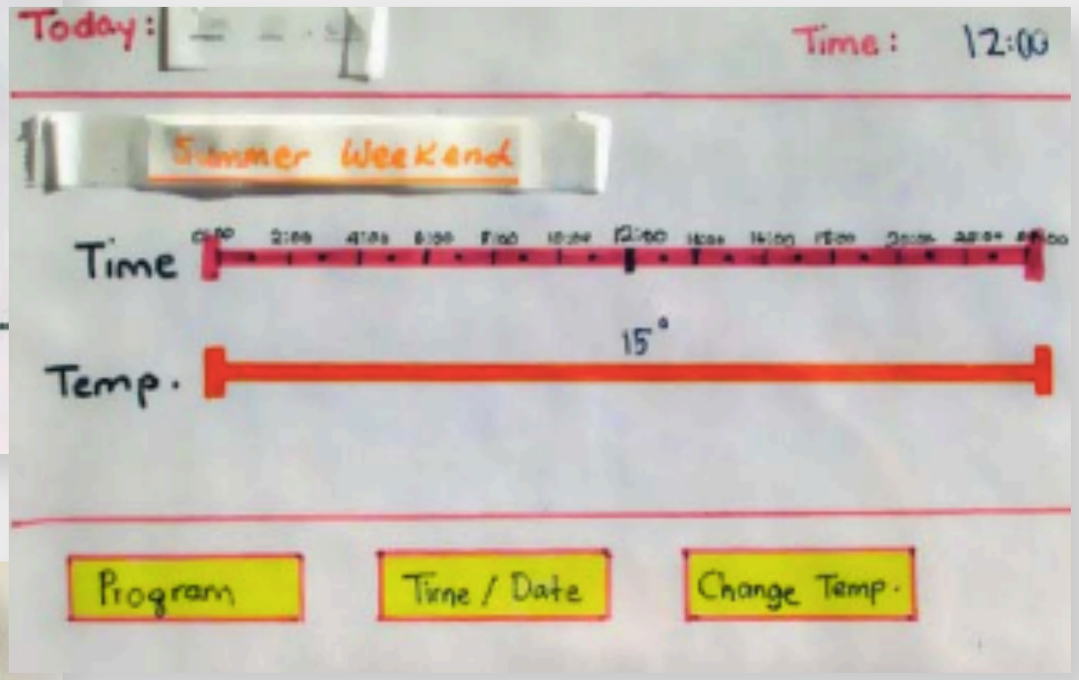


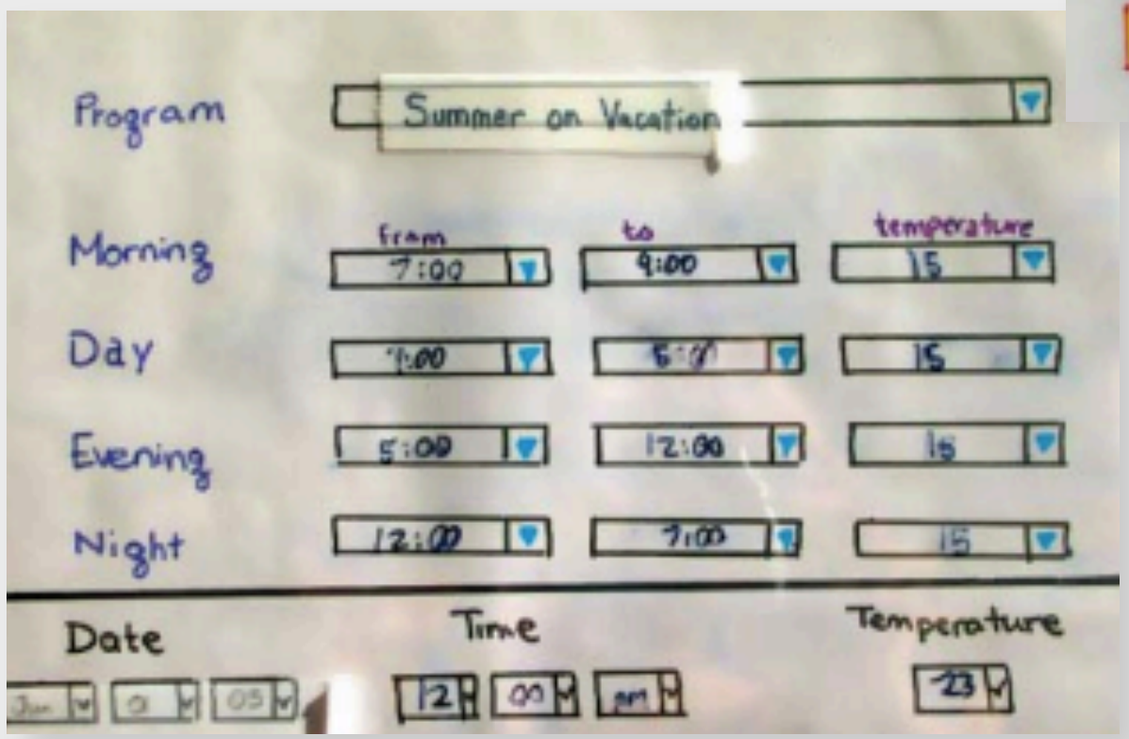
diagram from Tim Brown, IDEO

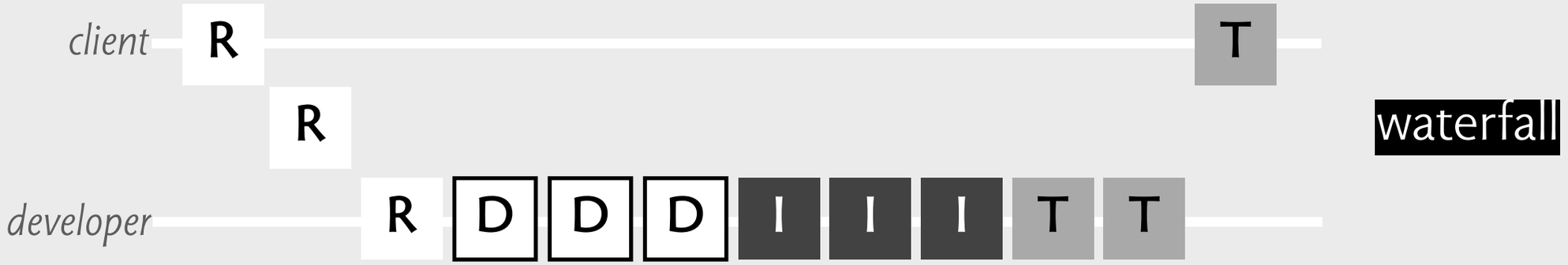
prototypes & user studies

paper prototypes

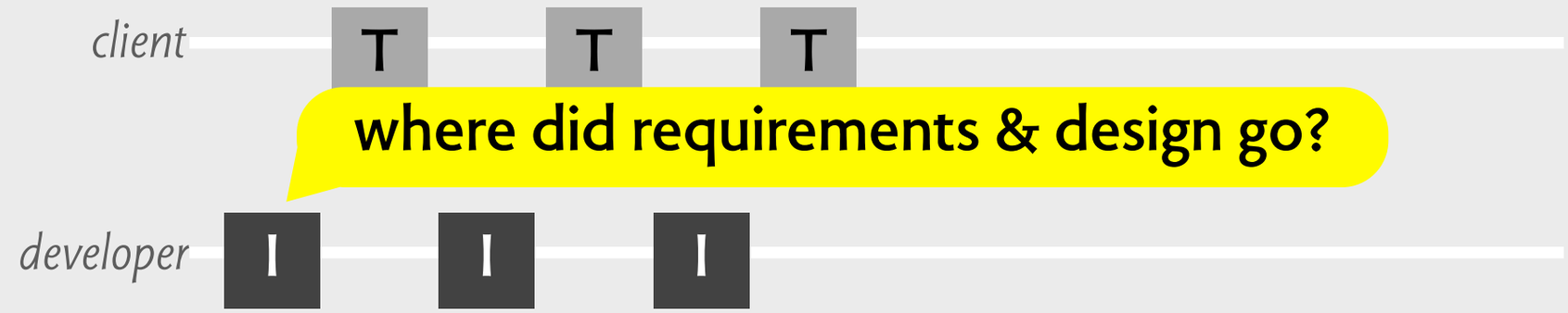




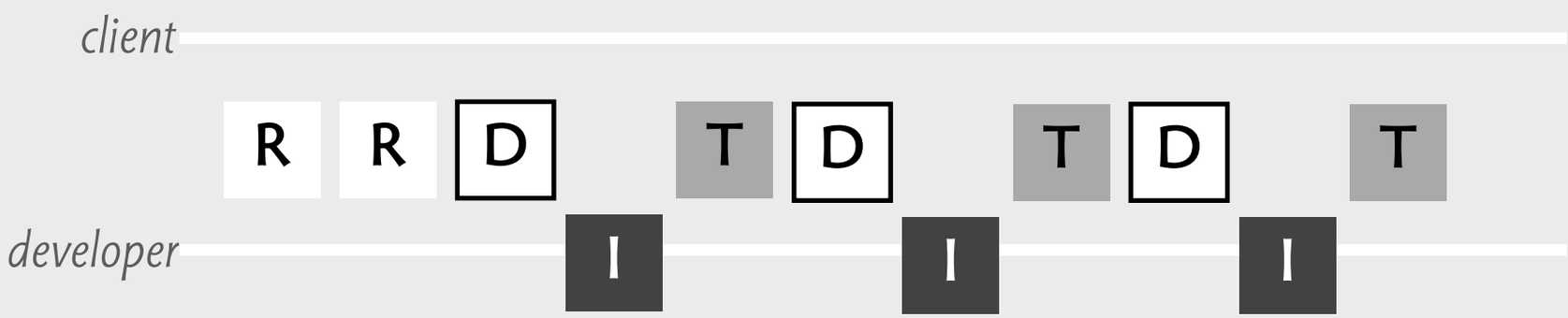




waterfall



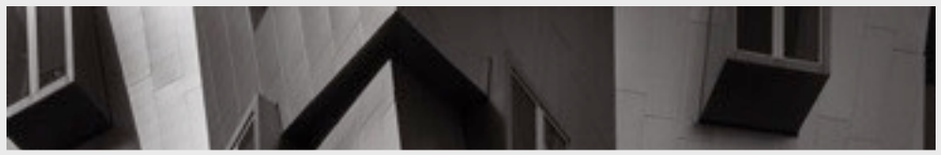
agile



design thinking

so what is software design?

designers & engineers



	designer	engineer
elements	door, window, wall	column, beam, truss
goals	comfortable, convenient, attractive	structural integrity, durable, sustainable

software design & engineering

	designer	engineer
elements	concepts	function, object, type
criteria	concept/purpose correspondence	decoupling & localization
