High performance. Delivered.

Conceptual Design:
The Essence of Software

Daniel Jackson, MIT

accenture

PROFESSIONAL EDUCATION

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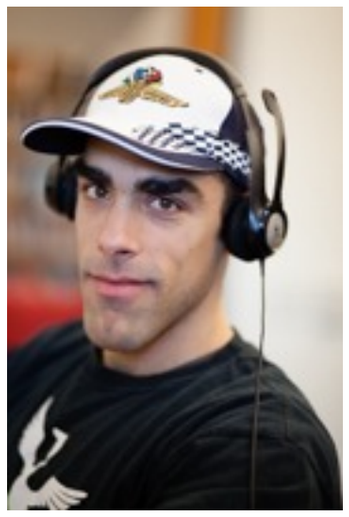
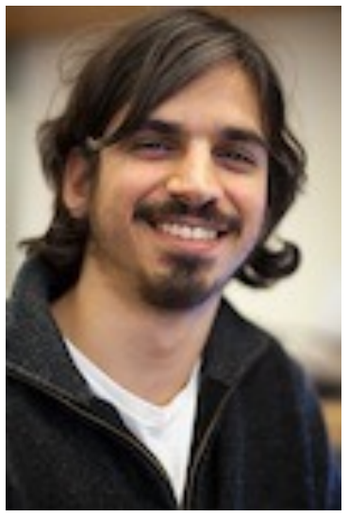
where I work: Gehry's Stata Center

software design group

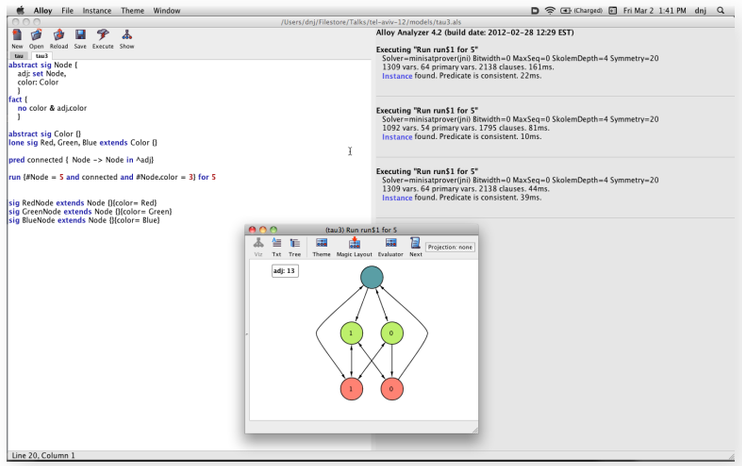




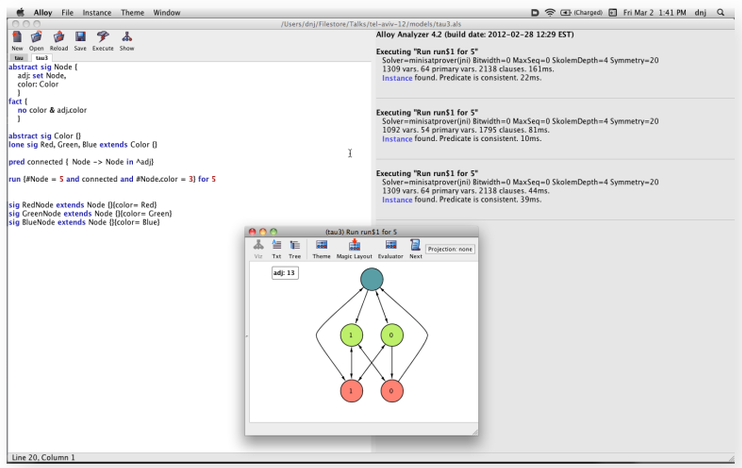
software design group

software design group

Alloy design analysis



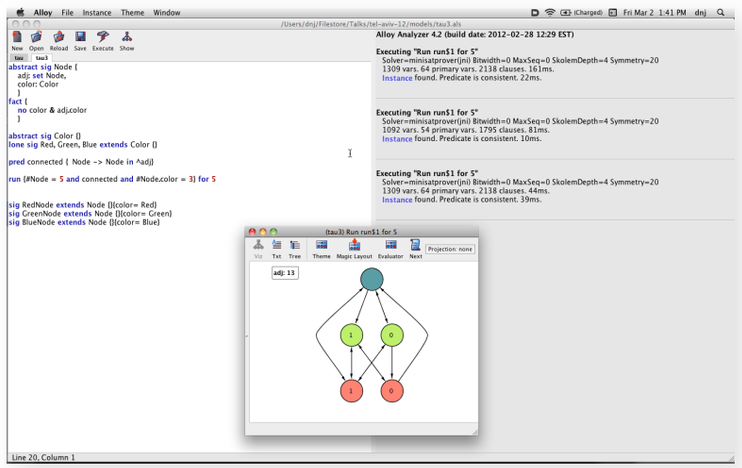
software design group



Alloy design analysis

finding security holes

software design group



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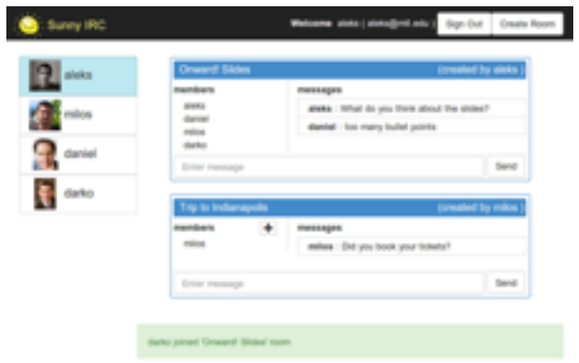
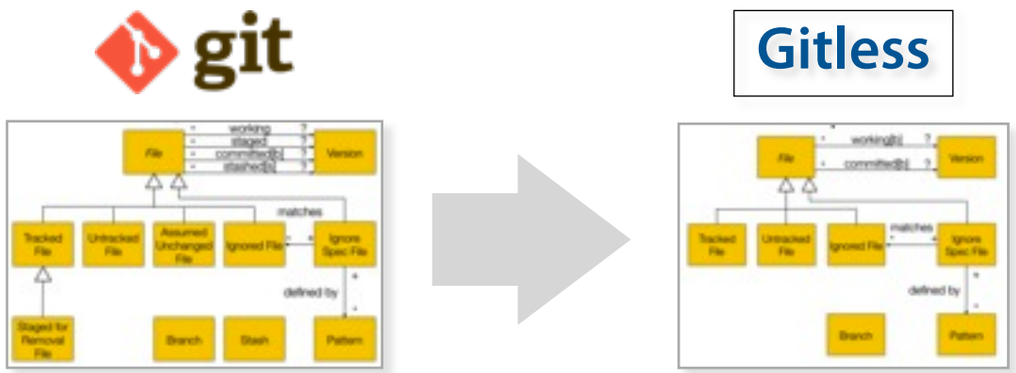


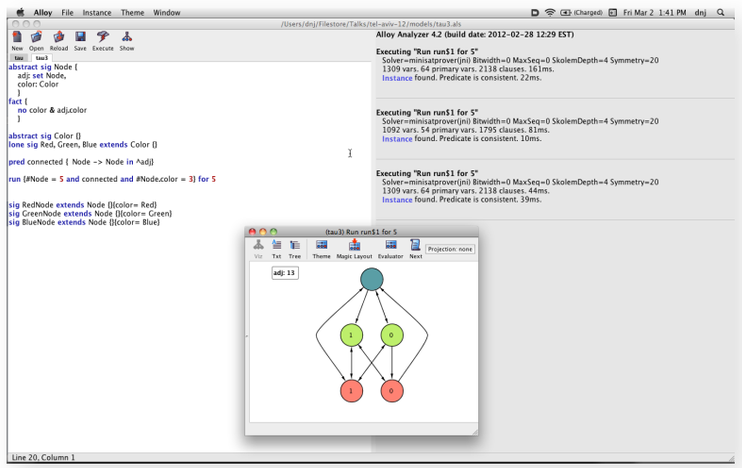
event-based apps

finding security holes

software design group



rethinking software design



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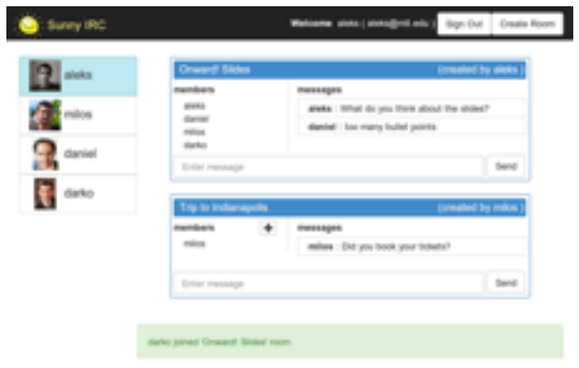
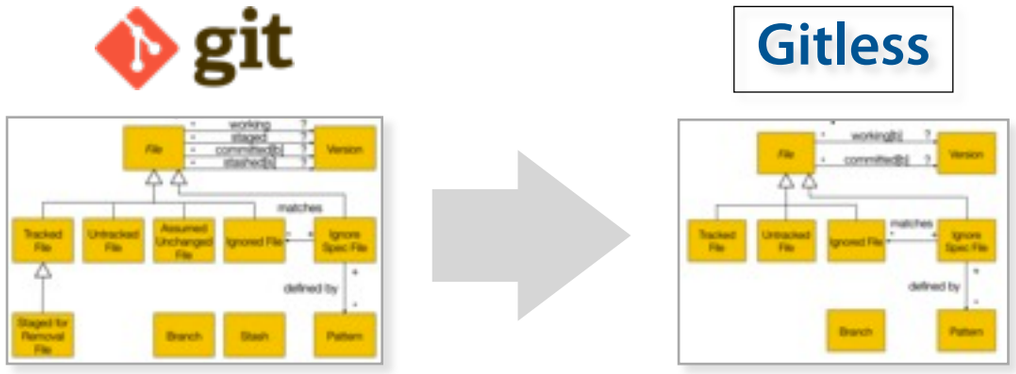


event-based apps

finding security holes

software design group

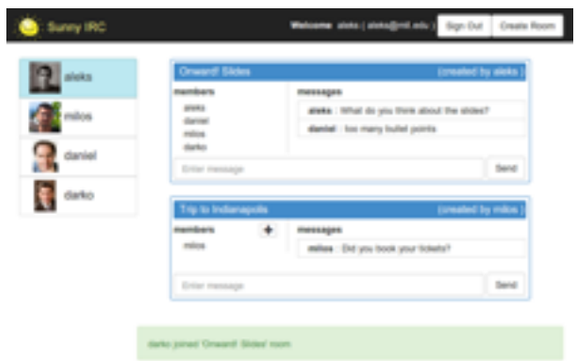


rethinking software design

going beyond code level

Alloy design analysis

exploiting SAT



event-based apps

new paradigms

finding security holes

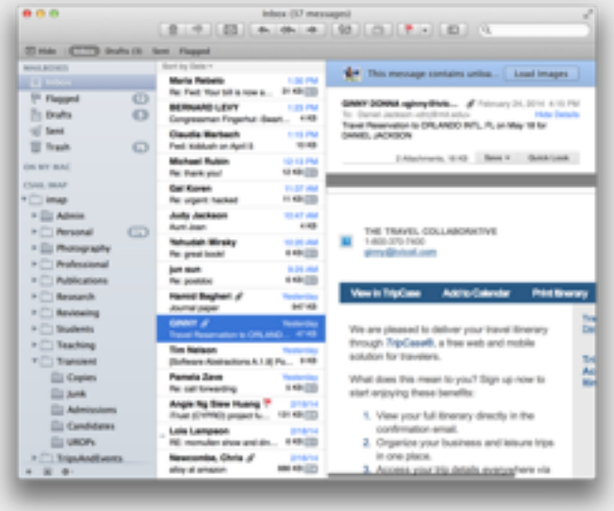
lightweight formalism

introduction

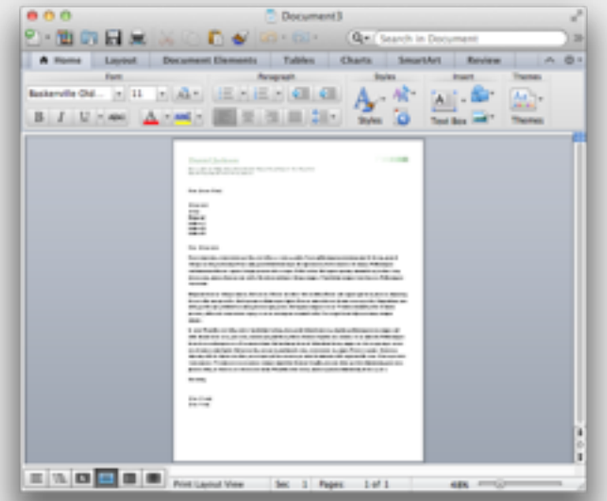
things built from parts

what's software built from?

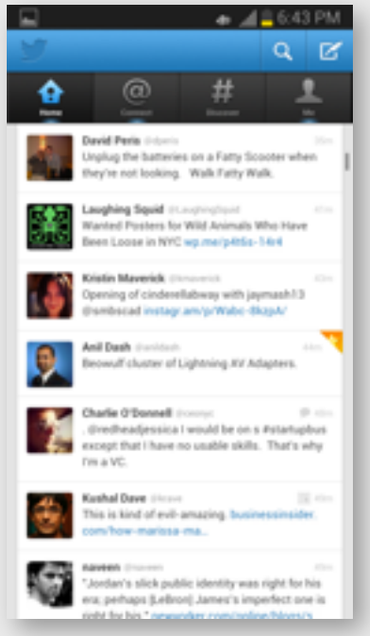
Apple Mail



Microsoft Word



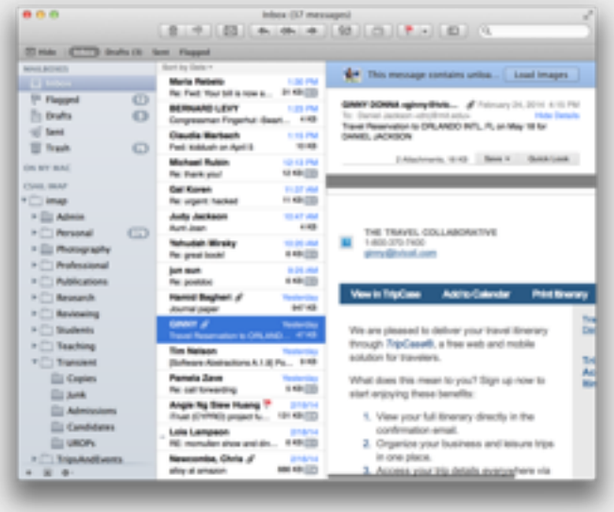
Twitter



what's software built from?

concepts!

Apple Mail



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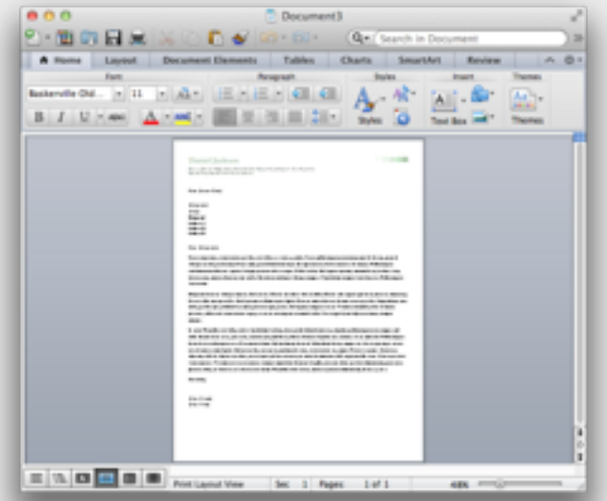

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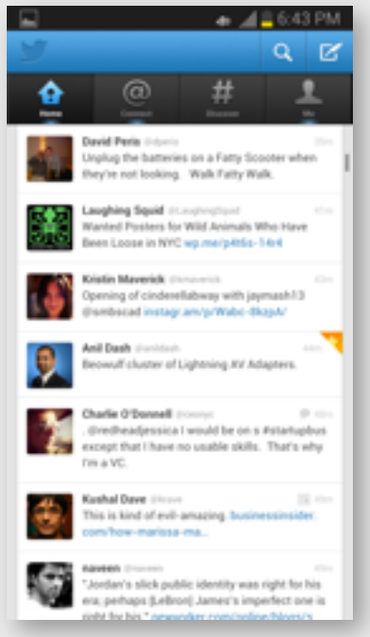

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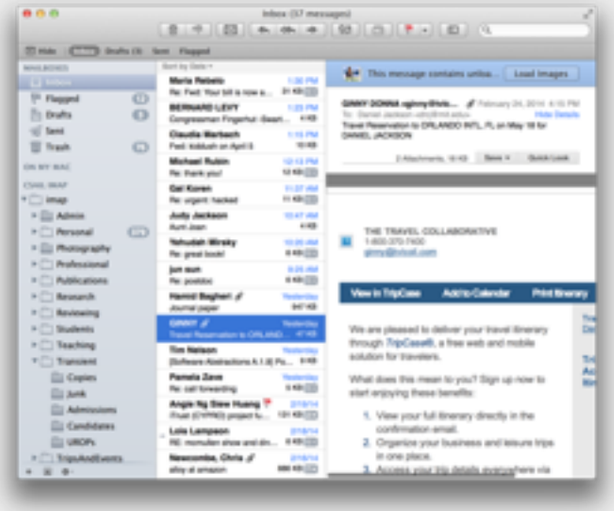
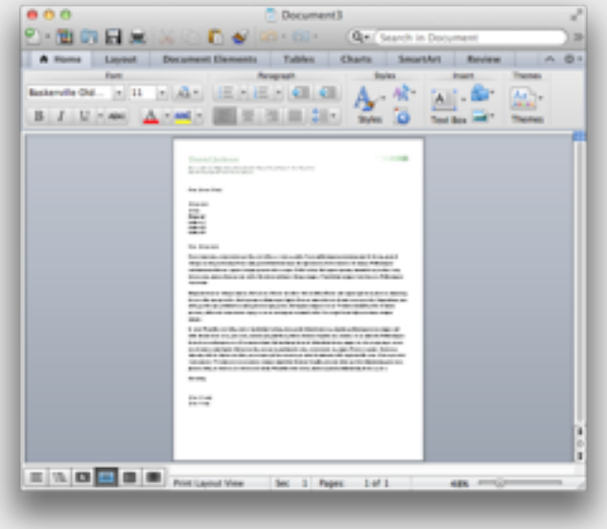


account
message
folder
conversation
...

Microsoft Word



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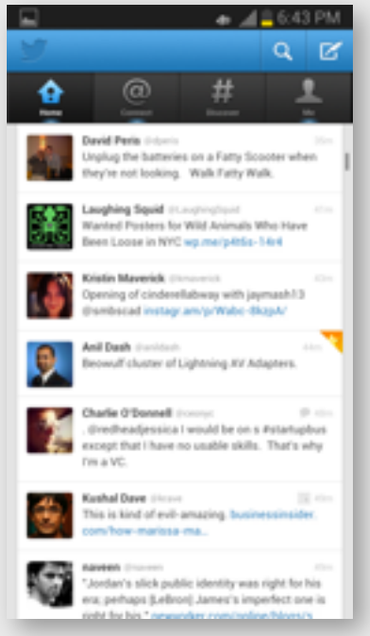

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concepts!

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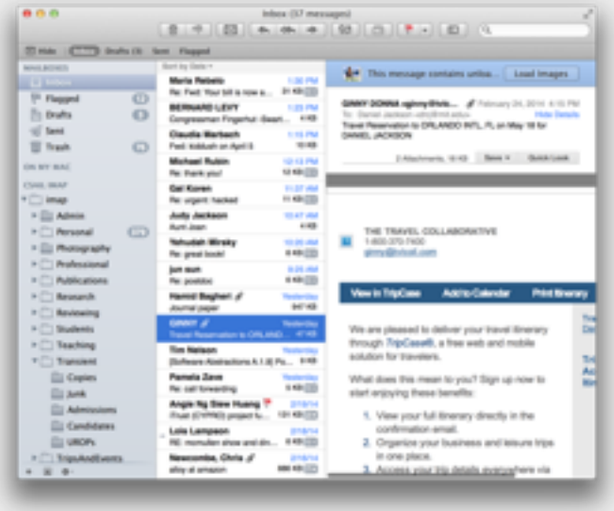

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...

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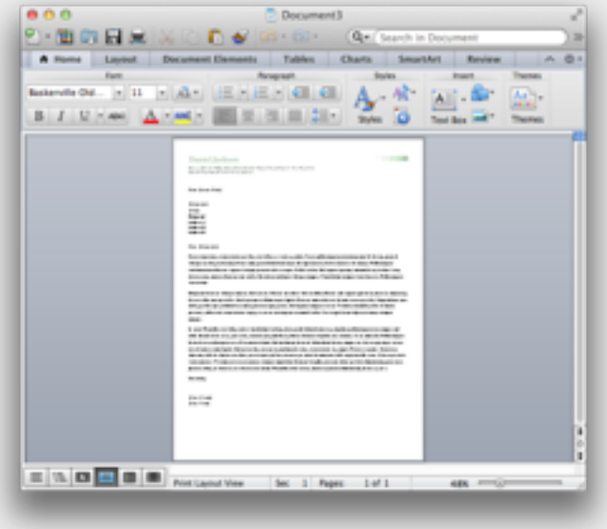
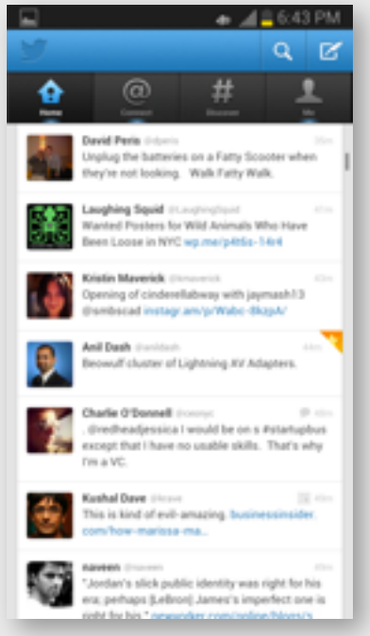


document
paragraph
style
stylesheet
...

Twitter



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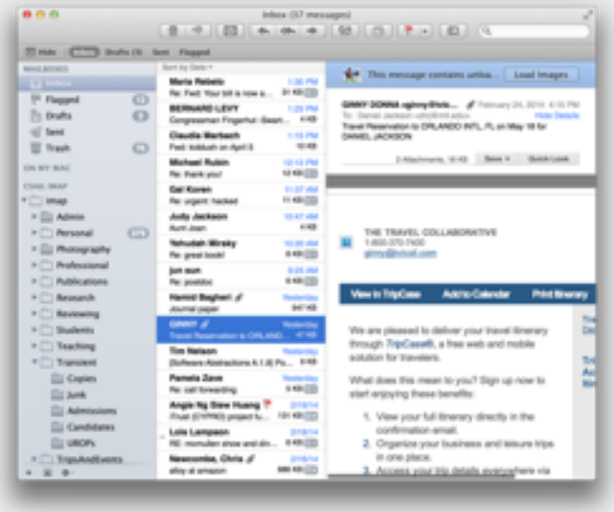

account
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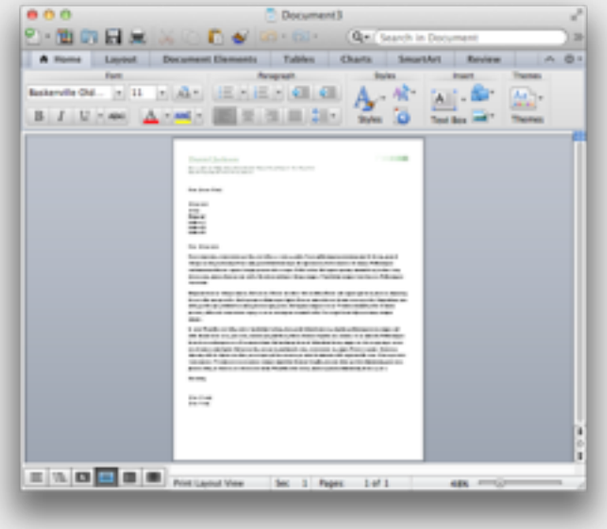
Microsoft Word



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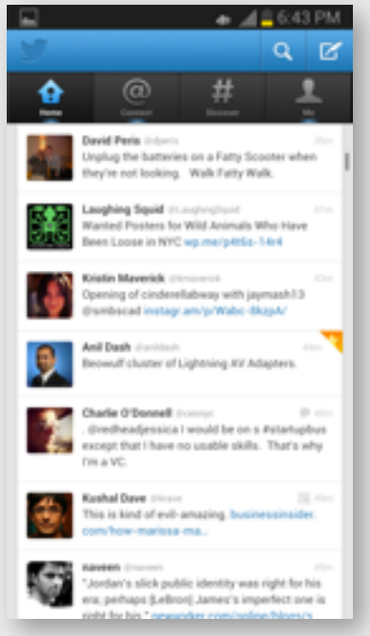
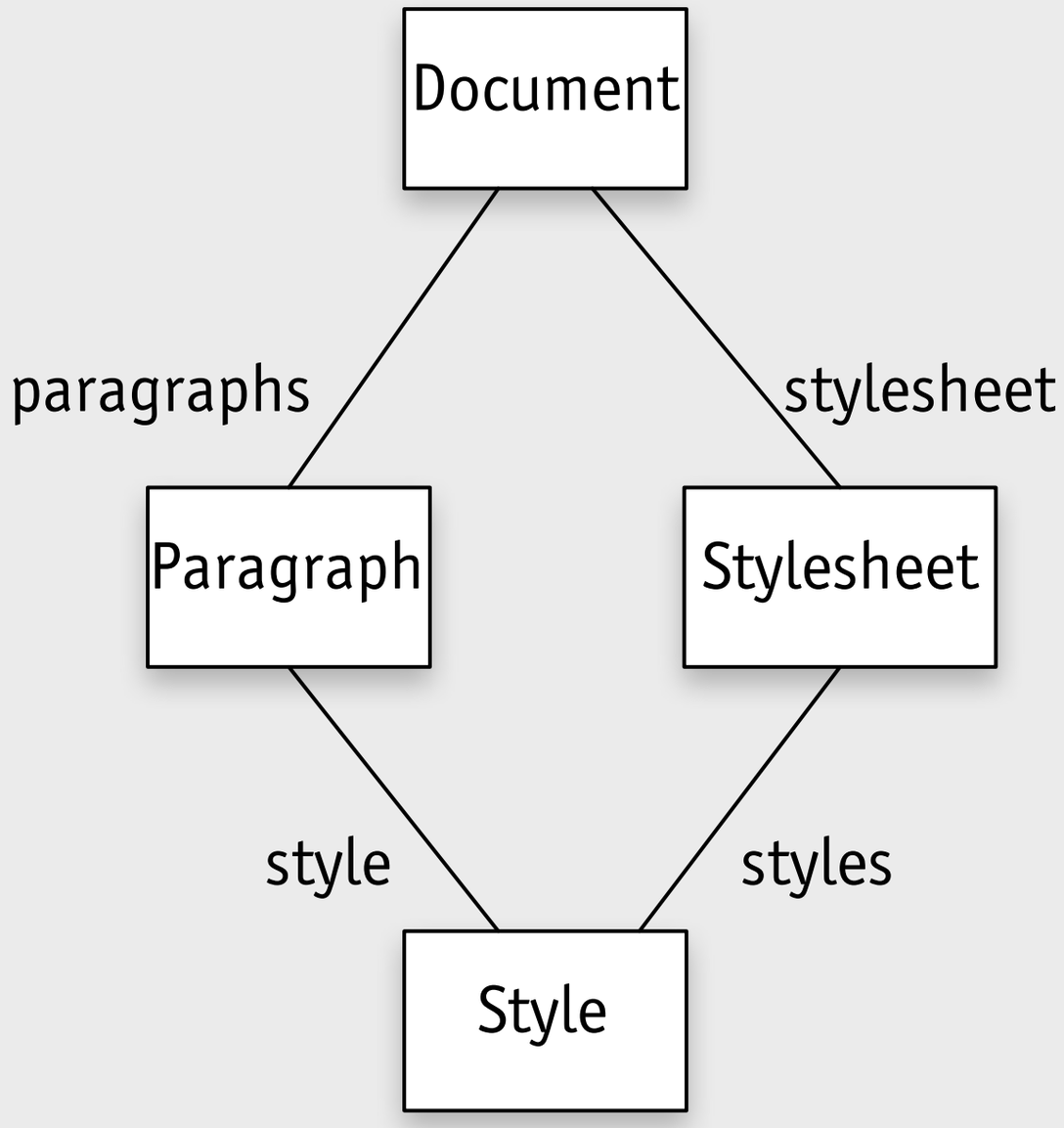
Twitter



user
tweet
hashtag
follower
...

a concept map for Word



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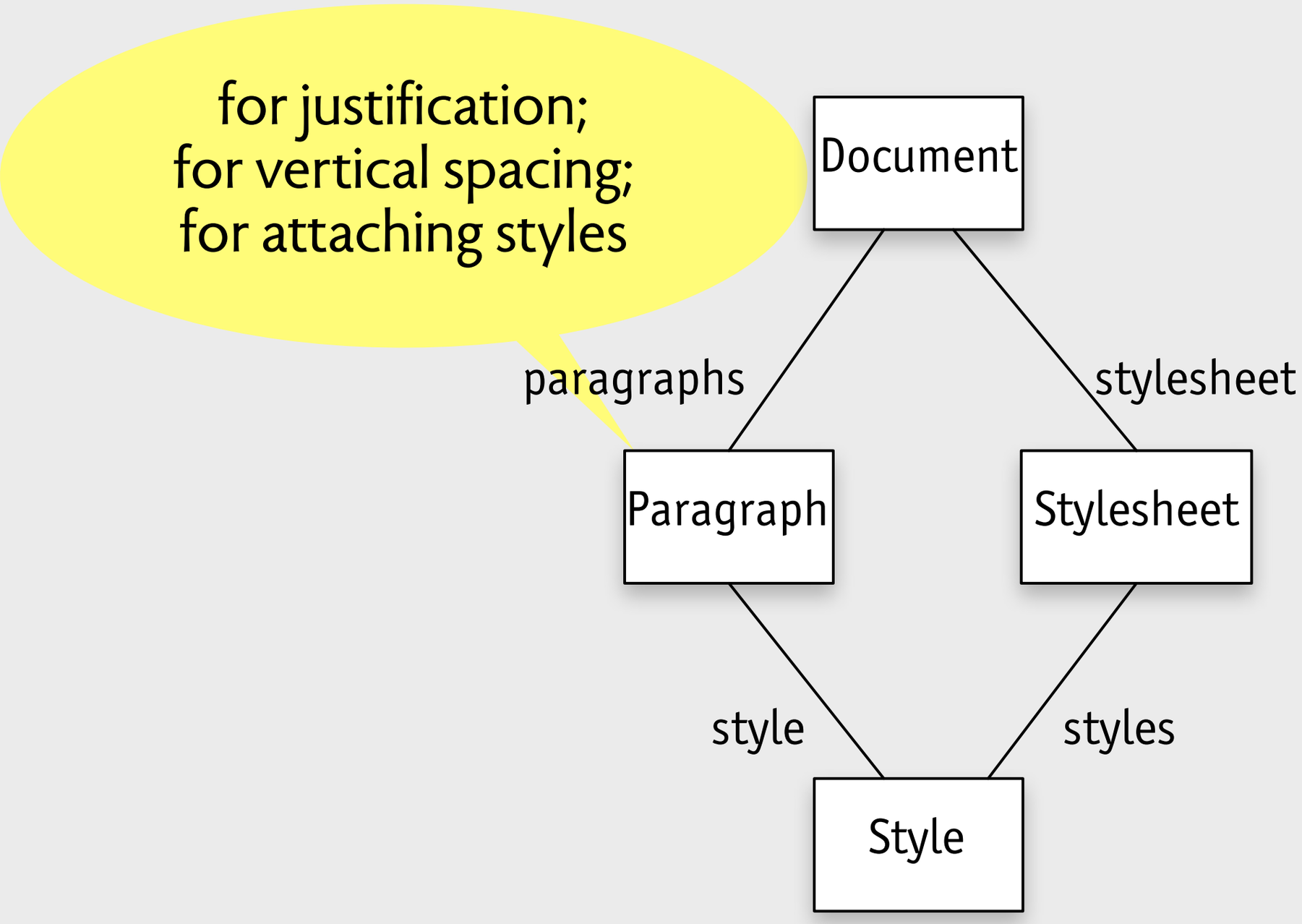

