rethinking software design

Daniel Jackson · CSAIL · MIT

SATURN Conference · San Diego · May 4, 2016
what is software design?
## designers & engineers

<table>
<thead>
<tr>
<th>elements</th>
<th>designer</th>
<th>engineer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>door, window, wall</td>
<td>column, beam, truss</td>
</tr>
<tr>
<td>goals</td>
<td>comfortable, convenient, attractive</td>
<td>structural integrity, durable, sustainable</td>
</tr>
<tr>
<td></td>
<td>designer</td>
<td>engineer</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>elements</td>
<td>?</td>
<td>function, object, type</td>
</tr>
<tr>
<td>goals</td>
<td>learnable, effective, tolerant</td>
<td>maintainable, correct, fast</td>
</tr>
</tbody>
</table>
the role of design criteria

<table>
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<th>elements</th>
<th>designer</th>
<th>engineer</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>function, object, type</td>
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<tr>
<td>criteria</td>
<td>?</td>
<td>decoupling &amp; localization</td>
</tr>
<tr>
<td>goals</td>
<td>learnable, effective, tolerant</td>
<td>maintainable, correct, fast</td>
</tr>
</tbody>
</table>
WARNING

OBSESSIVE DETAILS AHEAD
That’s quite obsessive, isn’t it?
Jonathan Ive in “Objectified”

The details are not the details. These make the design.
attributed to Charles Eames by Garrett
Someone accidentally deleted thousands of files in my company Dropbox: how can I quickly undelete them?
survey of MIT Dropbox users

correctly predicting behavior

good knowledge | average knowledge | poor knowledge

- delete shared folder results in leaving
- delete shared subfolder removes it

Kelly Zhang
3

software design problems
#1
email categories
gmail's categories

<table>
<thead>
<tr>
<th>Primary</th>
<th>Social</th>
<th>Promotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keith Muhammad at DeMont.</td>
<td>DeMontrond Auto Group - 14101 North Freeway Housto</td>
<td>12:19 pm</td>
</tr>
<tr>
<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>Keith Muhammad at DeMont.</td>
<td>DeMontrond Auto Group - 14101 North Freeway Housto</td>
<td>Aug 26</td>
</tr>
<tr>
<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.
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.
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

use tabs outside inbox
tabs disappear when you filter on a label
#2 camera settings
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!
#3 fonts & 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
what kind of problems are these?

- **Minor nitpicks?**
  - in all cases, can’t do useful things

- **Coding bugs?**
  - code seems to meet a coherent spec

- **User interface flaws?**
  - interfaces are clear and faithful to function
getting to the essence of an app
what characterizes an app?

**concepts!**

- Apple Mail
  - EmailAddress
  - Message
  - Folder or Label

- Microsoft Word
  - Paragraph
  - Format
  - Style

- Twitter
  - Tweet
  - Hashtag
  - Following

- Photoshop
  - PixelMap
  - Layer/Mask
  - Adjustment
concepts define classes

- 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 [this](http://www.macobserver.com/tmo/article/pages-linking-text-boxes)

Am I missing something, or is it really not possible anymore?
where are Word’s concepts from?

Charles Simonyi: brought key concepts to Word from Xerox PARC
rich concepts have long journeys
kinds of concept

even these were invented

**given concepts**
- electoral vote
- reservation
- social security number
- calendar event

**instrumental concepts**
- hashtag
- label
- friend
- follower

**enabling concepts**
- relative reference
- public key
- layer mask
- conference call

analogical, or new

solve a hard design problem

even these were invented

analogical, or new

solve a hard design problem
how to sketch a concept
how would you explain this?
the operational principle
a way to explain a concept

an archetypal scenario
separates essential from accidental aspects
shows how purpose is fulfilled
by combination of user & system actions

“if you pull a tab out, then when that time slot comes around, the light will go on”

Michael Polanyi
“if you change a style’s format, then all paragraphs of that style will change format accordingly”

“if you pull a tab out, then when that time slot comes around, the light will go on”

“if you select some files and they belong to a folder with keyboard focus, then pressing delete will move the files to the trash”

