Concepts: A New Modularity for Software
Daniel Jackson · MIT CSAIL · SPLASH 2018

with
Santiago Perez De Rosso
& Maryam Archie, Czarina Lao, Barry McNamara

funded by
MIT-SUTD International Design Center
ten years ago...
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.

________________________________________________________
Parents signature                      Date
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[Signature]

Parents signature ___________________________ Date

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February 11, 2013
acrobat to the rescue?
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Thank you!

---

how to add a signature in acrobat
-- open document in acrobat
-- Tools—>Advanced Editing—>Touchup Object Tool
-- right click at desired point | Place Image...
then select jpg

how to add date
-- Tools—>Typewriter
Ms. Frizzle will again be taking her third 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 understand that my child may encounter the normal risks of childhood play, including grazed knees, hurt feelings and exposure to toxic waste.

Parents signature

Date
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Parents signature       Date
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Parents Date

Select All Place Image... Find... Edit Page...
adobe photoshop: cropping surprises
adobe photoshop: cropping surprises
adobe photoshop: cropping surprises
adobe lightroom: easy cropping
adobe lightroom: easy cropping
i’m not alone

from http://amplicate.com
i’m not alone

from http://amplicate.com
i’m not alone
what's the essence of the problem?

not the user interface!
polished and organized
what’s the essence of the problem?

not the user interface!
polished and organized

task-oriented design
no unifying concepts
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
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
Version 9 (2008)

*task-oriented design*

no unifying concepts
Adobe Fixes Acrobat

Version 9 (2008)
- Task-oriented design
- No unifying concepts

Version 10 (2010)
- Improved interface
- But still no concepts
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
thinking about concepts
apps characterized by their concepts

Microsoft Word

Twitter

Photoshop
apps characterized by their concepts

Microsoft Word
Paragraph Format Style

Twitter

Photoshop
apps characterized by their concepts

Microsoft Word
Paragraph Format Style

Twitter
Tweet Hashtag Following

Photoshop
apps characterized by their concepts

Microsoft Word
- Paragraph
- Format
- Style

Twitter
- Tweet
- Hashtag
- Following

Photoshop
- PixelMap
- Layer/Mask
- Adjustment
app classes characterized by concepts too
app classes characterized by concepts too
app classes characterized by concepts too

text editor

word processor
app classes characterized by concepts too

text editor

word processor

desktop publishing app

waffling about concepts and fine points of design
app classes characterized by concepts too

text editor

line

buffer

word processor

desktop publishing app

waffling about concepts

and fine points of design
app classes characterized by concepts too

- **text editor**
  - line
  - buffer

- **word processor**
  - paragraph
  - format
  - style

- **desktop publishing app**

waffling about concepts and fine points of design
app classes characterized by concepts too

text editor
- line
- buffer

word processor
- paragraph
- format
- style

desktop publishing app
- stylesheet
- text flow
- page template

waffling about concepts and fine points of design
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?
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
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
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.
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...
explaining concepts

how to explain the style concept?

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**not ontological:** “a style is a mapping...”
explaining concepts

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Johnson-Laird: constructive semantics
explaining concepts

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

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

Johnson-Laird: constructive semantics

Michael Polanyi: operational principle
when concepts don’t fulfill purpose
when concepts don’t fulfill purpose
when concepts don’t fulfill purpose

Font:

Font style:

Size:

Font color:

Underline style:

Underline color:

Can be left blank

Cannot be blank
when concepts don’t fulfill purpose

Alexander’s *misfits*:
not bugs but bad specs
concepts: modules of behavior
concepts: modules of behavior
concepts: modules of behavior

inventive
concepts: modules of behavior

inventive

purposeful
concepts: modules of behavior

- inventive
- purposeful
- behavioral
concepts: modules of behavior

- inventive
- purposeful
- behavioral
- self-contained
concepts: modules of behavior