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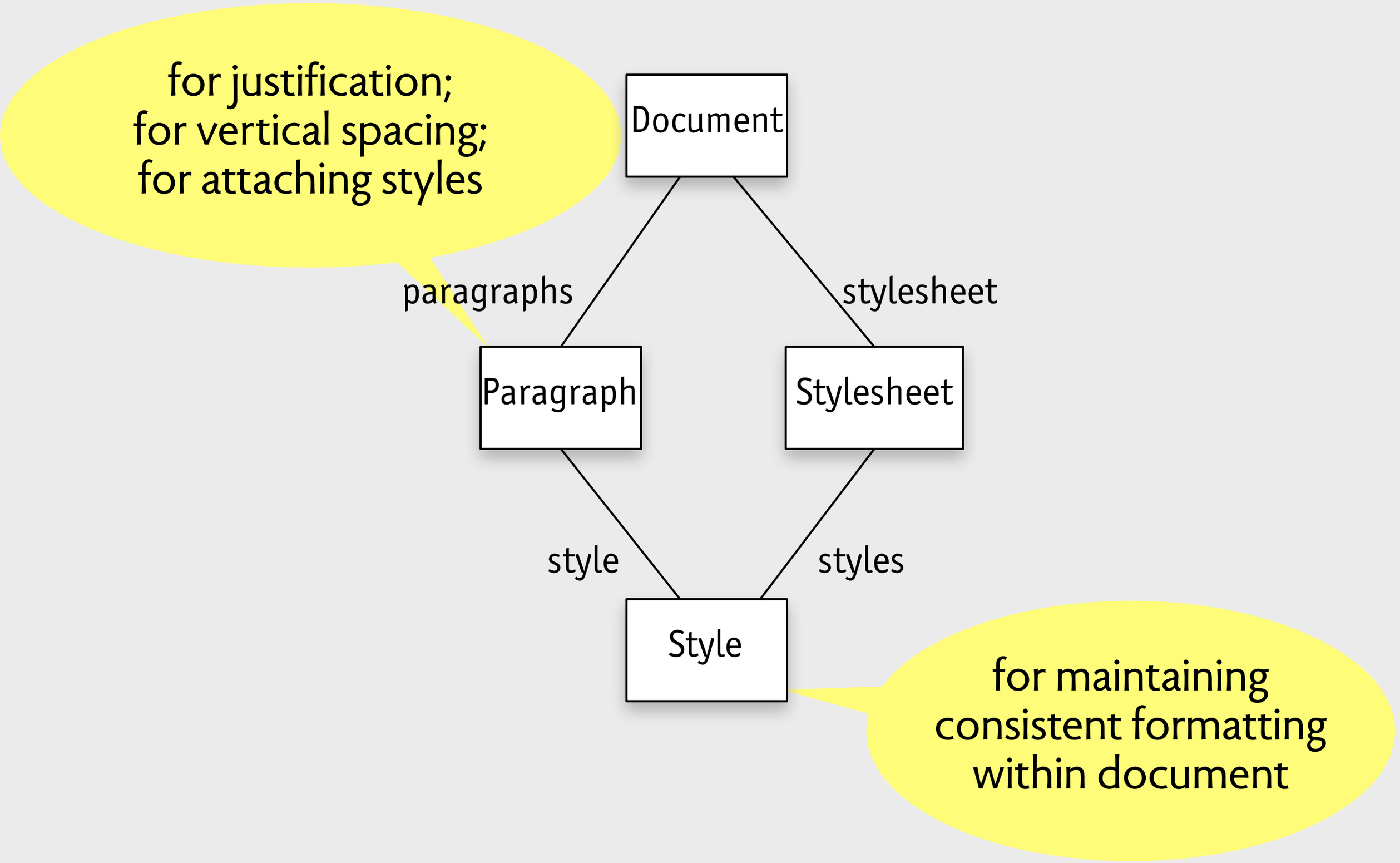
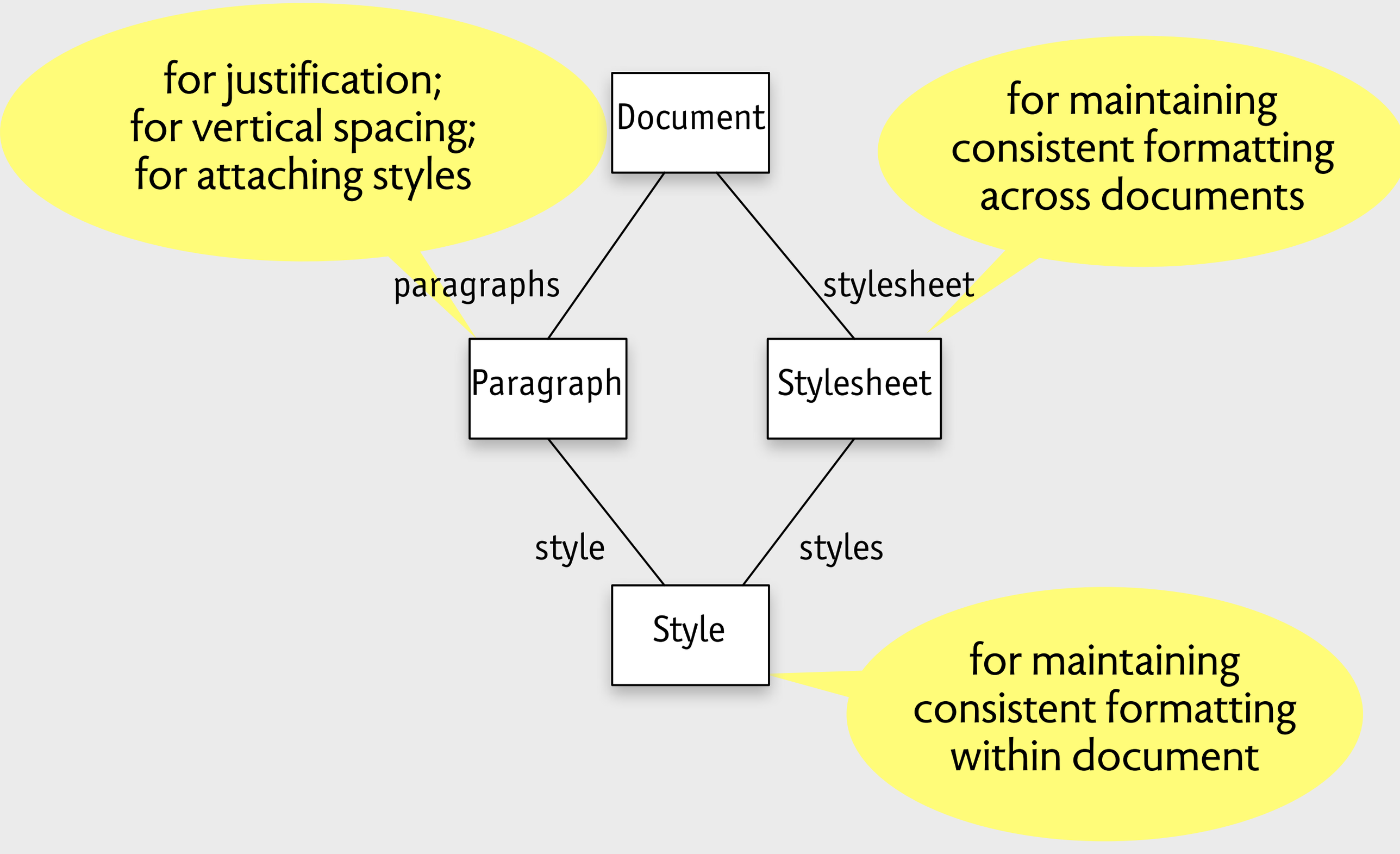


a concept map for Word



where do concepts come from?

natural

artificial

where do concepts come from?

natural

artificial

paragraph
section
chapter

where do concepts come from?

natural

artificial

paragraph
section
chapter

message

where do concepts come from?

natural

artificial

paragraph
section
chapter

message

shopping
cart

where do concepts come from?

natural

artificial

paragraph
section
chapter

shopping cart

message

friend
follower
profile

where do concepts come from?

natural

artificial

paragraph
section
chapter

message

shopping cart

friend
follower
profile

style
layer

where do concepts come from?

natural

artificial

paragraph
section
chapter

message

shopping cart

friend
follower
profile

style
layer

trash can

where do concepts come from?

natural

artificial

paragraph
section
chapter

message

shopping cart

friend
follower
profile

style
layer

trash can

directory

where do concepts come from?

natural

artificial

paragraph
section
chapter

message

shopping cart

friend
follower
profile

style
layer

trash can

directory

RMA

where do concepts come from?

natural

artificial

paragraph
section
chapter

message

shopping cart

friend
follower
profile

style
layer

trash can

directory

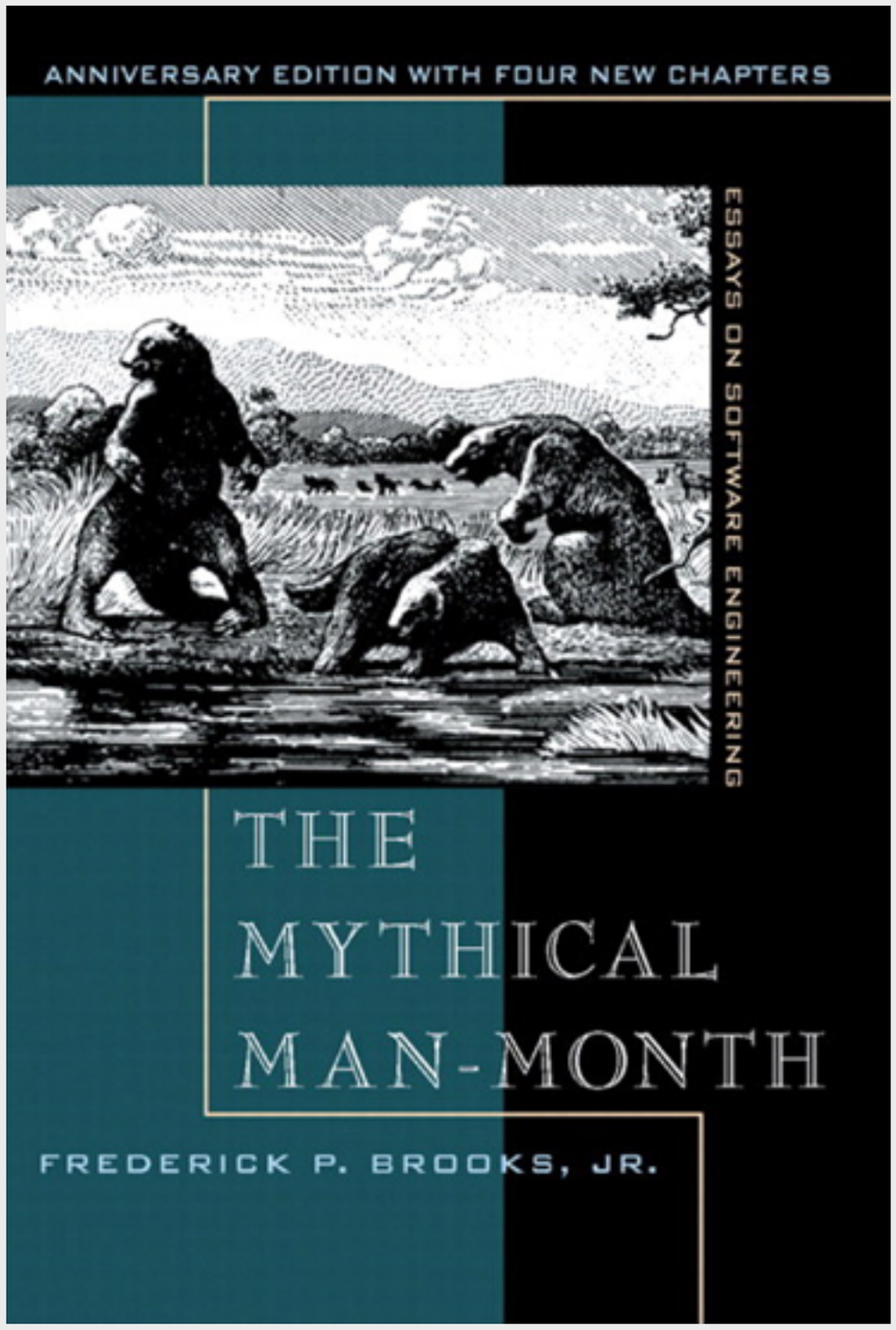
RMA

relative reference
PKI certificate

where Word's concepts came from

Charles Simonyi: brought key concepts to Word from Xerox PARC

fred brooks: "mythical man month"

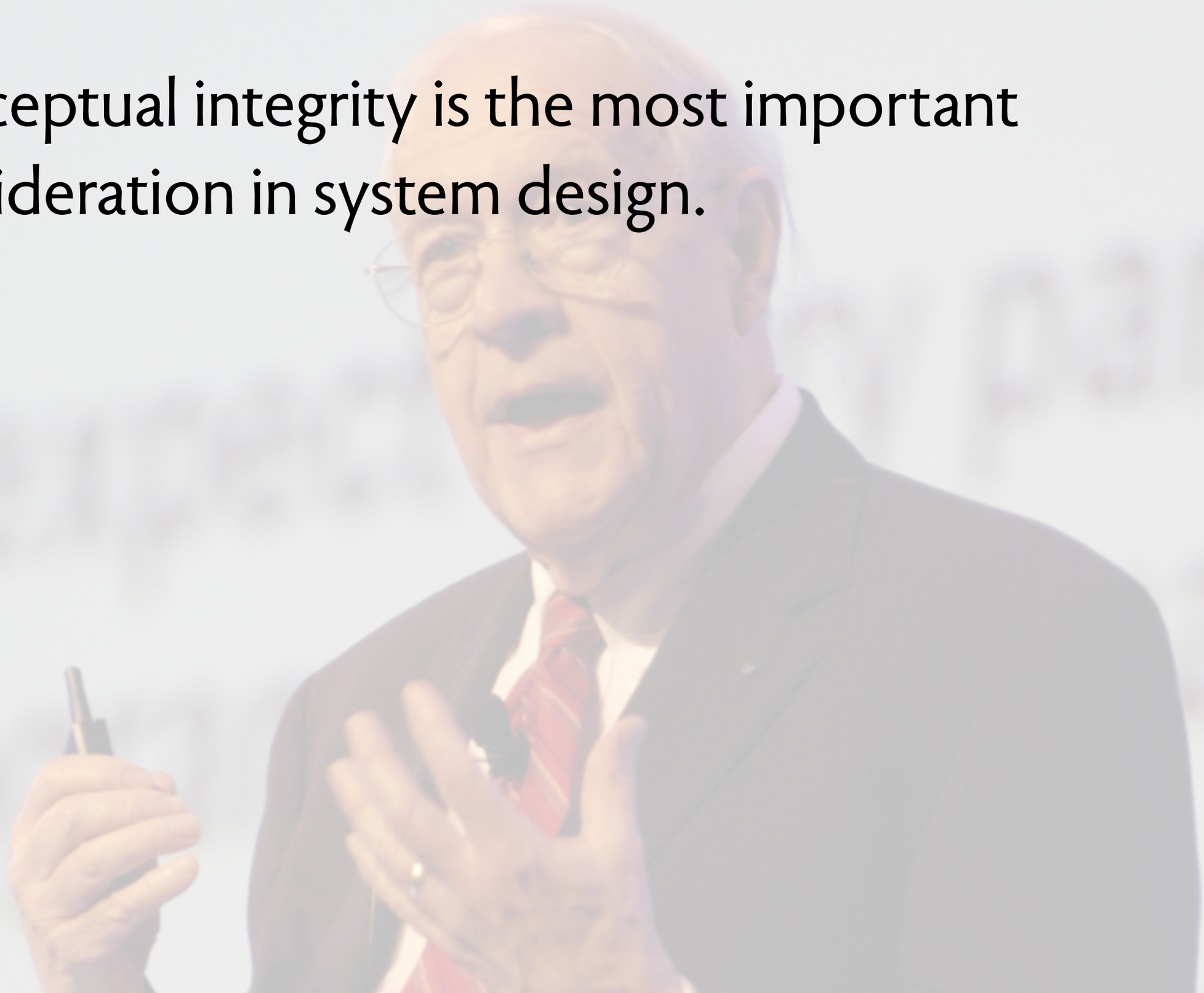


fred brooks on conceptual integrity

fred brooks on conceptual integrity

Conceptual integrity is the most important consideration in system design.

—1975



fred brooks on conceptual integrity

Conceptual integrity is the most important consideration in system design.

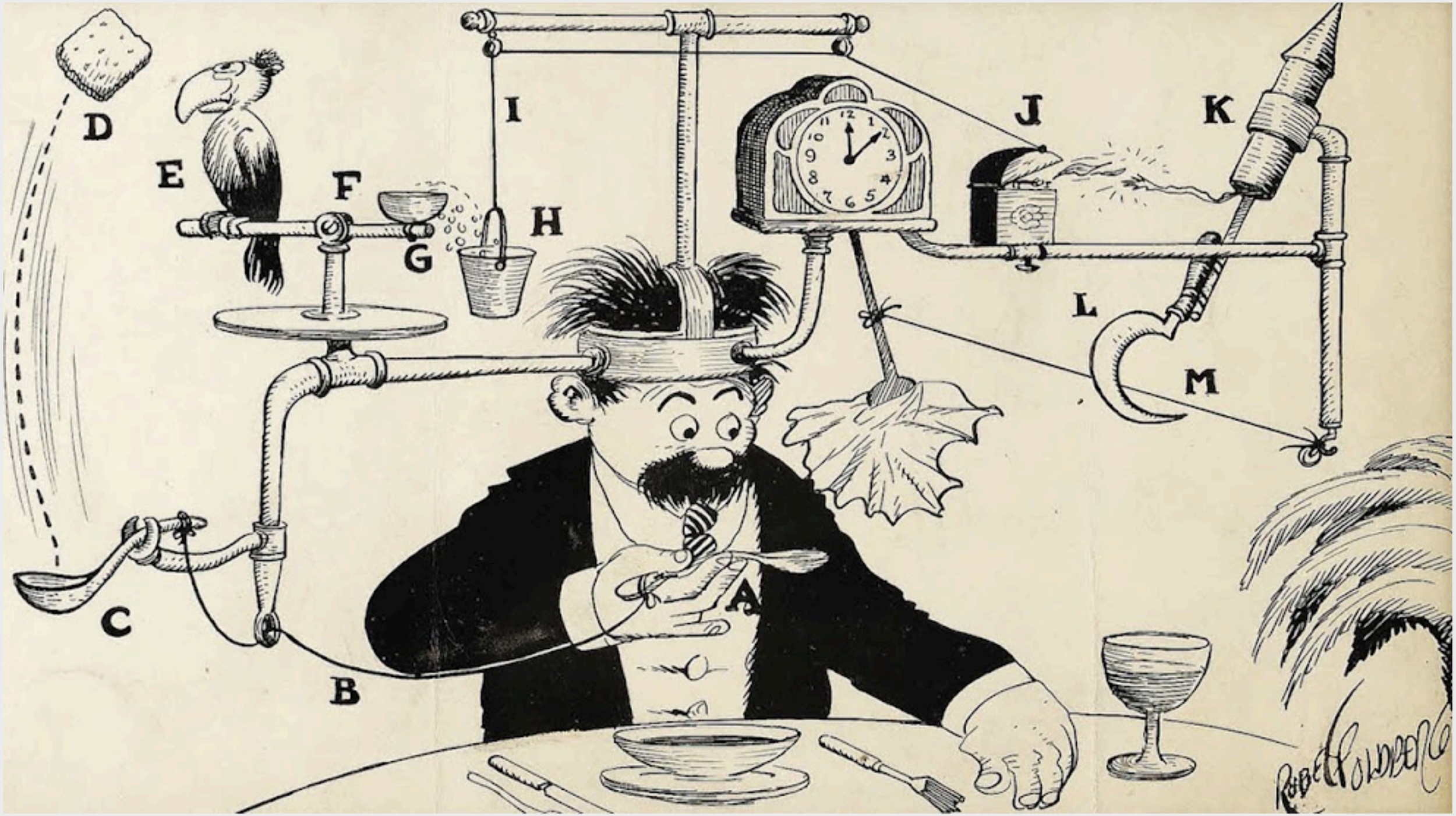
—1975

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

—1995

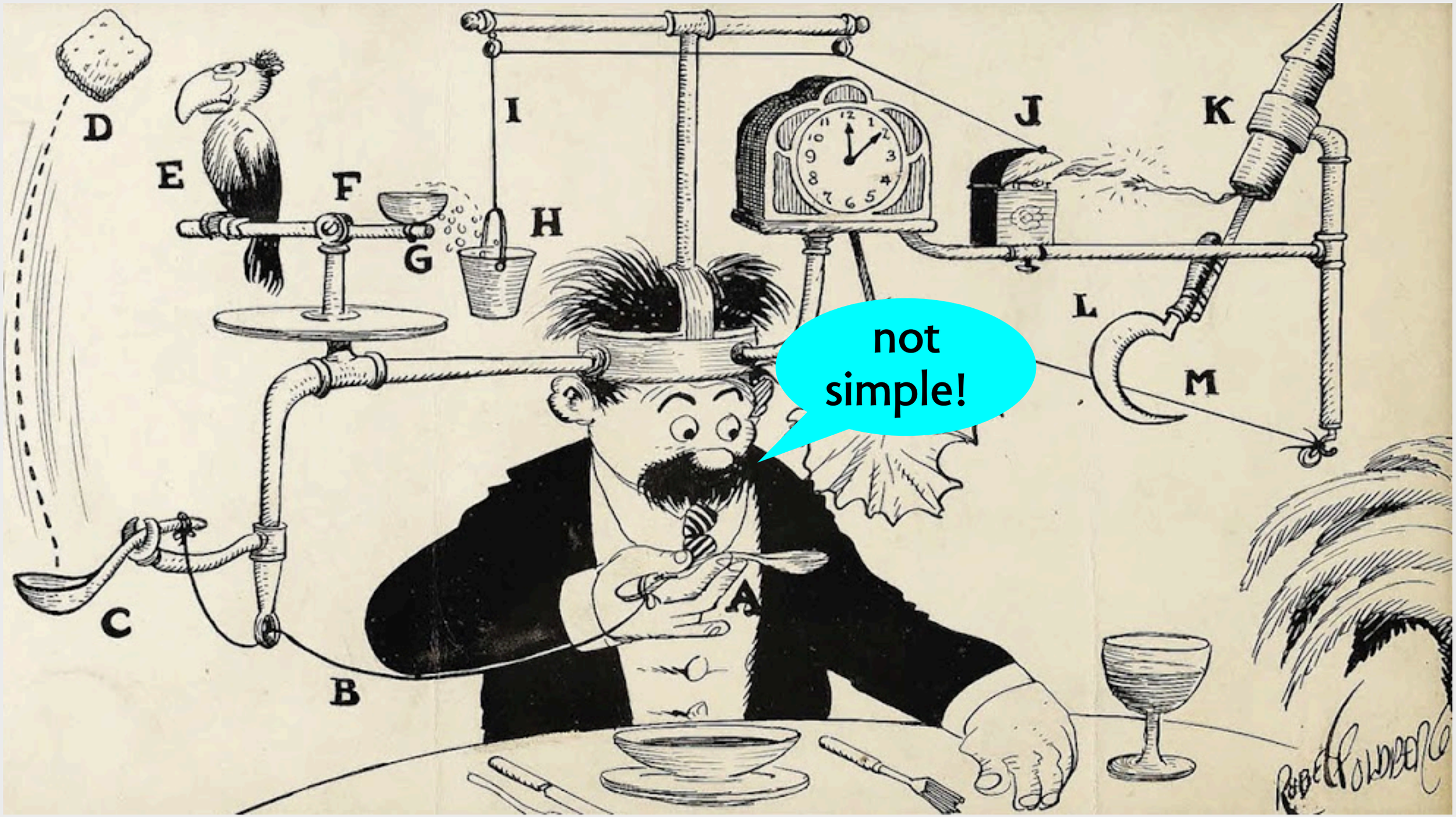
criteria for concepts

simple



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

simple



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

coherent

Kenwood “radio toaster”

coherent

Kenwood “radio toaster”

complete

Bay Bridge, CA in 1989 after Loma Prieta earthquake

complete

Bay Bridge, CA in 1989 after Loma Prieta earthquake

usable

usable

usable

usable

usable

a short tour

of the

confusing,

dangerous,

inadequate

& broken

the confusing

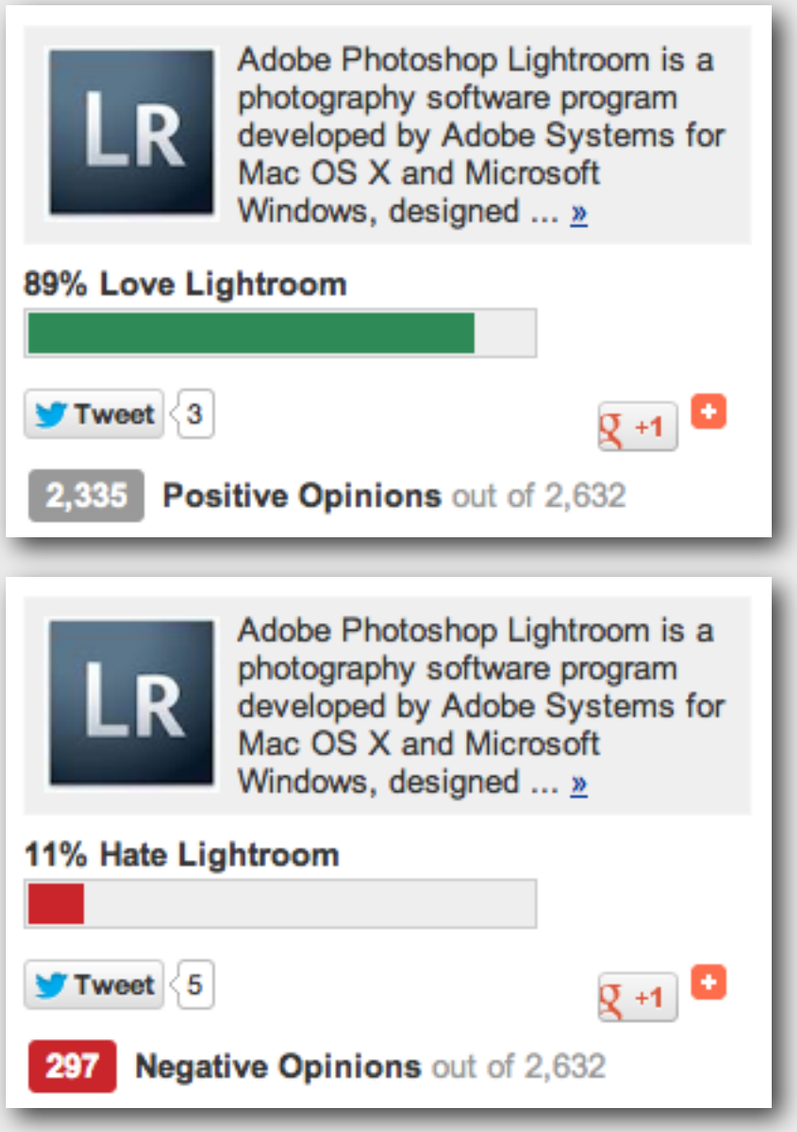
love & hate

from http://amplicate.com

love & hate

from http://amplicate.com

love & hate



from http://amplicate.com

love & hate

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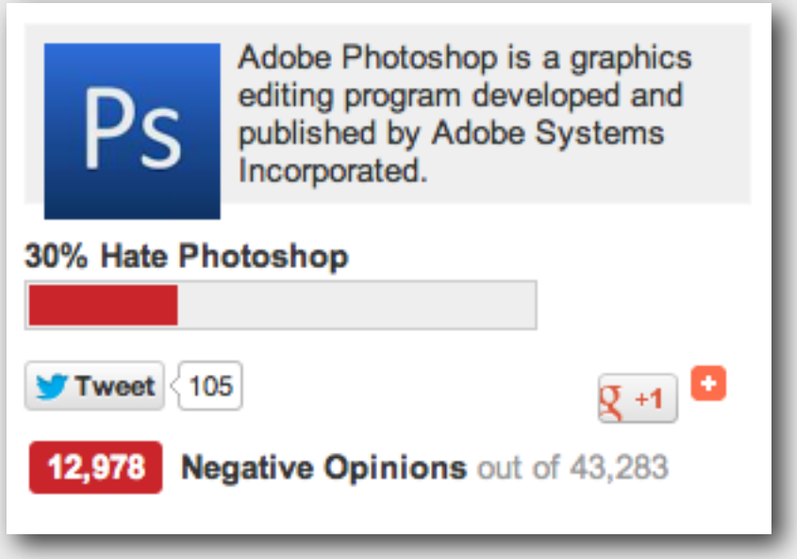
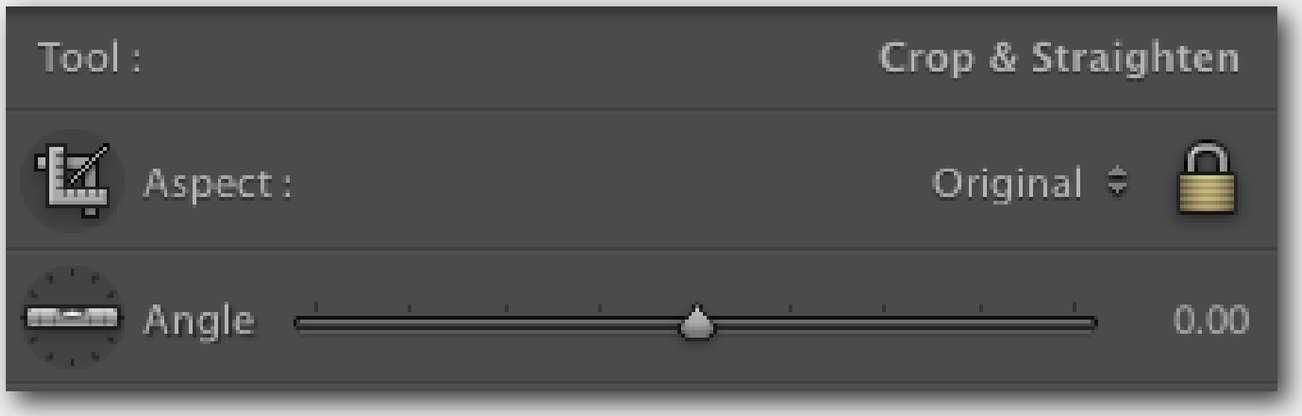


