

concepts in software design

Daniel Jackson · IFIP 2.3 · Orlando · May 2014

a puzzle

premise: large software systems are intricate and complex beyond human comprehension so no chance of achieving reliability by informal reasoning

so how did software get so reliable without proof?
better management, testing, type safety, etc [Hoare 96]

but maybe premise was wrong?

part 0

what are concepts?

part 1

concepts illustrated

part 2

concepts described

part 3

design flaws illustrated

part 4

design flaws described

part 0

what are concepts?

designing behavior

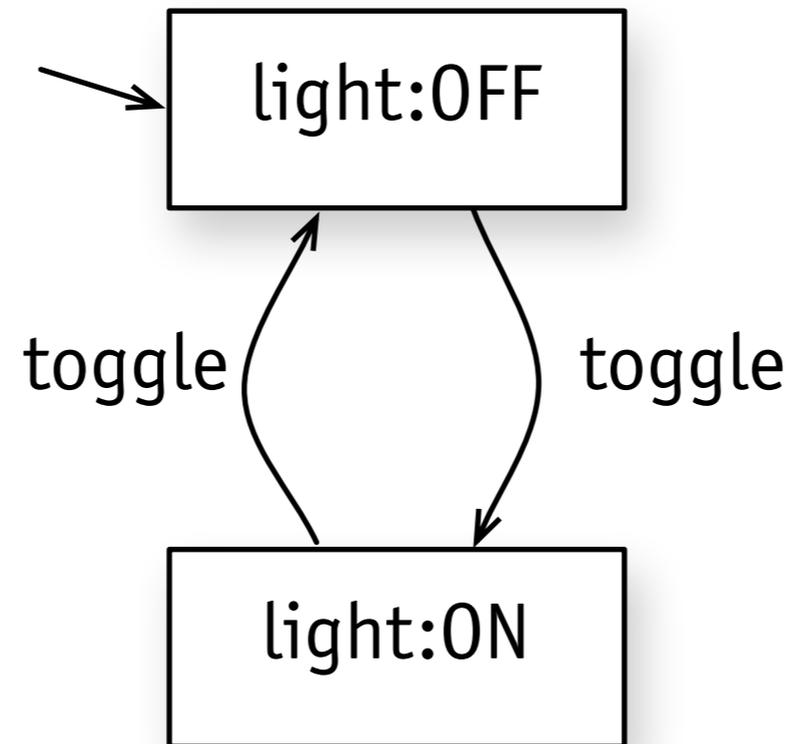
step 1: phenomena

identify phenomena (eg, events, states)
things that matter in the context of use

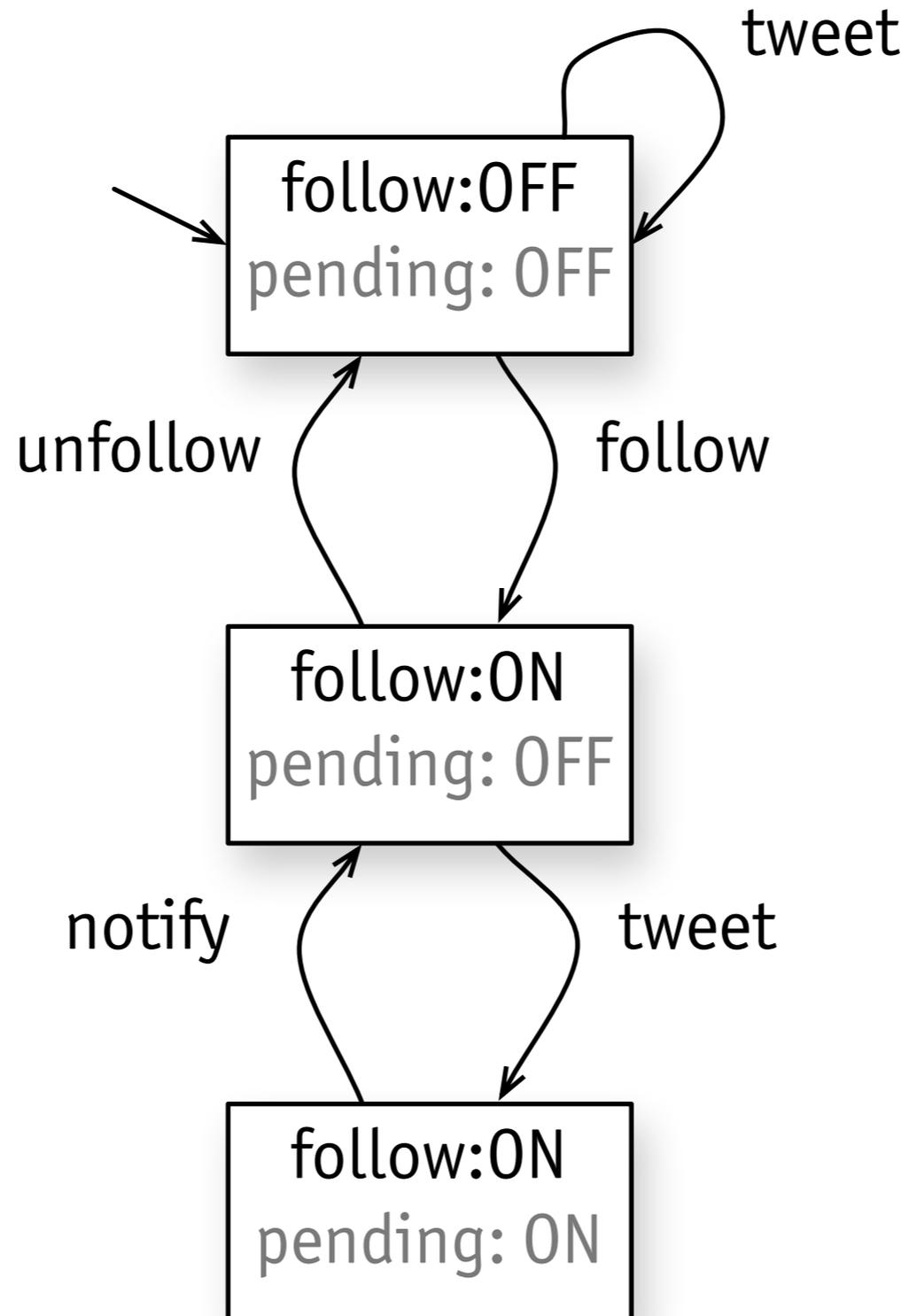
step 2: behaviors

constrain behaviors over phenomena
as traces, state machine, etc

example flashlight

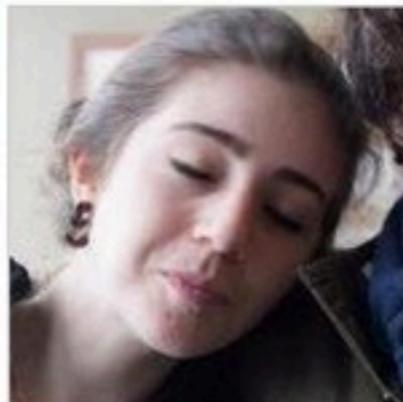


example twitter



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.

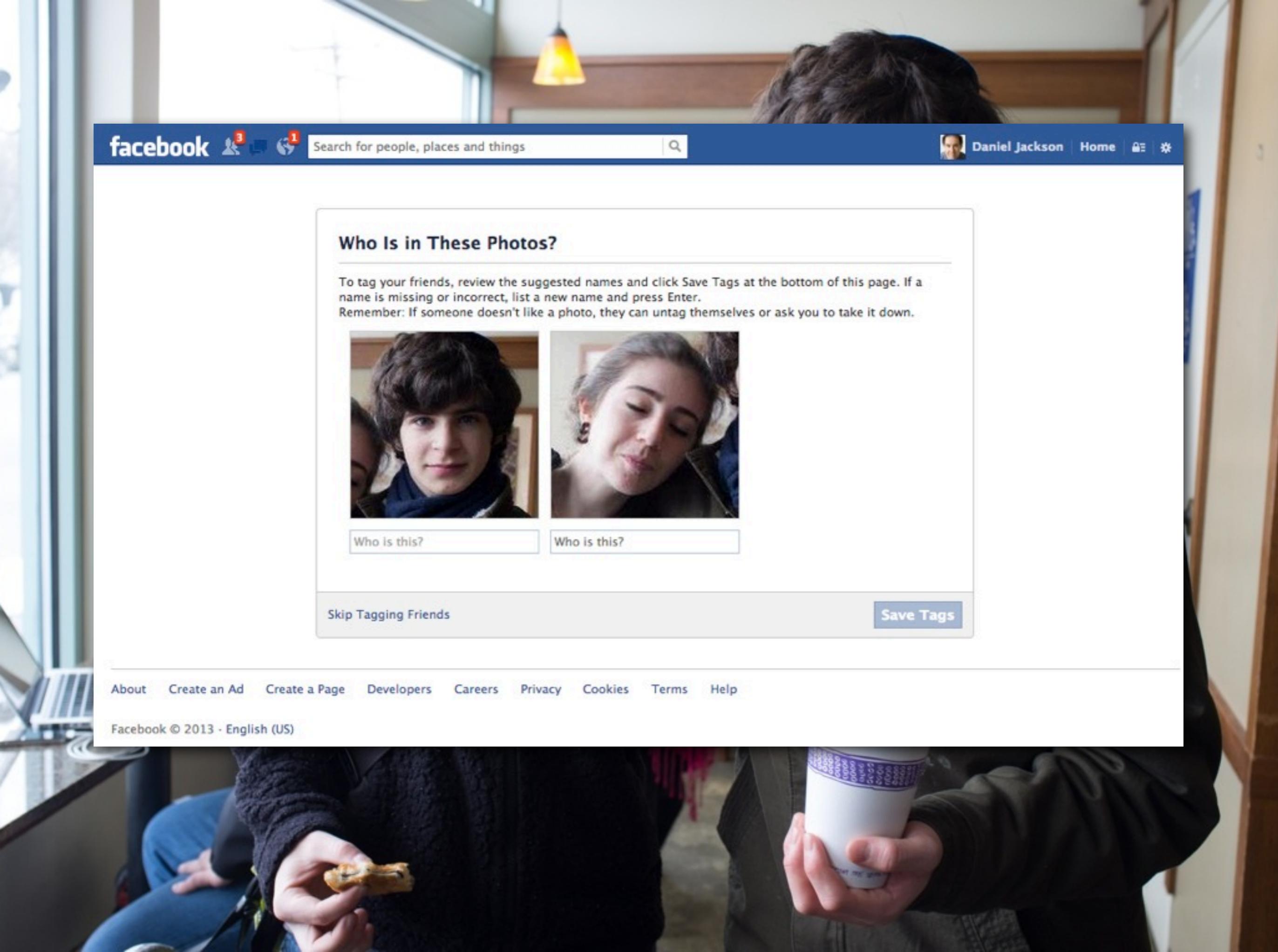


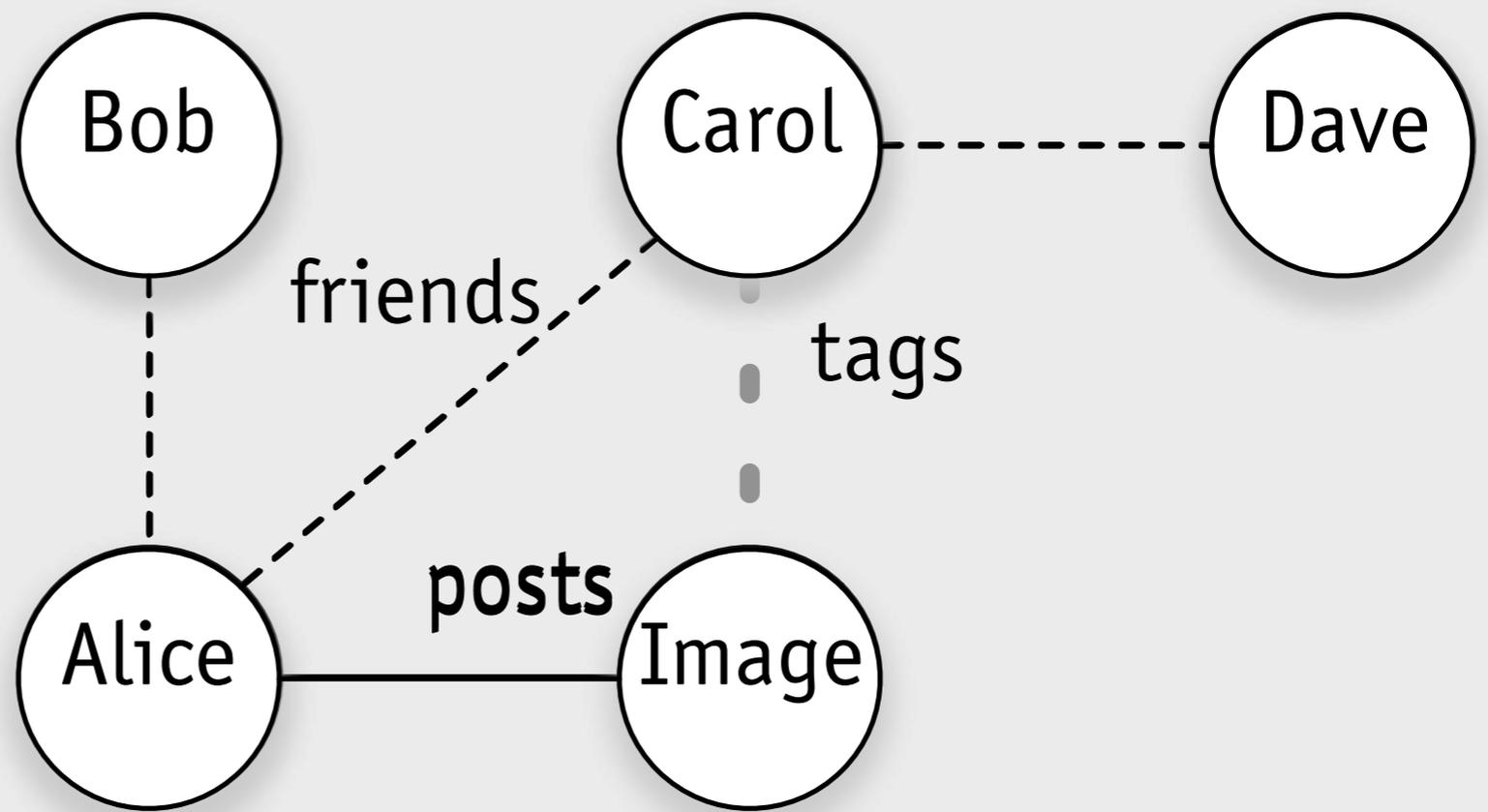
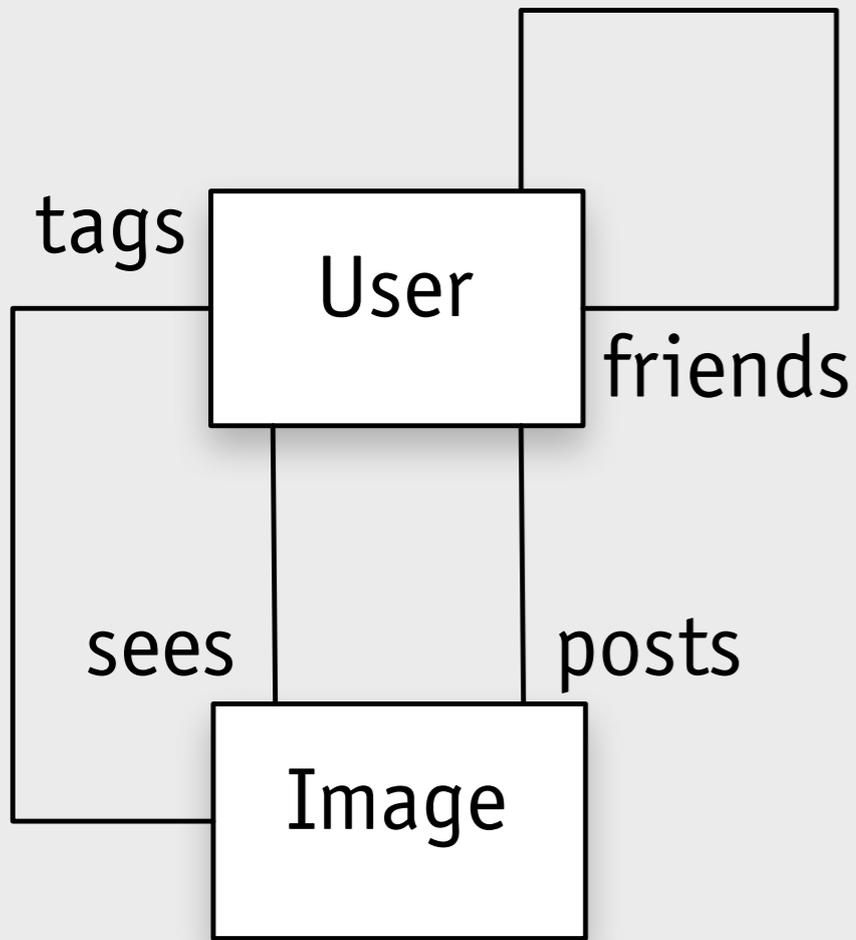
Who is this?

