Building Web Applications

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Good web applications: Design + Implementation

Some Design Goals:

- Intuitive to use
  - Don't need to take a course or read a user manual
- Accomplish task accurately and rapidly
  - Provide needed information and functionality
- Users like the experience
  - Joy rather than pain when using the app

The hardest part of good web applications is the **design**

Outside the scope of this course (and instructor)!

Good user interface principles are encoded in the toolkits and style guides

Some guiding design principles for Web Apps

- Be consistent

  Cognitive load less for the user

- Provide context

  User shouldn't get lost in the app

- Be fast

  Don't make the user wait

Consistency: Style guides & design templates

- Web apps should have a **style guide -** Covers the look and feel of the app
  - Style - Color schemes, animation, icons, images, typography, writing
  - User interactions - Menu, buttons, pickers, dialog boxes, tables, lists, ...
  - Layout - Structure, toolbars, content, responsiveness
- Patterns - If you do something multiple places do it the same way
  - Aided by reusable implementation components
  - Error handling, navigation, notifications, etc.
- Design templates - Follow a familiar structure
  - Example: Master-detail template

Style Guide Example: Material Design from Google

- Used in Google apps (e.g Android, web apps)
  - Influence by publishing (paper and ink) enhance with technology (3D look)
  - Focus on traditional print issues: grids, space, typography, scale, color, imagery
  - Heavy use of animation to convey action
- Dictates many aspect of design
  - Structure and layouts
  - User interface
  - Common patterns

Material Design Foundations

Environment - surfaces (e.g paper), depth, and shadows

Layout - responsive layout grid, breakpoints, white space

Navigation - changing views: Lateral, Forward, Backward

Color - recommendations for colors that work well together

Typography - recommendations for point size, weight, spacing

Iconography - visual expressions (language independent)

Shape - use different shapes to direct attention, identify, communicate

Motion - show information (e.g. relationships), focus attention, fun

Interaction - map touch to actions

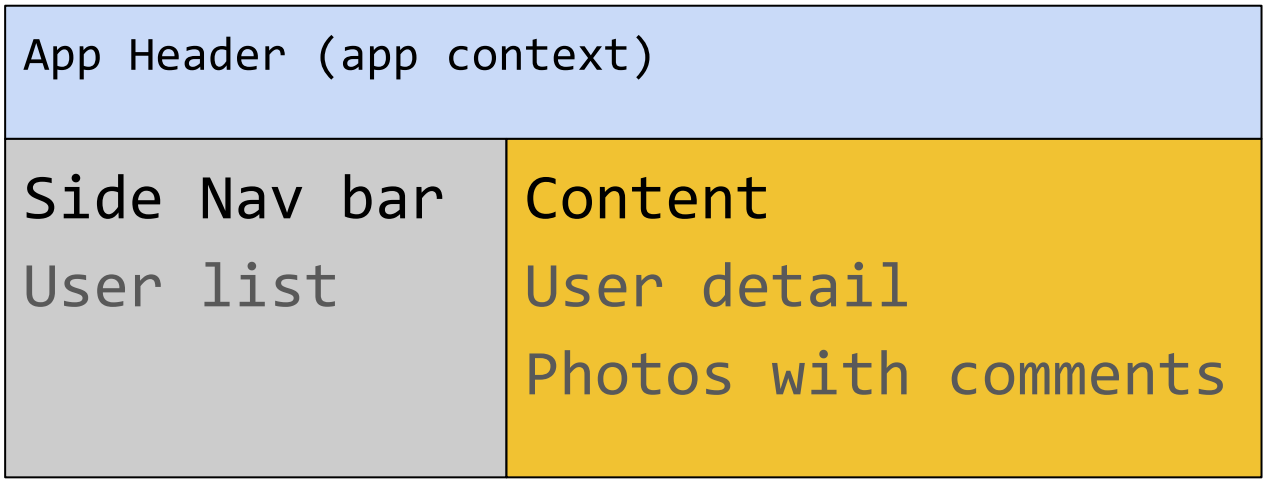
Communication - writing, formats, imagery, launch screen, onboarding

