



CSEN603 – Software Engineering

Lecture 6: Usability II

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Software Engineering

Architecture

Requirements Engineering

Design and Design Patterns

Implementation

Verification and Validation

Quality and Maintenance

Scale and Evolution

Economics

Process, Models, Methods

Dimensions of Usability – Efficiency

- Performance of the **backend, algorithms, and data structures** is important to analyze and improve
 - Dependent on system model and design, networking elements, programming language, data structures, databases, ...
- Performance of **interface between the user and the system** is also important
- How quickly can we get instructions and information across that interface?
- **Power Law of Practice** – Time to do a task for the n^{th} time decreases with frequency of doing task

$$T_n = T_1 \times n^{-\alpha}, \alpha \in [0.2, 0.6]$$

Efficiency – Best Practices for UIs

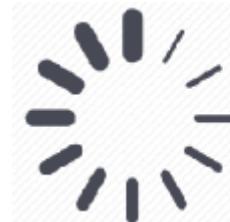
- If your interface has a **large number of related questions to ask a user**, **aggregate them into a single dialog**
 - e.g. a list of files, with multiple selection options, select all, unselect all options
- Make frequently used UI targets **BIG**
- Put UI targets **used together next to each other**
- Choose **keyboard shortcuts that are easily associated with commands**
- Use **defaults and history**
 - initial entry → most likely function
 - After use → previous/recent entry
- **Anticipate user action**

Interjection: Data Access, Networks, and Efficiency

- Software operations that transfer data from a backend DB or over the network have **unpredictable response times and are subject to delay**

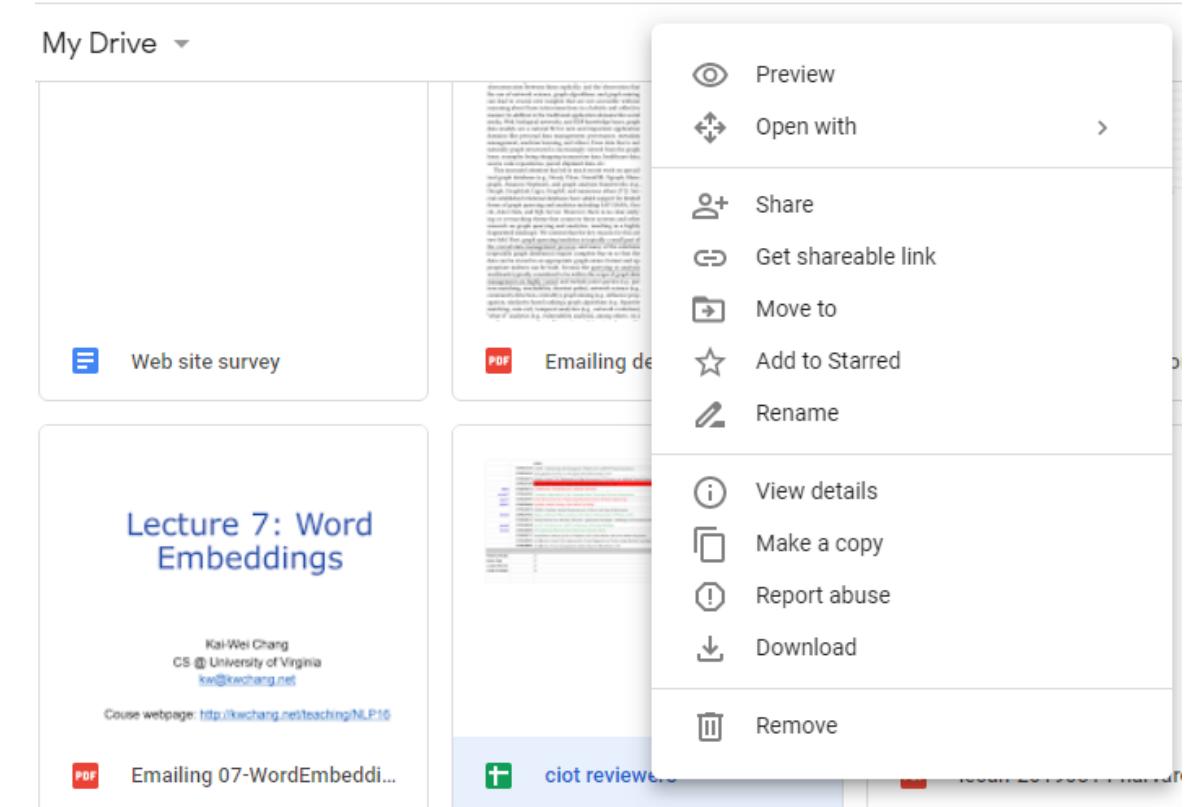
Best practices

- **Large data transfers should run asynchronously in a separate thread**
- **Provide visual feedback** to indicate that the operation is in progress
- **Provide option to cancel long running data transfers**
- **Write “good” SQL queries and optimize**



Dimensions of Usability – “Designing” for Errors

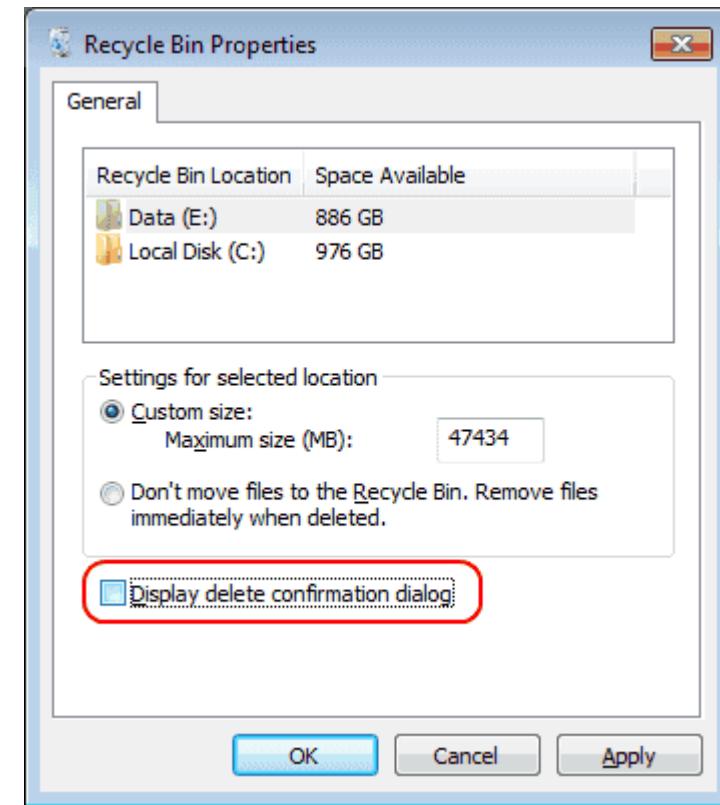
- **Slips and lapses** – Failure to correctly execute procedure, or failure of memory
 - “**Strong but wrong**” – similarity and frequency are causes of lapses
 - usually made by expert users
- **Capture slips** – two tasks that start with same sequence of actions
 - e.g. post share options on Facebook had Messenger as 2nd option but now is story
- **Description slips** – similar actions
 - e.g. instead of Ctrl+B you Ctrl+V
- **Mistakes** made by novice users



