#1: Getting Started

Links to **REPL examples** can be found at https://mvolkmann.github.io/blog/topics/#/blog/svelte/repls/.

What is Svelte? ...

- Alternative to other web frameworks
  - like React, Vue, and Angular
- Web application compiler, not a runtime library
- Doesn't use virtual DOM
  - https://svelte.dev/blog/virtual-dom-is-pure-overhead
- Developed by Rich Harris
  - "The Guardian" and "The New York Times"
  - created Ractive and Rollup

Svelte Requirements

- Need to know fundamentals
  - HTML
  - CSS
  - JavaScript or TypeScript
- Need to install Node.js
  - we'll see how later

Svelte Pros

- Fast
- Small bundle sizes often half size of other frameworks
- File-based component definitions
- CSS scoped by default
- Easy component state management (reactivity)
- Reactive statements (`?:`)
- Two-way data bindings
- Easy app state management (stores)
- Built-in animations

Svelte Cons

- Not yet as popular as alternatives
  - fewer developers, libraries, and other resources
- Can’t generate HTML in JS functions
  - in React, functions can return JSX
  - Svelte encourages creating more components

Svelte Compared to Other Options

- Svelte requires less code than Angular, React, and Vue to accomplish the same things
- Angular has a steep learning curve
- React uses JSX, hooks, and optionally Redux
- React and Vue use a virtual DOM
  - results in larger bundle sizes
  - slower than Svelte approach of using compiler-generated code to update DOM

Selected Svelte Resources

- Home page - https://svelte.dev

- “Rethinking Reactivity” talk by Rich Harris
- “Svelte and Sapper in Action” book

What is SvelteNative?

- Combines Svelte and NativeScript to build native mobile applications (Android and iOS)
- Thin layer over NativeScript API
- Renders native components, not web views
- Plugins allow access to all native device APIs
- Similar to ReactNative for React
- https://svelte-native.technology

What is Sapper?

- Framework built on Svelte
  - similar to Next for React or Nuxt for Vue
- Being replaced by SvelteKit
  - provides same features and more
- https://sapper.svelte.dev

What is SvelteKit? ...

- Replacement for Sapper
- https://kit.svelte.dev
- Provides
  - **`svelte-kit`** CLI tool
    - commands include **`build`**, **`dev`**, **`package`**, and **`preview`**
  - file-based page routing
  - file-based endpoints (REST services)
  - layouts
  - error page

npm scripts in **`package.json`** use these

can provide a common header, footer, and nav for a set of pages

… What is SvelteKit?

- And provides
  - code splitting for JS and CSS
    - page visits only load JS and CSS they need
  - fast hot module reloading (HMR) provided by Vite https://vitejs.dev
  - Server-Side Rendering (SSR) for first page visited by default
    - remaining pages rendered in browser
  - support for static sites and individual static pages
    - generated at build time
  - adapters for specific deployment targets
    - deno, netlify, node, static, vercel, and more

Vite

- Build tool
  - alternative to webpack, parcel, and Snowpack
  - uses **esbuild** to prebundle dependencies - https://esbuild.github.io
    - "extremely fast JavaScript bundler" implemented in Go
  - uses **Rollup** to bundle app code - https://rollupjs.org
- Development server
  - provides fast hot module reloading (HMR)
  - uses WebSockets
- https://vitejs.dev

"The Vite team is planning to shift completely to esbuild in the future."

Svelte REPL

- Stands for **R**ead **E**valuate **P**rint **L**oop
- Great for experimenting
- Write and run Svelte apps without installing anything
- Save apps to recall later - requires GitHub account
- Export apps to continue development outside REPL
- Limited set of libraries can be imported
- Cannot create/edit CSS files
- Can view generated JS and CSS

REPL Demonstration

- Let's write some code in the REPL!
  - create **`Counter`** component
  - create **`Greet`** component
- Review "Todo App" REPL

Page Routing Option #1

- Manual routing
  - use variable **`component`** to hold current page component
  - render a component specified in a variable with
    `<svelte:component this={component} props />`
  - use event handling to change **`component`**
  - ex. button or link click
  - URL in browser address bar never changes,
    so can't bookmark pages

Page Routing Option #2

- Hash Routing
  - also use **`<svelte:component this={component} props />`**
  - select new component with
    `<svelte:window on:hashchange={handleHashChange} />`
    - **`location.hash`** holds current hash value
  - URL in browser address bar does change (only hash portion), so can bookmark pages

Page Routing Option #3

- Use a library like page.js at https://github.com/visionmedia/page.js
  - “tiny Express-inspired client-side router”
  - not specific to Svelte

Page Routing Option #4

- Use SvelteKit file-based routing
- Best option in my opinion
- Described in section #3 “Deeper Into SvelteKit”

Component Source Files ...

- `.svelte` files with four optional parts
  - `<script context="module">...</script>`
    - think of as class level
    - can export multiple values including constants and functions
  - `<script>...</script>`
    - think of as instance level
    - automatically exports the component and cannot export anything else
  - HTML elements
    - can include Svelte logic syntax and `{expression}` interpolations
  - `<style>...</style>`
    - automatically scoped to component

Sections can appear in any order, but this is the **recommended order**.

... Component Source Files

```
<script context="module">
   not used often
</script>
<script>
  export let name;  declares a prop
</script>
<h1>Hello, {name}!</h1>  uses a prop
<style>
  h1 {  scoped to this component
    color: red;
  }
</style>
```

Props

- Primary way to pass data from parent components to child components
- Parent component example
  - `<SomeChild propA="some value" propB={7} />`
- Values can be any kind of JS value
  - boolean, number, string, object, array, function
- Shorthand for prop values in variable with same name
  - `<SomeChild {propA} {propB} />`
- Can spread object properties: `<SomeChild {...obj} />`

Accepting Props

- `.svelte` files are not JS files
- Svelte uses JS `export` keyword to identify props
- For example
  - `export let name;` required
  - `export let score = 0;` optional
- Use in JS code and interpolations just like any other variable

more on interpolations on next slide

- Parent components can `bind` to props to get updates
  - more on this later

Interpolation in HTML

- Expressions in curly braces
  - including function calls
- Examples
  - `<h1>{title}</h1>` variable
  - ```

      {amount * (taxRate + 1)}

    ```
    expression
  - `<p>{getDescription(product)}</p>` function call
    ```

Component State

- Variables declared at top level of **`<script>`** are state if used in HTML
- Changes to these variables trigger updates to DOM that depends on them
- Referred to as “reactivity”
- We saw this in REPL code for **`Counter`**, **`Greet`**, and **`Todo App`**

Reactivity

- DOM updates in response to changing top-level variables if ...
  - value is changed
  - value is an object and one of its properties is modified
- When changing an array, trigger reactivity by creating new array or assigning variable to itself
  - `myArr = myArr.concat(newValue);`
  - `myArr = [...myArr, newValue];`
  - `myArr.push(newValue); myArr = myArr;` most efficient

Reactive Statements ...

- `.svelte` files are not JS files
- Svelte uses label name `$` to mark “reactive statements”
- JS labels are followed by a colon
- Reactive statements are executed
  - initially
  - again when value of any referenced variable changes
- Like spreadsheet cells that contain formulas

... Reactive Statements ...

- Can be assignment to a variable not yet declared
  - `$: total = scores.reduce( (acc, s) => acc + s, 0);`

reactive declaration

- Can use for debugging
  - `$: console.log('total =', total);`
- Can call a function every time an argument changes
  - `$: evaluateCart(cart, taxRate);`

… Reactive Statements

- Can be a block containing any # of statements that are re-executed every time any referenced variable changes
- Example
  - ```
    let total;
    $: {
      total = scores.reduce(
        (acc, s) => acc + s, 0);
      console.log('total =', total);
    }
    ```
- See “Loan Calculator” REPL

re-executed every time **scores** array changes

How would this be implemented in other frameworks?
    ```

Conditional Logic in HTML ...

- Uses Mustache-like syntax
- `{#if some-condition}` opens with **#**

```
  HTML to render
{:else if other-condition}
  other HTML to render
{:else}
  more HTML to render
{/if}
```

continues with **:**

ends with **/**

... Conditional Logic in HTML

```
{#if temperature > 80}
  <p>It's hot.</p>
{:else if temperature < 40}
  <p>It's cold.</p>
{:else}
  <p>Go for a run!</p>
{/if}
```

Iteration in HTML ...