Front-end web frameworks

- Popular example: Bootstrap
  - CSS style sheets
    - Design templates
    - Grid layout system with responsive support (breakpoints, etc.)
    - Element styling
  - HTML components
    - Buttons, menus, toolbars, lists, table, forms, etc.
  - JavaScript
    - Modals, transitions, dropdowns, etc.
    - Originally jquery based
- ReactJS no-opinion. Popular: Material-UI
  - CSS style sheets and components for implementing Material design spec

Example: Use Material Design for a Photo App

- Use an Master-Detail template layout
  - Users with Photos with Comments
- Classic layout:



Material-UI w/React - Use grid to layout app

```
<Grid container spacing={8}>
    <Grid item xs={12}>    <!-- Top bar across the top (all 12 col on xsmall or bigger
       <TopBar />
    </Grid>
    <Grid item xs={4}>   <!-- Row with List (4 col) & either Detail or Photo (8 col)
       <UserList />
    </Grid>
     <Grid item sm={8}>
        <UserDetail ... />        <!-- 8 columns wide
                  or
        <UserPhotos ... />        <!--  8 columns wide
     </Grid>
 </Grid>
```

Use grid to layout app

```
<Grid container spacing={8}>
```

```
<Grid item xs={12}> <TopBar /> ...
```

```
<Grid item xs={4}>
   <UserList ...
```

```
<Grid item xs={8}>
   <UserDetail or <UserPhotos
```

Much useful functionality available for our app

Modals: Menu, Popover, Dialogs, Selects, SnackBars

Navigation: Tabs, Bottom Navigation, Drawers

Context tracking: AppBar, Stepper, Progress

Paper

Autocomplete

Tooltips

Badges

Deep linking support - React Router

To support bookmarking and sharing we can use React Router to load the views

The `content div` can be the React Router `Switch`

```
<Switch>
     <Route path="/users/:userId" component={UserDetail} />
     <Route path="/photos/:userId" component={UserPhotos}  />
     <Route path="/users" component={UserList}  />
</Switch>
```

The `UserList` sidebar can just use links to view

```
<Link to="/photos/57231f1a30e4351f4e9f4bd8">
   Photos of User Ellen Ripley
</Link>
```