Who is this?

[Skip Tagging Friends](#)

[Save Tags](#)



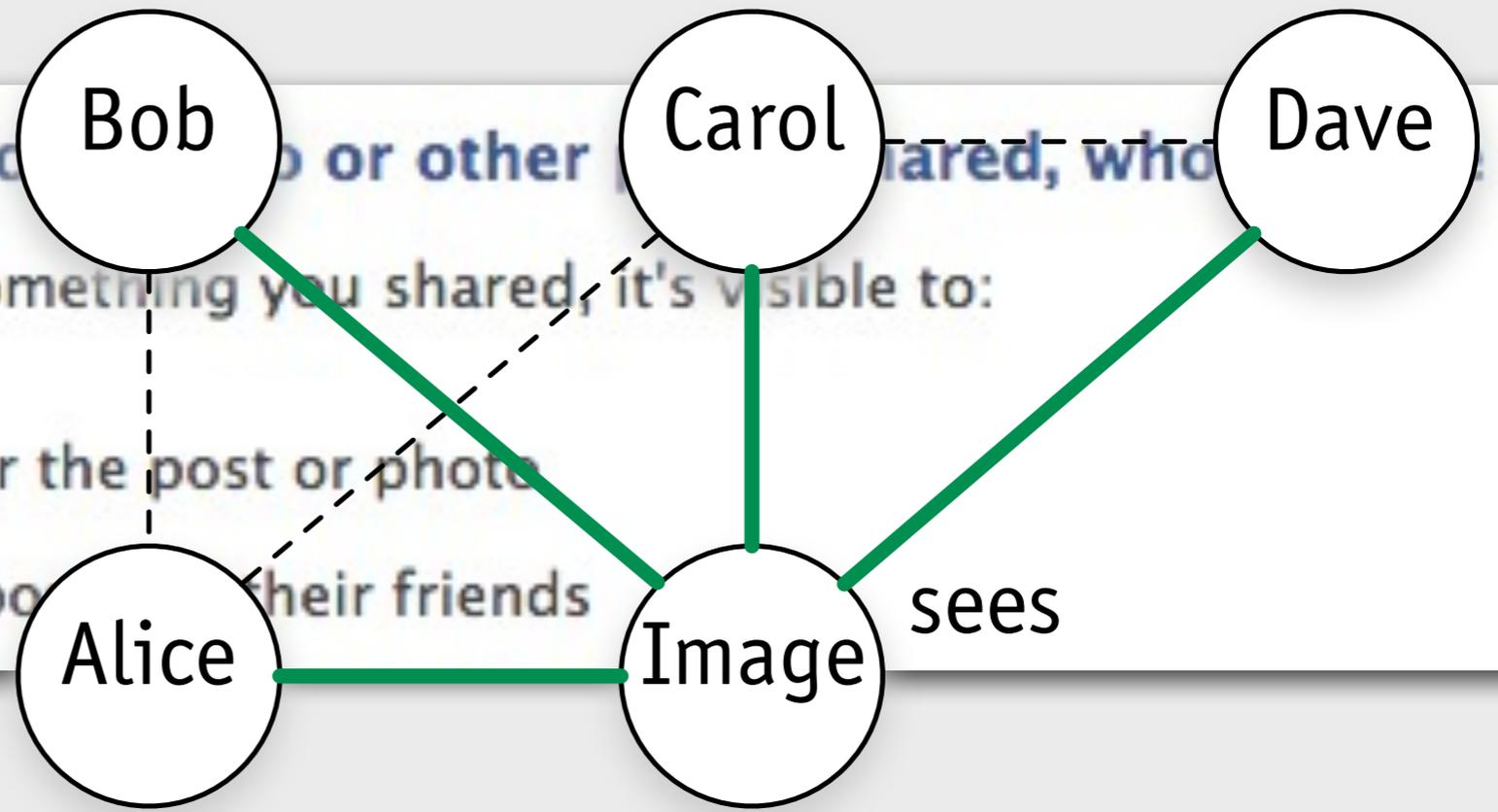


who can see the image?

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

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

1. The audience you chose for the post or photo
2. The person tagged in the post and their friends



designing behavior (revisited)

step 1: phenomena

identify phenomena (eg, events, states)
things that matter in the context of use

step 2: concepts

invent concepts to explain behavior

step 3: behaviors

constrain behaviors over phenomena
as traces, state machine, etc

a hypothesis

the quality of the concepts
in a software system's design
is (often) the determining factor
in whether the system is
usable, buildable, reliable

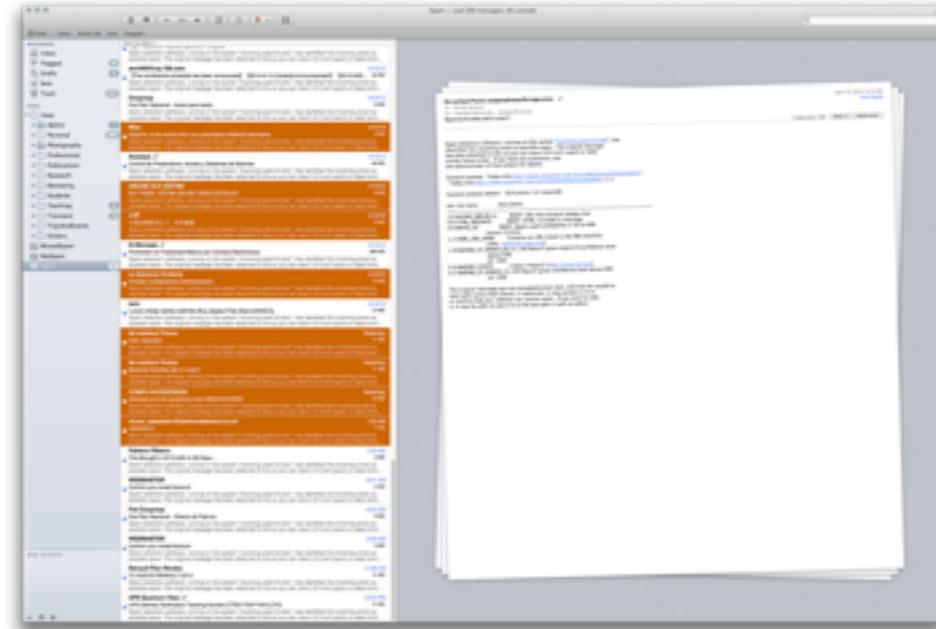
part 1

concepts illustrated

#1



selection in Lr



in Apple Mail



in Keynote

variants

>1 selection/document

contiguity

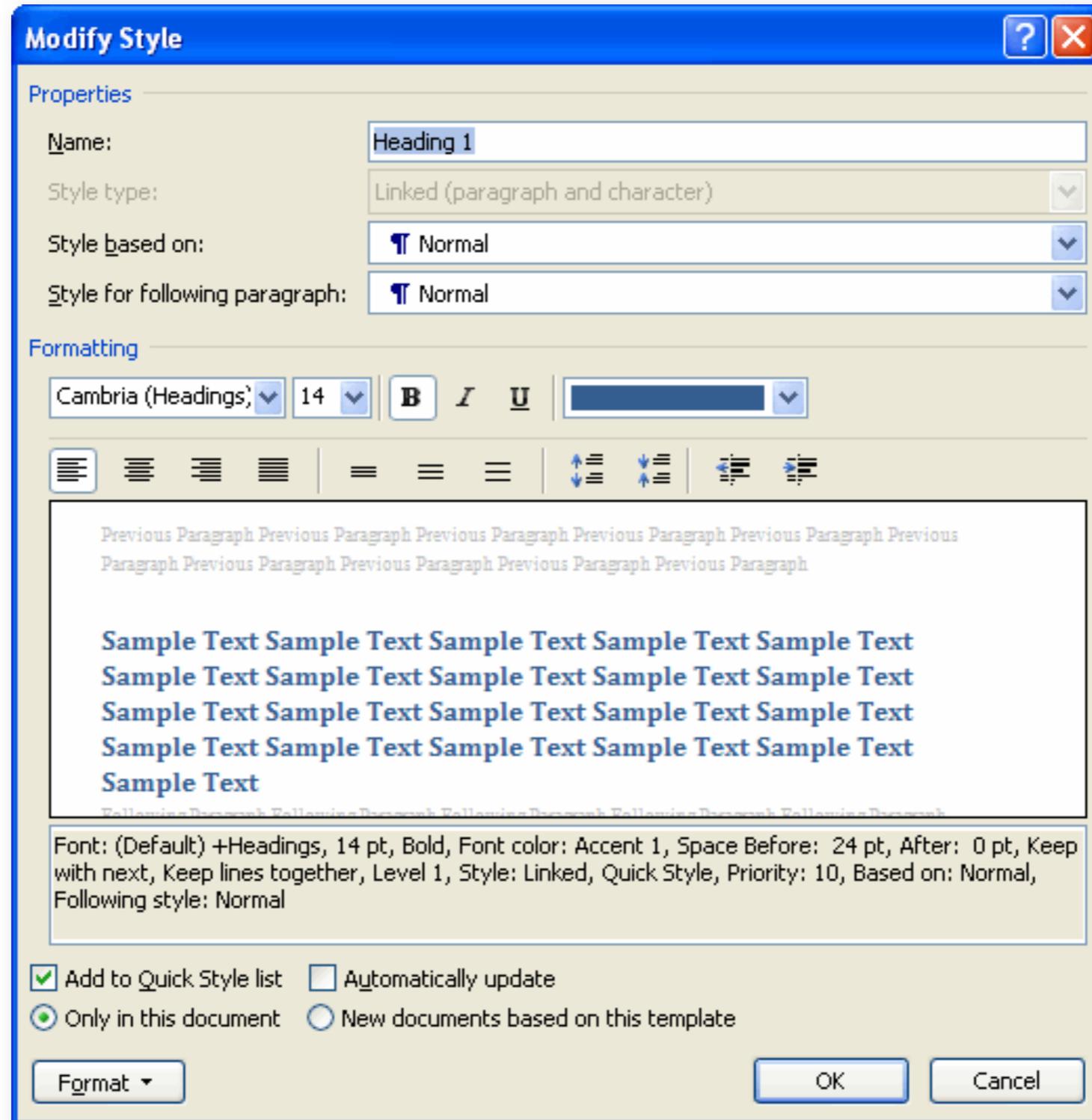
active element too

selection within groups

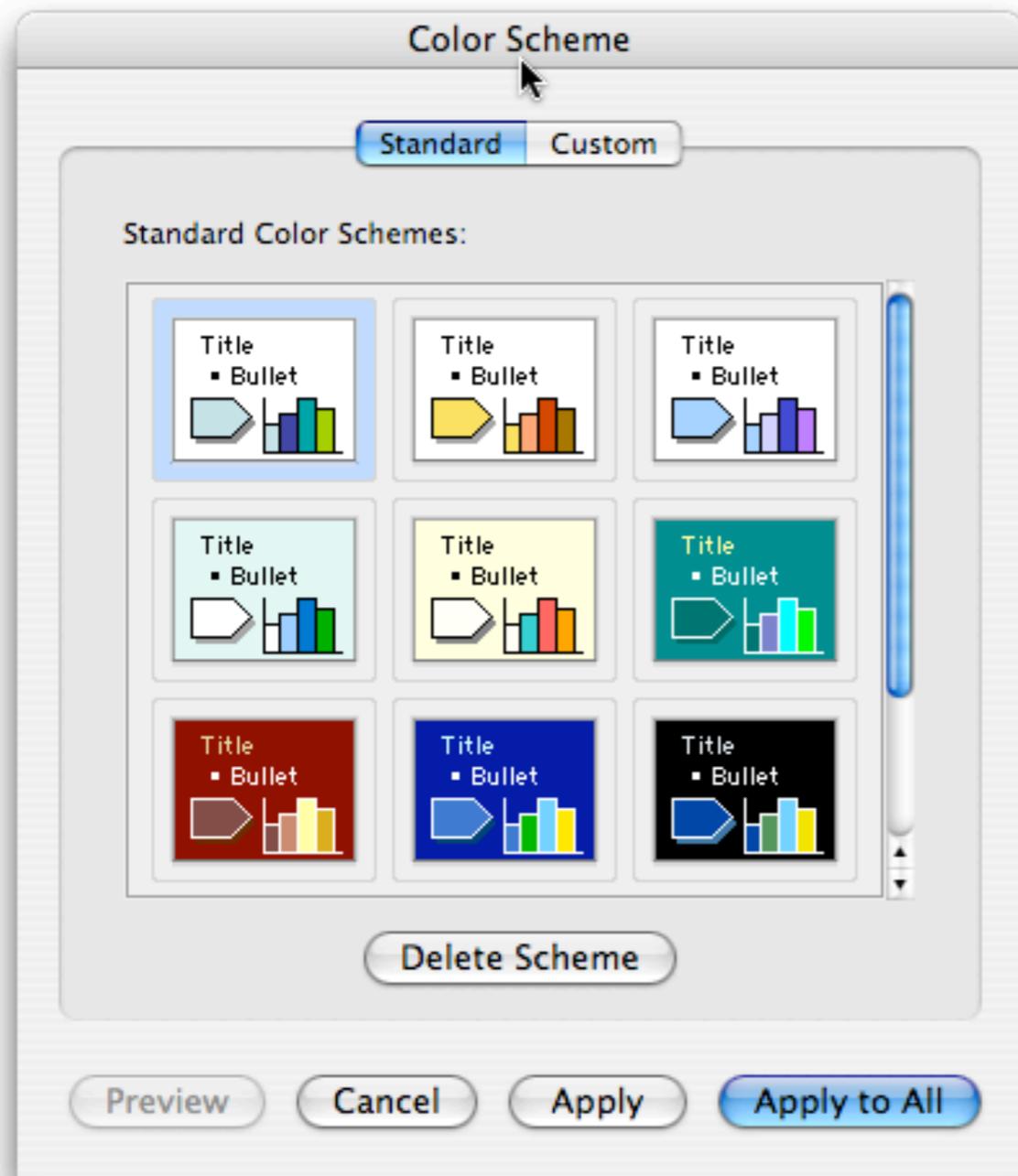
selection across groups

selection in [0..1]