- `{#each arrExpr as elemName, index (keyExpr)}`
  `HTML to render for each element`
  `{:else}`
  `HTML to render if array is empty`
  `{/each}`
- `, index` is optional
- `(keyExpr)` is optional
  - include when array elements will be added, deleted, or reordered
- `{:else}` block is optional

… Iteration in HTML

more on **bind** later

```
<select bind:value={favoriteColor}>
  <option value="">Select a color</option>
  {#each colors as color}
    <option>{color}</option>
  {/each}
</select>
```

assumes **colors** is an array of strings

Handling Promises in HTML ...

- `{#await promiseExpr}`
  `HTML to render before Promise resolves or rejects`
  `{:then result}`
  `HTML to render if Promise resolves`
  `{:catch error}`
  `HTML to render if Promise rejects`
  `{/await}`
- Not used often
  - more typical to handle with JS in `<script>`

could render a spinner

... Handling Promises in HTML

```
{#await getWeatherForecast(zipCode)}
  <p>... loading forecast ...</p>
{:then result}
  <p>
    high temperature today is
    {result.high}
  </p>
{:catch error}
  <p class="error">
    error getting forecast: {error}
  </p>
{/await}
```

Key Blocks ...

- Can surround HTML and components with a **`key`** block
- Causes corresponding DOM to be destroyed and recreated when value of expression changes
-
```
{#key expression}
  HTML and/or components
{/key}
```

… Key Blocks

- Example
  - ```
    {#key languageCode}
      <ContactInfo {person} />
    {/key}
    ```

assumes `ContactInfo` renders differently when `languageCode` changes

- Not used often
  - useful when HTML doesn't directly depend on a variable that has changed
    - perhaps variable is used in a function called in an interpolation
  - can use to cause a CSS animation to re-run
    ```

Importing Other Components

- Components don’t specify their own name
  - source file names imply their name
    and typically those names are used
- Parent components choose name in import
  - `import OtherName from './SomeName.svelte';`

Global vs. Scoped Styles ...

- CSS rules in **`<style>`** elements in **`.svelte`** files are scoped to the component
  - achieved by adding a generated CSS class name to all elements and CSS selectors (**`svelte-hash`**)
  - computed from hash of **`<style>`** contents
- Can include a CSS file for global styling
  - ex. create **`src/global.css`** and add following in **`src/routes/index.svelte`**
  - **`import '../global.css';`**

examine "CSS output" in Counter REPL

assumes use of SvelteKit file-based routing

… Global vs. Scoped Styles

- Prevent scoping in components with `:global(selector)`
- Example
  - suppose this component
    - renders `<div class="my-class">...</div>`
    - renders a component inside that `div`
      that renders an element with CSS class `other-class`
  - `.my-class :global(.other-class) { ... }`
- Starting with selector matching HTML in this component prevents global part from
  affecting components outside this one

consider what it would mean if `.my-class` was omittted

Conditional Styles

- `<div class="c1"`
  `class="c2 c3"`
  `class:c4={`***`expression`***`}`
  `class:c5>`
- **`c1`**, **`c2`**, and **`c3`** will always be applied
- **`c4`** will only be applied if
  `expression` evaluates to **`true`**
- **`c5`** will only be applied if
  there is a variable **`c5`** that evaluates to **`true`**

Installing Node.js

- Browse https://nodejs.org
  - click big, green button for LTS or Current version to download installer
  - double-click downloaded installer
- Can also use a tool like Node Version Manager (nvm)
  - installs multiple versions
  - can easily switch between them
  - https://github.com/nvm-sh/nvm

Creating a SvelteKit App ...

- **`npm init svelte@next`** ***`project-name`***
  - uses npm package **`create-svelte`**
- Answer questions
  - Which Svelte app template?
    - SvelteKit demo app or Skeleton project (prefer this)
  - Use TypeScript? (prefer yes)
  - Add ESLint for code linting? (prefer yes)
  - Add Prettier for code formatting? (prefer yes)

… Creating a SvelteKit App

- Follow instructions that are output to install dependencies and run locally
  - **`cd` *`project-name`***
  - **`npm install`**
  - **`npm run dev -- --open`** listens on port 3000 by default
- Recommended additional step
  - prevent ESLint from running on generated files by creating **`.eslintignore`** file containing line **`build/`**

Special Files and Directories

- **`src/app.html`** file
  - starting HTML file
- **`src/routes`** directory
  - holds page components and endpoints
- **`src/lib`** directory
  - holds other components and functions
- **`.svelte-kit`** directory
  - holds files generated by **`npm run dev`** and **`npm run build`** which create development and production versions of app

in **`build`** and **`dev`** subdirectories

Using ESLint

- Checks code for many issues
- To run, enter **`npm run lint`**

Default ESLint Config File Using TS

.eslintrc.cjs

```
module.exports = {
  root: true,
  parser: '@typescript-eslint/parser',
  extends: ['eslint:recommended', 'plugin:@typescript-eslint/recommended', 'prettier'],
  plugins: ['svelte3', '@typescript-eslint'],
  ignorePatterns: ['*.cjs'],
  overrides: [{ files: ['*.svelte'], processor: 'svelte3/svelte3' }]
  settings: {
    'svelte3/typescript': () => require('typescript')
  },
  parserOptions: {
    sourceType: 'module',
    ecmaVersion: 2019
  },
  env: {
    browser: true,
    es2017: true,
    node: true
  }
};
```

Can add globals and override rules. For example:

```
globals: {
  Cypress: 'readonly',
  cy: 'readonly',
  describe: 'readonly',
  it: 'readonly'
},
rules: {
  // Allow use of @ts-ignore.
  '@typescript-eslint/ban-ts-comment': 'off'
}
```

Using `svelte-check`

- Finds unused CSS
- Detects some accessibility issues
- Outputs JS/TS compiler errors
- To run, enter **`npm run check`**

Using Prettier

- Formats HTML, CSS, JS, TS, and more
- To run, enter **`npm run format`**
- Can also configure editor/IDE to run Prettier when files are saved
  - in VS Code, after modifying **`.prettierrc`** run “Developer: Reload Window”

Default Prettier Config File

.prettierrc

```
{
  "useTabs": true,
  "singleQuote": true,
  "trailingComma": "none",
  "printWidth": 100
}
```

Recommended additions and changes:

```
"arrowParens": "avoid",
"bracketSpacing": false,
"printWidth": 80,
"useTabs": false
```

`npm run dev` Options

- `-o` or `--open`
  - opens tab for app in default browser
- `-p` or `--port` followed by a number
  - listen on port other than 3000
- `-h` or `--host`
  - makes server available to other devices in same network
- `-H` or `--https`
  - uses HTTPS with self-signed certificate

Lesson #1 Q & A

#2: Deeper into Svelte

Lifecycle Functions

- Each are passed a function to invoke when the lifecycle event occurs
- **`onMount`**
  - invoked when component is added to DOM
- **`beforeUpdate`** rarely used
  - invoked before every component update
- **`afterUpdate`** rarely used
  - invoked after every component update
- **`onDestroy`** rarely used
  - invoked when component is removed from DOM

Uses include manipulating DOM generated by Svelte and calling REST services to get data to render.

Directives ...

- **`bind`** - two-way binding
  - **`<input bind:value={variable} />`**
- **`bind:this`** - DOM element access
  - **`<div class="dialog" bind:this={dialog}>`**
  - sets variable to DOM element
  - can use to manipulate DOM, perhaps in **`onMount`**
- **`class:name={condition}`** - conditional CSS class
  - we learned about conditional styles earlier

can also use with **`textarea`** and **`select`**

… Directives

- **`on:`*`name`*`={`*`function`*`}`** - event handling
  - ex. **`<button on:click={handleClick} />`**
  - can also use an arrow function
- **`use:`*`fnName`*** - action
  - function is invoked when element is added to DOM
  - see “Action Demo” REPL
- **`animate`**, **`transition`**, **`in`**, and **`out`**
  - covered soon on slides starting with “Animation”

Component Communication Options

Need	Solution	
parent passes data to child	**props**	already covered
parent passes HTML and components to child	slots	covered later w/ SvelteKit layouts
child notifies parent, optionally including data	**events**	covered next
ancestor makes static data available to descendants	context	not covered
component shares data between all instances	module context	already covered
any component subscribes to and publishes data	**stores**	covered next

Events ...

- Events go from child components to their parent
  - as seen in "Todo App" REPL which dispatches **`toggleDone`** and **`delete`** events
- To dispatch events from a component
  - ```
    import {createEventDispatcher} from 'svelte';
    const dispatch = createEventDispatcher();
    dispatch('my-event', data);
    ```
- To listen for events in parent component
  - ```
    <Child on:my-event={handleMyEvent} />
    ```
  - ```
    function handleMyEvent(event) {
      const data = event.detail;
      ...
    }
    ```

in **`script`** tag
    ```

… Events

- Events propagate up one level if no handler is specified
  - `<Child on:my-event />`
  - parent of component containing this can use `on` directive to handle the event

Stores ...