“if you tag a photo, then all friends of the person tagged will be able to see the photo”
purposes, principles & misfits

**concept:** trash

**purpose:** allow undo of deletions

**operational principle:** if you delete a file, it moves to a special folder; you can restore from there, but emptying it removes contents for good (and makes space on disk)

**misfit:** if you delete a file on an external drive, you cannot reclaim the space until you empty the trash, but then you’ll lose the ability to restore files deleted from the main drive

**misfit:** if you delete an old file and change your mind, you may not be able to find it again in the trash (if there are many deleted files and you forgot the file’s name)
how to model a concept
example word styles
There is no problem in computer science that cannot be solved by introducing another level of indirection. 

*David Wheeler*
concept dependences

\[ \langle c, c' \rangle \in \text{depends} \iff \forall a : \text{apps} \cdot c \in \text{concepts}(a) \Rightarrow c' \in \text{concepts}(a) \]
how to reuse a concept
other instantiations style

Powerpoint schemes

Indesign swatches
non-instantiations style

Apple color picker
swatch-color mapping fixed

Write 2 text editor
no element-style mapping
style generic concept

Element → Style → Rule → Value → Property

Stylesheet → Style → Style → Name

Element → Name

Style basedOn? Style next? Style name

Rule value !

Property !
# generic concept parts

<table>
<thead>
<tr>
<th>part</th>
<th>example</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td><strong>Style</strong></td>
</tr>
<tr>
<td>purpose</td>
<td>make it easy to maintain consistent format across set of elements</td>
</tr>
<tr>
<td>sample uses</td>
<td>Text formatting in word processors/layout apps (Word, Indesign, Pages, etc); rules in CSS; color themes in Powerpoint.</td>
</tr>
<tr>
<td>model</td>
<td><em>base, add-ons, variants</em></td>
</tr>
<tr>
<td>operations</td>
<td>add, delete, modify, apply, update</td>
</tr>
<tr>
<td>related to</td>
<td><strong>StyleBuffer, Stencil, Master</strong></td>
</tr>
<tr>
<td>issues</td>
<td>optional rules problem</td>
</tr>
</tbody>
</table>
concept selection

slides in Keynote

photos in Adobe Lightroom

messages in Apple Mail

objects in OS X Finder

thumbnails in Preview

notes in Evernote
subtlety selection scope

subset of selection in scope

subset of selection out of scope
Adobe Lightroom: brightest thumbnail is the “active photo”
subtlety continuous selection

Photoshop: outline shown with “marching ants”

Photoshop: selection shown in Quick Mask mode
subtlety folder selection

Google Drive: selecting folder = selecting children

CrashPlan: selecting folder = selecting all future children
Purposes: apply action in aggregate to many items at once
## Concept Catalog (so far)

<table>
<thead>
<tr>
<th>Instantiate</th>
<th>Organize</th>
<th>Relate</th>
<th>Resource</th>
<th>Save</th>
<th>Communicate</th>
<th>Personalize</th>
</tr>
</thead>
<tbody>
<tr>
<td>stylesheet</td>
<td>selection</td>
<td>friend</td>
<td>access token</td>
<td>history</td>
<td>message</td>
<td>account</td>
</tr>
<tr>
<td>master</td>
<td>folder</td>
<td>clique</td>
<td>notification</td>
<td>buffer</td>
<td>posting</td>
<td>karma</td>
</tr>
<tr>
<td>stencil</td>
<td>group</td>
<td>invitation</td>
<td>reservation</td>
<td>cursor</td>
<td></td>
<td>OOBA</td>
</tr>
<tr>
<td>style buffer</td>
<td>label</td>
<td>REST</td>
<td>sync</td>
<td></td>
<td></td>
<td>rating</td>
</tr>
<tr>
<td>style buffer</td>
<td>layer</td>
<td>cart</td>
<td>export</td>
<td></td>
<td></td>
<td>status</td>
</tr>
<tr>
<td>style buffer</td>
<td>stack</td>
<td>subscription</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>style buffer</td>
<td>alias</td>
<td>purchase order</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>style buffer</td>
<td>preset</td>
<td>RMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>style buffer</td>
<td>cursor</td>
<td>coupon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>style buffer</td>
<td>filter</td>
<td>catalog</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>style buffer</td>
<td>property</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>style buffer</td>
<td>metadata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
how to evaluate a concept
the fundamental principle