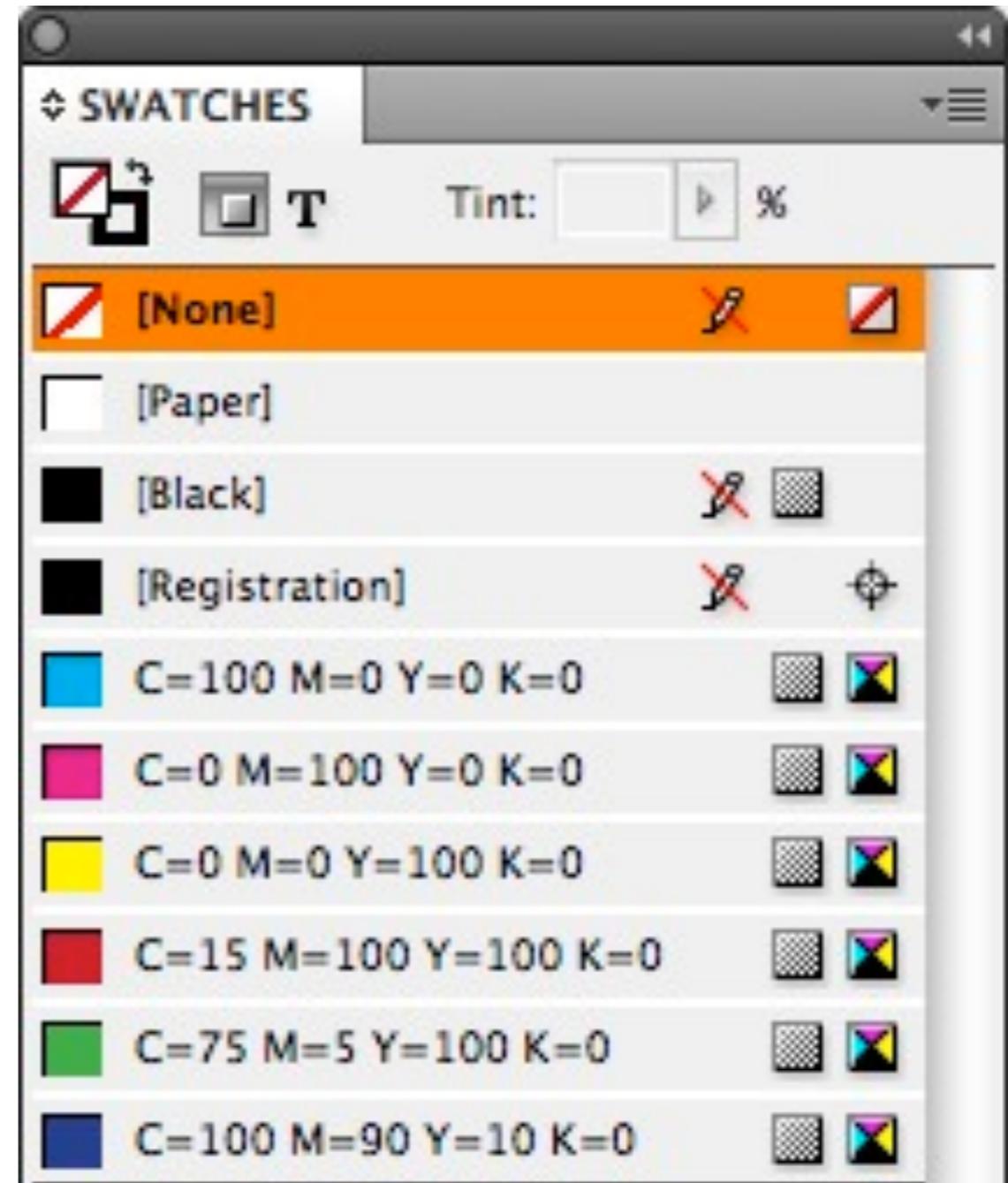
#2



styles in Microsoft Word



themes in Powerpoint



swatches in Indesign

variants

style sheet

style inheritance

applying subset of props

part 2

concepts described

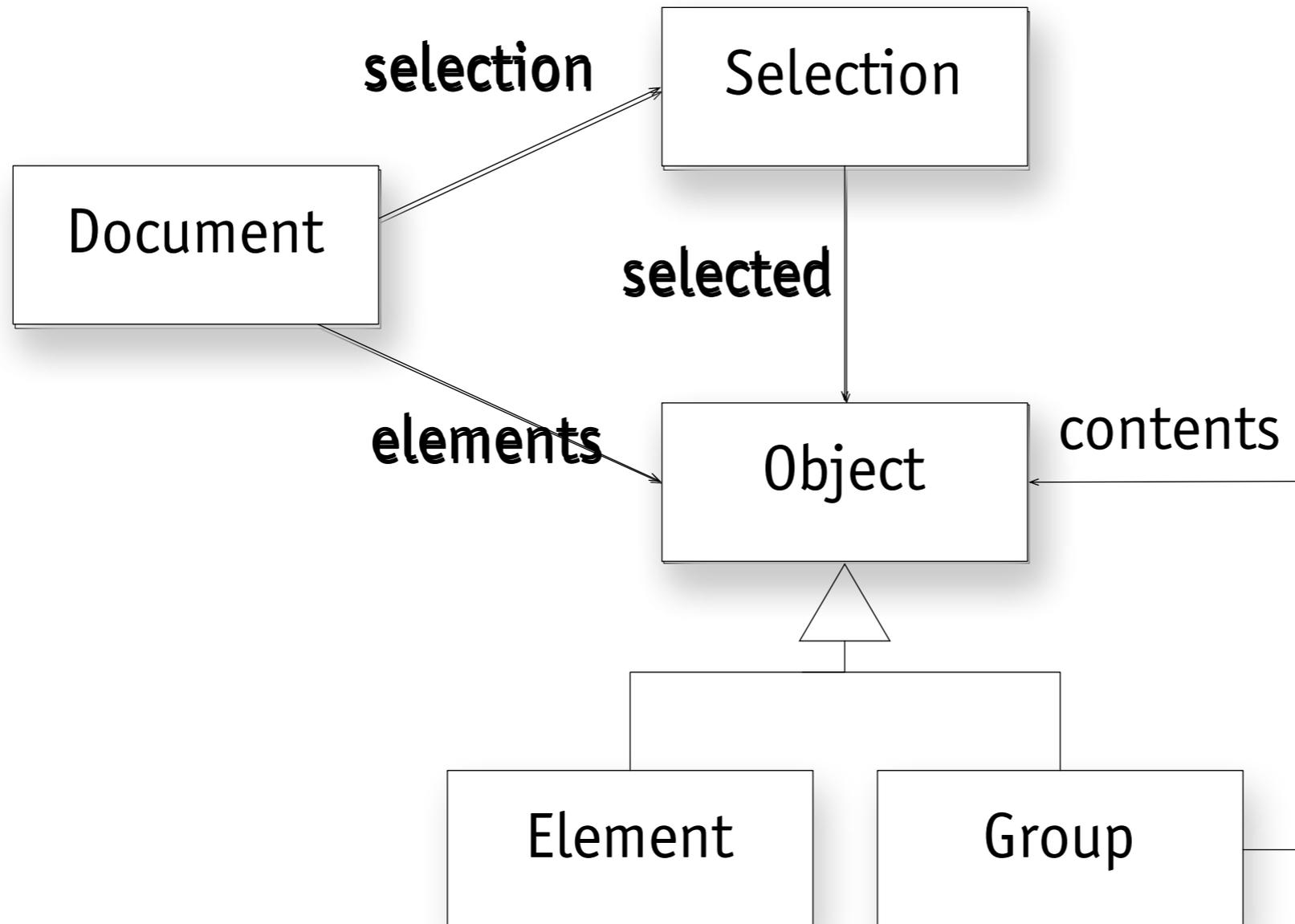
idea

concepts are sets & relations
represent diagrammatically

why diagrams?

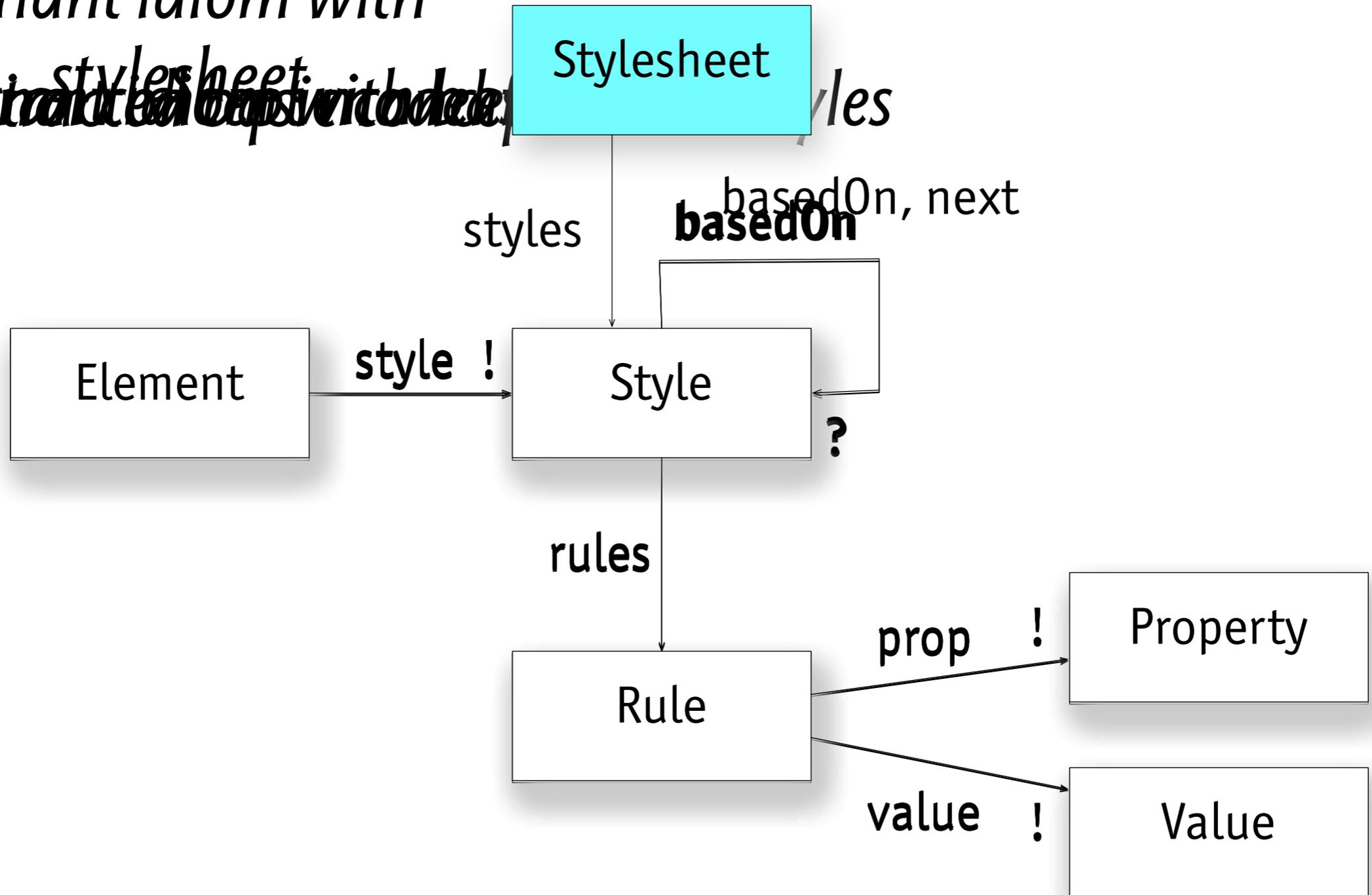
show hierarchy visually
suggest path invariants
partitioning diagram

idiom selection



idiom style

variant idiom with
original stylesheet
original stylesheet

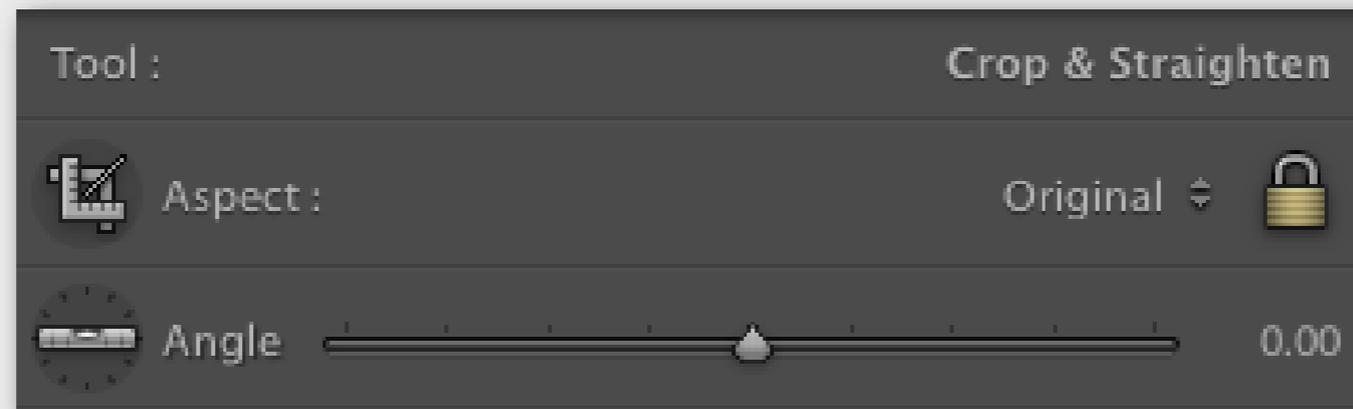


part 3

design flaws illustrated

#1

cropping lightroom



printing lightroom

Layout ▾

Ruler Units : Inches ▾

Margins

Left 0.25 in

Right 0.56 in

Top 0.25 in

Bottom 0.25 in

Page Grid

Rows 1

Columns 1

Cell Spacing

Vertical 0.00 in

Horizontal 0.00 in

Cell Size

Height 8.00 in

Width 6.00 in

Keep Square

Print Job ▾

Print to : Printer ▾

Draft Mode Printing

Print Resolution **240** dpi

Print Sharpening : Low ▾
Media Type : Glossy ▾

16 Bit Output

Color Management ◀

Profile : Managed by Printer ▾

Intent : Perceptual | Relative

Print Adjustment ▾

Brightness 0

Contrast 0

cropping photoshop

 Width: Height: Resolution: 



cropping photoshop

Resolution: 72





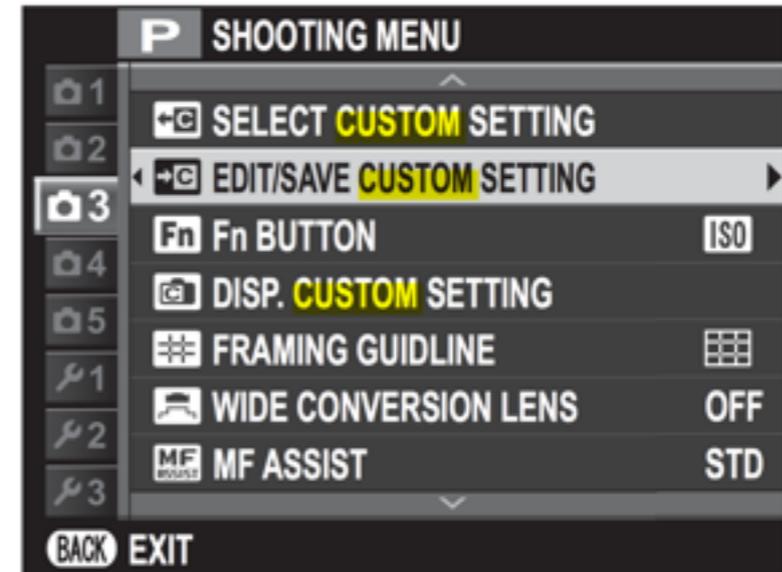
orthogonal



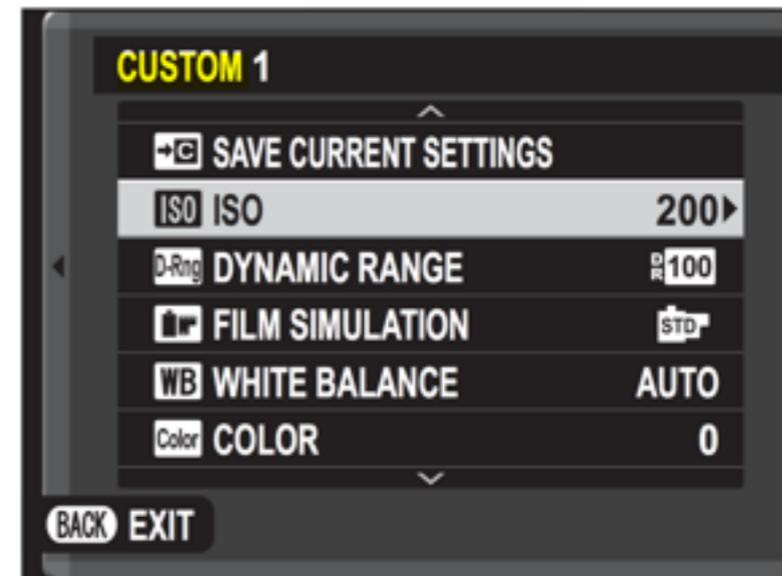
**not
orthogonal**

#2

custom settings fuji x100s



2 Highlight a custom settings bank and press **MENU/OK** to select. Adjust the following as desired and press **DISP/BACK** when adjustments are complete: **ISO** ISO, **D-Rng** DYNAMIC RANGE, **Film Simulation** FILM SIMULATION, **WB** WHITE BALANCE, **Color** COLOR, **Sharp** SHARPNESS, **Highlight Tone** HIGHLIGHT TONE, **Shadow Tone** SHADOW TONE, **NR** NOISE REDUCTION, and **Reset** RESET.



The X100's Custom Settings memories are useless.