- Hold data that can be shared between components
- Uses publish/subscribe
- Four kinds of stores
  - **writable** - components can modify most commonly used
  - **readable** - only the store can change
    - could get data from REST services and periodically update
  - **derived** - compute value from one or more other stores
  - **custom** - can provide a custom API to control data access
    - typically built from a writable store

… Stores

- Can define and export all stores in **`src/lib/stores.js`**
  - **`import {derived, readable, writable} from 'svelte/store';`**

create stores by calling these functions

- Can import stores in any components
- Refer to store value by preceding store name with $
  - automatically subscribes on first use and unsubscribes when component instance is destroyed
- See “Writable Store” REPL

To save store values in **`sessionStorage`**,
see “**`writableSession`** Store” slides in Bonus section.

Animation

- Supported by four packages
  - **`svelte/animate`**
  - **`svelte/easing`**
  - **`svelte/motion`**
  - **`svelte/transition`**
- All are CSS-based rather than JS-based
  - good performance because main thread is not blocked
- Can define custom transitions
  - see “Custom Transition (spin)” REPL

Easing Functions in `svelte/easing`

- These control rate of change through an animation
  - constant rate: **`linear`**
  - simple curves: **`sine`**, **`quad`**, **`cubic`**, **`quart`**, **`quint`**, **`expo`**, and **`circ`**
  - curves that move backward & forward: **`back`**, **`elastic`**, and **`bounce`**
  - actual names end in **`In`**, **`Out`**, or **`InOut`**
- Browse the Ease Visualizer to explore these
  - https://svelte.dev/examples#easing
  - for example, examine differences between **`backIn`**, **`backOut`**, and **`backInOut`**

`svelte/animate` Package

- Currently only defines **`flip`** function
  - stands for first, last, invert, play; doesn't flip anything
  - animates changes to x/y position from old to new
  - supports options **`delay`**, **`duration`**, and **`easing`**
  - see "Flip Animation" REPL

`svelte/motion` Package

- Defines **`spring`** and **`tweened`** functions
  - both return a writable store that is used to animate changes to a value
  - supports options **`delay`**, **`duration`**, **`easing`**, and **`interpolate`**
  - see “Pie Chart (svelte/motion)” REPL

to interpolate between values that are not numbers

`svelte/transition` Package

- Defines many directives
  - **`blur`**, **`draw`**, **`fade`**, **`fly`**, **`scale`**, and **`slide`**
  - see “Transition Animations” REPL
    - focus on one animation at a time
  - see “Draw Animation” REPL
    - works with SVG **`path`** elements
- Defines **`crossfade`** function
  - see “Crossfade Demo” REPL

Special Elements ...

- Render a dynamically selected component
  - **`<svelte:component this={`*`expr`*`} `*`props`*` />`**
  - recall use in manual and hash routing
- Handle **`window`** events
  - **`<svelte:window on:eventName={`*`function`*`} />`**
  - examples of window event names are **`hashchange`** and **`resize`**
  - recall use of **`hashchange`** in hash routing
  - can use **`resize`** to implement responsive components, in addition to CSS media queries

... Special Elements ...

- Get **`window`** properties
  - **`<svelte:window bind:`*`propertyName`*`={`*`variable`*`} />`**
  - available properties are
    `innerHeight`, **`innerWidth`**,
    `outerHeight`, **`outerWidth`**,
    `scrollX`, **`scrollY`**,
    and **`online`**
  - **`innerWidth`** is useful for developing responsive components
  - can only use once per component,
    but can bind to any number of properties

can use in reactive statements

… Special Elements

- Handle **`body`** events
  - **`<svelte:body on:`*`eventName`*`={`*`function`*`} />`**
  - not commonly used
- Insert elements in **`head`**
  - **`<svelte:head>`*`elements`*`</svelte:head>`**
  - examples include **`link`**, **`script`**, and **`title`**
- Specify Svelte compiler options
  - **`<svelte:options option={`*`value`*`} />`**
  - not commonly used

only **`title`** is commonly used

Some Libraries to Consider

- All are in npm - https://www.npmjs.com
- **dialog-polyfill**
  - for using HTML **`dialog`** element in browsers that do not yet support it (such as Firefox and Safari)
- **svelte-fa**
  - for rendering FontAwesome icons
- **svelte-material-ui**
  - collection of Material UI components implemented in Svelte

Testing SvelteKit Apps

- Three tools are covered
  - **Jest** for unit tests
  - **Cypress** for end-to-end tests
  - **Storybook** for component demos and manual testing
- All are demonstrated in GitHub repo https://github.com/mvolkmann/sveltekit-testing

Testing with Jest ... https://jestjs.io

- Install Jest
  - **`npm install -D name`** where ***`name`*** is
    - if using JavaScript, only **`jest`**
    - if using TypeScript, **`ts-jest`** and **`@types/jest`**
- Add npm scripts in **`package.json`**

```
"test": "jest src",
"test watch": "npm run test -- --watch",
```

... Testing with Jest ...

- Configure by creating **`jest.config.cjs`** containing

```
module.exports = {
  bail: false,
  moduleFileExtensions: ['js', 'ts'],
  transform: {
    '^.+\\.(ts|tsx)$': 'ts-jest'
  },
  verbose: true
};
```

file extension is **`.cjs`**, not **`.js`**

… Testing with Jest

- Create test files with **`.spec.js`** or **`.spec.ts`** extensions
- Example
  - **`src/lib/util.ts`**

```
export function add(n1: number, n2: number): number {
  return n1 + n2;
}
```

  - **`src/lib/util.spec.ts`**

```
import {add} from './util';
describe('util', () => {
  test('add works', () => {
    expect(add(0, 0)).toBe(0);
    expect(add(1, 2)).toBe(3);
  });
});
```

- To run tests
  - enter **`npm test`** or **`npm run test:watch`**

Jest Output

```
cd sveltekit-testing
npm test
```

```
> sveltekit-testing@0.0.1 test
> jest src

 PASS  src/lib/util.spec.ts
  util
    ✓ add works (2 ms)

Test Suites: 1 passed, 1 total
Tests:       1 passed, 1 total
Snapshots:   0 total
Time:        3.432 s
Ran all test suites matching /src/i.
```

Testing Components With Jest

- Jest can test components too
  - need to install additional libraries like **`svelte-jester`** and **`@testing-library/svelte`**
  - but consider relying on Cypress for component tests
- Much more to learn about Jest,
  but this is enough to get you started

Testing with Cypress ... https://www.cypress.io

- Install by entering **`npm install -D cypress`**
- Add npm scripts in **`package.json`**

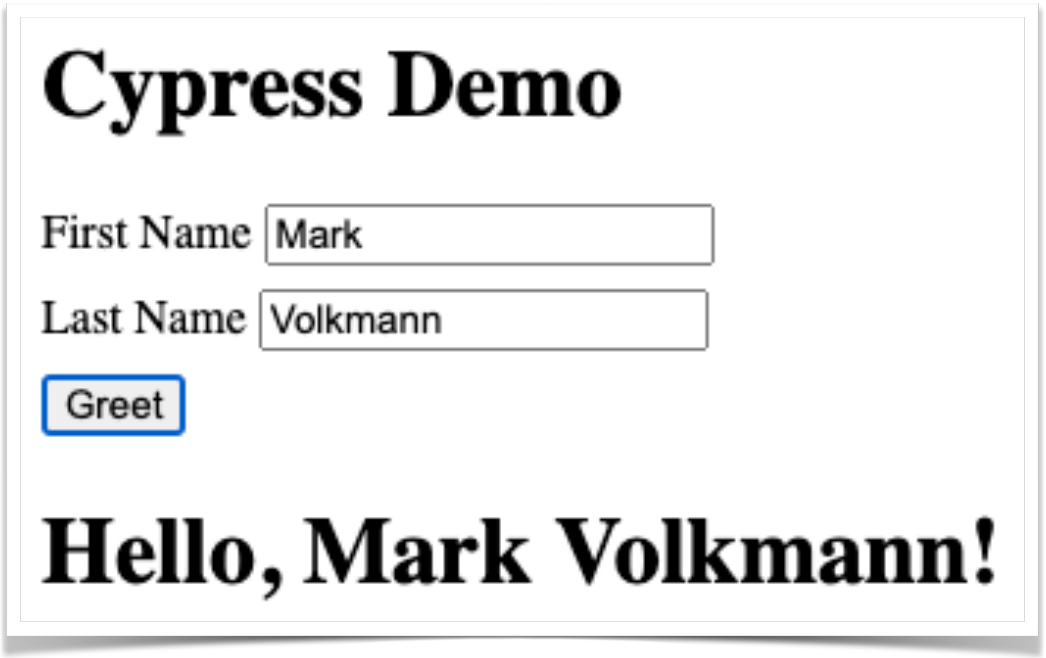
```
"cy:open": "cypress open",
"cy:run": "cypress run",
```