- inventive
- purposeful
- behavioral
- self-contained
- reusable
the style concept
the style concept

name
the style concept

name

purpose
name

purpose

structure
the style concept

name

purpose

structure

actions
the style concept

name

purpose

structure

actions

operational principle
the style concept

name  style

purpose

structure

actions

operational principle
<table>
<thead>
<tr>
<th>name</th>
<th>style</th>
</tr>
</thead>
<tbody>
<tr>
<td>purpose</td>
<td>enable consistent formatting</td>
</tr>
<tr>
<td>structure</td>
<td></td>
</tr>
<tr>
<td>actions</td>
<td></td>
</tr>
<tr>
<td>operational principle</td>
<td></td>
</tr>
</tbody>
</table>
the style concept

name: style

purpose: enable consistent formatting

structure:
- style: Element → Style
- value: Style → Property → Value

actions

operational principle
the style concept

<table>
<thead>
<tr>
<th>name</th>
<th>style</th>
</tr>
</thead>
<tbody>
<tr>
<td>purpose</td>
<td>enable consistent formatting</td>
</tr>
</tbody>
</table>
| structure | style: Element → Style  
| | value: Style → Property → Value |
| actions | new (pv: Property → Value) ≡ new s l value := value + s → pv  
| | delete (s: Style) ≡ style := style - Element → s  
| | assign (e: Element, s: Style) ≡ style := style ++ e → s  
| | modify (s: Style, p: Property, v: Value) ≡ value(s) := value(s) ++ p → v |

operational principle
the style concept

**name**  
*style*

**purpose**  
enable consistent formatting

**structure**  
style: Element $\rightarrow$ Style  
value: Style $\rightarrow$ Property $\rightarrow$ Value

**actions**  
new (pv: Property $\rightarrow$ Value) $\triangleq$ new s | value := value + s $\rightarrow$ pv  
delete (s: Style) $\triangleq$ style := style - Element $\rightarrow$ s  
assign (e: Element, s: Style) $\triangleq$ style := style ++ e $\rightarrow$ s  
modify (s: Style, p: Property, v: Value) $\triangleq$ value(s) := value(s) ++ p $\rightarrow$ v

**operational principle**  
if you create a new style, and assign it to two elements, and then modify the style, both elements will have the same property/value mapping
a research & teaching program

designing software with concepts

- a design theory
- design case studies
- design patterns
- code platform

concept structure & design rules [Onward 15]

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

about 30 so far

Deja Vu [Perez De Rosso]
three design problems
gmail categories
### Gmail's Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Subject</th>
<th>Details</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Google</td>
<td>New sign-in from Chrome on Mac</td>
<td>12:30 pm</td>
</tr>
<tr>
<td></td>
<td>Keith Muhammad at DeMont.</td>
<td>DeMontrond Auto Group - 14101 North Freeway Housto</td>
<td>12:19 pm</td>
</tr>
<tr>
<td></td>
<td>AT&amp;T High Speed Internet.</td>
<td>AT&amp;T High Speed Internet Service Activation - Your A1</td>
<td>10:37 am</td>
</tr>
<tr>
<td></td>
<td>Keith Muhammad at DeMont.</td>
<td>DeMontrond Auto Group - 14101 North Freeway Housto</td>
<td>Aug 26</td>
</tr>
<tr>
<td></td>
<td>betterbatonrougejobs.com</td>
<td>Job Update -- 2015-08-26 - Looking For An Advantage W</td>
<td>Aug 26</td>
</tr>
</tbody>
</table>
Choose which message categories to show as inbox tabs. Other messages will appear in the Primary tab.
some reactions
Everything You Need to Know About Gmail's New, Super-Confusing Layout

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

301,482  12  star

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

By Mark Wilson | Published 2 years ago | Follow

Like many Gmail users, I greeted the news of the introduction of tabs to the interface with a degree of anticipation -- now it was just a matter of waiting for the feature to roll out so I could try it for myself. Earlier today I was randomly signed out of my Gmail account, and after signing back in and checking the settings menus, I could see that tabs were now available to me. Excitement was short-lived, however; it quickly became apparent that this new feature is a disaster.
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!
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
what you can’t do

associate tabs with labels
feature available only for categories
what you can’t do

associate tabs with labels
feature available only for categories

create new categories
only new labels
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
image quality setting

- Fine
- Normal
- Fine+RAW
- Normal+RAW
- RAW
image quality setting

- FINE
- NORMAL
- FINE+RAW
- NORMAL+RAW
- RAW
aspect ratio
aspect ratio
image size setting
<table>
<thead>
<tr>
<th>Image Size</th>
<th>Frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:2</td>
<td>664</td>
</tr>
<tr>
<td>16:9</td>
<td>681</td>
</tr>
<tr>
<td>1:1</td>
<td>702</td>
</tr>
<tr>
<td>3:2</td>
<td>707</td>
</tr>
<tr>
<td>16:9</td>
<td>719</td>
</tr>
<tr>
<td>1:1</td>
<td>734</td>
</tr>
<tr>
<td>3:2</td>
<td>746</td>
</tr>
</tbody>
</table>

