



High performance. Delivered.

Conceptual Design: The Essence of Software

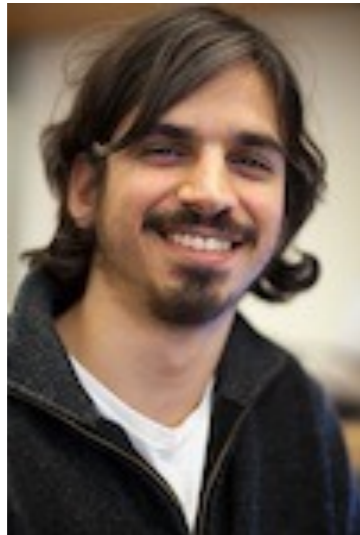
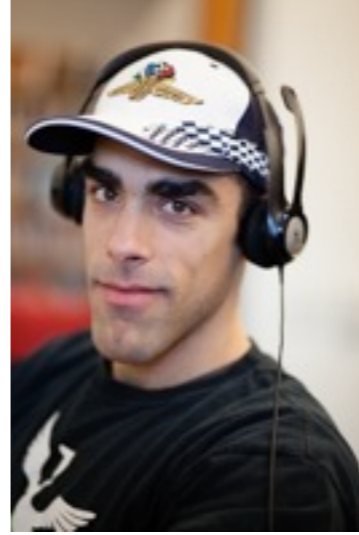
Daniel Jackson, MIT



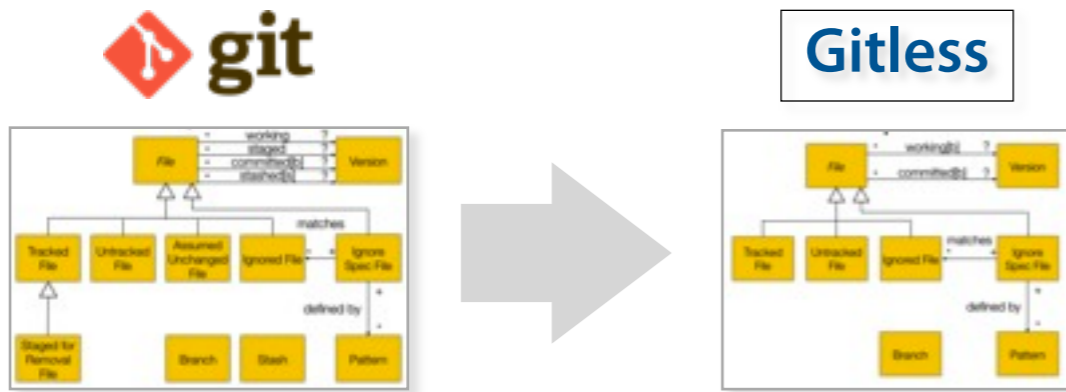
where I work: Gehry's Stata Center



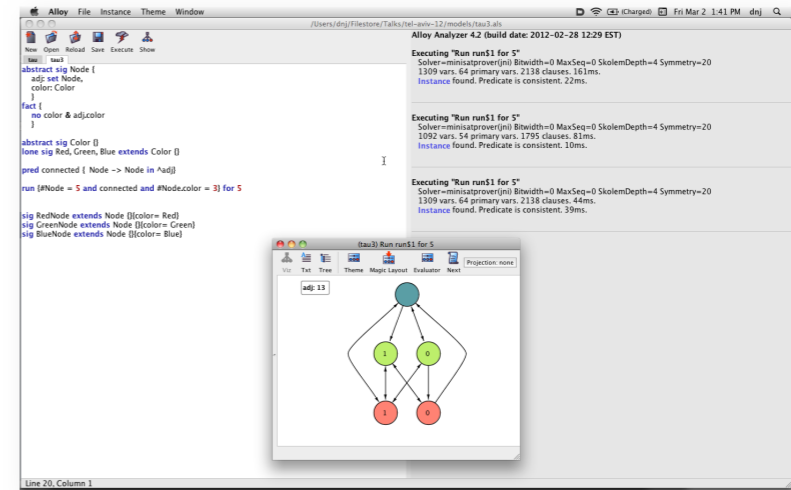
software design group



software design group



rethinking software design
going beyond code level



Alloy design analysis
exploiting SAT



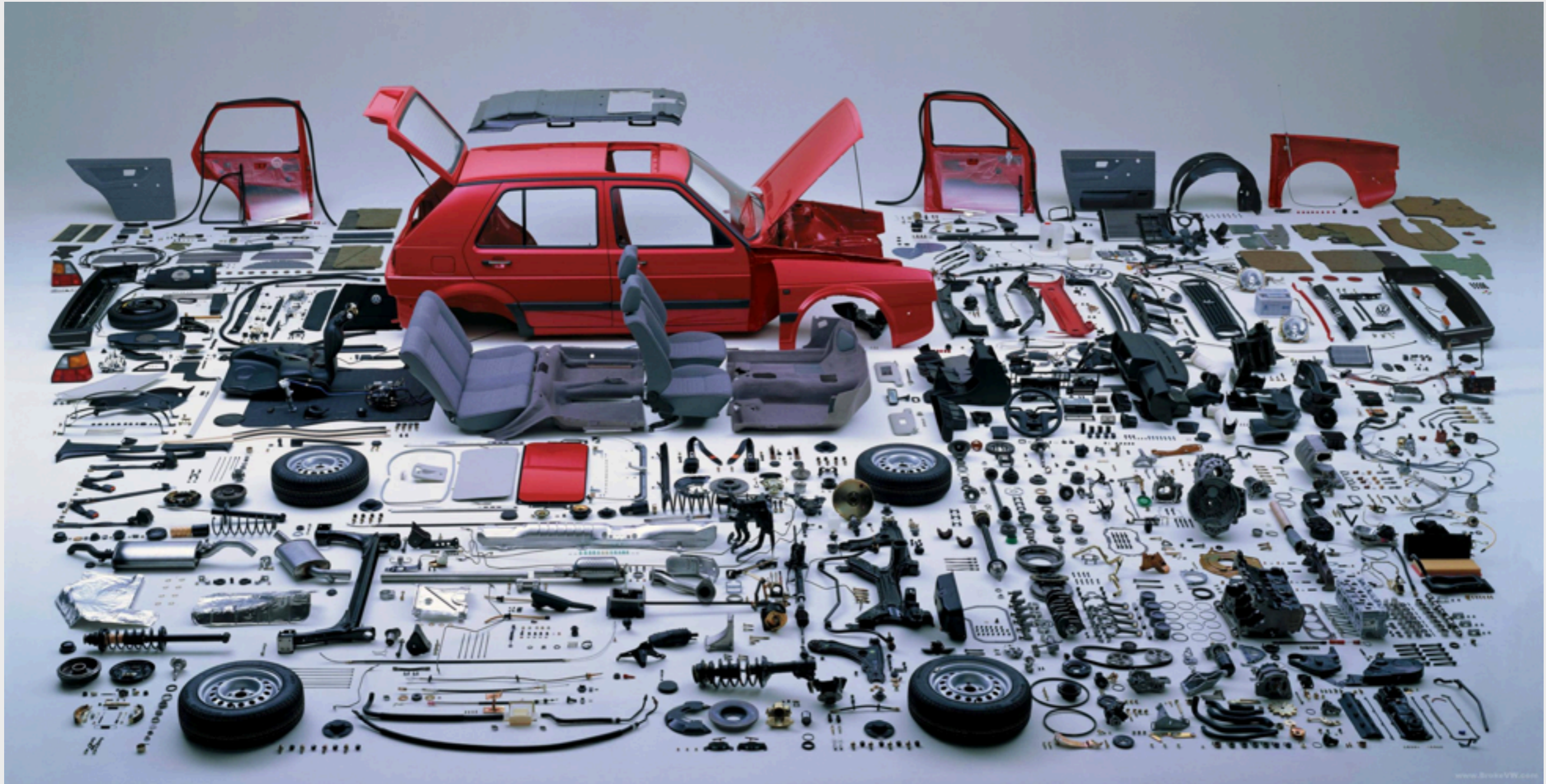
event-based apps
new paradigms



finding security holes
lightweight formalism

introduction

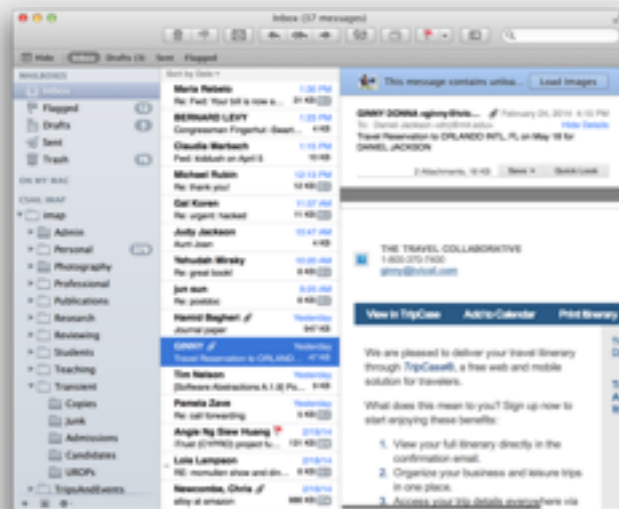
things built from parts



what's software built from?

concepts!

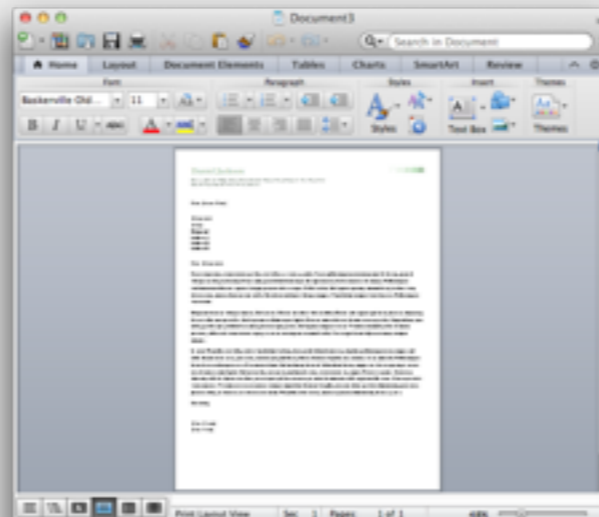
Apple Mail



account
message
folder
conversation

...

Microsoft Word



document
paragraph
style
stylesheet

...

Twitter

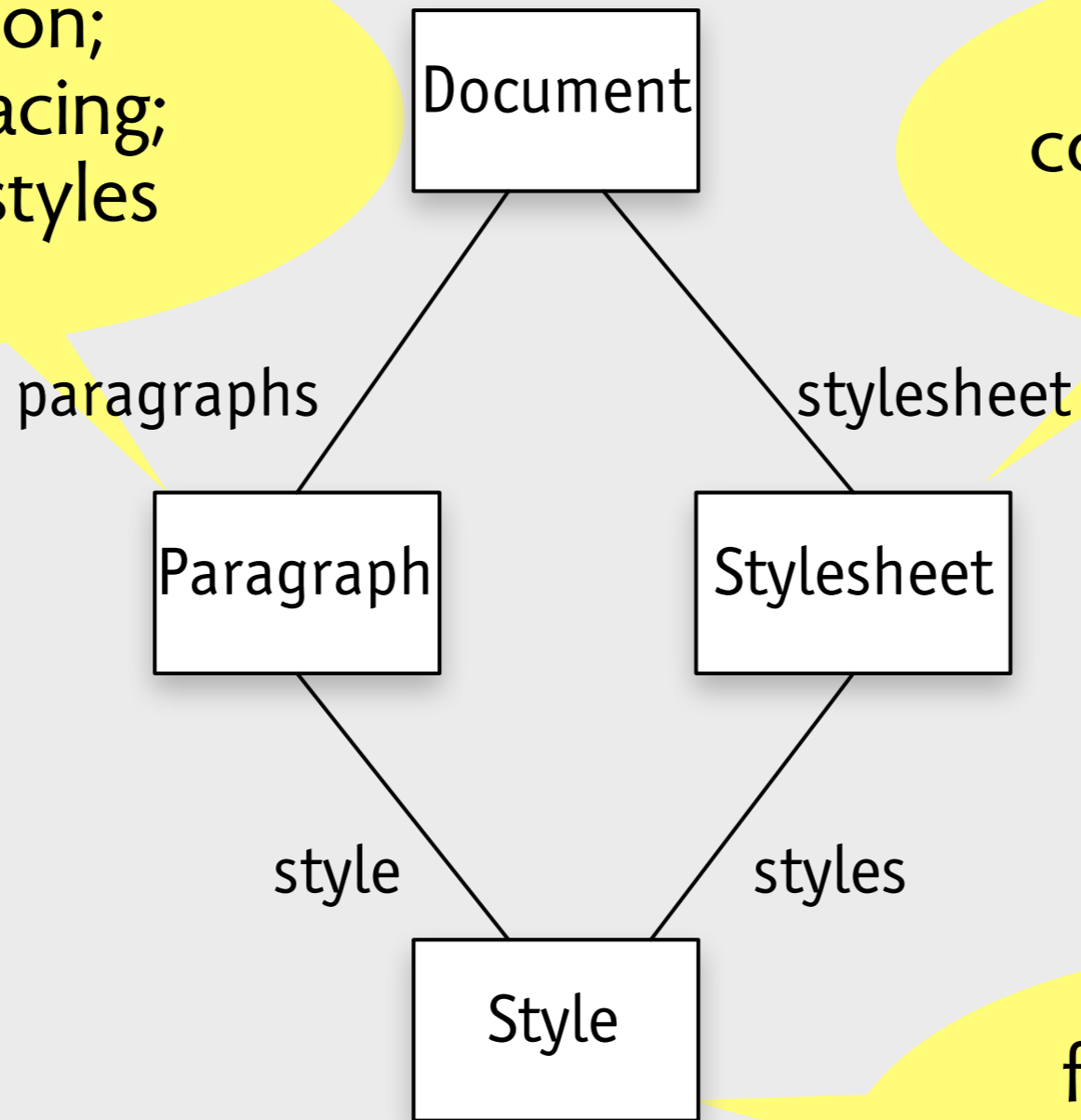


user
tweet
hashtag
follower

...