- Create initial Cypress files by entering
  - **`npm run cy:open`**
  - will get error "The plugins file is missing or invalid."
  - change extension of **`cypress/plugins/index.js`** to **`.cjs`**

… Testing with Cypress

- Create tests in **`cypress/integration`** directory with **`.spec.js`** extension
  - see example ahead
  - can delete provided example tests
- Run tests
  - start local server by entering **`npm run dev`**
  - start Cypress by entering **`npm run cy:open`**
  - click a specific test file or "Run *n* integration tests"
- Much more to learn about Cypress, but this is enough to get you started

Cypress: Example Component ...



… Cypress: Example Component

src/routes/index.svelte

```
<script>
  let firstName = '';
  let lastName = '';
  let greeting = '';
  function greet() {
    greeting = `Hello, ${firstName} ${lastName}!`;
  }
</script>
<h1>Cypress Demo</h1>

<form on:submit|preventDefault={greet}>
  <div>
    <label for="first-name">First Name</label>
    <input name="first-name" bind:value={firstName} />
  </div>
  <div>
    <label for="last-name">Last Name</label>
    <input name="last-name" bind:value={lastName} />
  </div>
  <button>Greet</button>
</form>

<h1>{greeting}</h1>

<style>
  form > div {
    margin-bottom: 0.5rem;
  }
</style>
```

Cypress: Example Test

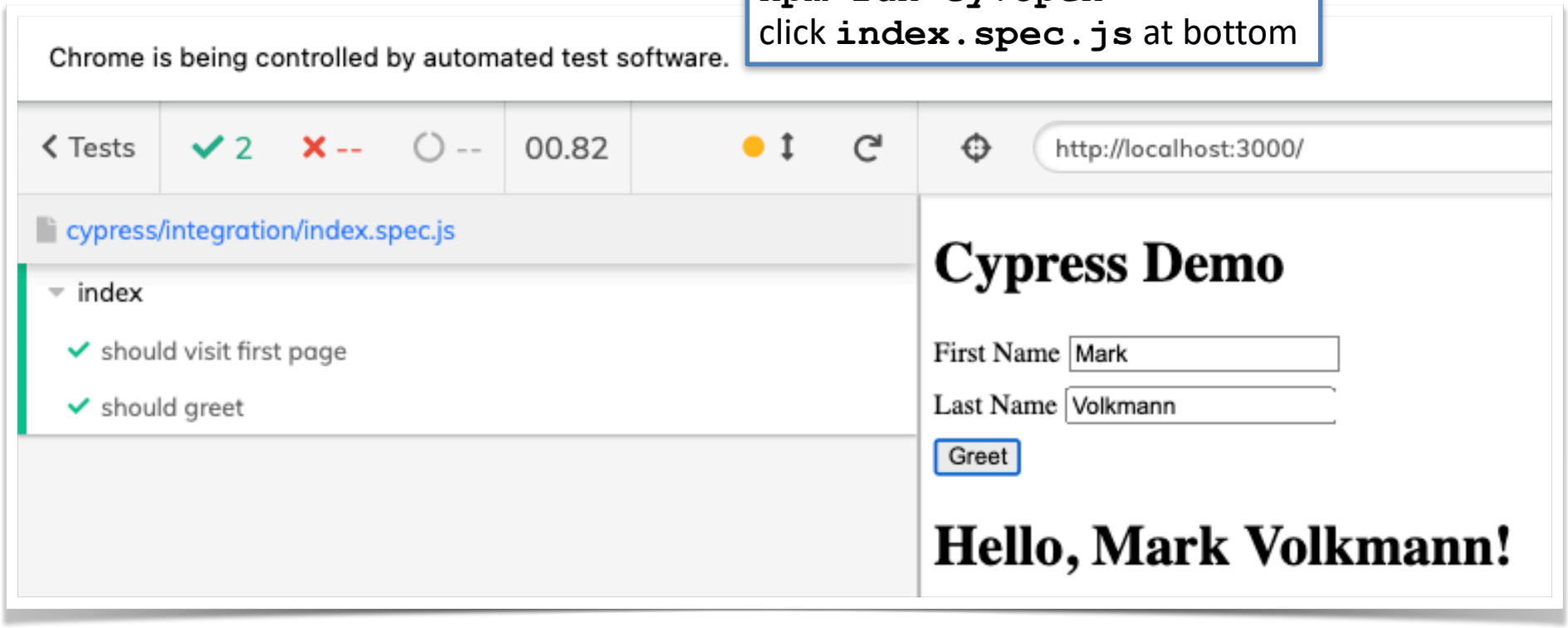
cypress/integration/index.spec.js

```
const baseurl = 'http://localhost:3000/';

describe('index', () => {
  it('should visit first page', () => {
    cy.visit(baseurl);
    cy.contains('Cypress Demo');
  });

  function type(label, text) {
    cy.contains(label).parent().children('input').type(text);
  }

  it('should greet', () => {
    cy.visit(baseurl);
    type('First Name', 'Mark');
    type('Last Name', 'Volkmann');
    cy.contains('Greet').click();
    cy.contains('Hello, Mark Volkmann!');
  });
});
```

finds parent element of **label**, then **input** child

Cypress Web UI

```
cd sveltekit-testing
npm run dev
```
open another terminal
```
npm run cy:open
```
click **`index.spec.js`** at bottom



Testing with Storybook ... https://storybook.js.org

- Install by entering **`npx sb init`**
- This does several things
  - adds npm scripts in **`package.json`**

```
"storybook": "start-storybook -p 6006",
"build-storybook": "build-storybook",
```

  - creates **`.storybook`** directory
    - contains **`main.js`** that configures Storybook
  - creates **`src/stories`** directory
    - contains example components and stories that can be deleted

… Testing with Storybook

- In **`.storybook/main.js`** change **`require`** to **`import`**
- Change extension of **`.storybook/main.js`** to **`.cjs`**
- Add stories
  - create files in **`src/stories`** with **`.stories.js`** extension
  - typically file name matches component source file name
  - these files can define multiple stories for the same component, each demonstrating different features
  - see example ahead
- Run by entering **`npm run storybook`**

Pie Component ...

```
<script>
  import {tweened} from 'svelte/motion';

  export let bgColor = 'tan';
  export let fgColor = 'blue';
  export let size = 50;
  export let value; // 0 to 100

  const store = tweened(value, { duration: 500 });
  let dashArray = '';
  $: half = size / 2;
  $: viewBox = `0 0 ${size} ${size}`;
  $: circumference = 2 * Math.PI * half;
  $: {
    const v = Math.max(0, Math.min(100, value));
    store.set(v);
    const dash = ((v / 100) * circumference) / 2;
    dashArray = `${dash} ${circumference - dash}`;
  }
</script>
```

Understanding this component is not important. It is just a good component to demonstrate in Storybook.

describes pie wedges

ensures value is in range

… Pie Component

```
<svg height={size} width={size} {viewBox}>
  <circle class="bg" fill={bgColor} r={half} cx={half} cy={half} />
  <circle
    class="fg"
    r={half / 2}
    cx={half}
    cy={half}
    fill="transparent"
    stroke={fgColor}
    stroke-width={half}
    stroke-dasharray={dashArray}
  />
</svg>

<style>
  svg {
    transform: rotate(-90deg);
  }
</style>
```

