beyond design thinking

Daniel Jackson · Singapore University of Technology & Design · January 2015

a sad story

Field Trip Permission Form

Dear Parents:

Ms. Frizzle will again be taking her second grade class on an exciting field trip. Please sign and return the permission slip below.

Thank you!

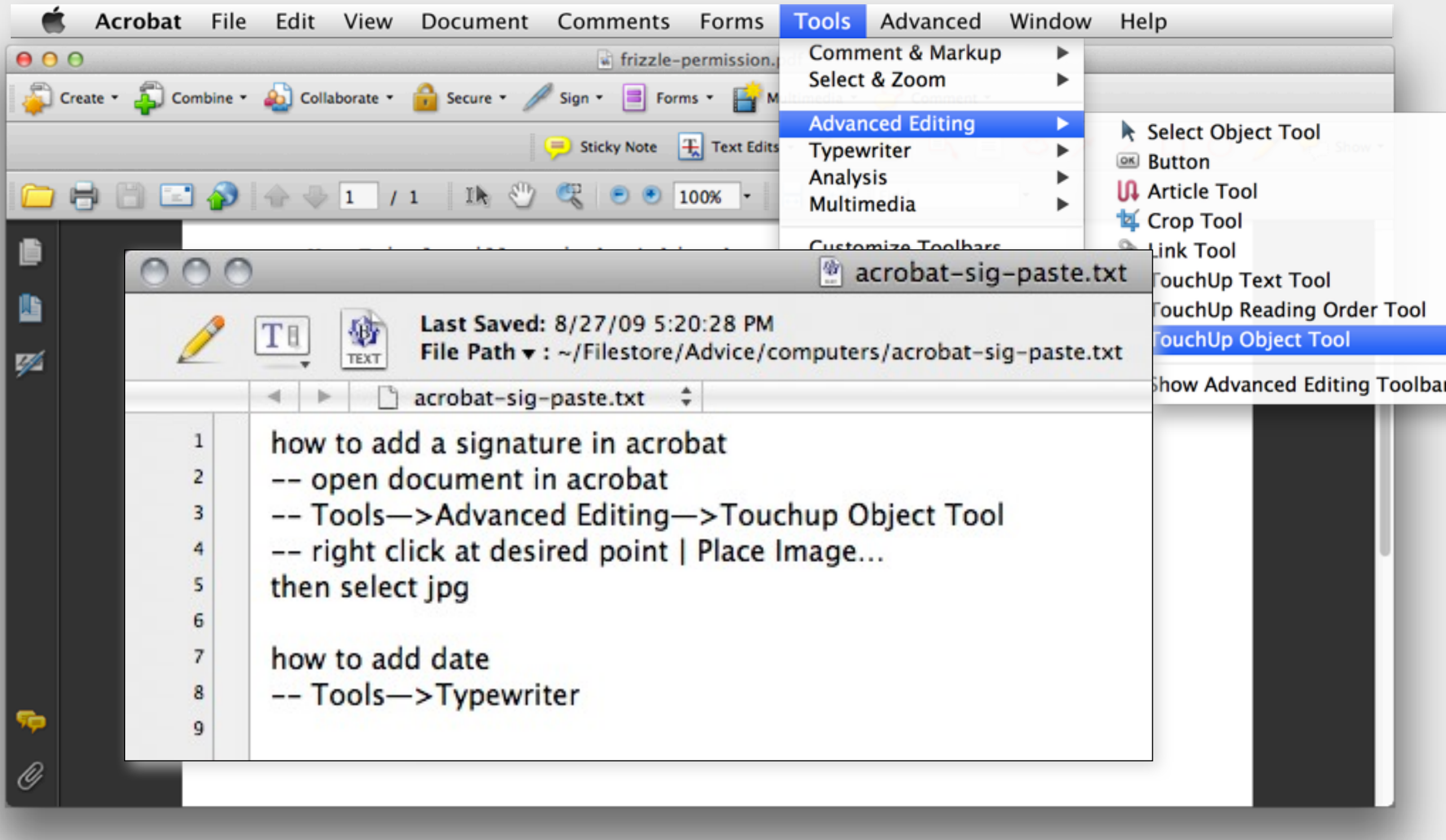
Yes, I give permission for my child to go on the second grade "Touch and Feel" trip on Friday February 13th to the NastyCo Nuclear Dump. I understood that my child may encounter the normal risks of childhood play, including grazed knees, hurt feelings and exposure to toxic waste.

Count Olaf

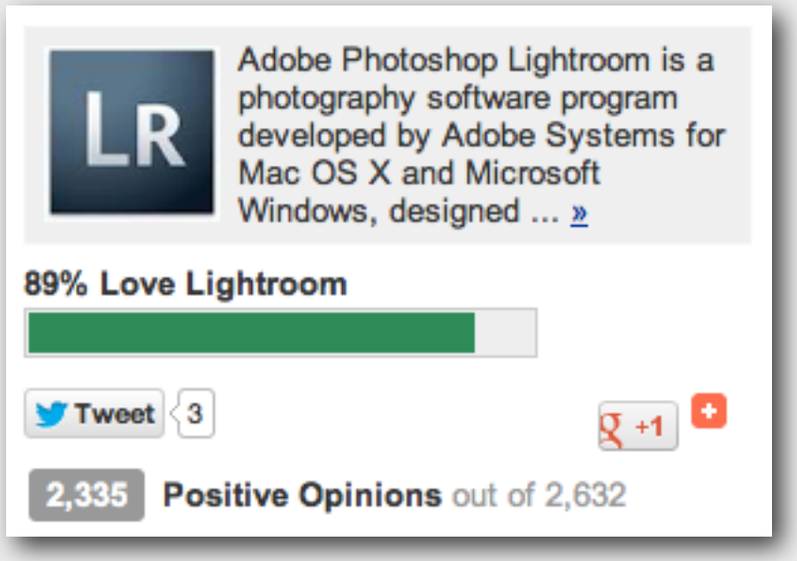
February 11, 2013

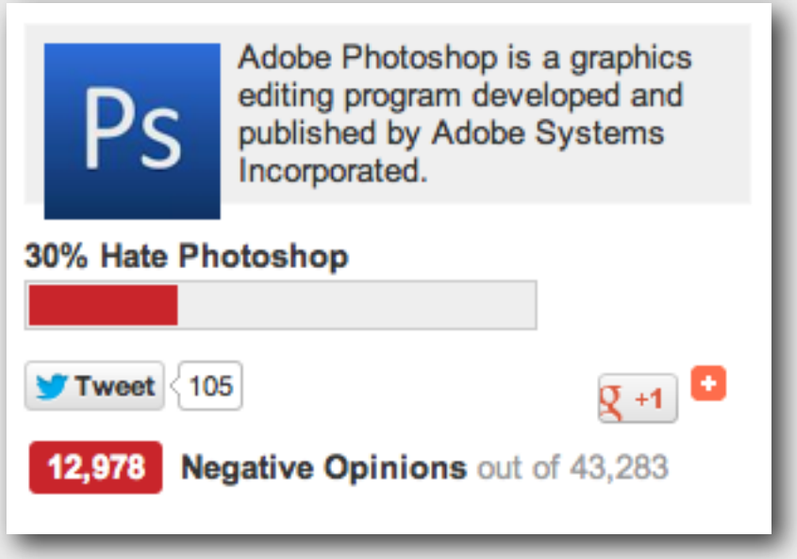
Parents signature Date

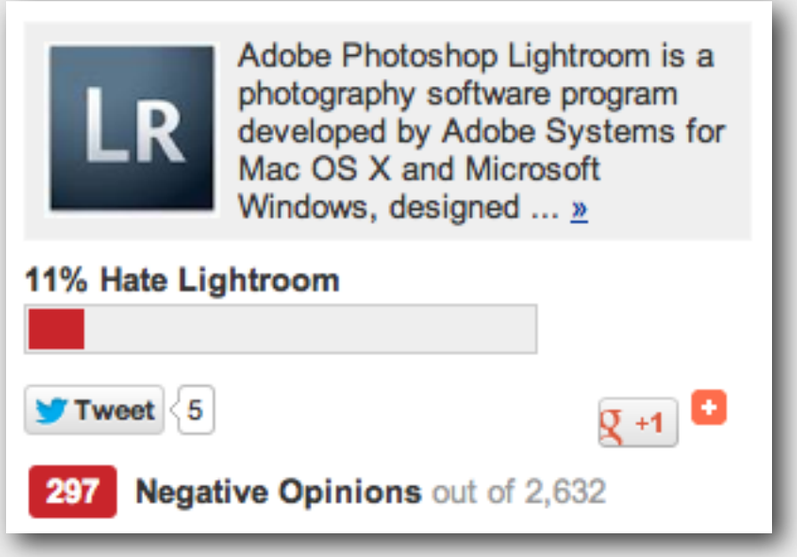
acrobat to the rescue



what we hate ... & love



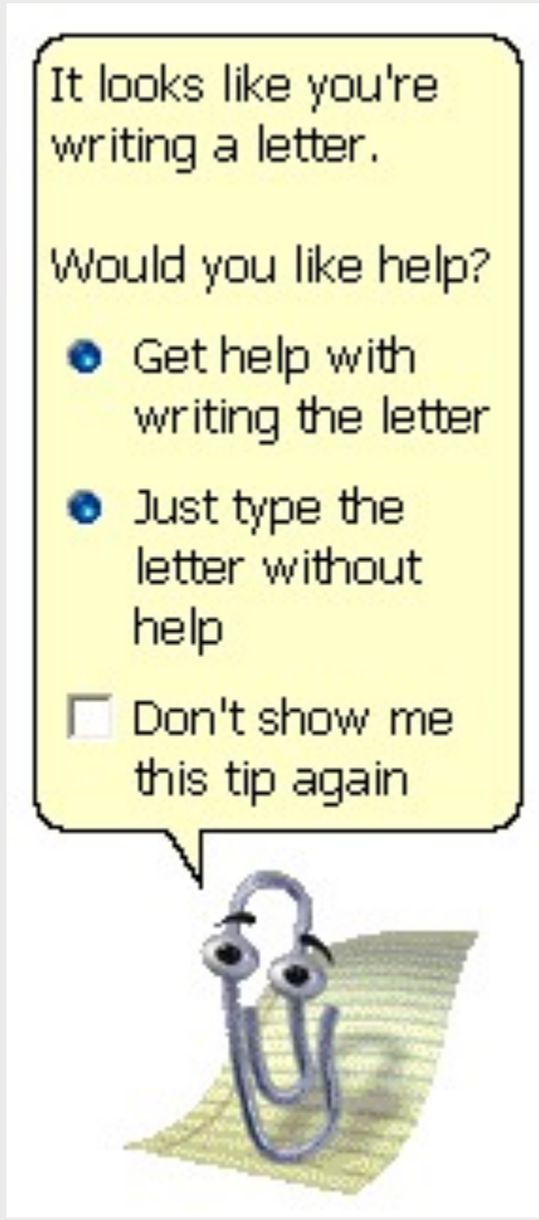




from http://amplicate.com

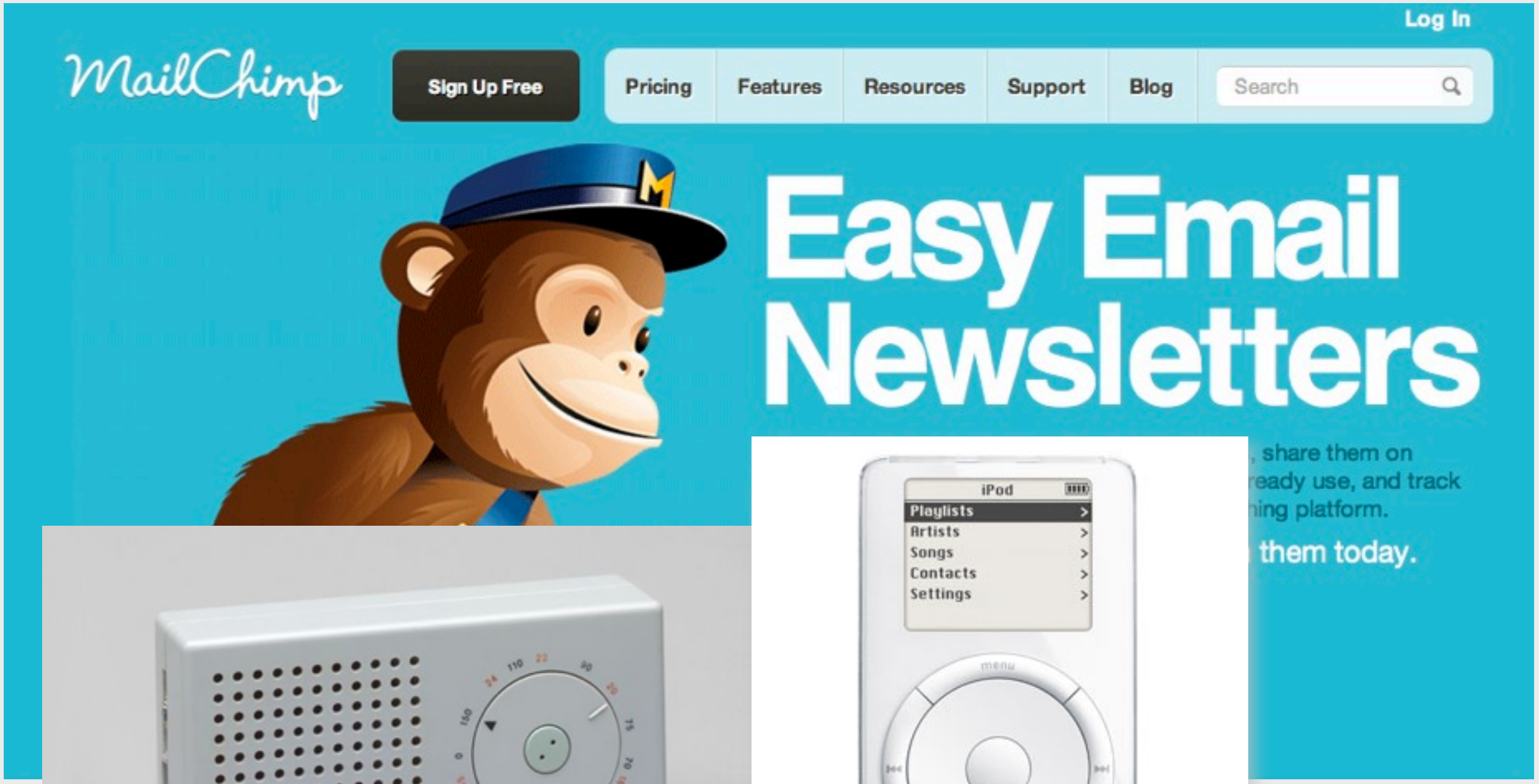
what's wrong?

lack of automation?



Clippy
2003-2008
RIP

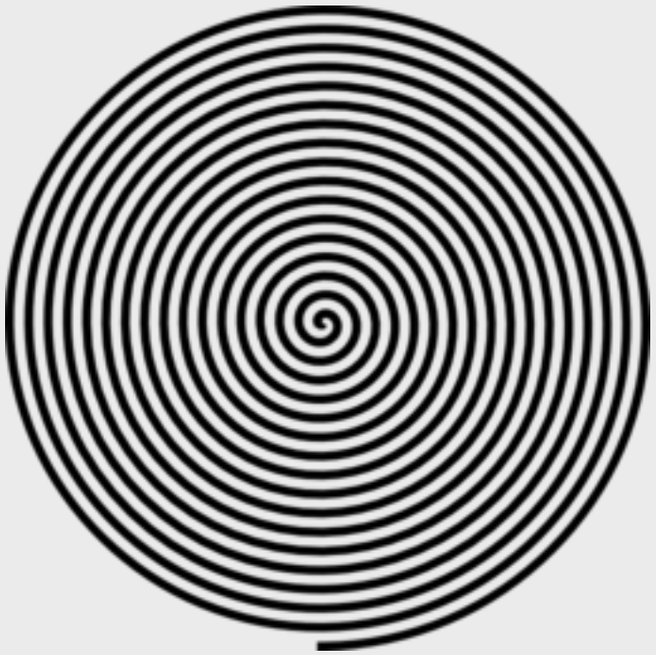
lack of style?



Dieter Rams, 1958
pocket transistor radio T3

Jony Ive, 2001
iPod

poor design process?



incremental

user-centered

evaluation-driven

prototyping

brainstorming

flawed user interface?

Aesthetics
Anticipation
Autonomy
Color
Consistency
Defaults
Discoverability
Efficiency of the User
Explorable Interfaces
Fitts's Law
Human-Interface Objects
Latency Reduction
Learnability
Metaphors
Protect Users' Work
Readability
Simplicity
State: Track it
Visible Interfaces
Bruce Tognazzini

Visibility
Feedback
Constraints
Mapping
Consistency
Affordance
Don Norman

Navigability
Consistency
Feedback
Mental model
Bill Moggridge

Visibility of system status
Match between system and the real world
User control and freedom
Consistency and standards
Error prevention
Recognition rather than recall
Flexibility and efficiency of use
Aesthetic and minimalist design
Help users recognize, diagnose, and recover from errors
Help and documentation
Jakob Nielsen

some claims

problem is deeper
in underlying structure, not interface

process is not enough
need a new design focus

user testing not informative
tells you something's wrong, not why

a theory of design

what's it for?

systems, not components
have humans at boundaries
conceptual, not physical

what's the goal?

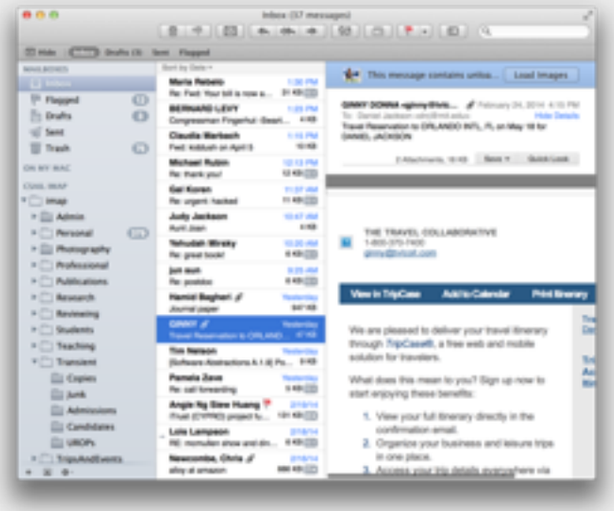
making design more systematic
avoiding wasting effort when bound to fail
codifying expert knowledge
distilling what works

concepts & software

what characterizes an app?

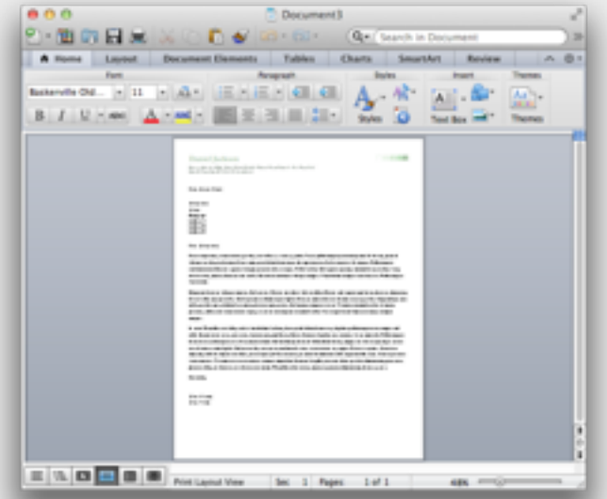
concepts!

Apple Mail



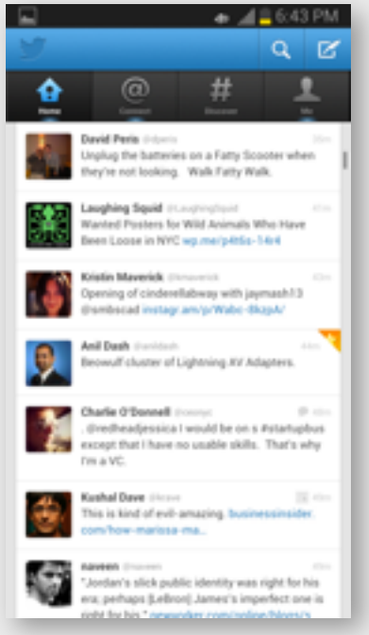
EmailAddress
Message
Folder or Label

Microsoft Word



Paragraph
Format
Style

Twitter



Tweet
Hashtag
Following

Photoshop

PixelMap
Layer/Mask
Adjustment

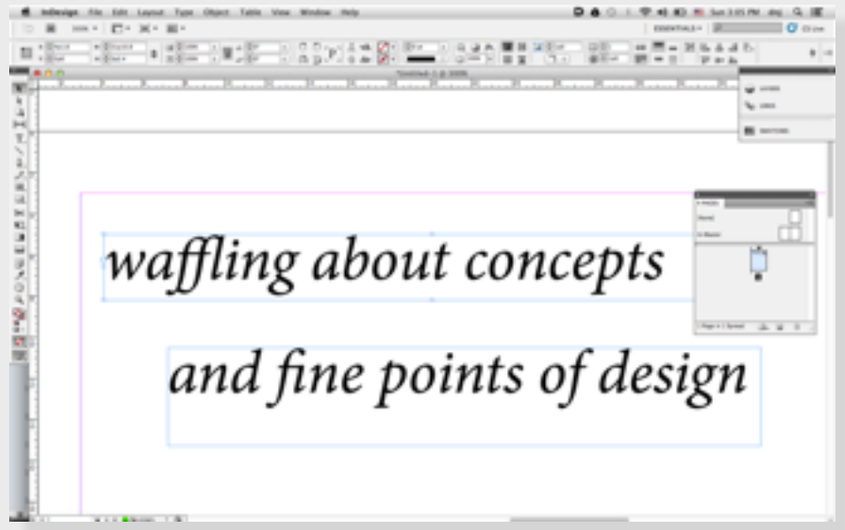
concepts differentiate classes

text editor

line, buffer,
character set

word processor

paragraph,
format, style



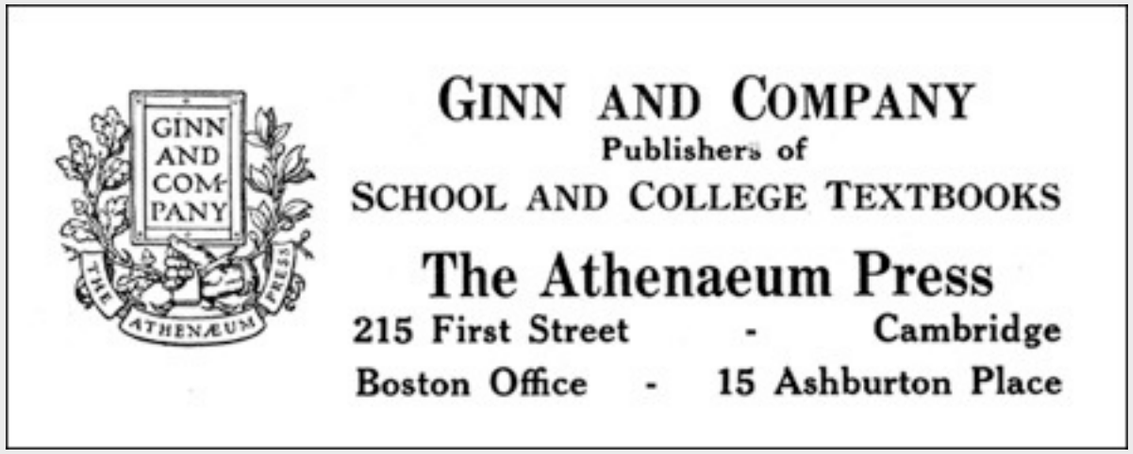
desktop publishing app

text flow, link,
page template

where are Word's concepts from?