1.) The X100's Custom Settings memories are useless. Unlike [Canon's brilliant C1, C2 and C3 Total Recall modes](#), the X100's EDIT/SAVE CUSTOM SETTINGS function only stores and recalls a few of the image parameters like sharpness and white balance, but not Auto ISO, image size, AF mode, flash or anything else. For these to be useful, they need to save *everything*, as Canon does. Even the LCD brightness needs to be saved and recalled, for instance, on my Canons, I use different presets for shooting outdoors or indoors.

annotations apple preview

The Washington Post

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Private consultants warned of risks before HealthCare.gov's Oct. 1 launch

By [Juliet Eilperin](#) and [Sandhya Somashekhar](#), Published: November 18



The Washington Post

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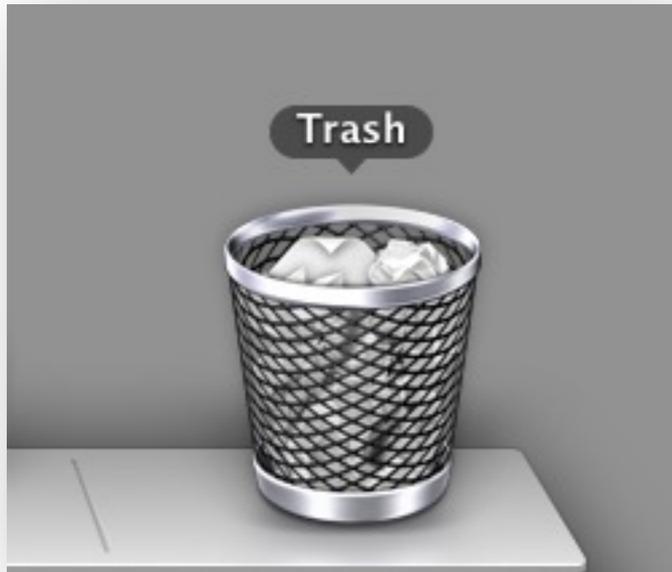




not general

#3

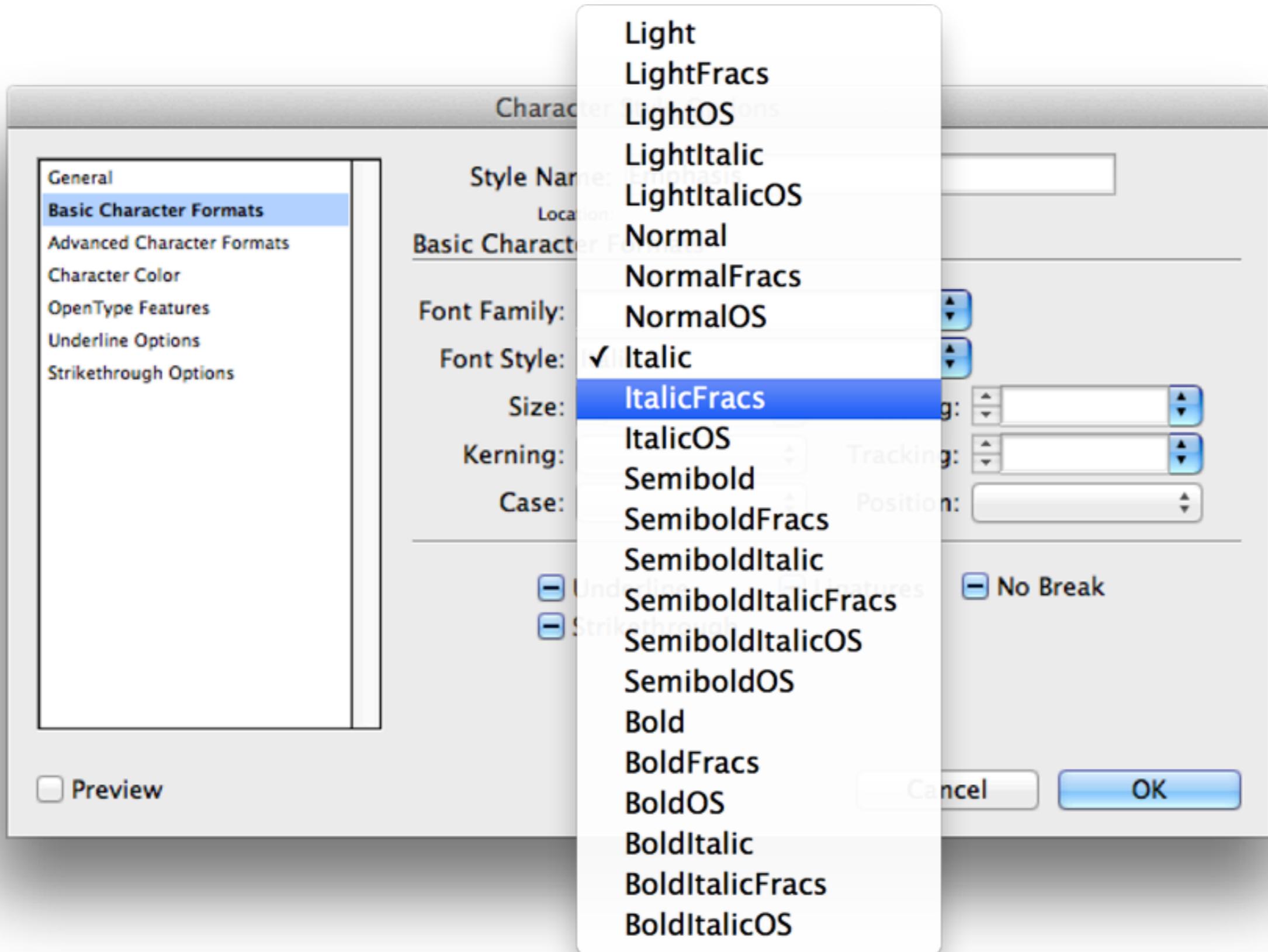
trash OS X finder



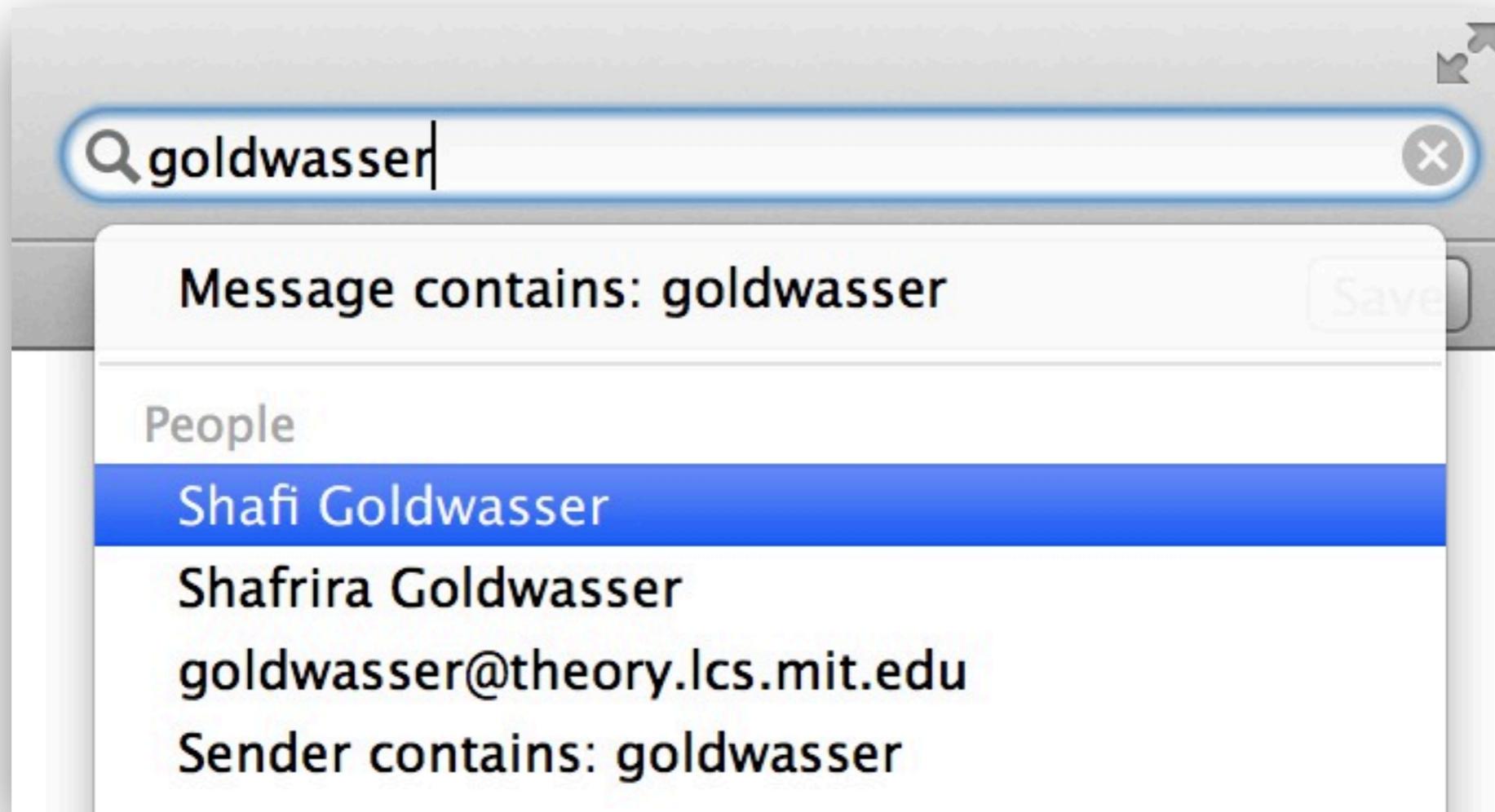
Trash		
Name	Date Modified	Size
Screen Shot 2013-02-25 at 11.46.27 AM	Today 11:46 AM	58 KB
Screen Shot 2013-02-25 at 11.45.46 AM	Today 11:45 AM	39 KB
bits.key	Yesterday 7:09 PM	326 KB
▶ 2013 2.16.58 PM	Feb 22, 2013 2:16 PM	--
▶ 2013-02-18	Feb 22, 2013 2:12 PM	--
▶ 2013-02-17	Feb 22, 2013 2:12 PM	--
▶ 2013-02-15	Feb 22, 2013 2:12 PM	--

how to make room on a USB thumb drive?
how to restore an old file deleted by mistake?

font style adobe indesign



search apple mail



looking for message from shafi@csail.mit.edu



not complete

#4

a sad dropbox tale

Quora

🔍 Search



Dropbox: [Edit](#)

Someone accidentally deleted thousands of files in my company Dropbox: how can I quickly undelete them? [Edit](#)

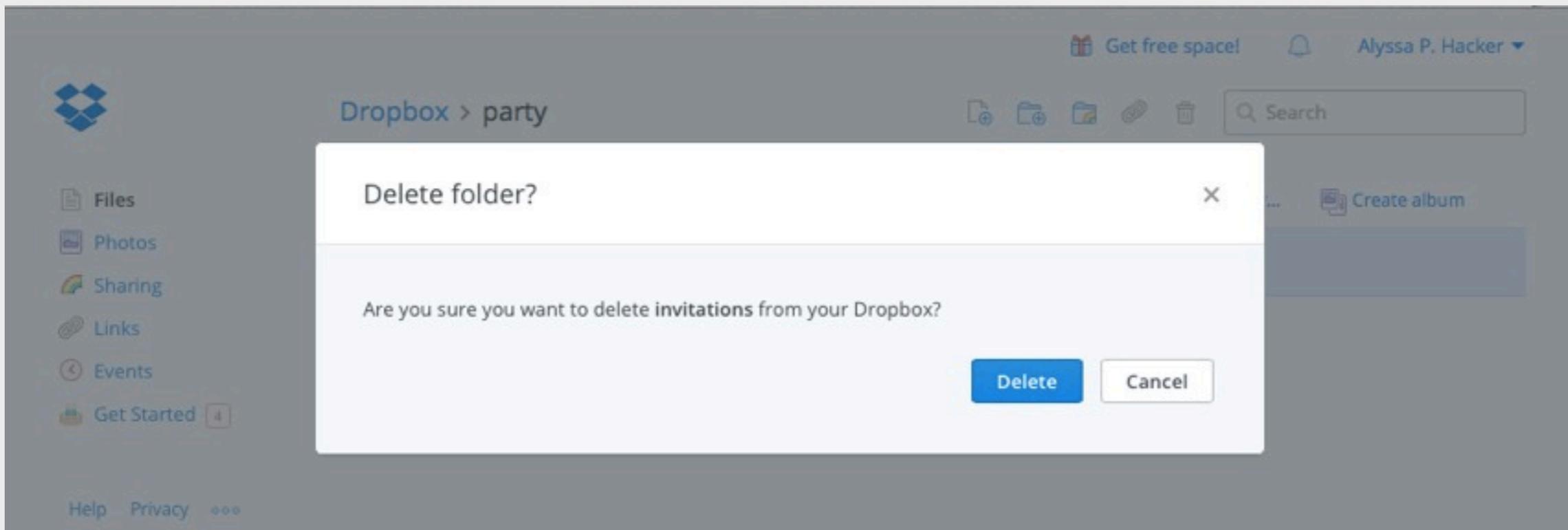
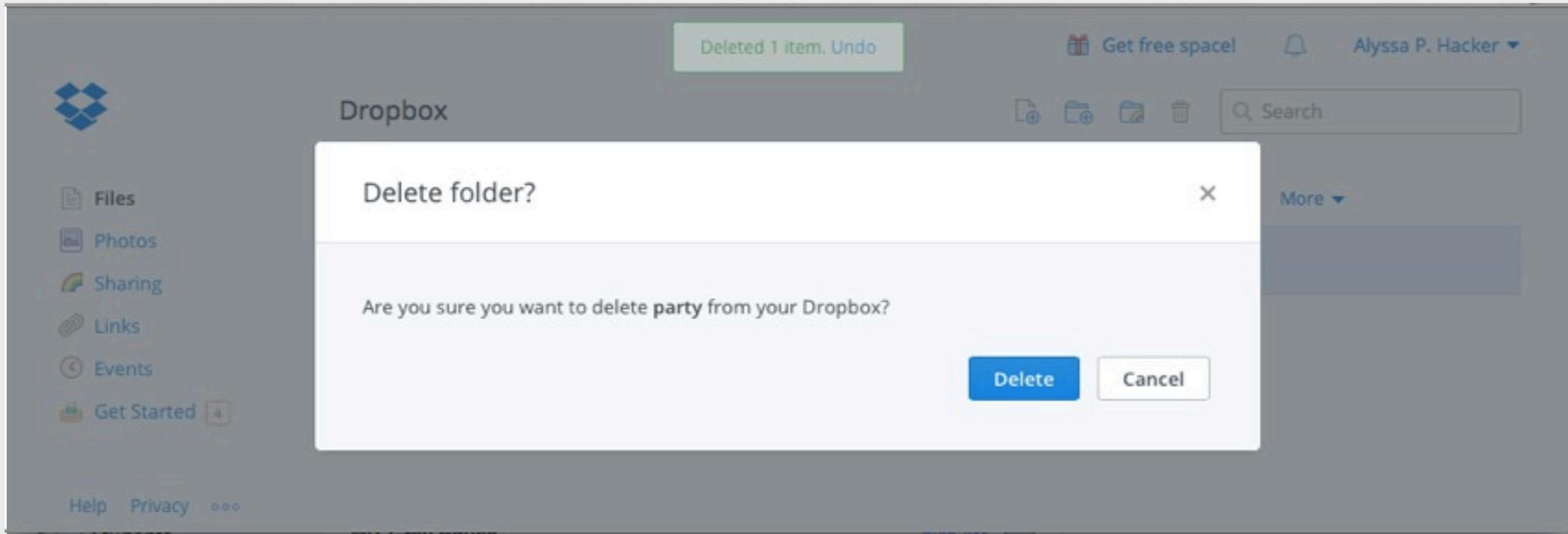
[Add Question Details](#)

[Comment](#) · [Share](#) · [Report](#) · [Options](#)

alyssa & ben plan a party

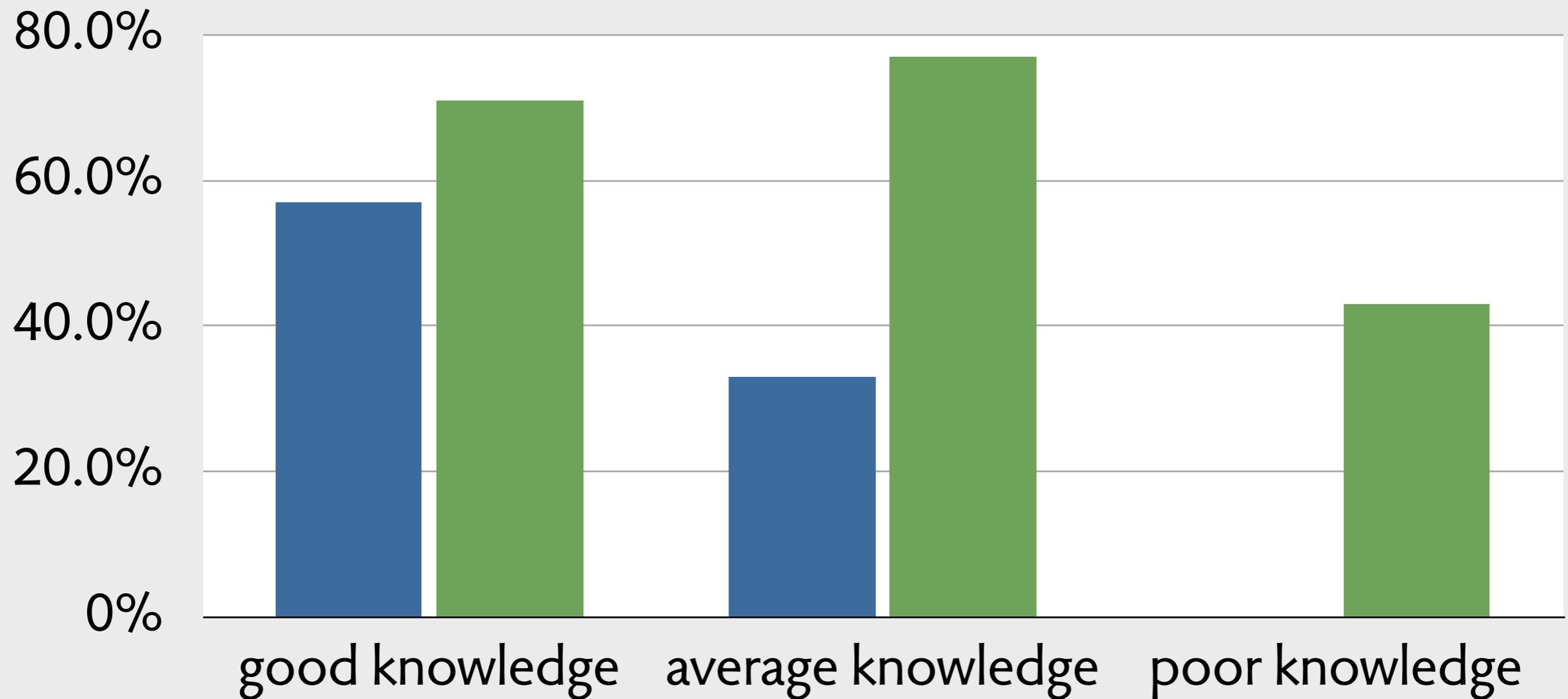
The screenshot shows the Dropbox web interface with a 'Share' dialog box open. The dialog is titled 'Share 'party' with others' and has a close button (X) in the top right corner. At the top right of the dialog, there is a checked checkbox labeled 'Allow members to invite others'. Below this, there is a search bar containing the text 'alyssa' and a blue link 'Import contacts' on the right. A search result is displayed in a light blue row, featuring an envelope icon, the name 'Alyssa P. Hacker', and the email address 'dnj+alice@csail.mit.edu'. At the bottom right of the dialog, there are two buttons: a blue 'Share folder' button and a white 'Cancel' button with a grey border. The background shows the Dropbox interface with the logo, navigation menu (Files, Photos, Sharing, Links, Events, Get Started), and user profile 'Ben Bitdiddle'.

