

design by concept

Daniel Jackson · CSAIL, MIT

9th Summer School on Formal Techniques · Menlo College, CA · May 19-24, 2019

lecture

one

how this
project started

a simple task: sign and return

Field Trip Permission Form

Dear Parents:

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

Thank you!

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

Count Olaf

November 7, 2008

Parents signature

Date

acrobat to the rescue?

The image shows a screenshot of the Adobe Acrobat application interface. The main window displays a document with the following text:

Ms. Frizzle will again be taking her exciting field trip. Please sign and return the permission slip below.

Thank you!

The **Tools** menu is open, showing the following options:

- Comment & Markup
- Select & Zoom
- Advanced Editing** (highlighted)
- Typewriter
- Analysis
- Multimedia
- Customize Toolbars...

The **Advanced Editing** submenu is also open, showing the following options:

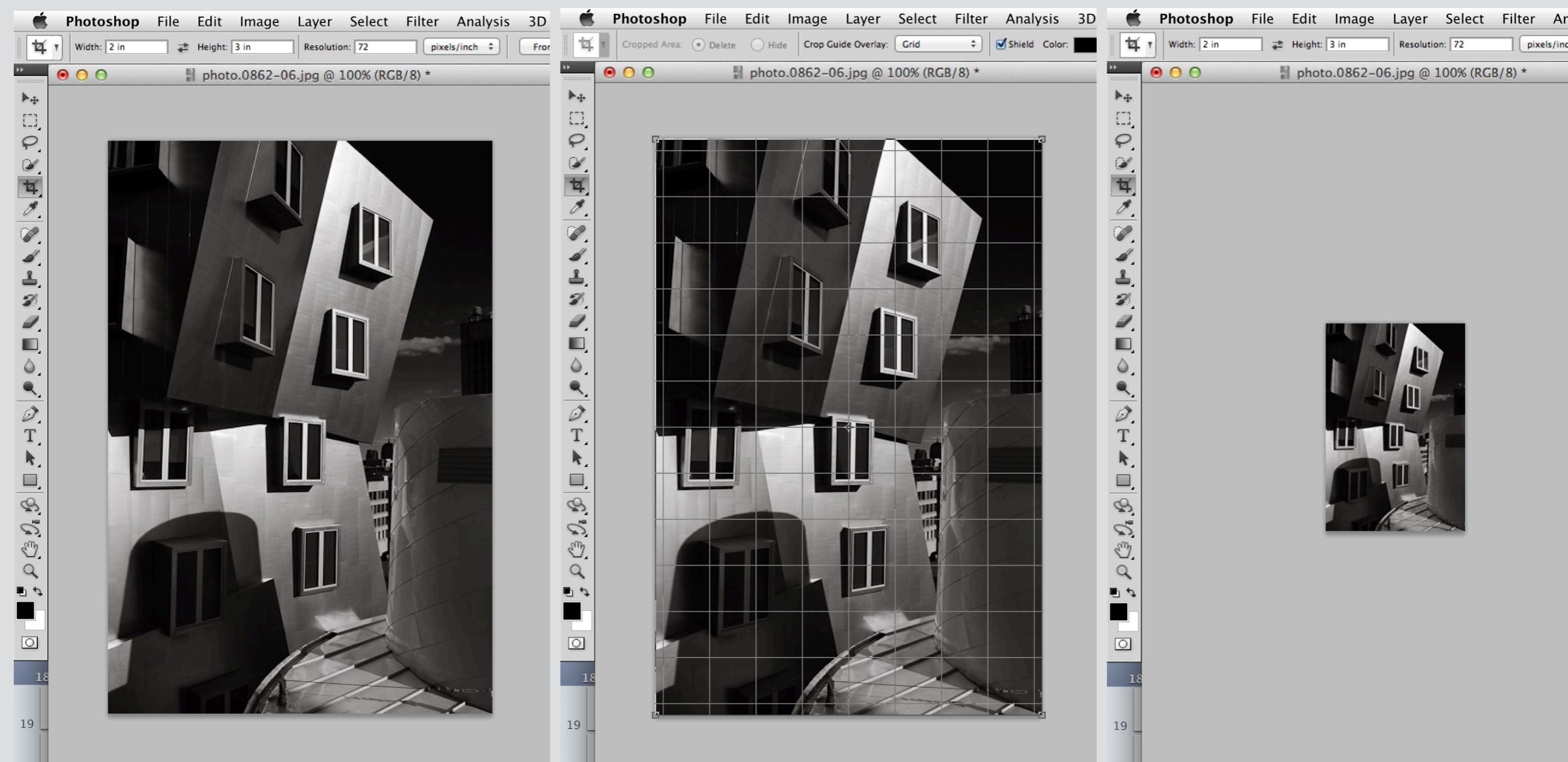
- Select Object Tool
- Button
- Article Tool
- Crop Tool
- Link Tool
- TouchUp Text Tool
- TouchUp Reading Order Tool
- TouchUp Object Tool** (checked)

In the foreground, a text editor window titled "acrobat-sig-paste.txt" is open. It shows the following text:

Last Saved: 8/27/09 5:20:28 PM
File Path : ~/Filestore/Advice/computers/acrobat-sig-paste.txt

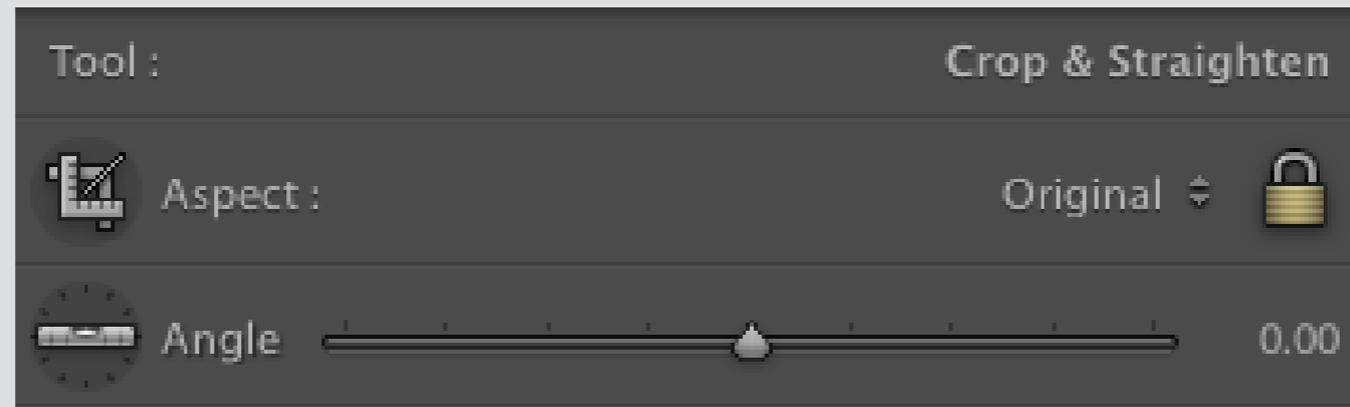
1	how to add a signature in acrobat
2	-- open document in acrobat
3	-- Tools-->Advanced Editing-->Touchup Object Tool
4	-- right click at desired point Place Image...
5	then select jpg
6	
7	how to add date
8	-- Tools-->Typewriter
9	

adobe photoshop: cropping surprises



any idea what's going on here?

adobe lightroom: easy cropping



i'm not alone



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



207 Positive Opinions out of 444



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

70% Love Photoshop



Tweet 87



30,305 Positive Opinions out of 43,283



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



2,335 Positive Opinions out of 2,632



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

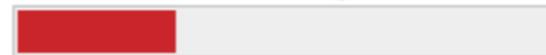


237 Negative Opinions out of 444



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

30% Hate Photoshop



Tweet 105

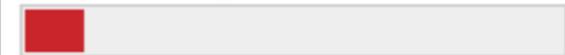


12,978 Negative Opinions out of 43,283



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

11% Hate Lightroom



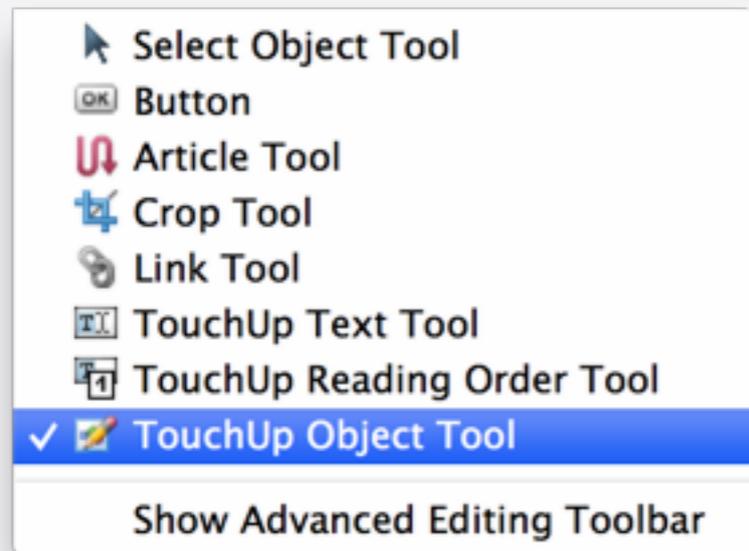
Tweet 5



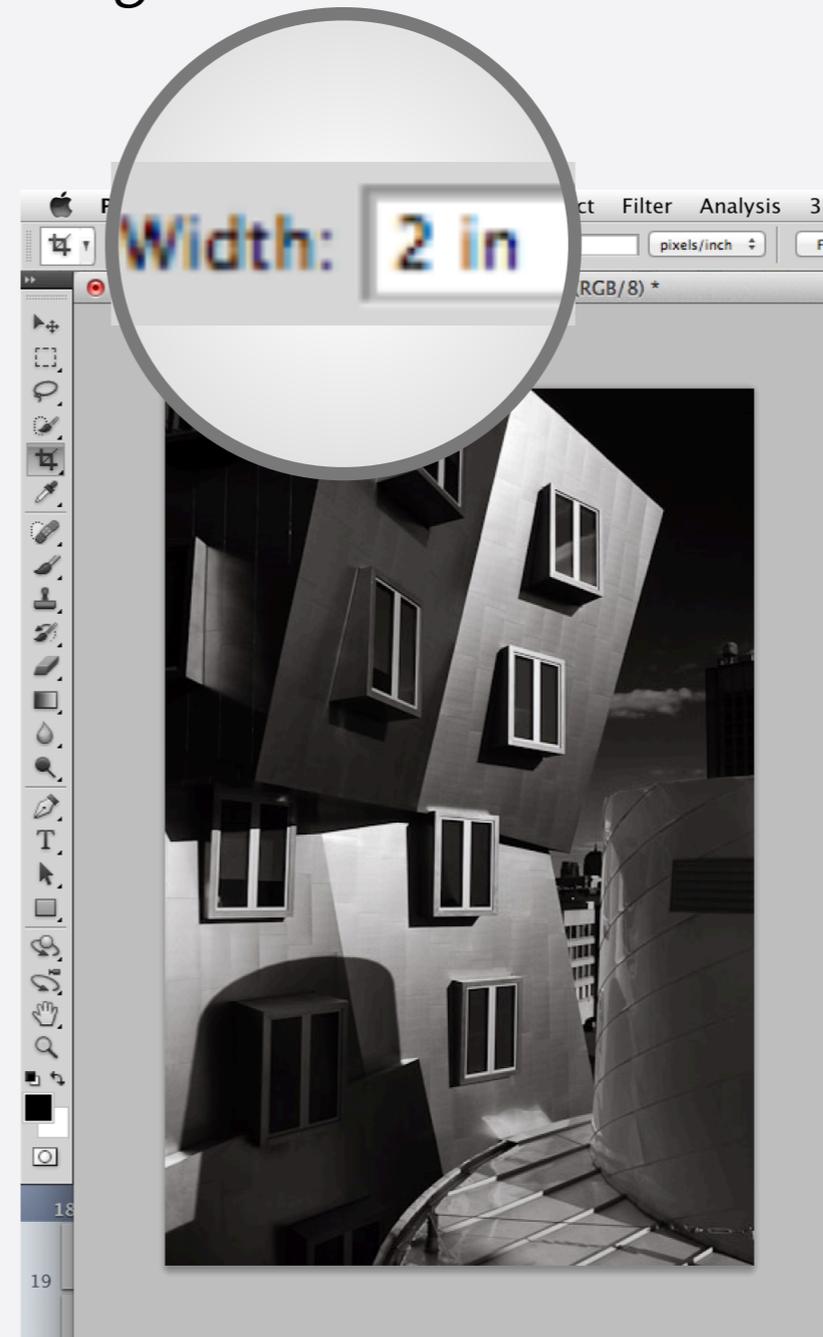
297 Negative Opinions out of 2,632

what's the essence of the problem?

not the user interface!
polished and organized



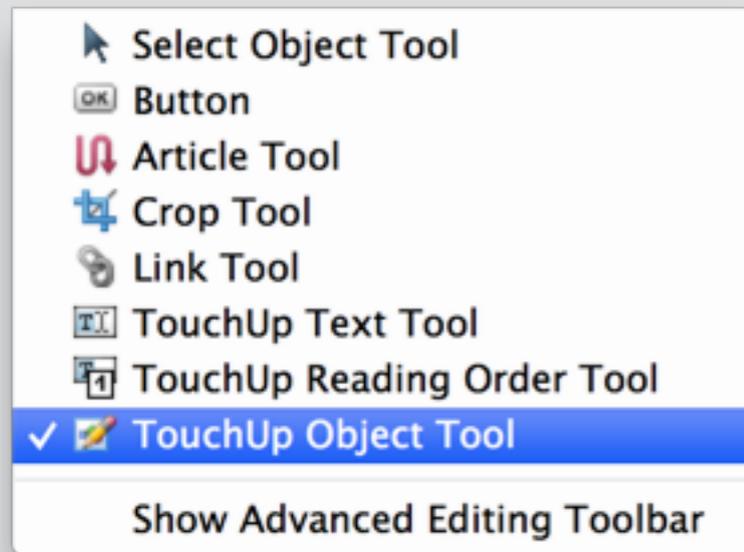
task-oriented design
no unifying concepts



complex concepts
cropping vs. resizing

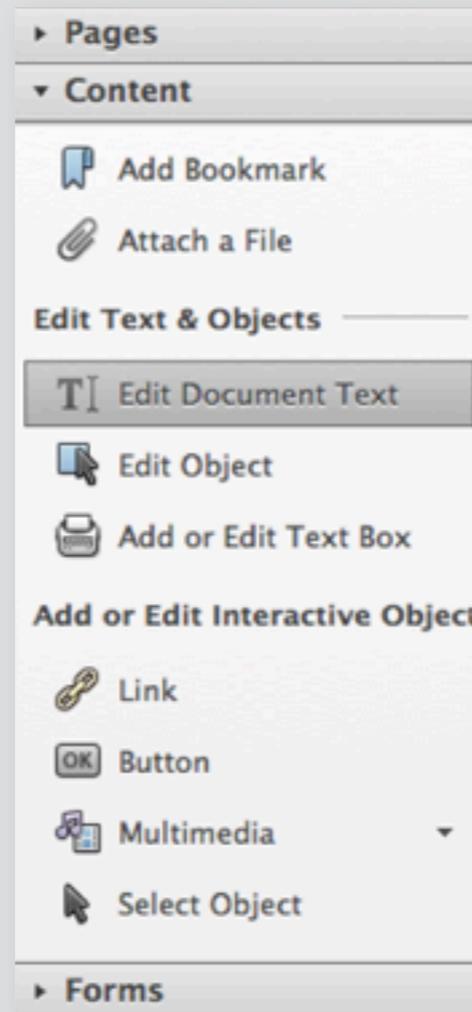
adobe fixes acrobat

Version 9 (2008)



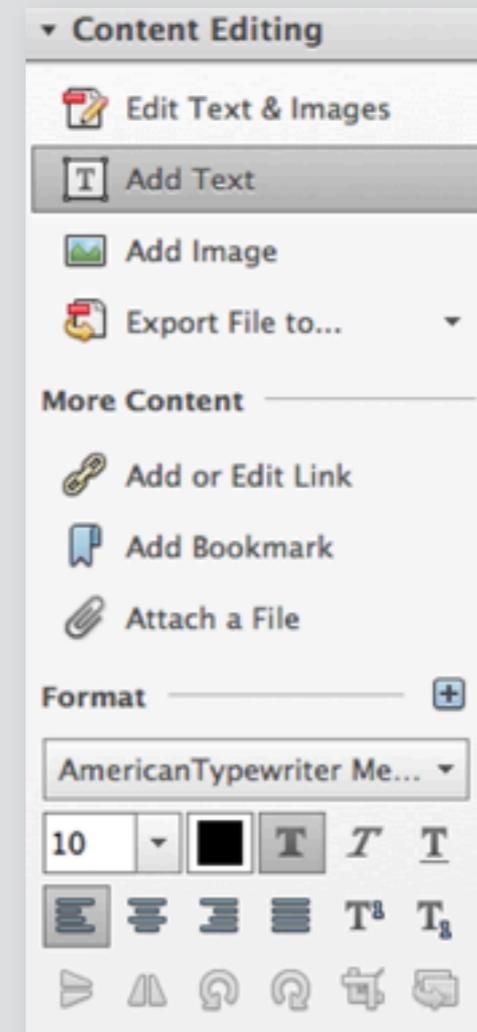
task-oriented design
no unifying concepts

Version 10 (2010)



improved interface
but still no concepts

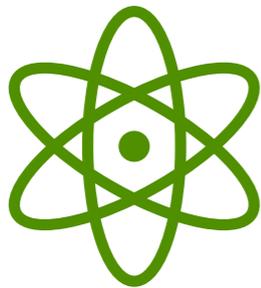
Version 11 (2012)



unifying concepts
text/image object

a research & teaching program

designing software with concepts



a design theory

*concept structure
& design rules
[Onward 15]*



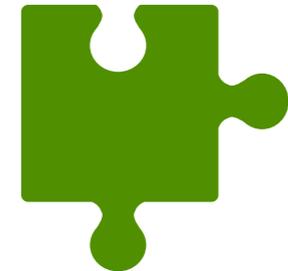
design case studies

*Gitless
[Perez De Rosso,
Onward 13,
OOPSLA 16]*



design patterns

about 30 so far



code platform

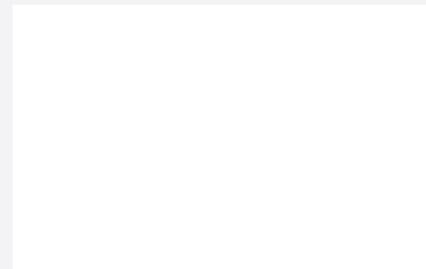
*Deja Vu
[Perez De Rosso]*

how bugs
led us astray

the software problem

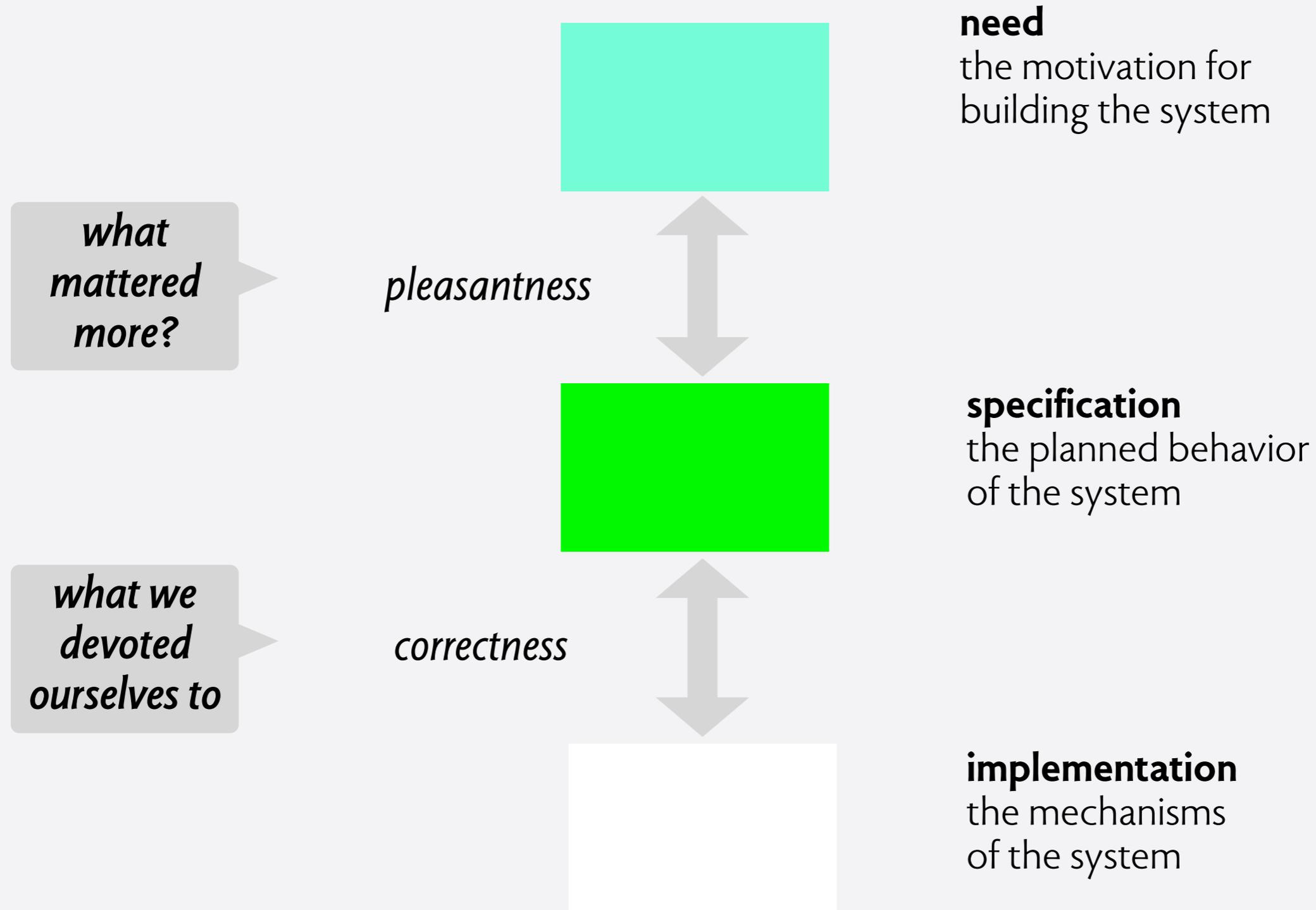


need
the motivation for
building the system



implementation
the mechanisms
of the system

separating concerns



correct \Rightarrow useful ?