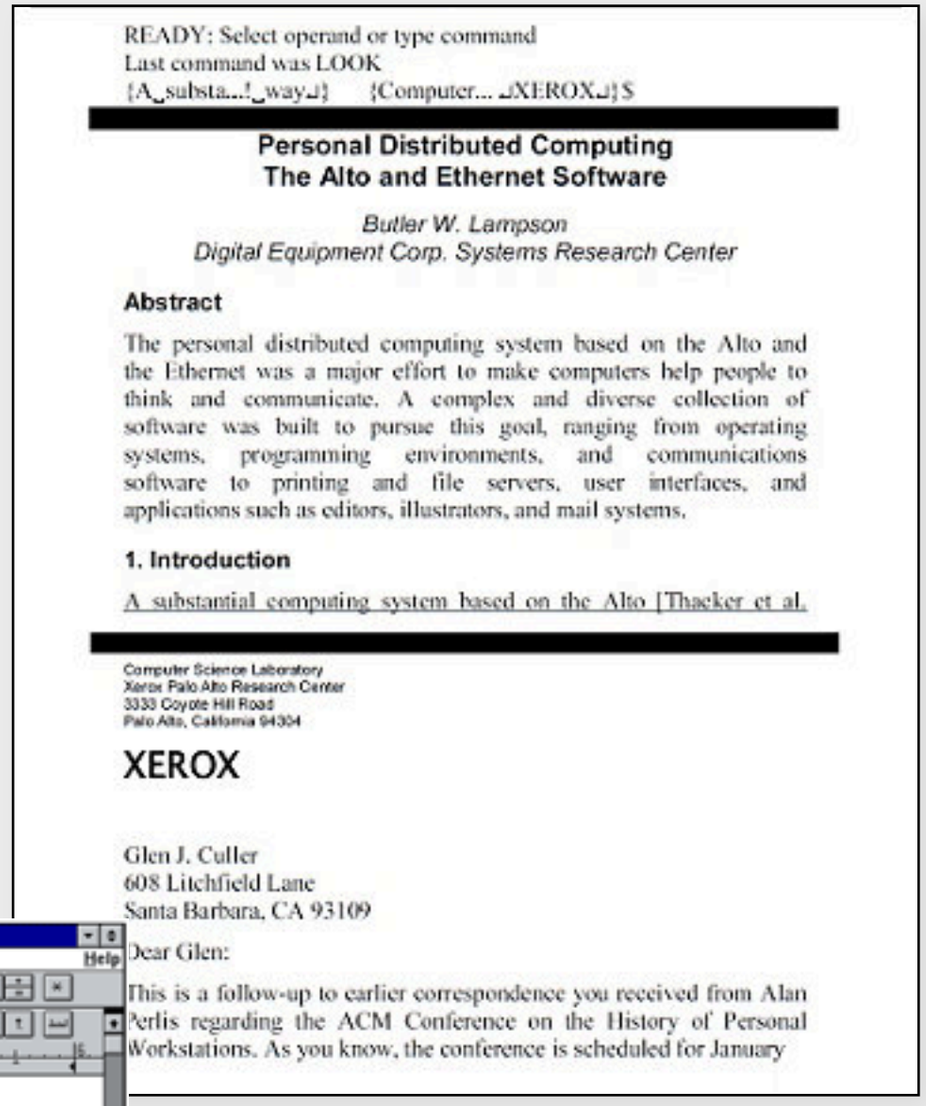
Charles Simonyi: brought key concepts to Word from Xerox PARC

rich concepts have long journeys



Ginn & Co, since 1868

Apple Pages, 2005


READY: Select operand or type command
Last command was LOOK
{A␣substa...!␣way␣} {Computer... ␣XEROX␣}$

Personal Distributed Computing
The Alto and Ethernet Software

Butler W. Lampson
Digital Equipment Corp. Systems Research Center

Abstract

The personal distributed computing system based on the Alto and the Ethernet was a major effort to make computers help people to think and communicate. A complex and diverse collection of software was built to pursue this goal, ranging from operating systems, programming environments, and communications software to printing and file servers, user interfaces, and applications such as editors, illustrators, and mail systems.

1. Introduction

A substantial computing system based on the Alto [Thacker et al.

Computer Science Laboratory
Xerox Palo Alto Research Center
3333 Coyote Hill Road
Palo Alto, California 94304

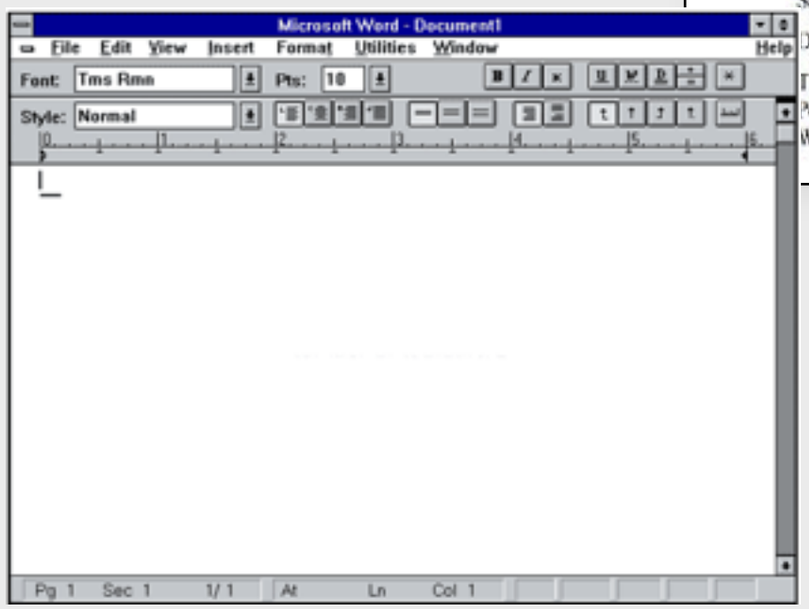
XEROX

Glen J. Culler
608 Litchfield Lane
Santa Barbara, CA 93109

Dear Glen:

This is a follow-up to earlier correspondence you received from Alan Perlis regarding the ACM Conference on the History of Personal Workstations. As you know, the conference is scheduled for January

Bravo, 1974

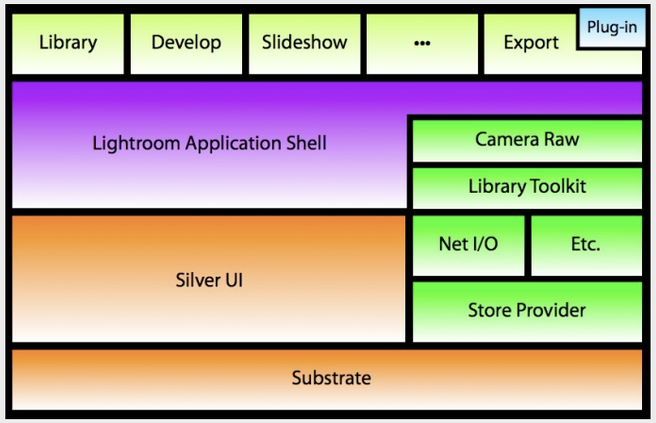


Microsoft Word, 1983

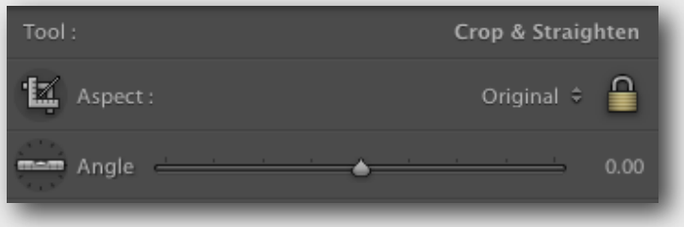
where do concepts come from?

domain concepts: exist in problem domain	analogic concepts: based on known notions	synthetic concepts: invented for software
photo, movie, song	blog post, email, tweet	friend, follower
account, balance	desktop, folder, file	relative reference
social security number	layer, mask, stacking	selection, buffer
typeface, ligature	cart, order, item	permission, capability

pervasiveness of concepts



code



interface

user's model

Image	Ratio
Crop	Resolution

concepts

Lightroom architecture diagram from
http://www.troygaul.com/LrExposedC4.html

hypothesis

software design is primarily
the design of concepts

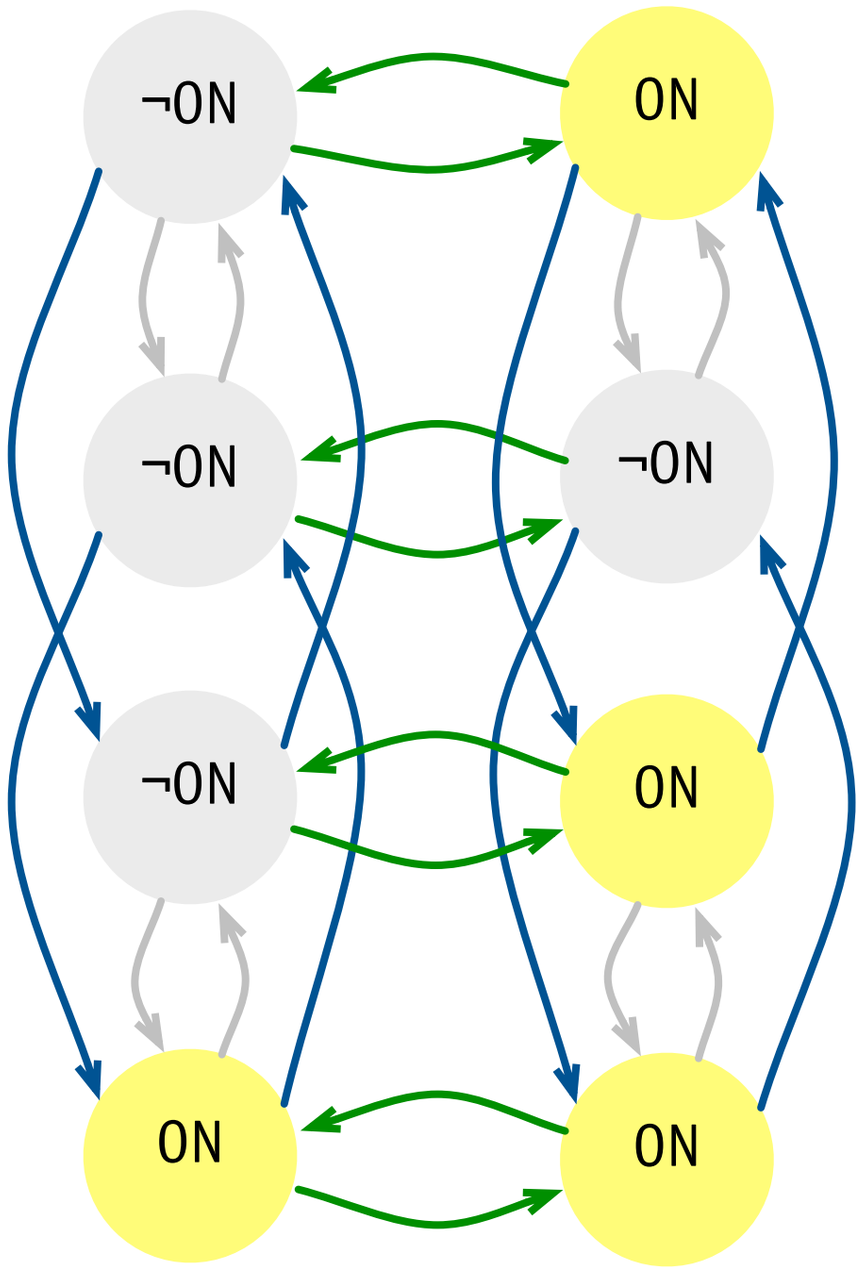
once concepts are chosen
game over (for the most part)

good concepts
usable, robust, maintainable

bad concepts
frustrating, fragile, inflexible

so what exactly is a concept?

a behavioral model



a conceptual model

```
on: bool
time: Slot
schedule: set Slot

inv on = (time ∈ schedule)

tick ≜  time := next(time)

toggle (s: Slot) ≜
    if s ∉ schedule then schedule := schedule ∪ {s}
    else schedule := schedule \ {s}
```

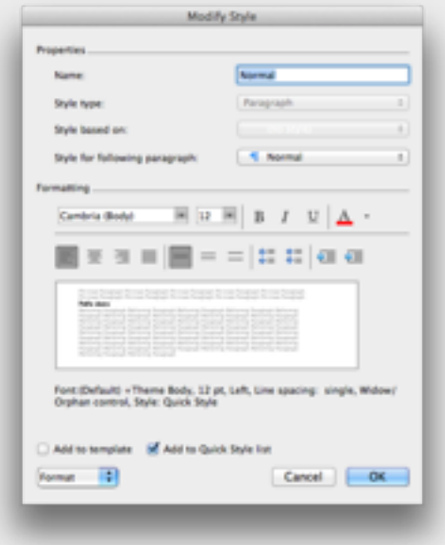
concepts as explanatory state

a concept is
part of the internal state
modifiable by user actions
indirectly affecting the external world

examples
style (Word): affects formatting
tag (Facebook): affects view permission
selection (Finder): affects result of delete, move, etc

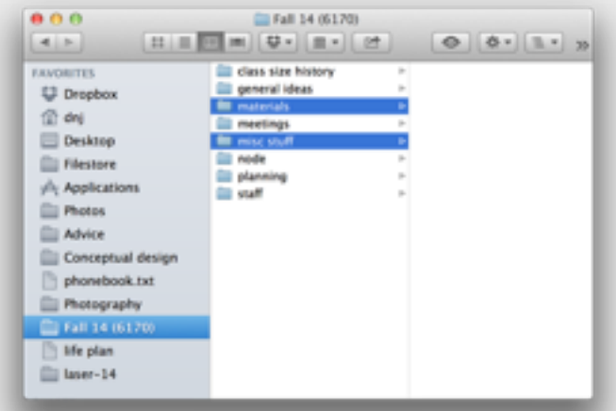
operational principle

if you modify the concept like this, the outcome will be...



"**if** you change a style's format, **then** all paragraphs of that style will change format accordingly"

"**if** you tag a photo, **then** all friends of the person tagged will be able to see the photo"

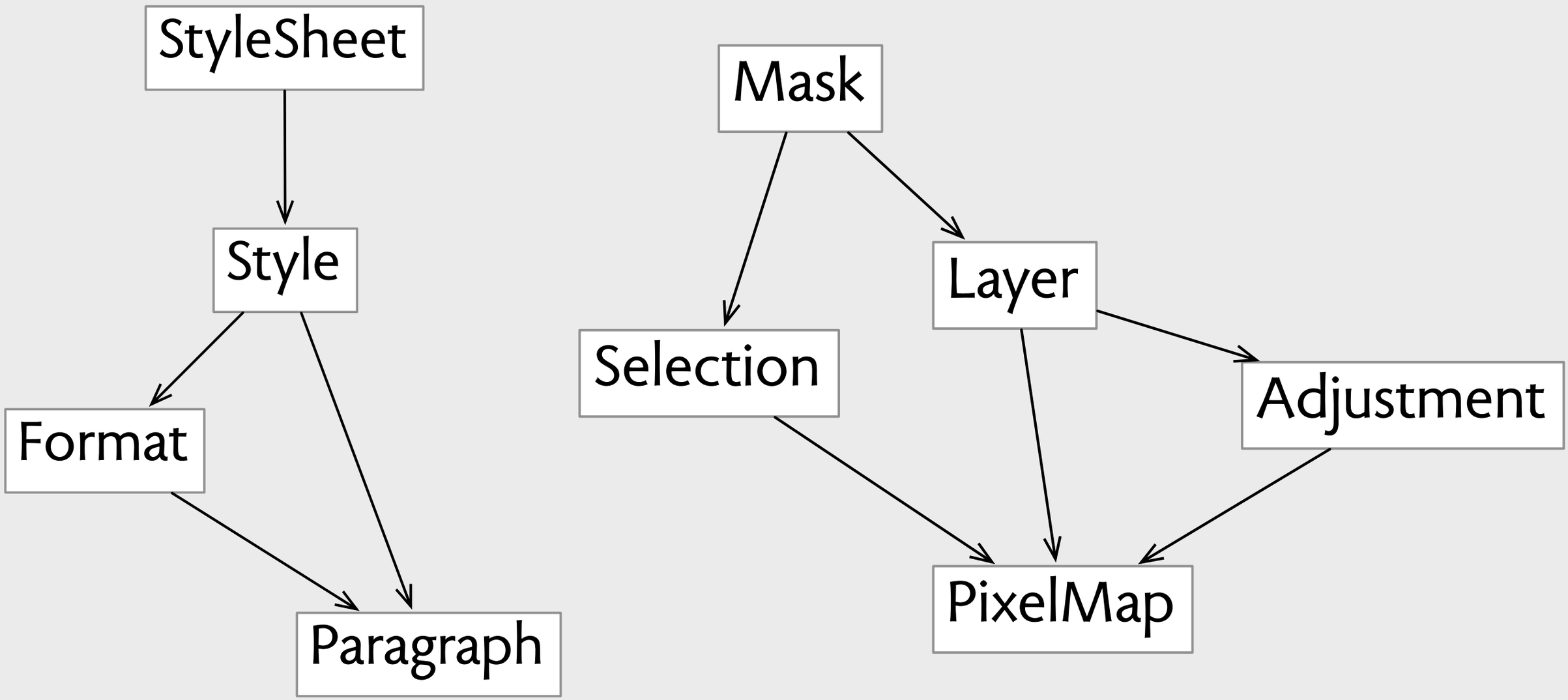


"**if** you select a file and it belongs to a folder with keyboard focus, **then** pressing delete will move the file to the trash"

concept sets and apps

for *c*(*a*), set of concepts used in application *a*,

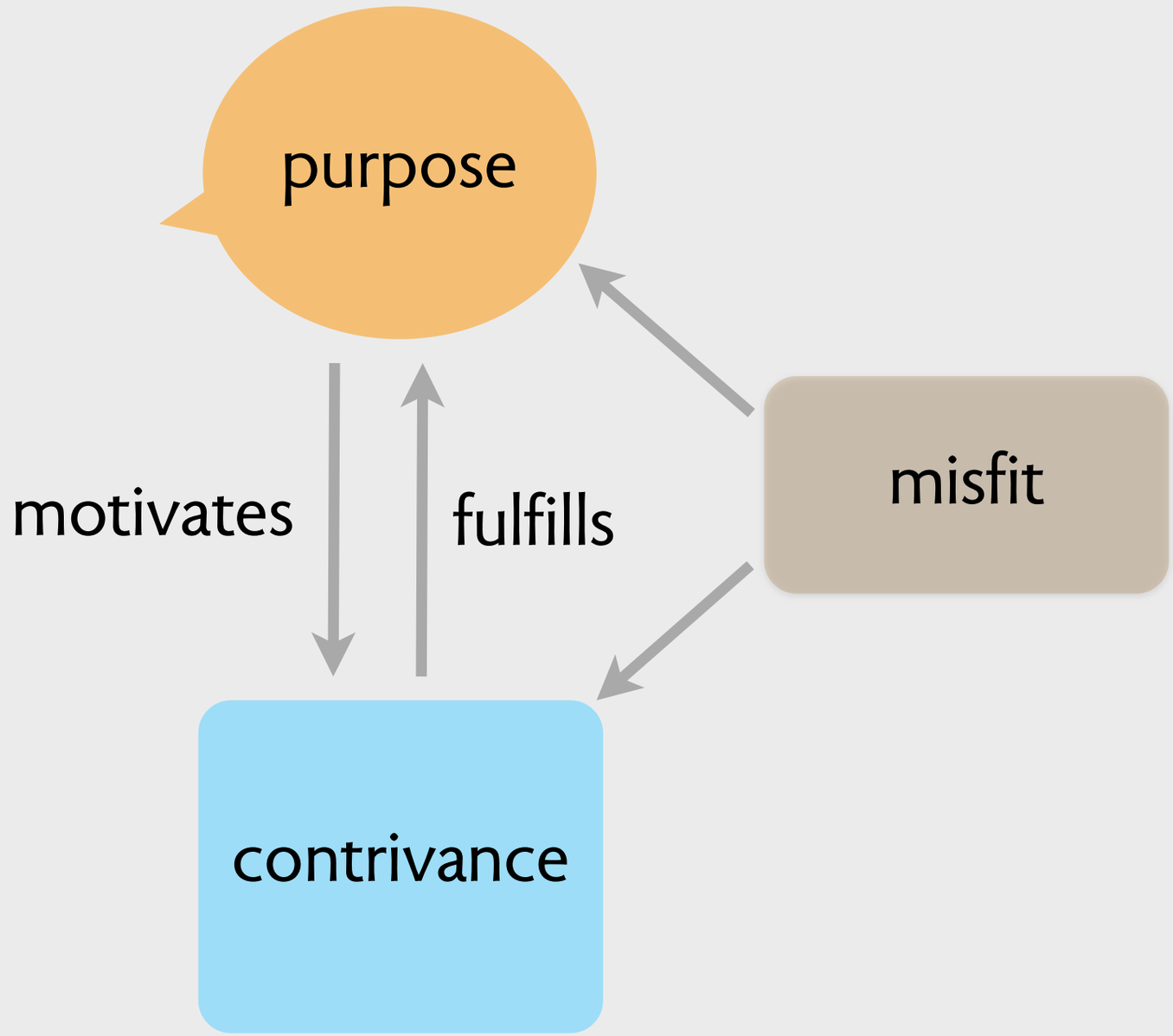
$\langle x,y \rangle \in \text{depends} \Leftrightarrow \forall a \cdot x \in c(a) \Rightarrow y \in c(a)$