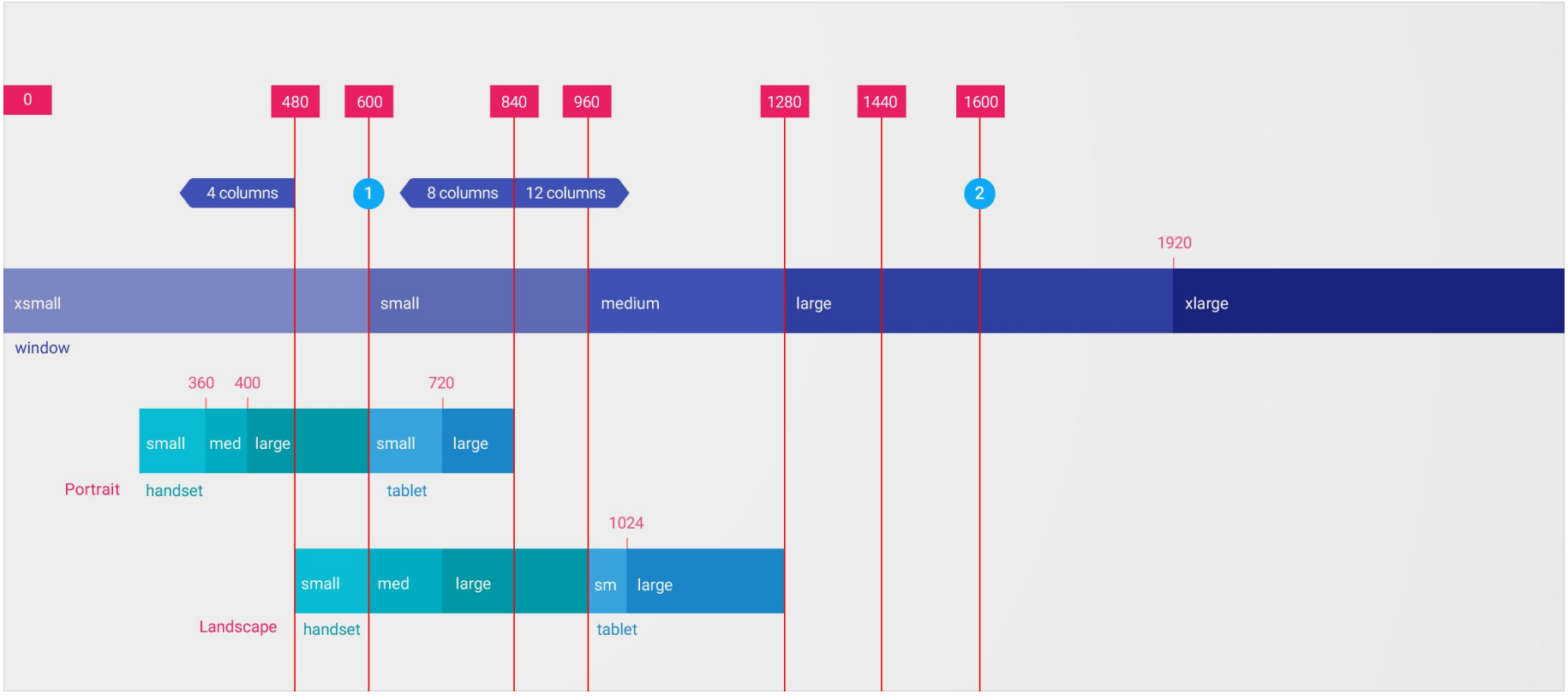
Responsive Design support

- Uses CSS flexbox - Relative sizing handles changes (flex attribute)

  `Grid ...` -- Smaller widths will have smaller content area

- Use CSS breakpoints to handle big differences

Material Breakpoint sizes: xs, sm, md, lg, xl



Material UI Breakpoints

Uses a simplified model based on screen width:

- xs, extra-small: 0px or larger
- sm, small: 600px or larger
- md, medium: 960px or larger
- lg, large: 1280px or larger
- xl, extra-large: 1920px or larger
    -

Material UI Responsive Support

- Grid Component - Grid takes `xs/sm/md/lg/xl=` columns properties

```
<Grid item xs={12} md={6} xl={3}> ...
```

- Hidden Component - Conditional rendering (`xsUp, lgDown`)

```
<Hidden mdUp>
    <Paper>This is a paper component except on md and bigger display</Paper>
</Hidden>
```

- `useMediaQuery` React interface to `@media`

```
const theme = useTheme();
const matches = useMediaQuery(theme.breakpoints.up('md'));
if (matches) ...
```

Accessibility

- Accessible Rich Internet Applications (ARIA)
- Provide text alternatives for any non-text content
  - Add text descriptions for things that need it

    `<a aria-label="Photo of user {{user.name}}" href=...`

    `<img aria-label="{{photo.description}}"`
- Provide alternatives for time-based media
  - Transcripts, sub-titles, etc.
- Work zoomed in, avoid quick timeouts, high contrast for foreground/background, work all keyboard and without keyboard, compatibility with assistive technologies, use simple sentences, etc.

Internationalization (I18N)

- Users want different: text, dates, numbers, currencies, and graphics
- Ultimately need a level of indirection. Consider: `<h1>Getting Started</h1>`
- Example: react-i18next: Look up translation by key
  - `Hello <strong title="this is your name">{name}</strong>, you have {count} unread message(s).`
  - ```
    <Trans i18nKey="userMessagesUnread" count={count}>
      Hello <strong title={t('nameTitle')}>{{name}}, you have {{count}}
           unread message.
    </Trans>
    ```
- Skip applying to user generated content
    ```

Testing the web app

- Unit testing
  - Each test targets a particular component and verifies it does what it claims it does
  - Requires mock components for the pieces that component interacts with
  - Example: Load an React component and run tests against it
    - Need to mock everything these touch (model data fetches, services, etc.)
- End-to-End (e2e) testing
  - Run tests against the real web application
  - Scripting interface into browser used to drive web application
  - Example: Fire up app in a browser and programmatically interact with it.
    - WebDriver interface in browsers useful for this
- Metric: Test Coverage
  - Does every line of code have a test?