a concept map for Word

for justification;
for vertical spacing;
for attaching styles



for maintaining
consistent formatting
across documents

for maintaining
consistent formatting
within document

where do concepts come from?

natural

artificial

paragraph

section

chapter

message

style

layer

trash can

directory

RMA

relative reference

PKI certificate

shopping
cart

friend

follower

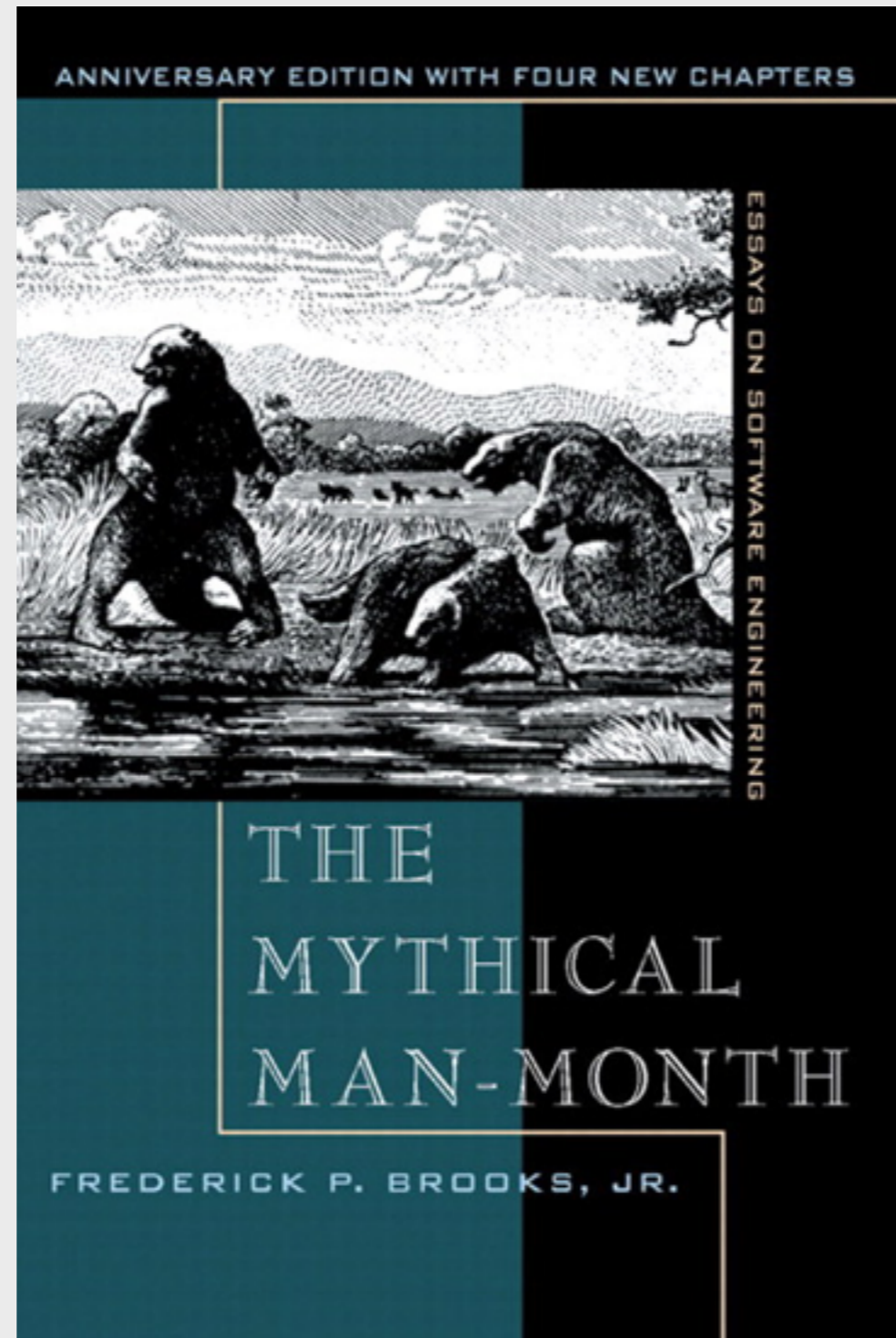
profile

where Word's concepts came from



Charles Simonyi: brought key concepts to Word from Xerox PARC

fred brooks: “mythical man month”



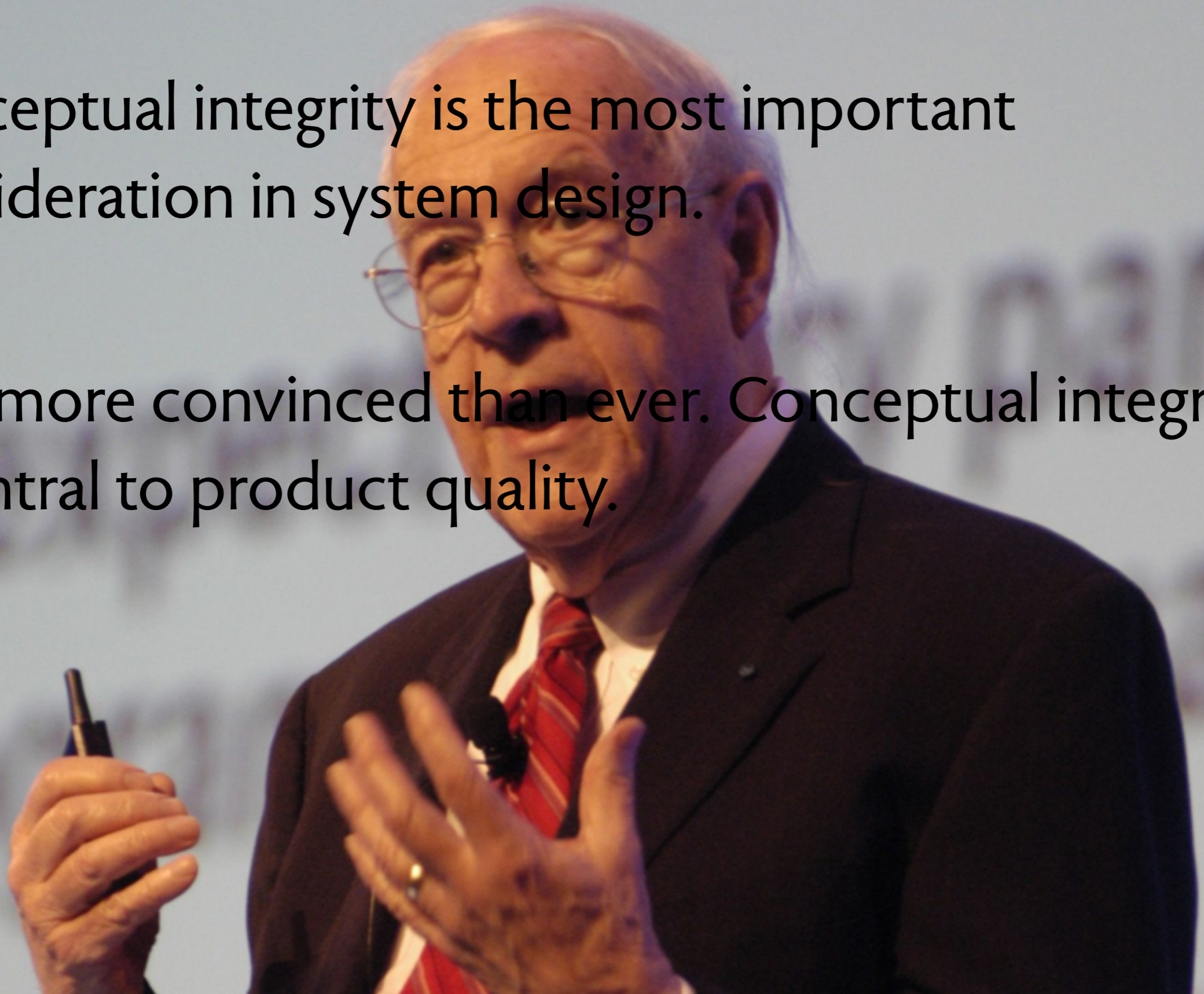
fred brooks on conceptual integrity

Conceptual integrity is the most important consideration in system design.

—1975

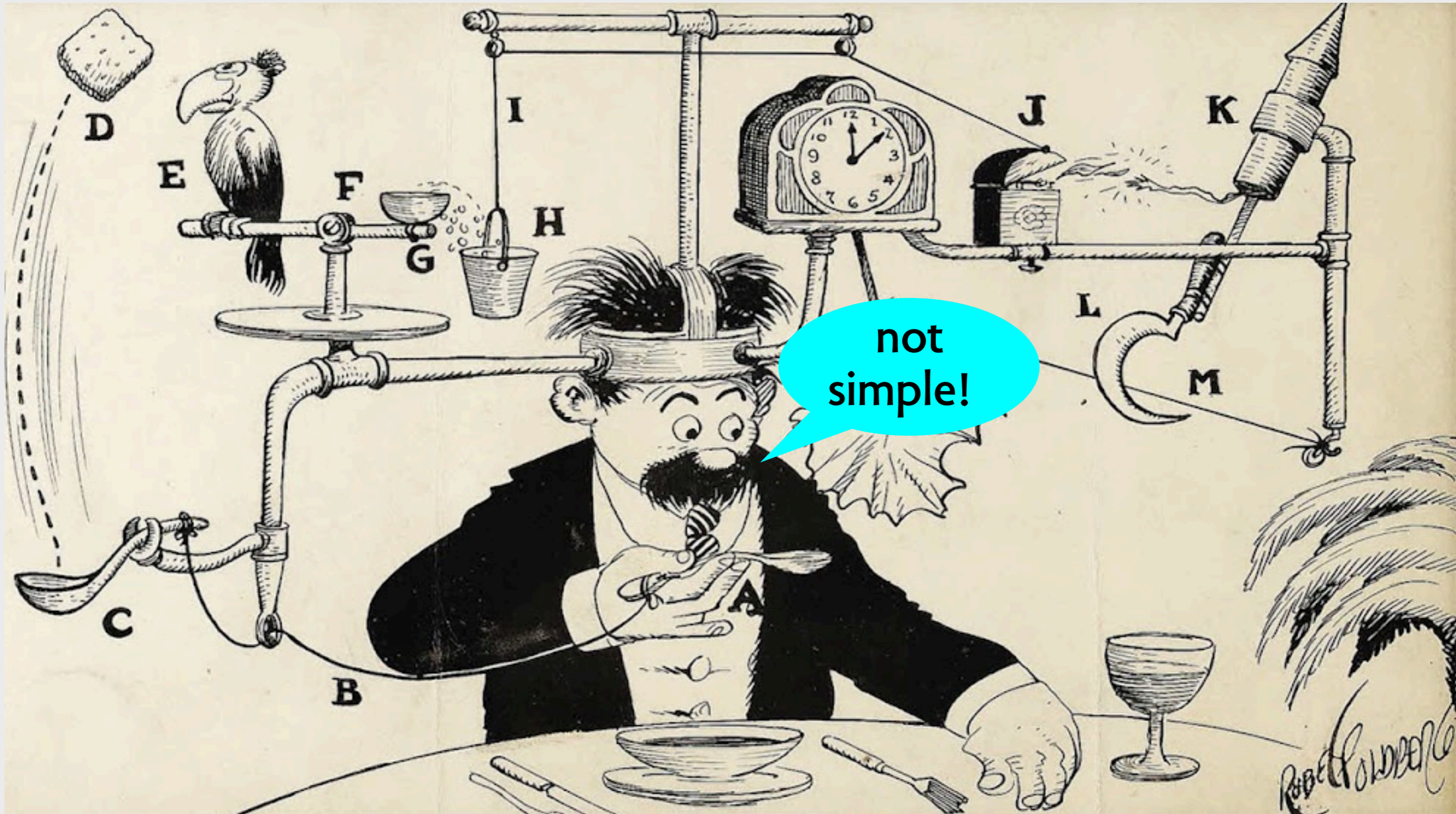
I am more convinced than ever. Conceptual integrity is central to product quality.

—1995



criteria for concepts

simple



not
simple!

Professor Butts and the Self-Operating Napkin (Rube Goldberg)

coherent



Kenwood "radio toaster"

complete



Bay Bridge, CA in 1989 after Loma Prieta earthquake

usable

not
usable!



a short tour
of the
confusing,
dangerous,
inadequate
& broken

the confusing

love & hate

 Adobe Photoshop Lightroom is a photography software program developed by Adobe Systems for Mac OS X and Microsoft Windows, designed ... [»](#)

89% Love Lightroom



 Tweet 3  +1 +

2,335 Positive Opinions out of 2,632

 Adobe Photoshop is a graphics editing program developed and published by Adobe Systems Incorporated.

70% Love Photoshop



 Tweet 87  +1 +

30,305 Positive Opinions out of 43,283

 Adobe Acrobat is a family of computer programs developed by Adobe Systems, designed to view, create, manipulate and manage files ... [»](#)

47% Love Acrobat



 Tweet 1  +1 +

207 Positive Opinions out of 444

 Adobe Photoshop Lightroom is a photography software program developed by Adobe Systems for Mac OS X and Microsoft Windows, designed ... [»](#)

11% Hate Lightroom




 Tweet 5  +1 +

297 Negative Opinions out of 2,632

 Adobe Photoshop is a graphics editing program developed and published by Adobe Systems Incorporated.