Pie Stories

```
import Pie from '../lib/Pie.svelte';

export default {
  title: 'Pie',
  component: Pie,
  argTypes: {
    bgColor: { control: 'color' },
    fgColor: { control: 'color' },
    size: { control: 'number' },
    value: { control: 'range' }
  }
};
```

creates controls for changing prop values

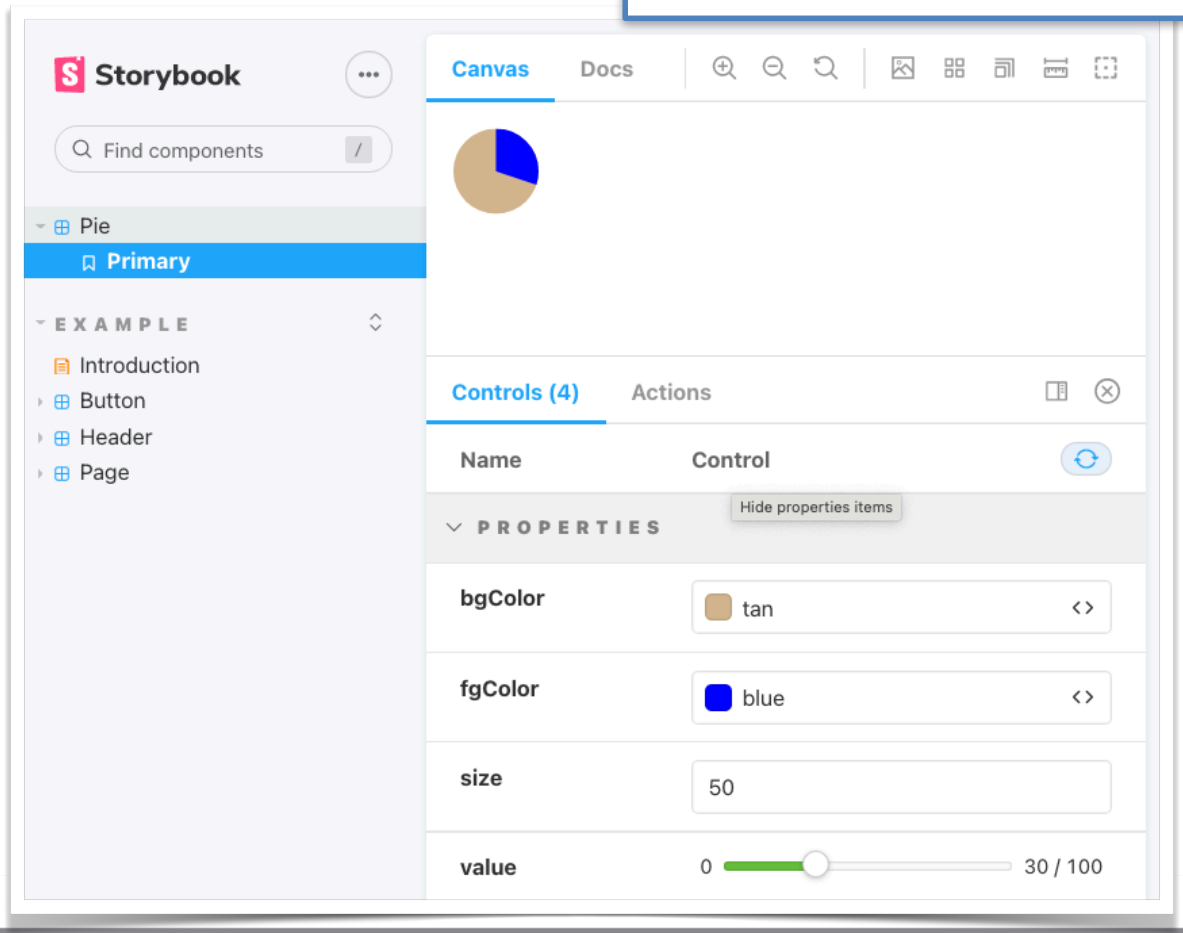
```
const Template = (props) => ({Component: Pie, props});

export const Primary = Template.bind({});
Primary.args = {
  bgColor: 'tan',
  fgColor: 'blue',
  size: 50,
  value: 30
};
```

defines default prop values

defines a story;
can define more than one with different names and default props

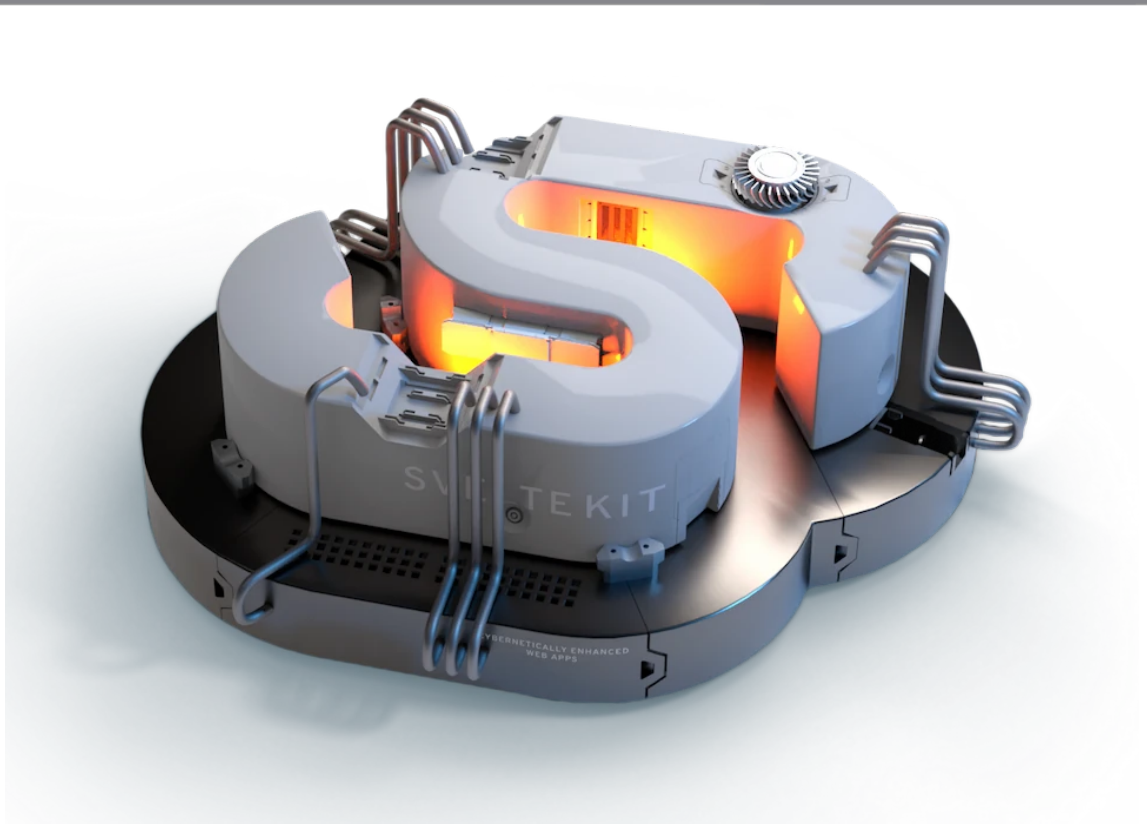
Storybook Web UI

```
cd sveltekit-testing
npm run storybook
```



Lesson #2 Q & A

#3: Deeper into SvelteKit



npm Scripts Provided by SvelteKit

- **`check`** - checks for errors using **`svelte-check`**
- **`check:watch`**
  - same as **`check`**, but rechecks automatically when changes are detected
- **`lint`** - checks for errors using ESLint
- **`format`** - formats code using Prettier
- **`dev`** - runs app in development mode
- **`build`** - builds production version of app using specified adapter
- **`preview`** - runs app in production mode
  - must build production version before running this

see bonus slides for more on adapters

Using TypeScript

- Request when creating a new SvelteKit project
  - can configure manually, but that's much more work
- Indicate usage in **`script`** tags
  - **`<script lang="ts">`**
- Add types to declarations including
  - props - **`export let name: type;`**
  - variables: **`const name: type;`** and **`let name: type;`**
  - function parameters
  - function return types

SvelteKit TypeScript types are defined in **`node_modules/@sveltejs/kit/types`**; import them from **`@sveltejs/kit`**

Server-Side Rendering (SSR)

- By default, SvelteKit renders first page visited on server and others in browser
- After downloading first server-rendered page, renders it again in browser to make it interactive
  - listening for events, updating state, and surgically updating DOM
- SSR can be disabled
  - globally - edit **`svelte.config.js`** and set **`kit.ssr`** to **`false`**
  - for a specific component

```
<script context="module">
  export const ssr = false;
</script>
```