in a well-designed system
each concept is motivated by one purpose
the ideal mapping

purposes

P1

C1

P2

C2

concepts
4 bad smells

unfulfilled purpose

overloaded concept

unmotivated concept

redundant concepts
unfulfilled purposes

Adobe Indesign: an unfulfilled purpose

allow
typeface
independent
styling

subfamily
introducing a concept

Keynote '09: has subfamilies

Keynote 6: gone again!
unfulfilled purposes (more)

- **user** (Apple Mail, Gmail)
  - ‘identify parties to communication’
  - weak search, no authentication

- **slide hierarchy** (Powerpoint)
  - ‘structure slides in a tree’
  - sections provide just one level

- **eject-after-import** (Lightroom)
  - ‘prevent accidental writing’
  - feature removed (and reinstated!)

- **binder** (Preview, Acrobat)
  - ‘maintain composite PDF doc’
  - can insert pages, but forgets source
unmotivated concepts

You never poke me on Facebook anymore.
unmotivated concepts (more)

- **buffer** (text editors)
  - Apple got rid of it

- **stash** (Git)
  - addresses branching misfits

- **boxing** (Java)
  - addresses primitives vs objects misfit

- **null** (Javascript)
  - when undefined is too vague
redundant concepts

classify messages

label

category

category in Gmail
a redundant concept
redundancy elimination in Acrobat

**Acrobat 10**

Image of Adobe Acrobat 10 showing the toolbars and a document with text. The image highlights the *Add Text* tool in the *Content Editing* panel. A note is made: "1 concept".
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]

3 forms of overloading:
- **piggybacking** new purpose hacked onto old concept
- **false convergence** two purposes looked the same
- **emergent purpose** users found second purpose for concept
piggybacking fuji camera
new purpose hacked onto old concept

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
two purposes looked the same

Performance Review Form 2016

Performance Summary

Evaluate and discuss the employee’s performance. Base your evaluation on the position requirements, MIT Core Competencies, achievement of the goals established during the past year, and your assessment of the employee’s accomplishments.

Goal Setting

State and discuss the expectations and goals for the upcoming review period. Give examples of how these goals can be met (e.g., training). How will you support the employee to accomplish these goals? Reference here

evaluation & goal setting
incompatible purposes
false convergence

two purposes looked the same

filter incoming posts
control access to my posts

distinct purposes

2011: Facebook added subscribe/follow
emergent purpose
users find second purpose for concept

initial purpose: summarize content

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

thanks to Shriram Krishnamurthi

emergent purpose: group by conversation

emergent purpose: group by conversation

thanks to Eunsuk Kang
gitless: a case study
This is Git. It tracks collaborative work on projects through a beautiful distributed graph theory tree model.

Cool. How do we use it?

No idea. Just memorize these shell commands and type them to sync up. If you get errors, save your work elsewhere, delete the project, and download a fresh copy.
Gitless: a version control system

About Gitless

Gitless is an experimental version control system built on top of Git. Many people complain that Git is hard to use. We think the problem lies deeper than the user interface, in the concepts underlying Git. Gitless is an experiment to see what happens if you put a simple veneer on an app that changes the underlying concepts. Because Gitless is implemented on top of Git (could be considered what Git pros call a "porcelain" of Git), you can always fall back on Git. And of course your coworkers you share a repo with need never know that you're not a Git aficionado.

Check out the documentation to get started. If you are a novice user that never used any version control system the documentation should be enough to get you started. If you are a Git pro looking to see what's different from your beloved Git you'll be able to spot the differences by glancing through the Gitless vs. Git section.

Download

- Mac OS X Binary (.tar.gz)
- Linux Binary (.tar.gz)
- Source Code (.tar.gz)

For installation instructions see the readme file. After installation, you should be able to execute the gl command. The current Gitless version is 0.7 which was released on 4/2015 (release notes).

