rethinking software design

Daniel Jackson · CSAIL · MIT

SATURN Conference · San Diego · May 4, 2016

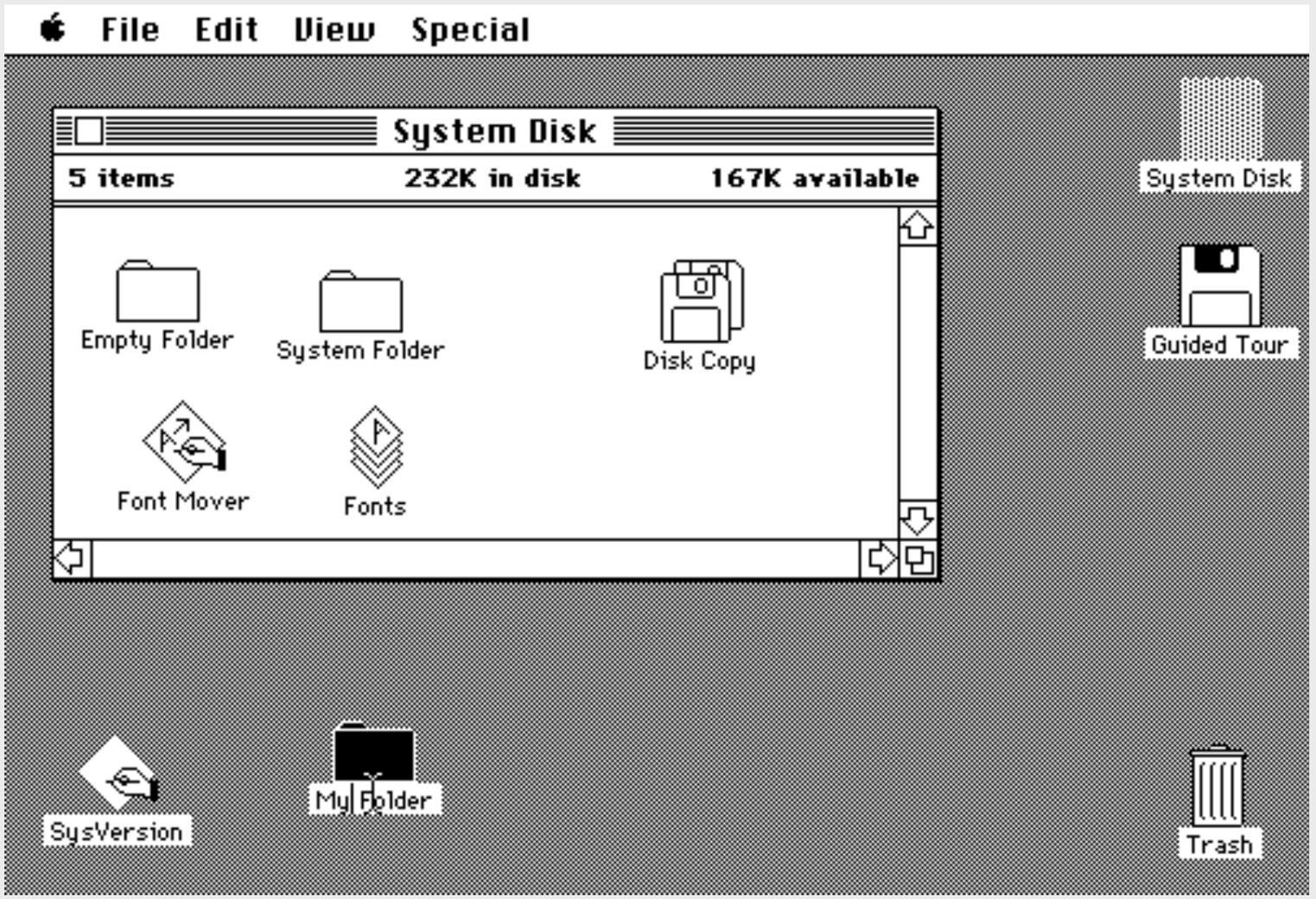
what is software design?

designers & engineers

designers & engineers

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

designers & engineers



designers & engineers

	designer	engineer
elements		function, object, type
goals	learnable, effective, tolerant	maintainable, correct, fast

designers & engineers

	designer	engineer
elements	?	function, object, type
goals	learnable, effective, tolerant	maintainable, correct, fast

the role of design criteria

	designer	engineer
elements	?	function, object, type
goals	learnable, effective, tolerant	maintainable, correct, fast

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the role of design criteria

	designer	engineer
elements	?	function, object, type
criteria		decoupling & localization
goals	learnable, effective, tolerant	maintainable, correct, fast

the role of design criteria

	designer	engineer
elements	?	function, object, type
criteria	?	decoupling & localization
goals	learnable, effective, tolerant	maintainable, correct, fast

WARNING

OBSESSIVE DETAILS AHEAD

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

Quora

Search

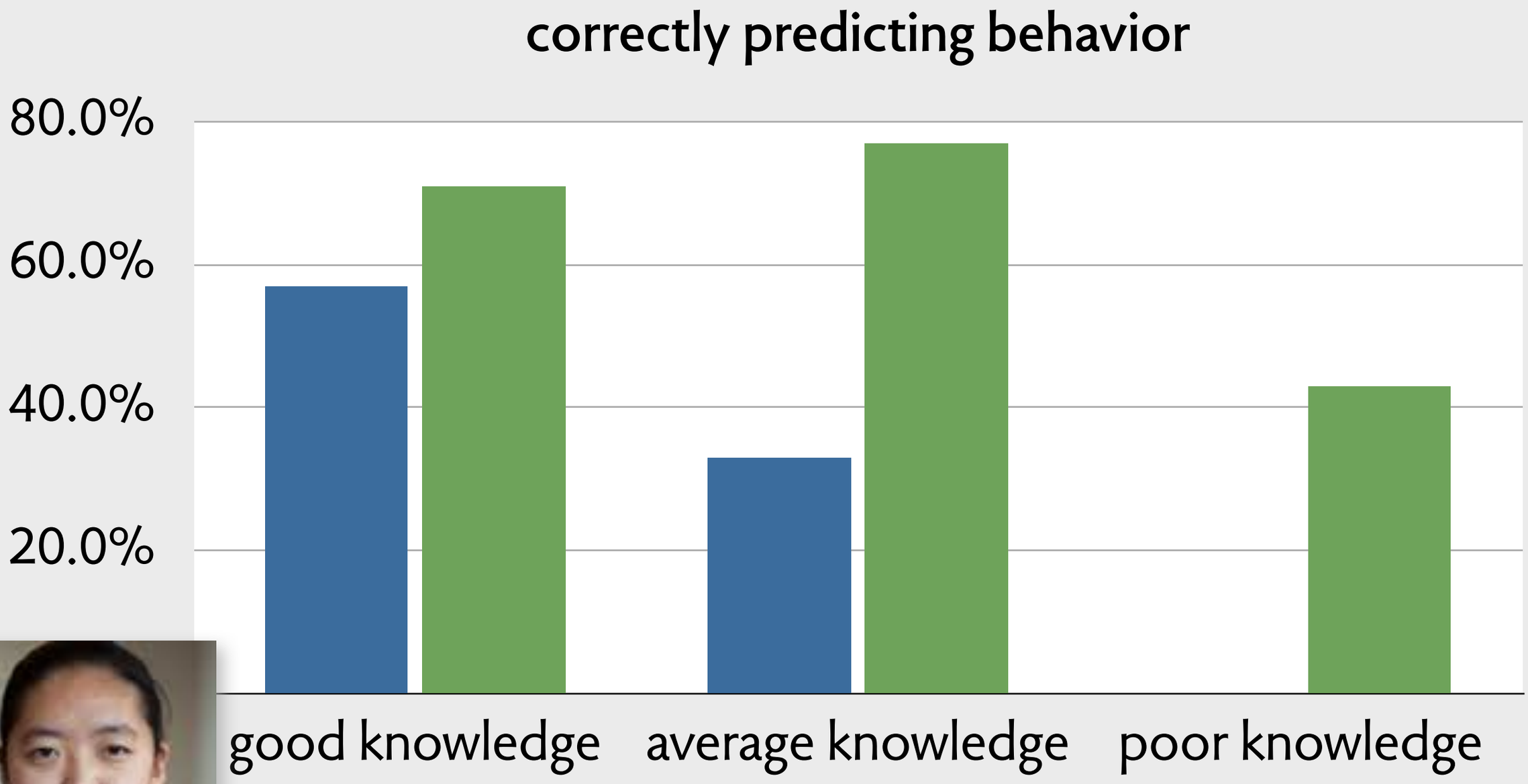
Dropbox: Edit

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

Add Question Details

Comment · Share · Report · Options

survey of MIT dropbox users



Kelly Zhang

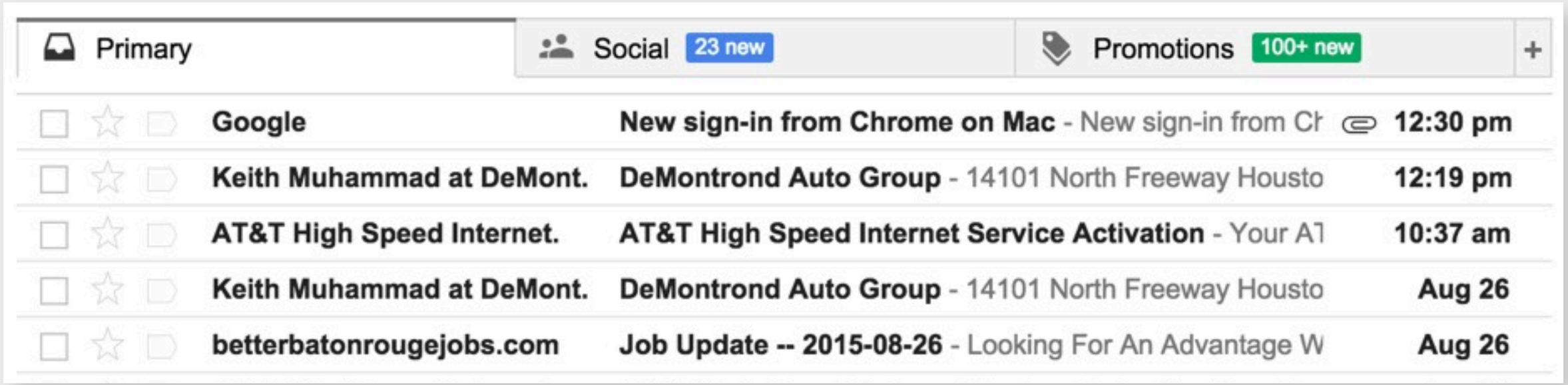
3

software design problems

#1

email categories

gmail's categories



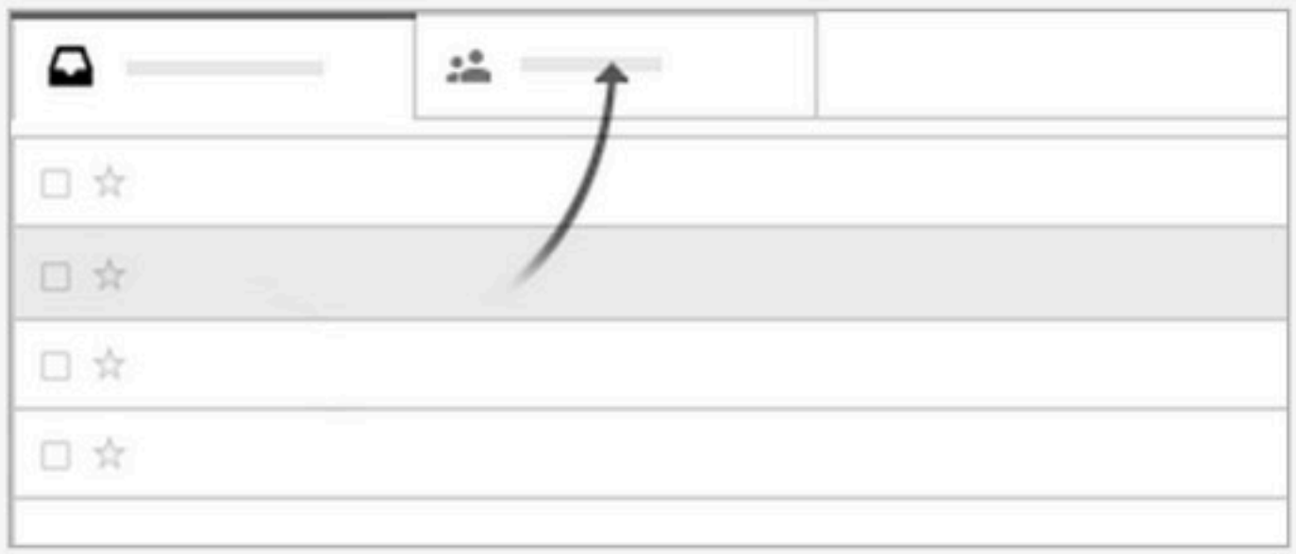
category tab settings

Categories:
Learn more

- [x] **Primary**
- [x] **Social**
- [x] **Promotions**
- [ ] **Updates**
- [ ] **Forums**

Starred messages

- [x] **Include starred in Primary**



Choose which message categories to show as inbox tabs. Other messages will appear in the Primary tab.

some reactions

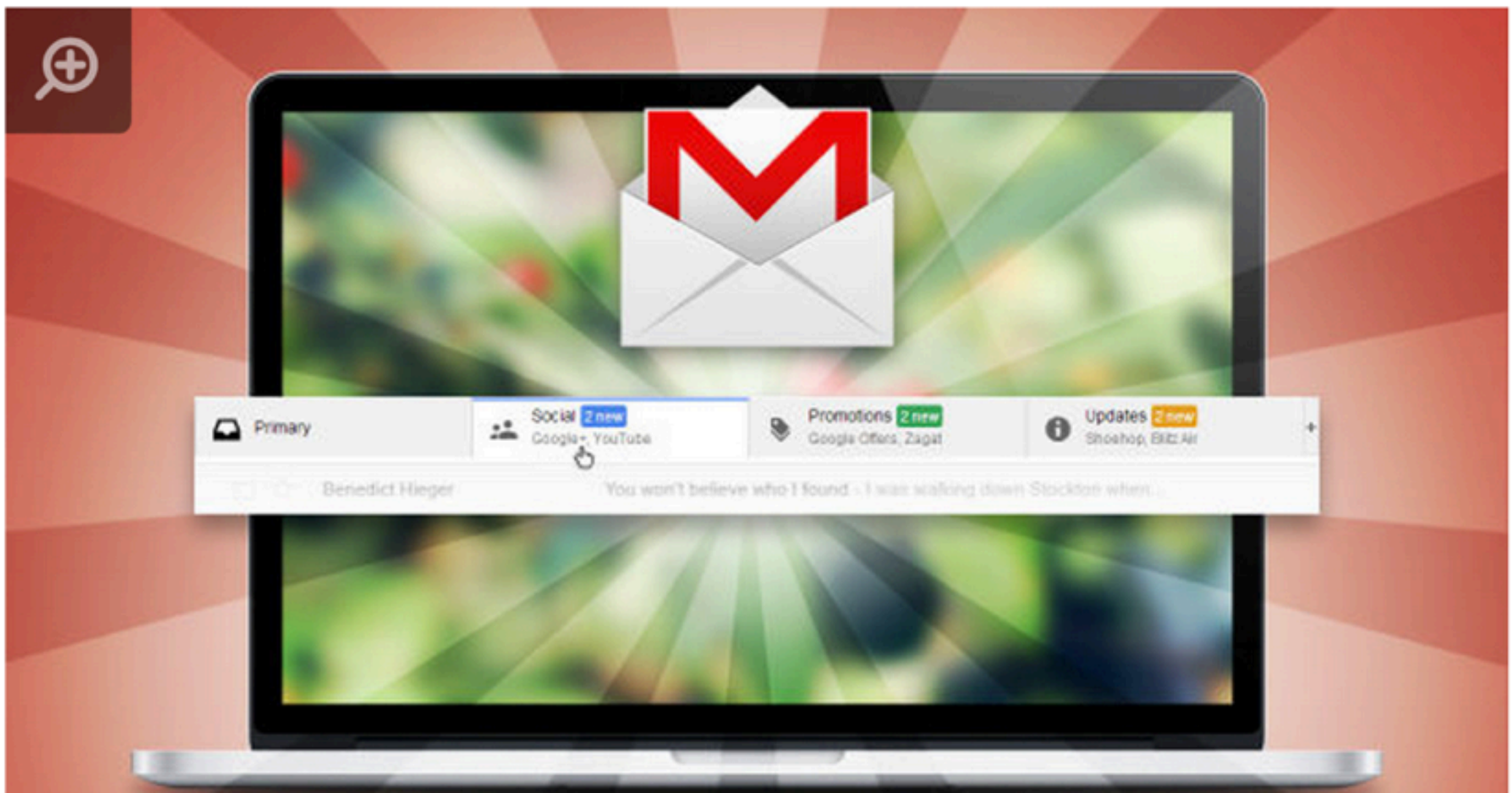
some reactions

Everything You Need to Know About Gmail's New, Super-Confusing Layout

Melanie Pinola

Filed to: GMAIL 6/07/13 9:00am

301,482 12



some reactions

Home › Quick Tech Tip: Disabling Gmail's Category Tabs

Quick Tech Tip: Disabling Gmail's Category Tabs

Mon, 07/29/2013 - 12:17 | Chuck Gray
in LibraryPoint Blog Tech Tutorials Teen Blog Tech Answers Science and Technology Self-Help and Instructional

Are you a Gmail user? Did you wake up a week or two ago to find that your new messages were now being automatically organized by Gmail into tabs of different, pre-determined categories? And, did you think, like me, that they were really ugly, stupid, and unnecessary? Here's a quick tip on how to rid yourself of them!

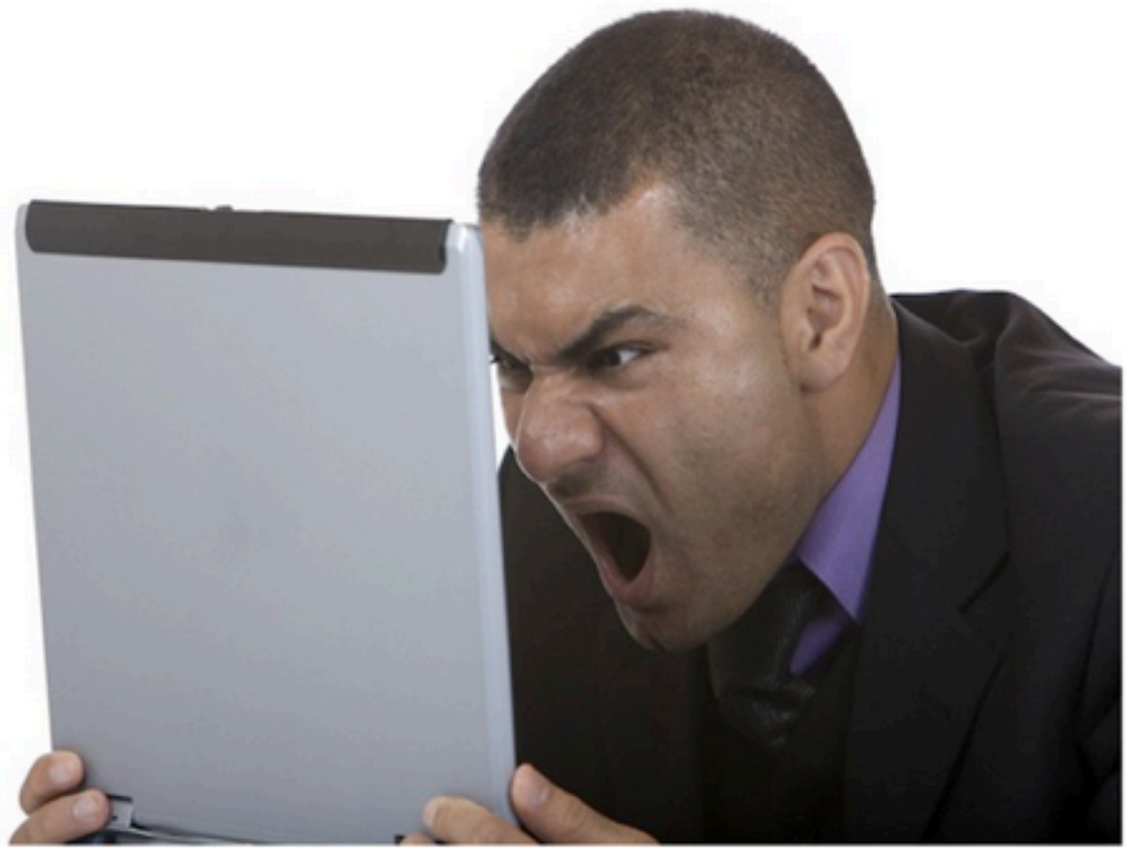
some reactions

Google gets it terribly, terribly wrong with Gmail tabs and makes me angry

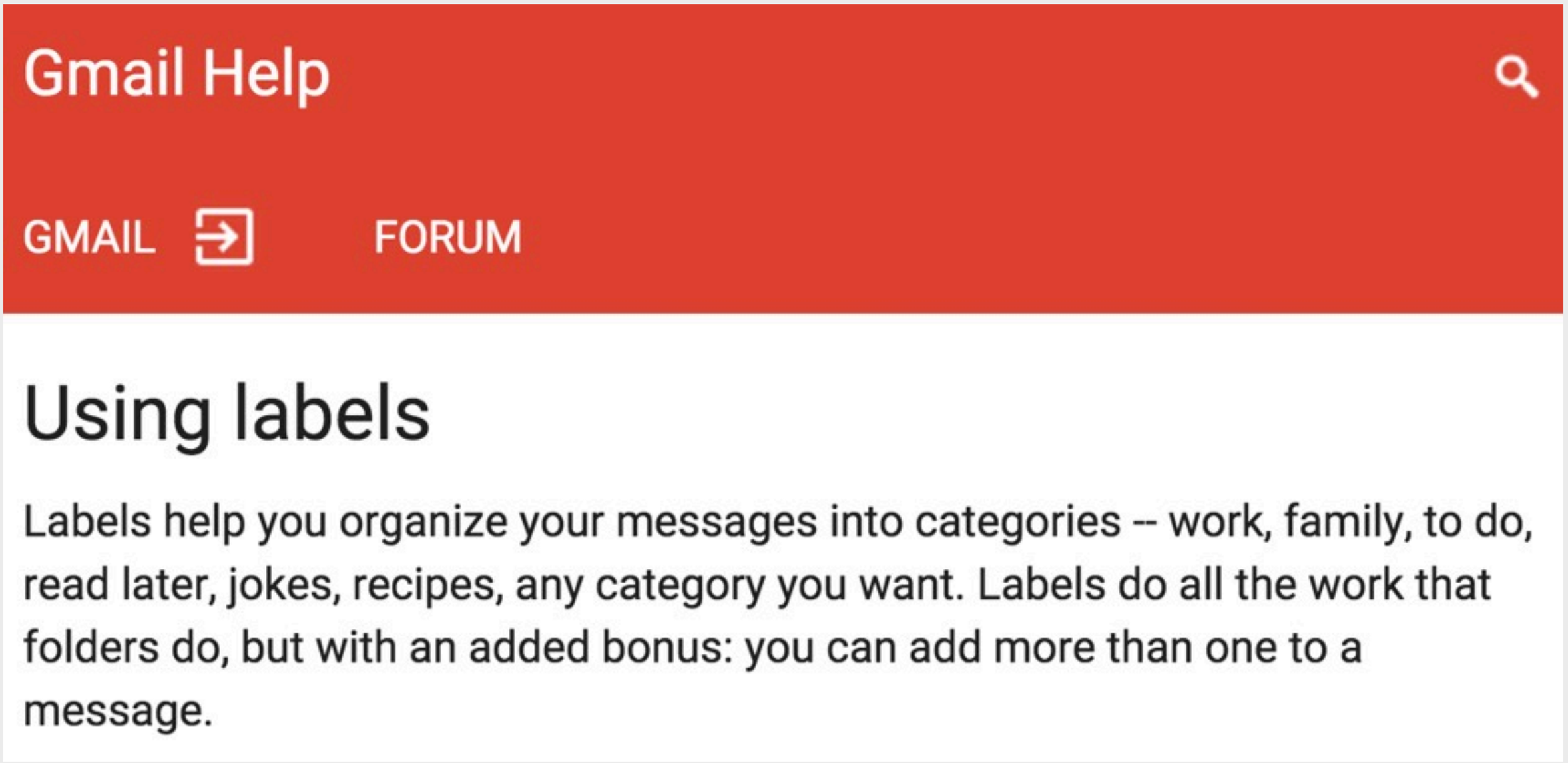
By Mark Wilson | Published 2 years ago | Follow

71 Comments | Like 55 | Share 11 | +1 37 | Tweet 30

Like many Gmail users, I greeted the news of the introduction of tabs to the interface with a degree of anticipation -- now it was just a matter of waiting for the feature to roll out so I could try it for myself. Earlier today I was randomly signed out of my Gmail account, and after signing back in and checking the settings menus, I could see that tabs were now available to me. Excitement was short-lived, however; it quickly became apparent that this new feature is a disaster.



how google explains labels (!)



what you can't do

what you can't do

associate tabs with labels

feature available only for categories

what you can't do

associate tabs with labels
feature available only for categories

use tabs outside inbox
tabs disappear when you filter on a label

#2

camera settings

my camera fuji x100s

image quality setting

image quality setting

image quality setting

aspect ratio

aspect ratio

image size setting

image size setting

image size setting

image size setting

non-standard ratio + raw?

what you can't do

non-standard aspect ratio + raw

even though raw images get nice nondestructive crop!

what you can't do

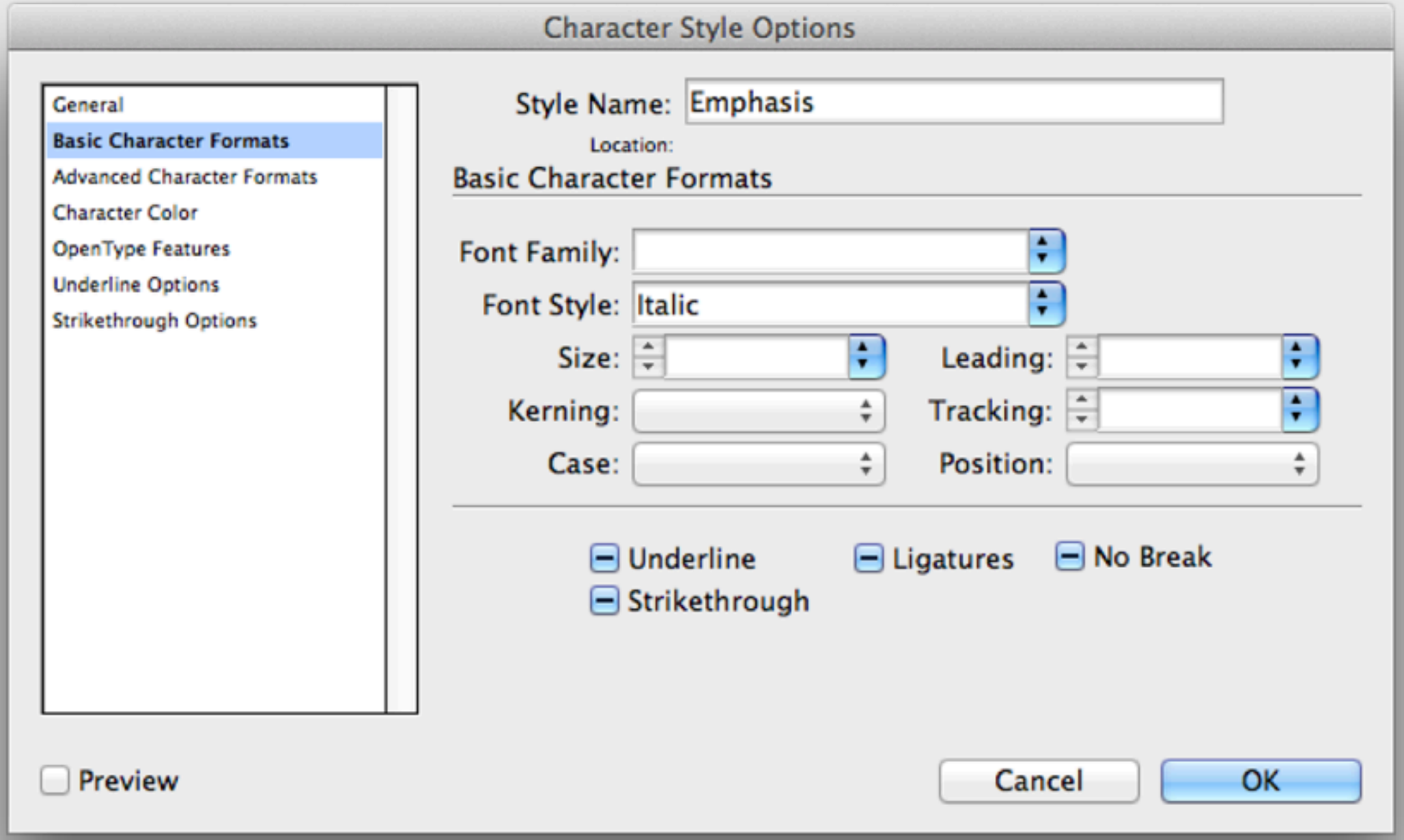
non-standard aspect ratio + raw

even though raw images get nice nondestructive crop!

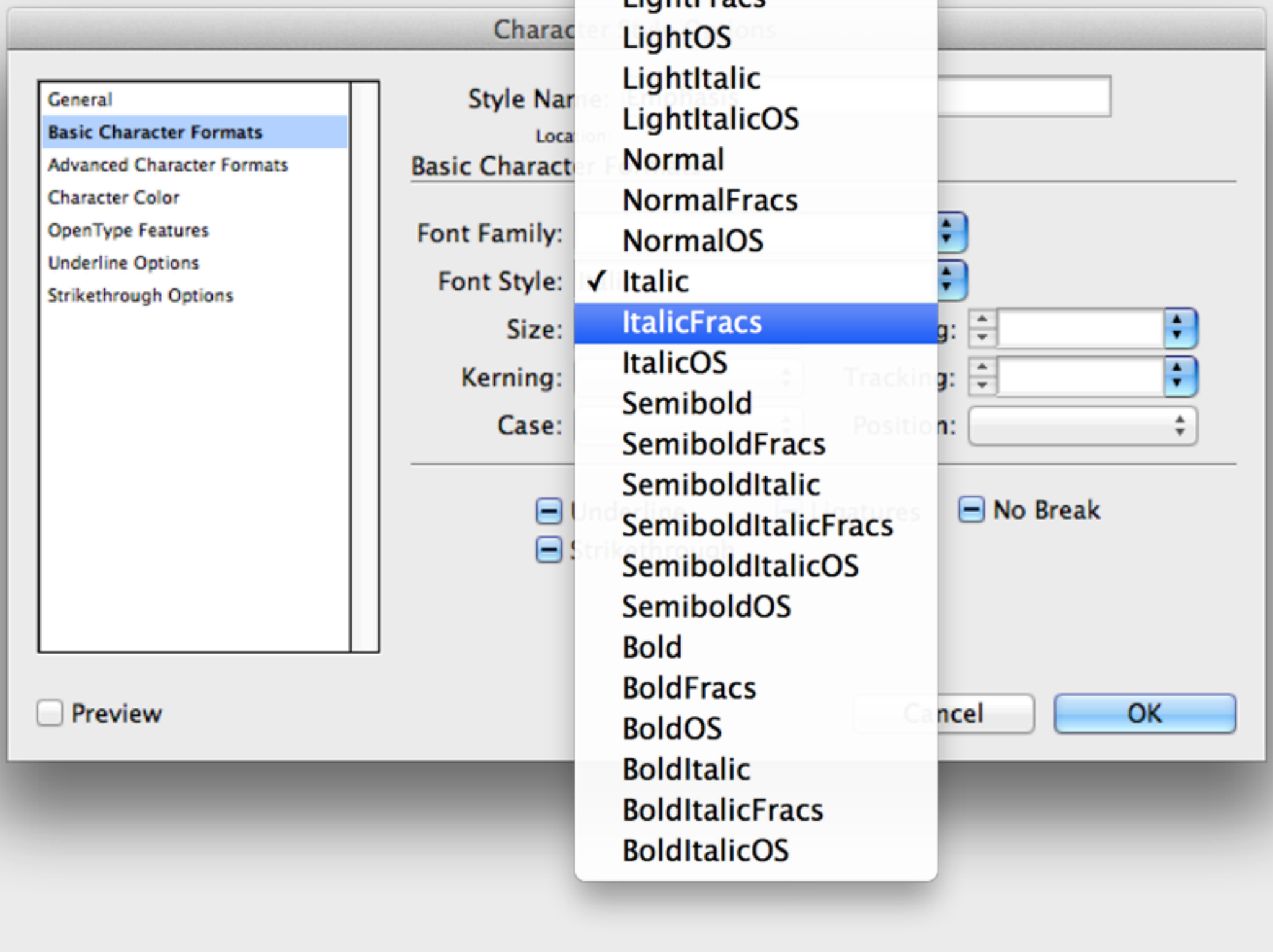
#3

fonts & styles

what's a font?


Character Style Options
General
Basic Character Formats
Advanced Character Formats
Character Color
OpenType Features
Underline Options
Strikethrough Options
Style Name: Emphasis
Location:
Basic Character Formats
Font Family:
Font Style: Italic
Size:
Leading:
Kerning:
Tracking:
Case:
Position:
Underline
Ligatures
No Break
Strikethrough
Preview
Cancel
OK

what's a font?


General
Basic Character Formats
Advanced Character Formats
Character Color
OpenType Features
Underline Options
Strikethrough Options
Font Family:
Font Style:
Size:
Kerning:
Case:
No Break
Preview
OK
Light
LightFracs
LightOS
LightItalic
LightItalicOS
Normal
NormalFracs
NormalOS
✓ Italic
ItalicFracs
ItalicOS
Semibold
SemiboldFracs
SemiboldItalic
SemiboldItalicFracs
SemiboldItalicOS
SemiboldOS
Bold
BoldFracs
BoldOS
BoldItalic
BoldItalicFracs
BoldItalicOS

what you can’t do

define a style that italicizes

Arno Regular to Arno Italic

Futura Book to Futura Book Oblique

Magma Light to Magma Light Italic

what kind of problems are these?

what kind of problems are these?

minor nitpicks?

in all cases, can't do useful things

what kind of problems are these?

minor nitpicks?
in all cases, can't do useful things

coding bugs?
code seems to meet a coherent spec

what kind of problems are these?

minor nitpicks?
in all cases, can't do useful things

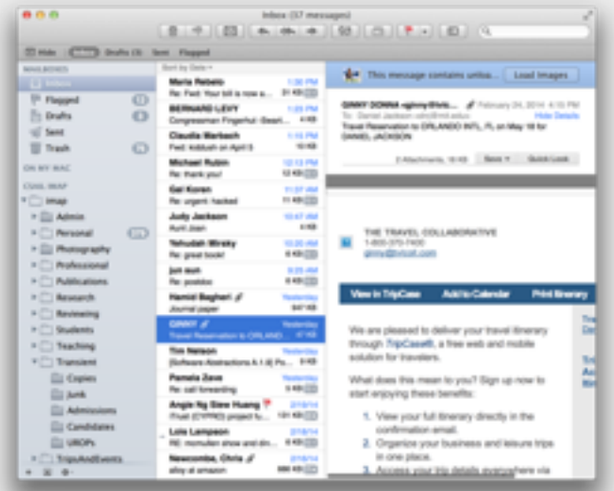
coding bugs?
code seems to meet a coherent spec

user interface flaws?
interfaces are clear and faithful to function

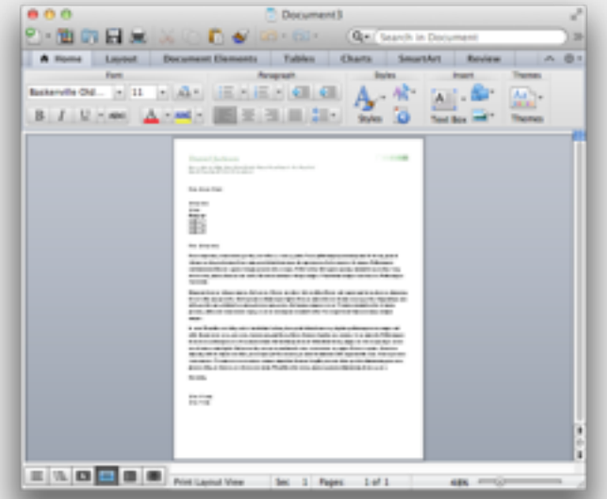
getting to the essence of an app

what characterizes an app?

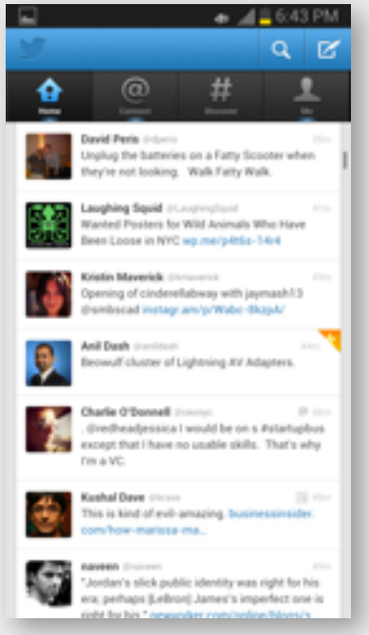
Apple Mail



Microsoft Word



Twitter

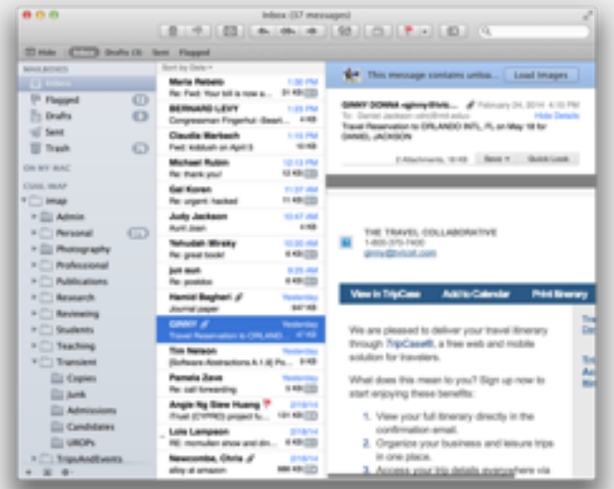


Photoshop

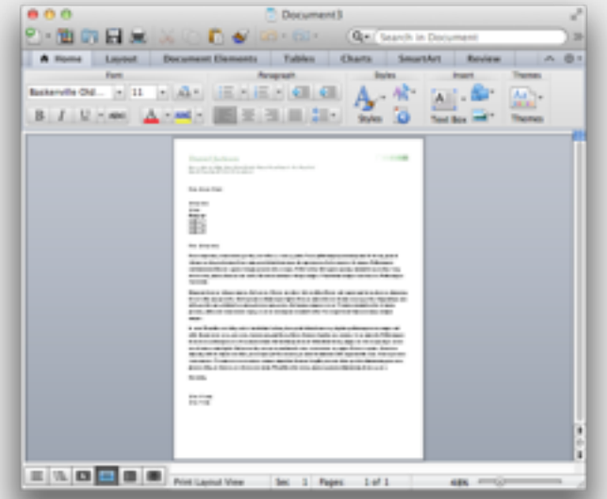
what characterizes an app?

concepts!

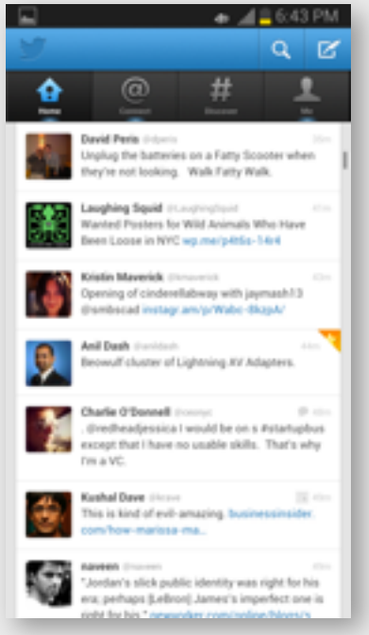
Apple Mail



Microsoft Word



Twitter



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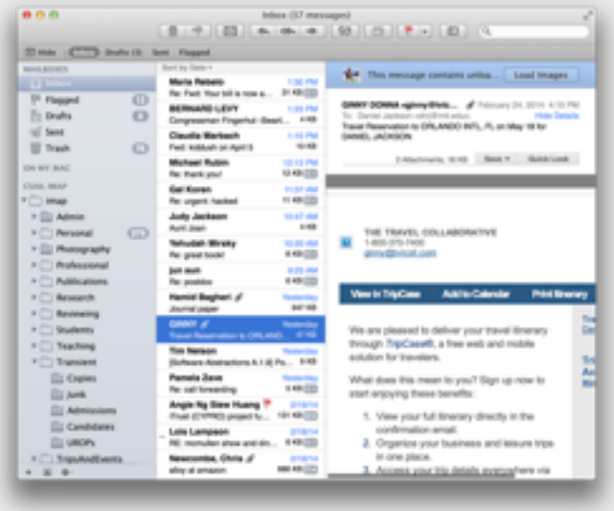
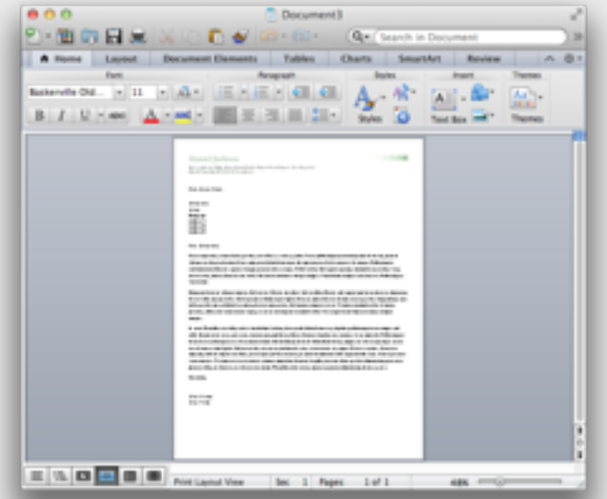
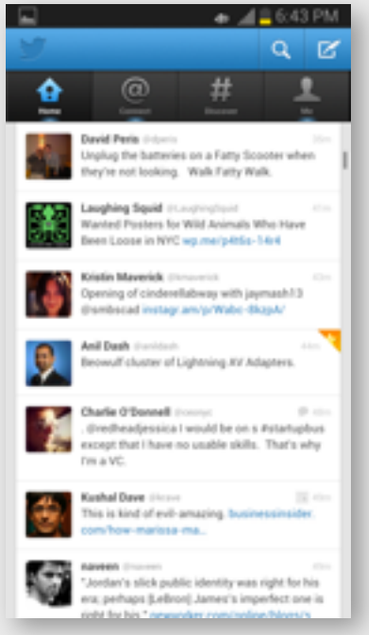


Microsoft Word



Twitter



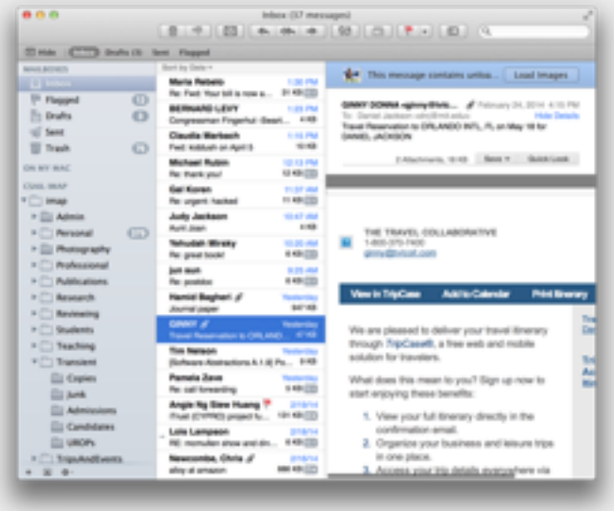
Photoshop

EmailAddress
Message
Folder or Label

what characterizes an app?

concepts!

Apple Mail



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Message
Folder or Label

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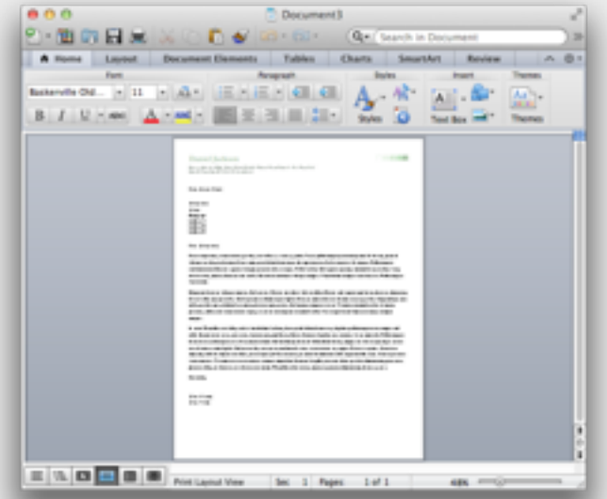
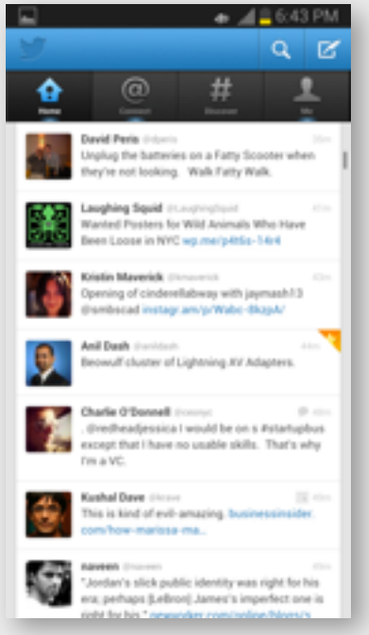


Paragraph
Format
Style

Twitter



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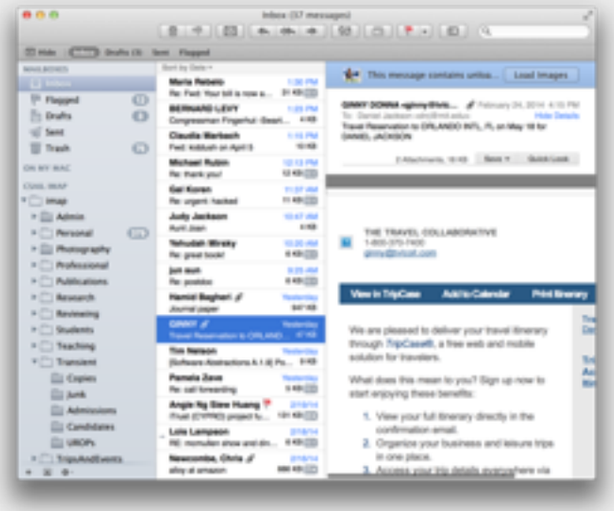
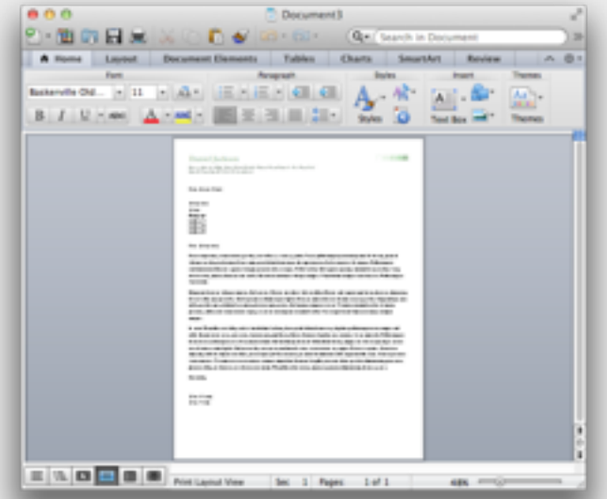


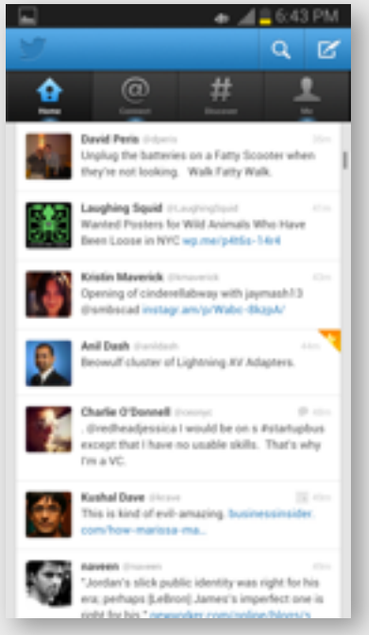
EmailAddress
Message
Folder or Label

Microsoft Word



Paragraph
Format
Style

Twitter



Tweet
Hashtag
Following

Photoshop

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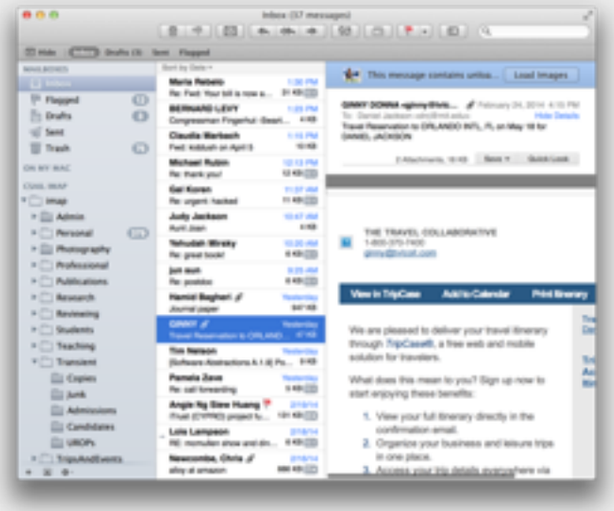
Apple Mail



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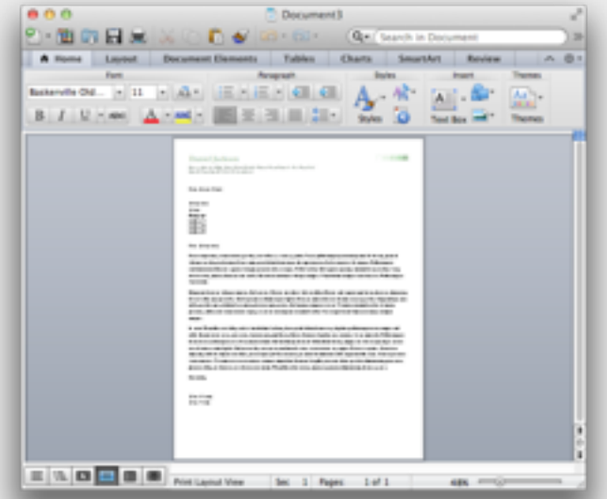
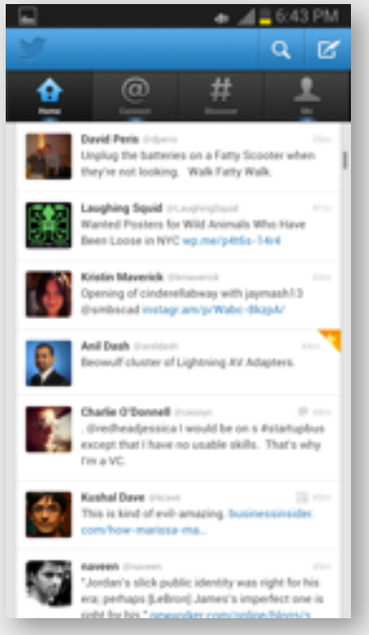
Microsoft Word



Paragraph
Format
Style

Twitter



Tweet
Hashtag
Following

Photoshop

PixelMap
Layer/Mask
Adjustment

concepts define classes

concepts define classes

text editor

concepts define classes

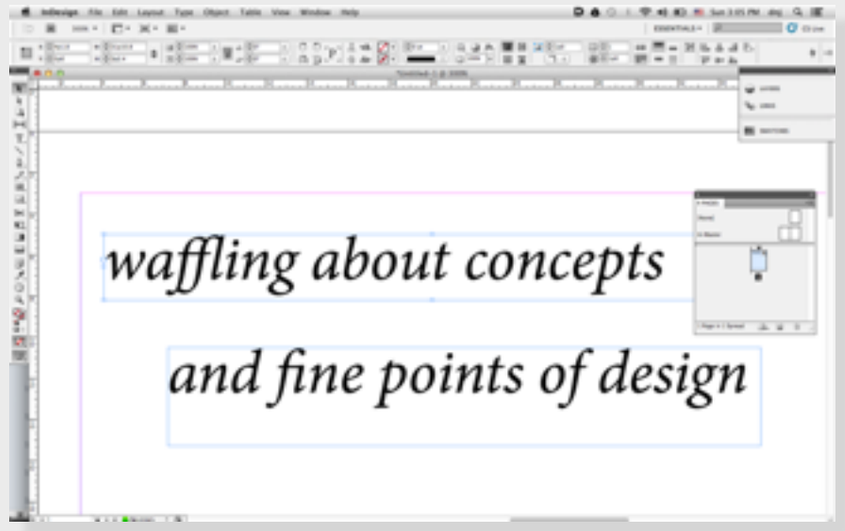
text editor

word processor

concepts define classes

text editor

word processor



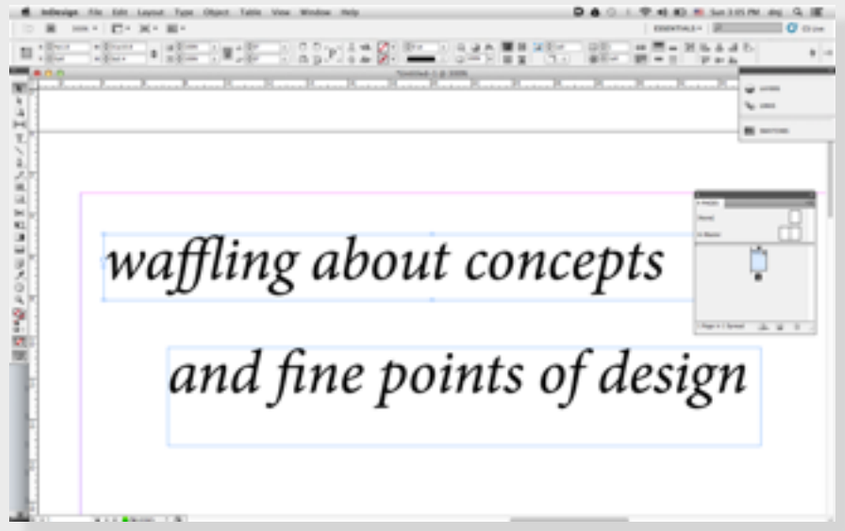
desktop publishing app

concepts define classes

text editor

line
buffer

word processor



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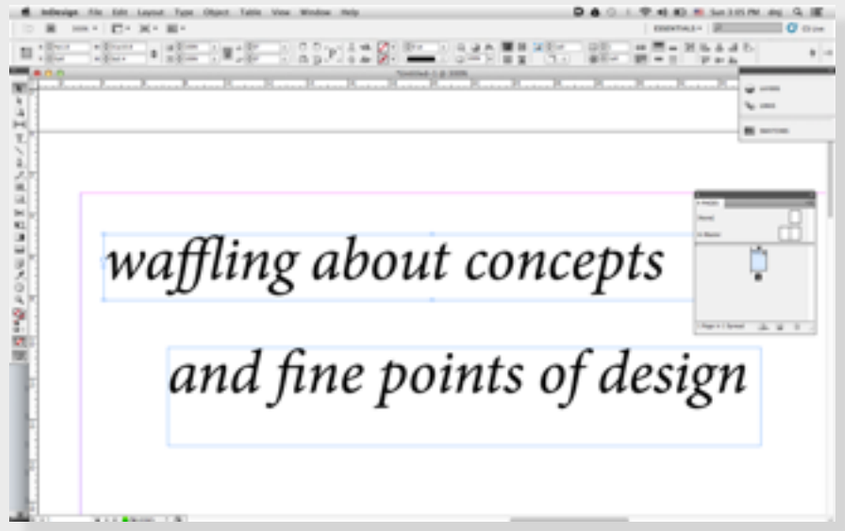

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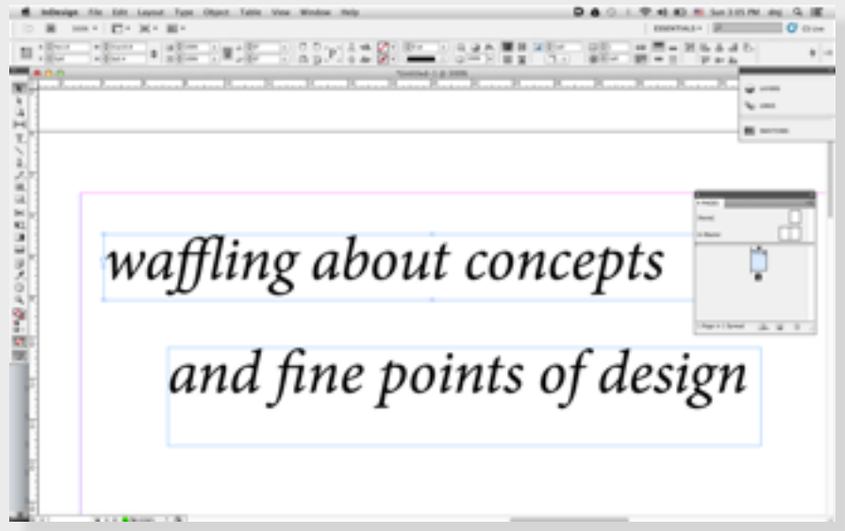


desktop publishing app

stylesheet
text flow
page template

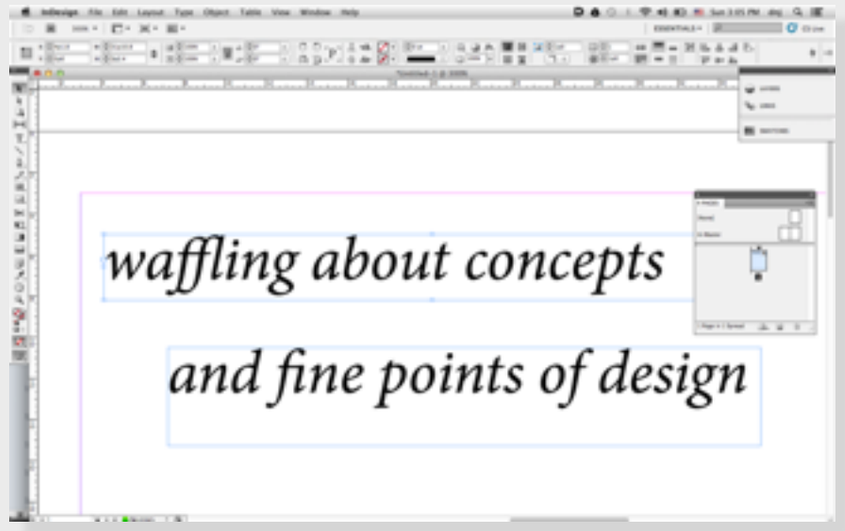
concepts define classes

text editor

line
buffer

word processor

paragraph
format
style



desktop publishing app

stylesheet
text flow
page template

jamonh
Oct 22, 2013 7:19 PM

Just upgraded to the new Pages and can't find a way to link text boxes anymore like

http://www.macobserver.com/tmo/article/pages-linking-text-boxes

Am I missing something, or is it really not possible anymore?

where are Word's concepts from?

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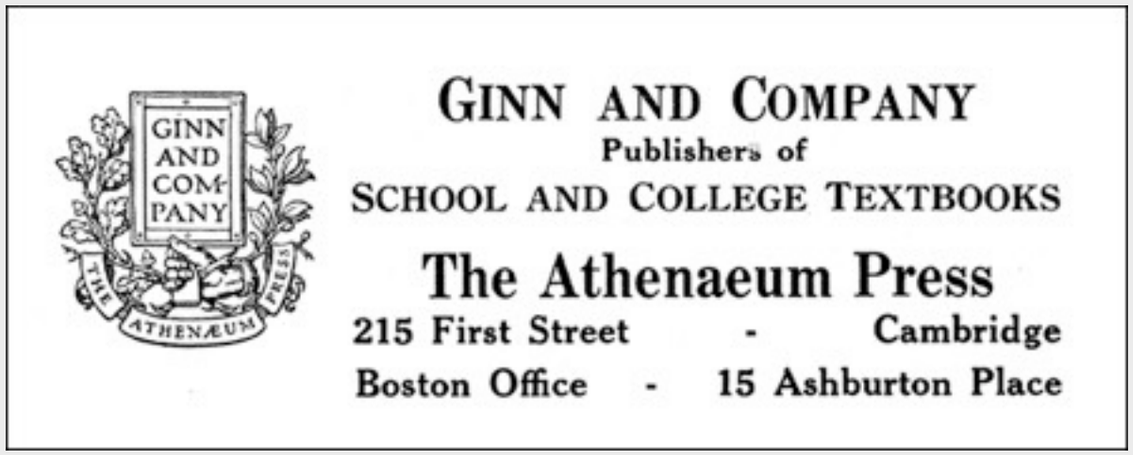
Charles Simonyi: brought key concepts to Word from Xerox PARC

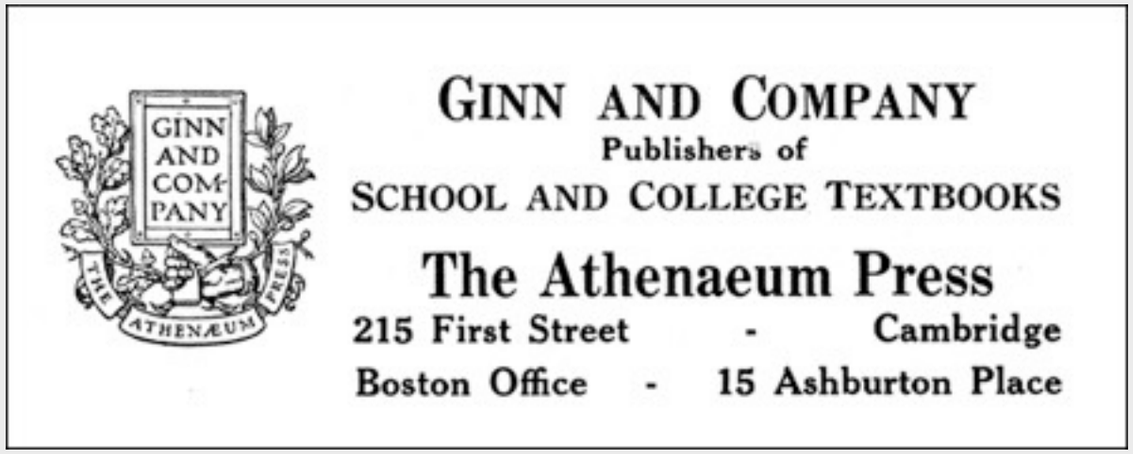
rich concepts have long journeys

rich concepts have long journeys



Ginn & Co, since 1868

rich concepts have long journeys



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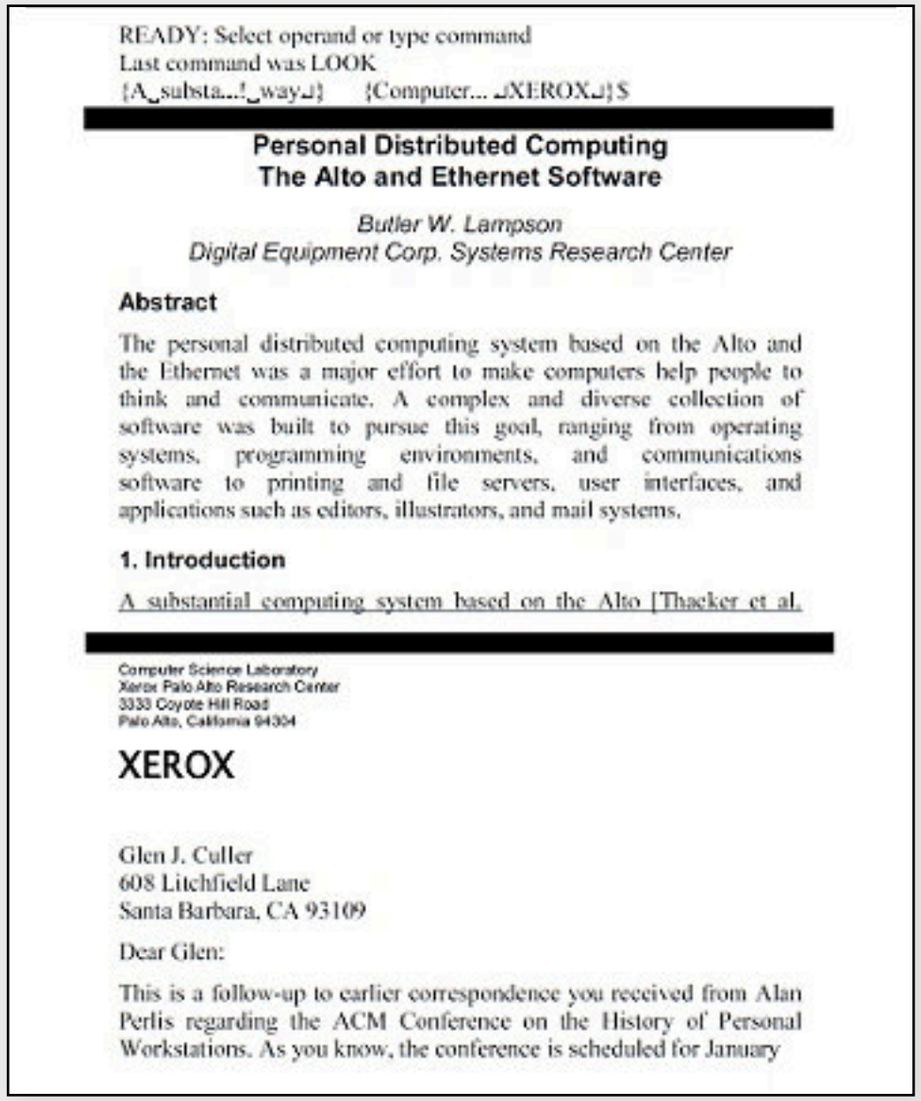

READY: Select operand or type command
Last command was LOOK
{A␣substa...!␣way␣} {Computer... ␣XEROX␣}$

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

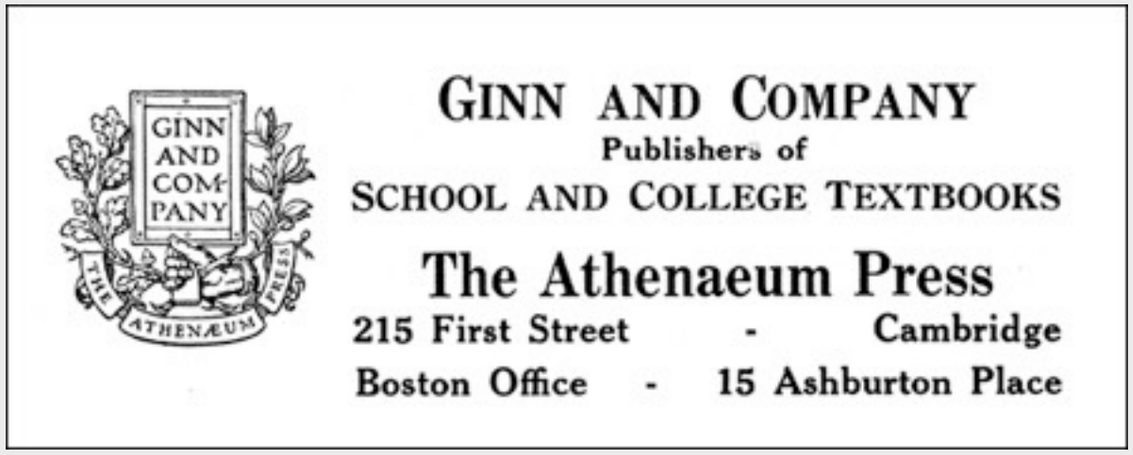
Glen J. Culler
608 Litchfield Lane
Santa Barbara, CA 93109

Dear Glen:

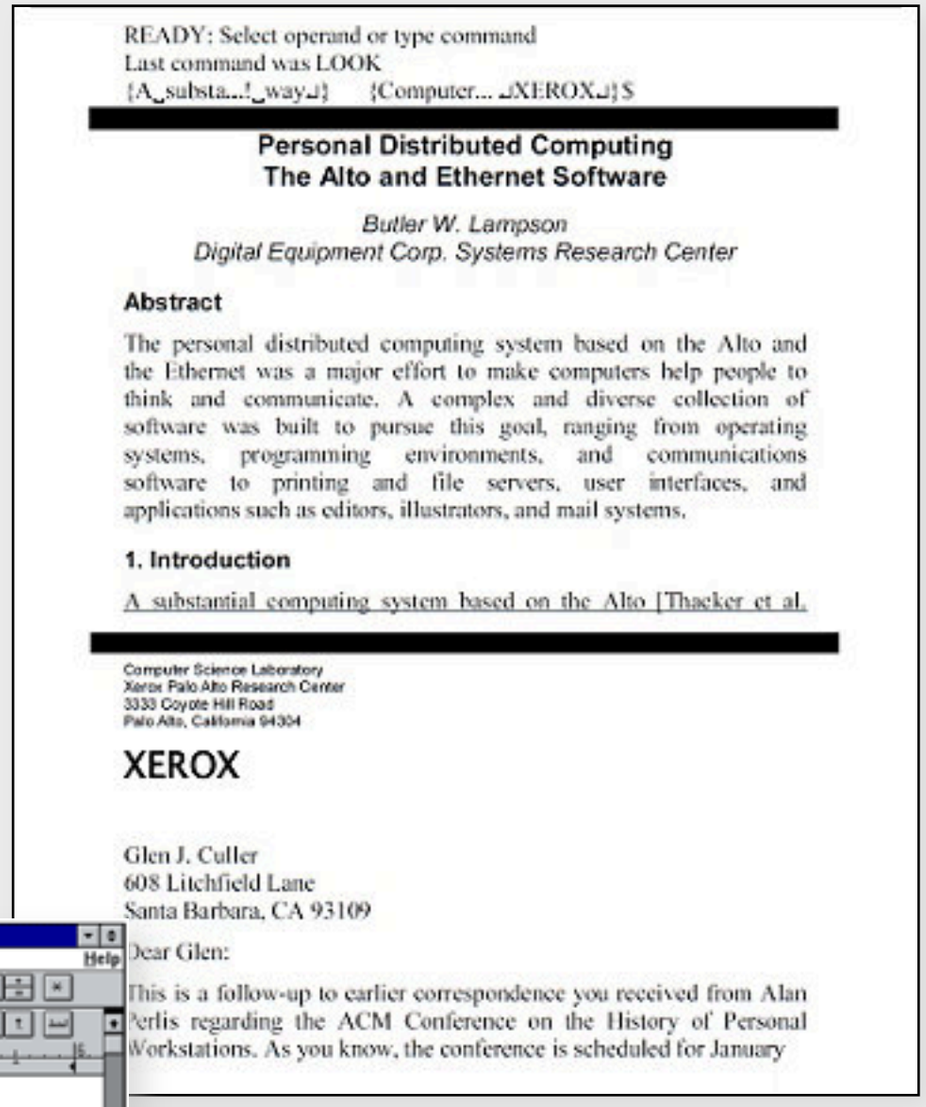
This is a follow-up to earlier correspondence you received from Alan Perlis regarding the ACM Conference on the History of Personal Workstations. As you know, the conference is scheduled for January

Bravo, 1974

rich concepts have long journeys



Ginn & Co, since 1868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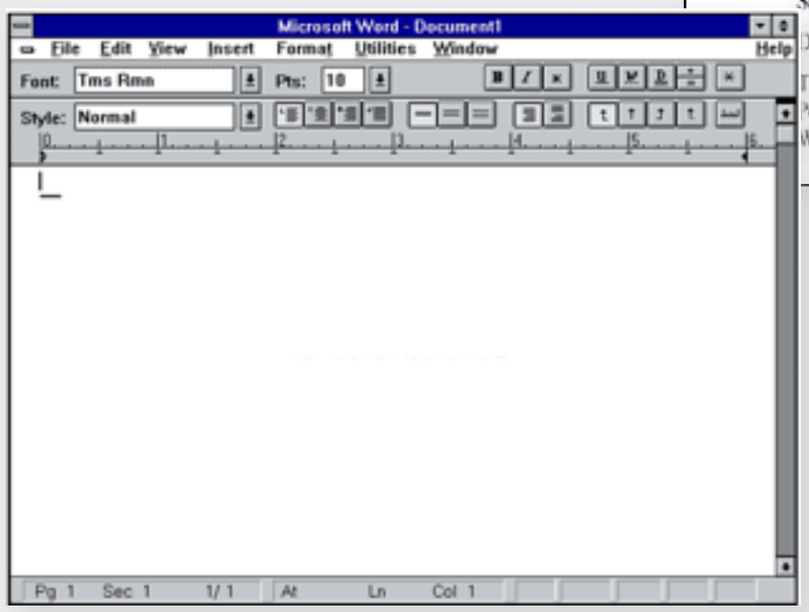
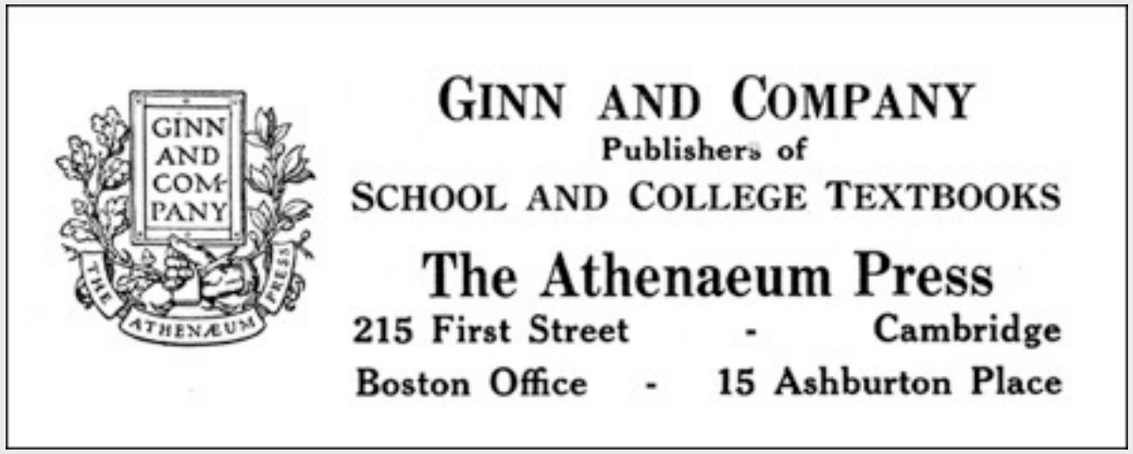


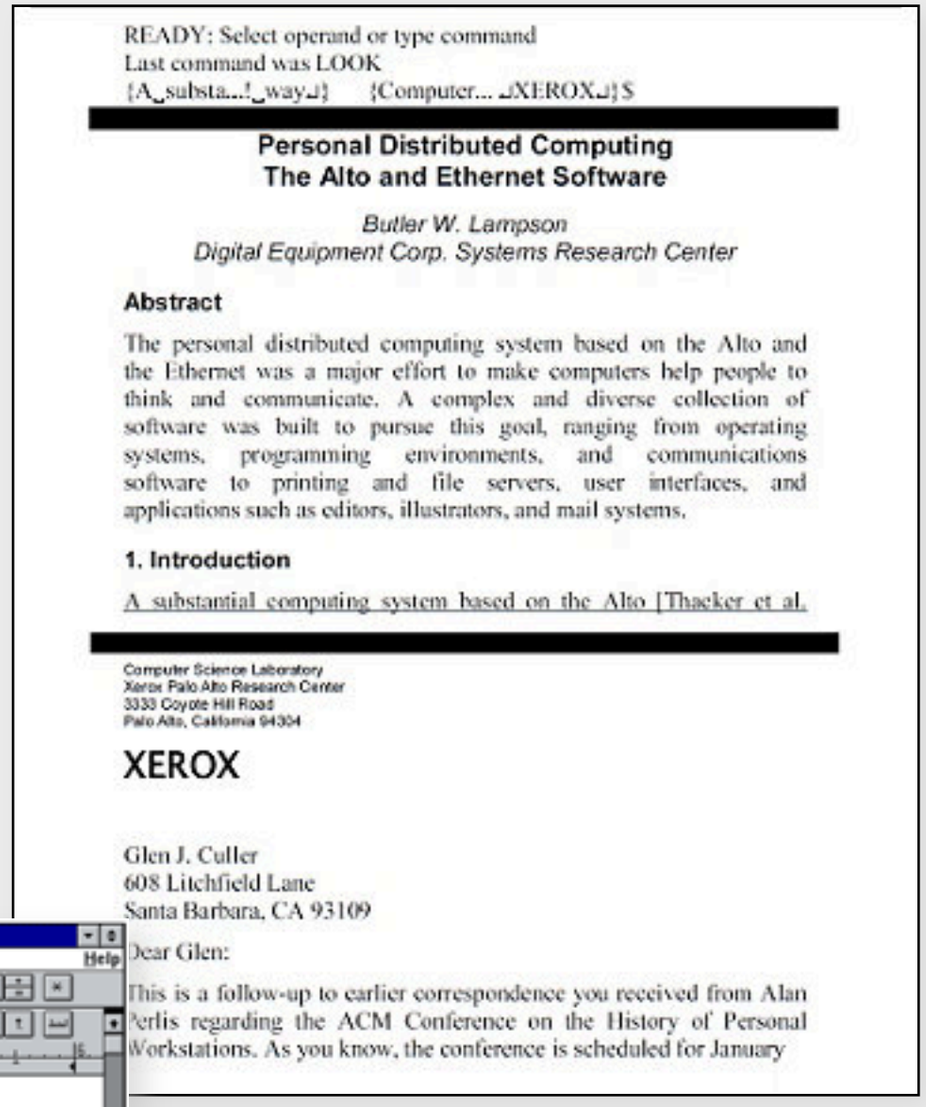
Microsoft Word, 1983

rich concepts have long journeys



Ginn & Co, since 1868

Apple Pages, 2005



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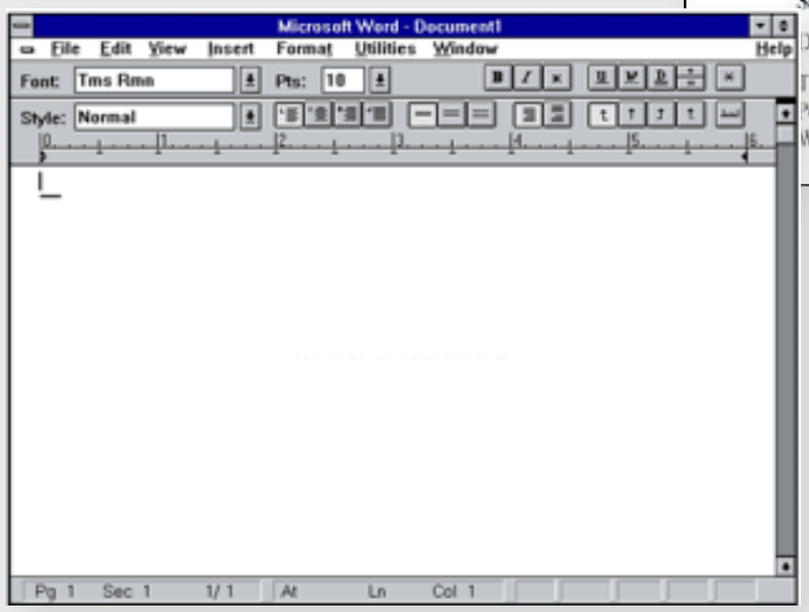

Microsoft Word, 1983

kinds of concept

kinds of concept

given concepts
electoral vote
reservation
social security number
calendar event

kinds of concept

given concepts	instrumental concepts
electoral vote	hashtag
reservation	label
social security number	friend
calendar event	follower

kinds of concept

given concepts	instrumental concepts	enabling concepts
electoral vote	hashtag	relative reference
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analogical, or new

solve a hard design problem

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how to sketch a concept

how would you explain this?

how would you explain this?

the operational principle

a way to explain a concept

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an archetypal scenario
separates essential from accidental aspects
shows how purpose is fulfilled
by combination of user & system actions

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a way to explain a concept

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"**if** you pull a tab out, **then** when that time slot comes around, the light will go on"

the operational principle

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Michael Polanyi

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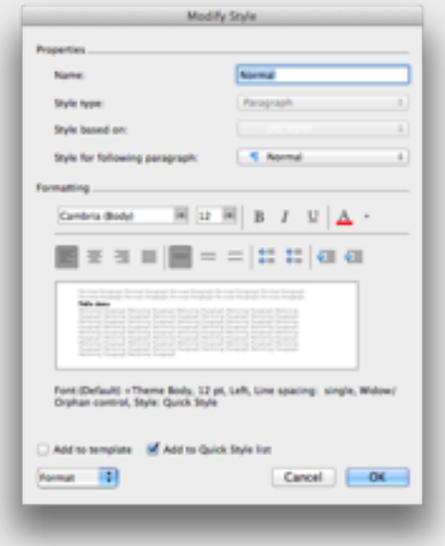

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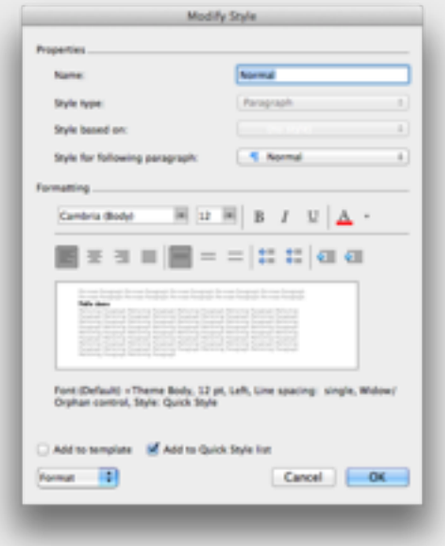

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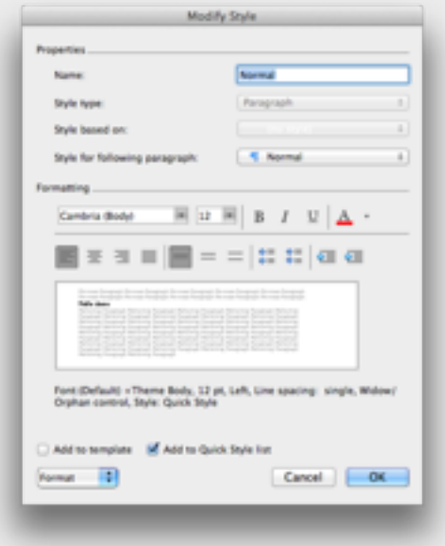

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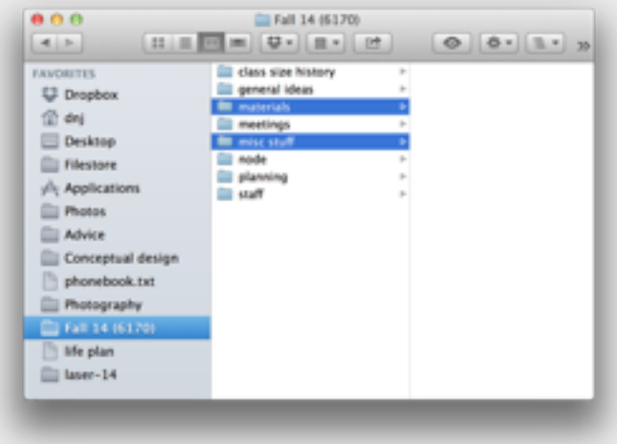
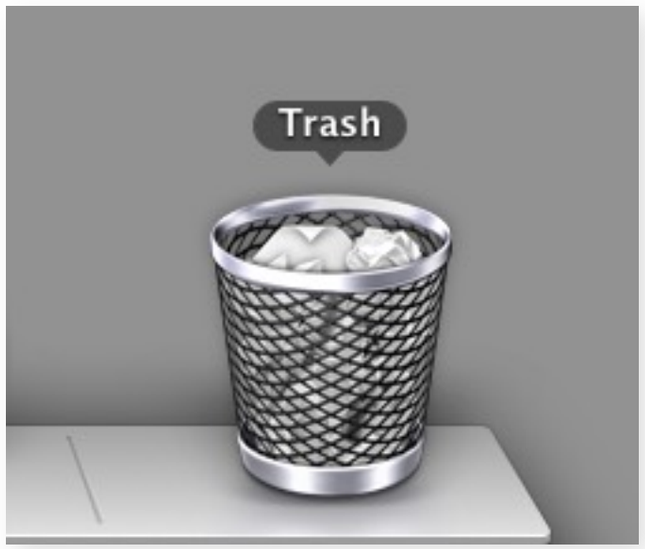