Primary Social Promotions +

☆ me, Alyssa (12) hacking meetups javascript - Hello again Be 11:48 am

label:hacking

☆ me, Alyssa (12) Inbox meetups javascript - Hello again Ben 9:43 am

label:meetups

☆ me, Alyssa (12) Inbox hacking javascript - Hello again Ben. 9:58 am

label:hacking label:meetups

☆ me, Alyssa (12) No messages match your search criteria. Try changing your search criteria, such as sender, date, size and more.

any gmail users who can explain?

correct \Rightarrow safe ?

airborne $\Leftrightarrow \neg$ WheelPulse

environment

\wedge

\neg WheelPulse \Leftrightarrow disabled

specification

$\Rightarrow?$

airborne \Leftrightarrow disabled

requirement



correct \Rightarrow secure ?

From: "TIG" <help@MIT.EDU>
Date: October 13, 2008 11:04:08 AM EDT
To: "'Daniel Jackson'" <dnj@csail.mit.edu>
Subject: your password

We recently ran a password checker to evaluate passwords of all CSAIL users, and your password was readily broken. Please choose a new password ASAP...

my password:

sergeantpepper1967

8 char limit: passwd utility silently truncated rest

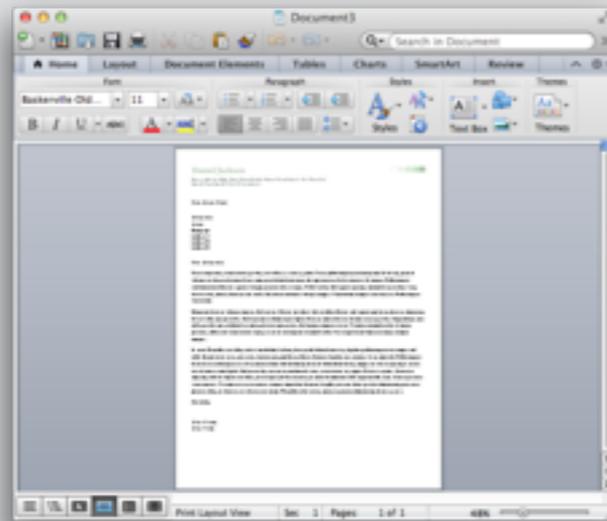
Aydal [2009]

*Analyzed Tokener for security
Found 9 anomalous scenarios
eg, new configuration file silently
ignored if one exists on disk*

what's a
concept?

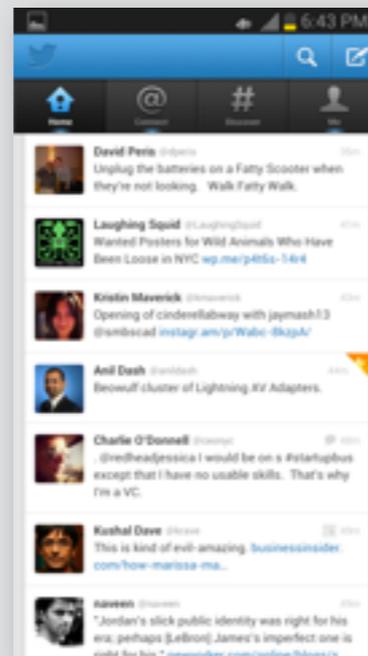
apps characterized by their concepts

Microsoft Word



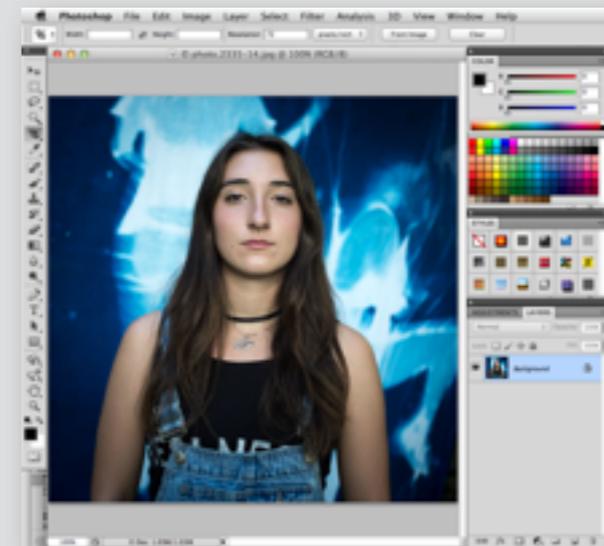
Paragraph
Format
Style

Twitter



Tweet
Hashtag
Following

Photoshop



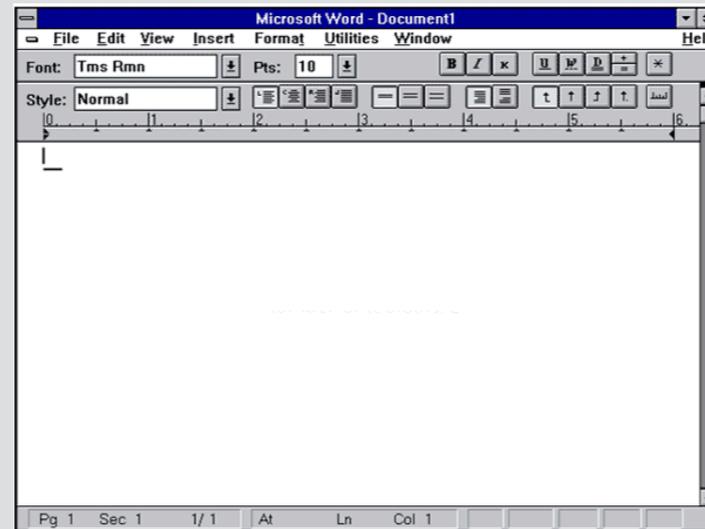
PixelMap
Layer/Mask
Adjustment

what's the difference between a text editor and a word processor?

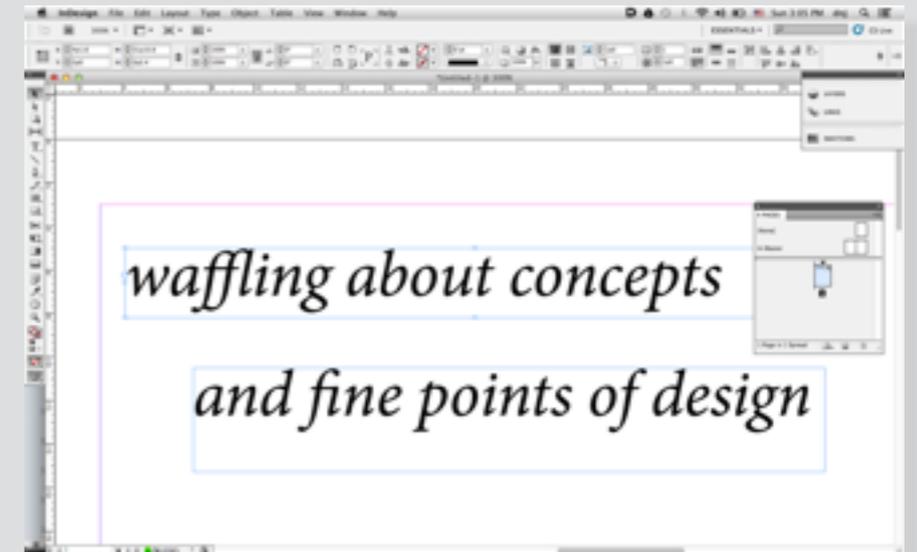
app classes characterized by concepts too



text editor
line buffer



word processor
paragraph
format
style



desktop publishing app
stylesheet
text flow
page template

jamonh
Oct 22, 2013 7:19 PM

Just upgraded to the new Pages and can't find a way to link text boxes anymore like <http://www.macobserver.com/tmo/article/pages-linking-text-boxes>

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

the conventional view

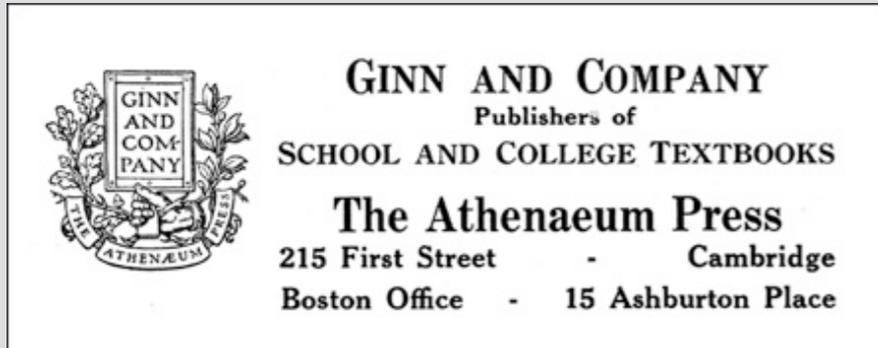
Conceptual model (computer science)

From Wikipedia, the free encyclopedia

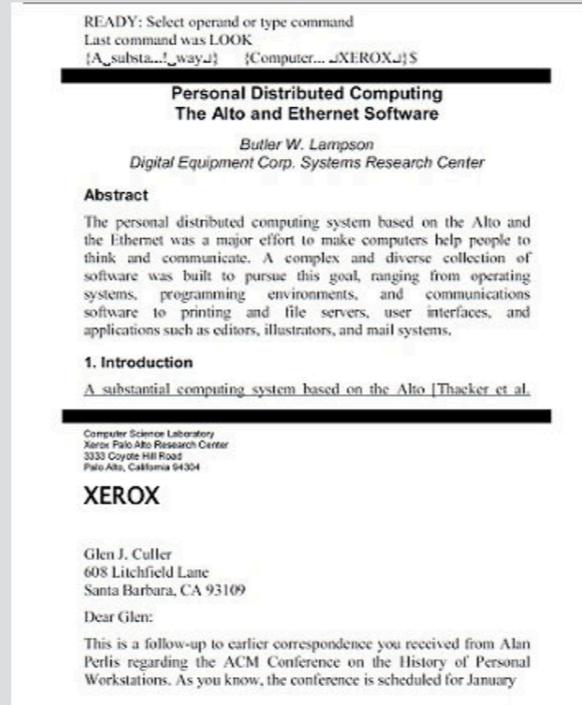
A [mental model](#) captures ideas in a [problem domain](#), while a **conceptual model** represents 'concepts' (entities) and relationships between them.

A conceptual model in the field of [computer science](#) is a special case of a general [conceptual model](#). To distinguish from other types of models, it is also known as a [domain model](#). Conceptual modeling should not be confused with other modeling disciplines such as [data modelling](#), [logical modelling](#) and

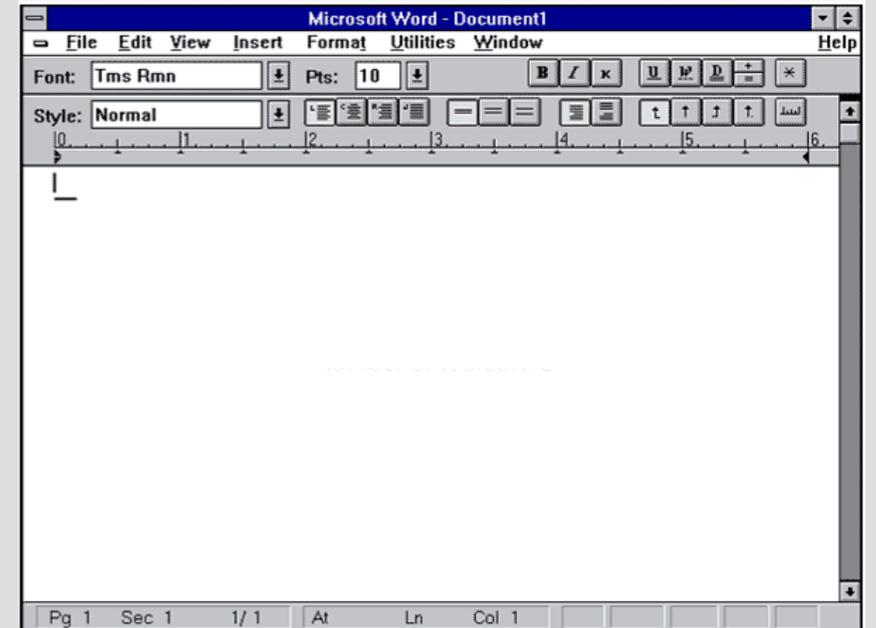
concepts are invented, not just out there



Tim Mott visits Ginn in 1974
brings idea of styles to PARC



Charles Simonyi's team
implements style in
Bravo text editor



Simonyi brings style
to Microsoft in 1983

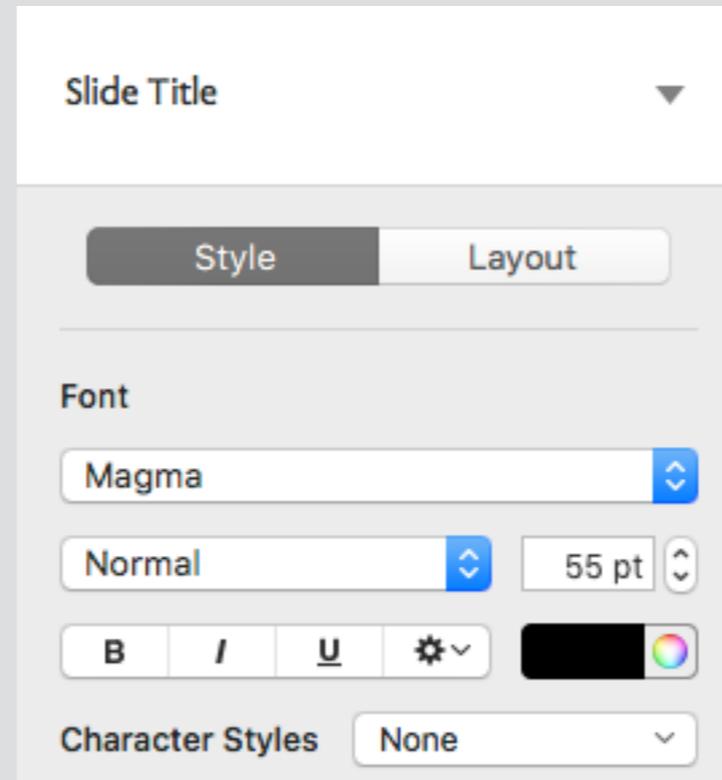
the rewards of inventing a good concept



who is this and what is he doing?

