software studio

conceptual design

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purposes

in this week’s lectures
what high-level software design is about

problem analysis
part of design, not a precursor

purposes
what they are & why they drive design
why inevitably incomplete

concepts
what they are & why they are design
how to express & evaluate
where do inventions come from?
slow progress

over many years...
many small improvements
add up to major change
exploiting new technology

one day...

a new technology becomes available and makes an old problem solvable
teflon

cell phones

camera sensors
getting lucky

one day...
an inventor has a eureka moment
often inspired by something very different
Velcro, 1941
George de Mestral notices burdock burrs sticking to his dog’s fur
Microwave oven, 1955
Percy Spencer notices that candy bar melts when standing in front of radar.
formulating the right problem

**one day...**

someone understands a problem
and formulates it in a crisp way
then others take up the challenge
The next question was the obvious one, “Can we produce a secure encrypted message, readable by the authorised recipient without any prior secret exchange of the key etc?” This question actually occurred to me in bed one night, and the proof of the theoretical possibility took only a few minutes. We had an existence theorem. The unthinkable was actually possible. The only remaining question was “Can it be made practicable?”. This took a while to answer.

James Ellis talking about ‘non-secret encryption’ (1970)
generalizing a problem

over time

a more general problem emerges
unifies problems across domains
Masoretic text (7th C) and RAID (1987)
examples of general problem of reliable transmission over unreliable channel
shrinking a problem

one day...
someone realizes problem is too hard
formulates a simpler problem
whose solution ends up subsuming the harder one
Tim Berners Lee’s browser (1991)
new problem: share documents; old problem: distributed computing
growing a problem

one day...

someone tries to solve a bigger problem and realizes it’s easier than solving the smaller one
old problem: serve traffic data; new problem: obtain & serve traffic data
identify the real problem

one day...
someone sees that the problem is a larger one
Lytro light field camera (2012)
old problem: focus image on sensor; new problem: select a focused image
mpMan, first MP3 player (1998) iPod & iTunes (2001)
old problem: build an MP3 player; new problem: provide a music service
Mimio interactive whiteboard (2010)
old problem: make image of whiteboard;
new problem: use whiteboard to make image
Vehicle Identification Number (1954)
old problem: make car theft hard; new problem: reduce car theft
lesson

you might think
technology advances because of clever solutions

but (more?) often
technology advances because someone rethinks the problem
designing on purpose
design is driven by purpose

- purpose
  - motivates
  - fulfills?
- contrivance
- misfit
example: a photo wall

changeable wall display of prints

motivates

fulfills?

- adhesive corners
  - not strong enough

- corkboard tiles
  - damages prints

- magnetic paint
  - ✔
as implemented
refining the purpose with misfits

- adhesive corners
- corkboard tiles
- magnetic paint

- blocks
- wifi

- changeable wall display of prints
  - strong enough
  - no damage

motivates

fulfills?

anticipated misfits
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. This is because it is through misfit that the problem originally brings itself to our attention. We take just those relations between form and context which obtrude most strongly, which demand attention most clearly, which seem most likely to go wrong. We cannot do better than this.
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

purpose: 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

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
conclusions

**specifications**
are precise designs descriptions
includes design of user too

**requirements**
can never be complete or precise
best we can do: purpose + known misfits
unity of purpose
Mitchell and Webb: “Unity of Purpose”
activity: identifying purposes
the purpose game

labels in Gmail

color labels

trashcan

friendship in FB
what’s the purpose of dropbox?

Securely share, sync, and collaborate

Dropbox for Business is the secure file sharing and storage solution that employees love and IT admins trust.

share: control who can read your files

sync: keep files on multiple machines consistent

collaborate: support multi-user editing of documents

store: expand space available by storing files in the cloud
spot the purpose!

**a purpose is**
not a specification (how it’s achieved)
not an anticipated misfit (what might do wrong)
not a qualification (how well it fits)

**which is a true purpose for a file synchronizer?**
- low latency for file transfers
- ultra-high availability
- enable access to files on multiple machines
- backup in case of hardware failure
- support for OS X, Windows and Linux
design thinking
a search for design methods...

popular approaches
  design thinking
  agile development
  user-centered design
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
design thinking
an exciting popular movement
advocates a design ‘way of thinking’

elements of design thinking
incremental process
user involvement
early & frequent prototyping
engaging other fields

but not a design method
doesn’t address design per se
what is software design?
To design something really well, you have to get it. You have to really grok what it’s all about. It takes a passionate commitment to really thoroughly understand something, chew it up, not just quickly swallow it. Most people don’t take the time to do that.
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
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.
warning: obsession ahead

software design:
smoothing rough & sharp edges
big picture by attention to small details