File-based Routing

- Pages and their URLs are described by directory and file names under **`src/routes`**
- File and directory names inside square brackets indicate that a path parameter will be captured
  - access in module context **`load`** functions with **`page.params`**
- Pages can be rendered in three ways
  - build time
  - runtime on server
  - runtime in browser

Mapping Files to URLs

all these file paths are under **`src/routes/`**

File	URL	Parameters
`index.svelte`	`/`	none
`person.svelte`	`/person`	none
`person/index.svelte`	`/person`	none
`person/[personId].svelte`	`/person/`*`personId`*	`personId`
`person/[personId]/index.svelte`	`/person/`*`personId`*	`personId`
`person/[personId]/dog/[dogId].svelte`	`/person/`*`personId`*`/dog/`*`dogId`*	`personId` and `dogId`
`person/[personId]/dog/[dogId]/index.svelte`	`/person/`*`personId`*`/dog/`*`dogId`*	`personId` and `dogId`
`person/[personId]/dog/[dogId]/photos.svelte`	`/person/`*`personId`*`/dog/`*`dogId`*`/photos`	`personId` and `dogId`

Demo Project

- Many features of SvelteKit are demonstrated in the GitHub repo at https://github.com/mvolkmann/sveltekit-routes

`load` Functions

- Page and layout source files can define a **`load`** function
  - can load data, perhaps by calling REST services
  - primary use is to specify props to pass to component instances
  - page is not rendered until this function completes
  - must be in **`module`** context because
    it runs before component is rendered
  - only used in page and layout components, not other components
  - called in both server (SSR) and browser (client-rendered)

`load` Function Parameter only one

- Object containing these properties

`fetch` and `page` are the most frequently used

  - **`fetch`**
    - function for using Fetch API provided by browser or a server library
  - **`page`**
    - object with **`host`**, **`path`**, **`params`**, and **`query`** properties

strings objects

  - **`session`**
    - for passing data from server such as current user id
  - **`stuff`**
    - data passed from layout components
    - useful when multiple pages have common layout and need same data

`load` Function Return Value

- Object containing these properties

`props`, `status`, and `error` are the most frequently used

  - **`error`** - error description if any, perhaps from REST call failures
  - **`maxage`** - seconds to cache page; doesn't apply to layouts
  - **`props`** - object specifying props to pass to component instances
  - **`redirect`**
    - to redirect to different page,
      perhaps based on data returned from a REST call
  - **`status`** - HTTP status code
  - **`stuff`** only specified in layout components
    - data provided as input to subsequent page and layout components

`load` Function Error Handling

- Don't need to wrap REST calls in try/catch if displaying errors using error page is acceptable
  - we'll see how to define an error page later
- But typically if **`res.ok`** is **`false`** the code should
  - return an object with **`error`** and **`status`** properties or
  - **`throw await res.text();`**

`load` Function Called When

- `load` functions are called when the page is rendered and again every time one of these change if they are used in the function
  - `page.path`
  - `page.params`
  - `page.query`
  - `session`
  - `stuff`

Example `load` Function

from `src/routes/person/[personId]/dog/[dogId]/index.svelte`

```
<script context="module" lang="ts">
  import type {LoadInput, LoadOutput} from '@sveltejs/kit';

  export async function load(
    {fetch, page}: LoadInput): Promise<LoadOutput> {
    const {personId, dogId} = page.params;
    const url = `/api/person/${personId}/dog/${dogId}`;
    const res = await fetch(url);
    if (res.ok) {
      const dog = await res.json();
      return {maxage: 60, props: {dog}};
    }

    const error = await res.text();
    return {error, status: res.status};
  }
</script>
```

Caches page for specified `personId` and `dogId` for 60 seconds. Any request for cached values received in that time period will be served the cached page and this `load` function will not run.

Prefetching ...

- Calls **`load`** function of page before request to navigate to page is made
  - can be triggered by hovering of an anchor tag (**`<a>`**) that has **`sveltekit:prefetch`** attribute
  - can be triggered programmatically by calling **`prefetch`** function defined in **`$app/navigation`**
    - ex. when **`mouseover`** or **`focus`** event occurs on **`button`** element
- Can make page render faster
  - because when navigation is actually requested, data needed by page has already been loaded

see **`a`** and **`button`** elements in **`src/routes/index.svelte`**

… Prefetching

- Regardless of whether prefetching is used,
  target page will not render
  until **`load`** function completes
- If **`load`** function might be slow,
  perhaps due to calling a slow REST service,
  display a loading indicator
  - see how the sveltekit-routes app implements this
    in **`src/routes/index.svelte`**
    by using the **`navigating`** store
    and a call to **`setCursor`**

also see Bonus slide
"Provided Modules - **`$app/stores`**"

Layouts

- Components that define common ...
  - content and formatting for a set of pages
  - optional **`load`** function
- Contain **`slot`** element for rendering a page component
- Defined in files named **`__layout.svelte`**
- Can be in multiple nested directories for nested layouts
- Layout in **`src/routes`**, applies to every page
  - common to define page header, nav links, and page footer here
  - if not present, defaults to only **`<slot />`**

Layout Example

```
<header>...</header>

<nav>...</nav>

<main>
  <slot />
</main>

<footer>...</footer>

<style>...</style>
```

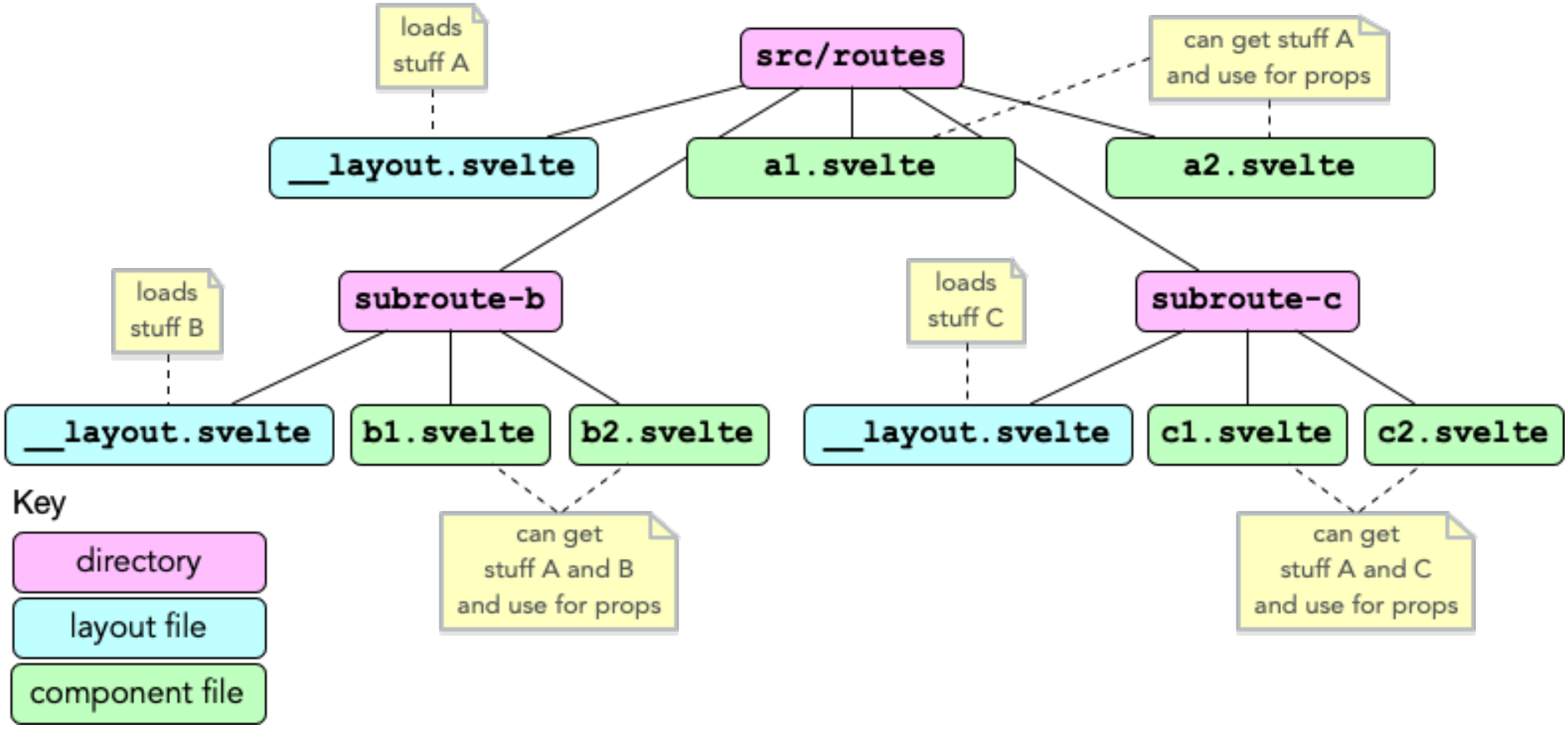
Sharing Data With Layouts

- If a set of pages share a common layout and the pages need some of same data from endpoints
  - define **`load`** function in **`__layout.svelte`**
    - get data from endpoints
    - return object with **`stuff`** property whose value is an object with properties that hold data needed by pages
  - define a **`load`** function in each page
    - get data needed from **`stuff`** property of **`LoadInput`** object
    - return object with **`props`** property whose value is an object with properties that hold prop values

could be just `<slot />`

see demo in repo sveltekit-layout-context

Nested Layouts



Error Page ...