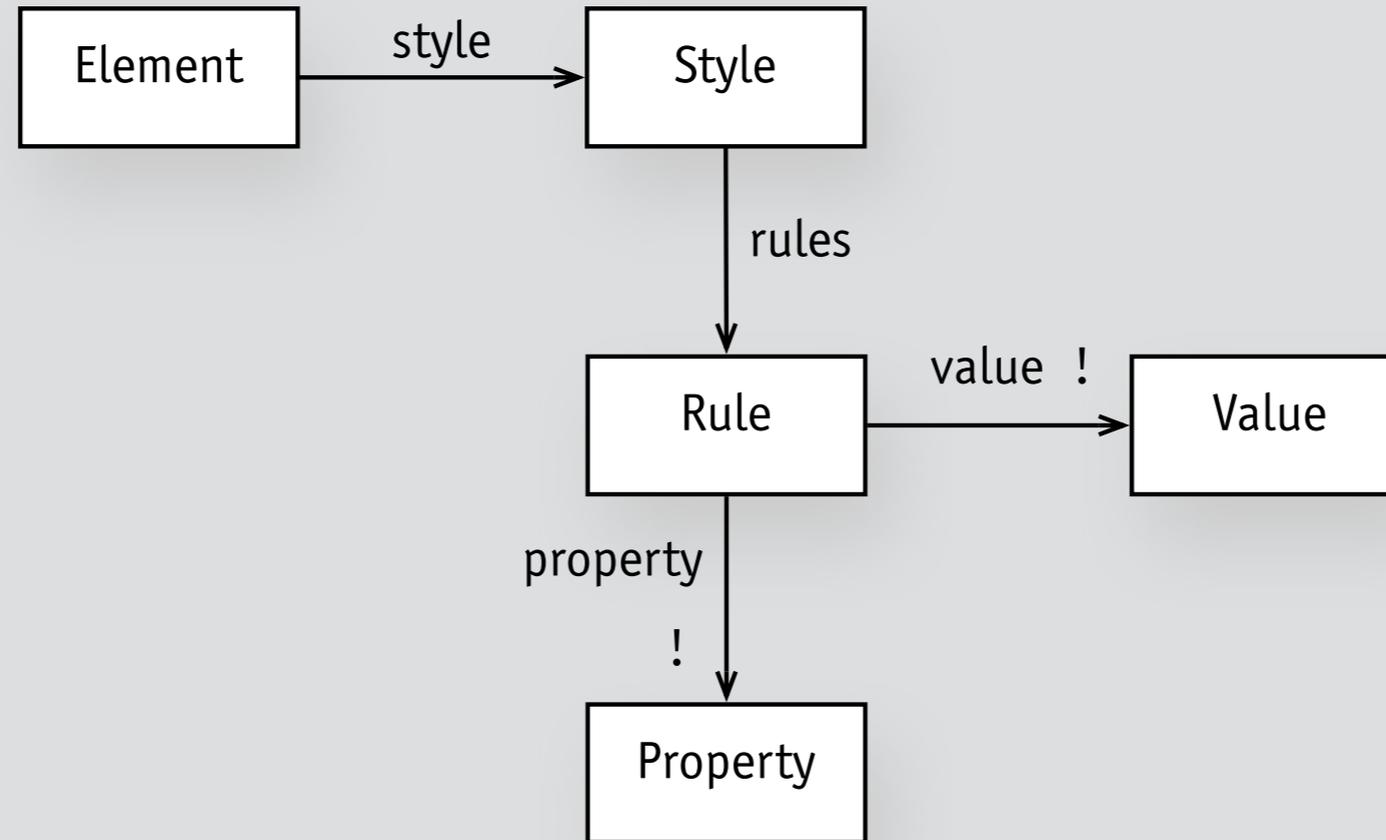
concepts have purpose

purpose of **style**: enable consistent formatting



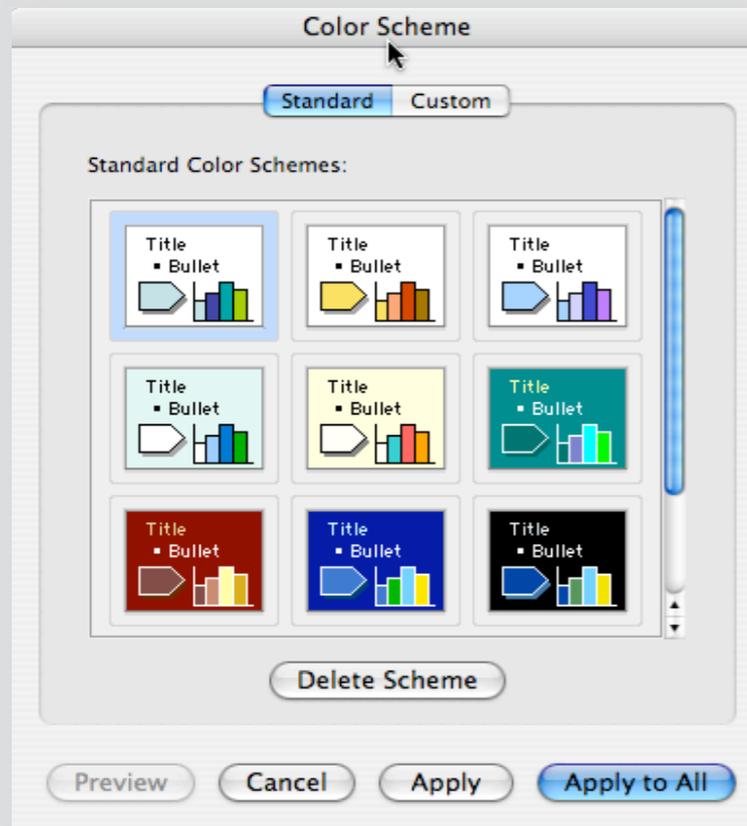
Apple Keynote
adds style concept
(2017?)

concept structure is designed not discovered

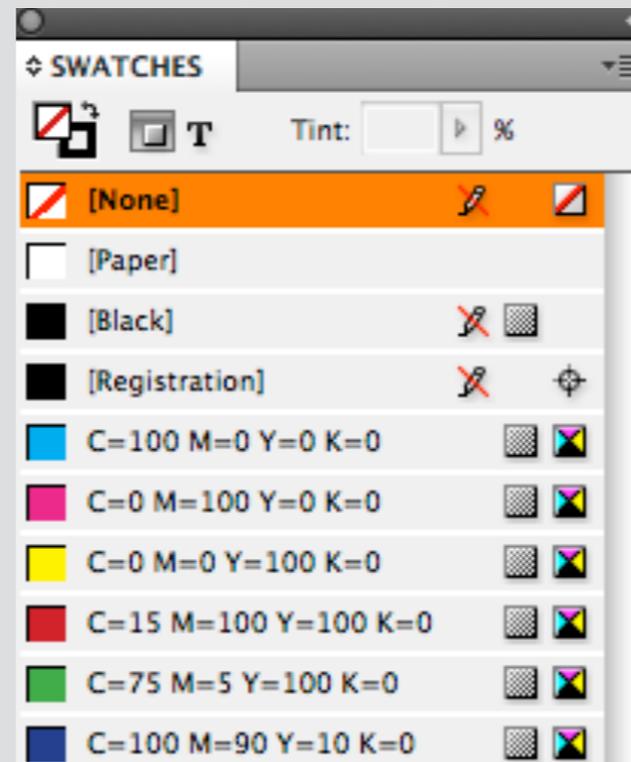


There is no problem
in computer science
that cannot be solved
by introducing another
level of indirection.
David Wheeler

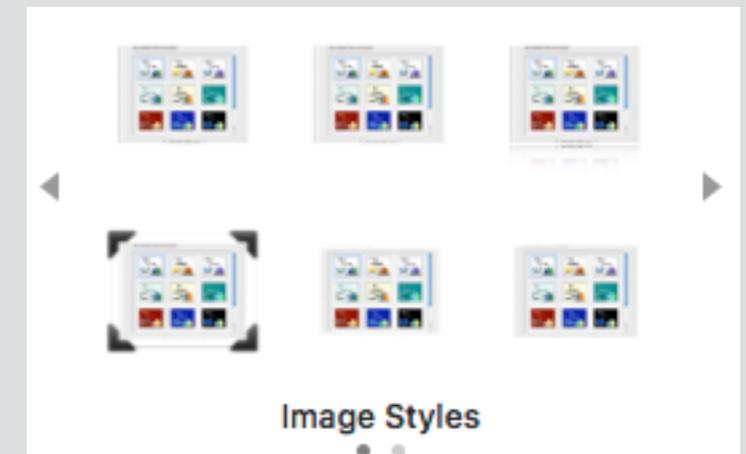
concepts are reusable



Powerpoint color schemes

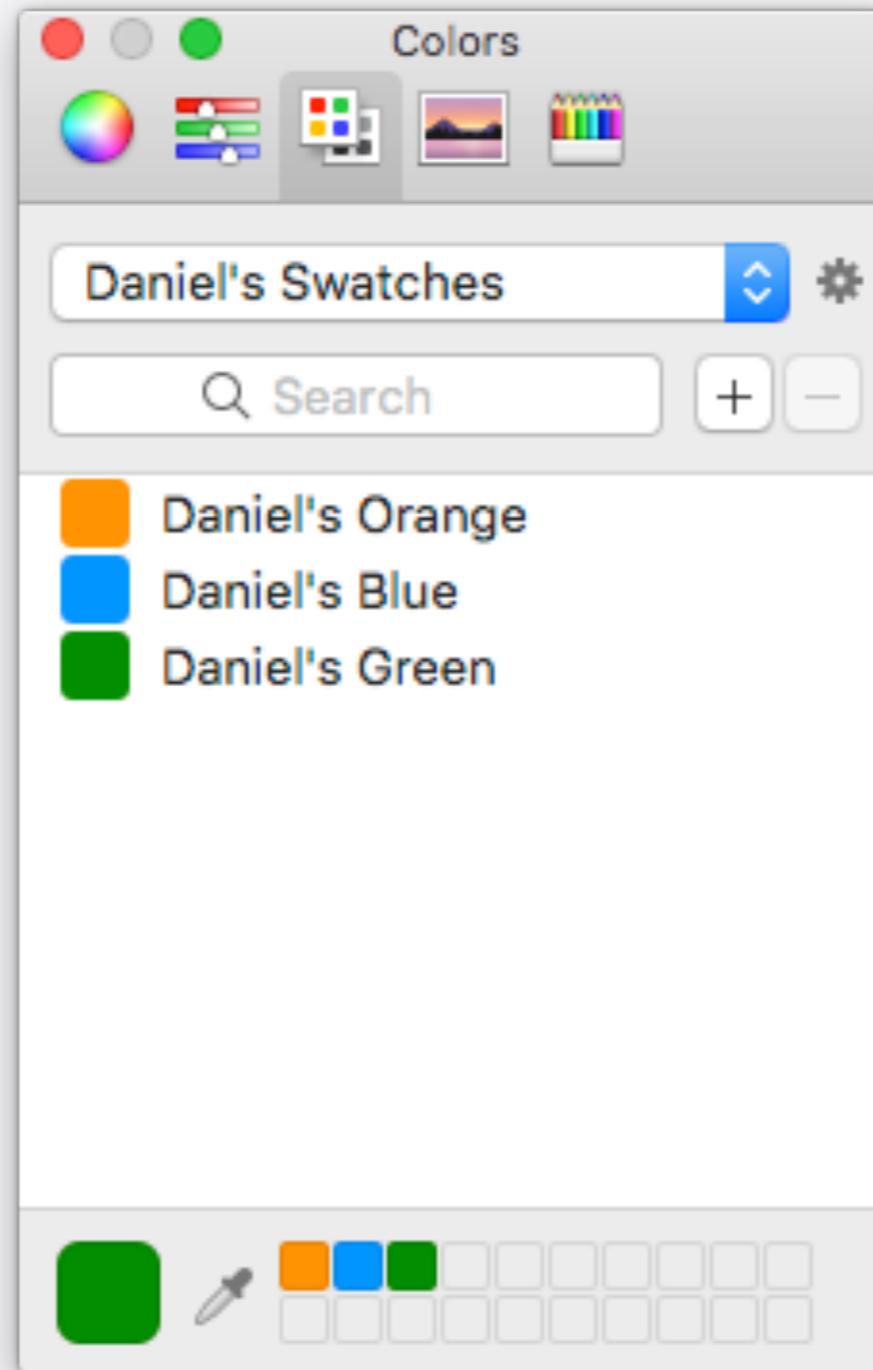


Indesign swatches



Keynote image styles

not an instance of style



what crucial action is missing?

explaining concepts

how to explain the style concept?

If you assign Heading to two paragraphs and then you change the style from bold to italic, both paragraphs will be changed in concert

If you create a style and assign to two elements, then when you modify the style, both elements will change...

not ontological: "a style is a mapping..."

not redundant: unlike full spec, shows how concept meets purpose



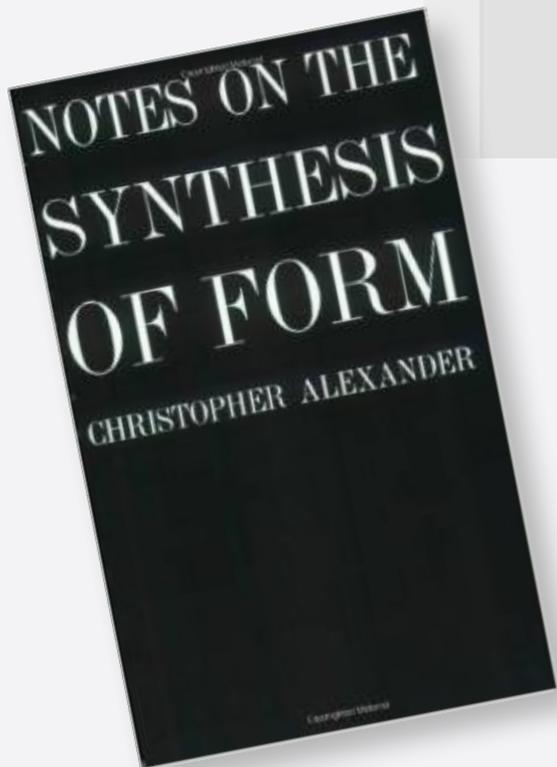
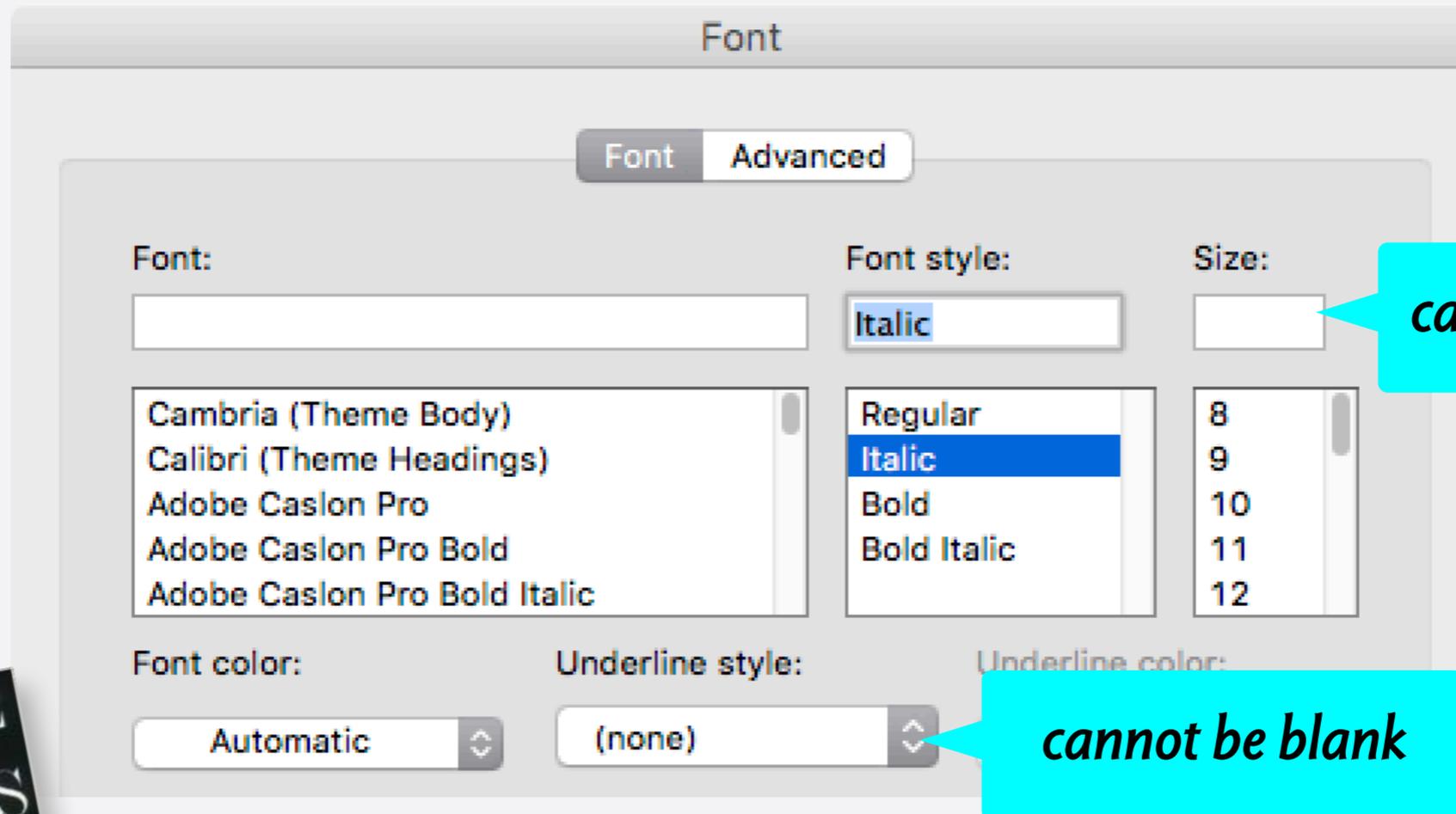
Johnson-Laird:
constructive semantics



Michael Polanyi
operational principle

if you have a full spec of the behavior of a concept, is the tactic redundant?

when concepts don't fulfill purpose



Alexander's **misfits**:
not bugs but bad specs

concepts: modules of behavior



inventive



purposeful



behavioral



self-contained



reusable

concept
models

a reservation concept

name

reservation

purpose

make access to shared resource reliable

structure

slots: Owner -> Slot
holds: User -> Slot

behavior

```
create (o: Owner, s: Slot)
  no slots.s => slots += o -> s

reserve (u: User, o: Owner, s: Slot)
  no holds.s and o -> s in slots => holds += u -> s

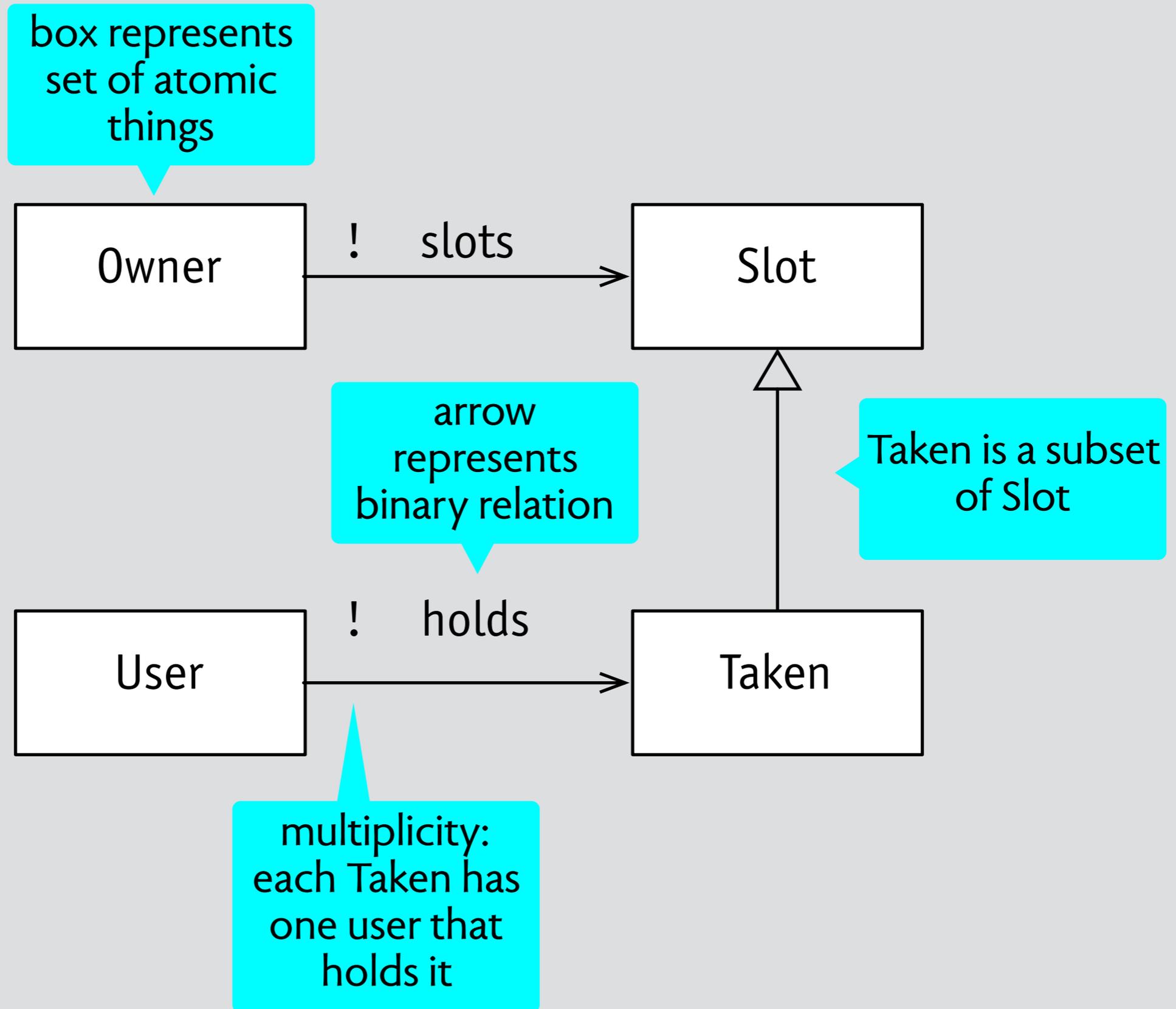
cancel (u: User, s: Slot)
  u -> s in holds => holds -= u -> s

use (u: User, o: Owner, s: Slot)
  u -> s in holds and o -> s in slots =>
```

tactic

if create(o,s); reserve(u,o,s); ... **no** cancel(u,s) ... **then can** use(u,o,s)

a relational diagram



alloy expressions in one slide

u: User
s: Slot
holds: User -> Slot
Taken: set Slot

a relation is a table of rows

holds = {(u1,s1), (u1,s2)}
holds' = {(u1,s1), (u1,s2), (u2,s3)}

a set is a relation with one column

Slot = {(s1), (s2), (s3), (s4)}
Taken = {(s1), (s2), (s3)}

a scalar is a set with one row

u = {(u2)}
s = {(s3)}

set operators

+ union, - difference, & intersection, in subset

Slot - Taken = {(s4)}
holds' - holds = {(u2,s3)}

relation operators

-> product
.join

product examples

u -> s = {(u2,s3)}
u -> Taken = {(u2,s1), (u2,s2), (u2,s3)}

join examples

u.holds' = {(s3)}
holds'.s = {(u2)}
holds.Slot = {(u1)}

formula examples

holds' = holds + u -> s
(also written holds += u -> s
User.holds = Taken
holds in User -> Slot