"**if** you select some files and they belong to a folder with keyboard focus, **then** pressing delete will move the files to the trash"

purposes, principles & misfits

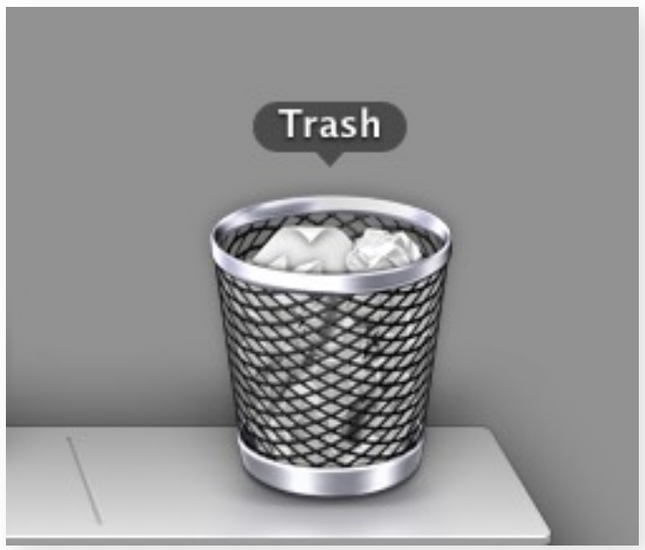
purposes, principles & misfits



concept: trash

purposes, principles & misfits

purpose: allow undo of deletions



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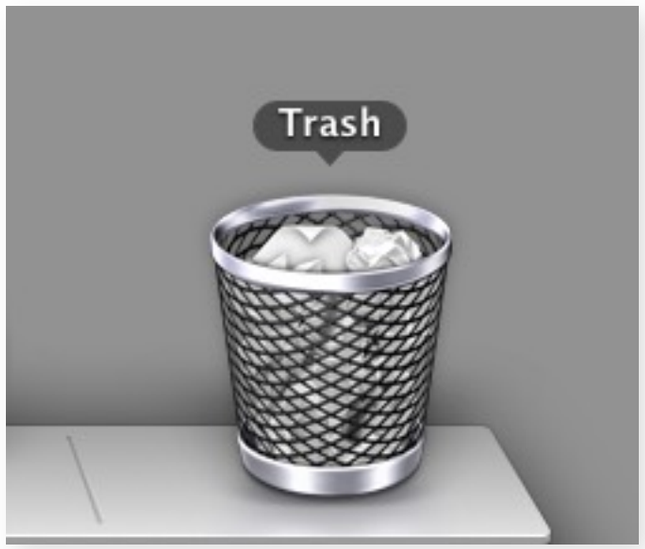

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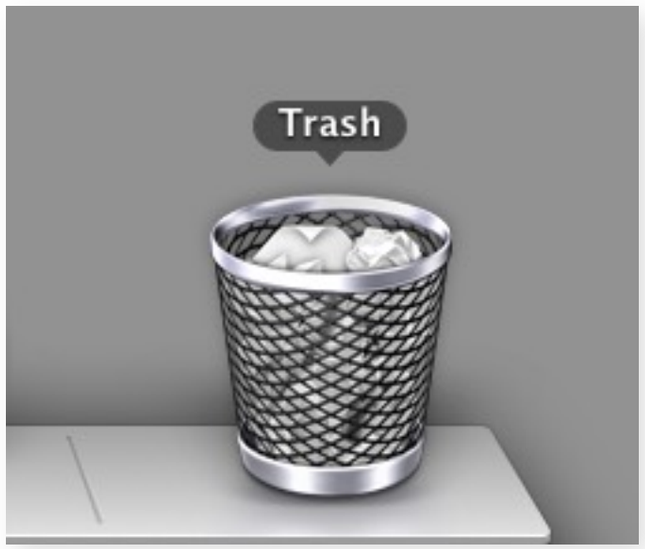

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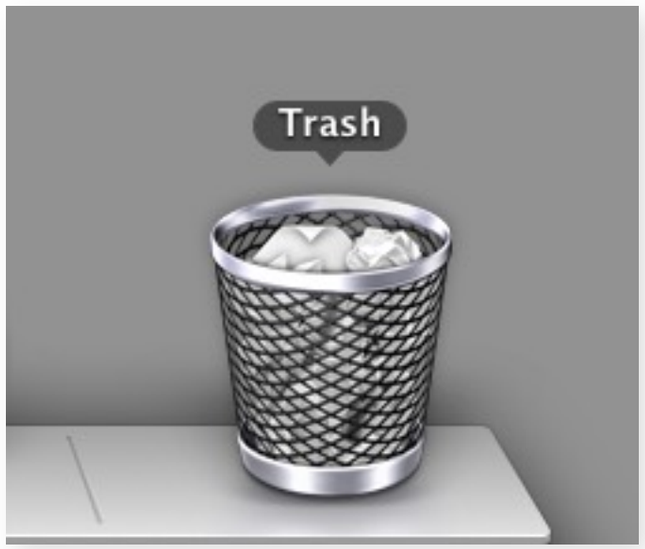

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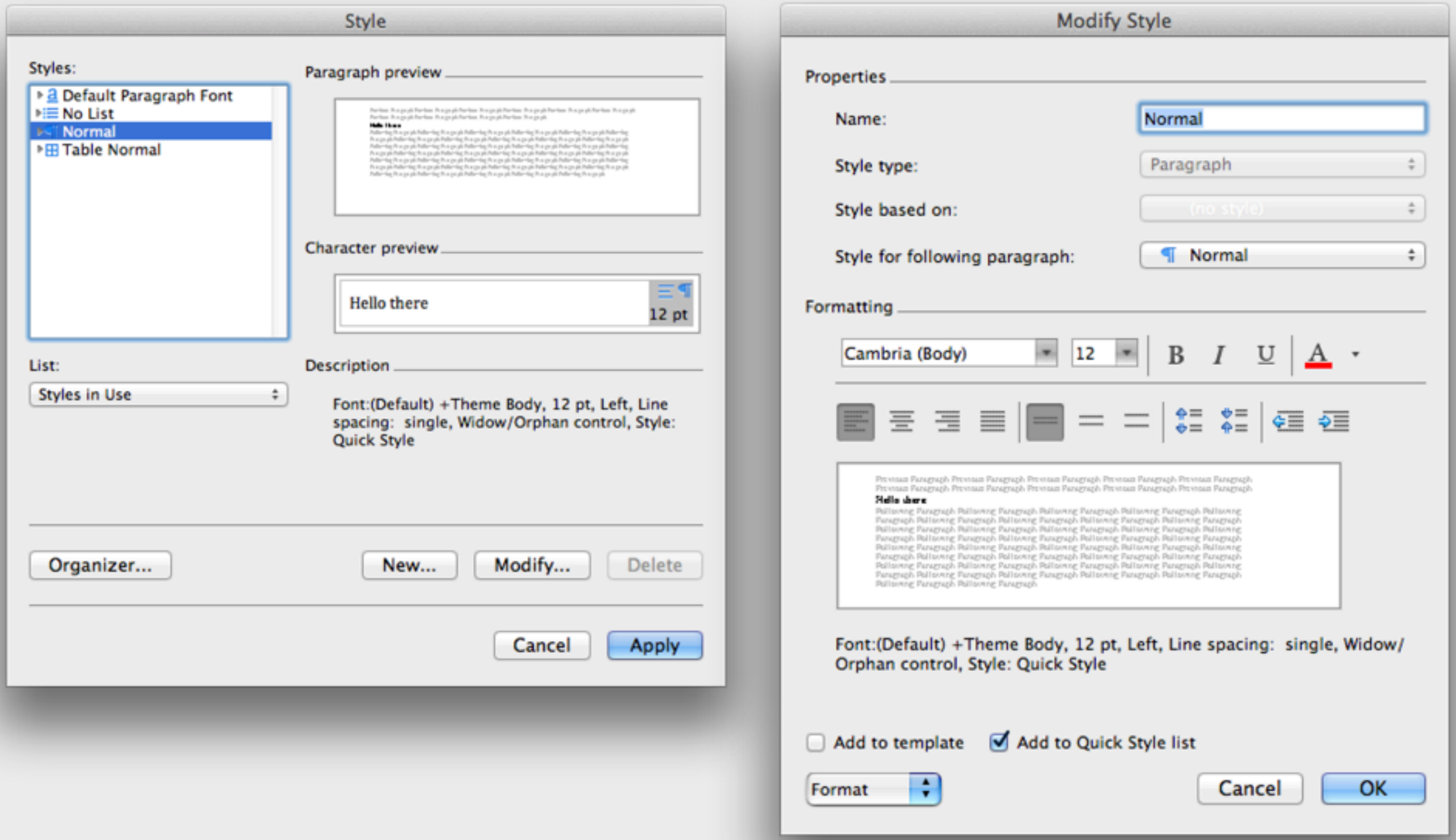
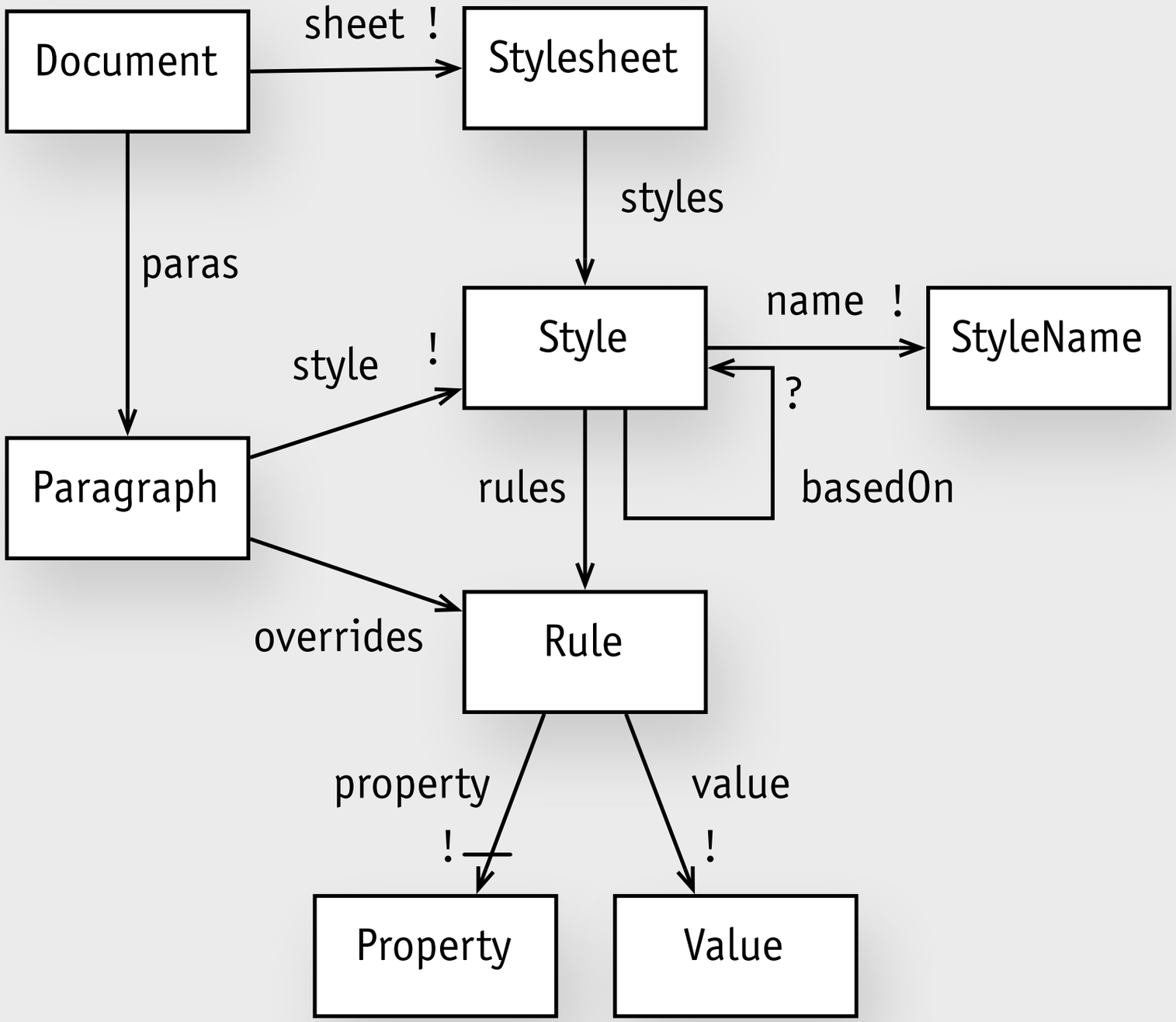
misfit: if you delete an old file and change your mind, you may not be able to find it again in the trash (if there are many deleted files and you forgot the file's name)

how to model a concept

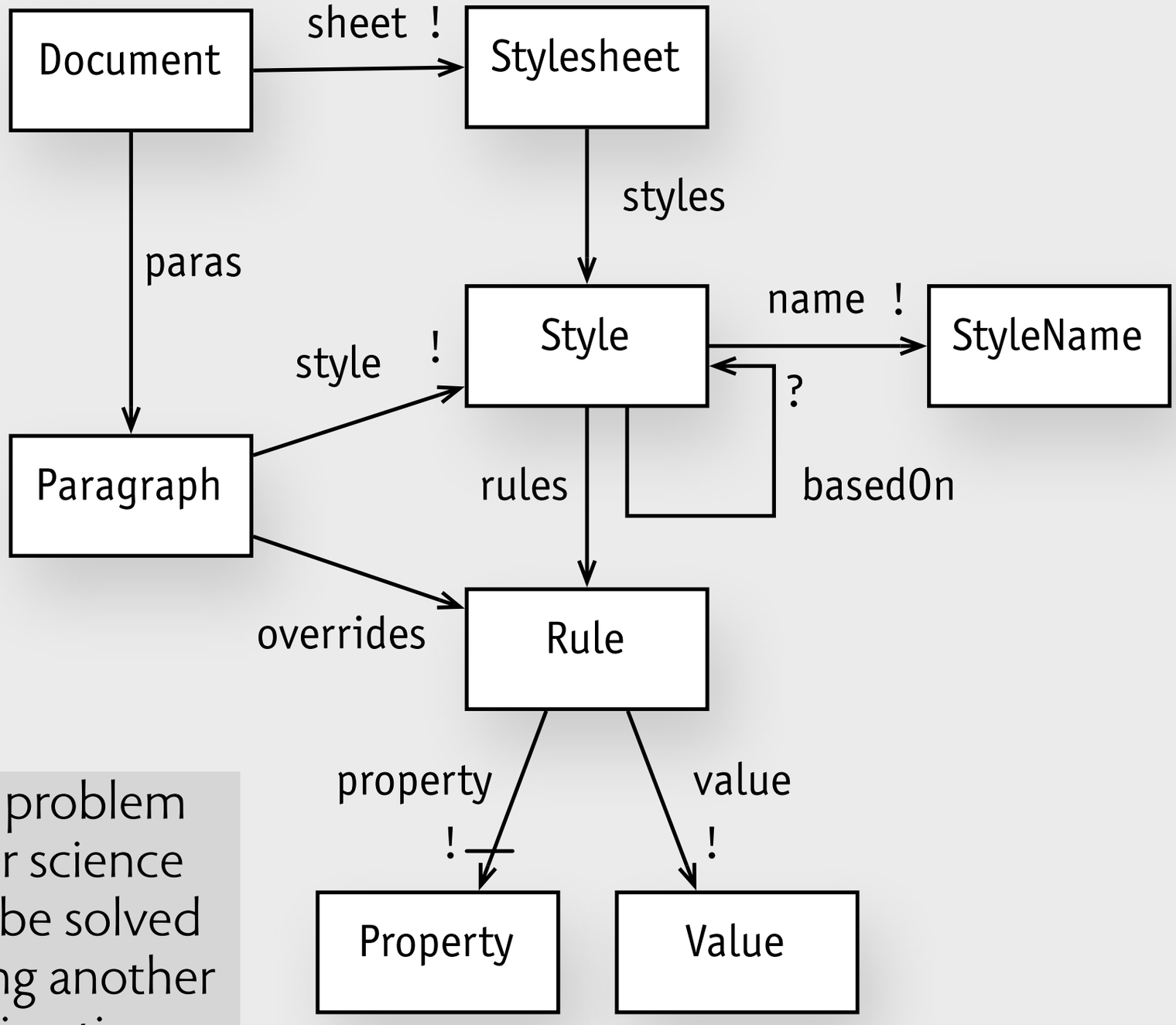
example word styles



data model word styles

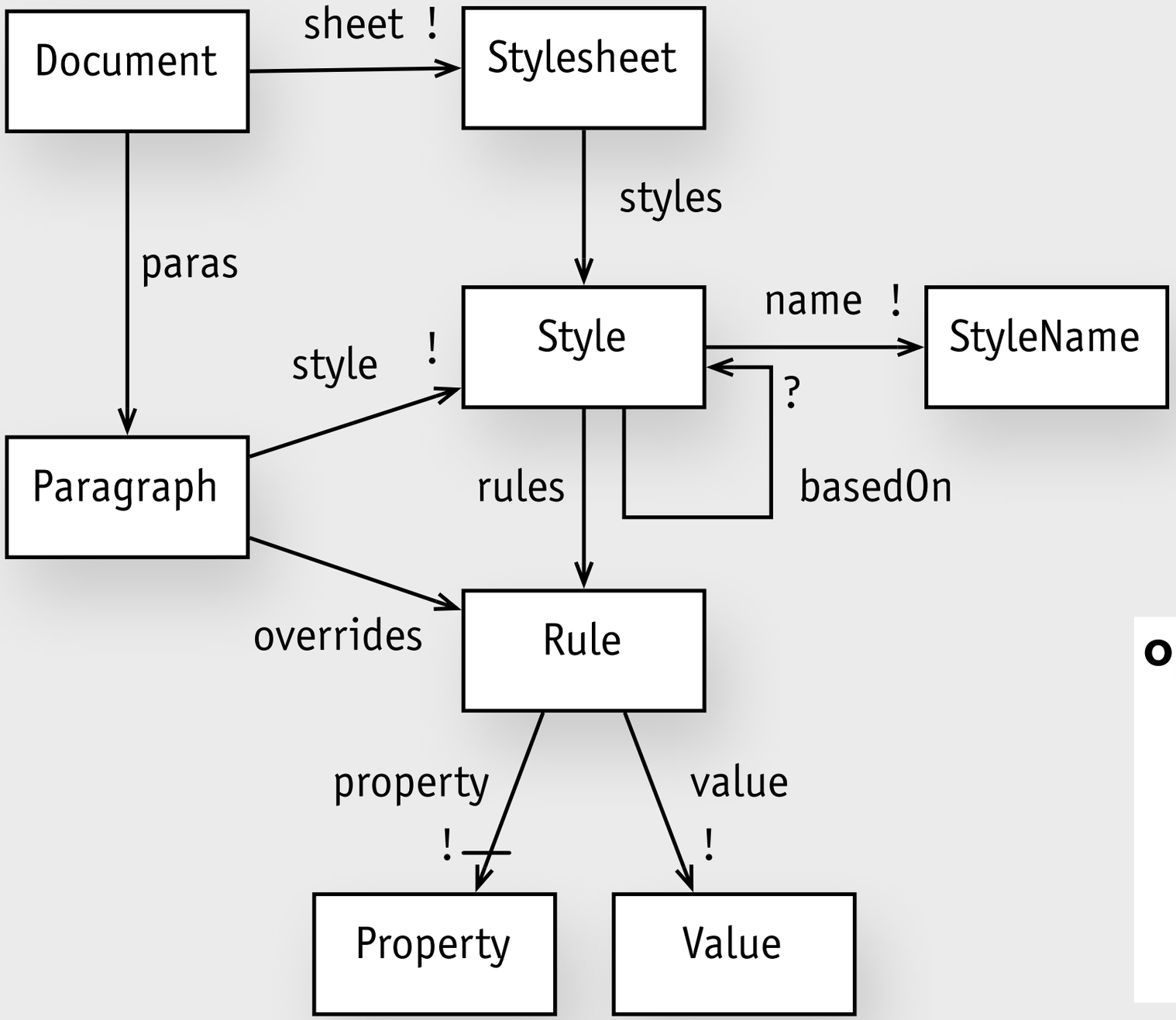


data model word styles



There is no problem
in computer science
that cannot be solved
by introducing another
level of indirection.
David Wheeler

data model **word styles**



operations

add
delete
modify
update
apply

concept dependences

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$\langle c,c' \rangle \in \text{depends} \Leftrightarrow \forall a: \text{apps} \cdot c \in \text{concepts}(a) \Rightarrow c' \in \text{concepts}(a)$

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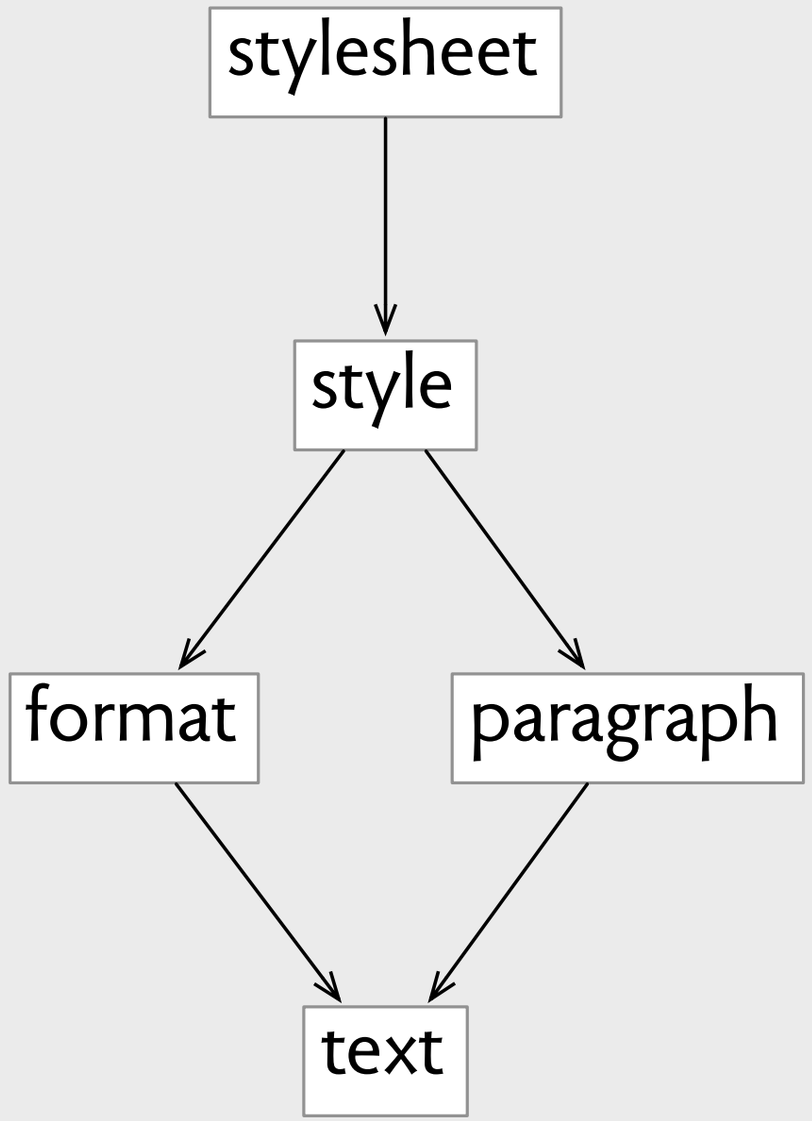

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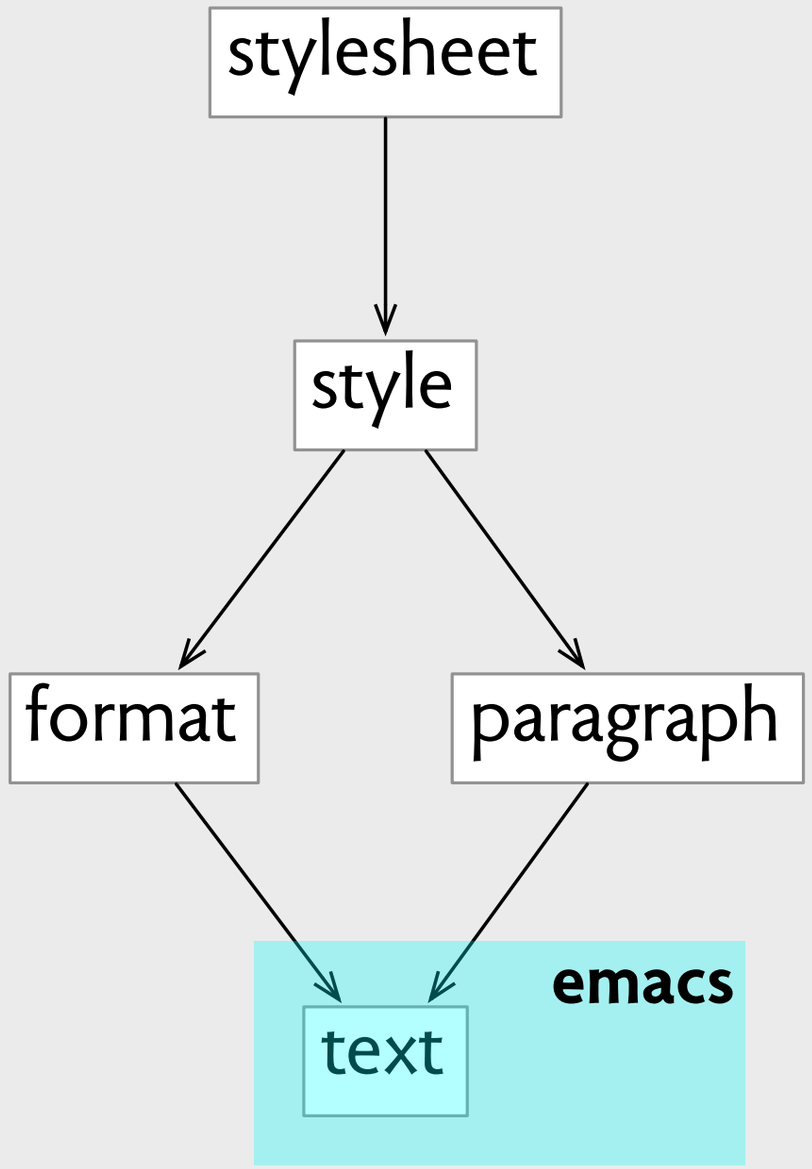

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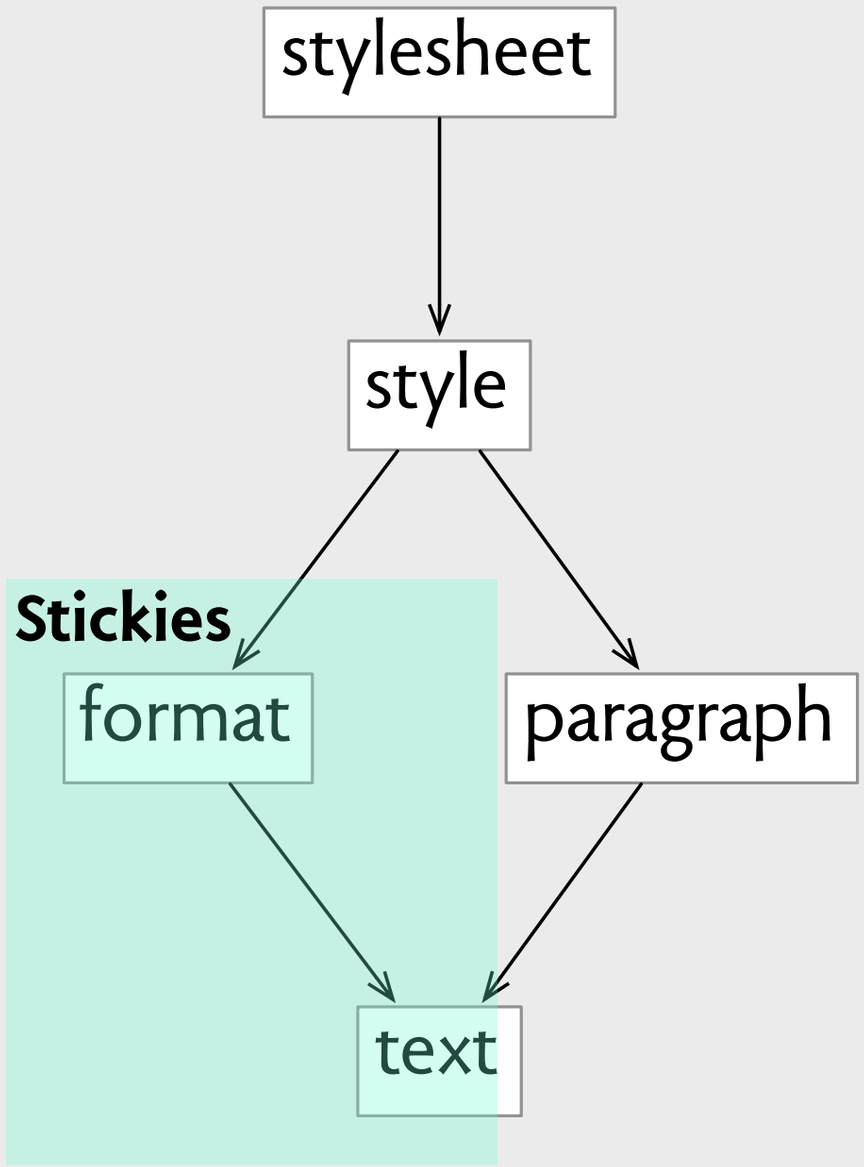

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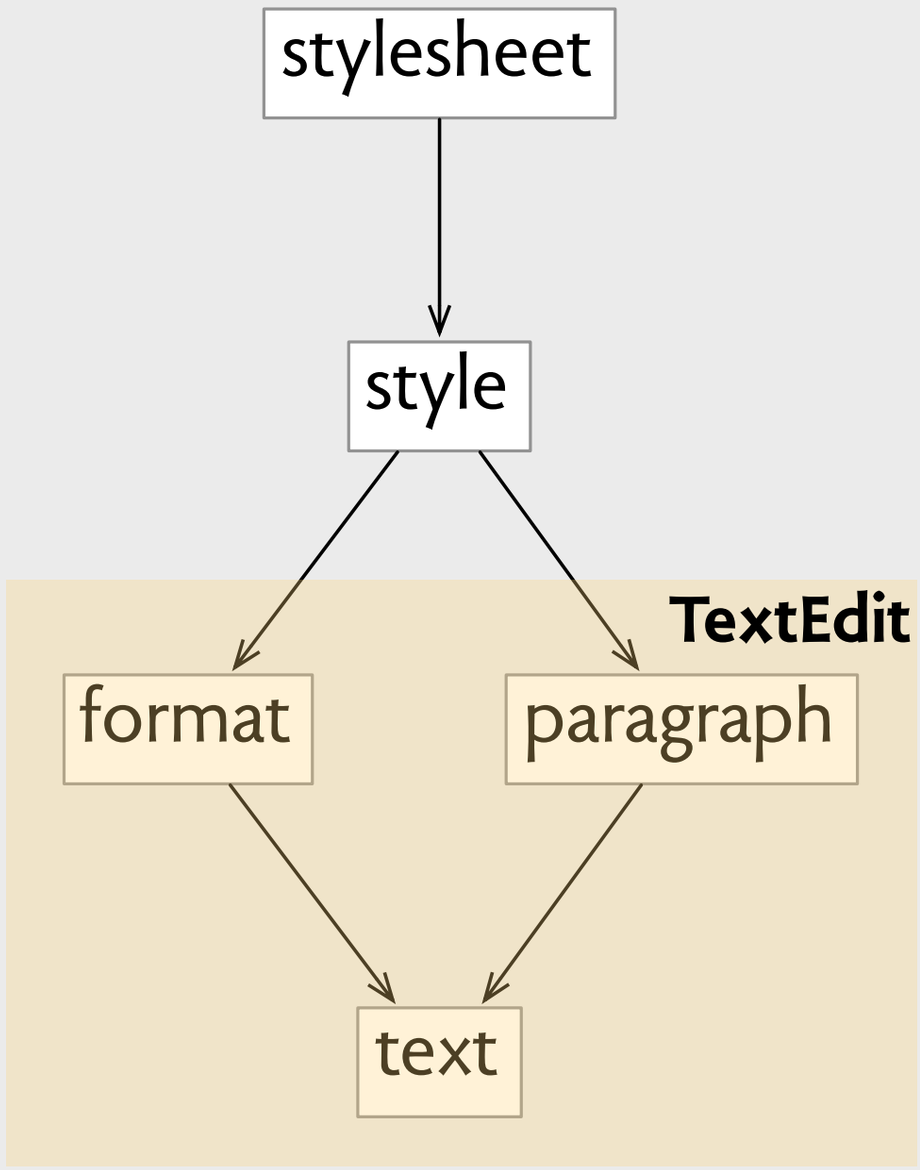

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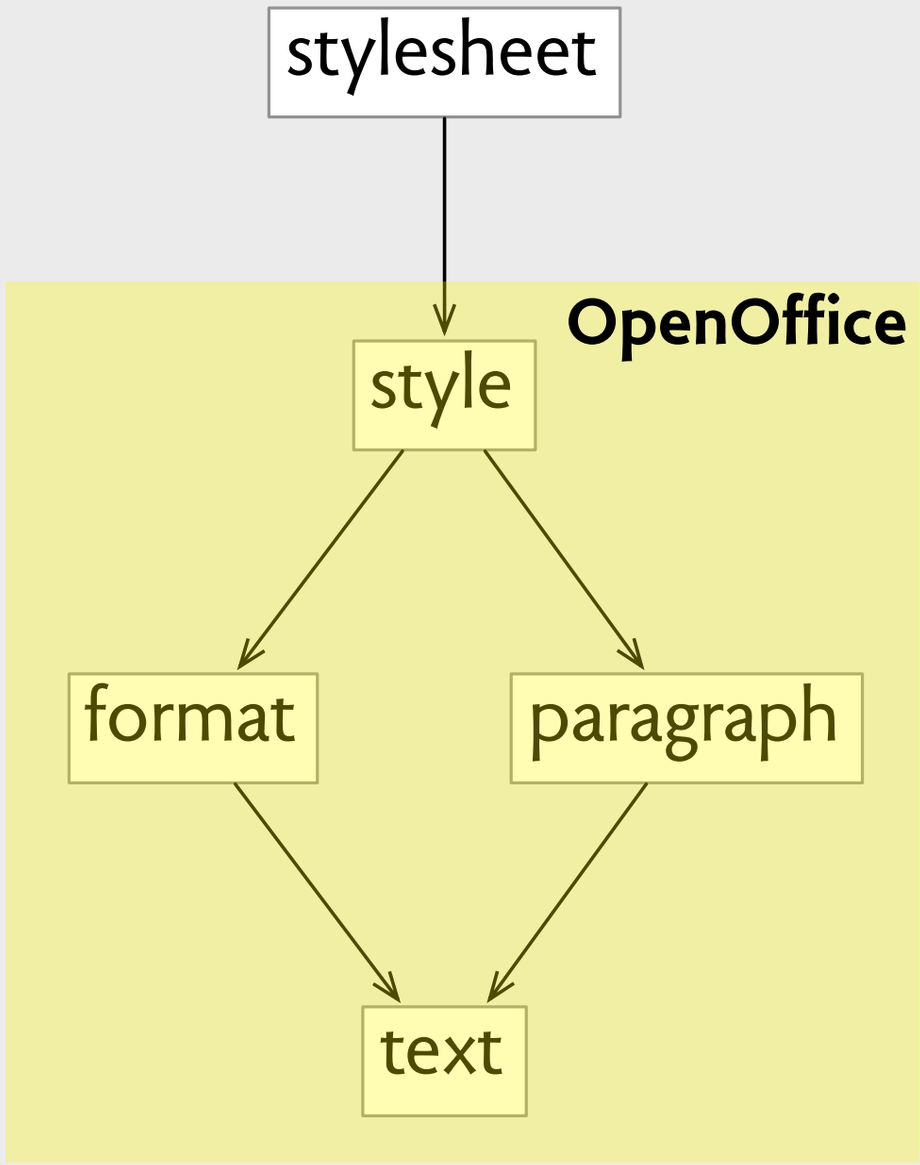

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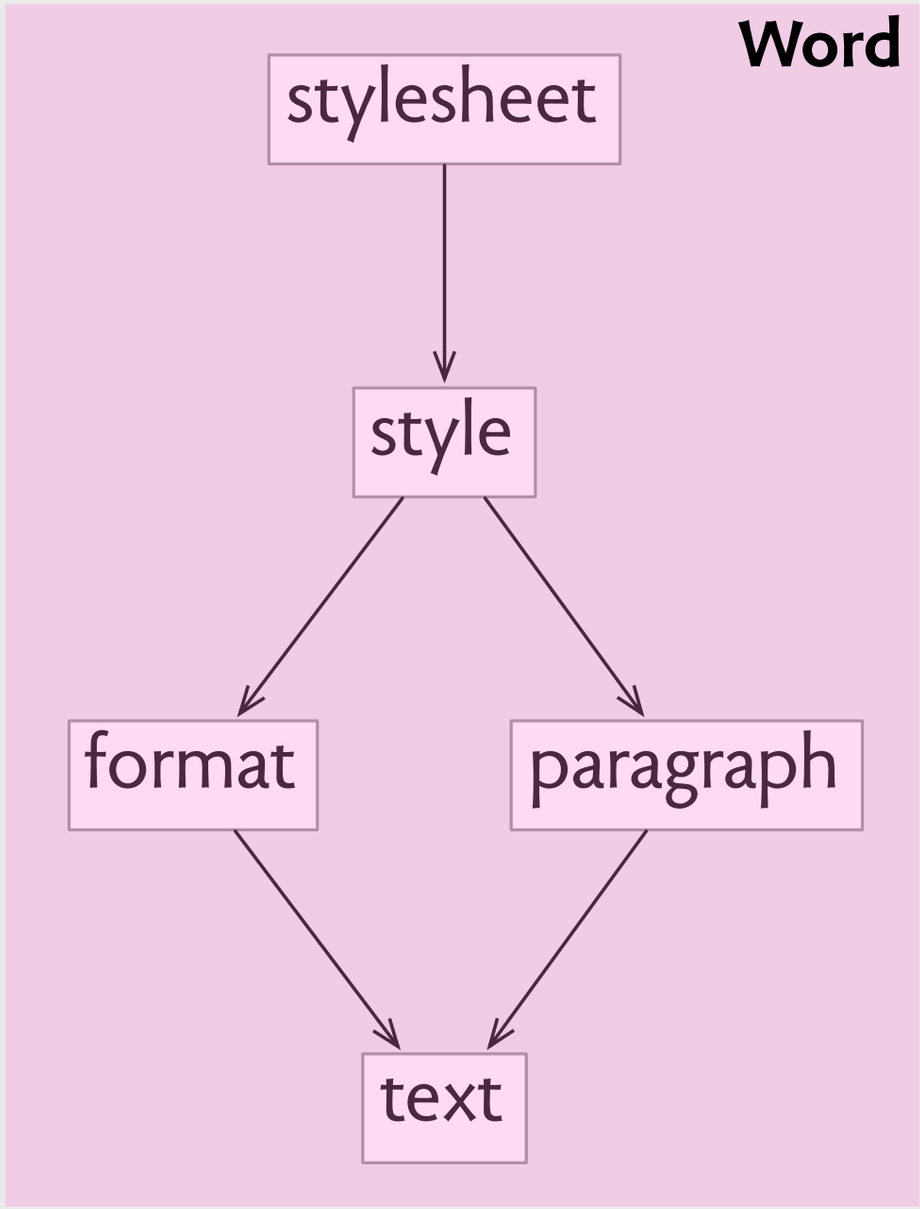
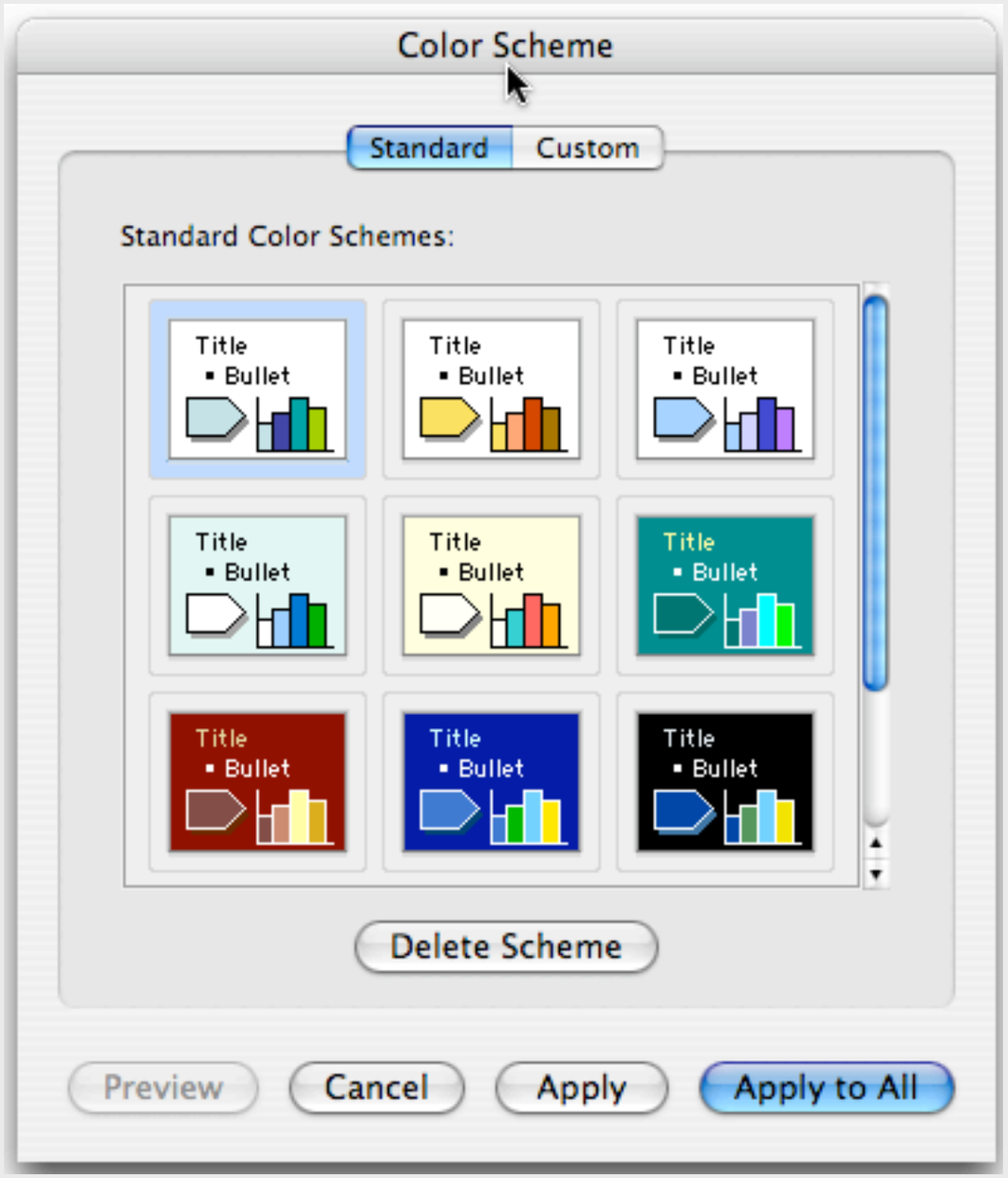
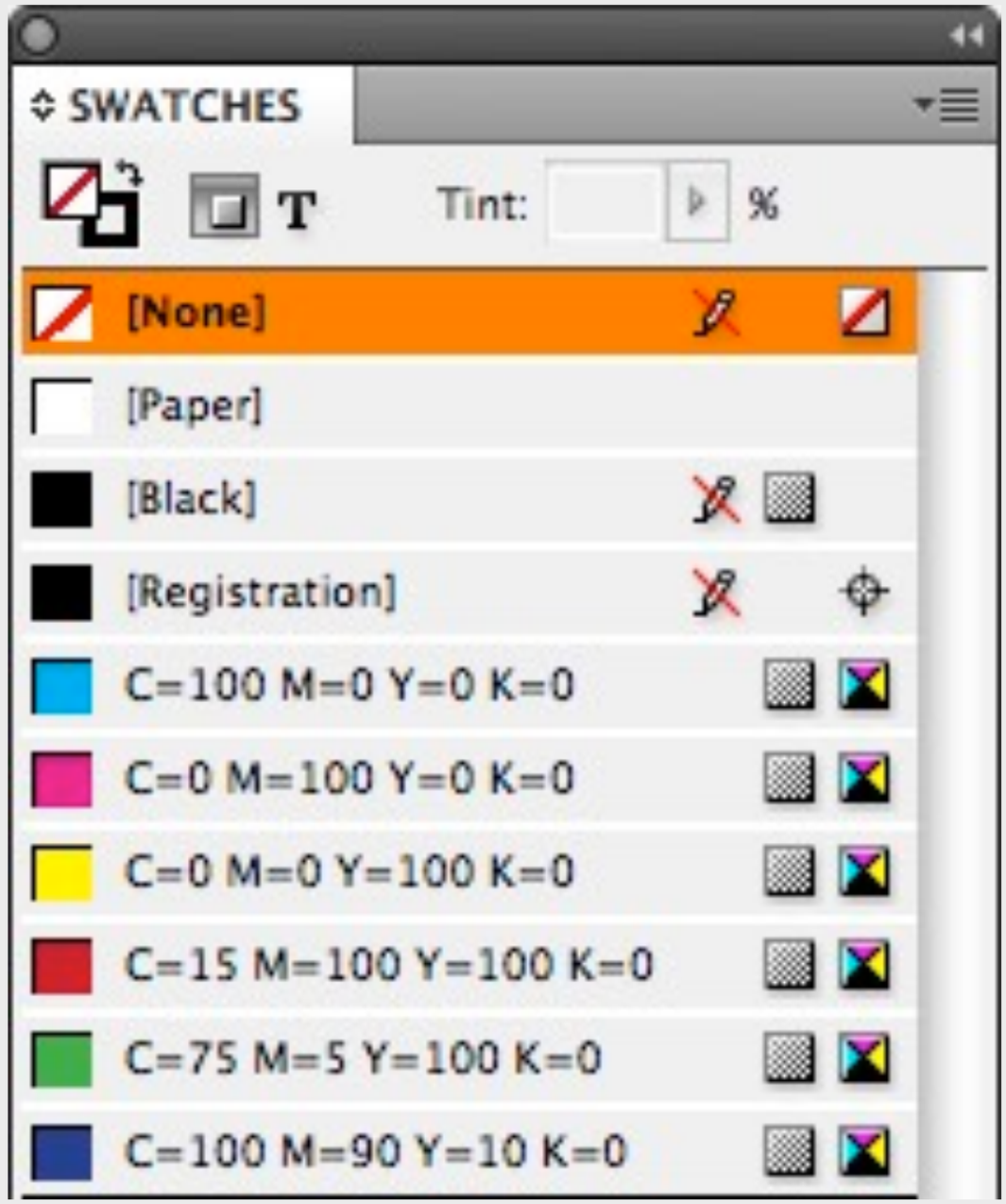


how to reuse a concept

other instantiations style

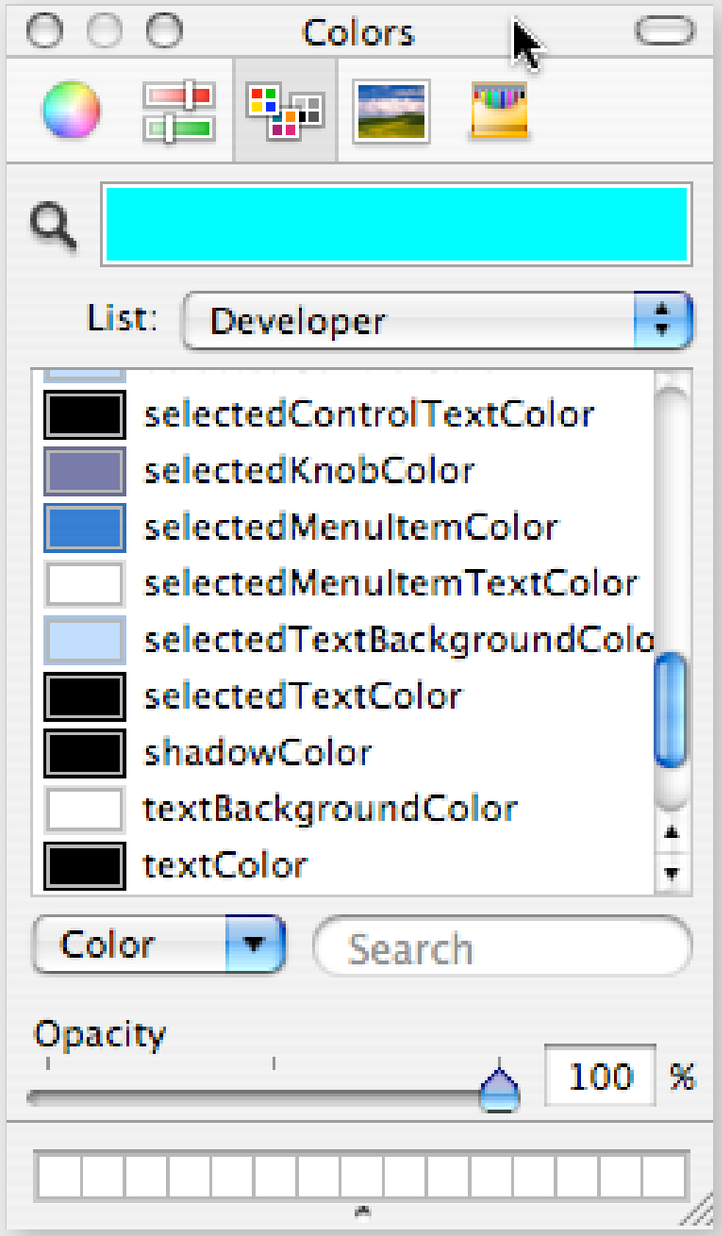


Powerpoint schemes

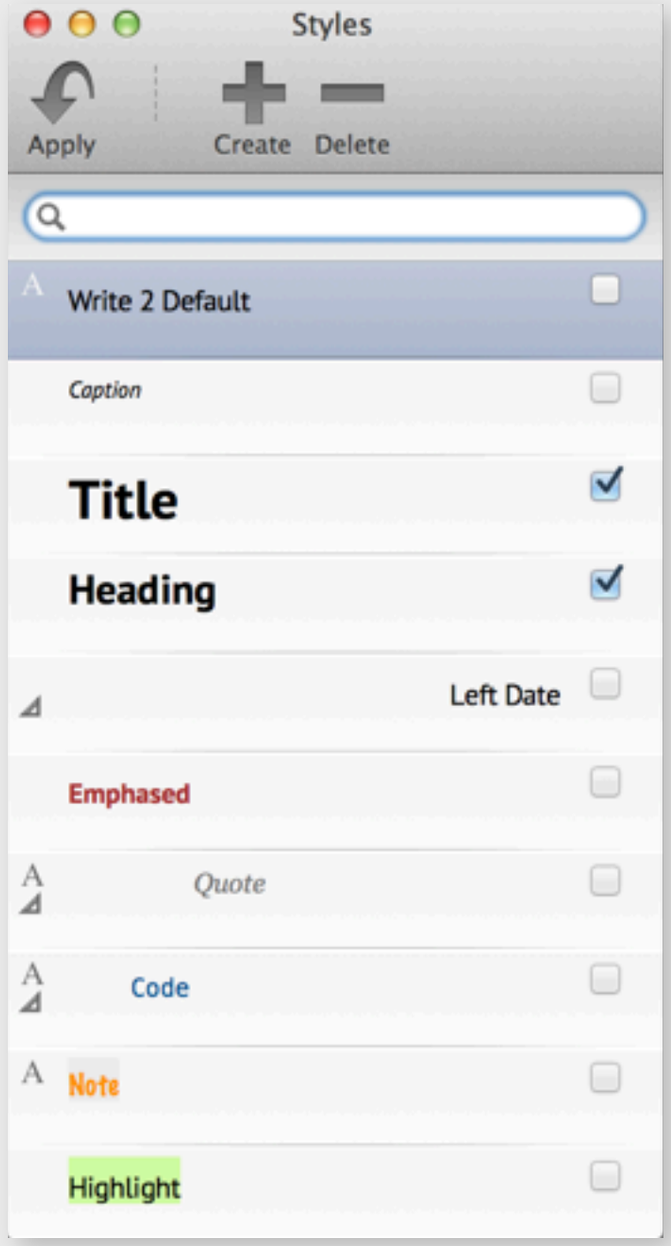


Indesign swatches

non-instantiations style

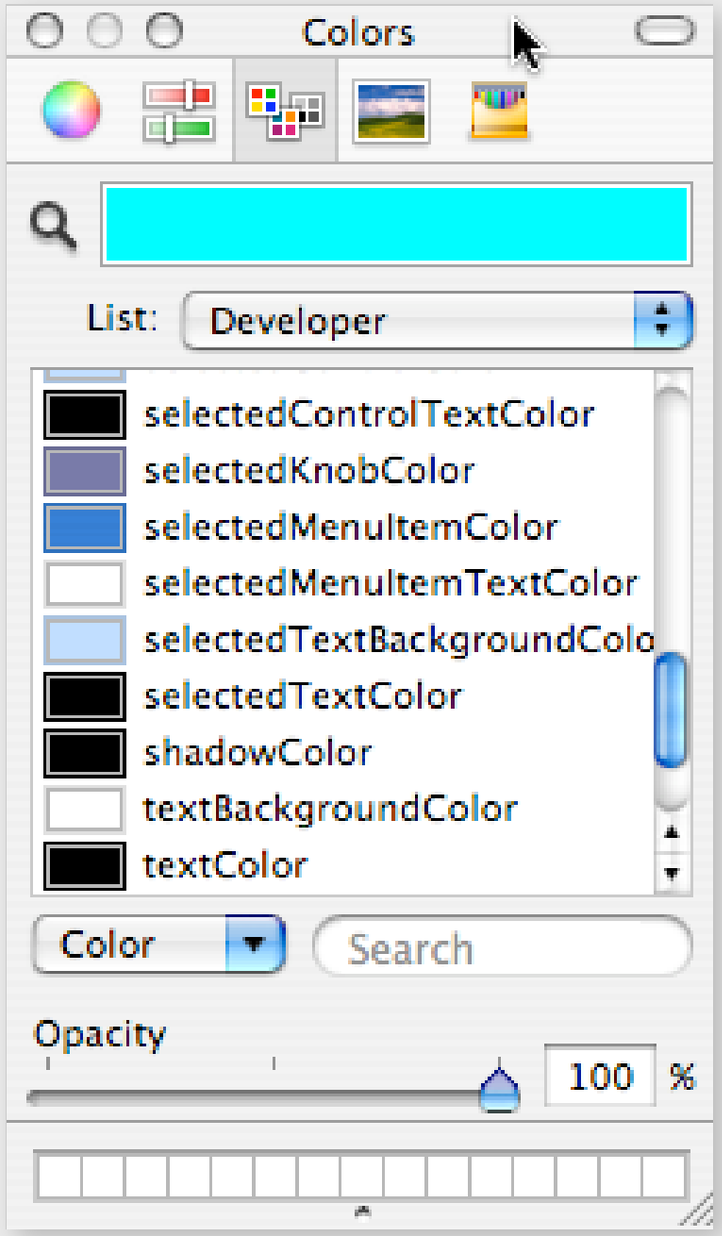


Apple color picker



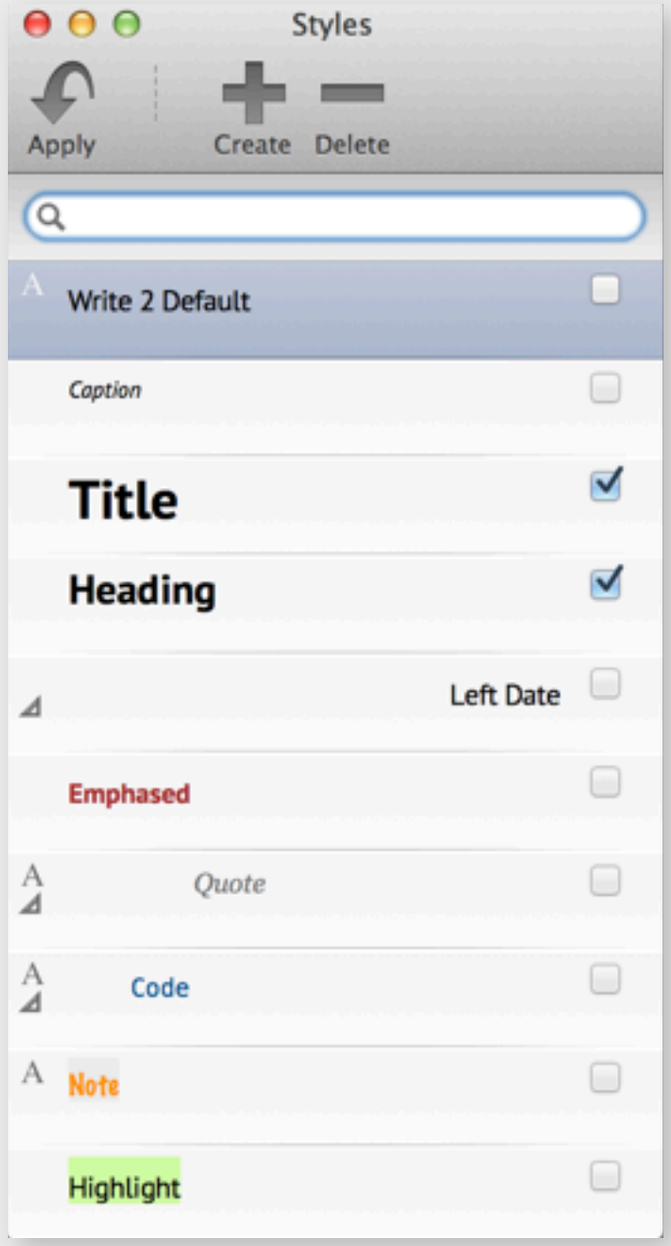
Write 2 text editor

non-instantiations style



Apple color picker

swatch-color mapping fixed



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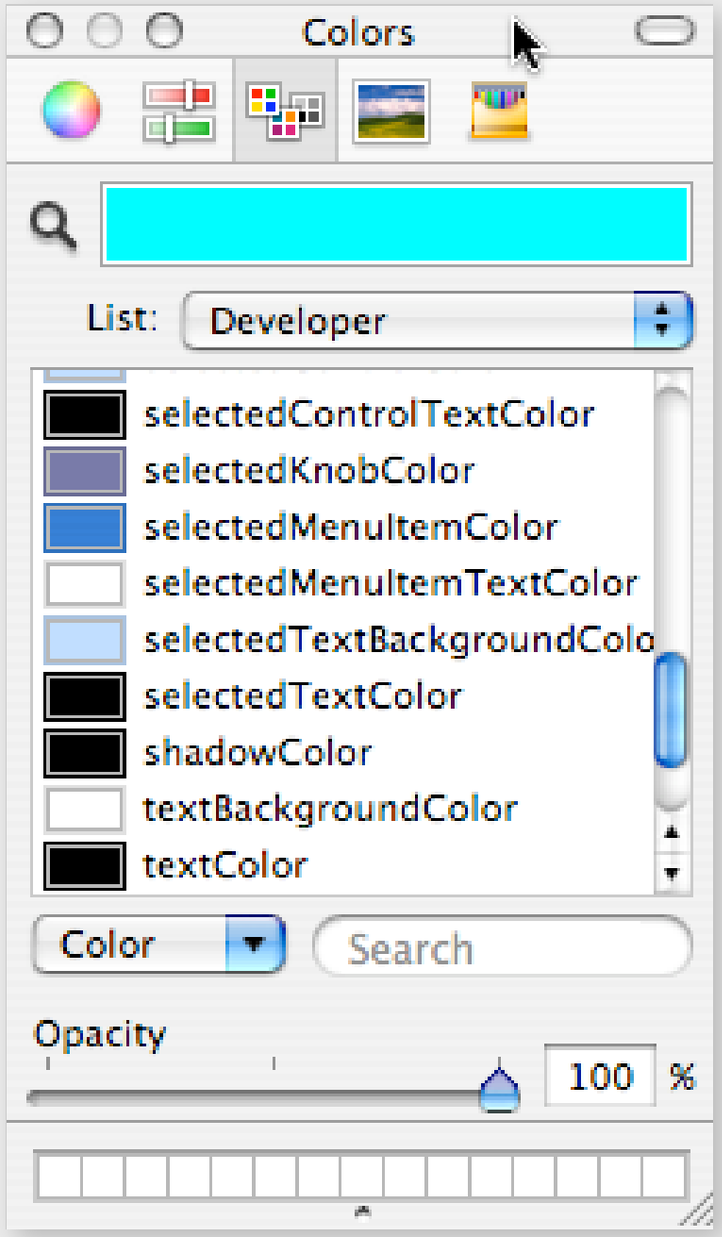

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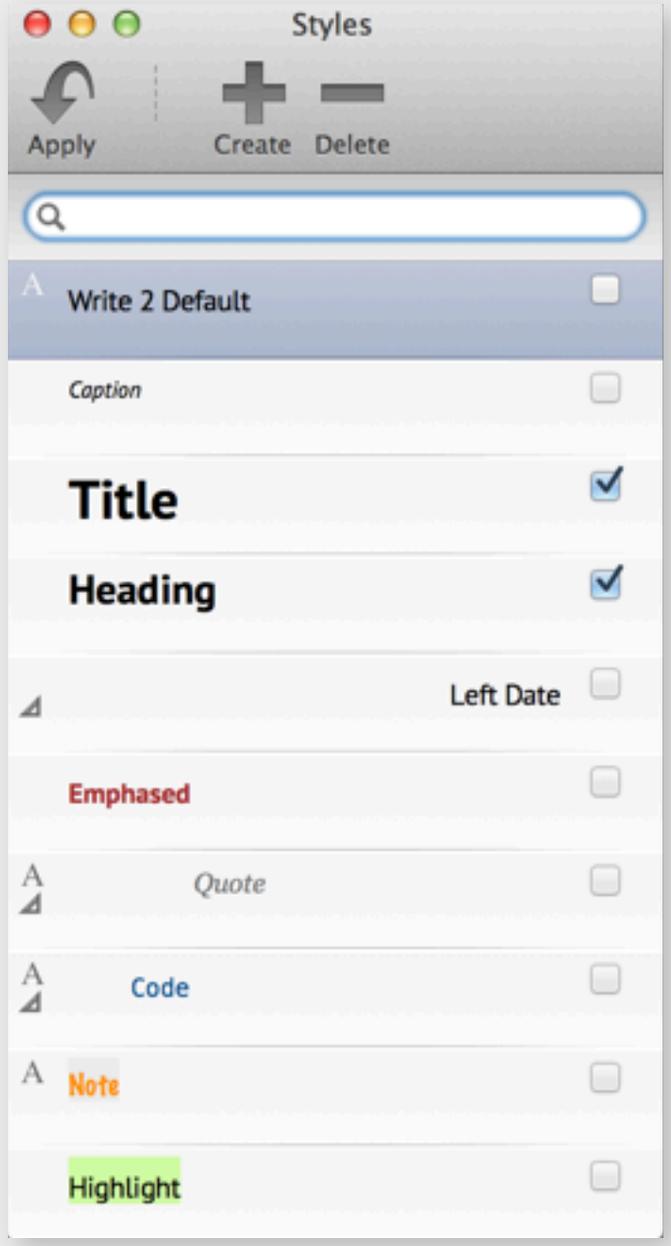
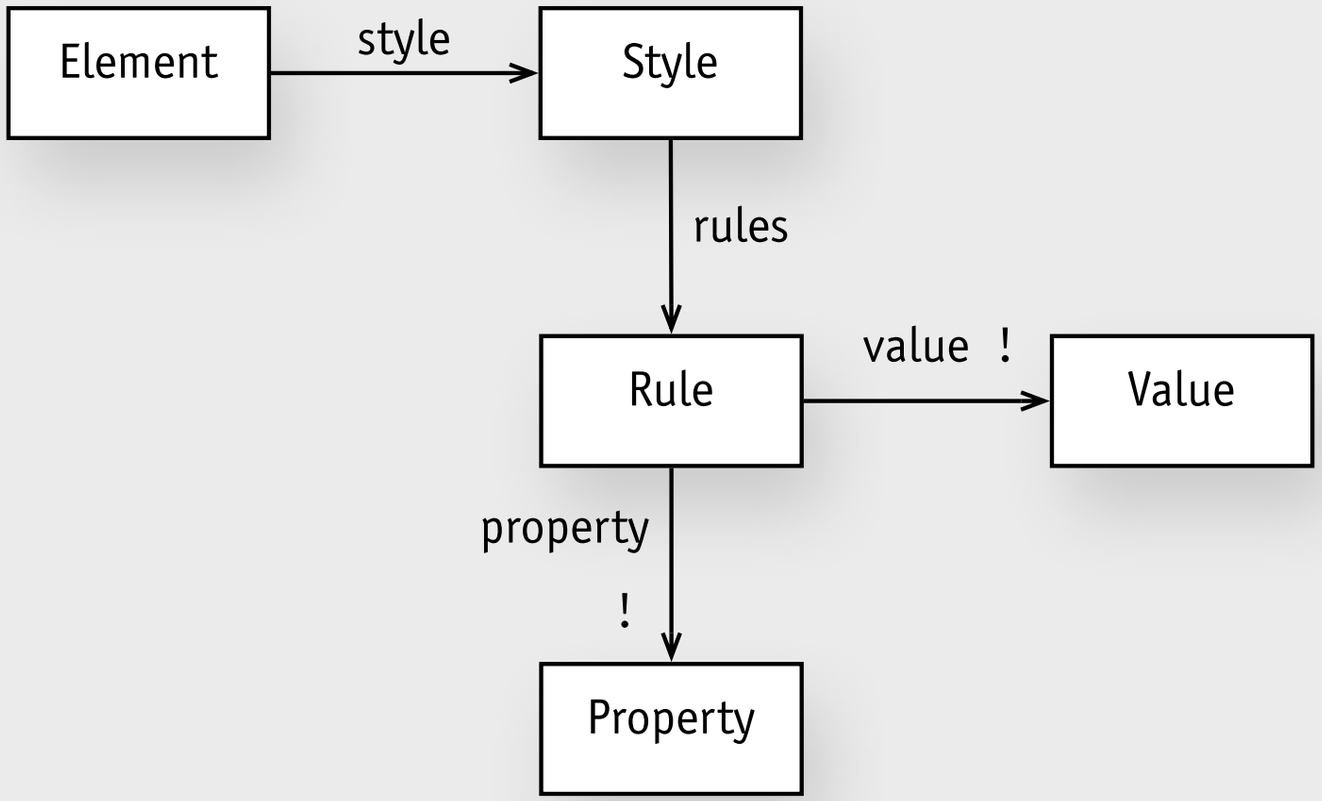


Write 2 text editor

no element-style mapping

style generic concept



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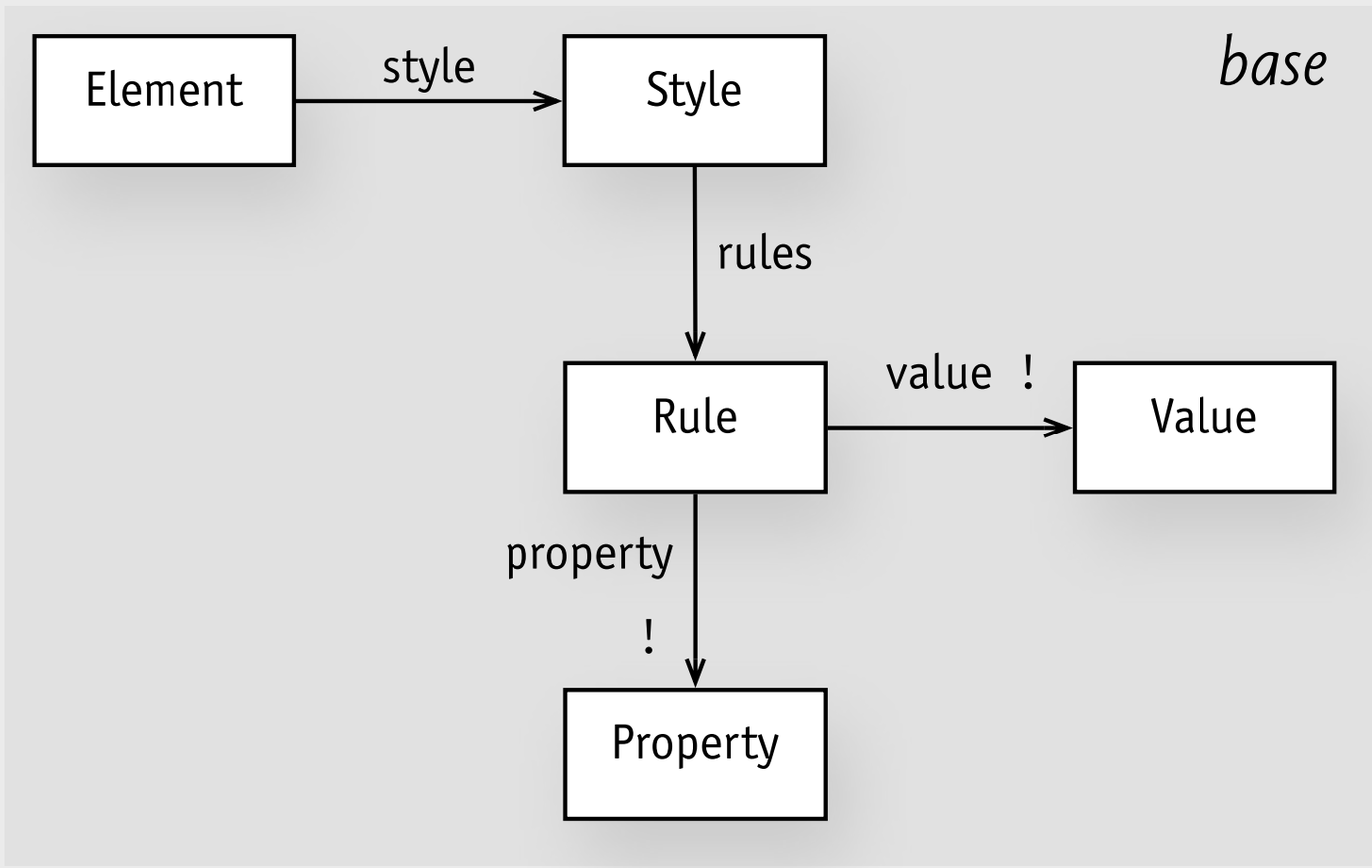

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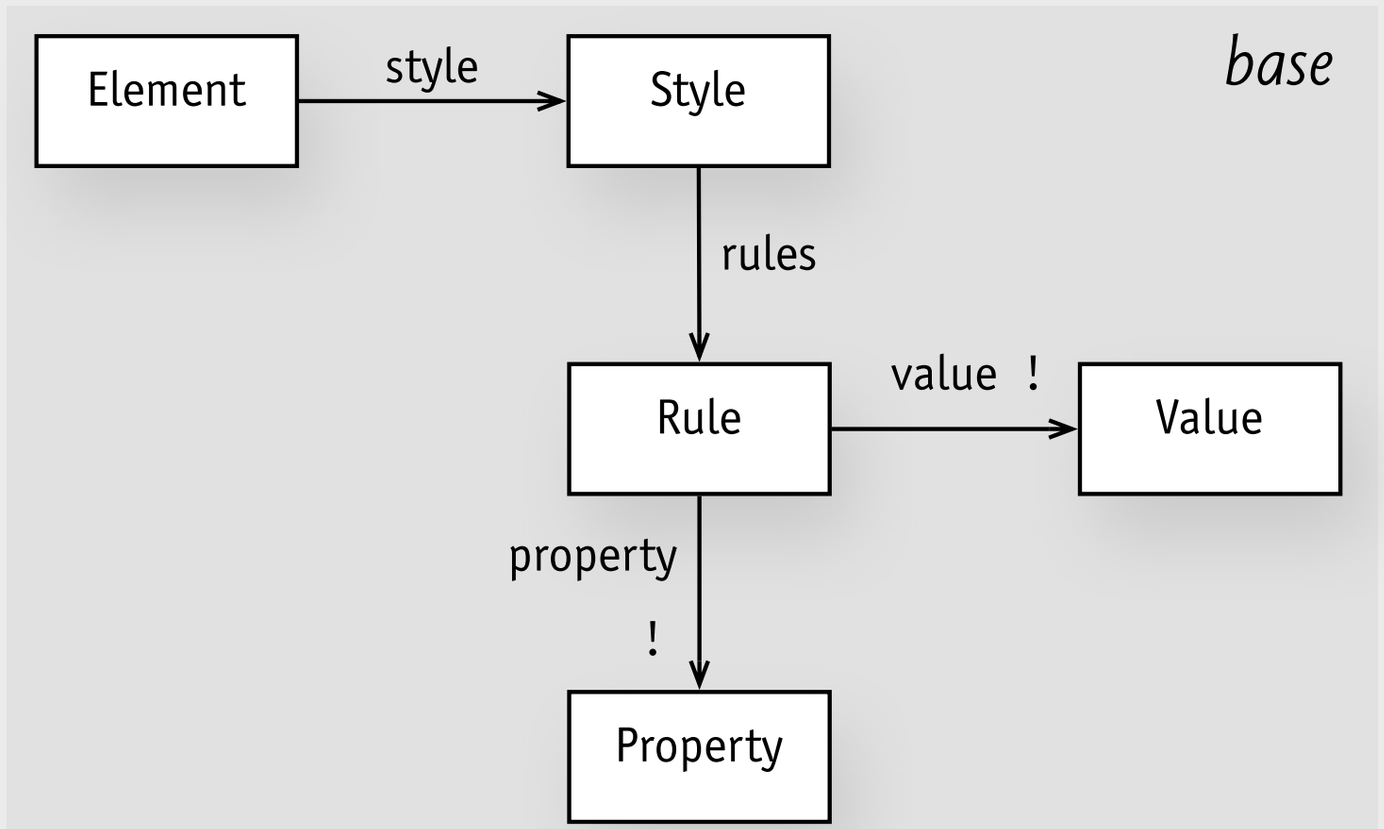

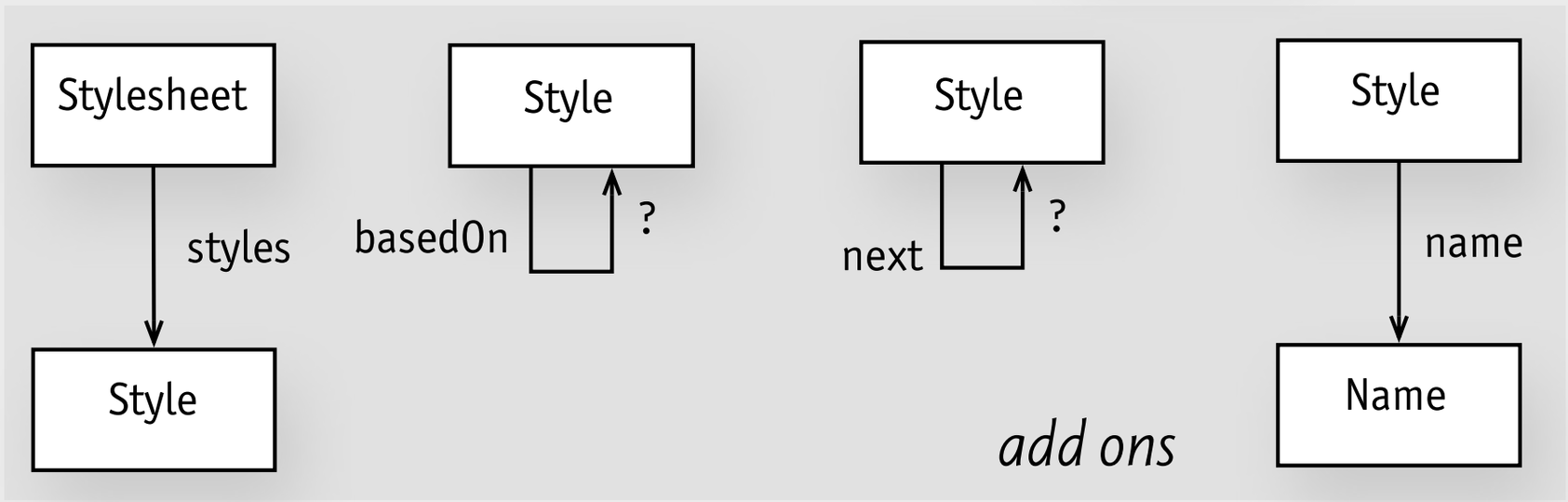

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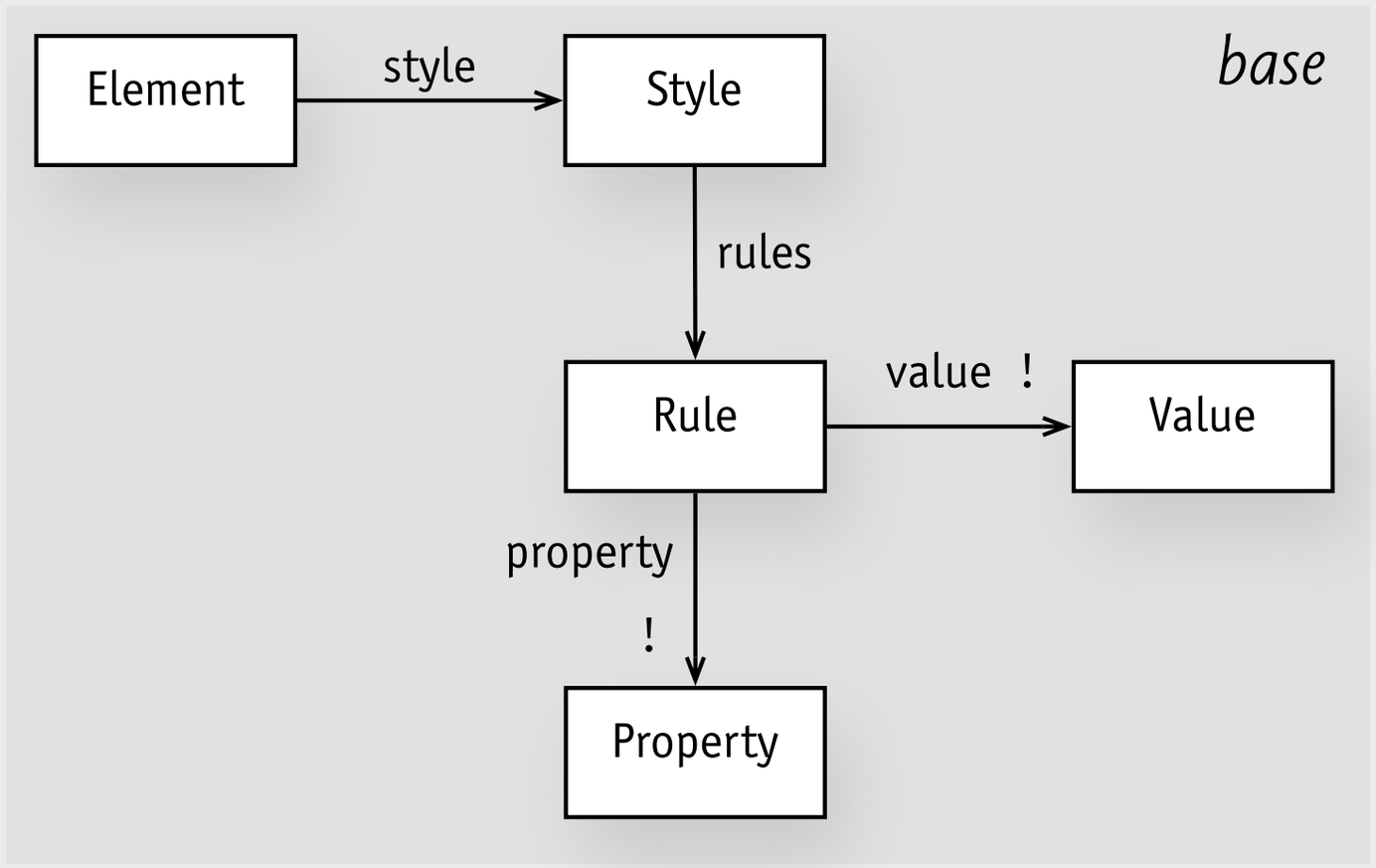
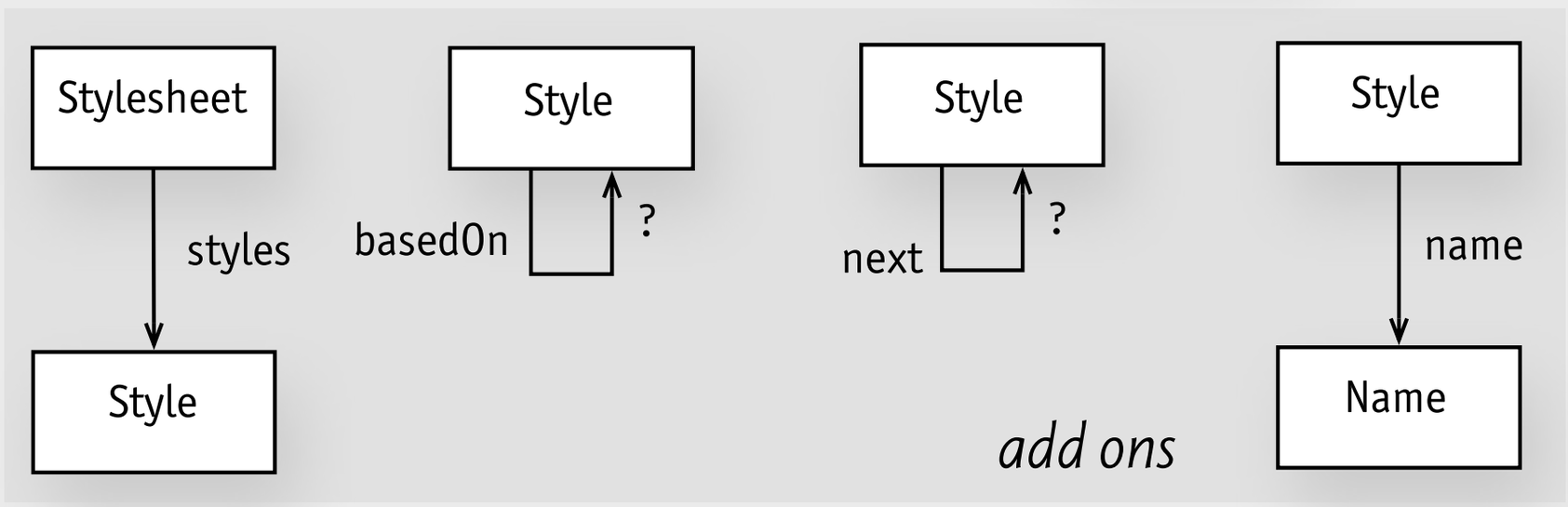
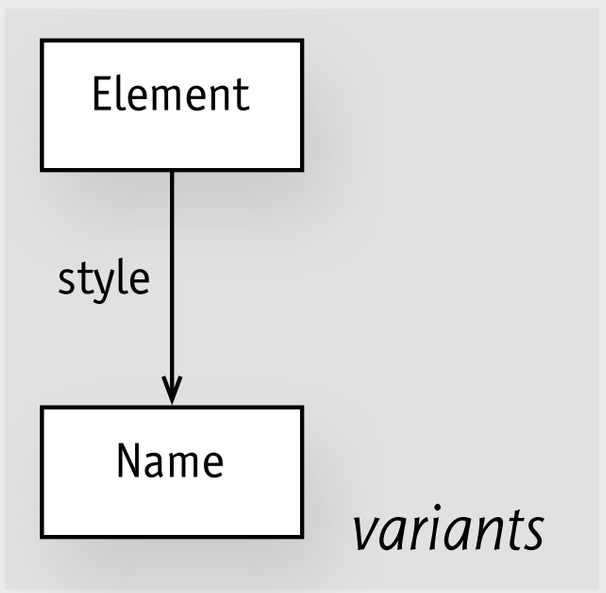






generic concept parts

part	example
name	**Style**
purpose	make it easy to maintain consistent format across set of elements
sample uses	Text formatting in word processors/layout apps (Word, Indesign, Pages, etc); rules in CSS; color themes in Powerpoint.
model	*base, add-ons, variants*
operations	add, delete, modify, apply, update
related to	**StyleBuffer, Stencil, Master**
issues	optional rules problem