goals	learnable, effective, tolerant	maintainable, correct, fast

software design tools

concepts
structuring functionality

modeling concepts
focused data models

usability heuristics
well known principles

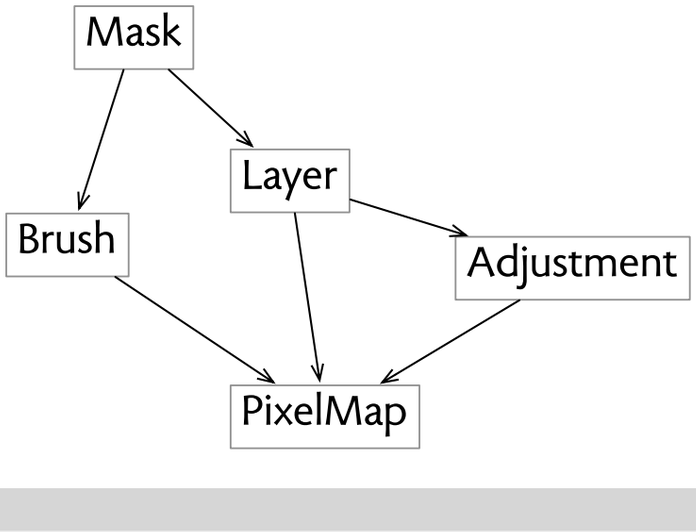
concepts

a common view of software design

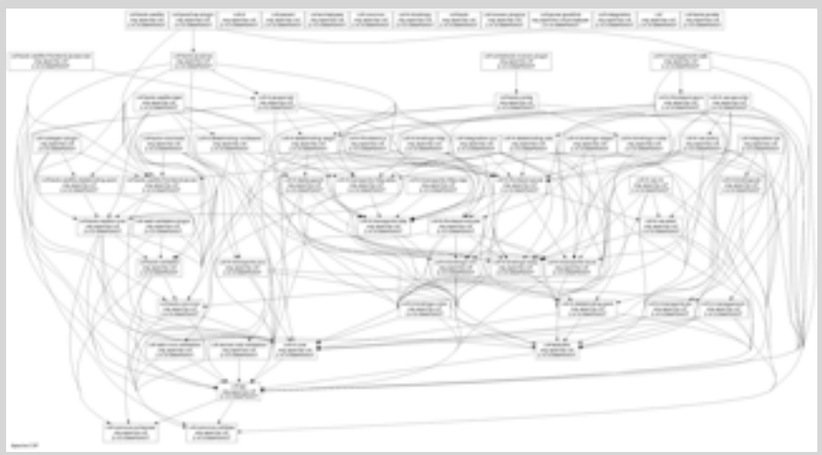
UI design
soft & human
about presentation

programming
hard & technical
about content

a better view of software design



conceptual design:
essential concepts
& behavior

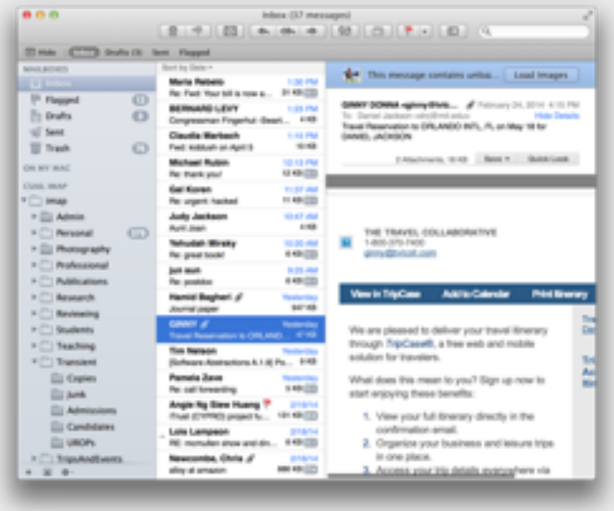


representation design:
organization & performance

what characterizes an app?

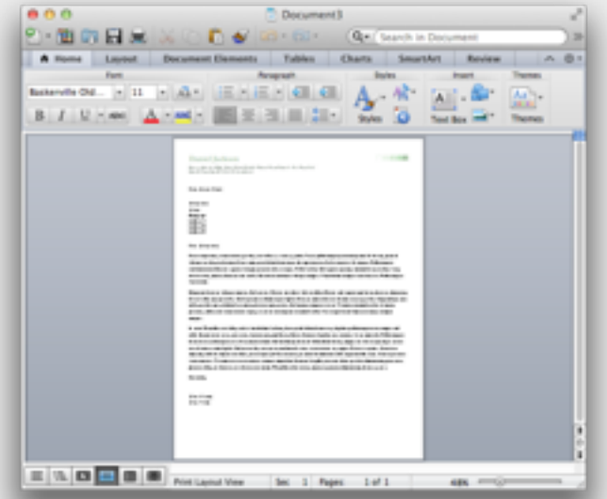
concepts!