$a \rightarrow b = \{ (a_0, \dots, a_n, b_0, \dots, b_m) \mid (a_0, \dots, a_n) \in a \wedge (b_0, \dots, b_m) \in b \}$

$a.b = \{ (a_0, \dots, a_{n-1}, b_1, \dots, b_m) \mid (a_0, \dots, a_n) \in a \wedge (a_n, b_1, \dots, b_m) \in b \}$

a reservation concept

name

reservation

purpose

make access to shared resource reliable

structure

slots: Owner -> Slot
holds: User -> Slot

behavior

```
create (o: Owner, s: Slot)
  no slots.s => slots += o -> s

reserve (u: User, o: Owner, s: Slot)
  no holds.s and o -> s in slots => holds += u -> s

cancel (u: User, s: Slot)
  u -> s in holds => holds -= u -> s

use (u: User, o: Owner, s: Slot)
  u -> s in holds and o -> s in slots =>
```

tactic

if create(o,s); reserve(u,o,s); ... **no** cancel(u,s) ... **then can** use(u,o,s)

checking a tactic with electrom

```
New Open Reload Save Execute Show
sig Slot {}
sig Owner {var slots: set Slot}
sig User {var holds: set Slot}

pred create [o: Owner, s: Slot] {
  no slots.s
  slots' = slots + o -> s
  holds' = holds
}

pred reserve [u: User, o: Owner, s: Slot] {
  no holds.s
  o -> s in slots
  holds' = holds + u -> s
  slots' = slots
}

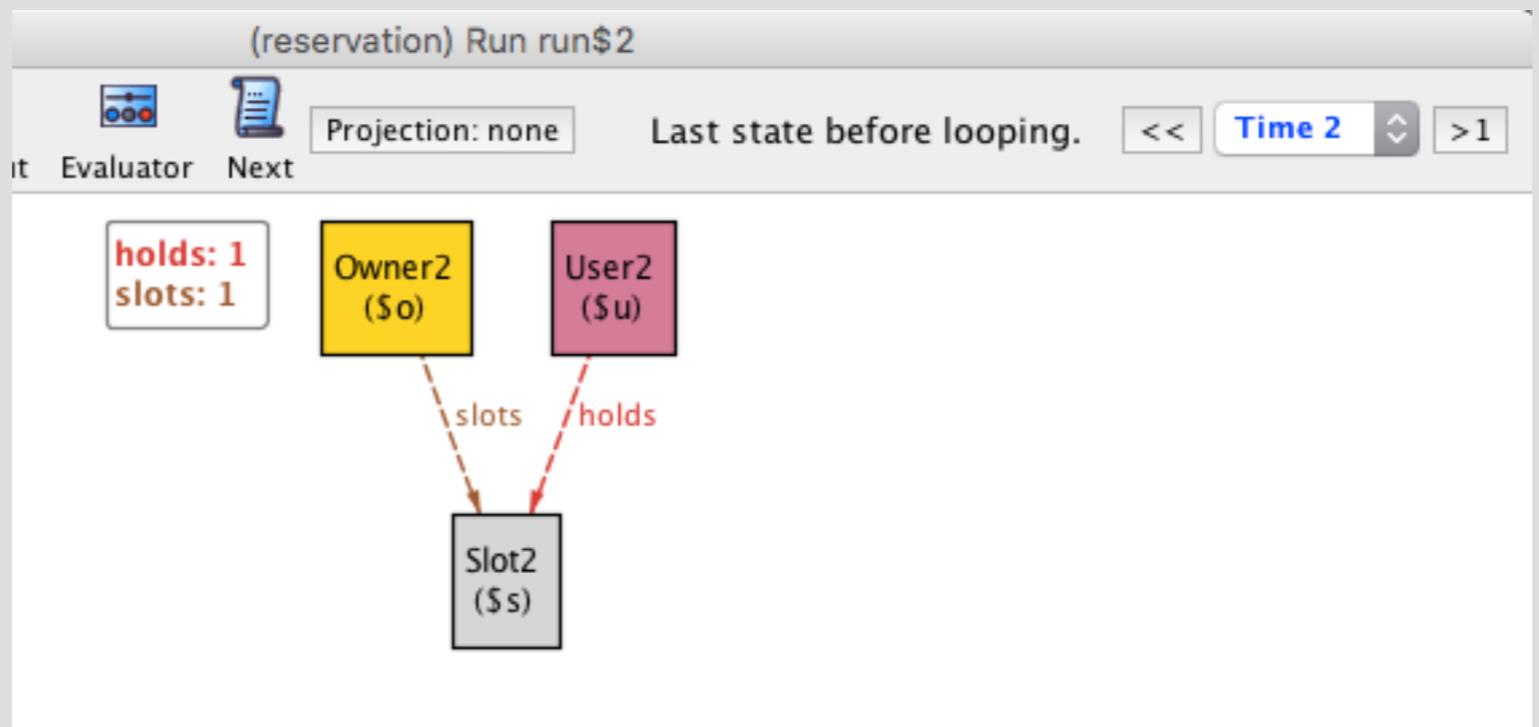
pred cancel [u: User, s: Slot] {
  u -> s in holds
  holds' = holds - u -> s
  slots' = slots
}

pred can_use [u: User, o: Owner, s: Slot] {
  u -> s in holds and o -> s in slots
}

pred skip {slots' = slots and holds' = holds}
```

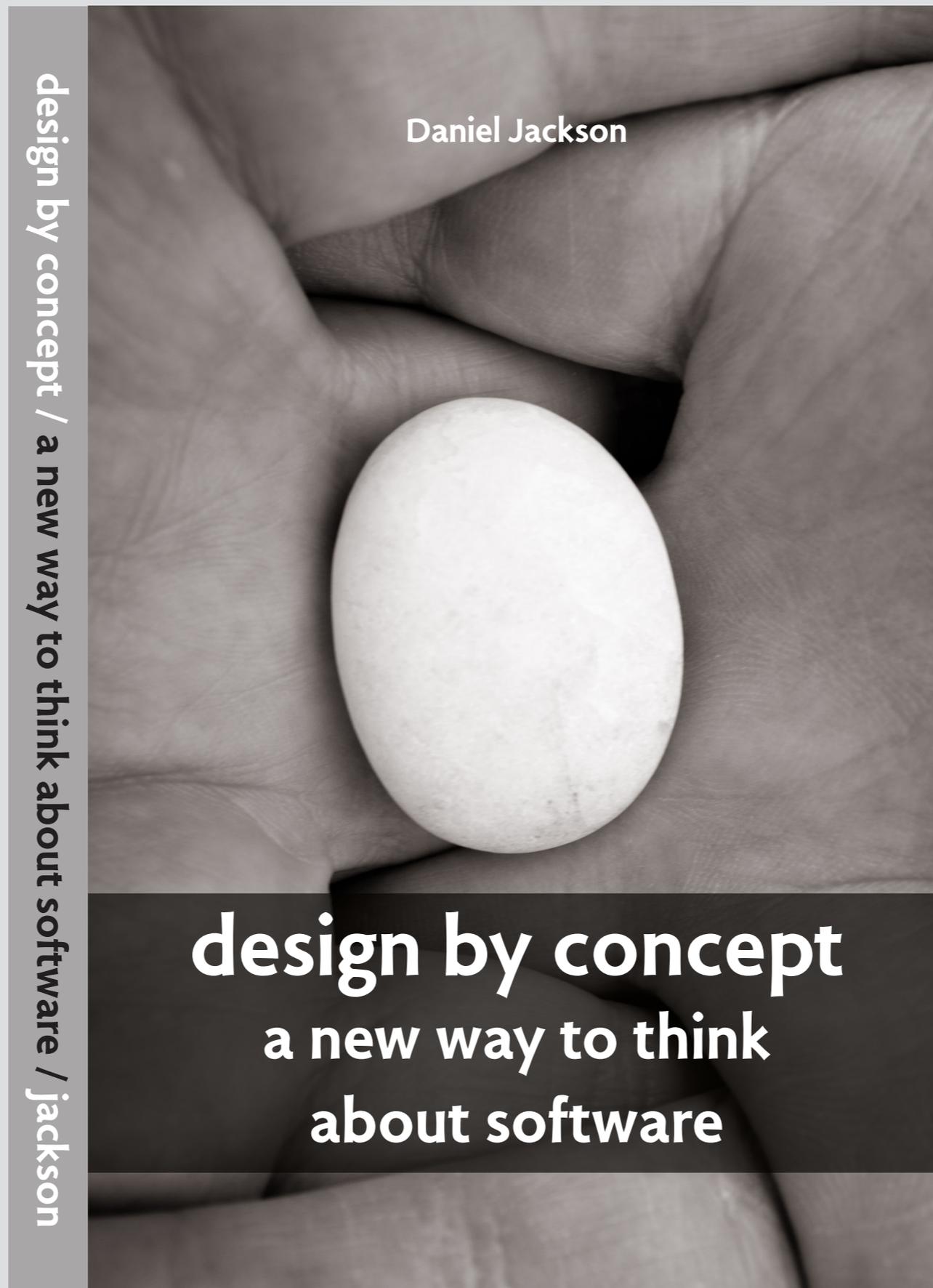
```
fact {
  no holds and no slots -- initially
  always (skip or some u: User, s: Slot, o: Owner |
    create[o,s] or reserve [u,o,s] or cancel[u,s])
}

check {
  -- can always use after reserve: not true
  all u: User, s: Slot, o: Owner |
    always (create[o,s] and after reserve[u,o,s]
      implies after after always can_use[u,o,s])
}
```



see: <https://github.com/haslab/Electrum>

a book draft

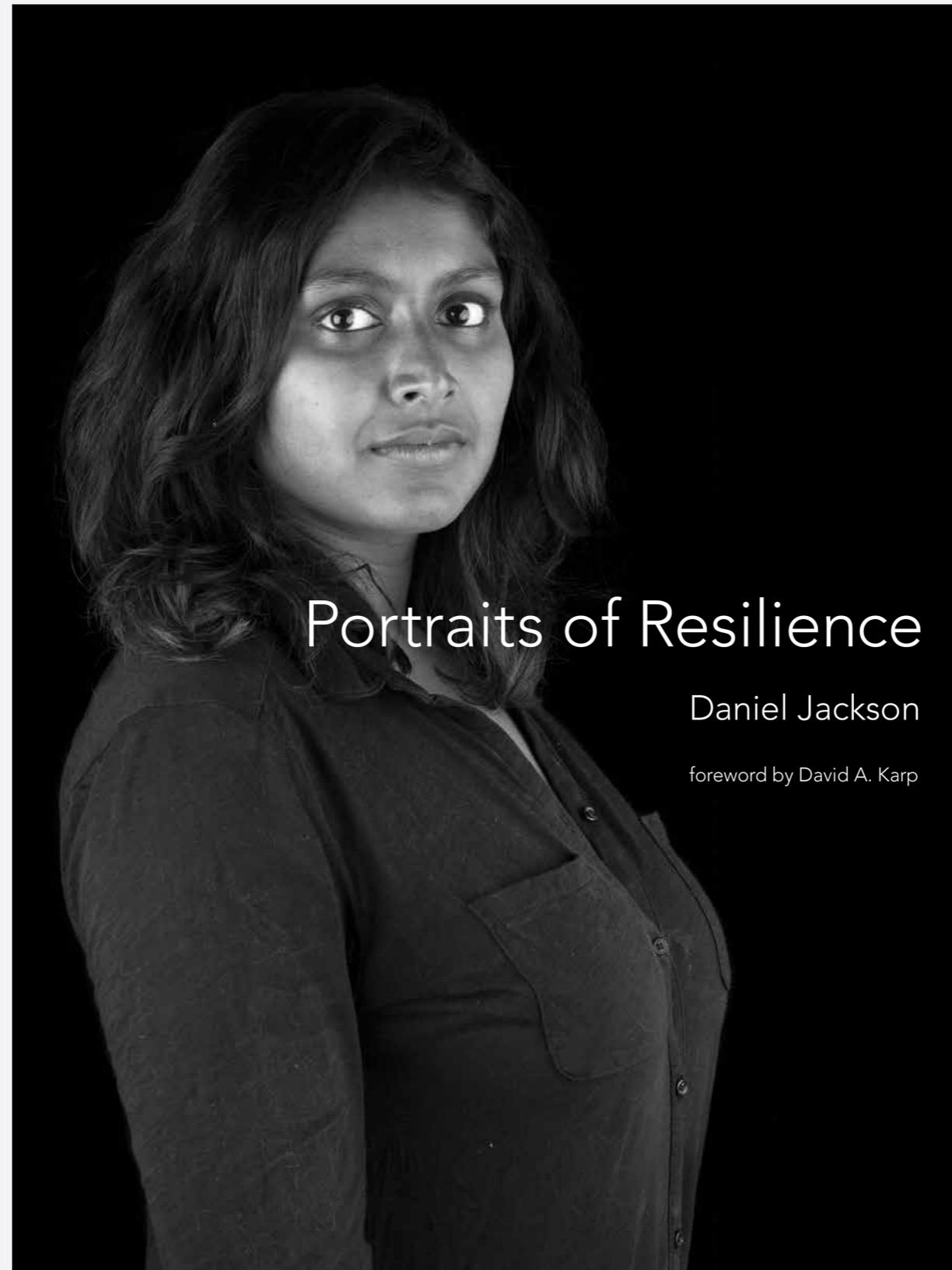


Daniel Jackson

design by concept
a new way to think
about software

design by concept / a new way to think about software / jackson

a rather different book



<http://portraitsofresilience.com>

studio 1

identifying concepts: resy

here's a typical reservation app. what concepts can you identify?

CAFE SUSHI

★★★★★ — RESY BOOK TONIGHT TOP RATED NEW ON RESY

Sushi • Harvard Square • About \$50 per person

Tomorrow 2 Guests Available Unavailable Sold Out Closed

LUNCH

12:00PM DINING ROOM	12:30PM DINING ROOM	1:00PM DINING ROOM
1:30PM DINING ROOM	2:00PM DINING ROOM	Notify Me

DINNER

8:30PM DINING ROOM	9:00PM DINING ROOM	Notify Me
-----------------------	-----------------------	-----------

BACK

RESY

Cafe Sushi uses Resy's hospitality platform to securely manage your account information and reservations.

Please enter your mobile phone number to verify or create an account:

+1

Continue

Cafe Sushi and Resy will only use this number to confirm and manage your reservation.

RESY

Check your mobile phone!

We sent a 6-digit confirmation code to **+1 (617) 396-1160**. It expires shortly, so enter it soon.

-

identifying concepts: stack exchange

another example: a typical Q&A app

Philosophy

Home
Questions
Tags
Users
Unanswered

All Questions

1,695 questions

Newest Frequent Votes Active Unanswered

Ask Question

74
votes

19
answers

32k views

Could 'cogito ergo sum' possibly be false?

I've heard it postulated by some people that "we can't truly know anything". While that does seem to apply to the vast majority of things, I can't see how 'cogito ergo sum' can possibly be false. ...

epistemology knowledge existence descartes skepticism

asked Jun 7 '11 at 22:00

 **Jez**
997 ● 2 ● 11 ● 22

186
votes

29
answers

26k views

Was mathematics invented or discovered?

What would it mean to say that mathematics was invented and how would this be different from saying mathematics was discovered? Is this even a serious philosophical question or just a meaningless/...

epistemology ontology philosophy-of-mathematics

asked Jun 7 '11 at 20:04

 **Ami**
1,484 ● 3 ● 12 ● 12

gmail
surprises

organizing messages



label:hacking



Gmail ▾



More ▾

1-1 of 1



COMPOSE

- Inbox
- Starred
- Sent Mail
- Drafts
- Trash

▾ Categories

- Social
- Promotions
- Updates
- Forums

hacking

- meetups
- todo
- More ▾

★ Alyssa P. Hacker

Inbox javascript - Reminds you of the old da

9:14 pm

0 GB (0%) of 15 GB used
[Manage](#)

[Terms](#) - [Privacy](#)

Last account activity: 14 hours ago
[Details](#)



automating filtering



Gmail

Navigation and utility buttons: Refresh, More, 1-1 of 1, Navigation arrows, Keyboard shortcuts, Settings

COMPOSE

Category tabs: Primary, Social, Promotions

Inbox (2)

Email list item: Alyssa P. Hacker, buy this! - My new JS book is out!, May 6

- Starred
- Sent Mail
- Drafts
- Trash

0 GB (0%) of 15 GB used [Manage](#) [Terms](#) - [Privacy](#) Last account activity: 14 hours ago [Details](#)

Categories

- Social
- Promotions
- Updates (1)
- Forums

hacking (1)

- meetups
- todo
- More

slightly surprising behavior #1



in:sent



Gmail



Move to Inbox



More



COMPOSE

javascript

Inbox x hacking x



Alyssa P. Hacker Reminds you of the old days, eh?

9:14 PM (33 minutes ago) ☆

Ben Bitdiddle <benito.bitdiddle@gmail.com>

9:40 PM (7 minutes ago) ☆

to Alyssa ▾

Yes, it does.



Click here to [Reply](#) or [Forward](#)

0 GB (0%) of 15 GB used
[Manage](#)

[Terms](#) - [Privacy](#)

Last account activity: 26 minutes ago
[Details](#)



slightly surprising behavior #2

Primary Social Promotions +

☆ me, Alyssa (12) hacking meetups javascript - Hello again Be 11:48 am

label:hacking

☆ me, Alyssa (12) Inbox meetups javascript - Hello again Ben 9:43 am

label:meetups

☆ me, Alyssa (12) Inbox hacking javascript - Hello again Ben. 9:58 am

label:hacking label:meetups

🔍 No messages matched your search. Try using [search options](#) such as sender, date, size and more.

slightly surprising behavior #3

Search bar: [] [Q] [Grid] [Bell] [B]

Actions: [] [Refresh] [More] 1-1 of 1 [Left] [Right] [Keyboard] [Settings]

Folder tabs: Primary | Social | Promotions | +

Message: ☆ me, Alyssa (10) [hacking] [meetups] javascript - Hello again Be 11:48 am

Search bar: has:nouserlabels [Q] [Grid] [Bell] [B]

Actions: [] [Download] [Warning] [Trash] [Move to Inbox] [Tag] [Refresh] [More] [Left] [Right] [Keyboard]

Message 1: ☆ Alyssa P. Hacker [Inbox] [Promotions] buy this! - My new JS box 10:33 am

Message 2: ☆ me, Alyssa (10) [Inbox] [hacking] [meetups] javascript - Oh, Al! 9:24 am

slightly surprising behavior #4

☐ ↕ ↻ More ▾ 1-2 of 2 < > 🗃️ ▾ ⚙️ ▾

[Empty Trash now](#) (messages that have been in Trash more than 30 days will be automatically deleted)

☐ 🗑️	me, Alyssa (13)	hacking	meetups	todo	javascript - Hello a	11:48 am
☐ 🗑️	Andy from Google	Updates	Ben, welcome to your new Googl			9:01 am

label:todo 🔍 🗃️ 🔔 B

☐ ↕ ↻ More ▾ 🗃️ ▾ ⚙️ ▾

There are no conversations with this label.

label:todo label:trash 🔍 🗃️ 🔔 B

☐ ↕ ↻ More ▾ 1-1 of 1 < > 🗃️ ▾ ⚙️ ▾

☐ 🗑️	me, Alyssa	Trash	hacking	meetups	todo	javascript -	10:11 am
------	------------	-------	---------	---------	------	--------------	----------

label:todo OR label:meetup 🔍 🗃️ 🔔 B

☐ ↕ ↻ More ▾ 🗃️ ▾ ⚙️ ▾

🔍 Some messages in Trash or Spam match your search. [View messages.](#)

slightly surprising behavior #5

The image shows a sequence of Gmail search results for a specific email. The email is from Alyssa P. Hacker, titled "buy this! - My new JS book is out", and is timestamped "10:33 am".