alyssa spoils everything



small survey of MIT dropbox users

correctly predict behavior



- delete shared folder results in leaving
- delete shared subfolder removes it

not transparent



part 4

design flaws described

idea: archetypal invariants

orthogonality

all $x: X \mid F(x)$ implies $G(x)$

generality

all $x: X \mid \text{expr}(x)$ in subset

completeness

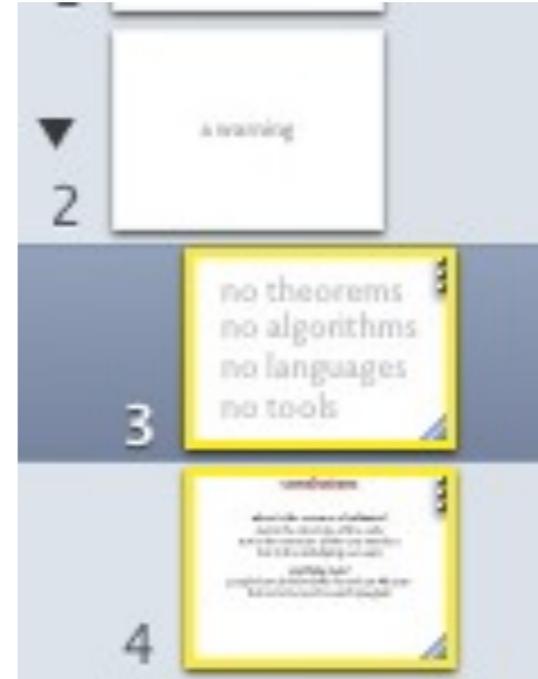
???

orthogonality

orthogonal apple keynote



skip slide



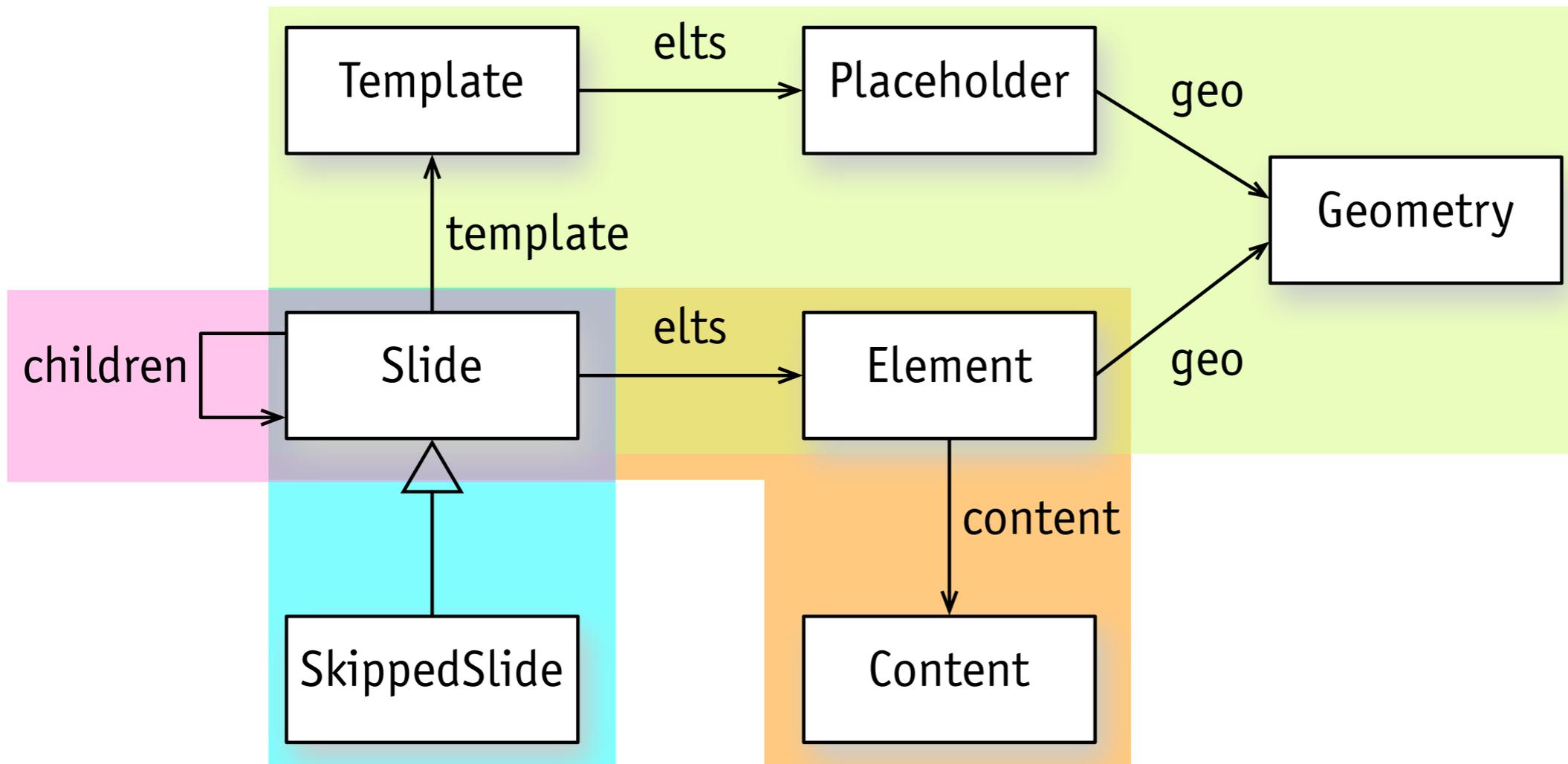
make parent



make
parent
and skip

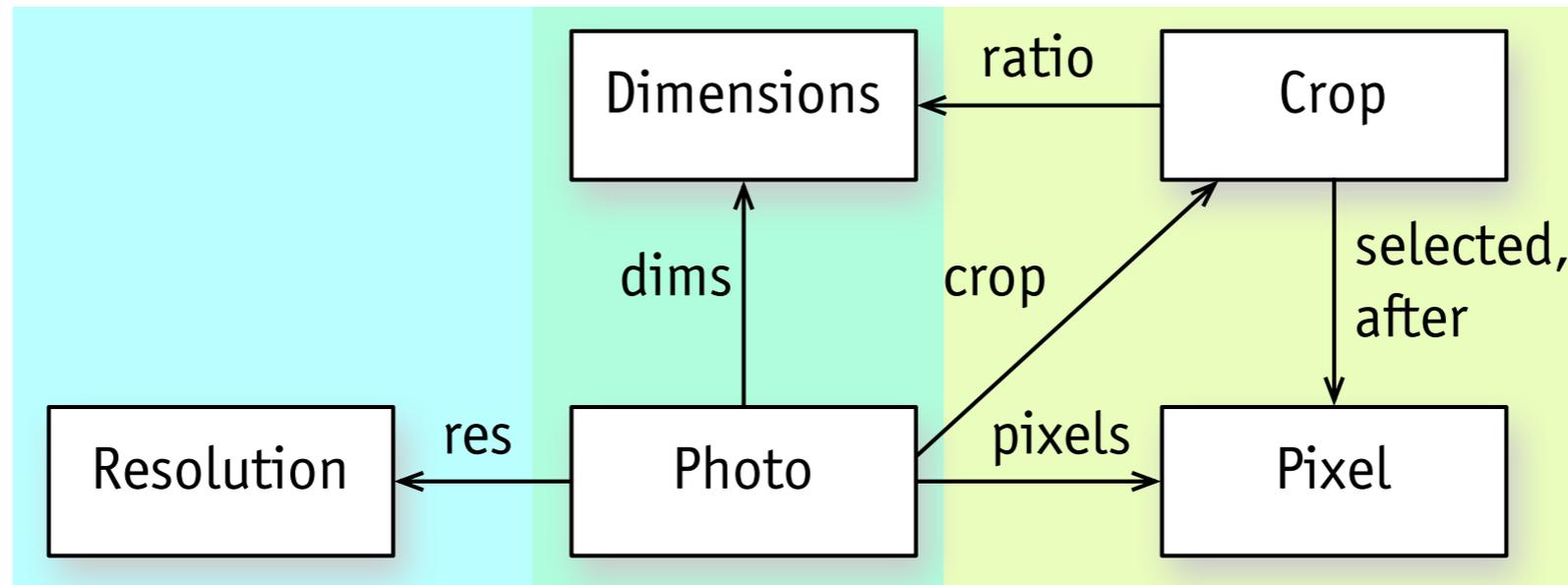
orthogonal apple keynote

assign concepts to features



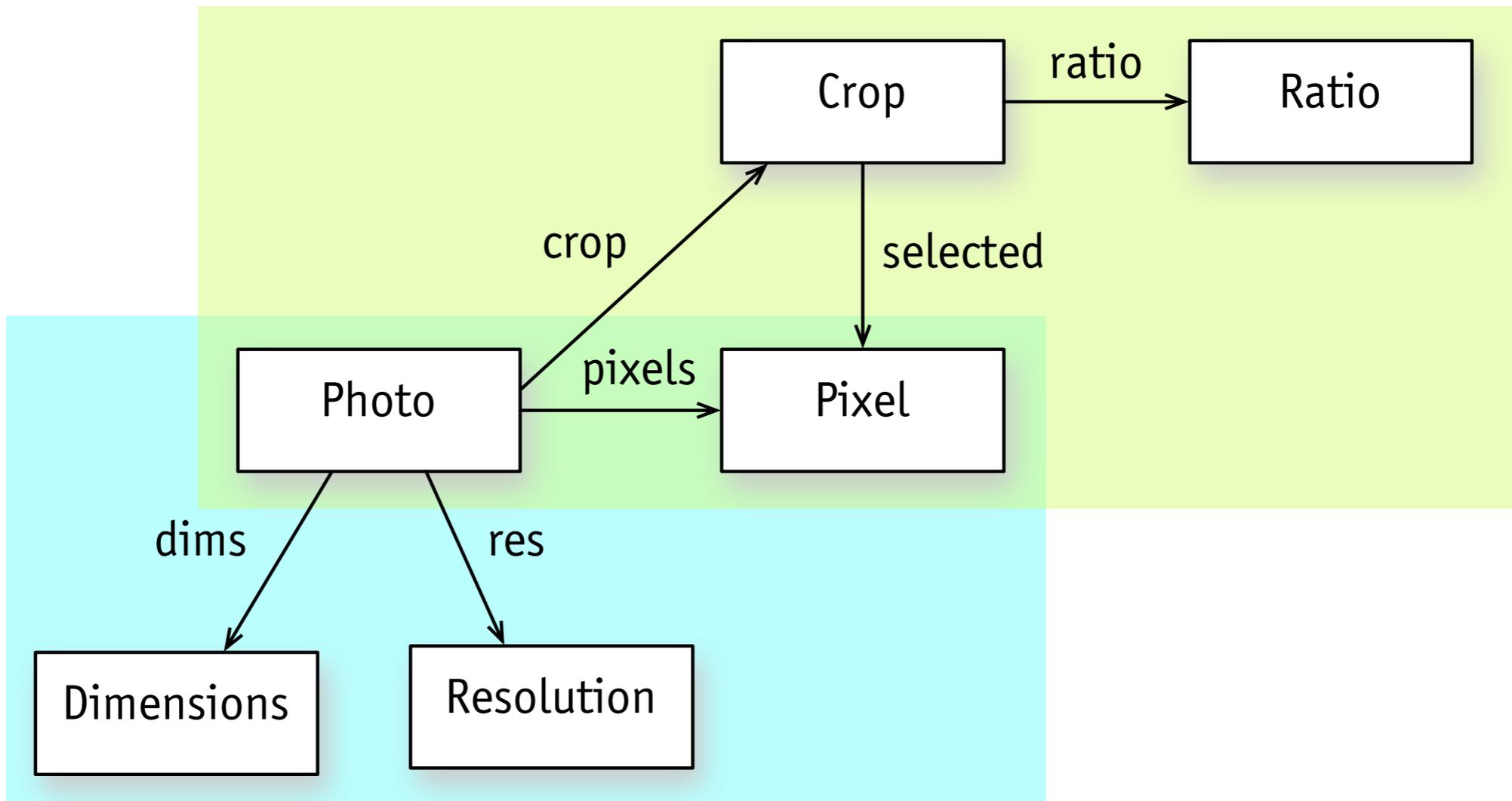
all $s: \text{Slide} \mid s \text{ in } \text{SkippedSlide}$ implies $s.\text{children}$ in SkippedSlide

not orthogonal photoshop

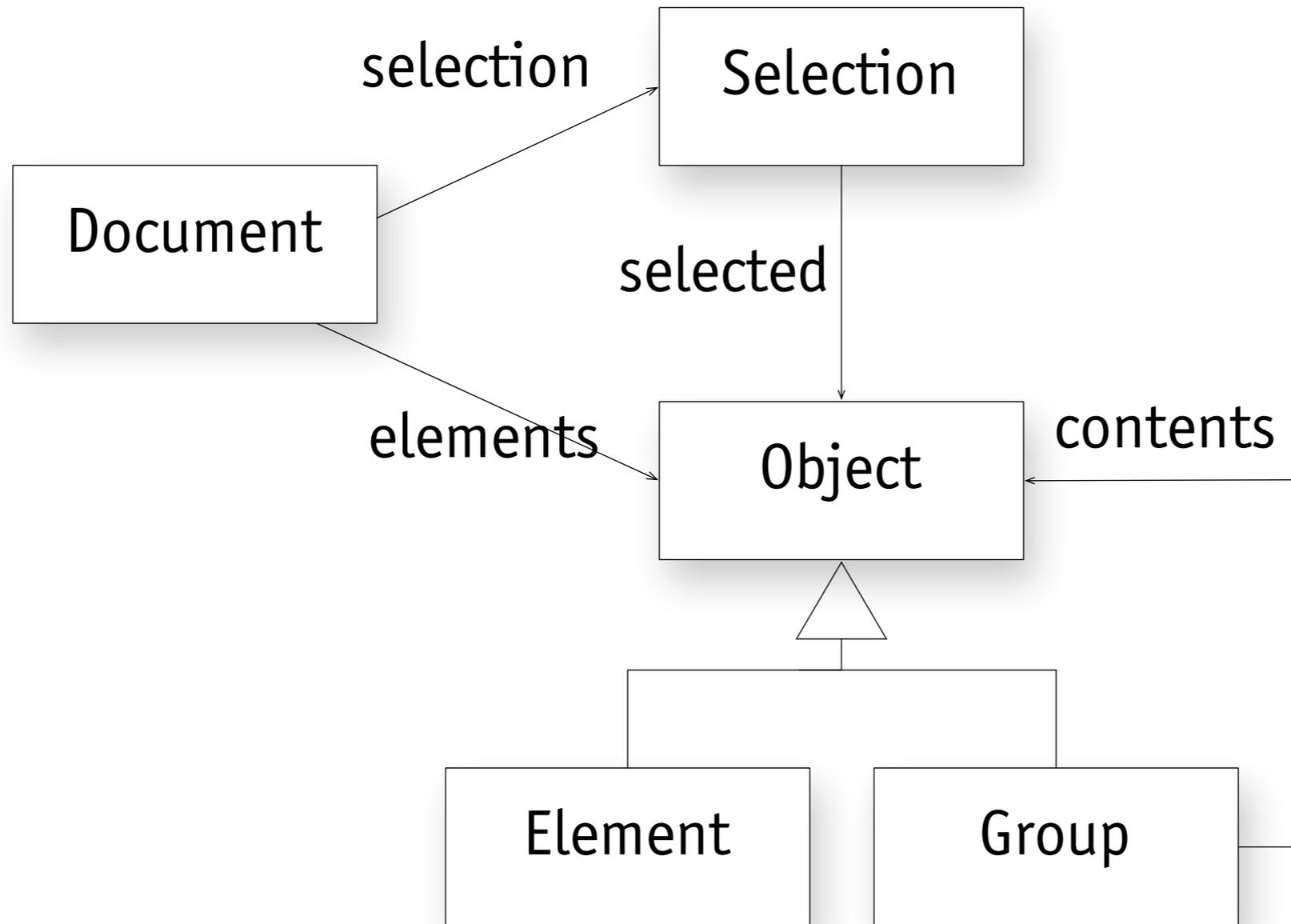


all p : Photo, c : $p.\text{crop} \mid \#c.\text{after} \times p.\text{res} = c.\text{ratio}$

orthogonal lightroom



orthogonality selection & groups



all s: Selection, o: s.selected & Group |
o.contents in s.selected

orthogonality HTTP methods

```
x Headers Preview Response Cookies Timing
Request URL: https://www.google.com/search?q=tel+aviv+university&
e&espv=210&es_sm=91&ie=UTF-8
Request Method: GET
Status Code: 200 OK
Request Headers (11)
Query String Parameters view source view URL encoded
q: tel aviv university
oq: tel aviv
aqs: chrome.0.69i59j69i57j0l4.1428j0j9
sourceid: chrome
espv: 210
es_sm: 91
ie: UTF-8
```