30% Hate Photoshop




 Tweet 105  +1 +

12,978 Negative Opinions out of 43,283

 Adobe Acrobat is a family of computer programs developed by Adobe Systems, designed to view, create, manipulate and manage files ... [»](#)

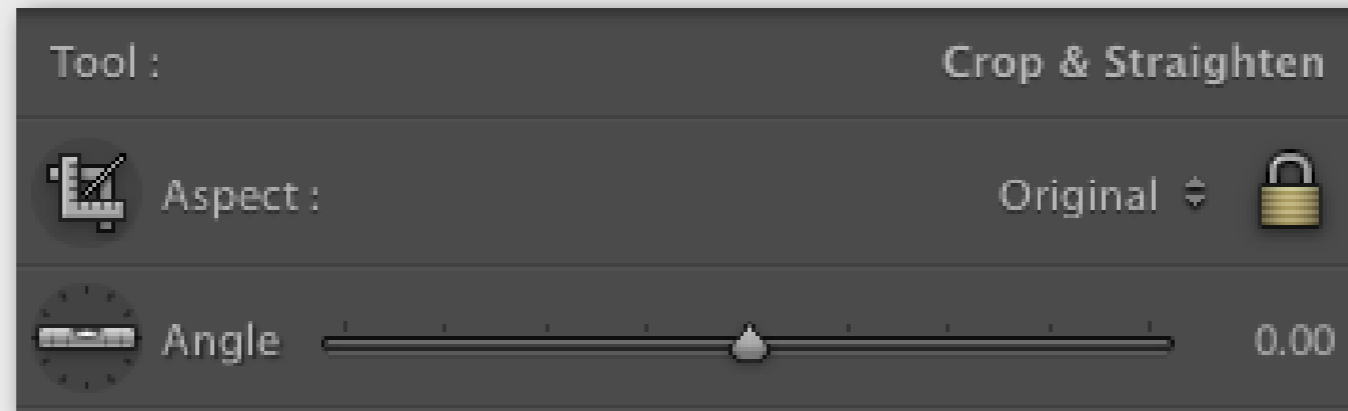
53% Hate Acrobat



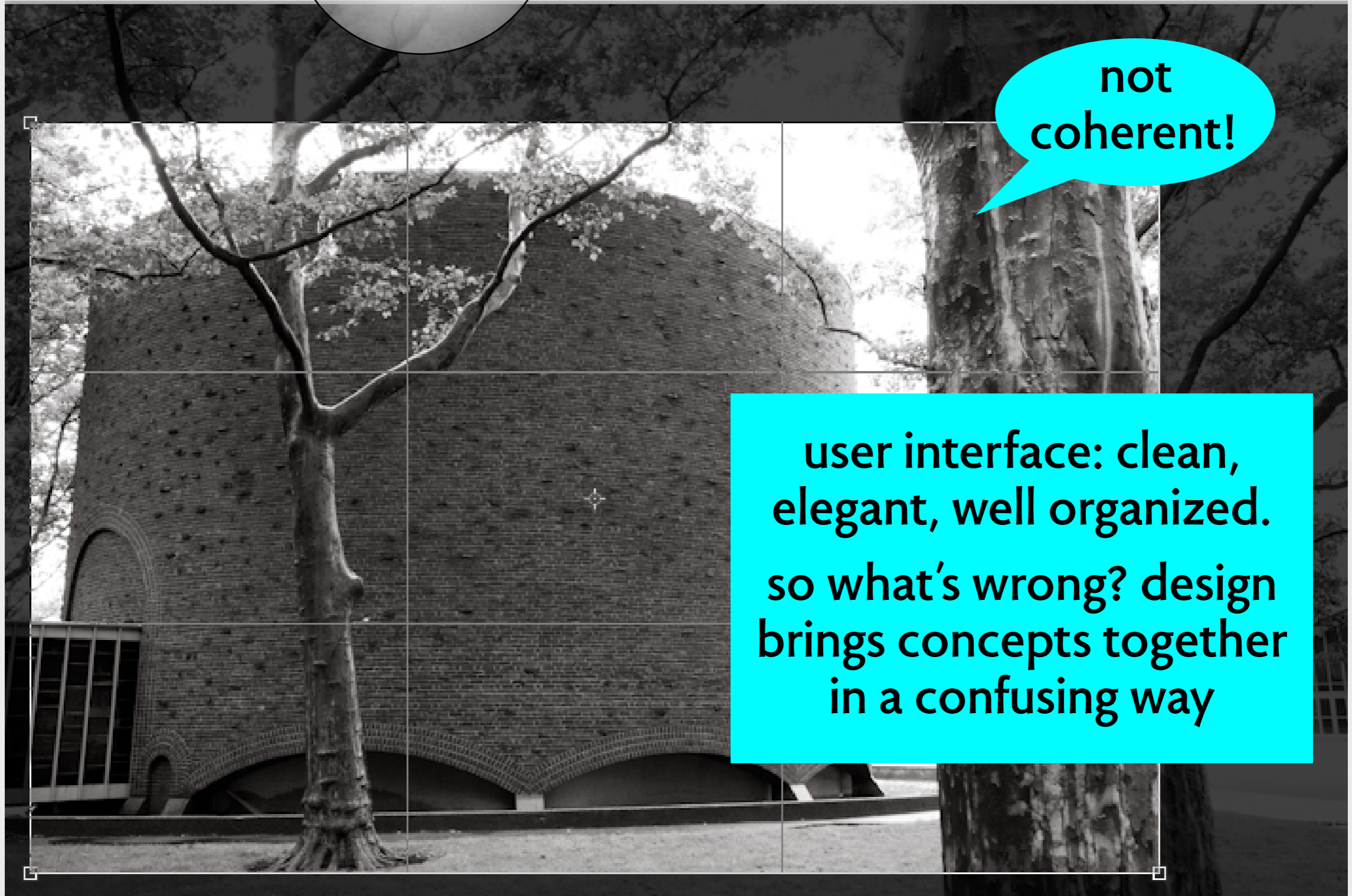
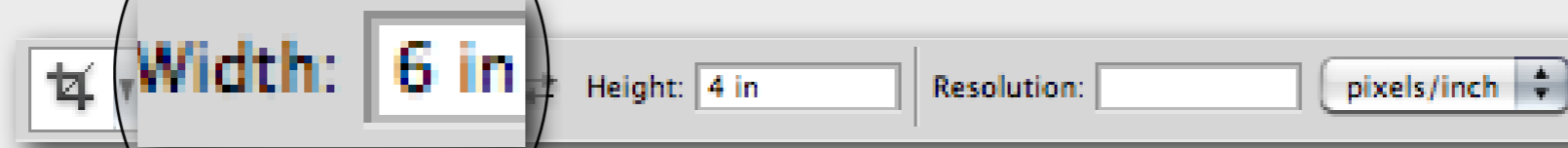
 Tweet 15  +1 +

237 Negative Opinions out of 444

cropping in adobe lightroom



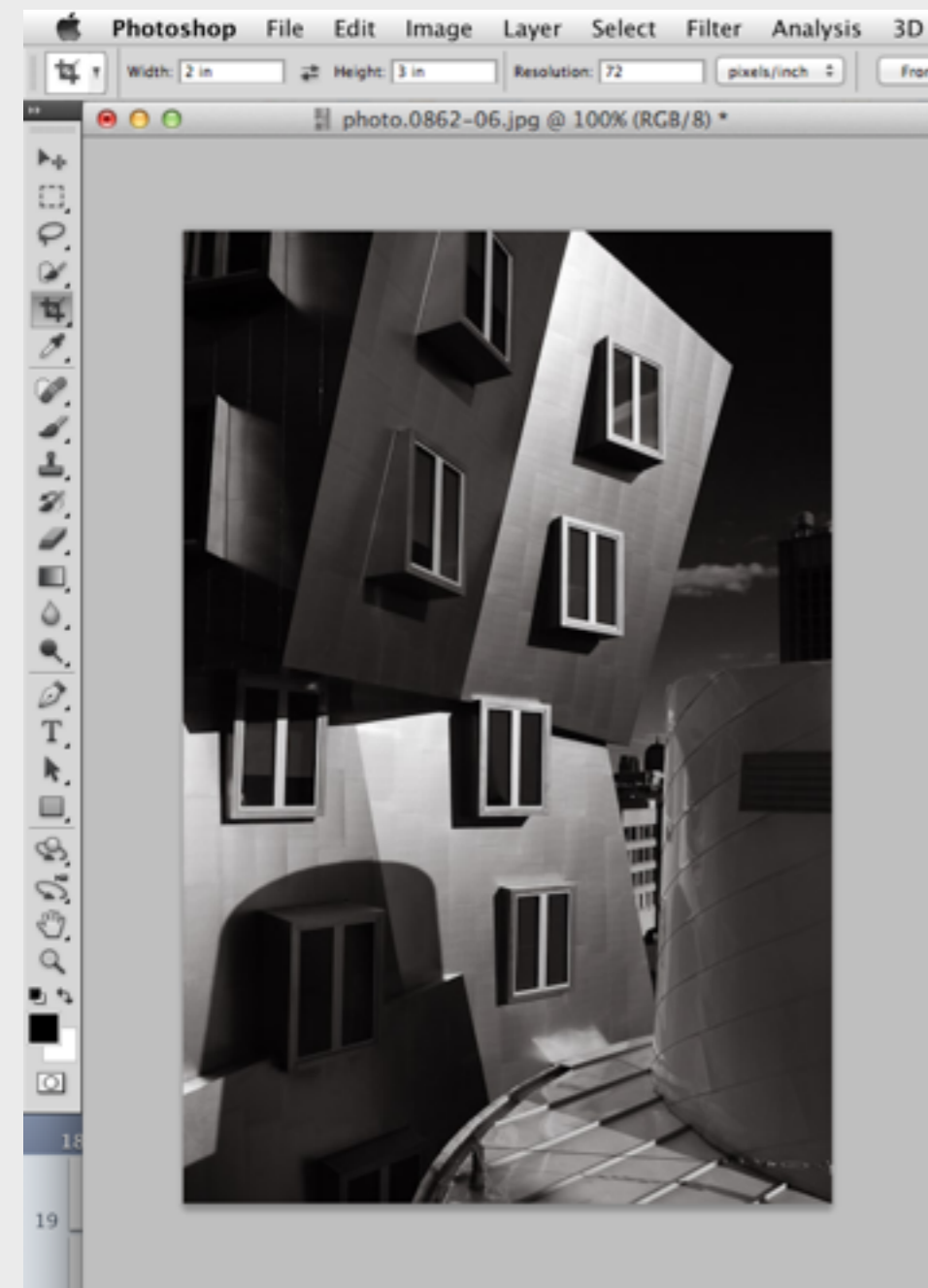
cropping in adobe photoshop



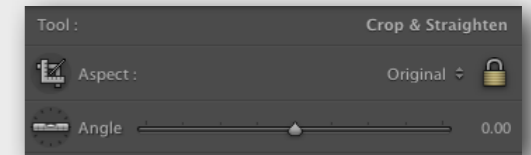
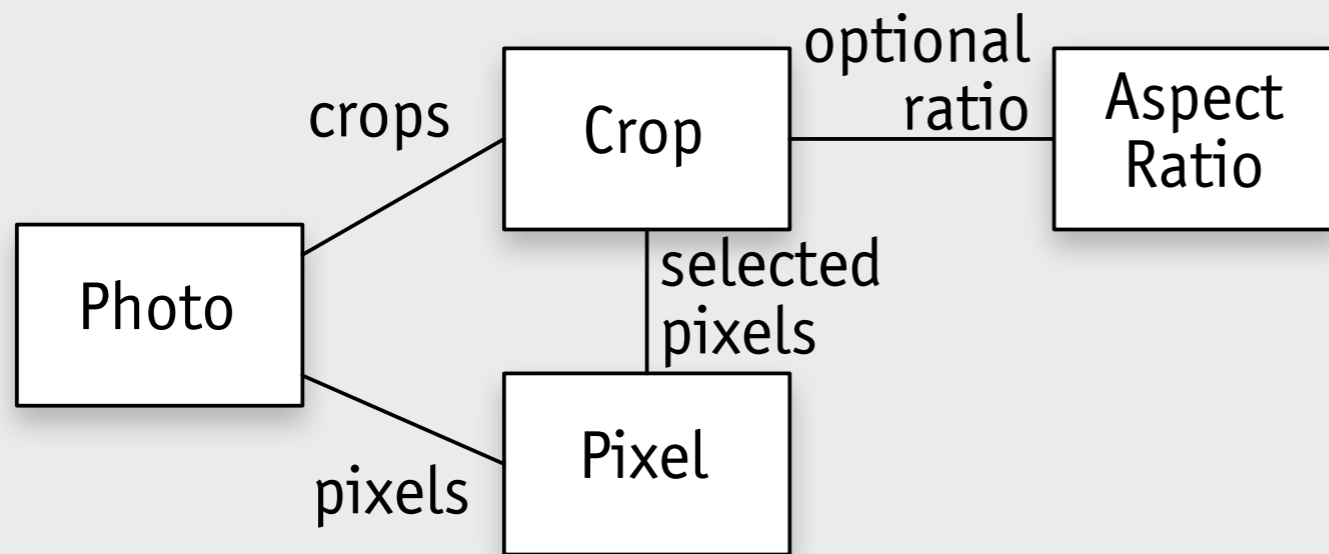
not coherent!

user interface: clean, elegant, well organized. so what's wrong? design brings concepts together in a confusing way