- Define in **`src/routes/__error.svelte`**
  - a default error page is provided if this is missing
- Rendered when
  - no matching route is found for URL
  - a page **`load`** function
    returns object with an **`error`** property
    or throws an error

… Error Page

- Define module context **`load`** function
  - passed object containing **`error`** and **`status`** properties
  - stack trace is present in **`error`** value in development, but removed in production to avoid exposing implementation details
  - return object with **`props`** property that specifies props to be passed to component defined in same file
- Define component to render
  - same as other components with **`script`** element, HTML, and **`style`** element

example on next slide

Error Page Example

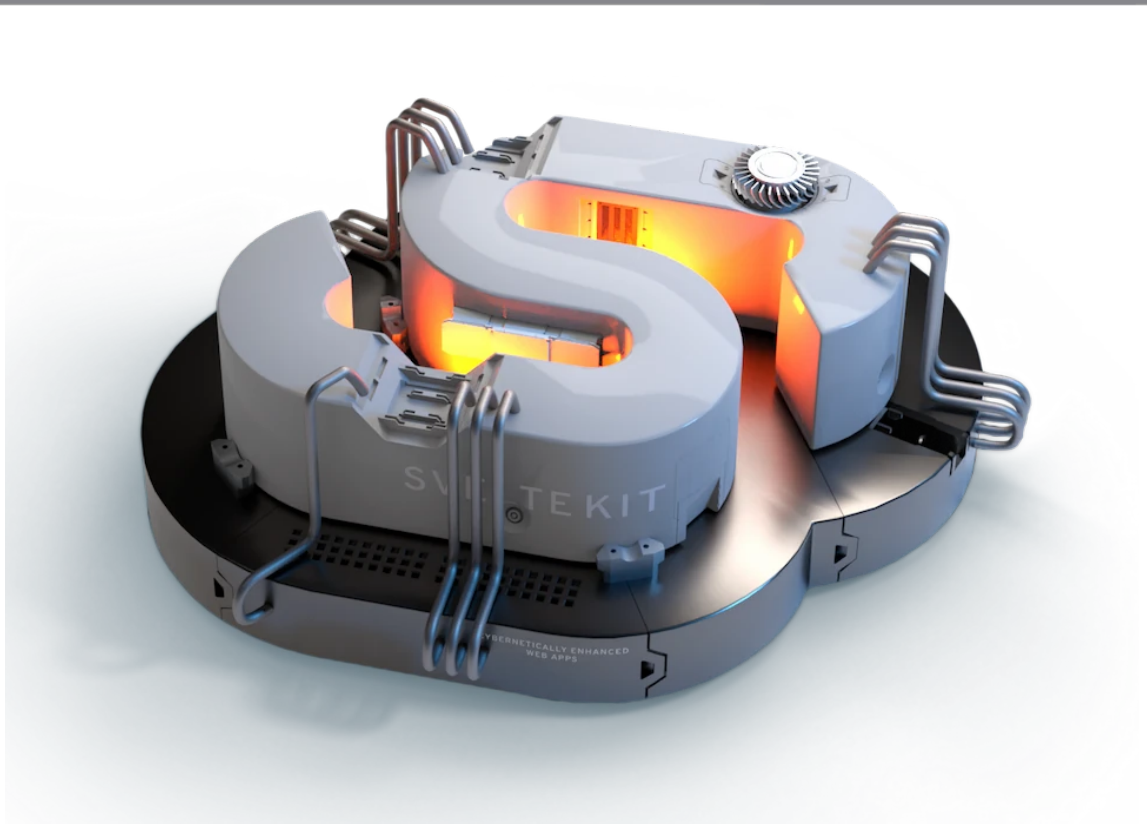
example in sveltekit-routes repo
`src/routes/__error.svelte`

```
<script context="module" lang="ts">
  import type {ErrorLoadInput, LoadOutput} from '@sveltejs/kit';

  export function load({error}: ErrorLoadInput): LoadOutput {
    return {
      props: {message: error.message}
    };
  }
</script>

<script lang="ts">
  export let message: string;
</script>
```

```
<h1>An error occurred</h1>
<p>{message}</p>

<style>
  p {
    color: red;
  }
</style>
```

Lesson #3 Q & A

#4: SvelteKit with API Endpoints



API Endpoints

- Endpoints are typically implemented as REST services
  - implies specific usage of HTTP verbs/methods
- SvelteKit apps can define the endpoints they use
  - can also use endpoints implemented with any tech stack hosted outside the app
    - Node.js, Deno, Python, Java, C#, Go, Rust, ...

API Endpoint Source Files ...

- Defined in **`src/routes`** directory like pages
- Two conventions
  - define in **`src/routes/api`** (prefer this)
  - define in **`src/routes`** in files with **`.json.js|ts`** extension
    - avoids conflict with page routes

... API Endpoint Source Files

- File and directory names inside square brackets indicate that a path parameter will be captured
  - just like in page routing
  - stored in **`Request`** object **`params`** property
- Define endpoints with exported functions named **`get`**, **`post`**, **`put`**, **`patch`**, and **`del`**
  - **`delete`** is a JS keyword
  - these can send requests to other endpoints using global **`fetch`** function

Endpoints Not Targeting Specific Resource

- Define in file named **`index.js|ts`**
- **`get`** function retrieves all instances
  - returns array of objects
- **`post`** function creates a new instance
  - returns the instance or at least its id
  - success status should be 201 Created
  - response header **`Location`** should be set to URL of new resource

Endpoints Targeting Specific Resource

- Define in file named **`[paramName].js|ts`**
  - typically **`paramName`** represents an instance id
- **`get`** function retrieves an existing instance
- **`put`** function updates all of an existing instance
- **`patch`** function updates parts of an existing instance
- **`del`** function deletes an existing instance

Endpoint Function Input/Output

- Passed a **`Request`** object
- Return **`Promise`** that resolves to a **`Response`** object

```
import type {Request, Response} from '@sveltejs/kit';
```

- Properties of **`Request`** and **`Response`** objects are described on next two slides

Request Properties

- **`method: string`** - **`GET`**, **`POST`**, **`PUT`**, **`PATCH`**, or **`DELETE`**
- **`host: string`** - of server
- **`path: string`** - of request URL
- **`params: Record<string, string>`** - path parameters
- **`query: URLSearchParams`** - query parameters
- **`headers: Headers`** - request headers
- **`rawBody: Uint8Array`** - binary request body
- **`body: ParameterizedBody<Body>`** - text request body
- **`locals: Locals`** - populated by "hooks" see bonus slides