Santiago Perez De Rosso
example: branch

**concept:** branch

**purpose:** support independent line of development

**operational principle:** when you switch branches, your working directory is synchronized with the new branch, and you can make and commit changes which will be invisible on other branches; when you’re done, you can merge the branch into the master branch...

**misfit:** can’t switch branches with uncommitted changes; can stash, but only if no conflicts...

**fix:** give branch its own working directory; when you switch branches, the working directory changes too, and the working directory associated with the previous branch is preserved
I enjoyed using Gitless. I found Gitless to be easier to use than Git. I found Gitless to be easier to learn than Git. I would continue using Gitless if I could.
conclusions
<table>
<thead>
<tr>
<th></th>
<th>designer</th>
<th>engineer</th>
</tr>
</thead>
<tbody>
<tr>
<td>elements</td>
<td>concepts <strong>¿</strong> purposes</td>
<td>function, object, type</td>
</tr>
<tr>
<td>criteria</td>
<td>1:1 = concept <strong>¿</strong> purpose</td>
<td>decoupling &amp; localization</td>
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<td>goals</td>
<td>learnable, effective, tolerant</td>
<td>maintainable, correct, fast</td>
</tr>
</tbody>
</table>
but how to choose increment?

how to structure design step?
a software design approach

users

structured needs of

motivate

developers

built by

evaluate

criteria

purposes

drive

concepts

related by

suggest

patterns

increments

organize

dependences
backup material
a new view
a common view of software design

UI design
soft & human
about presentation

programming
hard & technical
about content
a better view of software design

conceptual design: essential concepts & behavior

representation design: organization & performance
designing on purpose
design is driven by purpose

purpose

motivates

fulfills?

contrivance

misfit

✘

not a counterexample
example: a photo wall

changeable wall display of prints

motivates

fulfills?

adhesive corners

corkboard tiles

magnetic paint

not strong enough

damages prints

✔
as implemented
refining the purpose with misfits

- adhesive corners
- corkboard tiles
- magnetic paint

- strong enough
- no damage

- anticipated misfits
- unanticipated misfits

motivates

fulfills?
Such a list of requirements is potentially endless... But if we think of the requirements from a negative point of view, as potential misfits, there is a simple way of picking a finite set.
concepts driven by purposes too

application purpose

purpose

purpose

purpose

motivates

motivates

motivates

fulfills?

fulfills?

fulfills?

concept

concept

concept

application
example: microsoft word

create & format documents

- consistency within docs
- provide structure
- consistency across docs

motivates

style
paragraph
stylesheet

microsoft word
concepts are machines
example word styles
There is no problem in computer science that cannot be solved by introducing another level of indirection.

*David Wheeler*
concepts are closed
state & all relevant operations

concepts are situated
not awaiting composition
so a concept is not ...
OPs vs user stories
operational principle (vs user story)

connects to purpose
so OP for trash must include restore

has sufficient span
so OP for secure trash must go up to data recovery

separates essential from accidental
so OP for trash doesn’t say files disappear when eject disk
efficiency in design
sharing: the essence of good design?

thanks to Yishai Feldman
when overloading is acceptable

congrete purposes

abstract purpose

concept

P1

P2

P

C
shared concept amazon lists

Your Lists

Your Friends

Wish List

Find Items Across Your Lists

Wish List (15) Private

Shopping List (2) Private

Wish List

Add to list

Save an idea. Shop for it later.

Before They Pass Away
by Jimmy Nelson (Hardcover)

4.5 stars (149)

$99.37 Prime

Price dropped 13% (was $115.20 when added to List)

In Stock. Offered by Amazon.com.

53 Used & New from $95.32

Add comments, quantity & priority

What Can We Believe Where?: Photographs of the American West (Yale University Art Gallery)
by Robert Adams, Joshua Chuang, Jock Reynolds (Paperback)

4.5 stars (5)

$23.11 Prime

Only 7 left in stock--order soon. Offered by Amazon.com.