GET: query params
but no form data

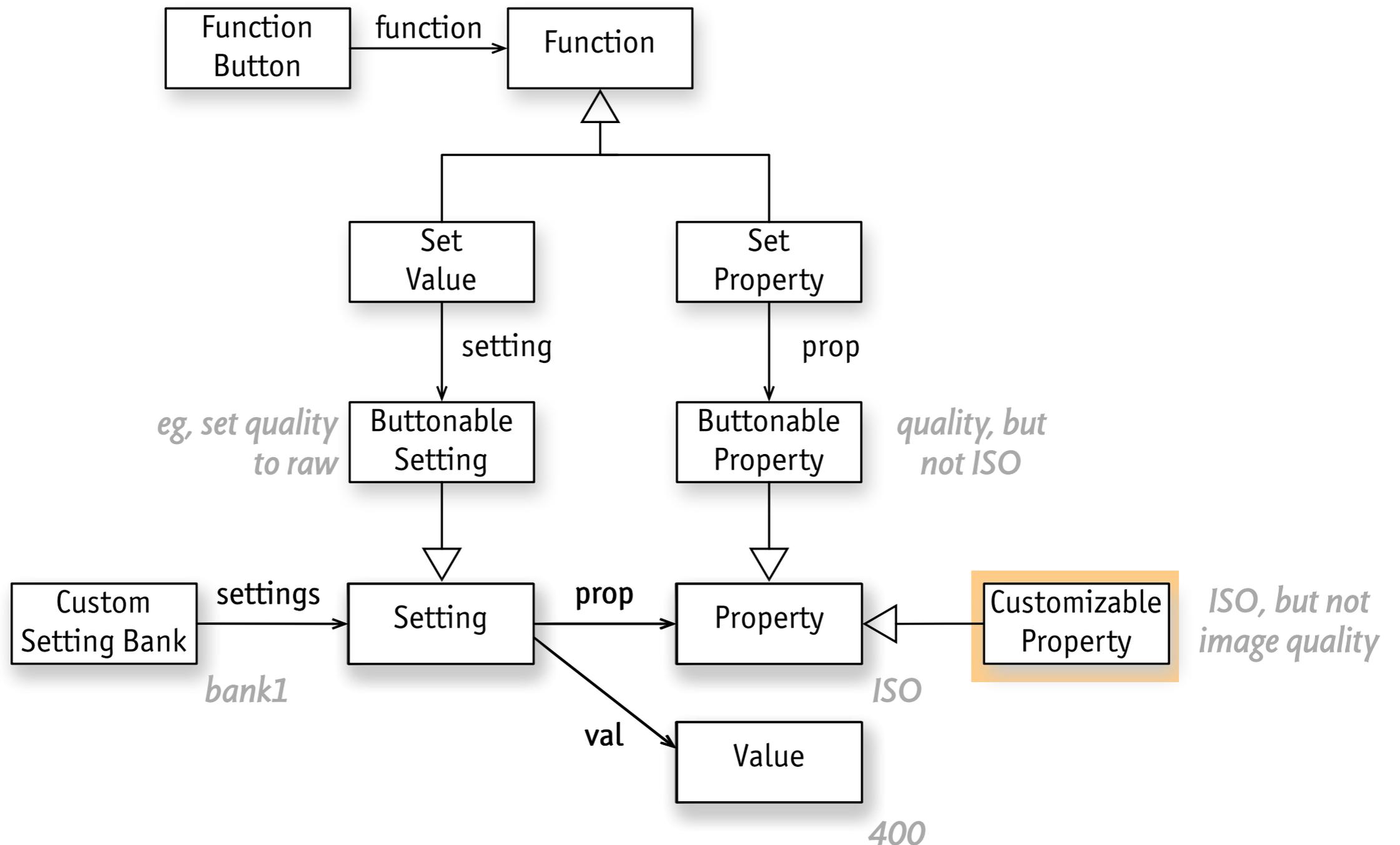
```
x Headers Preview Response Cookies Timing
Request URL: http://www.amazon.com/gp/product/handle-buy-box/ref=
Request Method: POST
Status Code: 200 OK
Request Headers (12)
Form Data view source view URL encoded
session-id: 175-2138999-3784551
ASIN: 3540713158
offerListingID: %2BeQPWvC7r5UAJdGNcTkpEZqrLqaz%2BFTyE4UDj3iSbP58Z
x4%3D
isMerchantExclusive: 0
merchantID: ATVPDKIKX0DER
isAddon: 0
nodeID: 283155
sellingCustomerID: A2R2RITDJNW1Q6
qid: 1387076683
sr: 8-1
storeID: books
tagActionCode: 283155
viewID: glance
rsid: 175-2138999-3784551
```

POST: query params
& form data

all `r: HttpRequest | r.method = get` implies
no `r.formData`

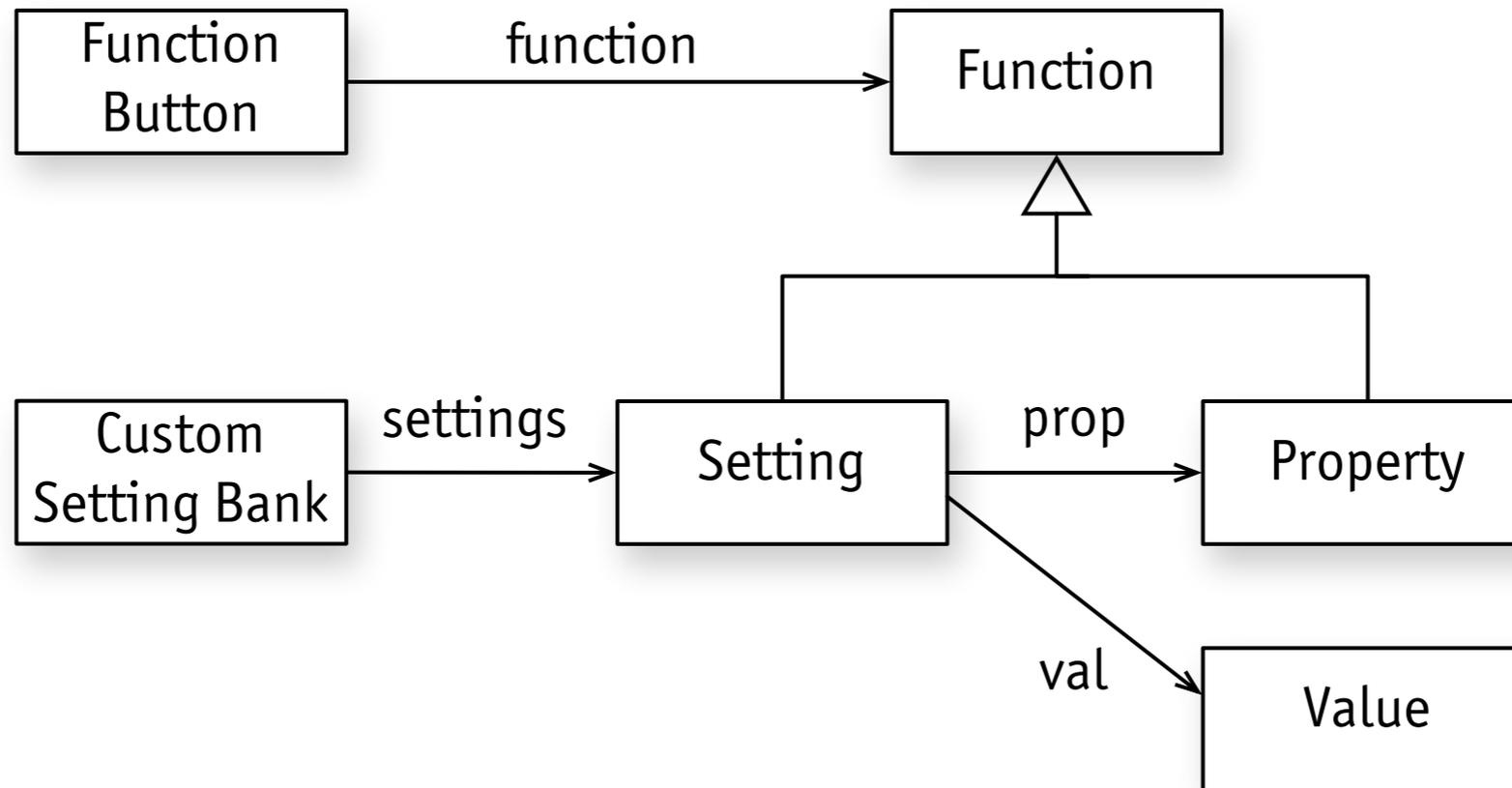
generality

not general fuji x100s

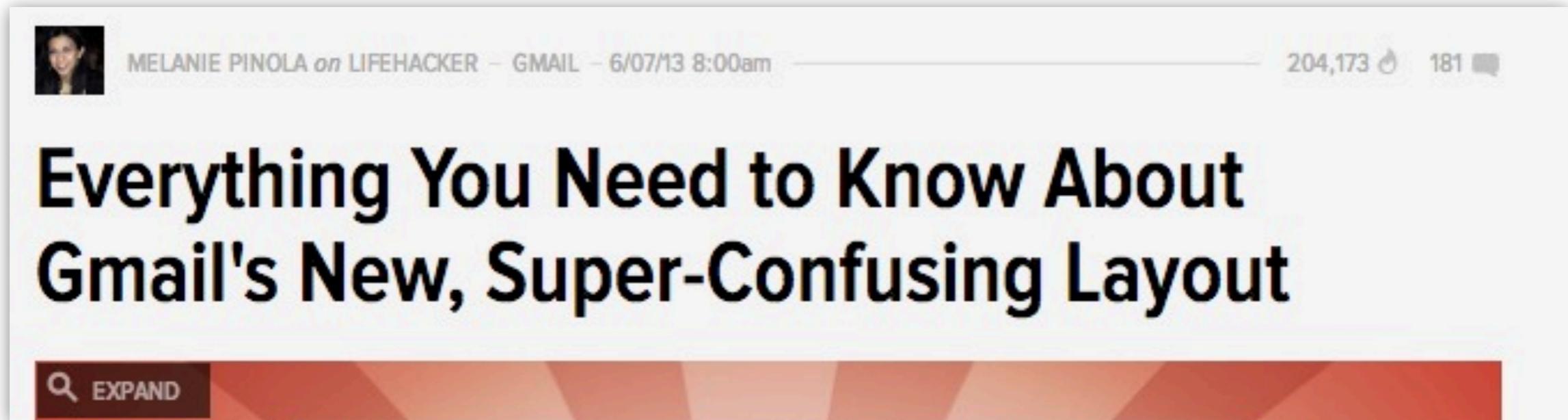


all b: Bank | b.settings.prop in **CustomizableProperty**

general fuji x100s reworked



generality gmail



MELANIE PINOLA on LIFEHACKER - GMAIL - 6/07/13 8:00am 204,173 181

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

EXPAND

[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](#)

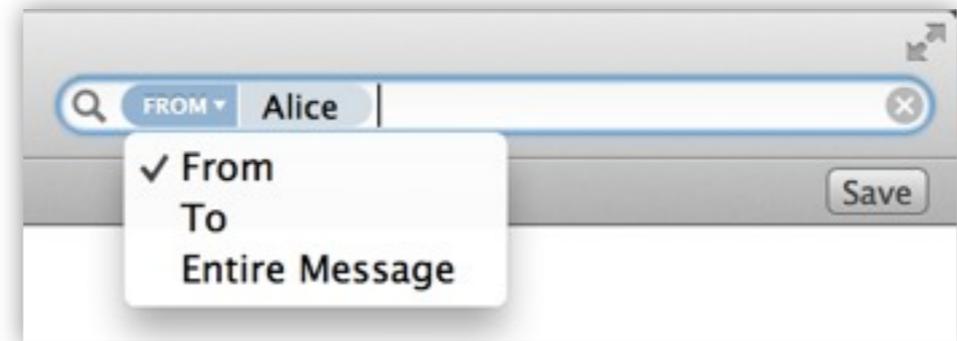
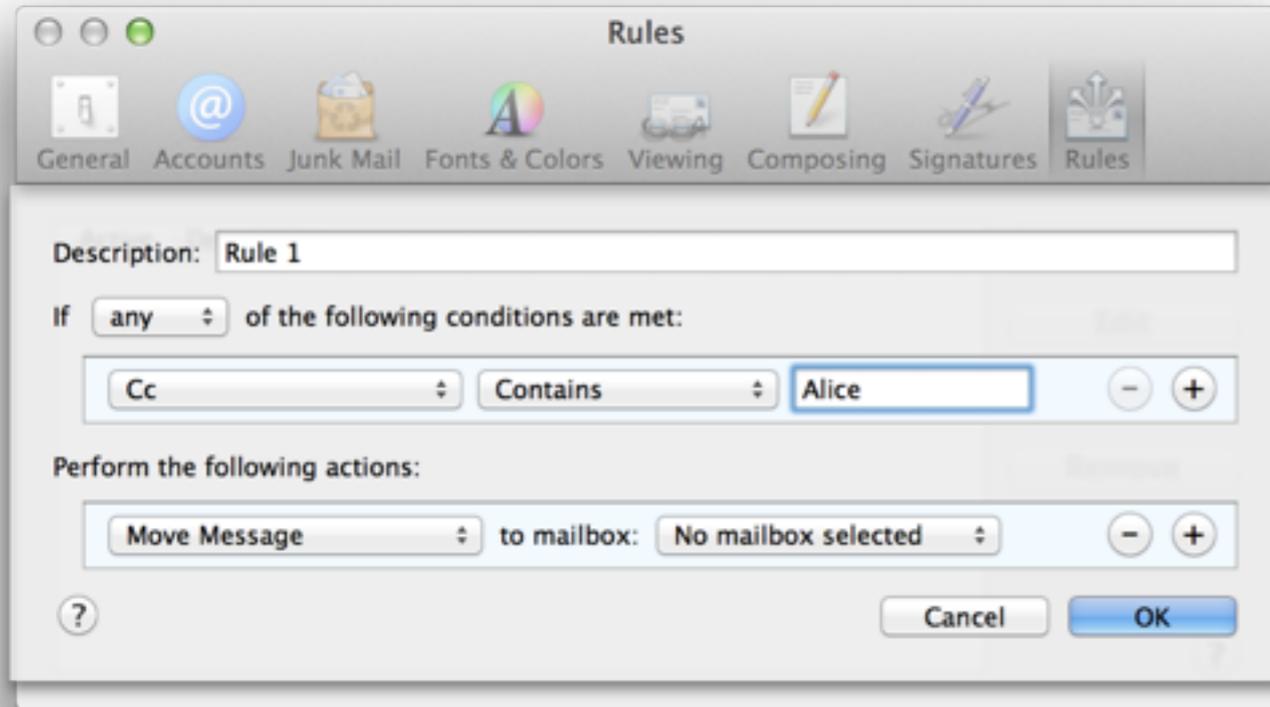
in [LibraryPoint Blog](#) [Tech Tutorials](#) [Teen Blog](#) [Tech Answers](#) [Science and Technology](#) [Self-Help and Instructional](#)