1. **Search: label:social**
The search results show the email in the "Social" category. The "Promotions" label is visible in the header but is not highlighted.

2. **Search: label:promotions**
The search results show the email in the "Social" category. The "Promotions" label is visible in the header but is not highlighted.

3. **Search: label:social label:promotions**
The search results show no messages. A message at the bottom states: "No messages matched your search. Try using [search options](#) such as sender, date, size and more."

exercise

find a partner so you can work in a pair

pick one of the Gmail surprises

all slides at <https://tinyurl.com/ssft9a>

analyze it in term of concepts

what are the key concepts involved?

which concept(s) is responsible for the surprise?

is the surprise a bug, a conceptual flaw or a user misunderstanding?

can you explain precisely what's going wrong?

can you generalize your observation?

design a fix

propose a modification that eliminates the surprise

lecture two

three
design
problems

gmail
categories

gmail's categories

 Primary			 Social 23 new			 Promotions 100+ new			+
<input type="checkbox"/>			Google	New sign-in from Chrome on Mac - New sign-in from Cr		12:30 pm			
<input type="checkbox"/>			Keith Muhammad at DeMont.	DeMontrond Auto Group - 14101 North Freeway Housto		12:19 pm			
<input type="checkbox"/>			AT&T High Speed Internet.	AT&T High Speed Internet Service Activation - Your A1		10:37 am			
<input type="checkbox"/>			Keith Muhammad at DeMont.	DeMontrond Auto Group - 14101 North Freeway Housto		Aug 26			
<input type="checkbox"/>			betterbatonrougejobs.com	Job Update -- 2015-08-26 - Looking For An Advantage W		Aug 26			

category tab settings

Categories:

[Learn more](#)

- Primary
- Social
- Promotions
- Updates
- Forums

Starred messages

- Include starred in Primary



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

some reactions

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



By [Mark Wilson](#)

Published 2 years ago

Follow

71 Comments

Like 55

Share 11

g+ 37

Tweet 30

Like many Gmail users, I greeted the [news](#)

[Home](#) › [Quick Tech Tip: Disabling Gmail's Category Tabs](#)

Quick Tech Tip: Disabling Gmail's Category Tabs

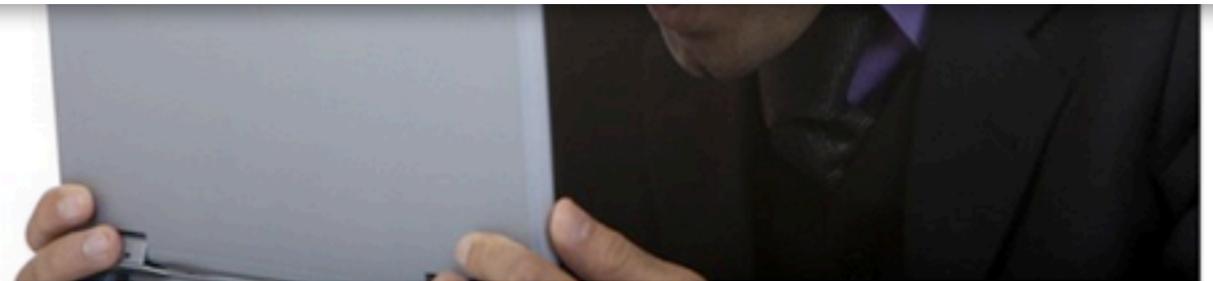
Mon, 07/29/2013 - 12:17 | [Chuck Gray](#)

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!

see that tabs were now available to me. Excitement was short-lived, however; it **quickly became apparent that this new feature is a disaster.**



how google explains labels (!)

Gmail Help



GMAIL 

FORUM

Using labels

Labels help you organize your messages into categories -- work, family, to do, read later, jokes, recipes, any category you want. Labels do all the work that folders do, but with an added bonus: you can add more than one to a message.

what you can't do

associate tabs with labels

feature available only for categories

create new categories

only new labels

use tabs outside inbox

tabs disappear when you filter on a label

fuji

aspect

ratio

my camera fuji x100s



image quality setting



aspect ratio



image size setting



non-standard ratio + raw?



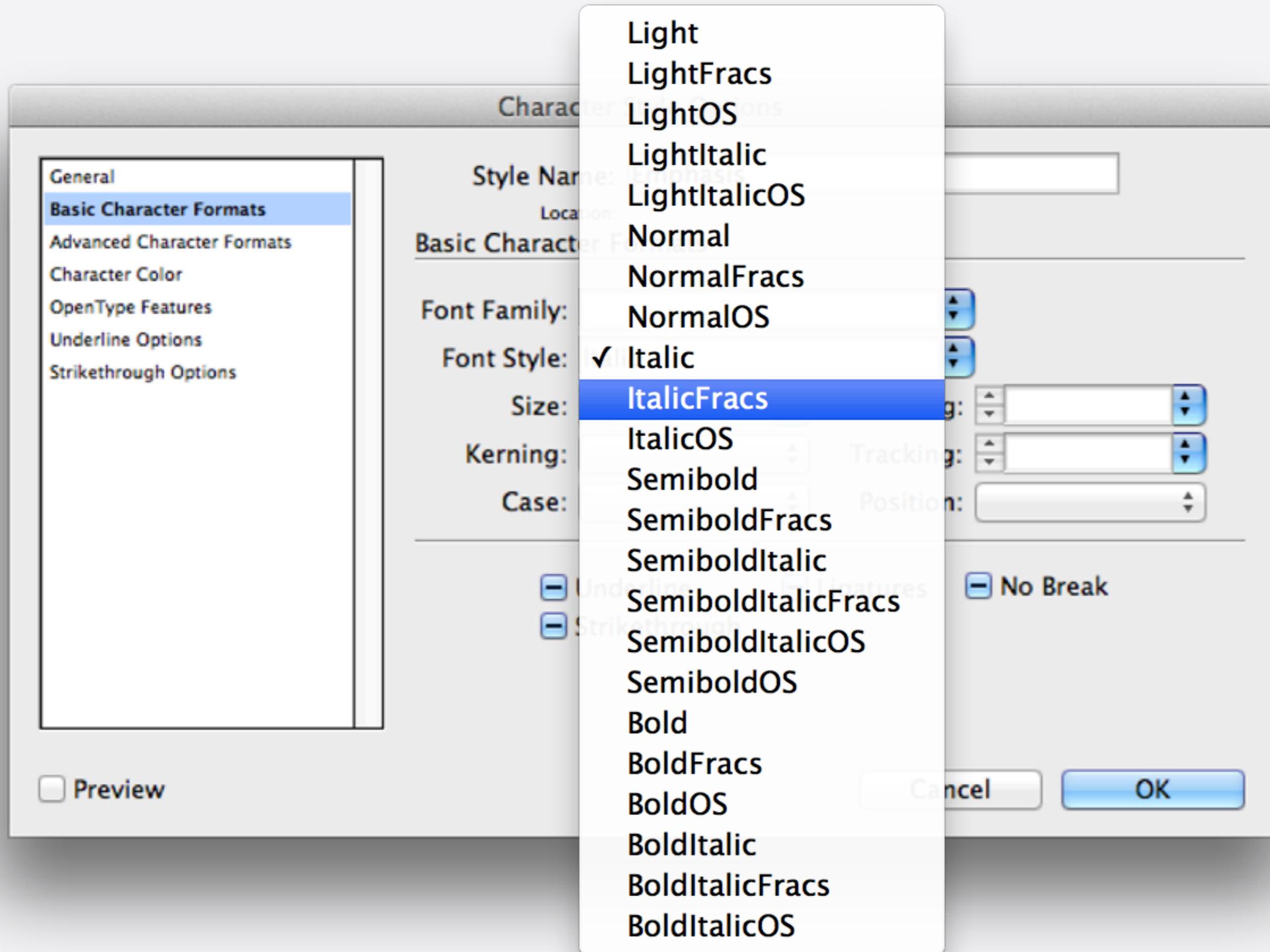
what you can't do

non-standard aspect ratio + raw
even though raw images get nice nondestructive crop!



indesign
styles

what's a font?



what you can't do

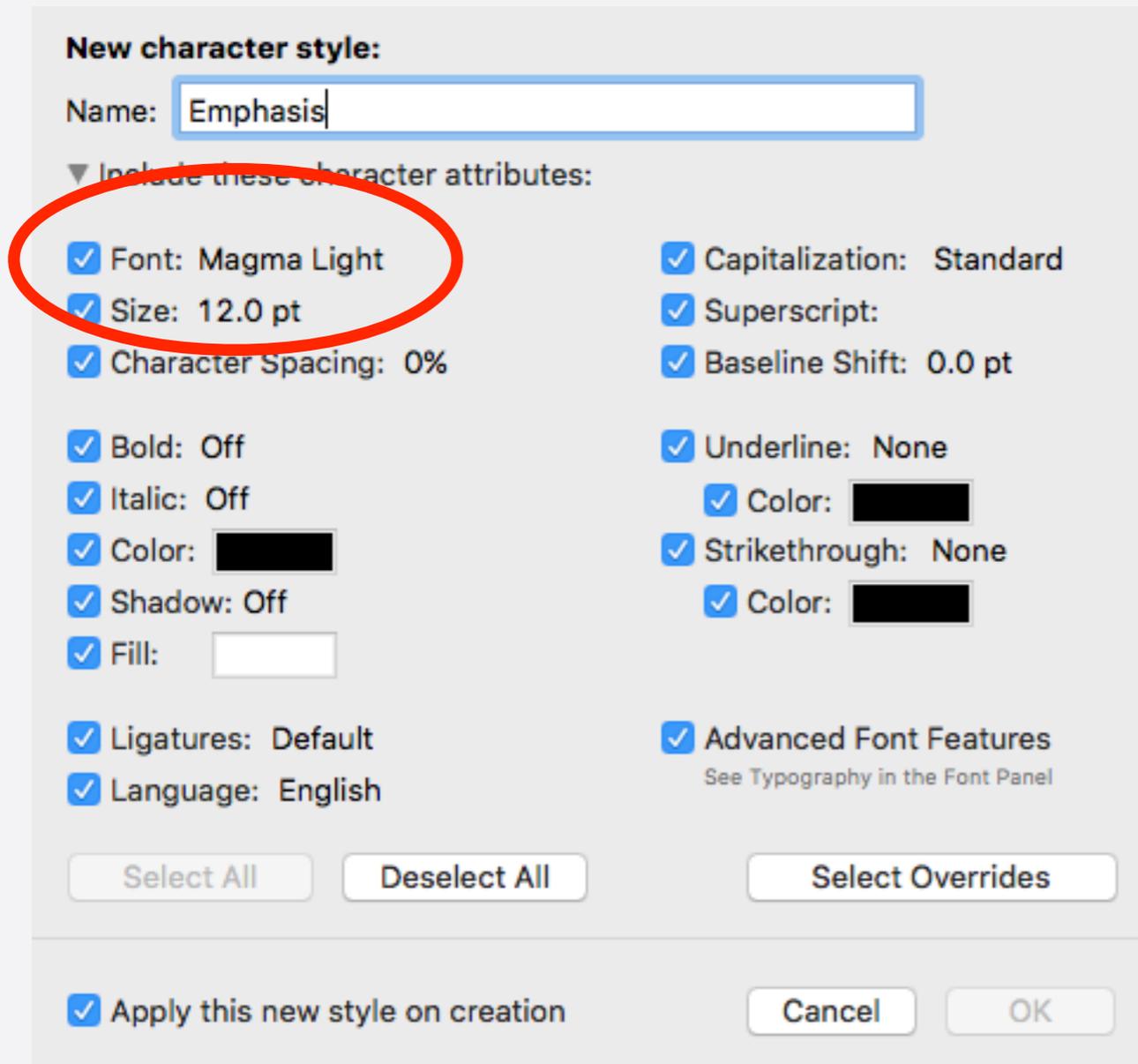
define a style that italicizes

Arno Regular to Arno Italic

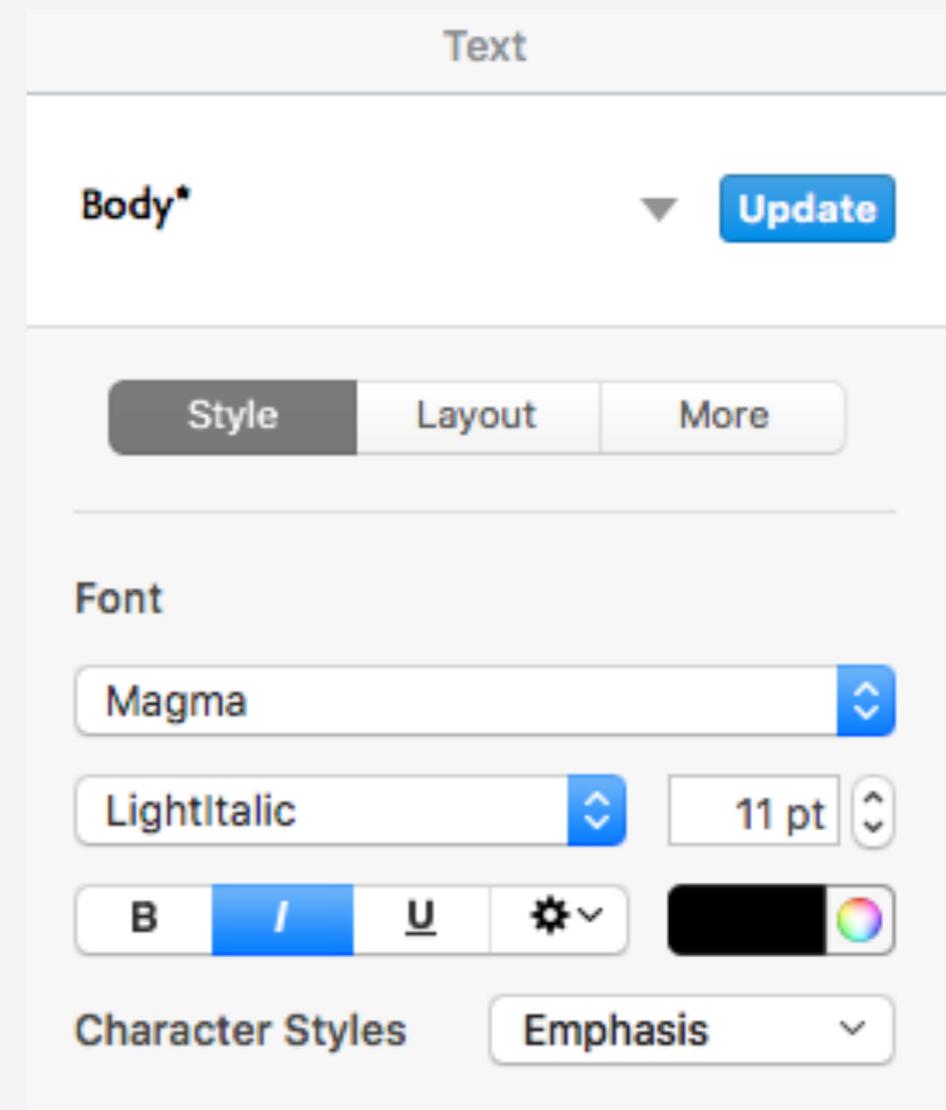
Futura Book to Futura Book Oblique

Magma Light to Magma Light Italic

introducing a concept



Keynote '09: has subfamilies



Keynote 6: gone again!

what's going on?

gmail

one purpose :: two concepts
organizing messages :: label + category

camera

two purposes :: one concept
aspect ratio + image resolution :: image size

style

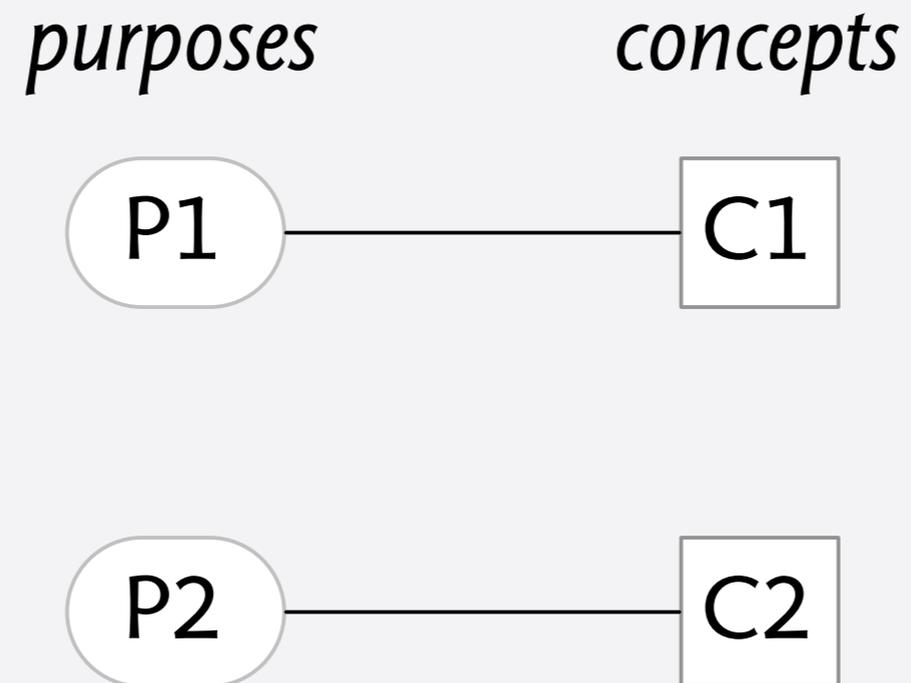
one purpose :: no concept
specify a font-independent styling :: ?

the
singularity
rule



Mitchell and Webb: "Unity of Purpose"