50 Used & New from $13.64

Add comments, quantity & priority
abstract purpose amazon lists

concrete purposes

- get friends to buy you items
- remember to buy items later

abstract purpose

record items you want

concept

list
shared concept doodle poll

concrete purpose: schedule a meeting

concrete purpose: vote on a choice
shared concept grayscale image in Ps

greyscale image

brushing pixels

brushing pixels in layer mask
shared concept placeholder

Keynote: no shared concept for title & body

Keynote: shared concept of placeholder
risks of shared concepts

limited functionality for concrete purpose

security & safety oversights

unexpected couplings

Doodle doesn’t offer some scheduling specific functionality that when2meet offers

Amazon wishlists privacy risk

http://www.dailymail.co.uk/news/article-2984542

Google forms: spreadsheet not synced with responses
The rôle of a formal functional specification is simply to act as a logical firewall between two completely different concerns... The pleasantness problem concerns the question whether a system... would satisfy our needs... The correctness problem concerns the question whether a given design meets such-and-such a formal functional specification. The logical firewall ... isolates computing science’s well-carved niche from the pleasantness problem to which science has little to contribute. Please note that I did not say that the one problem is more important than the other; after all, no chain is stronger than its weakest link.
user interface levels

shallower

- physical level
- linguistic level
- navigation level
- conceptual level

deeper
concept distinctions
given vs instrumental concepts

Instrumental: invented for app
- banking app
  - overdraft protection loan
  - automatic bill payment
  - available funds balance
  - account balance

Given: preexisted in domain
- social networking app
  - friendship
  - tag
  - post
  - photo
  - URL
- travel app
  - itinerary
  - agony factor
  - passenger profile
  - flight number
  - reservation

Note that all concepts, even given concepts are a means to an end.
these are not concepts...

but this is a concept for a user of the jQuery API (vs. a user of Chrome)
orthogonality & uniformity
orthogonality

orthogonality is violated when one concept’s fitness for purpose is undermined by another concept.
non-orthogonal concepts

- origin, space, exclusion (CSS)
  - 4 position values for $2 \times 3 \times 2$ options

- conversation & label (Gmail)
  - same subject, get same label

- listserv & bcc (SMTP)
  - modified subject reveals target

- title & reply (Tumblr)
  - adding ? to title enables replies (!)

- group & selection (many old apps)
  - can’t select object in a group

- group & connector (Keynote 5.3)
  - can’t select box if connected

Shriram Krishnamurthi
BCC example
Hi Daniel, Santiago,

I am not sure whether this falls into one of the conceptual design issues that you have been analyzing, but here's a little annoyance that I just ran into using labels in Gmail.

This evening, I made two separate reservations with Enterprise (one in Phoenix and another one in Vegas), and the company sent me a confirmation e-mail for each one of them. Usually, I tag travel-related e-mails using a label (e.g. "Vegas Trip 2014") so that I can easily find all the relevant e-mails for a particular trip. Now, the problem is that GMail automatically grouped the two Enterprise emails into a single conversation. It turns out that in GMail, a label applied to an e-mail in a conversation is applied to every other e-mail in the same conversation. This means I can't assign separate labels to the two car rentals! Ughh!

(By the way, is it possible to take an e-mail out of a conversation? Either this is impossible or the GMail UI does not make this easy).

Eunsuk
set ratio

set image quality

image size

image quality

an orthogonality violation

overloaded concept too
uniformity

uniformity is violated when instantiations differ with respect to fulfillment of purpose

... directly or indirectly
uniformity is violated when a concept has different versions or instantiations that behave differently for no good reason
non-uniform concepts

- deposits by check (banking)
  funds arrive before clearing

- primitive type (Java)
  not like a class type

- direct flight (Official Airline Guides)
  1 flight number, but >1 stop

- alerts (Apple iCal)
  can’t select email alerts for default

- custom settings (Fuji x100s)
  only some settings selectable
conceptual acrobatics
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

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
what we hate ... & love

from http://amplicate.com
cropping in adobe lightroom
cropping photoshop

Width: 6 in
Height: 4 in
Resolution: pixels/inch
cropping the whole image
it’s all about the concepts

Acrobat
- text box
- object
- document text

Photoshop
- channel
- layer
- mask

Lightroom
- action
- treatment
- effect

incoherent concepts, no clear purpose

powerful concepts with low level purposes

simple concepts with purposes aligned to common tasks
all’s well that ends well

acrobat 9
depth troubled

acrobat 10
user interface tweaks

acrobat 11
conceptual reworking
hard to discern any compelling concepts
Field Trip Permission Form

