

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

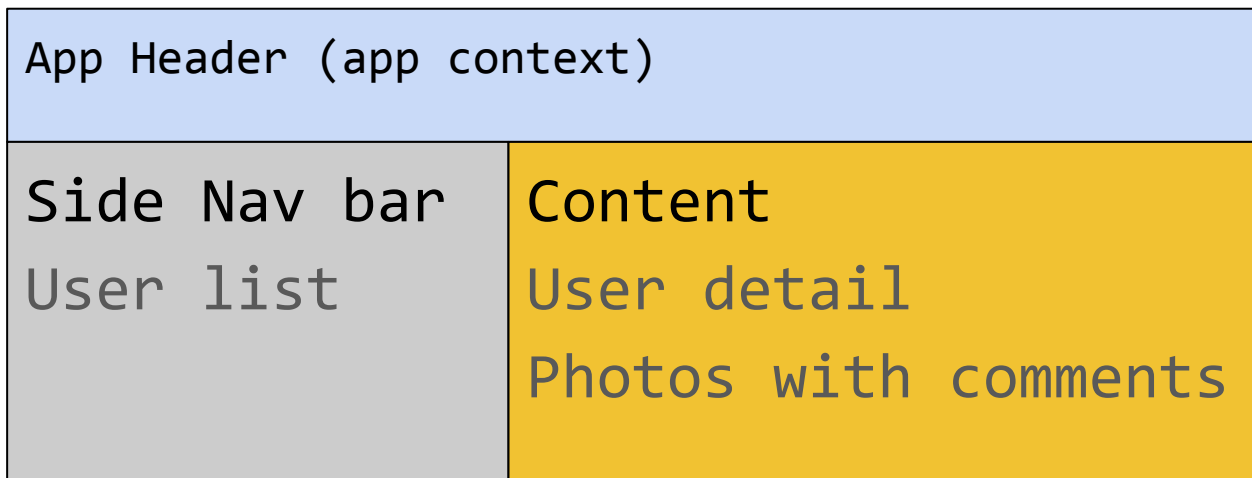
Communication - writing, formats, imagery, launch screen, onboarding

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>
```

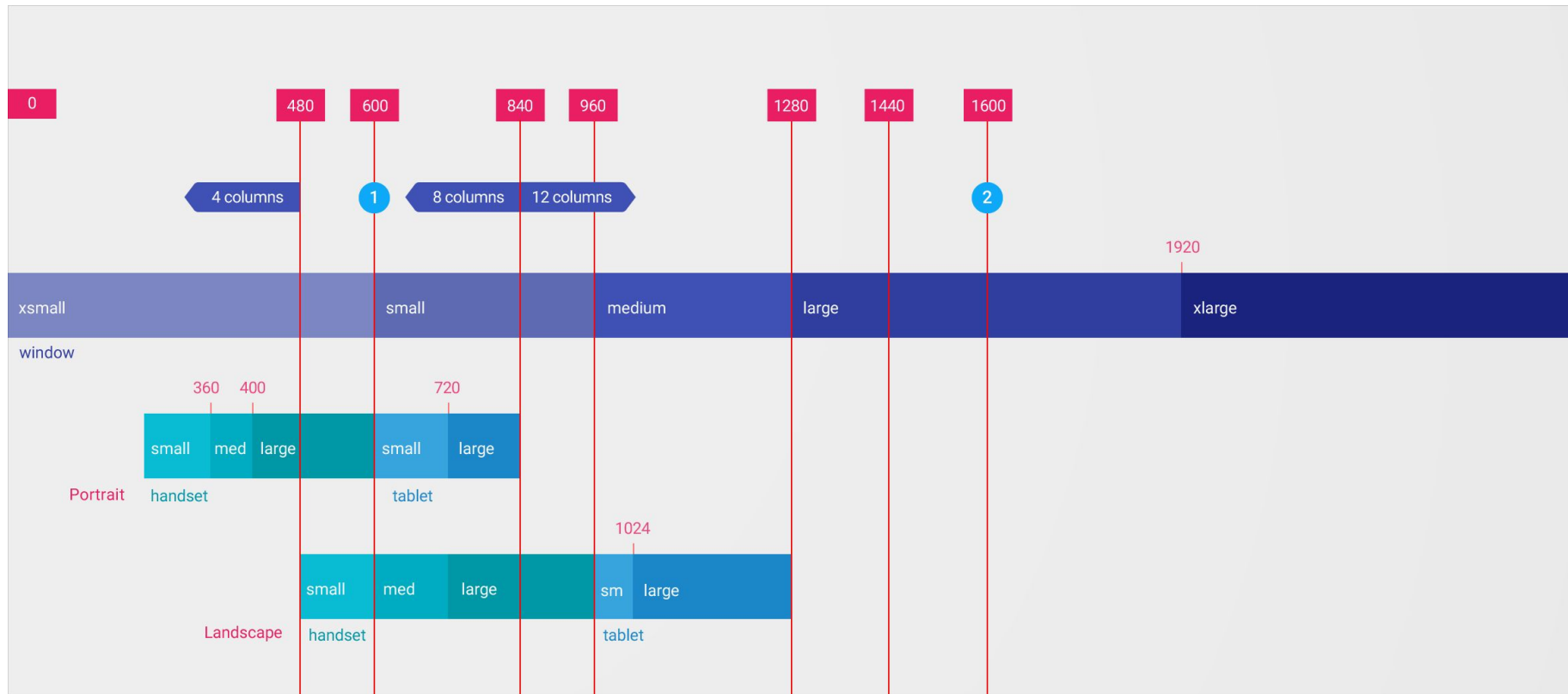
Responsive Design support

- 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

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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}`, 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?