Apple Mail



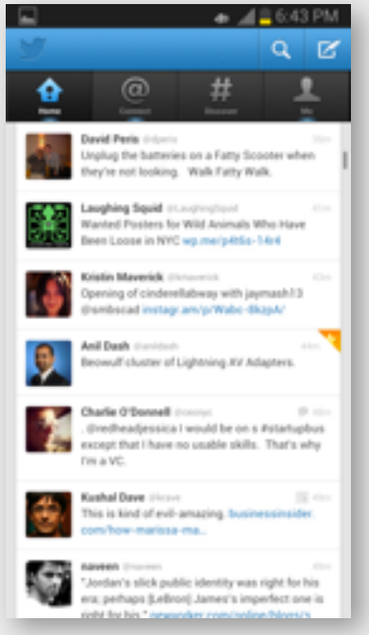
EmailAddress
Message
Folder or Label

Microsoft Word



Paragraph
Format
Style

Twitter



Tweet
Hashtag
Following

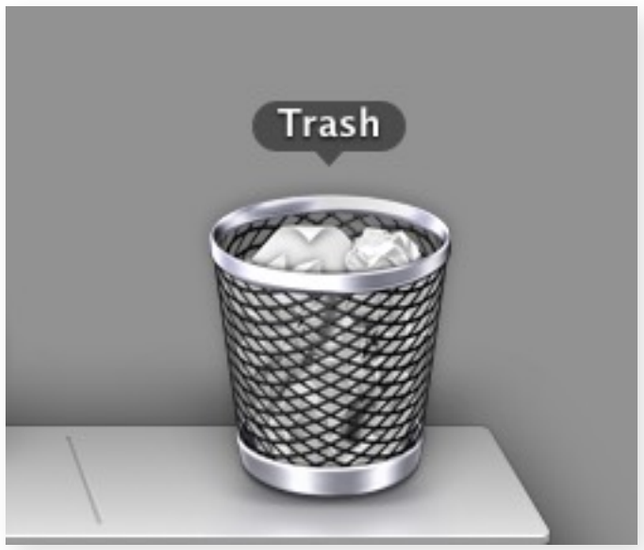
Photoshop

PixelMap
Layer/Mask
Adjustment

the fundamental principle

in a well-designed system
each concept is motivated by one purpose

concept, purpose, principle, misfit



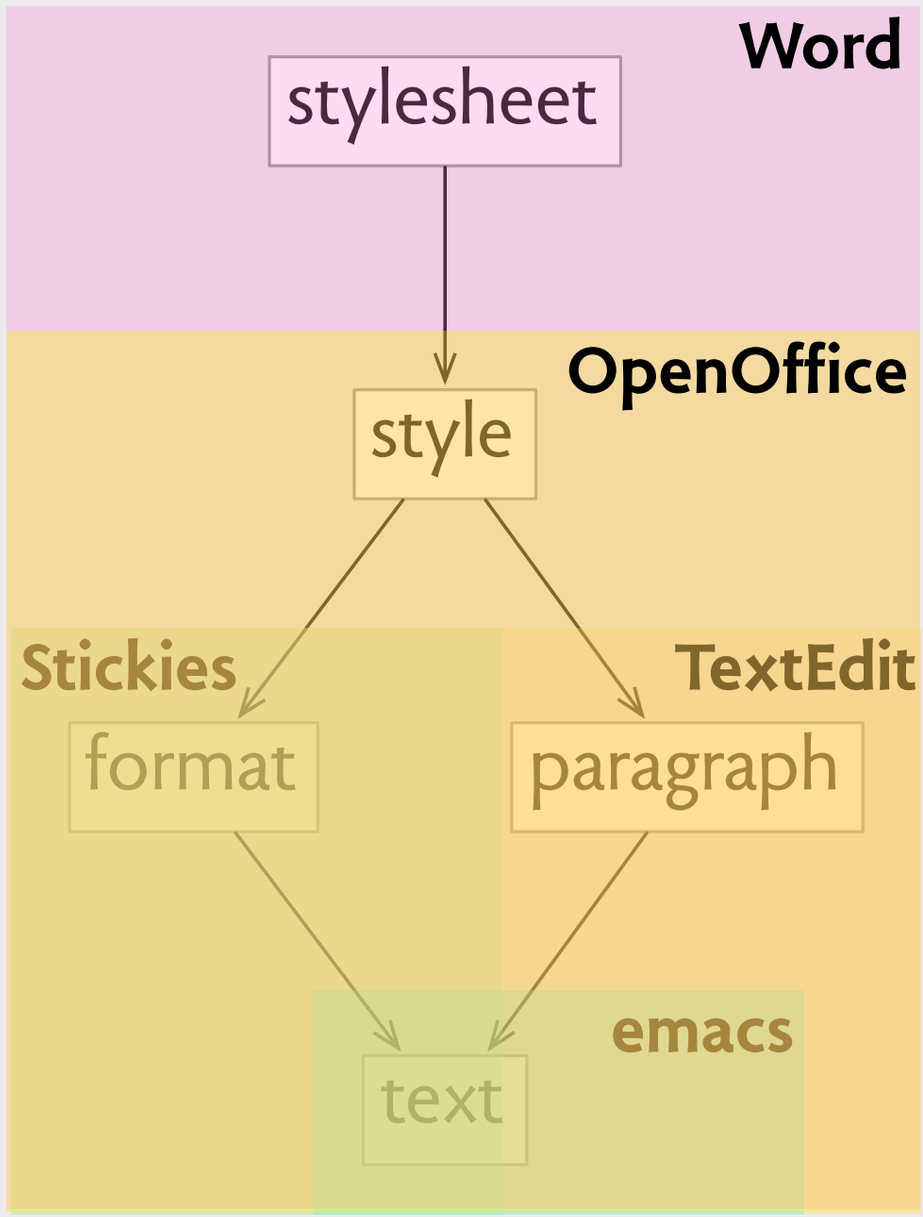
concept: trash

purpose: allow undo of deletions

operational principle: if you delete a file, it moves to a special folder; you can restore from there, but emptying it removes contents for good (and makes space on disk)

misfit: if you delete a file on an external drive, you cannot reclaim the space until you empty the trash, but then you'll lose the ability to restore files deleted from the main drive

organizing concepts



facebook 3 1 Search for people, places and things Daniel Jackson Home

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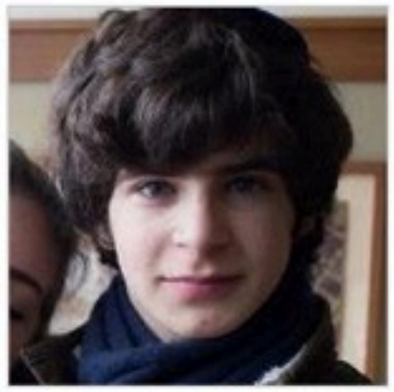
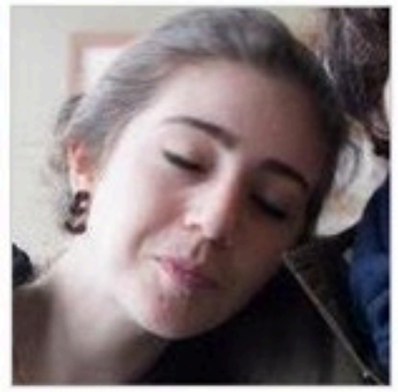
To tag your friends, review the suggested names and click Save Tags at the bottom of this page. If a name is missing or incorrect, list a new name and press Enter.
Remember: If someone doesn't like a photo, they can untag themselves or ask you to take it down.



Who is this?