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!

all t: Tab | t.label in **CategoryLabel**

generality apple mail



all f : Filter | some f .cc implies f in Rule

generality apple preview

The Washington Post

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Private consultants warned of risks before HealthCare.gov's Oct. 1 launch



By [Juliet Eilperin](#) and [Sandhya Somashekhar](#), Published: November 18

The Washington Post

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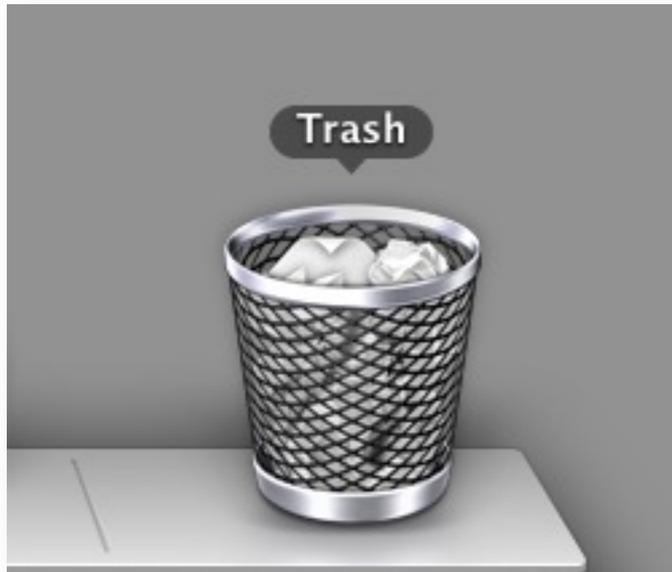


By [Juliet Eilperin](#) and [Sandhya Somashekhar](#), Published: November 18

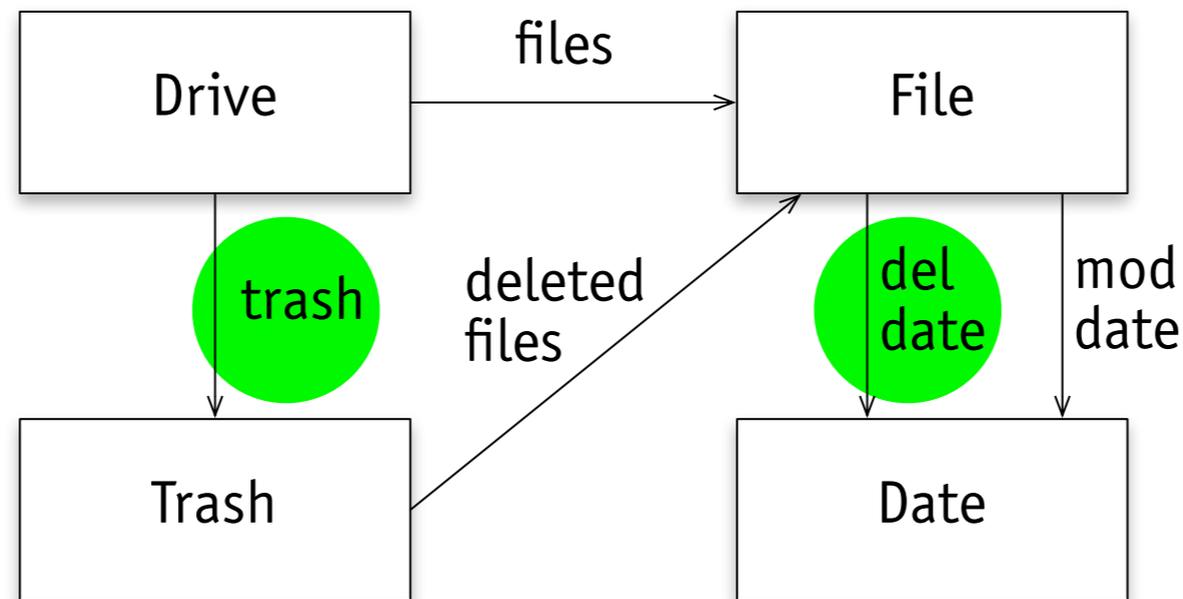
all a: Annotation | some a.text.format
implies a in **TextBox**

completeness

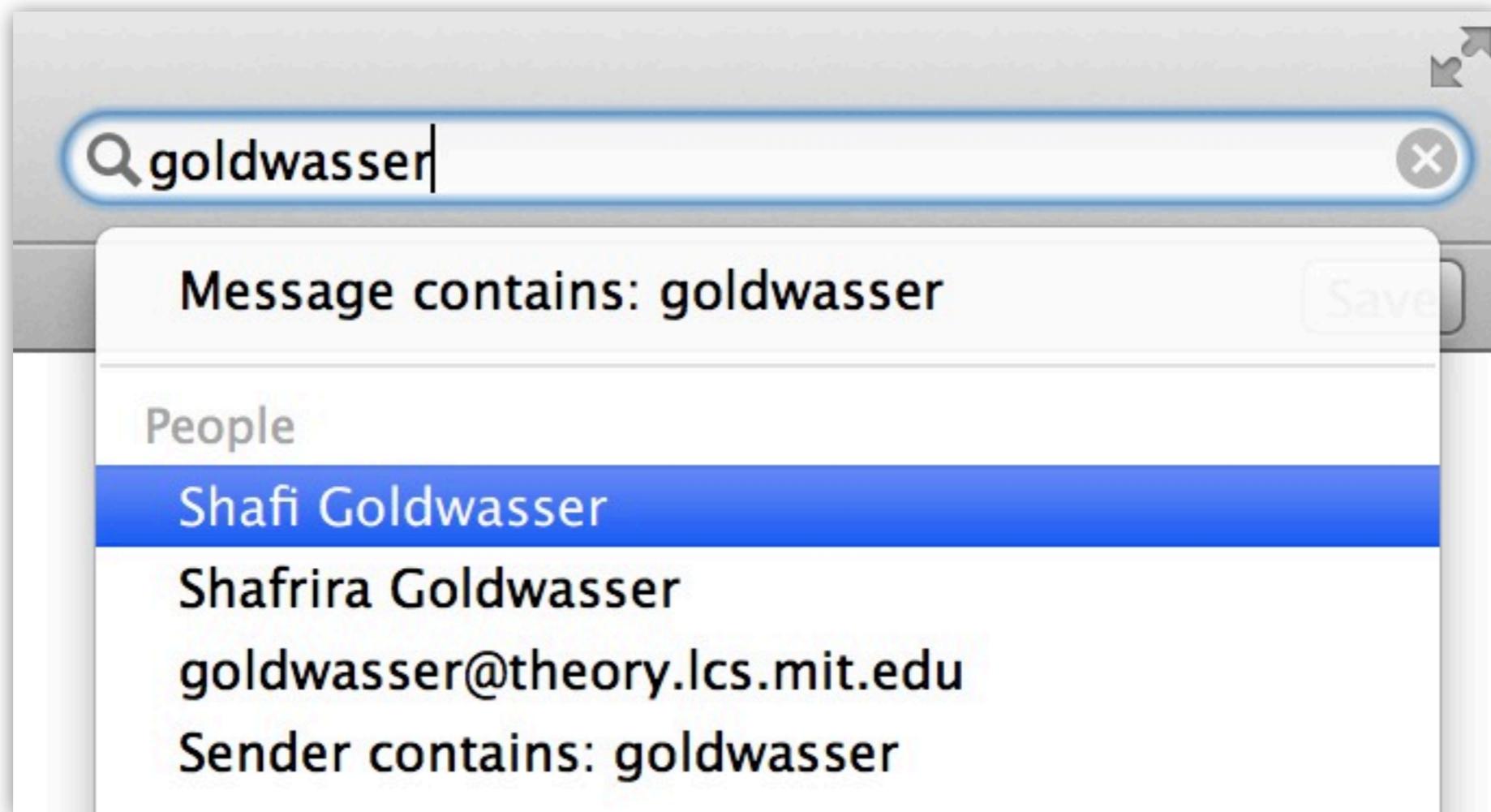
missing concept apple OS X trash



Name	Date Modified	Size
Screen Shot 2013-02-25 at 11.46.27 AM	Today 11:46 AM	58 KB
Screen Shot 2013-02-25 at 11.45.46 AM	Today 11:45 AM	39 KB
bits.key	Yesterday 7:09 PM	326 KB
▶ 2013 2.16.58 PM	Feb 22, 2013 2:16 PM	--
▶ 2013-02-18	Feb 22, 2013 2:12 PM	--
▶ 2013-02-17	Feb 22, 2013 2:12 PM	--
▶ 2013-02-15	Feb 22, 2013 2:12 PM	--



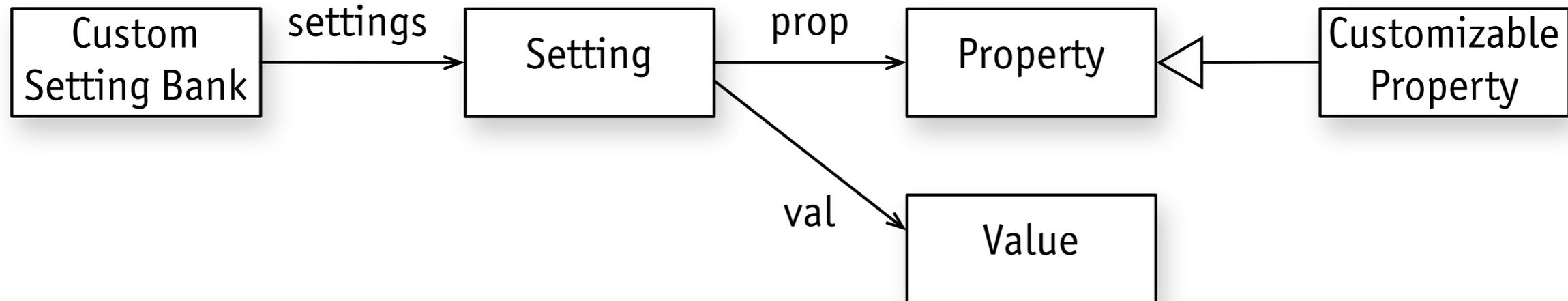
missing concept apple mail



message I'm looking for is from shafi@csail.mit.edu

user

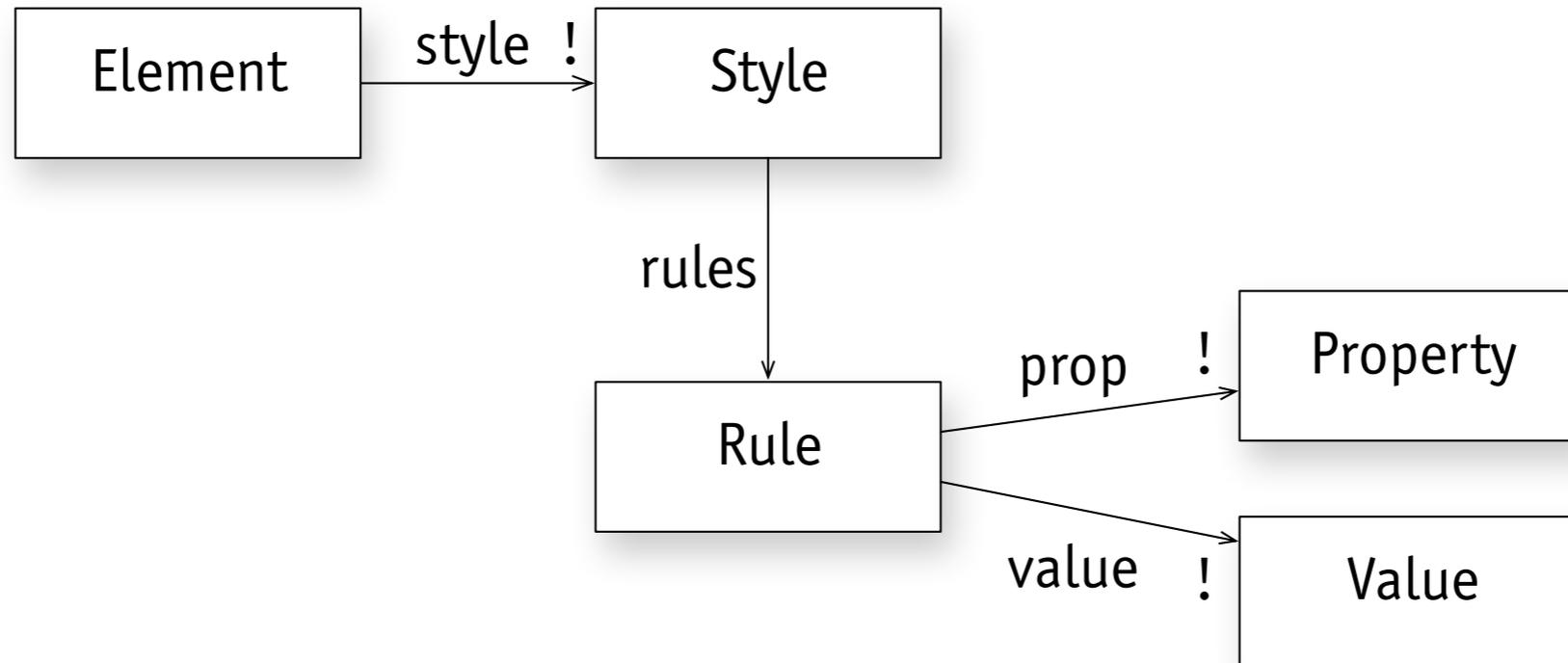
incompleteness fuji x100s



problem: can't use custom settings
just to override some selected settings

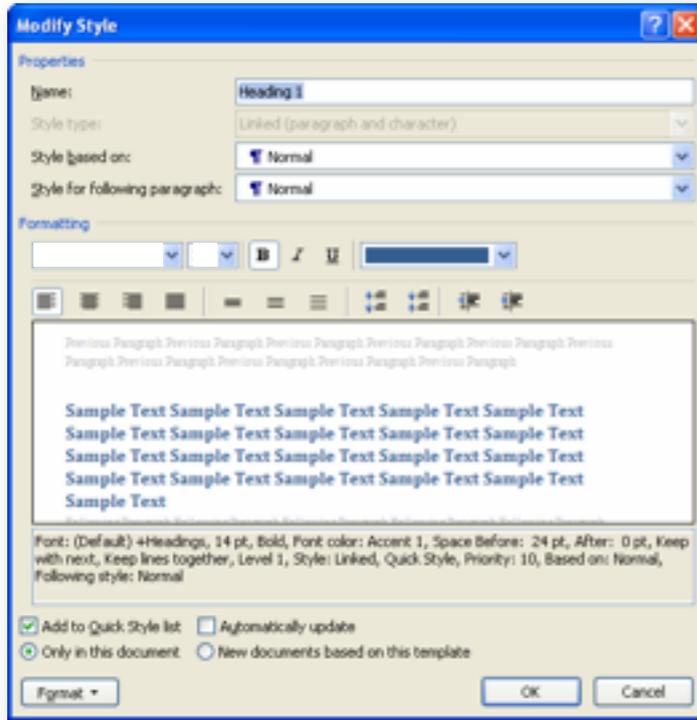
all b : Bank, p : CustomizableProperty |
some s : b .settings | s .prop = p