concept selection

concept selection

slides in Keynote

concept selection

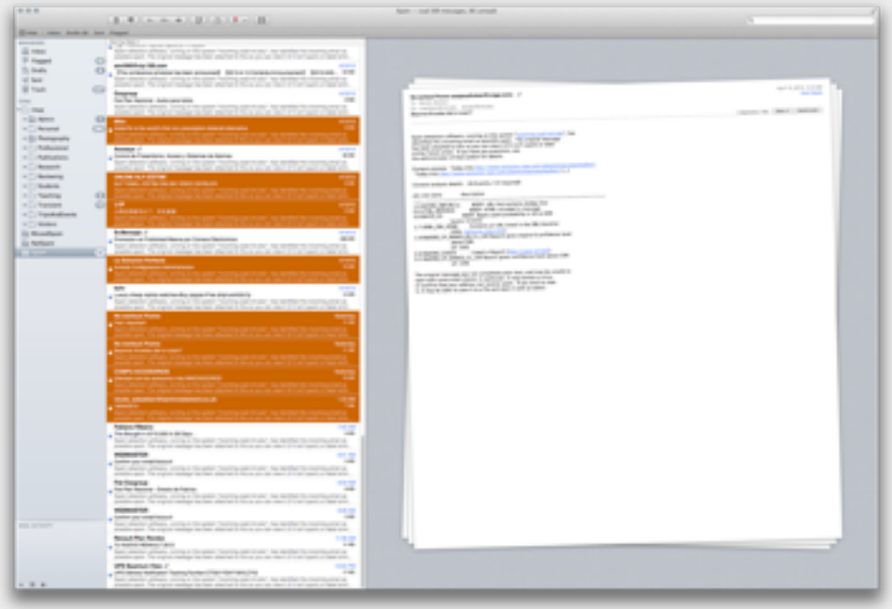
slides in Keynote

photos in Adobe Lightroom

concept selection

slides in Keynote

photos in Adobe Lightroom

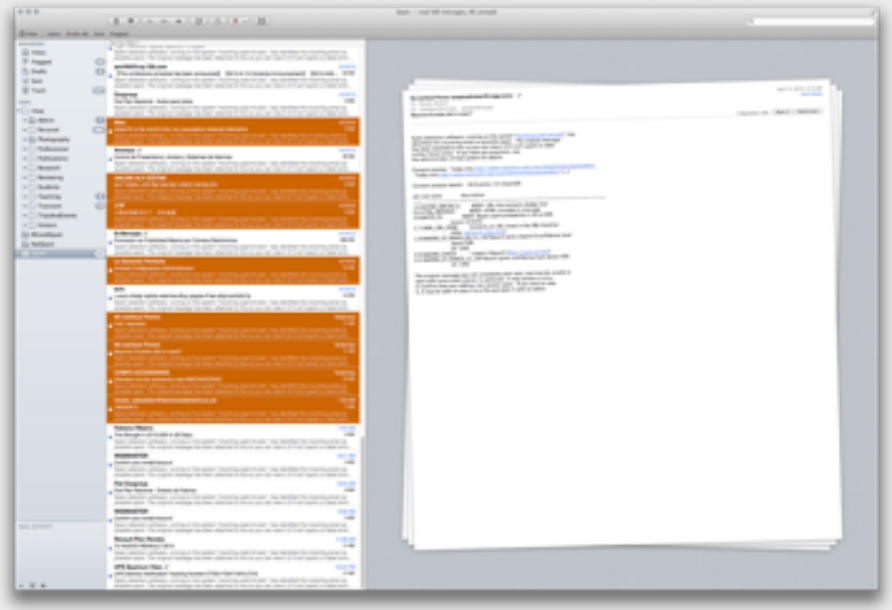


messages in Apple Mail

concept selection

slides in Keynote

photos in Adobe Lightroom



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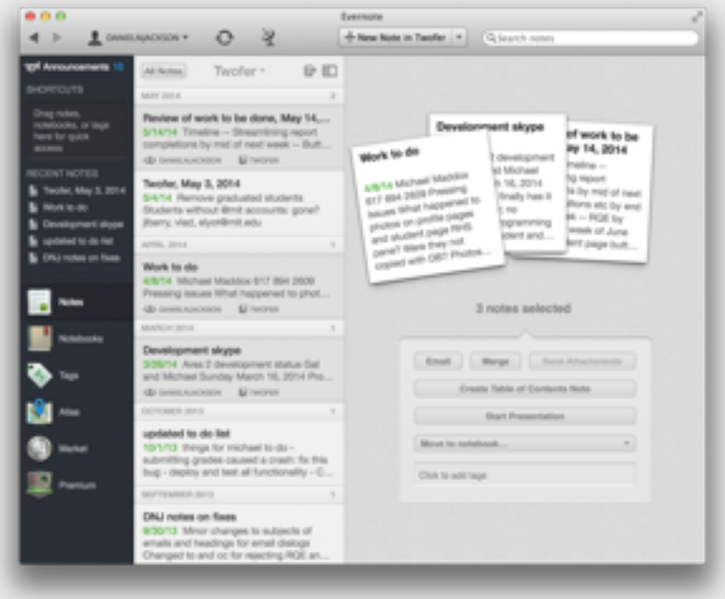
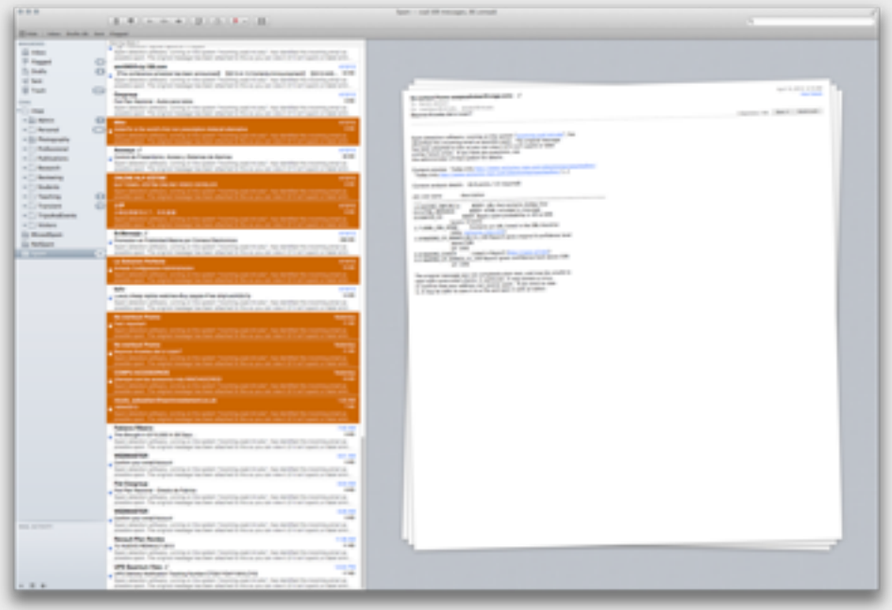


notes in Evernote

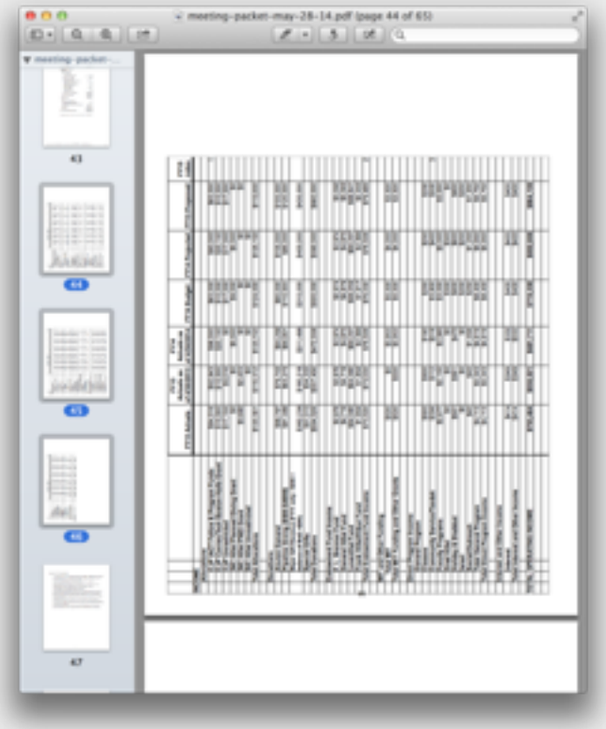
concept selection

slides in Keynote

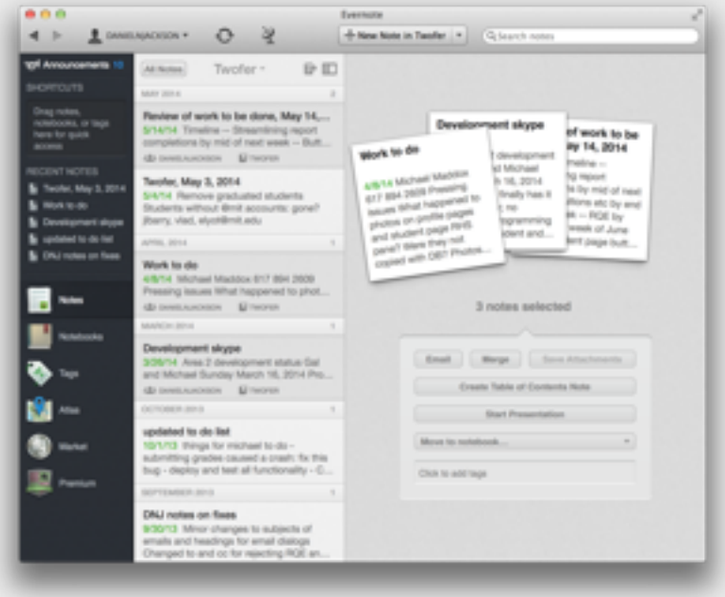
photos in Adobe Lightroom



messages in Apple Mail



thumbnails in Preview

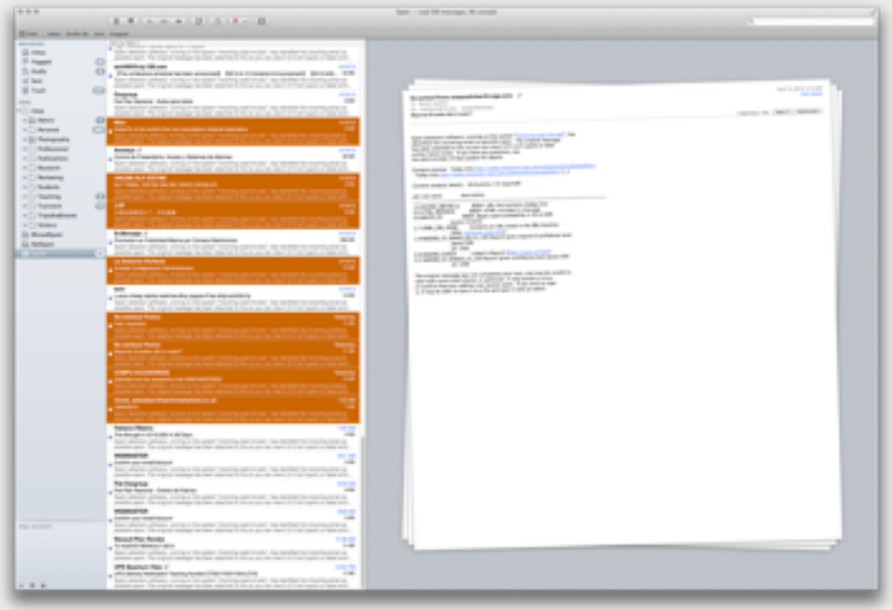


notes in Evernote

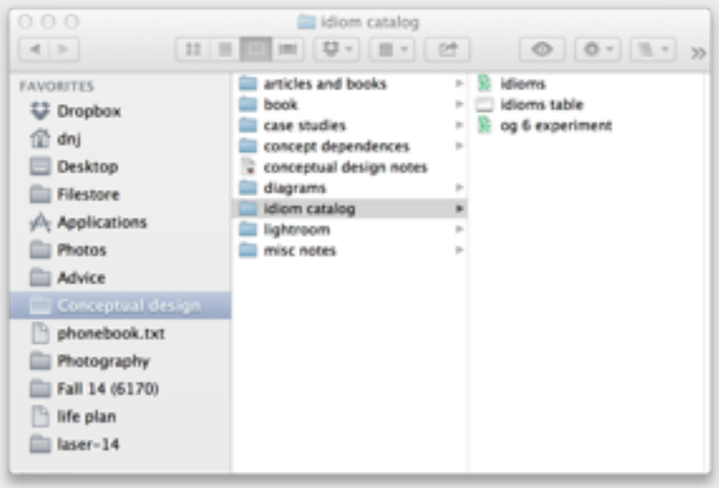
concept selection

slides in Keynote

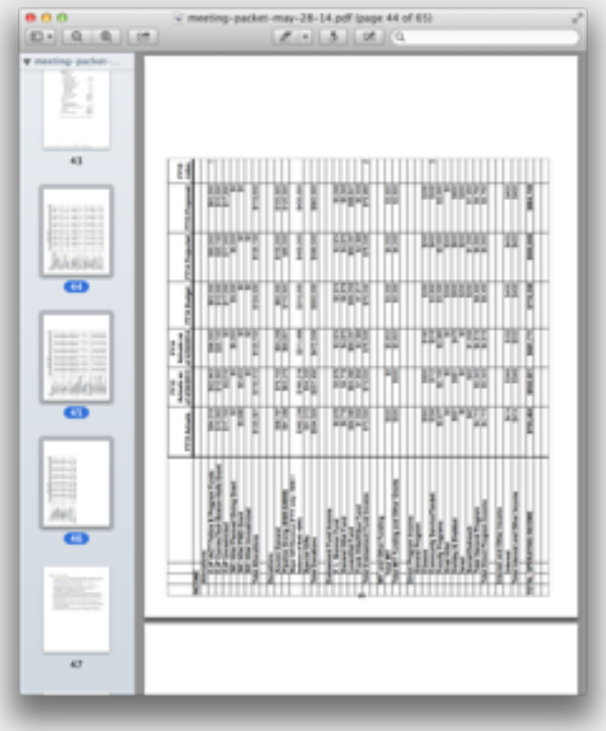
photos in Adobe Lightroom



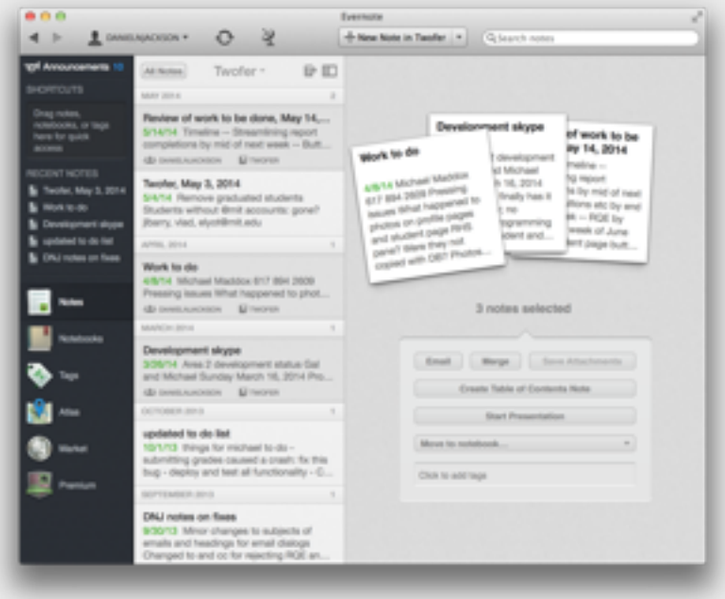
messages in Apple Mail



objects in OS X Finder

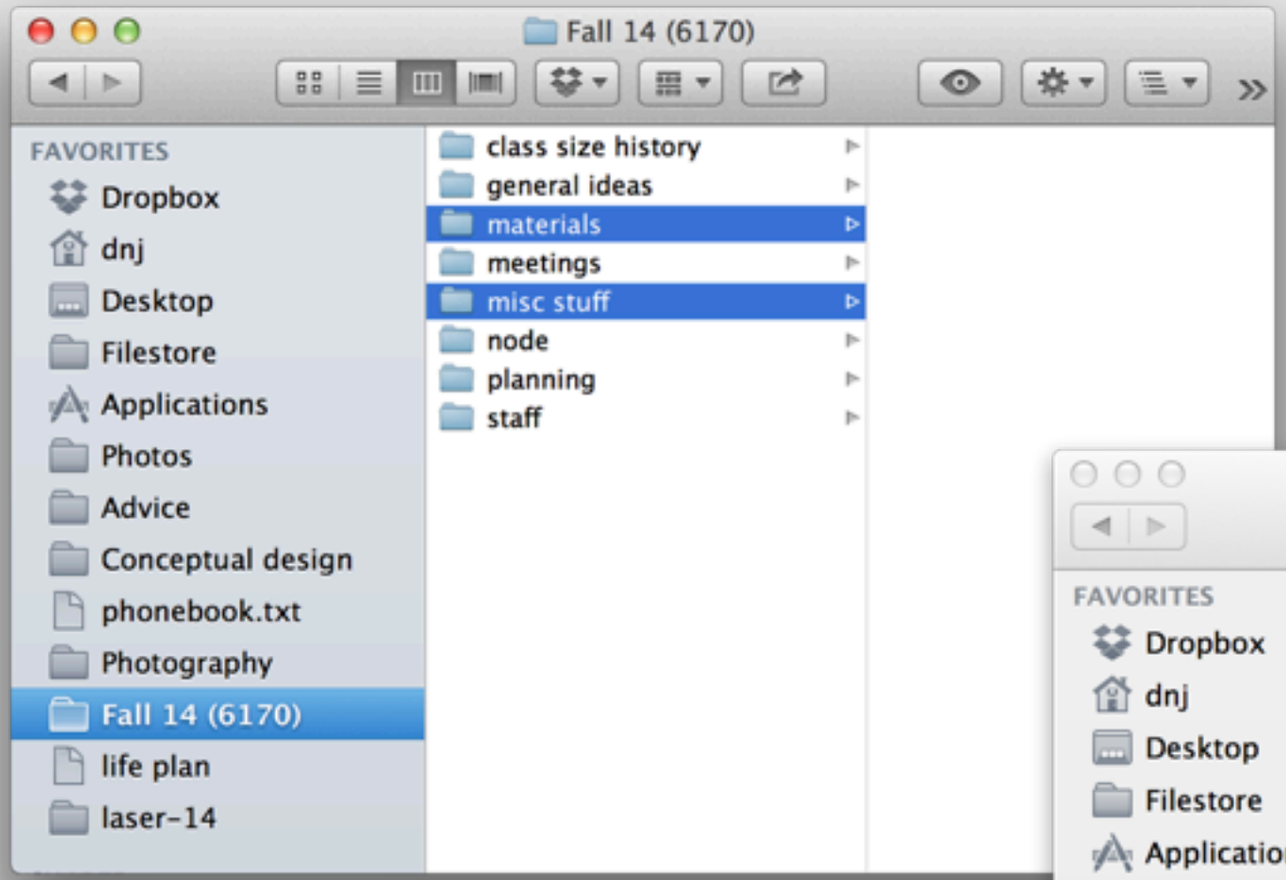


thumbnails in Preview

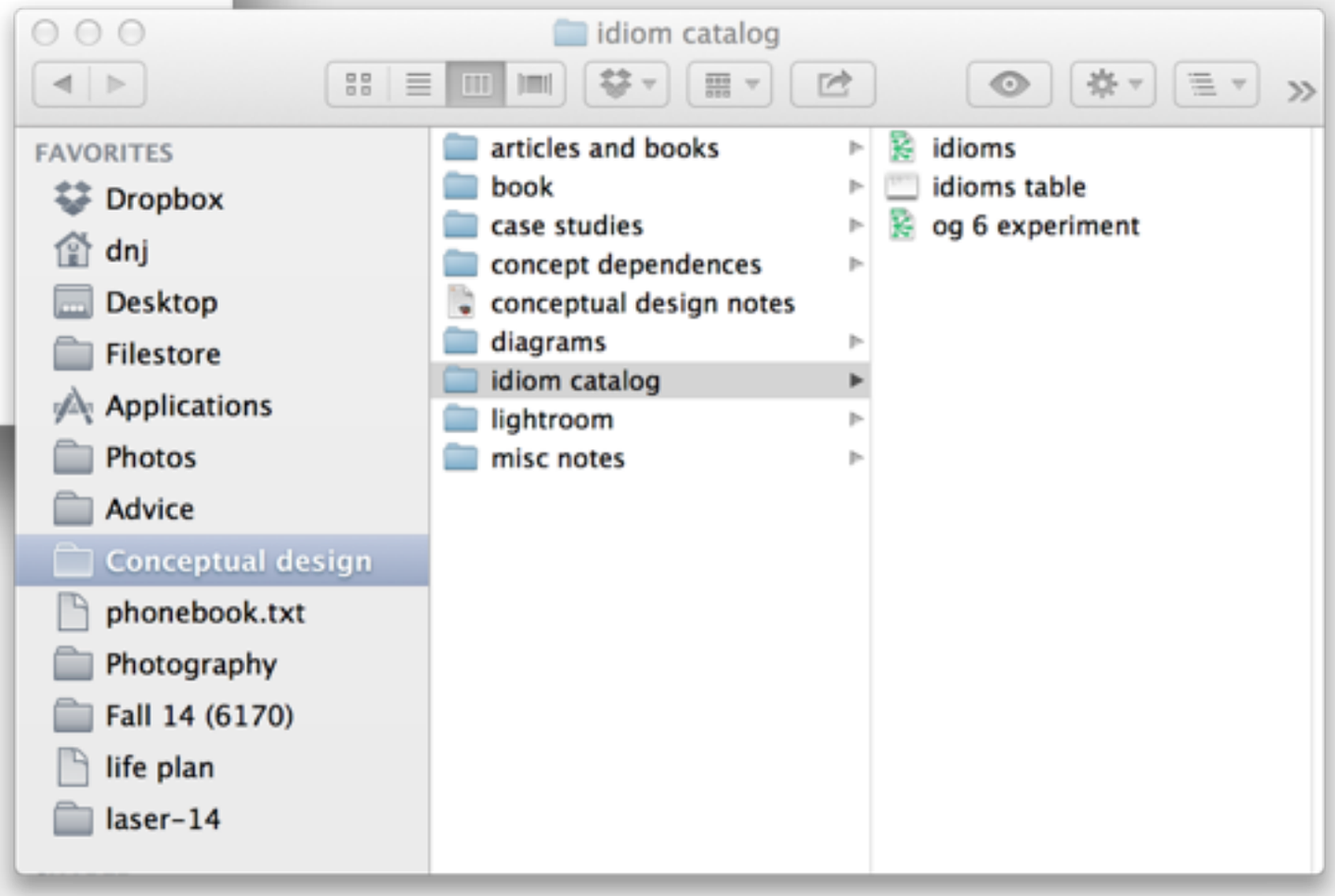


notes in Evernote

subtlety selection scope



subset of selection in scope

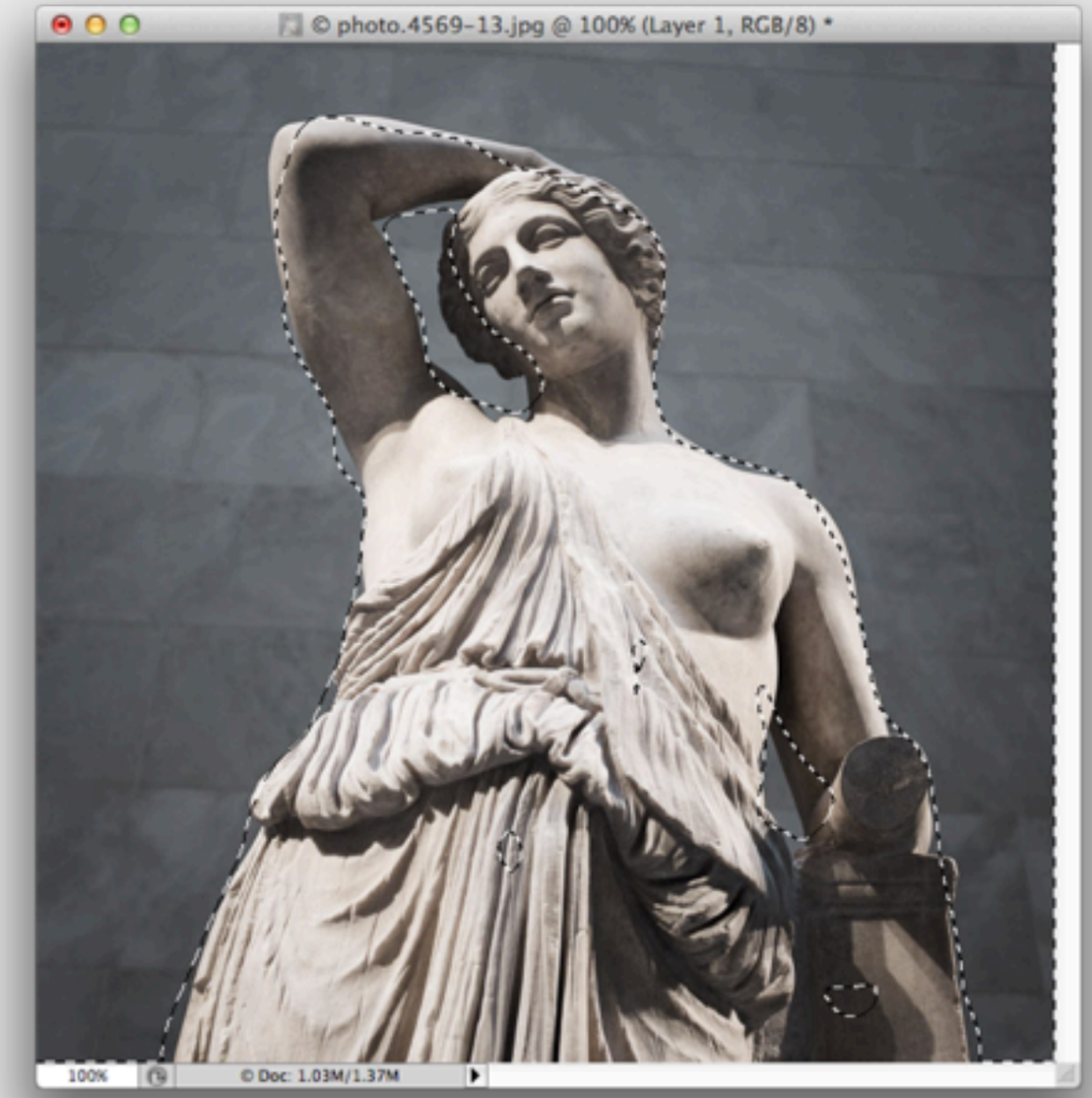


subset of selection out of scope

subtlety active element

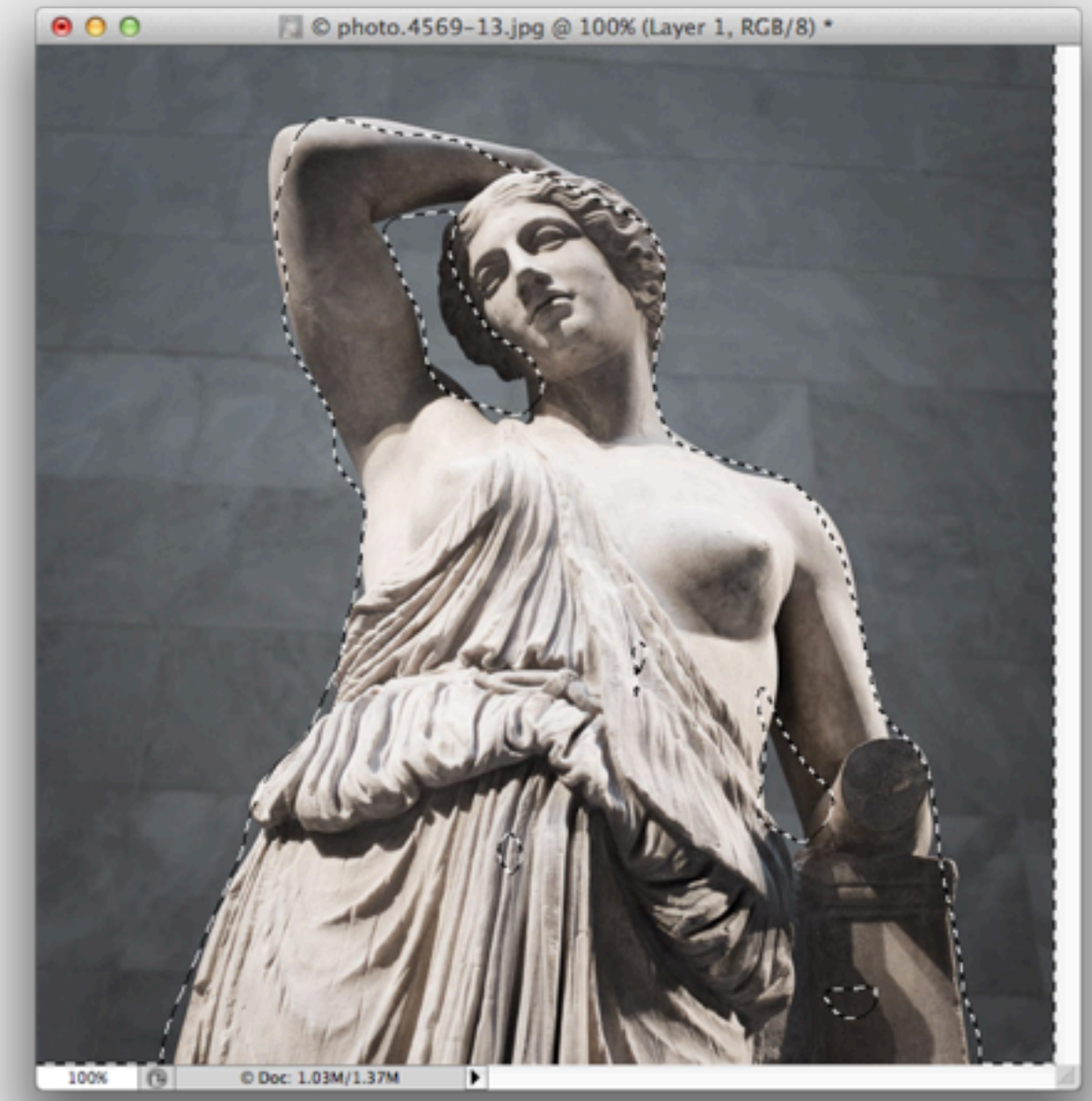
Adobe Lightroom: brightest thumbnail is the “active photo”

subtlety continuous selection

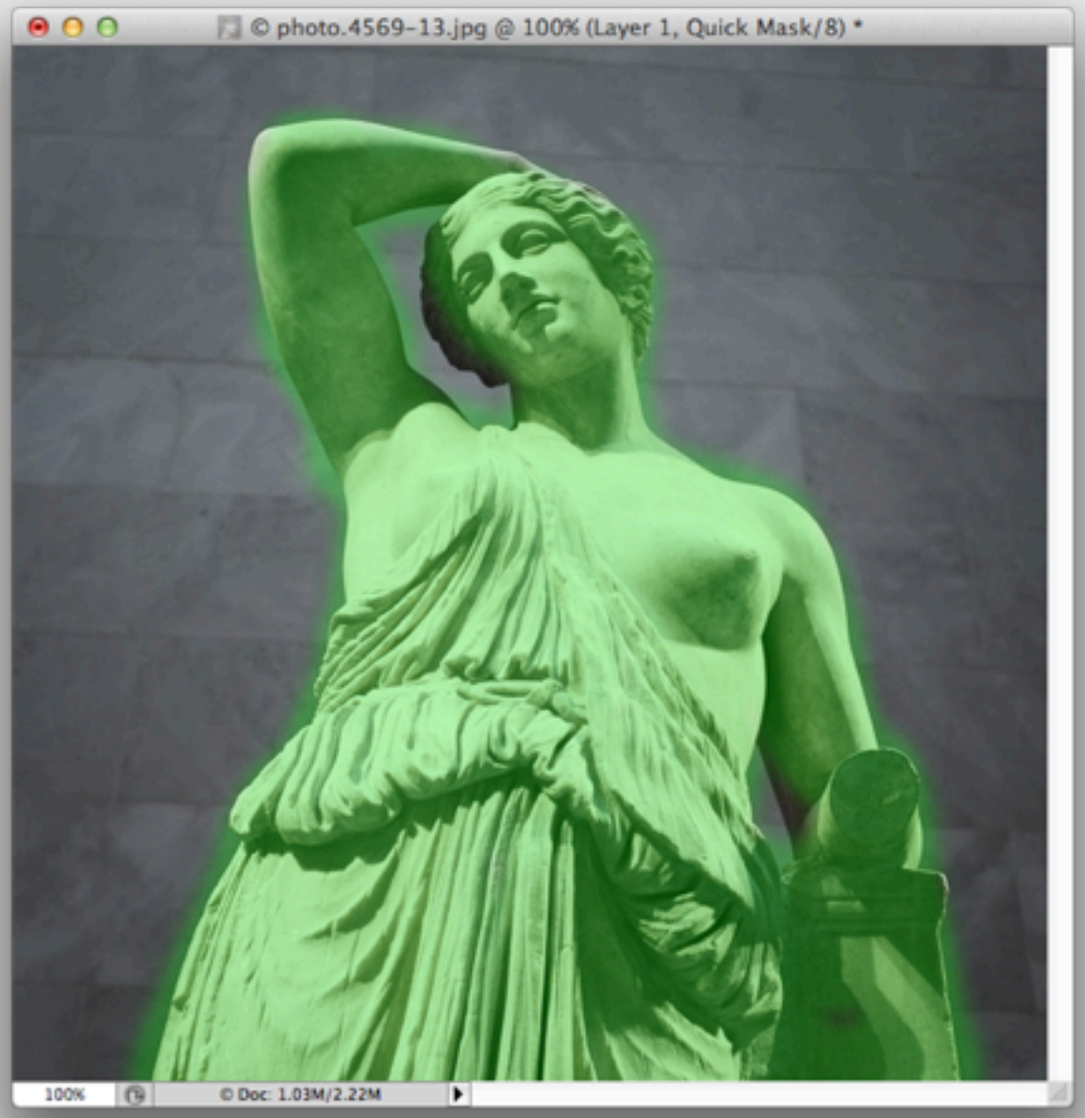


Photoshop: outline shown with
“marching ants”

subtlety continuous selection

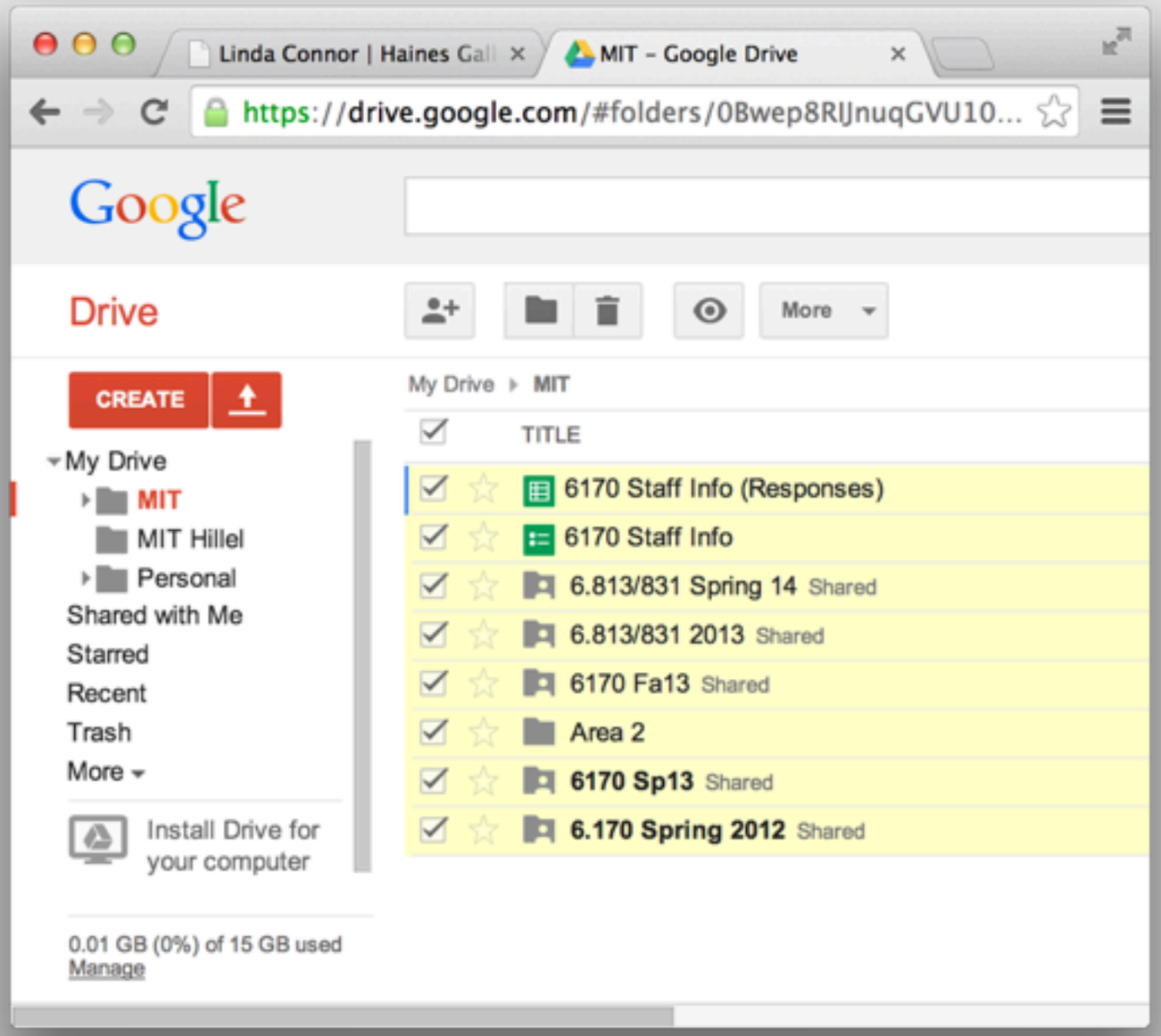


Photoshop: outline shown with "marching ants"



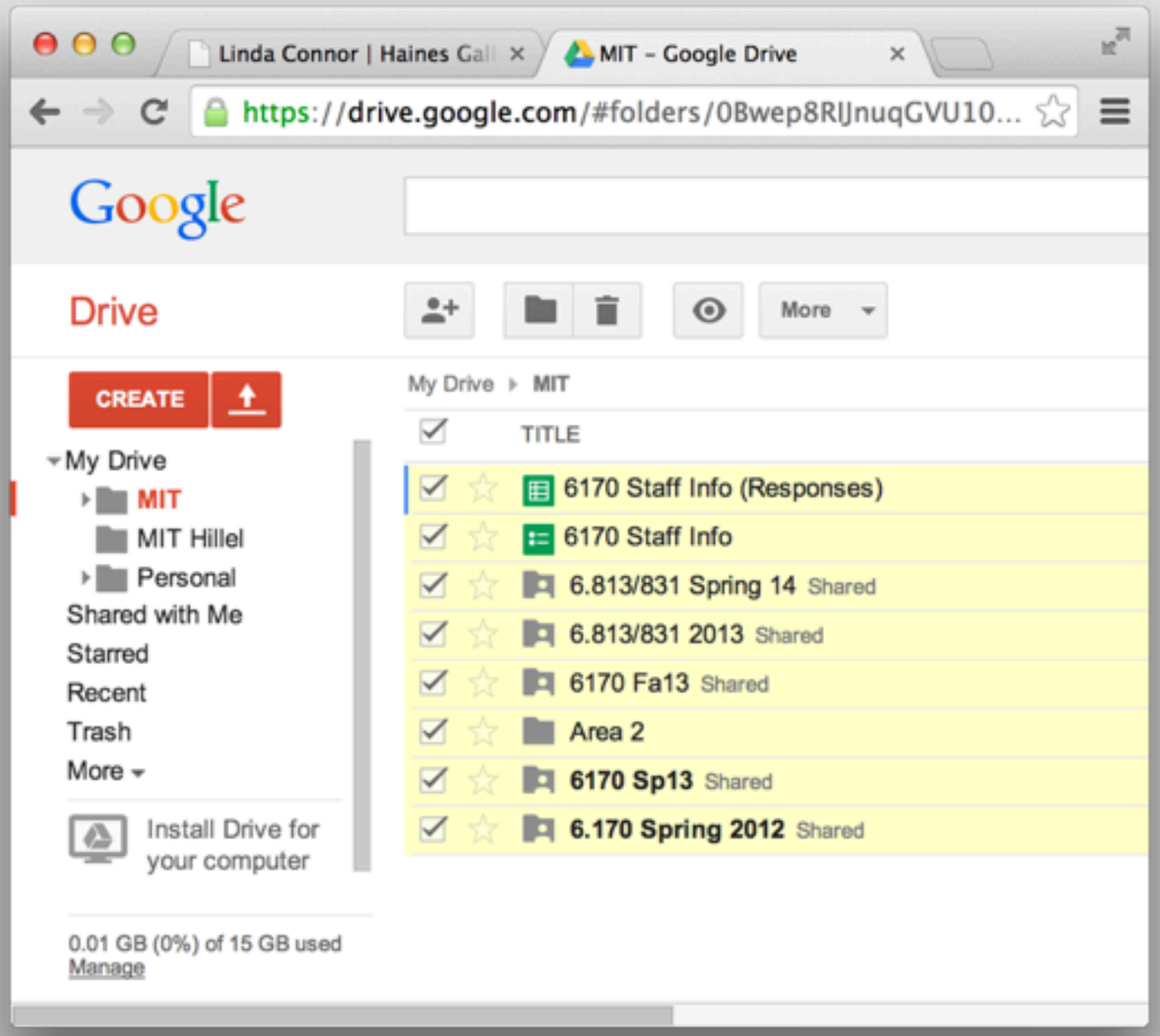
Photoshop: selection shown in Quick Mask mode

subtlety folder selection

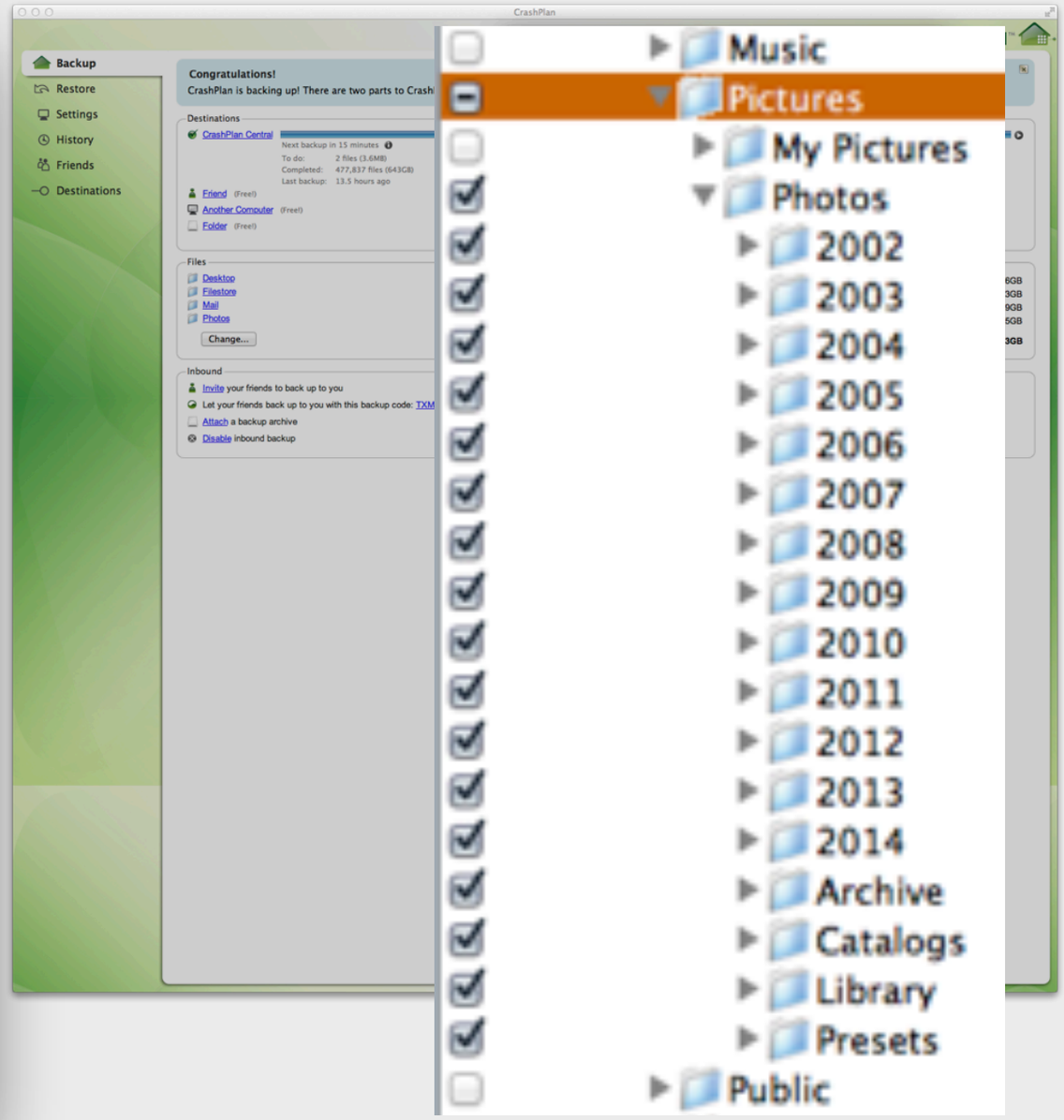


Google Drive: selecting folder = selecting children

subtlety folder selection

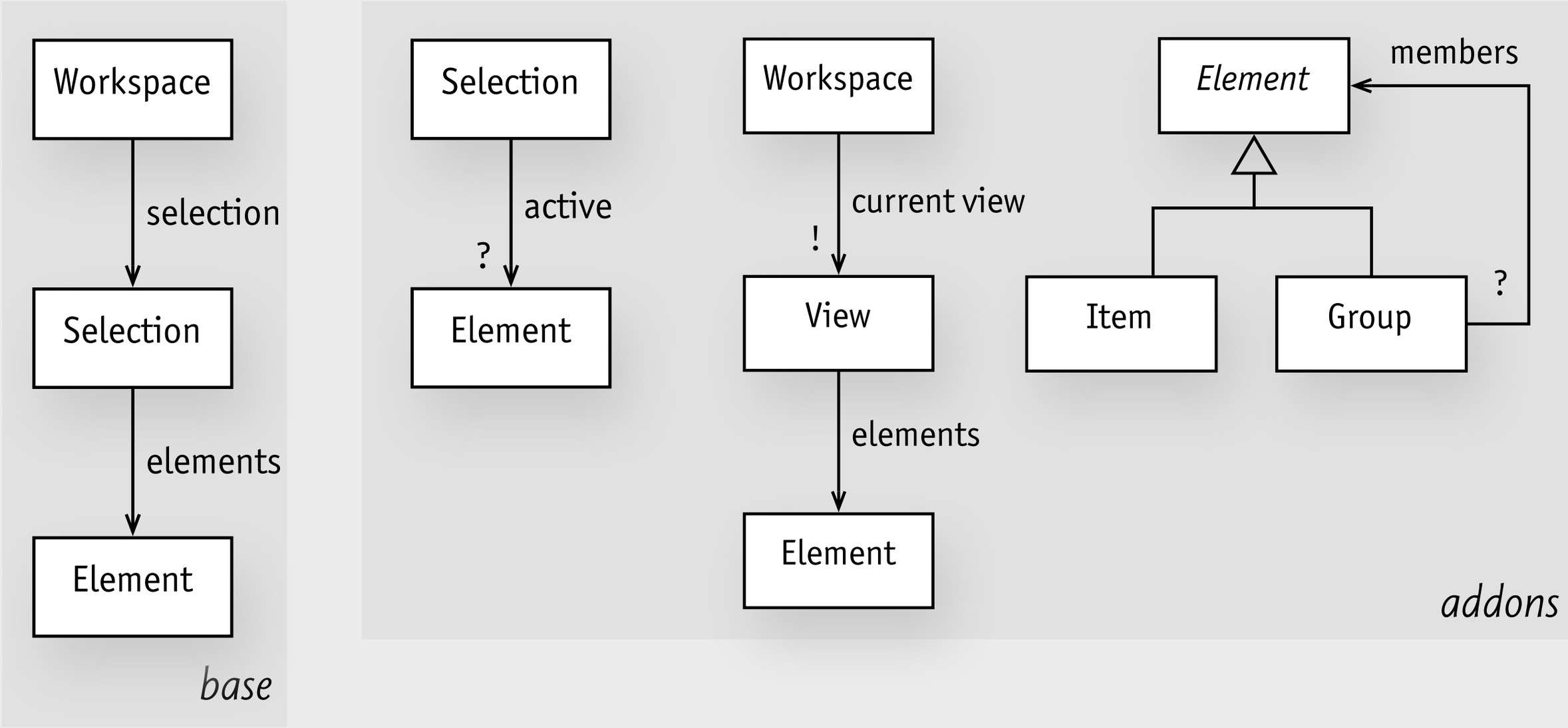


Google Drive: selecting folder = selecting children



CrashPlan: selecting folder = selecting all future children

concept selection



Purposes: apply action in aggregate to many items at once

concept 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					

how to evaluate a concept

the fundamental principle

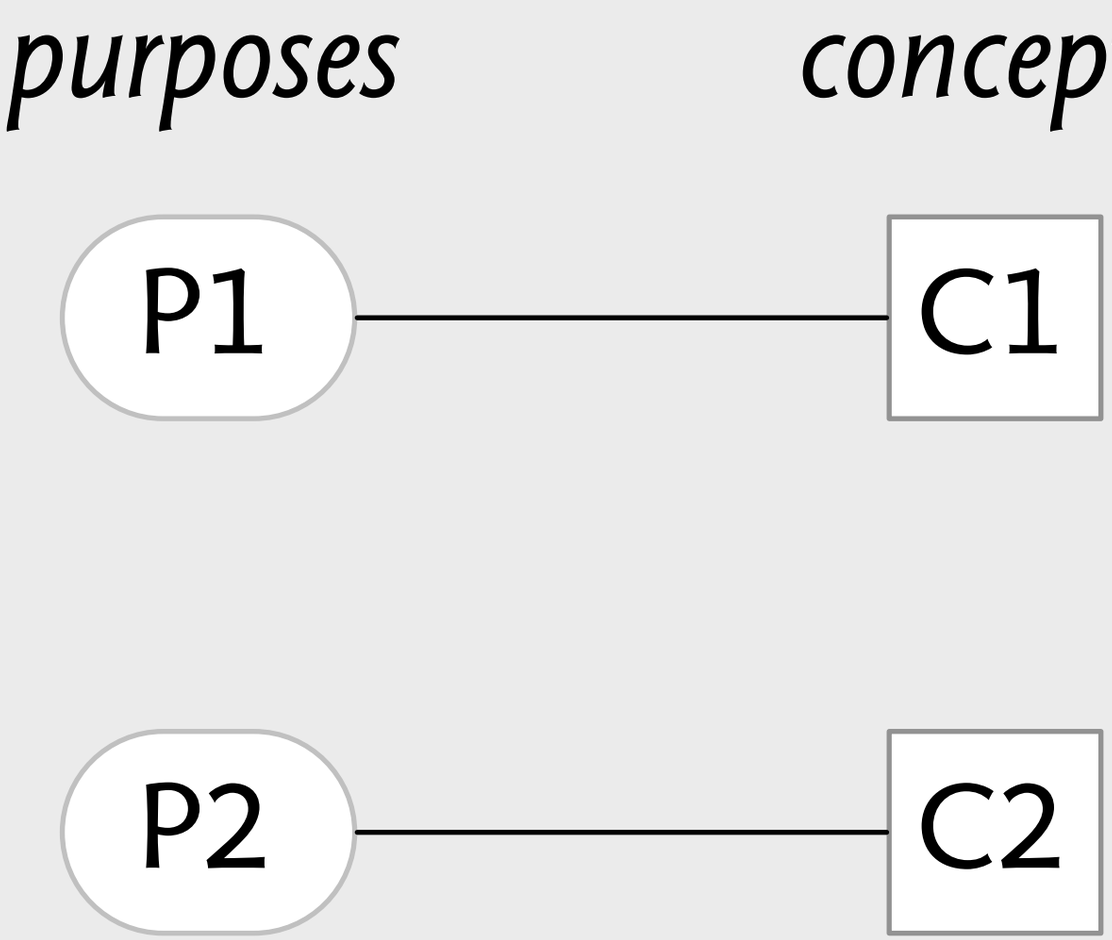
the fundamental principle

in a well-designed system

the fundamental principle

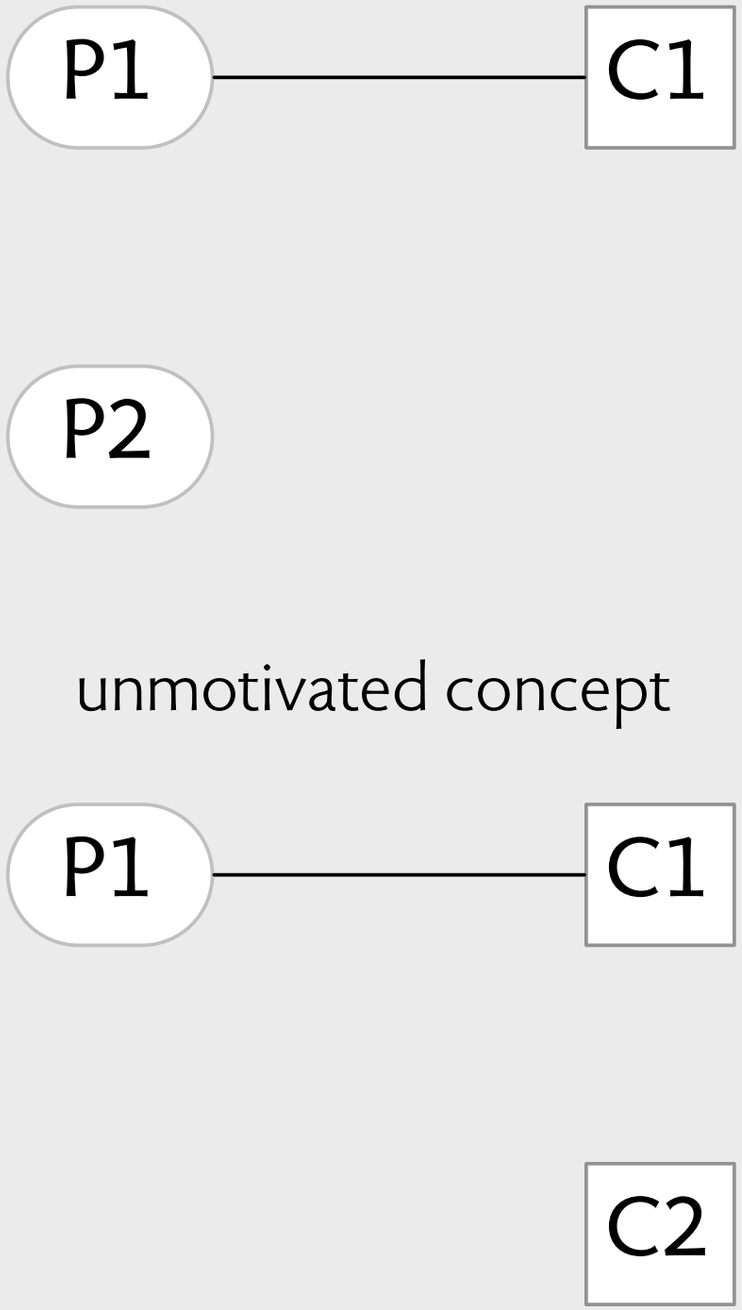
in a well-designed system
each concept is motivated by one purpose

the ideal mapping

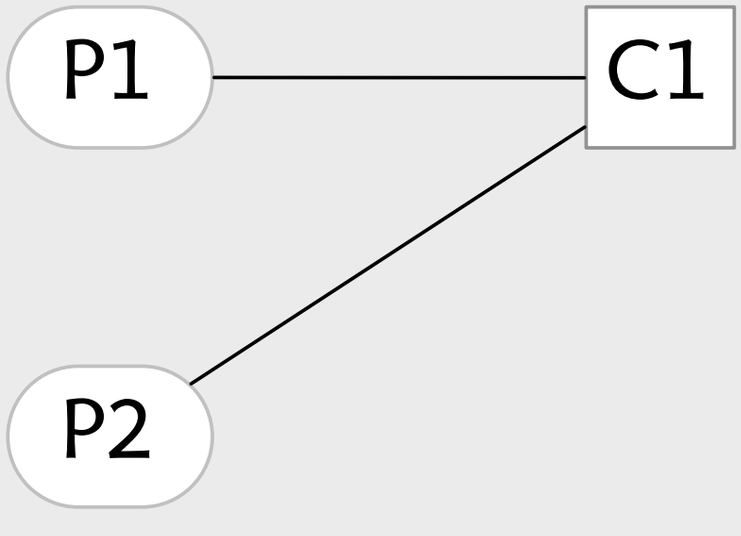


4 bad smells

unfulfilled purpose

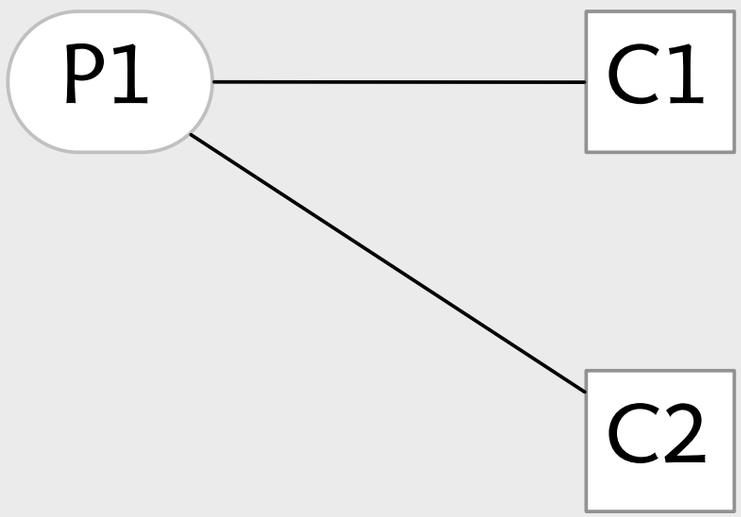


overloaded concept

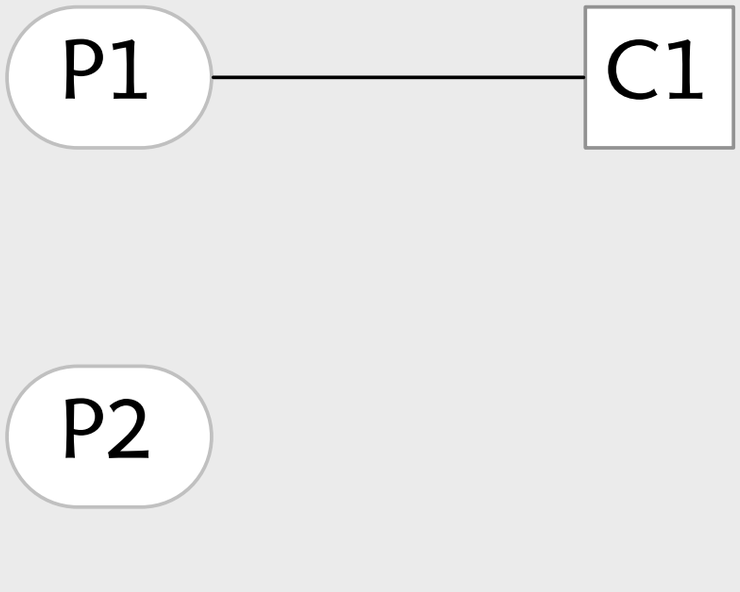


unmotivated concept

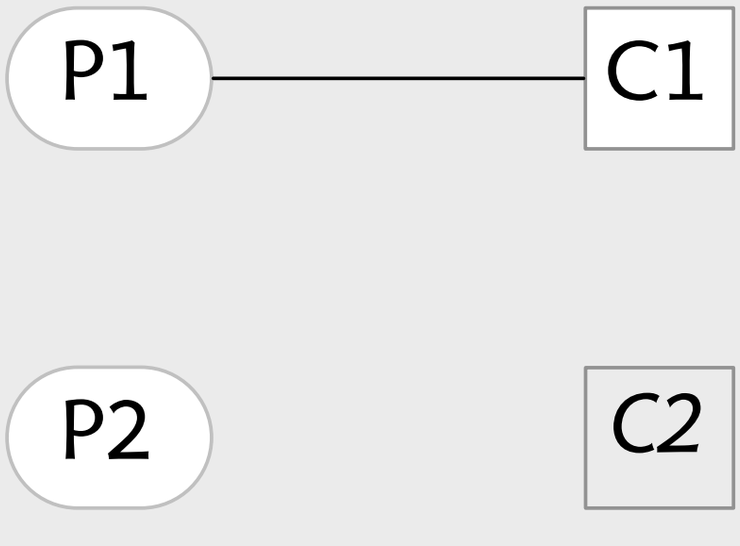
redundant concepts



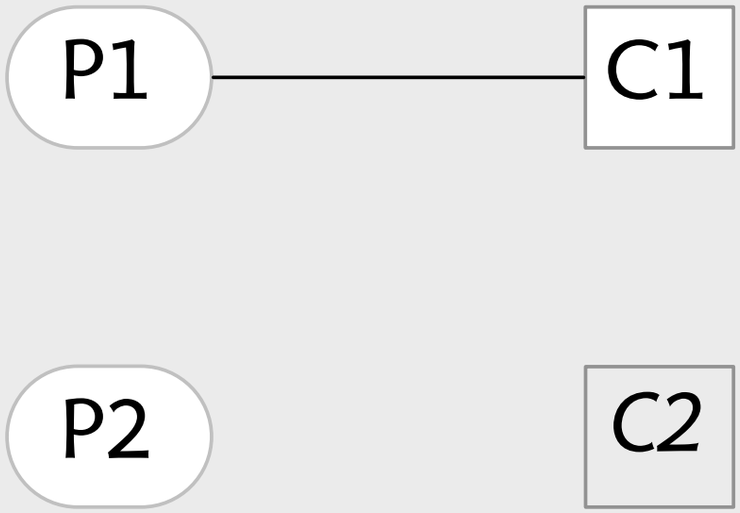
unfulfilled purposes



unfulfilled purposes

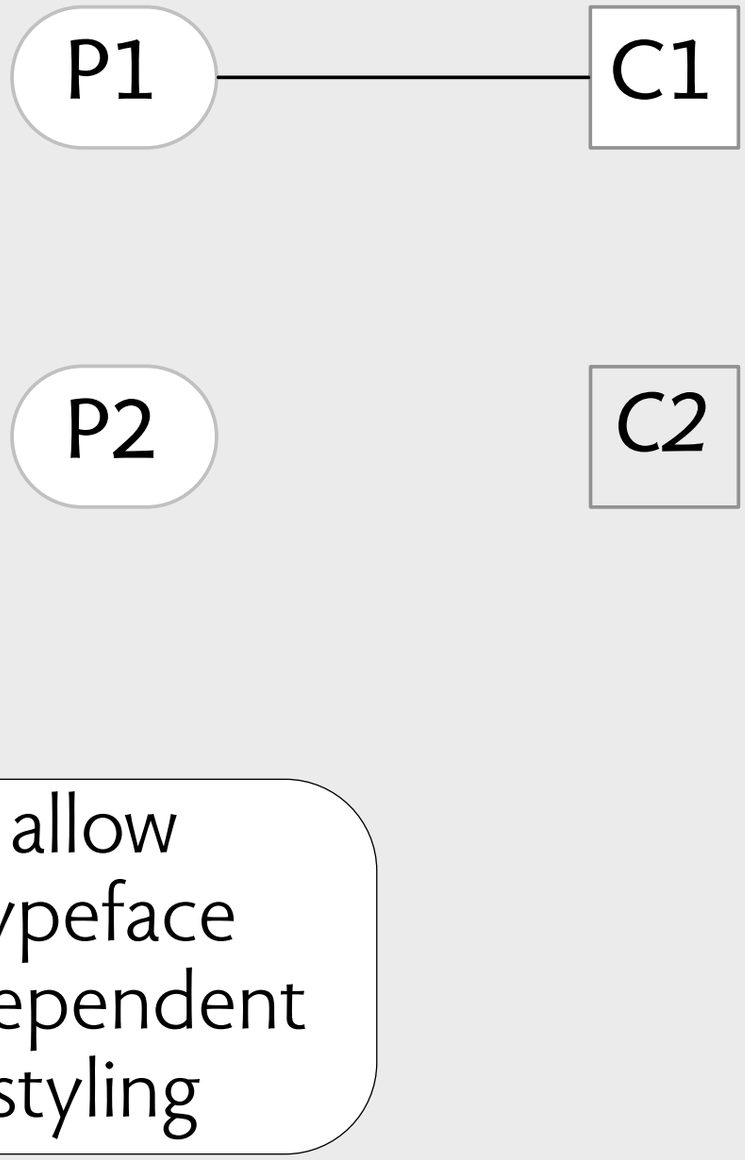


unfulfilled purposes



Adobe Indesign:
an unfulfilled purpose

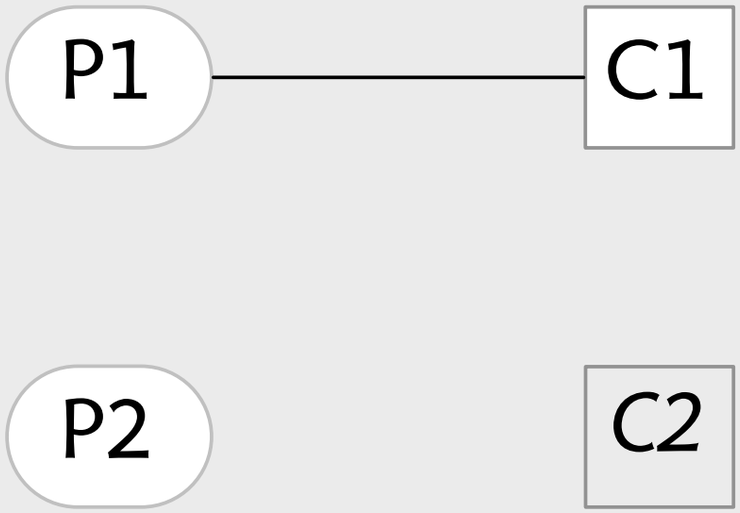
unfulfilled purposes



allow
typeface
independent
styling

Adobe Indesign:
an unfulfilled purpose

unfulfilled purposes



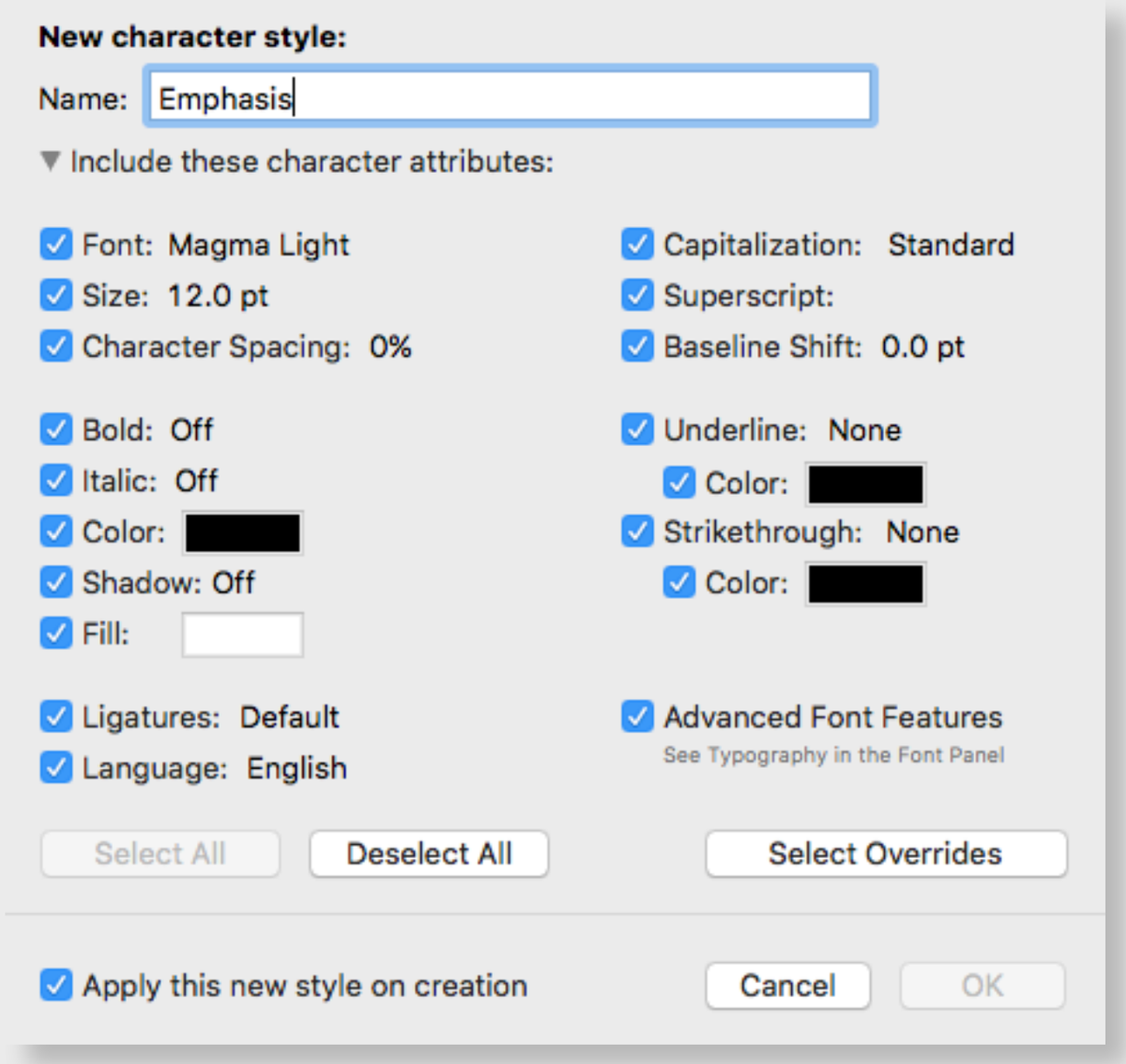
allow
typeface
independent
styling

subfamily

Adobe Indesign:
an unfulfilled purpose

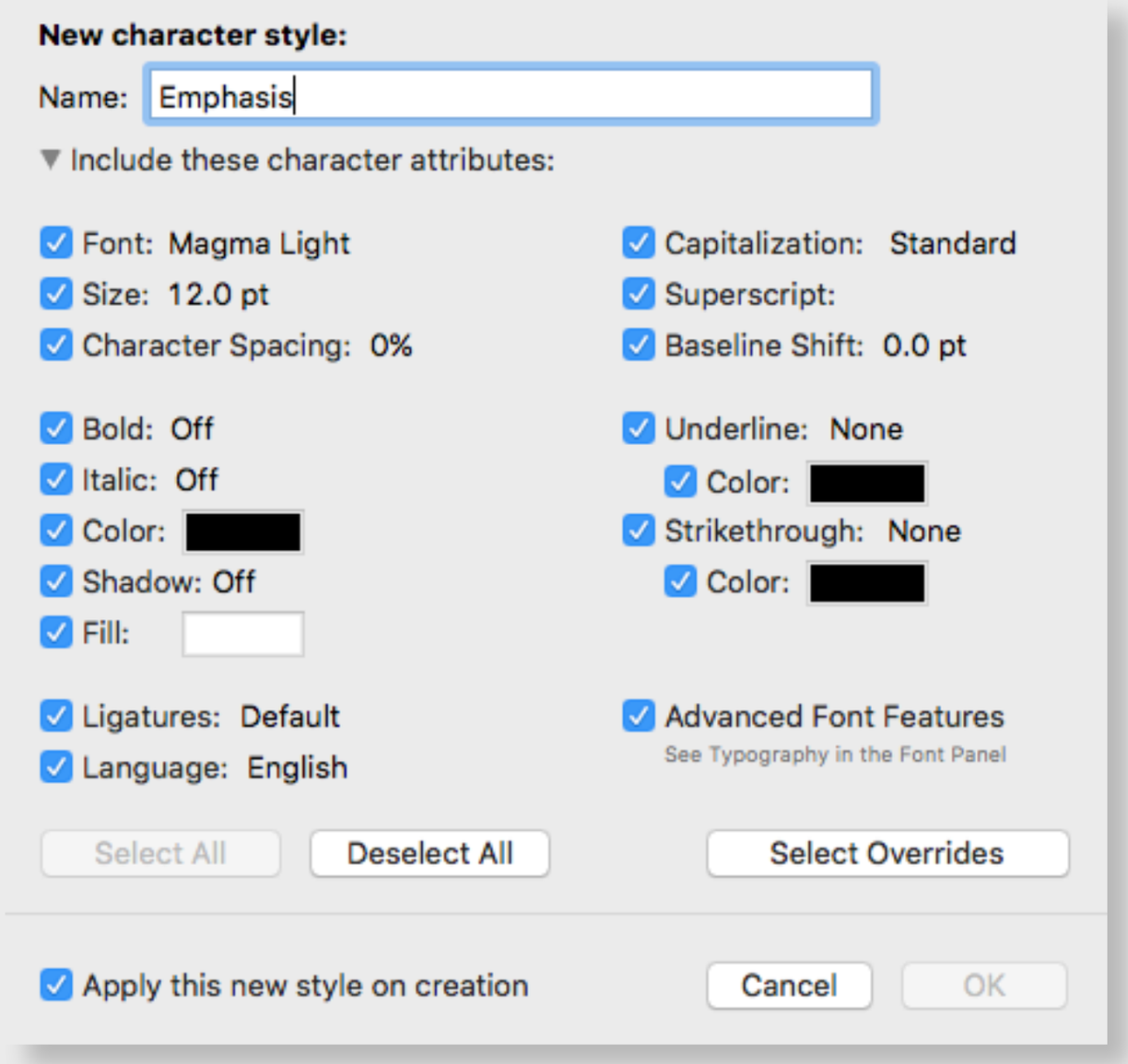
introducing a concept

introducing a concept

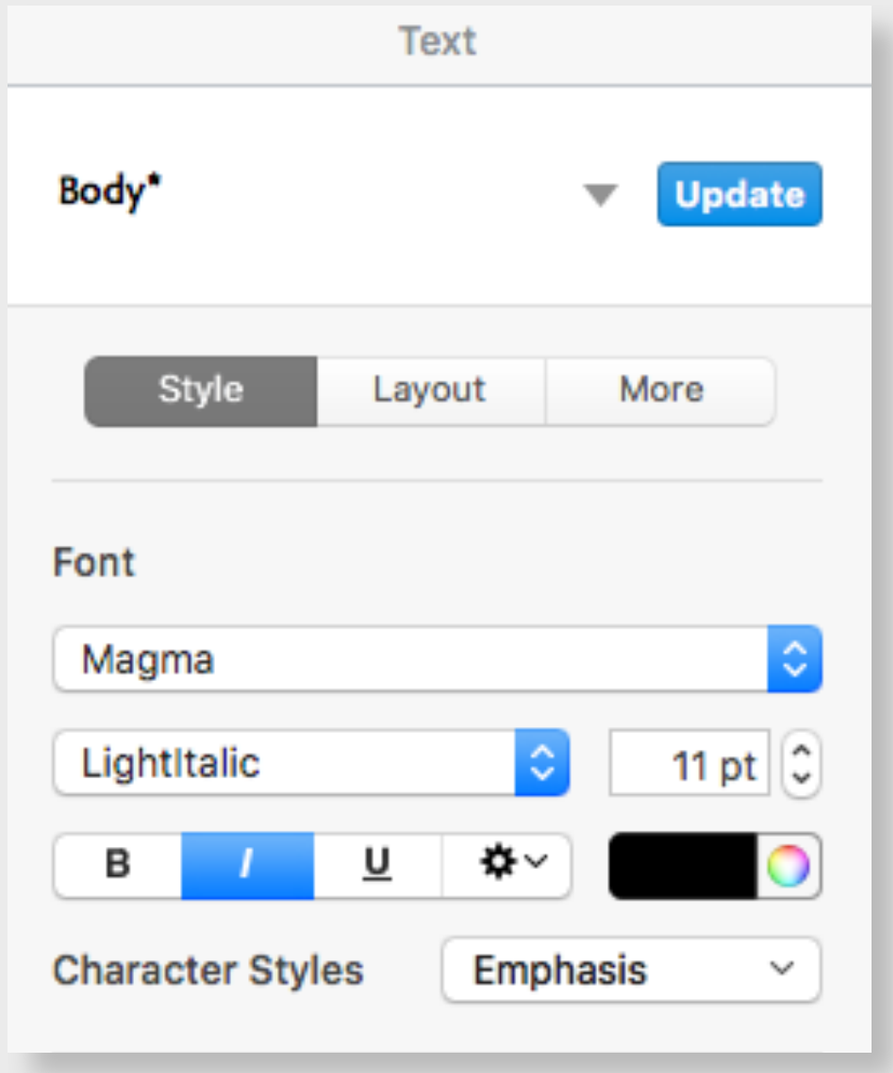


Keynote ’09: has subfamilies

introducing a concept

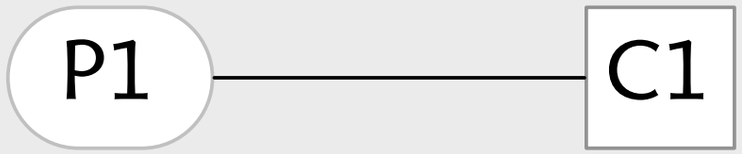


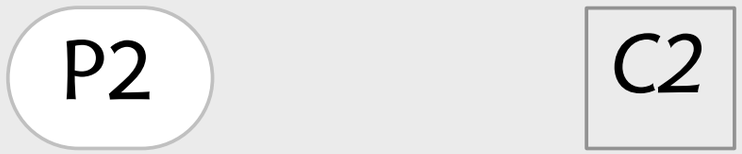
Keynote ’09: has subfamilies



Keynote 6: gone again!

unfulfilled purposes (more)





user (Apple Mail, Gmail)
'identify parties to communication'
weak search, no authentication

slide hierarchy (Powerpoint)
'structure slides in a tree'
sections provide just one level

eject-after-import (Lightroom)
'prevent accidental writing'
feature removed (and reinstated!)

binder (Preview, Acrobat)
'maintain composite PDF doc'
can insert pages, but forgets source

unmotivated concepts

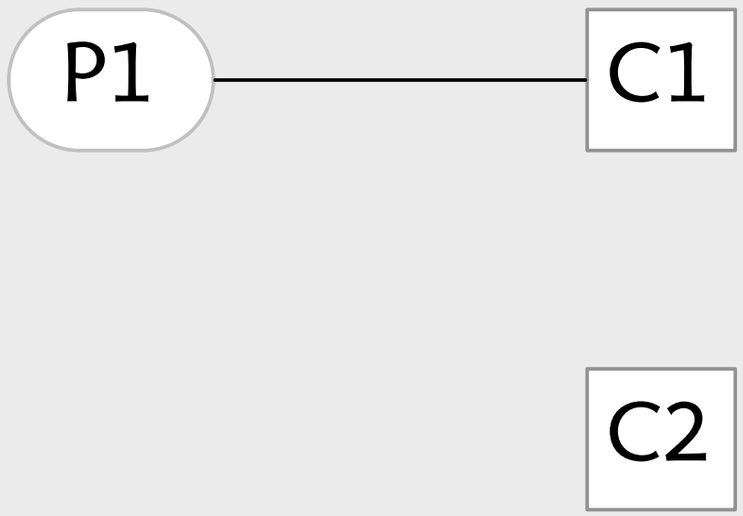
unmotivated concepts

P1 — C1

C2

unmotivated concepts (more)

unmotivated concepts (more)



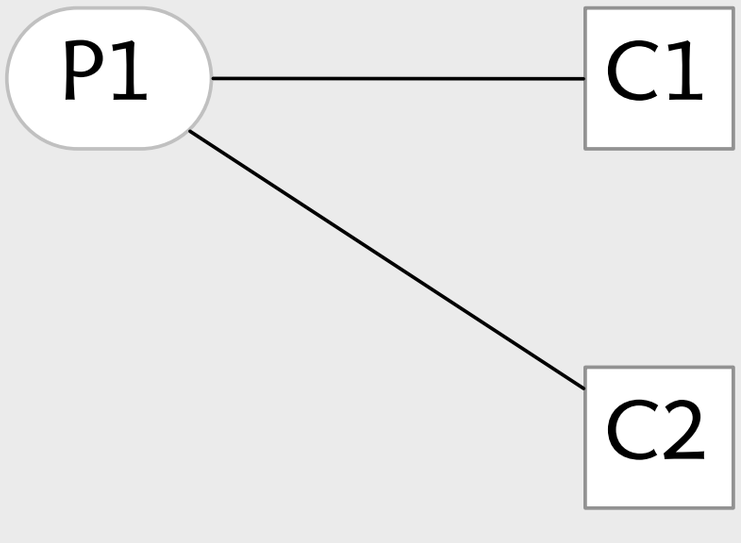
buffer (text editors)
Apple got rid of it

stash (Git)
addresses branching misfits

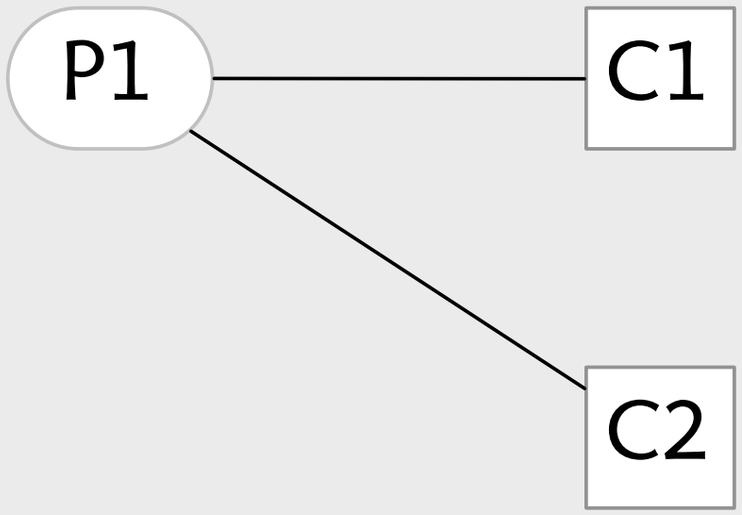
boxing (Java)
addresses primitives vs objects misfit