from http://amplicate.com

cropping in adobe lightroom

cropping in adobe lightroom



cropping in adobe photoshop

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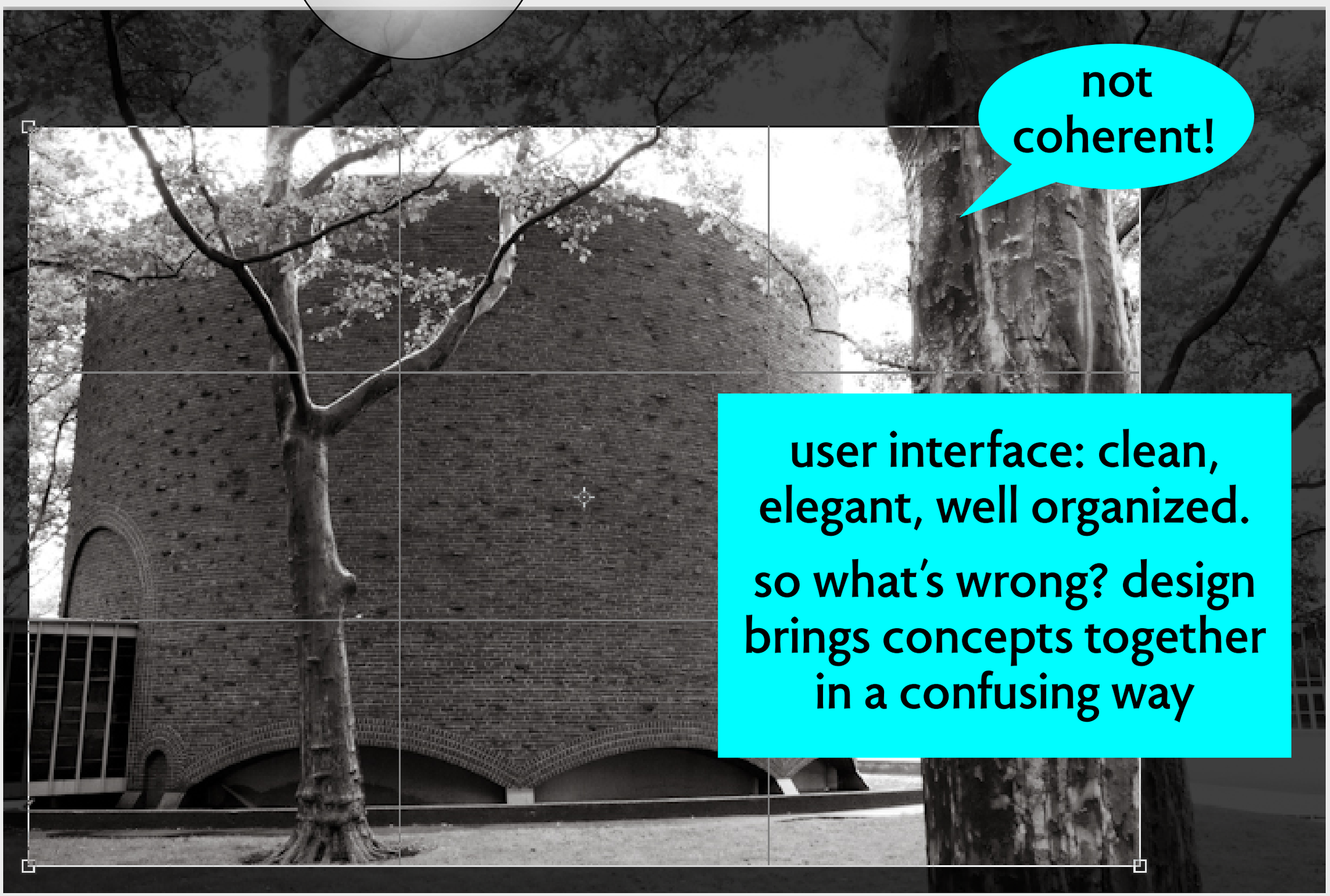
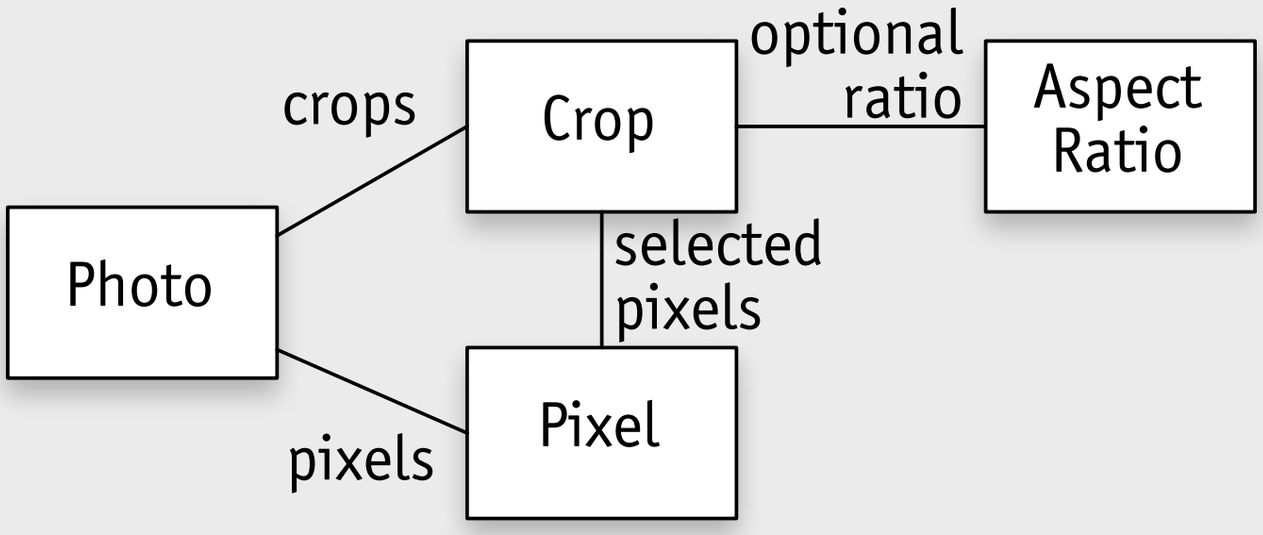
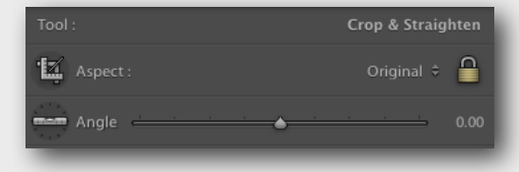


cropping the whole image

concept maps of cropping

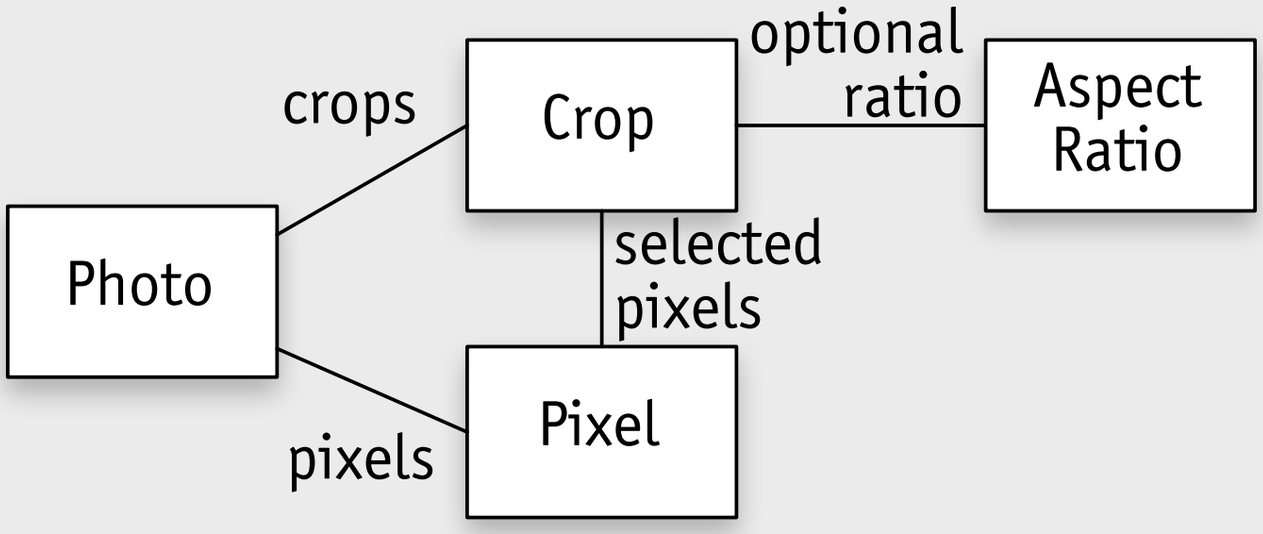
concept maps of cropping

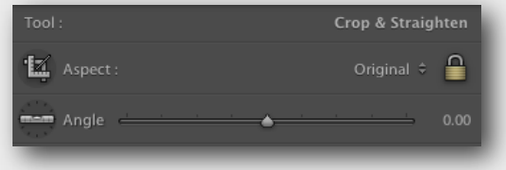




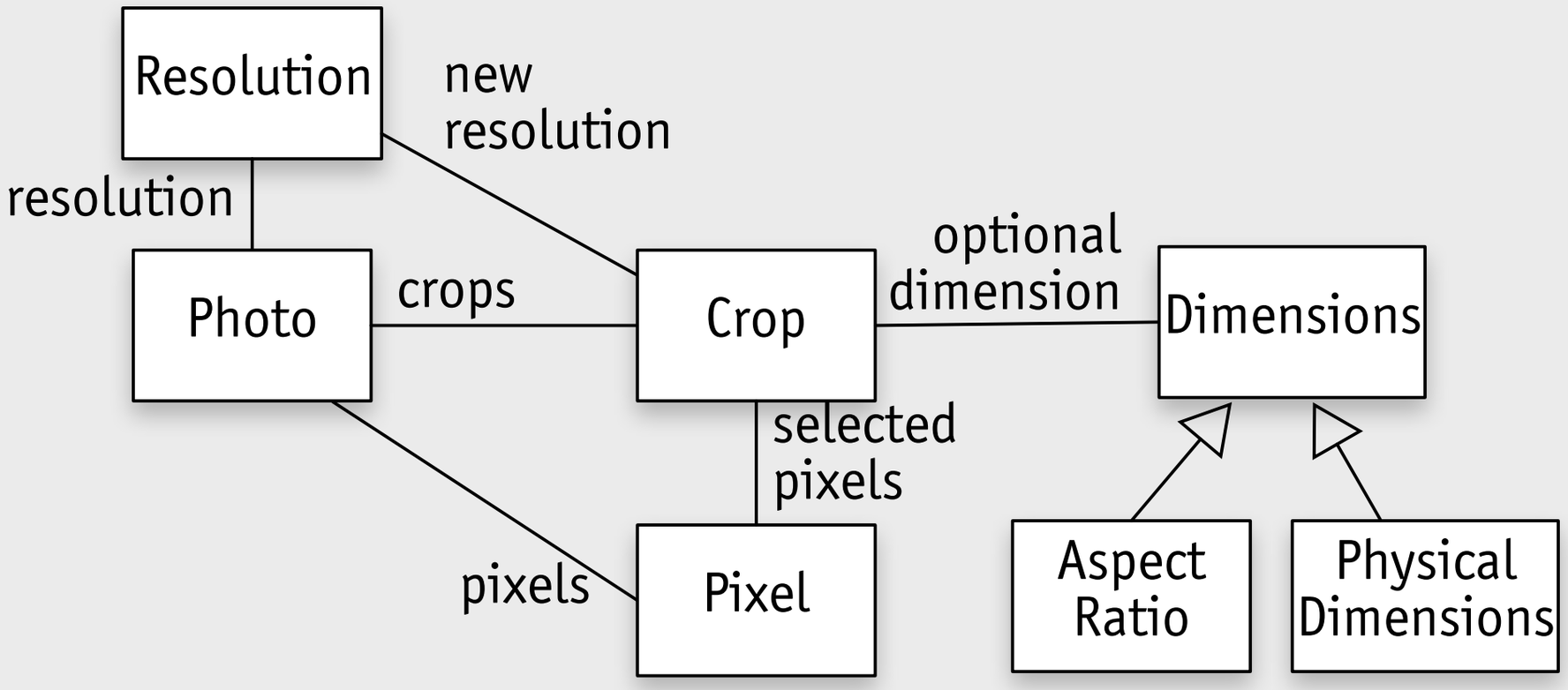
Lightroom

concept maps of cropping



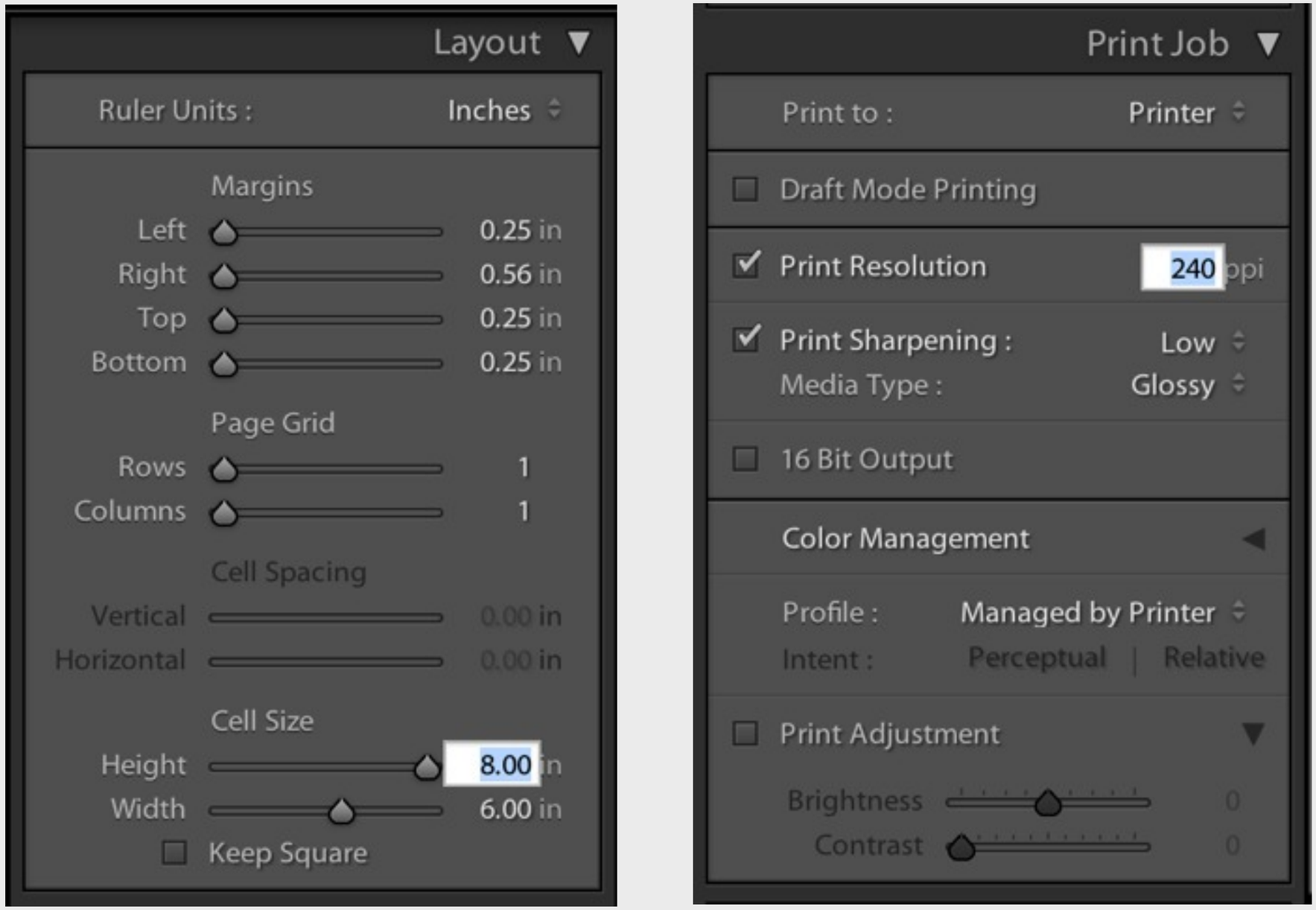


Lightroom



Photoshop

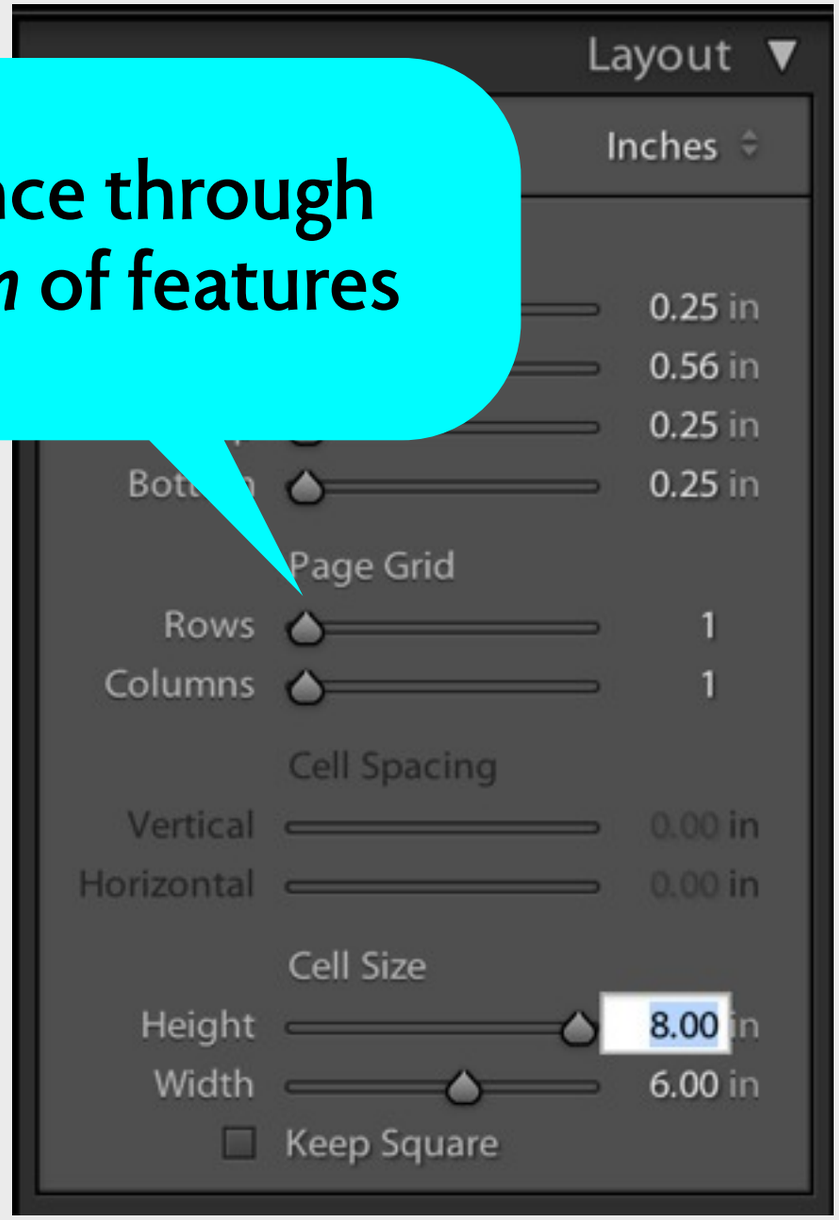
where did resolution go?

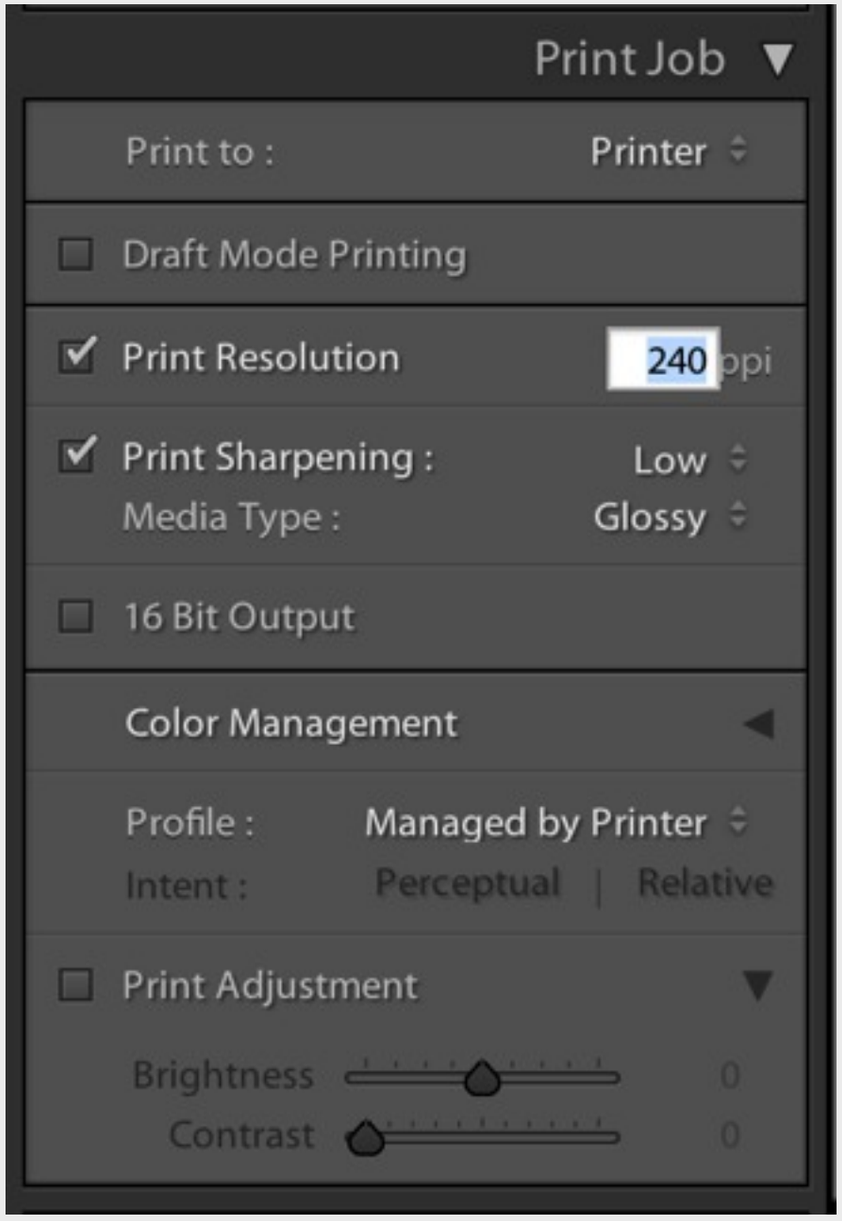


Lightroom printing module

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.
```

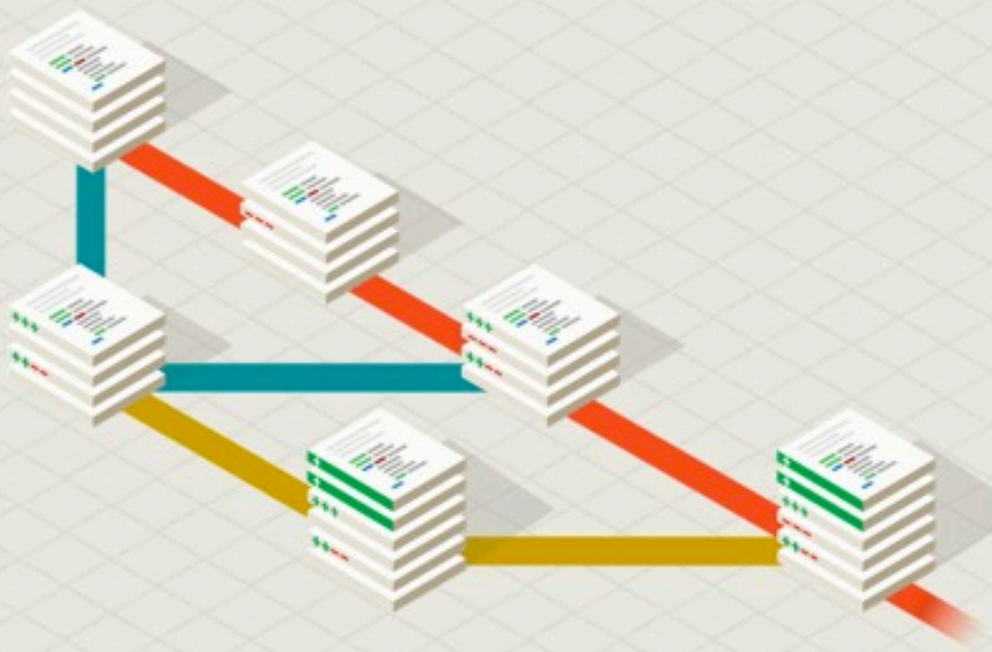
git

git --fast-version-control

Search entire site...

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
```

```
% git status
# On branch master
# Changes not staged for commit:
#   (use "git add <file>..." to update what will be committe
#   (use "git checkout -- <file>..." to discard changes in w
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changes were not saved in repository!

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not simple: too many concepts

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that git feeling

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Tracking New Files

In order to begin tracking a new file, you use the command `git add`. To begin tracking the `README` file, you can run this:

```
$ git add README
```

that git feeling

Tracking New Files

In order to begin tracking a new file, you use the command `git add`. To begin tracking the `README` file, you can run this:

```
$ git add README
```

If you run your status command again, you can see that your `README` file is now tracked and staged:

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

        new file:   README
```

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 look

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$ 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 dir

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

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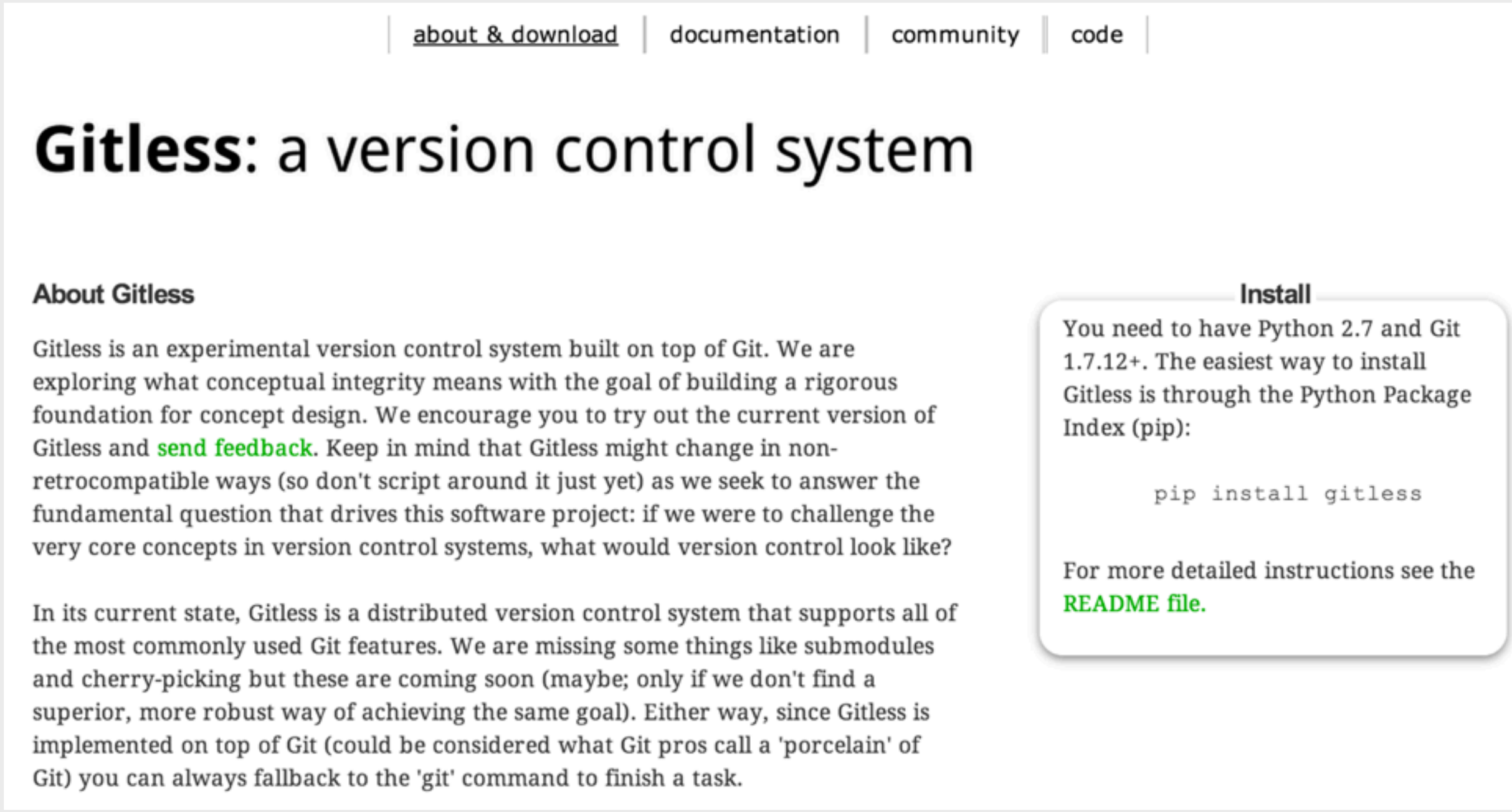
hoare on simplicity

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



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

STORAGE & NETWORKING file sharing, dropbox

Friends don't let friends delete shared Dropbox items

Christopher Breen
@BodyofBreen

Sep 9, 2013 5:00 AM

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

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

how dropbox explains it

How do I leave a shared folder?

« Back to Help Center

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.