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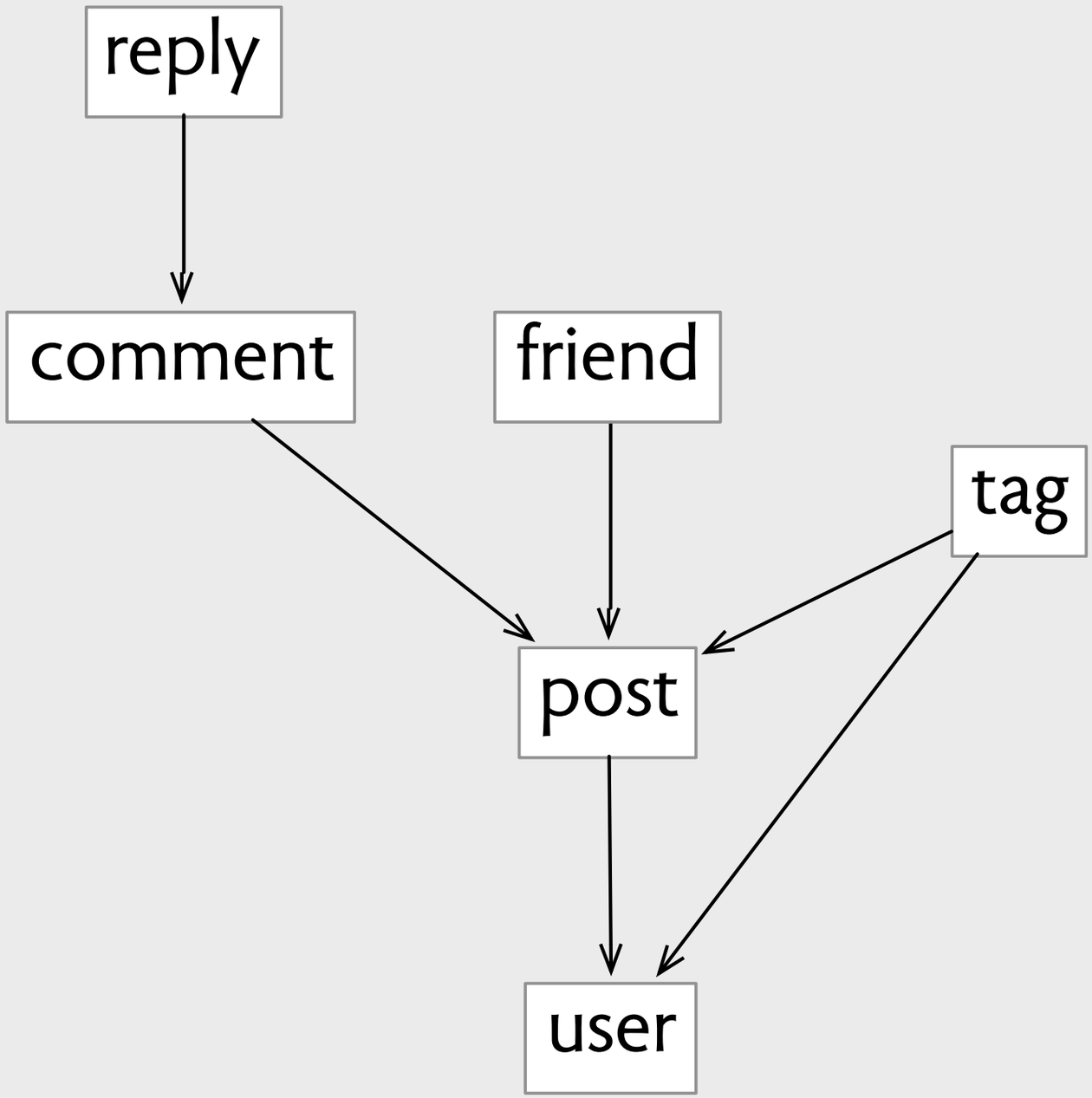
facebook concepts



tag concept

real purpose: increase connectivity of friend graph?

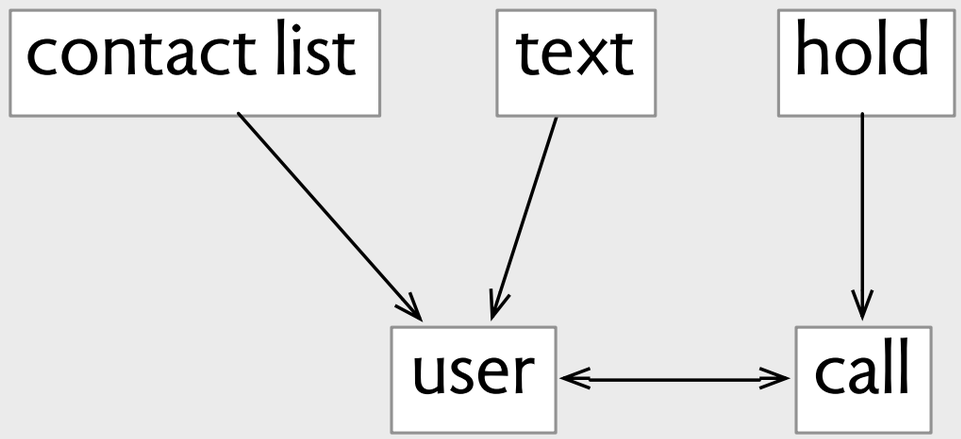
purpose: share photo with people who appear in it

operational principle: if you tag a photo, then it becomes visible to the person tagged, and to their friends (in addition to your friends)

misfit: suppose I get drunk at a party with strangers and one of them tags me. if my boss is my friend, she will now see the photo.

skype concepts

skype concepts



hold concept

why not just allow concurrent calls?

purpose: make it possible to multiplex calls

operational principle: if you put a call on hold, you can answer another call, and then switch back to the first one by putting that on hold (or ending it) and resuming the first.

modeling

the core of design

The central concern of Design is the conception and realisation of new things.

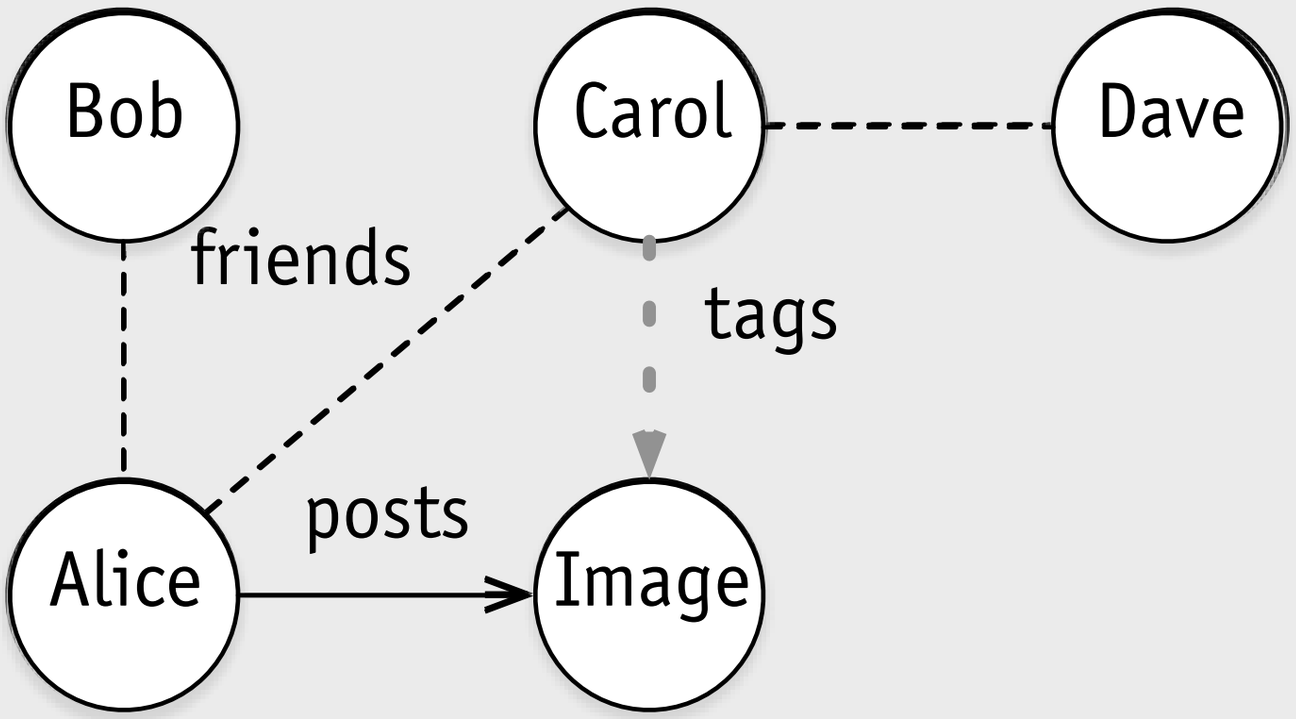
It encompasses the appreciation of material culture and the application of the arts of planning, inventing, making and doing.