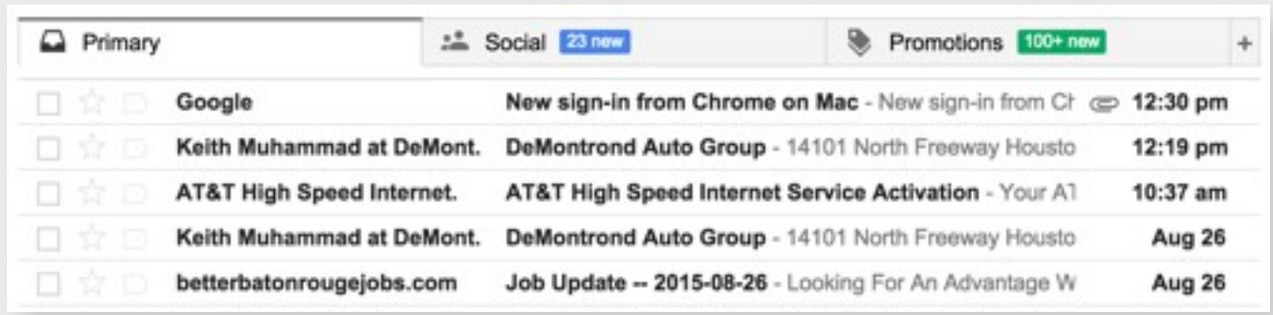
null (Javascript)
when undefined is too vague

redundant concepts



redundant concepts

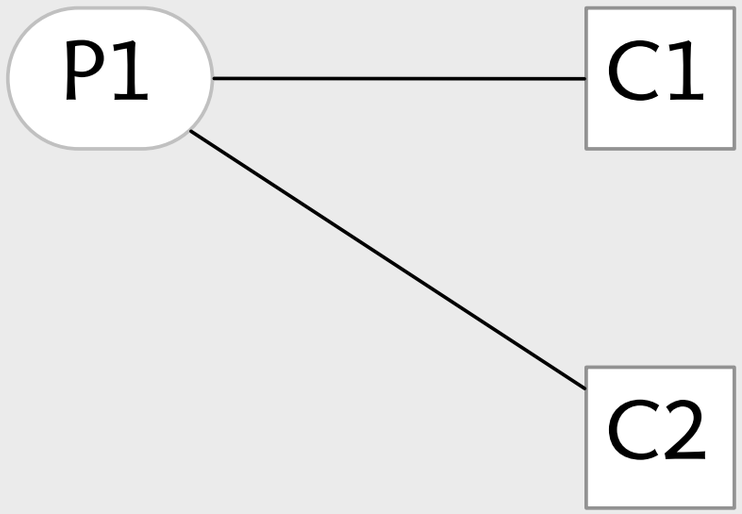


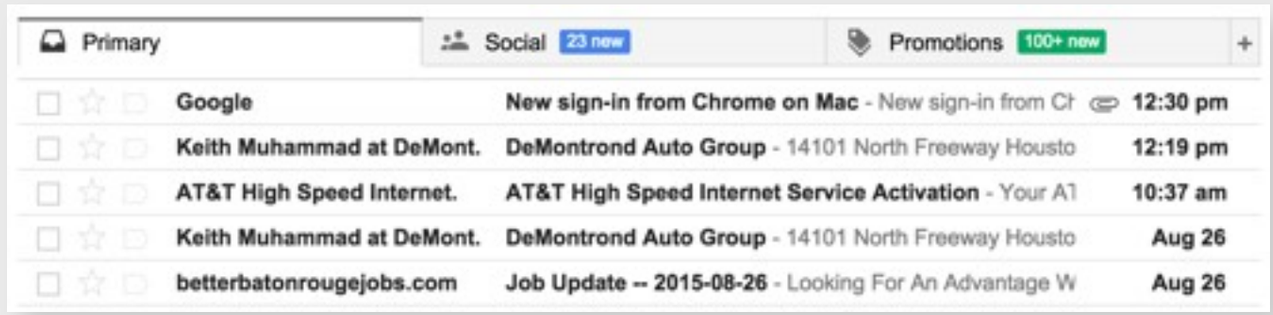


category in Gmail

a redundant concept

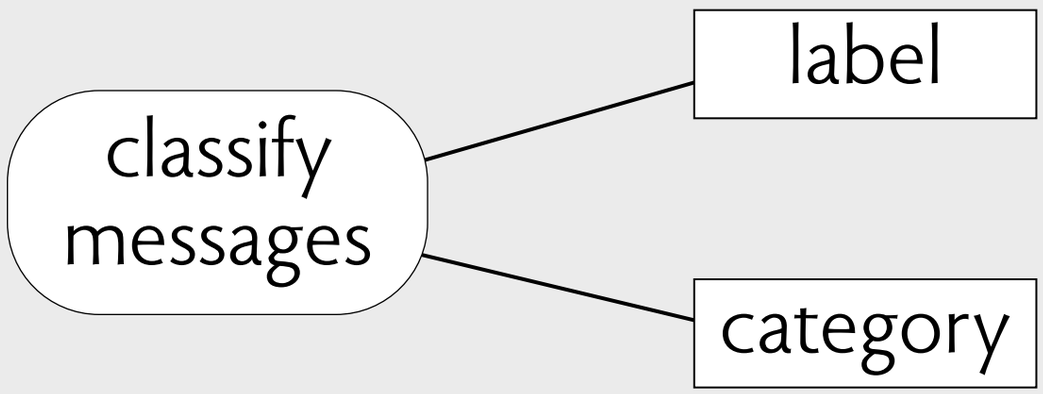
redundant concepts





category in Gmail

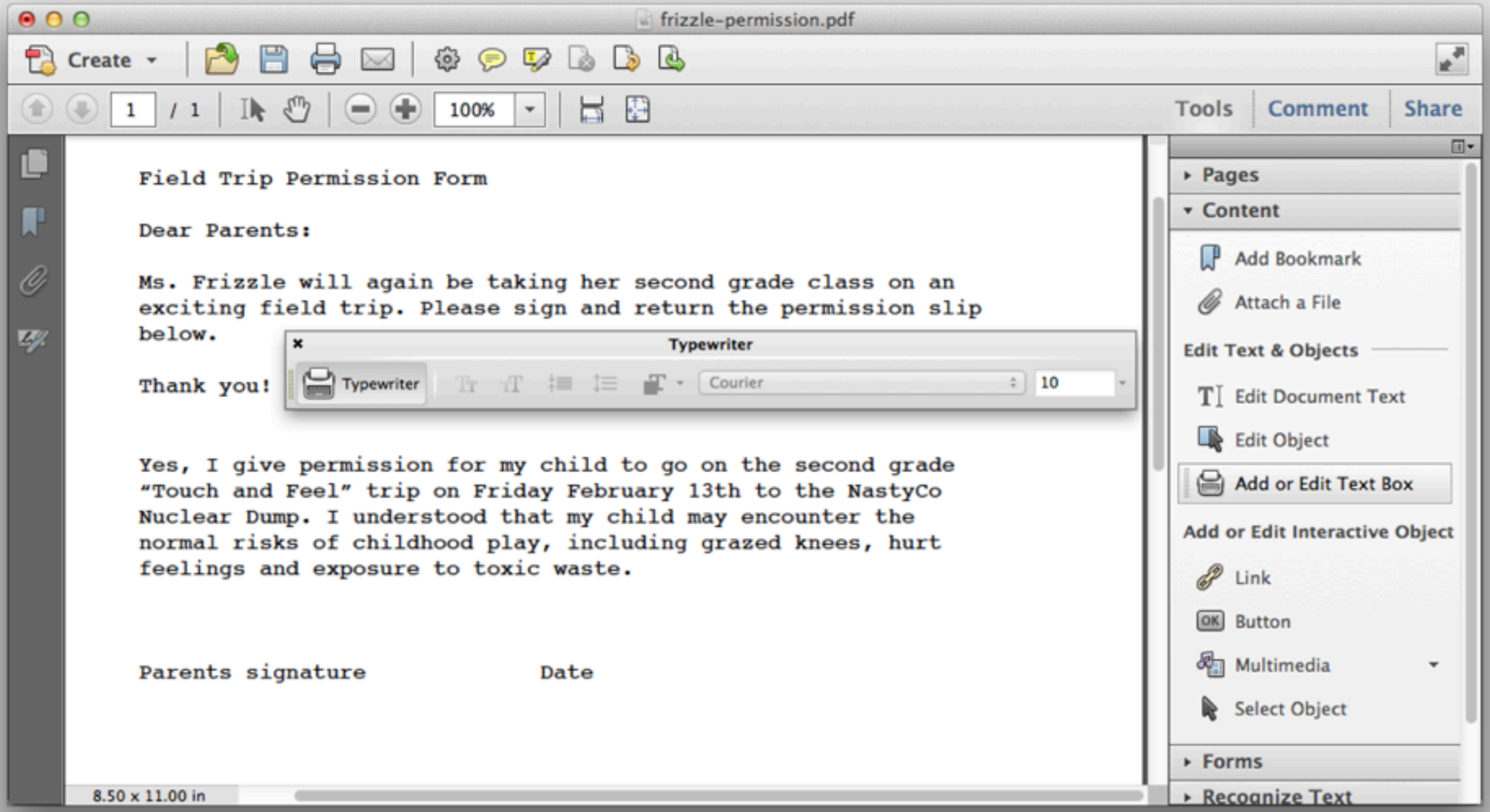
a redundant concept



redundancy elimination in Acrobat

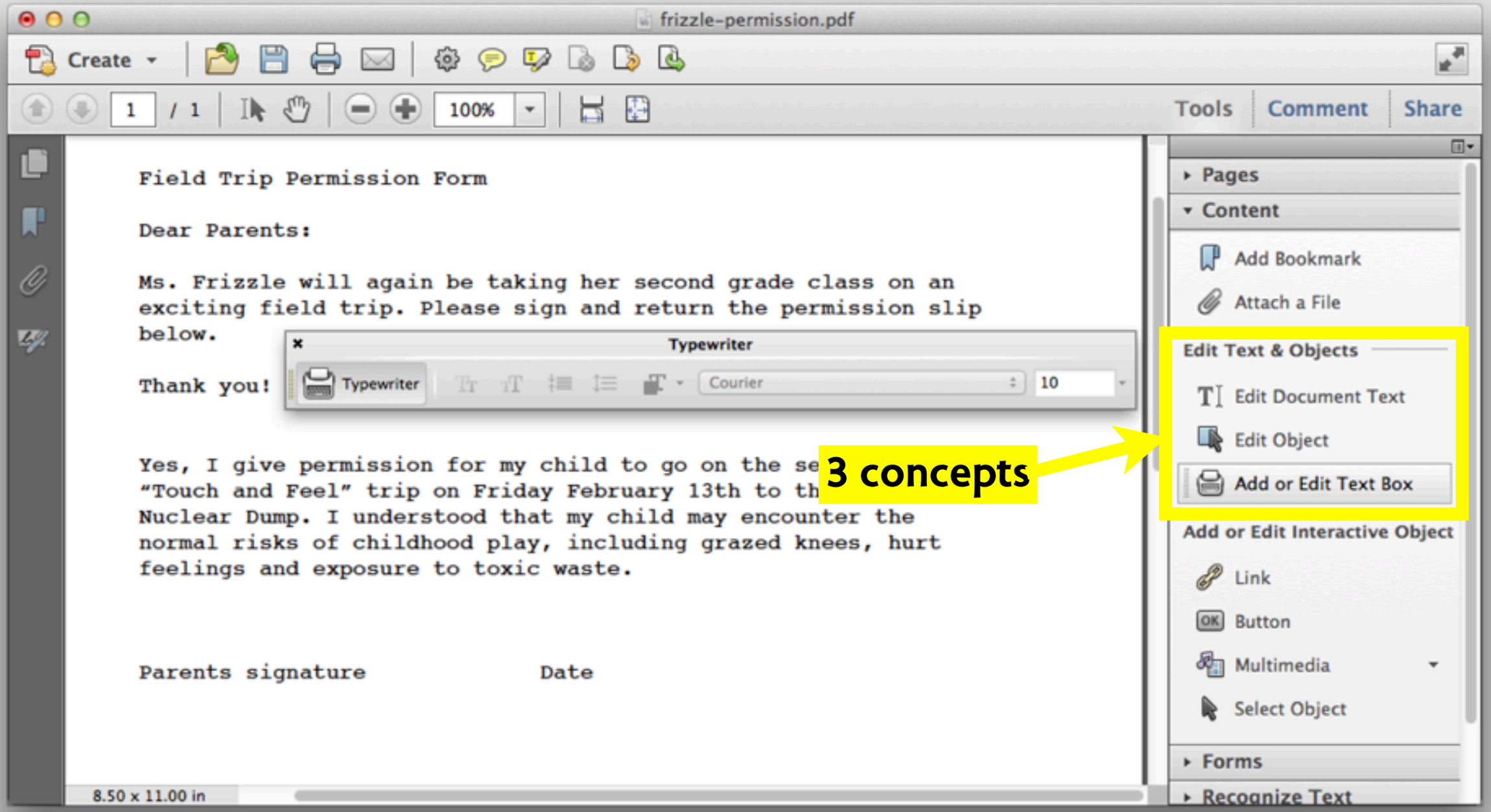
redundancy elimination in Acrobat

Acrobat 10



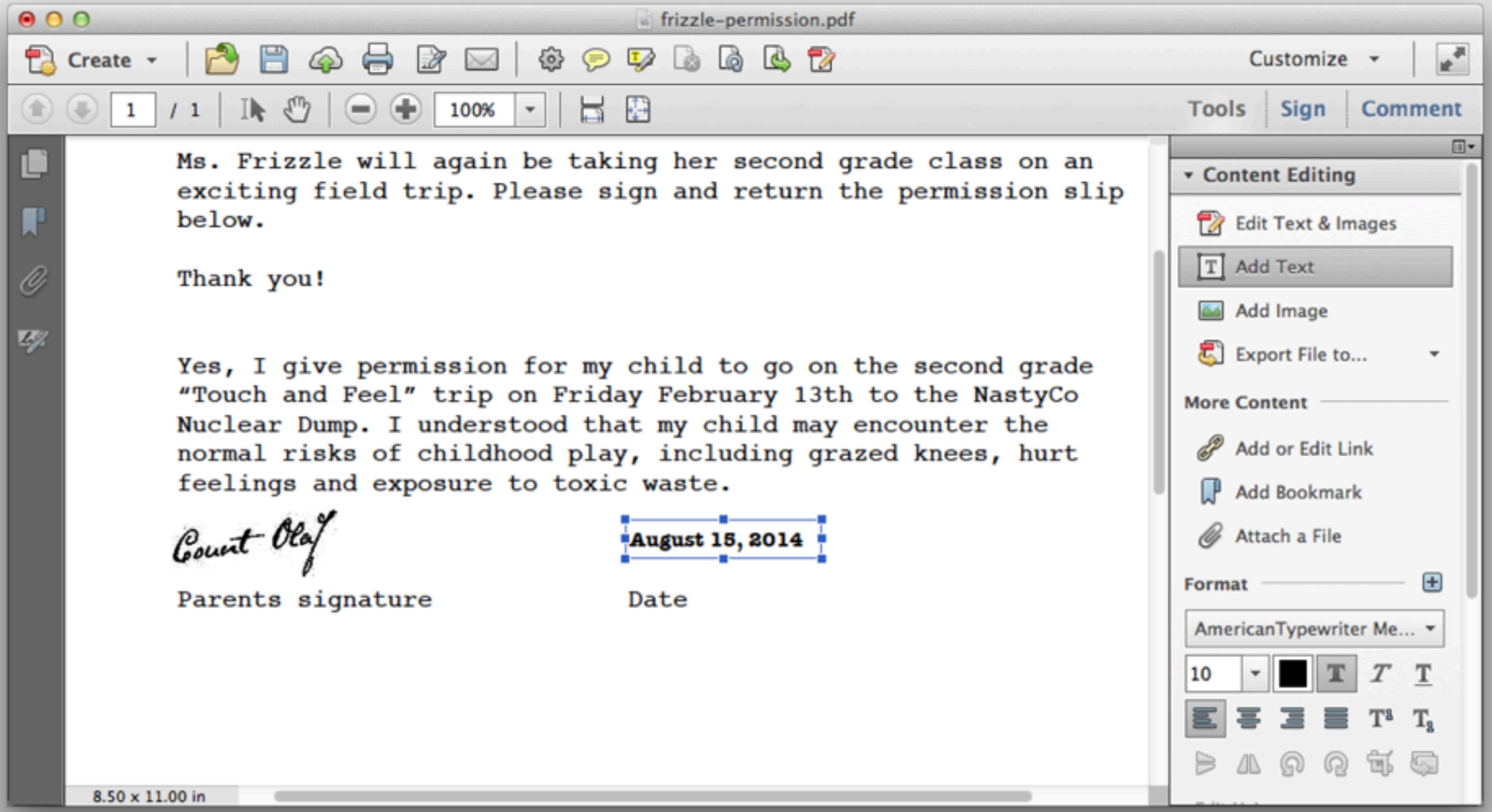
redundancy elimination in Acrobat

Acrobat 10



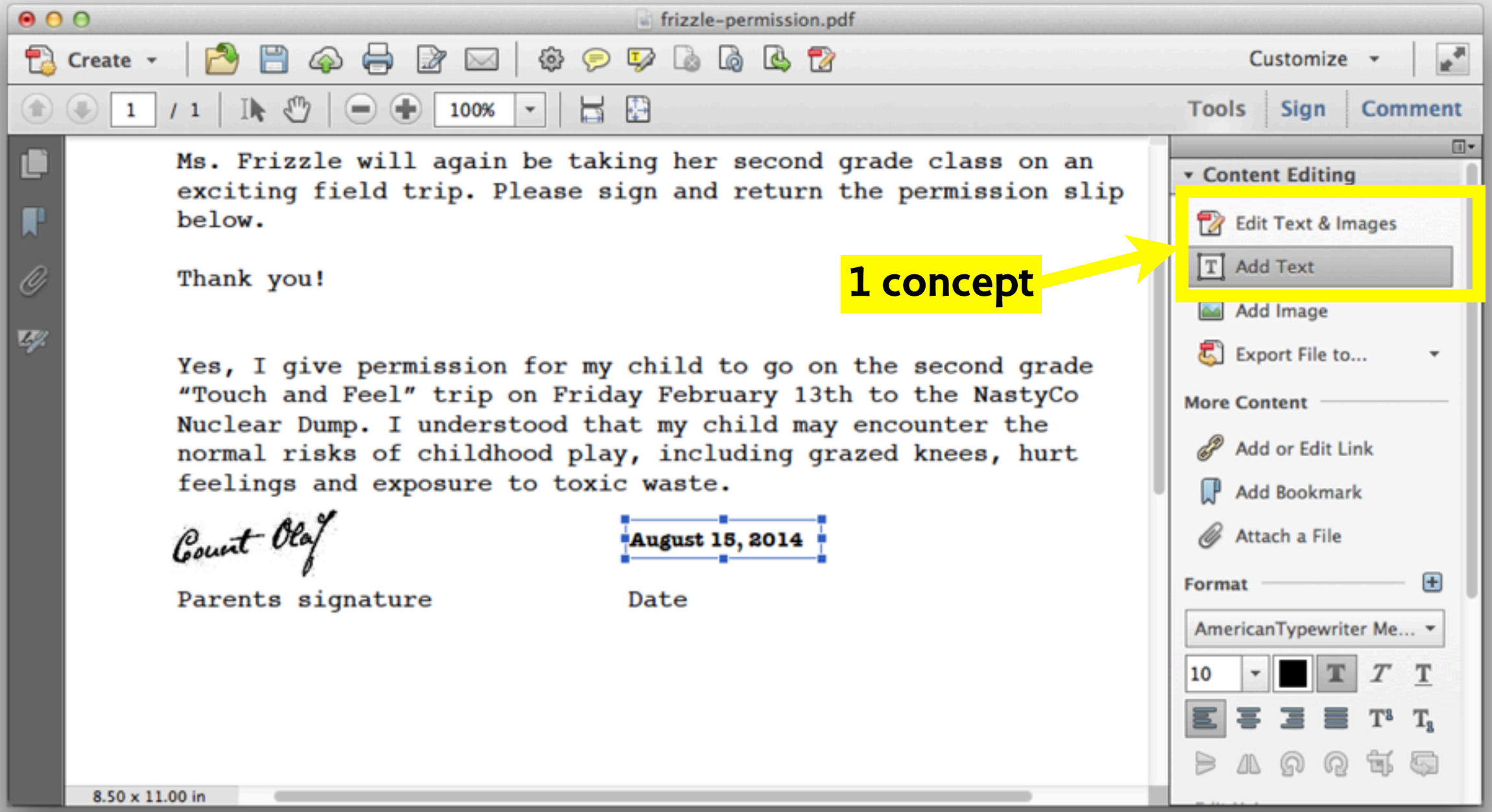
redundancy elimination in Acrobat

Acrobat 11



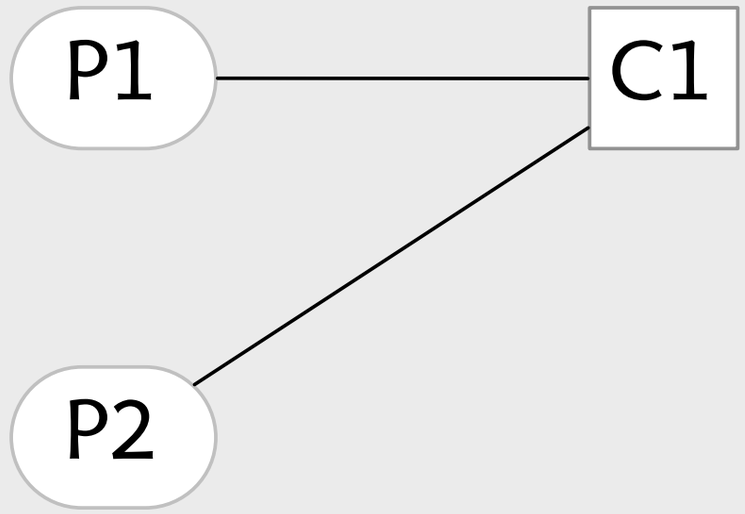
redundancy elimination in Acrobat

Acrobat 11



overloaded concepts

No one can serve two masters. Either you will hate the one and love the other, or you will be devoted to the one and despise the other. [Matthew 6:24]



overloaded concepts

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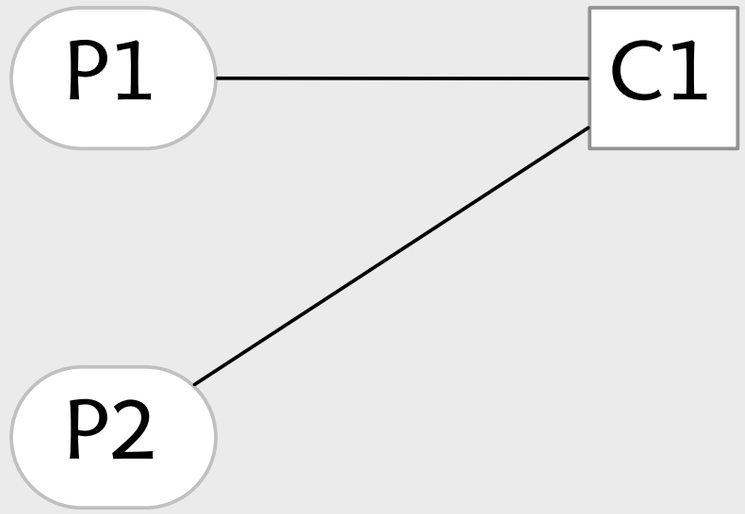


3 forms of overloading:

piggybacking new purpose hacked onto old concept

false convergence two purposes looked the same

emergent purpose users found second purpose for concept

piggybacking fuji camera

new purpose hacked onto old concept

piggybacking fuji camera

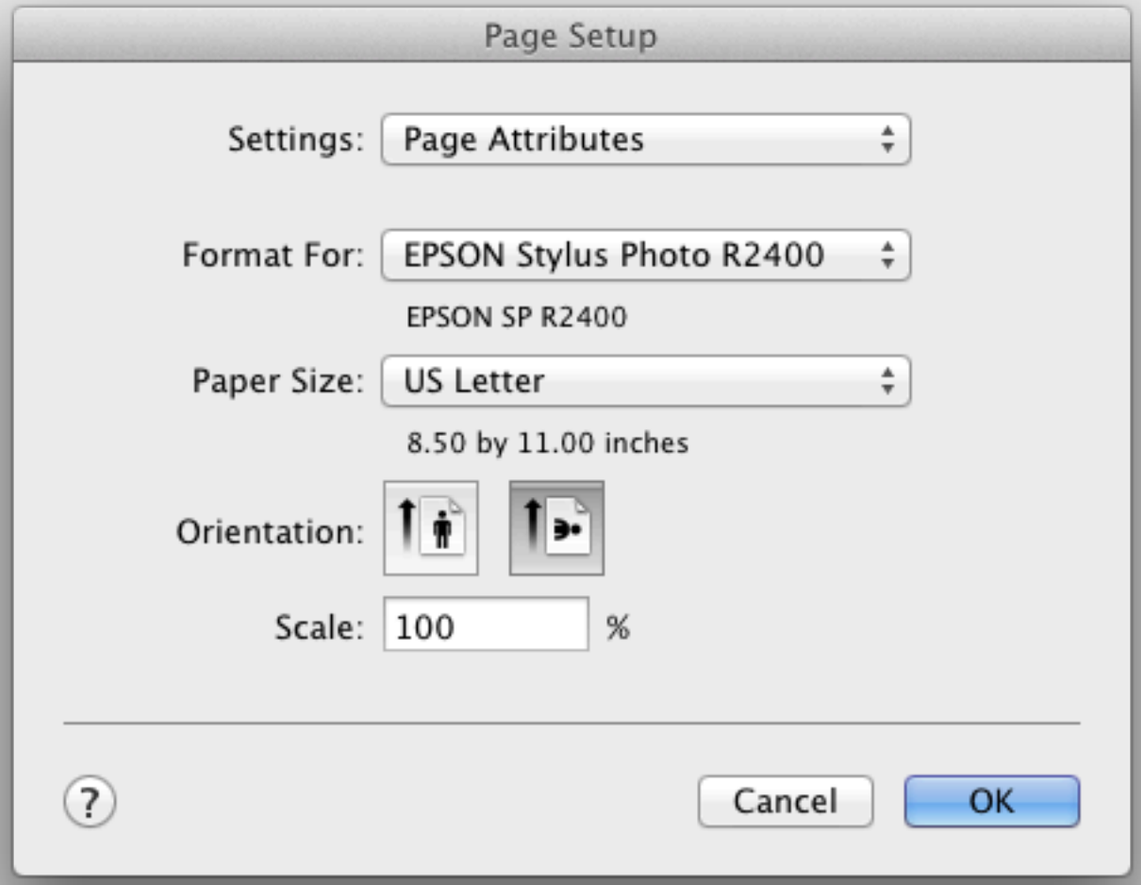
new purpose hacked onto old concept

image size

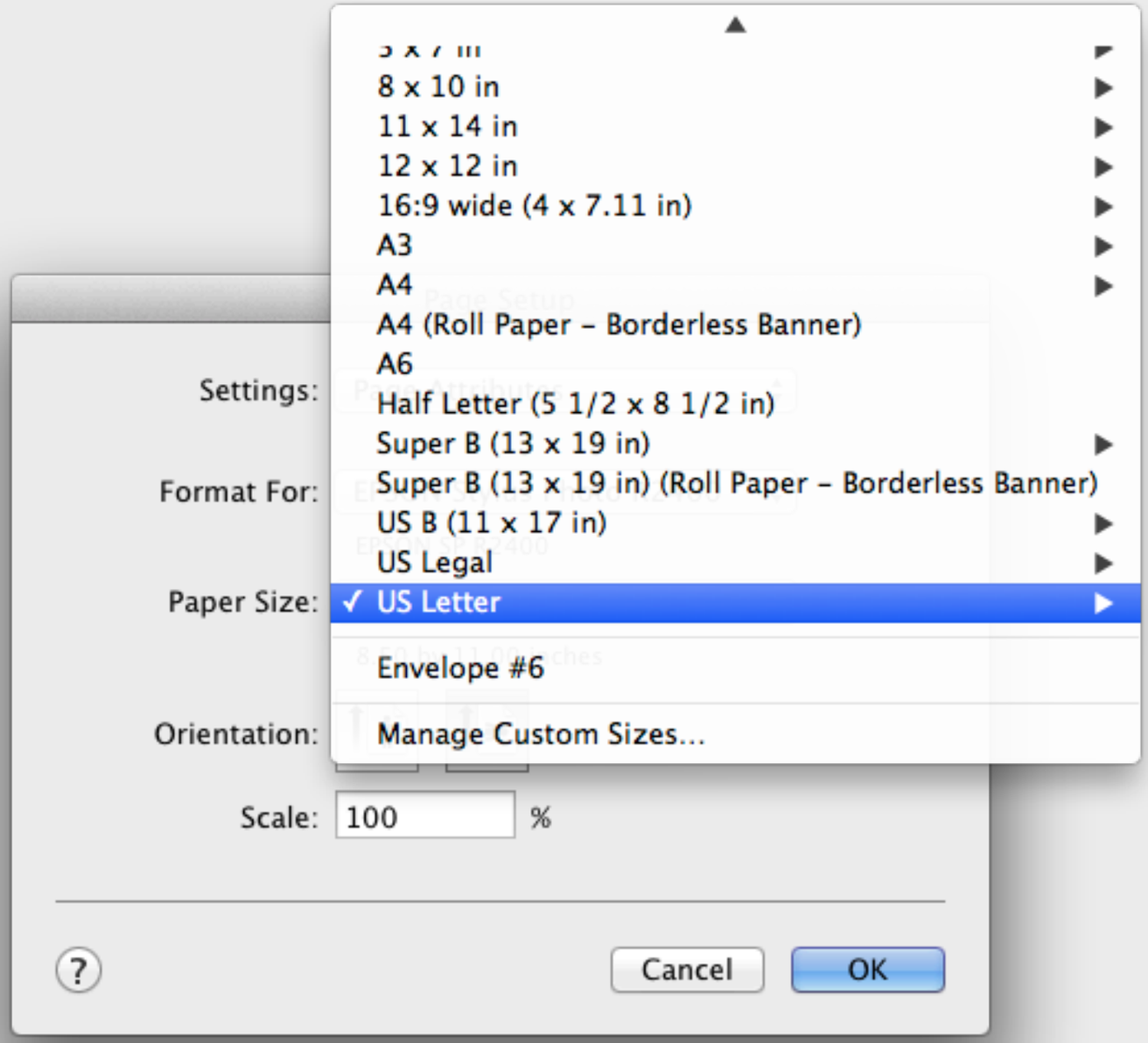
aspect ratio piggybacked on JPEG dimensions

piggybacking epson driver

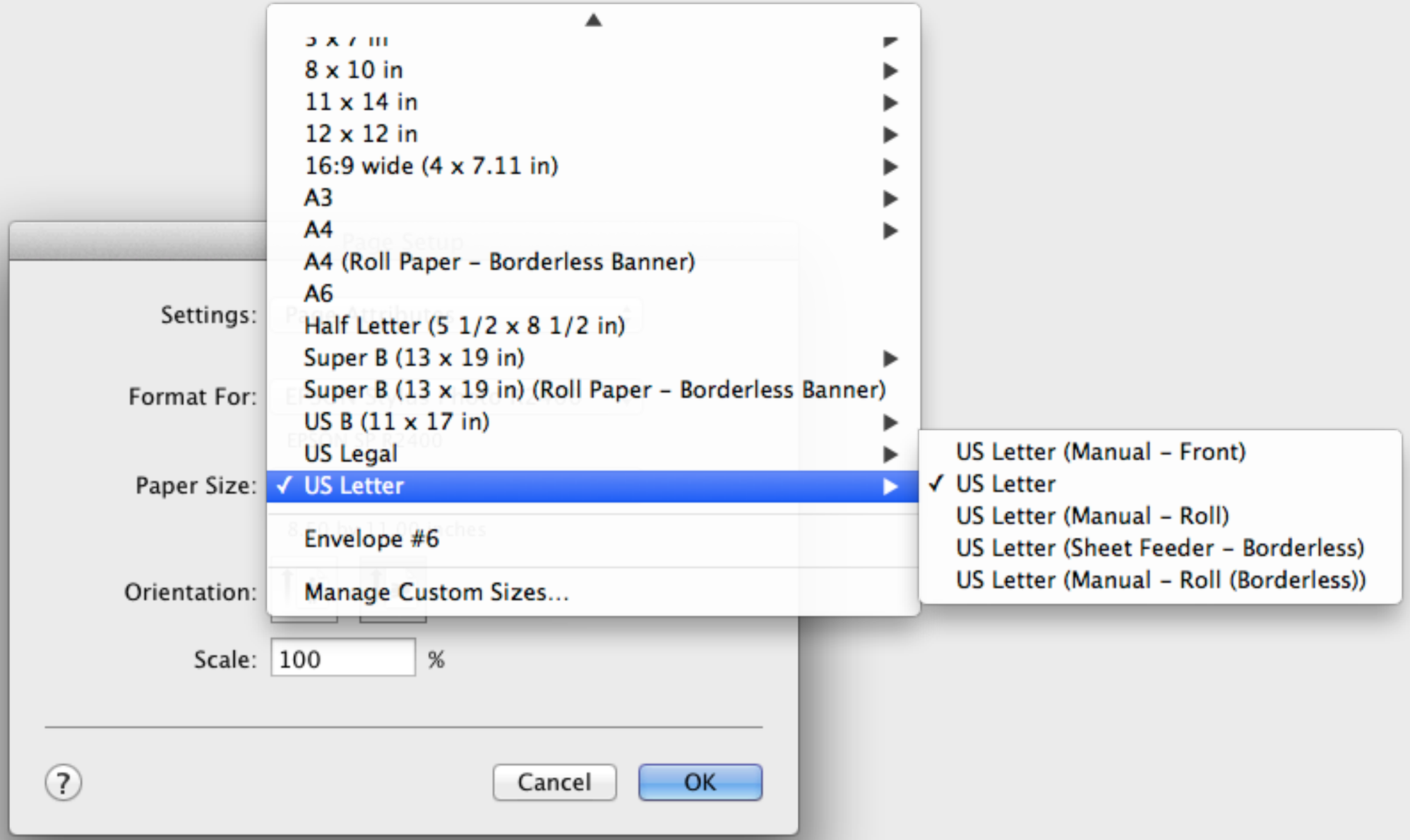
piggybacking epson driver



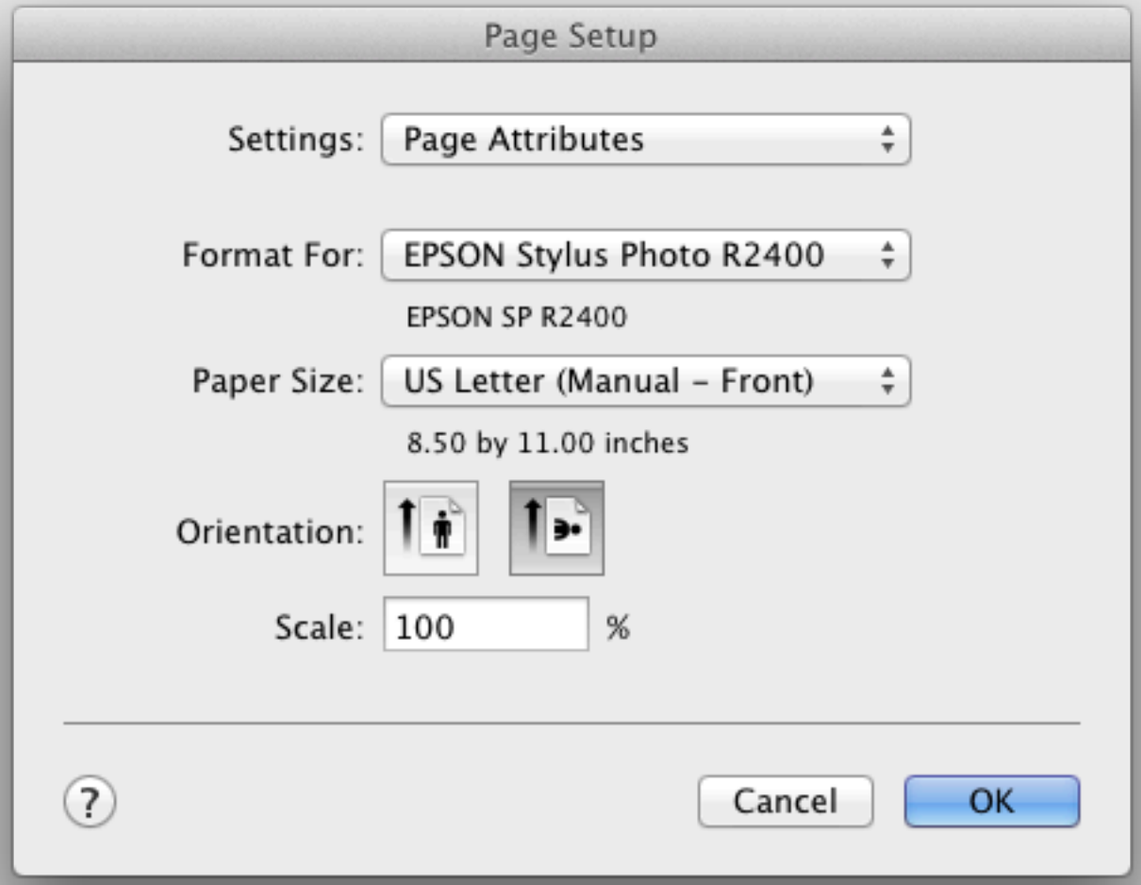
piggybacking epson driver



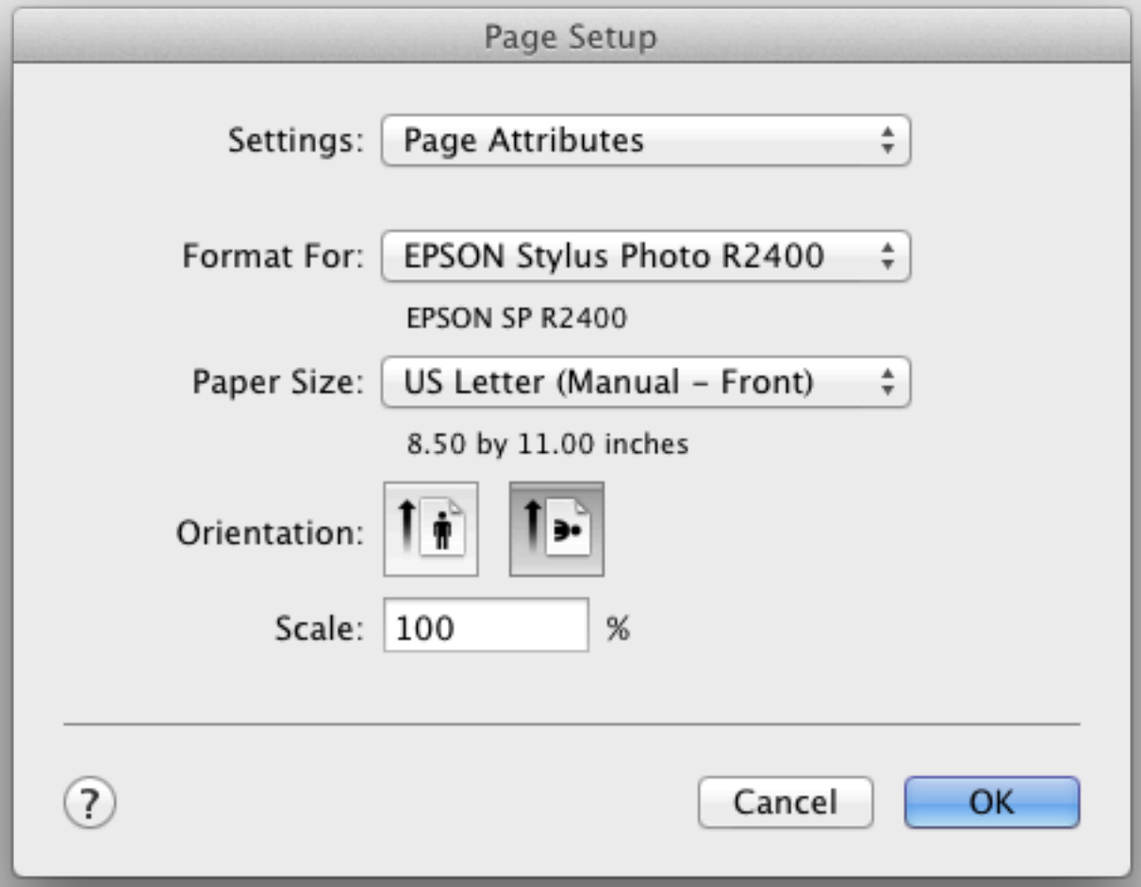
piggybacking epson driver



piggybacking epson driver



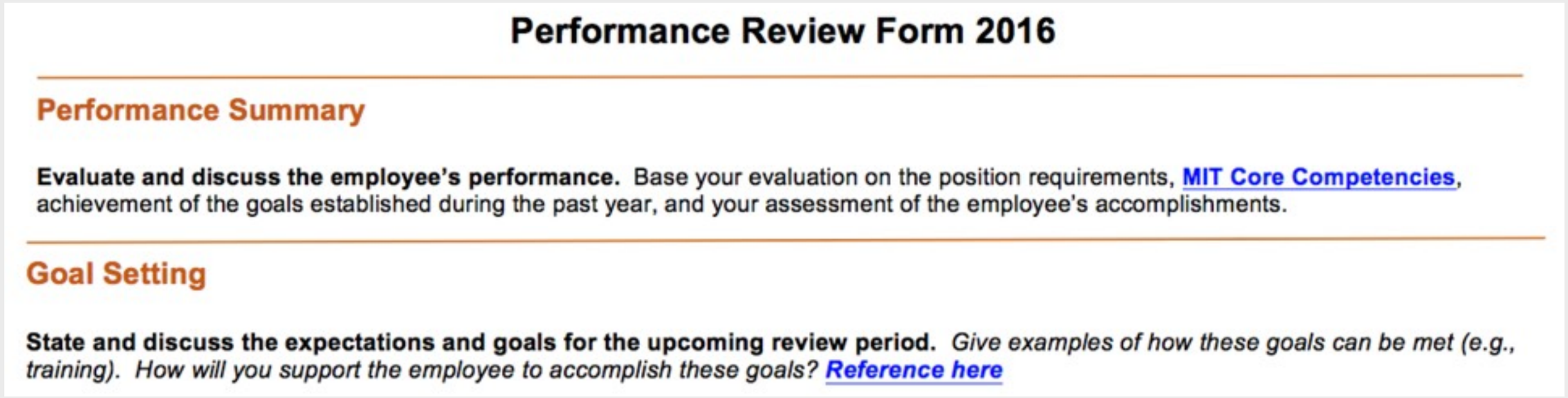
piggybacking epson driver



result: can't create custom size for front loading
also, page size presets in Lightroom hold feed setting

false convergence

two purposes looked the same



Performance Review Form 2016

Performance Summary

Evaluate and discuss the employee's performance. Base your evaluation on the position requirements, MIT Core Competencies, achievement of the goals established during the past year, and your assessment of the employee's accomplishments.

Goal Setting

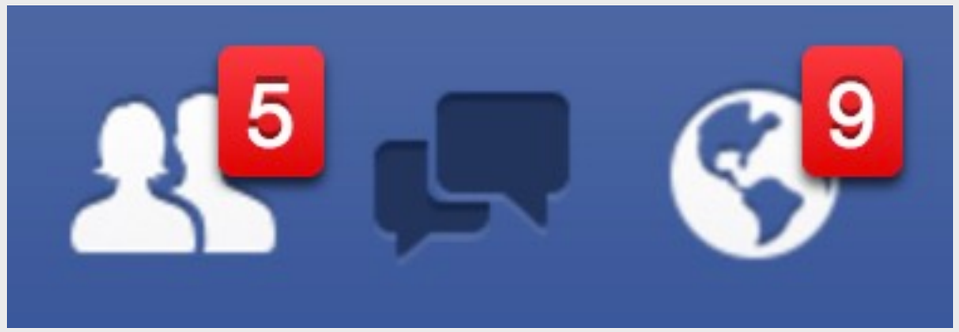
State and discuss the expectations and goals for the upcoming review period. *Give examples of how these goals can be met (e.g., training). How will you support the employee to accomplish these goals?* ***Reference here***

evaluation & goal setting

incompatible purposes

false convergence

two purposes looked the same



filter incoming posts
control access to my posts
distinct purposes

2011: Facebook added
subscribe/follow

emergent purpose

users find second purpose for concept

emergent purpose

users find second purpose for concept

To: Daniel Jackson <dnj@mit.edu>
Re: Catch me if you can in real life!

initial purpose: summarize content

emergent purpose

users find second purpose for concept

To: Daniel Jackson <dnj@mit.edu>
Re: Catch me if you can in real life!

initial purpose: summarize content

To: csail-related@lists.csail.mit.edu
Re: [csail-related] turn off the lights?

emergent purpose: show sender

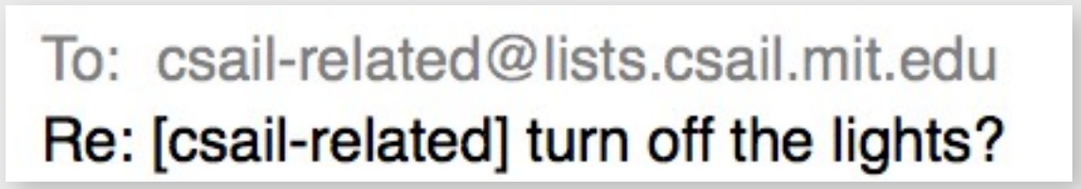
if you bcc a list, subject reveals to-address

thanks to Shriram Krishnamurthi

emergent purpose

users find second purpose for concept

initial purpose: summarize content



emergent purpose: show sender

if you bcc a list, subject reveals to-address

thanks to Shriram Krishnamurthi

emergent purpose: group by conversation

can't label reservations from Expedia by trip

thanks to Eunsuk Kang

gitless:

a case study

Git

I< < Prev Random Next > >I

I< < Prev Random Next > >I

Permanent link to this comic: http://xkcd.com/1597/
Image URL (for hotlinking/embedding): http://imgs.xkcd.com/comics/git.png

gitless: a reworking of git

Gitless: a version control system

Fork me on GitHub

About Gitless

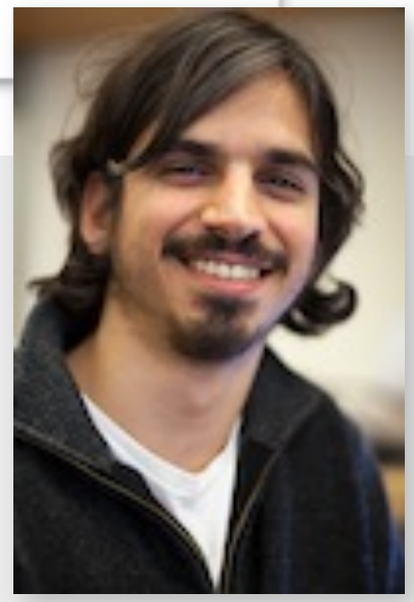
Gitless is an experimental version control system built on top of Git. Many people complain that Git is hard to use. We think the problem lies deeper than the user interface, in the concepts underlying Git. Gitless is an experiment to see what happens if you put a simple veneer on an app that changes the underlying concepts. Because Gitless is implemented on top of Git (could be considered what Git pros call a "porcelain" of Git), you can always fall back on Git. And of course your coworkers you share a repo with need never know that you're not a Git aficionado.

Check out the documentation to get started. If you are a novice user that never used any version control system the documentation should be enough to get you started. If you are a Git pro looking to see what's different from your beloved Git you'll be able to spot the differences by glancing through the Gitless vs. Git section.

Download

- Mac OS X Binary (.tar.gz)
- Linux Binary (.tar.gz)
- Source Code (.tar.gz)

For installation instructions see the readme file. After installation, you should be able to execute the `gl` command. The current Gitless version is 0.7 which was released on 4/2015 (release notes).



Santiago
Perez De Rosso

example: branch

concept: branch

example: branch

purpose: support independent line of development

concept: branch

example: branch

purpose: support independent line of development

operational principle: when you switch branches, your working directory is synchronized with the new branch, and you can make and commit changes which will be invisible on other branches; when you're done, you can merge the branch into the master branch...

concept: branch

example: branch

concept: branch

purpose: support independent line of development

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misfit: can't switch branches with uncommitted changes; can stash, but only if no conflicts...

example: branch

concept: branch

purpose: support independent line of development

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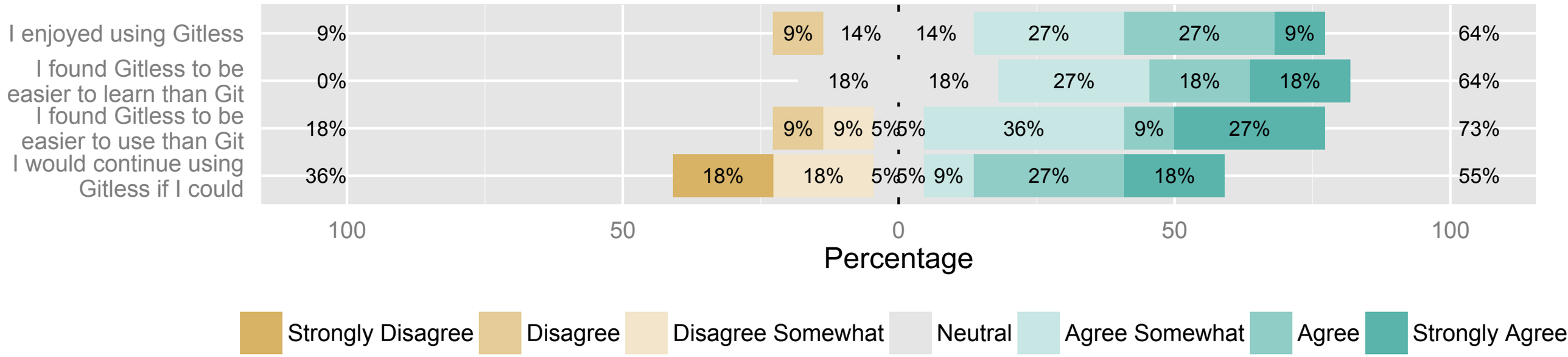
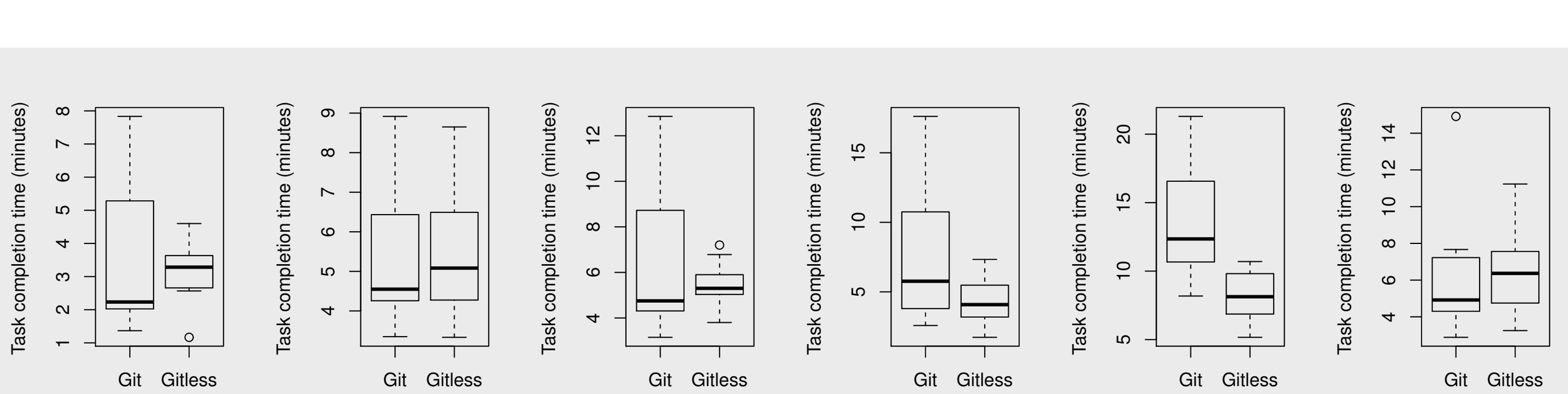
misfit: can't switch branches with uncommitted changes; can stash, but only if no conflicts...

fix: give branch its own working directory; when you switch branches, the working directory changes too, and the working directory associated with the previous branch is preserved

results of a user study





conclusions

	designer	engineer
elements	?	function, object, type
criteria	?	decoupling & localization
goals	learnable, effective, tolerant	maintainable, correct, fast

	designer	engineer
elements	concepts, purposes	function, object, type
criteria	?	decoupling & localization
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	designer	engineer
elements	concepts, purposes	function, object, type
criteria	1:1 = concept:purpose	decoupling & localization
goals	learnable, effective, tolerant	maintainable, correct, fast

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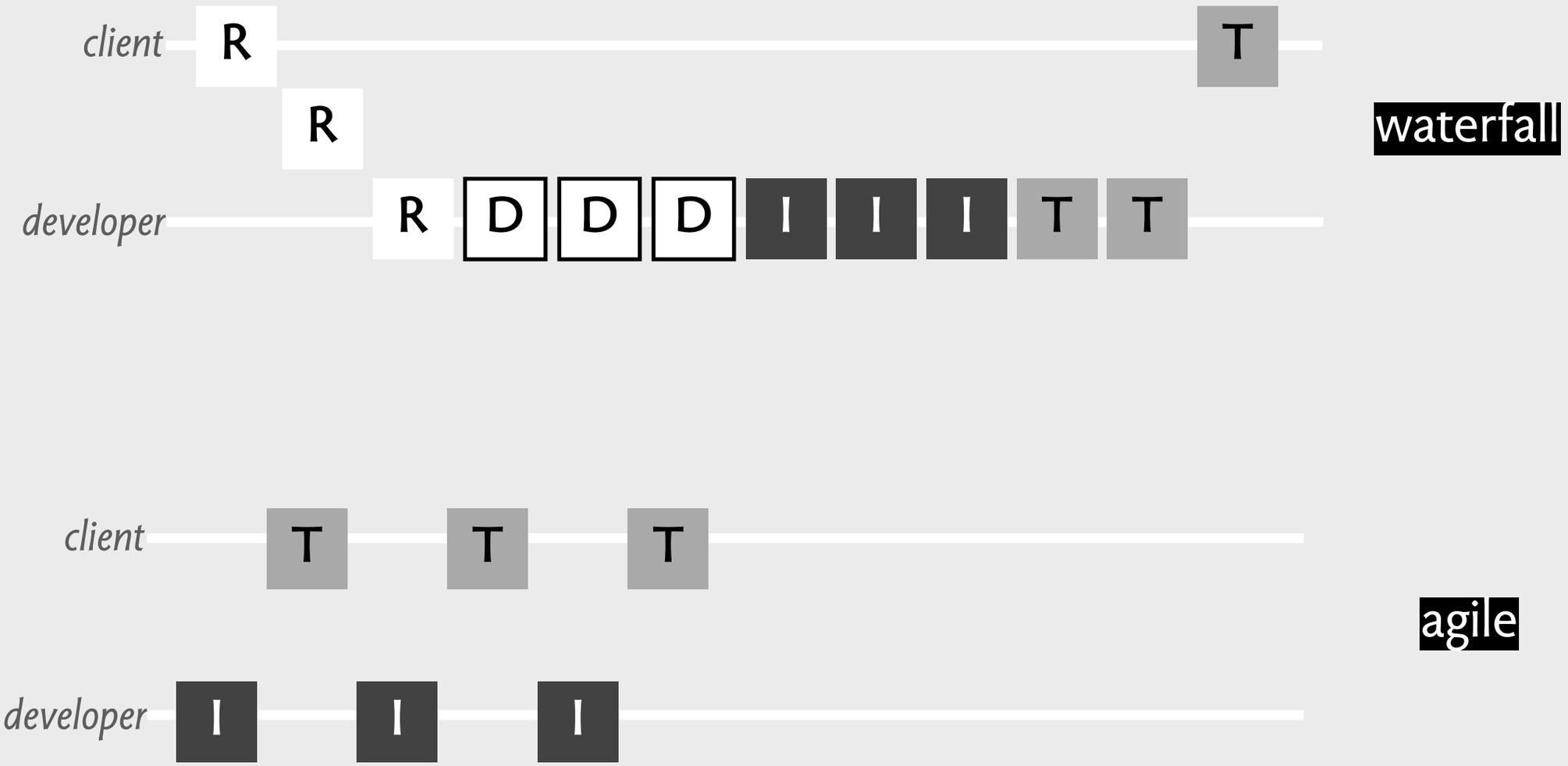
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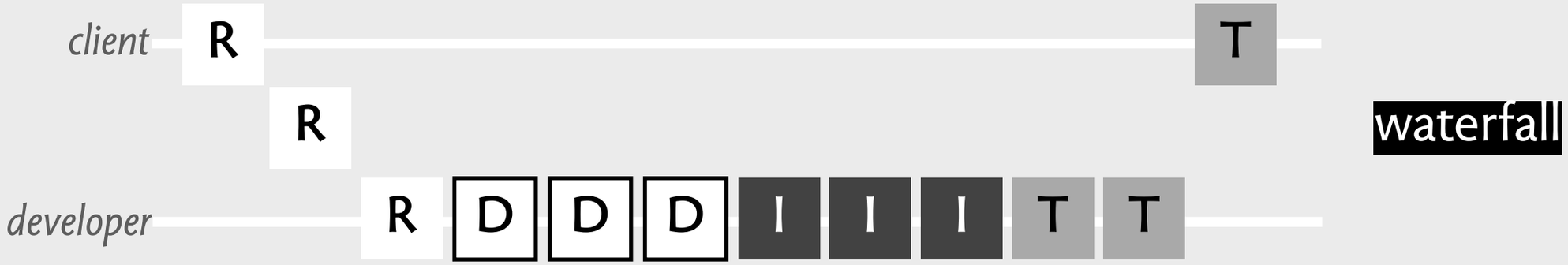
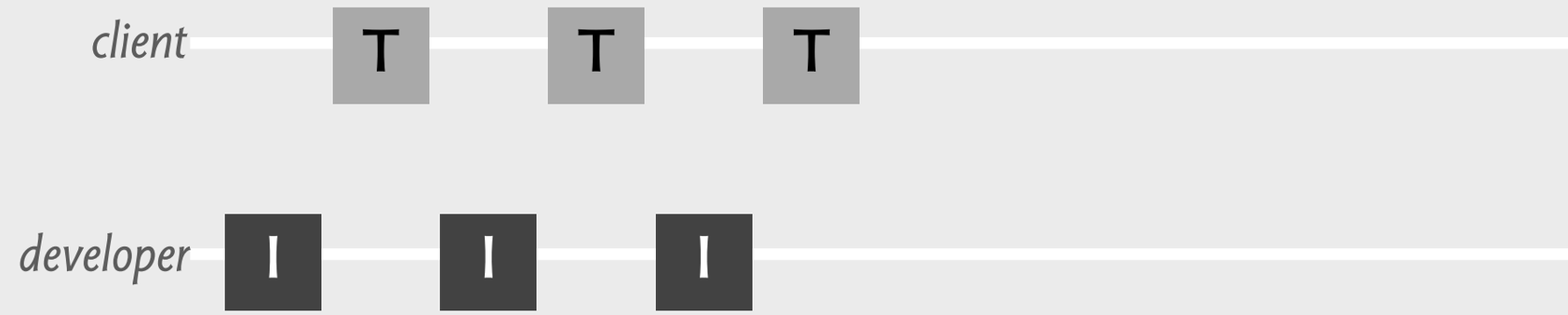
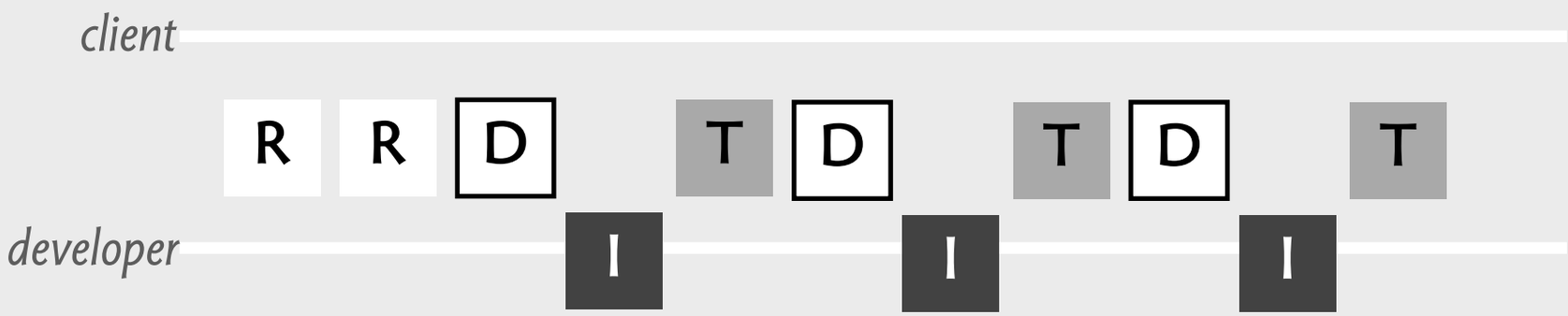


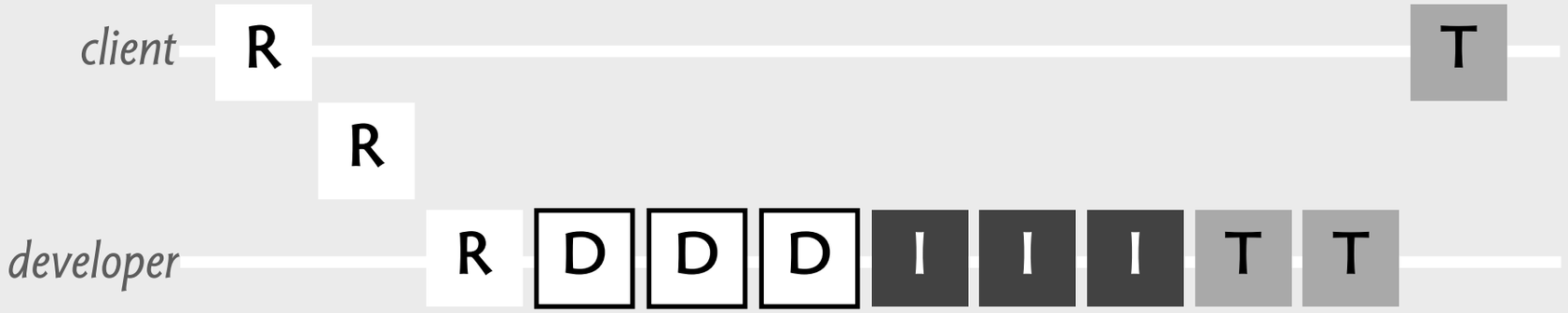
waterfall



agile



design thinking



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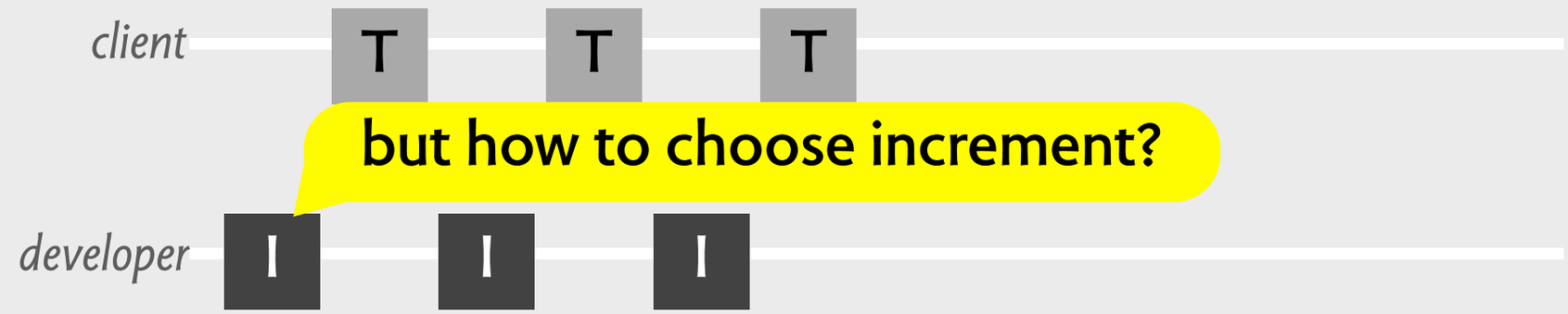
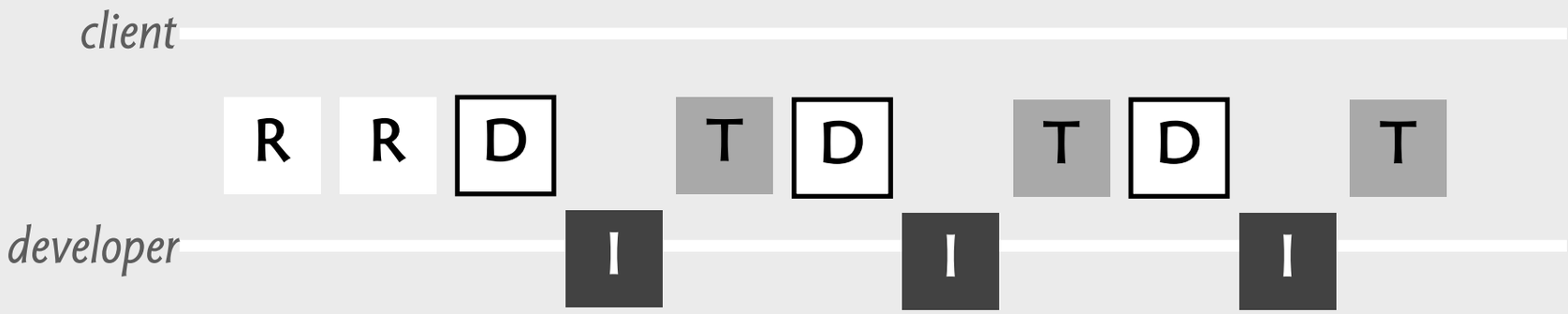
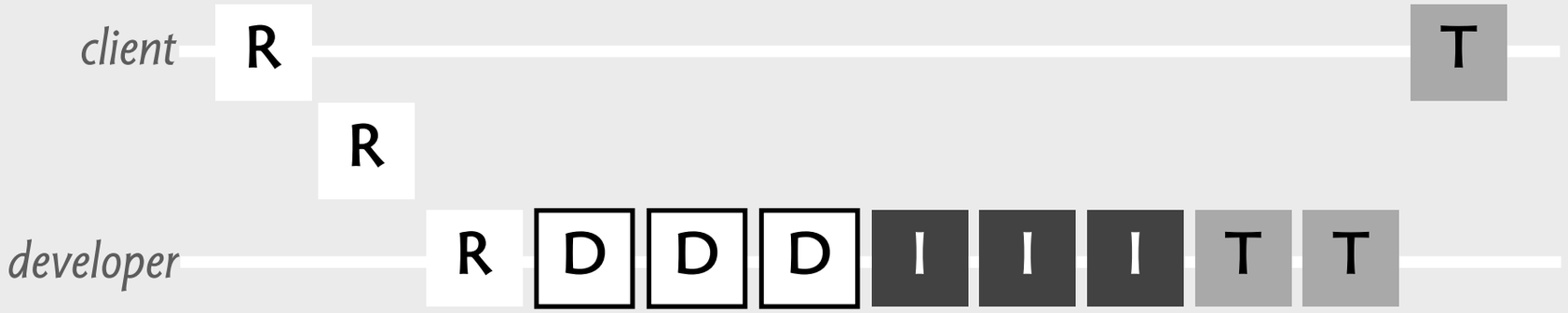


but how to choose increment?

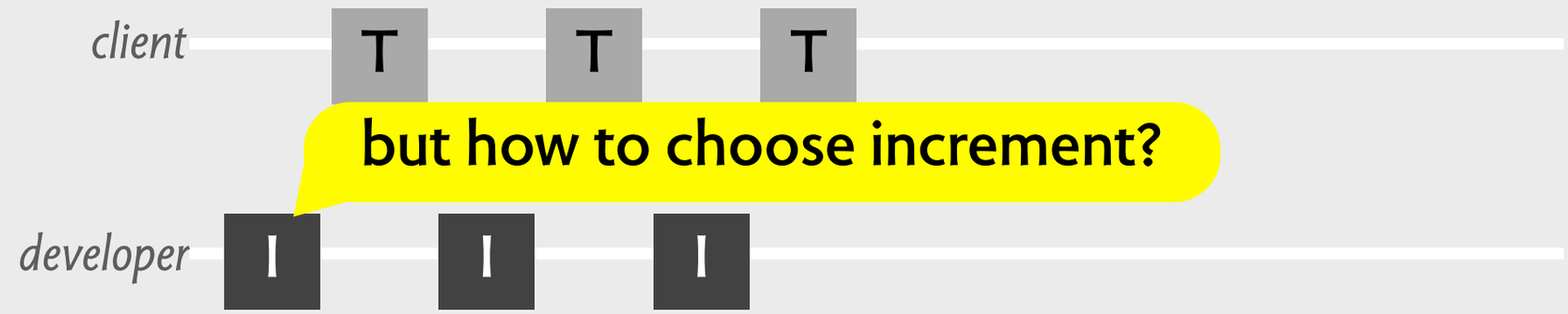
agile



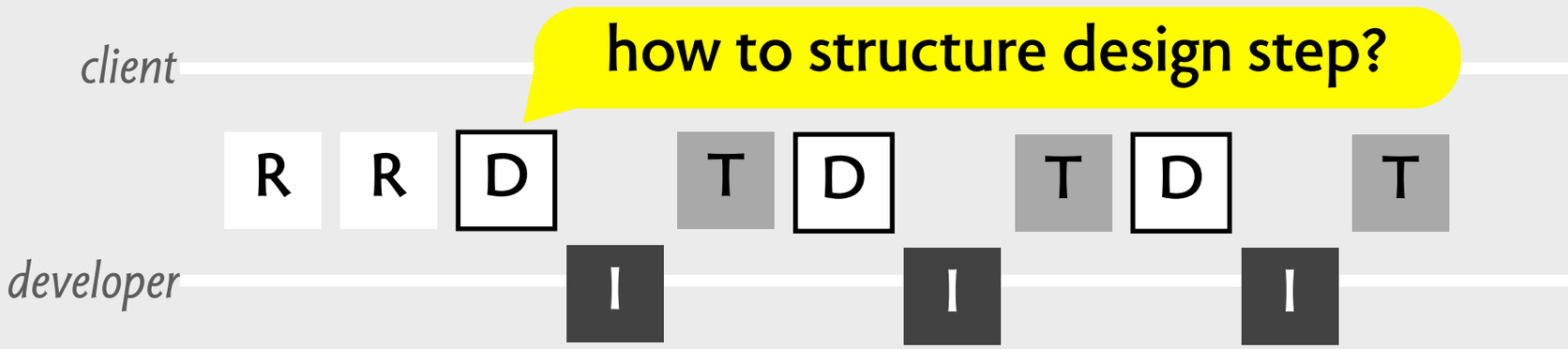
design thinking



waterfall

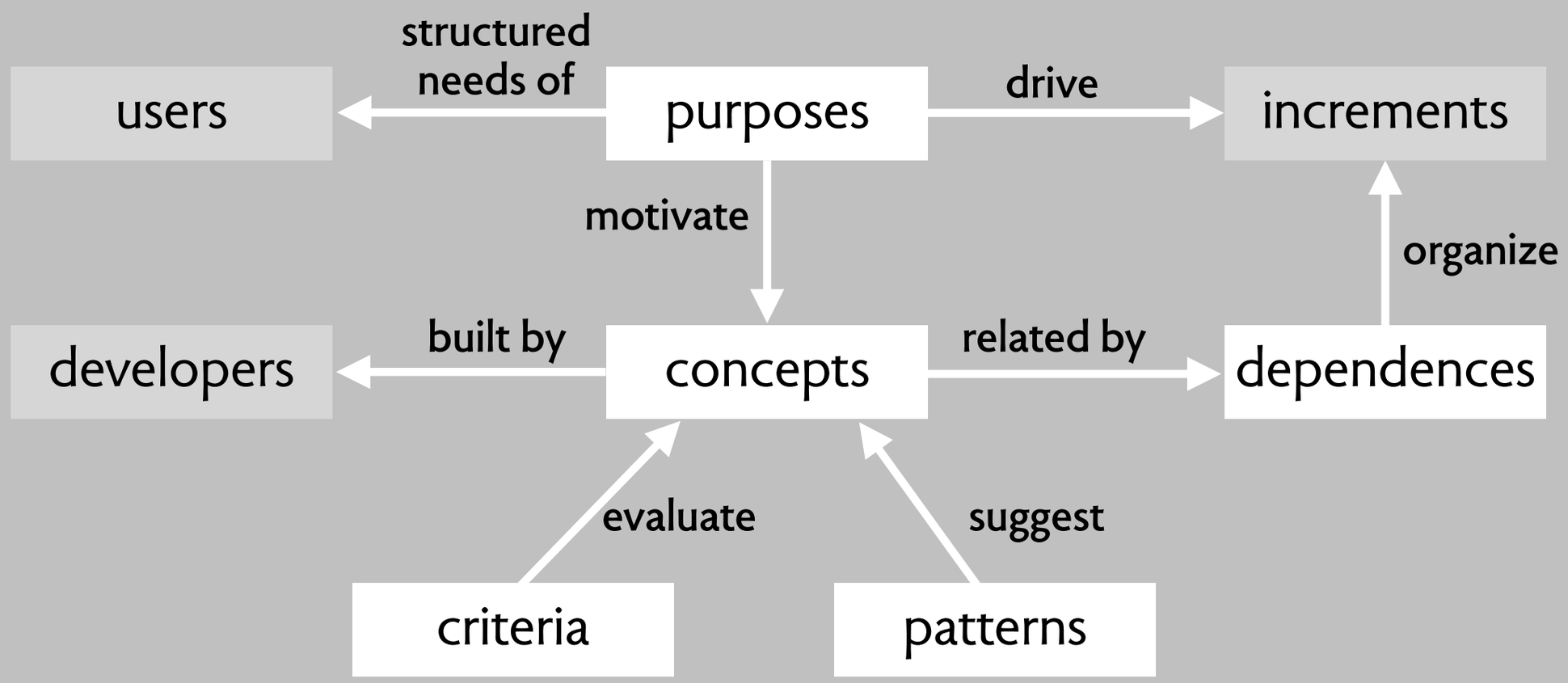


agile



design thinking

a software design approach



backup material

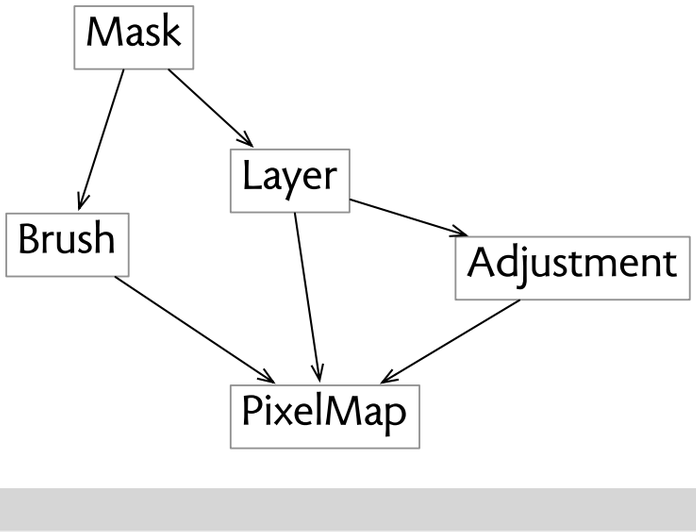
a new view

a common view of software design

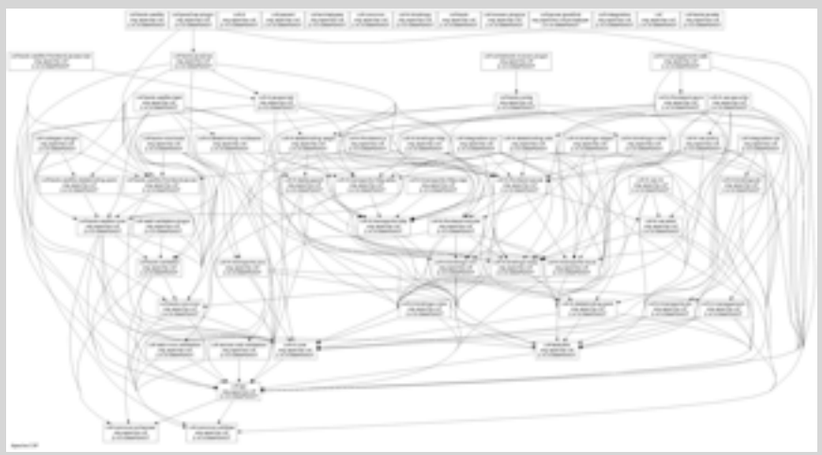
UI design
soft & human
about presentation

programming
hard & technical
about content

a better view of software design



conceptual design:
essential concepts
& behavior



representation design:
organization & performance

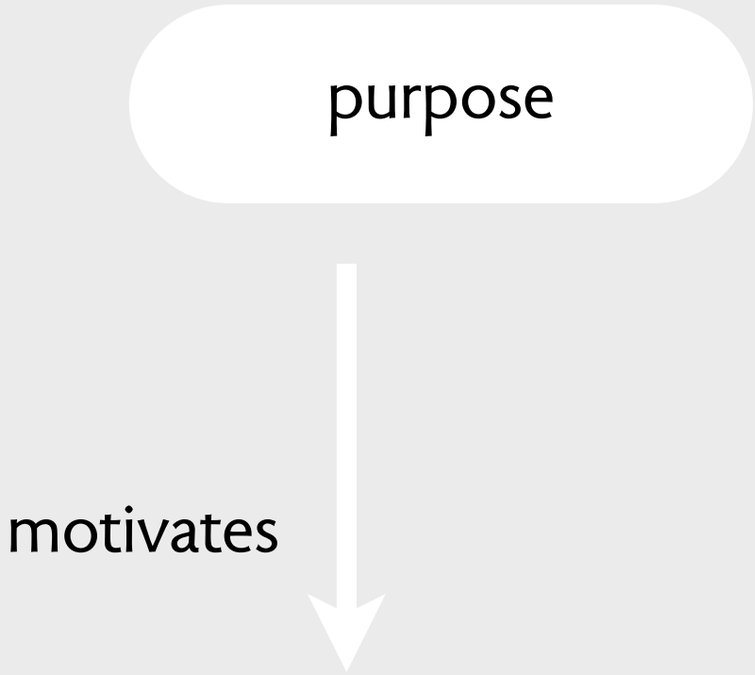
designing on purpose

design is driven by purpose

design is driven by purpose

purpose

design is driven by purpose



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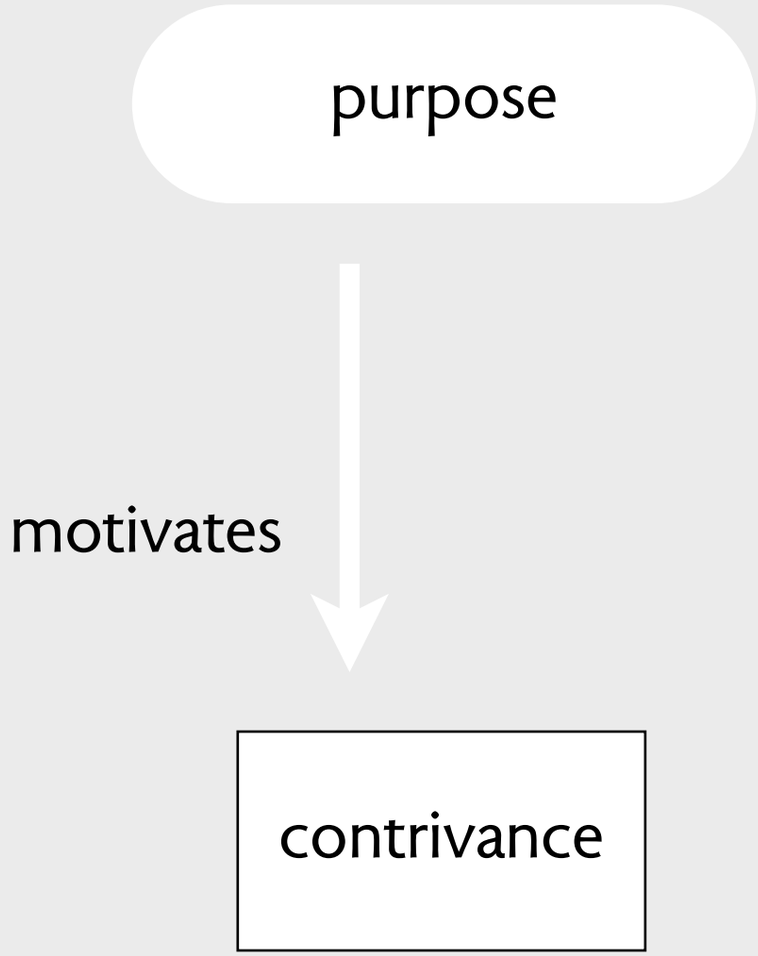

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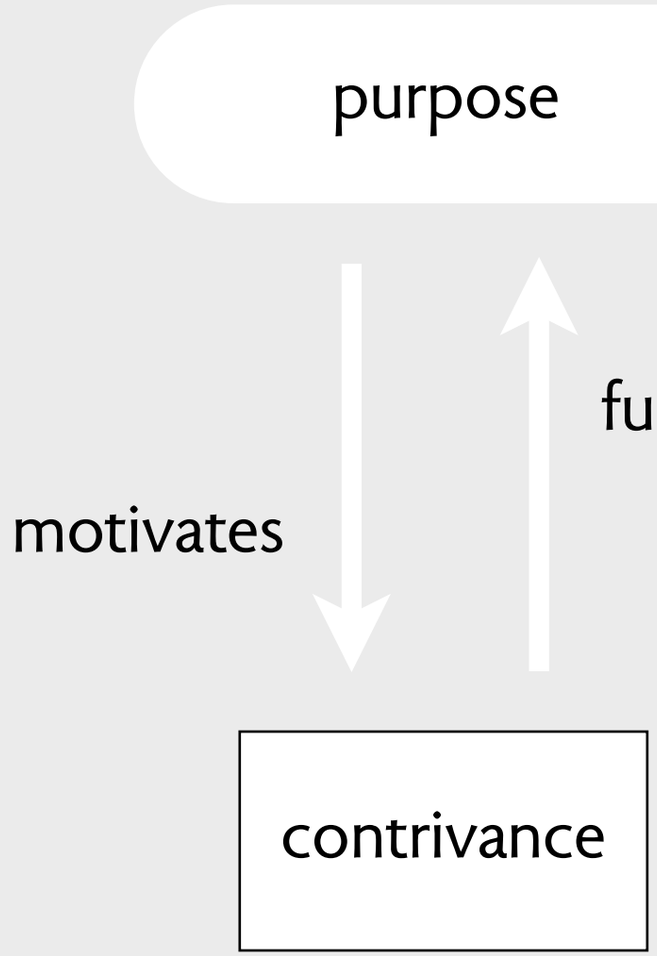

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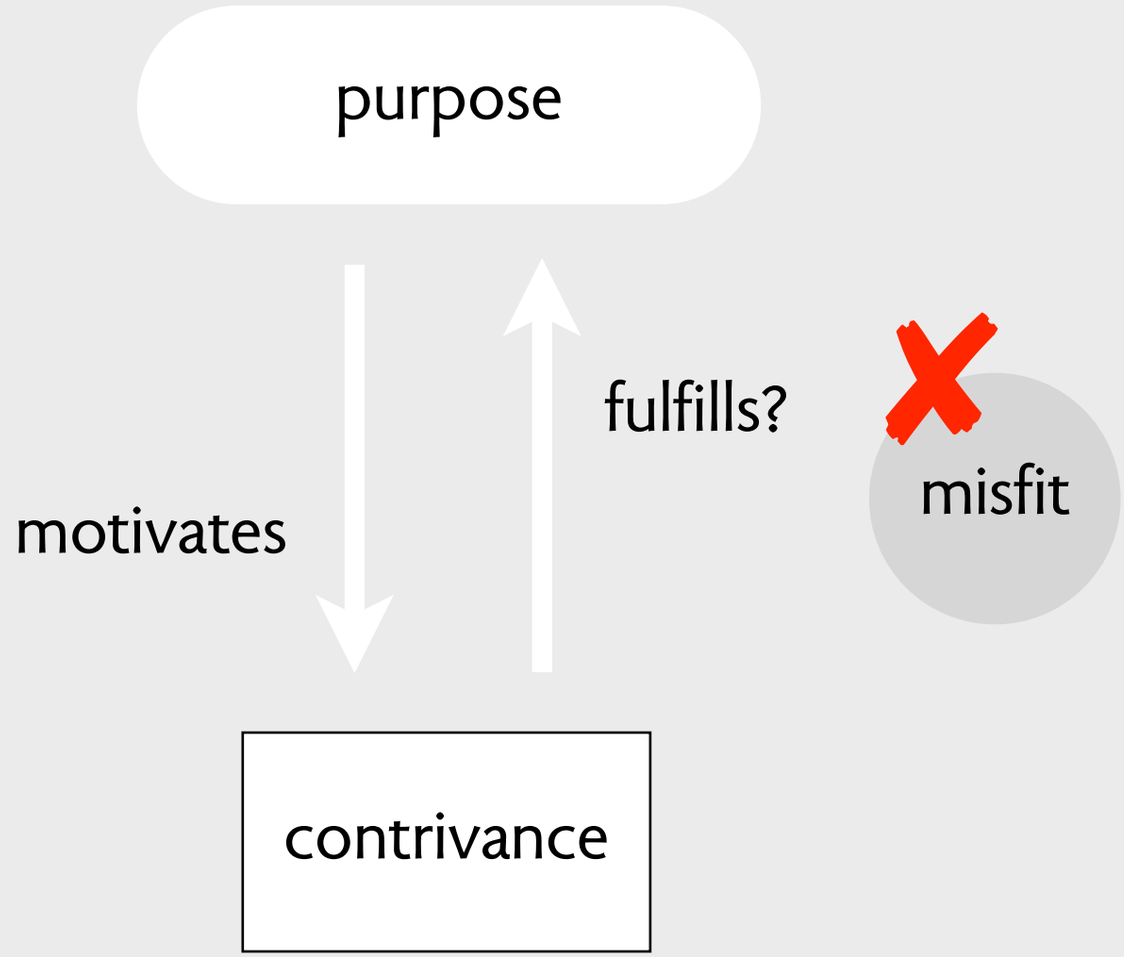

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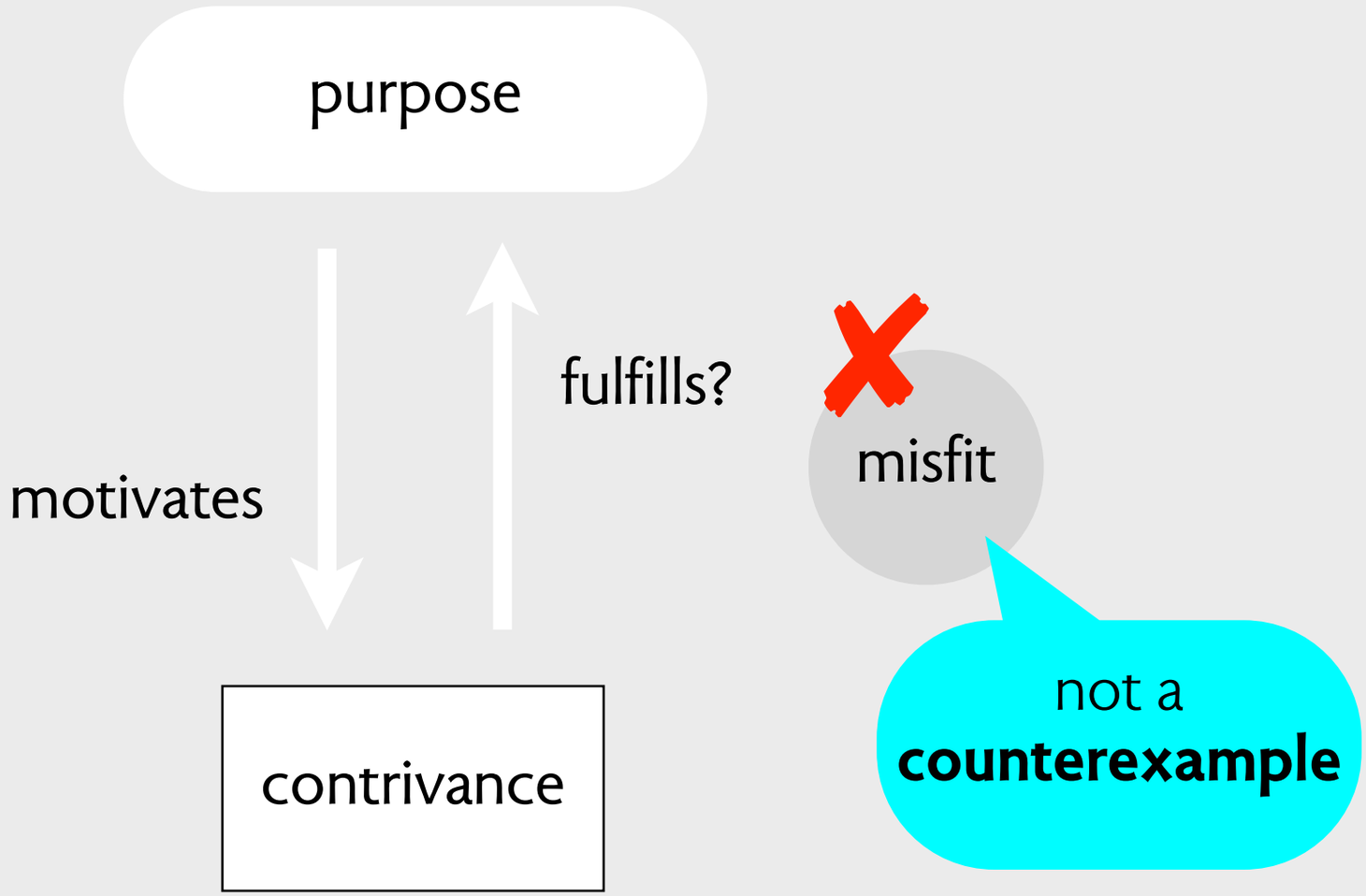


example: a photo wall

example: a photo wall

changeable wall
display of prints

example: a photo wall

changeable wall display of prints

motivates

example: a photo wall

changeable wall display of prints

motivates

corkboard tiles

example: a photo wall

changeable wall display of prints

motivates

adhesive corners

corkboard tiles

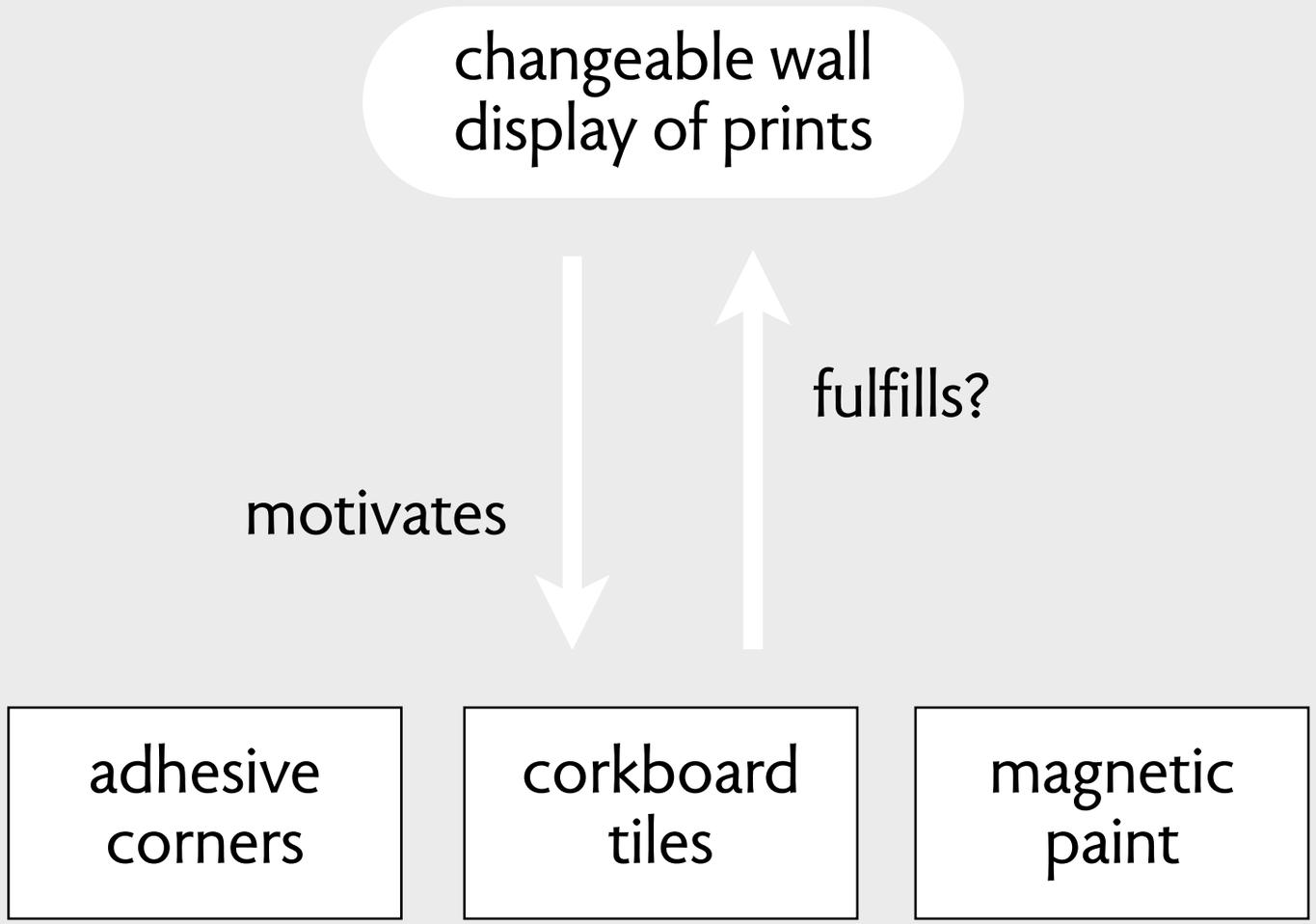
example: a photo wall

changeable wall display of prints

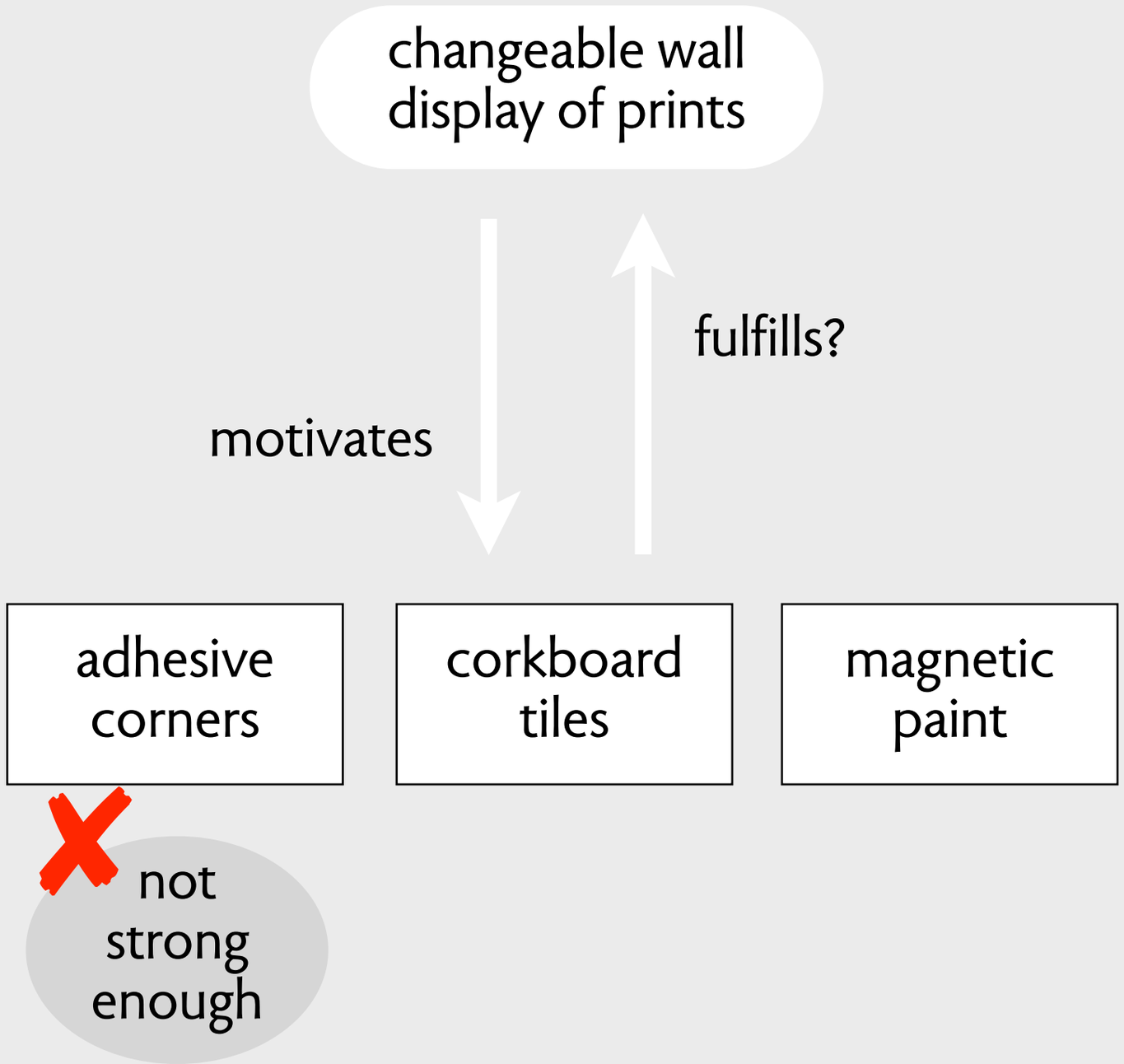
motivates

- adhesive corners
- corkboard tiles
- magnetic paint

example: a photo wall



example: a photo wall



example: a photo wall

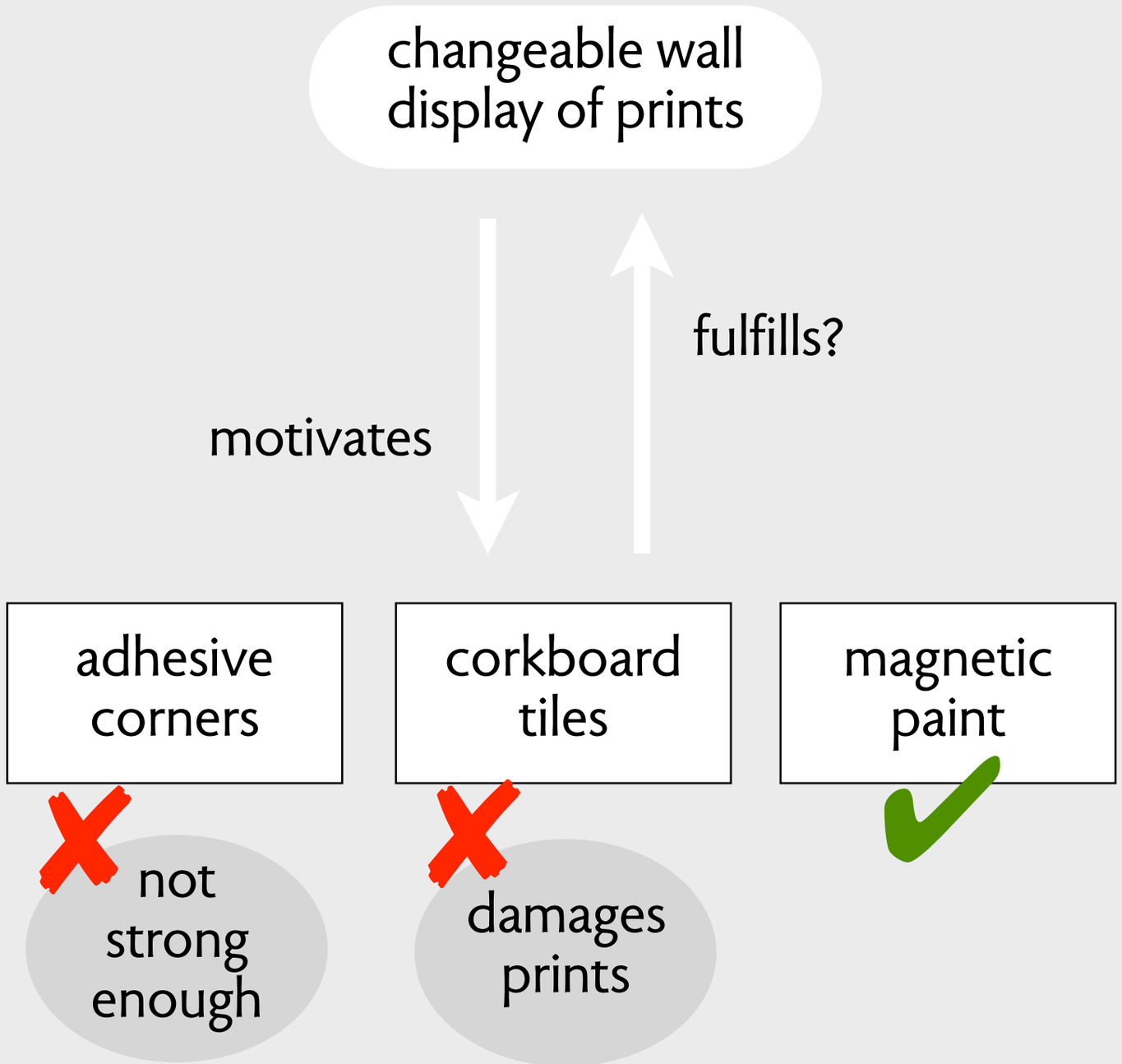
changeable wall display of prints

motivates

fulfills?