note: if depends is cyclic, then cycle suggests a grouping of concepts

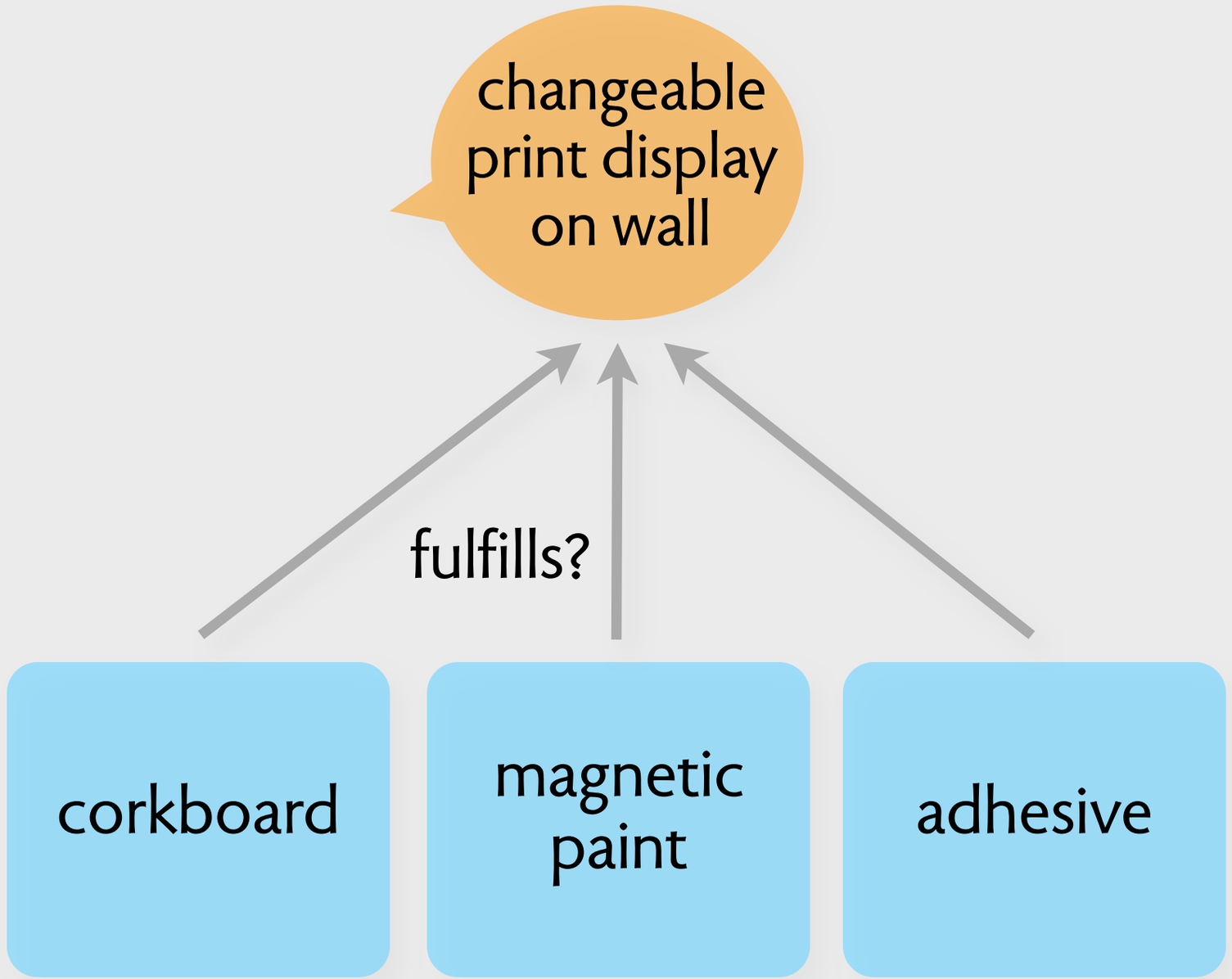
purposes

designing for a purpose

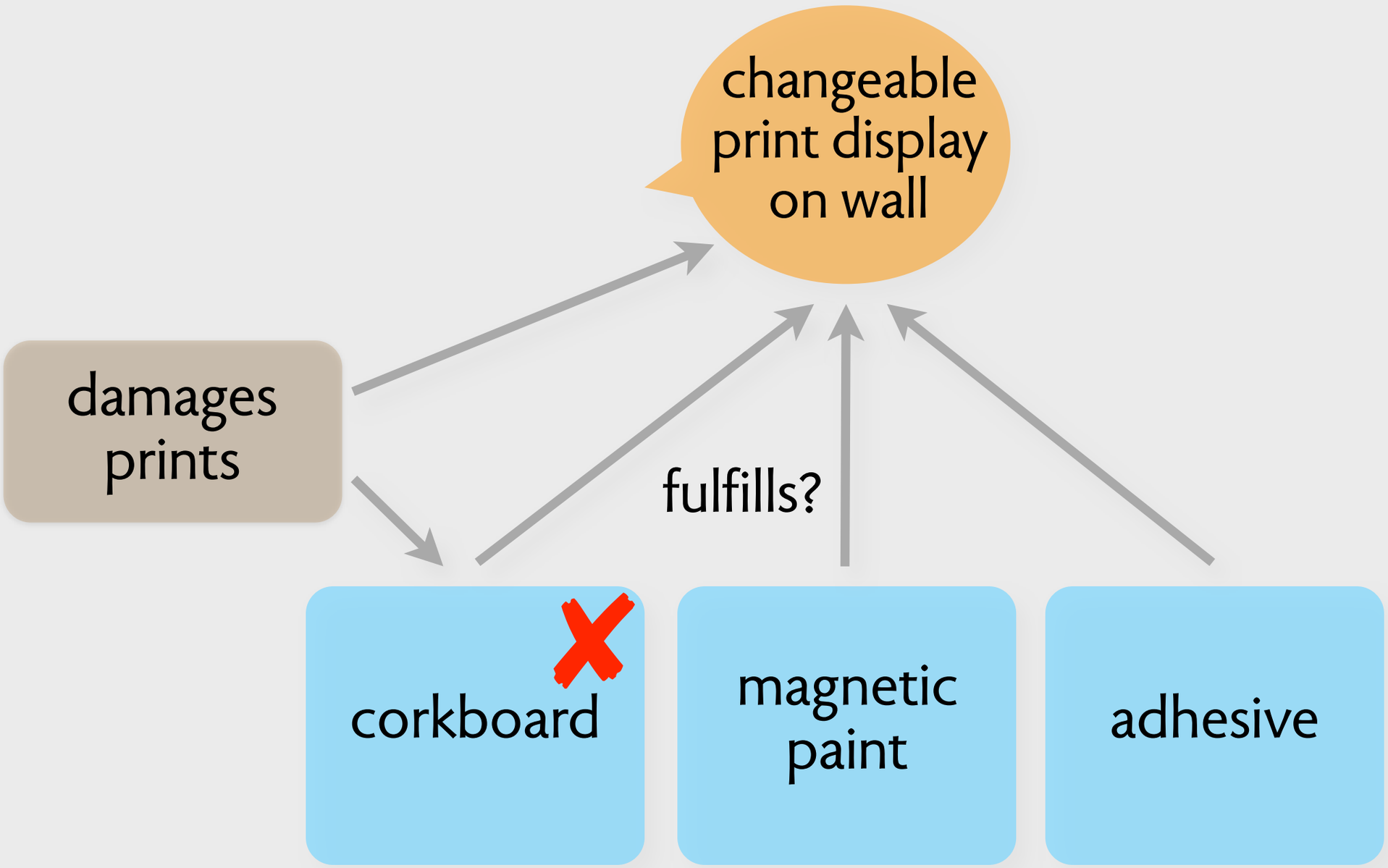


Magic is something you make
FIN
The First Time
KINFOLK

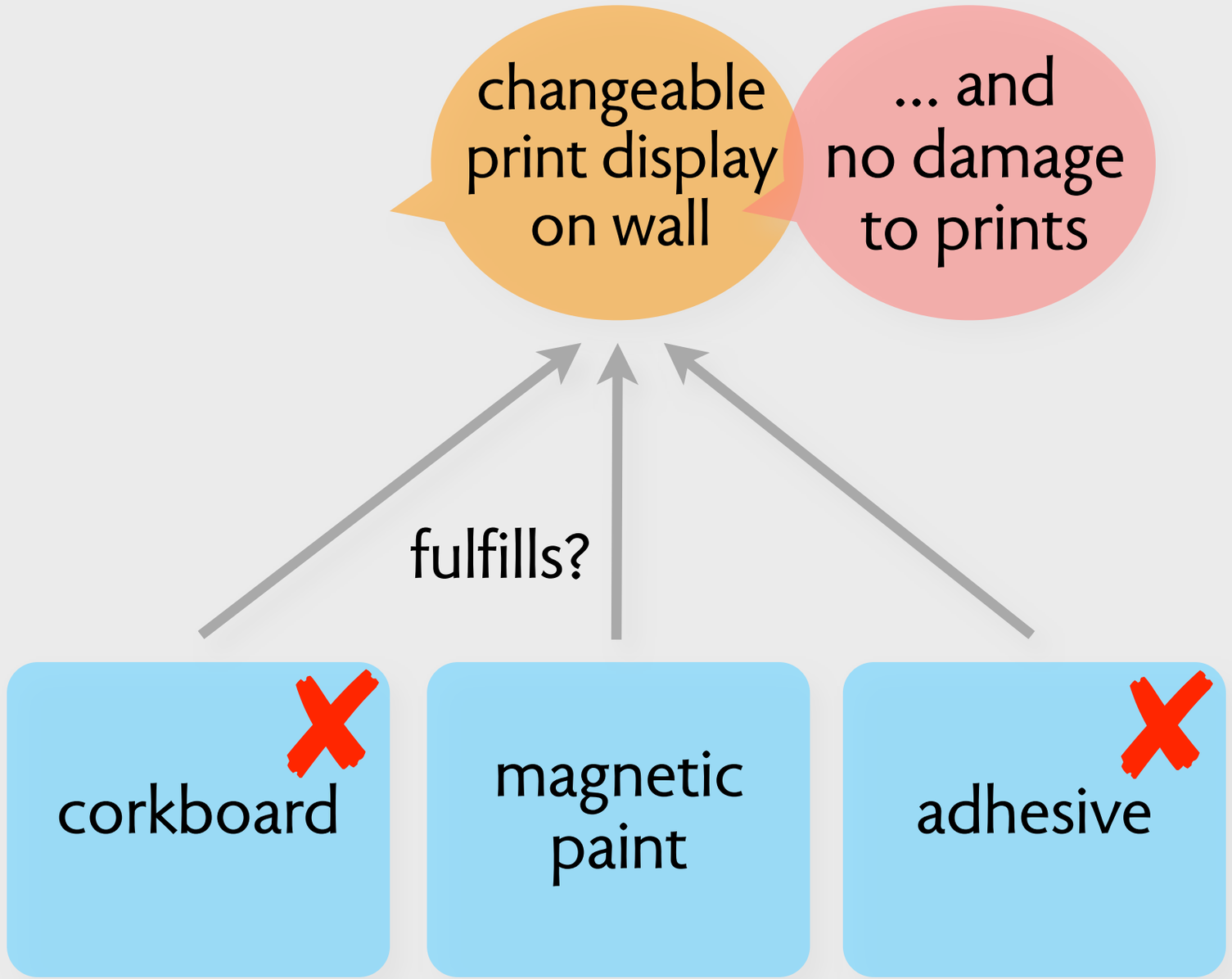
candidate contrivances



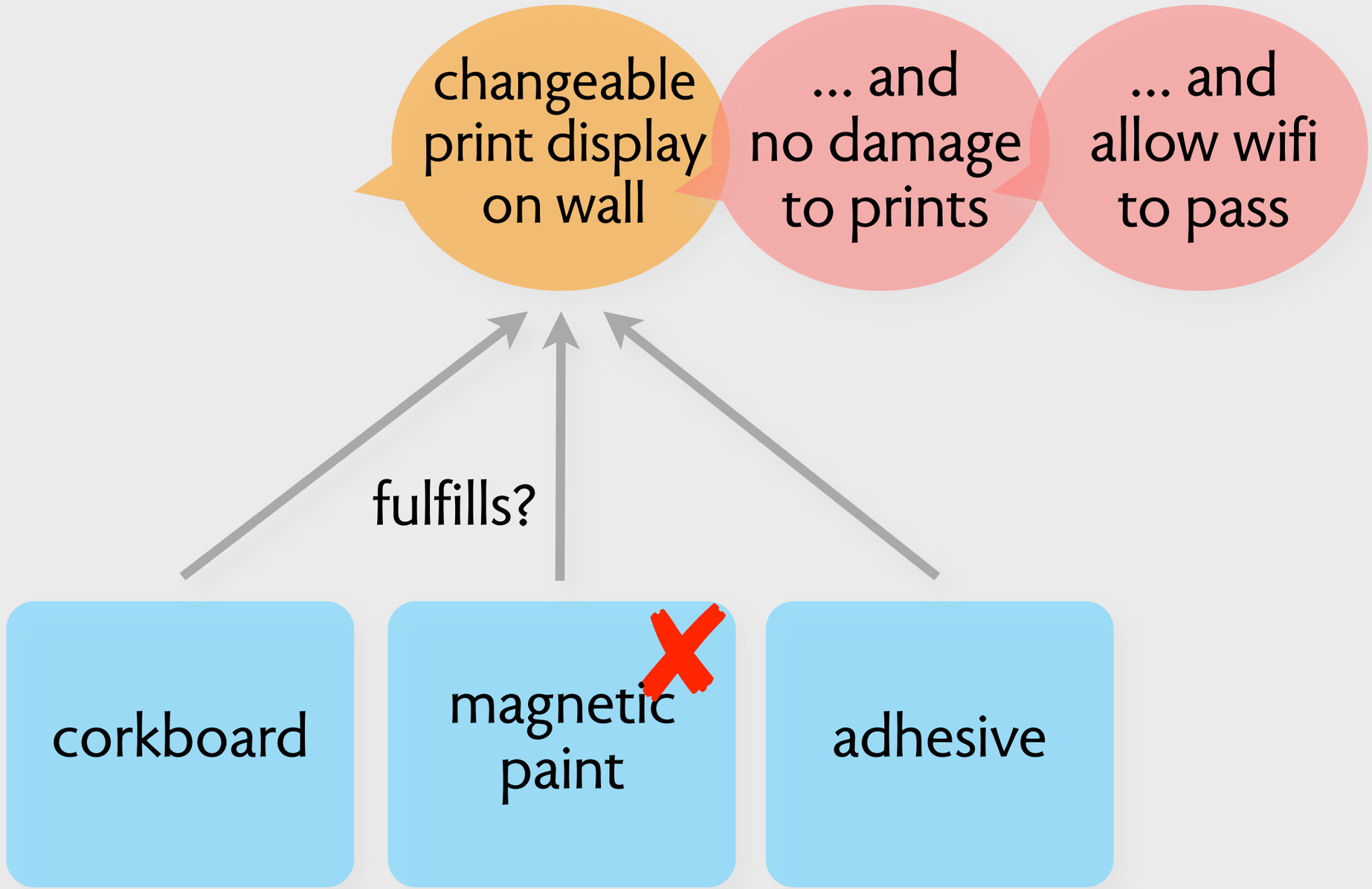
misfits

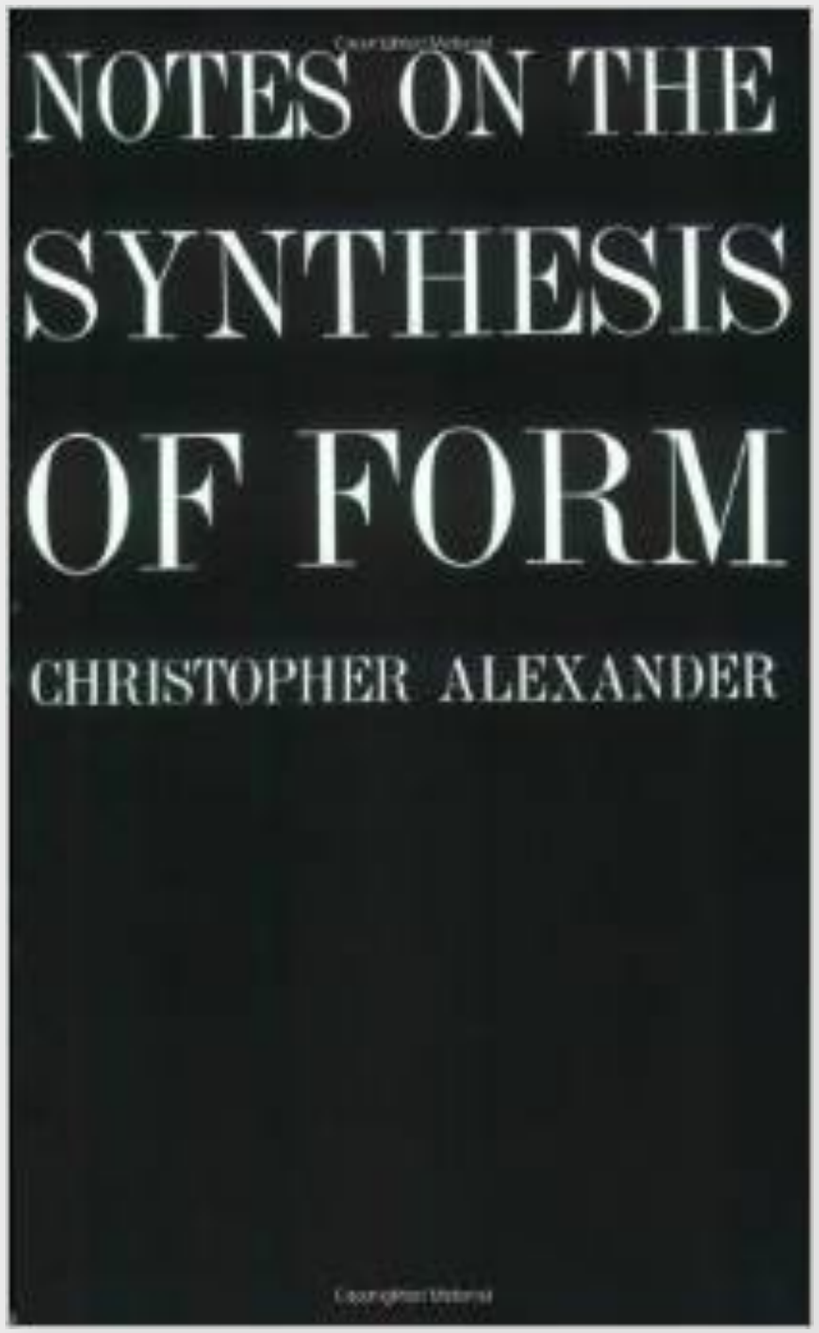

changeable print display on wall
damages prints
fulfills?
corkboard
magnetic paint
adhesive

adding refinements



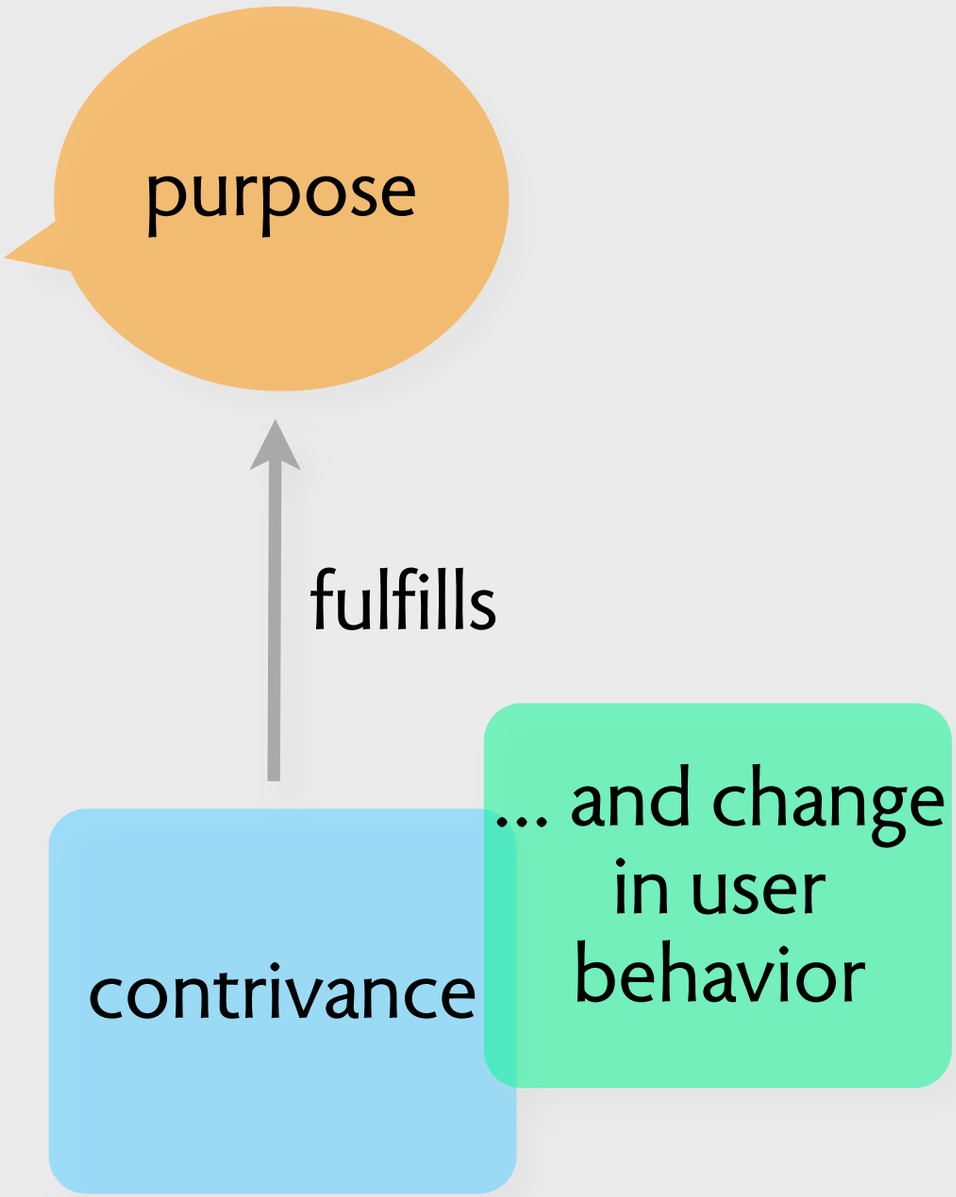
never fully predictable



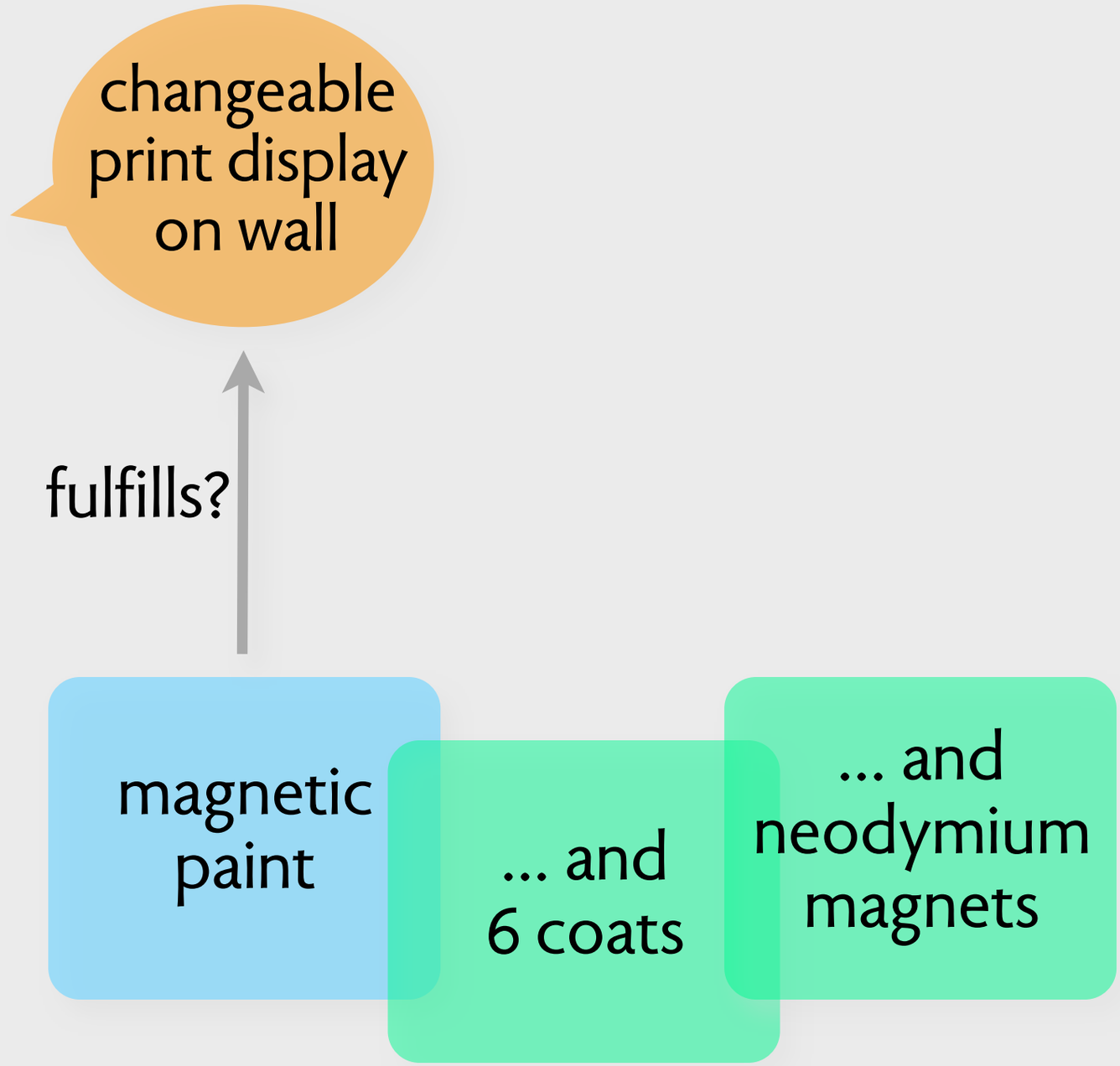


[S]uch a list of requirements is potentially endless... But if we think of the requirements from a negative point of view, as potential **misfits**, there is a simple way of picking a finite set. This is because it is through misfit that the problem originally brings itself to our attention. We take just those relations between form and context which obtrude most strongly, which demand attention most clearly, which seem most likely to go wrong. We cannot do better than this.