*4896x3264 (16M)*
image size setting
image size setting
non-standard ratio + raw?
what you can’t do

non-standard aspect ratio + raw
even though raw images get nice nondestructive crop!
what you can’t do

non-standard aspect ratio + raw
even though raw images get nice nondestructive crop!
what’s a font?
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
introducing a concept

Keynote ’09: has subfamilies
introducing a concept

Keynote ’09: has subfamilies

Keynote 6: gone again!
what’s going on?
what’s going on?

gmail
one purpose :: two concepts
organizing messages :: label + category
what’s going on?

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

camera
two purposes :: one concept
aspect ratio + image resolution :: image size
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
one-to-one mapping

purposes: P1

concepts: C1

purposes: P2

concepts: C2
one-to-one mapping

purposes

P1

C1

P2

C2

concepts

Nam Suh: Axiomatic Design
four ways to fail

unfulfilled purpose

unmotivated concept

overloaded concept

redundant concepts
overloading

fuji camera

new purpose piggybacked on old concept
new purpose piggybacked on old concept

<table>
<thead>
<tr>
<th></th>
<th>3:2</th>
<th>664</th>
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<tr>
<td>L</td>
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</tr>
<tr>
<td>S</td>
<td>3:2</td>
<td>746</td>
</tr>
</tbody>
</table>

image size
aspect ratio piggybacked on JPEG dimensions
overloading epson driver
overloading epson driver
overloading epson driver
overloading epson driver
overloading epson driver
overloading epson driver

result: can’t create custom size for front loading
also, page size presets in Lightroom hold feed setting
new purposes emerge for old concept
new purposes emerge for old concept

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

initial purpose: summarize content
overloading email subject

new purposes emerge for old concept

initial purpose: summarize content

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

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

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

thanks to Shriram Krishnamurthi
overloading email subject

new purposes emerge for old concept

initial purpose: summarize content

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

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

thanks to Shriram Krishnamurthi

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

emergent purpose: group by conversation

thanks to Eunsuk Kang

can’t label reservations from Expedia by trip
the uniformity rule
the uniformity rule

the operational principle should apply uniformly over states, types, arguments
the uniformity rule

the operational principle should apply uniformly over states, types, arguments

Numbers range: ... unless new cell is at end
the uniformity rule

the operational principle should apply uniformly over states, types, arguments

Keynote group: ... unless object is placeholder

Numbers range: ... unless new cell is at end
the uniformity rule

the operational principle should apply uniformly over states, types, arguments

Numbers range: ... unless new cell is at end

Keynote group: ... unless object is placeholder

Git branch: ... unless conflicts
the uniformity rule

the operational principle should apply uniformly over states, types, arguments

Numbers range: ... unless new cell is at end

Git branch: ... unless conflicts

Keynote group: ... unless object is placeholder

Dropbox share: ... unless ancestor
the genericity rule
the genericity rule

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

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

reusing a well-known generic concept is usually preferable to inventing one
the genericity rule
reusing a well-known generic concept is usually preferable to inventing one
the integrity rule
slightly surprising gmail behavior

<table>
<thead>
<tr>
<th>Primary</th>
<th>Social</th>
<th>Promotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️  ★  me, Alyssa (12)</td>
<td>hacking meetups javascript - Hello again B¢</td>
<td>11:48 am</td>
</tr>
</tbody>
</table>
slightly surprising gmail behavior
slightly surprising gmail behavior

<table>
<thead>
<tr>
<th>Folder</th>
<th>Search</th>
<th>Label</th>
<th>Sent By</th>
<th>Subject</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td></td>
<td>me, Alyssa (12)</td>
<td>hacking</td>
<td>javascript - Hello again Ben.</td>
<td>11:48 am</td>
</tr>
<tr>
<td>Social</td>
<td>label:hacking</td>
<td>me, Alyssa (12)</td>
<td></td>
<td>javascript - Hello again Ben.</td>
<td>9:43 am</td>
</tr>
<tr>
<td>Promotions</td>
<td>label:meetups</td>
<td>me, Alyssa (12)</td>
<td>hacking</td>
<td></td>
<td>9:58 am</td>
</tr>
</tbody>
</table>
slightly surprising gmail behavior
less surprising but more problematic?
less surprising but more problematic?
less surprising but more problematic?
less surprising but more problematic?