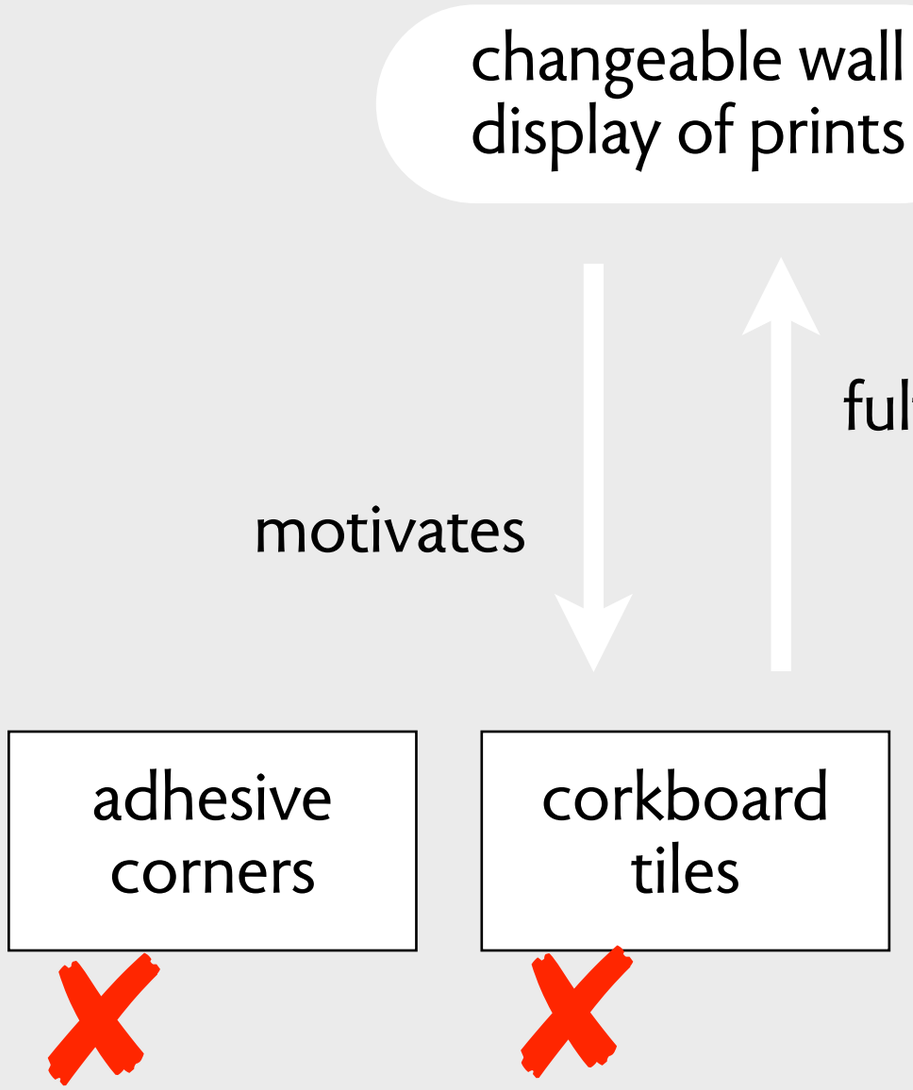
- adhesive corners — ✗ not strong enough
- corkboard tiles — ✗ damages prints
- magnetic paint

example: a photo wall

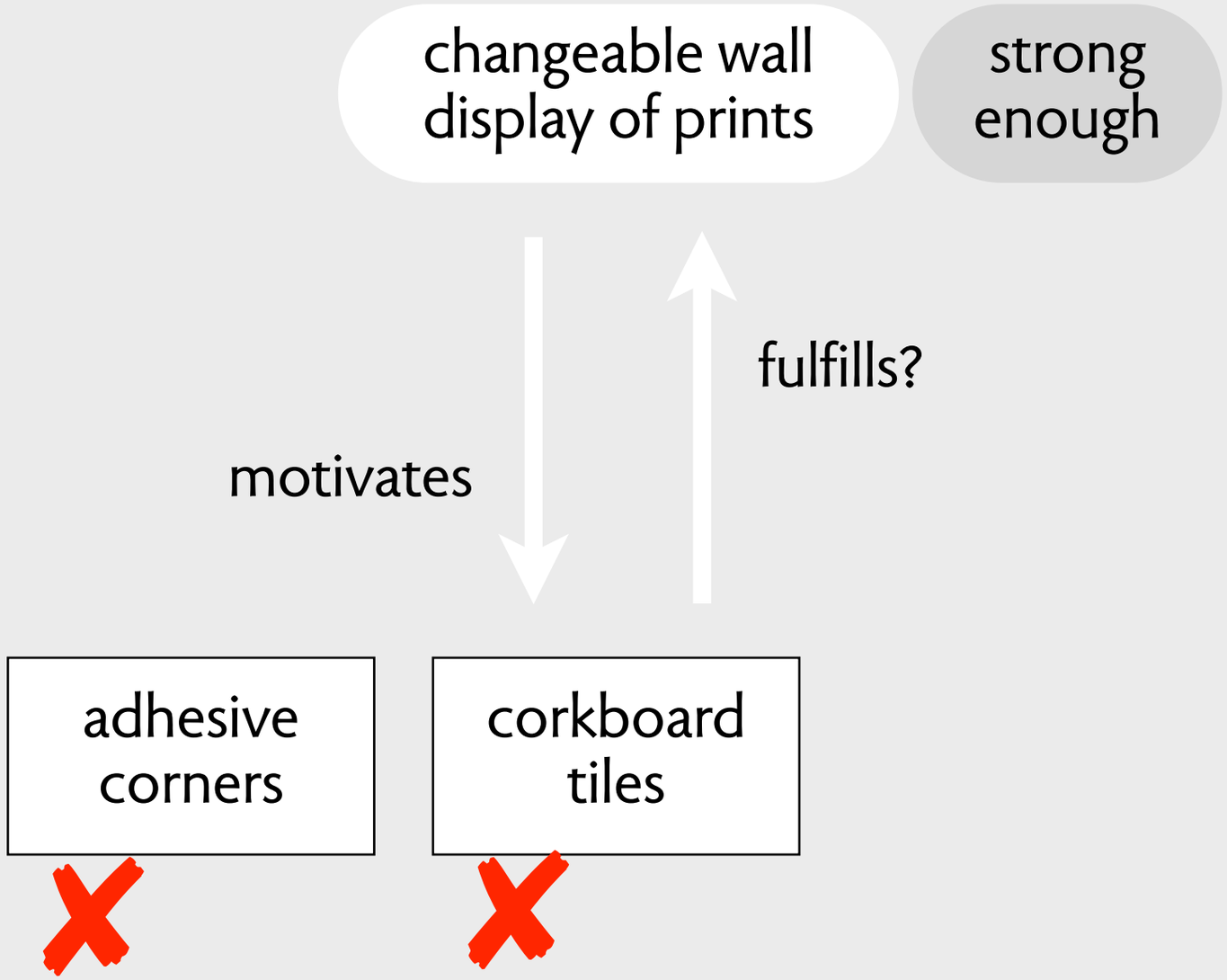


as implemented

refining the purpose with misfits



refining the purpose with misfits



refining the purpose with misfits

changeable wall display of prints

strong enough

no damage

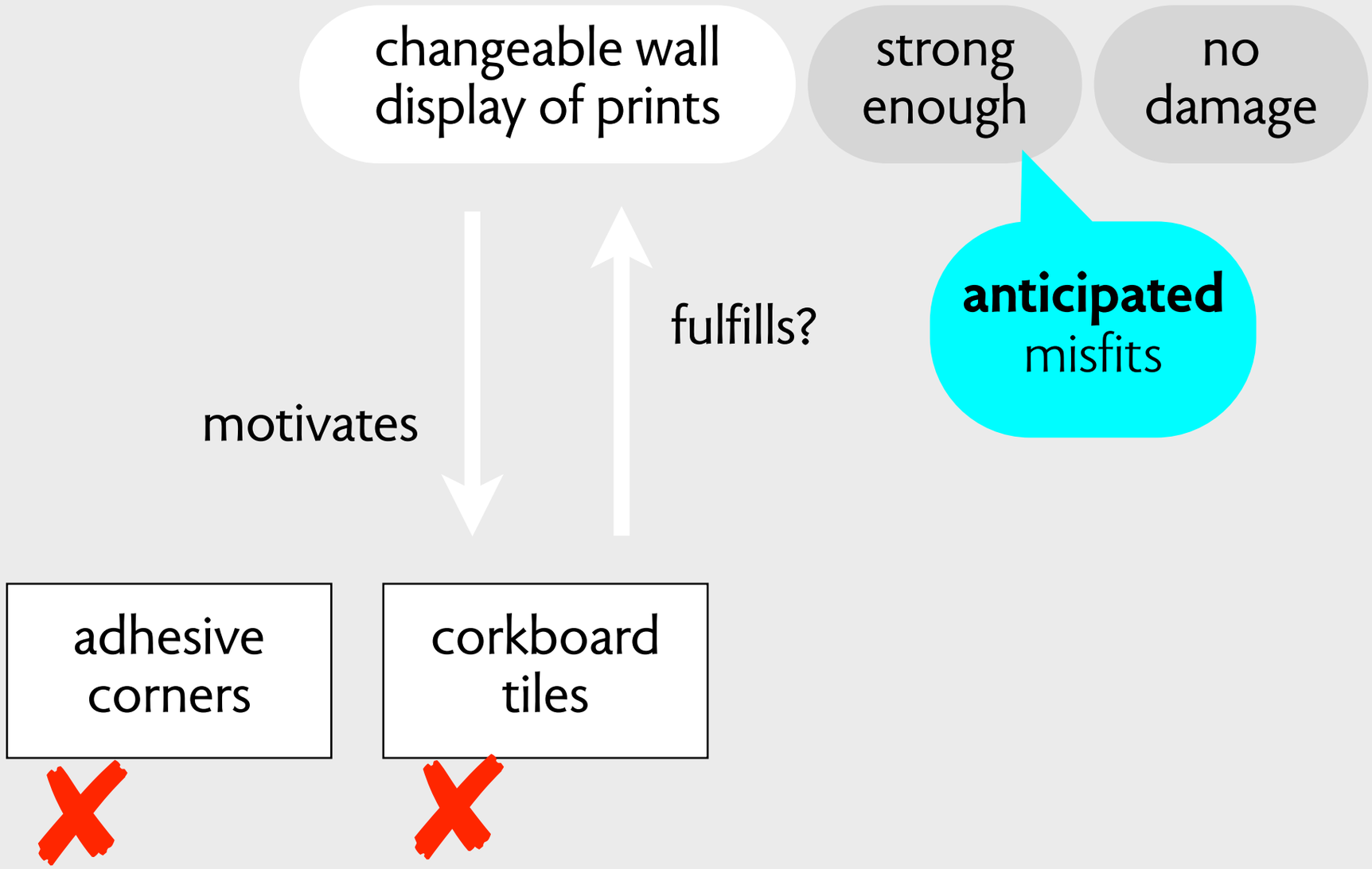
fulfills?

motivates

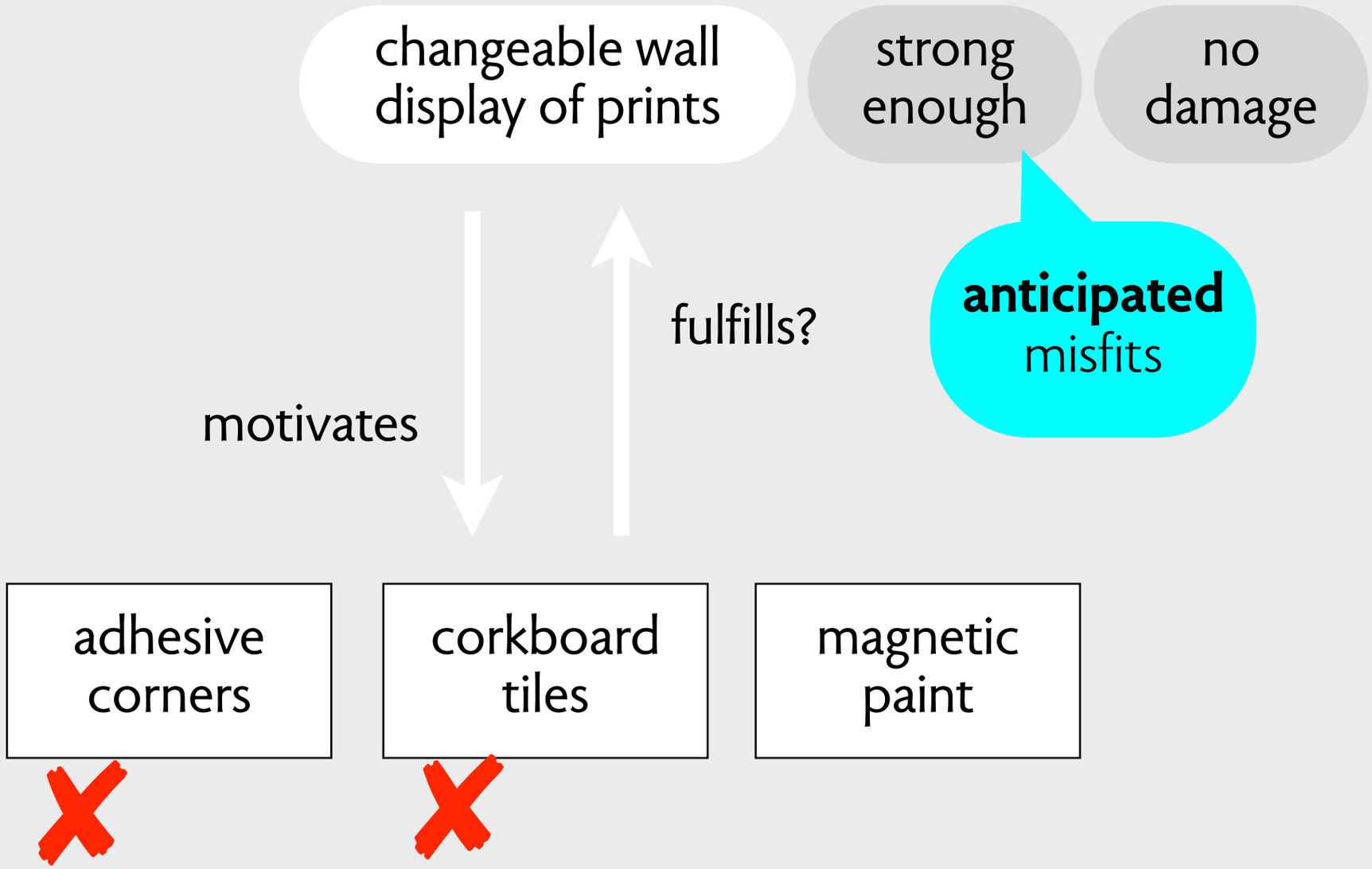
adhesive corners

corkboard tiles

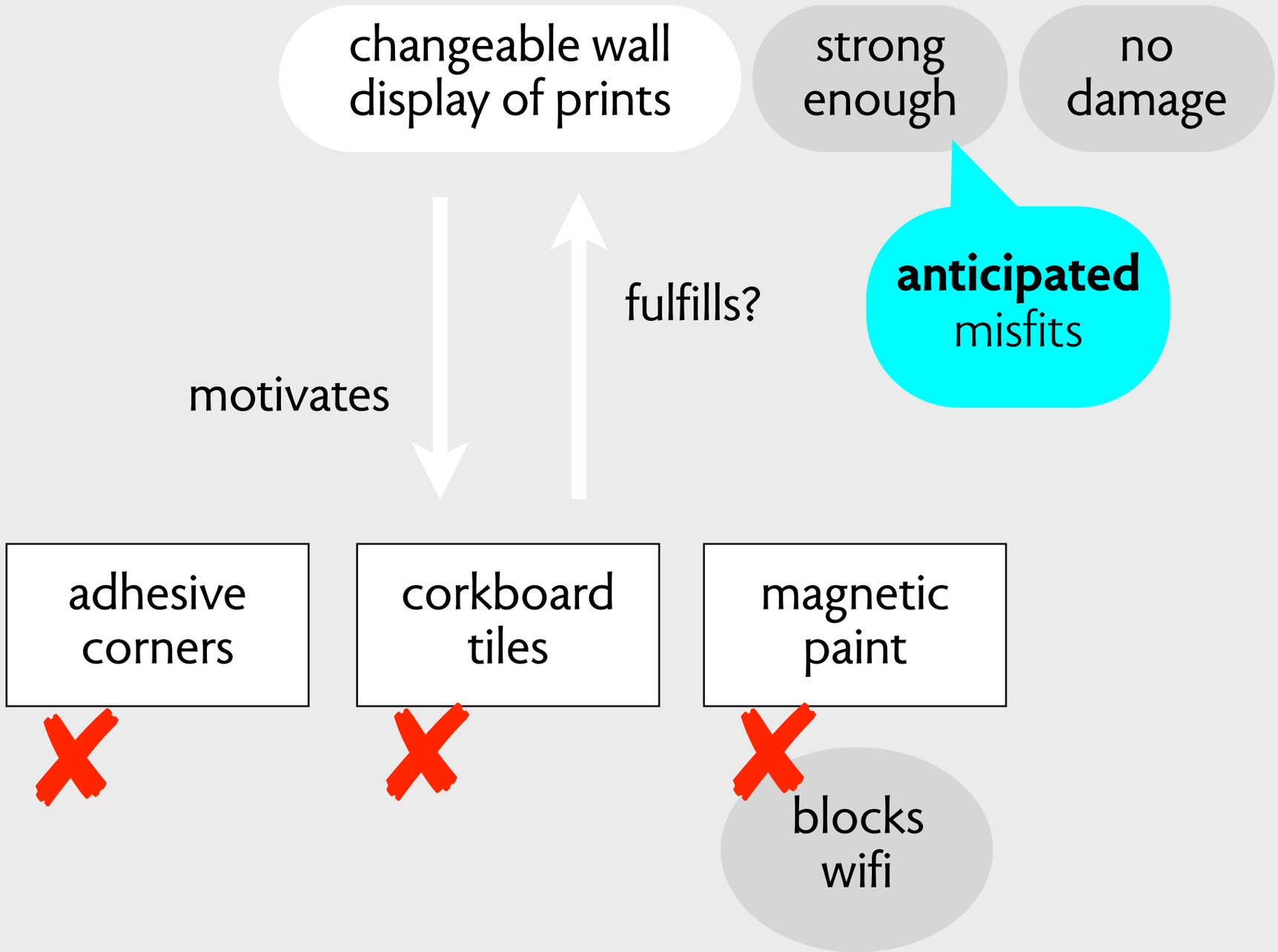
refining the purpose with misfits



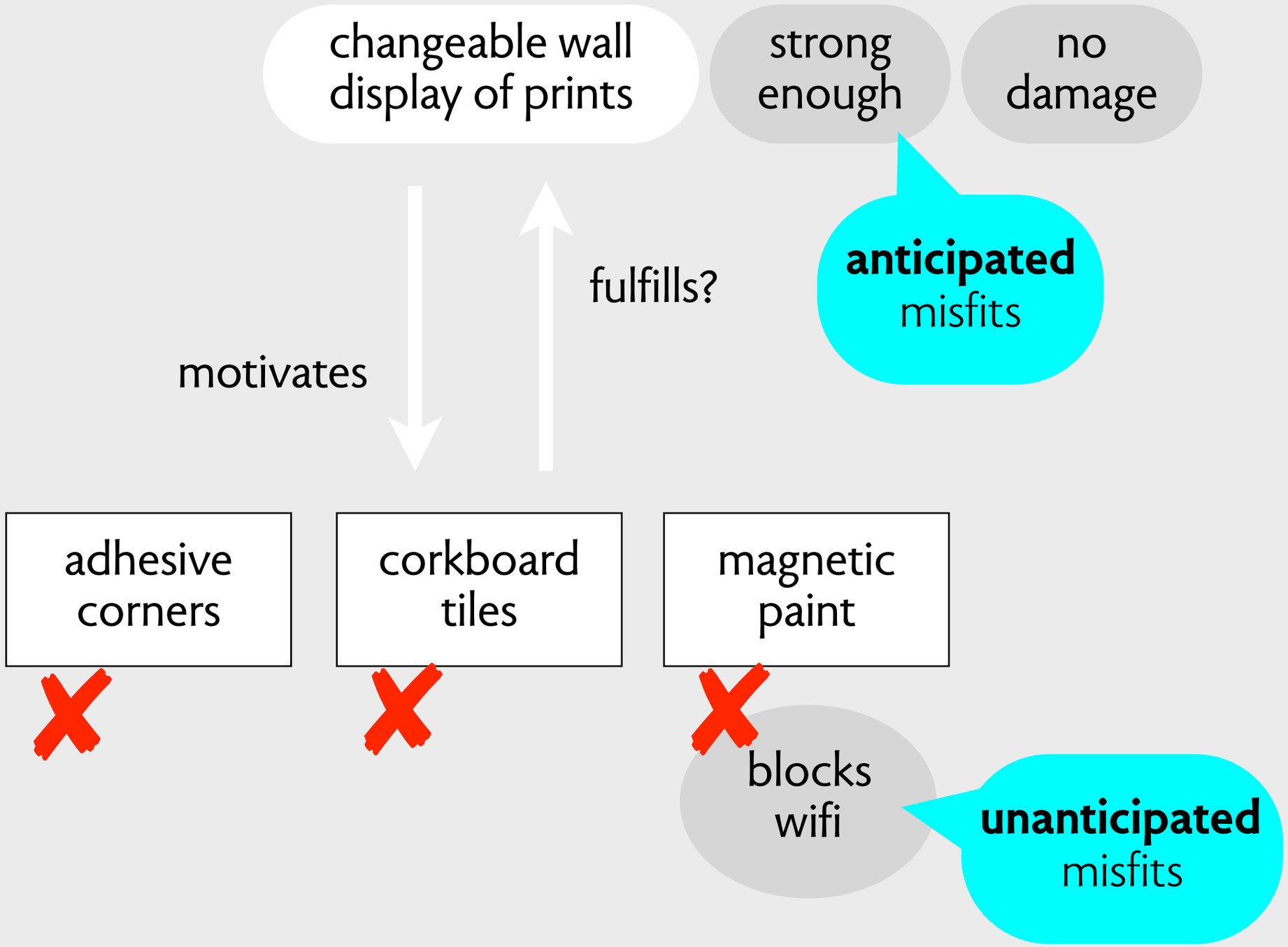
refining the purpose with misfits

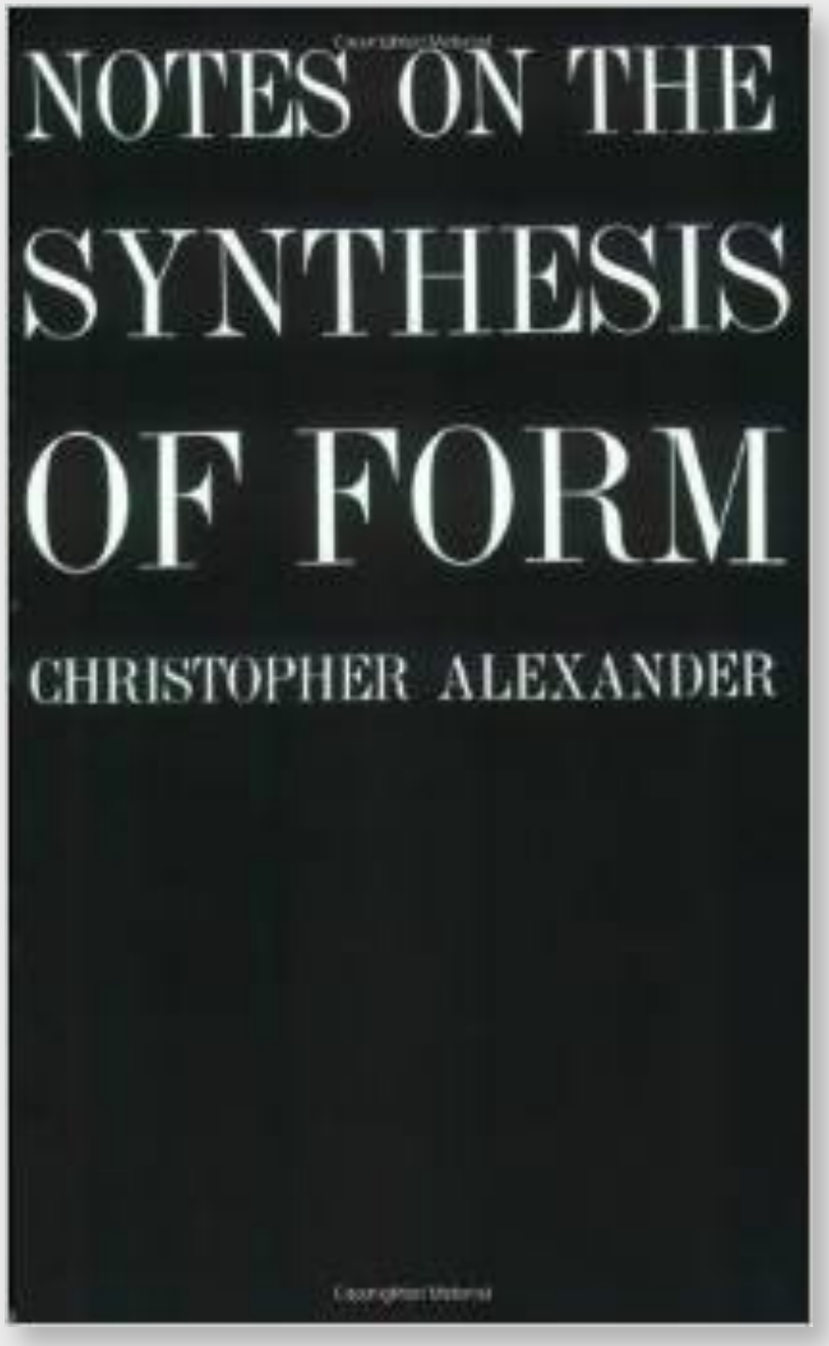


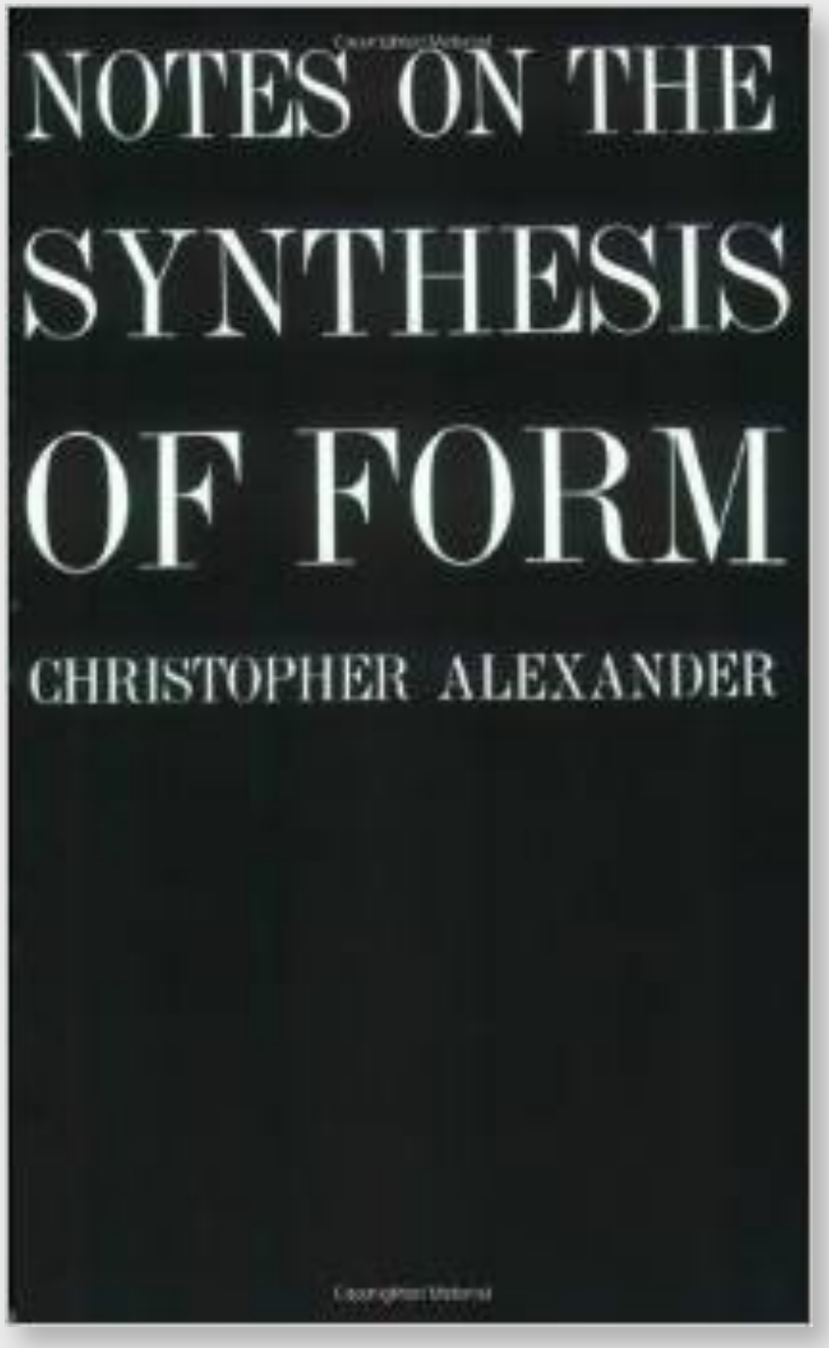
refining the purpose with misfits



refining the purpose with misfits




NOTES ON THE
SYNTHESIS
OF FORM
CHRISTOPHER ALEXANDER



Such 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.

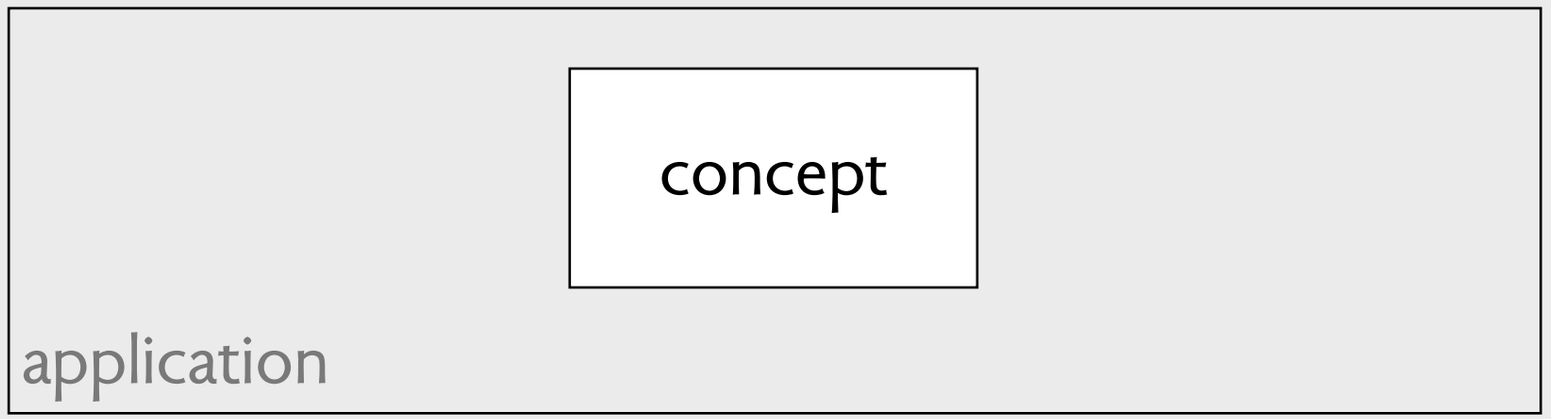
concepts driven by purposes too

application purpose

application

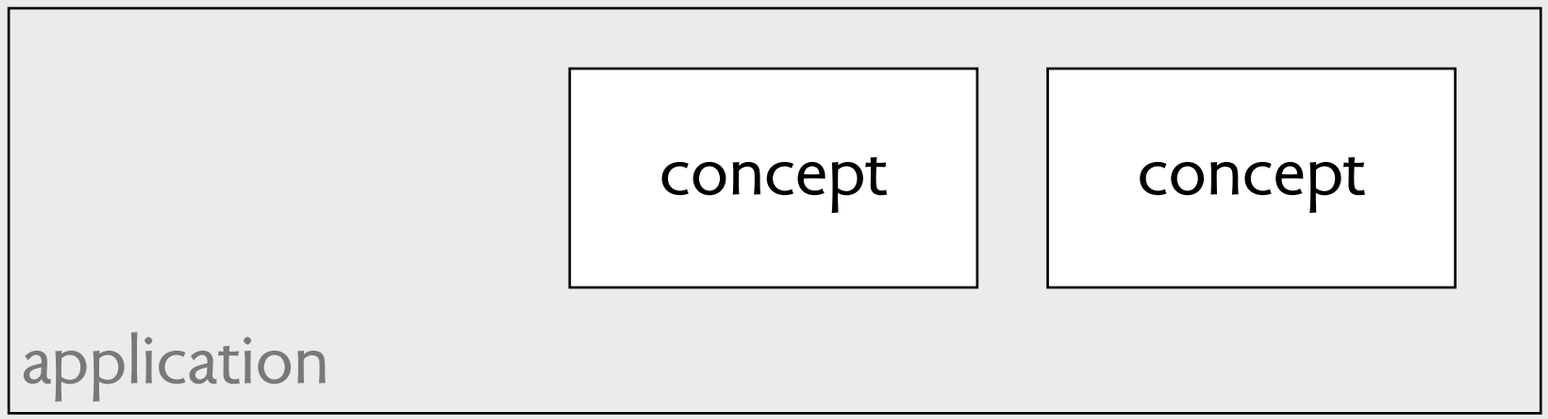
concepts driven by purposes too

application purpose



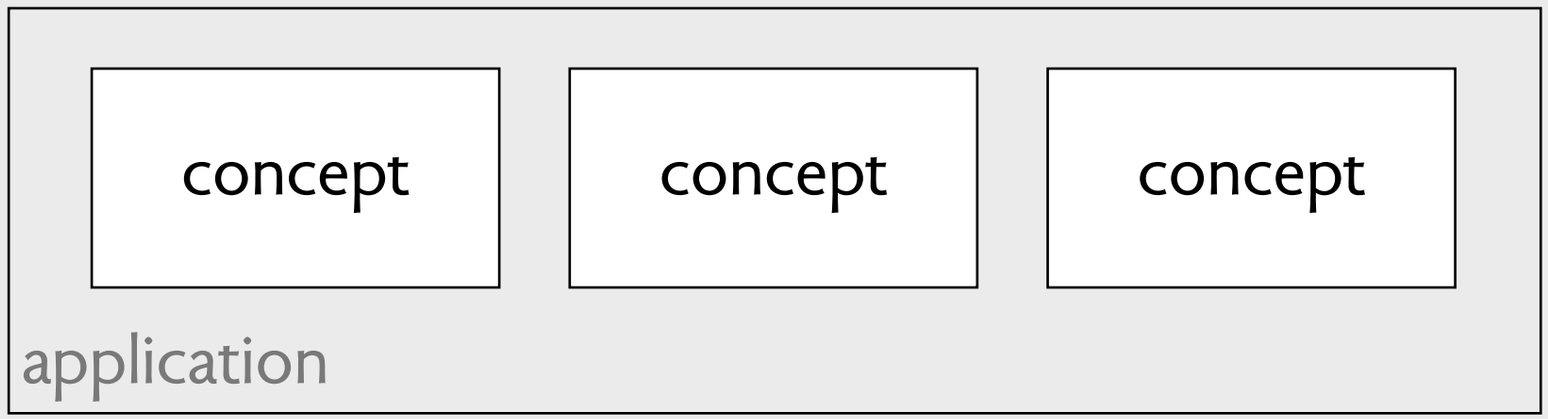
concepts driven by purposes too

application purpose

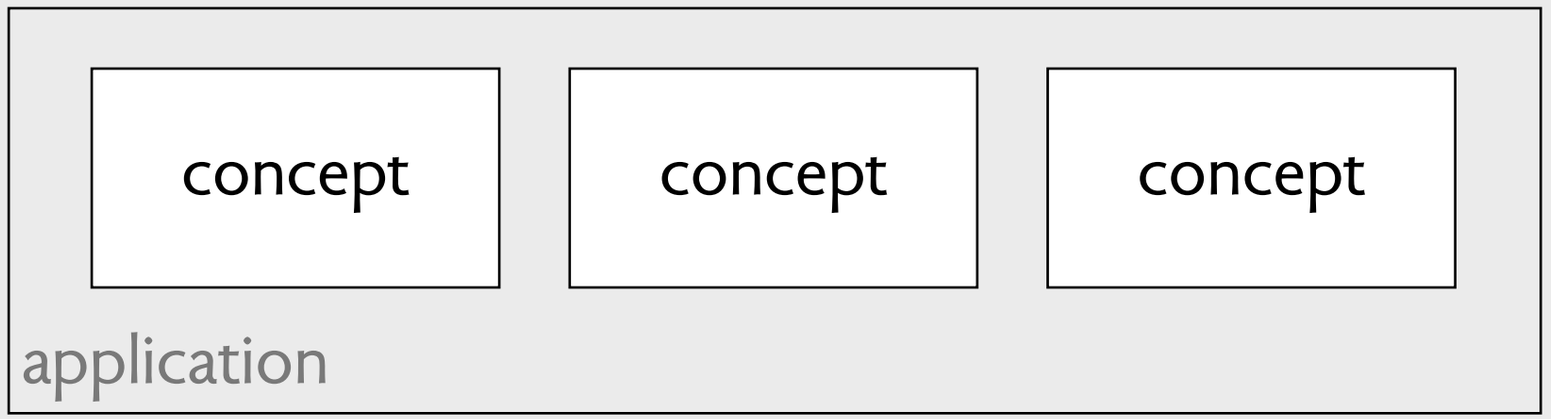


concepts driven by purposes too

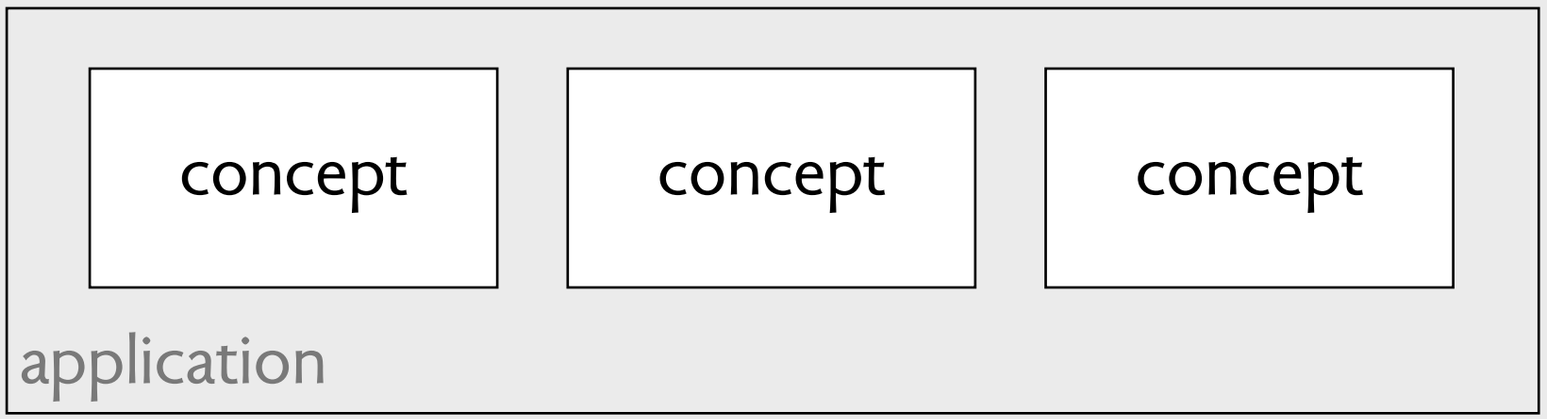
application purpose



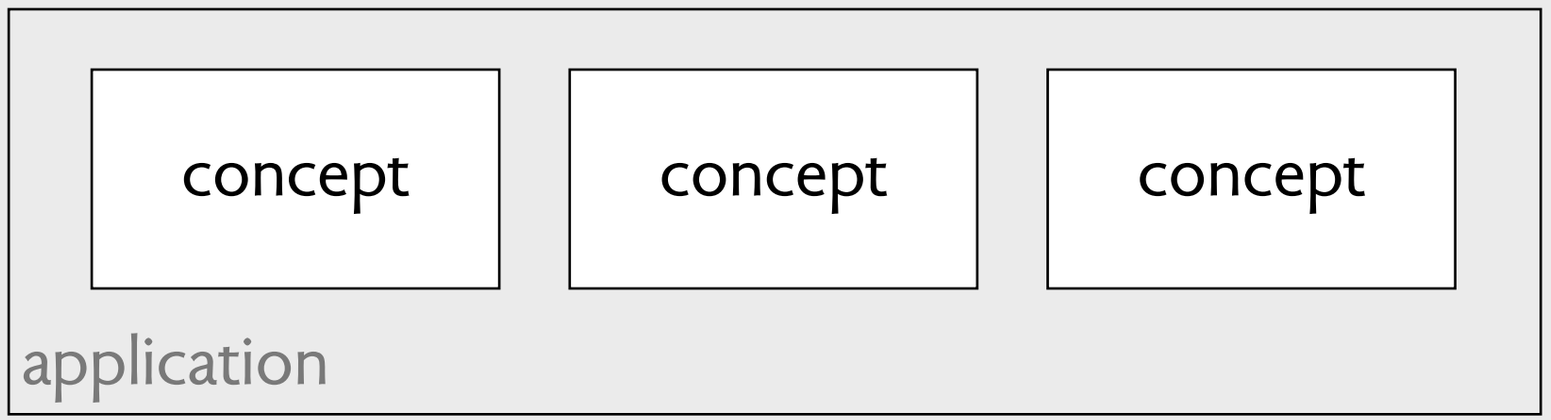
concepts driven by purposes too



concepts driven by purposes too



concepts driven by purposes too



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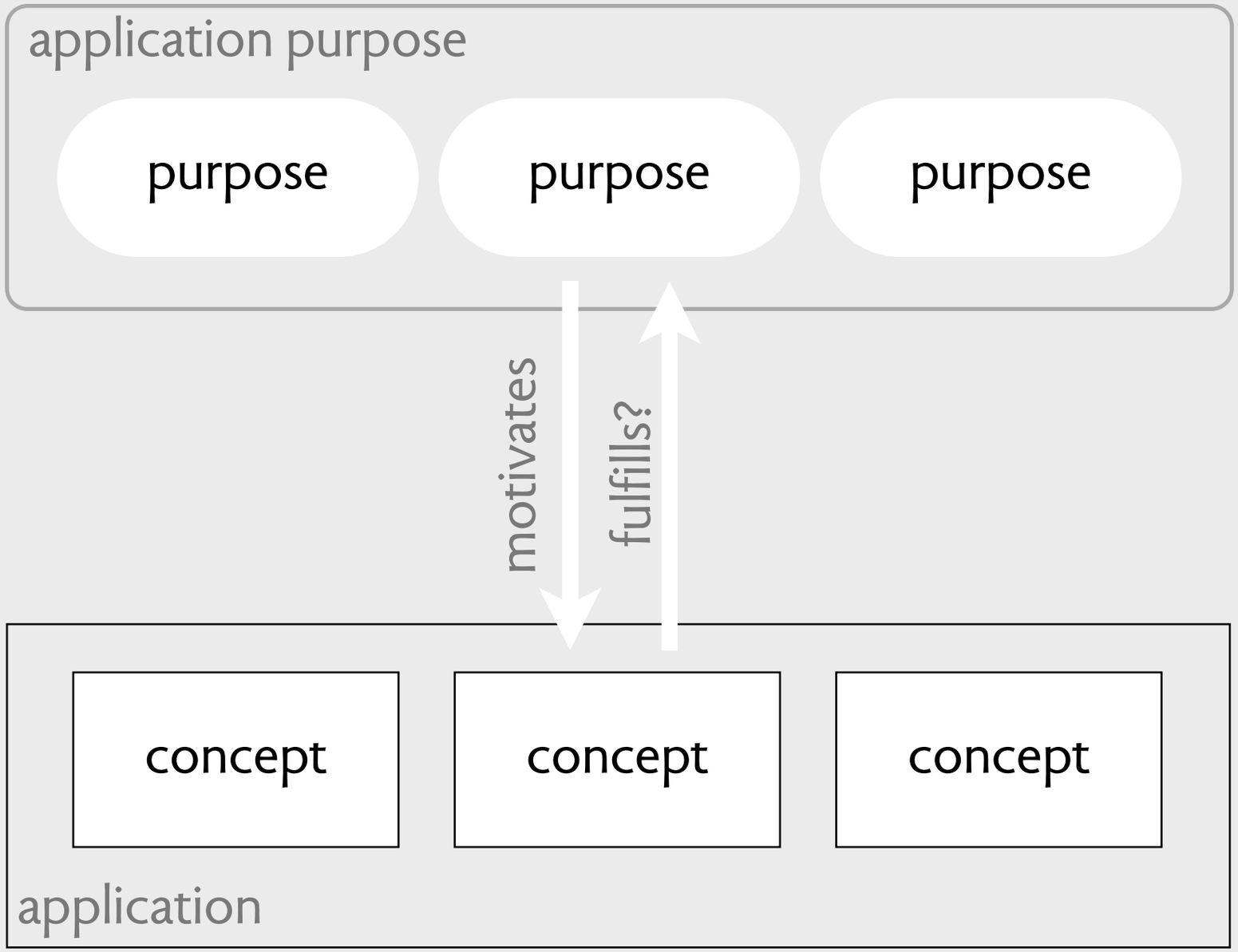

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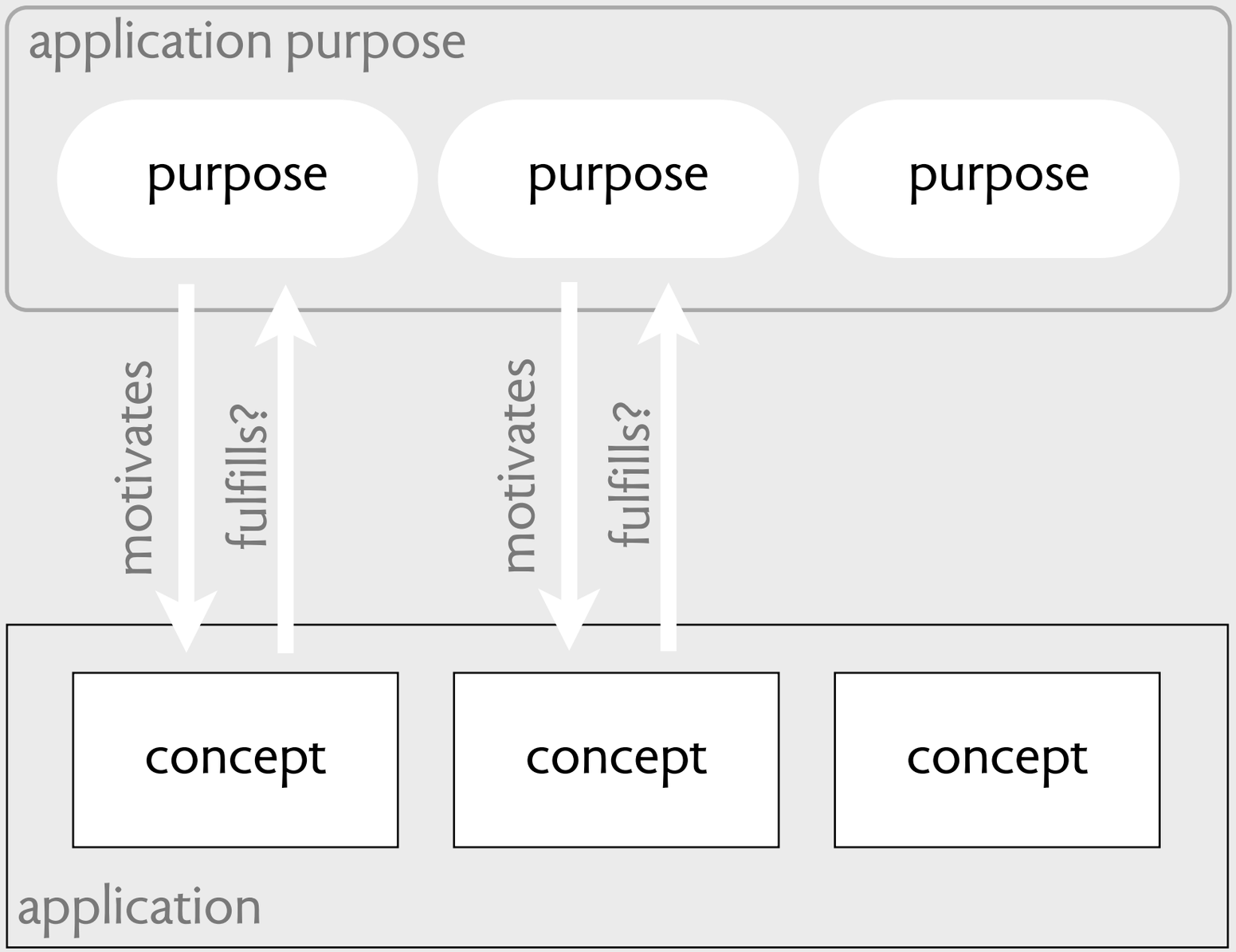
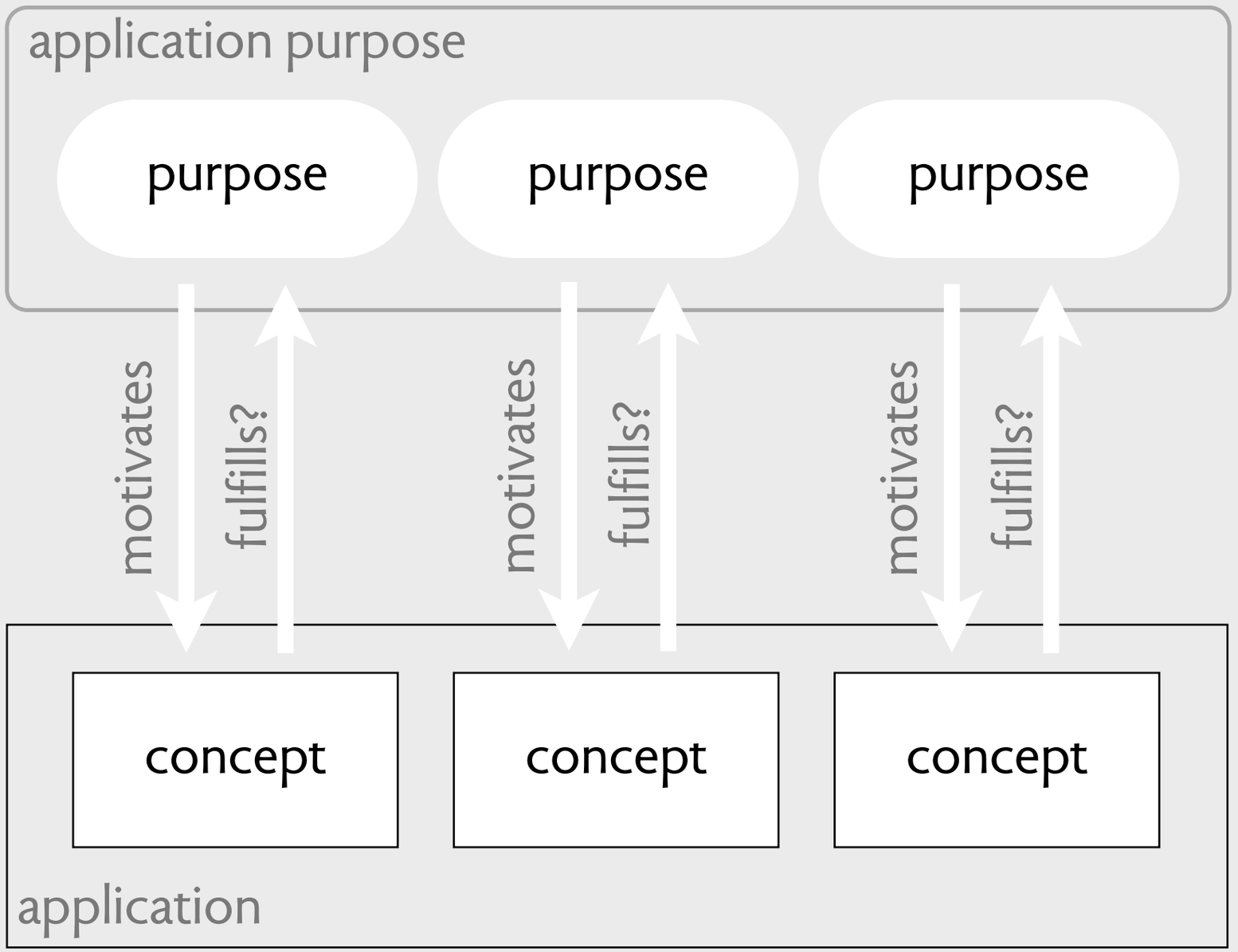


concepts driven by purposes too



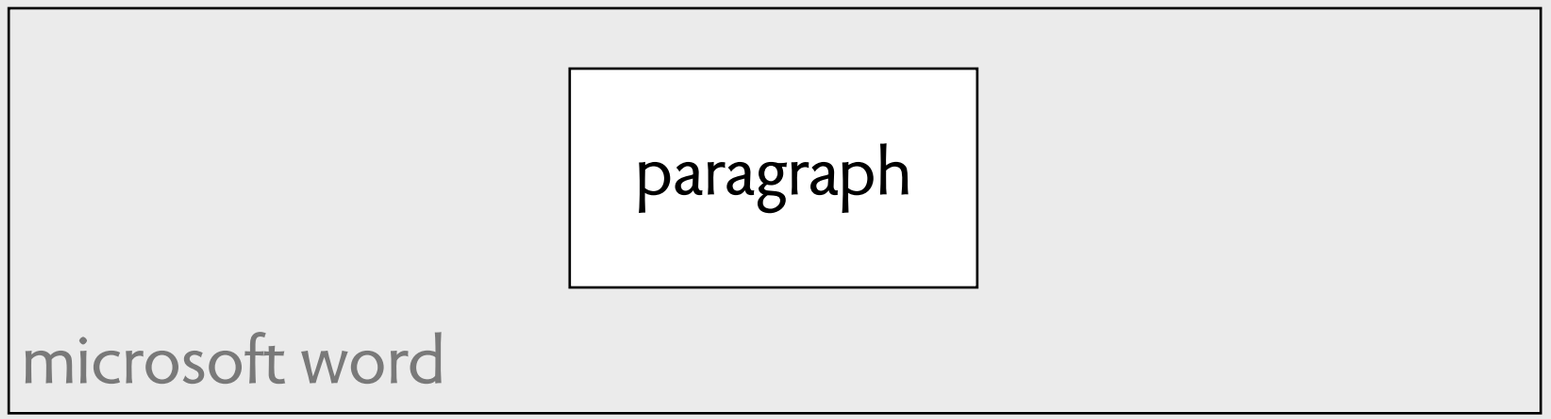
example: microsoft word

create & format documents

microsoft word

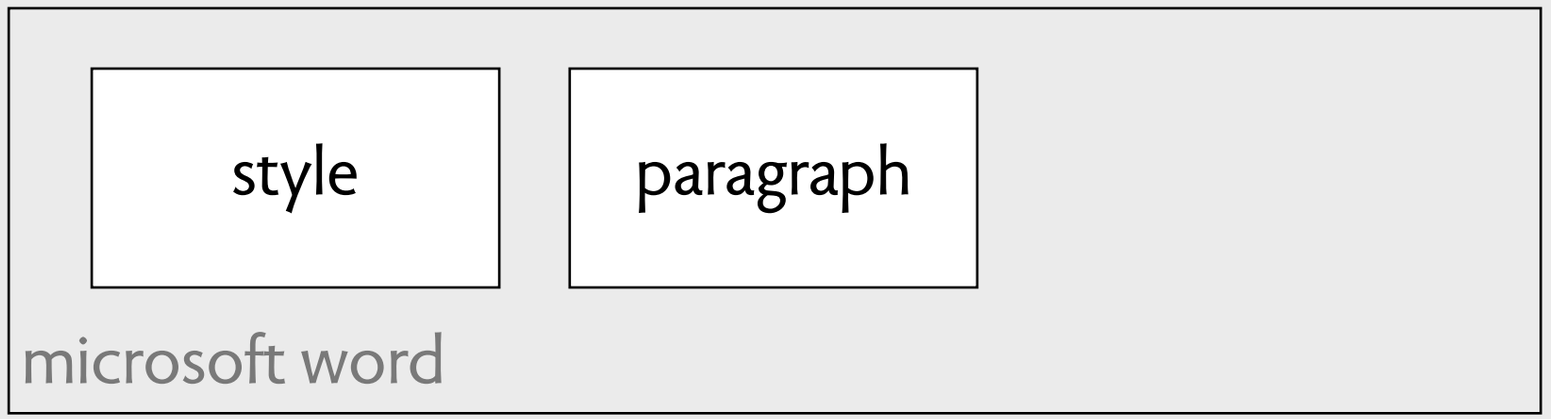
example: microsoft word

create & format documents



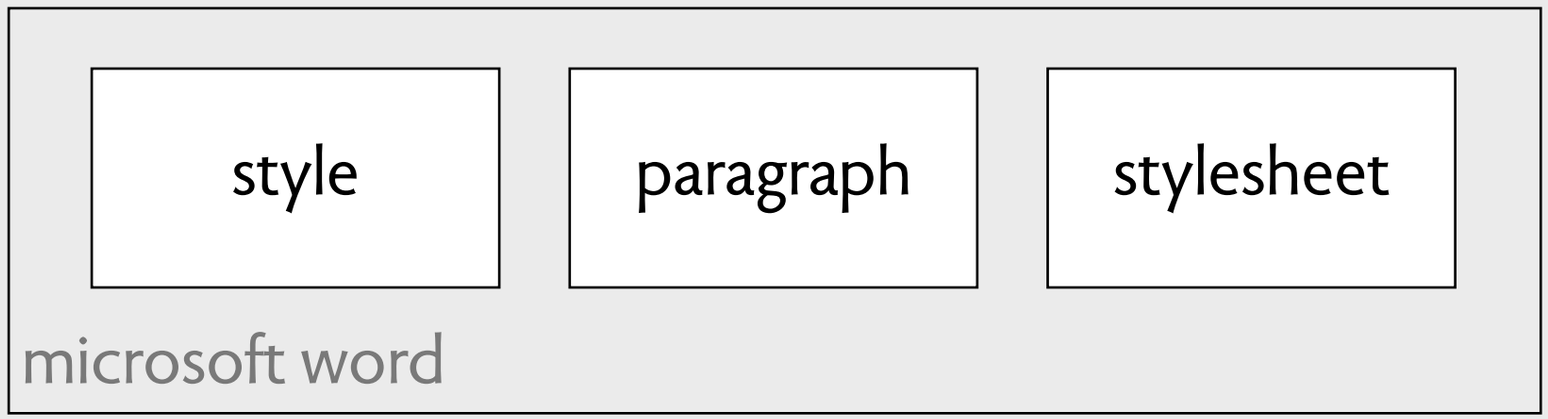
example: microsoft word

create & format documents

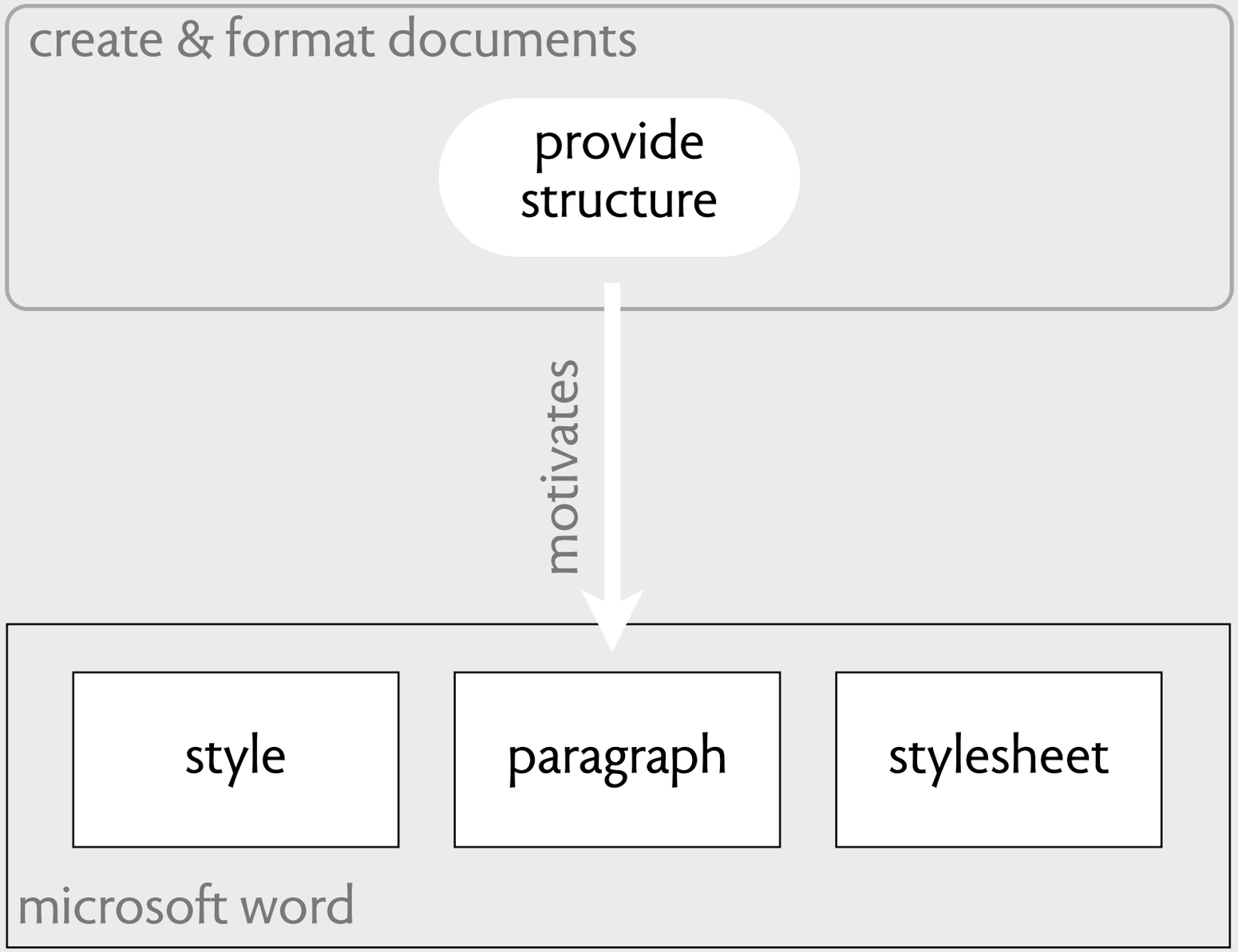


example: microsoft word

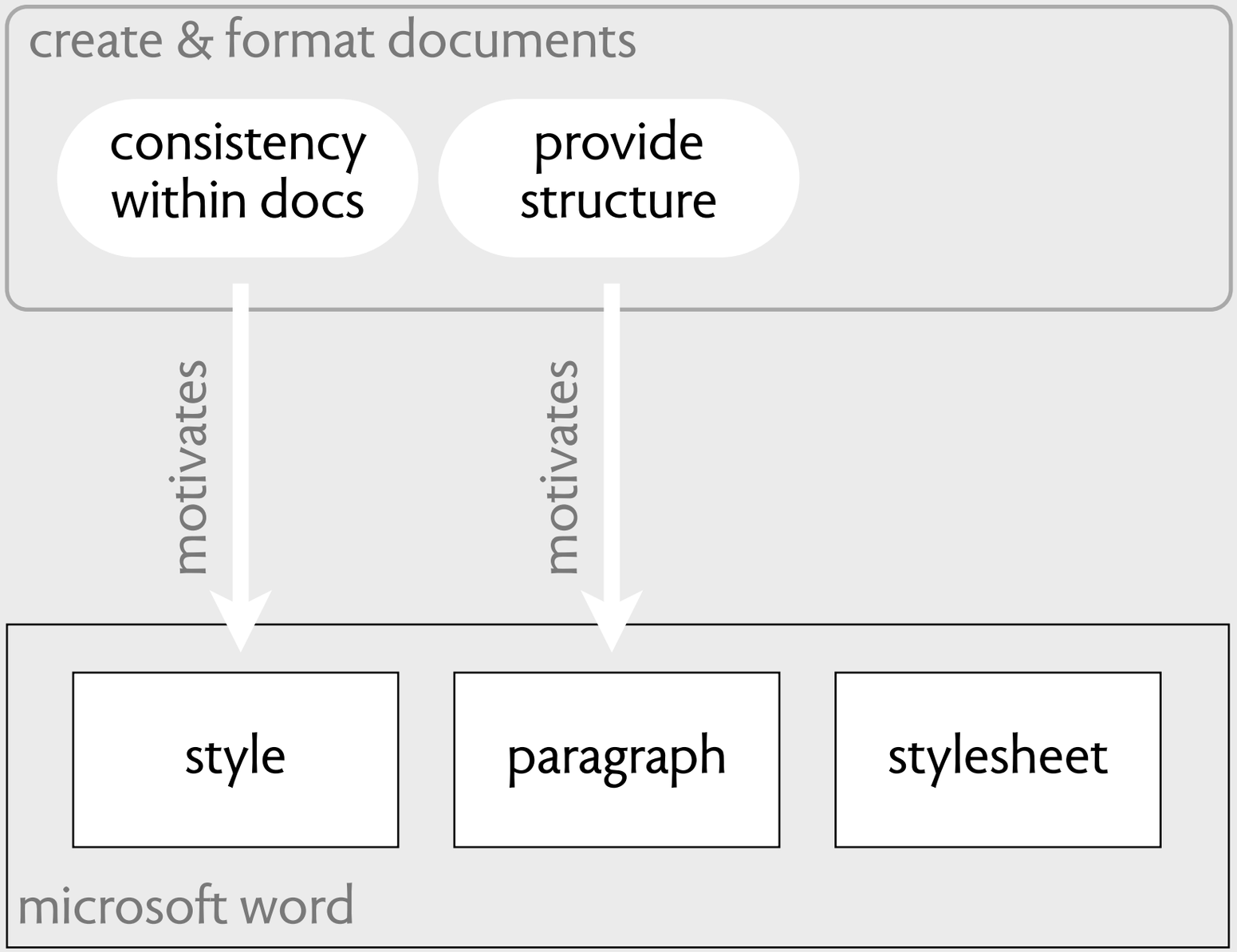
create & format documents



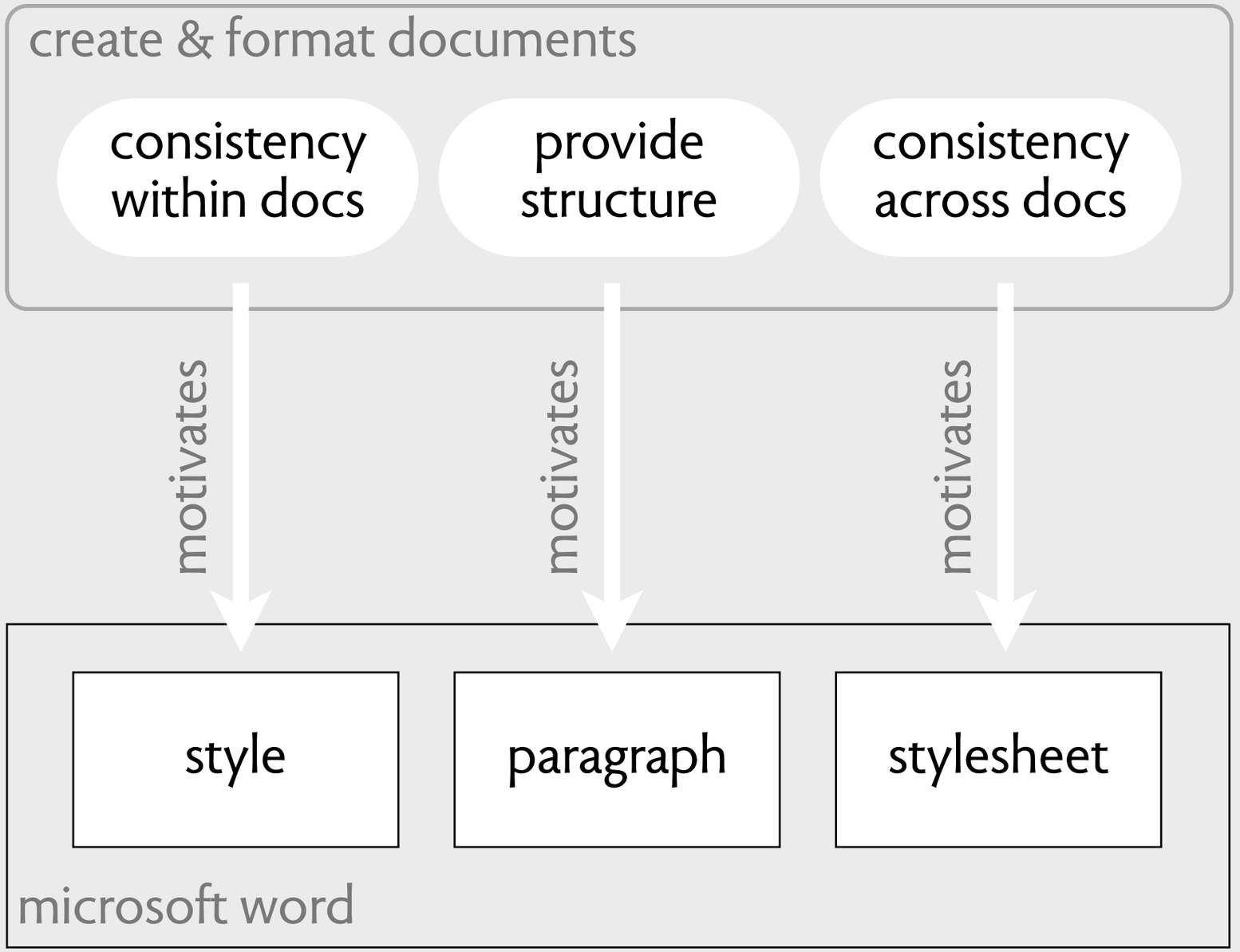
example: microsoft word



example: microsoft word

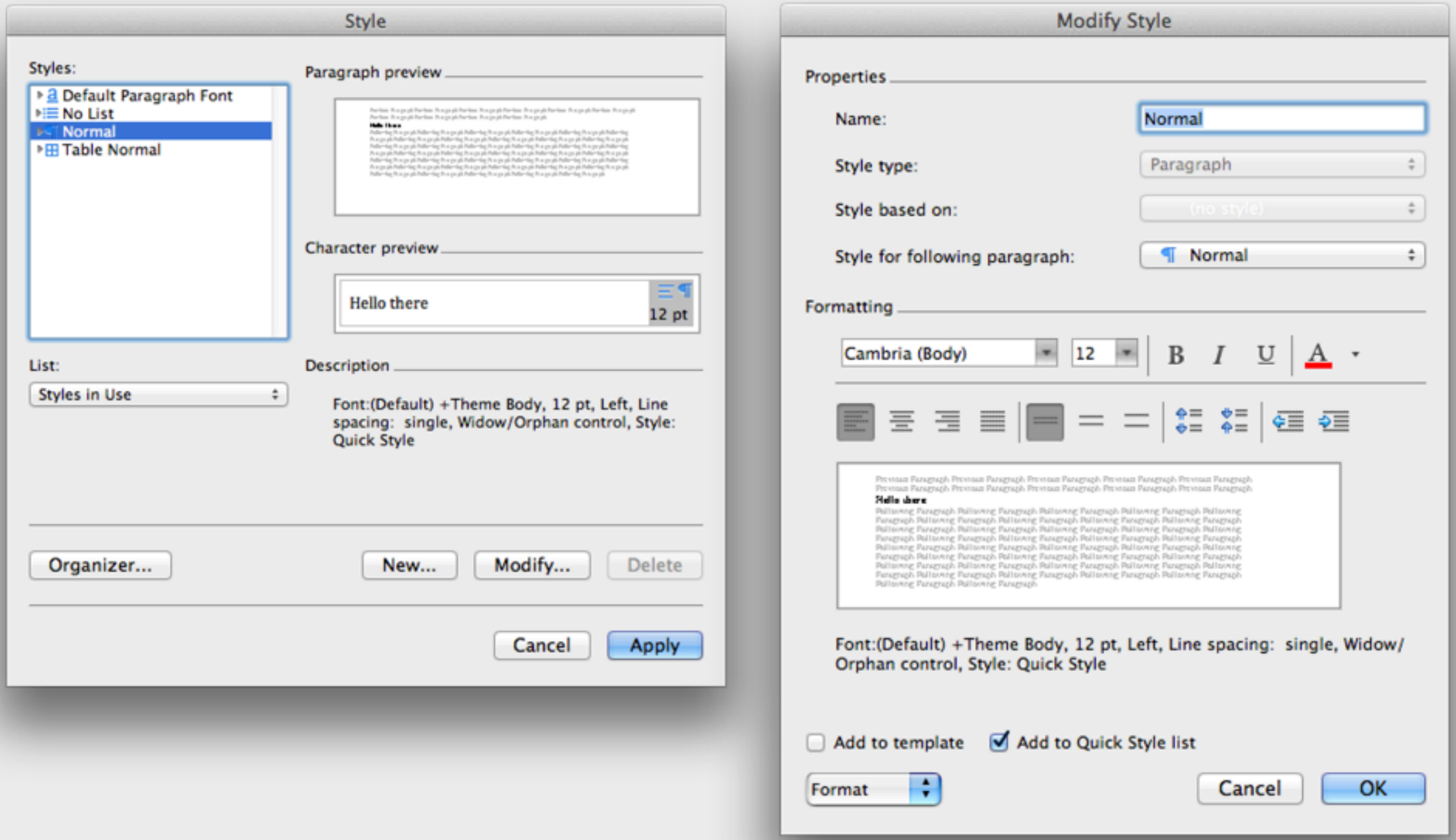


example: microsoft word

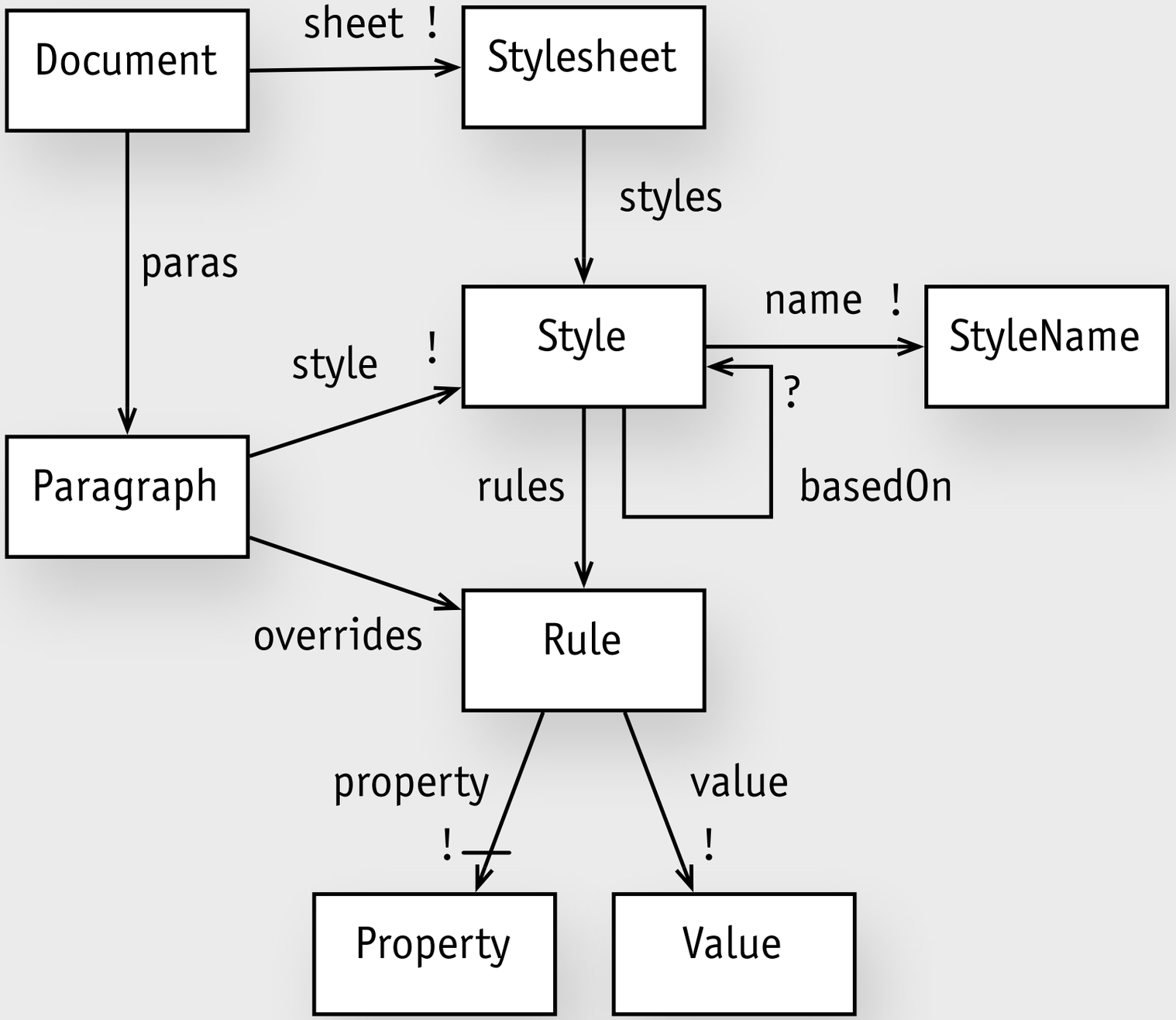


concepts are machines

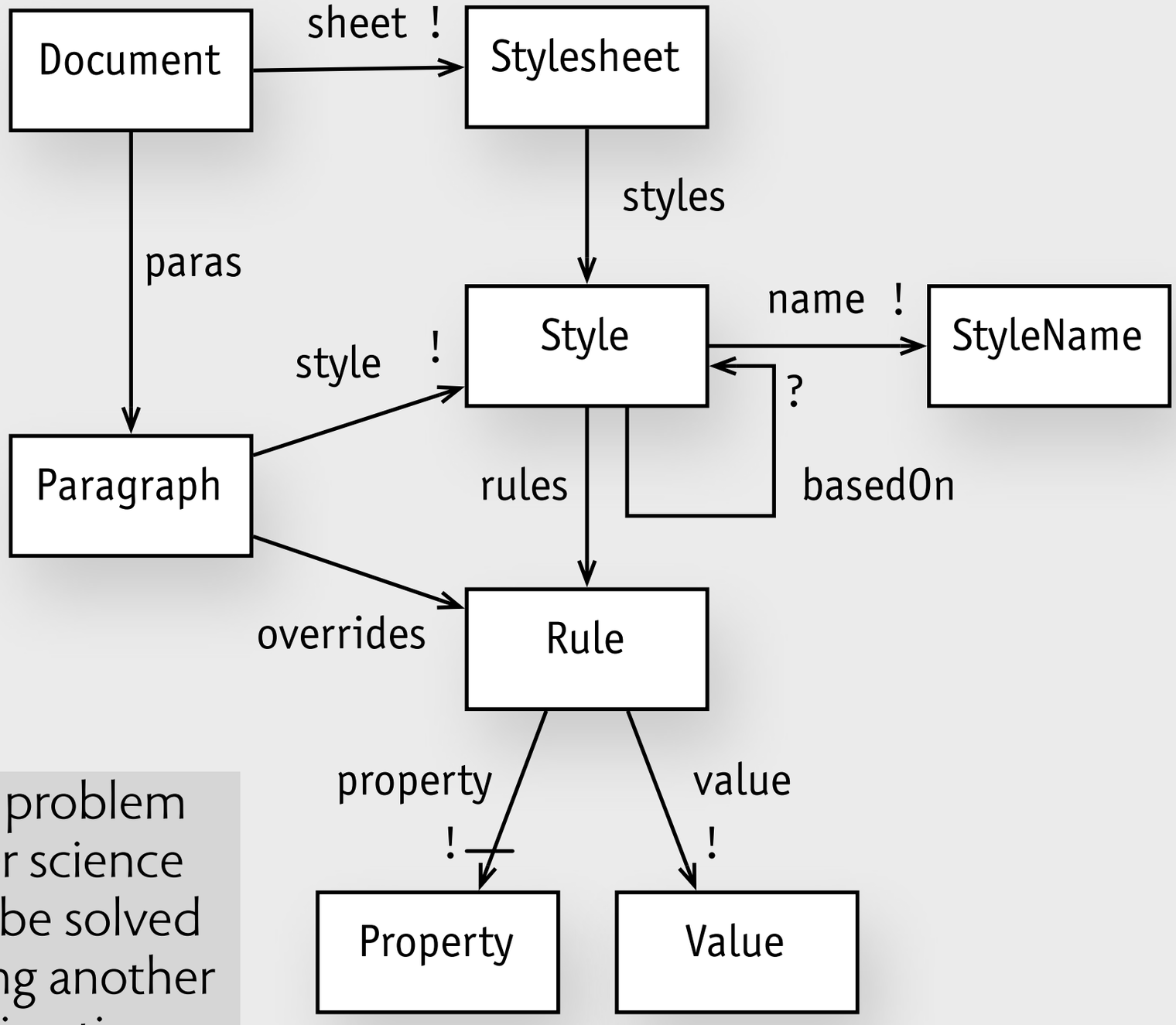
example word styles



concept model **word styles**

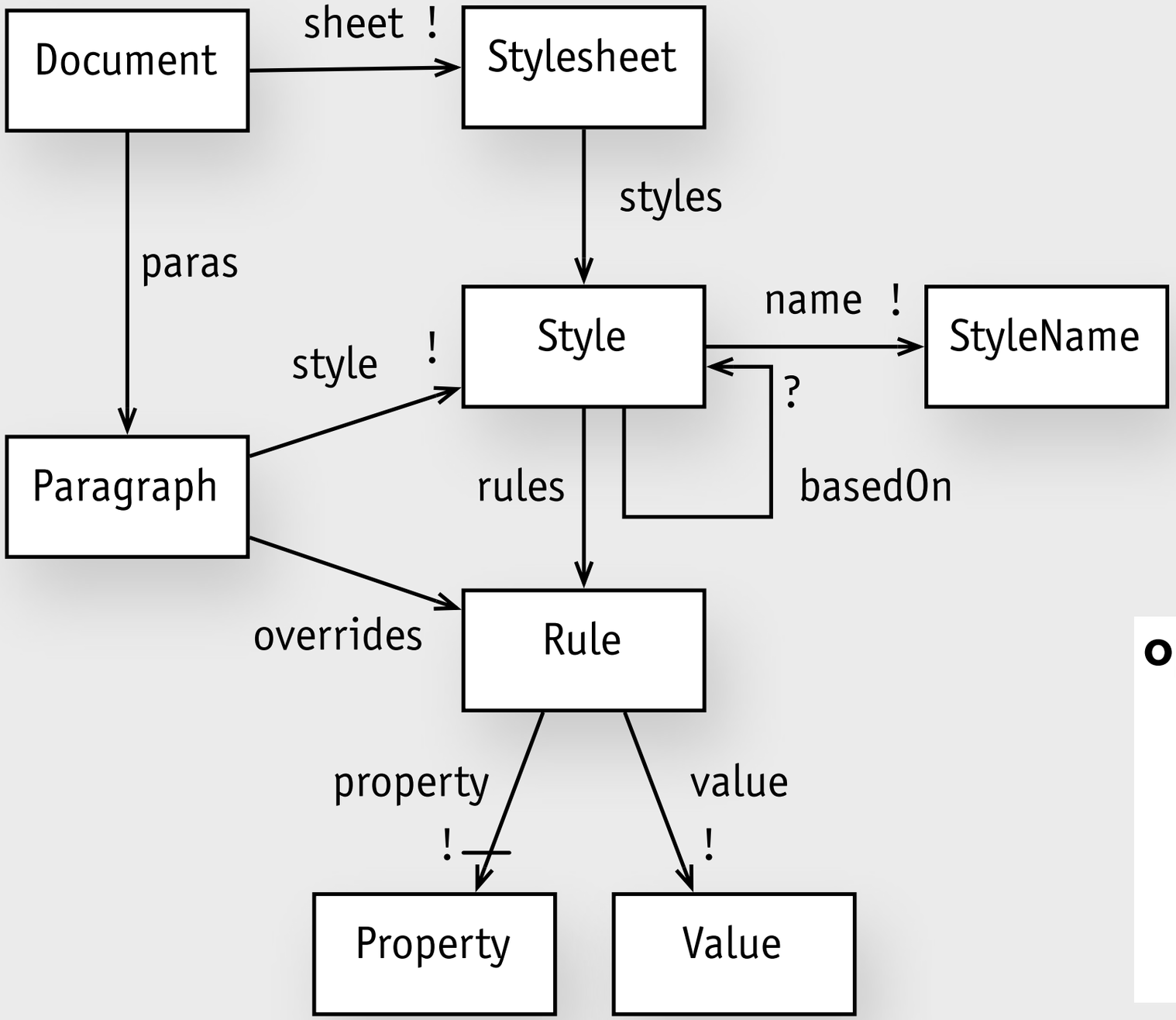


concept model **word styles**



There is no problem
in computer science
that cannot be solved
by introducing another
level of indirection.
David Wheeler