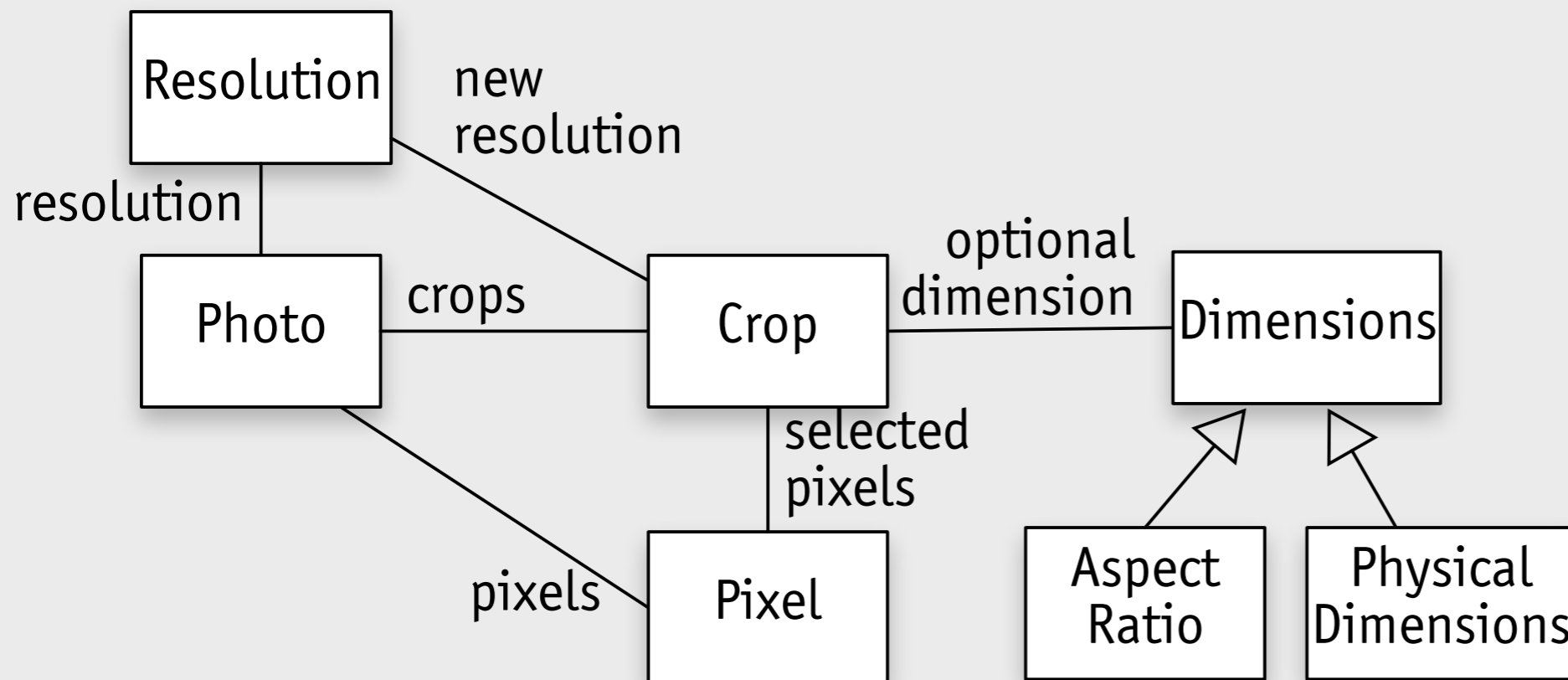
cropping the whole image



concept maps of cropping



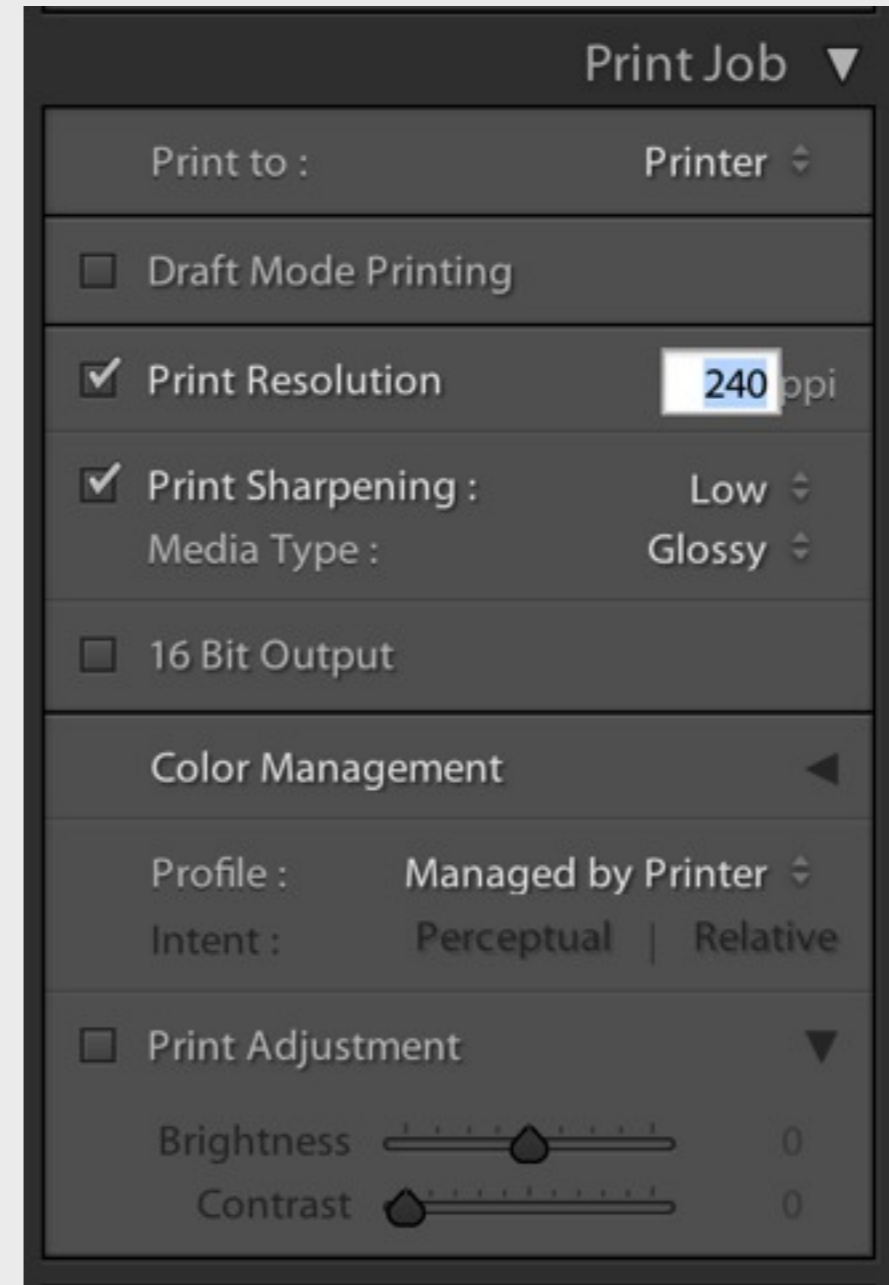
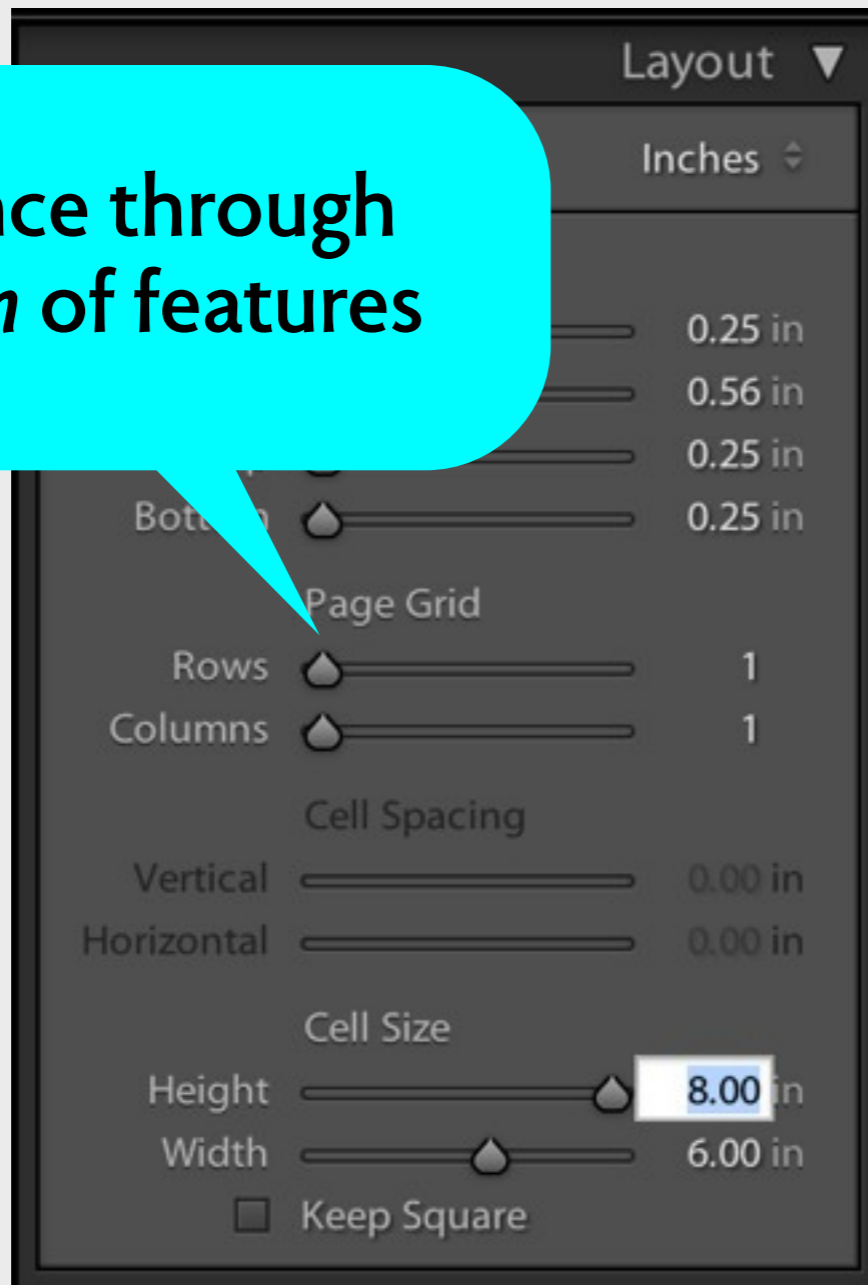
Lightroom



Photoshop

where did resolution go?

coherence through
separation of features




Lightroom printing module

subversion

```
% cat > readme.txt
hello. this is a new file.
% svn add readme.txt
A          readme.txt
% cat >> readme.txt
adding another line.
% svn commit -m "new readme file"
Password:
Adding          readme.txt
Transmitting file data .
Committed revision 15493.
```

git

 **git** --fast-version-control

Git is a **free and open source** distributed version control system designed to handle everything from small to very large projects with speed and efficiency.

Git is **easy to learn** and has a **tiny footprint with lightning fast performance**. It outclasses SCM tools like Subversion, CVS, Perforce, and ClearCase with features like **cheap local branching**, convenient **staging areas**, and **multiple workflows**.



Learn Git in your browser for free with **Try Git**.

git

```
% cat > readme.txt
hello. this is a new file.
% git add readme.txt
% cat >> readme.txt
adding another line.
% git commit -m "new readme file"
[master b455dc7] new readme file
1 file changed, 1 insertion(+)
create mode 100644 2014/inclass/readme.txt
```

not simple: too many concepts

changes were not saved in repository!

```
% git status
# On branch master
# Changes not staged for commit:
#   (use "git add <file>..." to update what will be committed)
#   (use "git checkout -- <file>..." to discard changes in working directory)
#
#       modified:   readme.txt
#
no changes added to commit (use "git add" and/or "git commit")
```

Staging Modified Files

Let's change a file that was already tracked. If you change a previously tracked file called `benchmarks.rb` and then run your `status` command again, you get something that looks like this:

```
$ git status
On branch master
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

        new file:   README

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

        modified:   benchmarks.rb
```

The `benchmarks.rb` file appears under a section named “Changes not staged for commit”, which means that a file that is tracked has been modified in the working directory but not yet staged. To stage it, you run the `git add` command (it's a multipurpose command — you use it to begin tracking new files, to stage files, and to do other things like marking merge-conflicted files as resolved). Let's run `git add` now to stage the `benchmarks.rb` file, and then run `git status` again:

hoare on simplicity



Almost anything in software can be implemented, sold, and even used given enough determination... But there is one quality that cannot be purchased in this way—and that is reliability. **The price of reliability is the pursuit of the utmost simplicity. It is a price which the very rich find most hard to pay.**

gitless: our reworking of git

[about & download](#)

[documentation](#)

[community](#)

[code](#)

Gitless: a version control system

About Gitless

Gitless is an experimental version control system built on top of Git. We are exploring what conceptual integrity means with the goal of building a rigorous foundation for concept design. We encourage you to try out the current version of Gitless and [send feedback](#). Keep in mind that Gitless might change in non-retrocompatible ways (so don't script around it just yet) as we seek to answer the fundamental question that drives this software project: if we were to challenge the very core concepts in version control systems, what would version control look like?

In its current state, Gitless is a distributed version control system that supports all of the most commonly used Git features. We are missing some things like submodules and cherry-picking but these are coming soon (maybe; only if we don't find a superior, more robust way of achieving the same goal). Either way, since Gitless is implemented on top of Git (could be considered what Git pros call a 'porcelain' of Git) you can always fallback to the 'git' command to finish a task.