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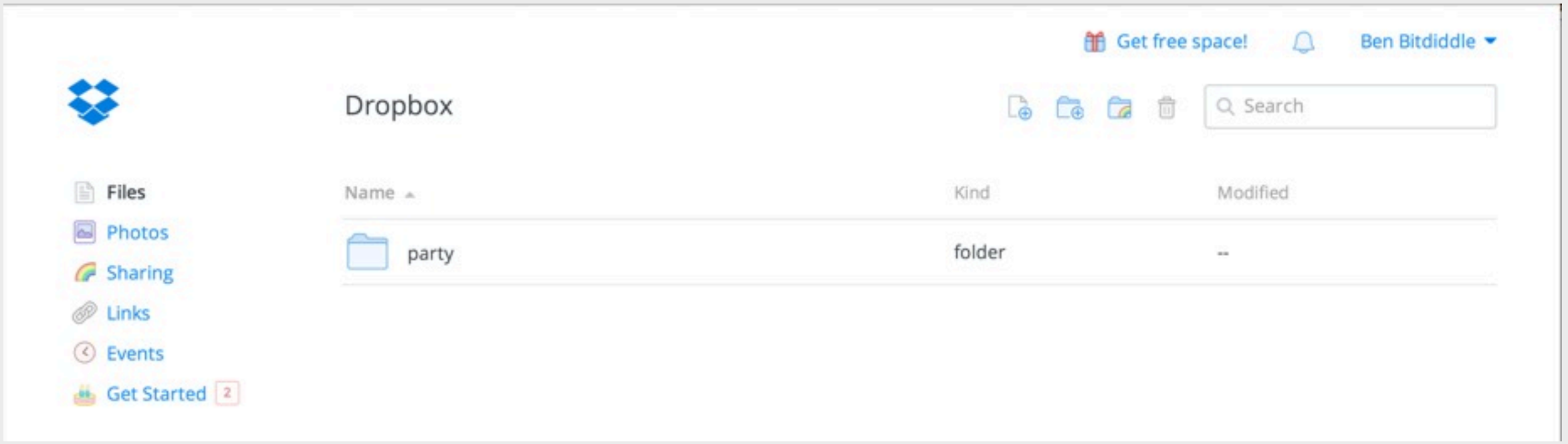
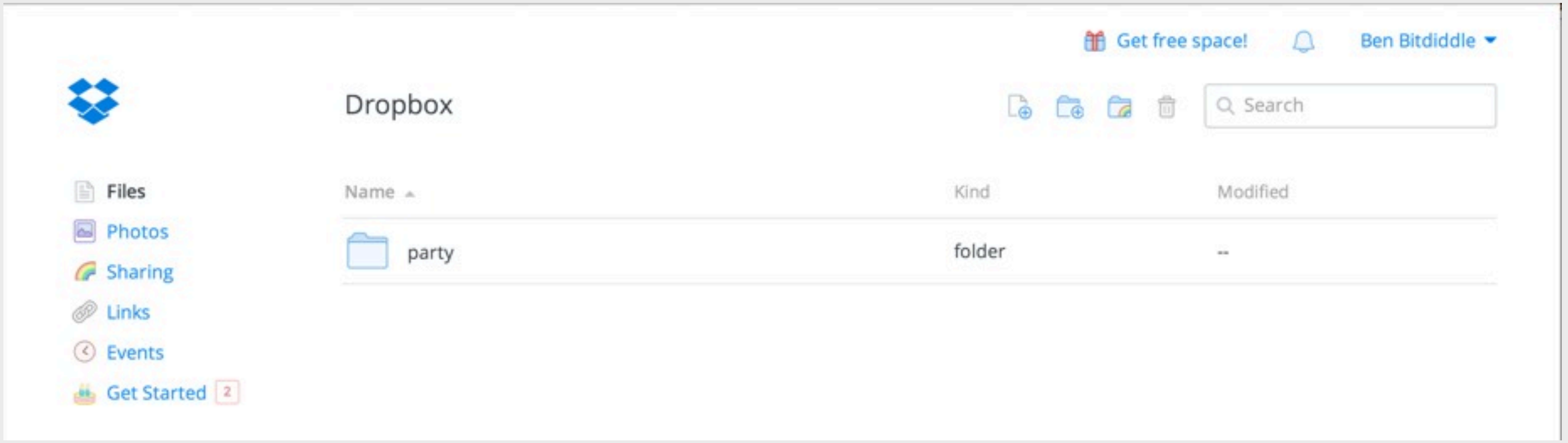
or by deleting it

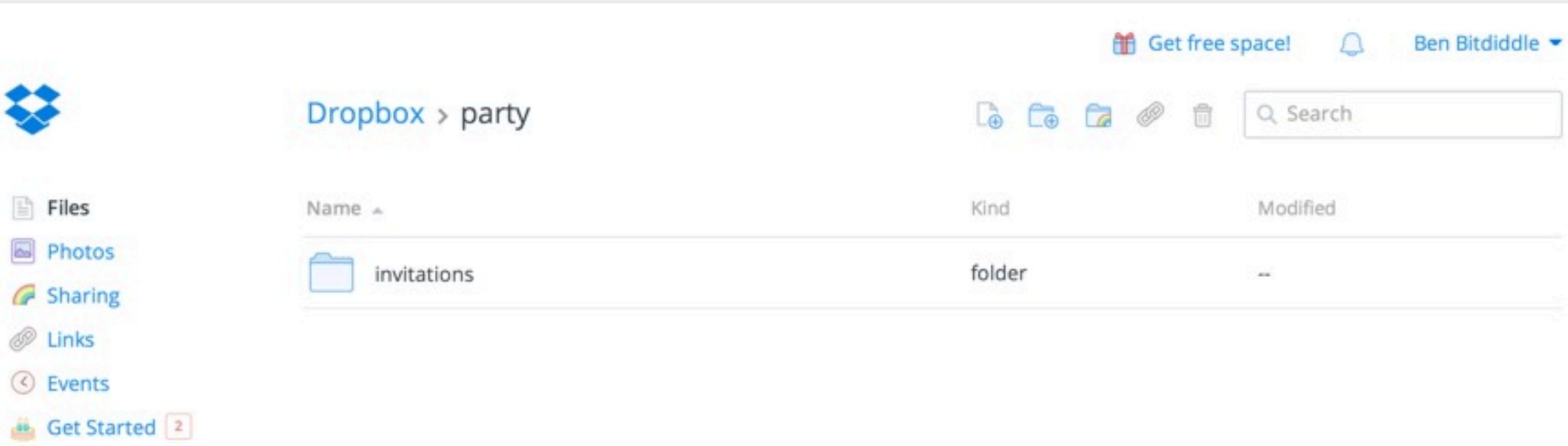
alyssa & ben plan a party

alyssa & ben plan a party



alyssa & ben plan a party





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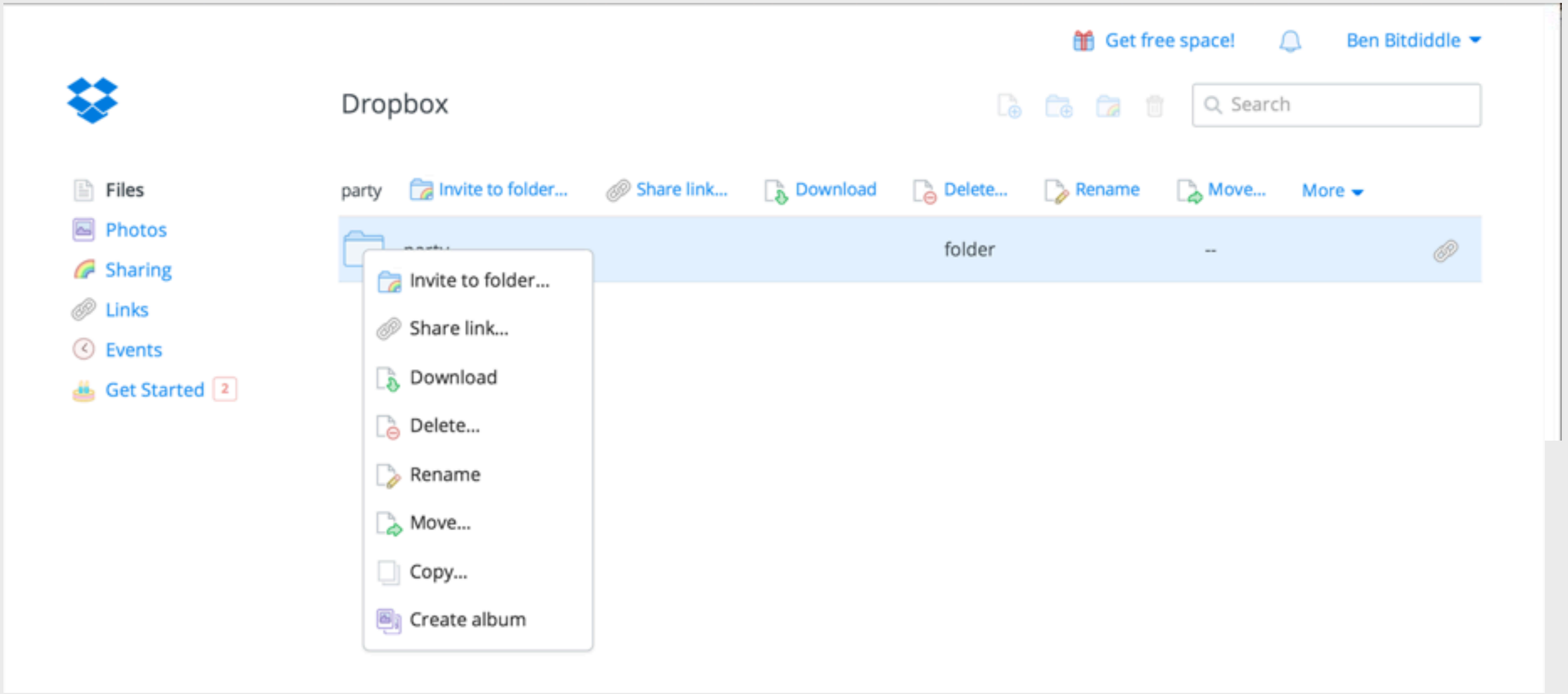

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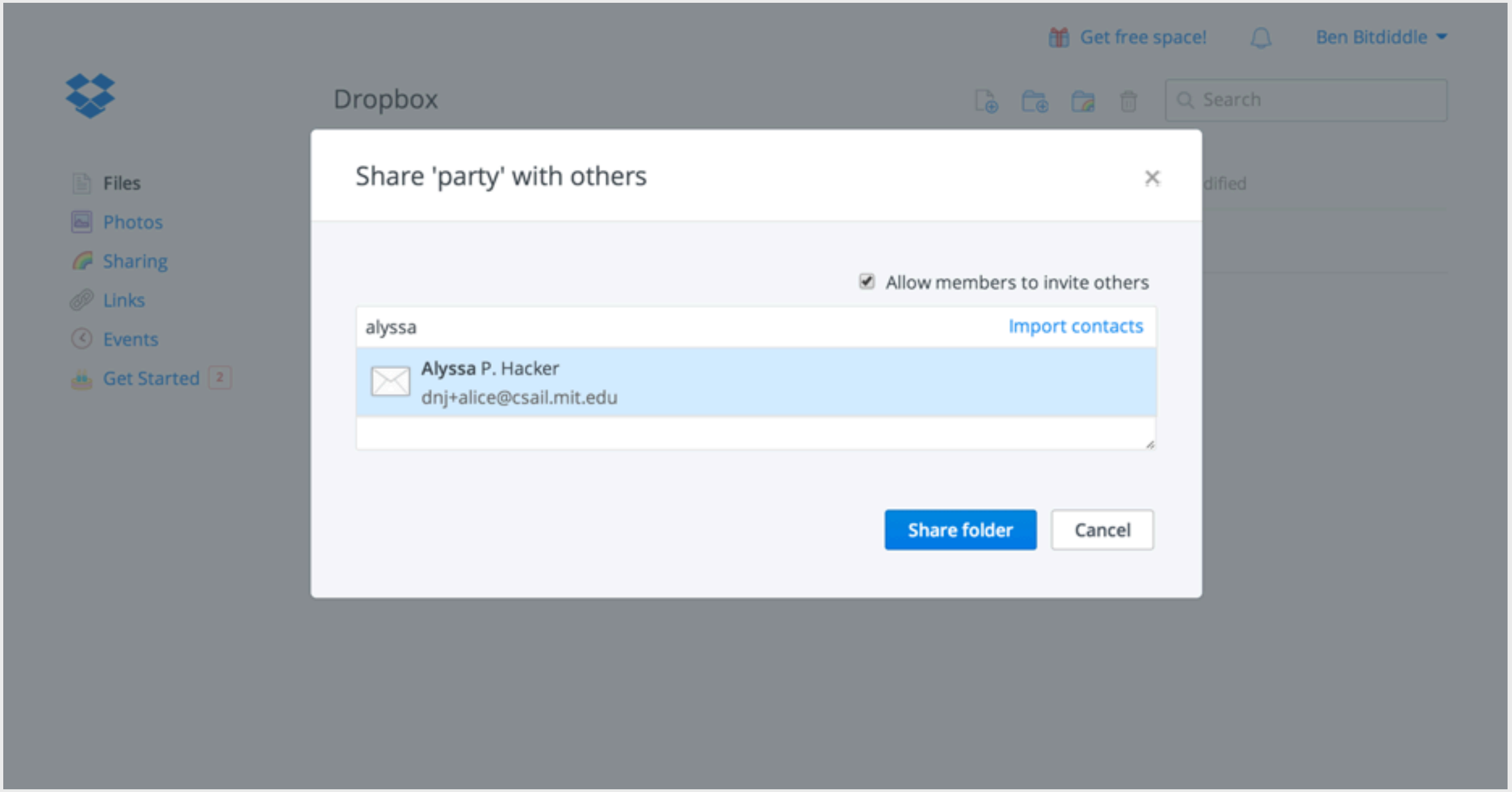

alyssa spoils everything

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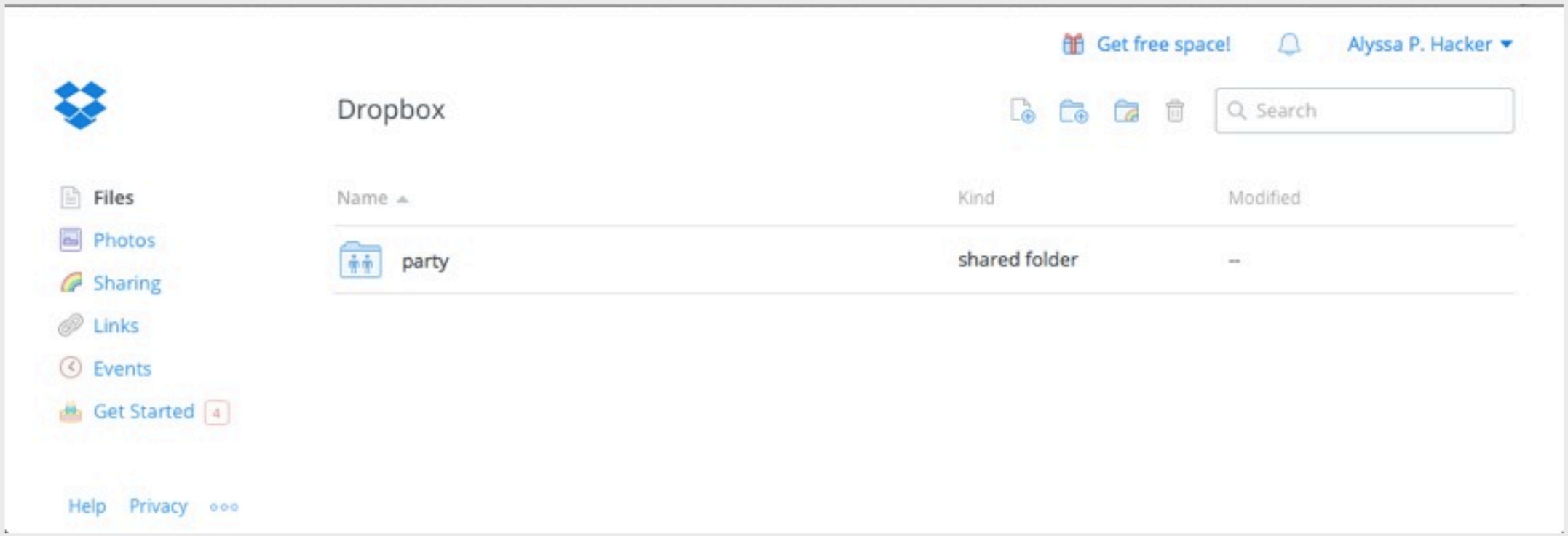

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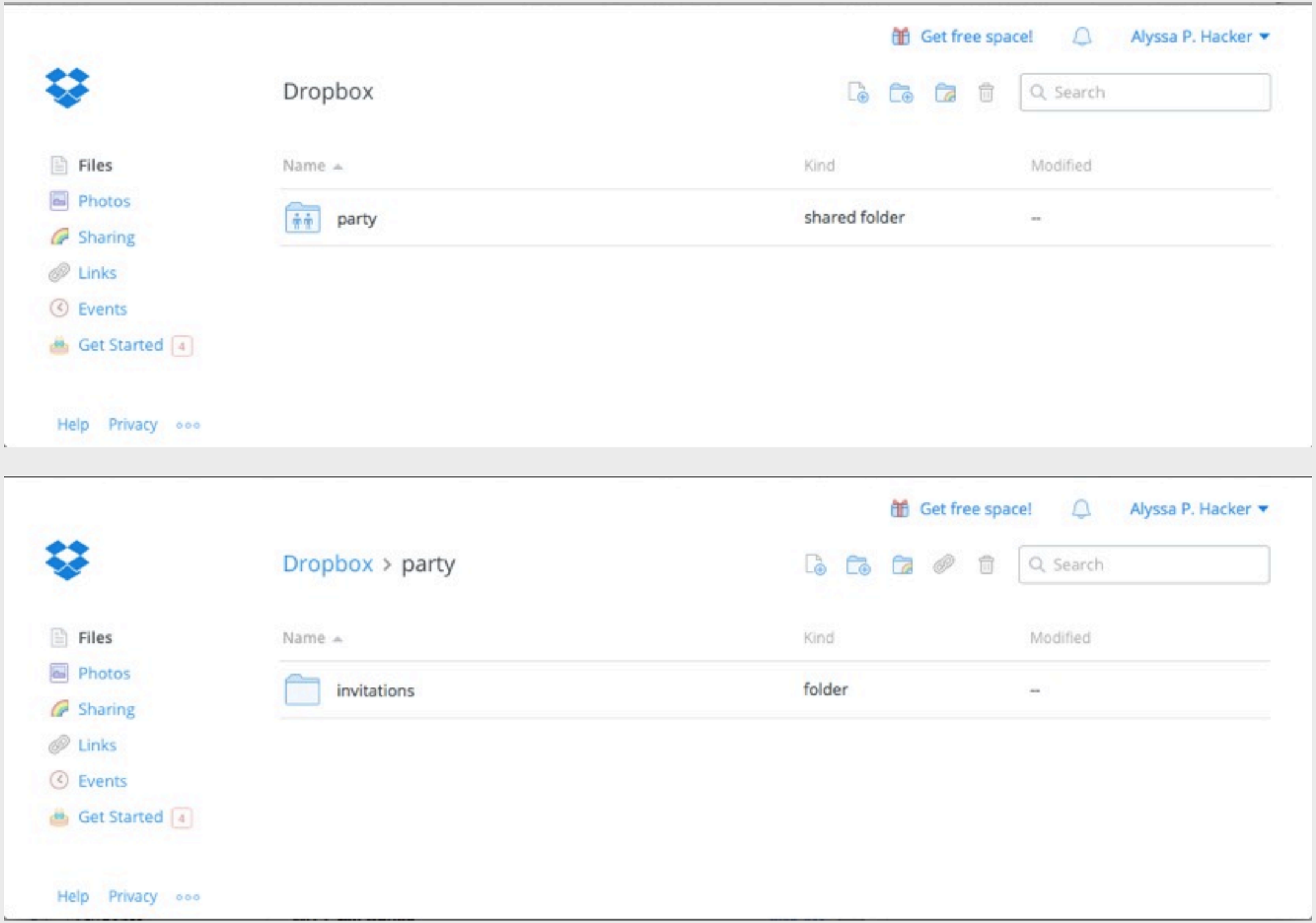

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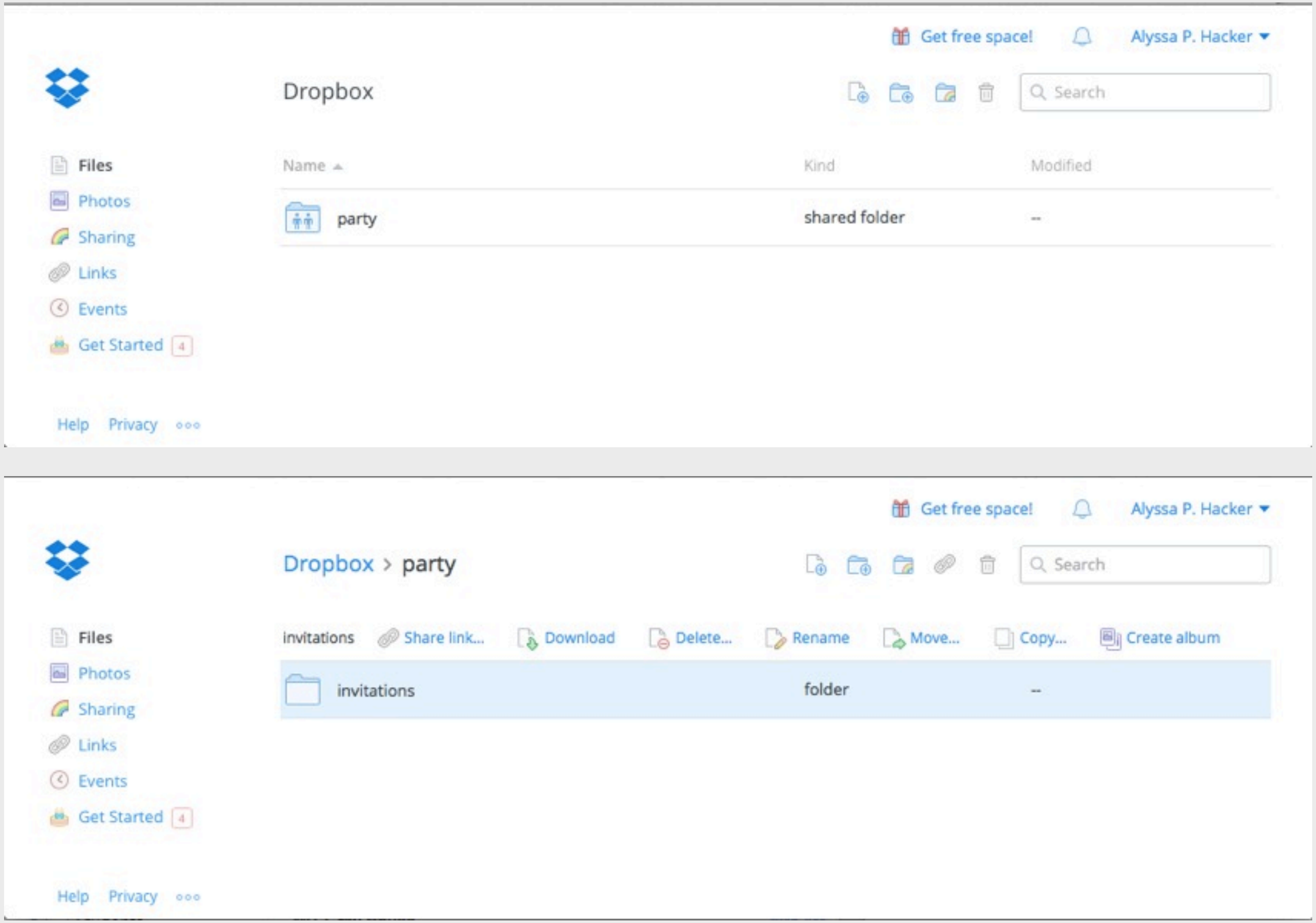

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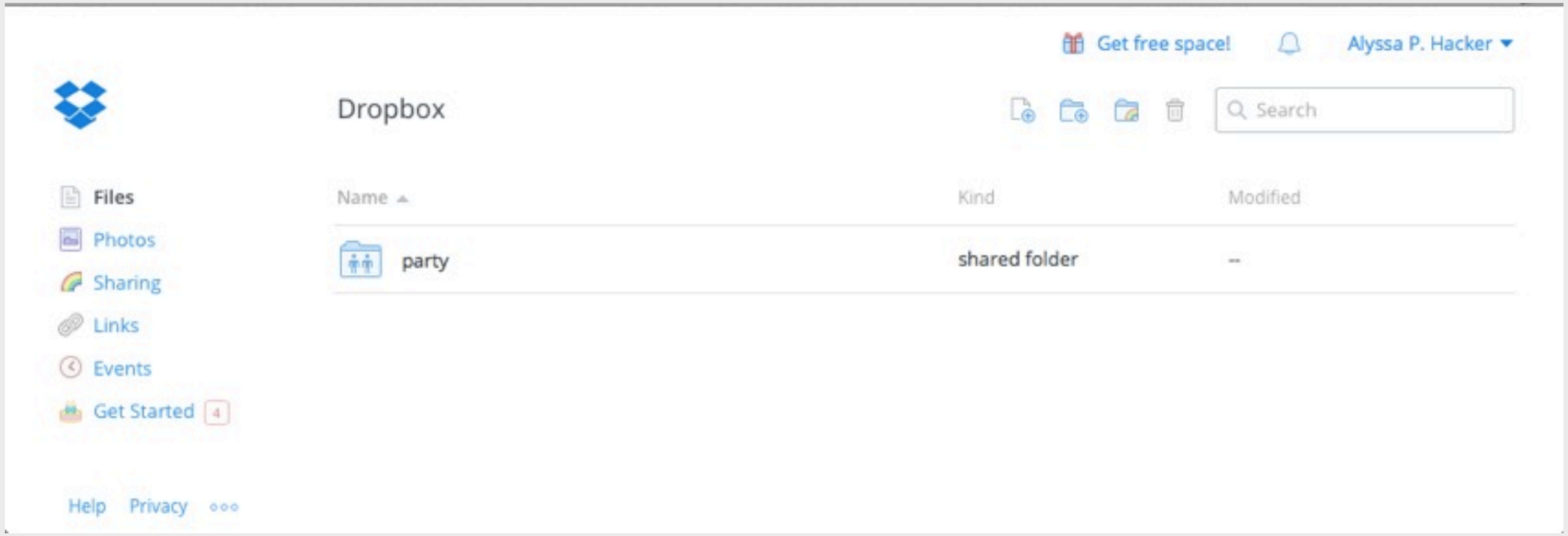

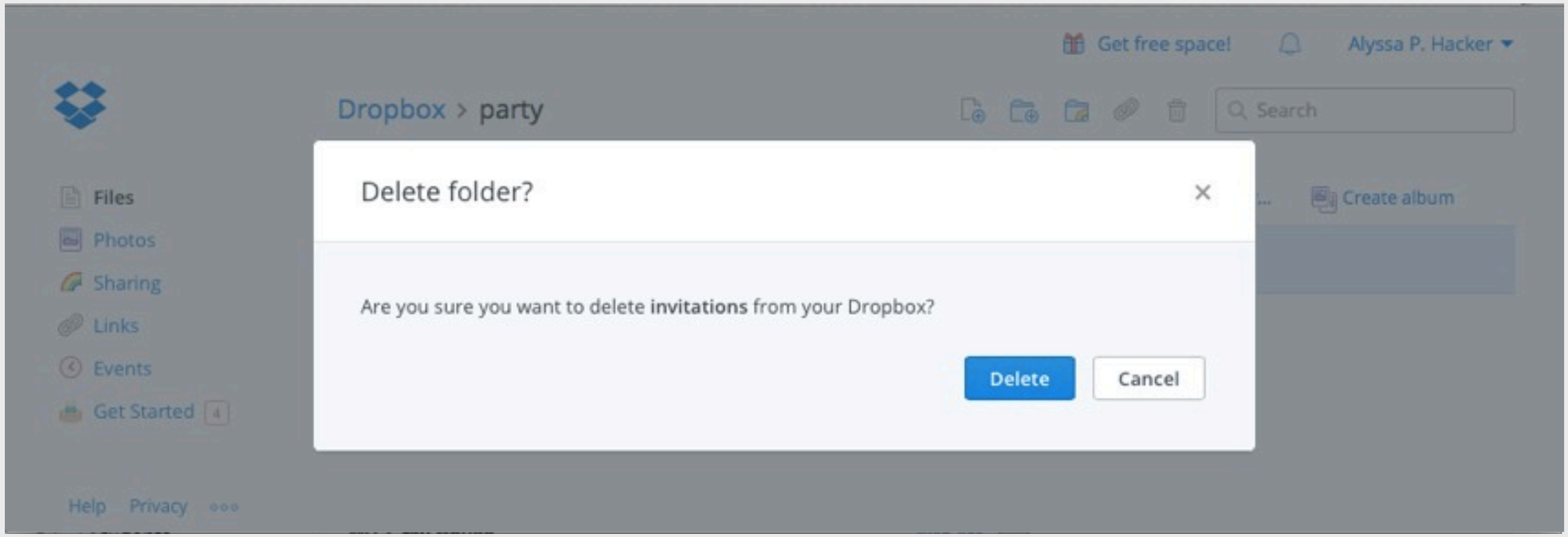

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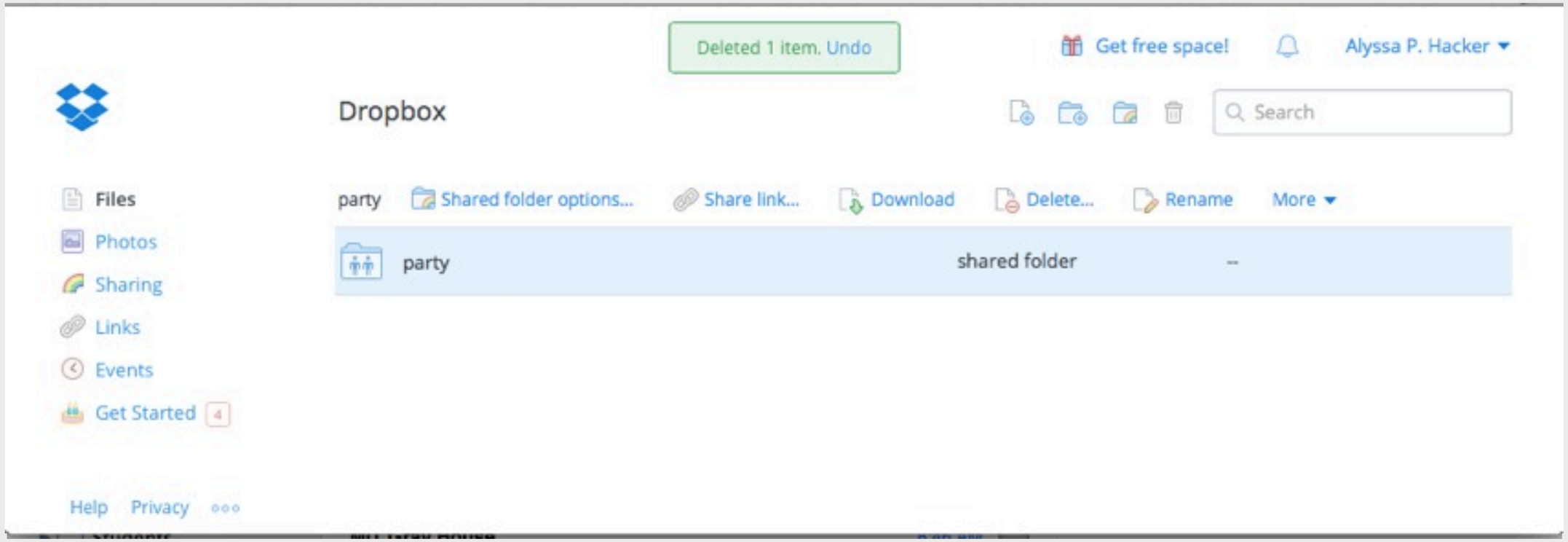