perturbing the context

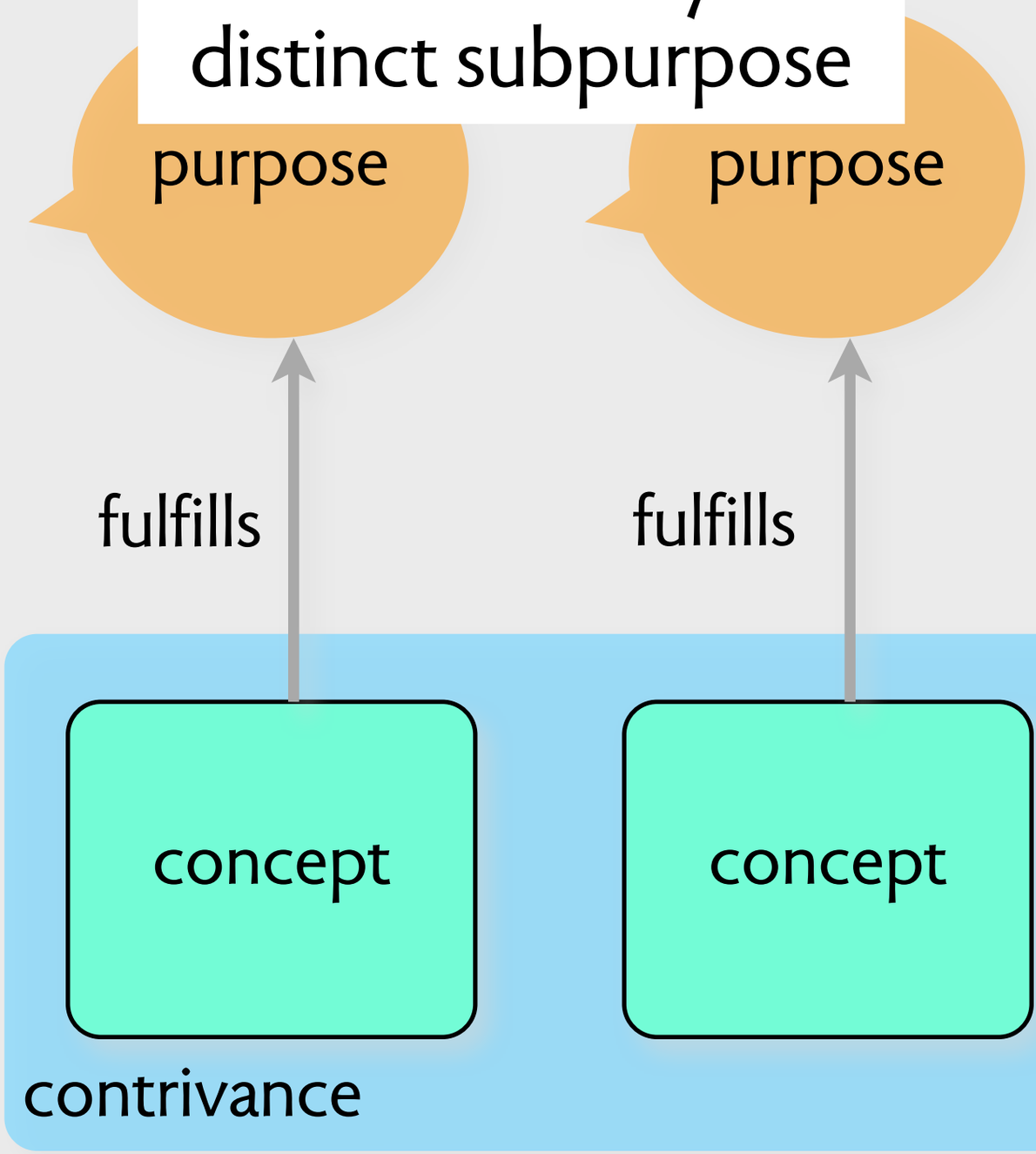


evaluating contextual demands

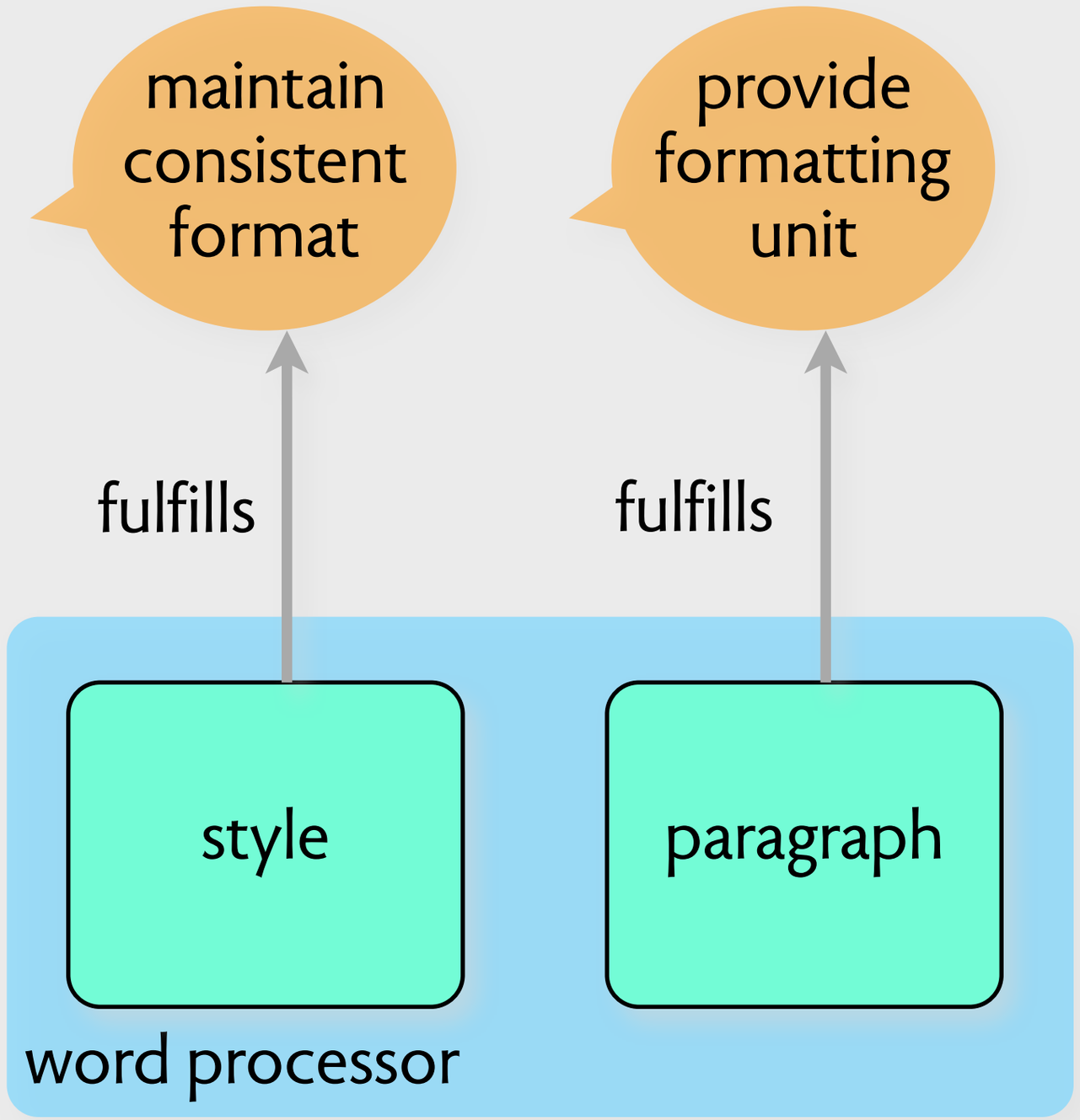


concepts & purposes

every concept is motivated by a distinct subpurpose

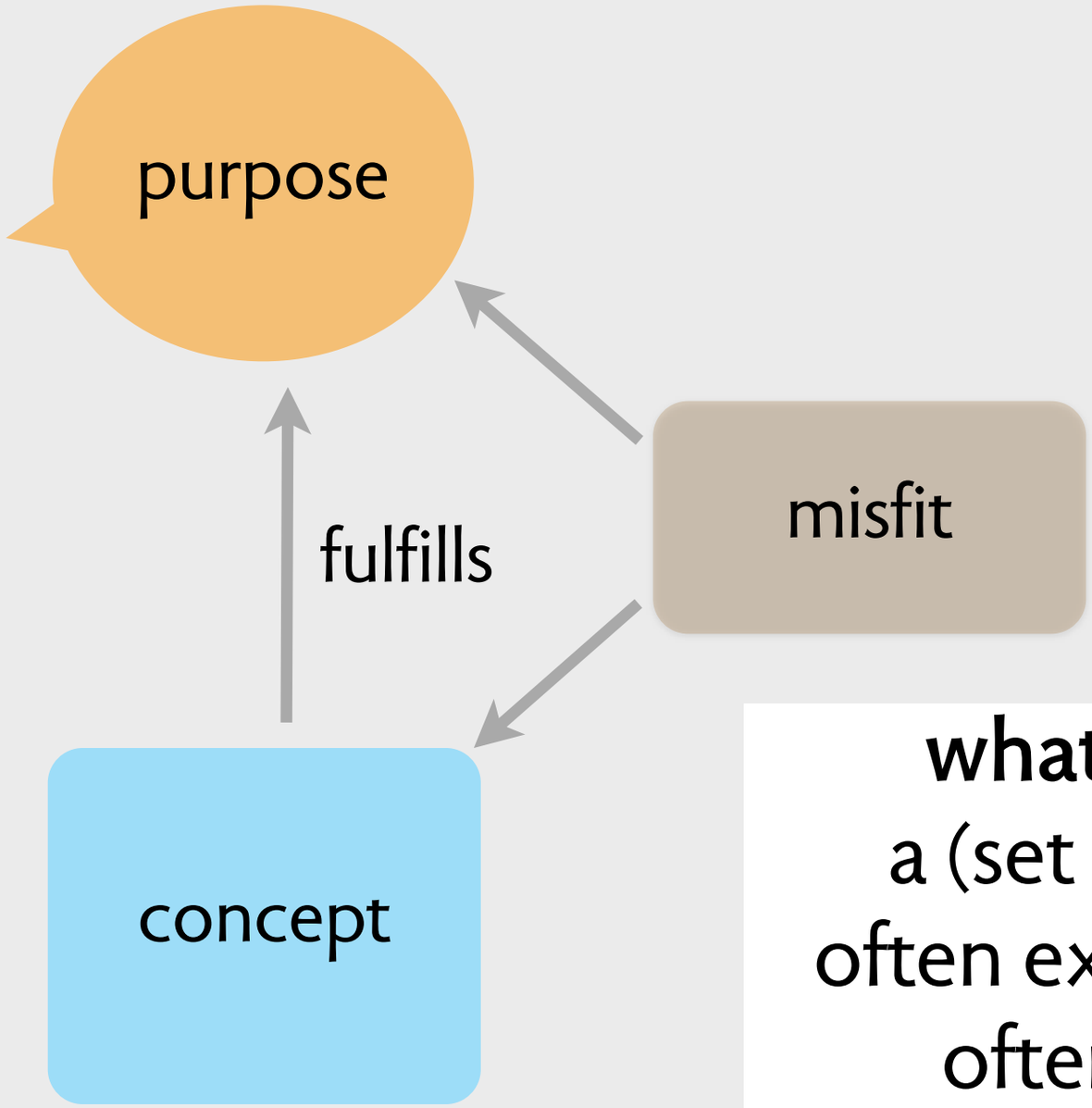


example: text formatting



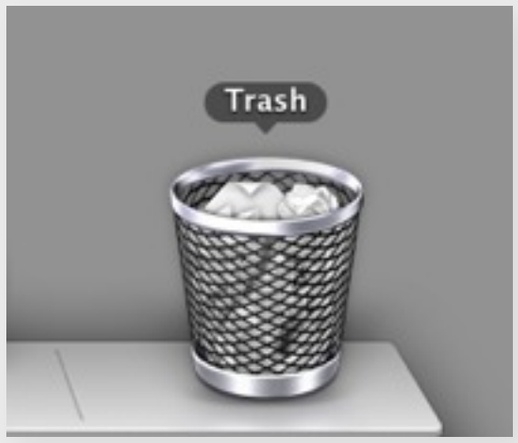
concepts & purposes

fit for purpose



what is a misfit?
a (set of) scenarios
often expands context
often surprising

misfit example



concept
Macintosh trash

purpose
allow files to be undeleted

scenario
user inserts USB key
attempts to copy files to it
finder says “not enough space”
user deletes all files on key
finder says “not enough space”
user realizes must empty trash
but this trashes all files on all disks...

concept

criteria

concept criteria

compelling:clear operational principle, one purpose

coherent: interaction with other concepts predictable

controllable: fulfills purpose without interference

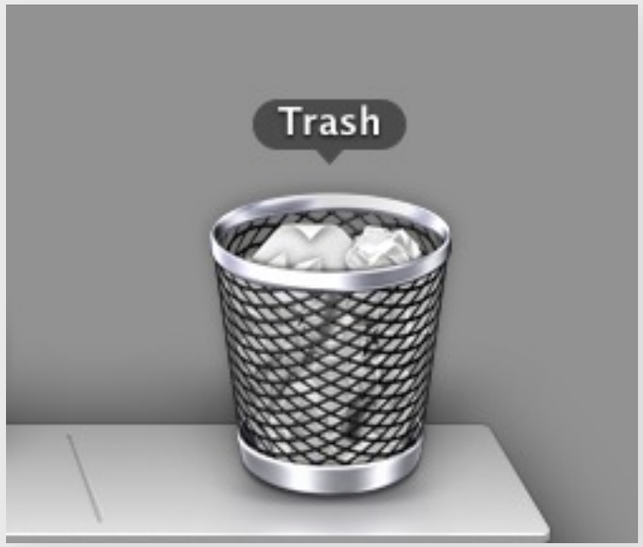
complete: general and uniform over concept's scope

consistent: represented consistently in the user interface

conventional: reuses existing concepts when applicable

compelling

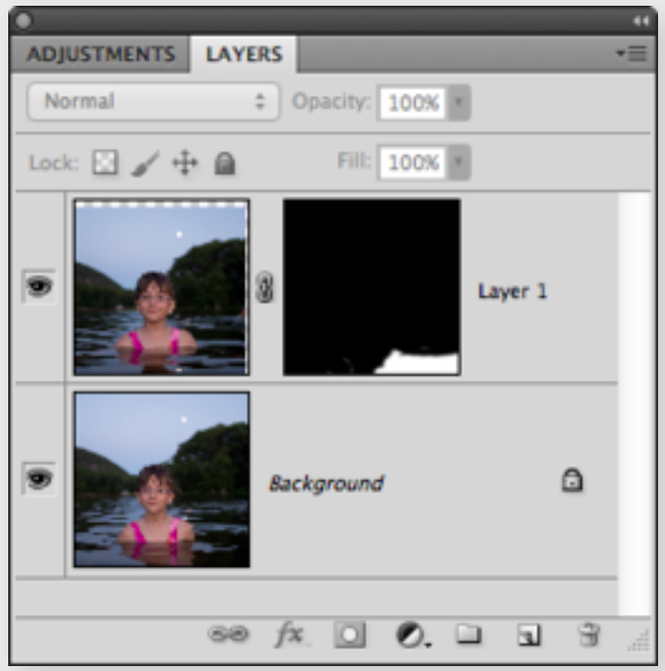
simple operational principle & motivated by one purpose



trash (OS X)

principle: delete moves to special folder; emptying it removes contents for good

purpose: allow undo of deletions



layer (Photoshop)

principle: resulting pixel map is background map with composition of functions given by layers

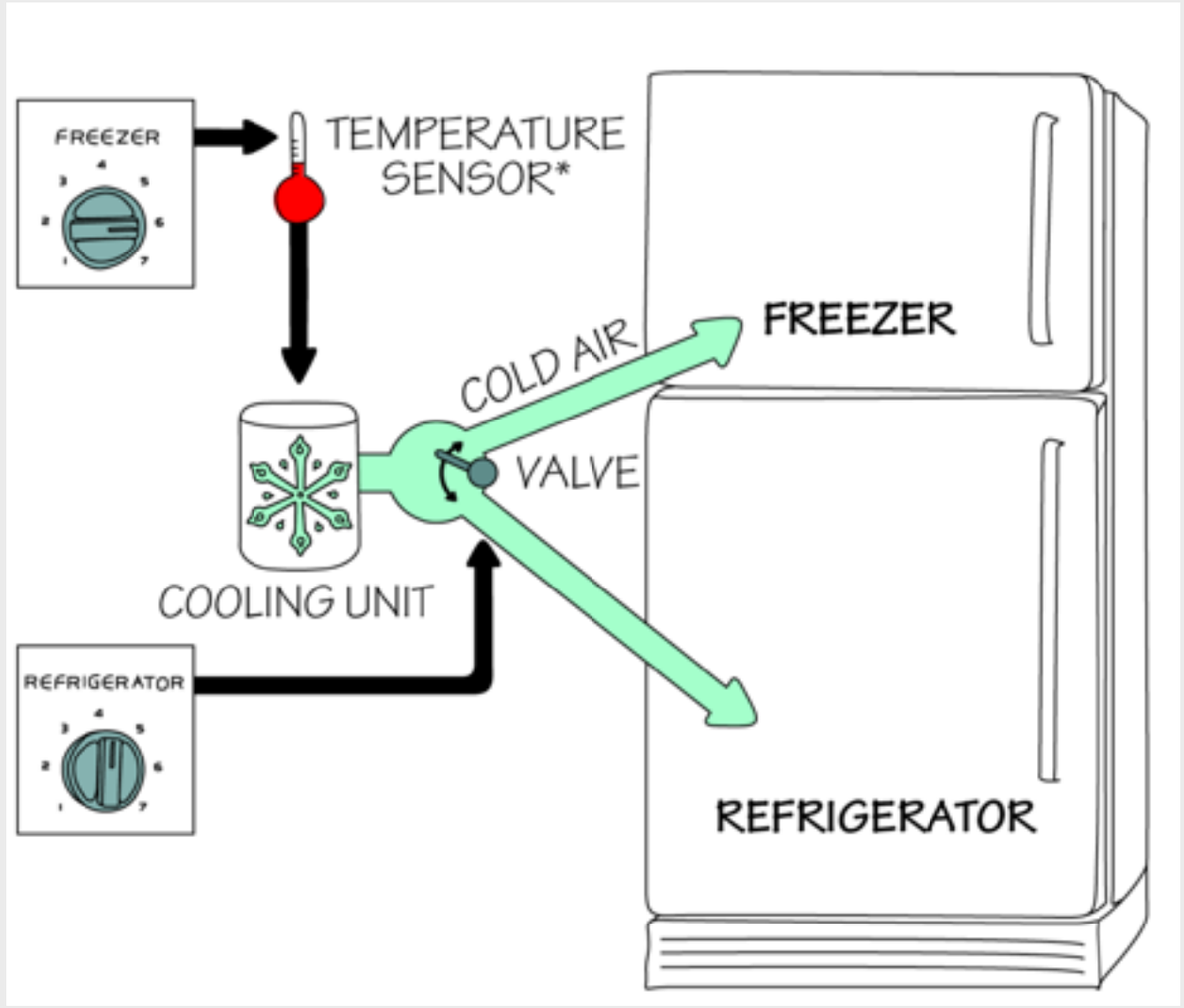
purpose: non-destructive edits

refrigerator controls

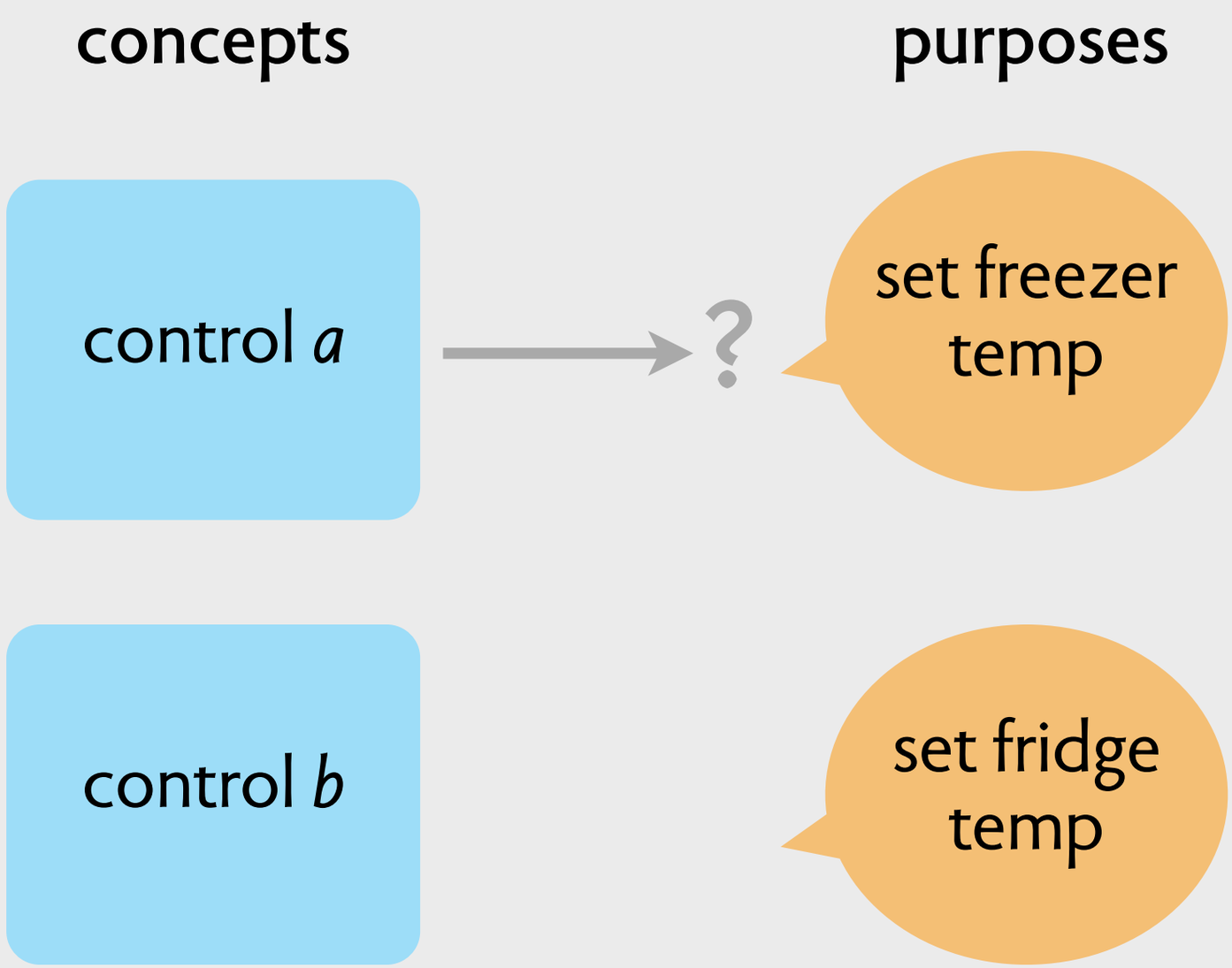
Don Norman, Design of Everyday Things, 1988 (2013)

controls

internal mechanism



refrigerator mapping



rating stars

from Marc Hamburg, lead Lightroom engineer

purpose? not collection or even catalog specific

more uncompelling concepts

no single clear purpose

Git's staging area

JPEG quality and resolution

Gmail's categories (vs labels)

no simple operational principle

CSS's dimensions (inches, pixels)