Dimensions of Usability – “Designing” for Errors

■ How to prevent

- Avoid habitual sequences and actions with similar descriptions
- Keep dangerous commands away from common commands
 - And in general, better to use many horizontal shallow menus than few deep menus
- Use confirmation dialogs? This affects efficiency
- Reversibility is better than confirmation



Writing Error Messages

- Best error messages are **NONE**

BUT

- Be precise

- e.g. name contains wrong characters

- Restate user's input

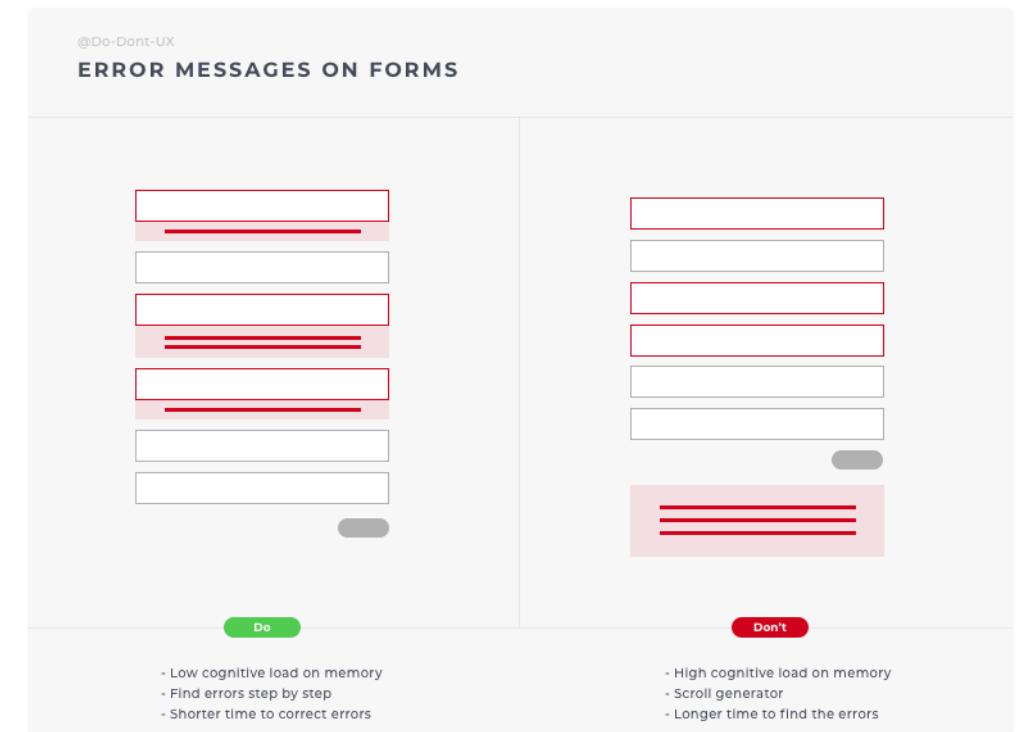
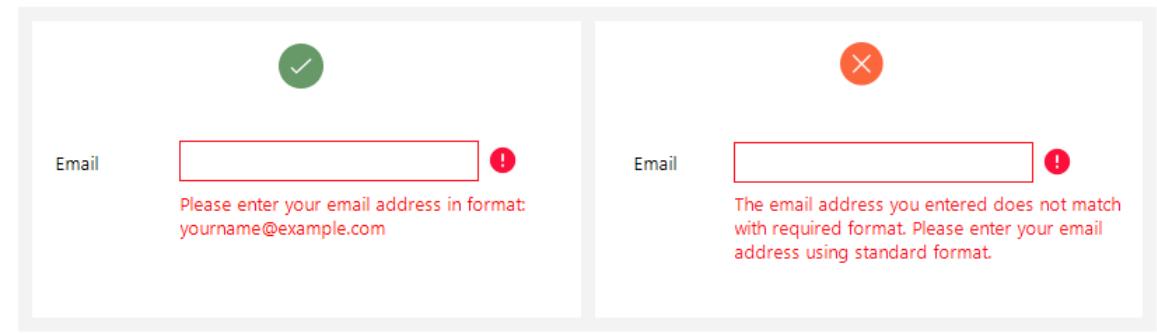
- e.g. cannot open file “SE.docx”

- Speak user's language

- e.g. NOT “Buffer Overflow Exception” or stack trace

- Suggest reason and solution

- e.g. cannot delete file. It might be in use. Close file before delete?



Give The User Control and Freedom

- Users like to **explore** interfaces to **learn**, so give them control
- All dialogs should have a Cancel button (All?)
- Allow user to override automatic options
- Have the option of “Never ask again”
- Give the user control over the data they entered (create, update, delete, read)
 - This will affect your system model in terms of data **mutability** (references in code to user data that can be changed by user)
- And do not arbitrarily limit user input

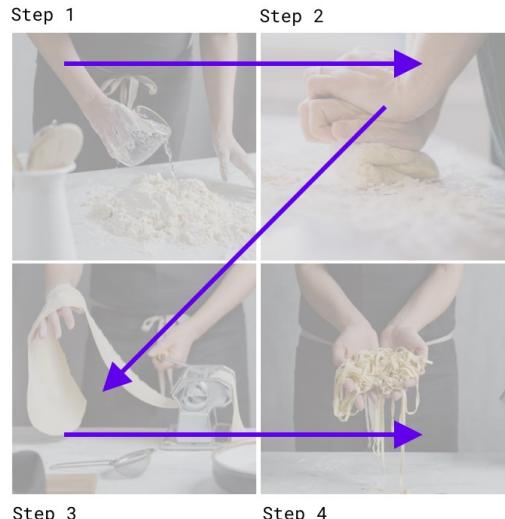
The screenshot shows a portion of a Facebook sign-up page titled "Sign Up and Start Using Facebook". Below the title, there is a brief description: "Join Facebook to **connect with your friends, share photos, and create your own profile**. Fill out the form below to get started (all fields are required to sign up).". The form includes fields for "Full Name" (containing "John Vieira-McEldowney"), "I am" (with "none of the above" selected), and "Email". A red arrow points from the text "The name contains too many capital letters." back to the "Full Name" field.

Dimensions of Usability – Accessibility

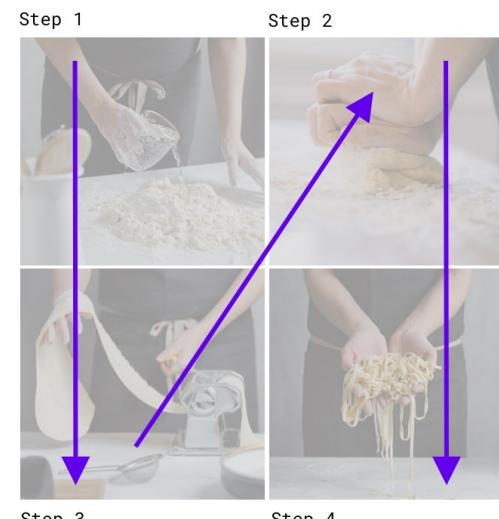
- **Software designers must be prepared to users with disabilities**
 - e.g., poor eyesight, lack of hearing, poor manual dexterity, situational disability such as a broken arm, limited knowledge of English
 - Requirements about accessibility are mostly related to the UI, not the system
 - You may have a legal requirement to support people with disabilities
- **Assistive technology**
 - Screen readers
 - Directional controllers
- **Signal what's available and what's important**
 - Visual feedback through labels, color, icons
 - Touch feedback (for touch-enabled UIs)
 - Important actions at top or bottom (reachable with shortcuts)
 - Related items next to each other
- **Simplify app's hierarchy**
 - Clearly visible elements
 - Sufficient contrast and size
 - A clear hierarchy of importance
 - Key information discernable at a glance
 - Navigation with minimum steps for clear flow
 - Frequently used tasks get focus control