At its core is the language of modelling...
equivalent to aptitudes in the language of the sciences (numeracy) and the language of humanities (literacy).

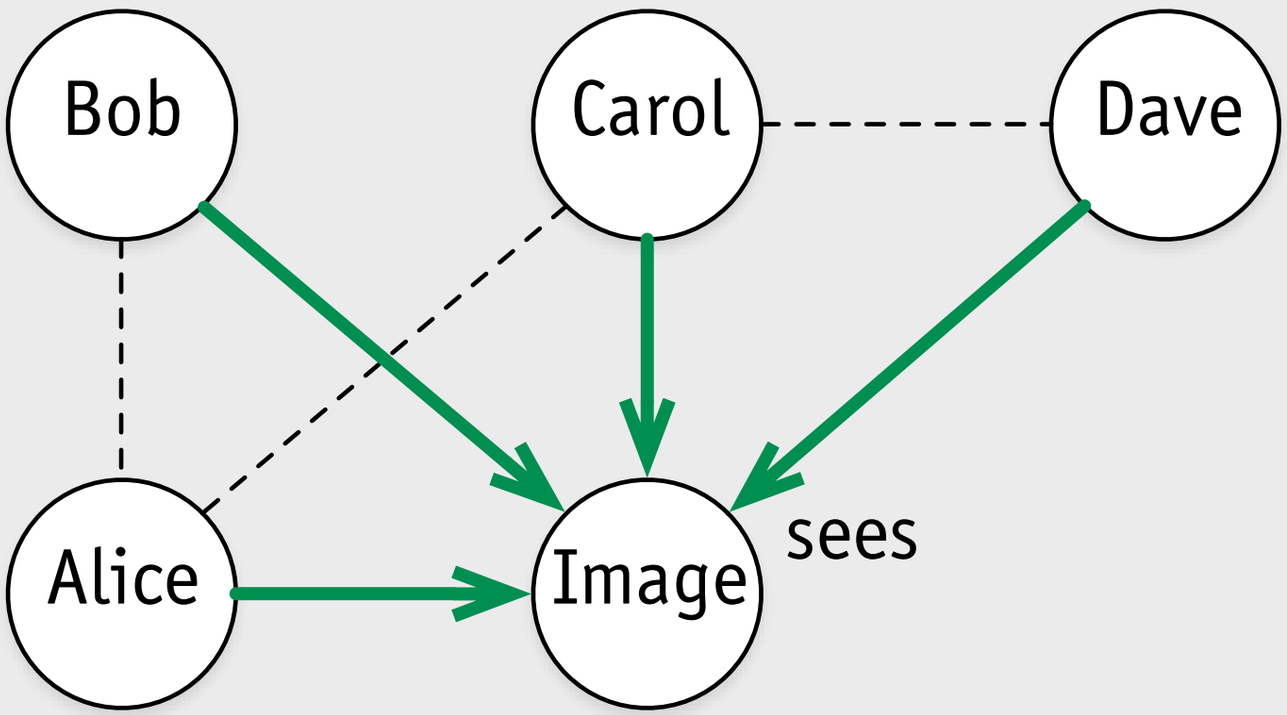
Design has its own distinct things to know, ways of knowing them, and ways of finding out about them.

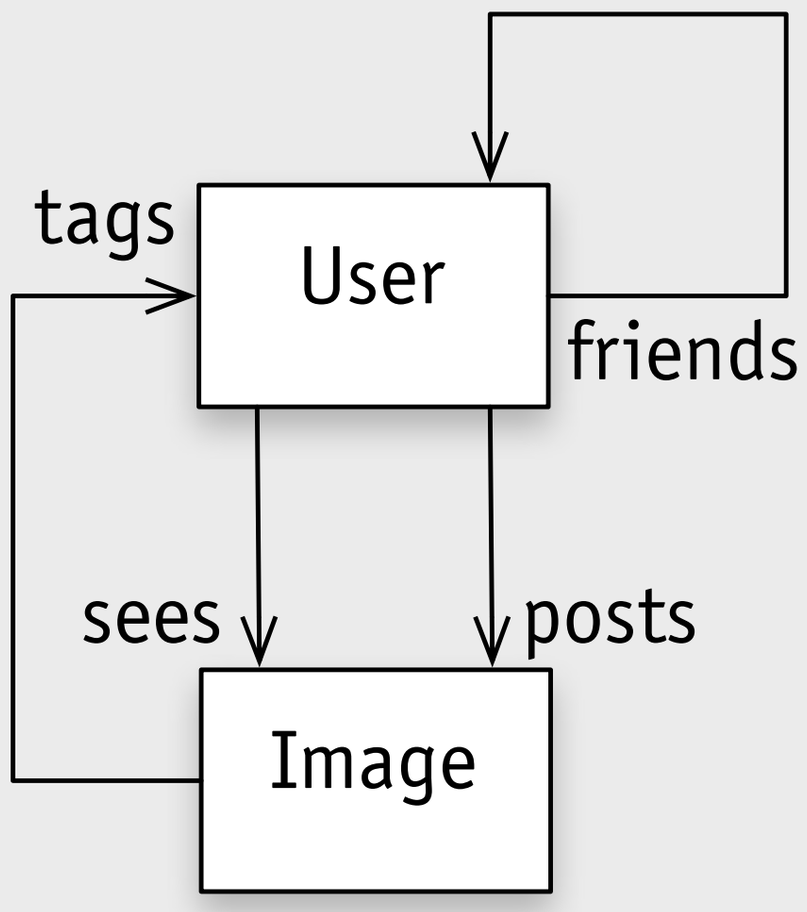
Nigel Cross (1982)
Designerly Ways of Knowing
excerpted from RCA report

facebook tags



who can see the image?