Install

You need to have Python 2.7 and Git 1.7.12+. The easiest way to install Gitless is through the Python Package Index (pip):

```
pip install gitless
```

For more detailed instructions see the [README file](#).

gitless at MIT: just google "gitless"

the dangerous

a common 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](#)

Friends don't let friends delete shared Dropbox items



Christopher Breen
@BodyofBreen

Sep 9, 2013 5:00 AM



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

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

how dropbox explains it



How do I leave a shared folder?

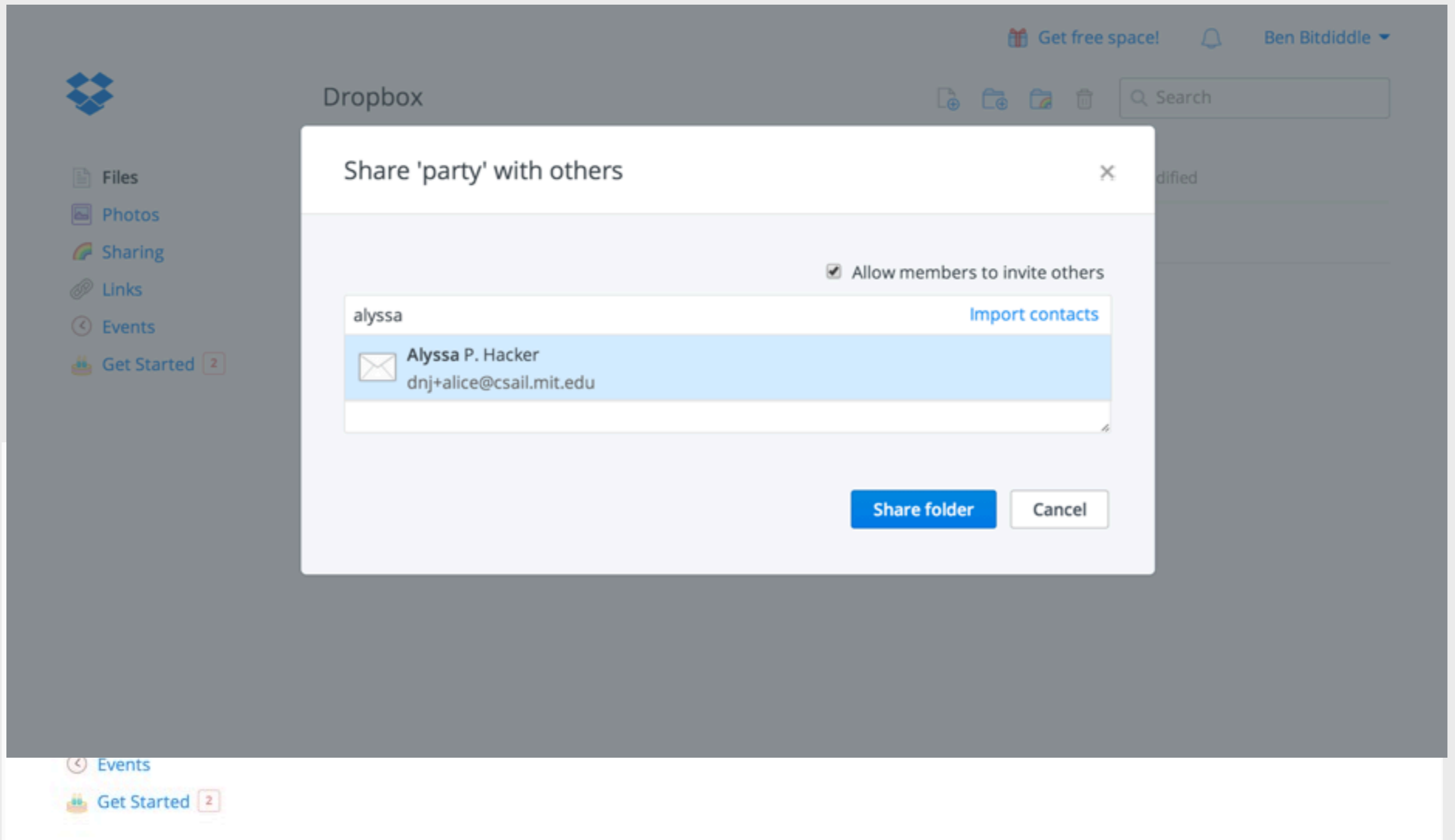
[« Back to Help Center](#)

by changing the folder's settings

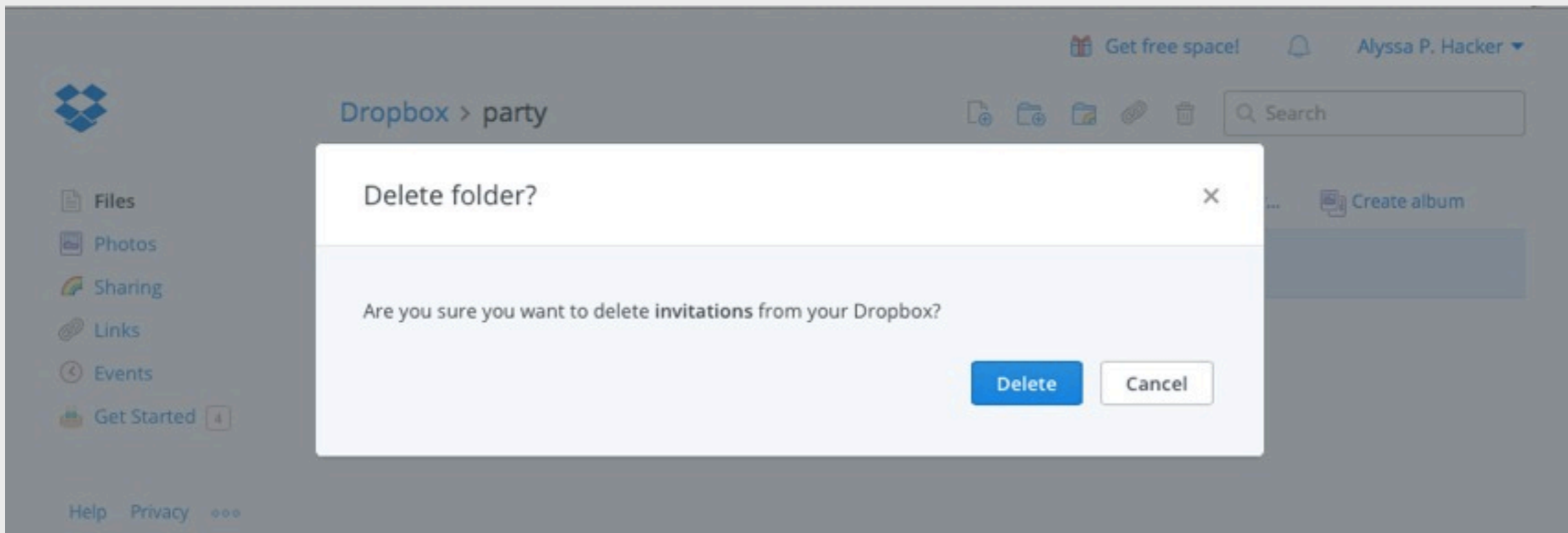
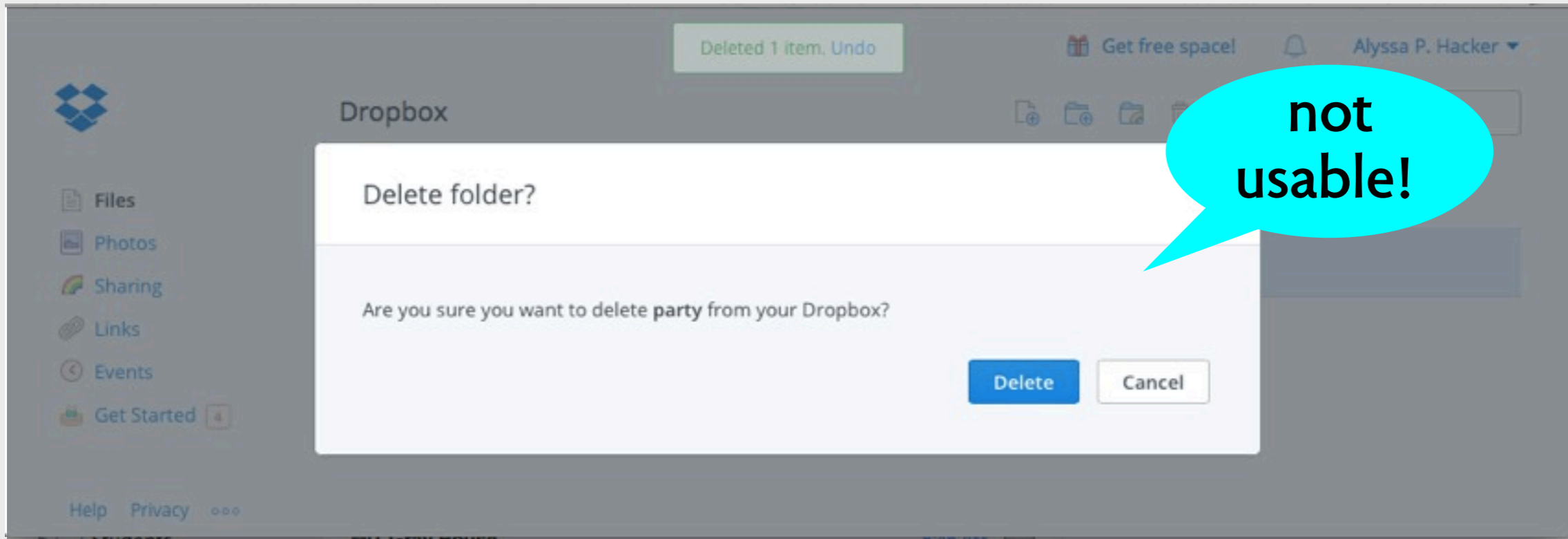
You can leave a [shared folder](#) at any time by changing the folder's settings on the Dropbox website or deleting it. If you change your mind or leave a folder accidentally, you can [rejoin it](#) later.

or by deleting it

alyssa & ben plan a party



alyssa spoils everything



in summary



How do I leave a shared folder?

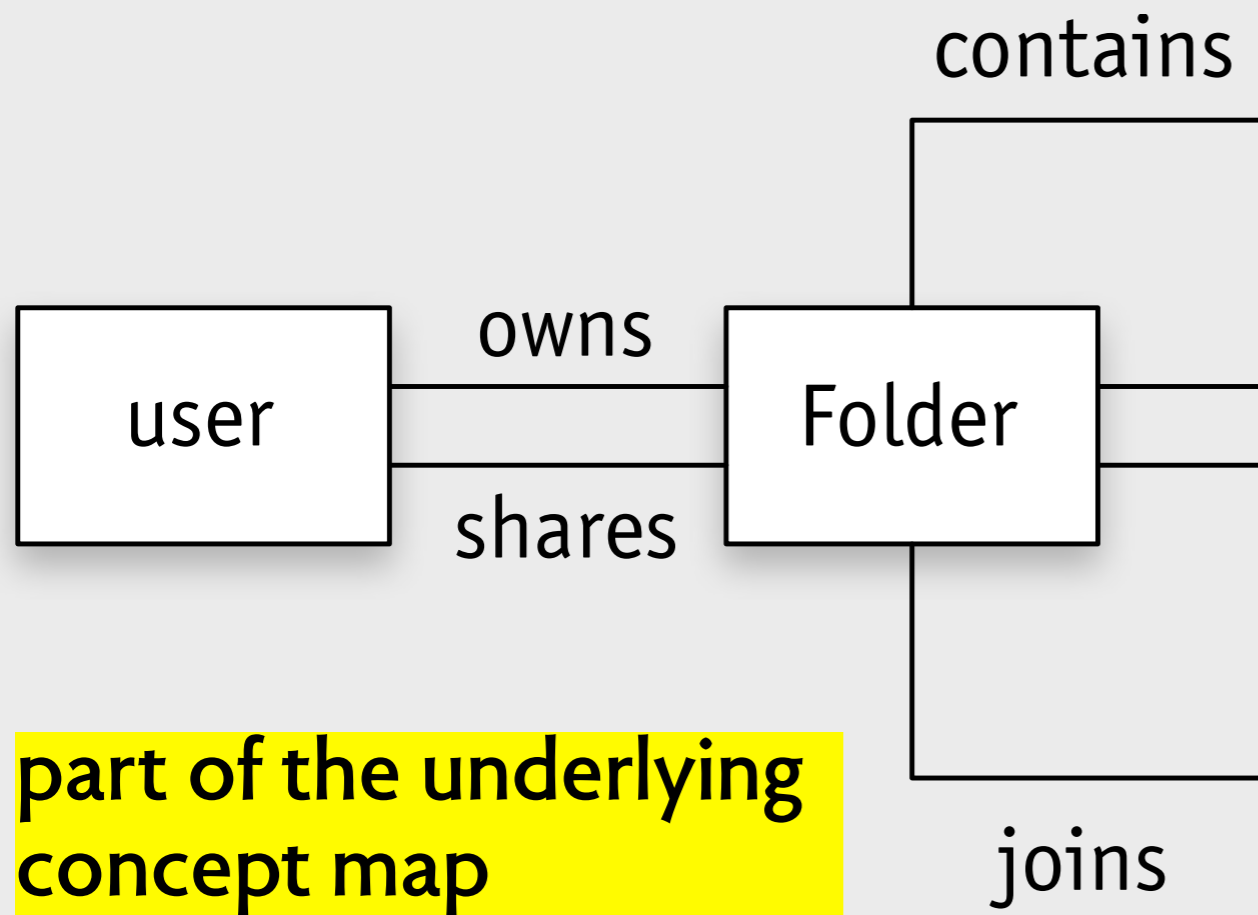
[« Back to Help Center](#)

You can leave a [shared folder](#) at any time by changing the permissions or deleting it. If you change your mind or leave a folder acc