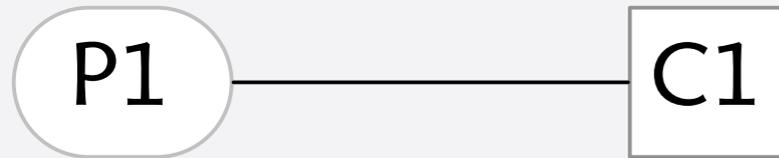
one-to-one mapping



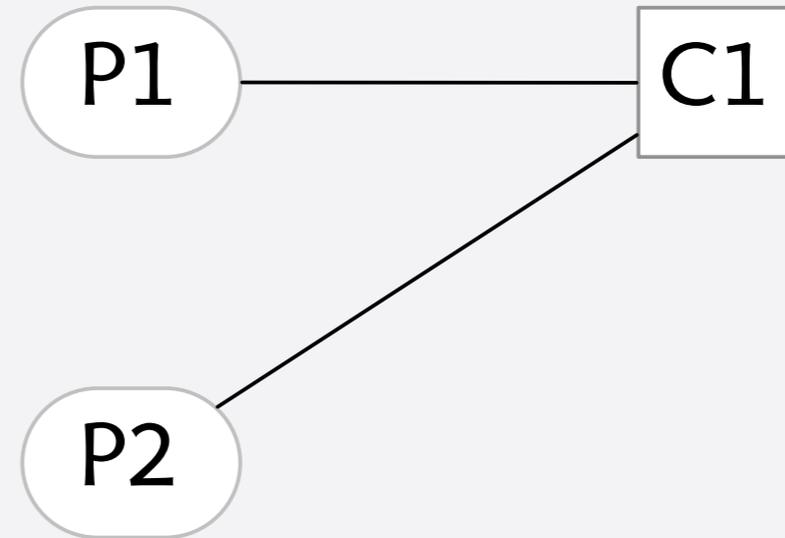
Nam Suh:
Axiomatic Design

four ways to fail

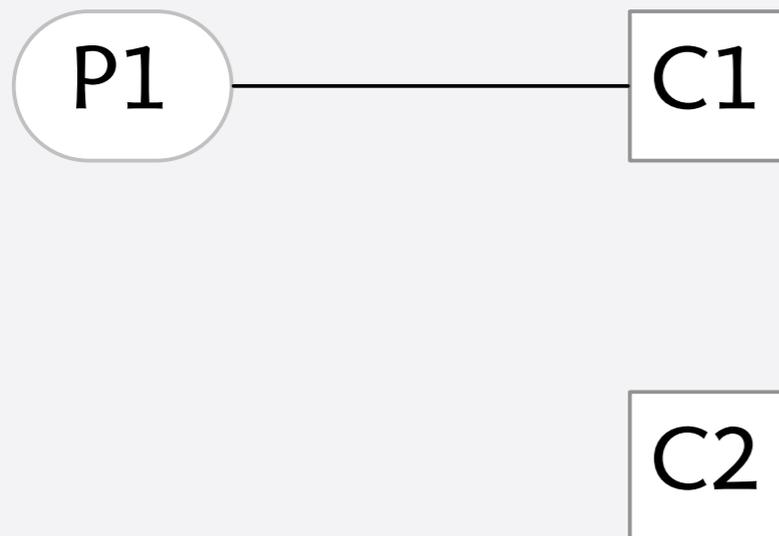
unfulfilled purpose



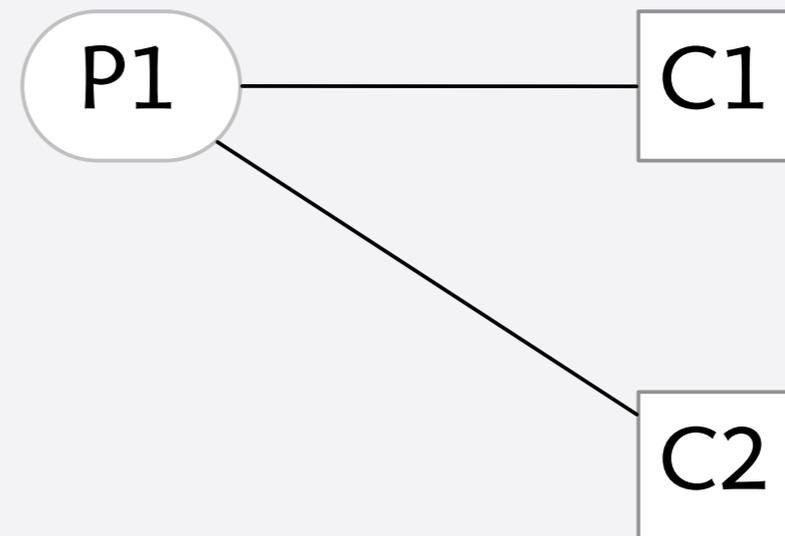
overloaded concept



unmotivated concept



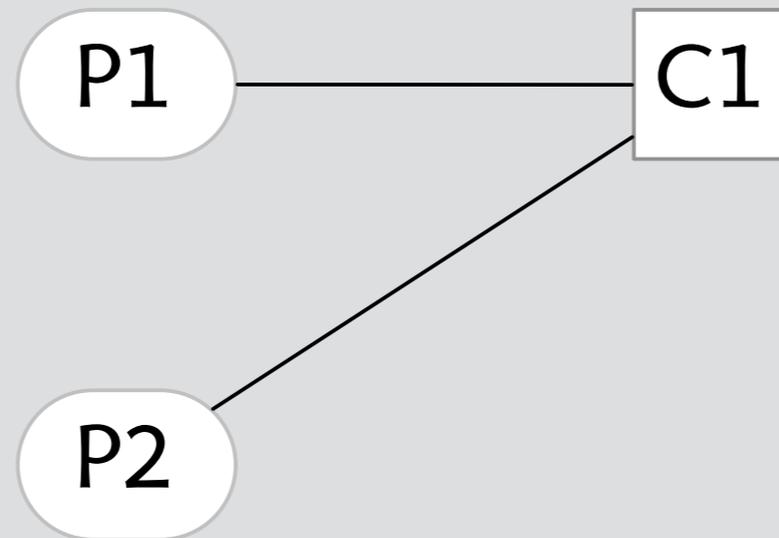
redundant concepts



kinds of
overloading

overloaded concepts

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



4 forms of overloading:

piggybacking new purpose hacked onto old concept

false convergence two purposes looked the same

emergent purpose second purpose emerged with use

denial designer believes second purpose unnecessary

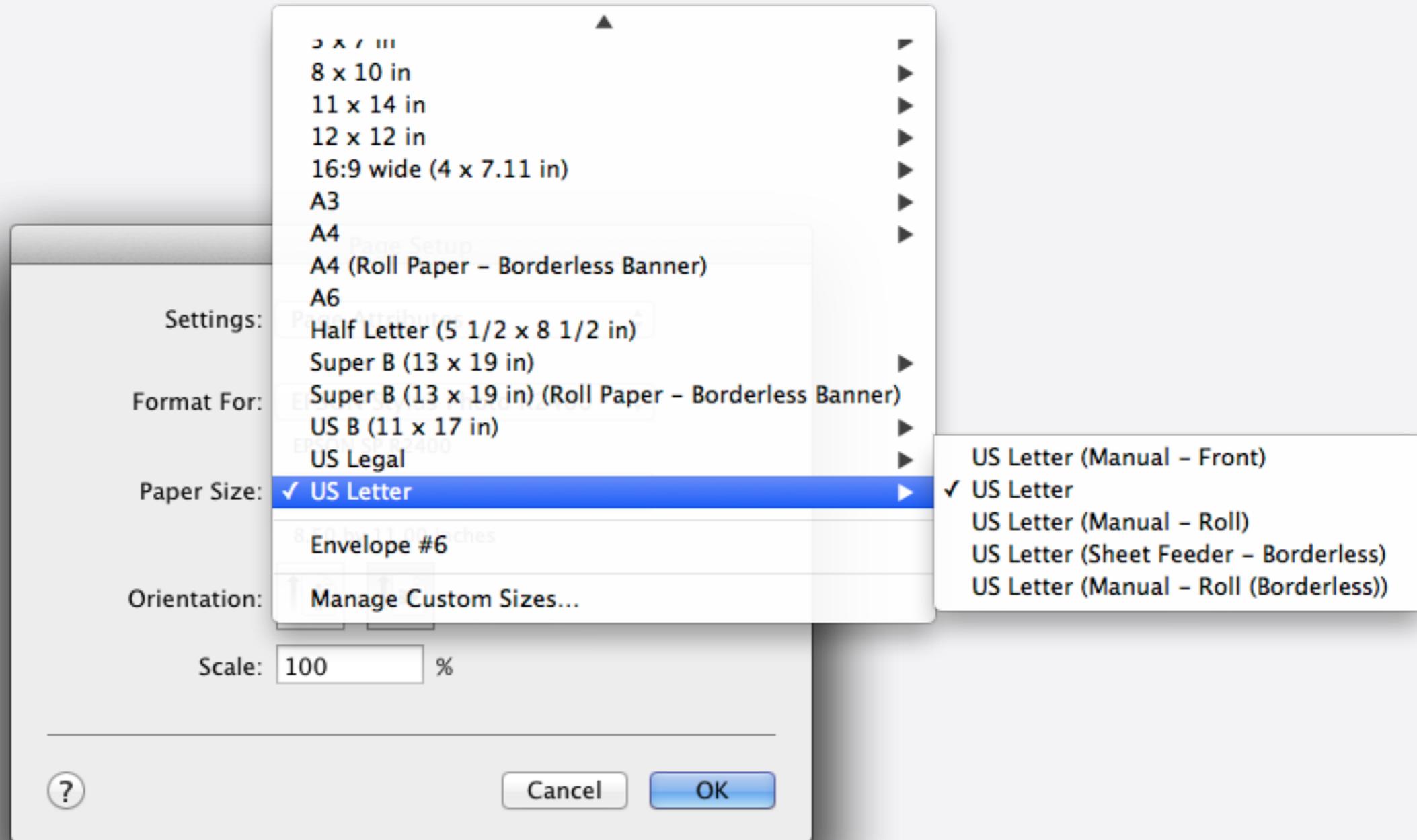
piggybacking fuji camera

new purpose hacked onto old concept

L	3:2	664
L	16:9	681
L	1:1	702
M	3:2	707
M	16:9	719
M	1:1	734
S	3:2	746

image size
aspect ratio piggybacked
on JPEG dimensions

piggybacking epson driver



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

false convergence facebook friend

two purposes looked the same



filter incoming posts
control access to my posts
distinct purposes

2011: Facebook added
subscribe/follow

emergent purpose email subject

users find second purpose for concept

To: Daniel Jackson <dnj@mit.edu>

Re: Catch me if you can in real life!

initial purpose: summarize content

To: csail-related@lists.csail.mit.edu

Re: [csail-related] turn off the lights?

emergent purpose: show sender
if you bcc a list, subject reveals to-address

thanks to Shriram Krishnamurthi

To: Daniel Jackson <dnj@mit.edu>

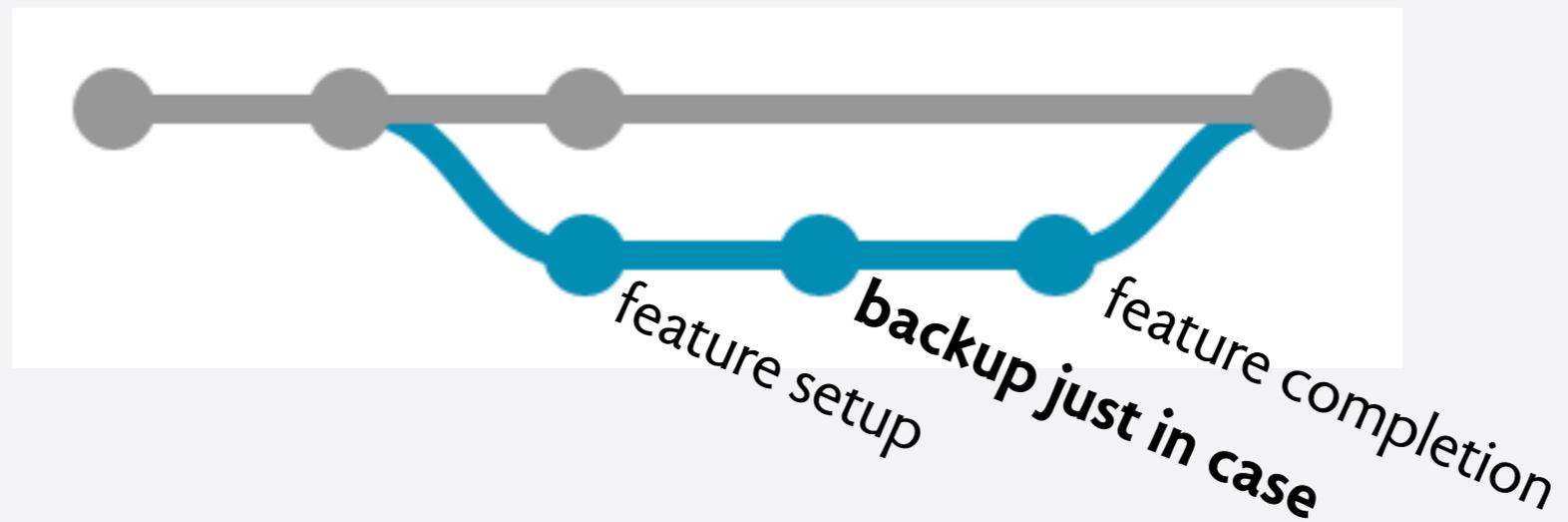
your trip reservation

emergent purpose: group by conversation
can't label reservations from Expedia by trip

thanks to Eunsuk Kang

denial commit

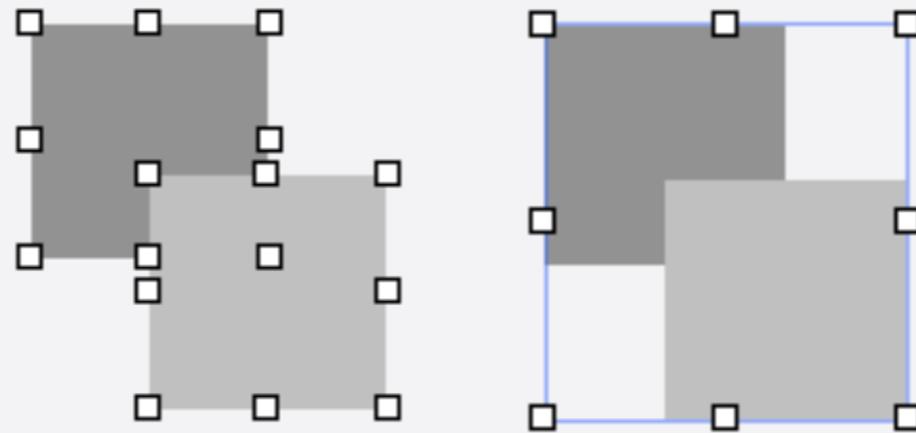
designer believes second purpose unnecessary



the
uniformity
rule

what makes a usable concept?

operational principle is uniform
always the same actions, irrespective of context



concept: **Group** (Keynote)

purpose: treat set as one

OP: ... select(objs); group(); mutate()...

quantified over state & args

unless objs contains a text body object

non-uniformity range

concept: **Range** (Numbers)

purpose: define formula over adjustable group of cells

OP: ... define formula over range... select(c) in range... add(direction)...formula updated

unless range cell c is at top of range and dir is above or...

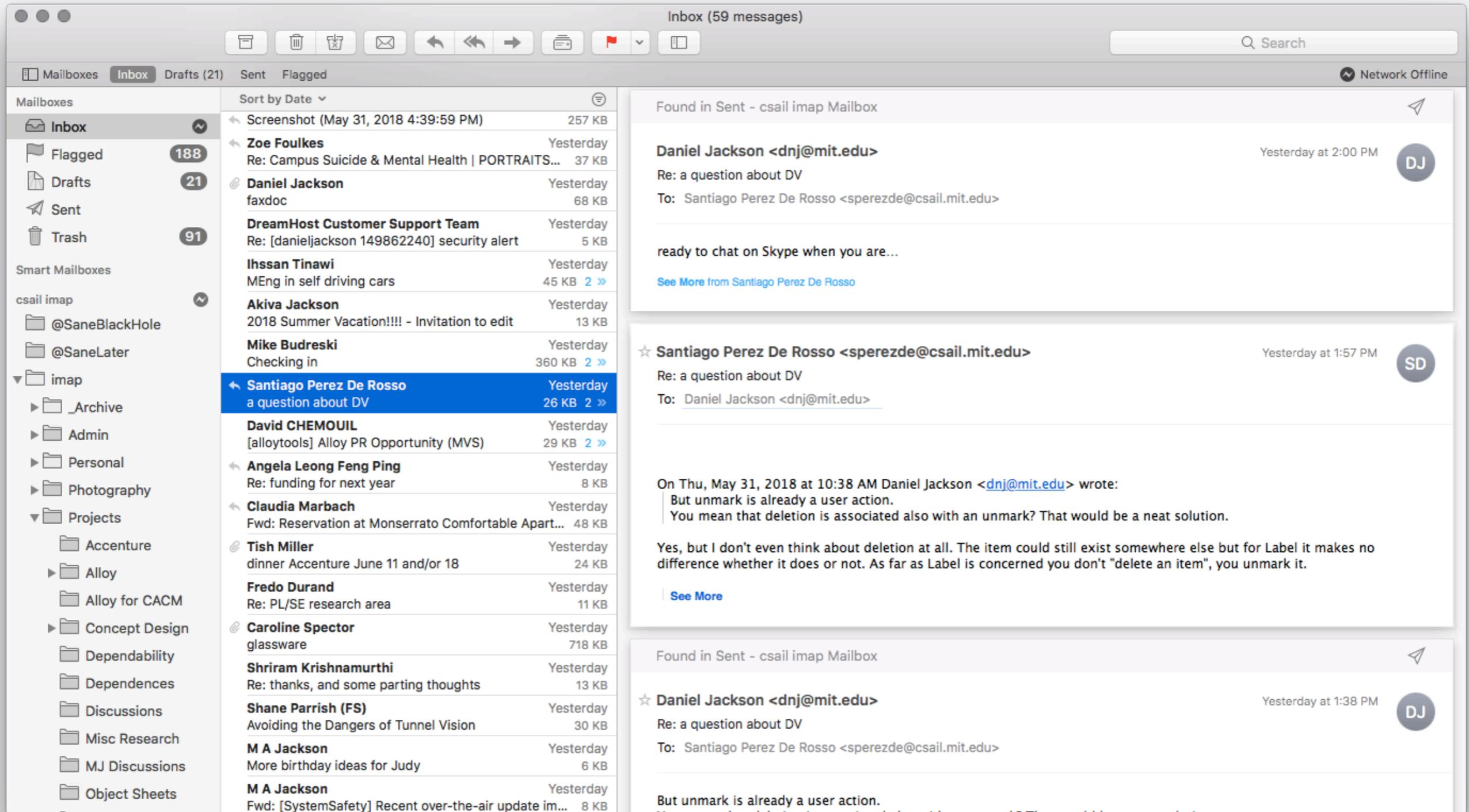
	A	B
1	item	cost
2	apples	\$4
3	bananas	\$2
4	grapes	\$6
5	kiwis	\$3
6		
7		

• fx SUM B2:B5

	A	B
1	item	cost
2	apples	\$4
3	bananas	\$2
4	cherries	
5	grapes	\$6
6	kiwis	\$3
7		
8		\$15

• fx SUM B2:B5

non-uniformity conversation



action applied to every message in conversation **unless** message in other folder or action is reply ...

kinds of non-uniformity

*varies
over type*

Keynote grouping **unless** objs contains a text body object

*varies over
mode*

Fuji aspect ratio setting **unless** set to raw only mode

*varies
over state*

Dropbox share folder **unless** folder is ancestor or descendant of shared folder

*varies
over state*

Git branch **unless** working directory contains uncommitted file or...