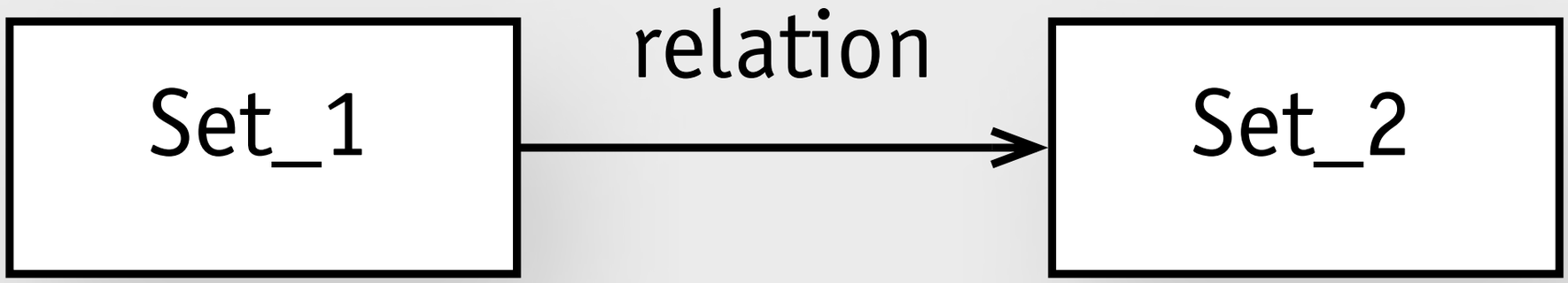




all i: Image | sees.i =
(posts.i).friends + (i.tags).friends

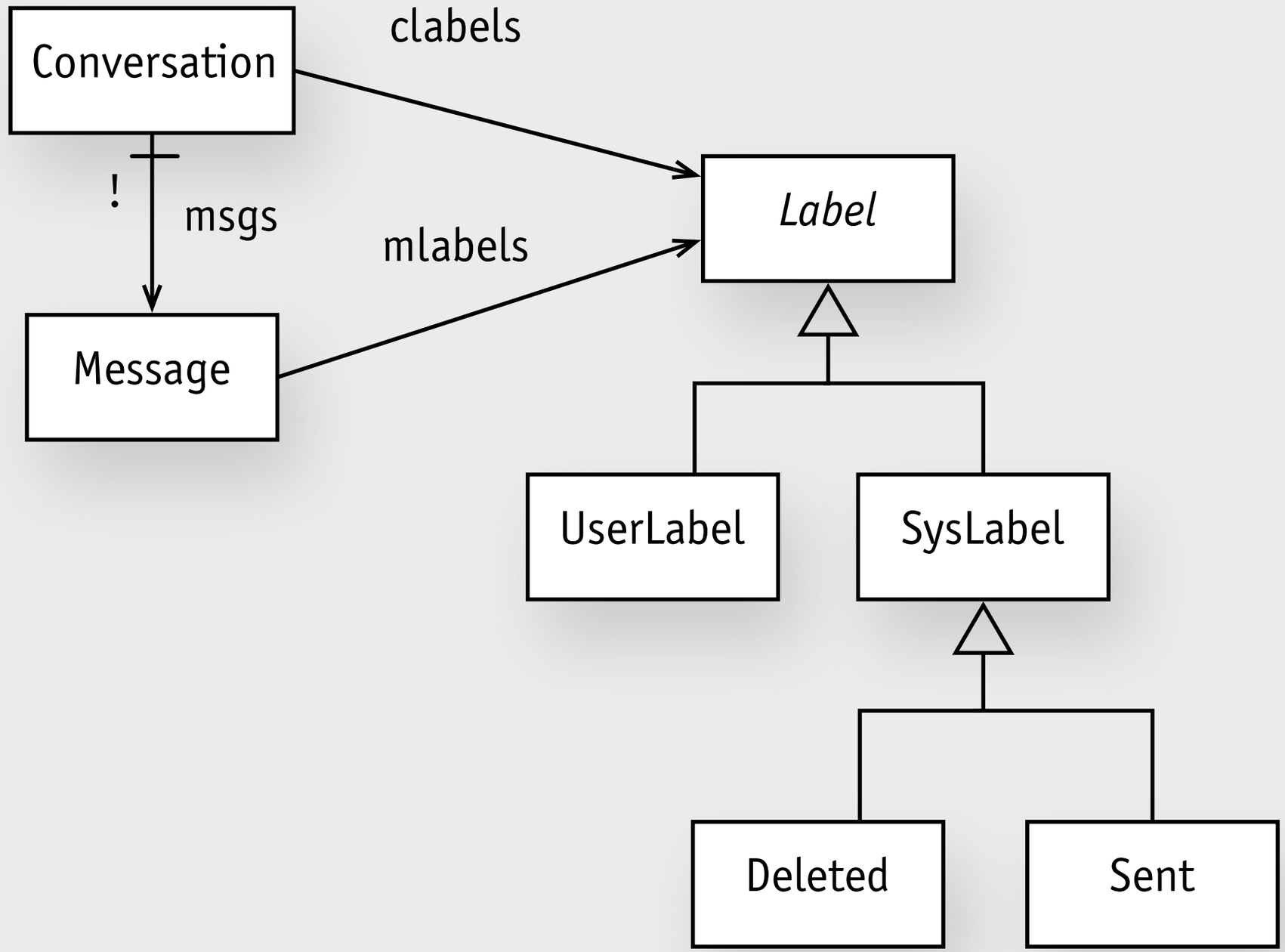
textual constraint in Alloy

modeling data (ie, state)



means that:
the state includes two sets Set1 and Set2
and a relation that associates elements of Set1 with elements of Set2

gmail labels



constraint that explains conversation labels:

all c: Conversation | c.clabels = c.msgs.mlabels

strange consequences

search for unlabelled messages

in conversation view, shows conversations

any conversation that contains an unlabelled message

but this conversation may appear to be labelled

no ops?

deleting then adding a label

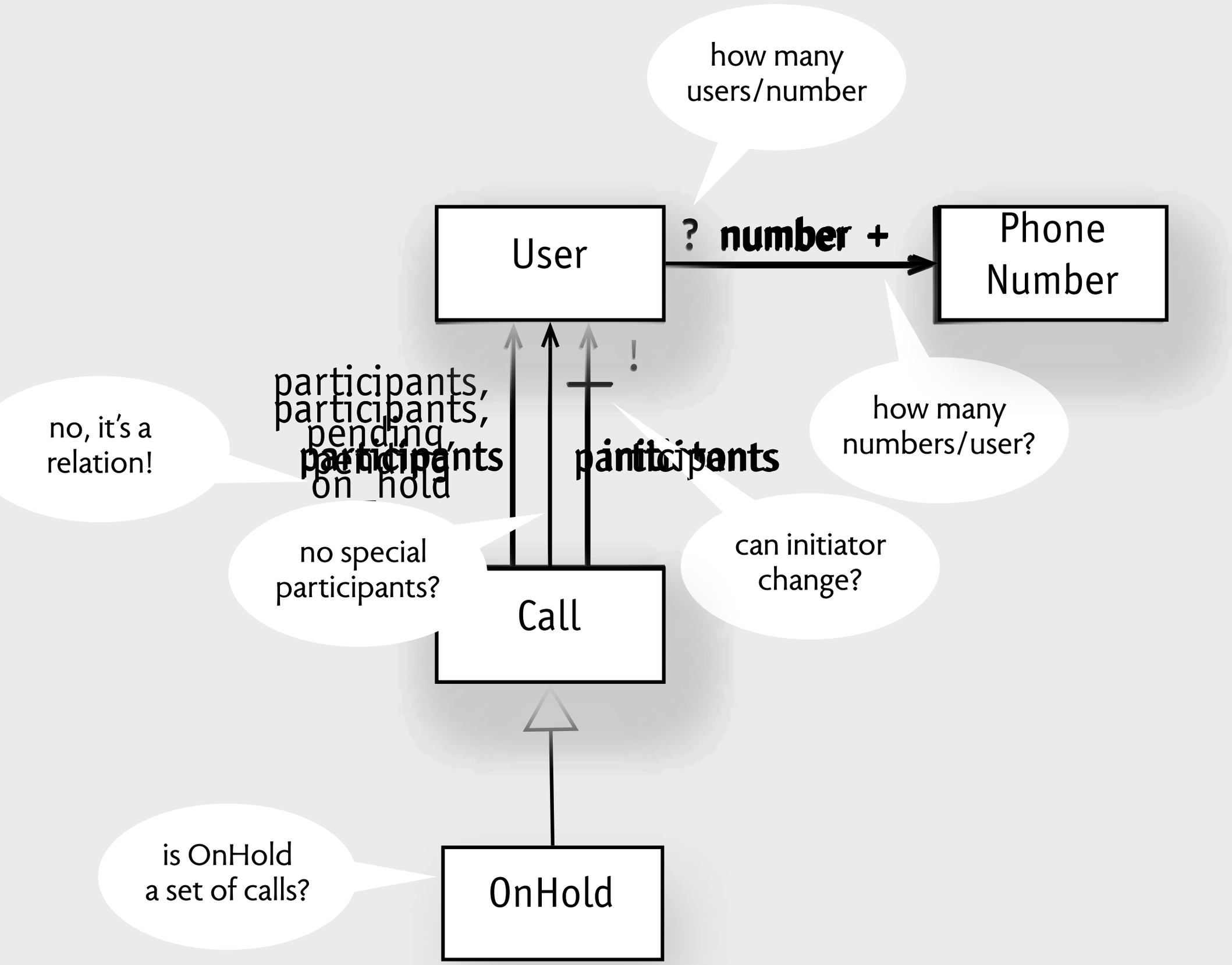
adding then deleting a label

both can modify a conversation

a puzzle

can a conversation have a Sent label?

