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

with
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& Maryam Archie, Czarina Lao, Barry McNamara

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

[Signature]

February 11, 2013

Parents signature       Date
acrobat to the rescue?

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

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
adobe photoshop: cropping surprises
adobe lightroom: easy cropping
i’m not alone

from http://amplicate.com
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
thinking
about
concepts
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

- 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?)
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.

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

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

name: style

purpose: enable consistent formatting

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

actions:
new (pv: Property → Value) ≜ new s | 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:
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
<table>
<thead>
<tr>
<th>Primary</th>
<th>Social</th>
<th>Promotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Star Gmail</td>
<td>[ ] Trash</td>
<td>[ ] Archive</td>
</tr>
<tr>
<td>[ ] Star Google</td>
<td>New sign-in from Chrome on Mac - New sign-in from Cr</td>
<td>12:30 pm</td>
</tr>
<tr>
<td>[ ] Star Keith Muhammad at DeMont.</td>
<td>DeMontrond Auto Group - 14101 North Freeway Housto</td>
<td>12:19 pm</td>
</tr>
<tr>
<td>[ ] Star 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>[ ] Star Keith Muhammad at DeMont.</td>
<td>DeMontrond Auto Group - 14101 North Freeway Housto</td>
<td>Aug 26</td>
</tr>
<tr>
<td>[ ] Star betterbatonrougejobs.com</td>
<td>Job Update -- 2015-08-26 - Looking For An Advantage W</td>
<td>Aug 26</td>
</tr>
</tbody>
</table>
category tab settings

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

Categories:
- Primary
- Social
- Promotions
- Updates
- Forums

Starred messages
- Include starred in Primary
Like many Gmail users, I greeted the news

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.
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

- Fine
- Normal
- Fine+Raw
- Normal+Raw
- Raw
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
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

image size
aspect ratio piggybacked on JPEG dimensions
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

initial purpose: summarize content

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

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

thanks to Shriram Krishnamurthi

thanks to Eunsuk Kang
the uniformity rule
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

Dropbox share: ... unless ancestor
the genericity rule
the genericity rule
reusing a well-known generic concept is usually preferable to inventing one
the integrity rule
slightly surprising gmail behavior
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
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 label concept

**purpose** organize items for easy retrieval

**state** labels: \( X \rightarrow Label \)

**actions**
- mark \((x: X, p: Label) \rightarrow labels' = labels + x \rightarrow p\)
- unmark \((x: X, p: Label) \rightarrow labels' = labels - x \rightarrow p\)

**spec**
- find \((ps: set Label): set X \triangleq result = \{x | ps \in x.labels\}\)

**operational principle**
- mark\((x,p)\) then find\((p):xs \Rightarrow x \in xs\)
- if no mark\((x,P)\) and then find\((p):xs \Rightarrow x \notin xs\)
when message \( m \) is sent

\[
\text{Label.mark}(m, \text{'sent'})
\]

occurs implicitly

when Sent link is clicked

\[
\text{Label.find('sent')}:ms
\]

occurs

but \( ms \) includes messages never marked
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 cliche actions
architecture of deja vu

- app
- action
- post
- comment
- upvote
- client
- server
- client-side
  library
- gateway
  post
  comment
  upvote
a sample app

```
{
  "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" }]
```
<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

```html
<dv action name="submit-post">
  <hackernews.navbar />
  <div class="main">
    <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 />
  </dv.txt>
  <authentication.authenticate id=hackernews.navbar.user hidden=true />
  <dv.link href="/item" params={ id: dv.gen-id.id } />
</dv.txt></div></dv.action>
```
rebuilding class projects
deja vu plans

- WYSIWYG designer (Barry McNamara)
- gateway 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
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

... according to South Facing Outdoors (105), the building is placed in such a way as to allow the sun to shine directly into it, across its gardens. From intimacy gradient (137), you have some idea of the overall distribution of public and private rooms within the building. This pattern marks those rooms and areas along the intimacy gradient which need the sunlight most, and helps to place them so that the indoor sunlight can be made to coincide with the rooms in the intimacy gradient which are most used.

+++ 

If the right rooms are facing south, a house is bright and sunny and cheerful; if the wrong rooms are facing south, the house is dark and gloomy.

Everyone knows this. But people may forget about it, and get confused by other considerations. The fact is that very few things have so much effect on the feeling inside a room as the sun shining into it. If you want to be sure that your house, or building, and the rooms in it are wonderful, comfortable places, give this pattern its due. Treat it seriously; cling to it tenaciously; insist upon it. Think of the rooms you know which do have sunshine in them, and compare them with the many rooms you know that don't.

From the pattern South Facing Outdoors (105), the building gets an orientation toward the south. Now the issue is the particular arrangement of rooms along this south edge. Here are some examples: (1) a porch that gets the evening sun late in the day; (2) a breakfast nook that looks directly into a garden which is sunny in the mornings; (3) a bathroom arranged to get full morning sun; (4) a workshop that gets full southern exposure during the middle of the day; (5) an edge of a living room where the sun falls on an outside wall and warms a flowering plant.

The key diagram for this pattern summarizes the relations between parts of the house and the morning, the afternoon and

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