“That’s quite obsessive, isn’t it?”
Jonathan Ive
https://www.youtube.com/watch?v=zaLMOSWAwdw
three
"snafus"
#1
camera settings
my camera fuji x100s
image quality setting

- Fine
- Normal
- Fine+Raw
- Normal+Raw
- Raw
aspect ratio
“image size” setting
non-standard ratio + RAW?
“image size”, revisited

“image size” is a very strange concept
what’s the snag?

**coupling**
aspect ratio & quality settings
can’t change independently

**confusion**
image size is image quality & ratio
#2 email categories
gmail’s categories

Your messages are automatically categorized into the following optional tabs:

<table>
<thead>
<tr>
<th>Tab</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Messages from friends and family, as well as any other messages that don’t appear in other tabs.</td>
</tr>
<tr>
<td>Promotions</td>
<td>Your deals, offers, and other promotional emails.</td>
</tr>
<tr>
<td>Social</td>
<td>Messages from social networks, media-sharing sites, online dating services, gaming platforms, and other social websites.</td>
</tr>
<tr>
<td>Updates</td>
<td>Notifications such as confirmations, receipts, bills, and statements.</td>
</tr>
<tr>
<td>Forums</td>
<td>Messages from online groups, discussion boards, and mailing lists.</td>
</tr>
</tbody>
</table>

- **Primary**
  - Google
    - New sign-in from Chrome on Mac - New sign-in from Chrome
    - 12:30 pm
  - Keith Muhammad at DeMont.
    - DeMontrond Auto Group - 14101 North Freeway Houston
    - 12:19 pm
- **Social**
  - AT&T High Speed Internet.
    - AT&T High Speed Internet Service Activation - Your A1
    - 10:37 am
  - Keith Muhammad at DeMont.
    - DeMontrond Auto Group - 14101 North Freeway Houston
    - Aug 26
- **Promotions**
  - betterbatonrougejobs.com
    - Job Update -- 2015-08-26 - Looking For An Advantage
    - Aug 26
Choose which message categories to show as inbox tabs. Other messages will appear in the Primary tab.
Google gets it terribly, terribly wrong with Gmail tabs and makes me angry

By Mark Wilson | Published 2 years ago | Follow

71 Comments

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.
Why the Tabs Are So Confusing

The tabs do give you a convenient way to automatically sort your inbox according to Gmail's preset categories and get notifications at a glance for when new emails come in. However, the tabbed view introduces a new, not-so-clear element in Gmail called "categories."

The tabs are based on these new categories. When you create a filter, in addition to being able to label a message, you can now categorize it as: Personal, Social, Updates, Promotions, or Forums from a drop-down box. These, as you see, match the tabs.

The problem is, you already have labels that also match these categories. Gmail, for example, adds Social Updates, Promotions, and Forums as SmartLabels in the left menu. The "Notifications" SmartLabel corresponds to the Updates tab (I wonder why they didn't just call the tab Notifications), but SmartLabels are not the same as Categories. Gmail's pre-designed SmartLabel filters makes it seem like that, but they're really two different things.
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’s the snag?

**what are categories?**
look like labels, smell like labels...
but not quite labels

**non-uniformity**
can’t use labels as tabs
tabs only apply to the inbox
#3 fonts & styles
What's a font?
what’s the snag?

styles are broken

can’t define a style that italicizes all fonts:
   Arno Regular to Arno Italic
   Futura Book to Futura Book Oblique
   Magma Light to Magma Light Italic
what kind of problems are these?

coding errors?
does the code meet the spec? are there bugs?

user interface design?
is the user interface not learnable, efficient or safe?

3 kinds of concept snag
confused concept: image size
redundant concept: category
missing concept: font subfamily
what’s an app about?
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,
character set

word processor
paragraph,
format, style

desktop publishing app
text flow, link,
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?

– Jamon
where are Word’s concepts from?

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

Ginn & Co, since 1868

Apple Pages, 2005

Microsoft Word, 1983

Bravo, 1974
kinds of concept

**domain 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

even these were invented

analogical, or new

solve a hard design problem

solve a hard design problem
activity: identifying concepts
spot the concept!

what are the concepts of a browser?