skype data


how many
users/number
User
? number +
Phone
Number
!
participants,
participants,
pending,
on_hold
participants
participants
no, it's a
relation!
how many
numbers/user?
no special
participants?
can initiator
change?
Call
is OnHold
a set of calls?
OnHold

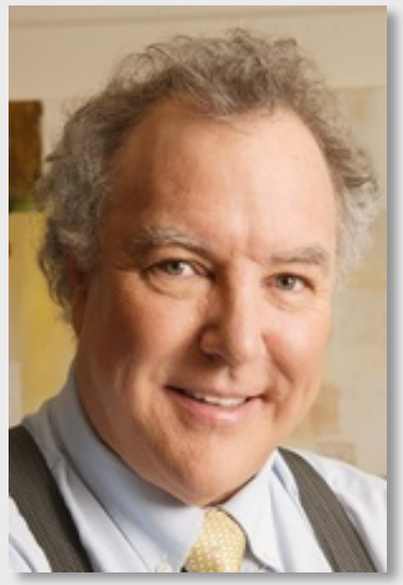
heuristics

sources of heuristics

Jakob Nielsen
10 Usability Heuristics

Ben Shneiderman
8 Golden Rules

Don Norman
Design of Everyday Things



Bruce Tognazzini
First Principles of Interaction Design

consensus heuristics

visibility

of functions, state, feedback

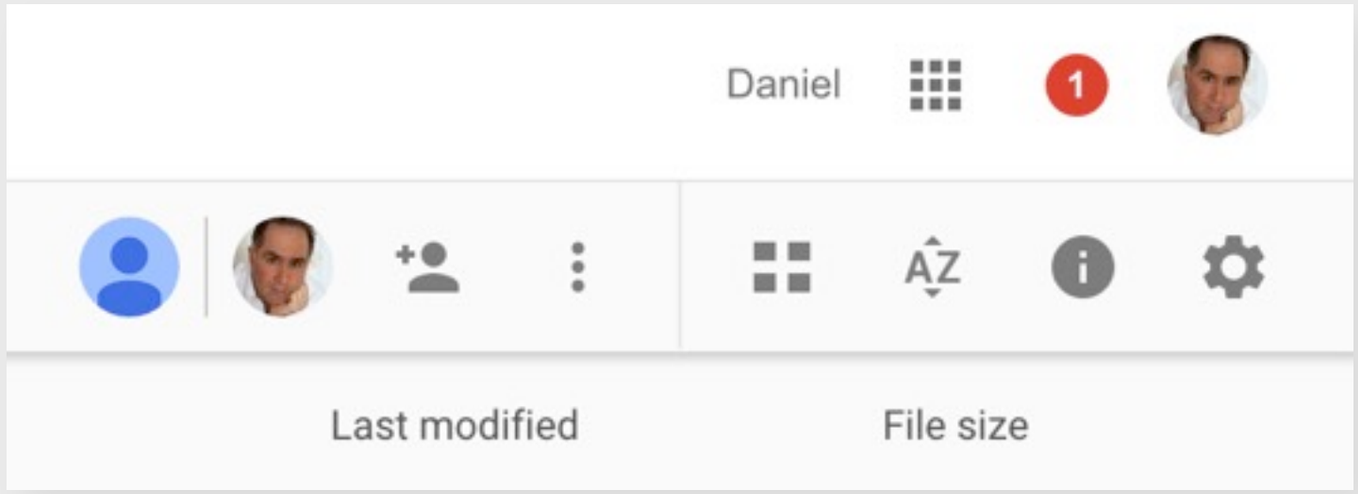
consistency

within app, platform, domain, culture

constraints

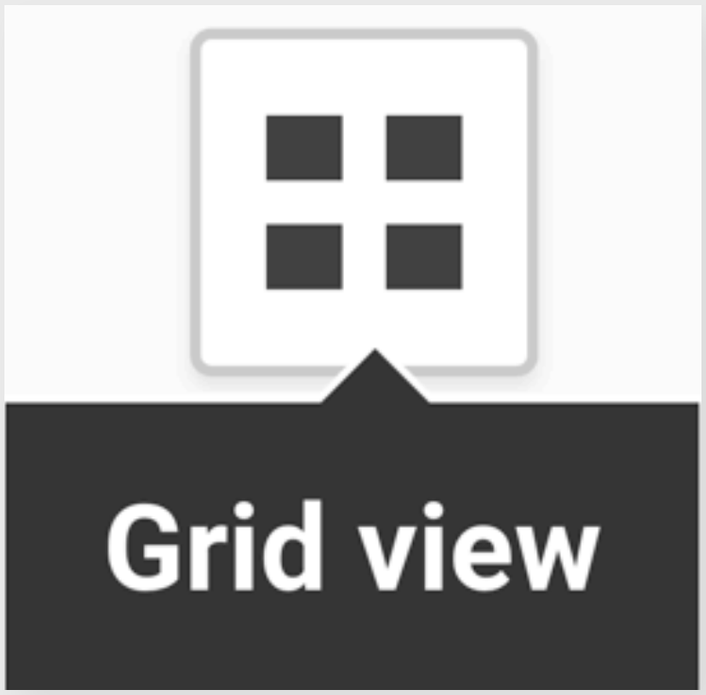