Tumblr's answers vs comments

serves someone else's purpose

direct flight (legs share flight number)

coherent

realization and interaction with other features is predictable

=AVERAGE(B3:B12)

	A	B	C
1	year	population	increase
2			
3	1999	272,690,813	2,442,810
4	1998	270,248,003	2,464,396
5	1997	267,783,607	2,555,035
6	1996	265,228,572	2,425,296
7	1995	262,803,276	2,476,255
8	1994	260,327,021	2,544,413
9	1993	257,782,608	2,752,909
10	1992	255,029,699	2,876,607
11	1991	252,153,092	2,688,696
12	1990	249,464,396	
13	average	261,351,109	

relative reference

=AVERAGE(B3:B12)

	A	B	C
1	year	population	increase
2			
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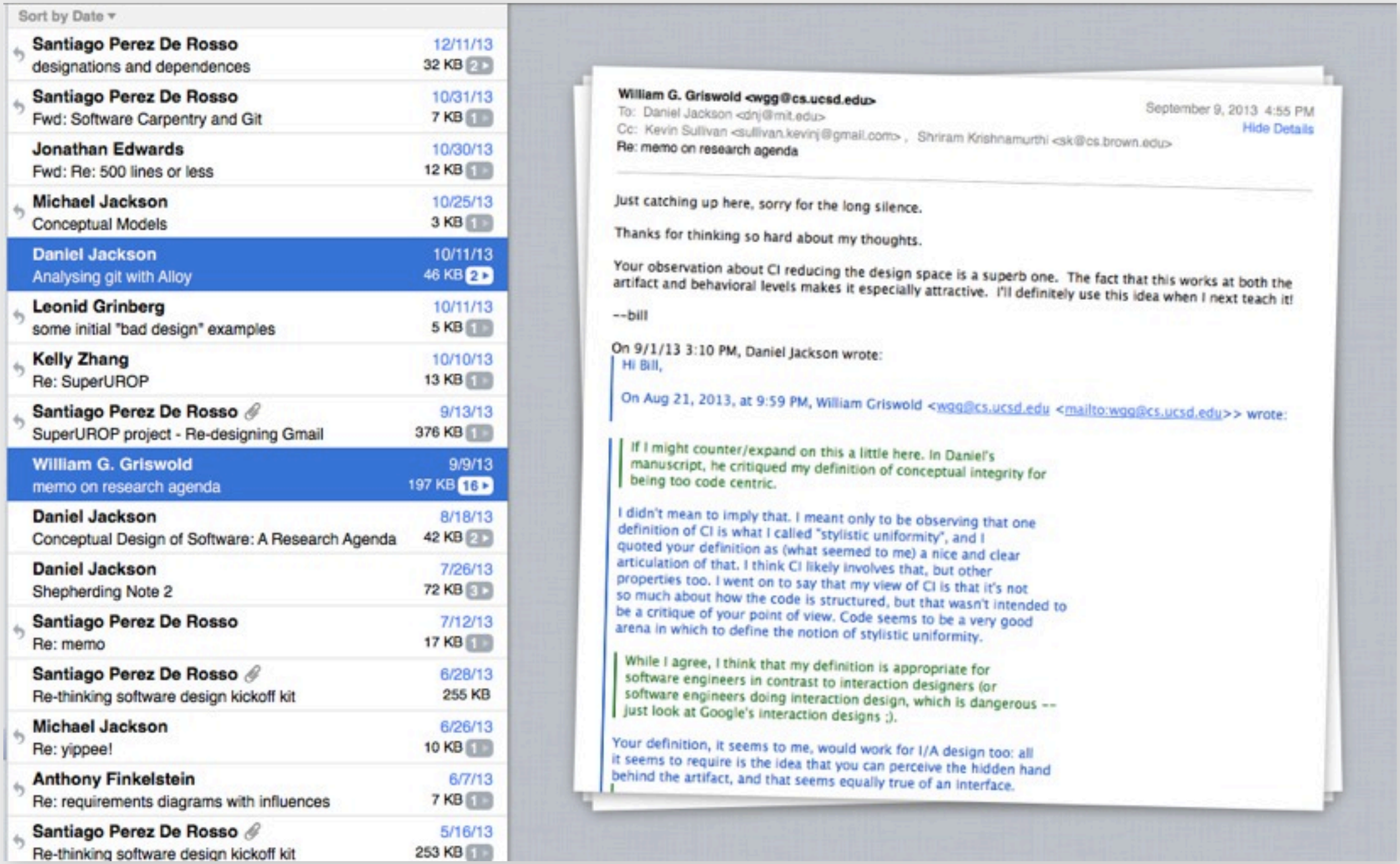
13			
14	average	261,351,109	

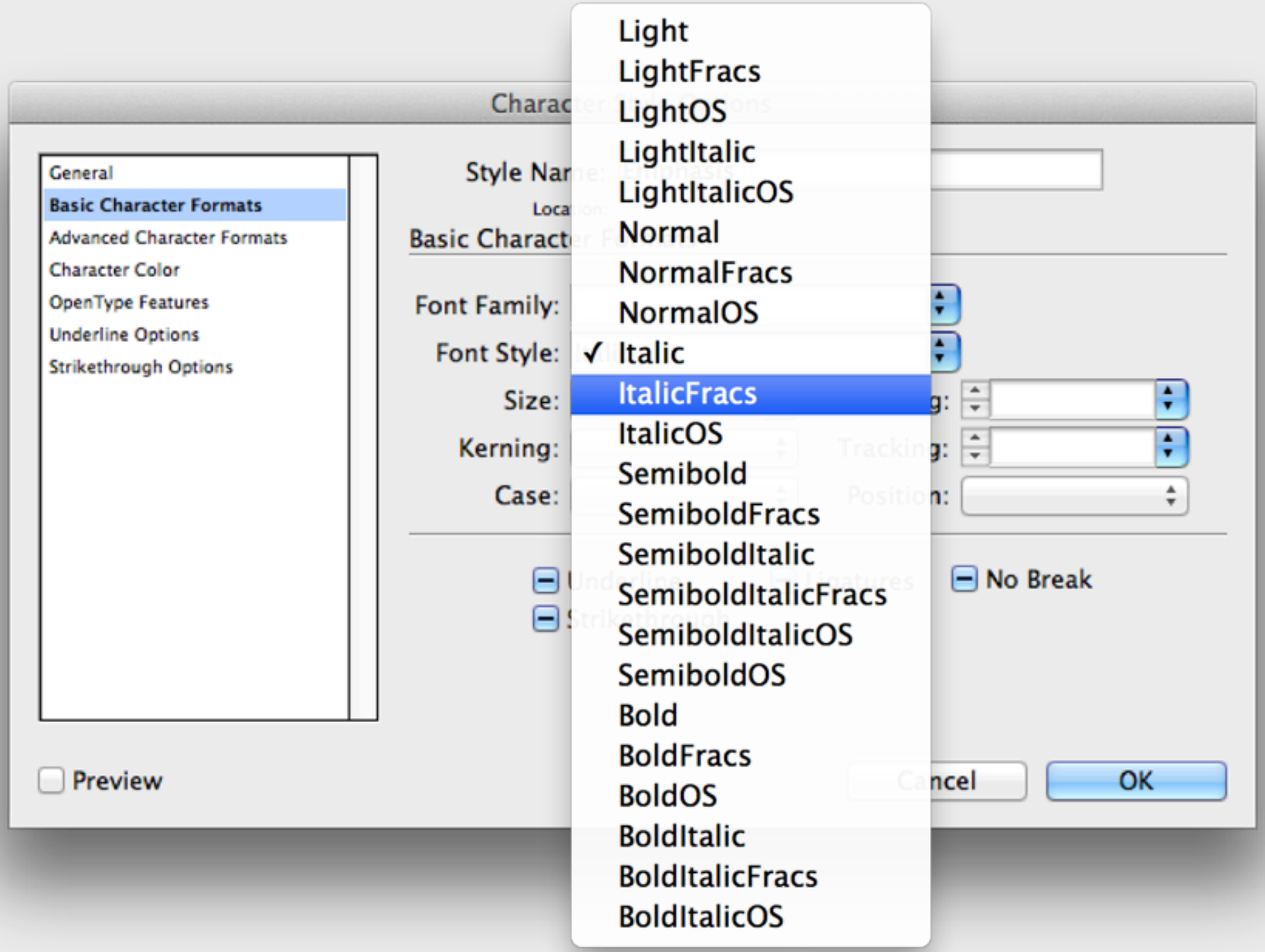
adding row: values unchanged

email conversations



Apple Mail: conversation consists of messages in multiple folders
move, delete, etc apply only to the subset in this folder

what's a font?



so character style can only italicize some fonts

more incoherent concepts

Apple Mail's contact names
appear in sent messages!

Facebook's shared album
can move photos in but not out

Google form column hide
hides in sheet, but not in published summary

controllable

fulfills purpose without interference from other concepts

skip slide

make parent

make parent and skip

skipping and hierarchy do not interfere in Apple Keynote

gmail labels & conversations

from Eunsuk Kang

Eunsuk Kang <eskang@csail.mit.edu>
To: Daniel Jackson <dnj@MIT.EDU> , Santiago Perez De Rosso <sperezde@csail.mit.edu>
an example of bad coupling in gmail?

December 11, 2014 2:27 AM
Hide Details
Conceptual Design

Hi Daniel, Santiago,

I am not sure whether this falls into one of the conceptual design issues that you have been analyzing, but here's a little annoyance that I just ran into using labels in Gmail.

This evening, I made two separate reservations with Enterprise (one in Phoenix and another one in Vegas), and the company sent me a confirmation e-mail for each one of them. Usually, I tag travel-related e-mails using a label (e.g. "Vegas Trip 2014") so that I can easily find all the relevant e-mails for a particular trip. Now, the problem is that Gmail automatically grouped the two Enterprise emails into a single conversation. It turns out that in Gmail, a label applied to an e-mail in a conversation is applied to every other e-mail in the same conversation. This means I can't assign separate labels to the two car rentals! Uggh!

(By the way, is it possible to take an e-mail out of a conversation? Either this is impossible or the Gmail UI does not make this easy).

Eunsuk

conversations interfere with labels

aspect ratio fuji x100s

image quality setting

aspect ratio

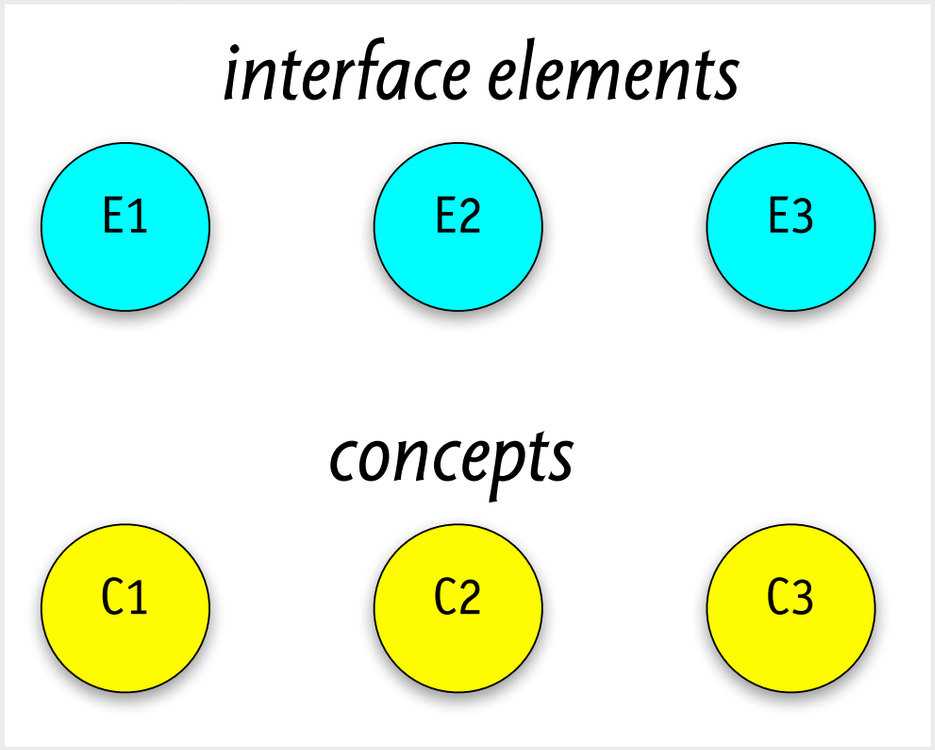
“image size” setting

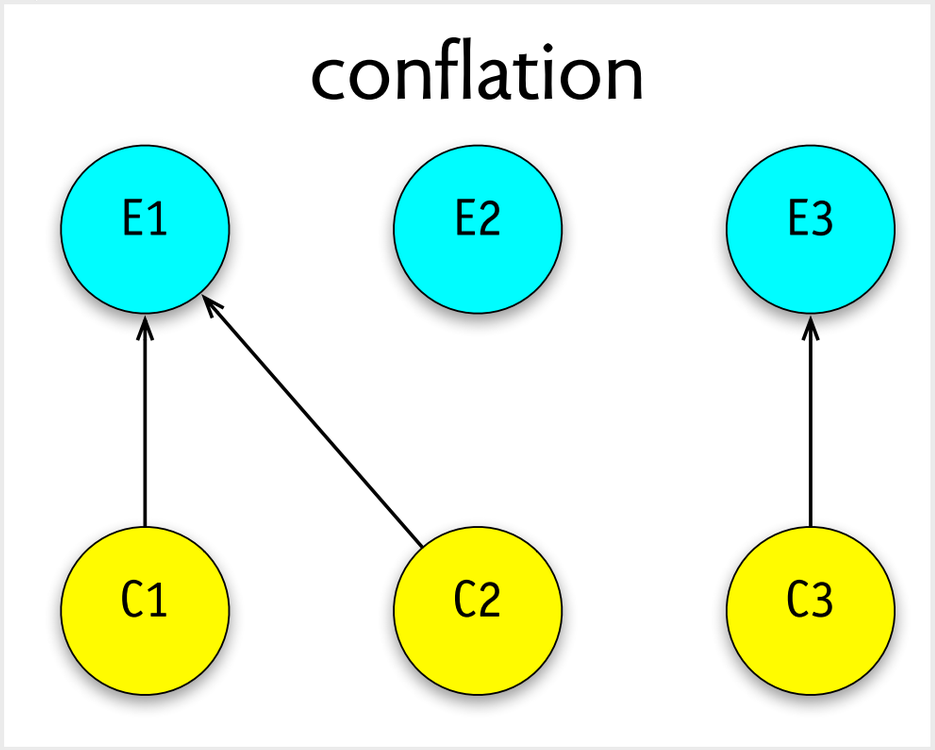
non-standard ratio + RAW?

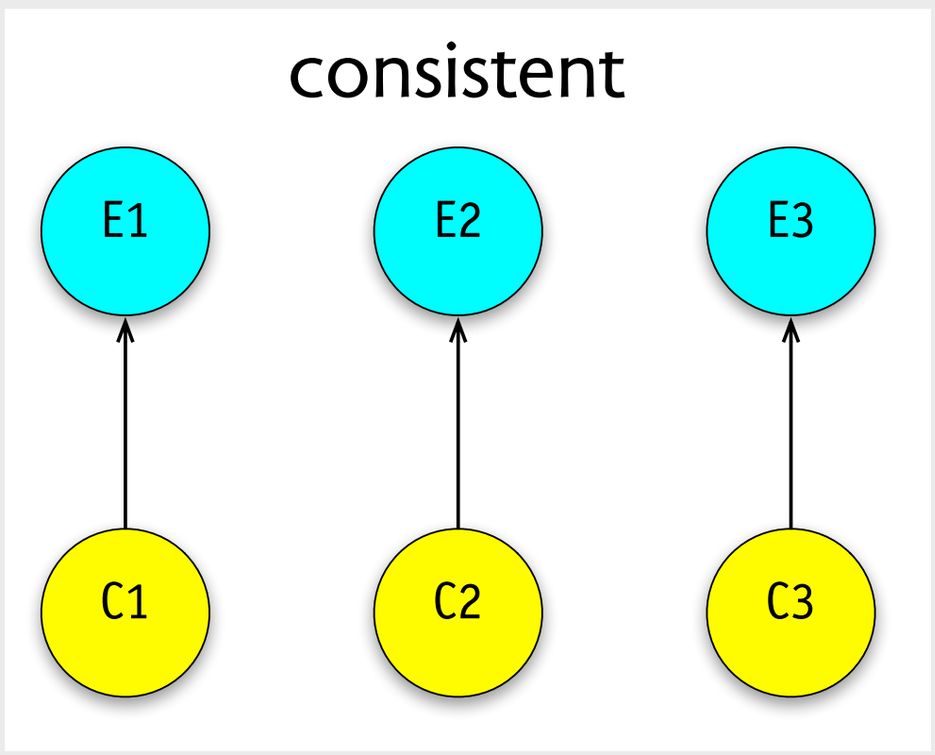
image quality interferes with image size