concept model **word styles**



operations

add
delete
modify
update
apply

concept characteristics

concept characteristics

concepts are closed

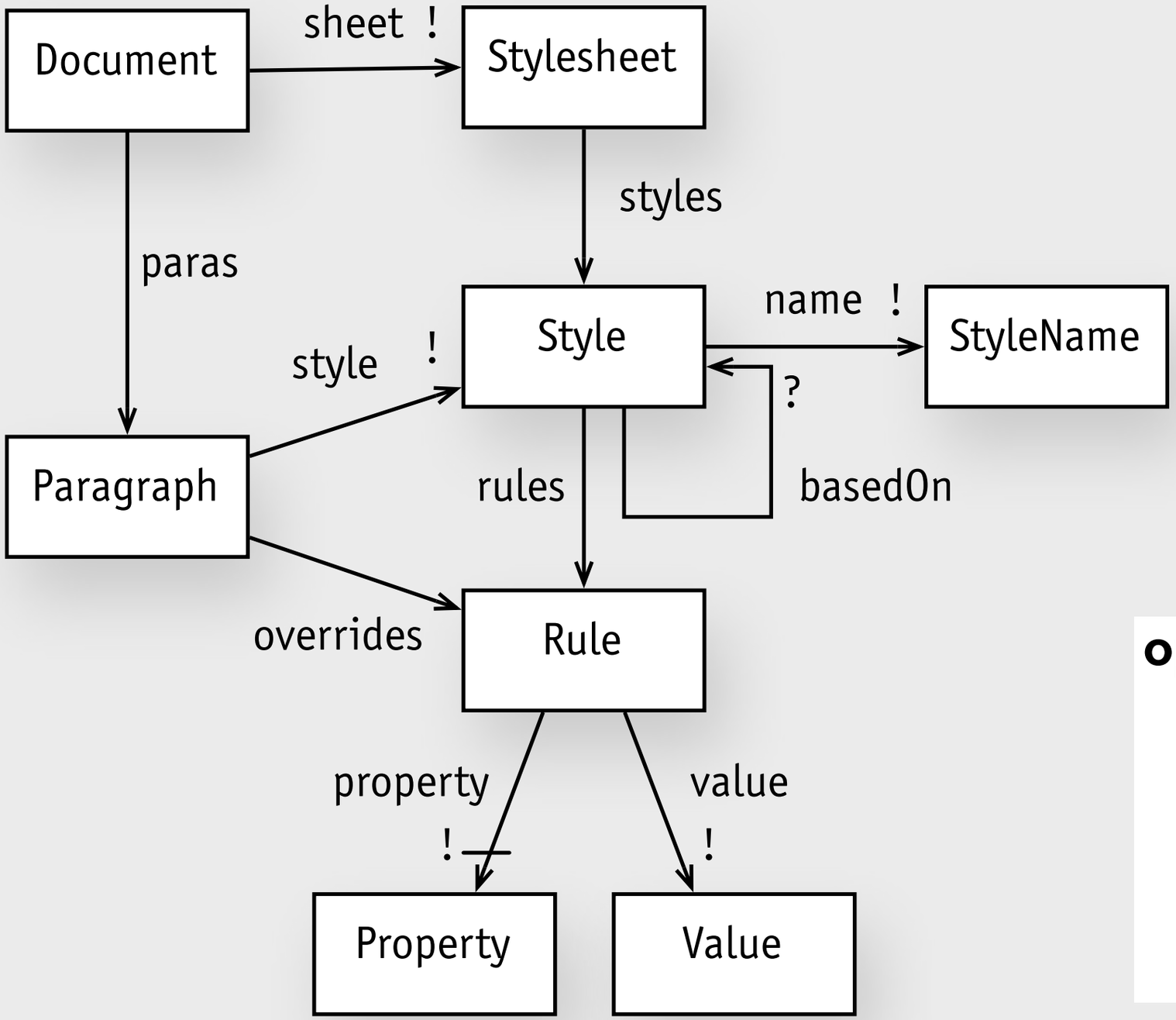
state & all relevant operations

concept characteristics

concepts are closed
state & all relevant operations

concepts are situated
not awaiting composition

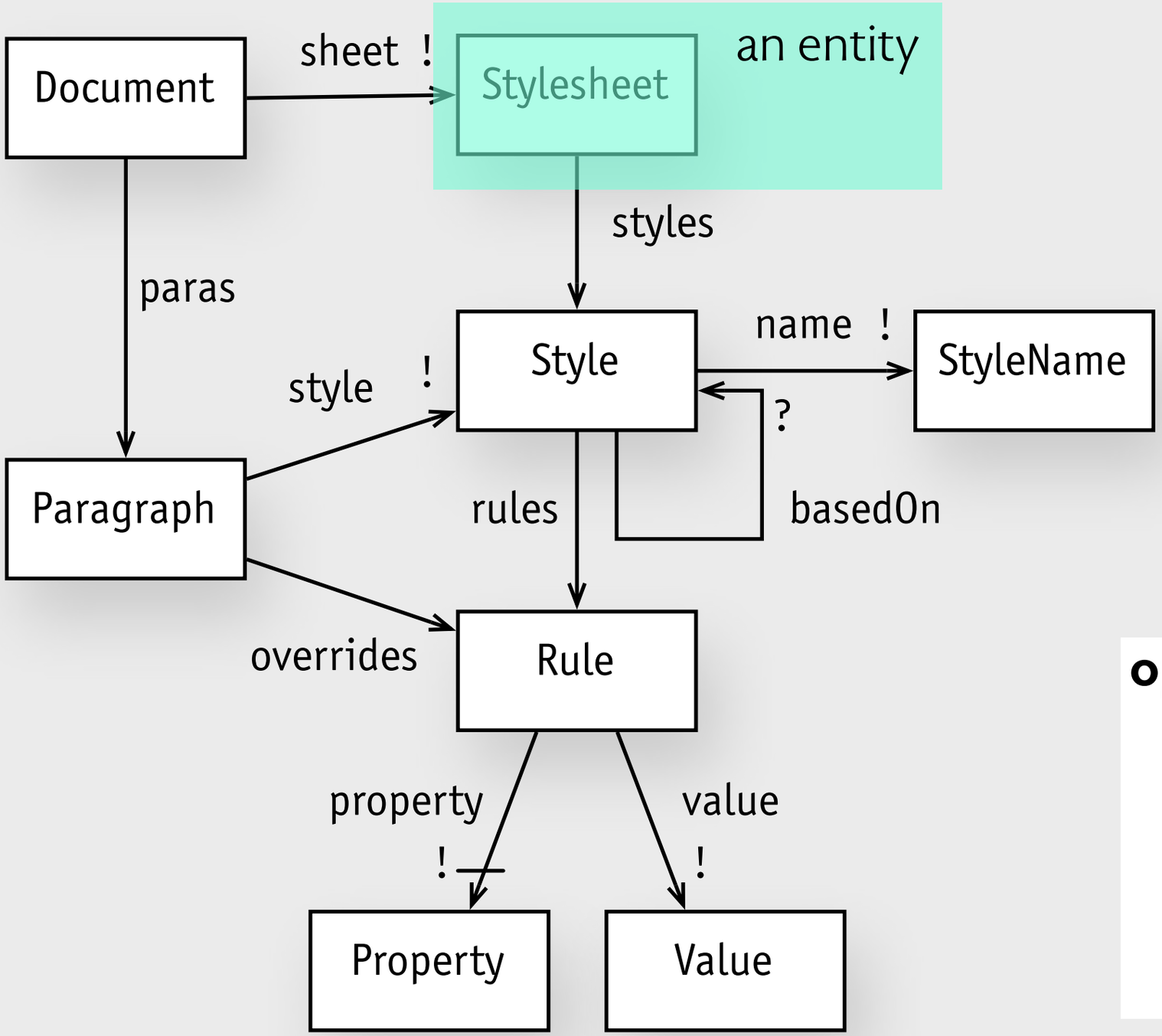
so a concept is not ...



operations

add
delete
modify
update
apply

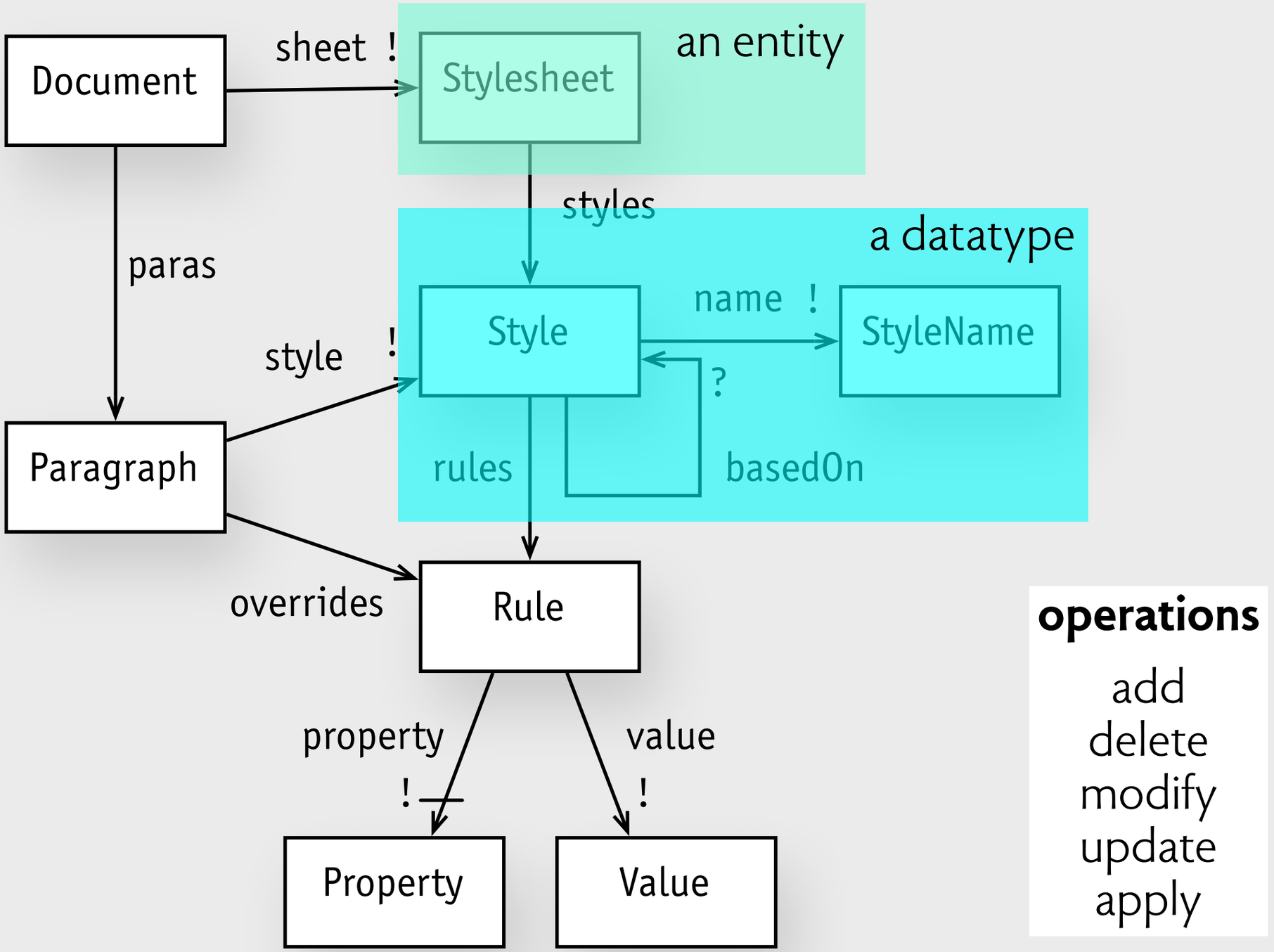
so a concept is not ...



operations

add
delete
modify
update
apply

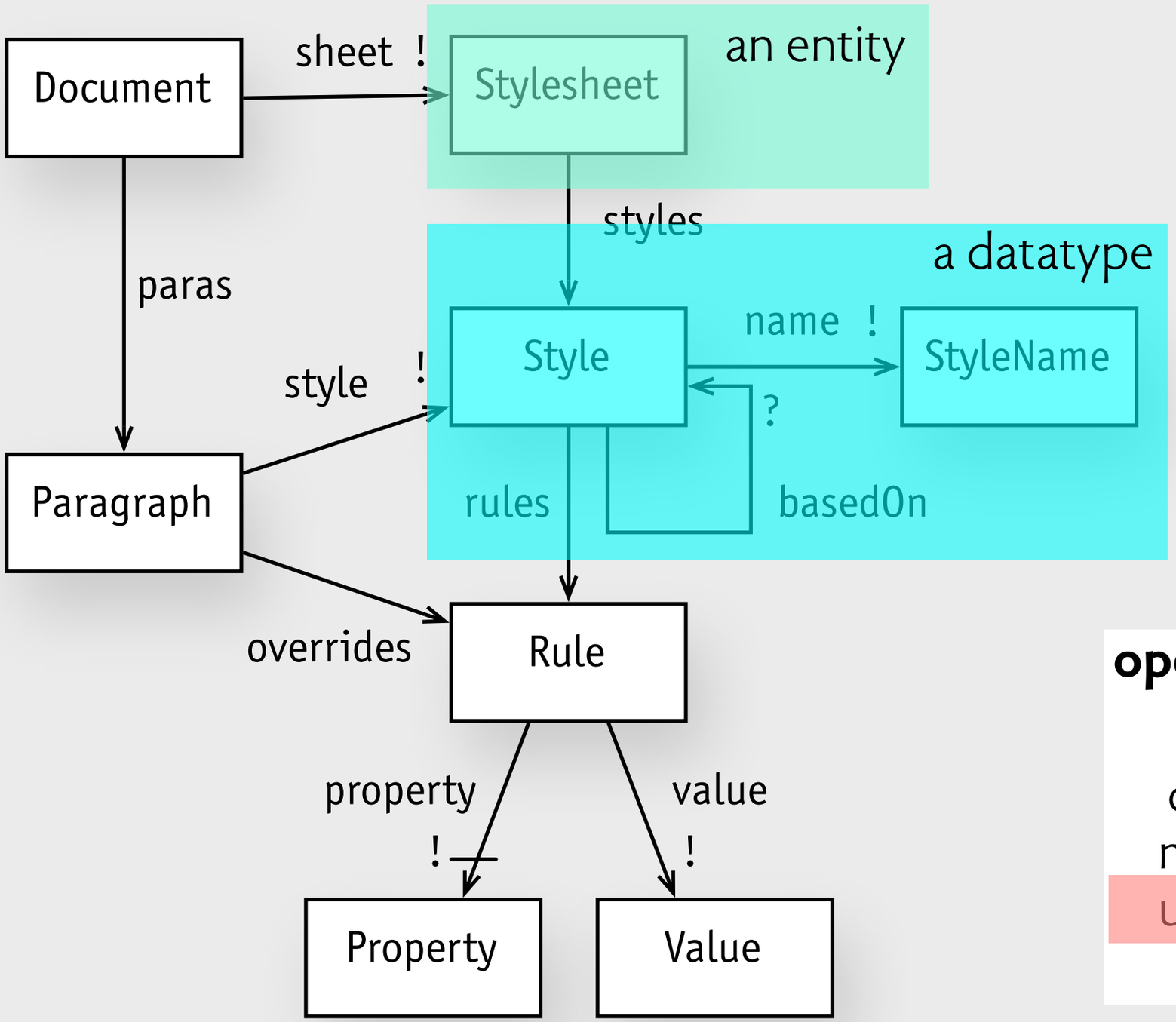
so a concept is not ...



operations

add
delete
modify
update
apply

so a concept is not ...



operations

add
delete
modify
update — a feature
apply

OPs vs user stories

operational principle (vs user story)

operational principle (vs user story)

connects to purpose

so OP for trash must include restore

operational principle (vs user story)

connects to purpose
so OP for trash must include restore

has sufficient span
so OP for secure trash must go up to data recovery

operational principle (vs user story)

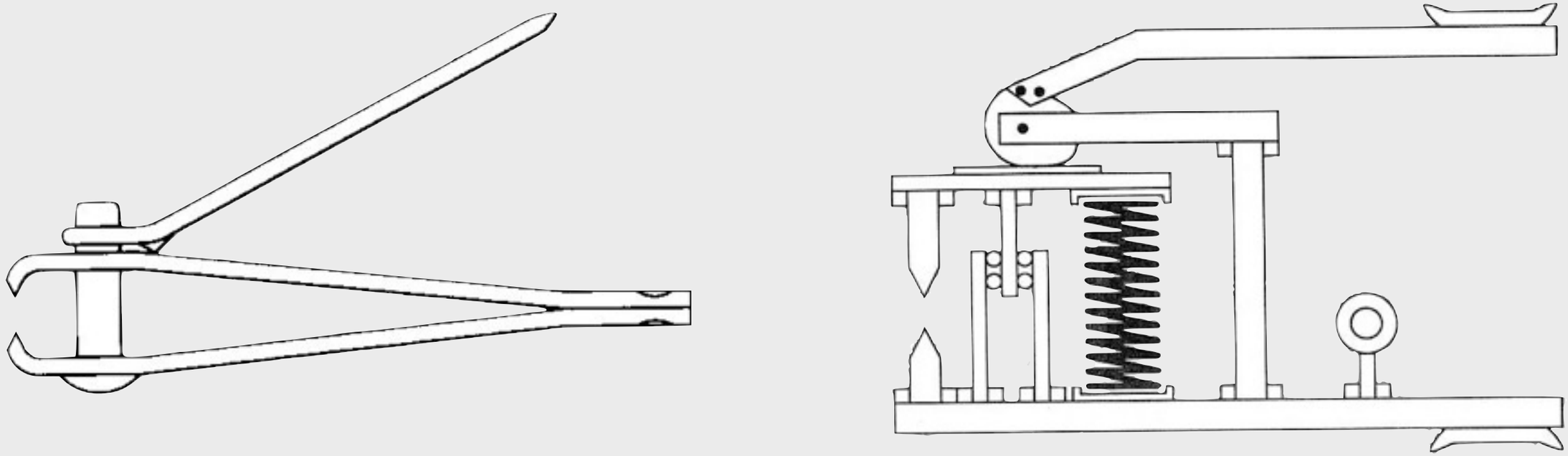
connects to purpose
so OP for trash must include restore

has sufficient span
so OP for secure trash must go up to data recovery

separates essential from accidental
so OP for trash doesn't say files disappear when eject disk

efficiency in design

sharing: the essence of good design?



from Karl Ulrich, *Computation and Pre-Parametric Design* (1988)

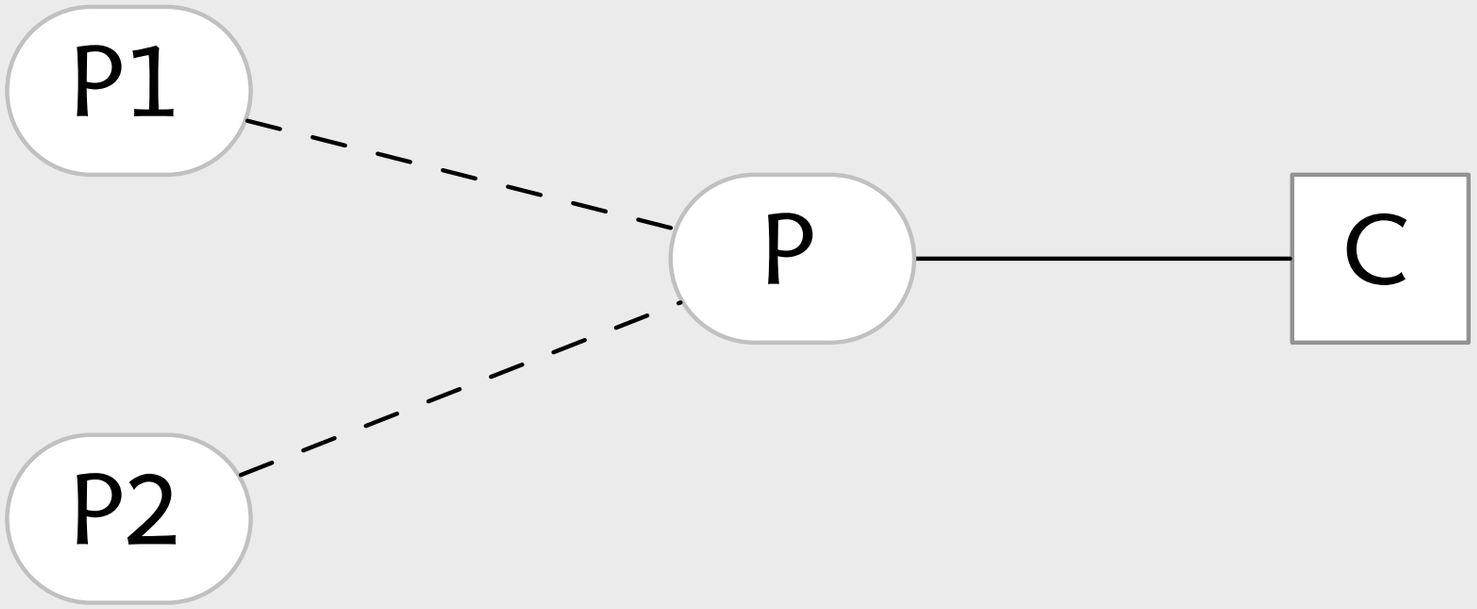
thanks to Yishai Feldman

when overloading is acceptable

concrete purposes

abstract purpose

concept



shared concept **amazon lists**

Your Lists | Your Friends

Find Items Across Your Lists

Wish List (15) **Private**

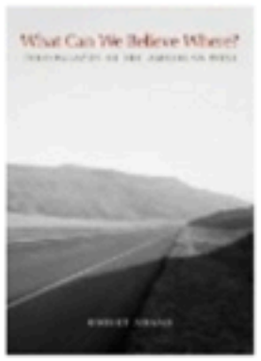
Shopping List (2) Private

Wish List

Save an idea. Shop for it later. | Add to list

Before They Pass Away
by Jimmy Nelson (Hardcover)
★★★★½ (149)
$99.37 Prime
Price dropped 13% (was $115.20 when added to List)
In Stock. Offered by Amazon.com.
53 Used & New from $95.32

Add comments, quantity & priority



What Can We Believe Where?: Photographs of the American West (Yale University Art Gallery)
by Robert Adams, Joshua Chuang, Jock Reynolds (Paperback)
★★★★★ (5)
$23.11 Prime
Only 7 left in stock--order soon. Offered by Amazon.com.
50 Used & New from $13.64

Add comments, quantity & priority

abstract purpose amazon lists

concrete purposes

abstract purpose

concept

get friends to buy you items

record items you want

list

remember to buy items later

shared concept **doodle poll**

concrete purpose: schedule a meeting

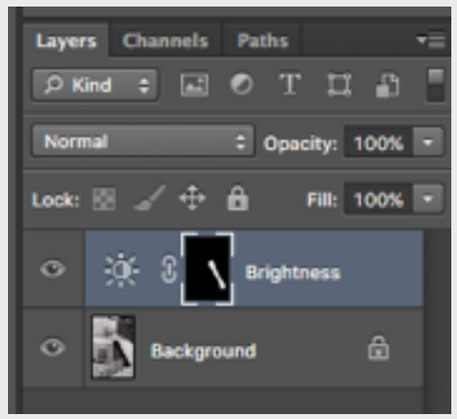
concrete purpose: vote on a choice

shared concept grayscale image in Ps

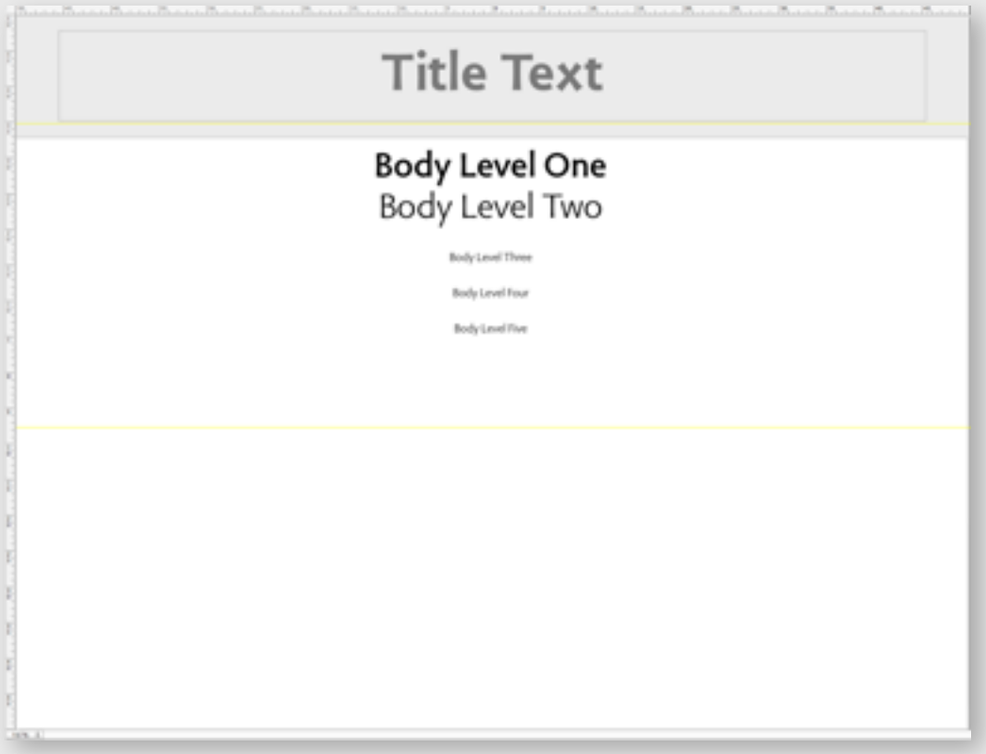
greyscale image

brushing pixels

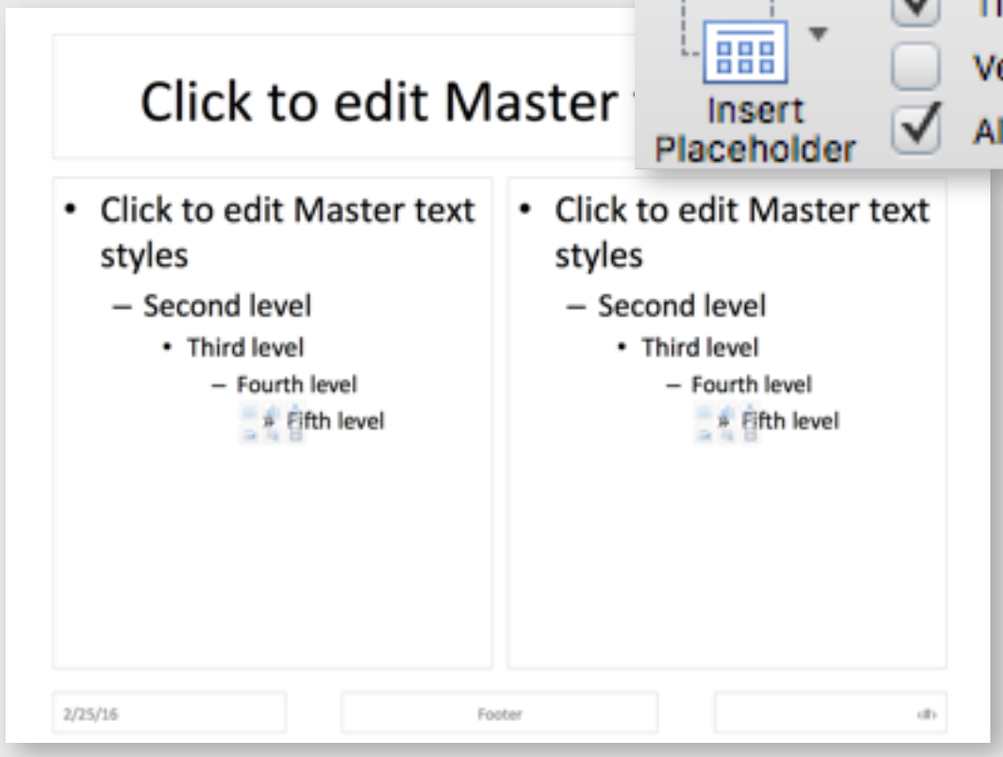
brushing pixels in layer mask



shared concept placeholder



Keynote: no shared concept for title & body

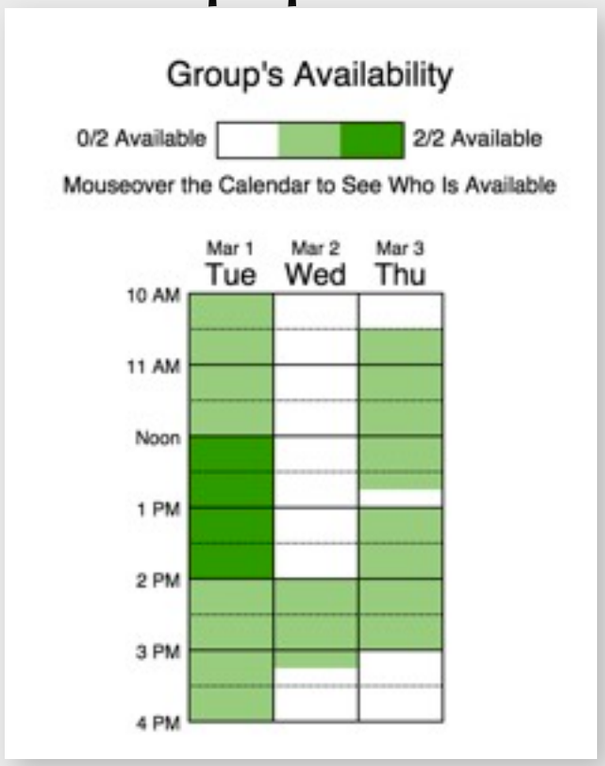


Keynote: shared concept of placeholder

risks of shared concepts

risks of shared concepts

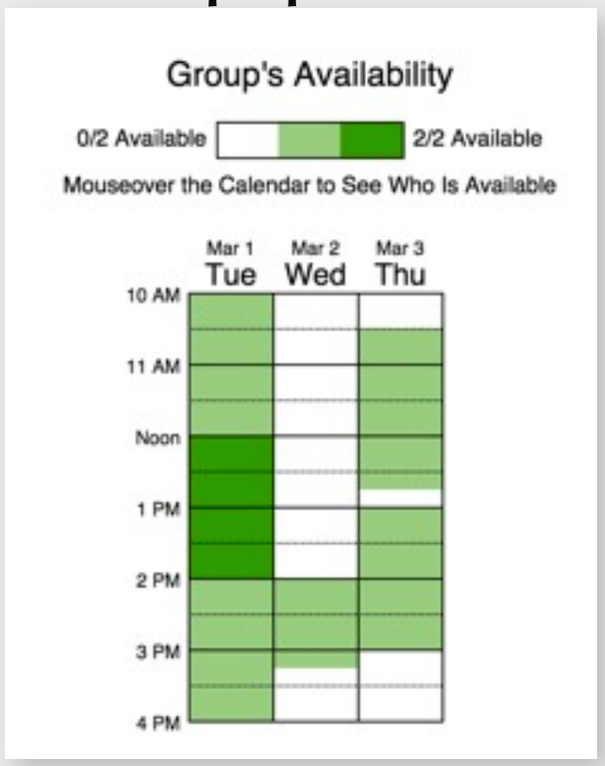
limited functionality for concrete purpose



Doodle doesn't offer some scheduling specific functionality that when2meet offers

risks of shared concepts

limited functionality for concrete purpose



Doodle doesn't offer some scheduling specific functionality that when2meet offers

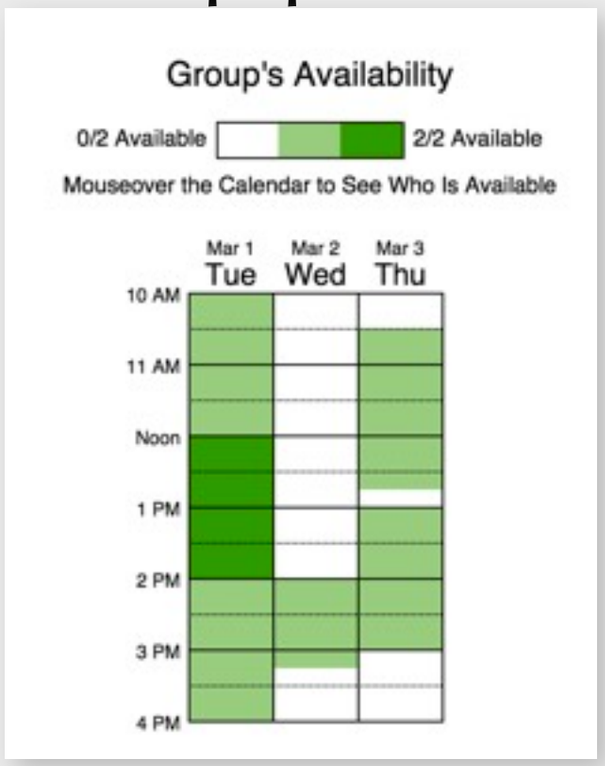
security & safety oversights

Amazon wishlists privacy risk

http://www.dailymail.co.uk/news/article-2984542

risks of shared concepts

limited functionality for concrete purpose



Doodle doesn't offer some scheduling specific functionality that when2meet offers

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Amazon wishlists privacy risk

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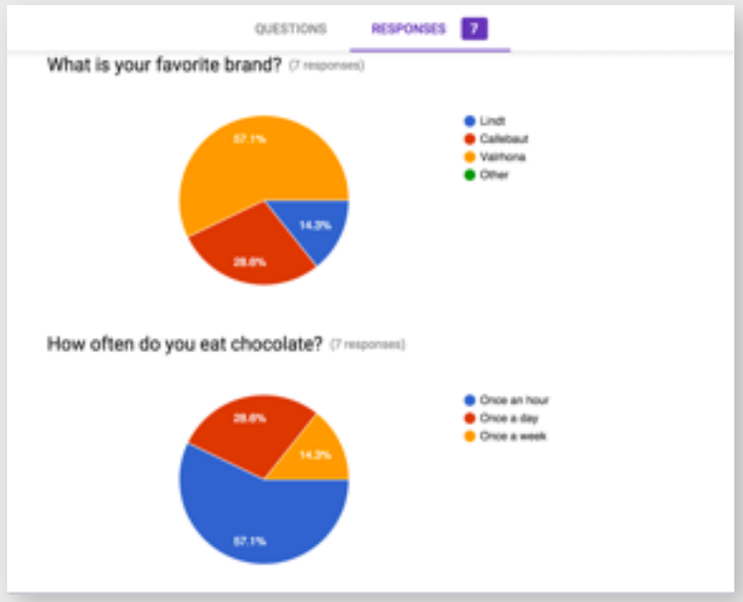
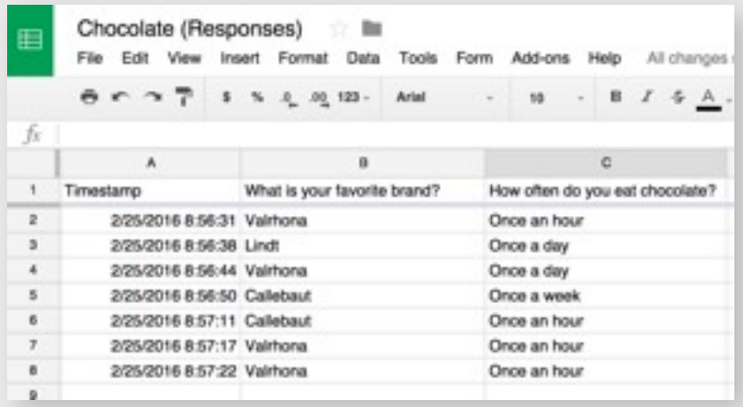
unexpected couplings





Google forms: spreadsheet not synced with responses

the root of the problem

Edsger Dijkstra
EWD952

the root of the problem

The rôle of a formal functional specification is simply to act as a logical firewall between two completely different concerns... The **pleasantness problem** concerns the question whether a system... would satisfy our needs... The correctness problem concerns the question whether a given design meets such-and-such a formal functional specification. The logical firewall ... isolates computing science's well-carved niche from the pleasantness problem to which science has little to contribute. Please note that I did not say that the one problem is more important than the other; after all, no chain is stronger than its weakest link.

Edsger Dijkstra
EWD952

user interface levels

shallower

deeper

physical level

linguistic level

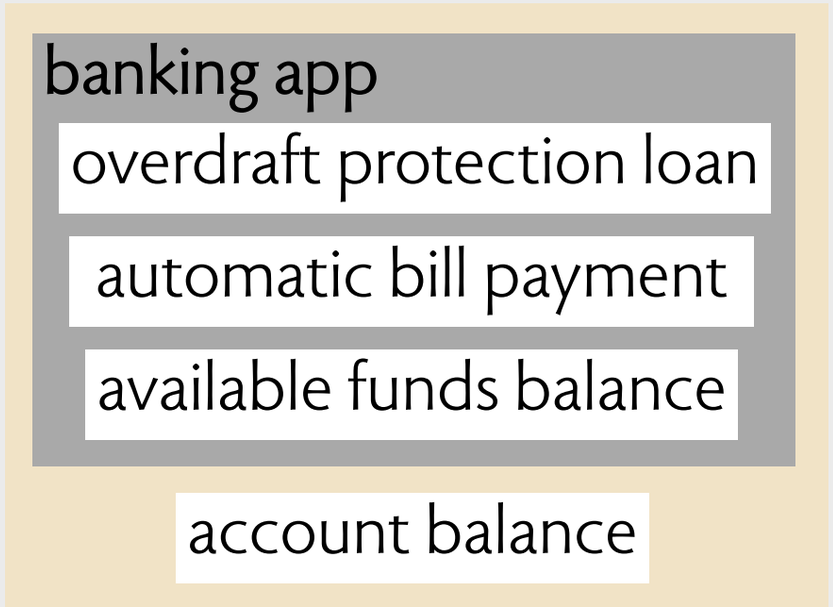
navigation level

conceptual level

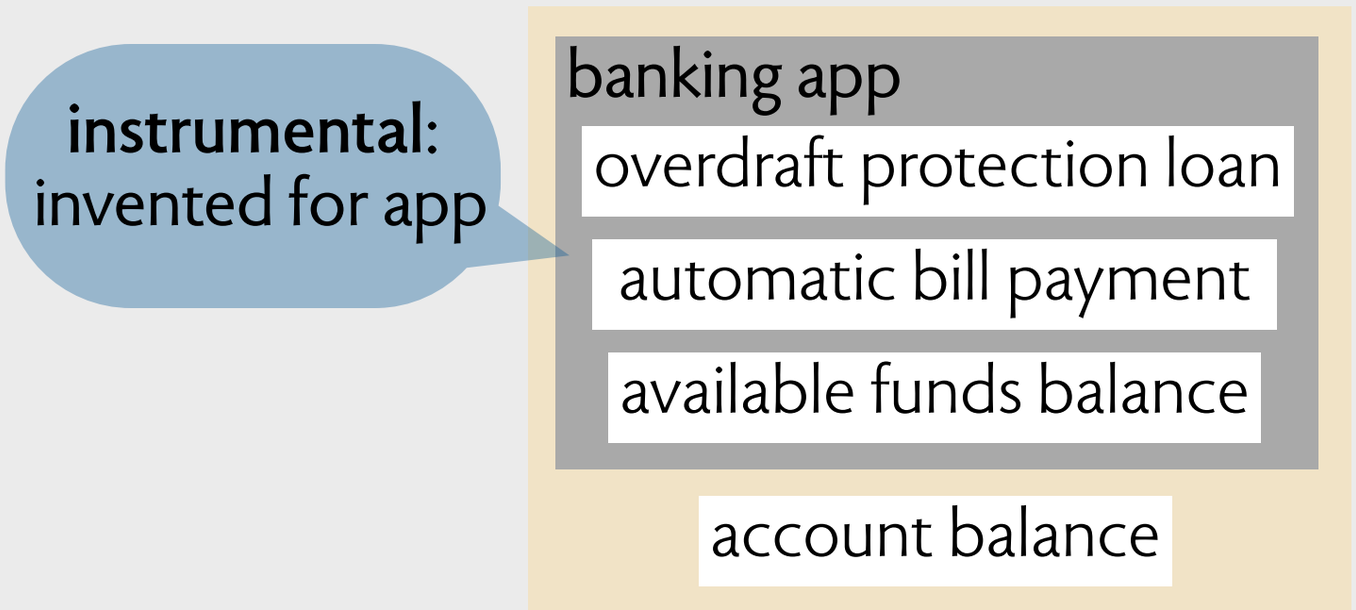
concept distinctions

given vs instrumental concepts

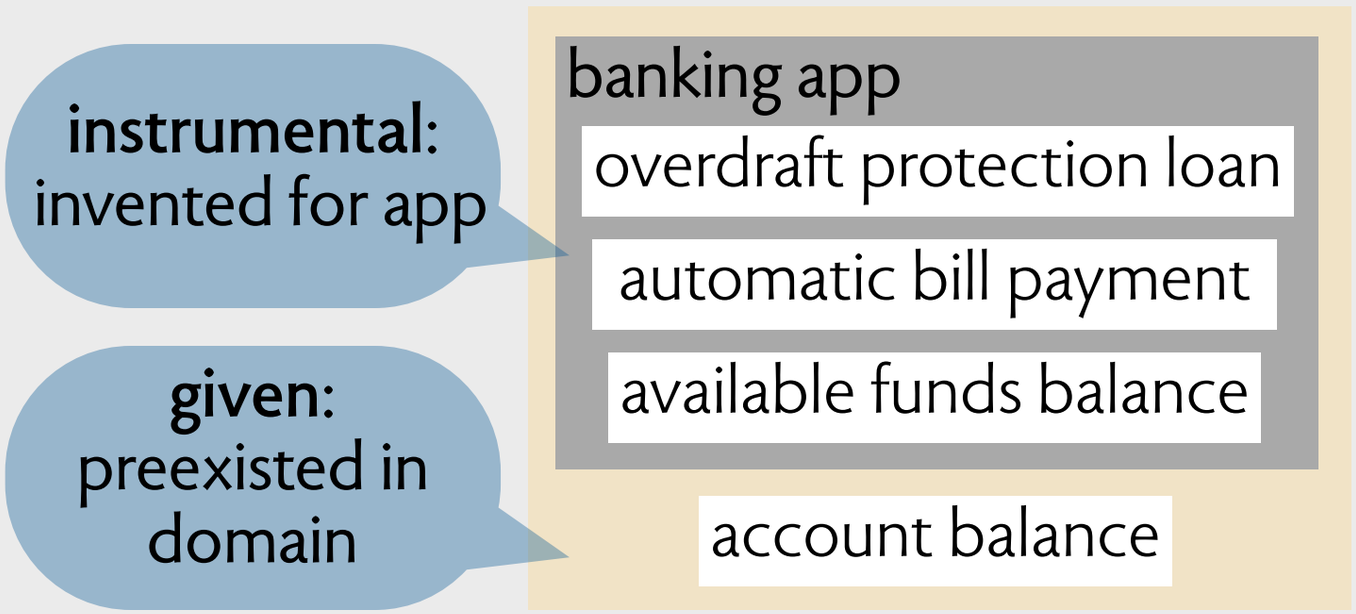
given vs instrumental concepts



given vs instrumental concepts



given vs instrumental concepts



given vs instrumental concepts

instrumental:
invented for app

given:
preexisted in
domain

banking app

overdraft protection loan

automatic bill payment

available funds balance

account balance

travel app

itinerary

agony factor

passenger profile

flight number

reservation

given vs instrumental concepts

instrumental:
invented for app

given:
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banking app

- overdraft protection loan
- automatic bill payment
- available funds balance

account balance

social networking app

- friendship
- tag
- post

photo

URL

travel app

- itinerary
- agony factor
- passenger profile

flight number

reservation

given vs instrumental concepts

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invented for app

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banking app

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- automatic bill payment
- available funds balance

account balance

social networking app

- friendship
- tag
- post

photo

URL

travel app

- itinerary
- agony factor
- passenger profile

flight number

reservation

note that all concepts, even given concepts are a means to an end

these are not concepts...

these are not concepts...

search

authentication

these are not concepts...

search

authentication

purposes

these are not concepts...

search

authentication

purposes

concepts

search string

certificate

these are not concepts...

search

authentication

DOM element

HTTP request

purposes

implementation details

concepts

search string

certificate

these are not concepts...

search

authentication

DOM element

HTTP request

purposes

concepts

implementation details

concepts

search string

certificate

web page

link

these are not concepts...

but this is a concept for a user of the jQuery API (vs. a user of Chrome)

search

authentication

DOM element

HTTP request

purposes

concepts

search string

certificate

implementation details

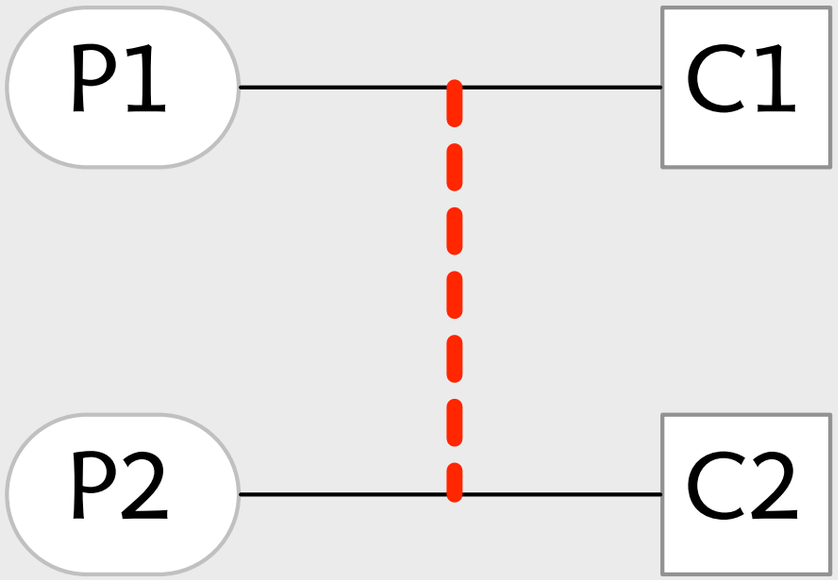
concepts

web page

link

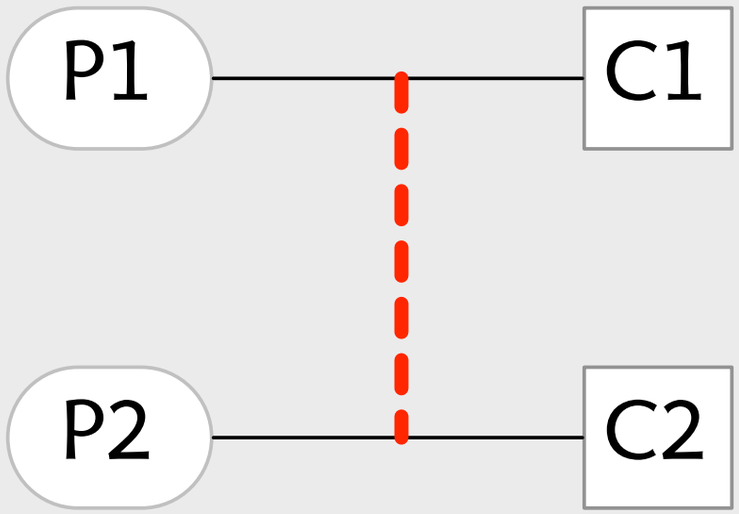
orthogonality & uniformity

orthogonality

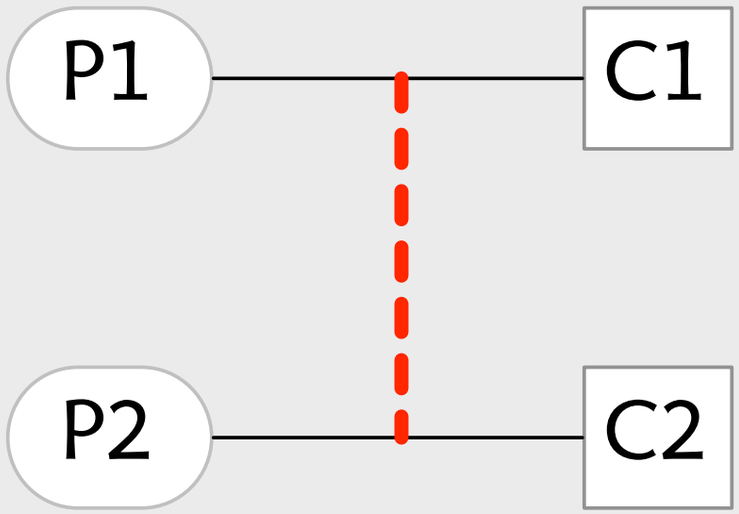


orthogonality is violated when one
concept's fitness for purpose is undermined
by another concept

non-orthogonal concepts

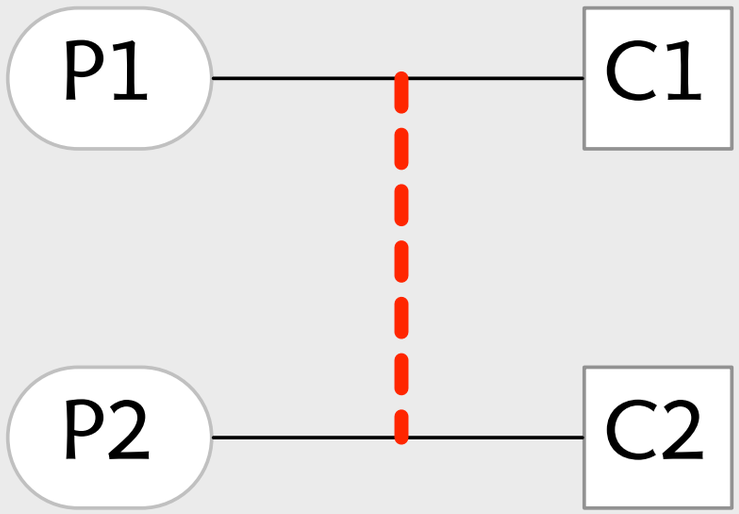


non-orthogonal concepts



origin, **space**, **exclusion** (CSS)
4 position values for 2×3×2 options

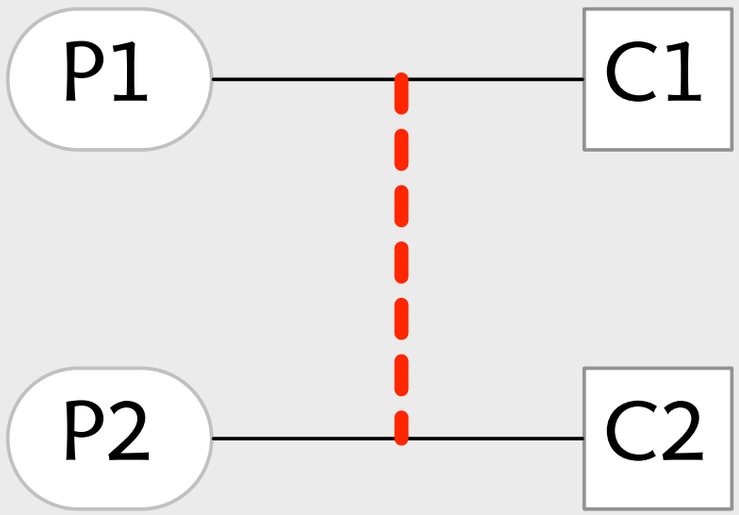
non-orthogonal concepts



origin, space, exclusion (CSS)
4 position values for 2×3×2 options

conversation & label (Gmail)
same subject, get same label

non-orthogonal concepts



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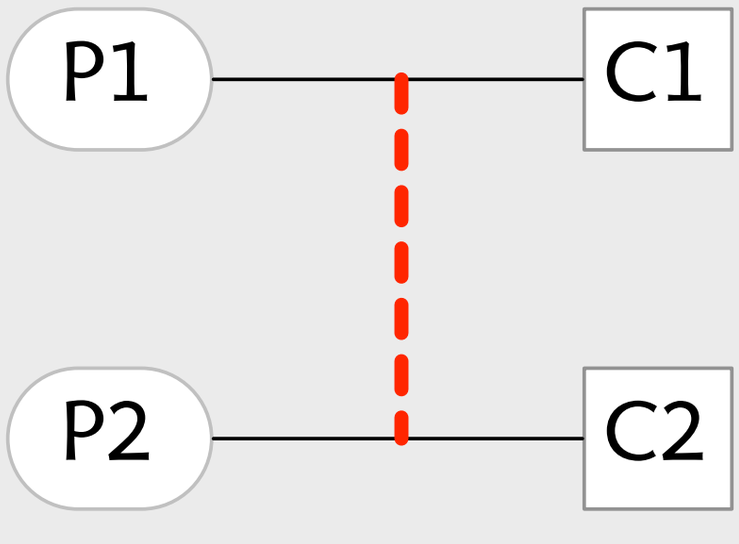
listserv & bcc (SMTP)
modified subject reveals target

non-orthogonal concepts



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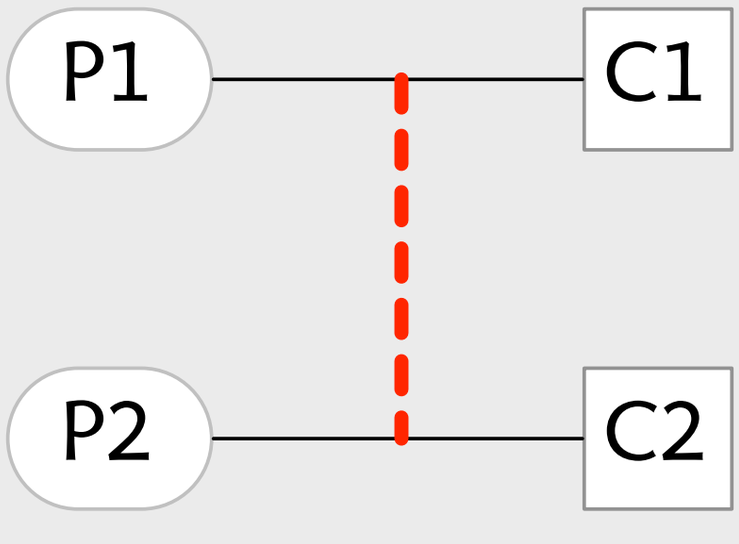
modified subject reveals target

title & reply (Tumblr)
adding ? to title enables replies (!)

non-orthogonal concepts



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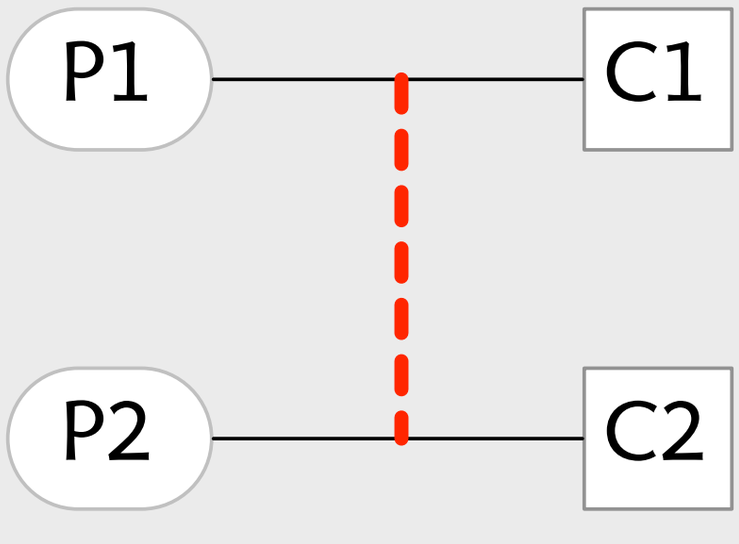
group & selection (many old apps)
can't select object in a group

non-orthogonal concepts



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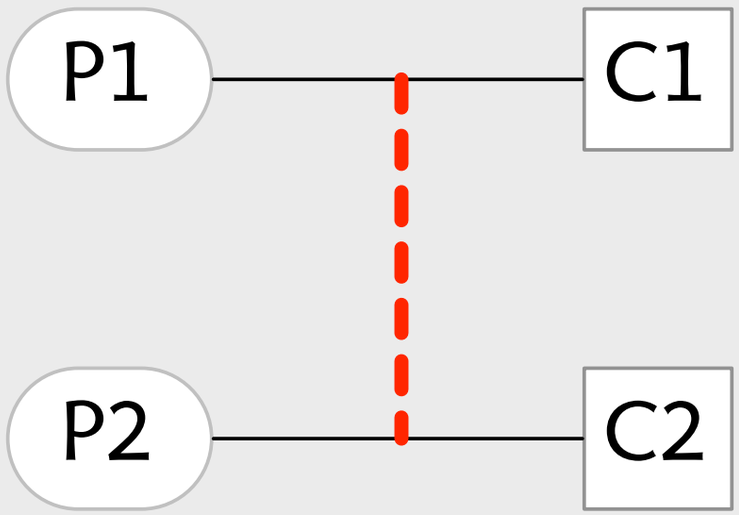
adding ? to title enables replies (!)

group & selection (many old apps)
can't select object in a group

group & connector (Keynote 5.3)
can't select box if connected

non-orthogonal concepts



Shriram Krishnamurthi
BCC example

origin, space, exclusion (CSS)
4 position values for 2×3×2 options

conversation & label (Gmail)
same subject, get same label

listserv & bcc (SMTP)
modified subject reveals target

title & reply (Tumblr)
adding ? to title enables replies (!)

group & selection (many old apps)
can't select object in a group

group & connector (Keynote 5.3)
can't select box if connected

non-orthogonal concepts gmail

from Eunsuk Kang

Eunsuk Kang <eskang@csail.mit.edu> December 11, 2014 2:27 AM
To: Daniel Jackson <dnj@MIT.EDU> , Santiago Perez De Rosso <sperezde@csail.mit.edu> Hide Details
an example of bad coupling in gmail? Conceptual Design

Hi Daniel, Santiago,

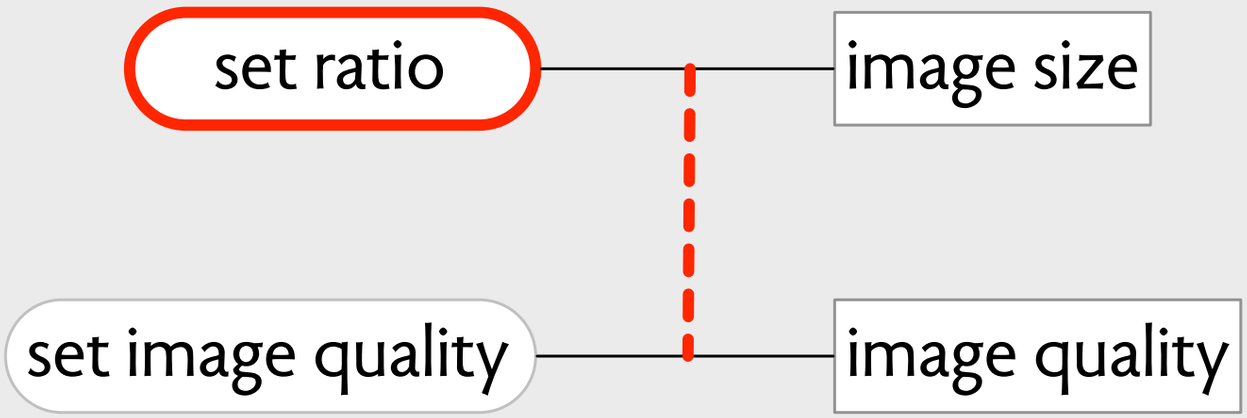
I am not sure whether this falls into one of the conceptual design issues that you have been analyzing, but here's a little annoyance that I just ran into using labels in Gmail.

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!

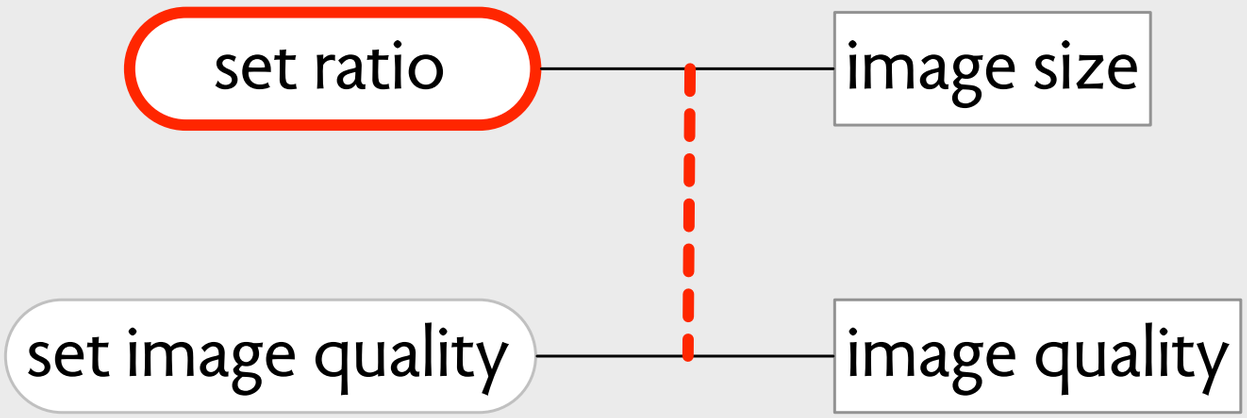
(By the way, is it possible to take an e-mail out of a conversation? Either this is impossible or the Gmail UI does not make this easy).

Eunsuk

conversations interfere with labels



an orthogonality violation



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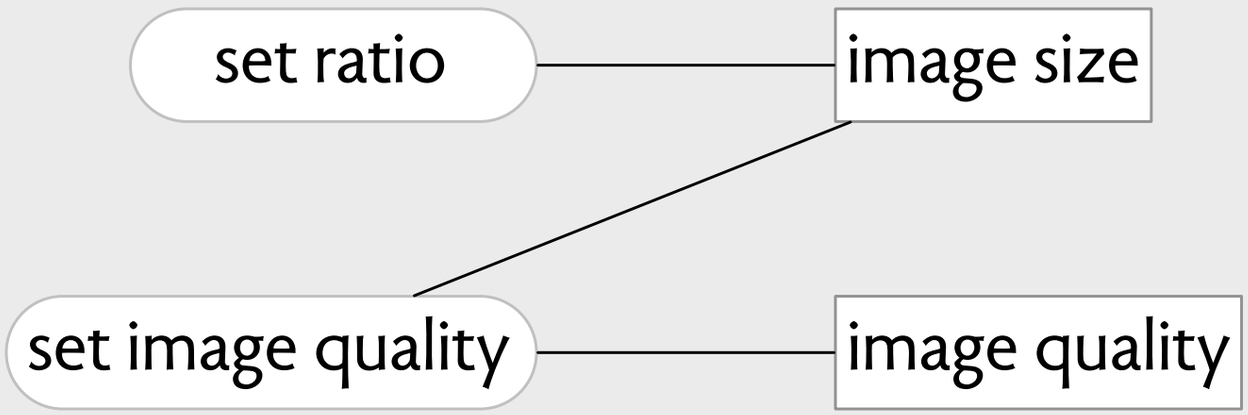
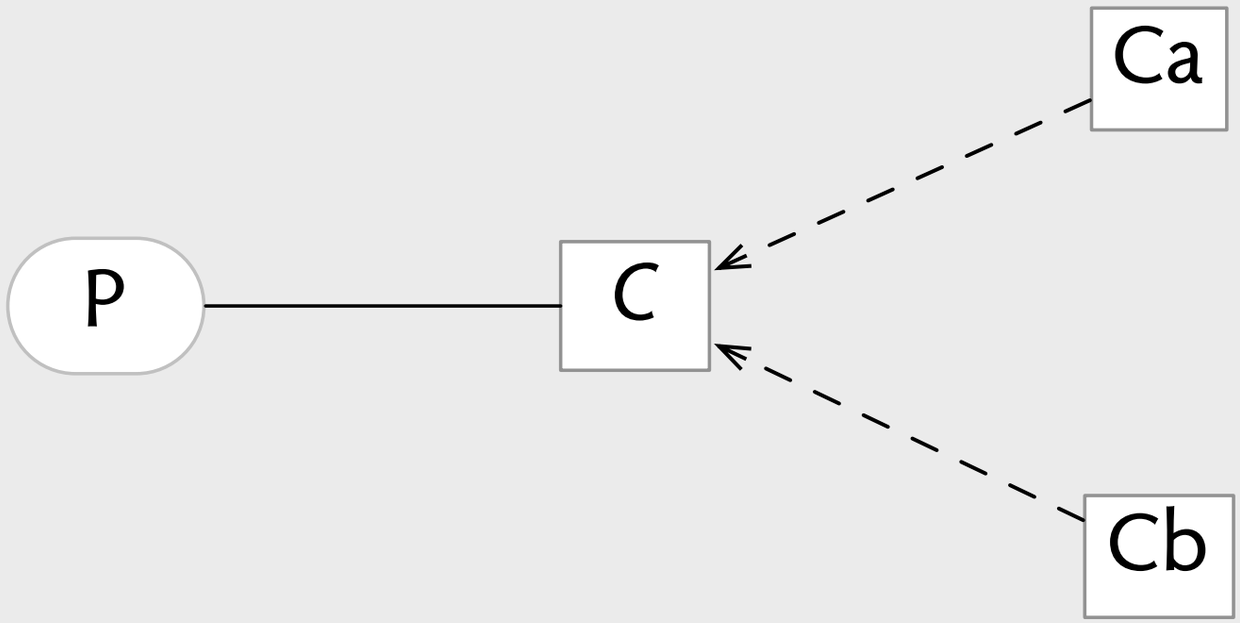


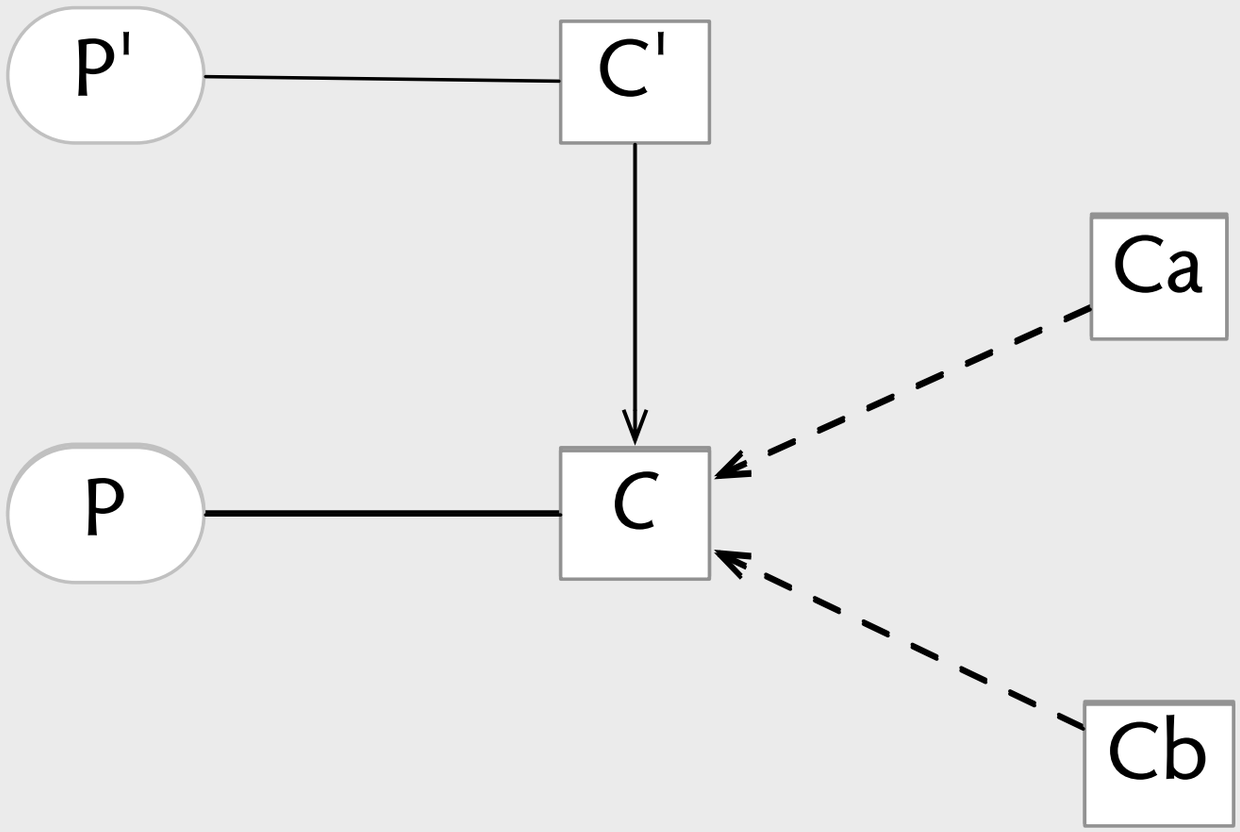
overloaded concept too

uniformity



uniformity is violated when instantiations
differ with respect to fulfillment of purpose

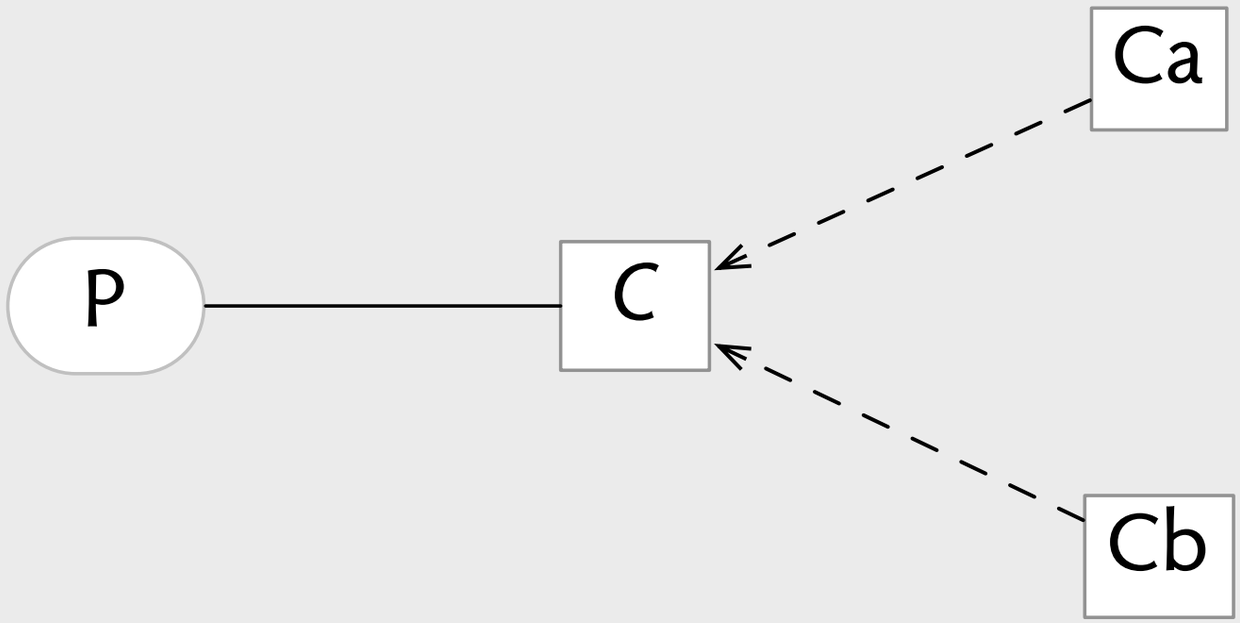
uniformity



uniformity is violated when instantiations
differ with respect to fulfillment of purpose

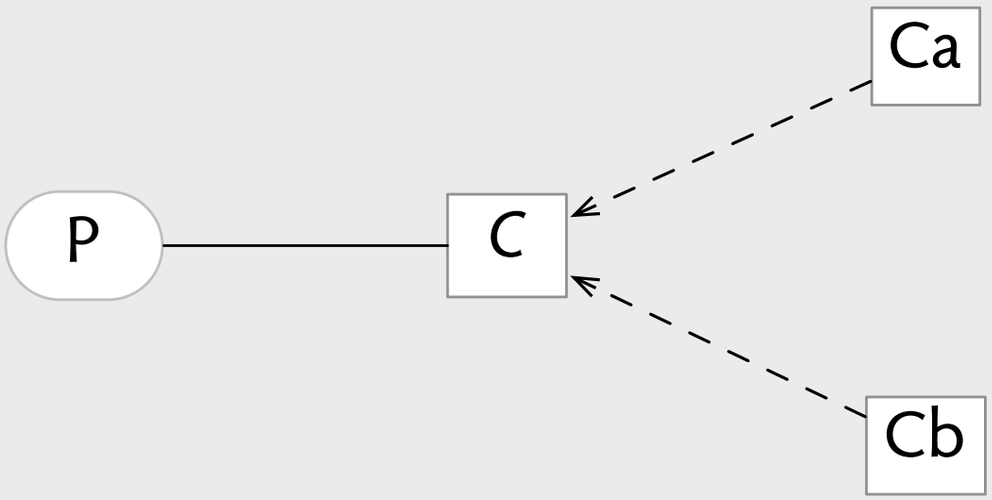
... directly or indirectly

uniformity

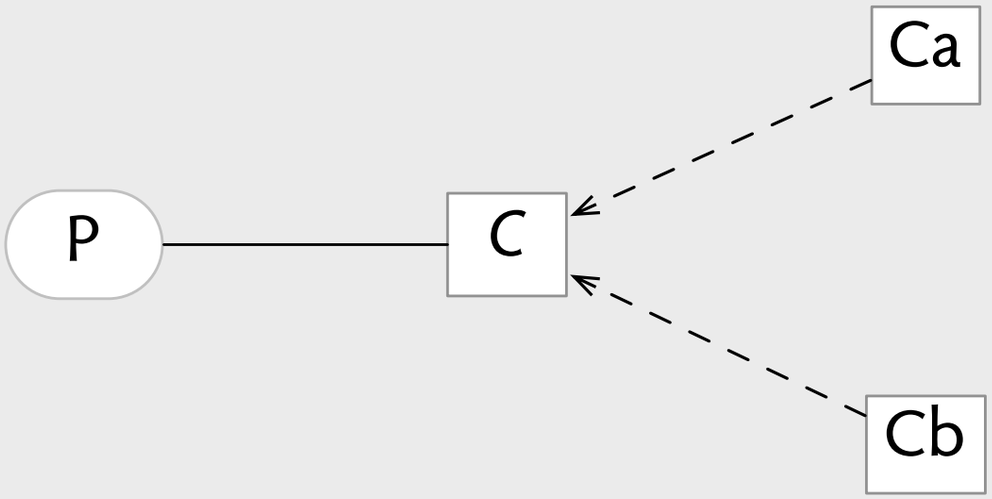


uniformity is violated when a concept
has different versions or instantiations
that behave differently for no good reason

non-uniform concepts

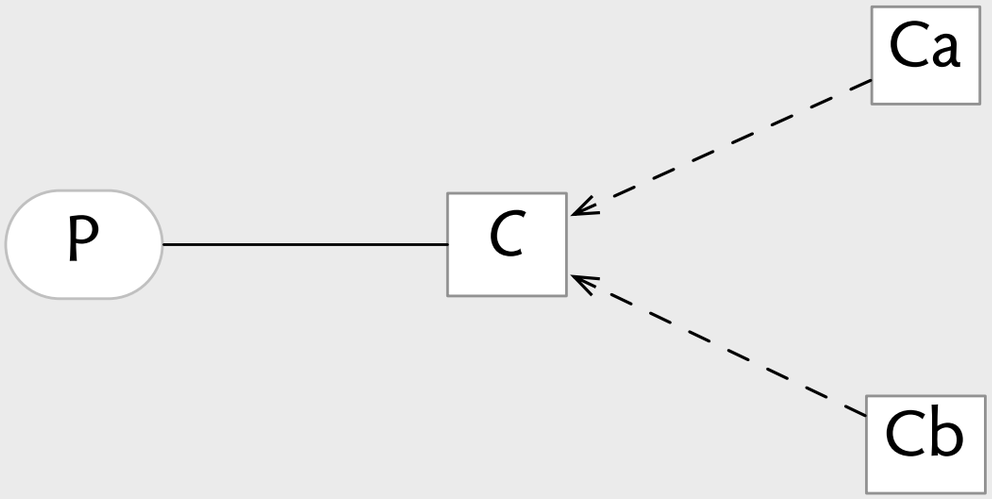


non-uniform concepts



deposits by check (banking)
funds arrive before clearing

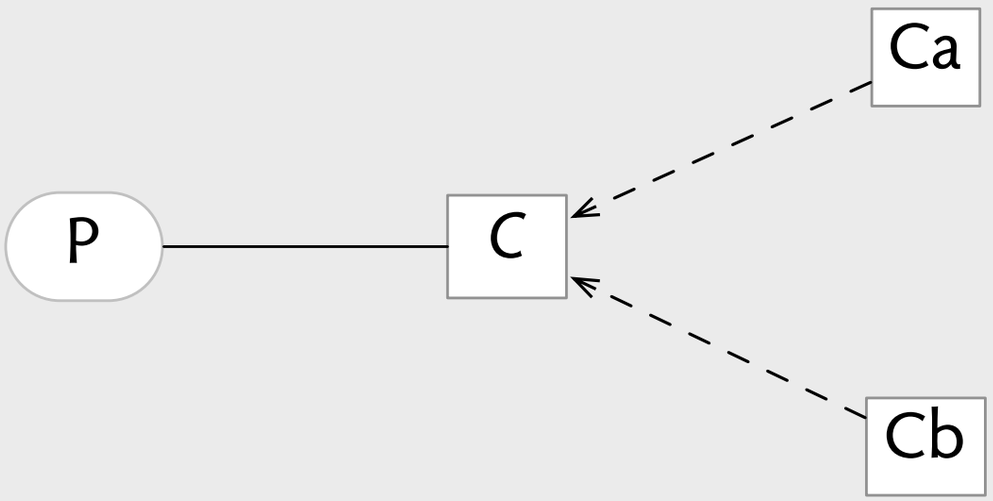
non-uniform concepts



deposits by check (banking)
funds arrive before clearing

primitive type (Java)
not like a class type

non-uniform concepts



deposits by check (banking)
funds arrive before clearing

primitive type (Java)
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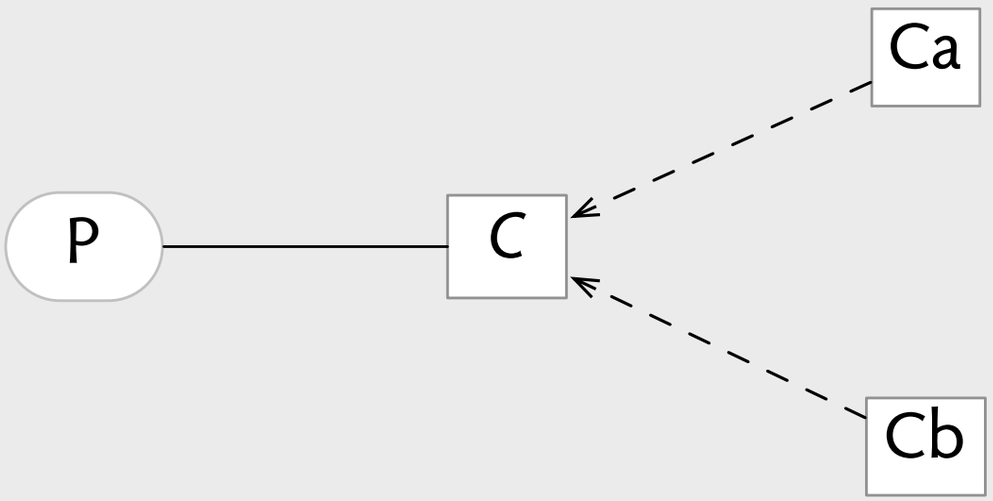
direct flight (Official Airline Guides)
1 flight number, but >1 stop

non-uniform concepts



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alerts (Apple iCal)
can't select email alerts for default

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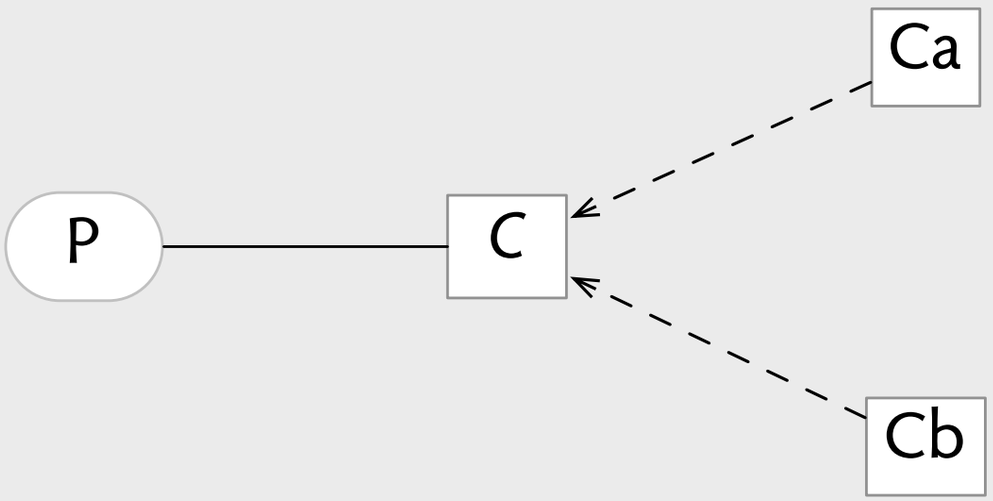

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1 flight number, but >1 stop

alerts (Apple iCal)
can't select email alerts for default

custom settings (Fuji x100s)
only some settings selectable

conceptual acrobatics

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.