Accessibility – Navigation

Screen readers rely on top-down HTML structure and will verbalize in the top down order



```
<section class="container">  
  <img class="step-1" />  
  <img class="step-2" />  
  <img class="step-3" />  
  <img class="step-4" />  
</section>
```



```
<section class="container">  
  <div class="col-left">  
    <img class="step-1" />  
    <img class="step-3" />  
  </div>  
  <div class="col-right">  
    <img class="step-2" />  
    <img class="step-4" />  
  </div>  
</section>
```

Do

Don't

Accessibility – Color

- **Color contrast** is important for users to distinguish various text and non-text elements
- Higher contrast makes the imagery easier to see
- Use a good contrast ratio for text and for icons (3:1 or 4.5:1 foreground to background)

The Woodman set to work at once

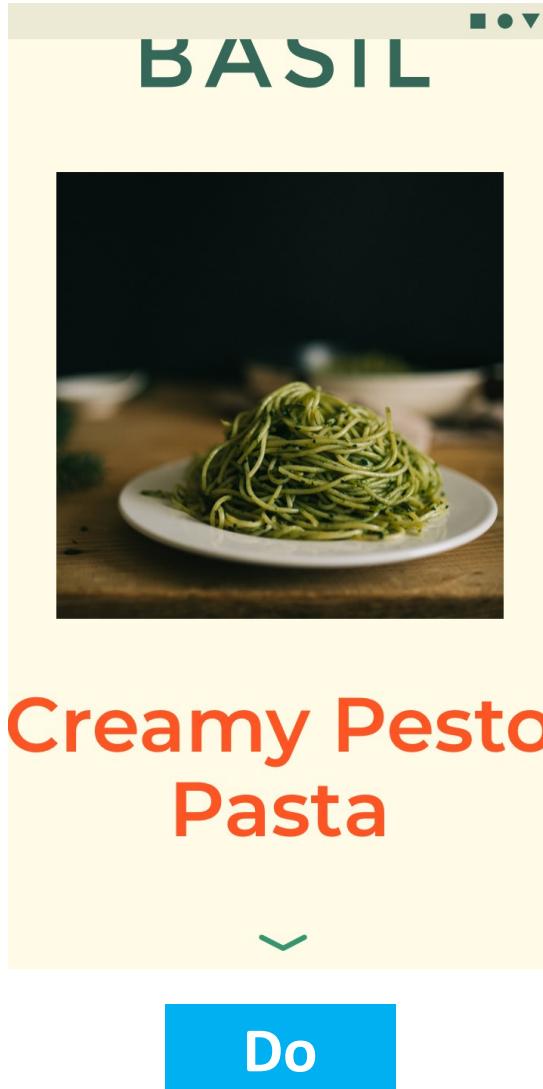
Do

The Woodman set to work at once

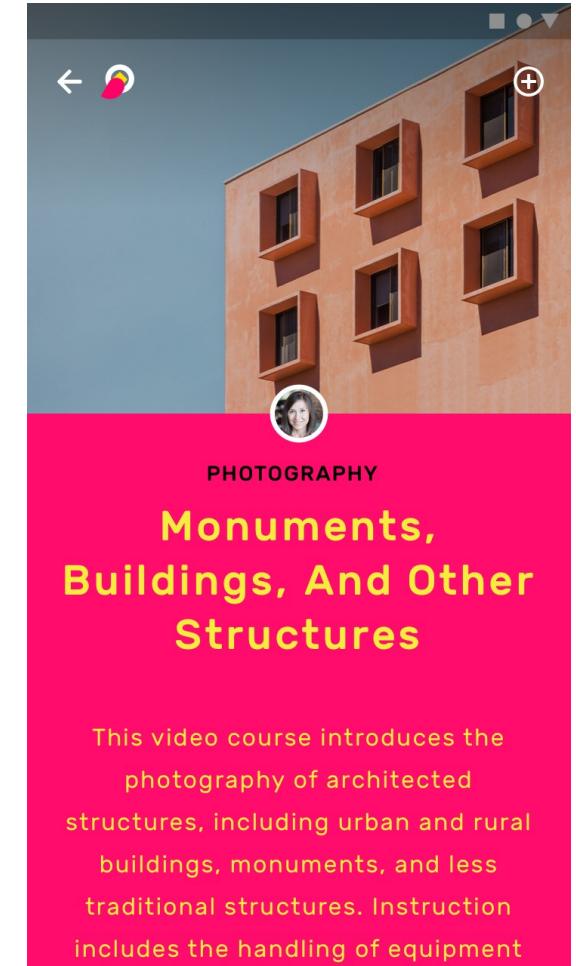
Don't

Accessibility – Color of Text

- **Colored text** should be used sparingly to draw attention and apply selective emphasis
- Large headlines and short text snippets are best for colored text
- Should not use color for long body copy text
- You can use the [Material Palette](#) to test your color choices for background and foreground elements



Do



Don't

Accessibility – Alt Text

- **Accessibility text** is text used by screen reader accessibility software
- Accessibility text includes visible text (e.g. labels for UI elements, links) and nonvisible descriptions that don't appear on screen (e.g. alternative text for images)
- Visible and nonvisible text should be descriptive and meaningful



Tokyo Tower
Japan

Here is the view from my hotel window of the Tokyo Tower in Minato, Japan. The Tokyo Tower is the second tallest structure in Japan.

ALT TEXT

The Tokyo Tower and skyline at night



Tokyo Tower
Japan

Here is the view from my hotel window of the Tokyo Tower in Minato, Japan. The Tokyo Tower is the second tallest structure in Japan.

ALT TEXT

Skyline

Do

Don't

Accessibility – Alt Text

- Most screen readers do not read more than 125 characters of text, so make alternative text concise
- Include targeted keywords in alternative text, but do not use just keywords



Tokyo Tower
Japan

Here is the view from my hotel window of the Tokyo Tower in Minato, Japan. The Tokyo Tower is the second tallest structure in Japan.

ALT TEXT

The Tokyo Tower and skyline at night



Tokyo Tower
Japan

Here is the view from my hotel window of the Tokyo Tower in Minato, Japan. The Tokyo Tower is the second tallest structure in Japan.

ALT TEXT

Tokyo, tok yo, Japan, japan, ja pan, sushi, tower, evening, night, buildings, build, sky, skyline, view

Do

Don't

Accessibility – Alt Text

- Do not repeat image caption/description in alternative text, otherwise the screen reader will read the same thing twice



Tokyo Tower
Japan

Here is the view from my hotel window of the Tokyo Tower in Minato, Japan. The Tokyo Tower is the second tallest structure in Japan.