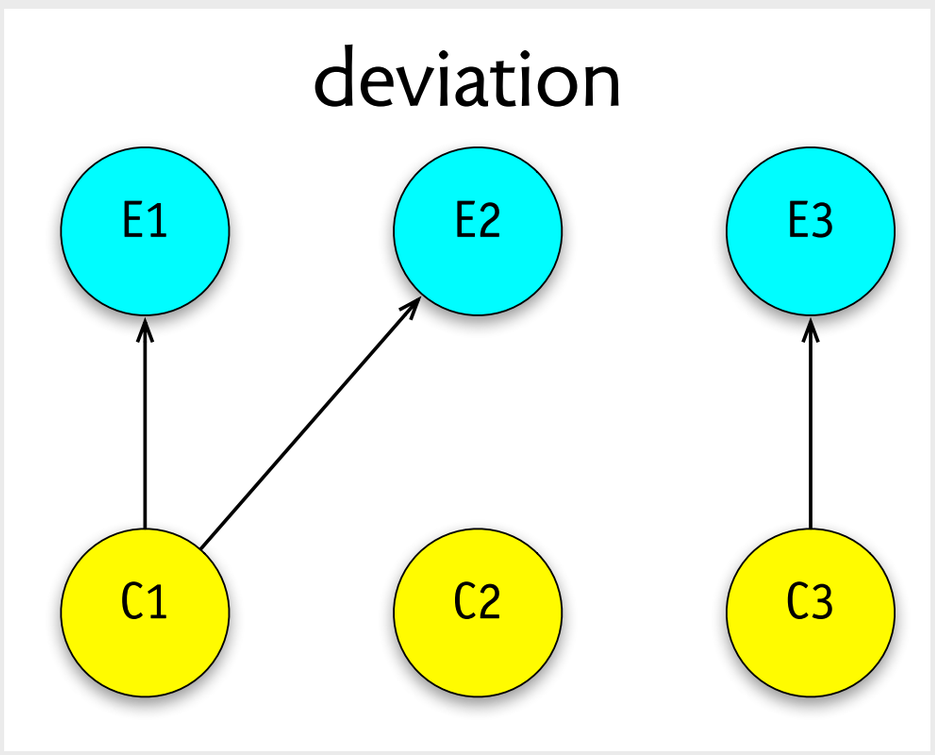
consistent

represented consistently in the user interface





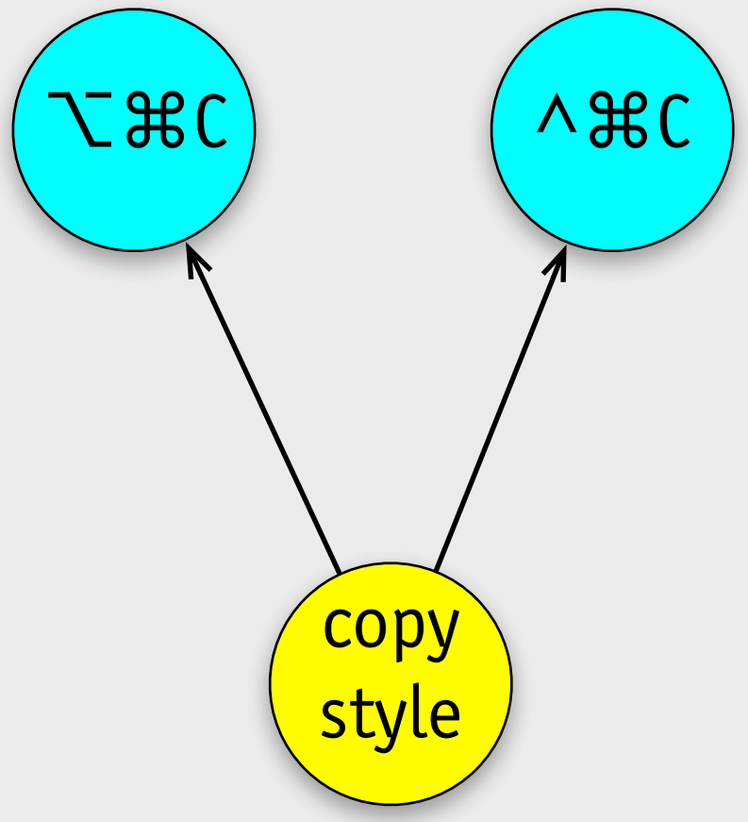




deviation in OS X apps

OmniGraffle:
control key

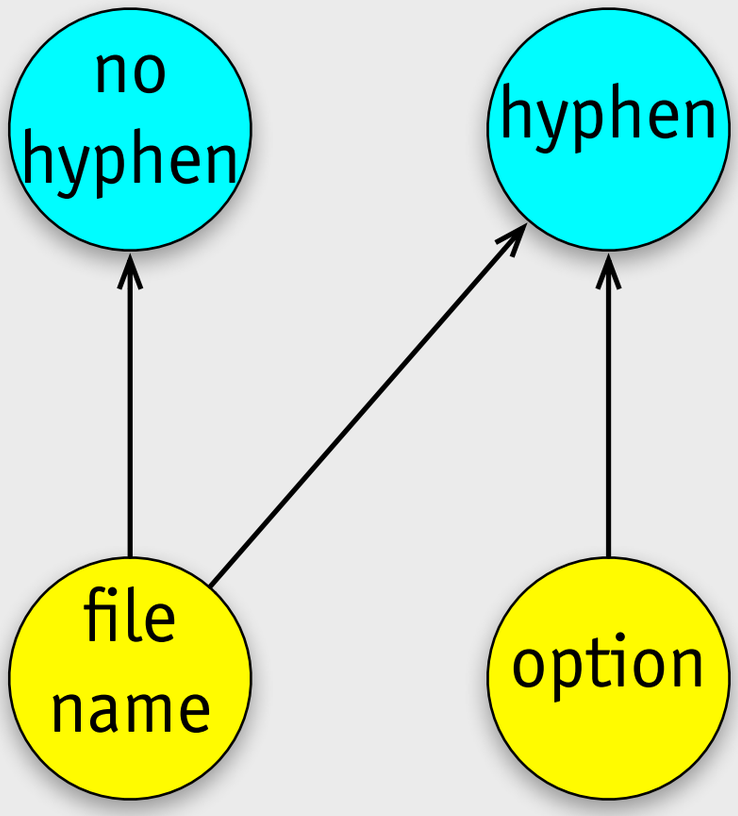
Apple apps:
option key



conflation in unix

from the Unix Hater's Handbook

```
[chim:~] dnj% mv readme -README
[chim:~] dnj% mv -README readme
mv: illegal option -- R
usage: mv [-f | -i | -n] [-v] source target
       mv [-f | -i | -n] [-v] source ... directory
```



a sad dropbox tale

Quora

Search

Dropbox: Edit

Someone accidentally deleted thousands of files in my company Dropbox: how can I quickly undelete them? Edit

Add Question Details

Comment · Share · Report · Options

STORAGE & NETWORKING file sharing, dropbox

Friends don't let friends delete shared Dropbox items

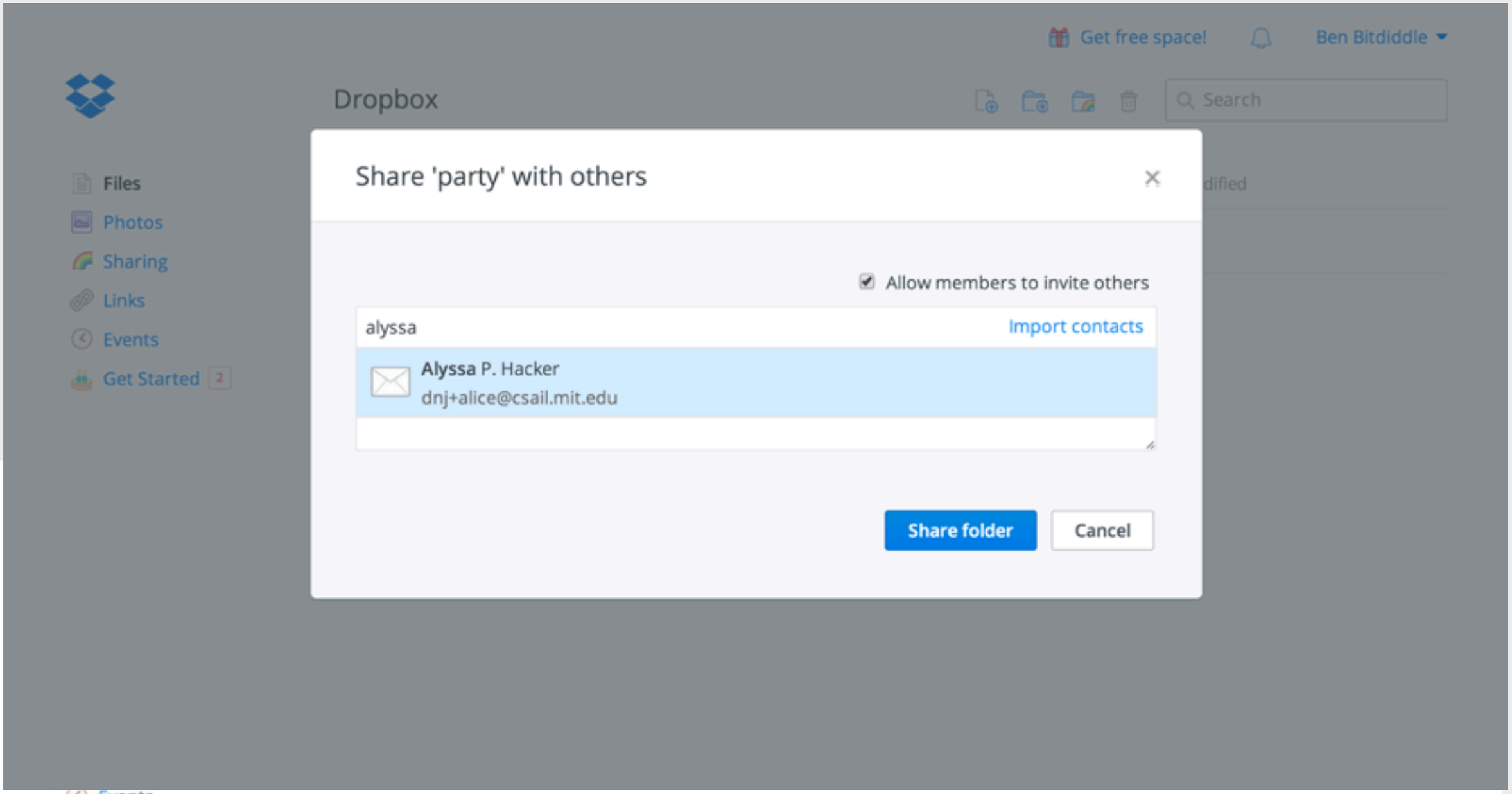
Christopher Breen
@BodyofBreen

Sep 9, 2013 5:00 AM

Reader Paul Cramblett has a problem with others who just don’t know how to share. He writes:

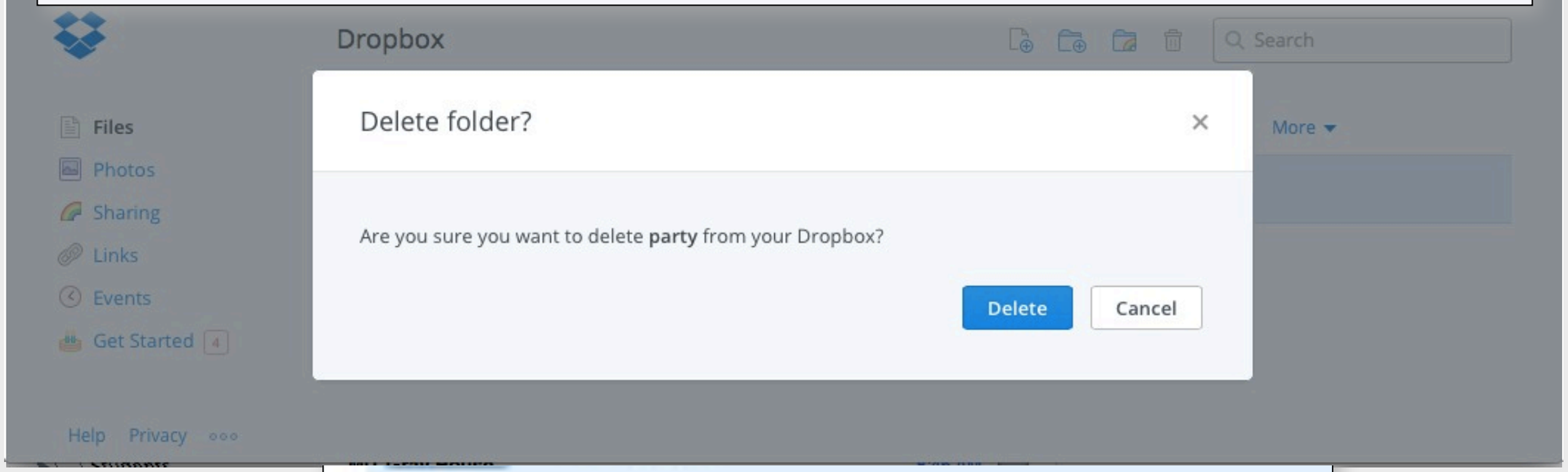
> *I maintain a Dropbox folder that I use to share files with a select group of friends. I've tried to explain how Dropbox works to these people but someone invariably drags all the files out of the folder, which means they’re no longer available to the rest of us. Is there some way to prevent files from being removed by someone who doesn’t understand the difference between “copy” and “move”?*

alyssa & ben plan a party



alyssa spoils everything

Are you sure you want to delete **party** from your Dropbox?



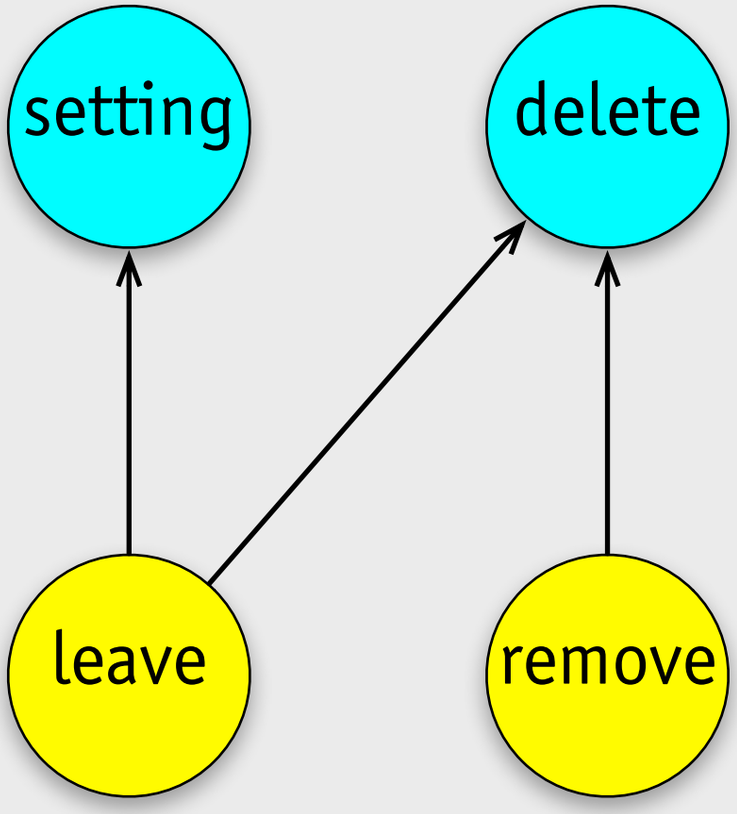
Are you sure you want to delete **invitations** from your Dropbox?

conflation in dropbox

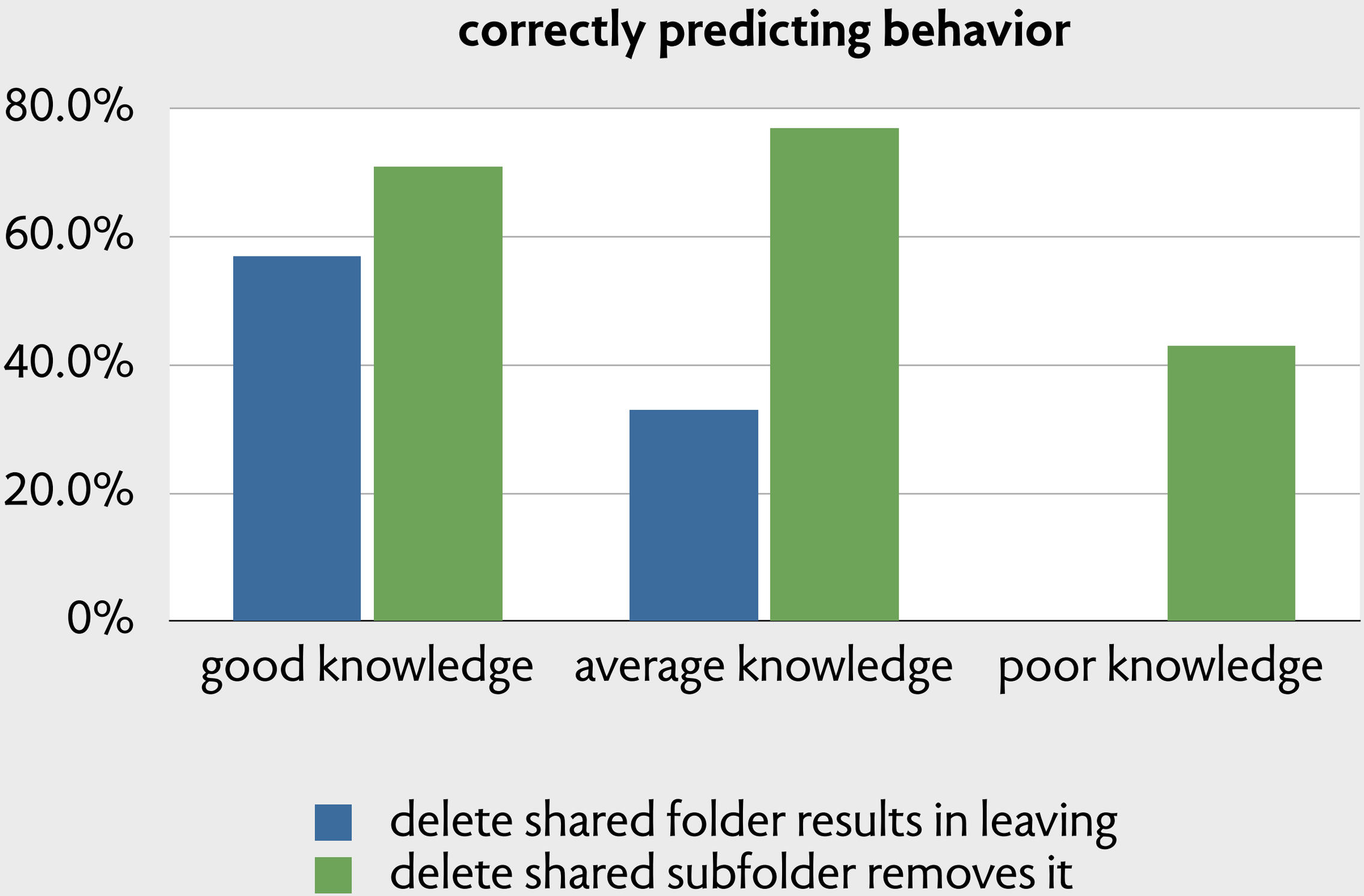
How do I leave a shared folder?

“by changing the folder’s settings or by deleting it”

You can leave a shared folder at any time by changing the folder's settings on the Dropbox website or deleting it. If you change your mind or leave a folder accidentally, you can rejoin it later.