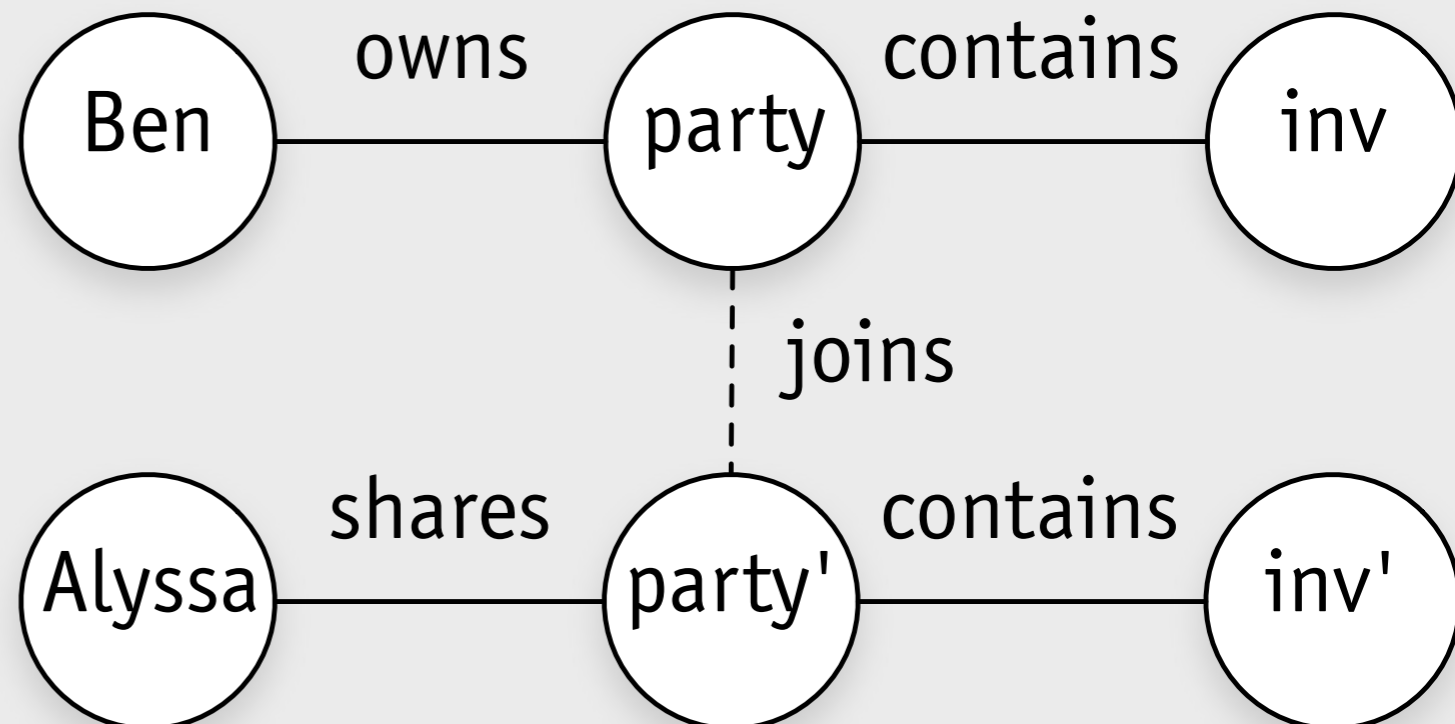
**concepts are fine: share,
leave, rejoin.**

**so what's wrong? user
interface confuses
deletion with leaving**

what's going on?



Alyssa deletes party', party stays
Alyssa deletes inv', inv goes



mozying along

http://support.mozy.com/articles/en_US/FAQ/What-happens-if-I-delete-a-file-marked-for-backup

What happens if I delete a file marked for backup?

Article ID: 000003709

Date: 07/15/2012



| [Comment](#) |



If you delete a file and then run a backup, MozyHome assumes that you no longer need a backup copy of that file and marks the file to be removed. (We keep it for 30 days, just in case you change your mind.) After 30 days, the file is deleted from our servers and you are no longer able to get it back.

**not
coherent!**

If you delete a file and then run a backup, MozyHome assumes that you no longer need a backup copy of that file and marks the file to be removed...

what's going on?

propagate deletion?

file sync: yes, to keep things ordered

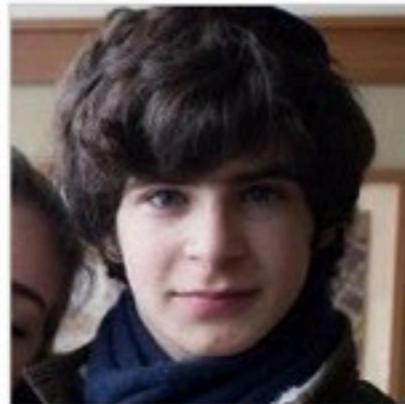
backup: no, to make sure things aren't lost

why would Mozy propagate deletion?

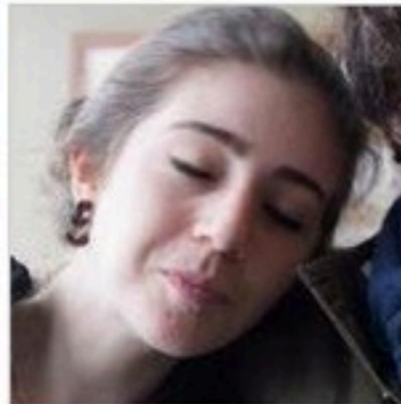
prevent you from using as secondary storage

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.



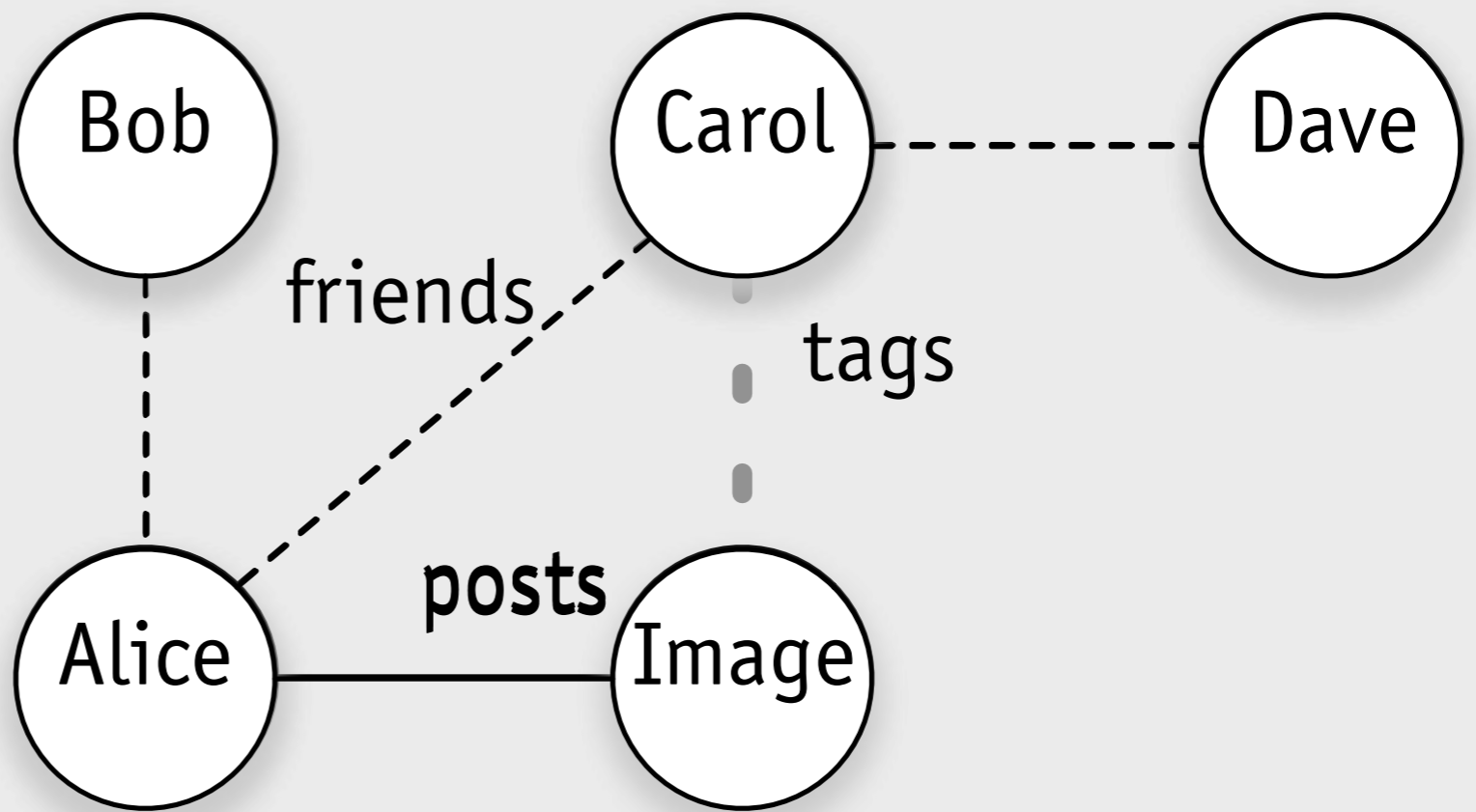
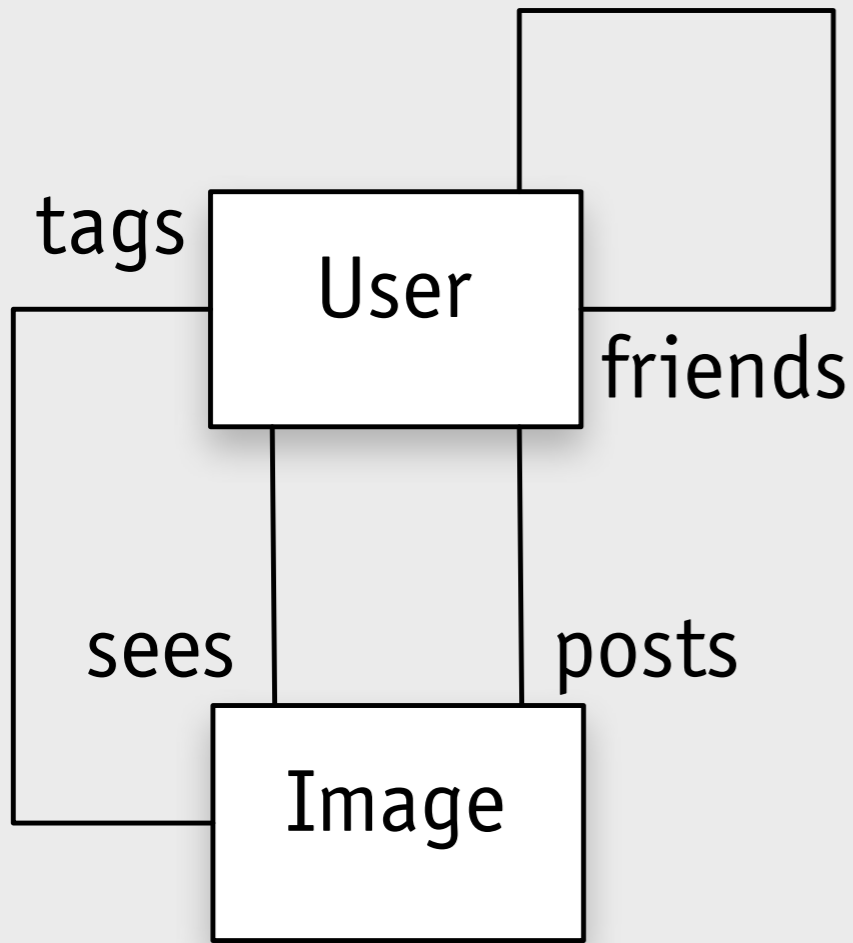
Who is this?



Who is this?

[Skip Tagging Friends](#)

[Save Tags](#)

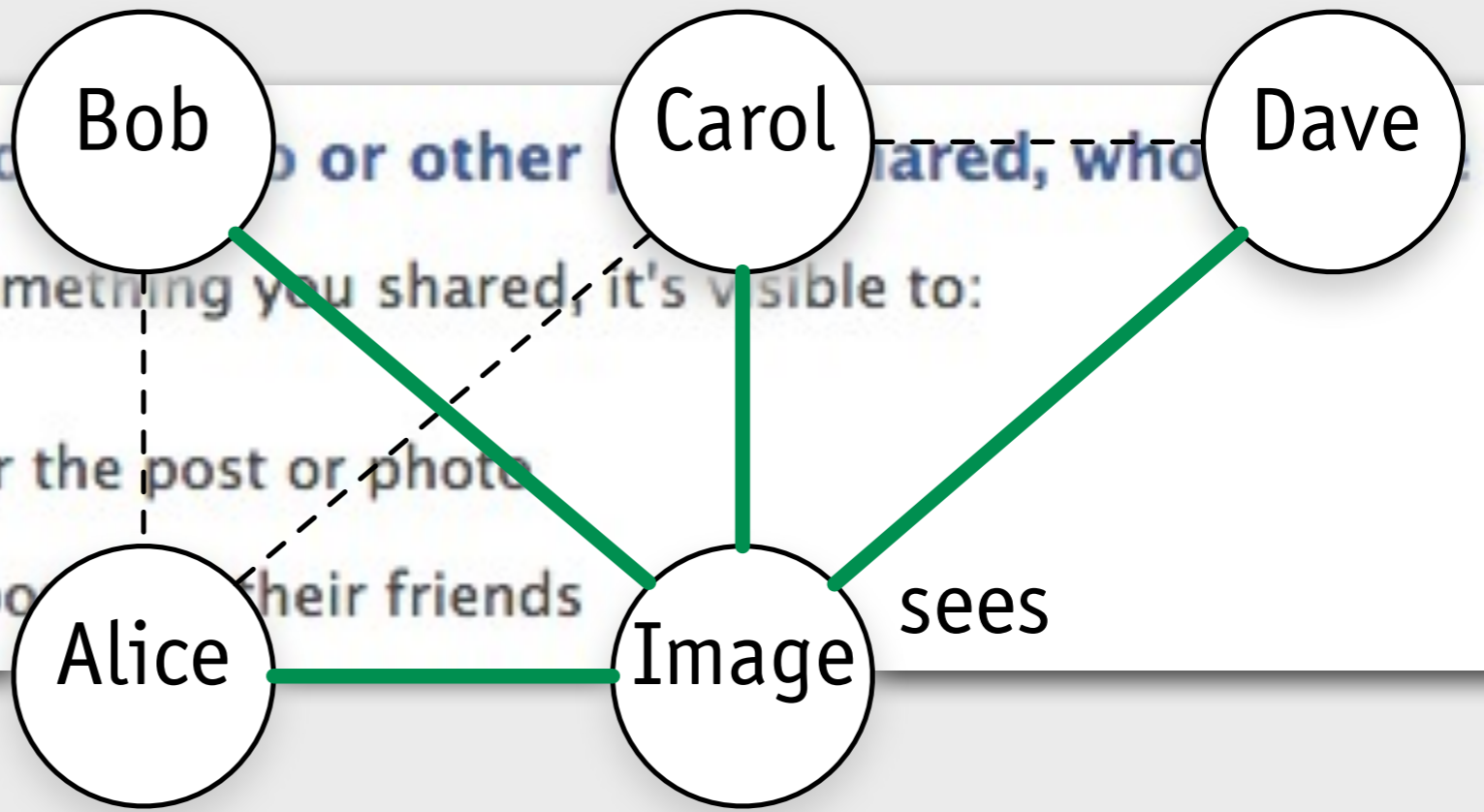


who can see the image?