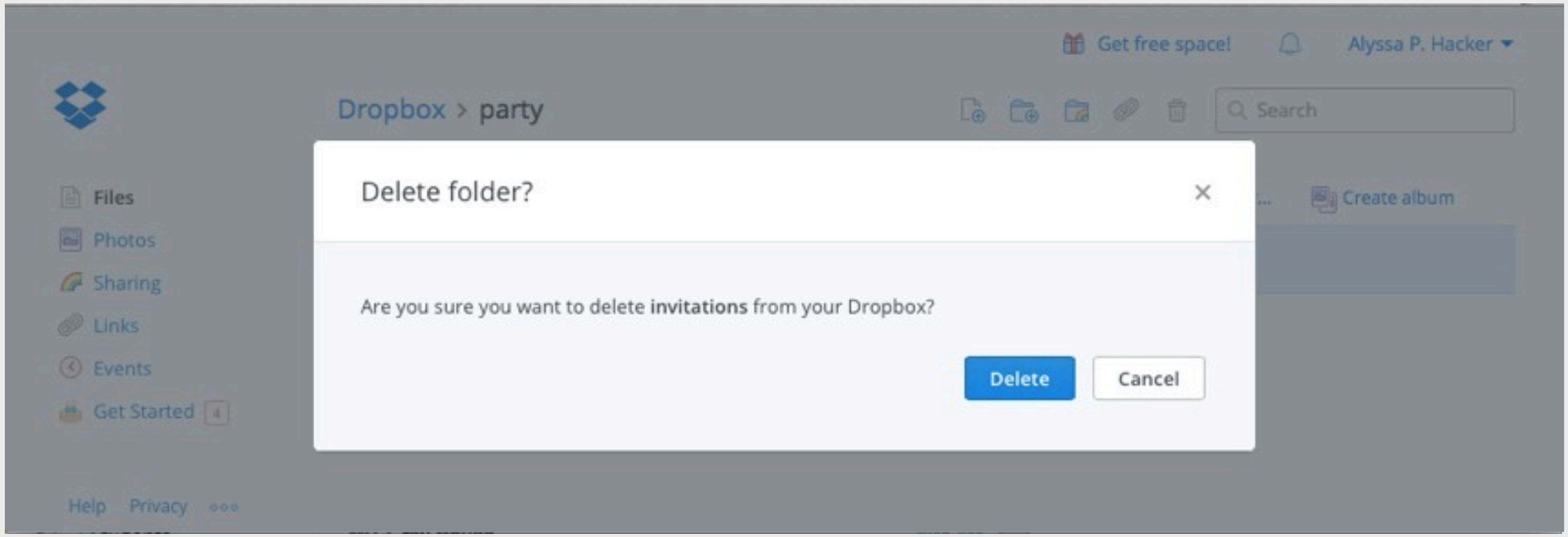

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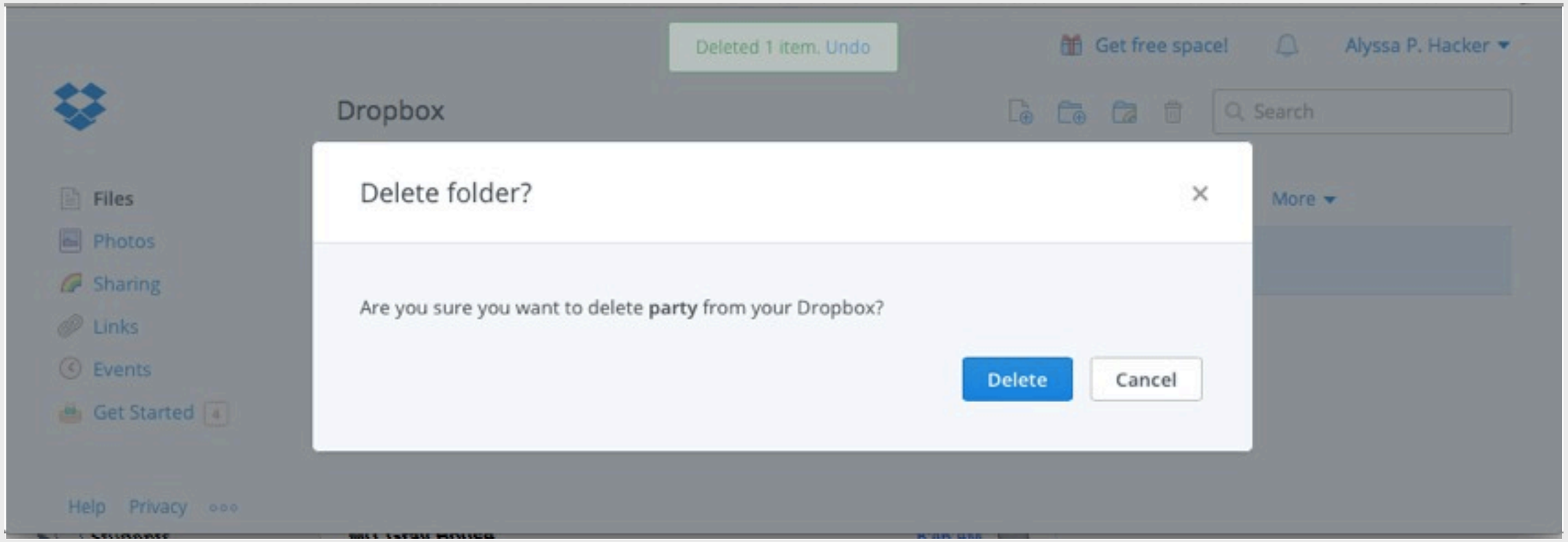

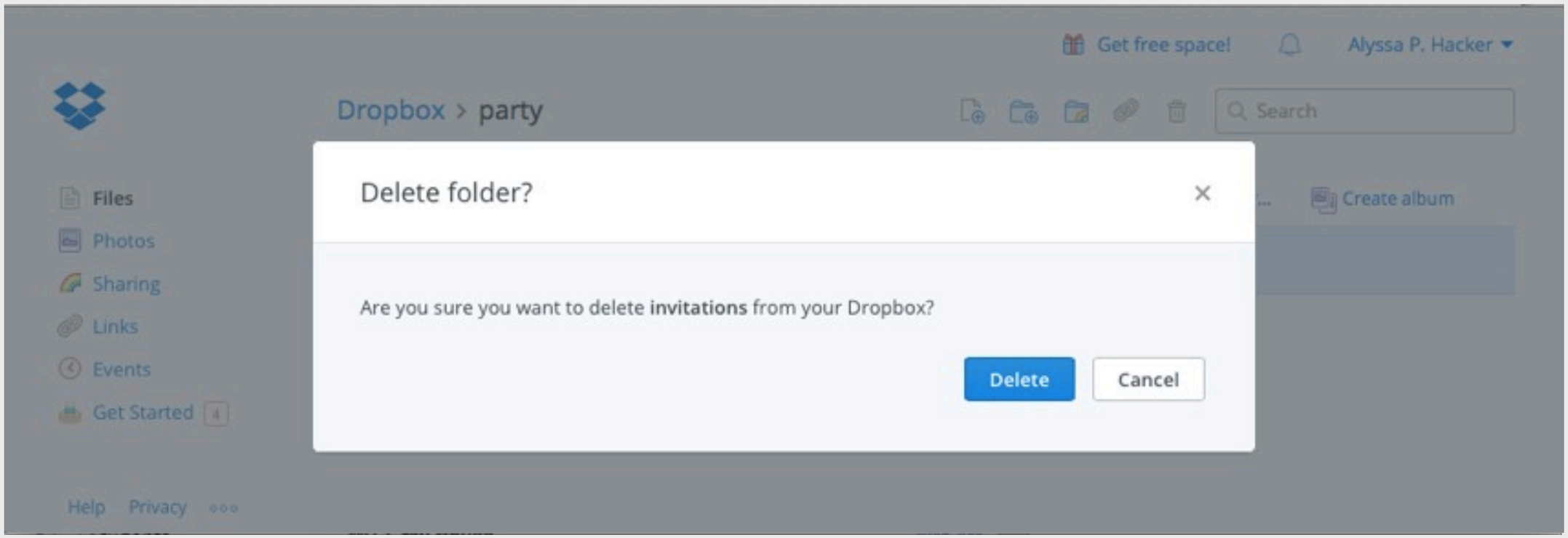

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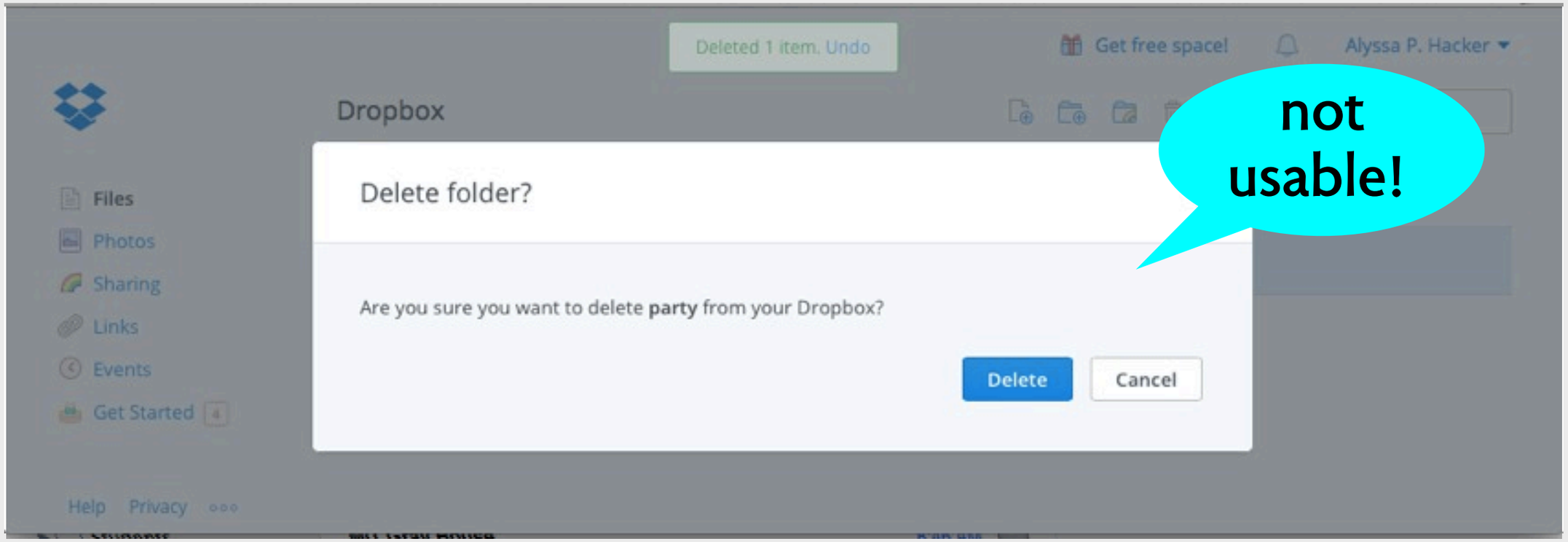
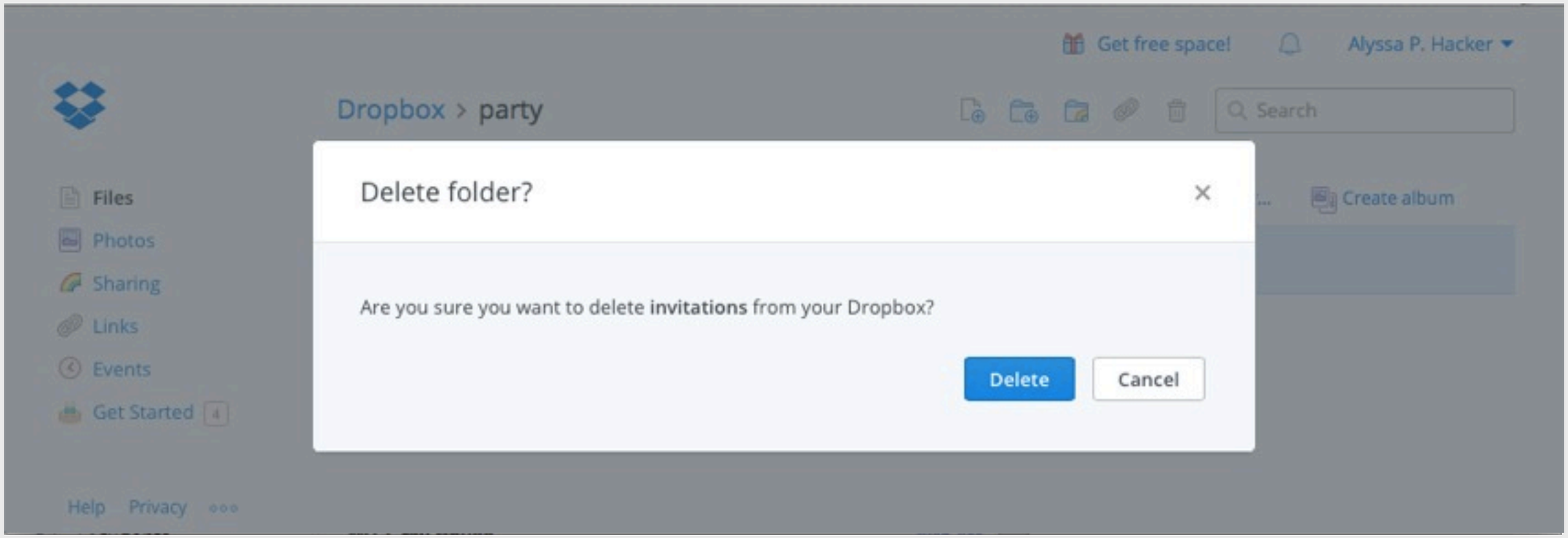
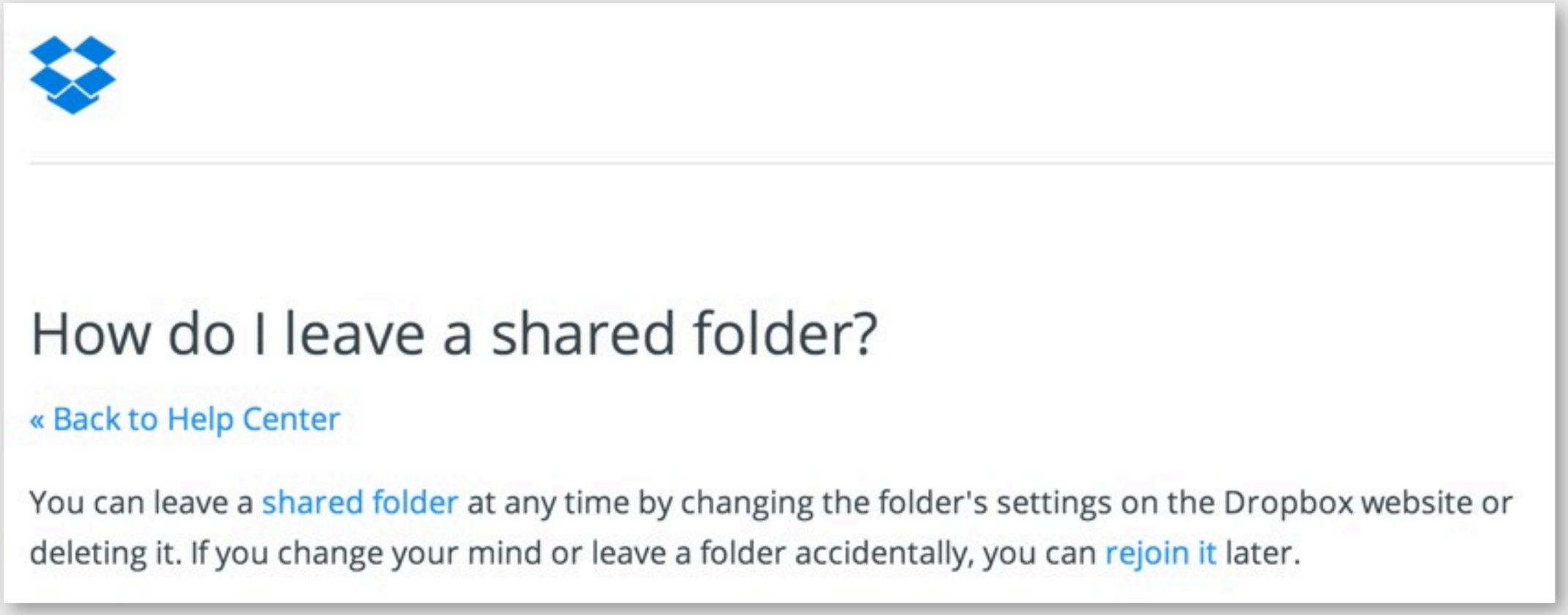




in summary



How do I leave a shared folder?

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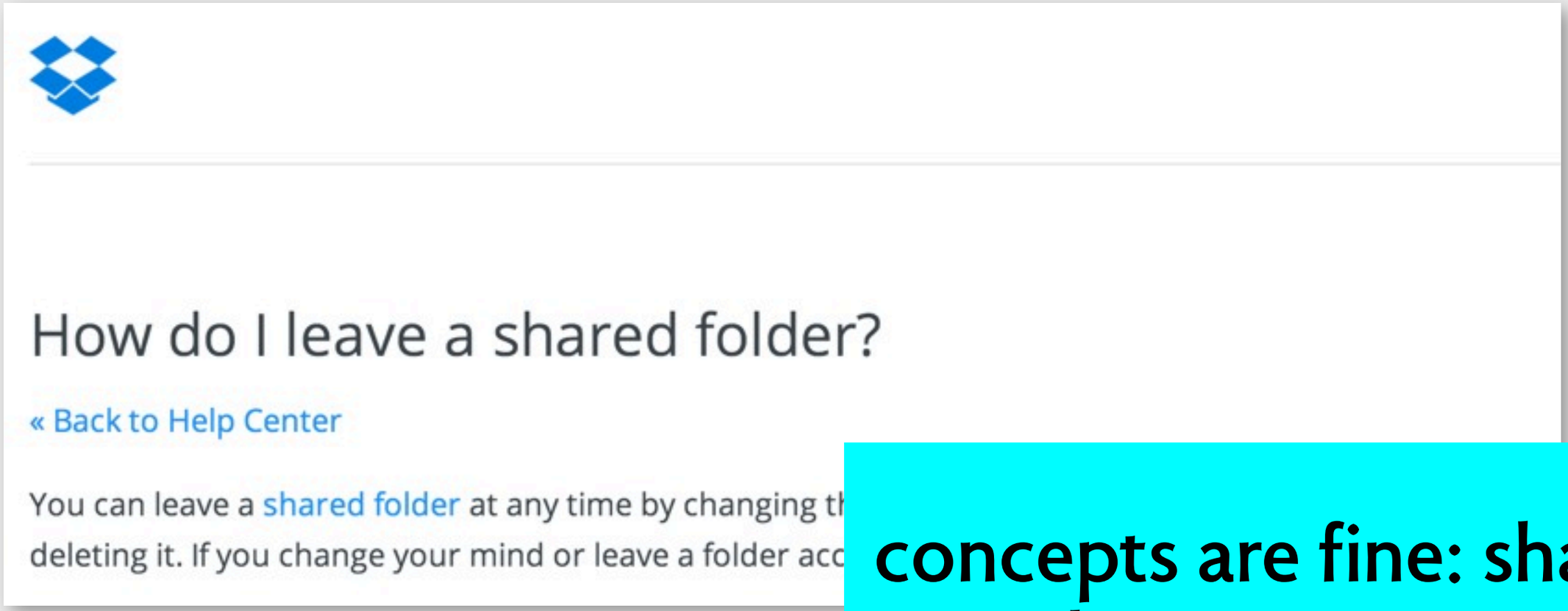

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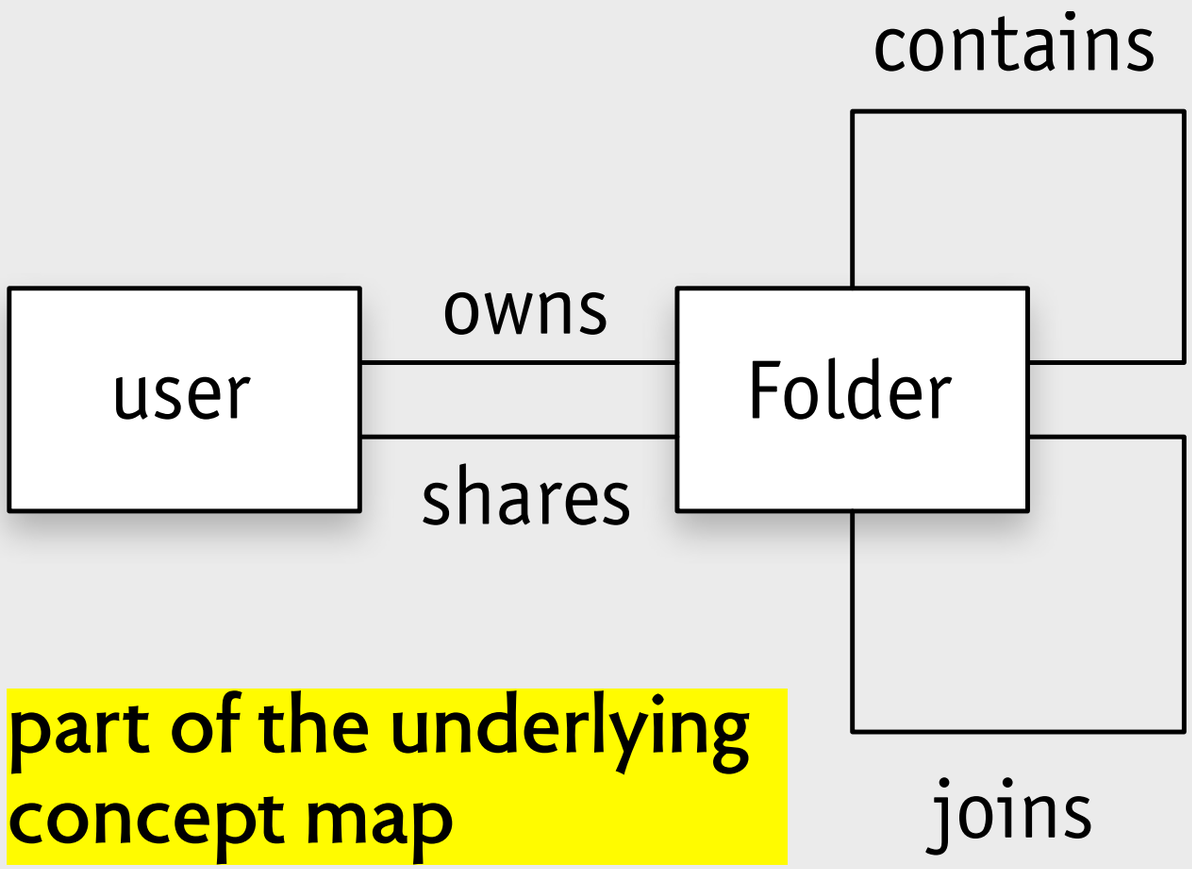
concepts are fine: share, leave, rejoin.

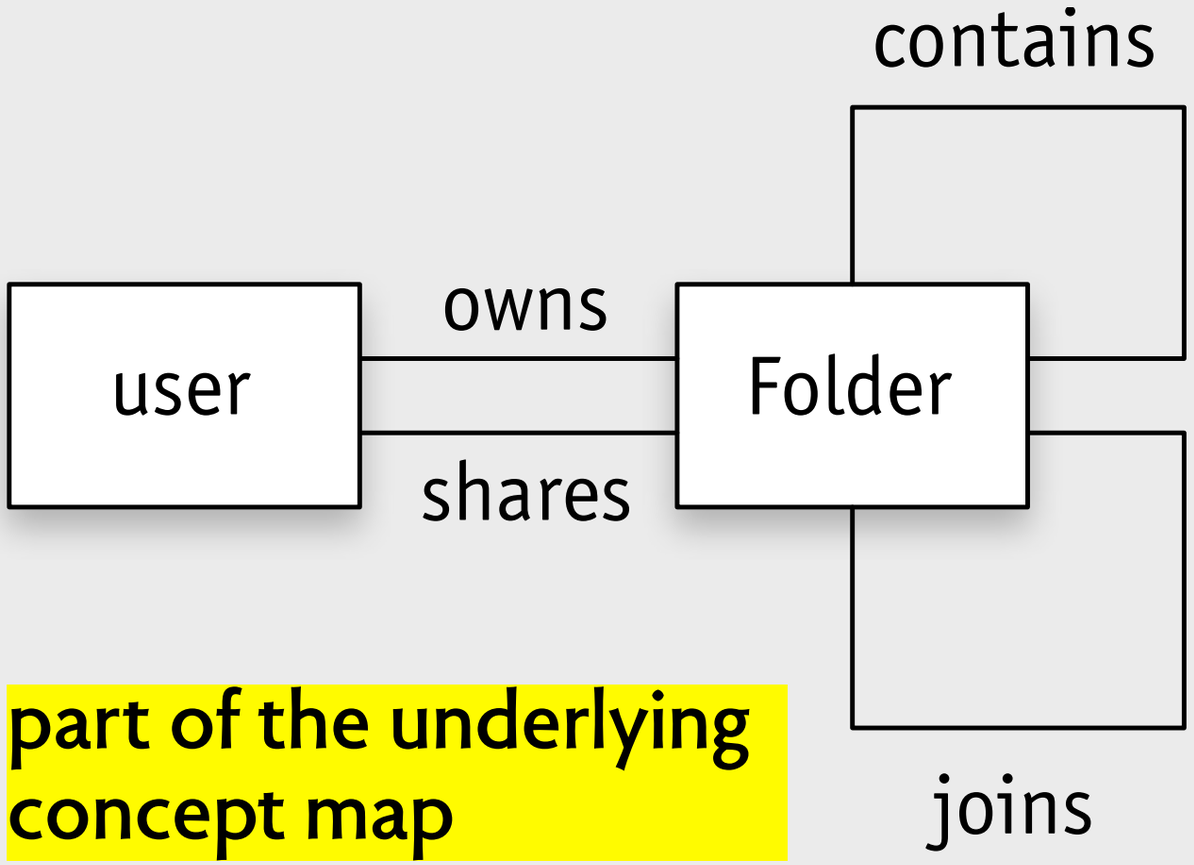
so what's wrong? user interface confuses deletion with leaving

what's going on?



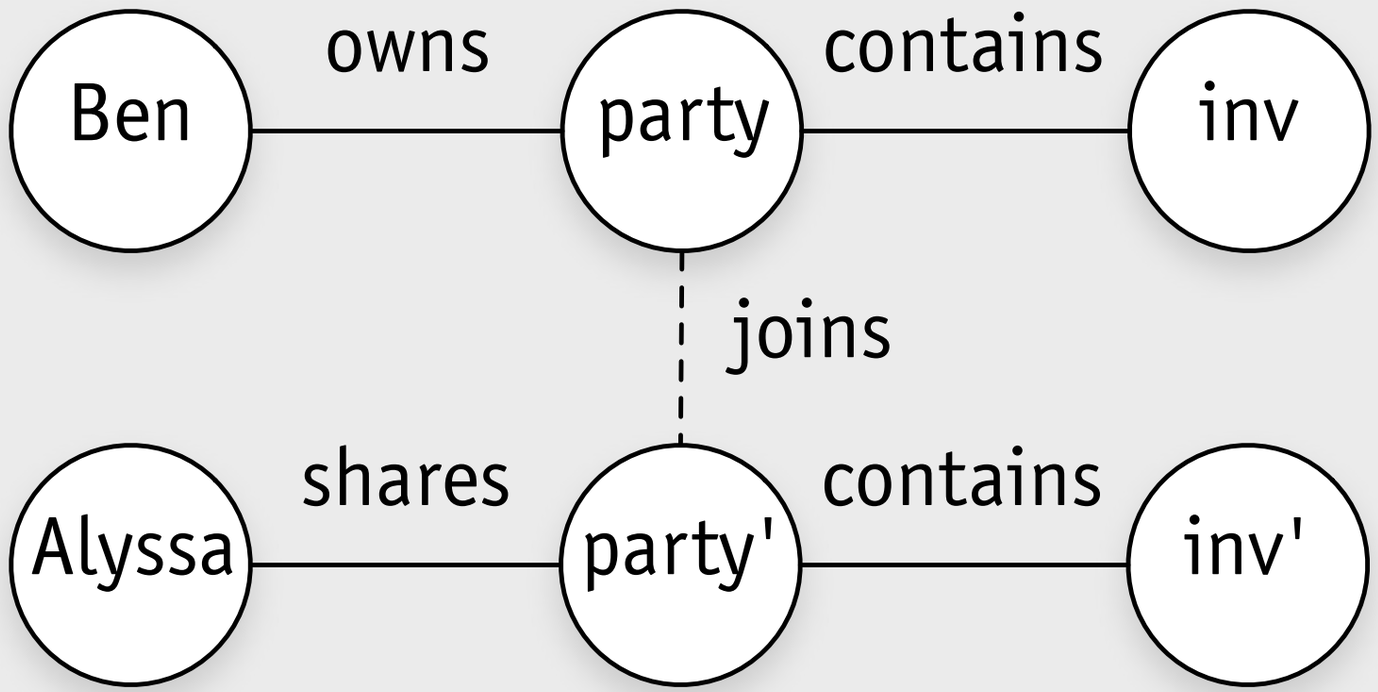
part of the underlying concept map

what's going on?



part of the underlying concept map

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.

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not coherent!

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what's going on?

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propagate deletion?

file sync: yes, to keep things ordered

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

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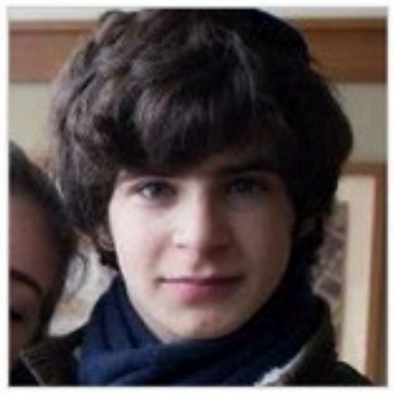
why would Mozy propagate deletion?

prevent you from using as secondary storage

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?

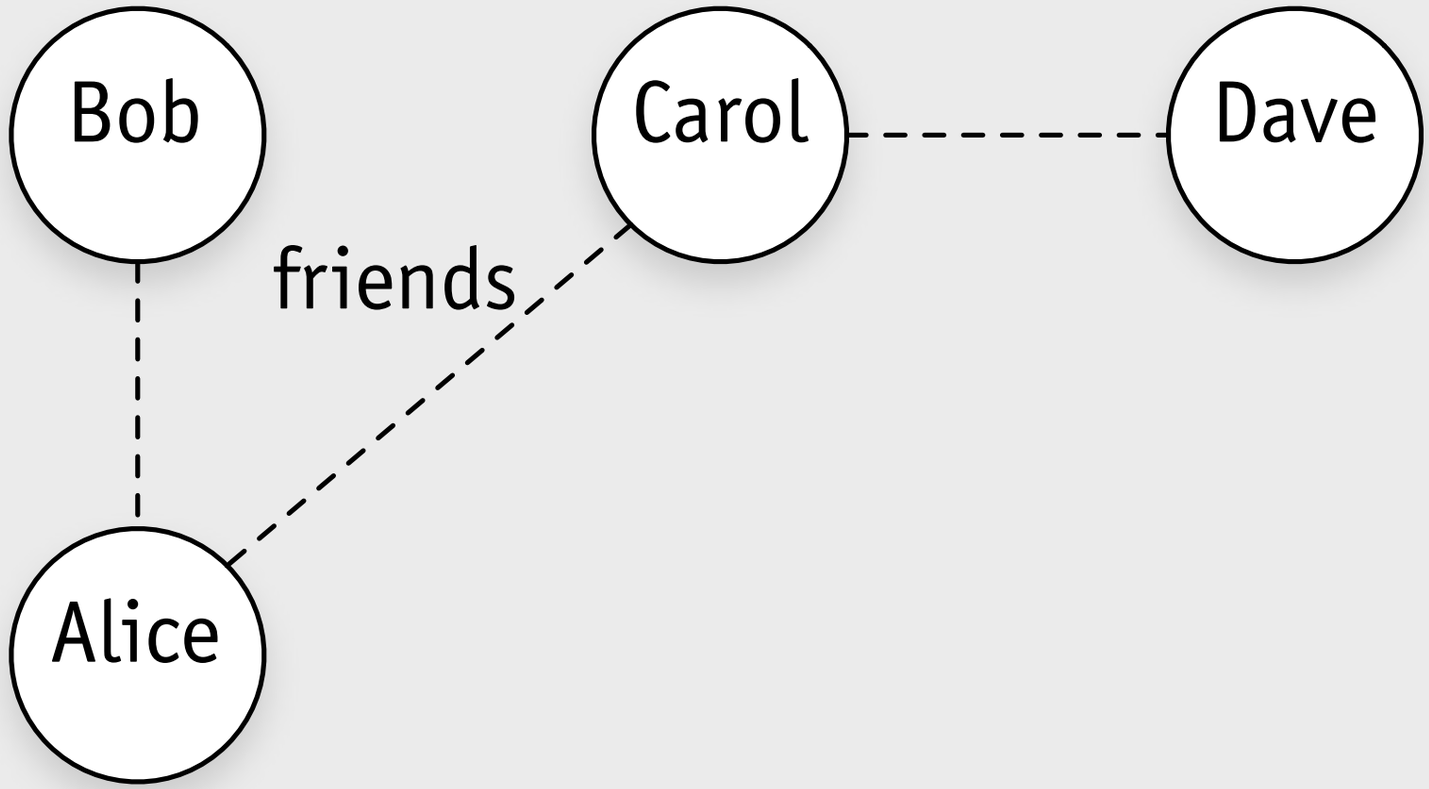
Who is this?