*varies
over arg*

Twitter mention **unless** mention includes first character of tweet

the
genericity
rule

how concepts get applied

	NY Times	StackExchange	Amazon
upvote	comments	answers	reviews
notification	breaking news	replies	when shipped
related	articles	questions	items

why reuse a concept?

familiarity
users will get it

save work
design options known

no surprises
misfits anticipated

options for upvote?

misfit of notification?

the genericity rule

reusing a well-known generic concept is usually preferable to inventing one

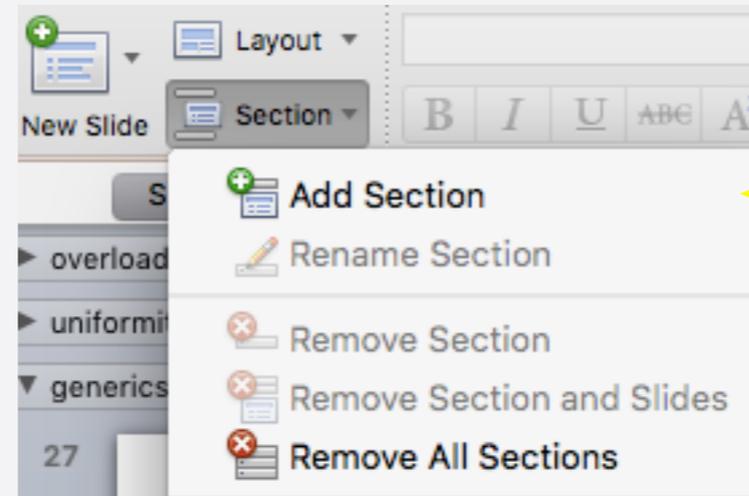
in Powerpoint



in Keynote



Powerpoint commands



what role does slide selection play in add?

what would you call this concept?

concept

composition

example: reservation

name

reservation

purpose

make access to shared resource reliable

structure

reserved: bool = false

behavior

```
reserve()  
  reserved := true  
use ()  
  reserved => reserved := false  
cancel ()  
  reserved => reserved := false
```

tactic

if reserve() and no cancel then can use()

tactic defines a property of the trace set

structure defines state space

actions
give a labeled transition relation defining a trace set

```
{<>,  
<reserve>,  
<reserve, cancel>,  
<reserve, use>,  
<reserve, use, cancel>,  
...  
}
```

example: authentication

name	authentication
purpose	identify participant in interaction
structure	ok: bool = false
behavior	login() ok := true logout () ok => ok := false auth () ok =>
tactic	if login() and no logout() then can auth()

what are the traces?

```
{<>,
<login>,
<login, auth>,
<login, auth, auth>,
<login, logout>,
<login, auth, logout>,
...
}
```

composing concepts

application

MyReservationApp

includes

reservation, authentication

behavior

login

authentication.login

logout

authentication.logout

reserve:

reservation.reserve

authentication.auth

cancel:

reservation.cancel

authentication.auth

use:

reservation.use

concepts
used

action of app is
binding of
concept actions

binding: Action -> Concept -> Action

```
{(login, authentication, login),  
(logout, authentication, logout),  
(reserve, reservation, reserve),  
(reserve, authentication, auth),  
(cancel, reservation, cancel),  
(cancel, authentication, auth),  
(use, reservation, use)}
```

semantics of composition

traces of **reservation**

```
{<>,
<reserve>,
<reserve, cancel>,
<reserve, use>,
<reserve, use, cancel>,
...
}
```

traces of **authentication**

```
{<>,
<login>,
<login, auth>,
<login, auth, auth>,
<login, logout>,
<login, auth, logout>,
...
}
```

binding: Action -> Concept -> Action

```
{(login, authentication, login),
(logout, authentication, logout),
(reserve, reservation, reserve),
(reserve, authentication, auth),
(cancel, reservation, cancel),
(cancel, authentication, auth),
(use, reservation, use)}
```

map trace t onto concept C with binding B

```
let map(t, C, B) =
map (<>, C, B) = <>
map (append(t, a), C, B) =
  if no C.(a.B) then map(t, C, B)
  else append(map(t, C, B), C.(a.B))
```

traces are all those consistent with concept traces

traces = {t in action* | all C: includes | map(t, C, B) in traces(C)}

```
{<>,
<login>,
<login, logout>,
<login, reserve>,
<login, reserve, use>,
...
}
```

reservation (again)

name

reservation

purpose

make access to shared resource reliable

structure

slots: Owner -> Slot
holds: User -> Slot

behavior

```
create (o: Owner, s: Slot)
  no slots.s => slots += o -> s

reserve (u: User, o: Owner, s: Slot)
  no holds.s and o -> s in slots => holds += u -> s

cancel (u: User, s: Slot)
  u -> s in holds => holds -= u -> s

use (u: User, o: Owner, s: Slot)
  u -> s in holds and o -> s in slots =>
```

tactic

if create(o,s); reserve(u,o,s); ... **no** cancel(u,s) ... **then can** use(u,o,s)

authentication (again)

name

authentication

purpose

identify participant in interaction

structure

password: User \rightarrow Password
sessions: set User

behavior

register (u: User, p: Password)
 no u.password \Rightarrow password += u \rightarrow p
login (u: User, p: Password)
 u.password = p \Rightarrow sessions += u
logout (u: User)
 u **in** sessions \Rightarrow sessions -= u
auth (u: User)
 u **in** sessions \Rightarrow

tactic

if register(u,p), login(u,p), no logout(u) then can auth(u)

rating

name

rating

purpose

identify participant in interaction

structure

used: User -> Item

rated: User -> Item -> Int

rating: Item -> Int = {i: Item, r: Int | avg (User, rated)}

behavior

use (u: User, i: Item)

used += u -> i

rate (u: User, i: Item, r: Int)

u -> i **in** used => u.rated += i -> r

show (i: Item): Int

result = i.rating

tactic

if user(u,i), rate(u,i,r)... for multiple u... and show(i):r then r is avg of user's ratings

reservation app (again)

application

MyReservationApp

includes

reservation, authentication, rating

behavior

```
register(u,p)
  authentication.register(u,p)
login(u,p)
  authentication.login(u,p)
logout(u)
  authentication.logout(u)
reserve(u,o,s)
  reservation.reserve(u,o,s)
  authentication.auth(u)
use(u,o,s)
  reservation.use(u,o,s)
  rating.use(u,o)
cancel(u,s)
  reservation.cancel(u,s)
  authentication.auth(u)
```

```
rate(u,o,r)
  authentication.auth(u)
  rating.rate(u,o,r)
showRating(o)
  rating.show(o)
```

ratings are
authenticated

can't rate
until you've used
reservation

the
integrity
rule

looking at sent messages in gmail

The screenshot shows the Gmail inbox interface. At the top left, there is a hamburger menu icon, the Gmail logo, and the text "Gmail". To the right is a search bar labeled "Search mail". Below the search bar, there are navigation icons for "Compose", "Inbox" (with a "1" notification), "Starred", and "Snoozed". The main area shows a list of emails under the "Primary" tab. The first email is from "Google Photos" with the subject "Ben, finish setting up your Google Photos account" and a date of "Oct 16". The second email is from "Alyssa, me 4" with the subject "javascript - Is JavaScript just Scheme with prototypes and some hacky coercions?" and a date of "Jul 30".

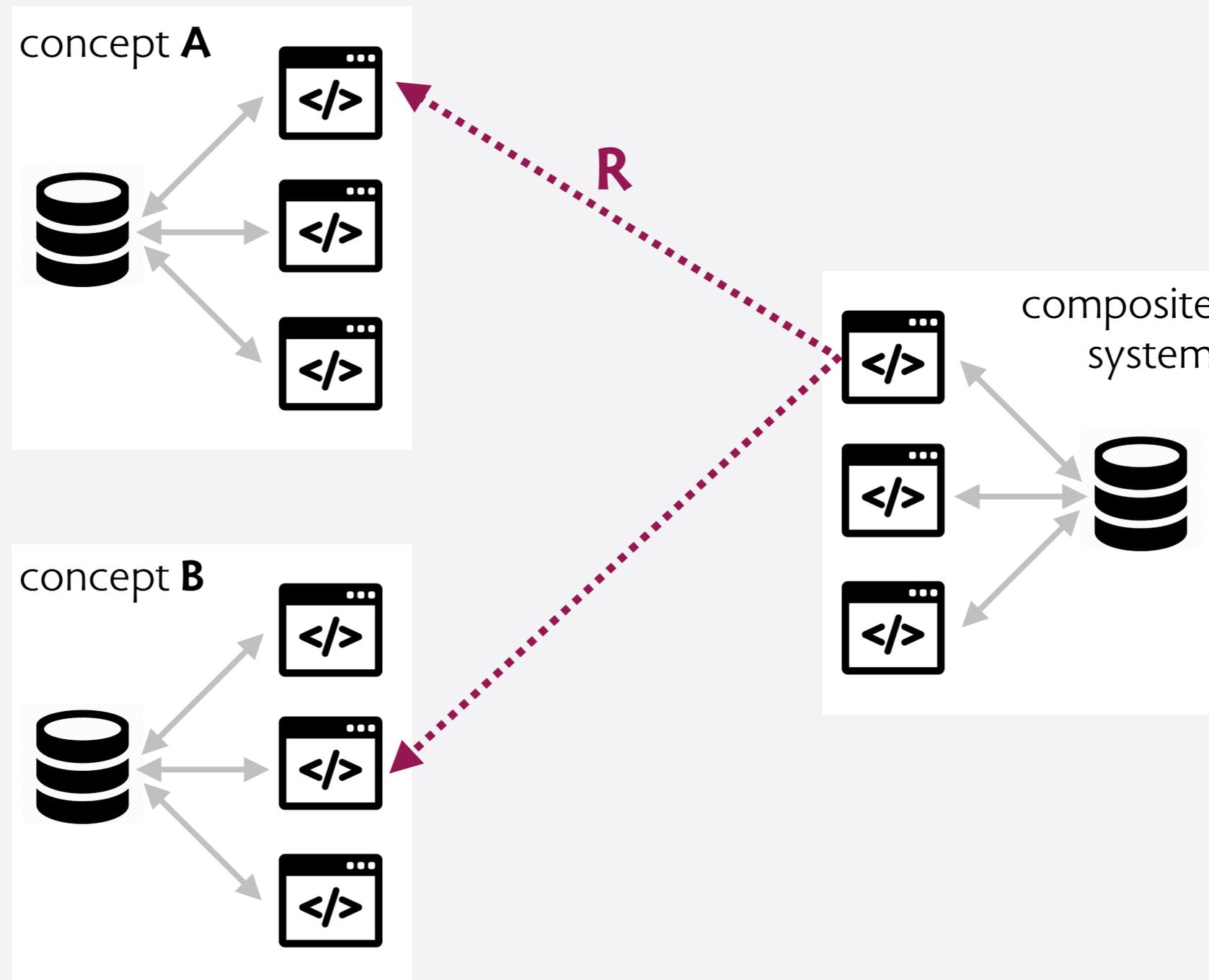
The screenshot shows a conversation thread for the email with the subject "javascript". The search bar at the top contains "in:sent". The thread includes the following messages:

- Alyssa P. Hacker** <alyssa.pure.hacker@gmail.com> to me
Reminds you of the old days, eh?
- Ben Bitdiddle** <benito.bitdiddle@gmail.com> to Alyssa
Yes, it does.
- Alyssa P. Hacker**
JavaScript makes me feel nostalgic for Scheme.
- Ben Bitdiddle** <benito.bitdiddle@gmail.com> to Alyssa
Is JavaScript just Scheme with prototypes and some hacky coercions?

A red callout bubble on the right side of the thread contains the text: "can't see which messages were sent".

interpreting composite behavior

each action in composite system
interpreted as zero or more actions in each concept



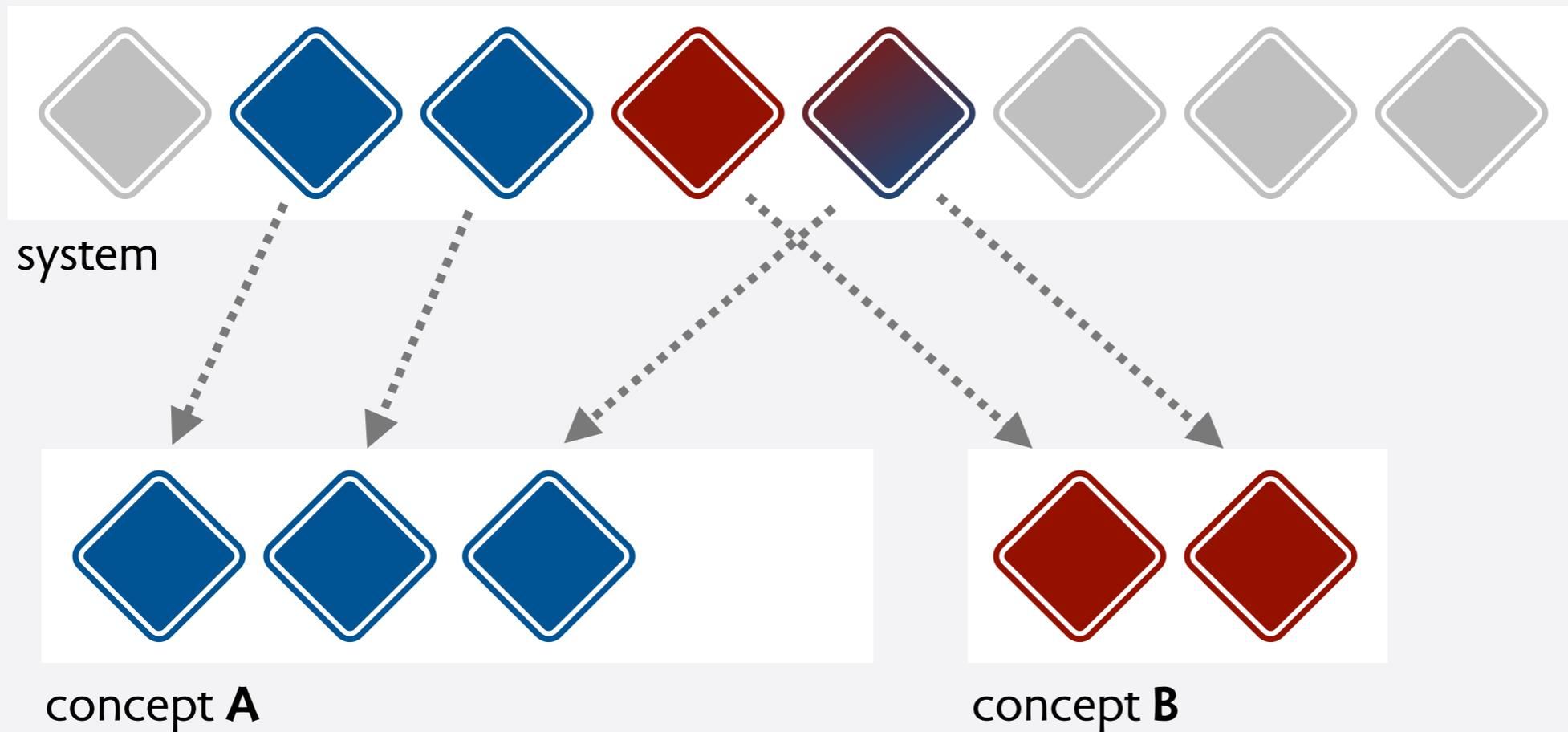
the integrity rule

when concepts are combined, each concept's behavior and OP should still apply

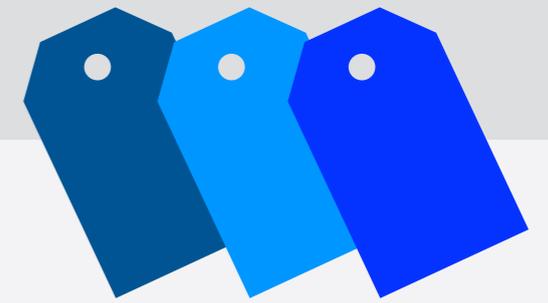
a simple criterion

projected behavior must satisfy concept spec:

$\forall c: \text{concept} \mid \forall t: \text{traces}(\text{sys}) \mid R_c(t) \in \text{traces}(c)$



the label concept



name label

purpose organize items for easy retrieval

structure labels: X -> Label

behavior

```
mark (x: X, p: Label)
  labels += x -> p

unmark (x: X, p: Label)
  p in x.labels => labels -= x -> p

find (ps: set Label): set X
  result = {x | ps in x.labels}
```

tactic

```
if mark(x,p); find(p):xs then x in xs
if no mark(x,P); find(p):xs then x !in xs
```

conversation breaks label

The screenshot shows a Gmail conversation with the search filter 'in:sent'. The conversation includes four messages from Alyssa P. Hacker and Ben Bitdiddle. Three green annotations are overlaid on the messages:

- Message 1 (Alyssa P. Hacker):** "when message m is sent `Label.mark(m, 'sent')` occurs implicitly".
- Message 2 (Ben Bitdiddle):** "when Sent link is clicked `Label.find('sent'):ms` occurs".
- Message 4 (Ben Bitdiddle):** "but ms includes messages never marked".

The interface shows the search bar with 'in:sent', a toolbar with icons for back, forward, archive, report spam, delete, mute, snooze, print, and share. The conversation title is 'javascript' with labels 'Inbox x', 'hacking x', and 'meetups x'. The messages are dated from May 8 to July 30.

integrity violations trash

*what happens when
you unmount a drive?*



interaction of Trash and Volume (Apple Finder)
unmount of Volume removes files from Trash
not expressible in terms of Trash actions
a solution: one trash/volume?

deja vu

reversing the process



the same concepts, again & again
post, comment, upvote, notification, ...

hard work to build
libraries often just client- or server-side
easy in a CMS, but structure hard-wired

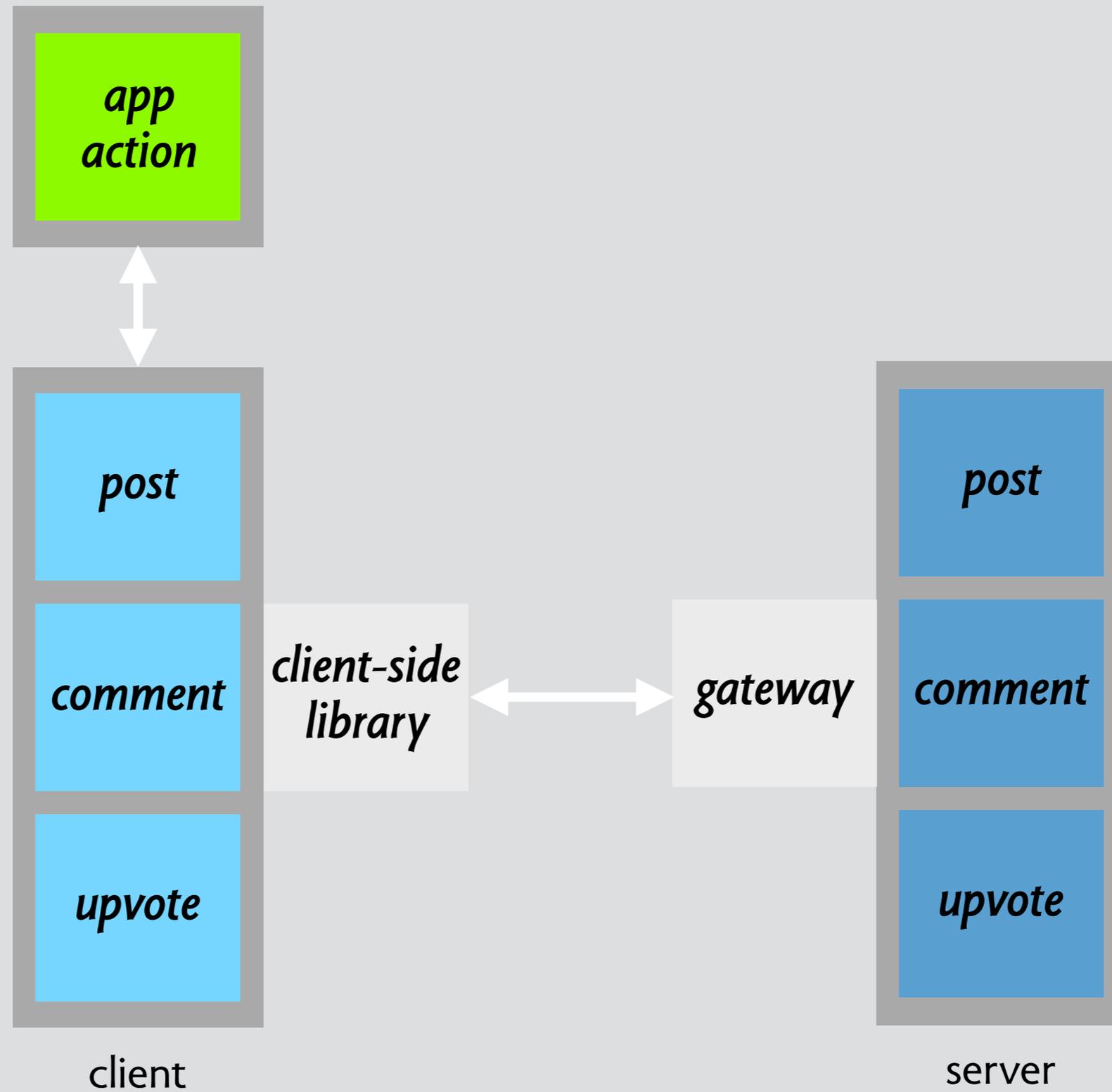


idea: concept cliches
full stack implementation

app-specific assembly
in HTML, no JS or backend code

action synchronization
build app action by joining cliché actions

architecture of deja vu



a sample app

auth

DV Hacker News Submit

ben Sign Out

▲ **SPLASH 2018** (2018.splashcon.org)