ALT TEXT

The Tokyo Tower and skyline at night



An antique mahogany and tufted green velvet rocking chair from the 1920s in the home library of Dr. Black

Found at a garage sale in Orlando, Florida this antique collectors item now lives in the home library of Dr. Simone Black. The chair now sits surrounded by hundreds of books and the natural

ALT TEXT

An antique mahogany and tufted green velvet rocking chair from the 1920s in the home library of Dr. Black

Do

Don't

Accessibility – Action Text

- **Action verbs** should indicate what an element or link does if tapped not what an element looks like
 - Consider other navigation options when describing how to interact with a control
 - If icon is an action and is selected, the text label can specify the action for screen reader to verbalize (e.g. Add to wish list)
 - If icon is a property of an item (coded as checkboxes), screen readers will verbalize the current state (e.g. on/off)



"Edit"



"Voice search"



"Pencil"



"Tap to speak"

Do

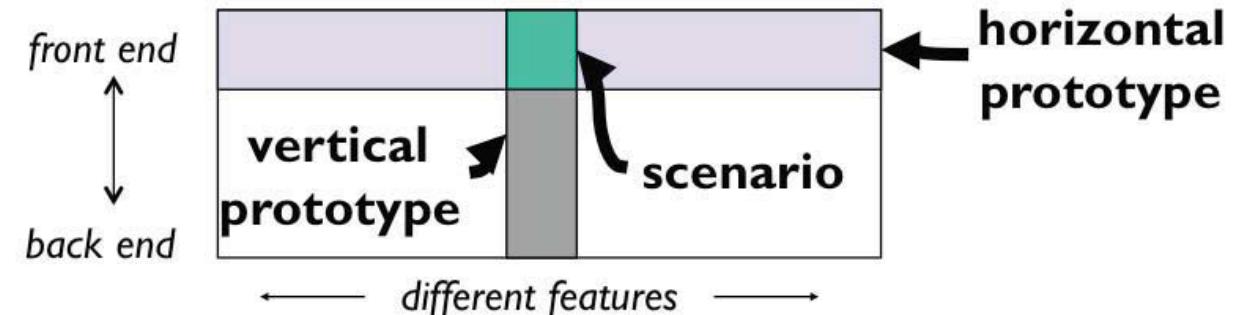
Don't

User-driven Design

- Users appear in the requirements analysis phase, then in the acceptance testing phase
- **But should be involved in an iterative design process to capture problems in UX early**
- **If you wait until acceptance testing**, UI problems may affect your system design dramatically
- You may follow an **iterative design/development process** – you release versions of your software to market and use evaluations to release better future versions
- But even with an iterative process, **you should not allow bad designs to be released to market and hope they will be evaluated by users for a next “better” version release**
 - Users may not use future versions ☹
 - A better approach is to **involve users early in low-fidelity designs before development**

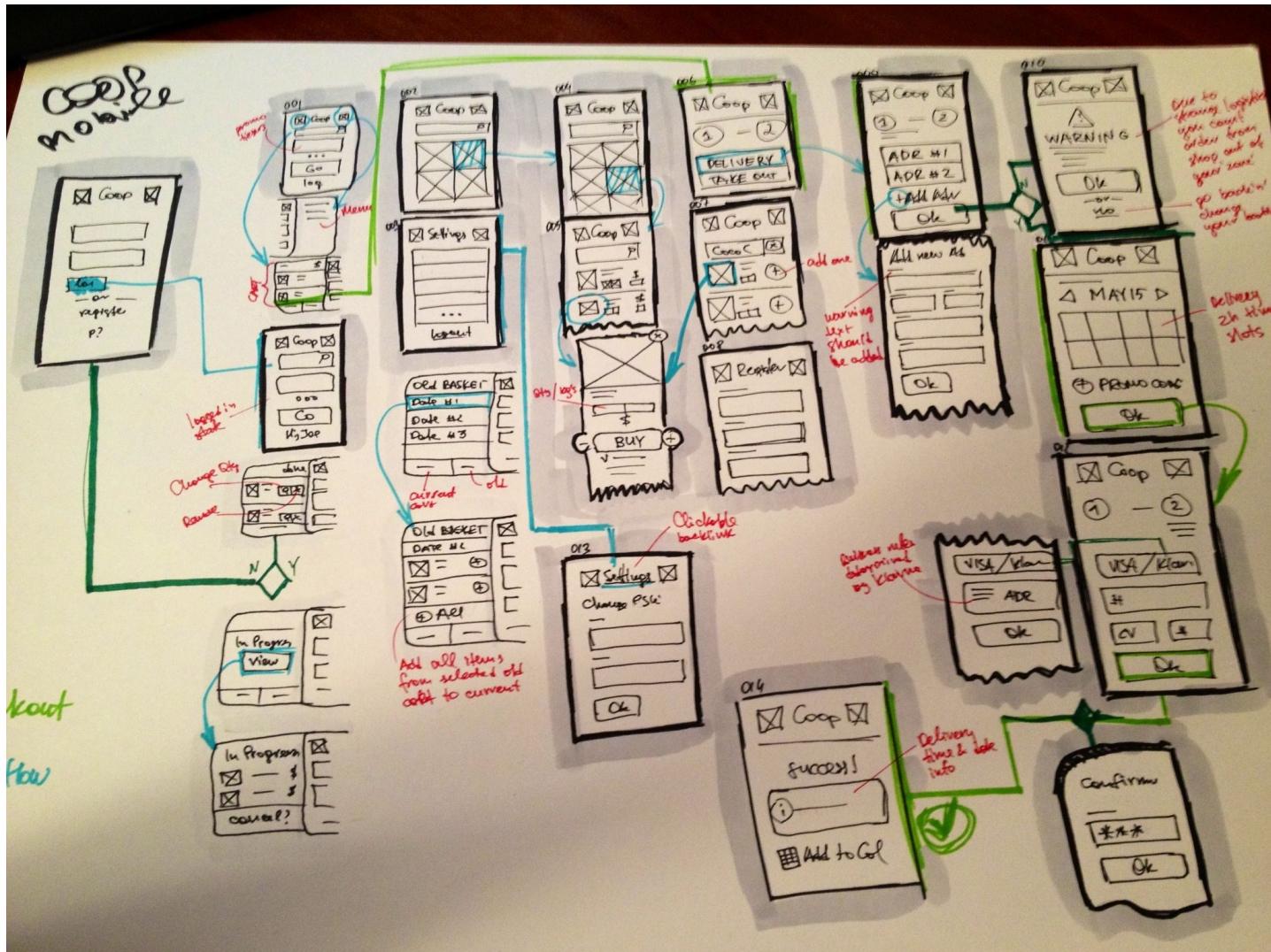
More on Fidelity in Designs

- **Release low-fidelity “cheap” mockups first** (Scenarios, Wizard of Oz), **show to users, get their feedback and evaluation**, and **incrementally build higher-fidelity prototypes** (HTML), then **develop refined models**
 - Makes it possible to build multiple parallel mockups of alternative designs in early stages of system
 - Focus now on task analysis and constant evaluation
- **Breadth** → number of features covered
- **Depth** → degree of functionality
- **Look** → appearance and graphics
- **Feel** → input method