small survey of MIT dropbox users



study by Kelly Zhang

conventional

reuses existing concepts when applicable

concept idioms: across apps

style: separate formatting from element

selection: select objects to apply action to set

subtle issues & their solution

reapply in different context

eg, partial styles

some apps are just cliches

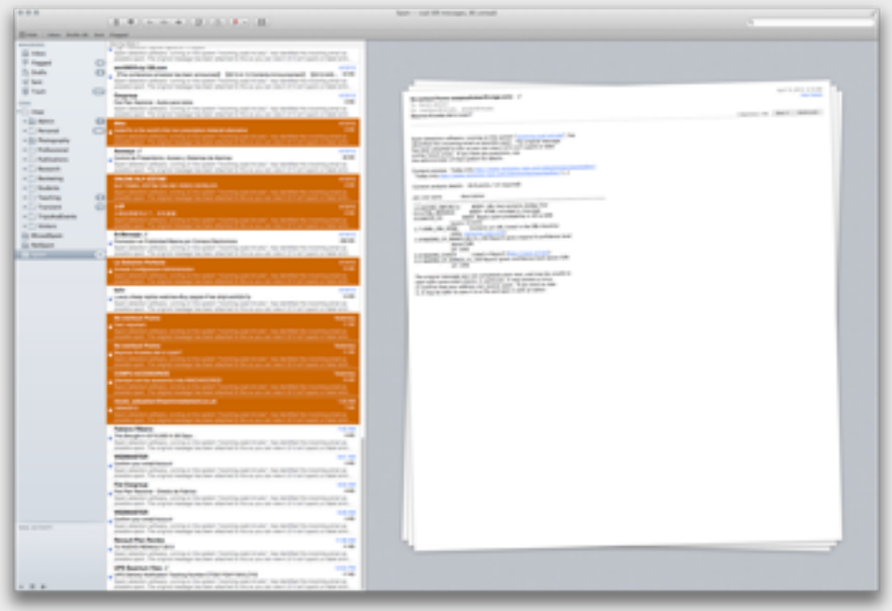
collection of idiomatic concepts

social app = {profile, post, friend, notify}

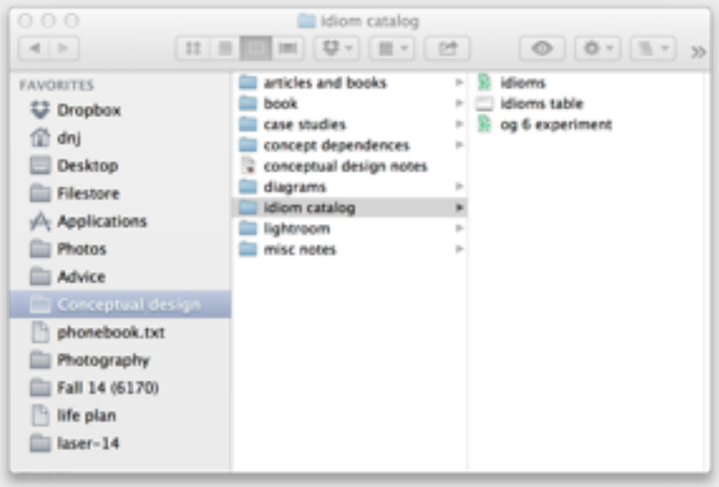
concept idiom selection

slides in Keynote

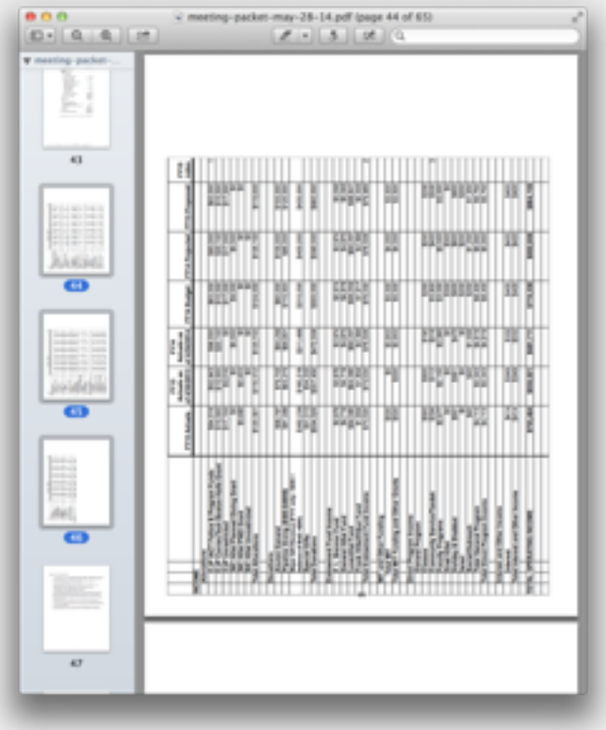
photos in Adobe Lightroom



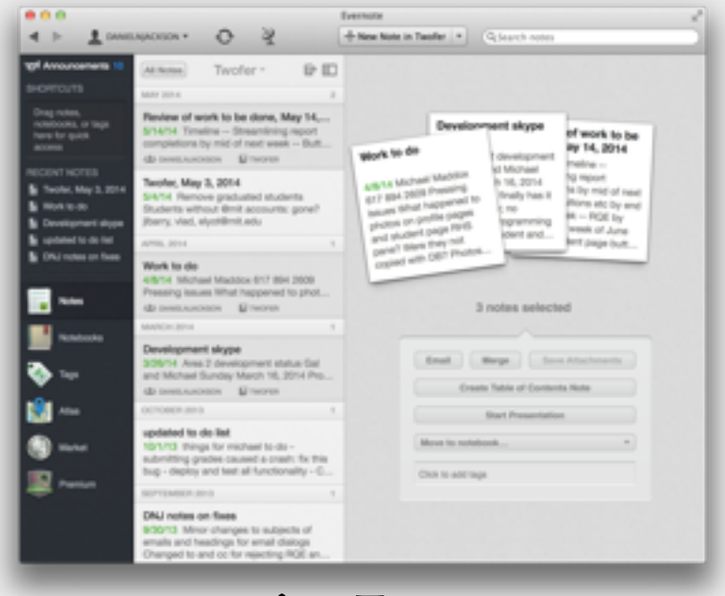
messages in Apple Mail



objects in OS X Finder

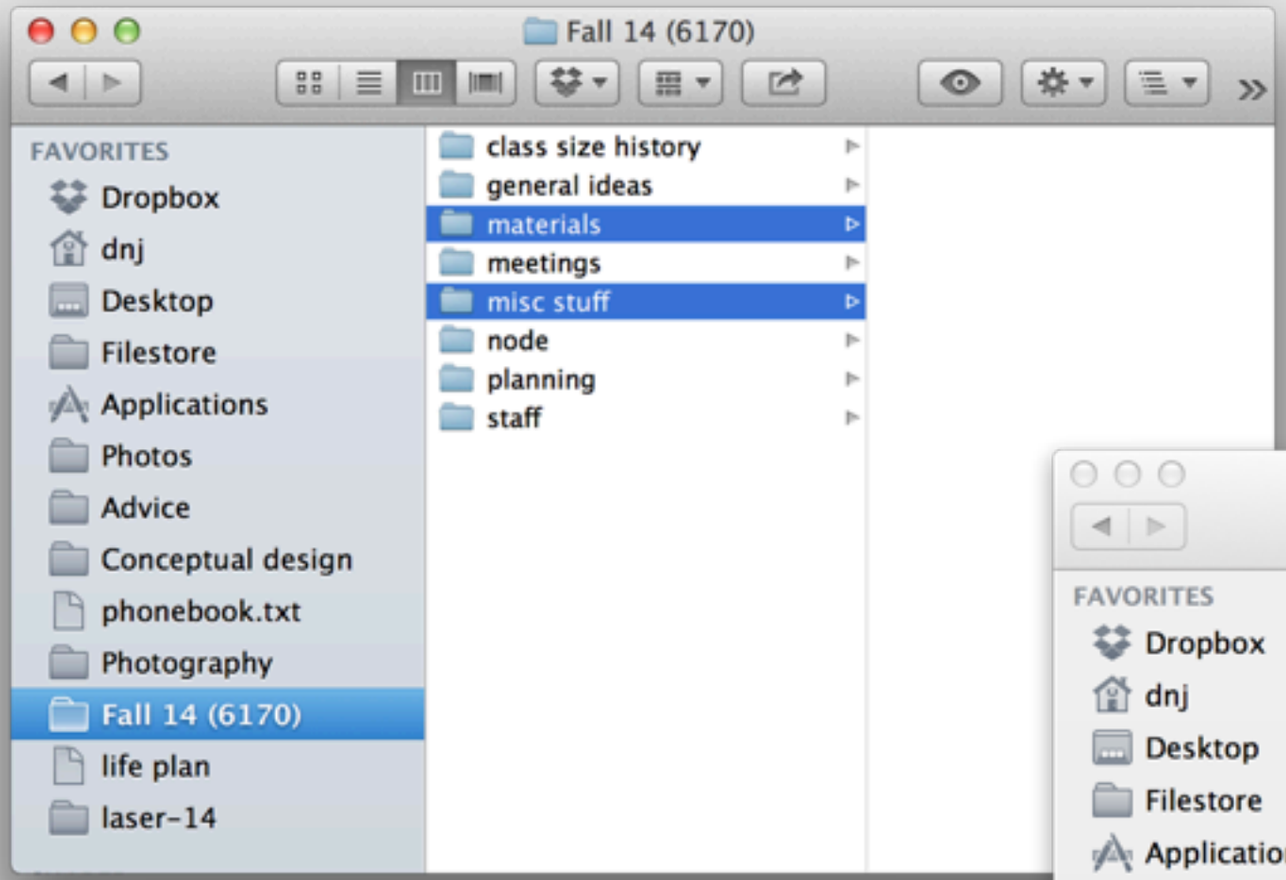


thumbnails in Preview

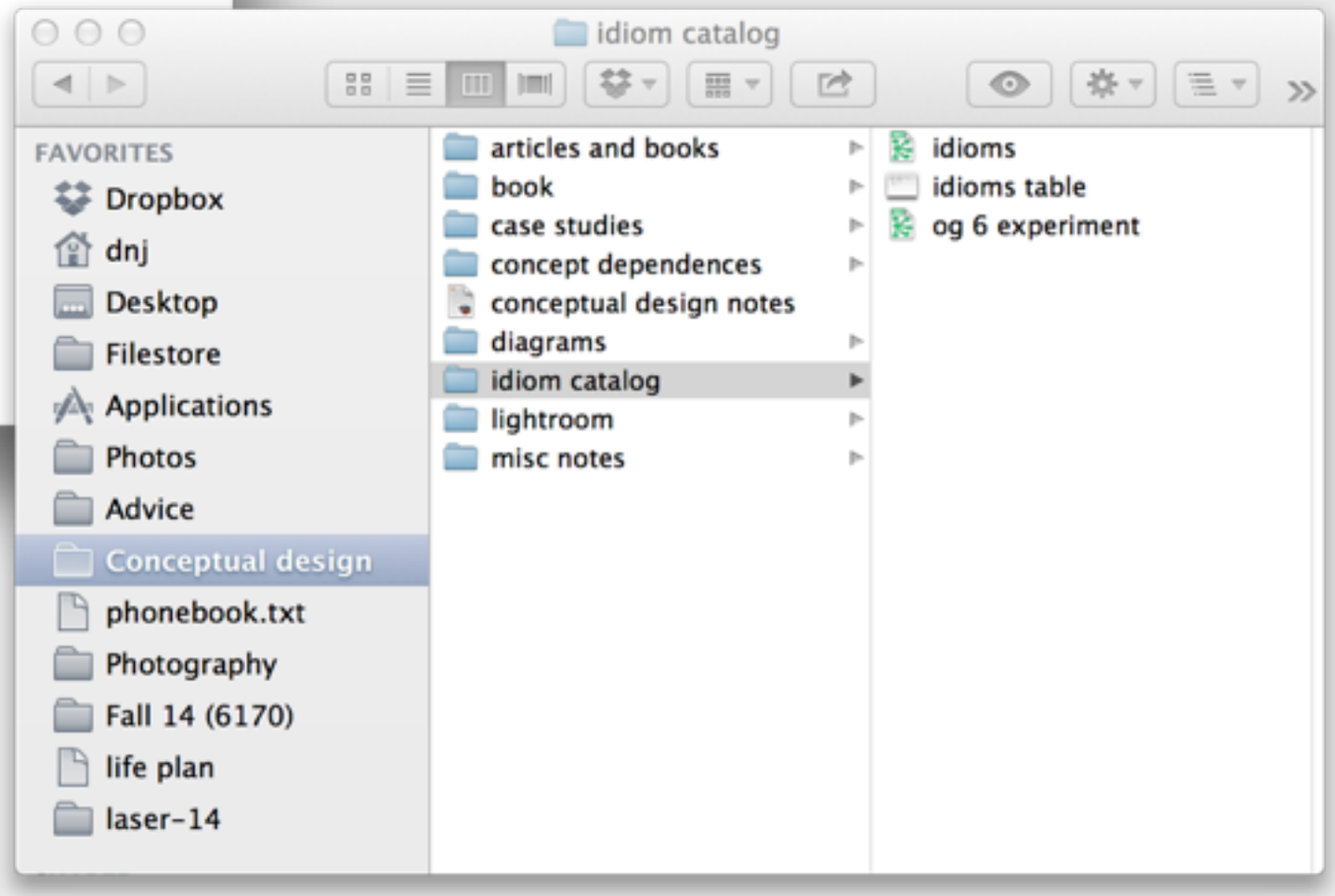


notes in Evernote

subtlety selection scope



subset of selection in scope

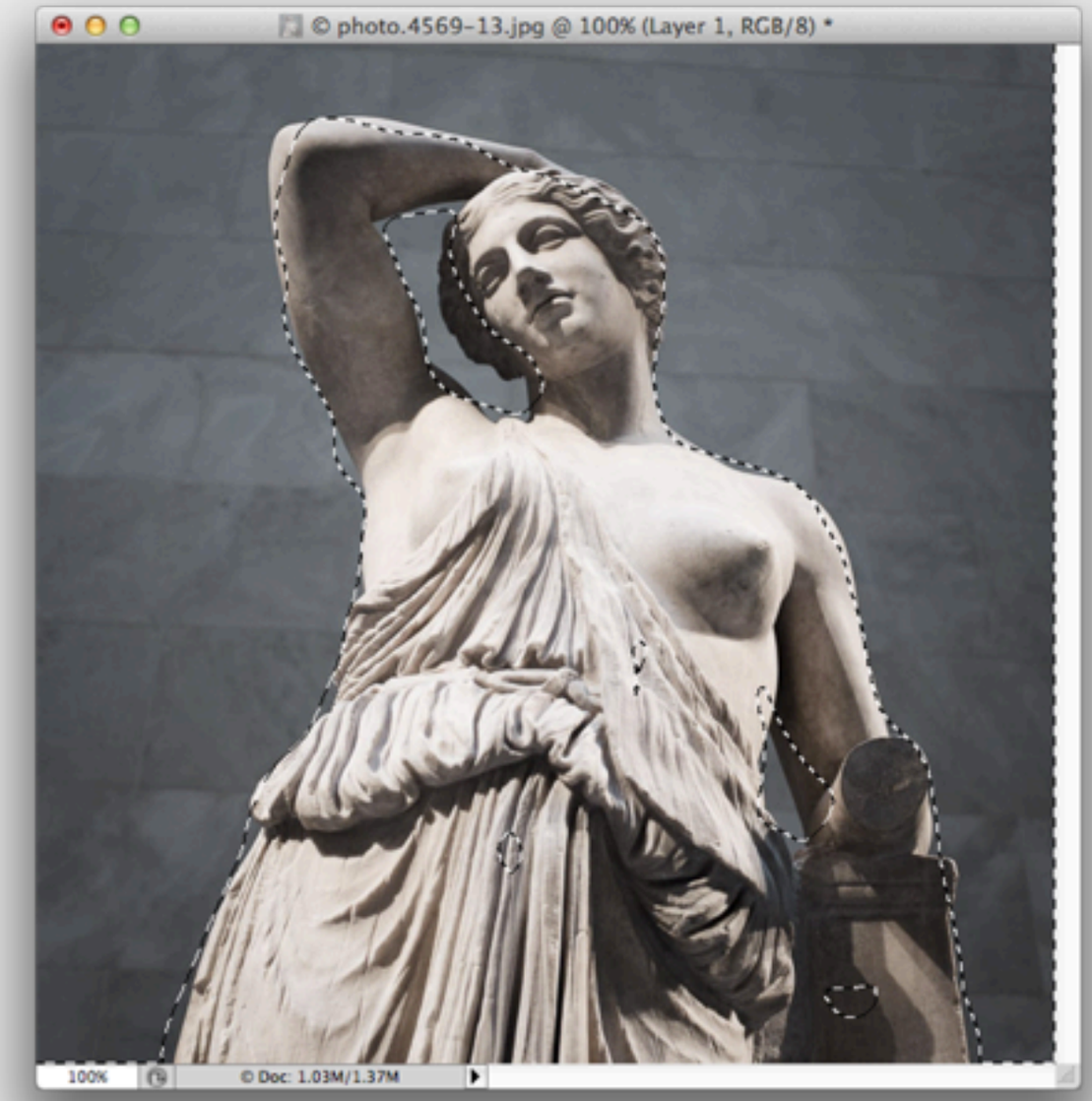


subset of selection out of scope

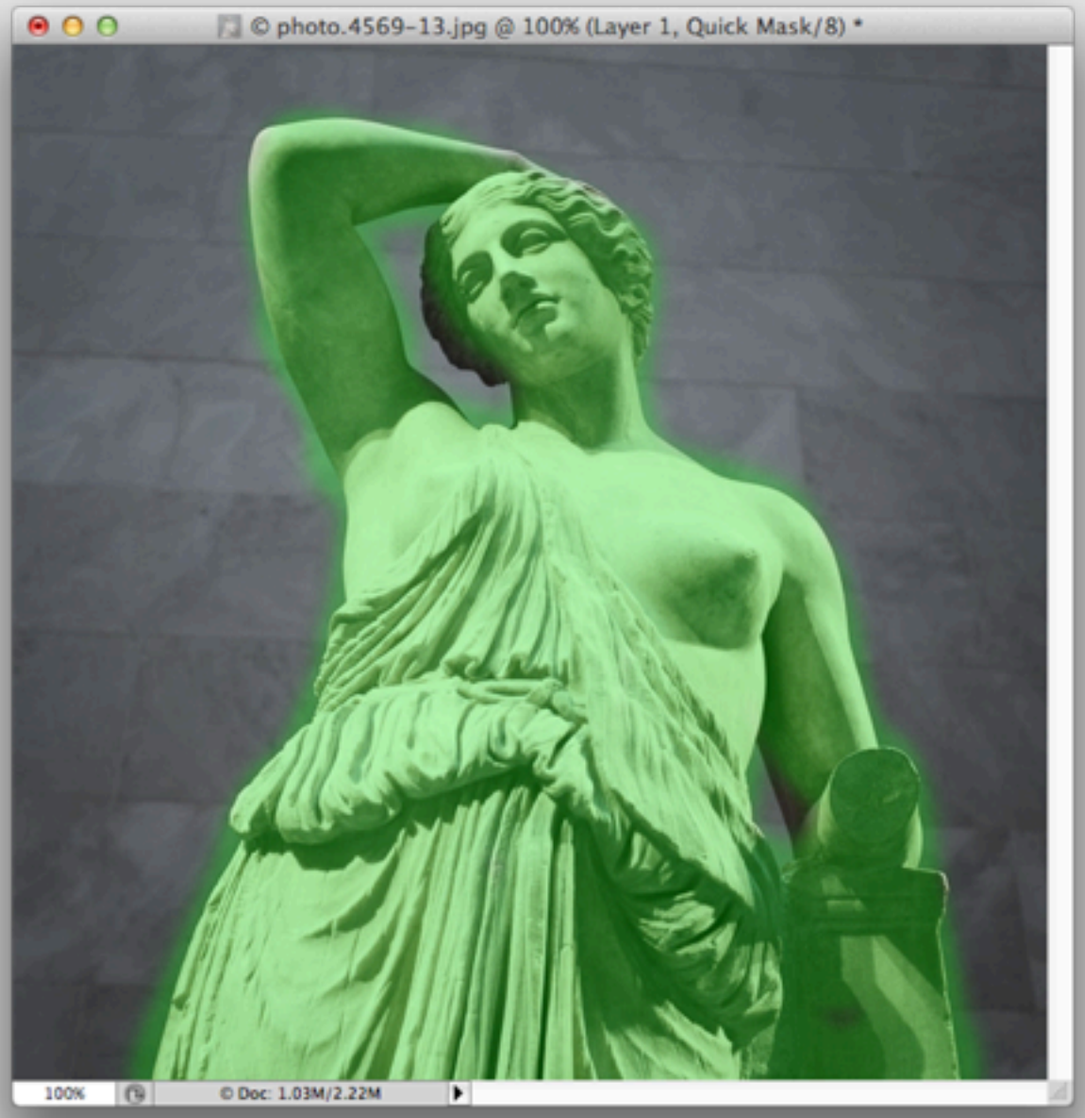
subtlety active element

Adobe Lightroom: brightest thumbnail is the “active photo”

subtlety continuous selection

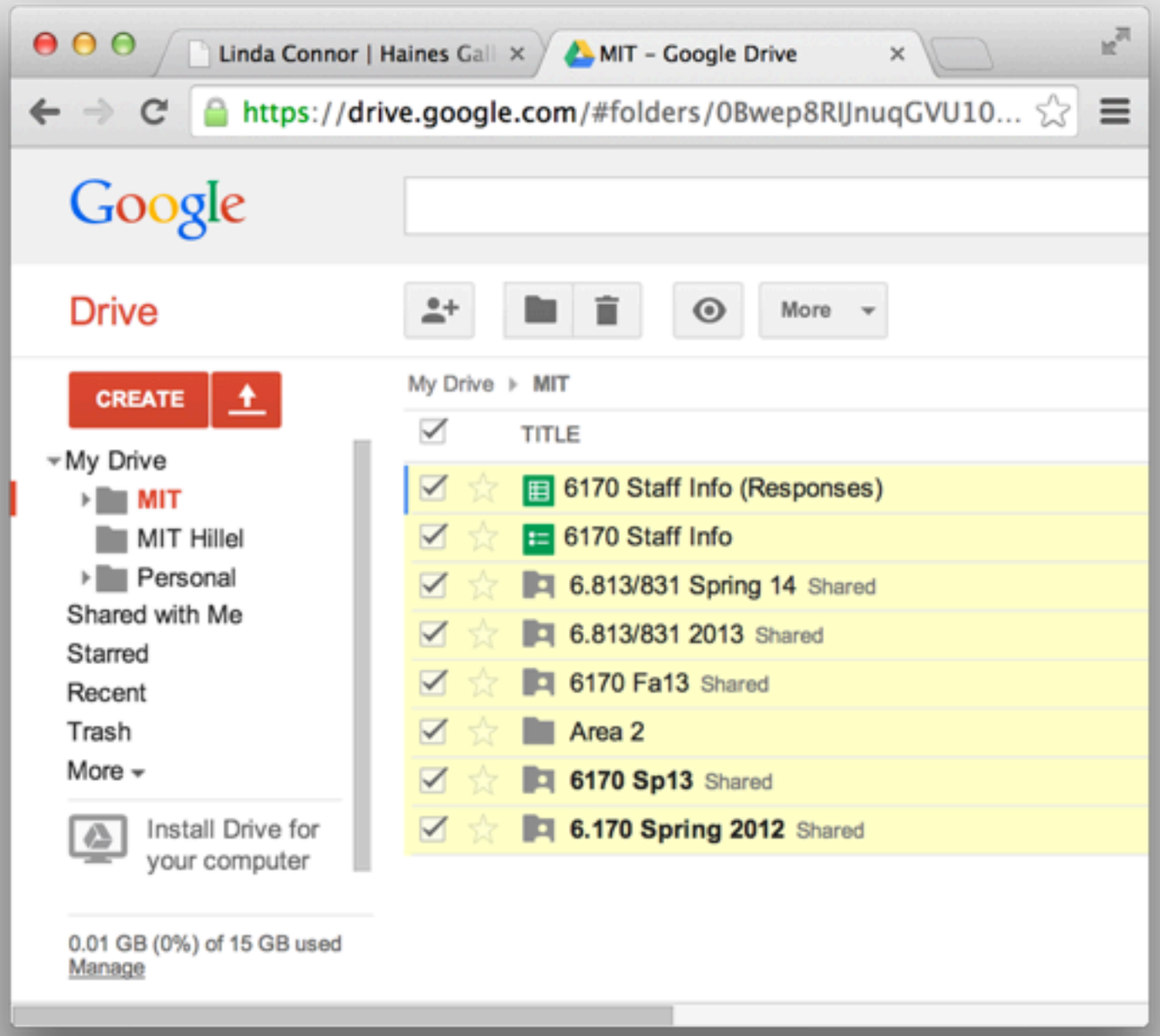


Photoshop: outline shown with “marching ants”