incompleteness style

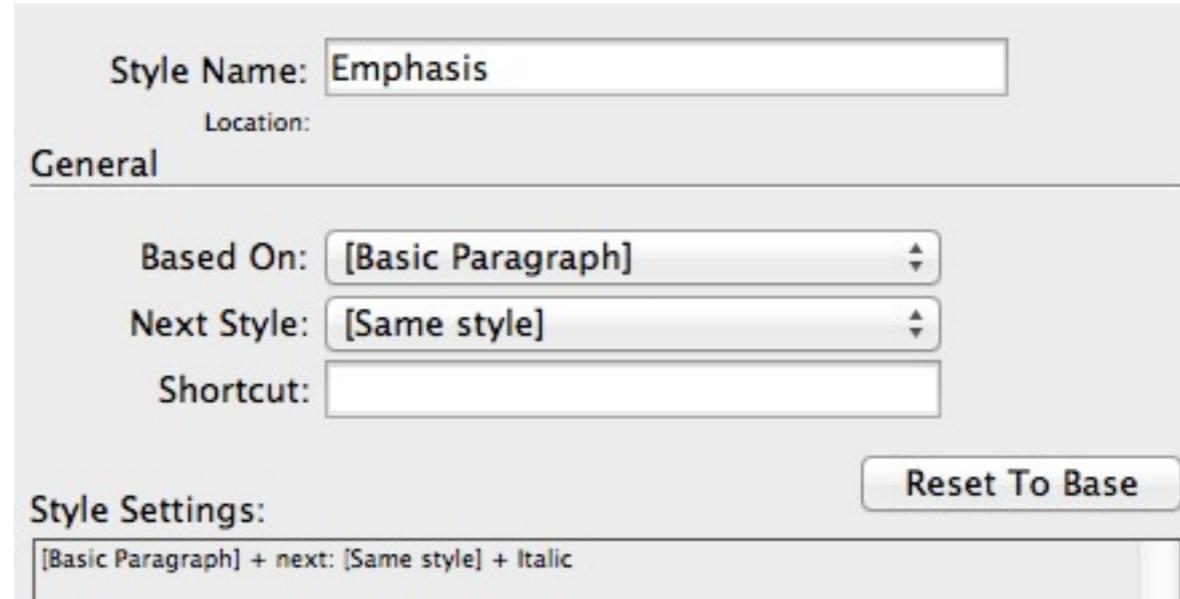


all s : Style, p : Property |
some r : $s.rules$ | $r.prop = p$

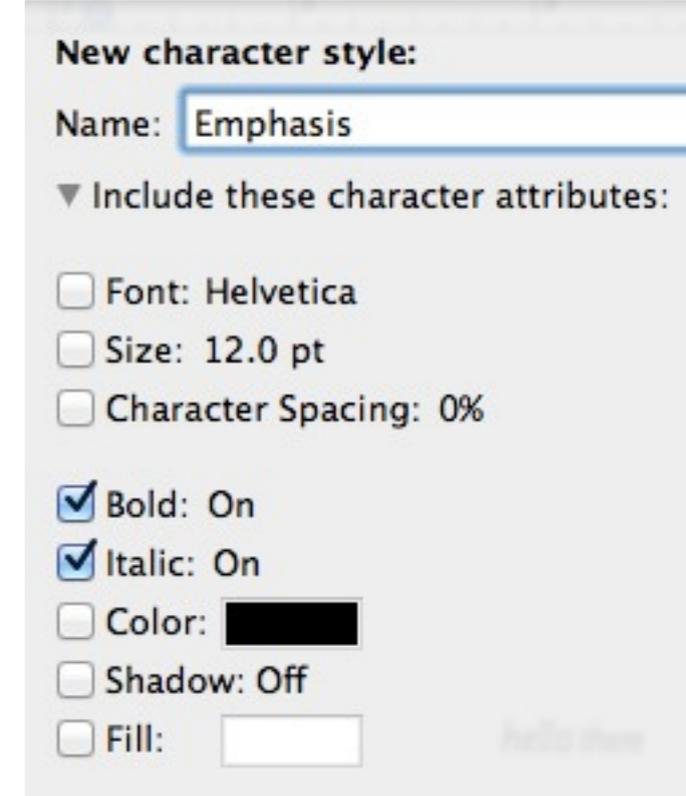
incompleteness style examples



Word: property absent until entered; then remove only in Visual Basic!



Indesign: property absent until entered; then remove only with Reset (since 2007)



Pages: aaah! properties are optional

incompleteness inevitable

how to invite same user multiple times using devise invitable



I am working with devise invitable gem with rails 3.2 application . My problem is that

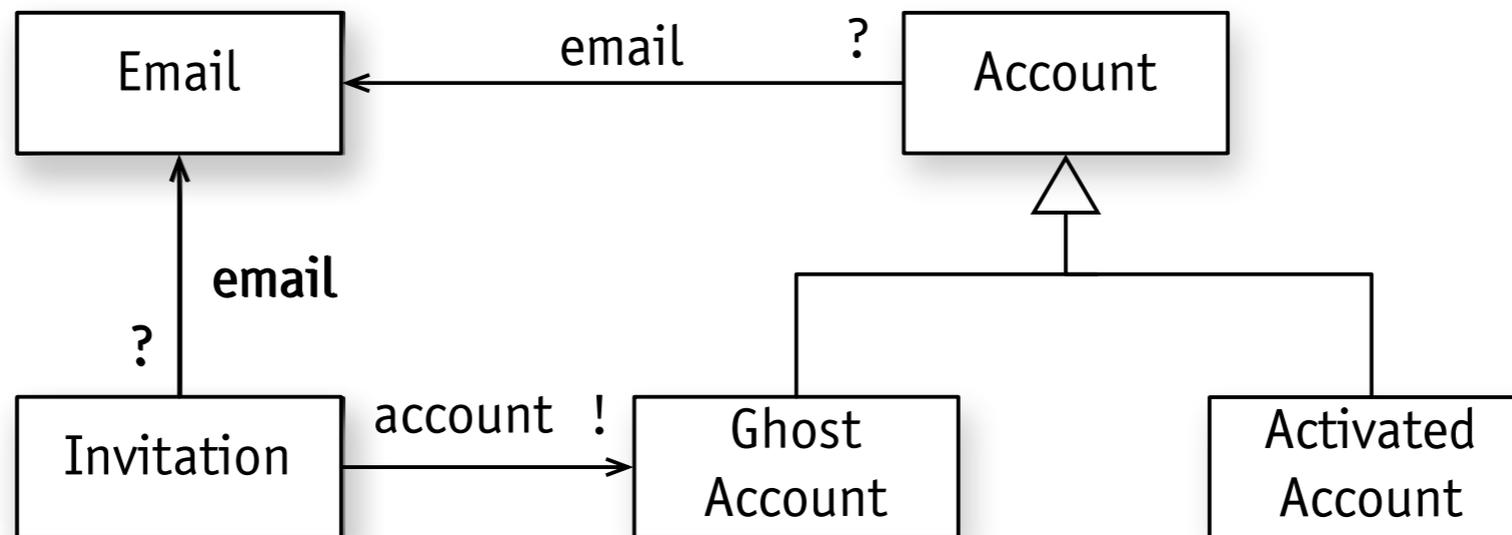
1



I have a user who involves in several groups , so group owner will send invitation to that user . Now I want to implement the functionality to send invitation for the same user from different groups , but devise invitable not allows me to do that ..



Can anyone help me .. thanks in advance ..



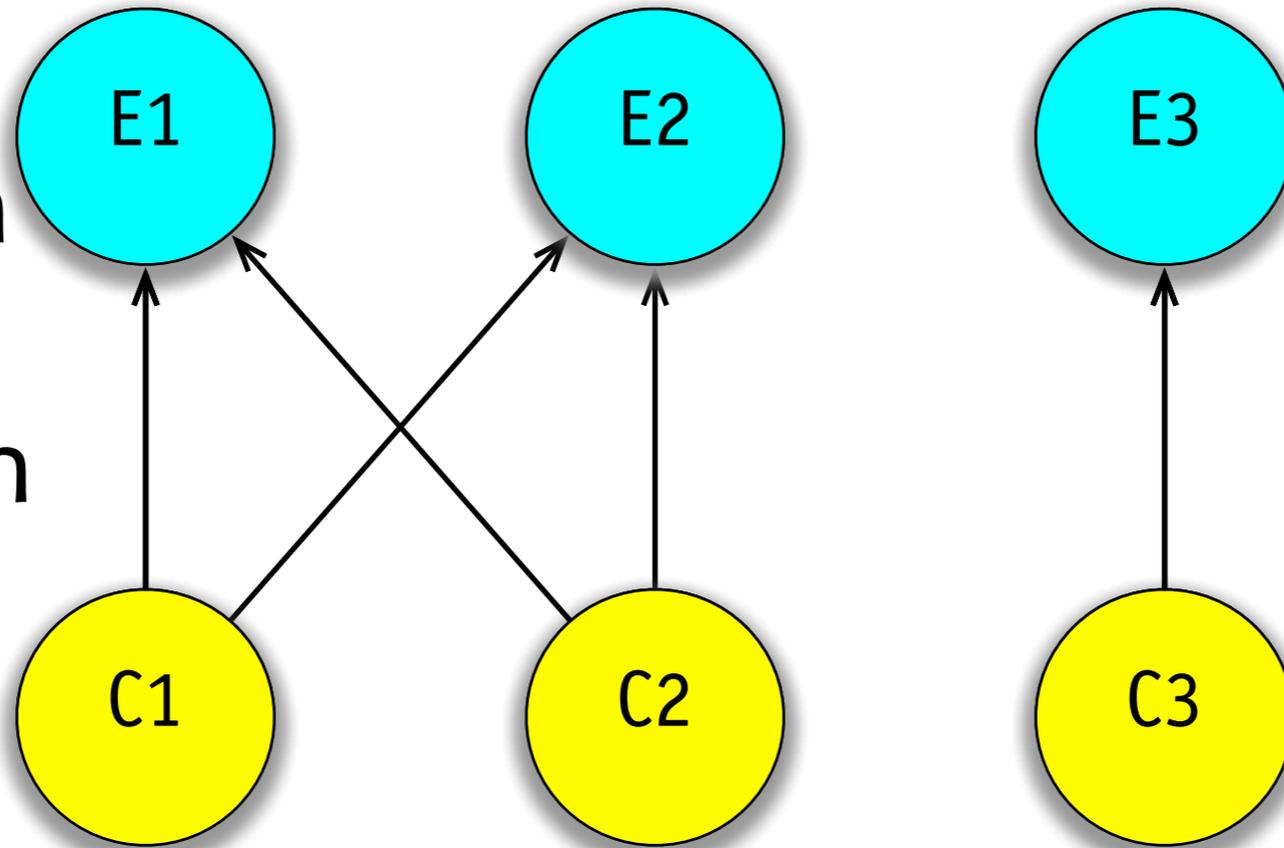
all e: Email | #email.e \neq 1

transparency

representation flaws

user interface
elements

faithful
representation
inconsistent
representation
indistinct
representation

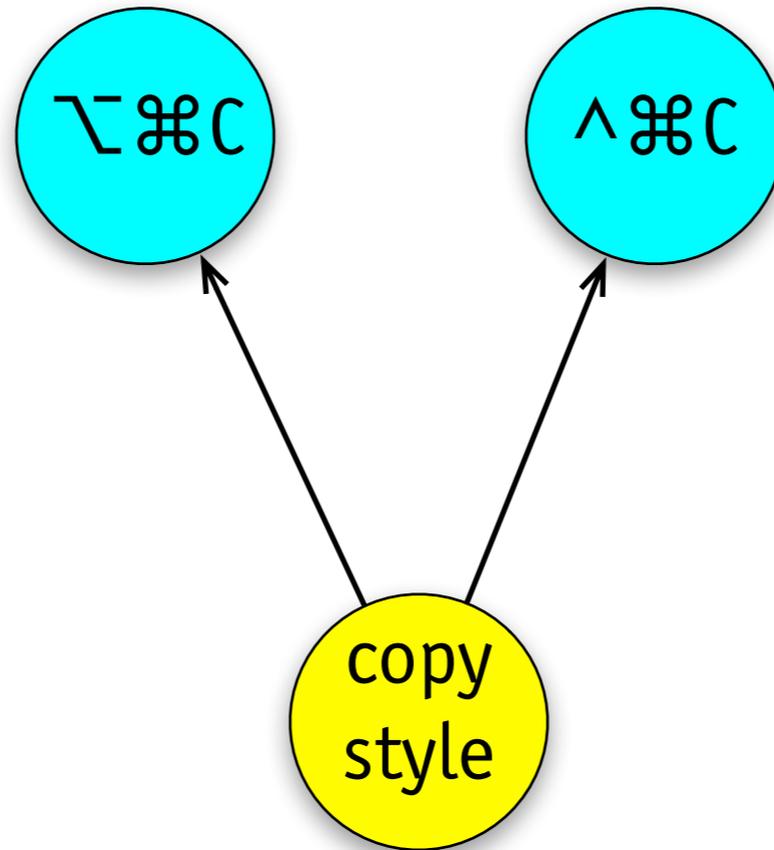


concepts

consistency OS X apps

*OmniGraffle:
control key*

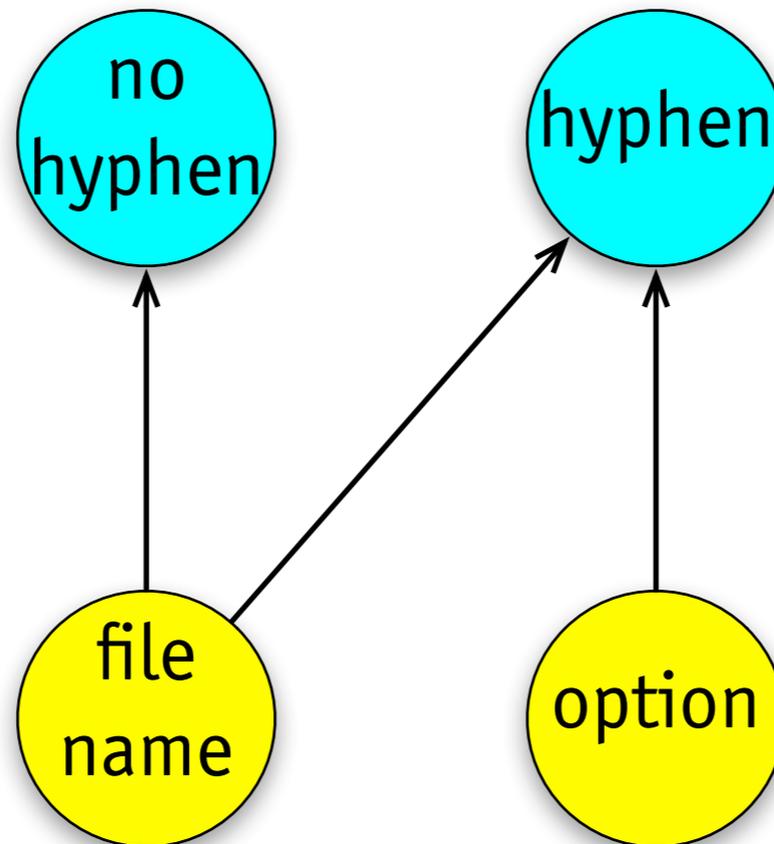
*Apple apps:
option key*



distinctness unix

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

from the Unix Hater's Handbook



distinctness dropbox

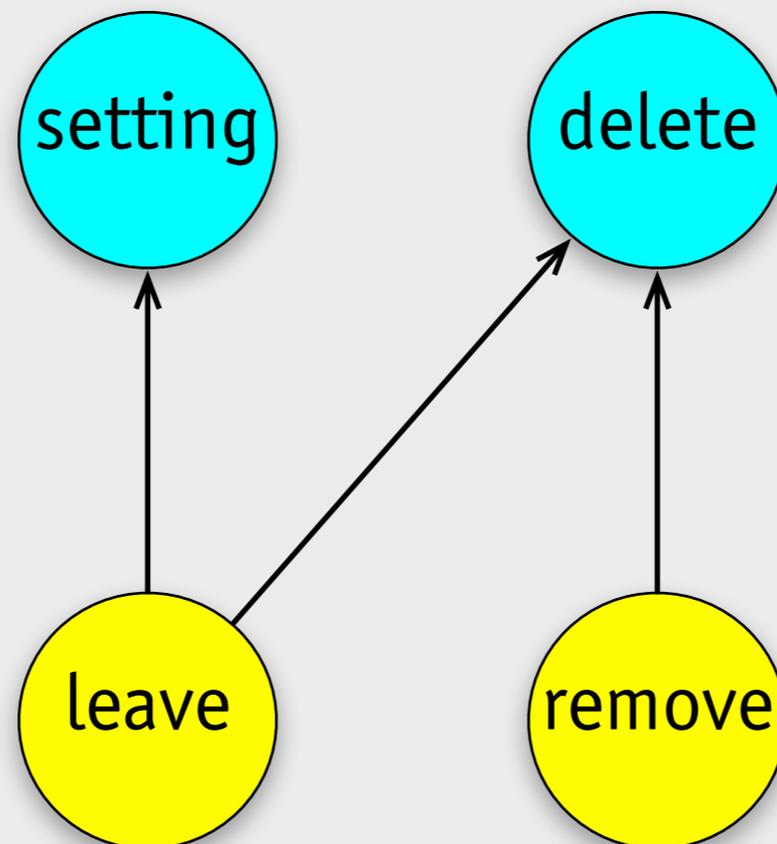
How do I leave a shared folder?

[« Back to Help Center](#)

by changing the folder's settings

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

or by deleting it



where do concepts come from?

**domain concepts:
exist in problem domain**

photo, movie, song

direct flight, code share

401k, CDO, commission

typeface, ligature

**analogic concepts:
based on known notions**

blog post, email, tweet

desktop, folder, file

layer, mask, stacking

cart, order, item

**synthetic concepts:
invented for software**

relative reference

hypertext link

tag, keyword

select, cut buffer

evolving concepts often confusing
direct flights, CSS pixel dimensions
some concepts are key enablers
relative references, paragraph styles

concluding thought

premise: large software systems are intricate and complex beyond human comprehension so no chance of achieving reliability by informal reasoning

so how did software get so reliable without proof?
better management, testing, type safety, etc [Hoare 96]

but maybe premise was wrong?
with strong concepts, informal reasoning goes very far
with orthogonality & generality, can control complexity