Generating Designs – Sketches

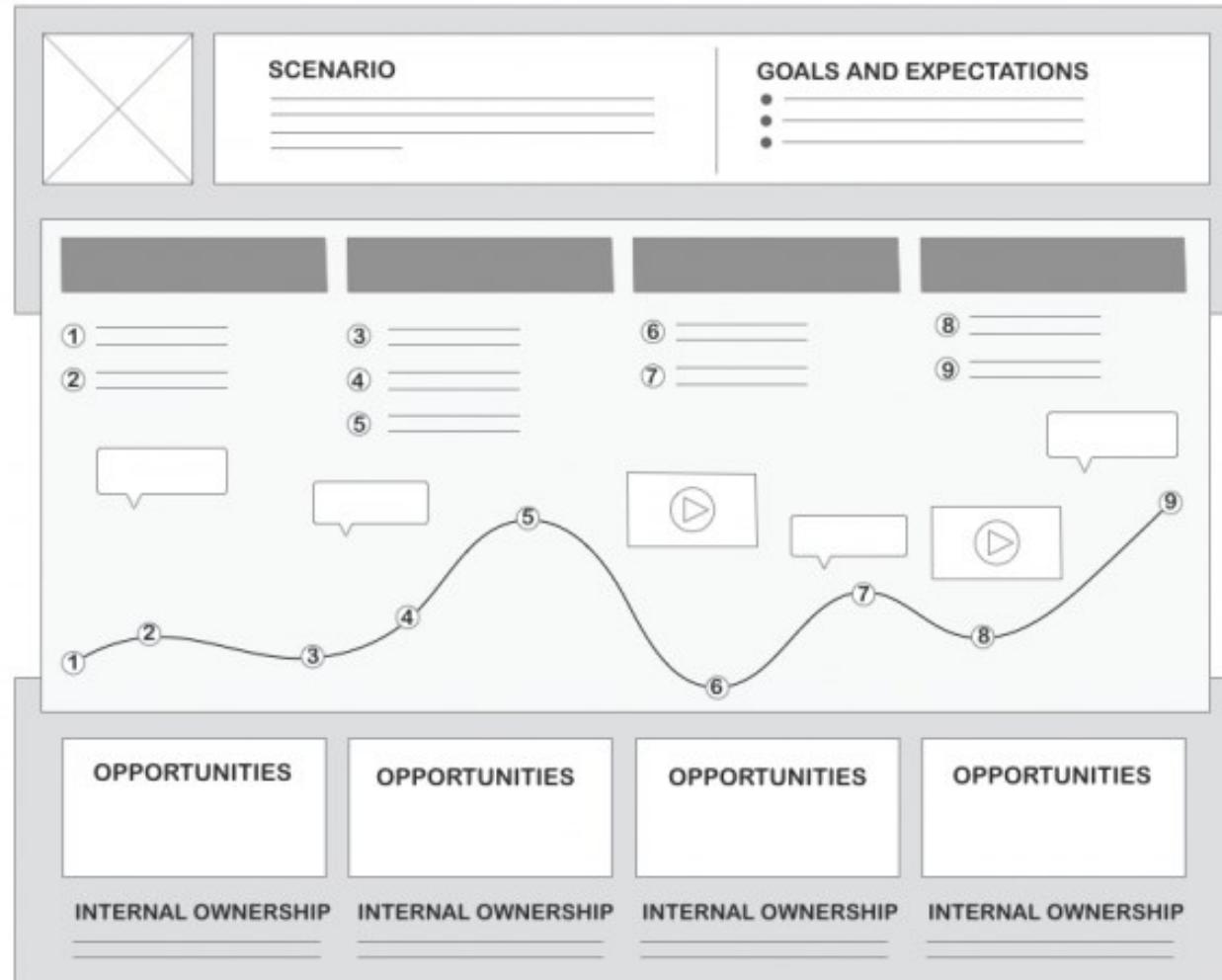
- Makes **user feel safe** knowing that design is not final
- **Nonprogrammers can help**
- **Easier to change**
- **Generate many ideas**, describe your ideas in writing, brainstorm with team
- **Example App:** location-based photo app – how would you design home page?
- **Limitations of sketching?**



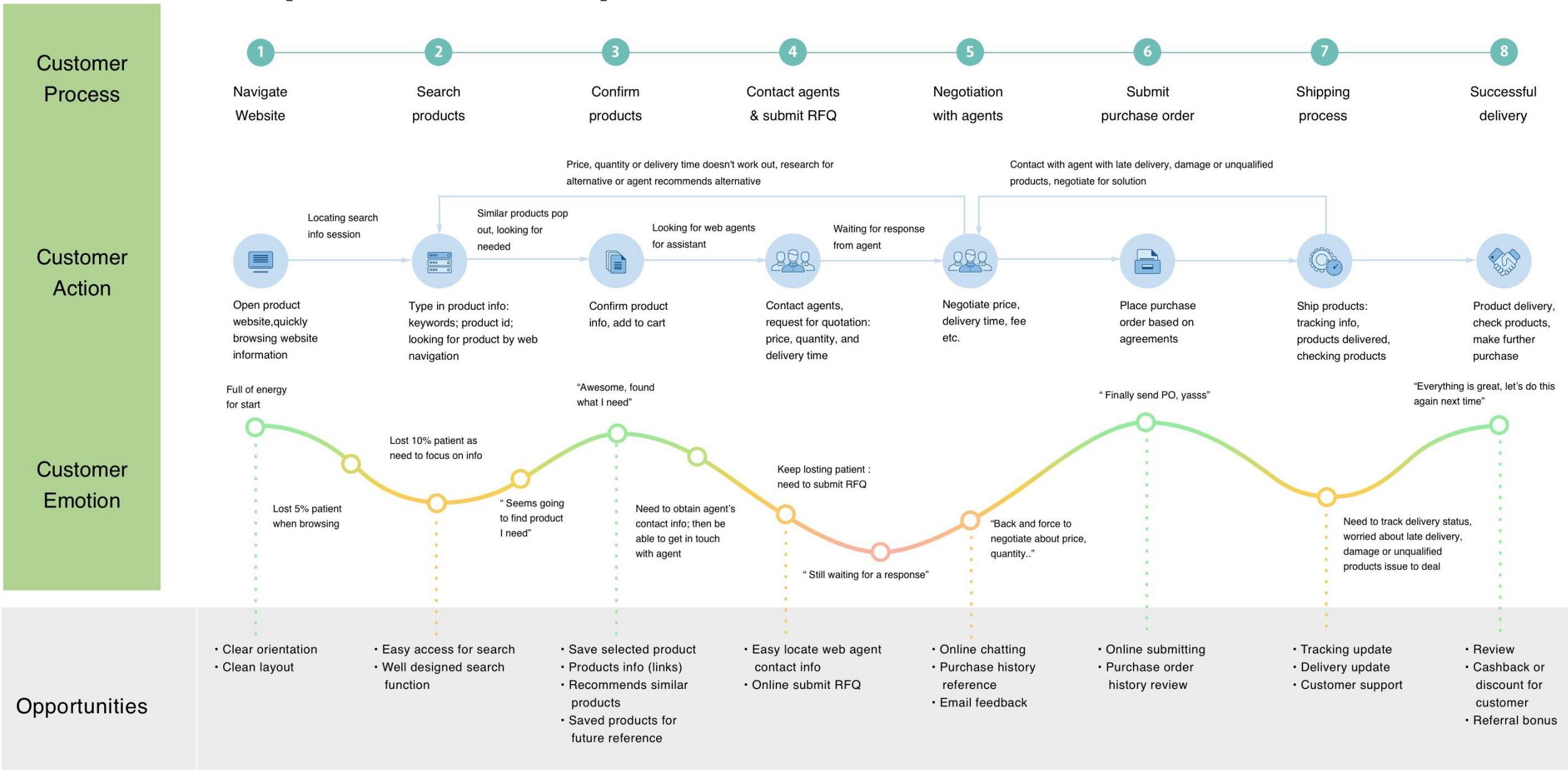
Generating Designs – Scenarios or “User Journeys”