prevent errors

platform consistency

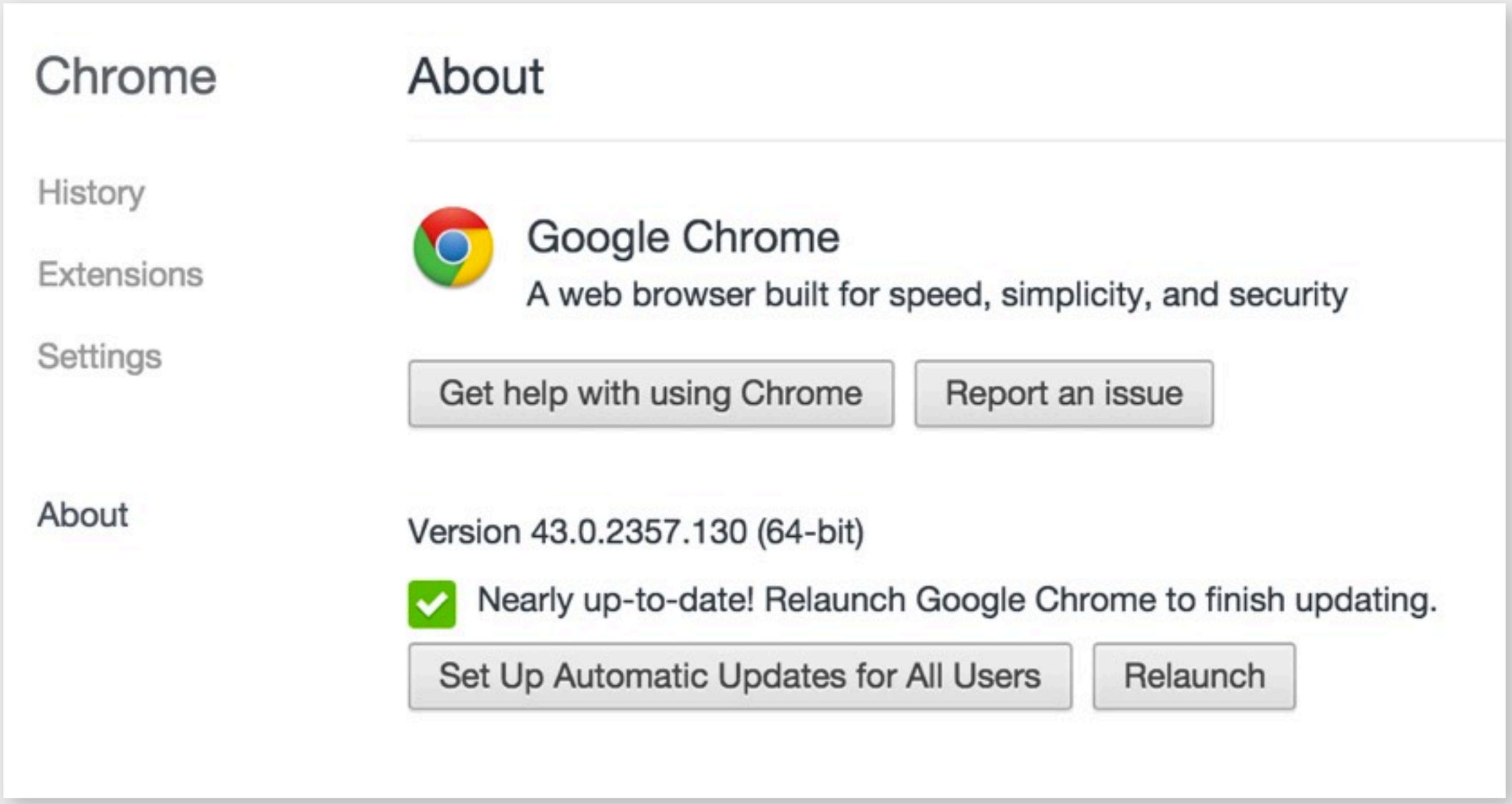


design lesson:
make sure same name or symbol used for a function or feature throughout

icons shown in Google Drive

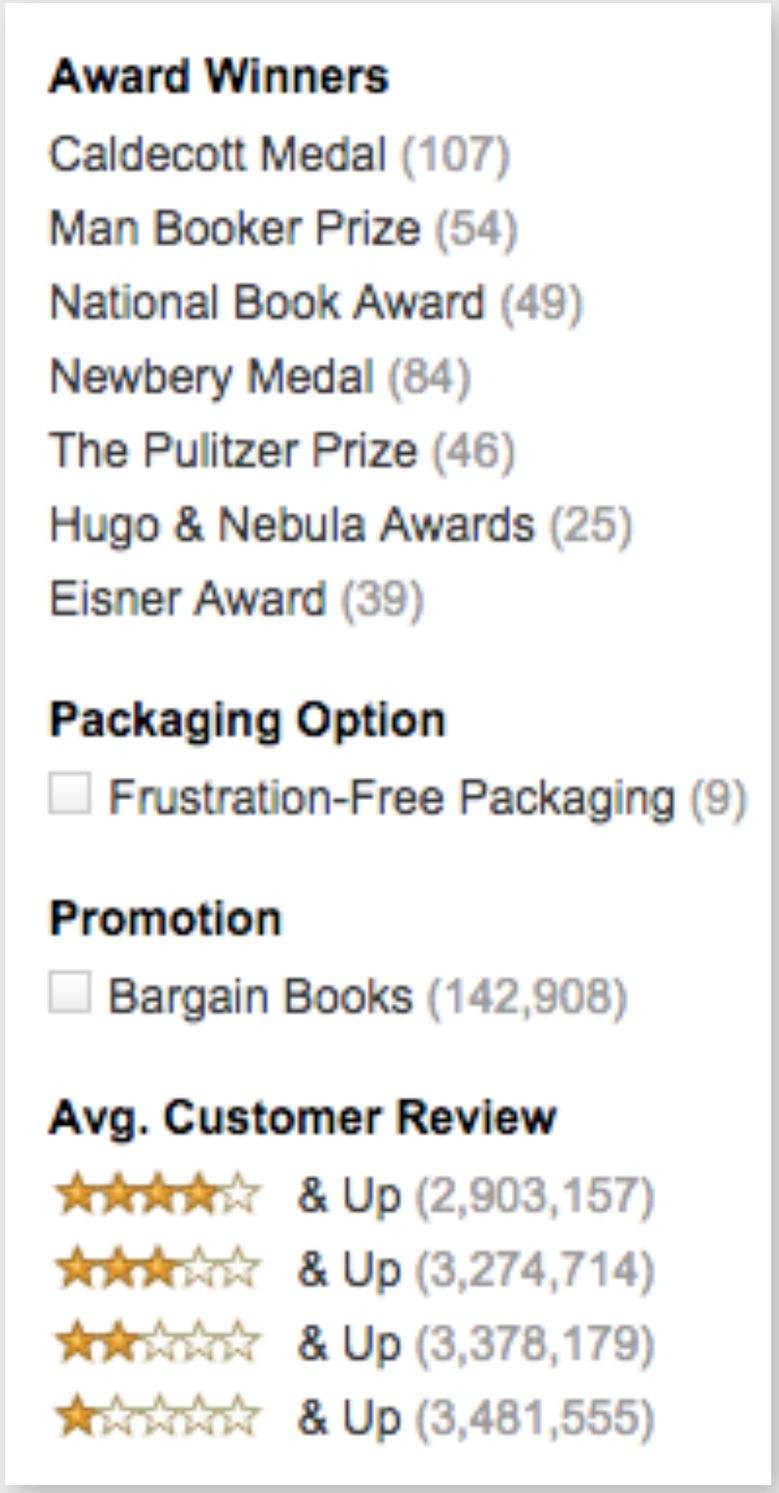


cultural consistency

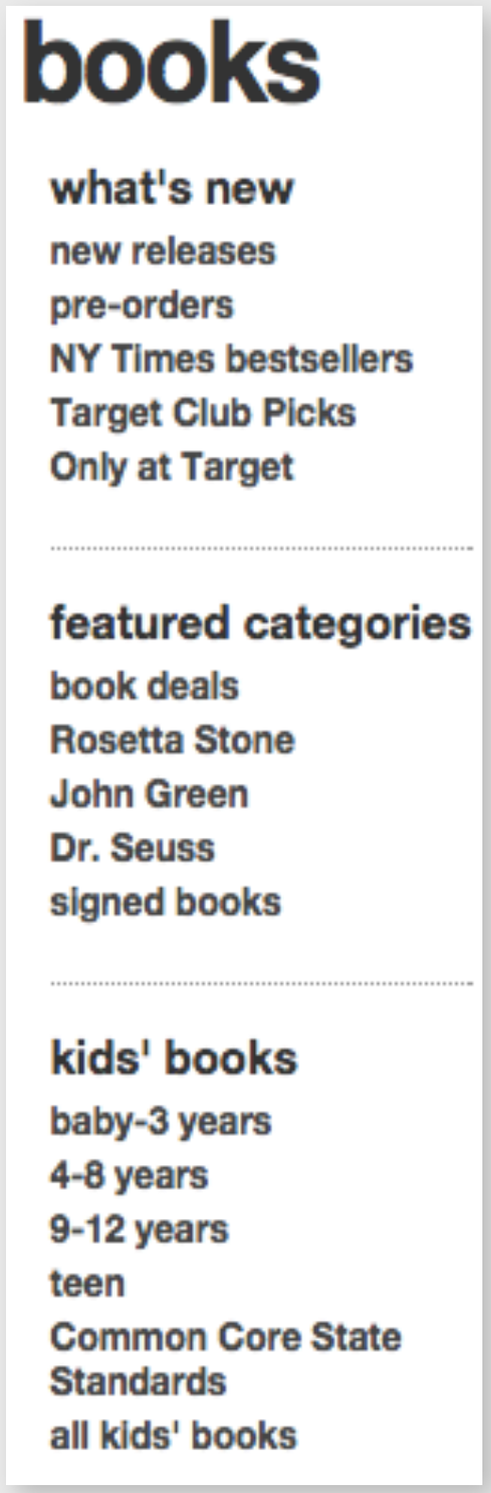


why is 'History' greyed out?

heuristic: information scent



amazon.com



ToysRUs.com

design lesson:
give good scent to aid information 'foraging'

conclusions

design thinking
will change software development

brings good ideas
user-centeredness
incrementality
prototypes

applied to software
focused data models
usability heuristics
concepts & purposes

to learn more, see references at http://tinyurl.com/acn-refs