_____

Parents signature Date

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Count Olaf

Parents signature Date

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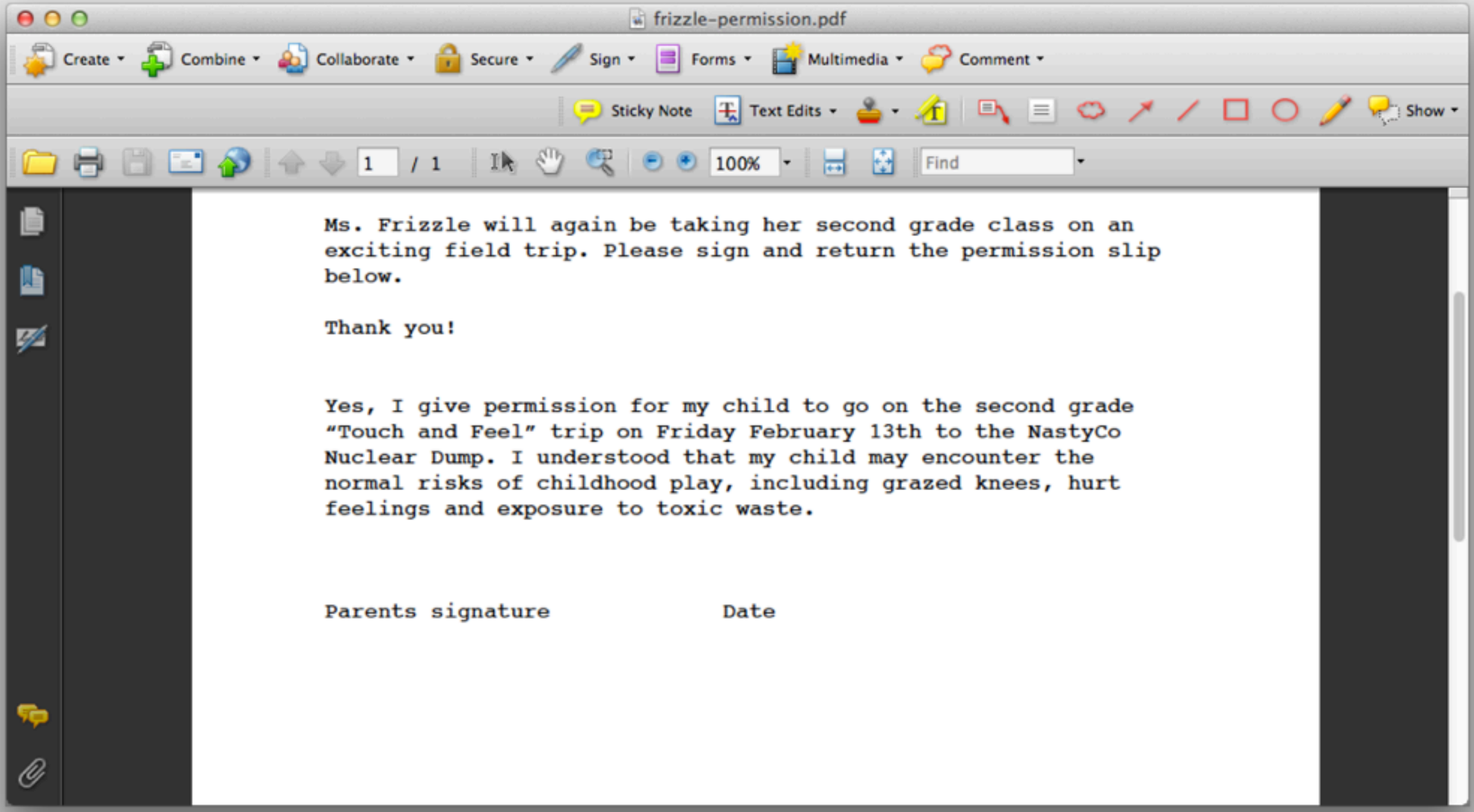
Count Olaf February 11, 2013

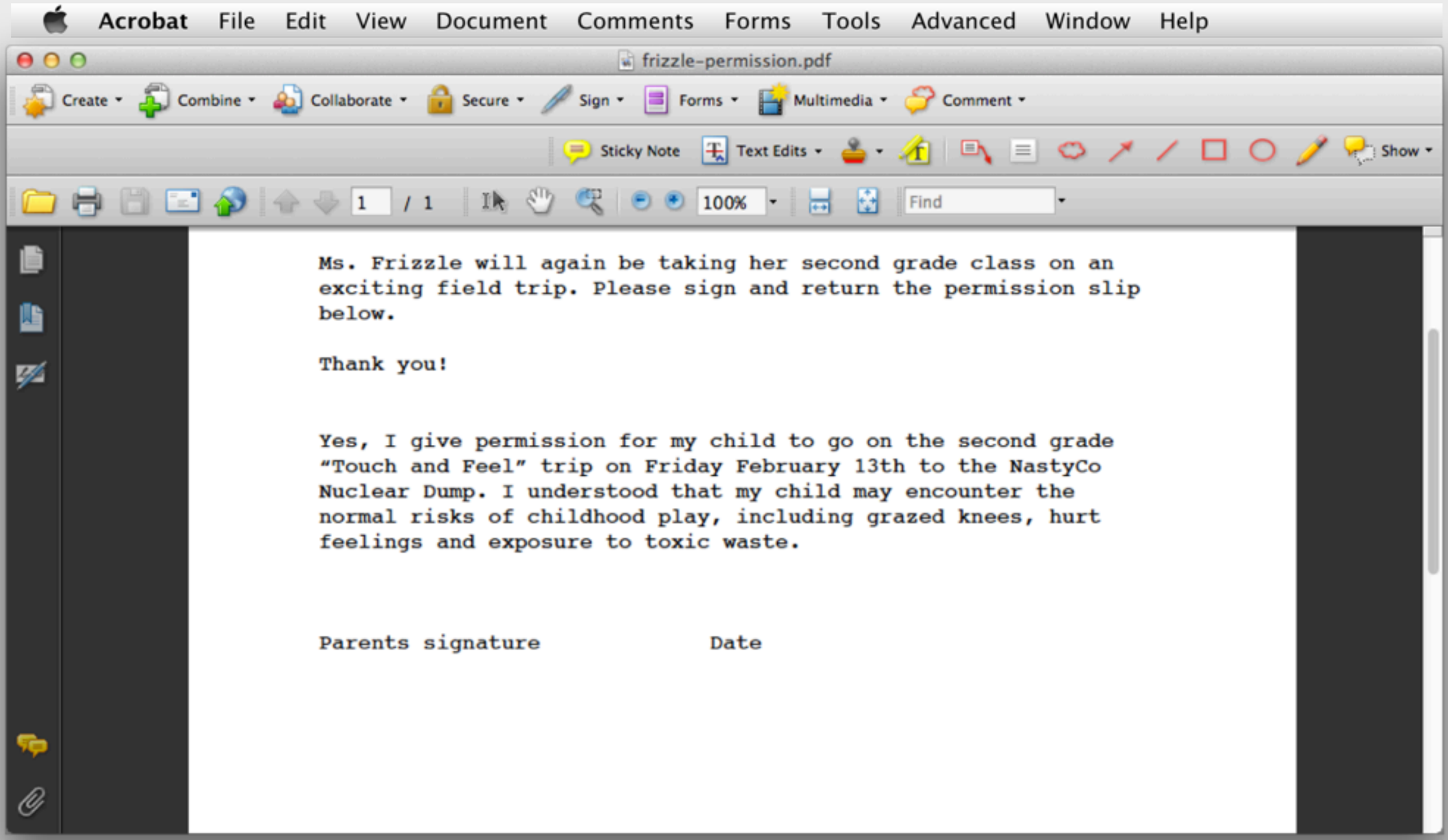
Parents signature Date

acrobat to the rescue

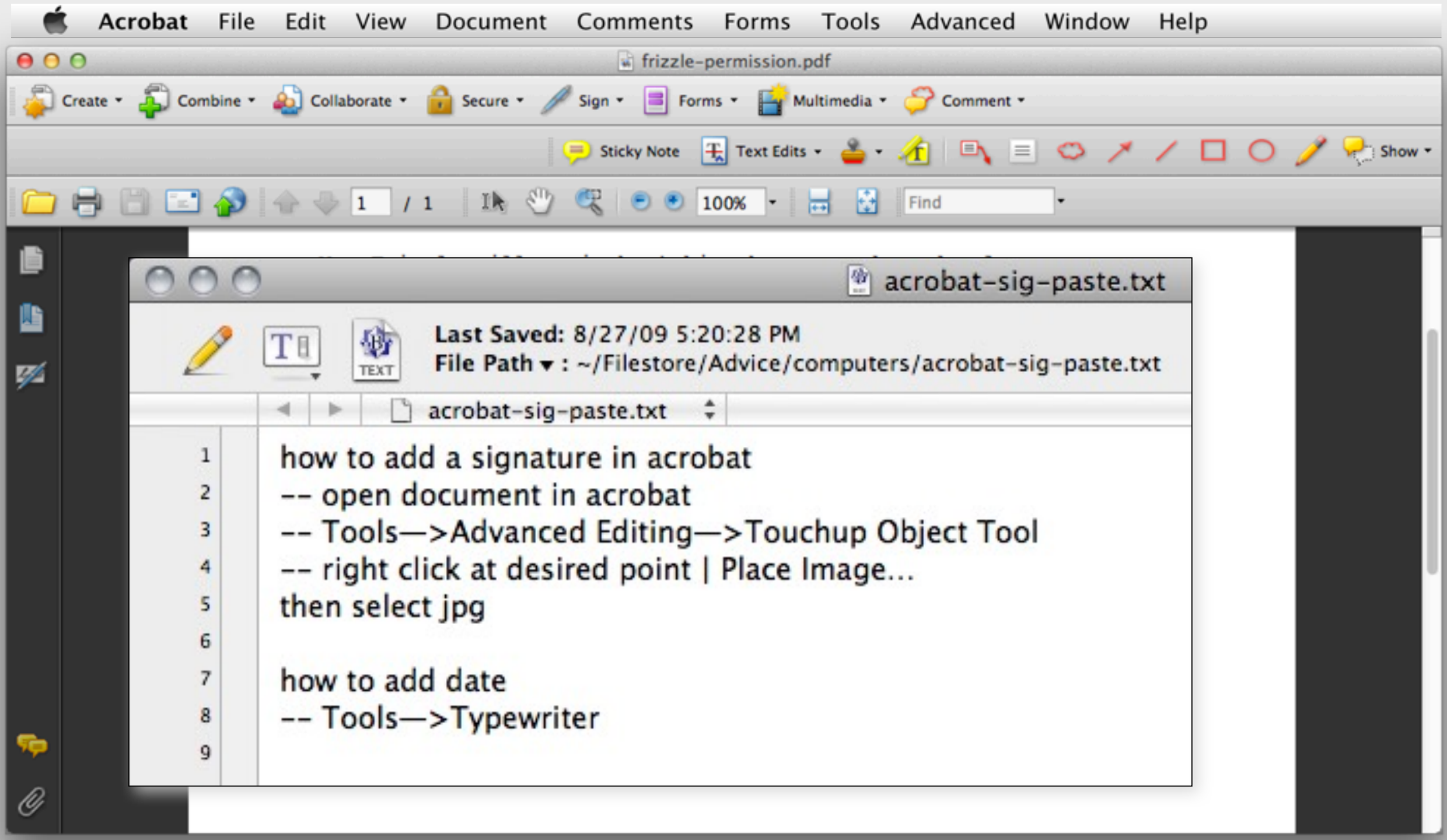
acrobat to the rescue



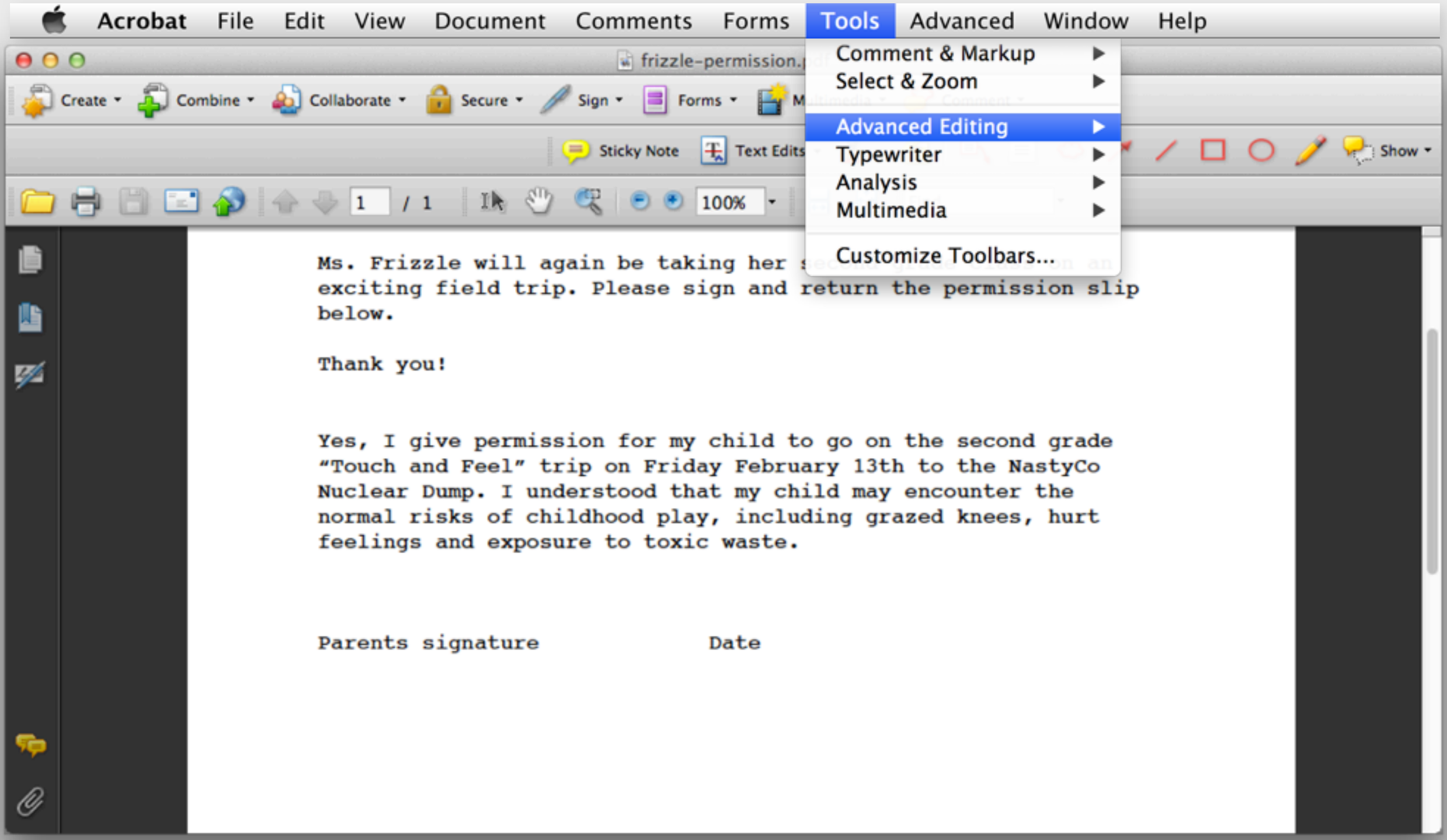
acrobat to the rescue



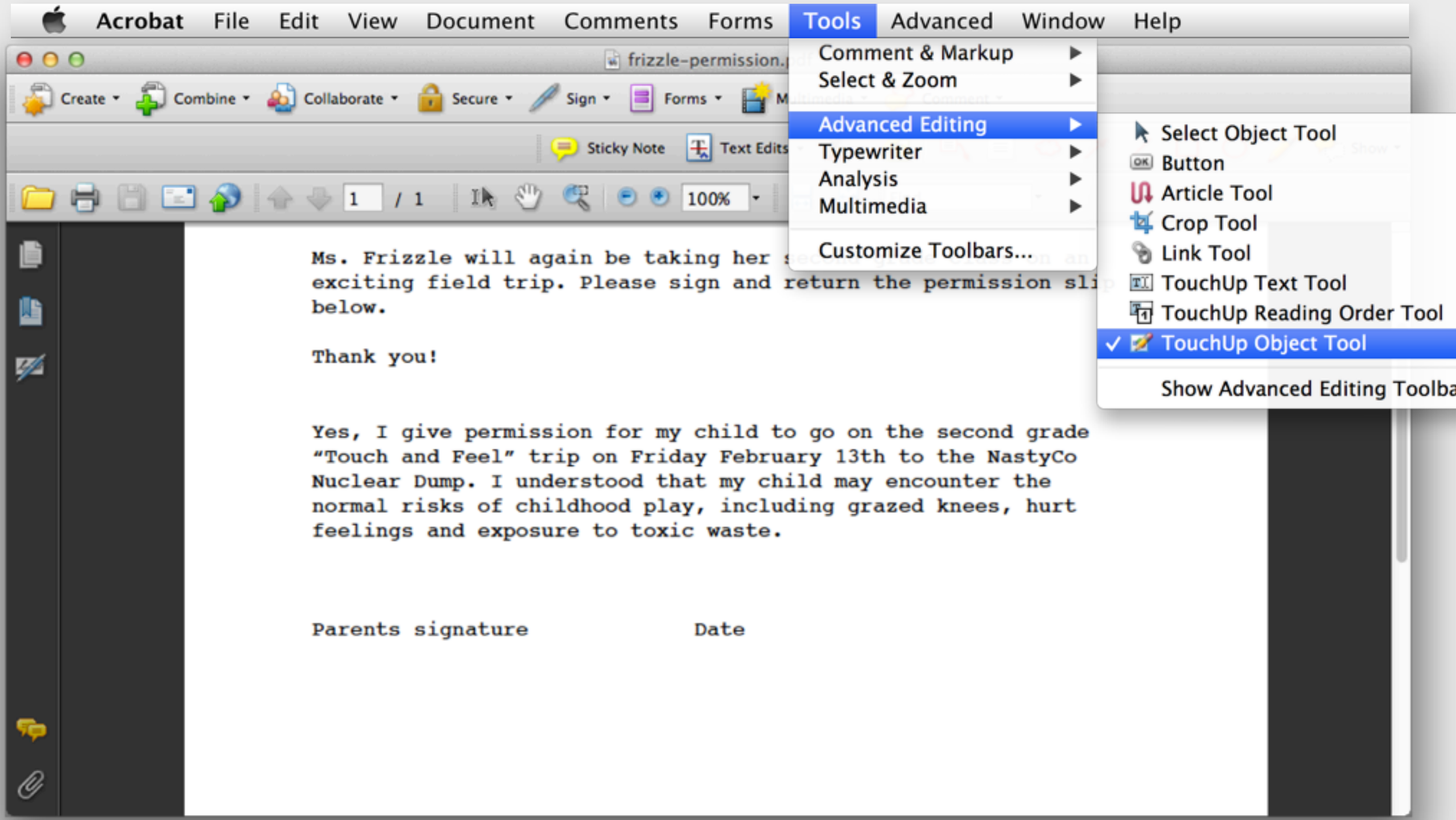
acrobat to the rescue



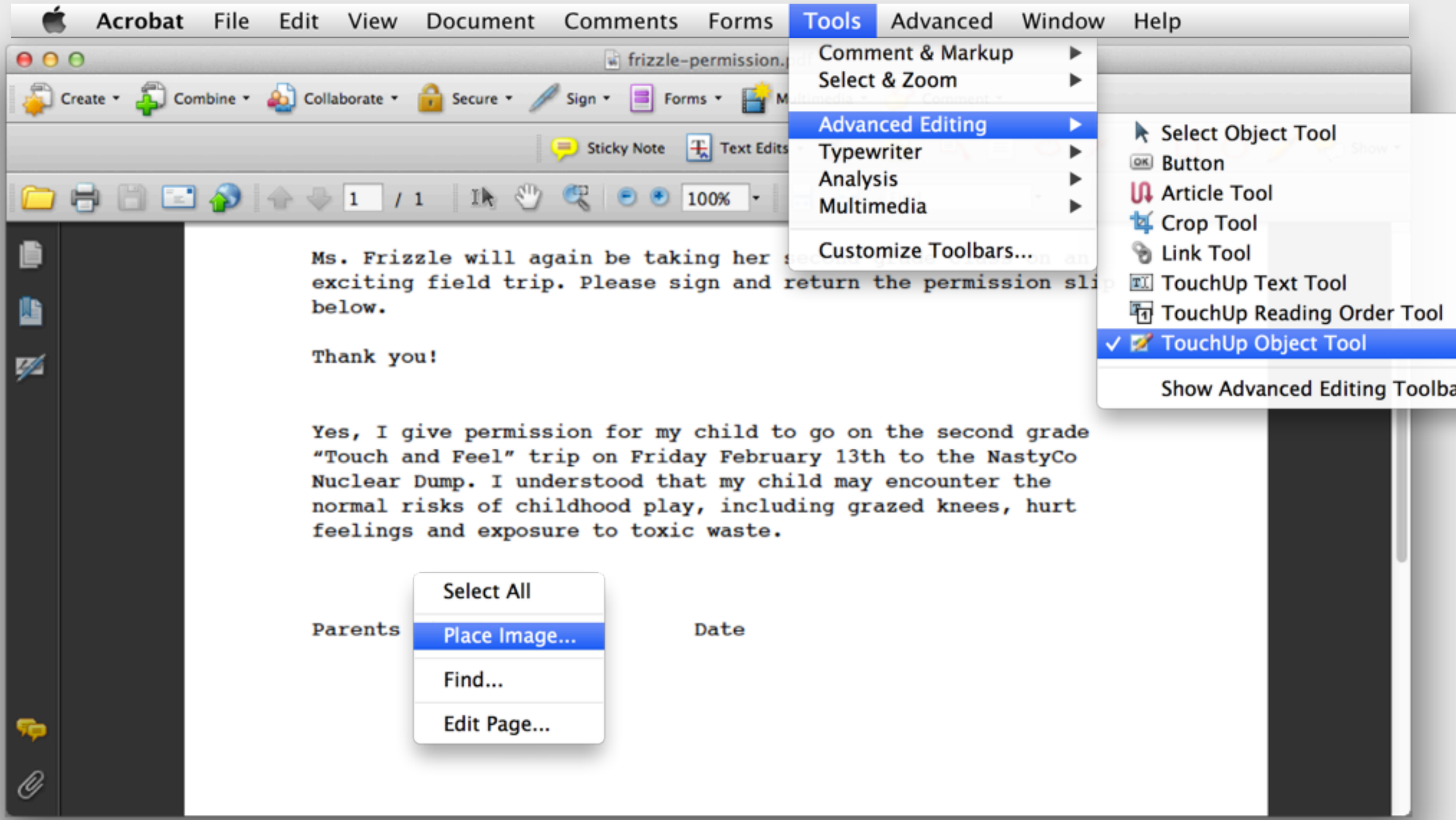
acrobat to the rescue



acrobat to the rescue



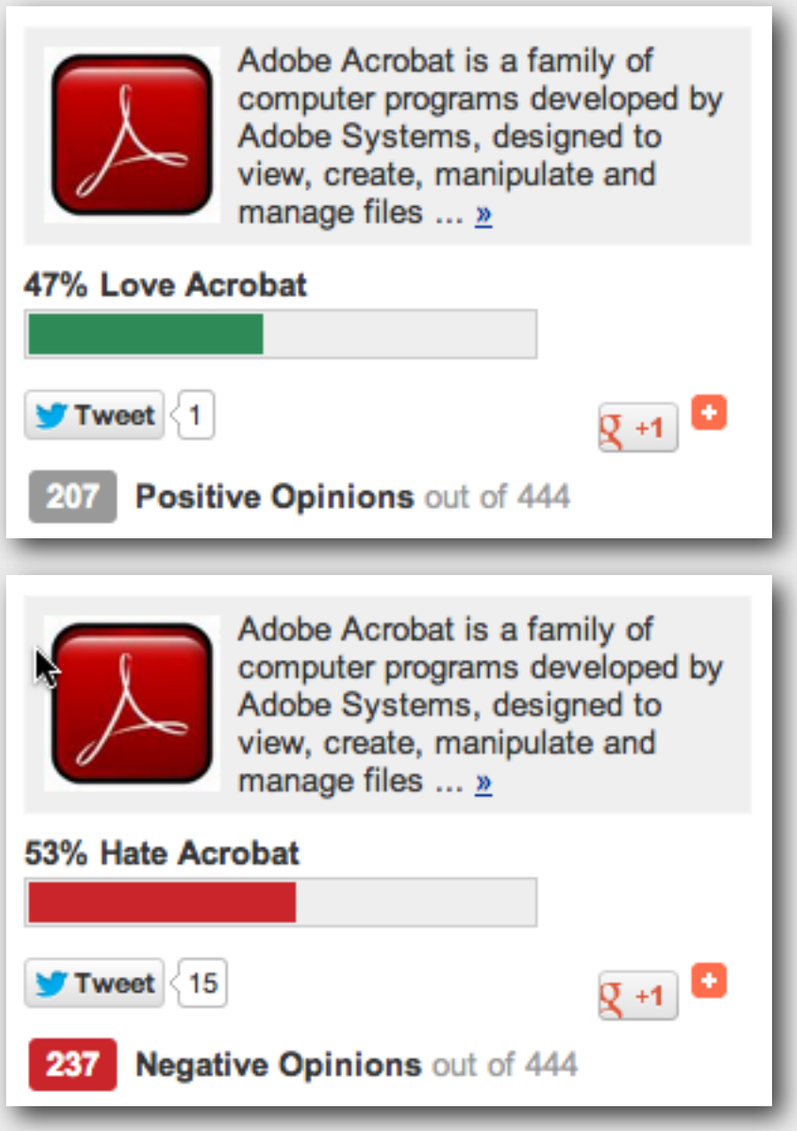
acrobat to the rescue



what we hate ... & love

from http://amplicate.com

what we hate ... & love



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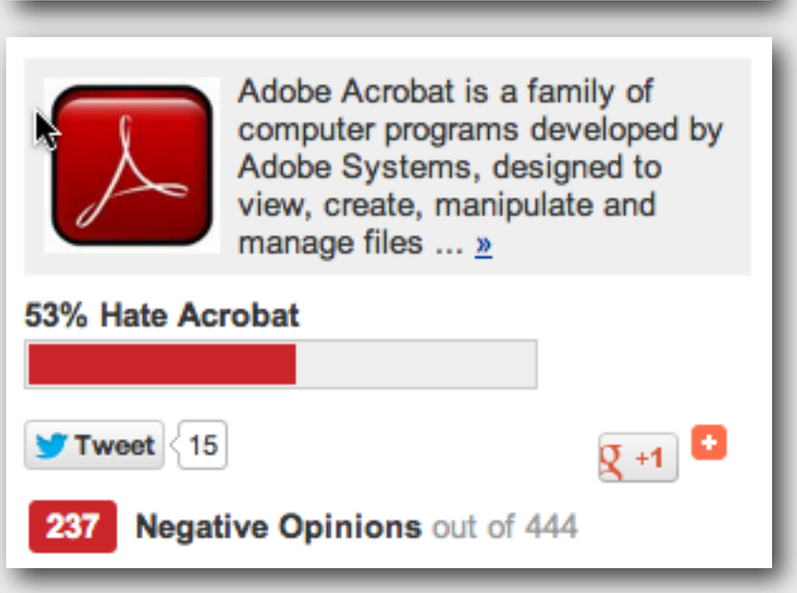
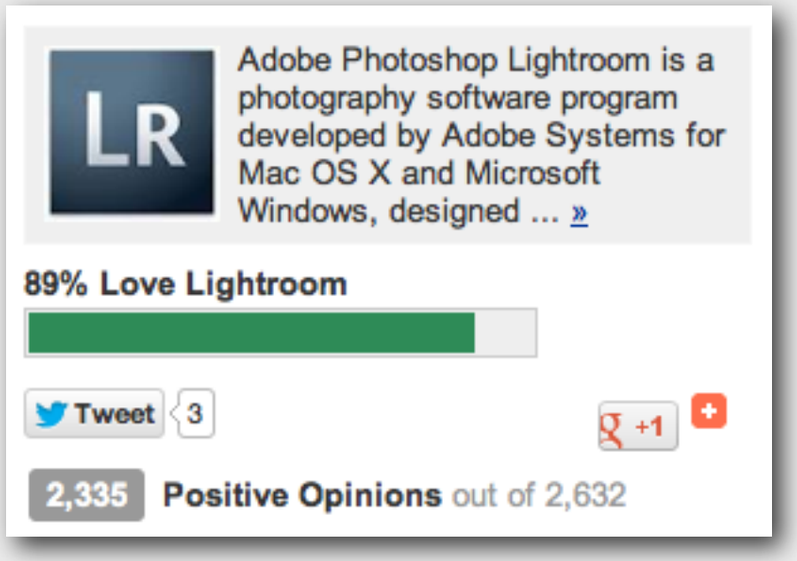
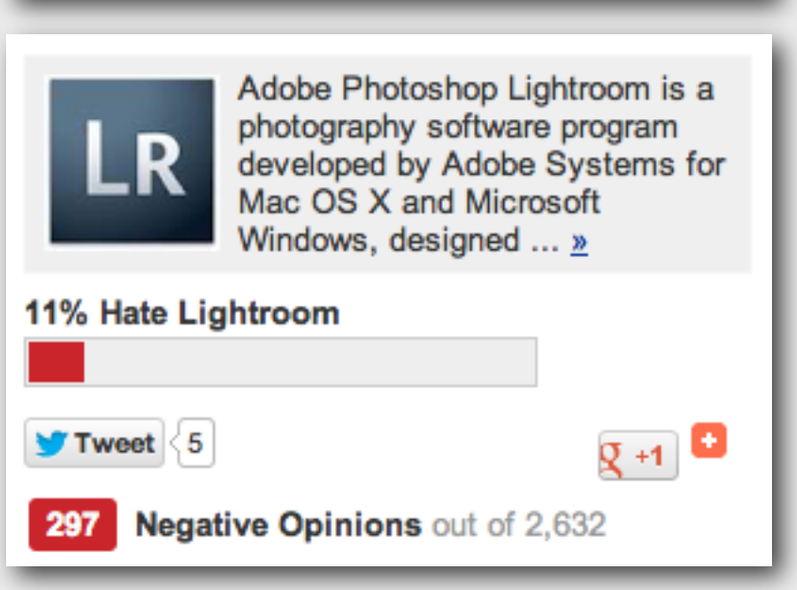
what we hate ... & love







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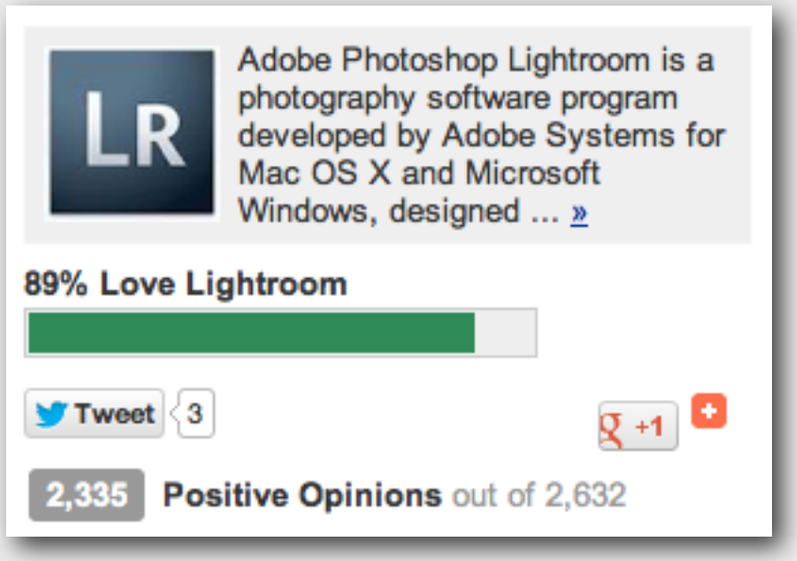
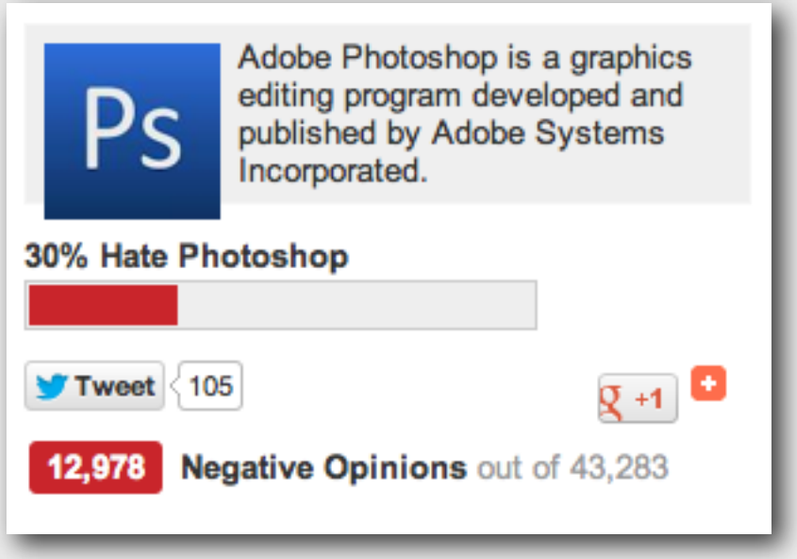
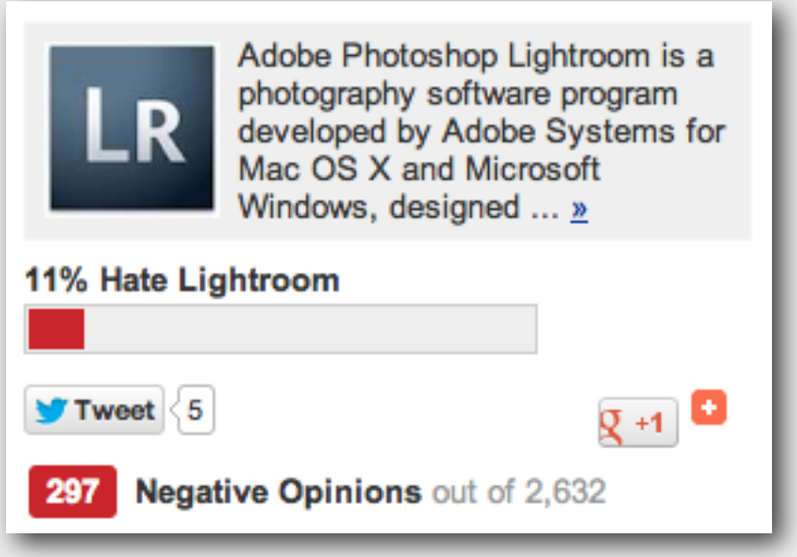
what we hate ... & love



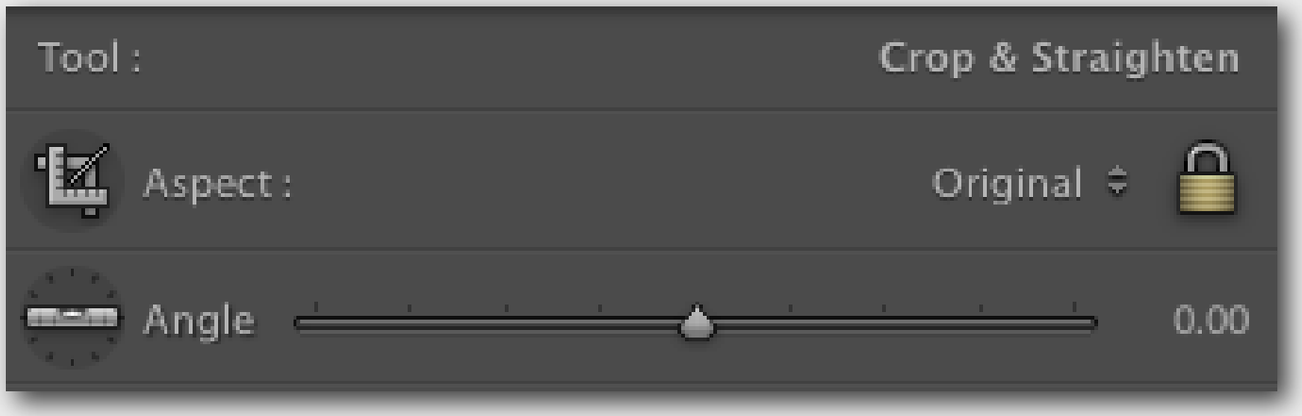




from http://amplicate.com

cropping in adobe lightroom

cropping in adobe lightroom



cropping photoshop

cropping photoshop

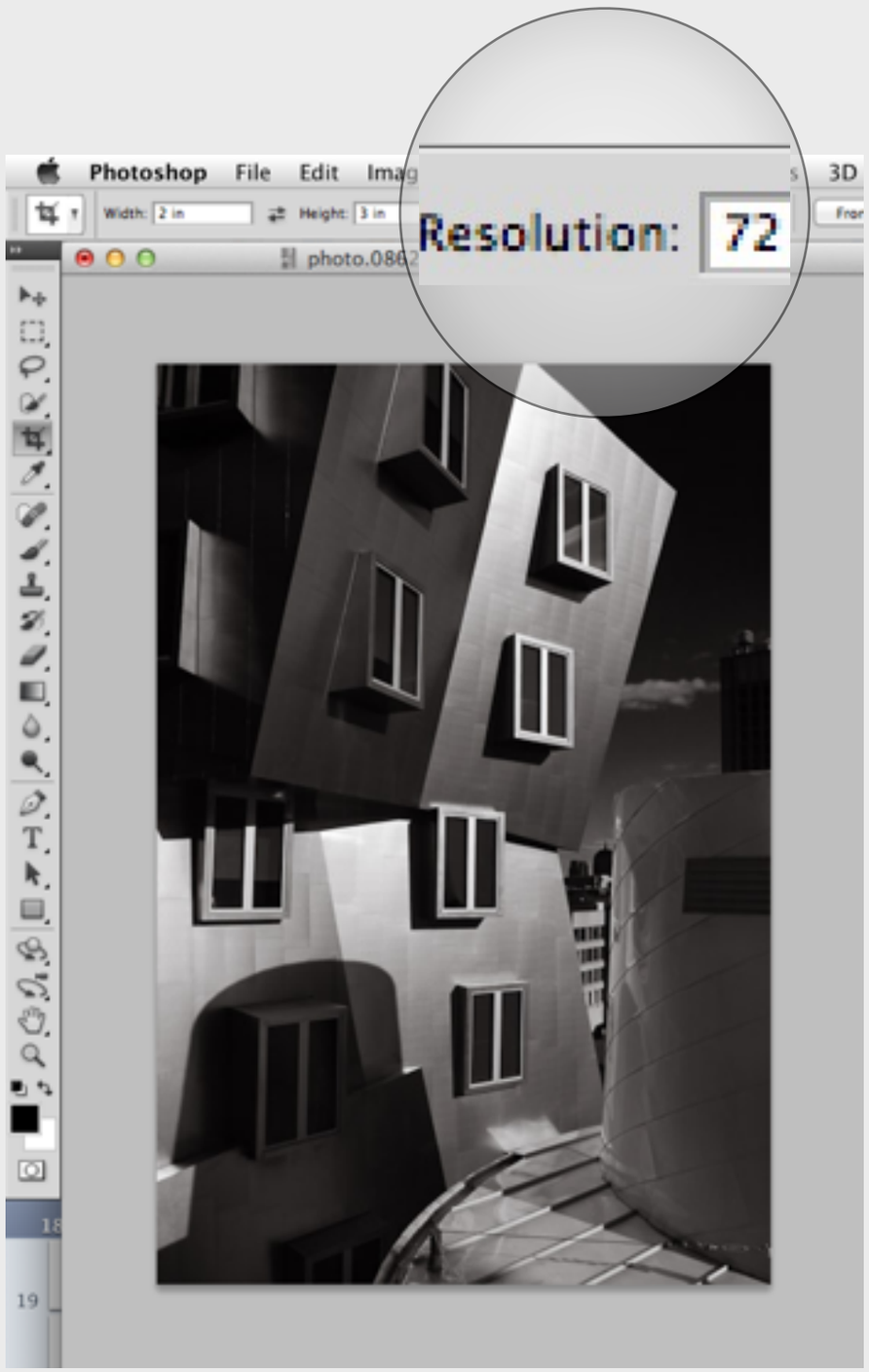
cropping photoshop

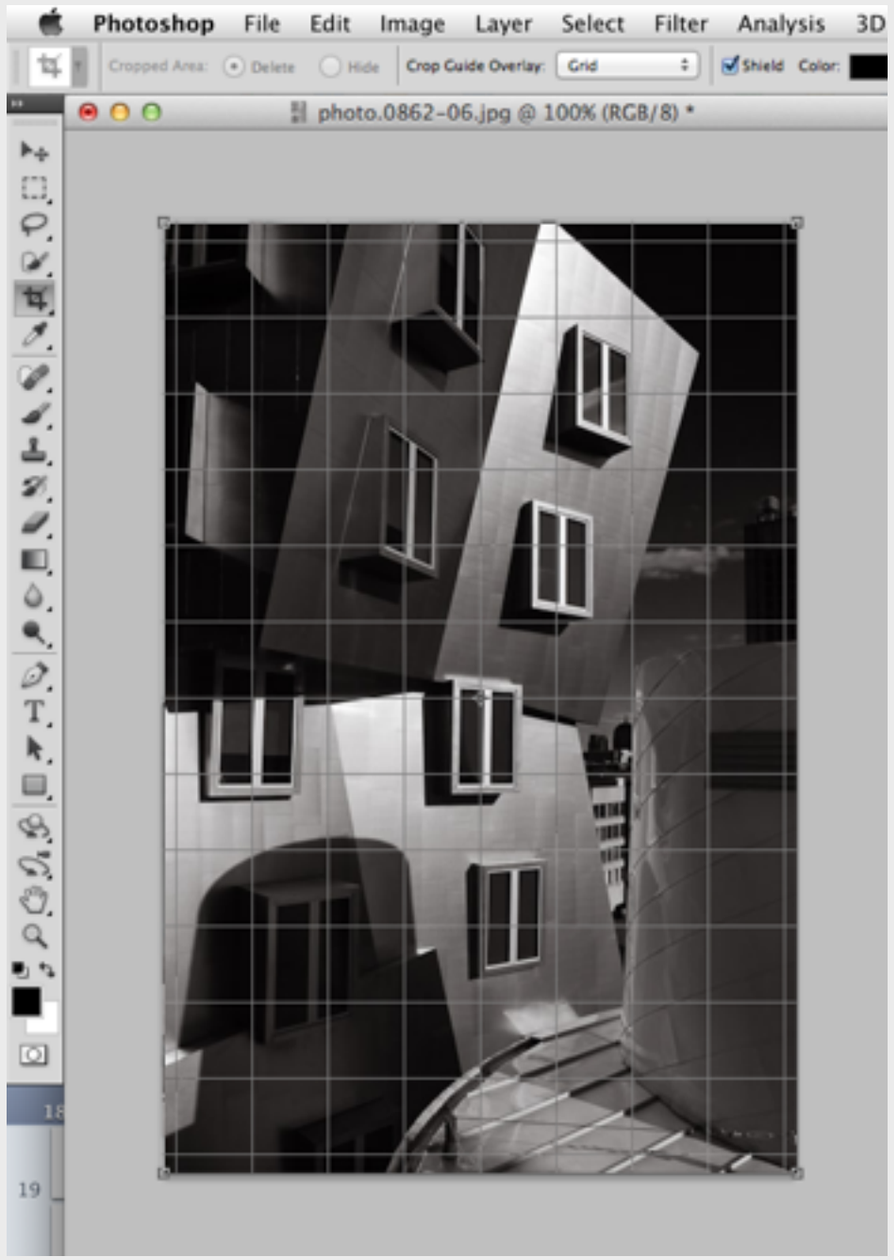
cropping the whole image

cropping the whole image

cropping the whole image

cropping the whole image





it's all about the concepts

Acrobat
text box
object
document text

Photoshop
channel
layer
mask

Lightroom
action
treatment
effect

it's all about the concepts

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incoherent concepts, no clear **purpose**

it's all about the concepts

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powerful concepts with low level **purposes**

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it's all about the concepts

Acrobat
text box
object
document text

incoherent concepts, no clear **purpose**

Photoshop
channel
layer
mask

powerful concepts with low level **purposes**

Lightroom
action
treatment
effect

simple concepts with **purposes** aligned to common tasks

all's well that ends well

all's well that ends well

acrobat 9

deeply troubled

all's well that ends well

acrobat 9
deeply troubled

acrobat 10
user interface tweaks

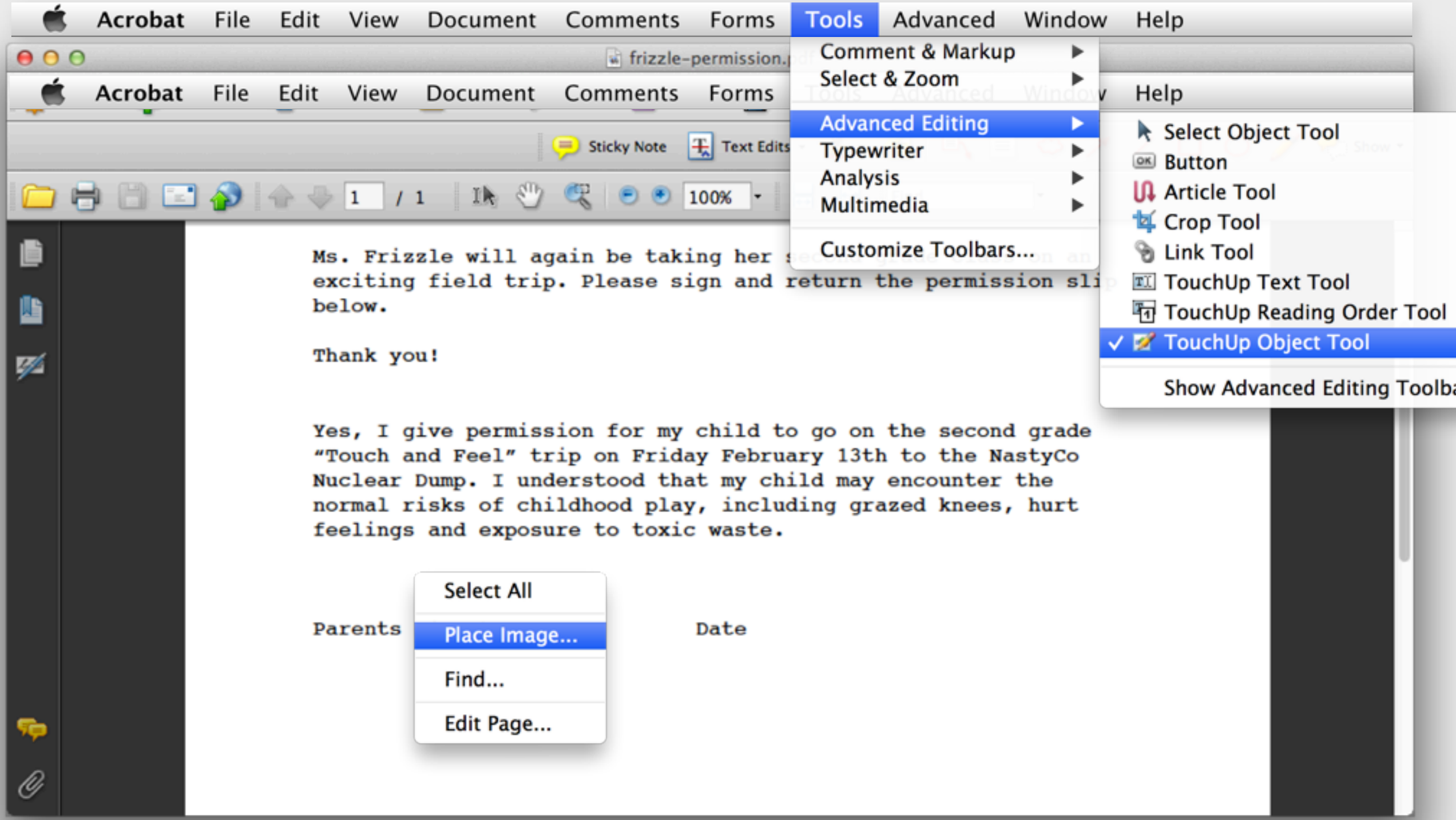
all's well that ends well

acrobat 9
deeply troubled

acrobat 10
user interface tweaks

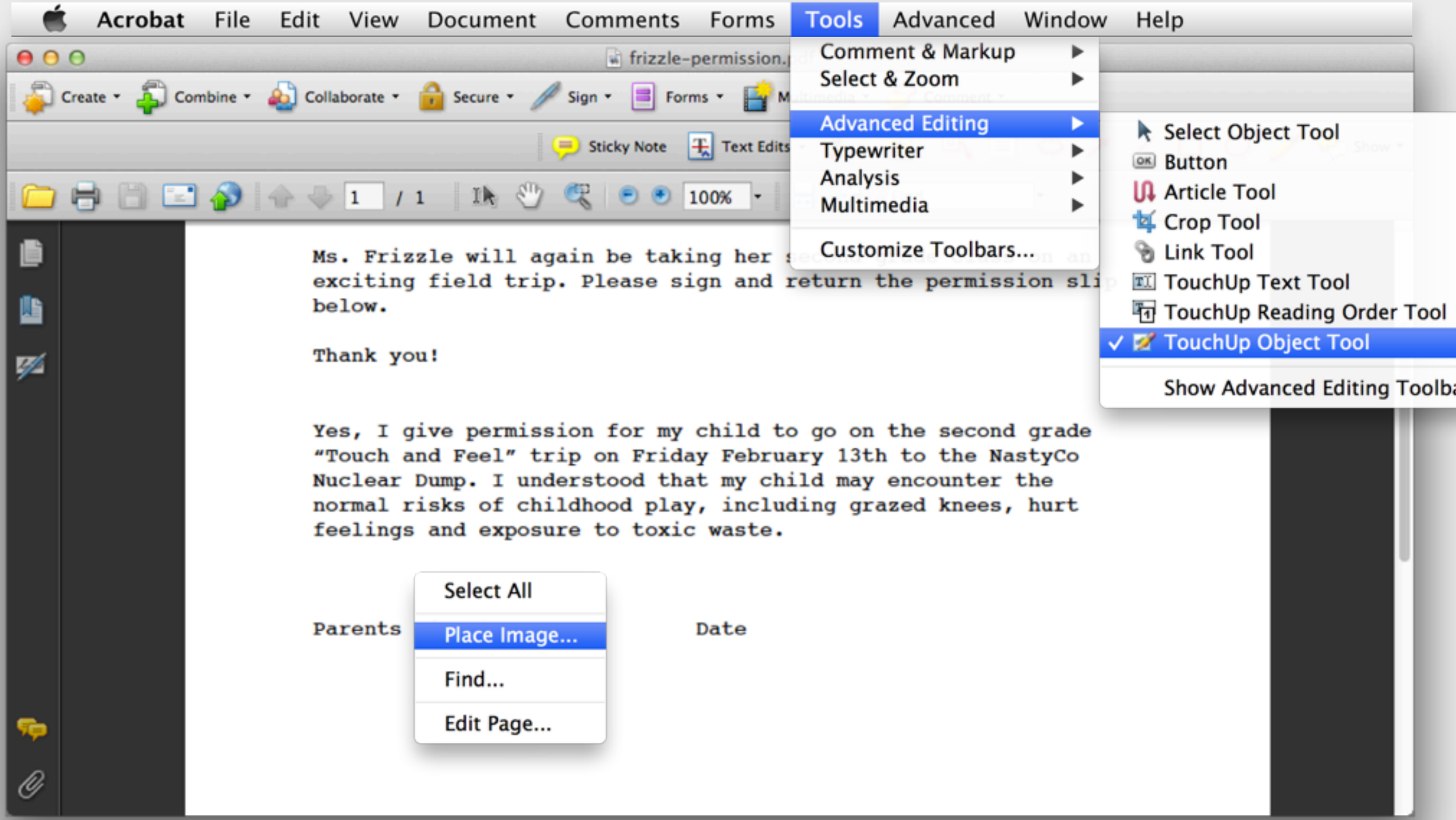
acrobat 11
conceptual reworking

acrobat (version 09)



hard to discern any compelling concepts

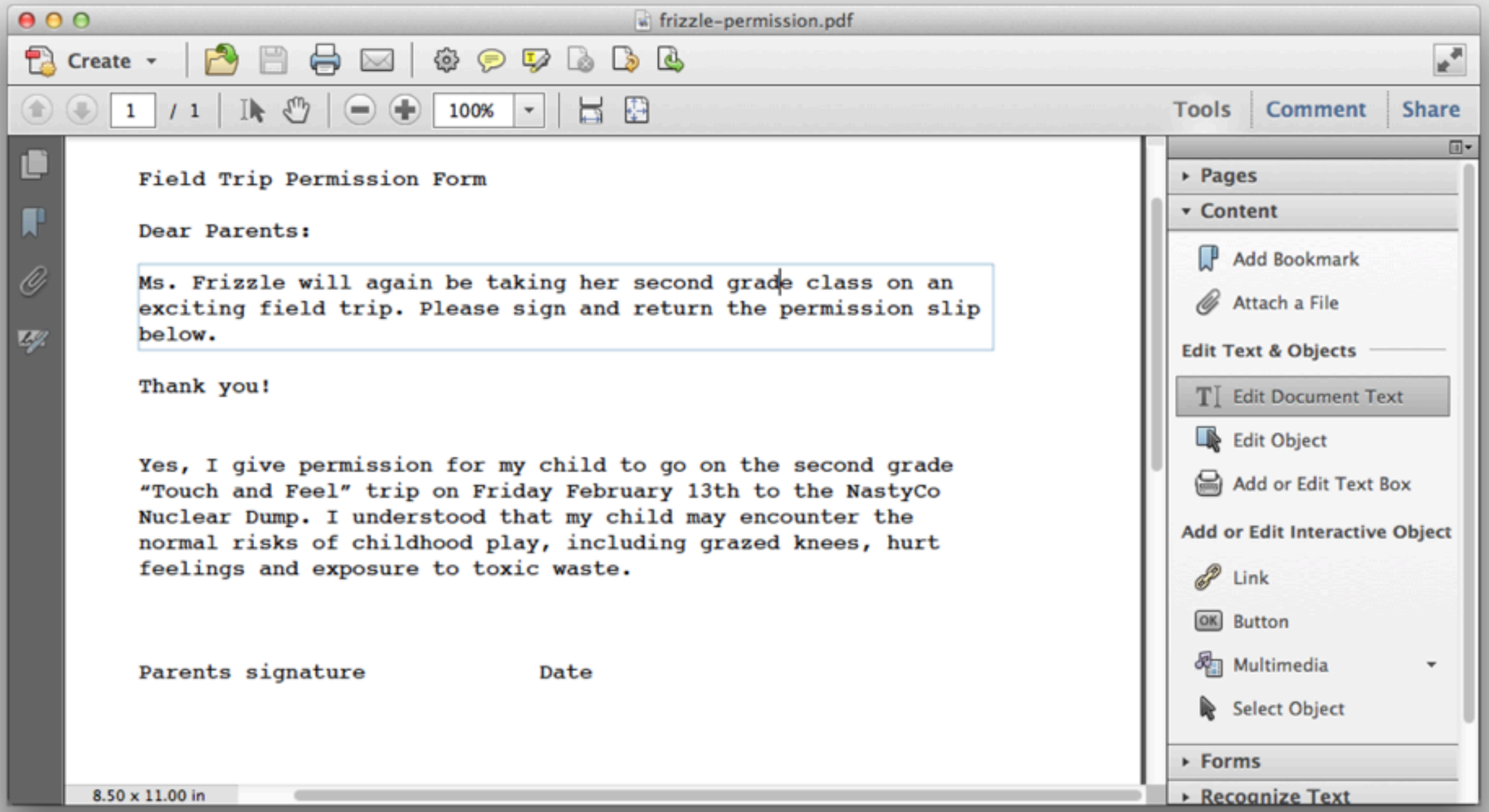
acrobat (version 09)



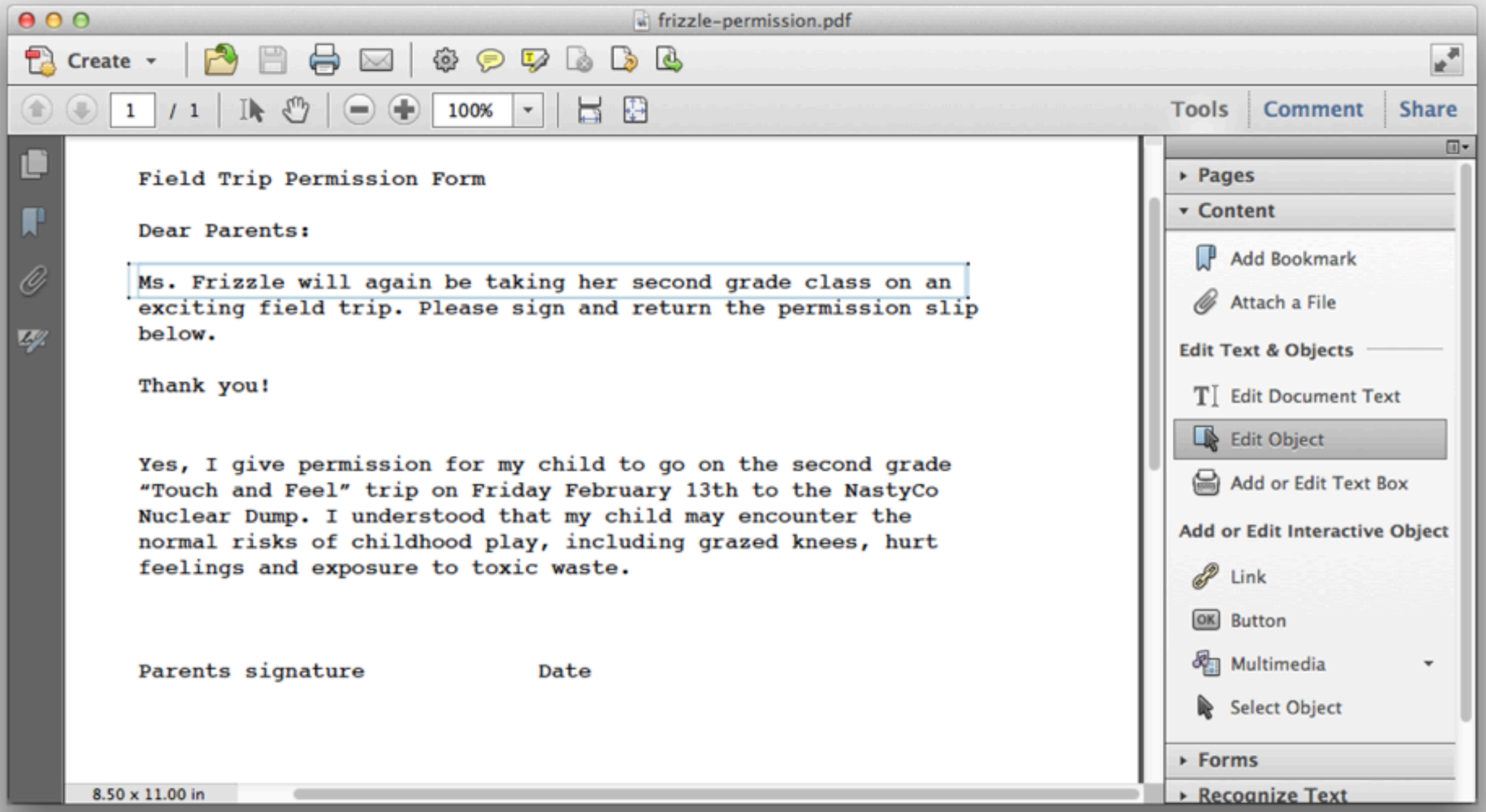
hard to discern any compelling concepts

acrobat (version 10)

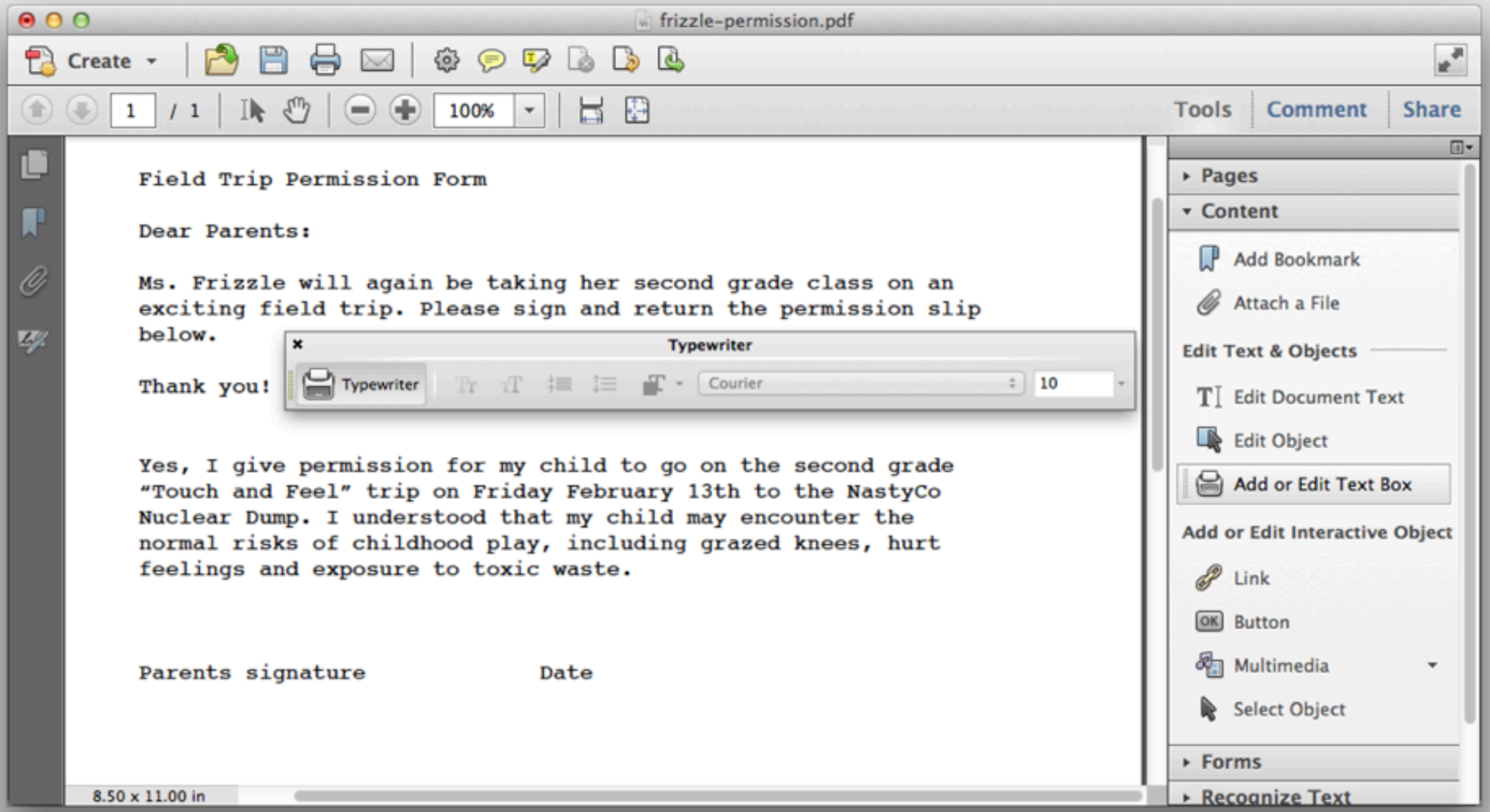
acrobat (version 10)



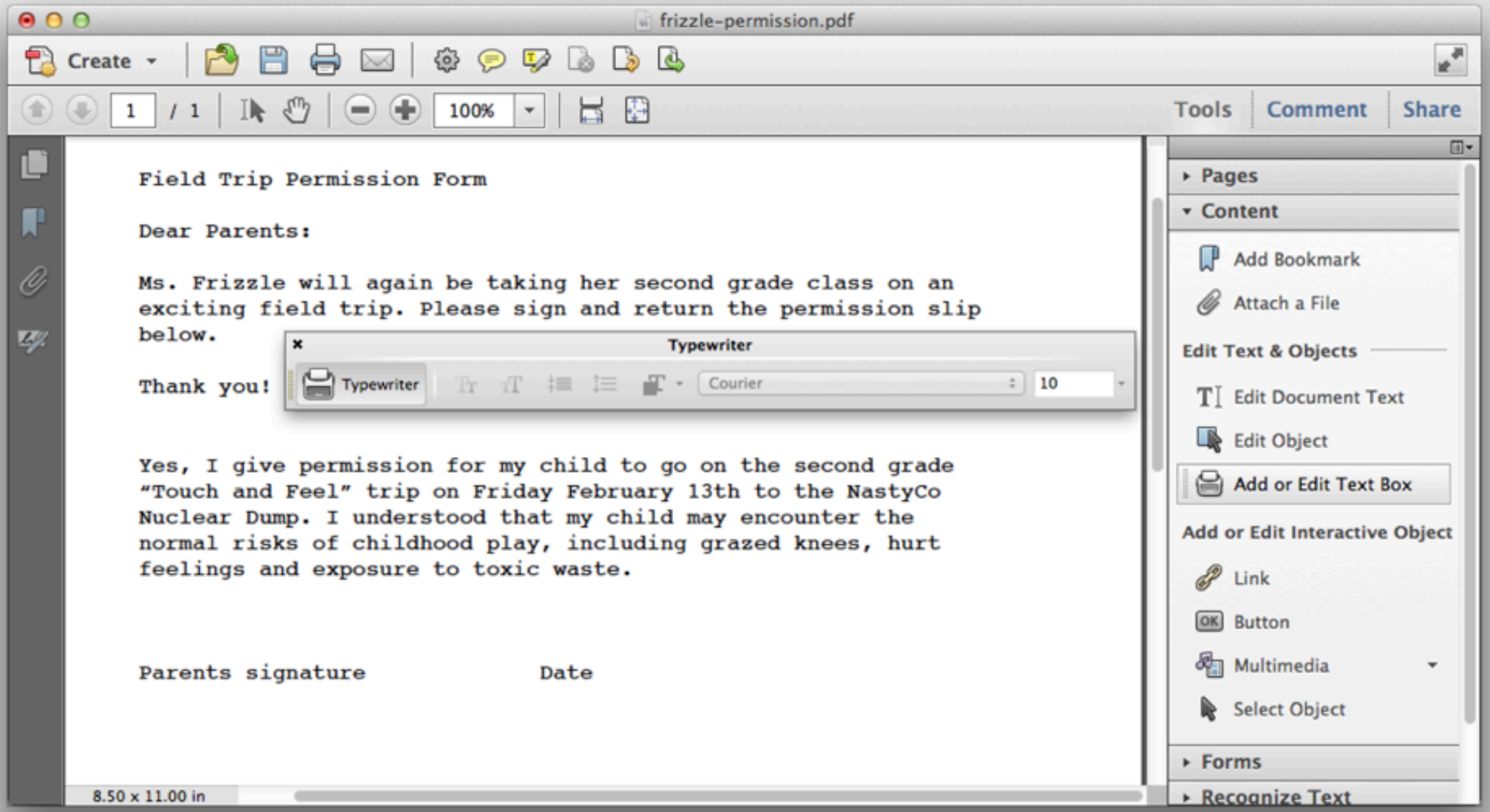
acrobat (version 10)



acrobat (version 10)

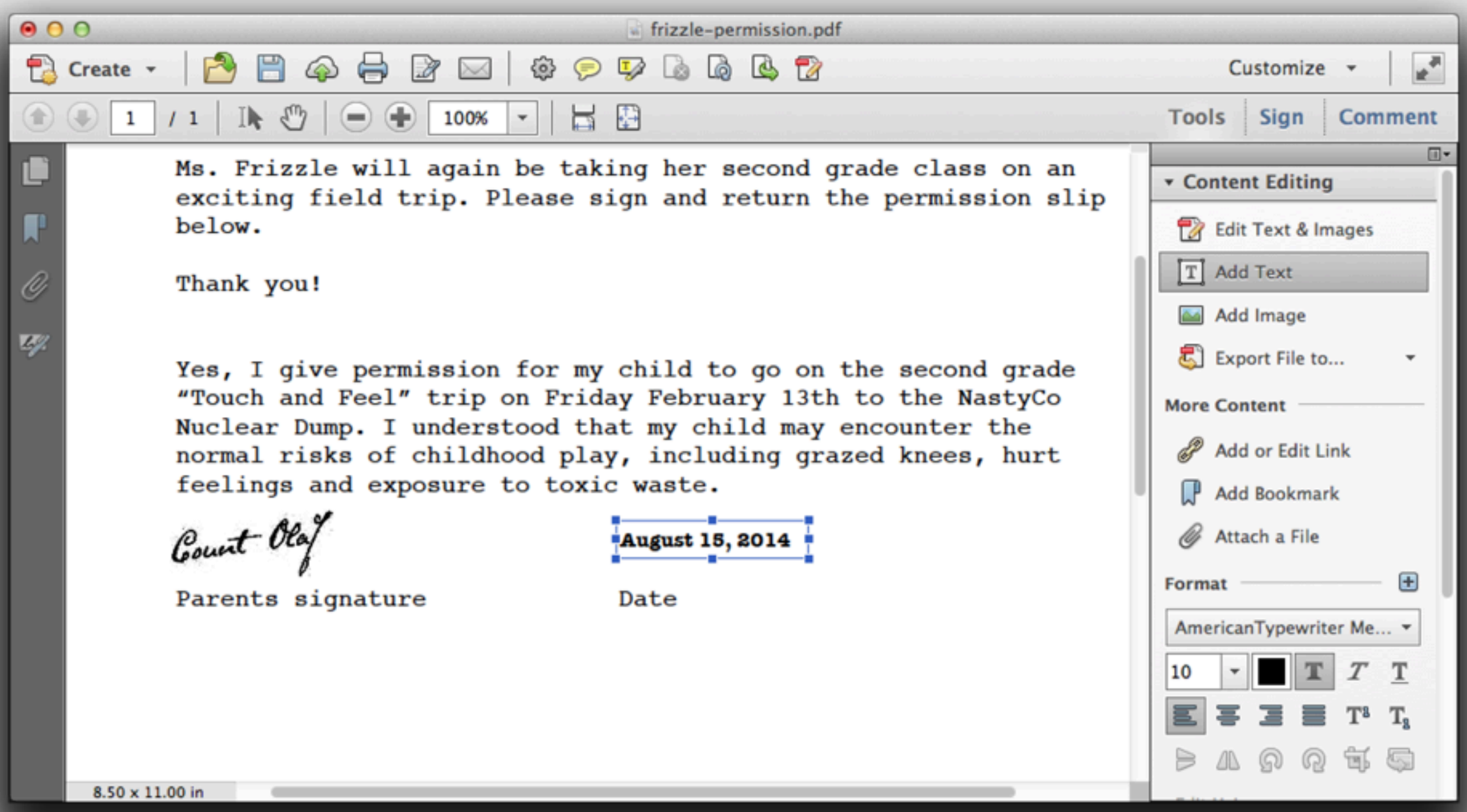


acrobat (version 10)



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

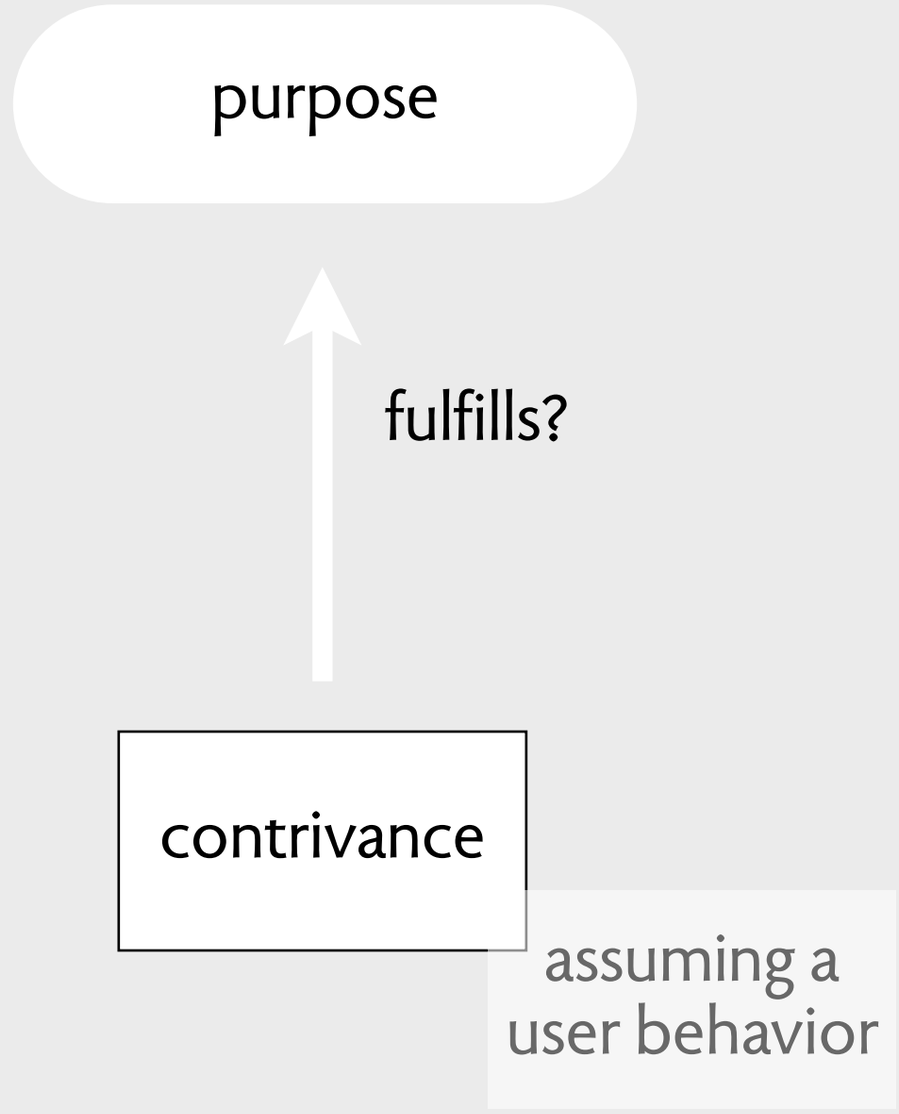
acrobat (version 11)



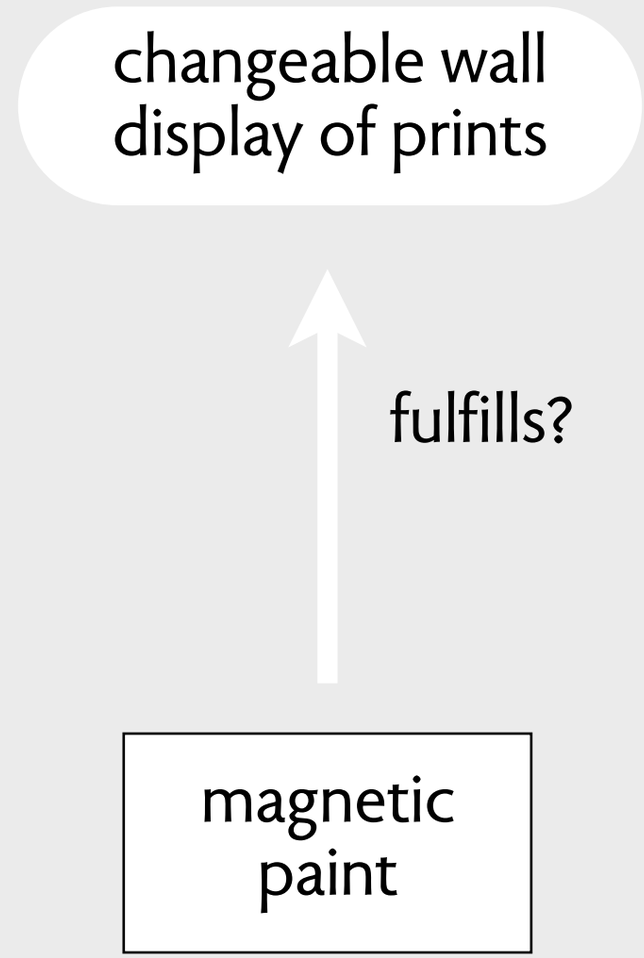
conceptual reworking: now just *text*

designing
the user

designing the user too



example: magnetic paint



example: magnetic paint

changeable wall
display of prints

fulfills?

magnetic
paint

six coats

example: magnetic paint

changeable wall display of prints

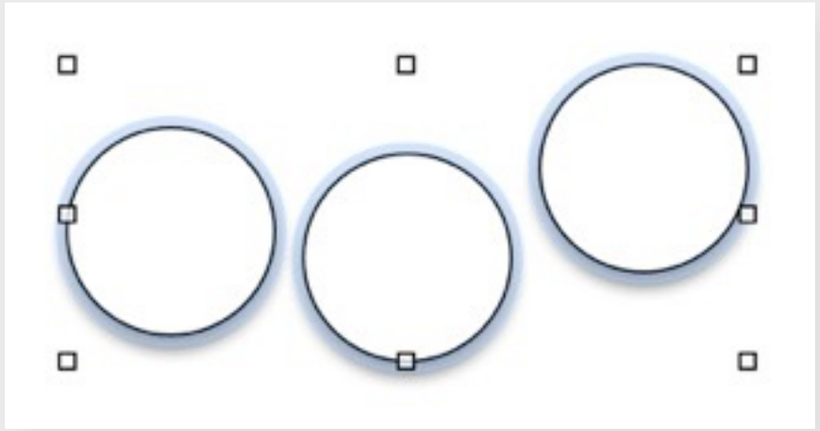
fulfills?