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



tagging in facebook

Privacy Shortcuts



Who can see my stuff?

2013

2012

2011



not simple!

Timeline and Tagging Settings

Who can add things to my timeline?	Who can post on your timeline?	Friends	Edit
	Review posts friends tag you in before they appear on your timeline?	Off	Edit
Who can see things on my timeline?	Review what other people see on your timeline		View As
	Who can see posts you've been tagged in on your timeline?	Friends	Edit
	Who can see what others post on your timeline?	Only Me	Edit
How can I manage tags people add and tagging suggestions?	Review tags people add to your own posts before the tags appear on Facebook?		Edit
	When you're tagged in a post, who do you want to add to the audience if they aren't already in it?	Friends	Edit
	Who sees tag suggestions when photos that look like you are uploaded?	No One	Edit

not complete!

what that dialog should really say

Timeline and Tagging Settings

When a psychopathic stranger photographs me at a party and tags me, who can see the photo?

All of their friends and fellow psychopaths, your future employers, girlfriends, and parents-in-law

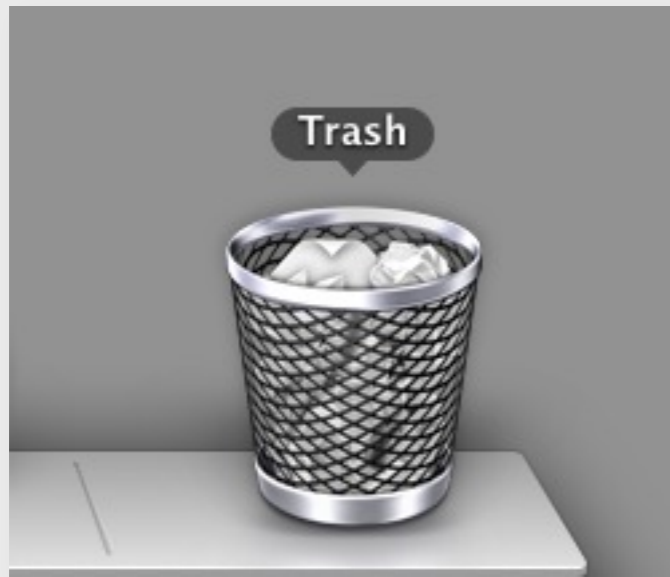
Thank you, Facebook!



the inadequate

undoing deletion in Mac trash

not complete!

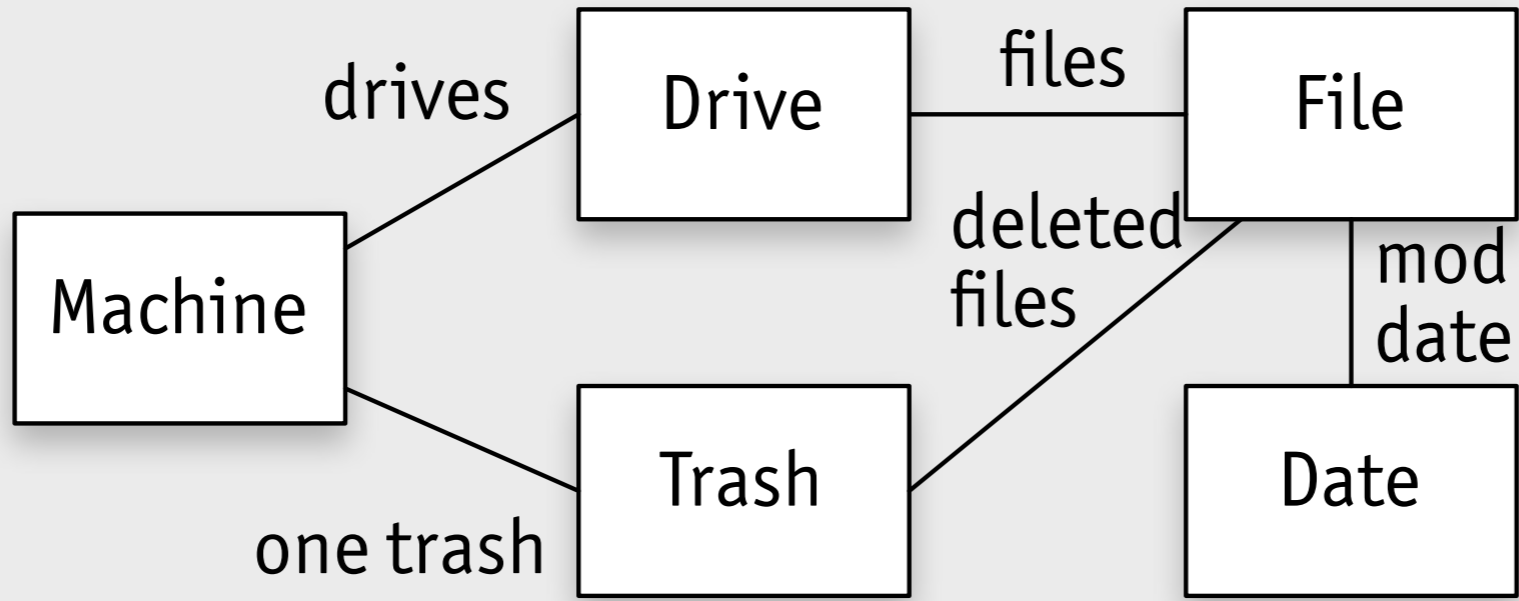


Name	Date Modified	Size
Screen Shot 2013-02-25 at 11.46.27 AM	Today 11:46 AM	58 KB
Screen Shot 2013-02-25 at 11.45.46 AM	Today 11:45 AM	39 KB
bits.key	Yesterday 7:09 PM	326 KB
▶ 2013 2.16.58 PM	Feb 22, 2013 2:16 PM	--
▶ 2013-02-18	Feb 22, 2013 2:12 PM	--
▶ 2013-02-17	Feb 22, 2013 2:12 PM	--
▶ 2013-02-15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

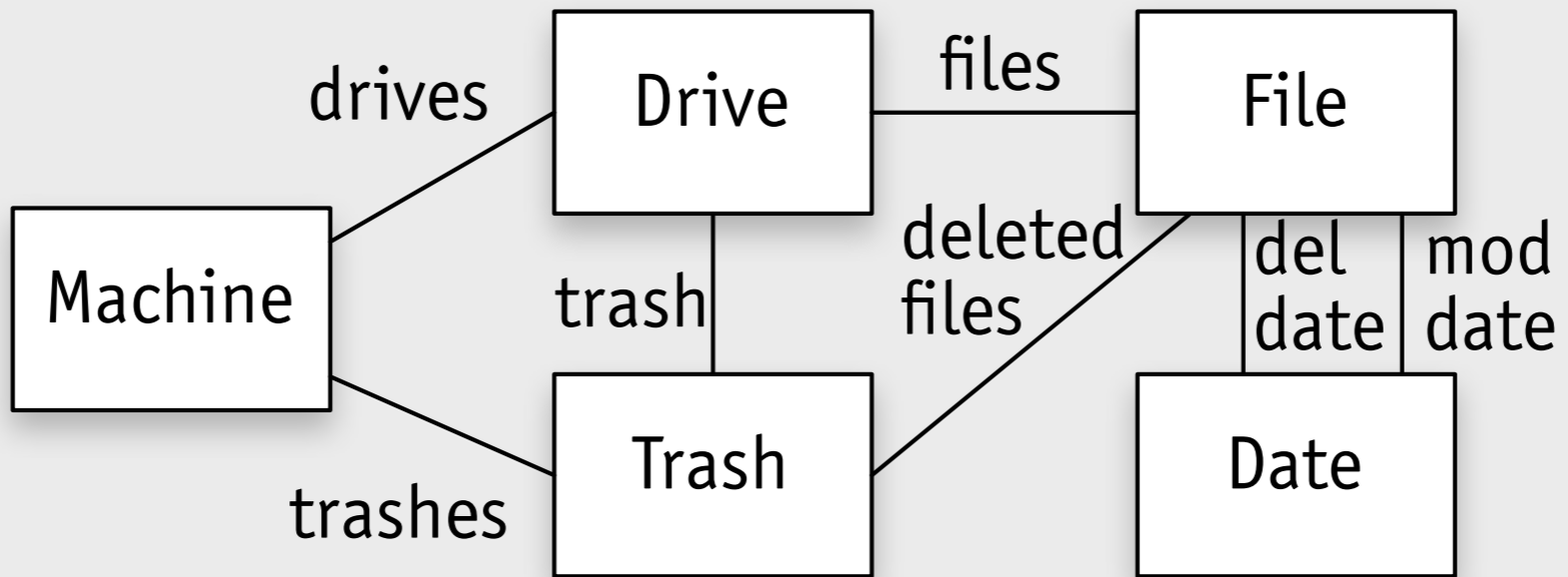
deleting from external drive (eg USB)
can't reuse space until trash emptied

retrieving accidentally deleted files
no date of deletion

partial emptying
not possible



what exists

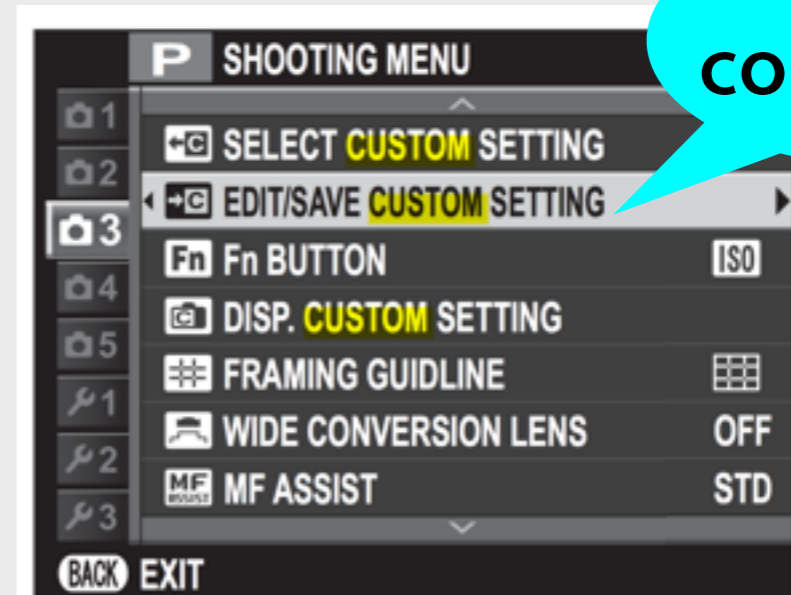


what we need

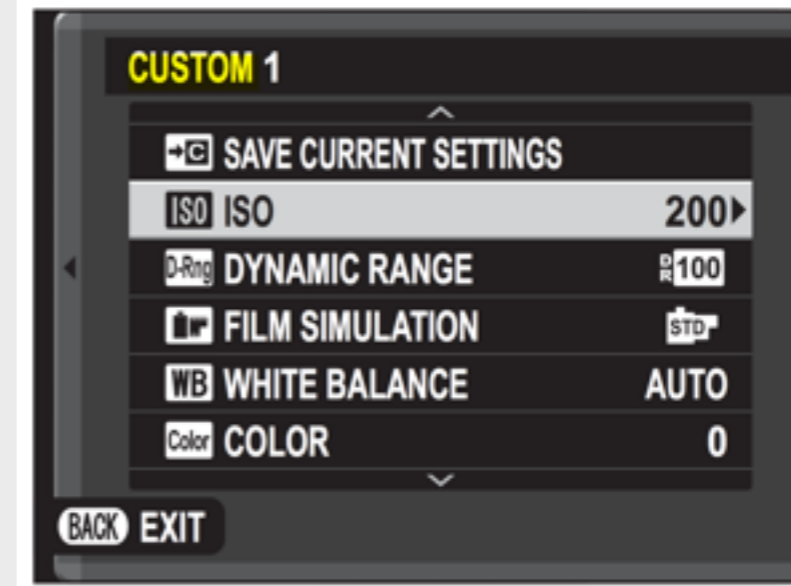
custom settings in fuji x100s



not complete!