can’t see which messages were sent
interpreting composite behavior

each action in composite system
interpreted as zero or more actions in each concept
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:
\( \forall c: \text{concept} \mid \forall t: \text{traces(sys)} \mid R_c(t) \in \text{traces}(c) \)
the integrity rule

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∀ c: concept | ∀ t: traces(sys) | Rc(t) ∈ traces(c)
the integrity rule

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a simple criterion

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

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a simple criterion
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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:
∀ c: concept | ∀ t: traces(sys) | R_c(t) ∈ traces(c)
the label concept

**Purpose**
organize items for easy retrieval

**State**
labels: \( X \to Label \)

**Actions**
- mark \( (x: X, p: Label) \triangleq \text{labels}' = \text{labels} + x \to p \)
- unmark \( (x: X, p: Label) \triangleq \text{labels}' = \text{labels} - x \to p \)

**Spec**

find \( (ps: \text{set Label}): \text{set } X \triangleq \text{result} = \{x \mid ps \text{ in } x.labels\} \)

**Operational Principle**

mark \((x,p)\) then find \((p):xs \Rightarrow x \text{ in } xs\)

if no mark \((x,P)\) and then find \((p):xs \Rightarrow x \notin \text{in } xs\)
conversation breaks label
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?
conversation breaks label

when message \( m \) is sent

Label.mark(\( m \), 'sent')
occurs implicitly
conversation breaks label

when message \( m \) is sent
\[
\text{Label.mark}(m, \text{'sent'})
\]
occurs implicitly

when Sent link is clicked
\[
\text{Label.find('sent'):ms}
\]
occurs
conversation breaks label

when message m is sent
Label.mark(m, 'sent')
occurs implicitly

when Sent link is clicked
Label.find('sent'):ms
occurs

but ms includes
messages never marked
deja vu
reversing the process
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
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 cliche actions
architecture of deja vu

post
comment
upvote

client-side library

post
comment
upvote

client

gateway

server
architecture of deja vu

client

post

comment

upvote

client-side library

gateway

post

comment

upvote

server
<table>
<thead>
<tr>
<th>Title</th>
<th>Link(s)</th>
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</thead>
<tbody>
<tr>
<td>SPLASH 2018</td>
<td>(2018.splashcon.org)</td>
<td>3</td>
<td>eva</td>
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**DV Hacker News**  Submit

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a sample app

DV Hacker News  Submit

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a sample app

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

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

```
"routes": [
    { "route": 
      "news", "action": "home" 
    },
    { "route": 
      "post", "action": "post-detail" 
    },
    { "route": 
      "login", "action": "login" 
    },
    { "route": 
      "submit", "action": "submit-post" 
    }
]
```
SVLASH 2018 (2018.splashcon.org)
3 points by eva | comments

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
<dv.action name="home">
  <hackernews.navbar />
<dv.action name="home">
  <hackernews.navbar />

<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>
</dv.action>
</dv.action>
<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Url</td>
<td></td>
</tr>
</tbody>
</table>

Submit
<dv.action name="submit-post">
<dv.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 submitted" />
    <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>
<dv.action name="submit-post">
<hackernews.navbar />
<div class="main">
    <dv.tx>
        <dv.gen-id />
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<dv.link href="/item" params={ id: dv.gen-id.id } />
</dv.tx> </div> </dv.action>
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submit post action

```html
<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"]
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      newObjectSavedText="Post submitted" />
    <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 name="submit-post">
<hackernews.navbar />
<div class="main">
<dv.tx>
<dv.gen-id />
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rebuilding class projects
deja vu plans

WYSIWYG designer (Barry McNamara)

cliche library for social apps (Maryam Archie)

gateway

security: stop request forgeries

cliche support

make it easier to author cliches (Czarina Lao)
closing thoughts
user-centered design: conceptual model should be designed
formal methods: software defined by its behavior
both originating around 1974
putting the “thinking” into “design thinking”

**theory of usability**: collections of heuristics

**design thinking**: focused on empirical evaluation

see Natasha Jen, *Design Thinking is Bullsh*t*
patterns

concepts: more like Alexander's patterns?
https://tinyurl.com/conceptproject
to be notified about release of book & platform
a different project

Portraits of Resilience
Daniel Jackson
foreword by David A. Karp

http://portraitsofresilience.com