magnetic paint

six coats

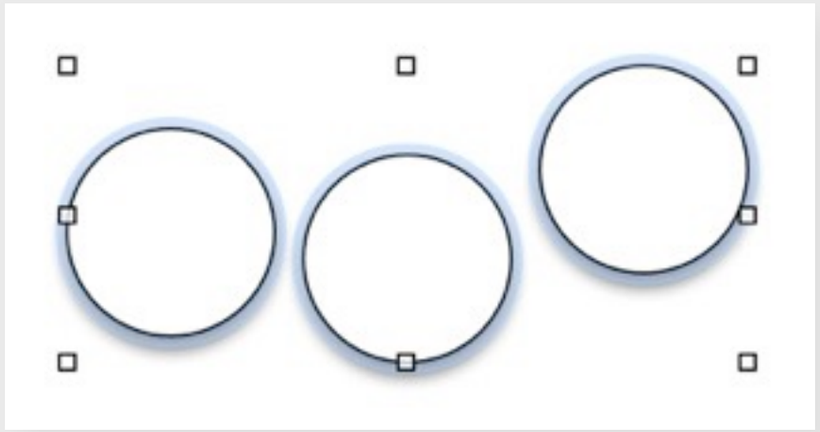
neodymium magnets

example: aligning elements



purpose: help align objects

example: aligning elements



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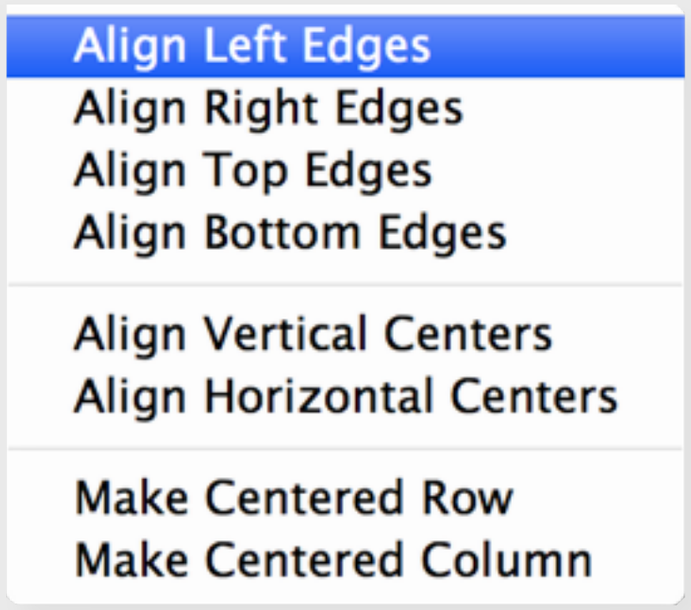
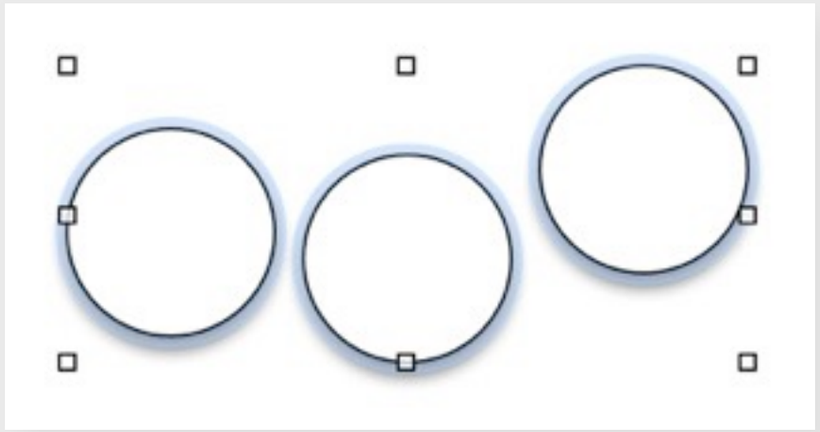


a contrivance: autoalign

example: aligning elements



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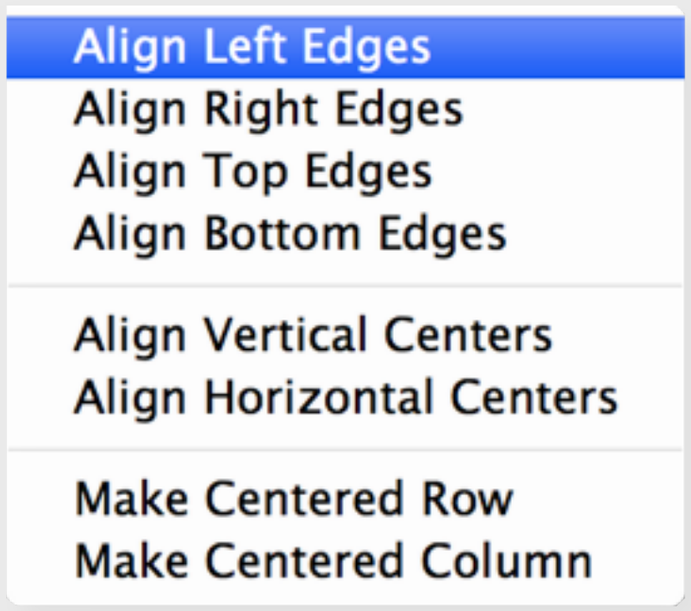
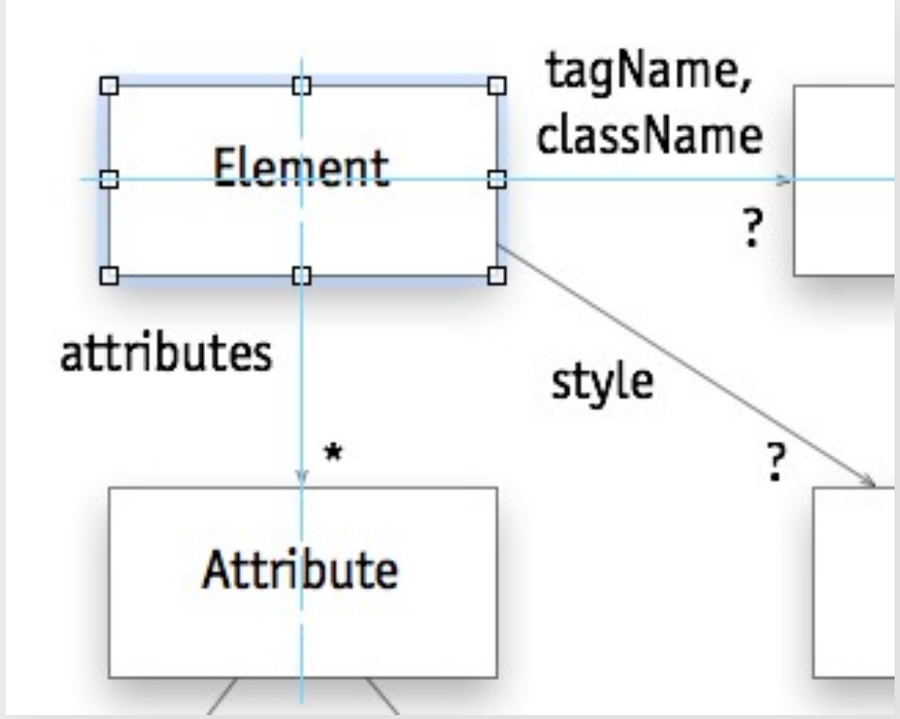
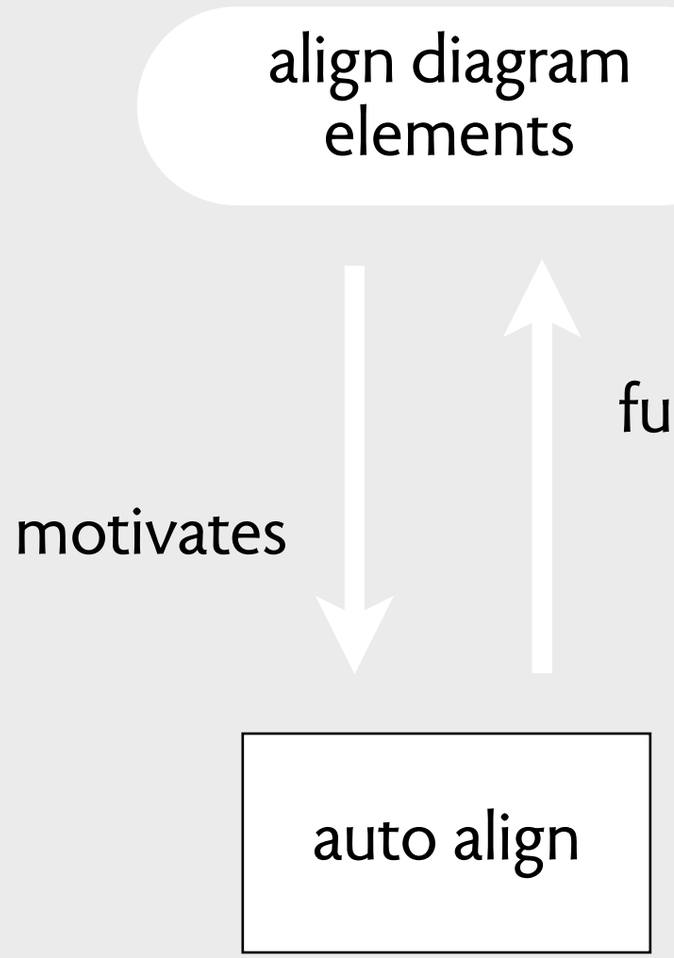


a contrivance: autoalign

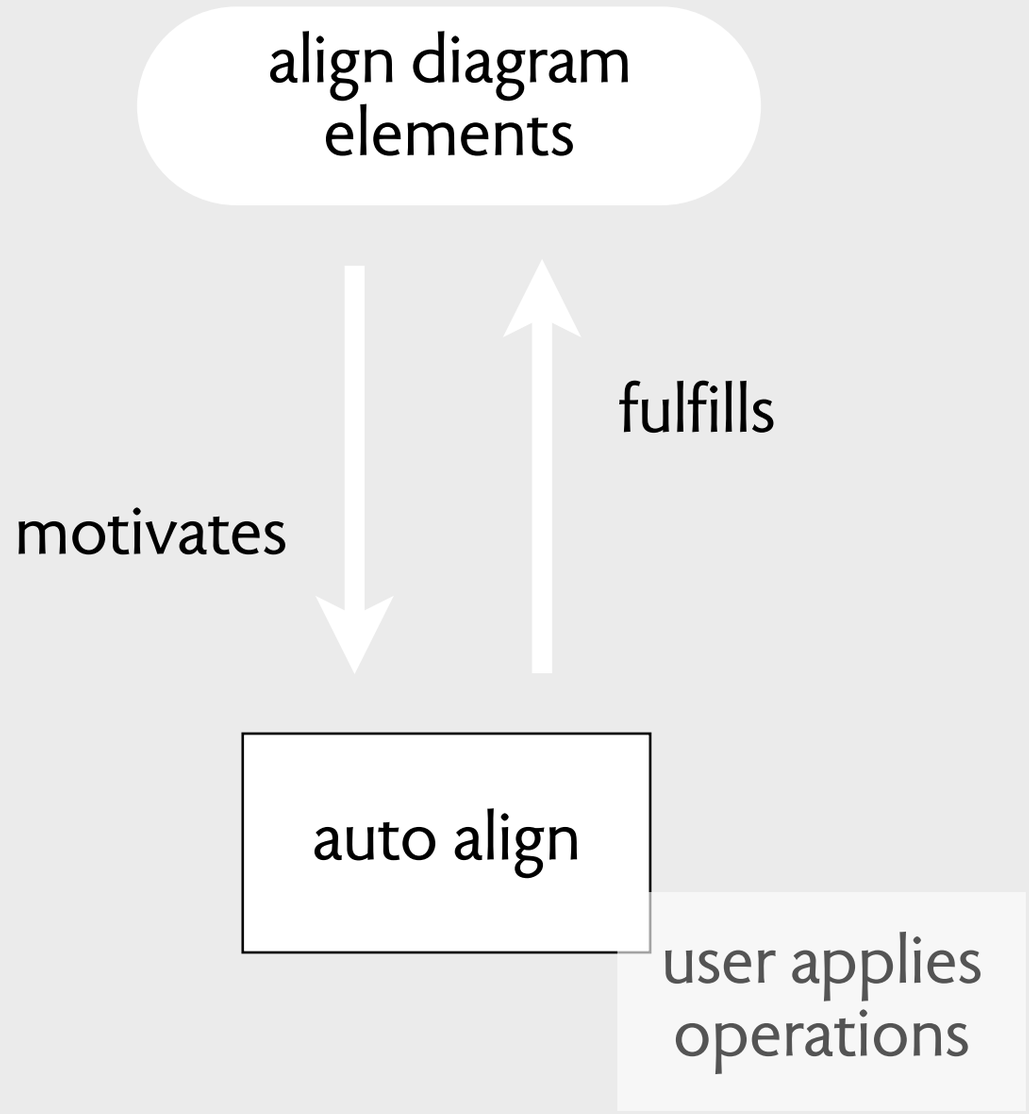


a better contrivance: snap align

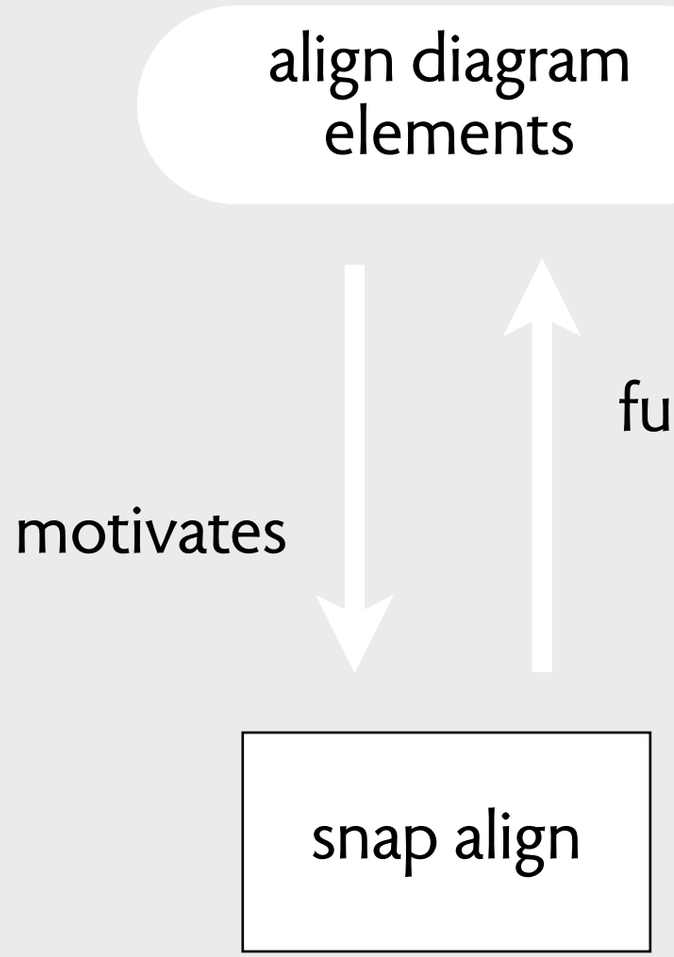
example: auto align



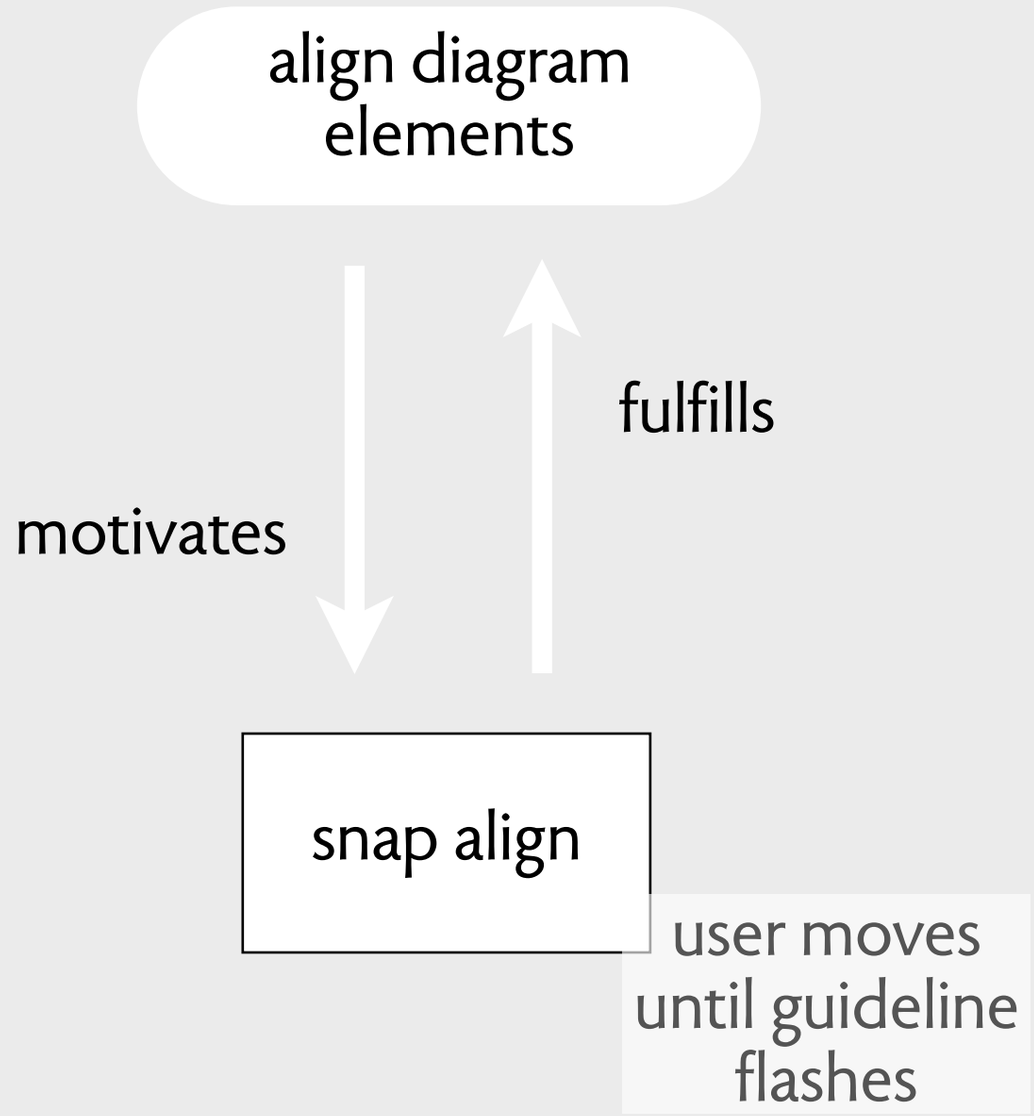
example: auto align



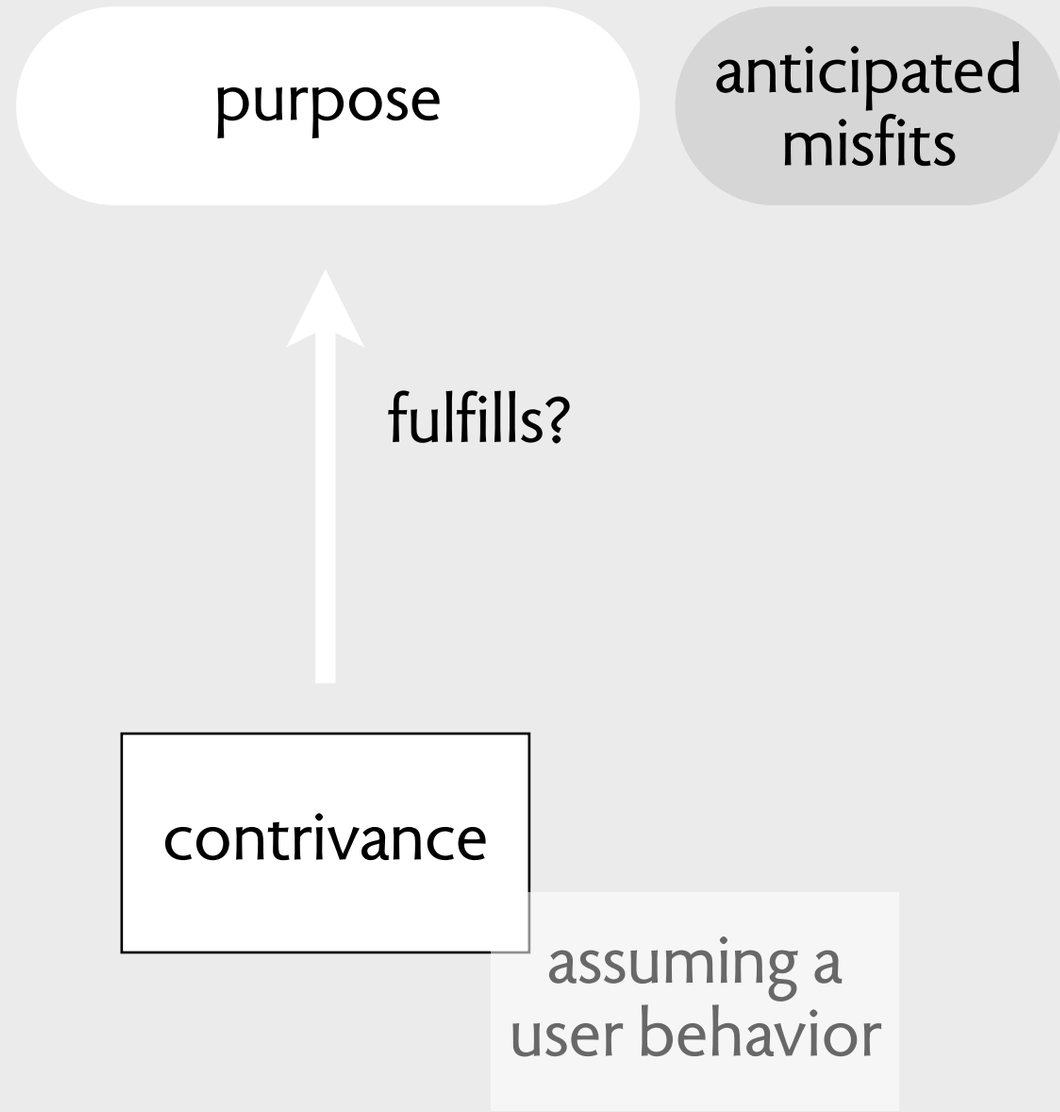
example: snap align



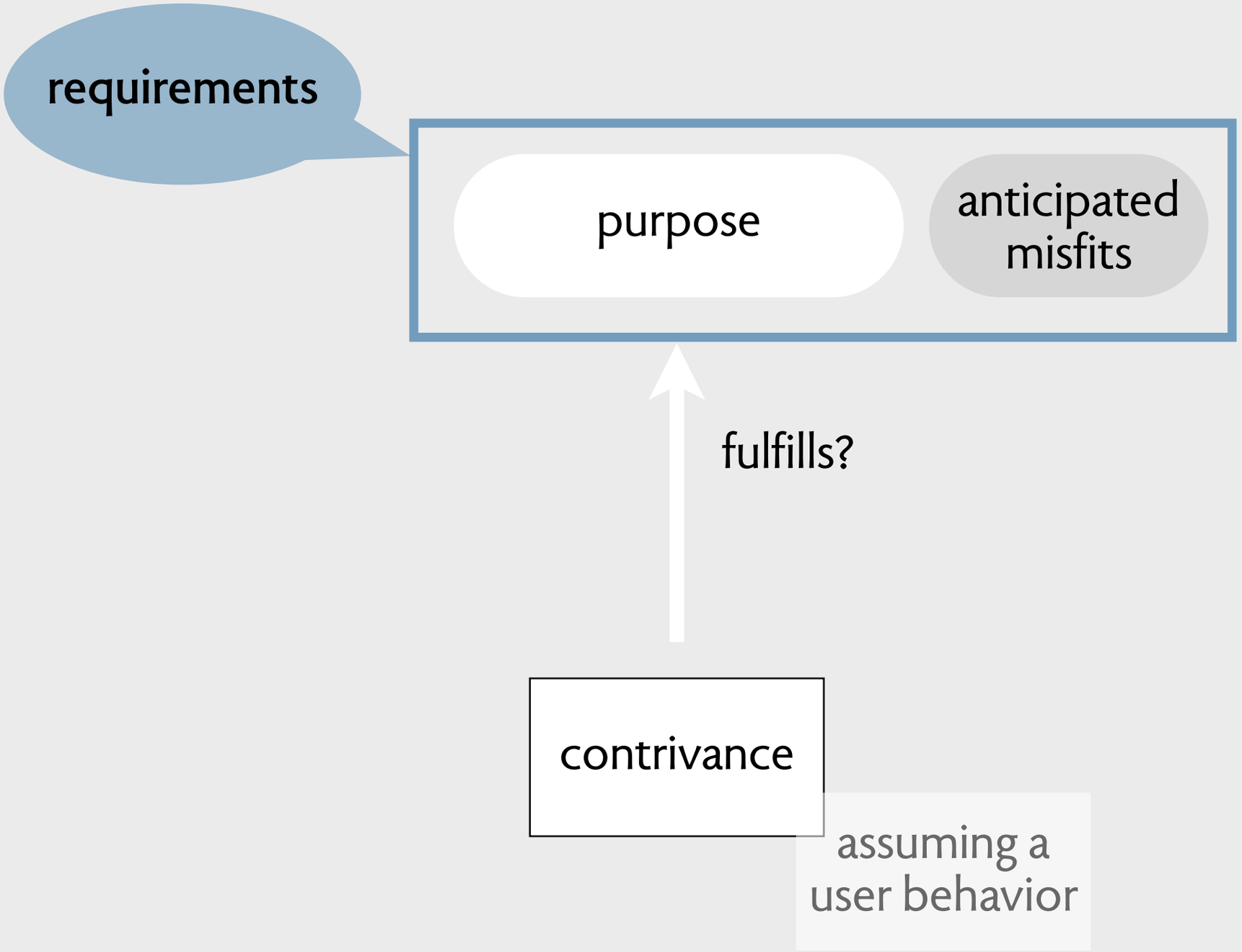
example: snap align



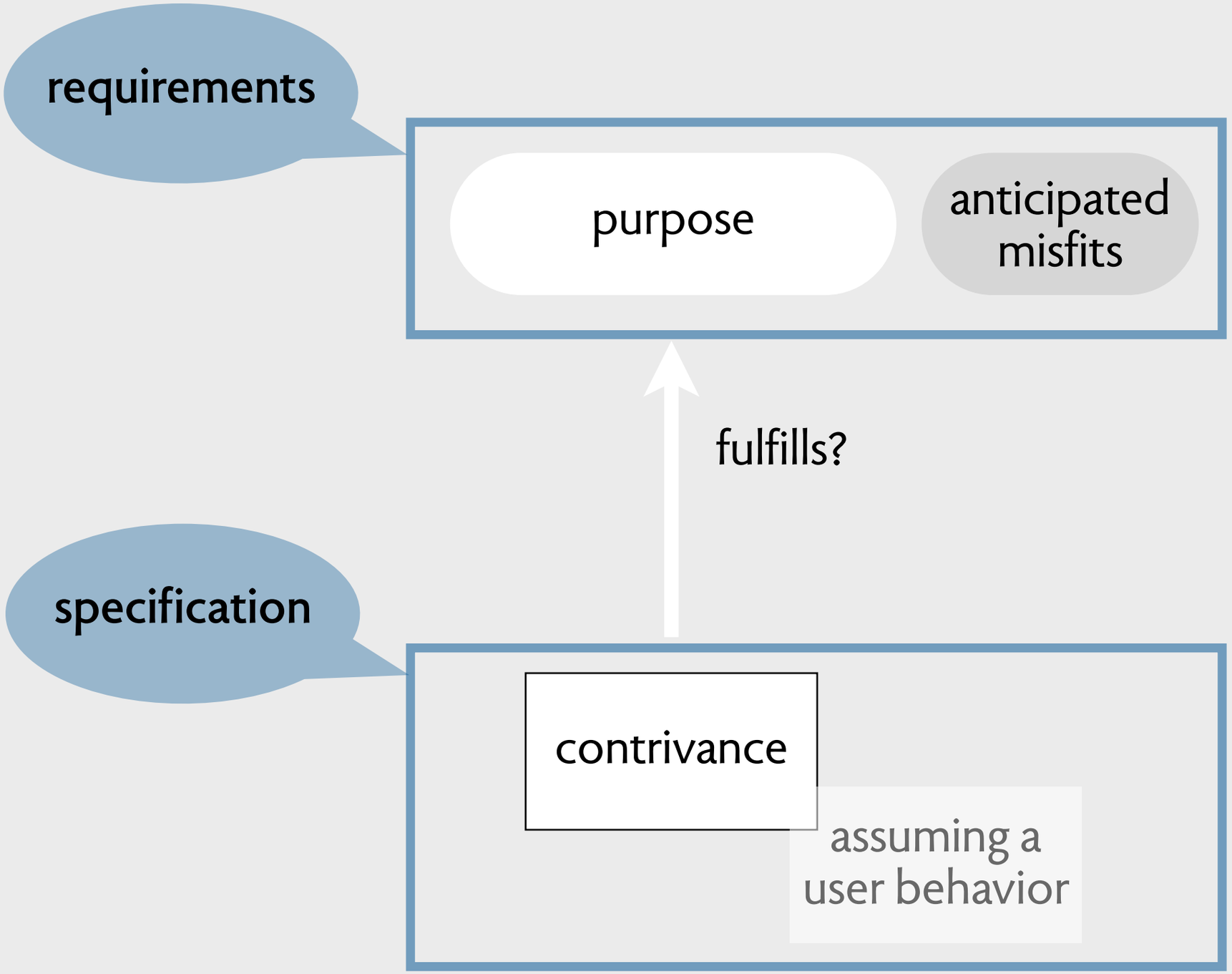
in conventional software terms



in conventional software terms

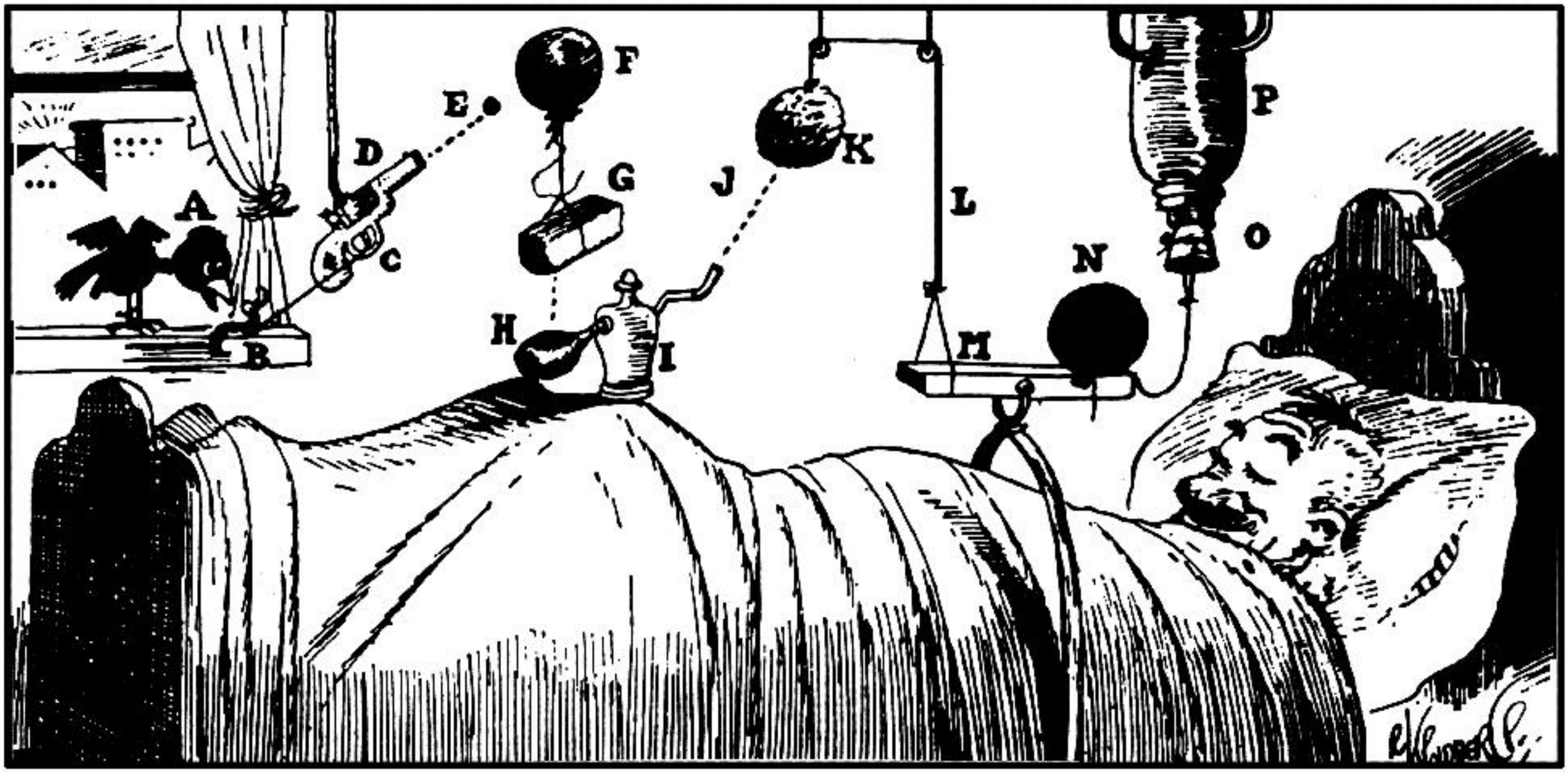


in conventional software terms



abstract affordances

Simple Alarm Clock



The early bird (**A**) arrives and catches worm (**B**), pulling string (**C**) and shooting off pistol (**D**). Bullet (**E**) busts balloon (**F**), dropping brick (**G**) on bulb (**H**) of atomizer (**I**) and shooting perfume (**J**) on sponge (**K**)–As sponge gains in weight, it lowers itself and pulls string (**L**), raising end of board (**M**)–Cannon ball (**N**) drops on nose of sleeping gentleman–String tied to cannon ball releases cork (**O**) of vacuum bottle (**P**) and ice water falls on sleeper's face to assist the cannon ball in its good work.

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New Alarm

Time | Alarm

Alarm Time: 6:00 AM

Alarm Date:

- (•) One time alarm

  4/16/2013

- ( ) Repeating alarm

Sun	Mon	Tue	Wed	Thu	Fri	Sat

[x] Enable Alarm

Delete | Cancel | OK

New Alarm

Invalid alarm time

Please select a date and time in the future.

OK

Alarm Date:

One time alarm

4/16/2013

Repeating alarm

Sun	Mon	Tue	Wed	Thu	Fri	Sat

Enable Alarm

Delete

Cancel

OK

New Alarm

Time | Alarm

Alarm Time: 6:00 AM

Alarm Date:

- (•) One time alarm

  4/17/2013

- ( ) Repeating alarm

Sun	Mon	Tue	Wed	Thu	Fri	Sat

[x] Enable Alarm

Delete | Cancel | OK

New Alarm

Time | Alarm

Alarm Time: 6:00 AM

Alarm Date:

One time alarm

4/17/2013

Repeating alarm

Sun	Mon	Tue	Wed	Thu	Fri	Sat

Enable Alarm

Delete | Cancel | OK

✓ 06:00 AM Tomorrow

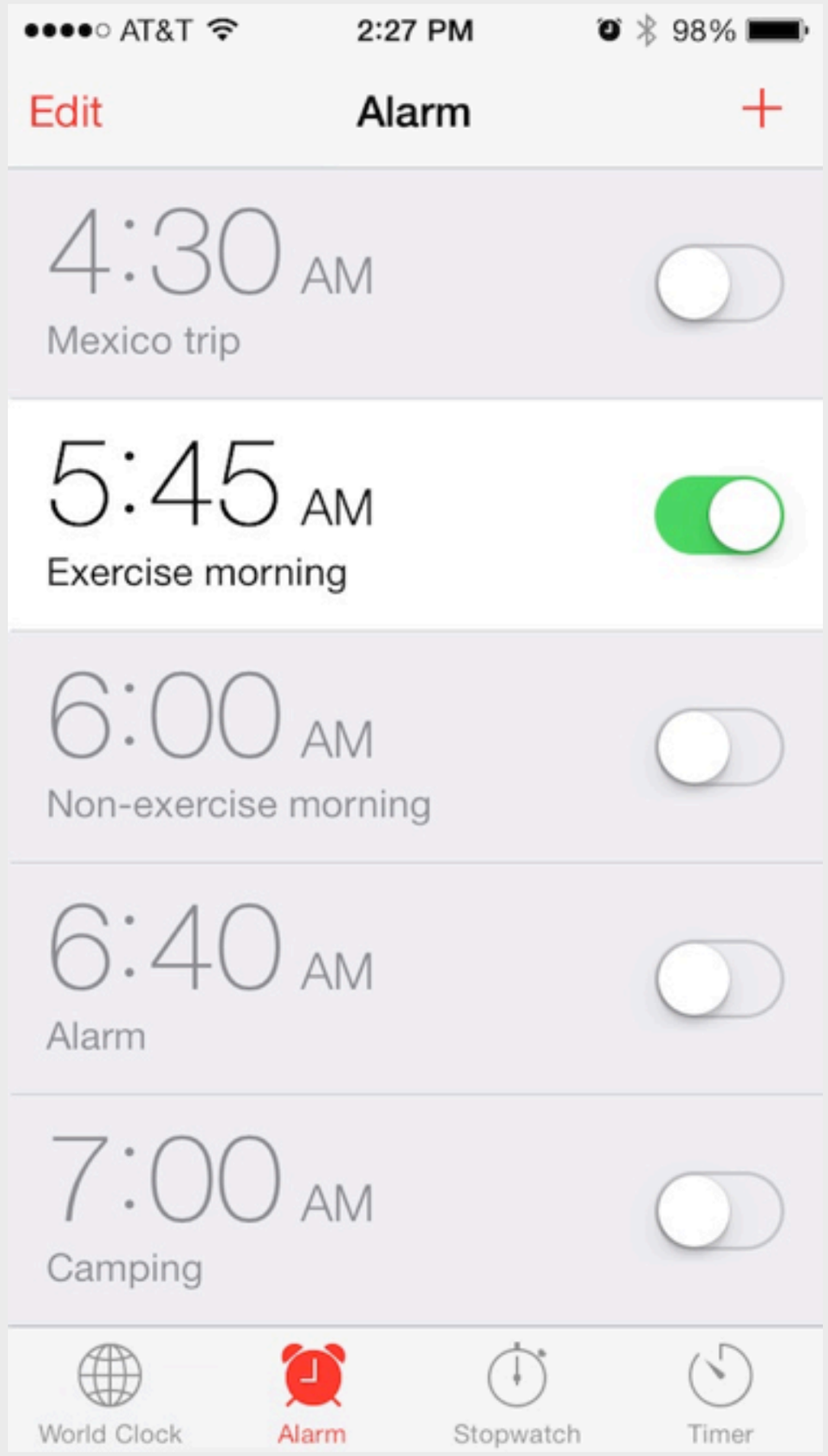
New Alarm...
New Timer...
New Stopwatch...

About Alarm Clock 2
Check for updates...
Preferences...

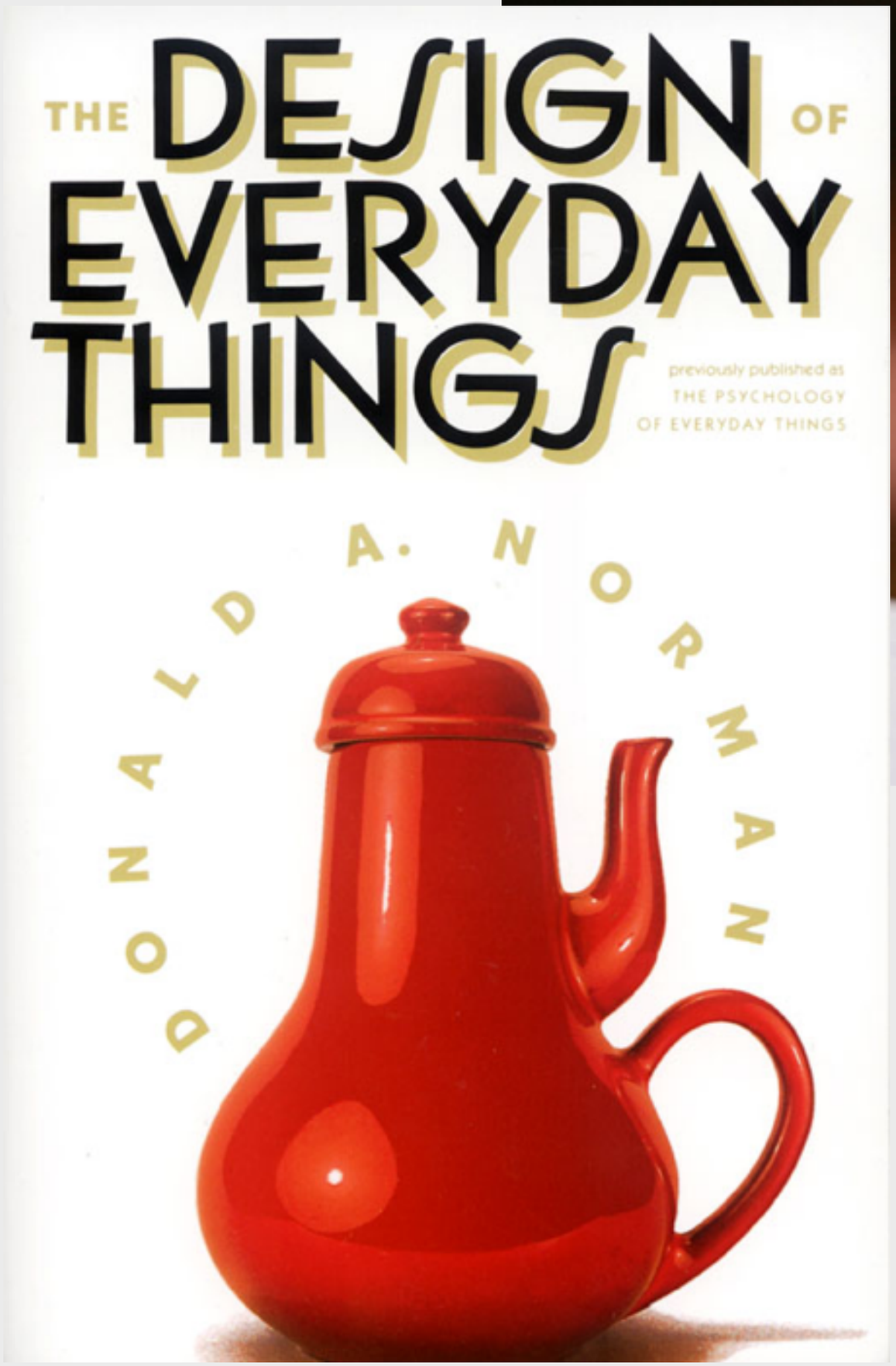
Quit

INVOTIS

CE


AT&T
2:27 PM
98%
Edit
Alarm
4:30 AM
Mexico trip
5:45 AM
Exercise morning
6:00 AM
Non-exercise morning
6:40 AM
Alarm
7:00 AM
Camping
World Clock
Alarm
Stopwatch
Timer

Donald Norman



Donald Norman

James Gibson (1977): “action possibilities” latent in environment

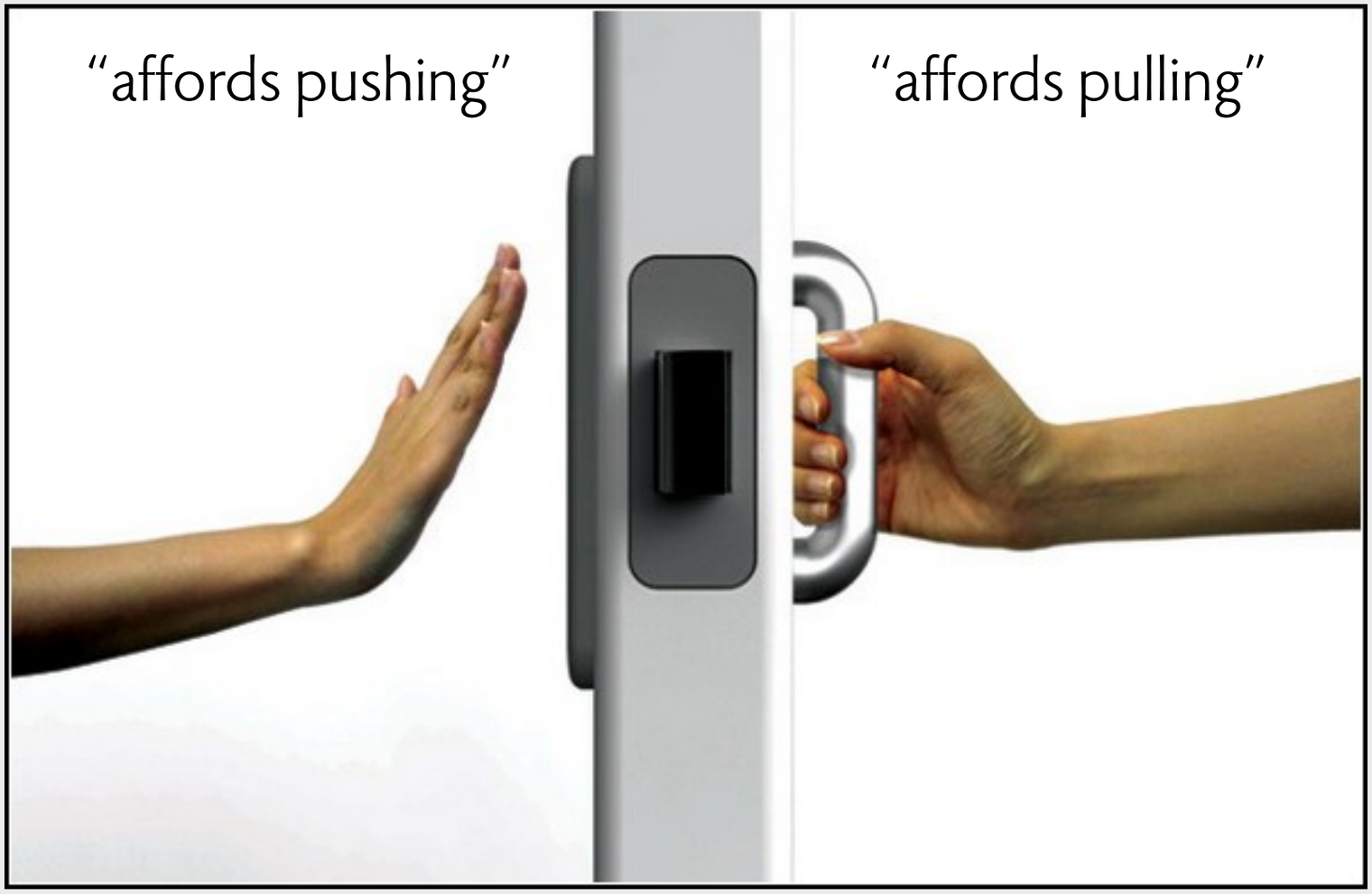
James Gibson (1977): “action possibilities” latent in environment

Donald Norman (1988): action possibilities that are perceivable

a door with good affordances

a door with good affordances

a door with good affordances



“norman doors”

“norman doors”

push or pull?

“norman doors”

push or pull?

door with user manual

“norman doors”

push or pull?

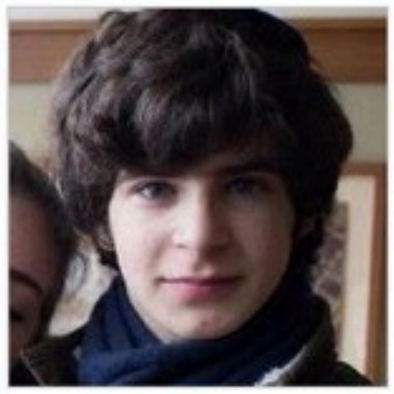
door with user manual

conflicting instructions

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

Who Is in These Photos?

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?

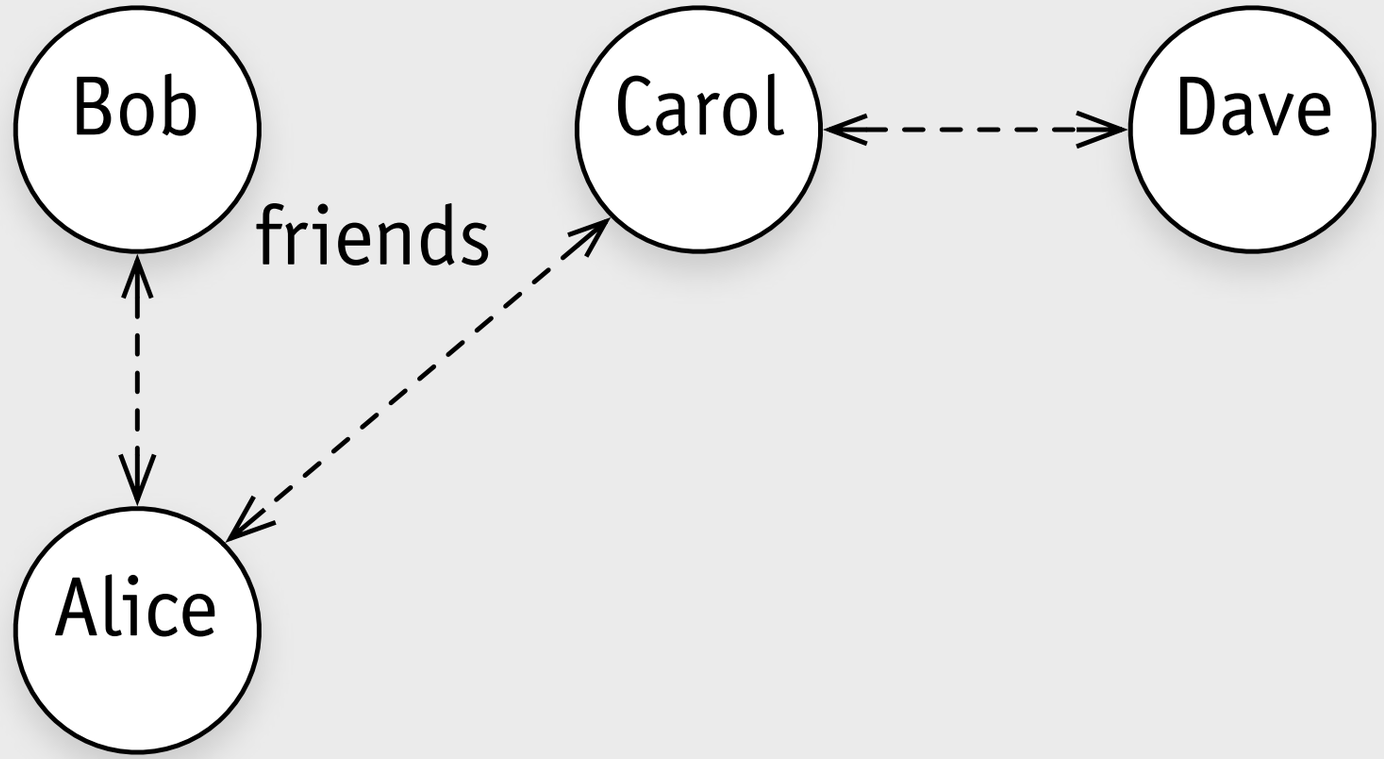
Who is this?

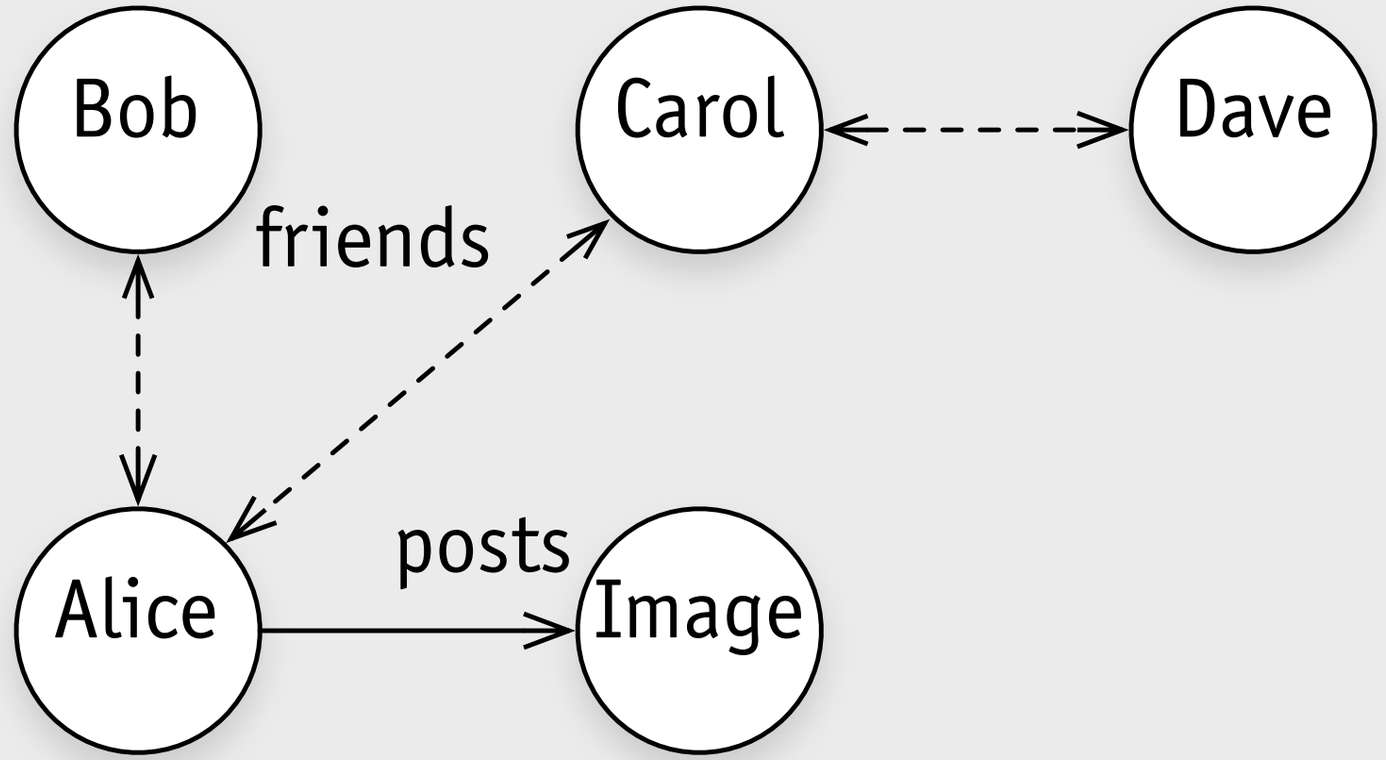
Skip Tagging Friends

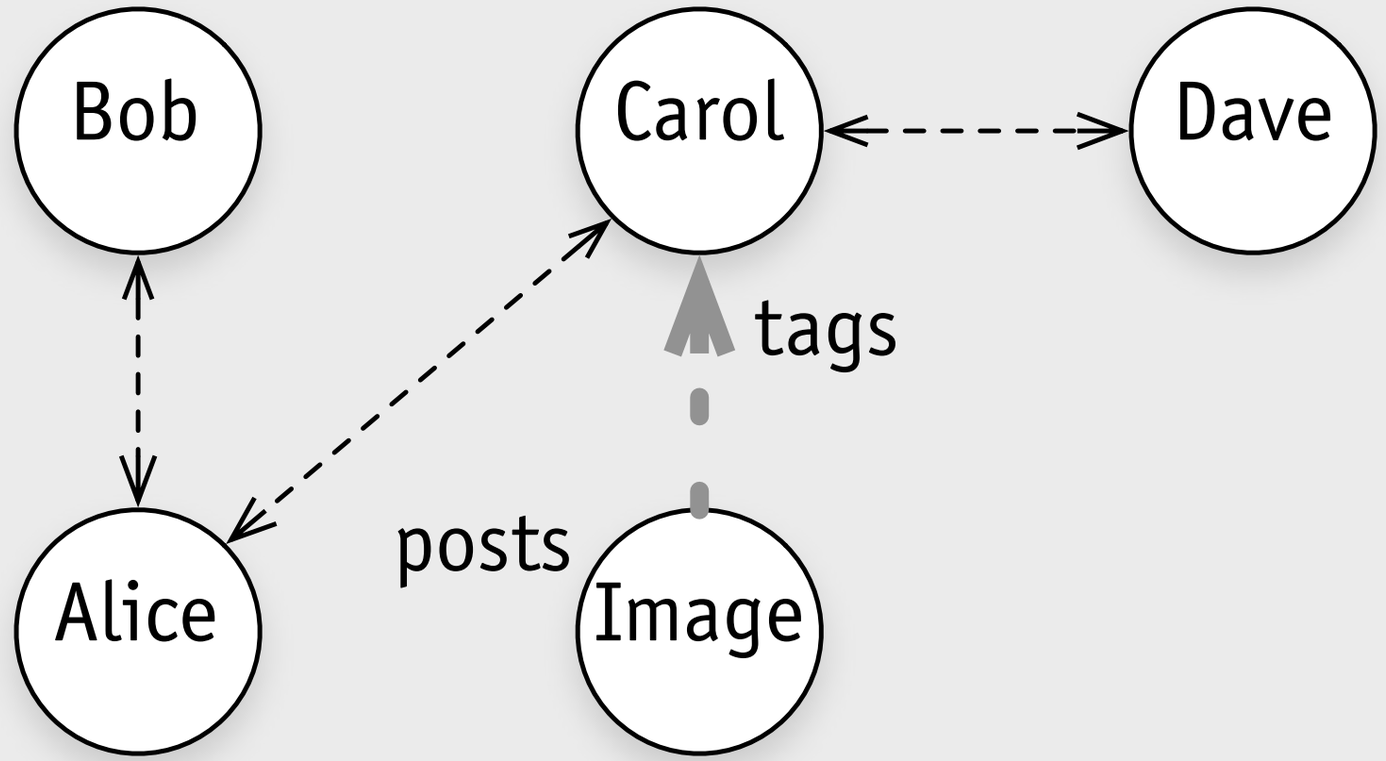
Save Tags

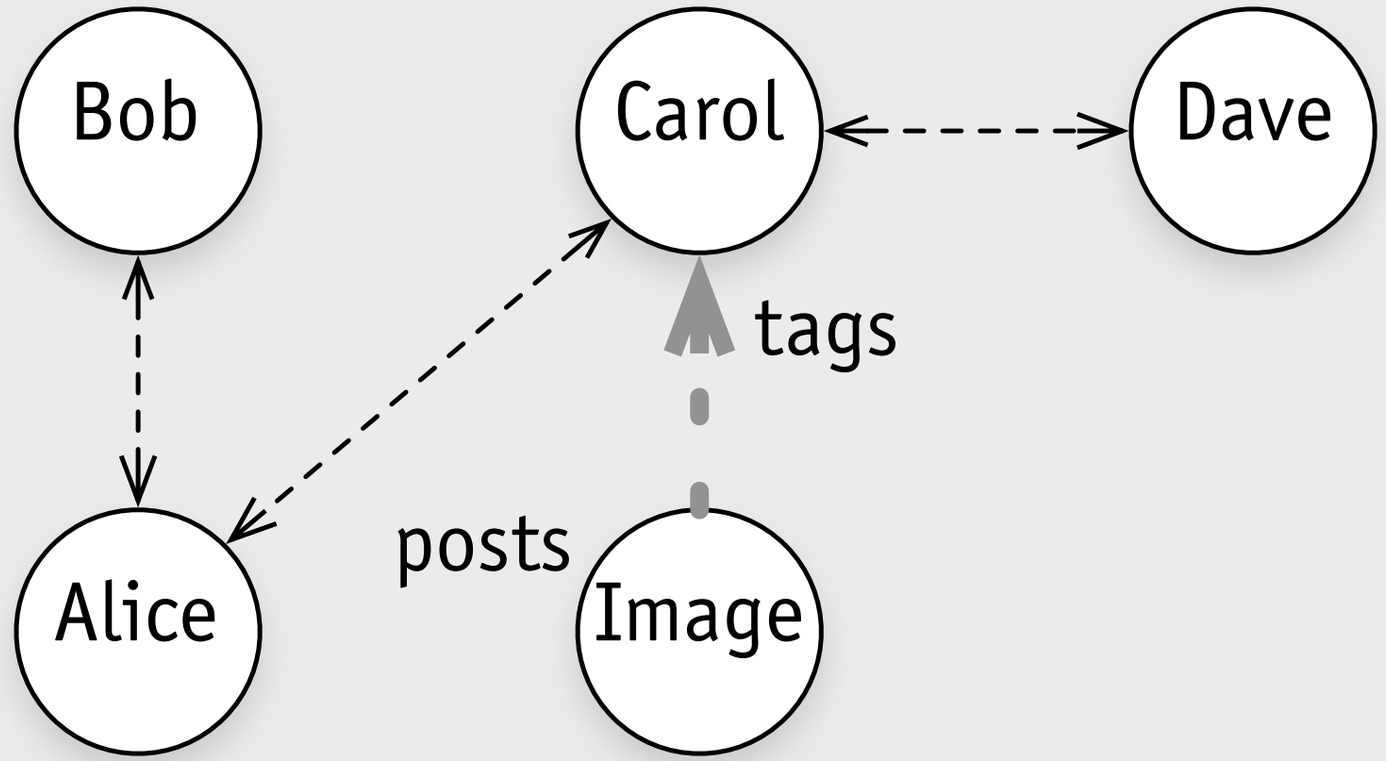
About Create an Ad Create a Page Developers Careers Privacy Cookies Terms Help

Facebook © 2013 · English (US)

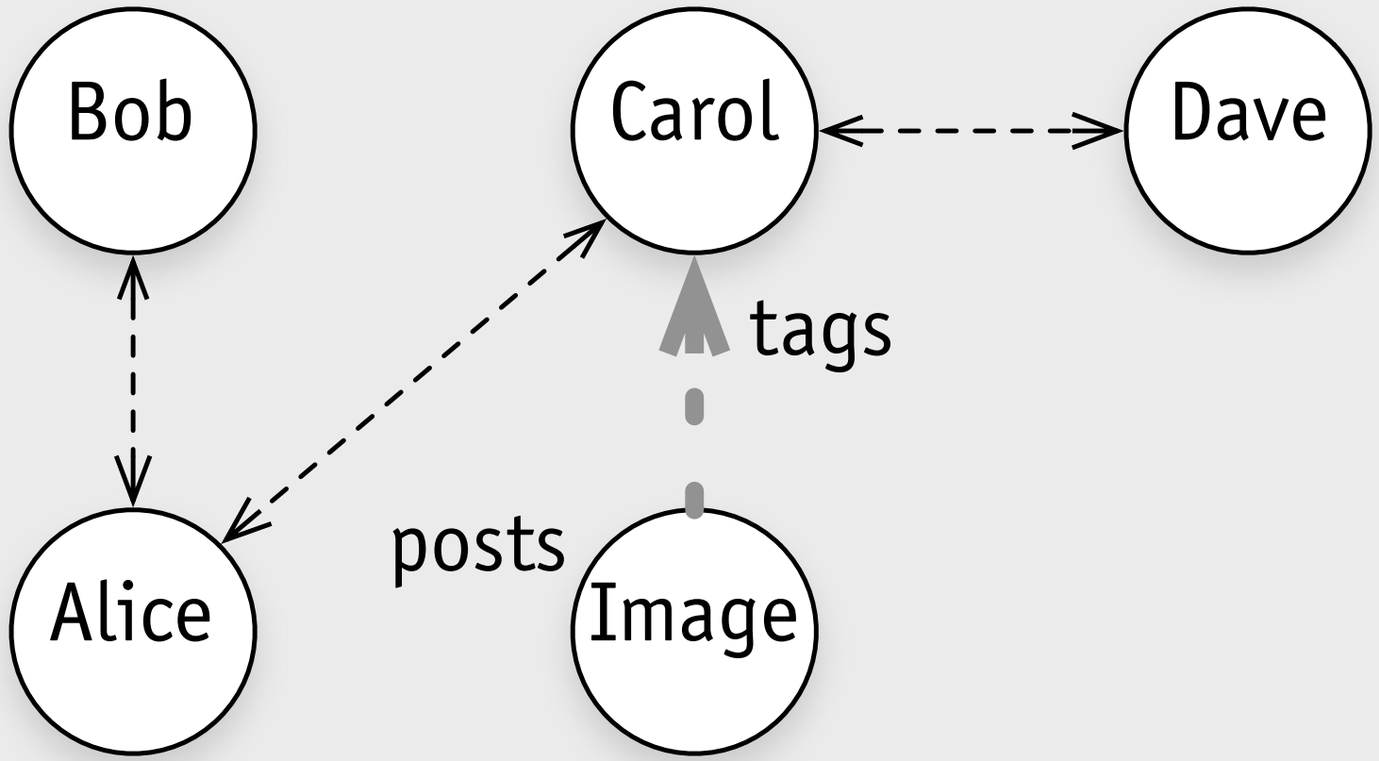

Bob
Carol
Dave
friends
Alice


Bob
Carol
Dave
friends
Alice
posts
Image


Bob
Carol
Dave
tags
posts
Alice
Image



who can see the image?



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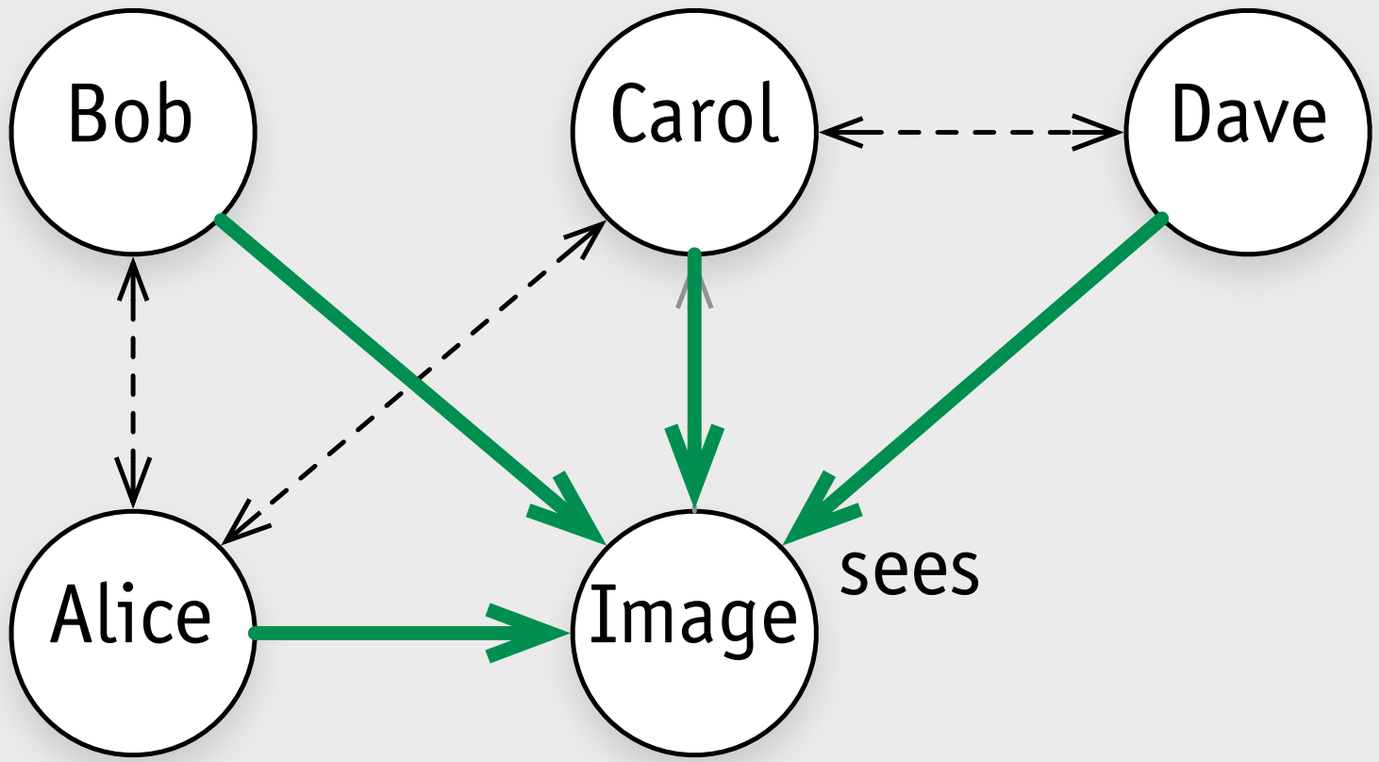
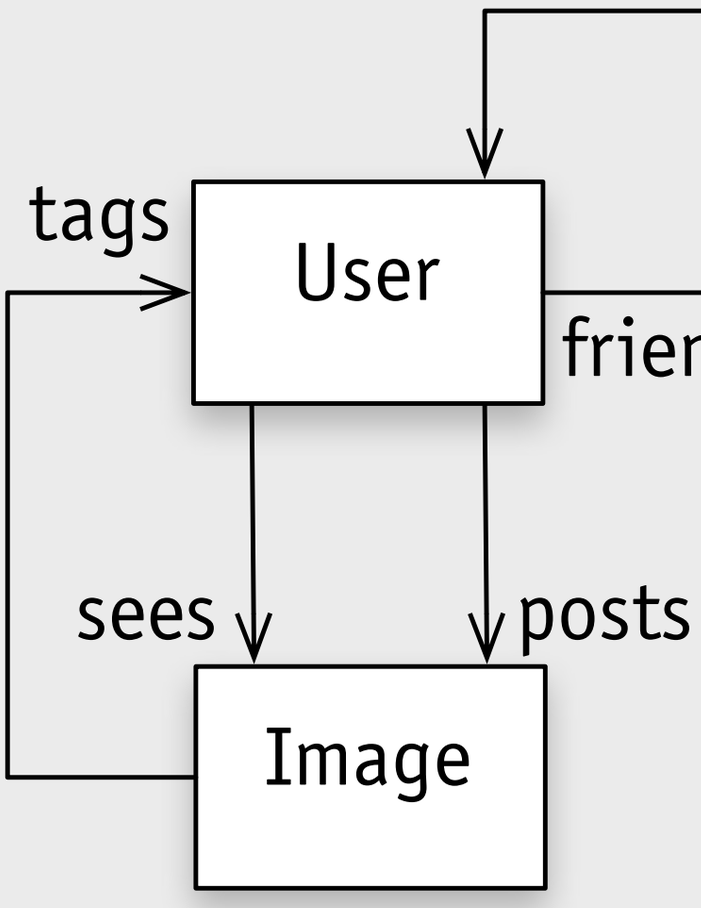
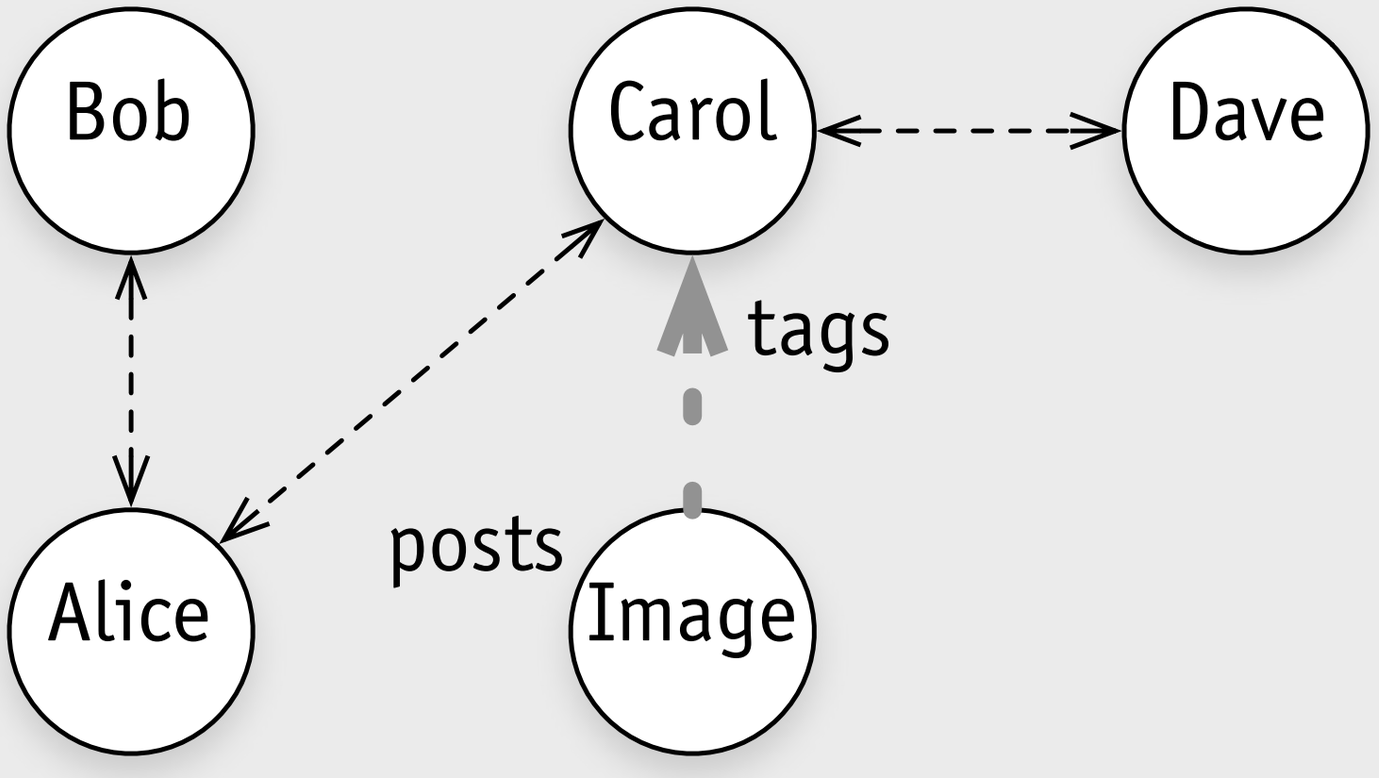
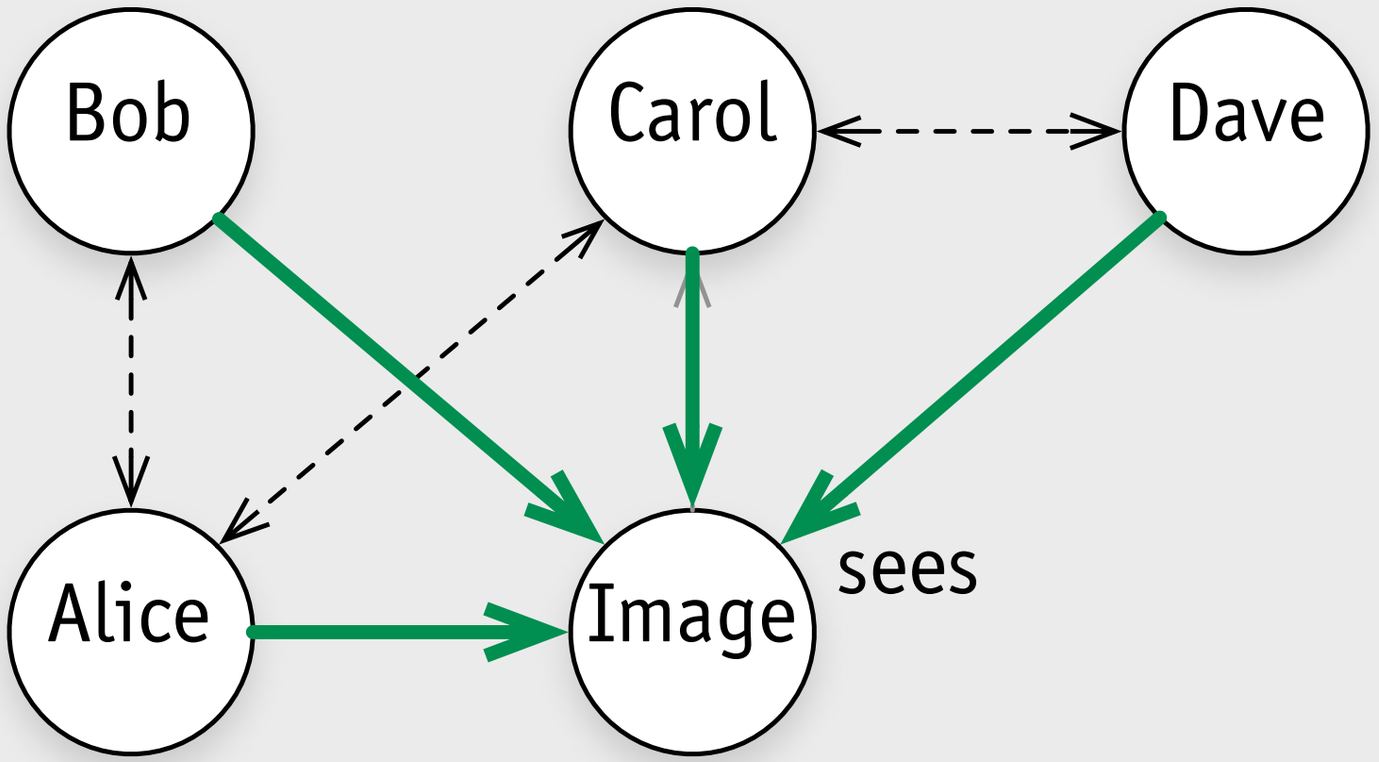






who can see the image?



what facebook says

When someone adds a tag to a photo or other post I shared, who can see it?

When someone adds a tag to something you shared, it's visible to:

- The audience you chose for the post or photo
- The person tagged in the post and their friends

what facebook says

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When someone adds a tag to something you shared, it's visible to:

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- The person tagged in the post and their friends

as a textual constraint in Alloy:

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

what facebook should say

When a psychopathic stranger takes a photo of me at a party and tags me, who can see it?

When someone adds a tag to something you didn’t share, it's visible to:

- All of their friends and fellow psychopaths
- All of your future employers, boyfriends, girlfriends and in-laws

lesson

lesson

for physical designs

effects are clear, if hard to predict

affordances connect actions to effects

lesson

for physical designs

effects are clear, if hard to predict

affordances connect actions to effects

for software designs

effects are often not clear

affordances become ‘abstract’

lesson

for physical designs

effects are clear, if hard to predict

affordances connect actions to effects

for software designs

effects are often not clear

affordances become ‘abstract’

so we need to

convey to users effects of actions

challenge: effects are indirect

design thinking

process

process

optimize organization & task structure

Taylor (1880s), Toyota JIT (1980s), CMM (1990s), agile (2000s)

“new” activities

“new” activities

brainstorming

"new" activities

brainstorming

user studies

"new" activities

brainstorming

user studies

prototypes

style

style

Dieter Rams, 1958
pocket transistor radio T3

style

Dieter Rams, 1958
pocket transistor radio T3

Henry Hobson Richardson, 1877
Trinity Church, Boston

style

Dieter Rams, 1958
pocket transistor radio T3

Henry Hobson Richardson, 1877
Trinity Church, Boston

Leica, 1953
M3 rangefinder camera

style

Dieter Rams, 1958
pocket transistor radio T3

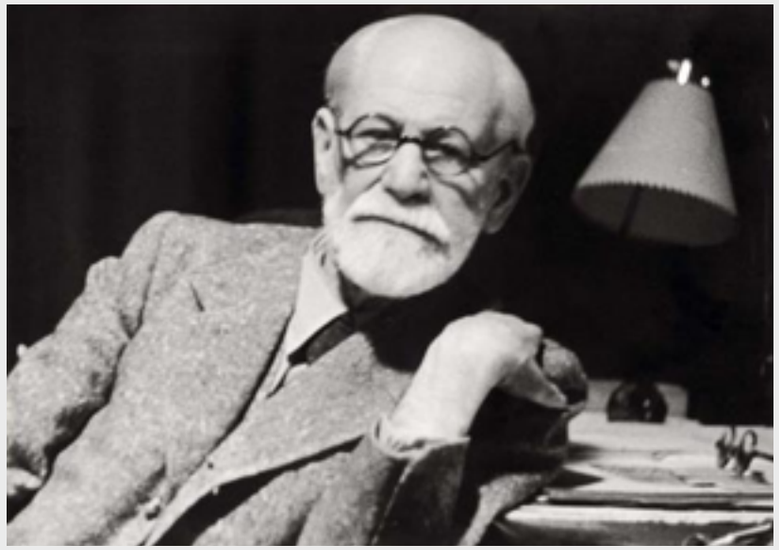
Henry Hobson Richardson, 1877
Trinity Church, Boston

Alfonso Bialetti, 1933
La Moka coffee maker

Leica, 1953
M3 rangefinder camera

broadening

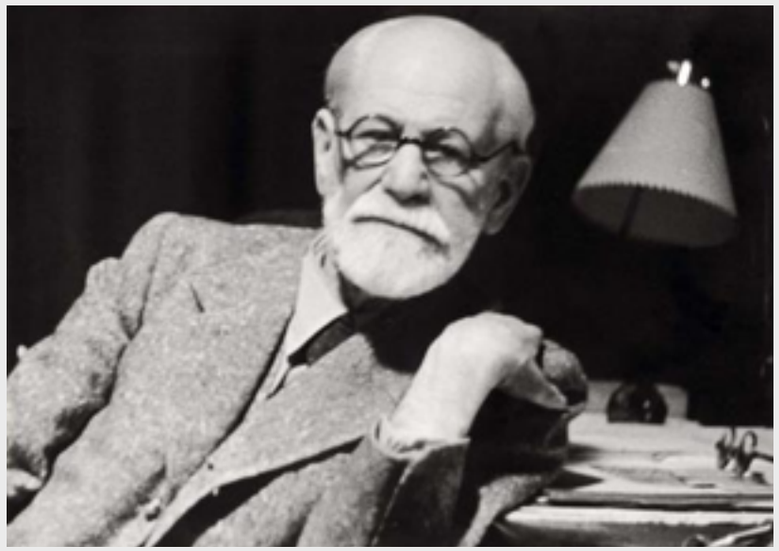
broadening



psychology

broadening

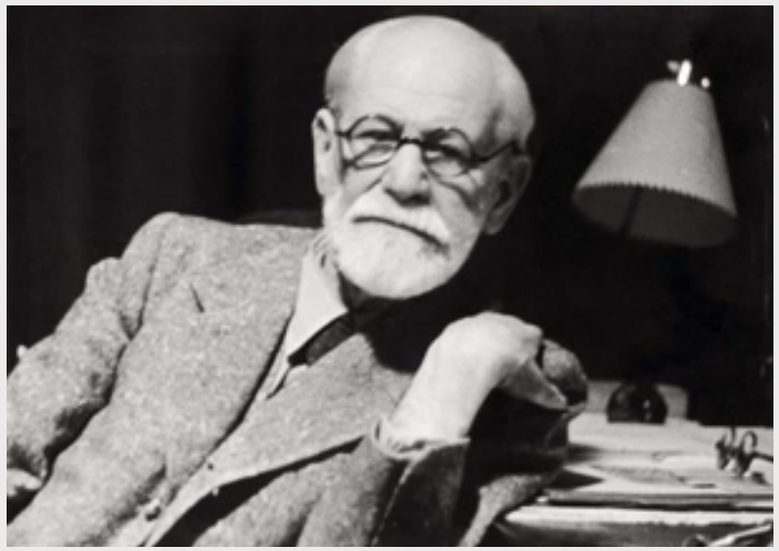
anthropology



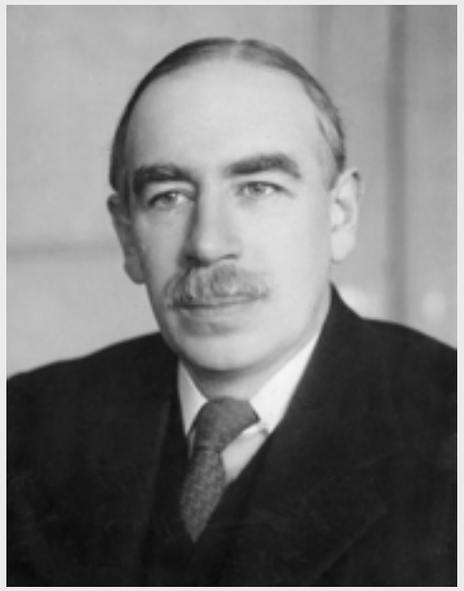
psychology

broadening

anthropology



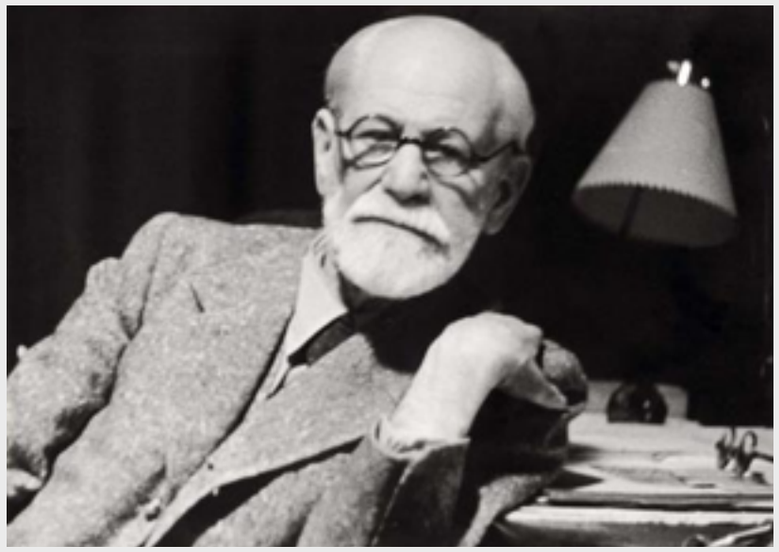
psychology



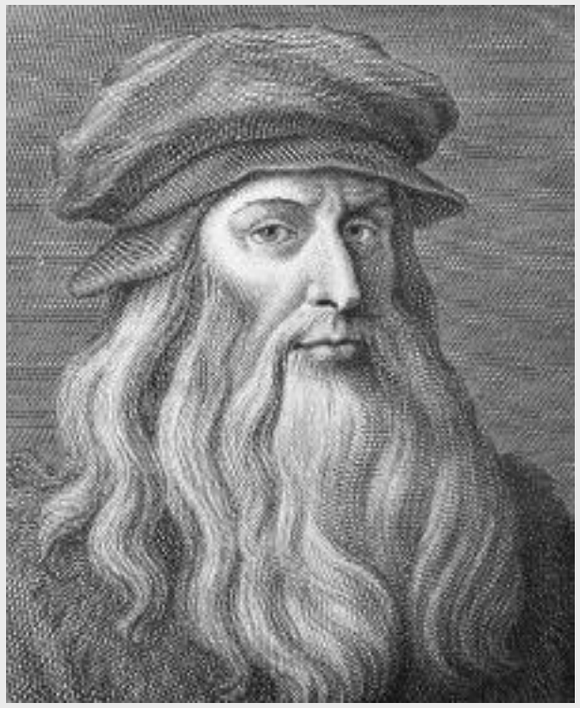
economics

broadening

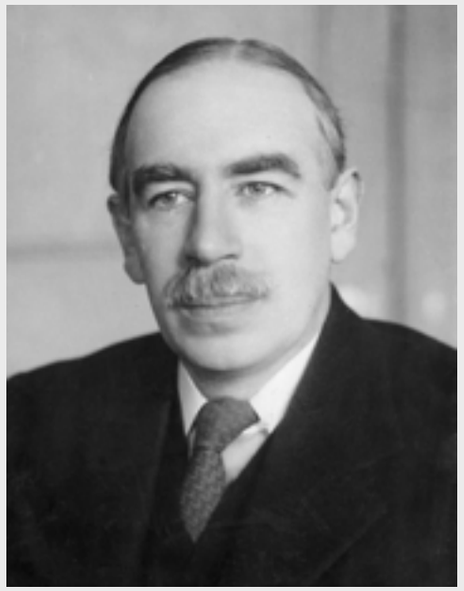
anthropology



psychology



art



economics

nature of software design

fred brooks: essence and accident

fred brooks: essence and accident

[T]o see what rate of progress one can expect in software technology, let us examine the difficulties of that technology. Following Aristotle, I divide them into **essence**, the difficulties inherent in the nature of software, and **accidents**, those difficulties that today attend its production but are not inherent.

fred brooks: essence and accident

[T]o see what rate of progress one can expect in software technology, let us examine the difficulties of that technology. Following Aristotle, I divide them into **essence**, the difficulties inherent in the nature of software, and **accidents**, those difficulties that today attend its production but are not inherent.

The **essence of a software entity is a construct of interlocking concepts**: data sets, relationships among data items, algorithms, and invocations of functions. This essence is abstract in that such a conceptual construct is the same under many different representations. It is nonetheless highly precise and richly detailed.

fred brooks: essence and accident

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The **essence of a software entity is a construct of interlocking concepts**: data sets, relationships among data items, algorithms, and invocations of functions. This essence is abstract in that such a conceptual construct is the same under many different representations. It is nonetheless highly precise and richly detailed.

I believe **the hard part** of building software to be the specification, design, and testing of **this conceptual construct, not the labor of representing it** and testing the fidelity of the representation. We still make syntax errors, to be sure; but they are fuzz compared with the conceptual errors in most systems.

mental models