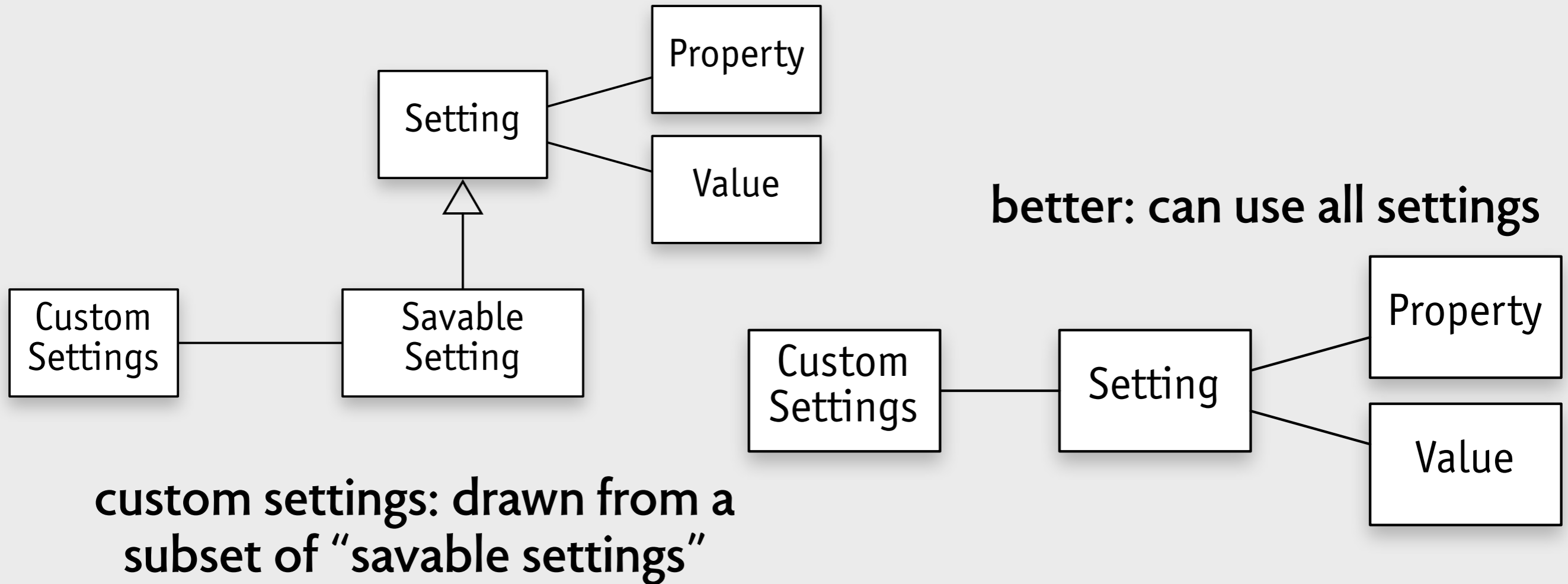
2 Highlight a custom settings bank and press **MENU/OK** to select. Adjust the following as desired and press **DISP/BACK** when adjustments are complete: **ISO** ISO, **D-Rng** DYNAMIC RANGE, **Film** FILM SIMULATION, **WB** WHITE BALANCE, **Color** COLOR, **Sharp** SHARPNESS, **Tone** HIGHLIGHT TONE,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



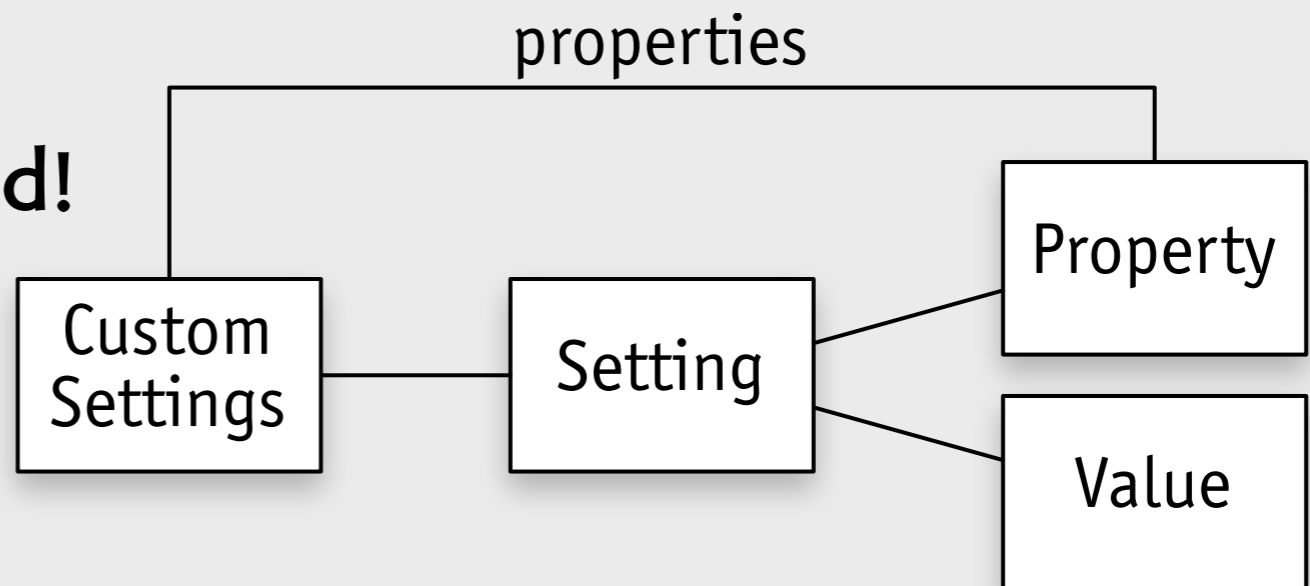
Ken Rockwell review of x100s:

The X100's Custom Settings memories are useless.

fuji x100s concept map

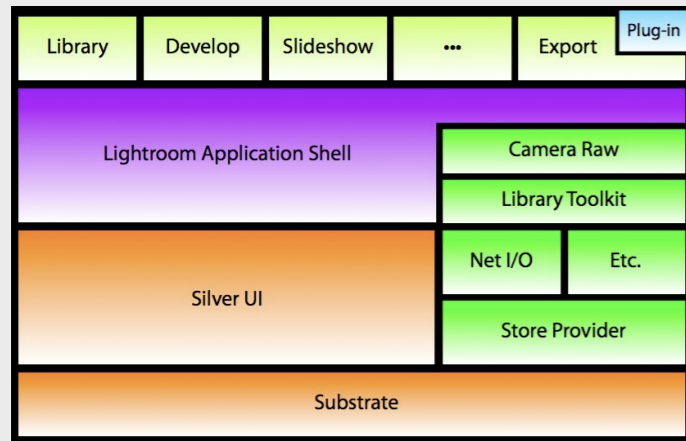


best: choose which properties are included!



the broken

two sides of the interface



code

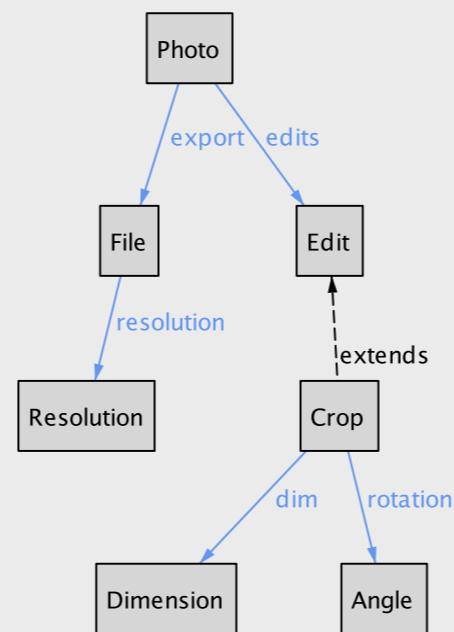


interface



user's model

bad conceptual model: *developer* is confused



conceptual model

bad conceptual model: *user* is confused

gmail labels & filters

The screenshot displays the Gmail web interface. At the top left is the Google logo. A search bar contains the text 'label:starred' and a blue search button with a magnifying glass icon. Below the search bar is a navigation bar with the 'Gmail' logo and three buttons: a square with a dropdown arrow, a refresh icon, and a 'More' button with a dropdown arrow. On the left side, there is a sidebar with a red 'COMPOSE' button and a list of folders: 'Inbox (838)', 'Starred', 'Important', 'Sent Mail', 'Drafts', 'Personal', 'Travel', and 'More'. The main content area shows two email results. The first email is from 'Gmail Team' with a star icon, a dropdown arrow, and a 'Gmail Team' label. The second email is from 'sanmarin' with a star icon, a dropdown arrow, and a 'sanmarin' label. Both emails are marked as 'Inbox' and have their subject lines visible.

Google

label:starred

Gmail

COMPOSE

Inbox (838)

Starred

Important

Sent Mail

Drafts

Personal

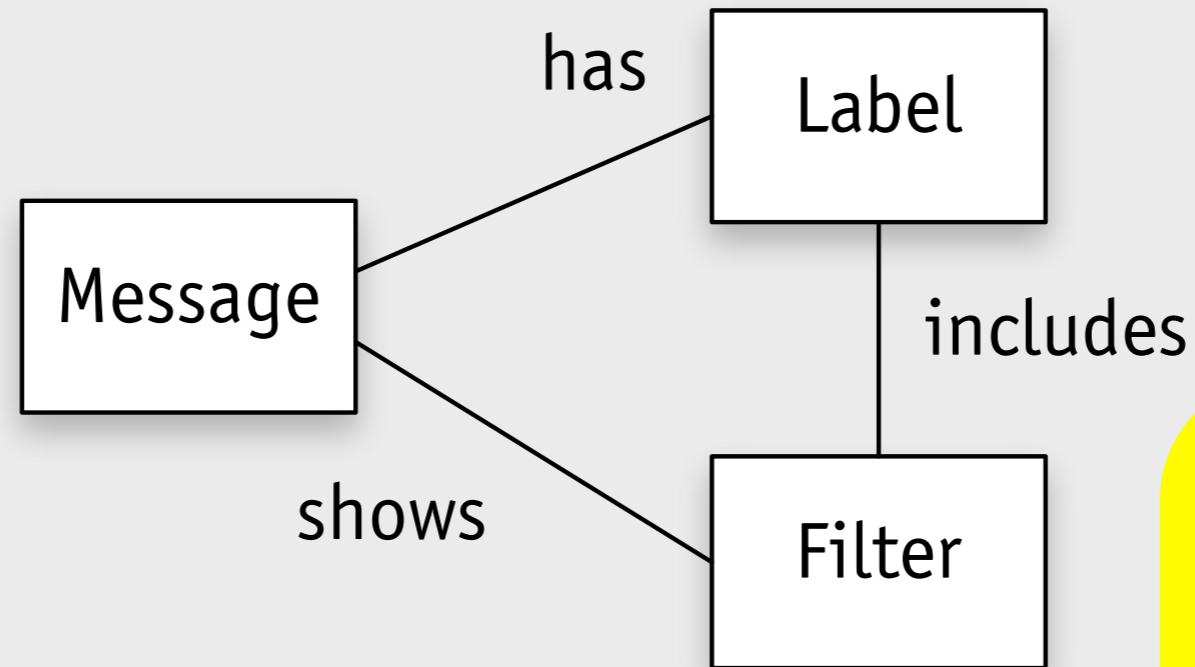
Travel

More

Gmail Team Inbox Welcome to the new Gmail inbox - Hi Daniel Meet the r


sanmarin Inbox Service Request Completed for 2404 - Dear Dakota Nar

gmail concept map



basic principle:
if message M has label L,
then search for L will show M

show deleted
messages? no.
what if you *search* for
deleted messages?

 A deleted message matches your search. [View it](#) or g

generally won't show trashed messages

label:work

not coherent!
conceptual confusion
leads to bugs

hmm...

label:work label:trash

if you ask for them explicitly, you'll see *some*

lessons

how to make better software

early in design

what are the concepts?

how are they connected?

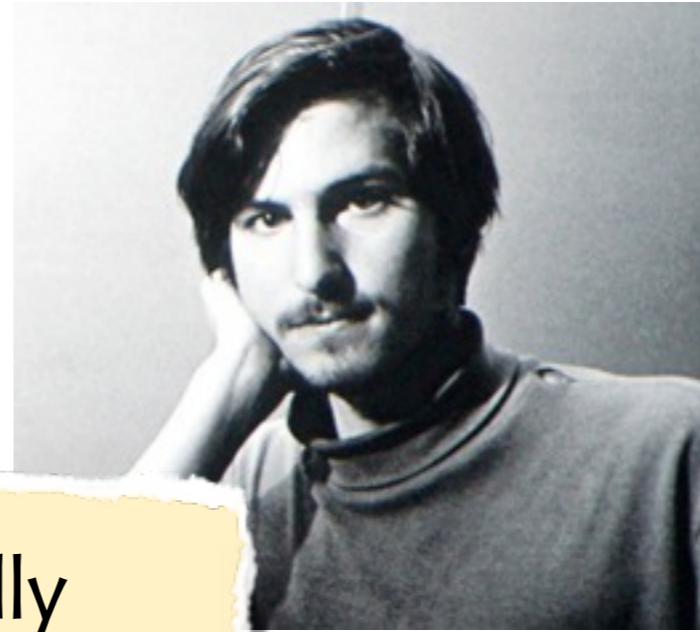
evaluation of concepts

simple, coherent, usable, complete?

when facing a problem

in code or user interface

ask: is this actually a conceptual flaw?



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