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Parents signature  Date

user interface has been reworked but still text, text box, object
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

August 15, 2014

Date
designing

the user
designing the user too

purpose

fulfills?

contrivance

assuming a user behavior
example: magnetic paint

changeable wall display of prints

fulfills?

magnetic paint

six coats

neodymium magnets
example: aligning elements

purposen: help align objects

a contrivance: autoalign

a better contrivance: snap align
example: auto align

align diagram elements

motivates

fulfills

auto align

user applies operations
example: snap align

- align diagram elements
- motivates
- fulfills

snap align

- user moves until guideline flashes
in conventional software terms

requirements

specification

contrivance

purpose

fulfills?

anticipated misfits

assuming a user behavior
abstract affordances
The early bird (A) arrives and catches worm (B), pulling string (C) and shooting off pistol (D). Bullet (E) busts balloon (F), dropping brick (G) on bulb (H) of atomizer (I) and shooting perfume (J) on sponge (K)—As sponge gains in weight, it lowers itself and pulls string (L), raising end of board (M)—Cannon ball (N) drops on nose of sleeping gentleman—String tied to cannon ball releases cork (O) of vacuum bottle (P) and ice water falls on sleeper’s face to assist the cannon ball in its good work.
James Gibson (1977): “action possibilities” latent in environment

Donald Norman (1988): action possibilities that are perceivable
a door with good affordances

“affords pushing”

“affords pulling”
“norman doors”

push or pull?

doors with user manual

conflicting instructions
Who Is in These Photos?

To tag your friends, review the suggested names and click Save Tags at the bottom of this page. If a name is missing or incorrect, list a new name and press Enter. Remember: If someone doesn't like a photo, they can untag themselves or ask you to take it down.

Who is this?  Who is this?

Skip Tagging Friends  Save Tags
friends

User

posts

Image

sees

who can see the image?

Bob

Carol

Dave

Bob

friends

Carol

tags

Dave

posts

Alice

Image

Alice

Image

sees

who can see the image?
what facebook says

When someone adds a tag to a photo or other post I shared, who can see it?

When someone adds a tag to something you shared, it's visible to:
- The audience you chose for the post or photo
- The person tagged in the post and their friends

as a textual constraint in Alloy:
all i: Image | sees.i = (posts.i).friends + (i.tags).friends
When a psychopathic stranger takes a photo of me at a party and tags me, who can see it?

When someone adds a tag to something you didn’t share, it's visible to:

- All of their friends and fellow psychopaths
- All of your future employers, boyfriends, girlfriends and in-laws
for physical designs
effects are clear, if hard to predict
affordances connect actions to effects

for software designs
effects are often not clear
affordances become ‘abstract’

so we need to
convey to users effects of actions
challenge: effects are indirect
design thinking
process

optimize organization & task structure
Taylor (1880s), Toyota JIT (1980s), CMM (1990s), agile (2000s)
“new” activities

brainstorming

user studies

prototypes
Dieter Rams, 1958
pocket transistor radio T3

Henry Hobson Richardson, 1877
Trinity Church, Boston

Alfonso Bialetti, 1933
La Moka coffee maker

Leica, 1953
M3 rangefinder camera
broadening

anthropology

psychology

art

economics
nature of software design
To see what rate of progress one can expect in software technology, let us examine the difficulties of that technology. Following Aristotle, I divide them into **essence**, the difficulties inherent in the nature of software, and **accidents**, those difficulties that today attend its production but are not inherent.

The **essence of a software entity is a construct of interlocking concepts**: data sets, relationships among data items, algorithms, and invocations of functions. This essence is abstract in that such a conceptual construct is the same under many different representations. It is nonetheless highly precise and richly detailed.

I believe **the hard part** of building software to be the specification, design, and testing of **this conceptual construct**, not the labor of representing it and testing the fidelity of the representation. We still make syntax errors, to be sure; but they are fuzz compared with the conceptual errors in most systems.
mental models