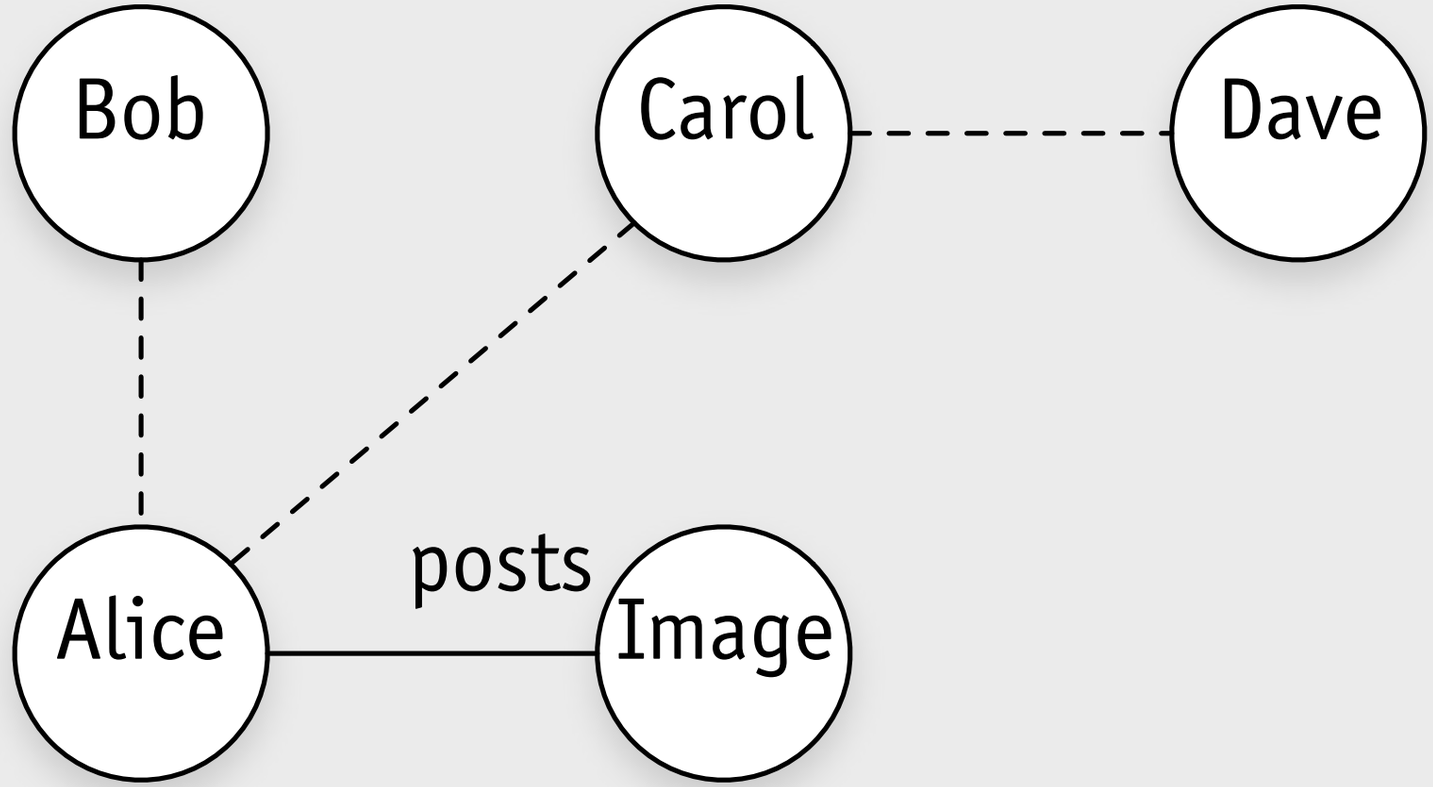
Skip Tagging Friends

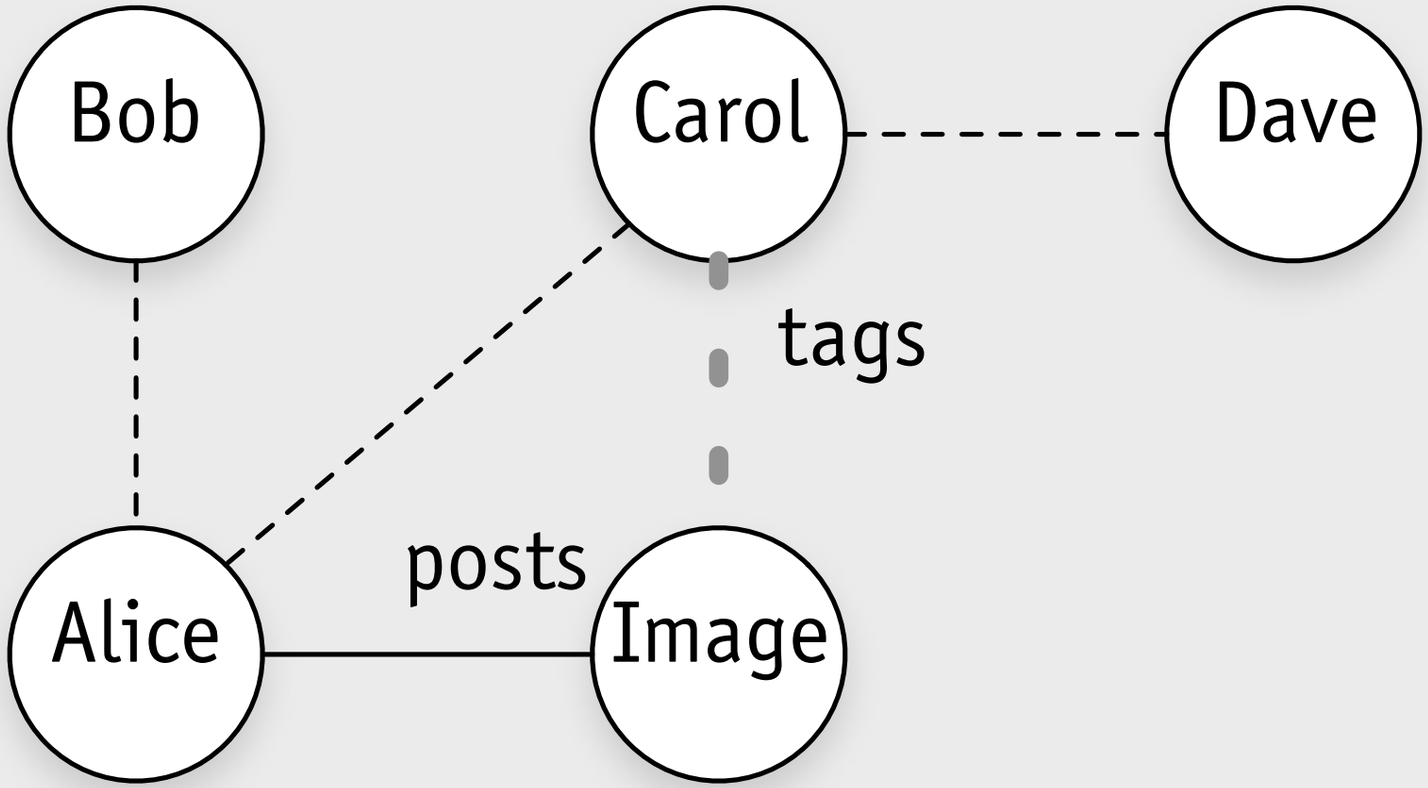
Save Tags

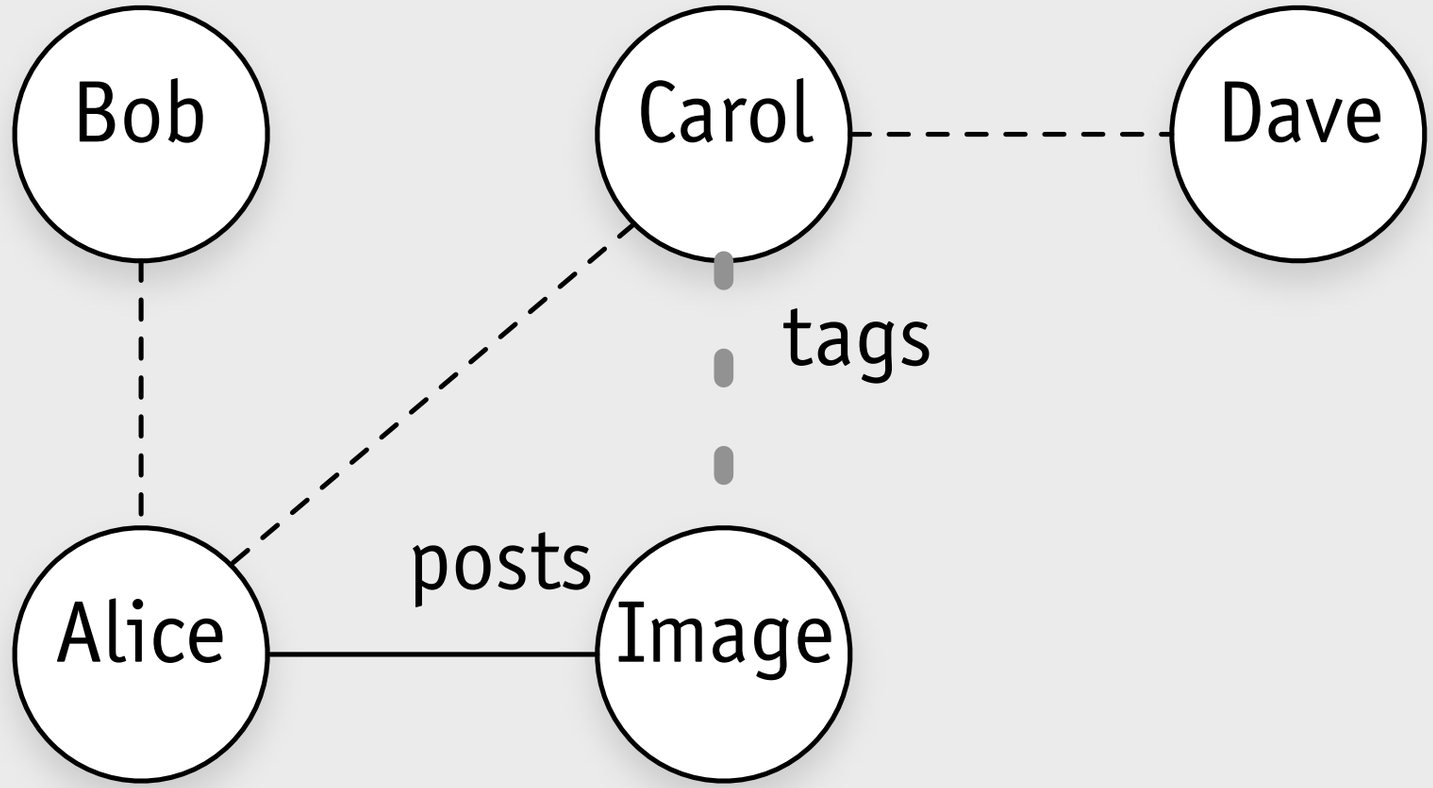
About Create an Ad Create a Page Developers Careers Privacy Cookies Terms Help

Facebook © 2013 · English (US)

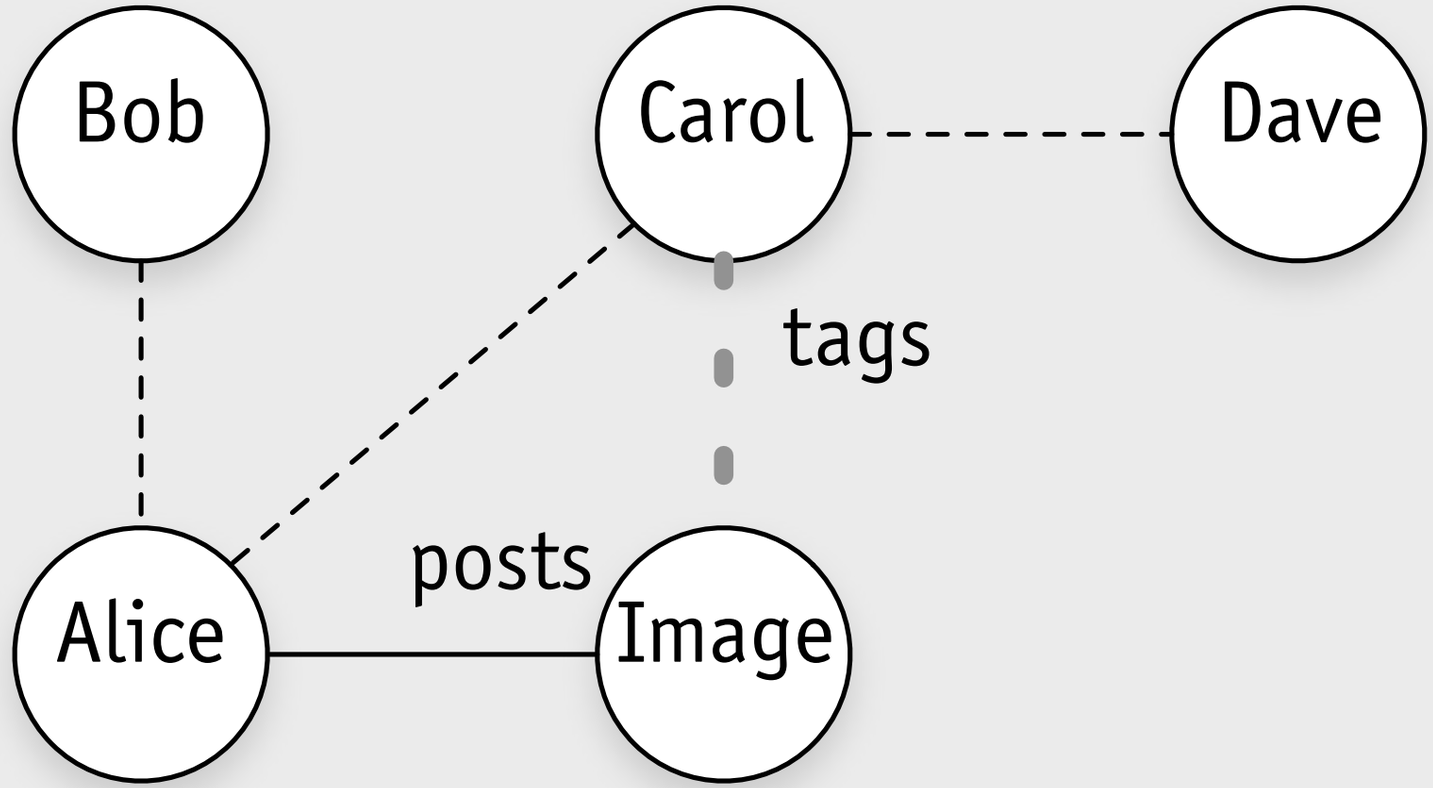

Bob
Carol
Dave
friends
Alice


Bob
Carol
Dave
Alice
posts
Image


Bob
Carol
Dave
tags
Alice
posts
Image



who can see the image?

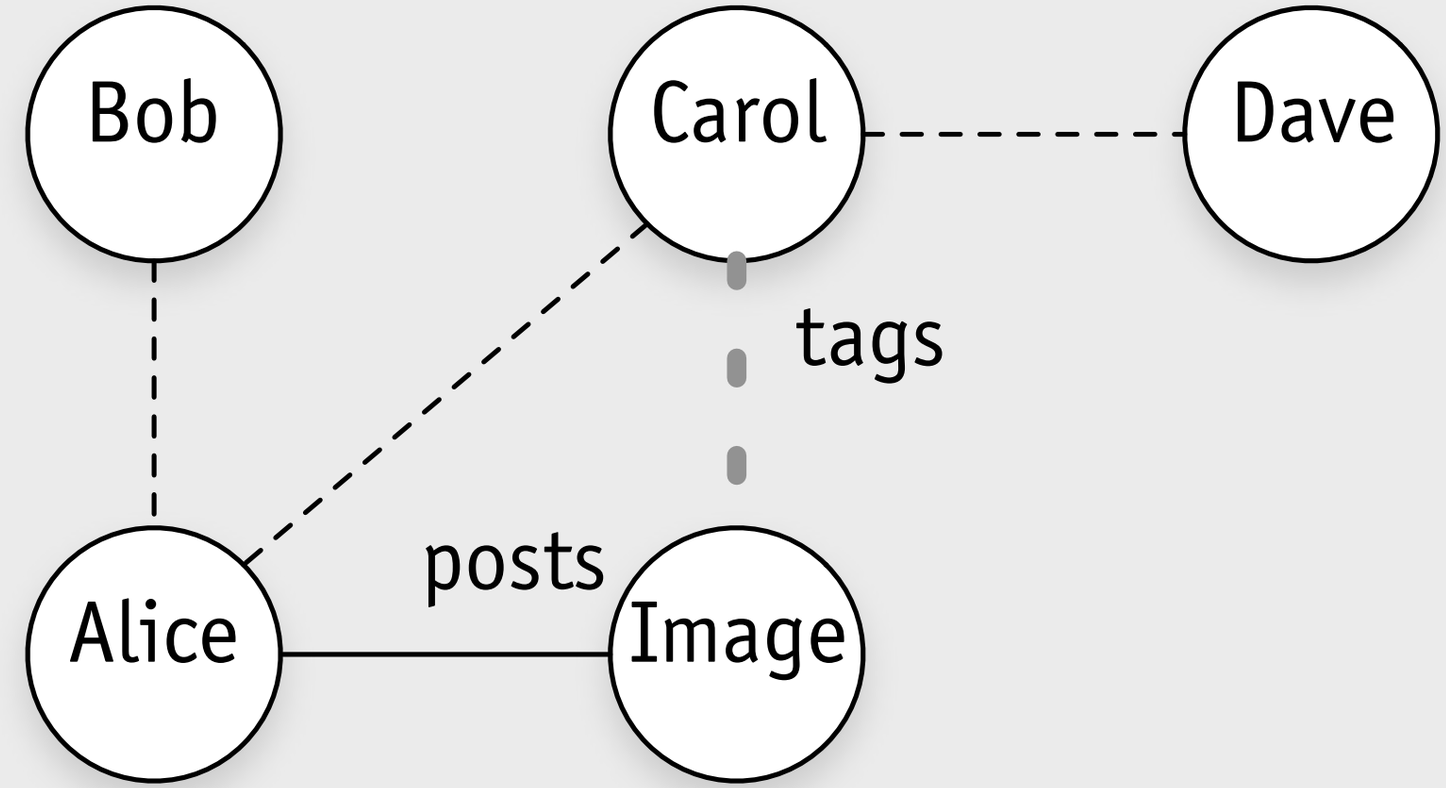


who can see the image?

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:

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



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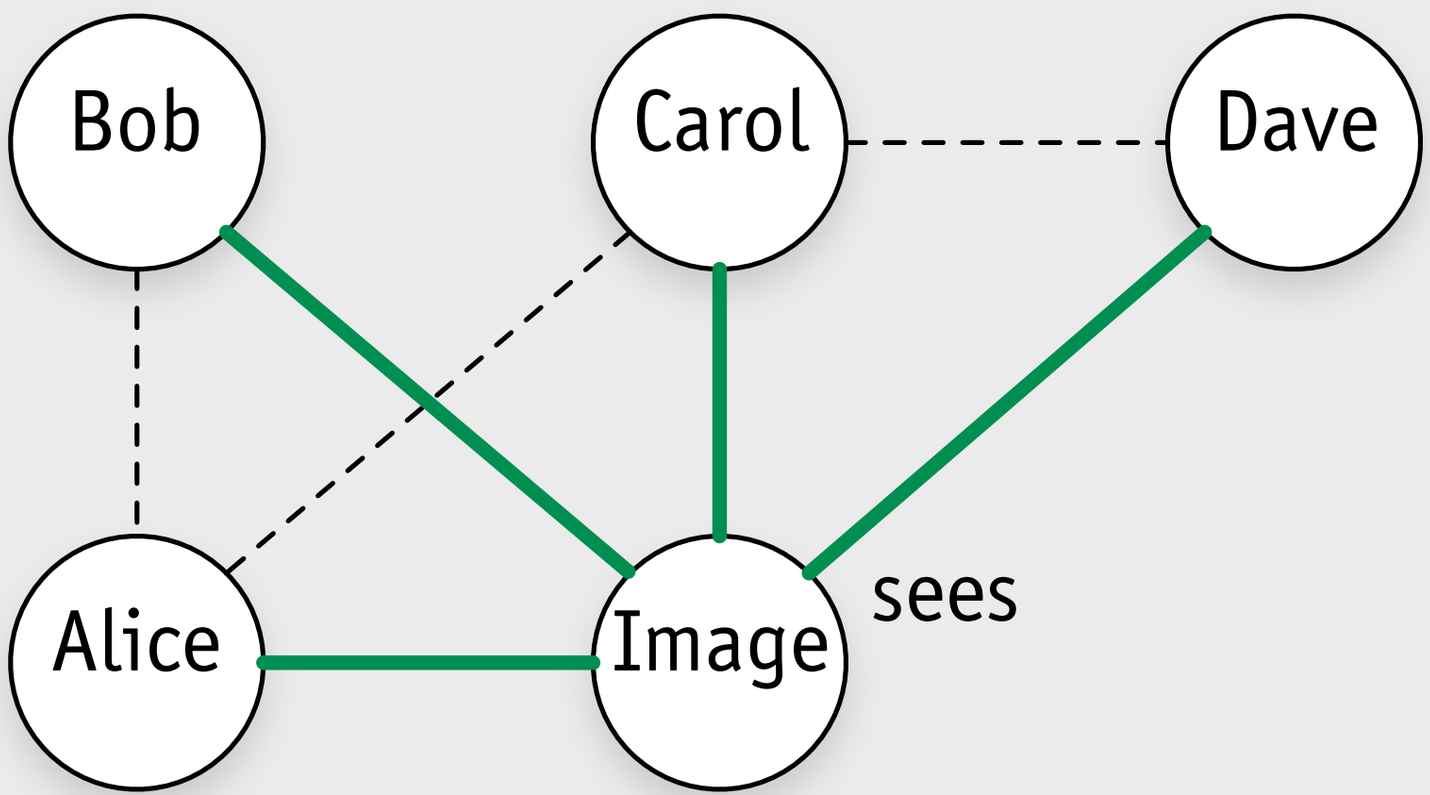

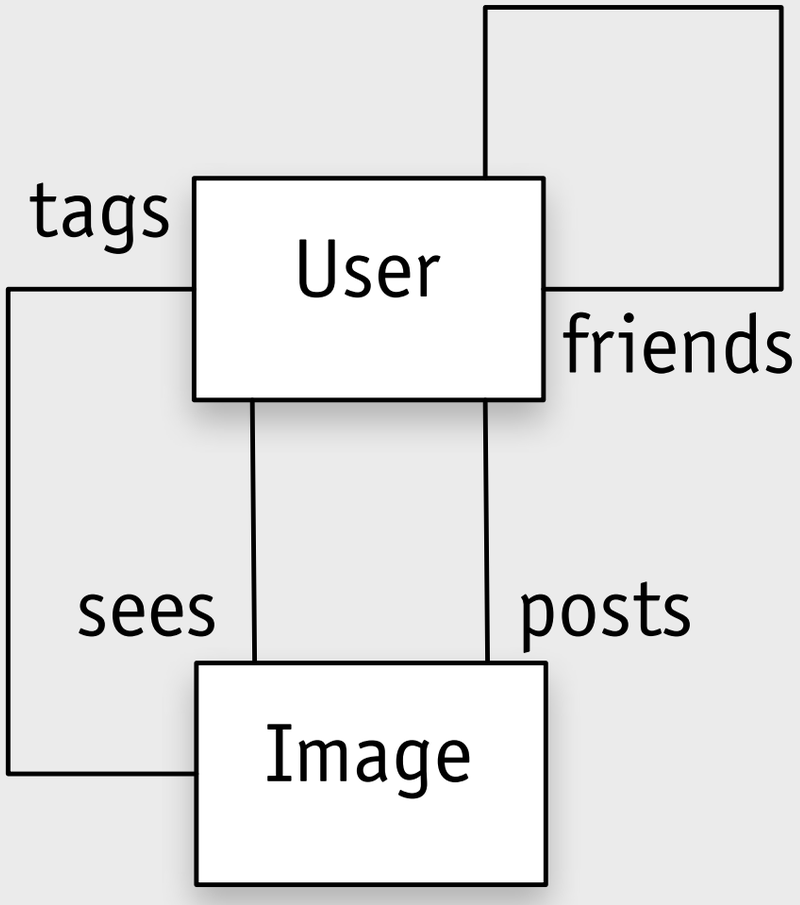

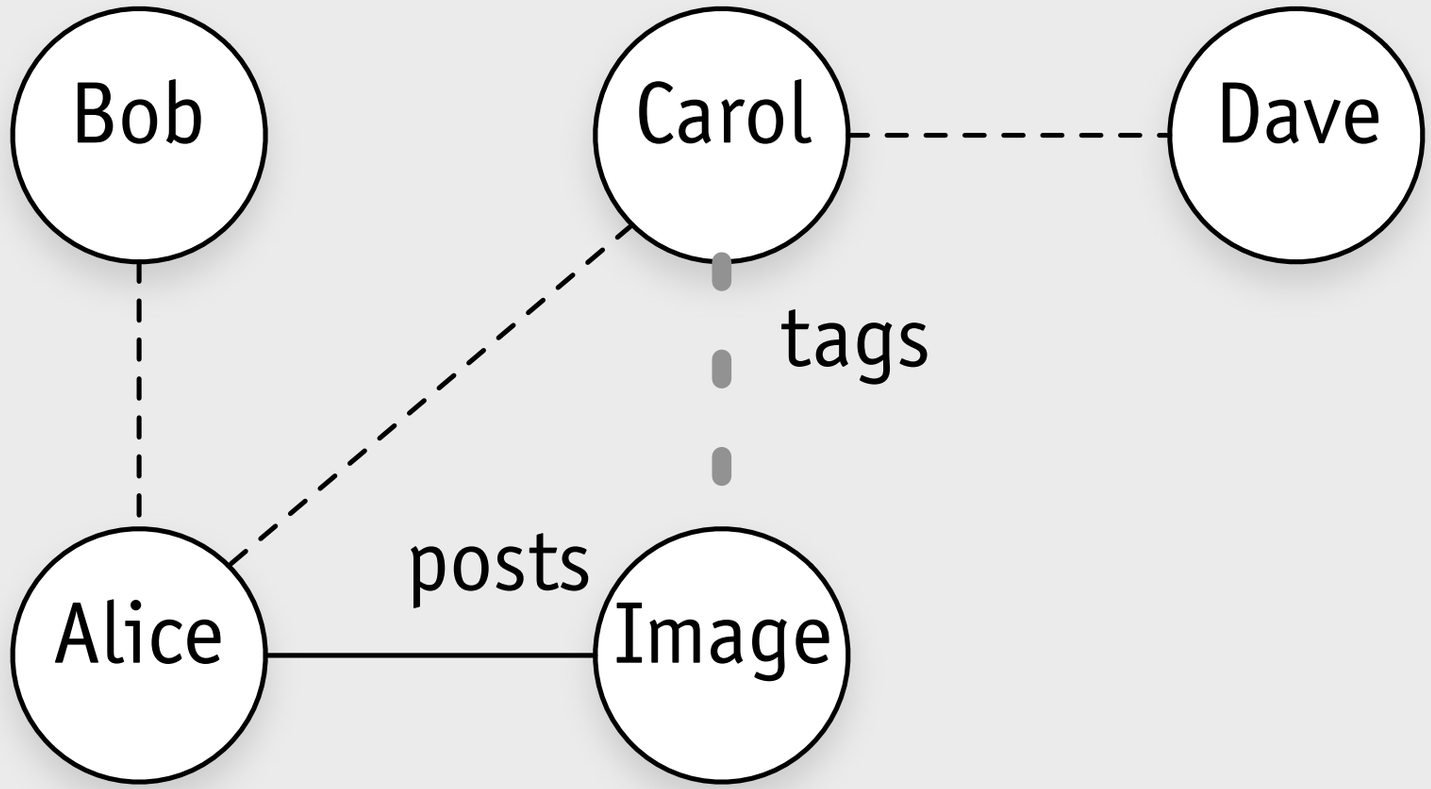

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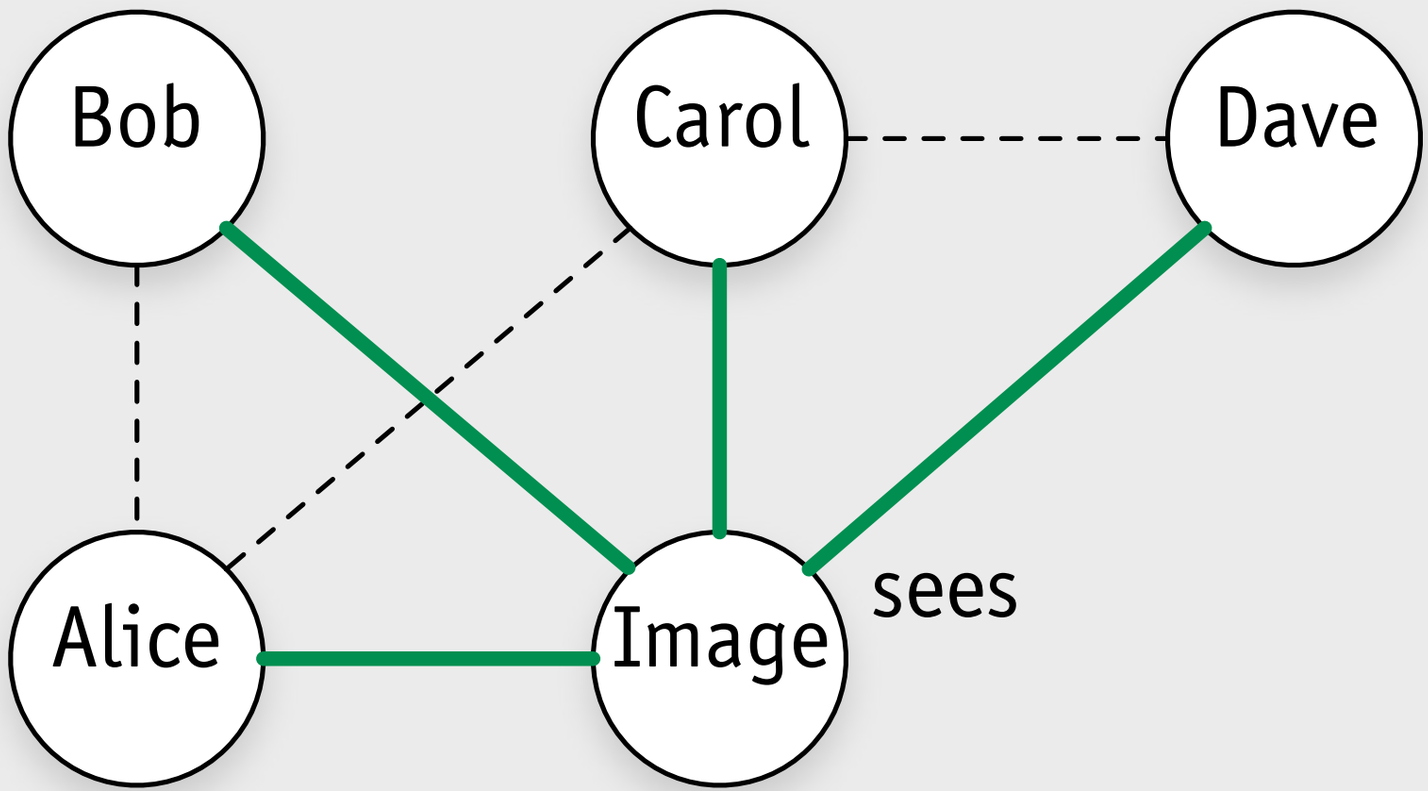
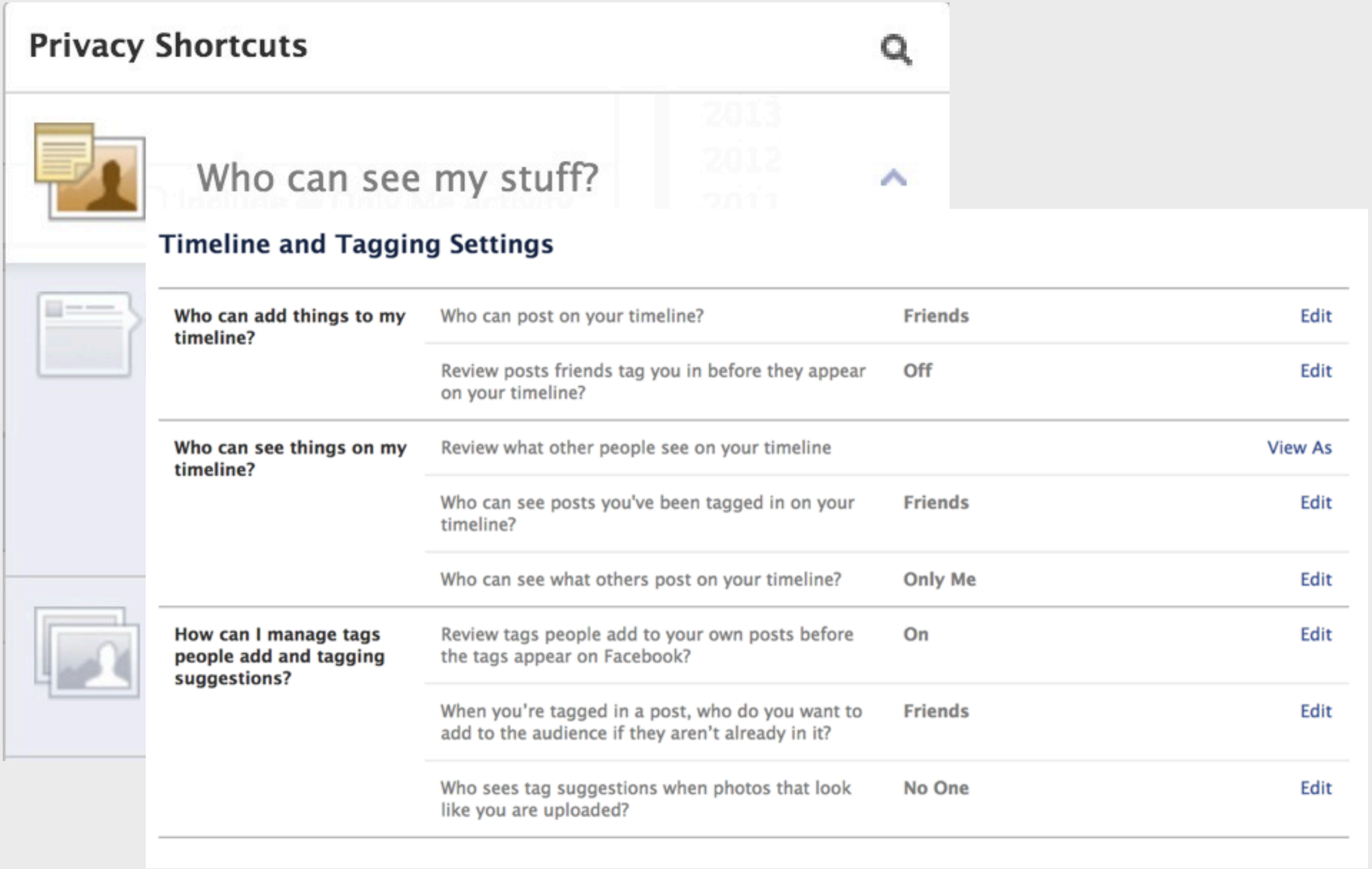