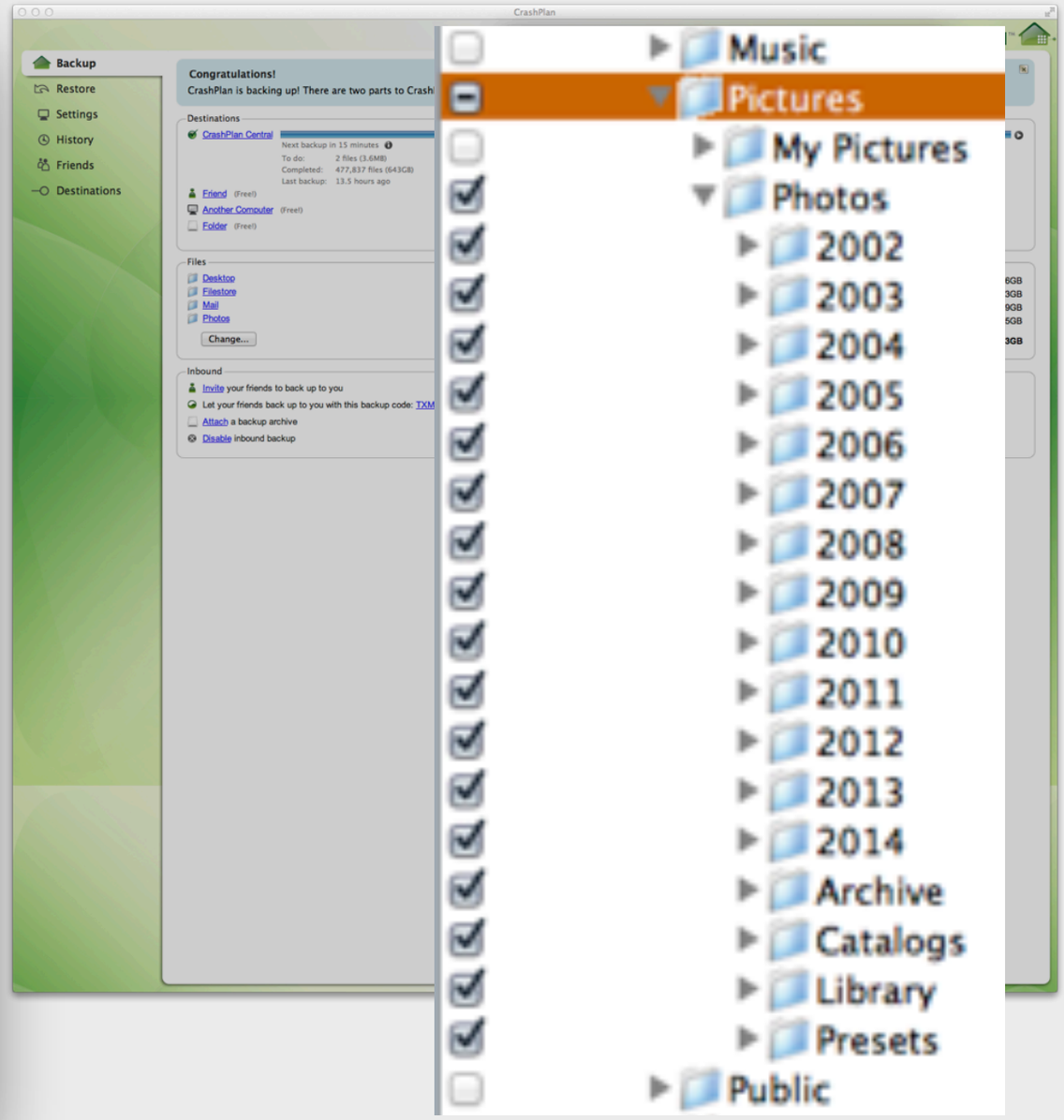


Photoshop: selection shown in Quick Mask mode

subtlety folder selection

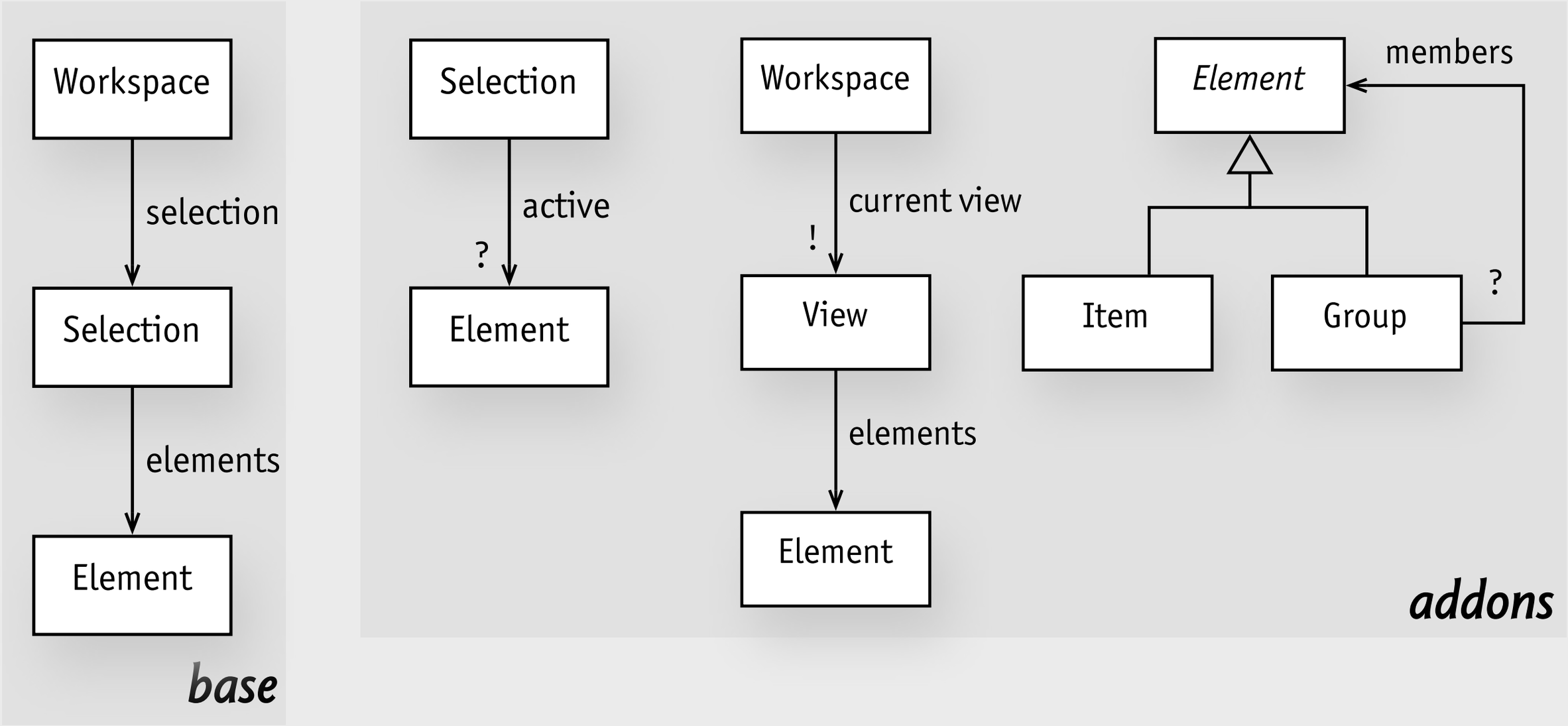


Google Drive: selecting folder = selecting children



CrashPlan: selecting folder = selecting all future children

concept idiom selection



Purposes: apply action in aggregate to many items at once

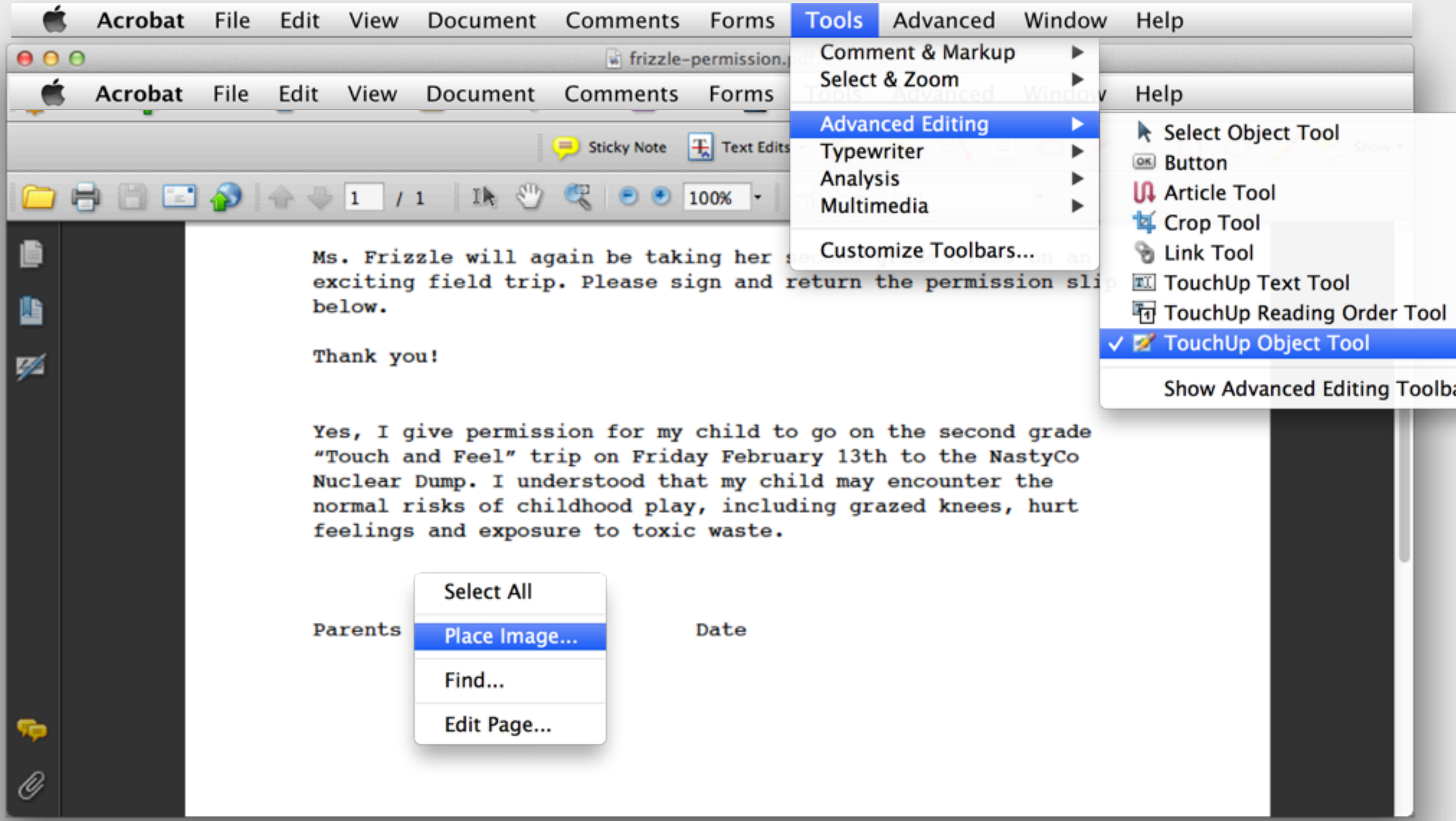
idiom catalog (so far)

instantiate	*organize*	*relate*	*resource*	*save*	*communicate*	*personalize*
stylesheet	**selection**	**friend**	**access token**	**history**	**message**	**account**
master	**folder**	**clique**	**notification**	**buffer**	**posting**	**karma**
stencil	**group**	**invitation**	**reservation**	**cursor**		**OOBA**
style buffer	**label**		**REST**	sync		**rating**
	layer		cart	export		status
	stack		subscription			
	alias		purchase order			
	preset		RMA			
	cursor		coupon			
	filter		catalog			
	property					
	metadata					

a happy end

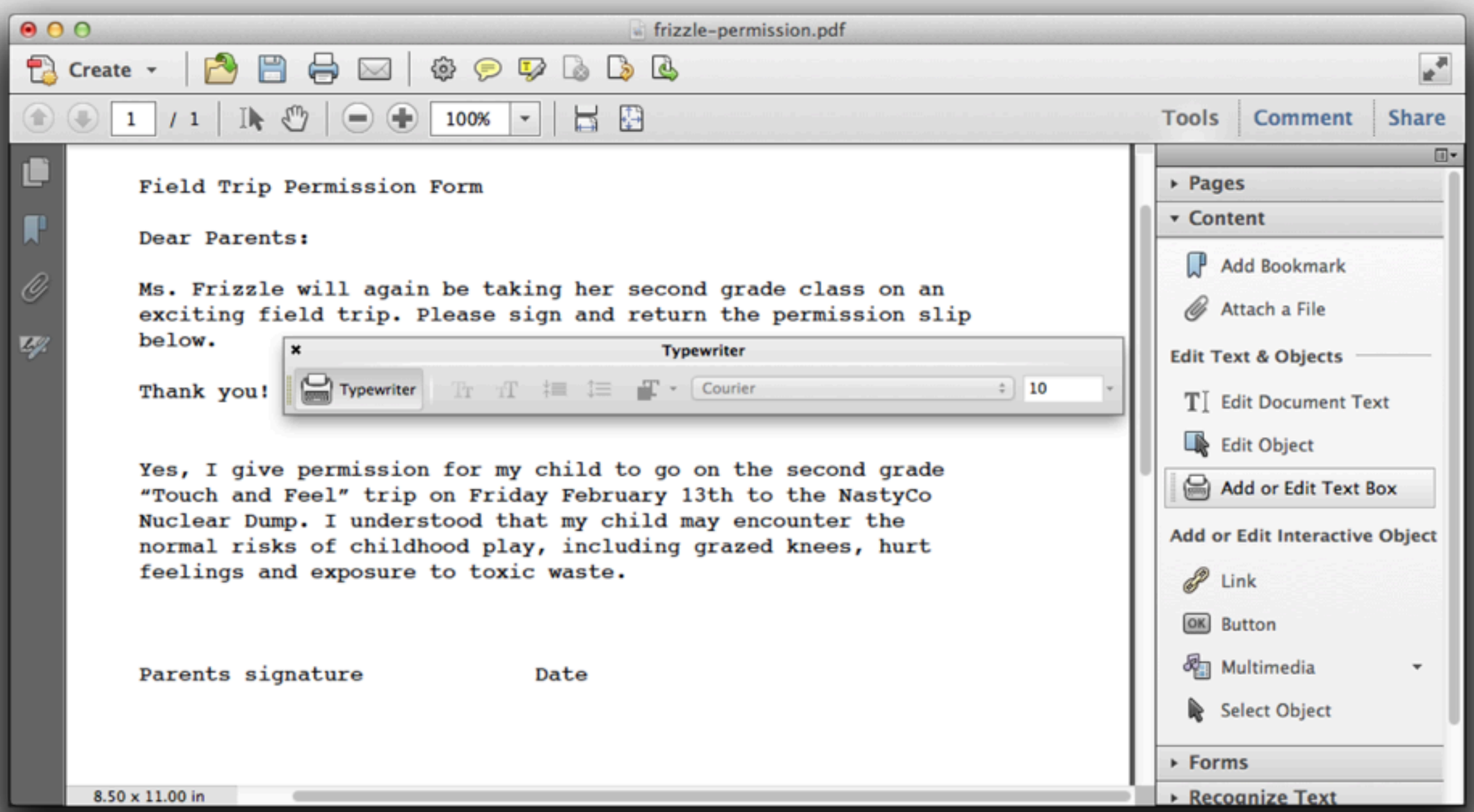
to a sad story?

acrobat (version 09)



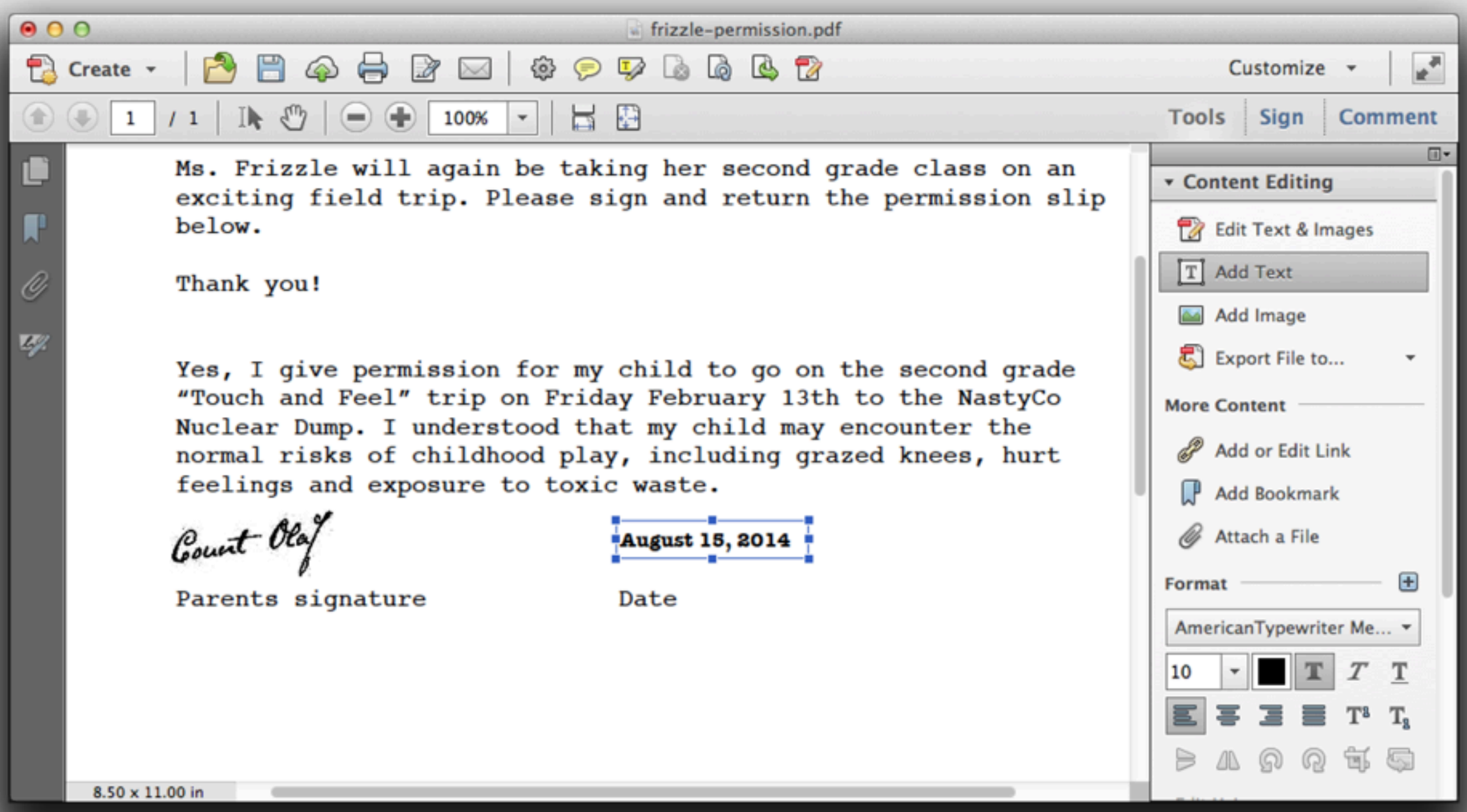
hard to discern any compelling concepts

acrobat (version 10)



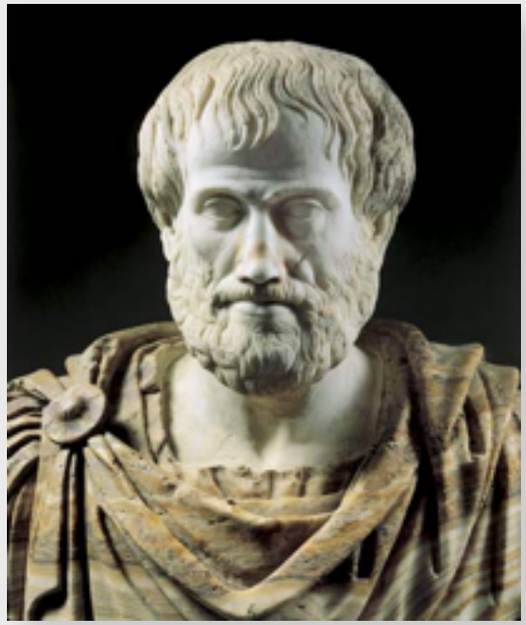
user interface has been reworked but still *text*, *text box*, *object*

acrobat (version 11)



conceptual reworking: now just *text*

related work & inspirations



Aristotle: telos

Fred Brooks:
conceptual integrity

Michael Jackson:
problem frames

Nam Suh:
independence axiom

David Parnas:
uses relation

Martin Fowler:
analysis patterns

Michael Polanyi:
operational principle

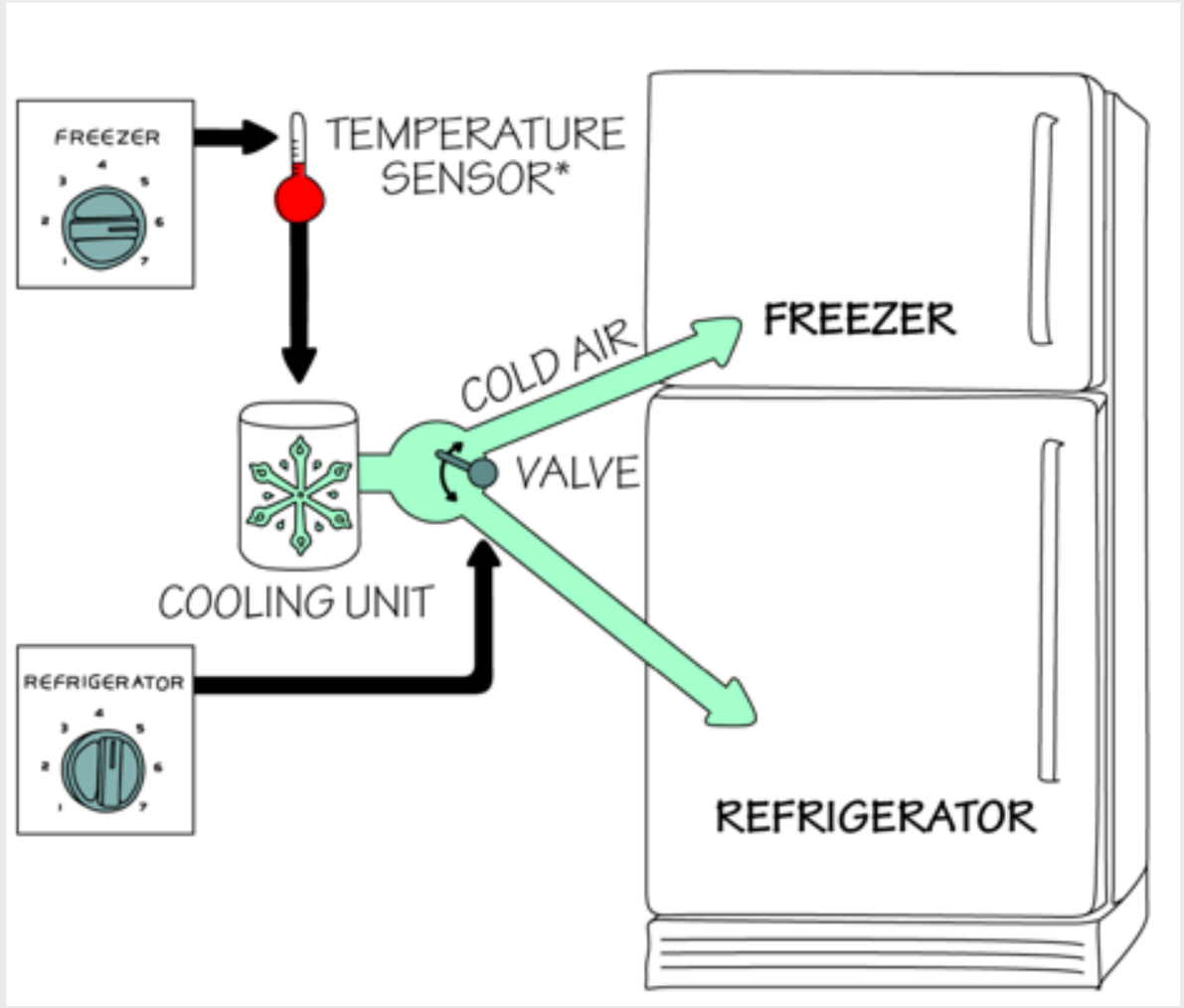
Christopher Alexander:
misfits

refrigerator controls

Don Norman, Design of Everyday Things, 1988 (2013)

controls

internal mechanism



mental models

Don Norman

Don Norman's analysis of the fridge

system image is 'incoherent or inappropriate'
so user's mental model misaligned with designer's model

my viewpoint

the design concepts are simply wrong
this is not a user interface problem

reflections

on software as math

The choice of functional specifications — and of notation to write them down in— may be far from obvious, but their rôle is clear: it is to act as a logical firewall between two different concerns. The one is the "**pleasantness problem**", i.e., the question of whether an engine meeting the specification is the engine we would like to have; the other one is the "**correctness problem**", i.e., the question of how to design an engine meeting the specification.

Dijkstra, EWD952

A very large program is, by necessity, composed of a large number, say N, individual components and the fact that N is large implies that the individual program components must be produced with a very high confidence level. If for each individual component the probability of being right equals p, for the whole program the probability P of being right will satisfy

$P \leq p^N$

and if we want **P to differ appreciably from zero, p must be very close to one, because N is so large**.

Dijkstra, EWD303

Fortunately, the problem of program correctness has turned out to be far less serious than predicted.

Hoare, 1996

sources of reliability

interfaces

concepts

localization

bad concepts
confuse user *and* developer
and lead to unreliable code

limits of formalism

engineering science
mathematical models of behavior
engineering as application of science

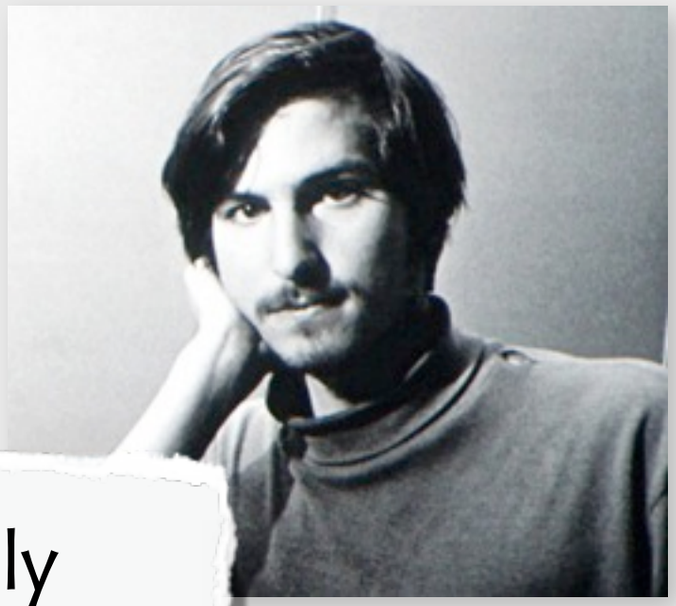
but
physics cannot understand a clock
purposes cannot be formalized
essence of design is intent, not behavior

unused slides

mitch kapor on designers

Architects work in the medium of buildings, graphic designers work in paper and other print media, industrial designers on mass-produced manufactured goods, and software designers on software. **The software designer should be the person with overall responsibility for the conception and realization of the program.**

A Software Design Manifesto, 1996



To design something really well, you have to **get it**. You have to really grok what it's all **about**. It takes a passionate commitment to really thoroughly **understand** something, chew it up, not just quickly swallow it. Most people don't take the time to do that.

a metaphor

software design:
smoothing rough & sharp edges
big picture by attention to small details

"That's quite obsessive, isn't it?"
Jonathan Ive

https://www.youtube.com/watch?v=zaLMOSWAwdw