3 points by eva | comments

property

*scoring
(x2)*

▲ **Software Design Group** (sdg.csail.mit.edu)

2 points by eva | comments

▲ **Concept design** (sdg.csail.mit.edu)

1 points by alyssa | comments

▲ **Déjà Vu** (sdg.csail.mit.edu)

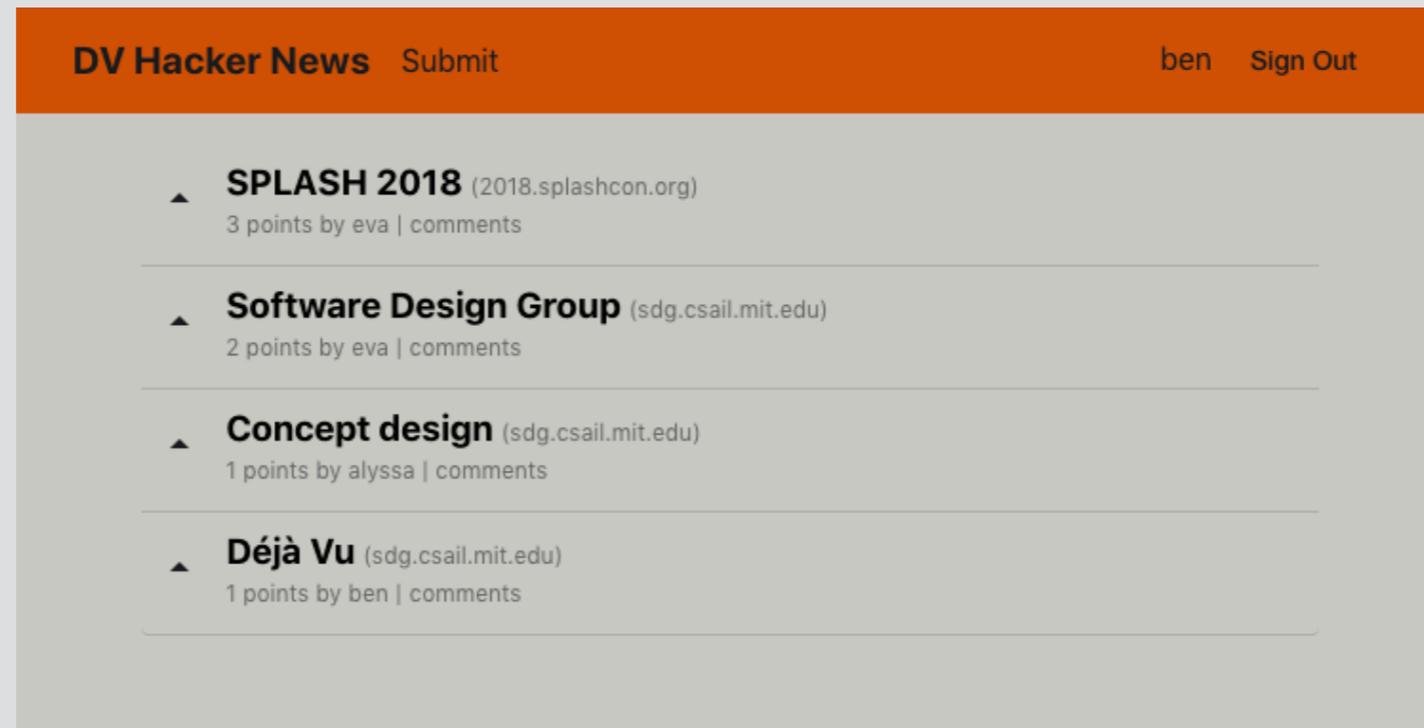
1 points by ben | comments

comment

```
{
  "name": "hackernews",
  "usedCliches": {
    "authentication": {},
    "comment": {},
    "property": {...},
    "scoringposts": {"name": "scoring"}
    "scoringcomments": {"name": "scoring"}
  },
```

```
"routes": [
  { "route": "", "action": "home" },
  { "route": "news", "action": "home" },
  { "route": "post", "action": "post-detail" },
  { "route": "login", "action": "login" },
  { "route": "submit", "action": "submit-post" }
]
```

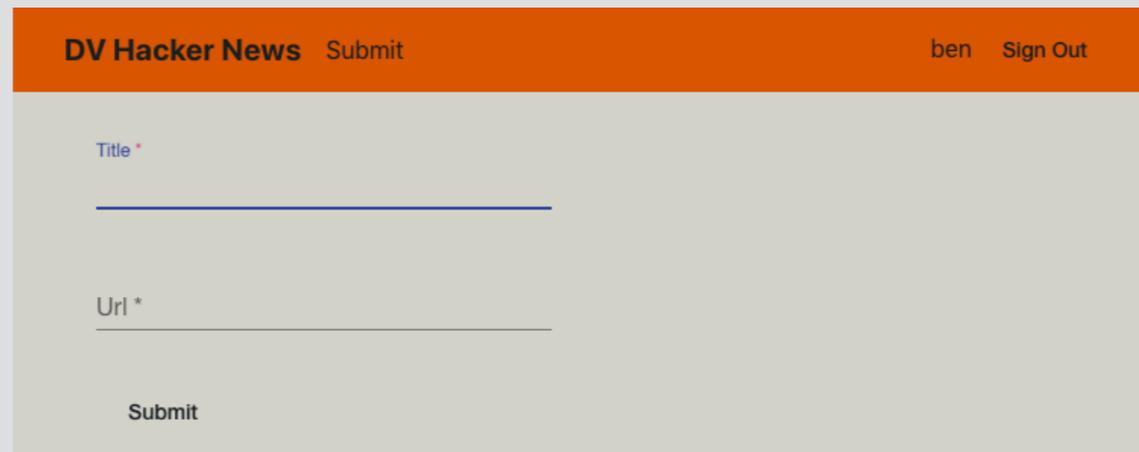
home action



The screenshot shows the DV Hacker News home page. At the top, there is an orange navigation bar with the text "DV Hacker News" and a "Submit" button on the left, and the user name "ben" and a "Sign Out" link on the right. Below the navigation bar, there is a list of four posts, each with a small upward-pointing triangle icon to its left. The posts are: "SPLASH 2018 (2018.splashcon.org)" with 3 points by eva and a link to comments; "Software Design Group (sdg.csail.mit.edu)" with 2 points by eva and a link to comments; "Concept design (sdg.csail.mit.edu)" with 1 point by alyssa and a link to comments; and "Déjà Vu (sdg.csail.mit.edu)" with 1 point by ben and a link to comments. Each post is separated from the next by a thin horizontal line.

```
<dv.action name="home">
  <hackernews.navbar />
  <div class="main">
    <scoringposts.show-targets-by-score
      noTargetsText="No posts yet"
      showAscending=false
      showScores=false
      showTarget=<hackernews.show-post post=$target id=$id />
    </scoringposts.show-targets-by-score>
  </div>
</dv.action>
```

submit post action



```
<dv.action name="submit-post">
<hackernews.navbar />
<div class="main"> <dv.tx>
  <dv.gen-id />
  <property.create-object
    id=dv.gen-id.id
    initialValue={ author: hackernews.navbar.user.username }
    showExclude=["author"]
    buttonLabel="submit"
    newObjectSavedText="Post"
  </property.create-object>
  <scoringposts.create-score
    targetId=dv.gen-id.id
    value=0
    hidden=true />
  <authentication.authenticate id=hackernews.navbar.user hidden=true />
  <dv.link href="/item" params={ id: dv.gen-id.id } />
</dv.tx> </div> </dv.action>
```

generate id

transaction

id used

set param

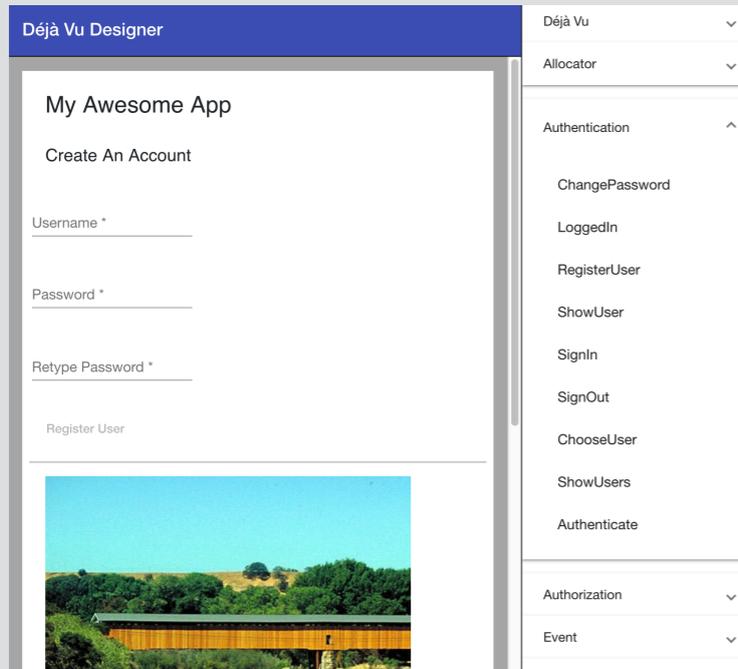
id used

redirect

rebuilding class projects

	Authentication	Authorization	Passkey	Transfer	Rating	Follow	Geolocation	Comment	Event	Label	Group	Task	Scoring	Property	Chat
Accord	1	1	0	0	1	0	0	0	0	0	1	0	1	2	0
ChoreStar	2	2	0	1	1	0	0	0	0	0	0	1	0	0	0
MapMIT	1	1	0	0	0	0	2	0	1	0	1	0	0	1	0
Rendezvous	1	1	0	0	0	0	2	1	1	1	1	0	0	1	0
SweetSpots	1	1	0	0	1	1	1	1	0	1	0	0	0	1	0
Potluck	1	1	0	1	0	0	0	0	1	0	1	0	0	1	0
GroceryShip	1	1	0	2	1	0	0	0	1	0	0	1	0	2	0
Lingua	1	1	0	0	0	0	0	1	0	1	0	0	1	1	1
LiveScorecard	1	1	2	0	0	0	0	0	1	1	2	1	1	1	0

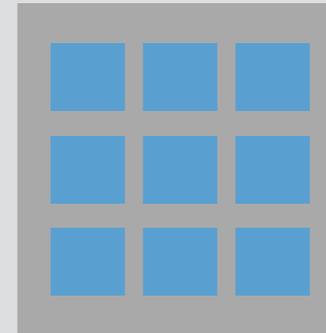
other aspects of deja vu



WYSIWYG designer
(Barry McNamara)



security: stop
request forgeries



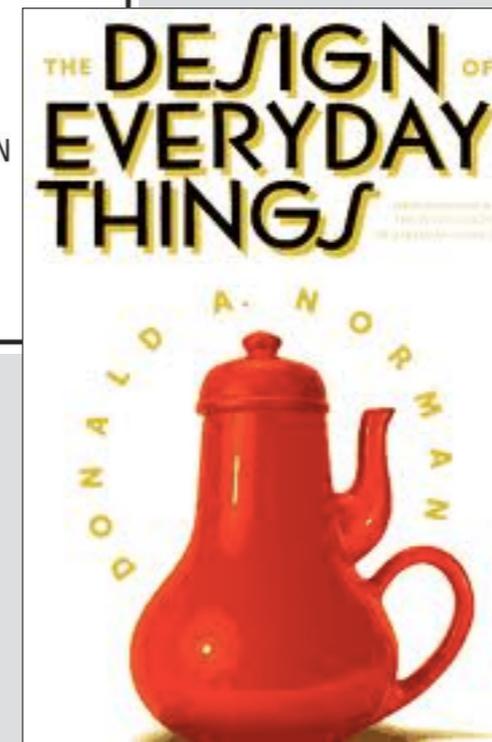
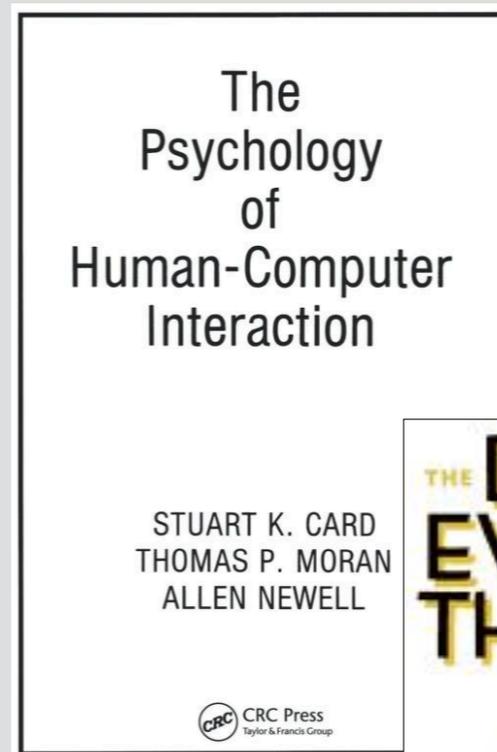
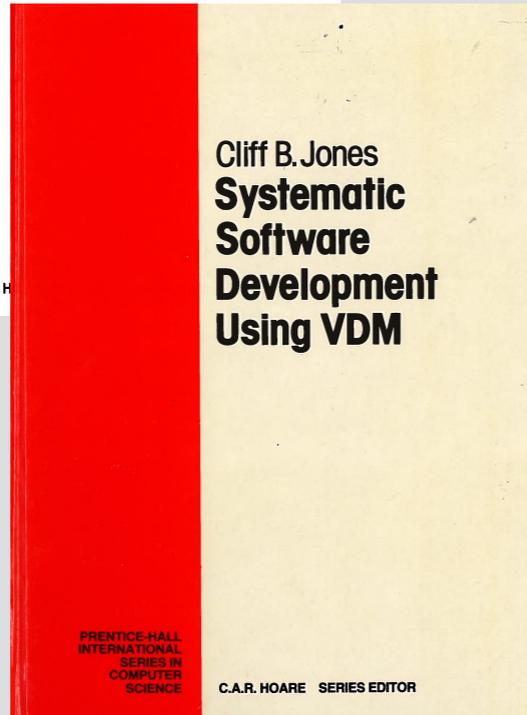
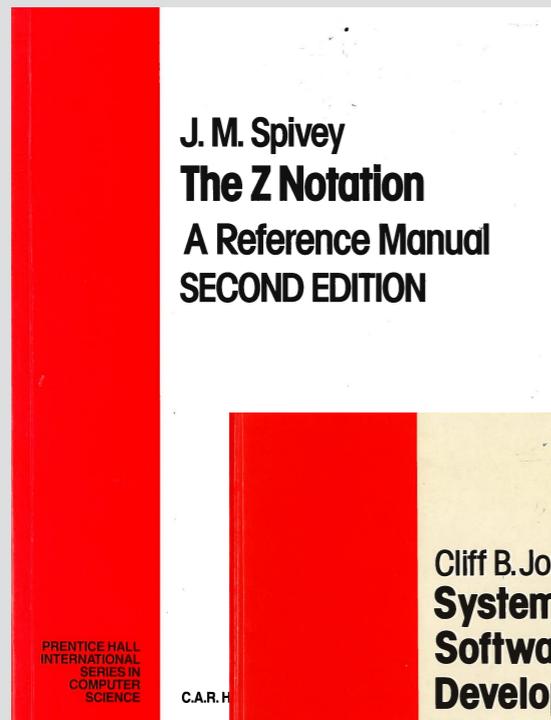
cliche library
for social apps
(Maryam Archie)



make it easier
to author cliches
(Czarina Lao)

closing
thoughts

bringing two fields together



user-centered design: conceptual model should be designed
formal methods: software defined by its behavior
both originating around 1974

<https://tinyurl.com/dbctouch>

to keep in touch and be notified about publication of book

<https://tinyurl.com/postcard-get>

to sign up for monthly resilience postcards

studio 2

facebook



Civility = optimism.

When our country and the world seem to be unraveling, it's tempting to dream of radical responses. If civic norms are undermined daily by the most powerful members of our society, why should we, the little people, not cast them off too? How will we ever save our society, our country, our planet if we continue to be fettered by conventional niceties?

Subscribe to Resilience Postcards at:
<https://www.portraitsofresilience.com/subscribe/...> See More



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👍 Like 💬 Comment ➦ Share

👤 Thank you for writing this Daniel, so true!!!

Like · Reply · 18w



Write a comment...



construct concept models in this order
post, friend, comment, upvote, tag

specify application binding

for each concept, give
purpose: informally stated
structure: text or diagram
behavior: actions specified formally
tactic: informal scenario

hints: make each concept
minimal: only essential functionality
free-standing: makes sense alone
orthogonal: avoid overlap

what issues came up?

reminder: a reservation concept

name

reservation

purpose

make access to shared resource reliable

structure

slots: Owner -> Slot
holds: User -> Slot

behavior

```
create (o: Owner, s: Slot)
  no slots.s => slots += o -> s

reserve (u: User, o: Owner, s: Slot)
  no holds.s and o -> s in slots => holds += u -> s

cancel (u: User, s: Slot)
  u -> s in holds => holds -= u -> s

use (u: User, o: Owner, s: Slot)
  u -> s in holds and o -> s in slots =>
```

tactic

if create(o,s); reserve(u,o,s); ... **no** cancel(u,s) ... **then can** use(u,o,s)

reminder: alloy expressions in one slide

u: User
s: Slot
holds: User -> Slot
Taken: set Slot

a relation is a table of rows

holds = {(u1,s1), (u1,s2)}
holds' = {(u1,s1), (u1,s2), (u2,s3)}

a set is a relation with one column

Slot = {(s1), (s2), (s3), (s4)}
Taken = {(s1), (s2), (s3)}

a scalar is a set with one row

u = {(u2)}
s = {(s3)}

set operators

+ union, - difference, & intersection, in subset

Slot - Taken = {(s4)}
holds' - holds = {(u2,s3)}

relation operators

-> product
.join

product examples

u -> s = {(u2,s3)}
u -> Taken = {(u2,s1), (u2,s2), (u2,s3)}

join examples

u.holds' = {(s3)}
holds'.s = {(u2)}
holds.Slot = {(u1)}

formula examples

holds' = holds + u -> s
(also written holds += u -> s
User.holds = Taken
holds in User -> Slot

$a \rightarrow b = \{ (a_0, \dots, a_n, b_0, \dots, b_m) \mid (a_0, \dots, a_n) \in a \wedge (b_0, \dots, b_m) \in b \}$

$a.b = \{ (a_0, \dots, a_{n-1}, b_1, \dots, b_m) \mid (a_0, \dots, a_n) \in a \wedge (a_n, b_1, \dots, b_m) \in b \}$