Three zones:

- 1. Actor, Scenario, and Expectations** – represent persona, user story, and goals
- 2. Experience** – represent phases, actions, mindsets, and emotions
- 3. Opportunities**, ownership, and metrics to optimize UX



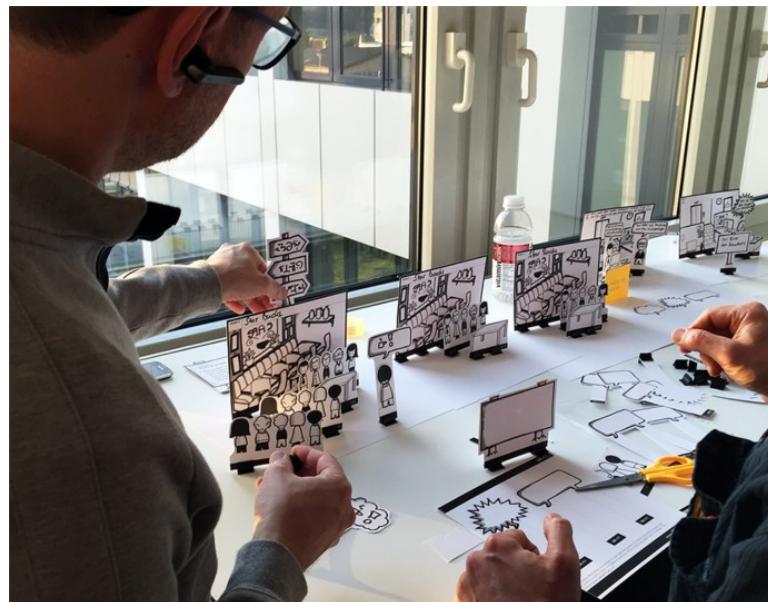
Example User Journey



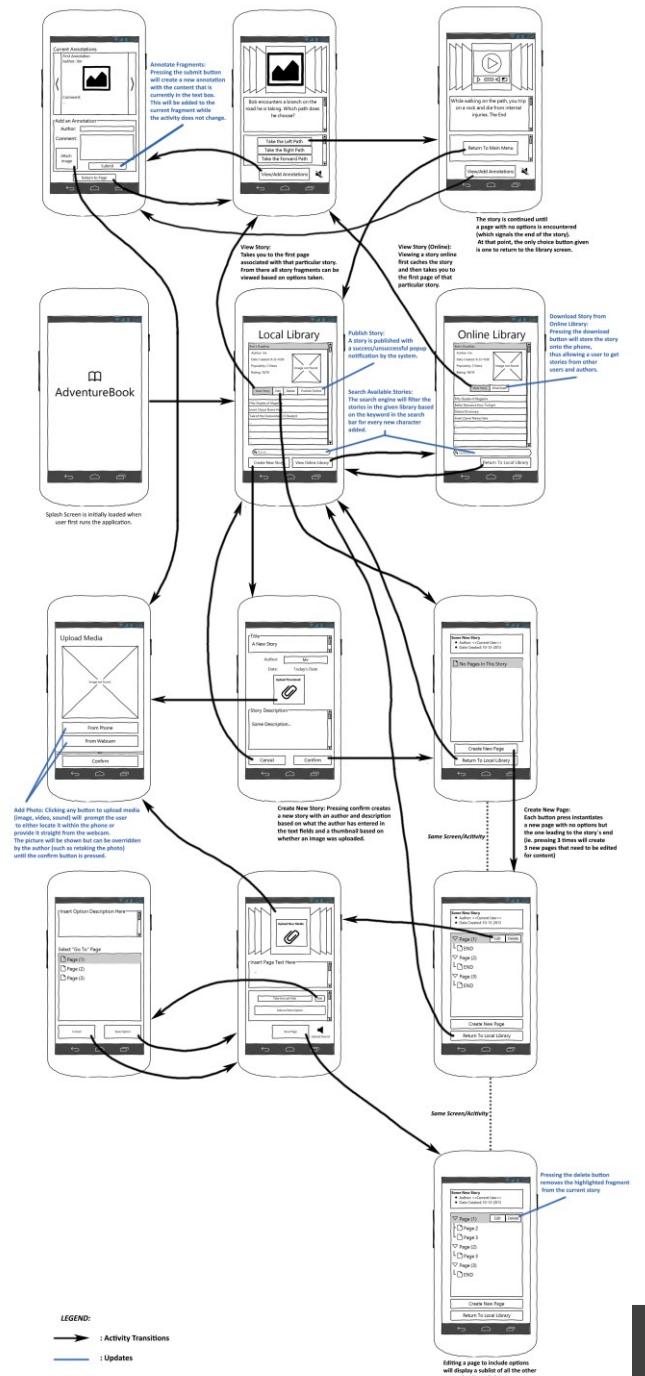
Generating Designs – Storyboards, Wizard of Oz

- **Storyboards** (using Photoshop, Balsamiq, or custom tools)

- “Connected” sequences of sketches illustrating a scenario – showcase how design satisfies goal (given a user and a goal, does design deliver goal?)
 - Show hotspots of connectivity