tagging in facebook



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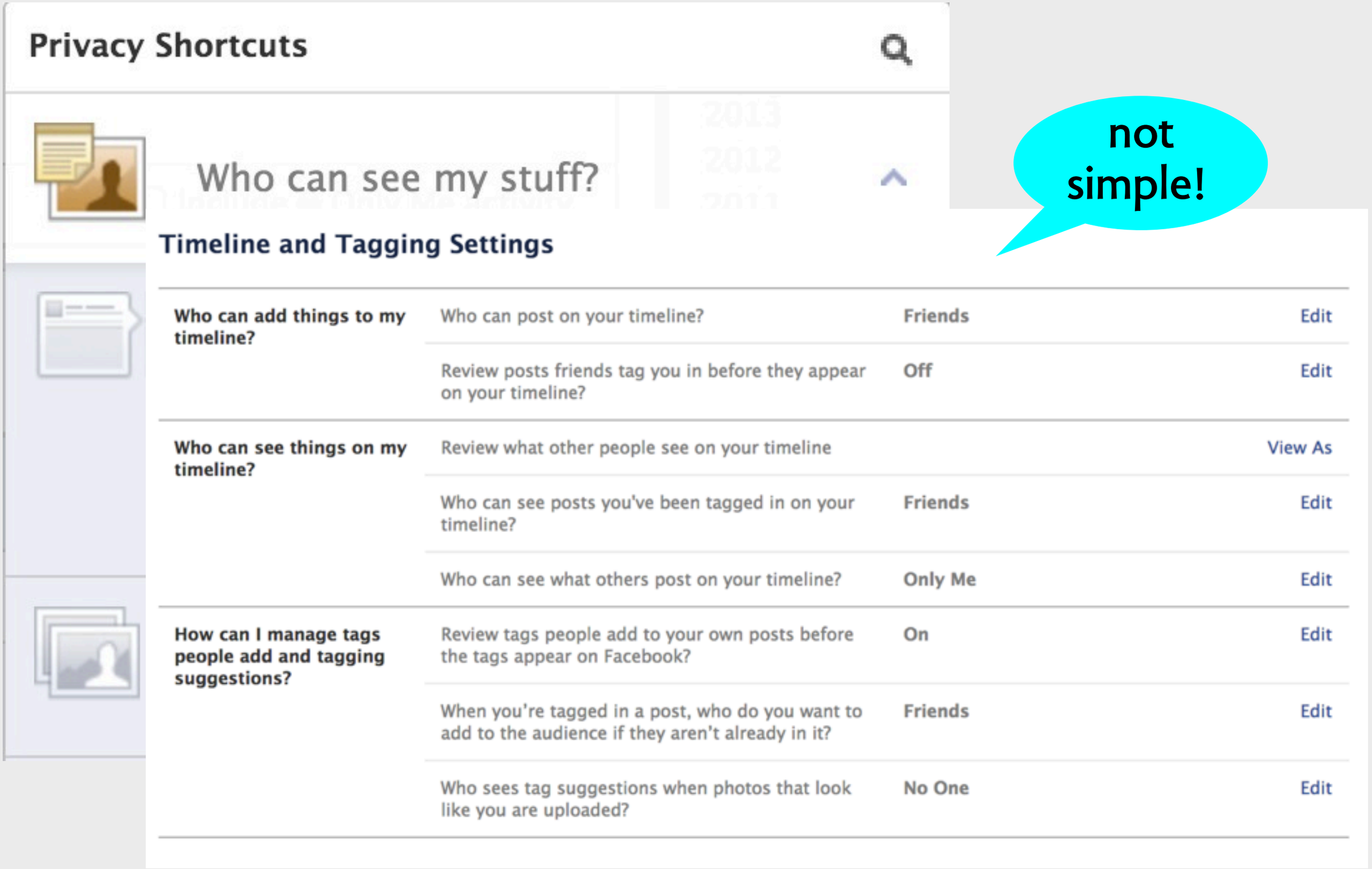

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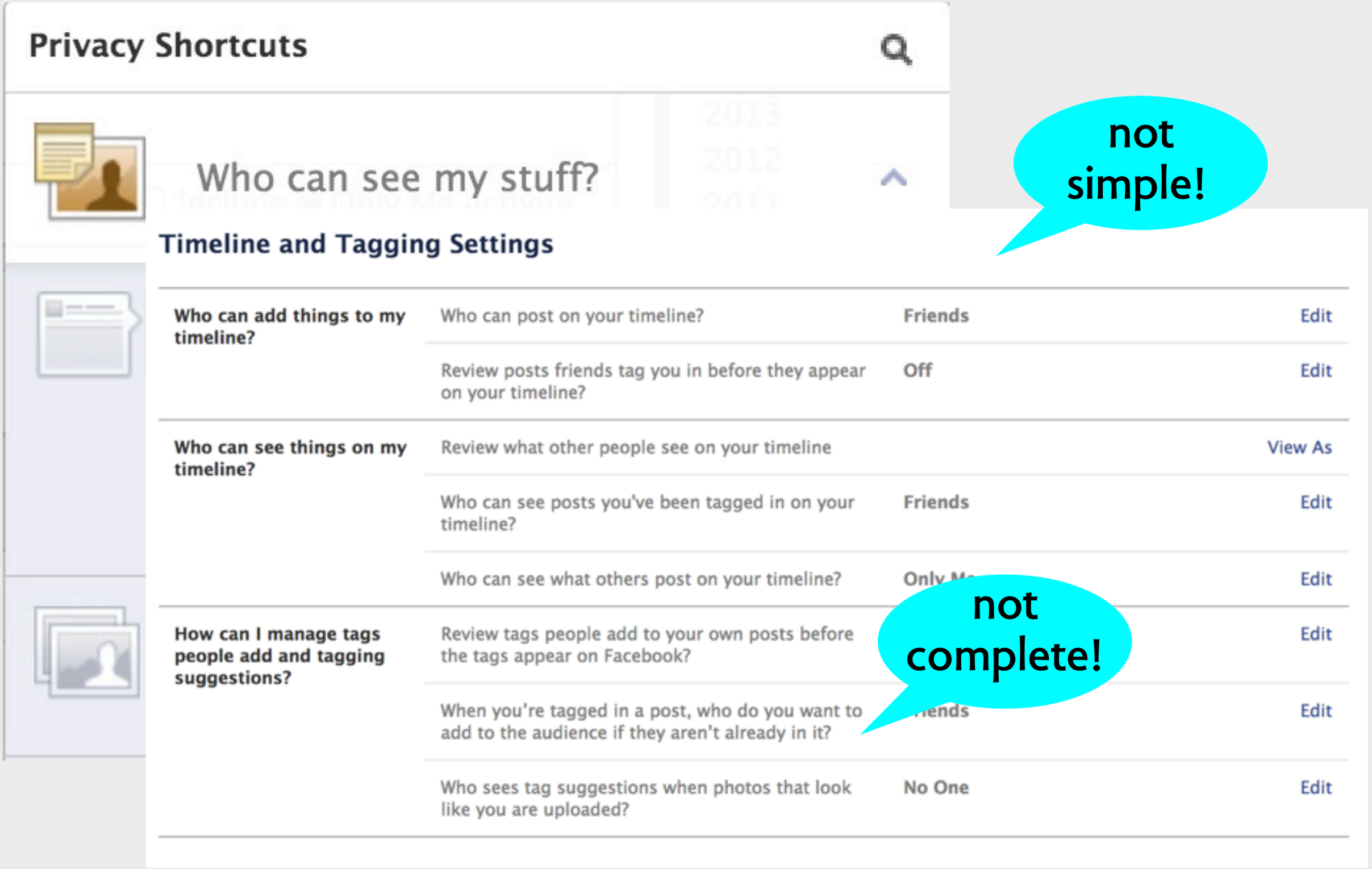


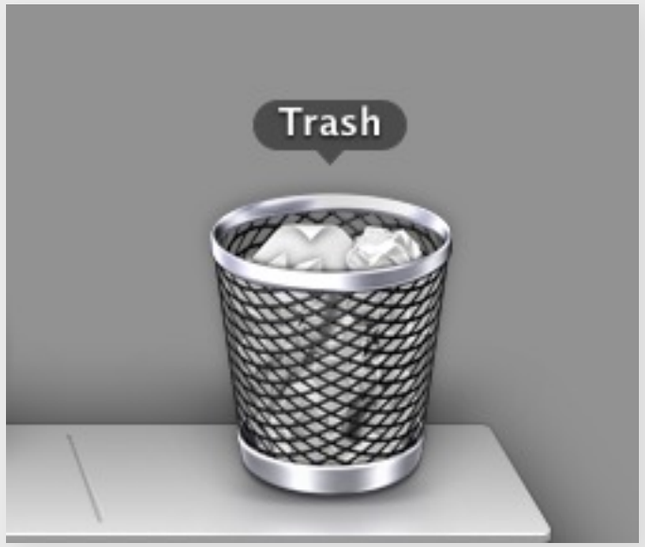
what that dialog should really say

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



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	--

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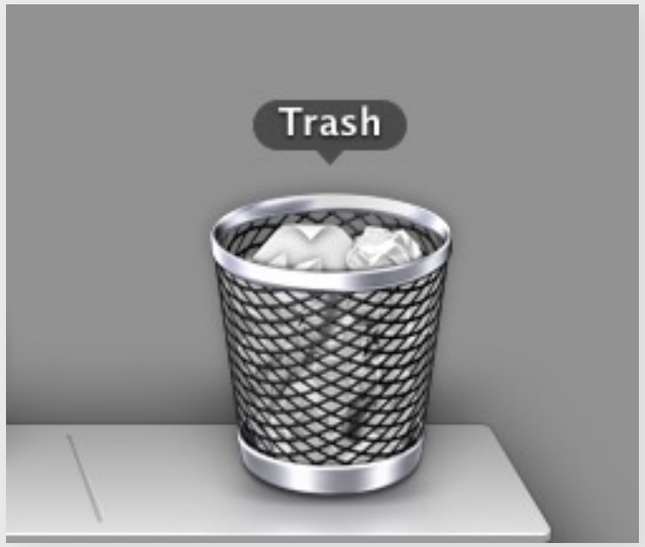

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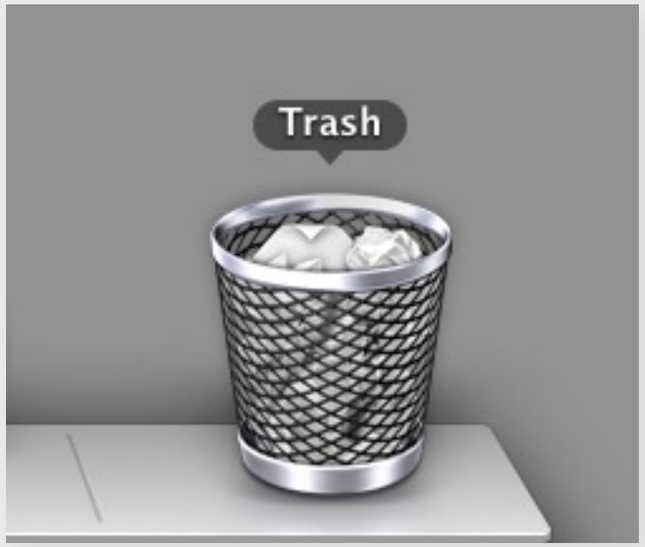
deleting from external drive (eg USB)
can't reuse space until trash emptied

undoing deletion in Mac trash



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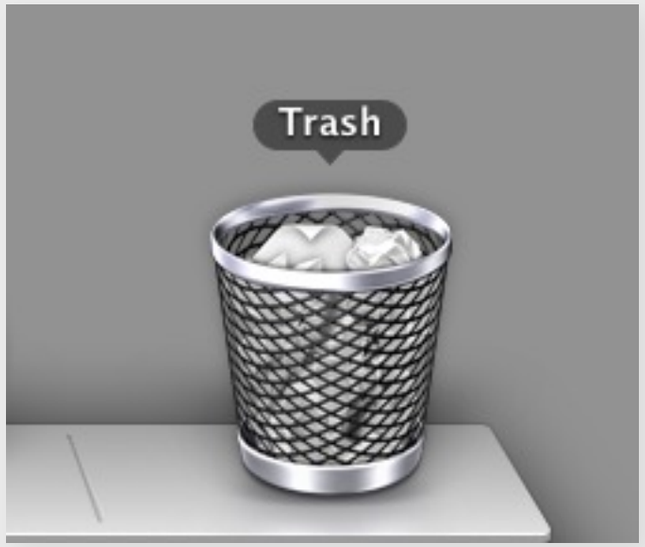
can't reuse space until trash emptied

retrieving accidentally deleted files
no date of deletion

undoing deletion in Mac trash



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deleting from external drive (eg USB)
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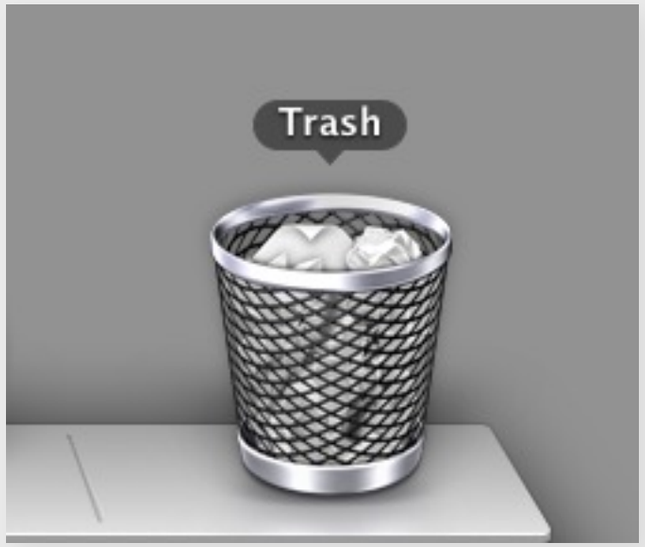
retrieving accidentally deleted files
no date of deletion

partial emptying
not possible

undoing deletion in Mac trash



not complete!

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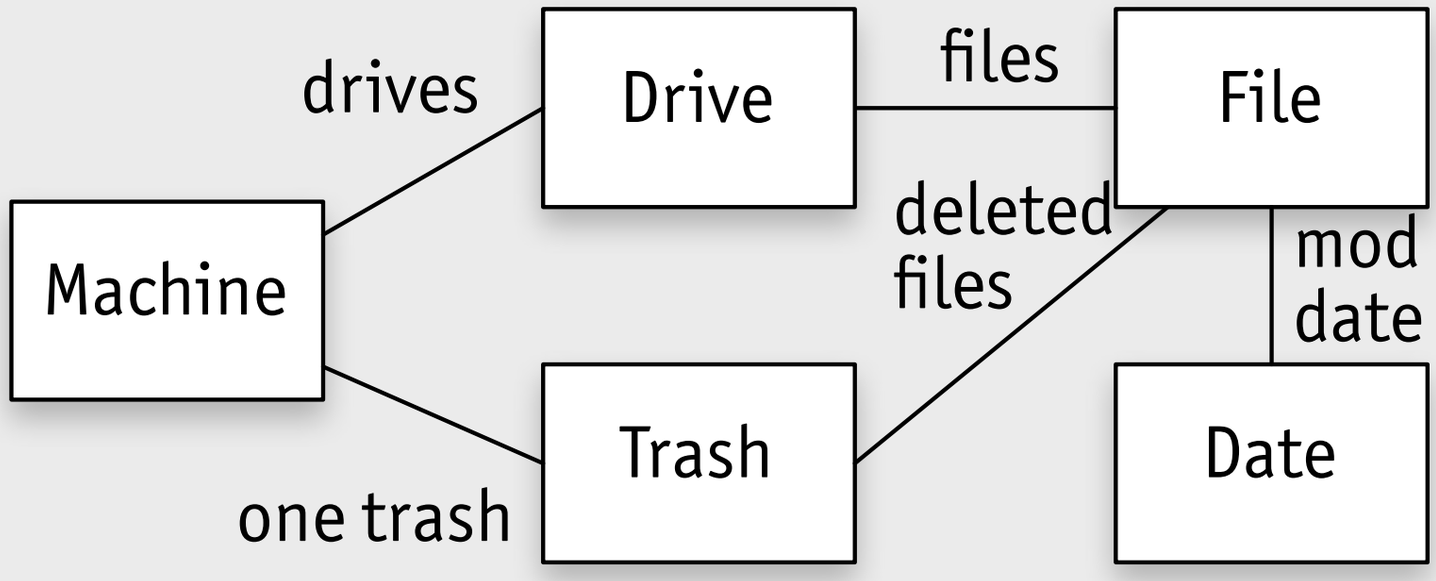
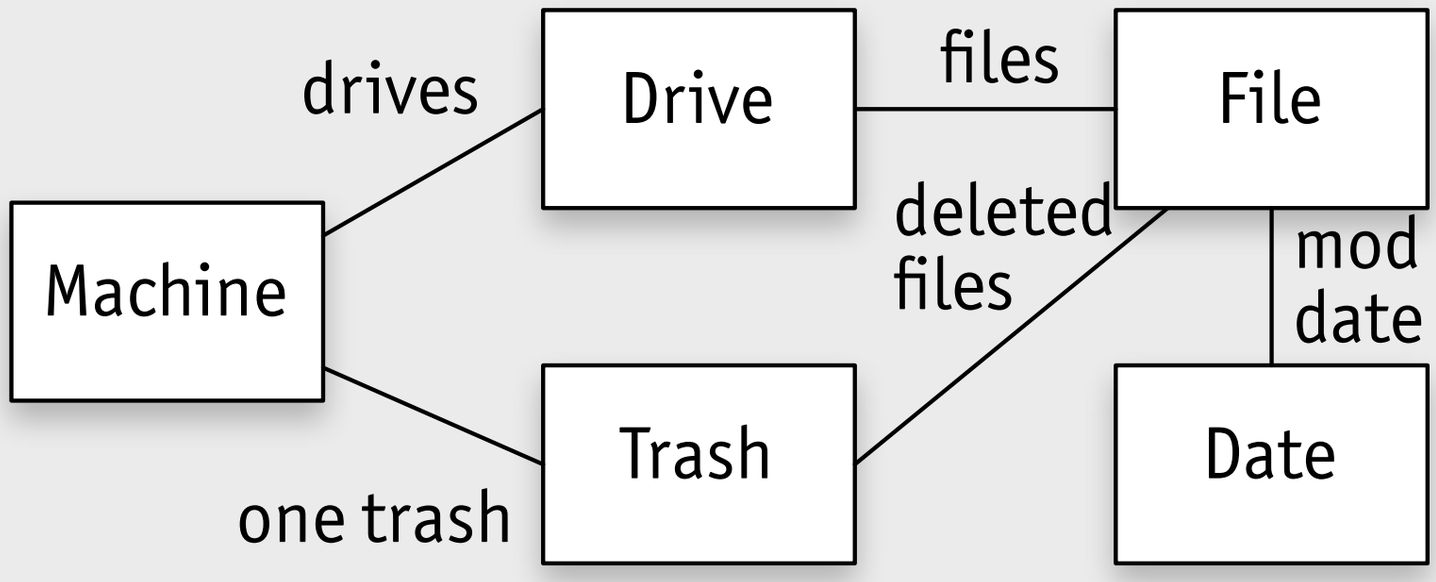

drives
Drive
files
File
Machine
deleted
files
mod
date
Trash
Date
one trash

what exists



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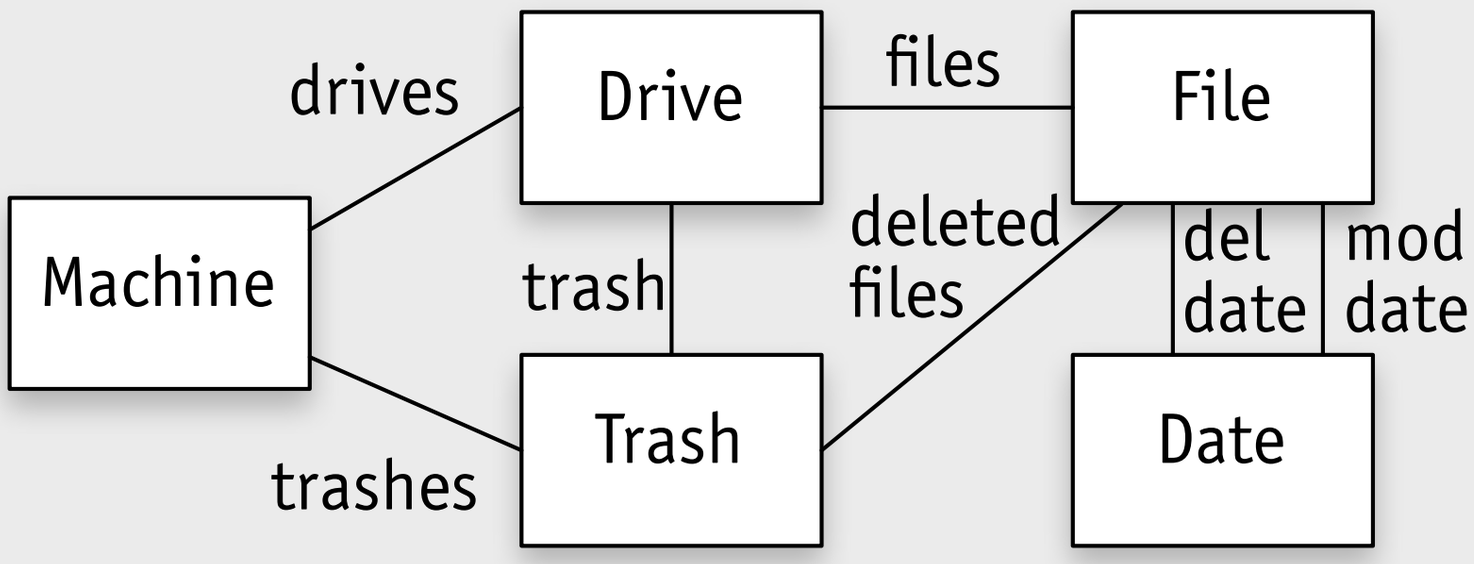
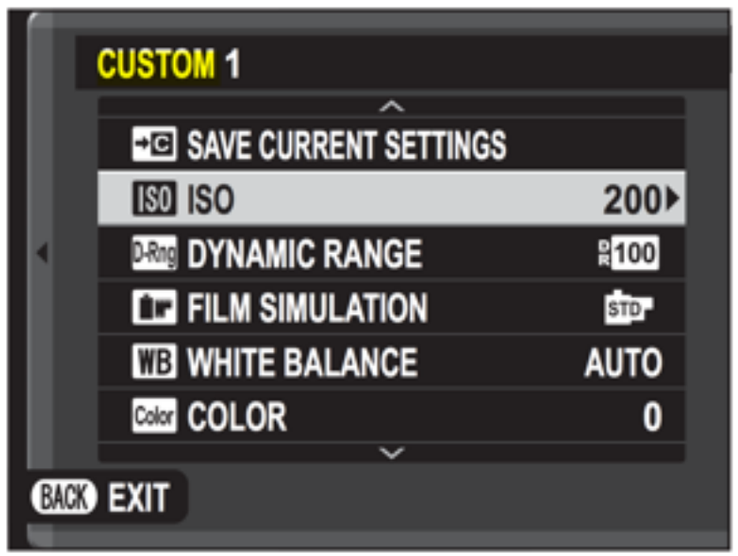


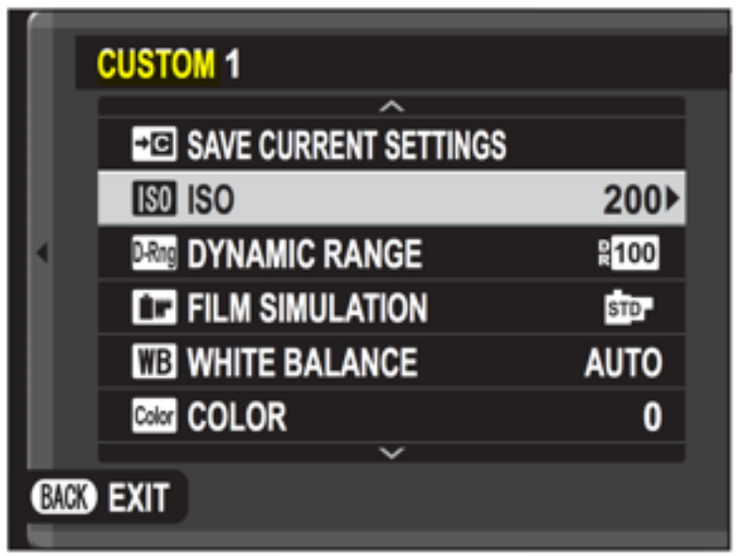
what we need

custom settings in 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**, **WB WHITE BALANCE**, **Color COLOR**, **Sharp SHARPNESS**, **Tone HIGHLIGHT TONE**, **Tone SHADOW TONE**, **NR NOISE REDUCTION**, and **RESET**.

custom settings in fuji x100s



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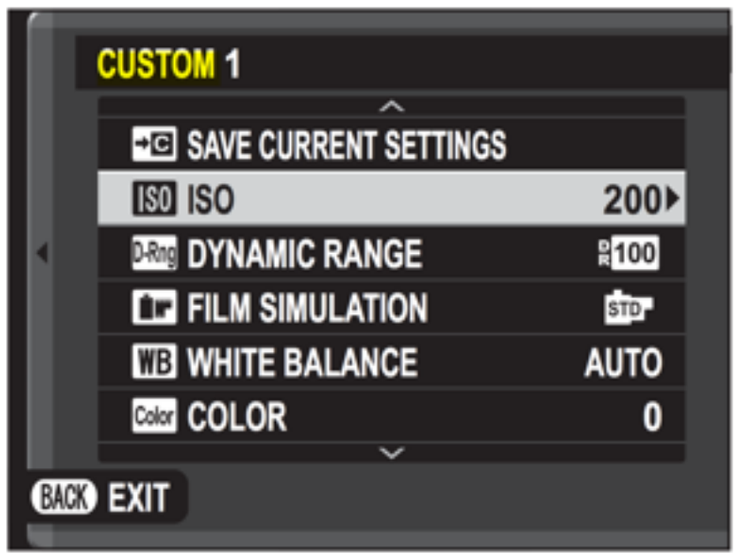
Ken Rockwell review of x100s:

custom settings in fuji x100s



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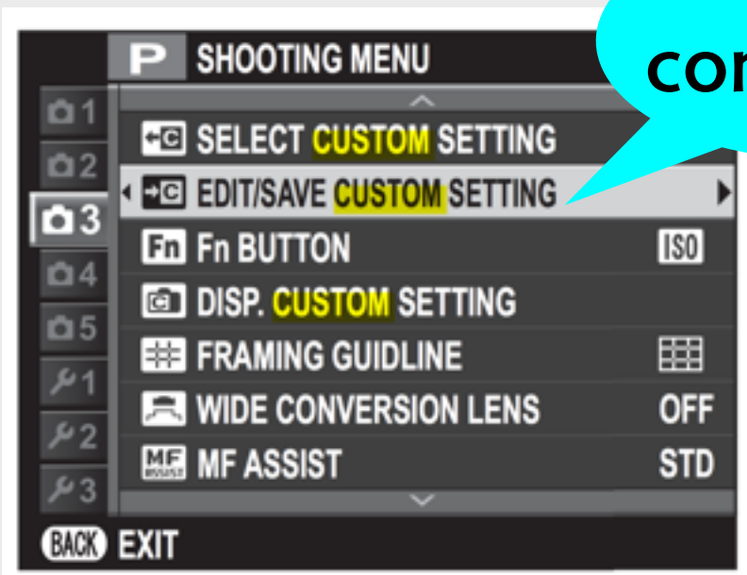
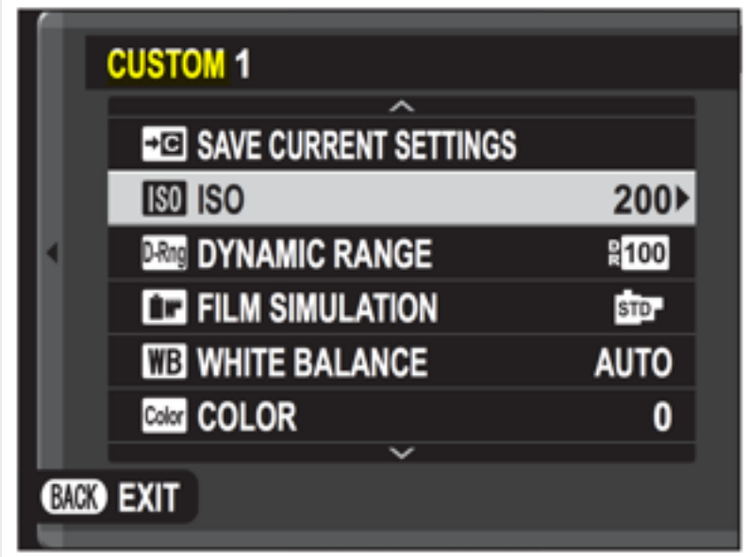
Ken Rockwell review of x100s:

"The X100's Custom Settings memories are useless."

custom settings in fuji x100s

not complete!