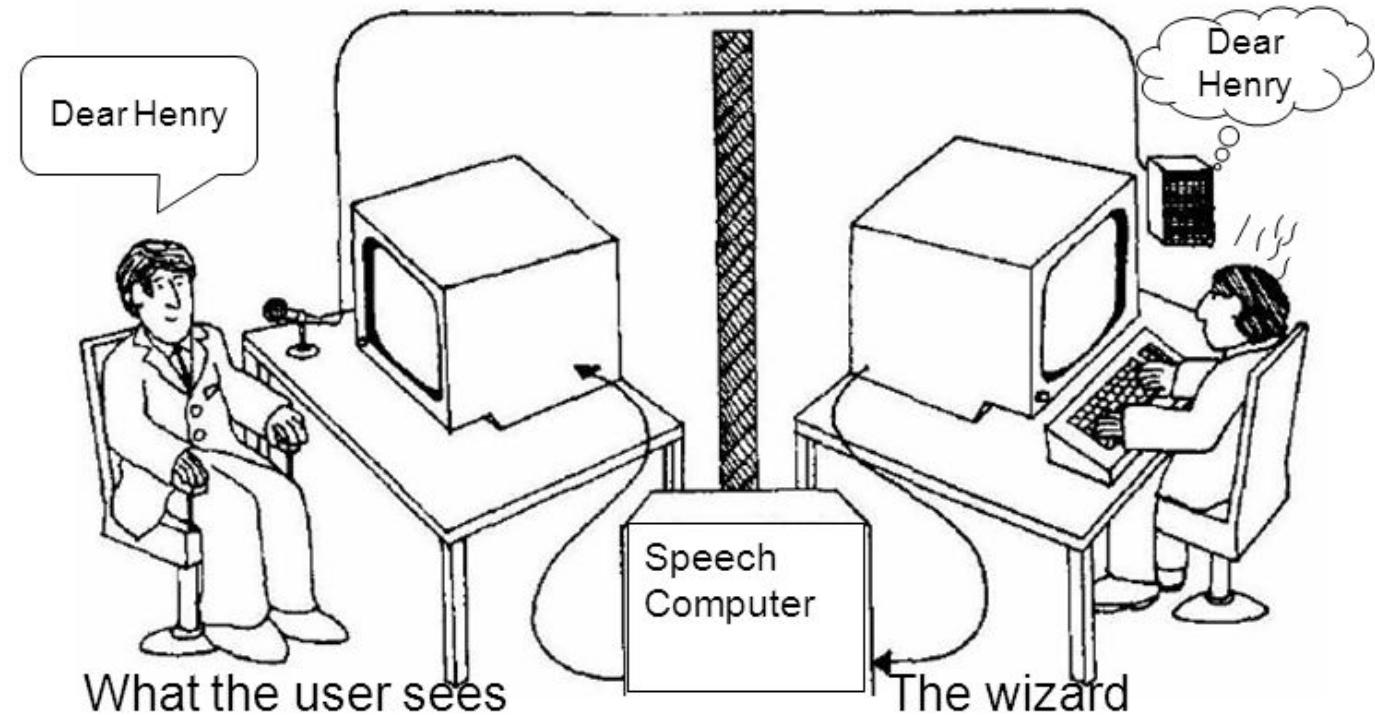
SAP's printable storyboarding kit



Generating Designs – Storyboards, Wizard of Oz

■ Wizard of Oz

- Computer frontend, human backend (simulation of software that does not yet exist)
- User interacts with frontend, and human designer figures out response behind the scenes



Gould, Conti & Hovanecz, Comm ACM 26(4) 1983.

Design Patterns for UI - <https://ui-patterns.com/>

Structural

- e.g. Wizard

Navigation

- e.g. Breadcrumbs

Widgets

- e.g. Dropdown lists

User Interface Design Patterns

Getting input

Getting the user to input data is a task that should be tailored to the context of use.

Dealing with data

Data can be searched, formatted, overviewed, and browsed in a variety of ways.

Miscellaneous

Patterns that haven't found their main category yet.

Navigation

The user needs to locate specific features and content and needs navigation to accomplish this.

Social

Allow the user to associate, communicate, and interact with other people online.

Onboarding

The user needs to acquire the necessary knowledge, skills, and behaviors to become effective.

Persuasive Design Patterns

Cognition

Patterns of psychological tendencies that cause the human brain to draw incorrect conclusions.

Perception and memory

Patterns in how we visually perceive, interpret, and remember meanings as we interact with systems.

Game mechanics

Games engage, involve, and influence us through its playful nature.

Feedback

As the users interacts with your system feedback motivate them to take the next step.

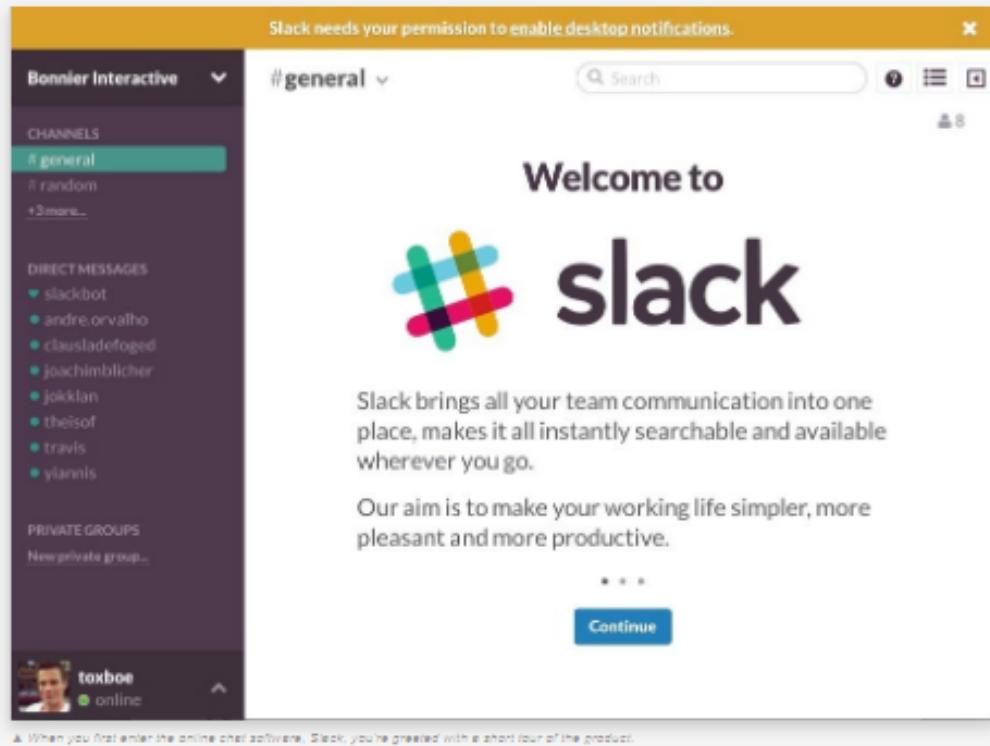
Social

Allow the user to associate, communicate, and interact with other people online.

Problem summary

The user wants to learn the products and services you offer in order to make a decision to join a service or buy a product.

Example



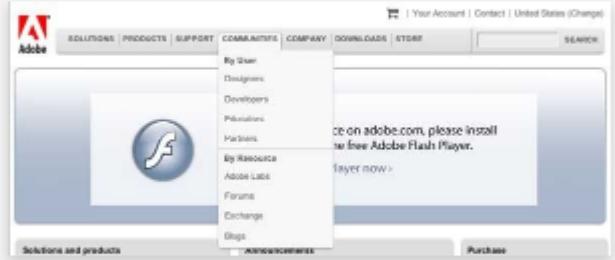
Usage

- Use to give users an insight into what a product is about before they spend time or money on the full product.
- Use to help sell your product.
- Use to allow users to make an "informed" purchase decision.
- Use to instruct users in how to solve common tasks.
- Use to teach users about your product and what it can do.
- Use to teach users about uncommon features.
- Use to teach users about non-website related issues.

Problem summary

The user needs to navigate among sections of a website, but space to show such navigation is limited.

Example



Vertical Dropdown Menu UI Pattern

Usage

- Use when there are between 2 – 9 sections of content that need a hierarchical navigation structure.
- Use when your functionality resembles one of a desktop application. Imitate the metaphor.
- Do not use when there is a need to single out the location of the current section of the site. Then use the [Navigation Tabs](#).

Problem summary

The user needs to categorically filter the data displayed in tables by the columns.

Example

Showing: 1-10 of 294 Next 10 >					
Filter by	All OSs	Free	All licenses	less than 5 MB	All categories
Name	Red Upload Lite 3.12	Free	Free	Ratings	Date added
Sponsored	Red Upload Lite 3.12	Free	Free to try	Total downloads	
	Category: Applets				
	Provide your Web site with file uploading functionality with progress monitor.				
	Core FTP LE 2	Free	Free	User rating:	Date added
	Category: FTP Software			08/10/2007	1,483,094
	Manage your files remotely and securely via FTP with SFTP and SSL.				

Usage

- Use when you have a very large data set of results that is too large to show in one page
- Use when one or more table columns can easily be summarized into categories to filter by.

Walkthrough UI Pattern

Table Filter UI Pattern

Lessons Learned from Social Media Apps

DO

- Always make it look like the app is doing something
- Order content based on importance
- Anticipate a user's move

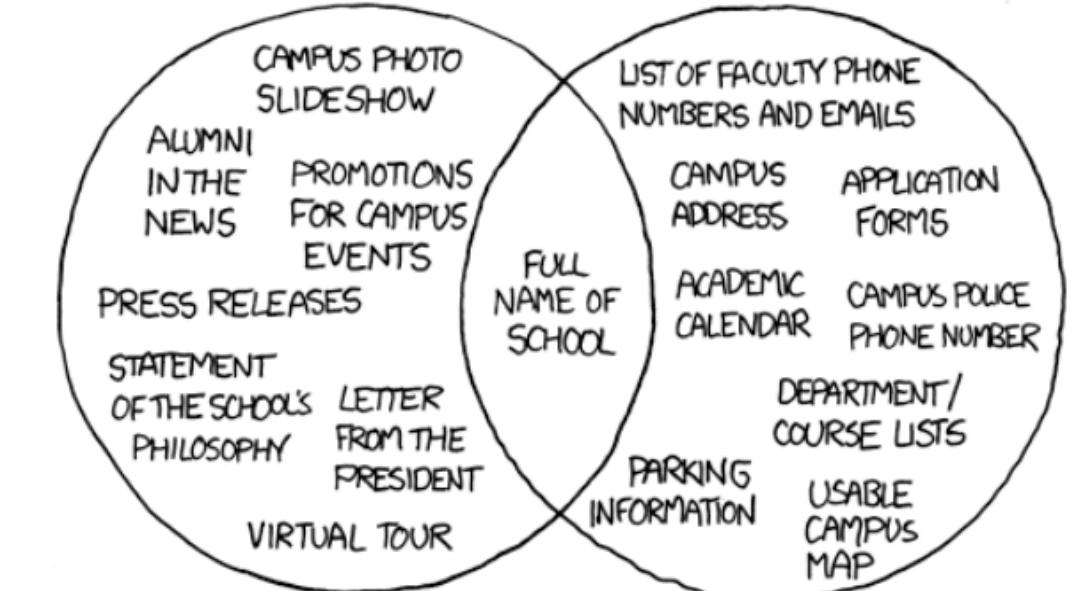
AVOID

- Not knowing your users
- Inconsistency
- Not giving the users what they want

The screenshot shows the Craigslist homepage with several sections:

- Top navigation:** craigslist eg, egypt
- User options:** create a posting, my account
- Search bar:** search craigslist
- Event calendar:** event calendar (M T W T F S S) with dates 24, 25, 26, 27, 28, 29, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22.
- Community:** activities, artists, childcare, classes, events, general, groups, local news, lost+found, missed, connections, musicians, pets, politics, rants & raves, rideshare, volunteers.
- Housing:** apts / housing, housing swap, housing wanted, office / commercial, parking / storage, real estate for sale, rooms / shared, rooms wanted, sublets / temporary, vacation rentals.
- Jobs:** accounting-finance, admin / office, arch / engineering, art / media / design, biotech / science, business / mgmt, customer service, education, etc / misc, food / bev / hosp, general labor, government, human resources, legal / paralegal, manufacturing, marketing / pr / ad, medical / health, nonprofit sector, real estate, retail / wholesale, sales / biz dev, salon / spa / fitness, security.
- Services:** automotive, beauty, cell/mobile, computer, creative, cycle, event, farm+garden, financial, household, labor/move, legal, lessons, marine, pet, real estate, skilled trade, sm biz ads, travel/vac, write/ed/tran.
- For Sale:** antiques, appliances, arts+crafts, atv/utv/sno, auto parts, aviation, baby+kid, barter, beauty+hlth, bike parts, bikes, farm+garden, free, furniture, garage sale, general, heavy equip, household, jewelry, materials, motorcycle parts, motorcycles.
- Discussion forums:** help, faq, abuse, legal, avoid scams & fraud, personal safety tips, terms of use, privacy policy, system status, about craigslist, craigslist open source.

THINGS ON THE FRONT PAGE OF A UNIVERSITY WEBSITE



Further Themes to Recall and Explore

Output → graphics and rendering

Input → input modes and listeners

High-fidelity Layout → HTML and CSS

Accessibility and HCI → How to provide an inclusive UX for the visually impaired, hearing impaired, users with motor disabilities

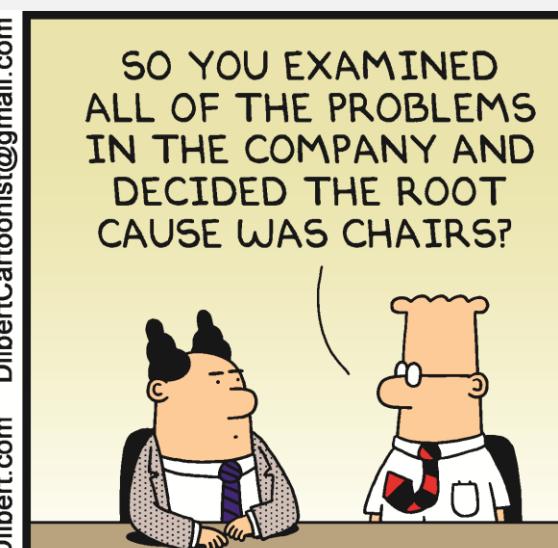
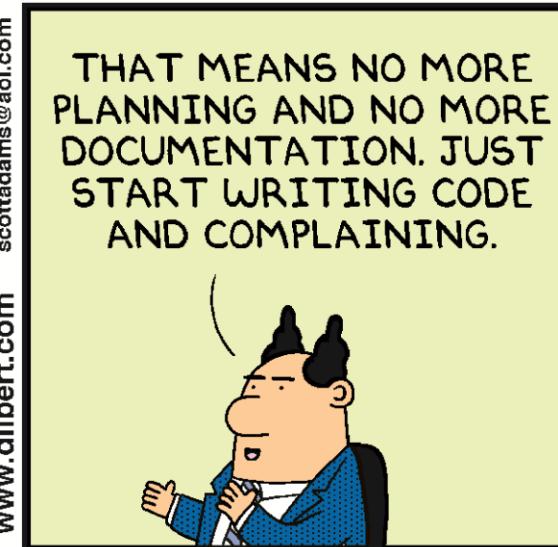
Further Fun Readings

<https://engineering.instagram.com/beautiful-performant-android-ui-62ce61ca748c>

<https://slack.engineering/android-ui-automation-part-1-building-trust-de3deb1c5995>

<https://slack.engineering/android-ui-automation-part-2-making-it-easy-57335c7379cc>

<https://code.facebook.com/posts/1716776591680069/react-16-a-look-inside-an-api-compatible-rewrite-of-our-frontend-ui-library/>



NEXT WEEK on
SE – Process
and Methods –
Agile

Disclaimer

Content is adapted from MIT's User Interface Design and Implementation course and Google's Material Design portal