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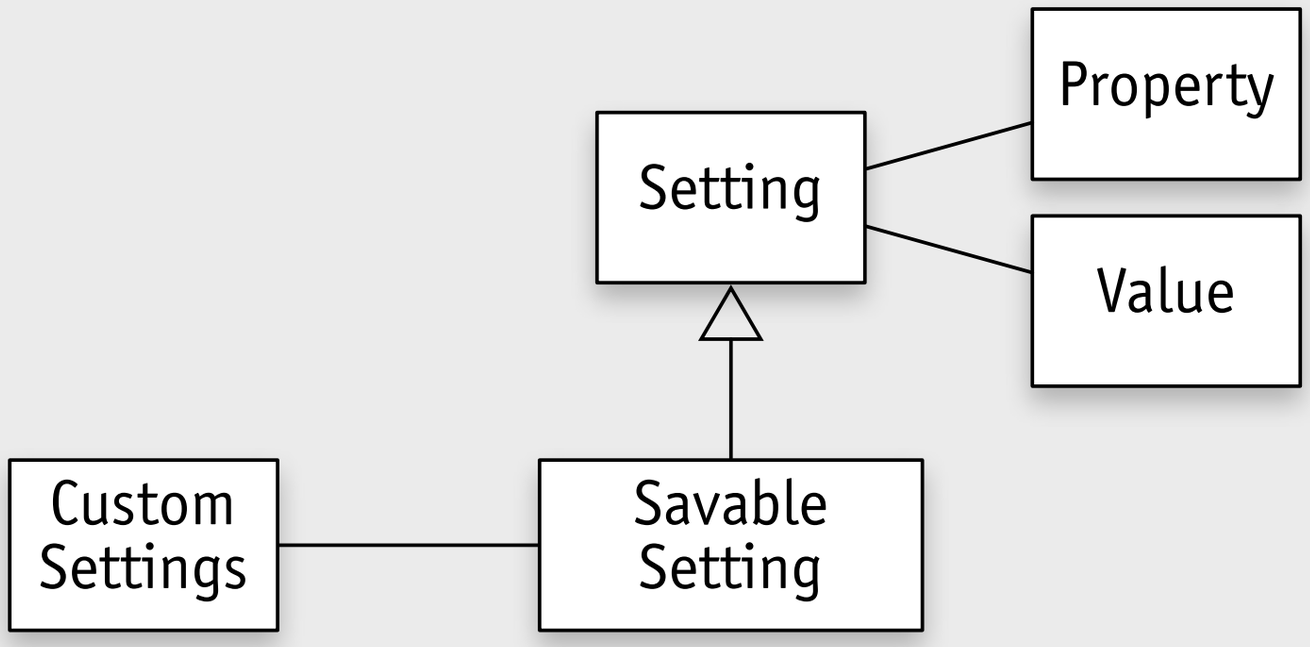
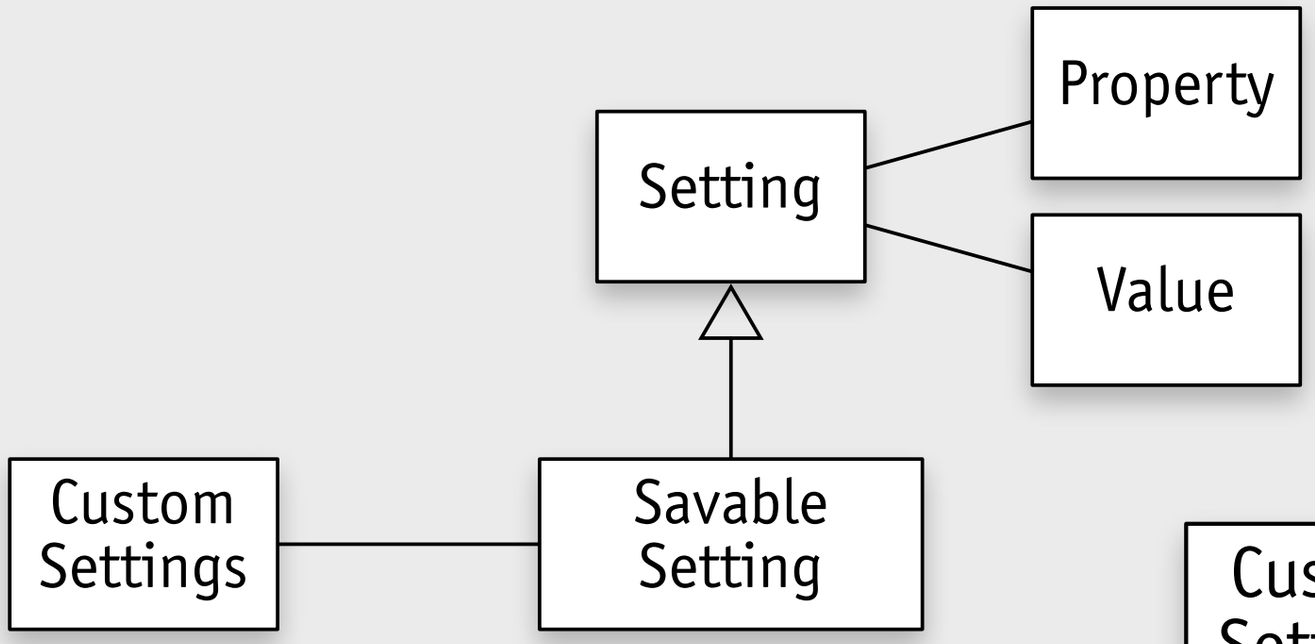
fuji x100s concept map



custom settings: drawn from a subset of “savable settings”

fuji x100s concept map



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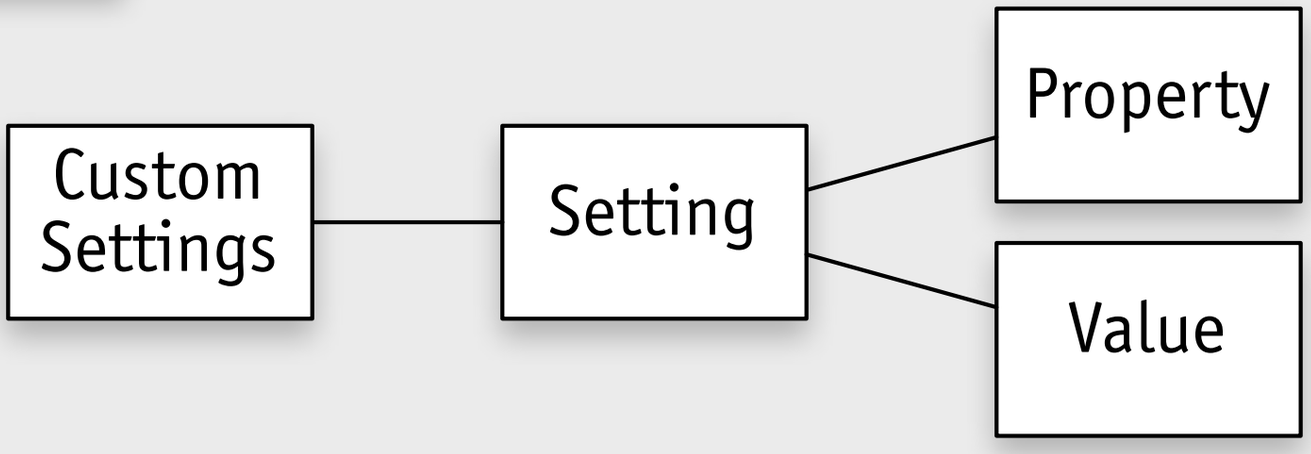
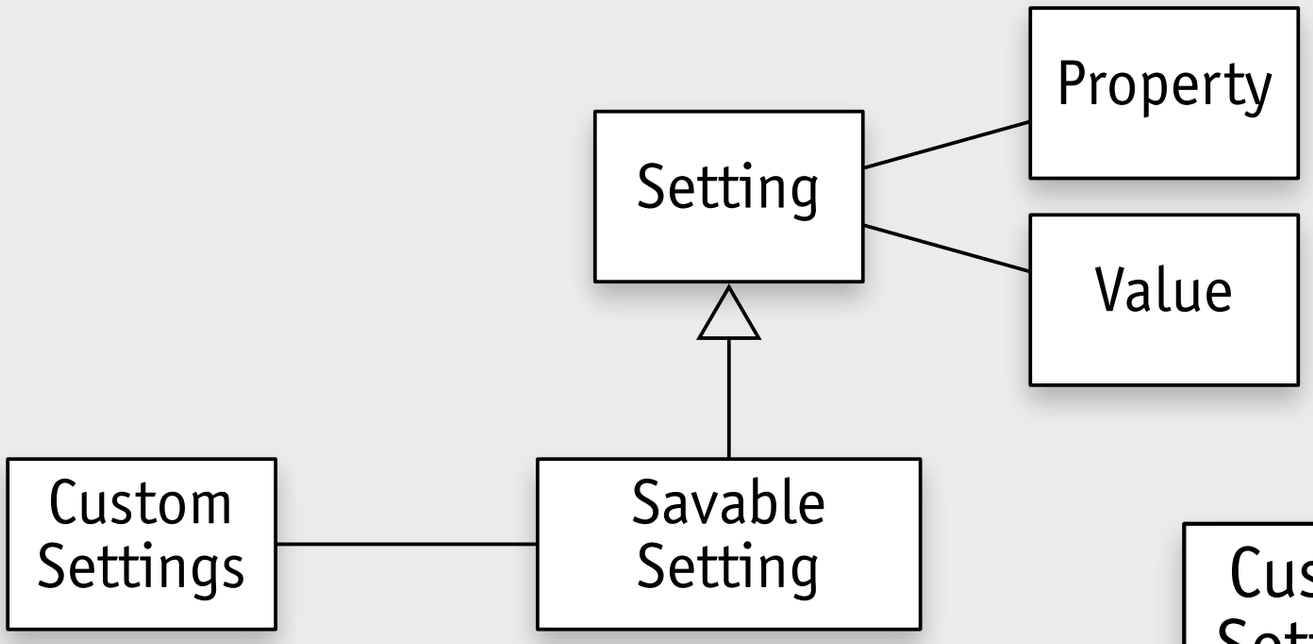
better: can use all settings



fuji x100s concept map



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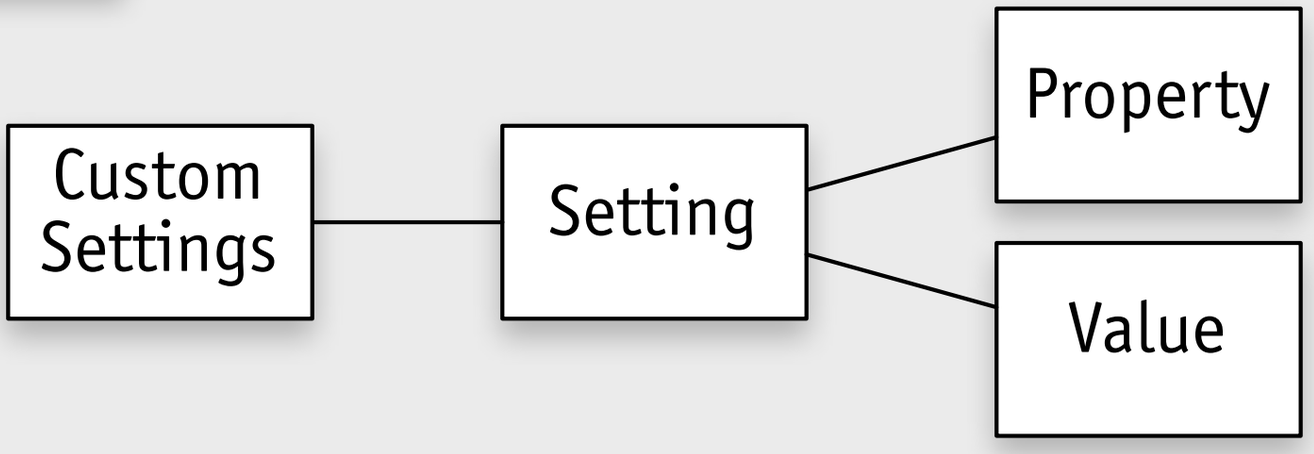
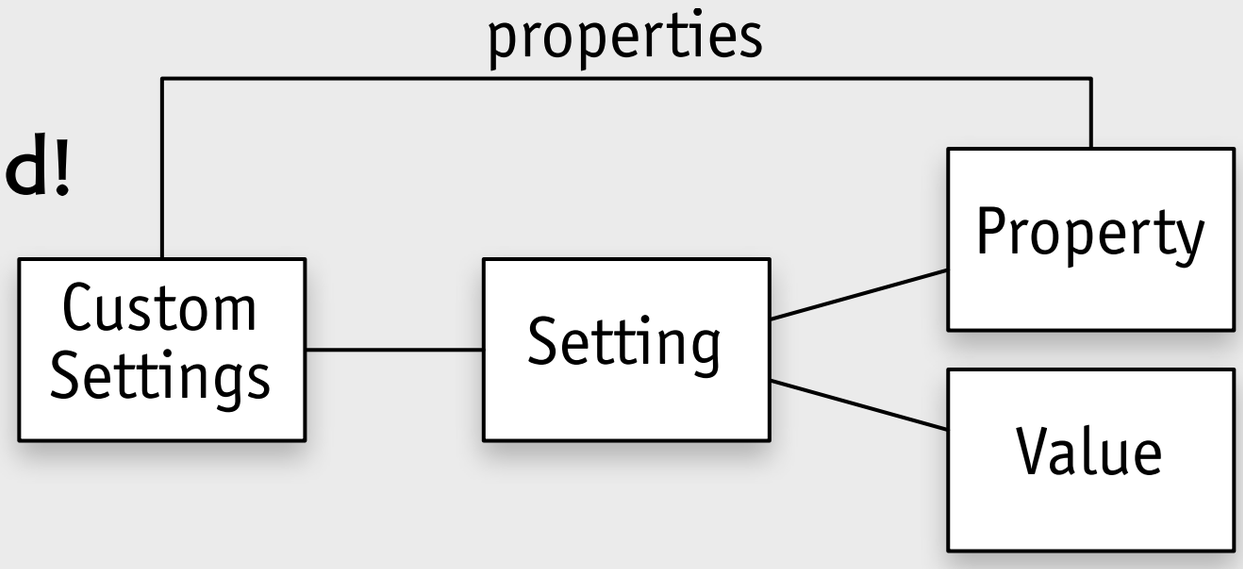


best: choose which properties are included!



the broken

two sides of the interface

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

two sides of the interface

interface

Lightroom architecture diagram from
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two sides of the interface

interface

user's model

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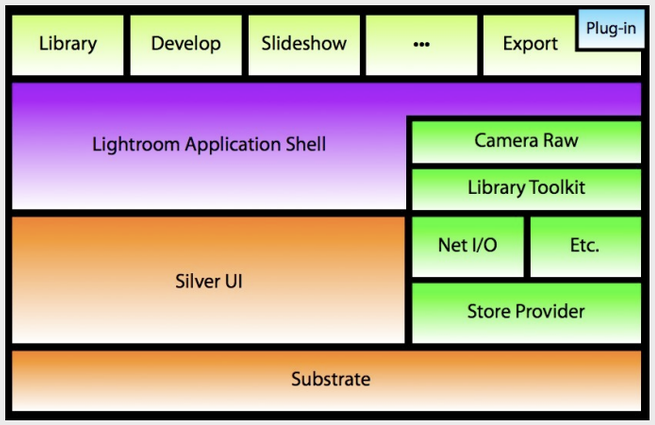

code

interface

user's model

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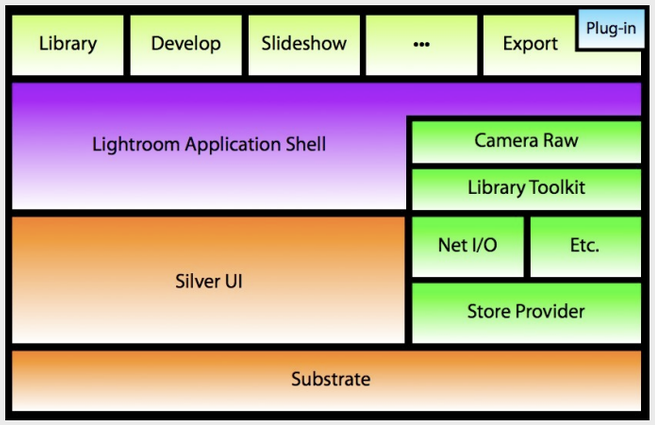

code

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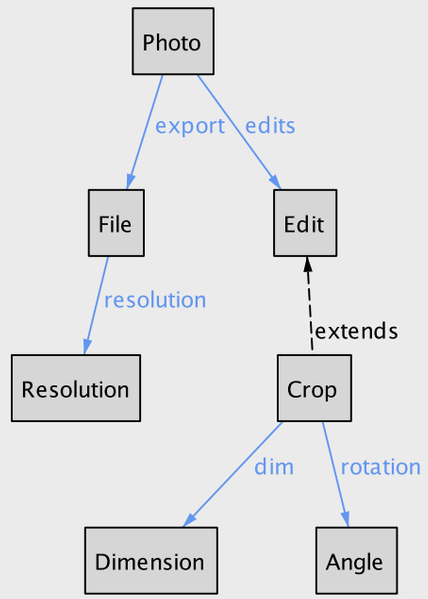

conceptual model

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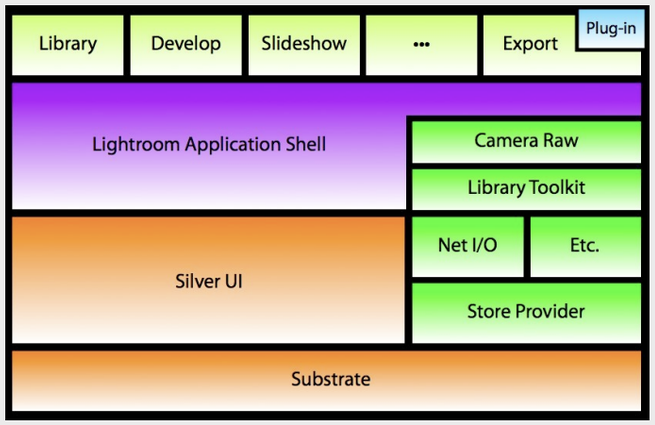

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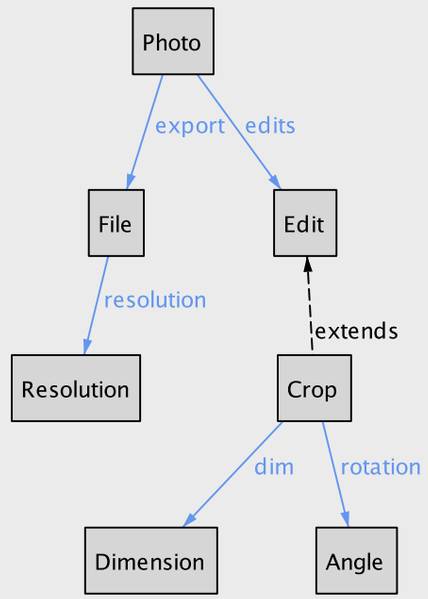

conceptual model

bad conceptual model: *user* is confused

Lightroom architecture diagram from
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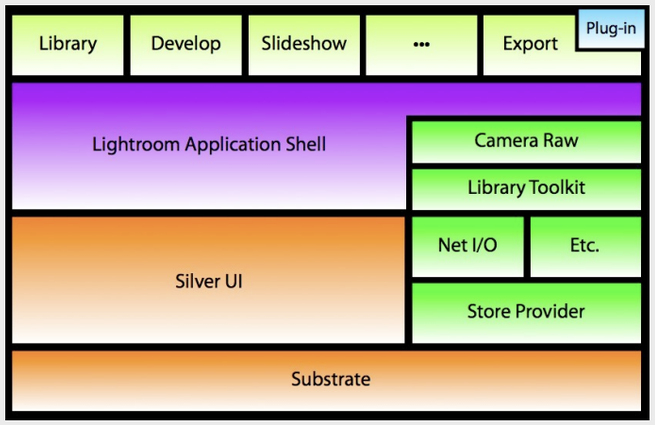

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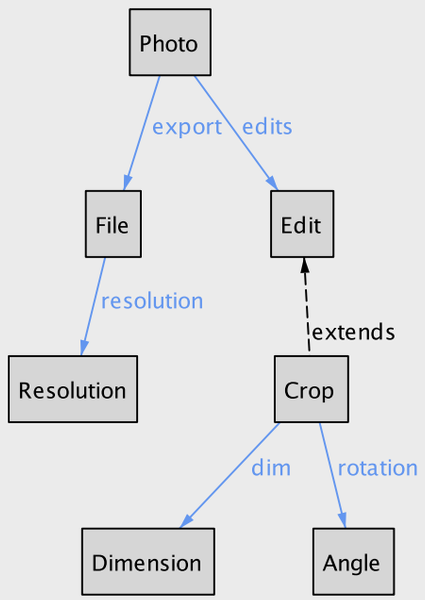
user's model

bad conceptual model: *developer* is confused



conceptual model

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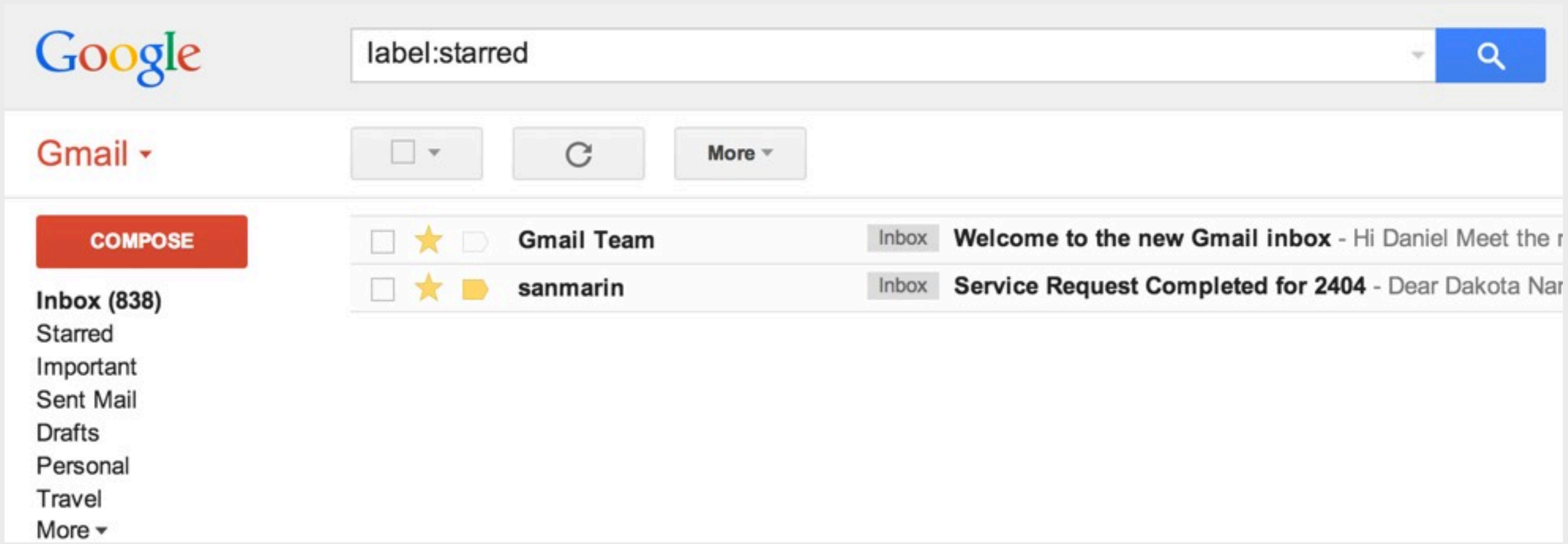
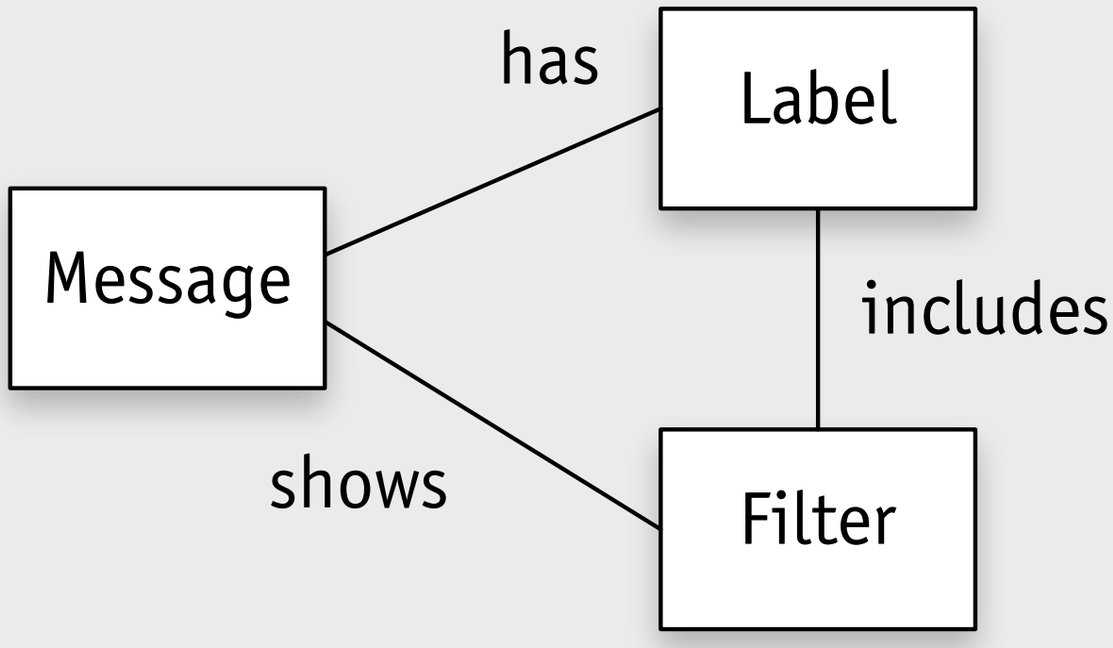
gmail labels & filters

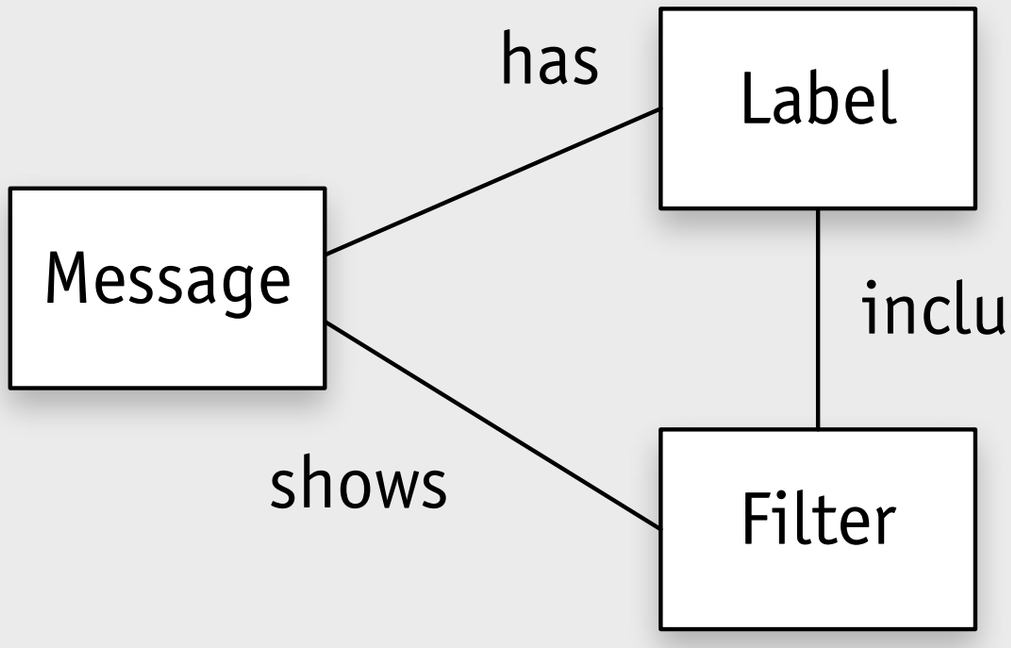


gmail concept map



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

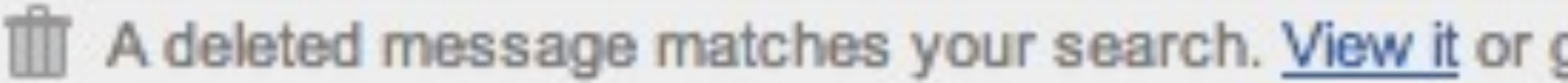
gmail concept map



show deleted messages? no.

what if you *search* for deleted messages?

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



generally won't show trashed messages

A deleted message matches your search. View it or g

generally won't show trashed messages

in:trash

More

Empty Trash now (messages that have been in Trash more than 30 days will b

Abbie — Bedrock Freight Brokerage, LLC is Interested in You - Now Hiring: Co

Amazing Ipad Keyboard — Easily Type on Your iPad Quickly and Accurately! - Typing On Your i

sanmarin — Service Request Completed for 2404 - Dear Dakota Nannette Jackso

label:work label:trash

More

Your Job Recommendations Trash Work Receptionist, FT Sr. Assistant Manager, and more! -

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

A deleted message matches your search. View it or g

generally won't show trashed messages

label:work

More

hmm...

There are r

label:work label:trash

More

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

A deleted message matches your search. View it or g

generally won't show trashed messages

label:work

More

not coherent!
conceptual confusion
leads to bugs

hmm...

There are r

label:work label:trash

More

Your Job Recommendations Trash Work Receptionist, FT Sr. Assistant Manager, and more! -

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

lessons

how to make better software

how to make better software

early in design
what are the concepts?
how are they connected?

how to make better software

early in design
what are the concepts?
how are they connected?

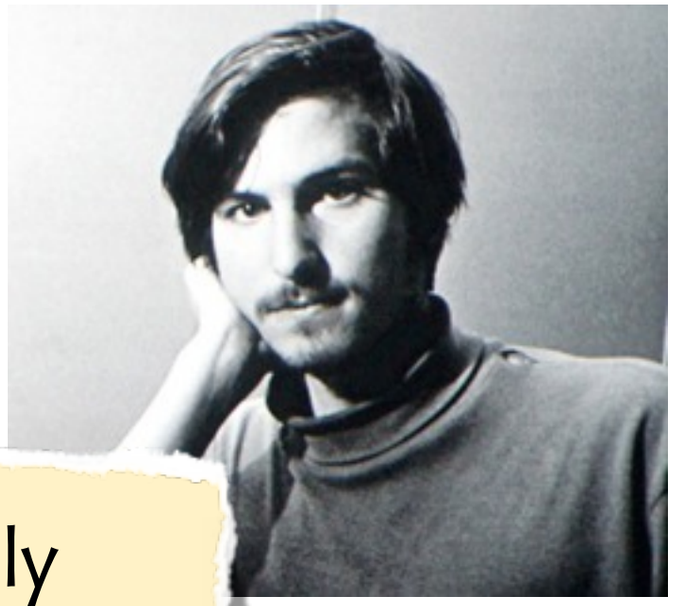
evaluation of concepts
simple, coherent, usable, complete?

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.