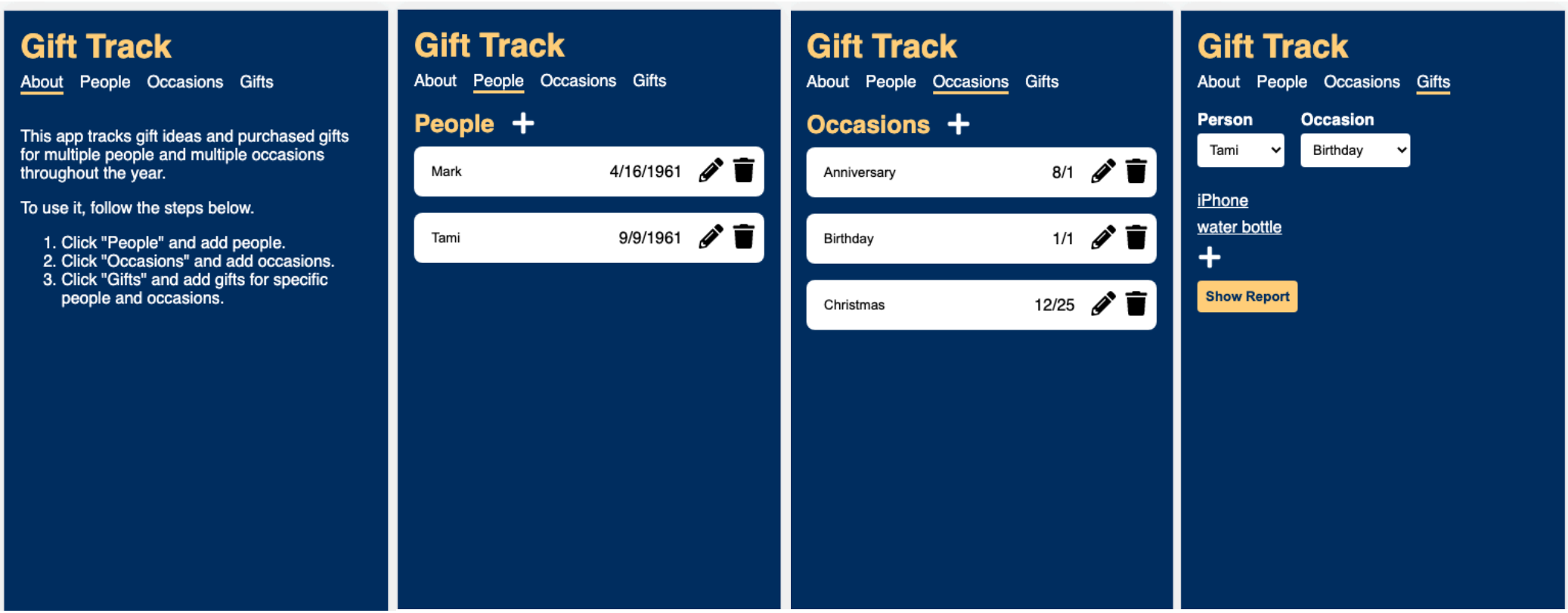
Response Properties

- **`status?: number`** - HTTP status code
  - defaults to 200
- **`headers?: ResponseHeaders`** - response headers
  - object where keys are header names and values are their values
- **`body?: JSONResponse | Uint8Array`** - response body
  - string if **`Content-Type`** is **`text/plain`**
  - object, array, or primitive if **`Content-Type`** is **`application/json`**
  - **`FormData`** object if **`Content-Type`** is **`application/x-www-form-urlencoded`** or **`multipart/form-data`**
  - **`Uint8Array`** otherwise; can hold binary data

Gift Track App ...

- Let's look at an app that uses many features of SvelteKit, including endpoints
- Tracks gift ideas for specific people and occasions
- Designed to work well on mobile devices
- 4 pages: About, People, Occasions, and Gifts
- Supports CRUD operations
  - on people, occasions, and gifts
  - demo each of these
- Persists to SQLite database

... Gift Track App



Endpoint Examples ...

- From Gift Track app https://github.com/mvolkmann/gift-track
  - **src/routes/api/occasion/index.ts**

An occasion has a **name** (ex. Birthday), **id**, and an optional date.

```
import type {Request} from '@sveltejs/kit';
import type {Occasion} from '$lib/types';
import {addOccasion, getAllOccasions} from '../data';

export async function get(): Promise<{body: Occasion[]}> {
  return {body: getAllOccasions()};
}

export async function post(request: Request): Promise<{body: Occasion}> {
  let occasion = (request.body as unknown) as Occasion;
  occasion = addOccasion(occasion);
  return {body: occasion};
}
```

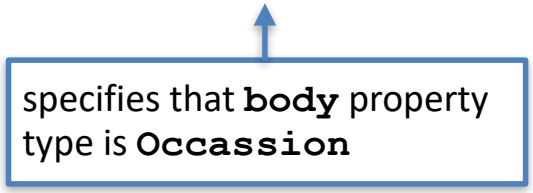
TypeScript hack

new value includes assigned id

… Endpoint Examples …

- **src/routes/api/occasion/[occasionId].ts**

```
import type {Request} from '@sveltejs/kit';
import type {Occasion, OccasionResponse} from '$lib/types';
import {deleteOccasion, getOccasion, updateOccasion} from '../data';

export async function del(request: Request): Promise<OccasionResponse> {
  const id = Number(request.params.occasionId);
  const success = deleteOccasion(id);
  return {status: success ? 200 : 404};
}
```



… Endpoint Examples

- **src/routes/api/occasion/[occasionId].ts**

```
export async function get(request: Request): Promise<OccasionResponse> {
  const id = Number(request.params.occasionId);
  const occasion = getOccasion(id);
  return occasion ? {body: occasion} : {status: 404};
}

export async function put(request: Request): Promise<OccasionResponse> {
  const id = Number(request.params.occasionId);
  const occasion = (request.body as unknown) as Occasion;
  occasion.id = id;
  const success = updateOccasion(occasion);
  return {status: success ? 200 : 404};
}
```

TypeScript hack

More Endpoint Details

- Default JSON responses
  - if no `Content-Type` header is specified and body is an object, it will be converted to a JSON string
- If nothing is returned, `status` is set to `404`
- Files under `src/routes` with names beginning with an underscore are considered private
  - not pages or endpoints
  - can be imported by page and endpoint files
  - used to share code between these

Segment #4 Q & A

Wrap Up and Next Steps

- Now that you have seen nearly all the features of Svelte and SvelteKit ...
  - Consider how you would achieve the same things in other frameworks.
  - Would it require more code?
  - Would that code be harder to understand?
- There's no substitute for hands on experience
  - create some SvelteKit apps
  - send me questions; glad to help! - r.mark.volkmann@gmail.com

Bonus Material Follows!

#5: Bonus Material

Including Dynamic HTML

- Can create strings of HTML in JS
  and render with `{@html expression}`
- Sanitize if untrusted
  - prevents cross-site scripting attacks
    by removing elements like `script`
  - one library to consider is sanitize-html in npm

`writableSession` Store ...

- Custom store that saves value in **`sessionStorage`**
- Restores value from there on browser refresh

```
import {writable} from 'svelte/store';
import type {Writable} from 'svelte/store';

function persist<T>(key: string, value: T) {
  if (value === null || value === undefined) {
    sessionStorage.removeItem(key);
  } else {
    sessionStorage.setItem(key, JSON.stringify(value));
  }
}
```

continued on next slide

... writableSession Store

```
function writableSession<T>(key: string, initialValue: T): Writable<T> {
  const sessionValue = JSON.parse(sessionStorage.getItem(key));
  const store = writable<T>(sessionValue || initialValue);
  store.subscribe(value => persist<T>(key, value));
  return store;
}

// Example usage
export const temperatureStore = writableSession<number>(
  'temperature',
  100 // initial value
);
```

Component Libraries

- A SvelteKit project can define a component library instead of an app
- Steps
  - add npm script **`"package": "svelte-kit package"`**
  - enter **`npm run package`**
    - compiles components in **`src/lib`** into **`package`** directory
    - contains all files needed to publish to npm including
      - **`package.json`** file
      - compiled component definitions
      - TypeScript type definitions in **`.d.ts`** files
  - enter **`npm publish`** to publish to npm

Route Conflicts

- Can occur when generating static pages that get content from endpoints (not common)
  - because output is written to file system
  - example: endpoints defined in **`src/routes/api/sport/index.js`** and **`src/routes/api/sport/hockey.js`** generate the files **`sport`** and **`sport/hockey`**
  - creates a conflict because **`sport`** cannot be both a file and directory
  - a solution is to modify the endpoint file extensions so the files are **`src/routes/api/sport/index.json.js`** and **`src/routes/api/sport/hockey.json.js`**
  - now generated files are named **`sport.json`** and **`sport/hockey.json`** and **`sport`** is only a directory

Using Environment Variables

- Vite uses **`dotenv`** to load environment variables from a **`.env`** file https://github.com/motdotla/dotenv
- Currently names should start with **`VITE_`**
- Create file **`src/lib/env.js|ts`** and add lines like
  `export const NAME = import.meta.env.VITE_NAME;`
- Import in **`.svelte`** and **`.js|ts`** files with
  `import {NAME} from '$lib/env';`

`tick` Function

- Rarely needed
  - one use case is restoring cursor position in an **`input`** after programmatically modifying its value
    - ex. masked input for entering a phone number
- Returns a **`Promise`**
  - resolves when pending DOM state changes have been applied
- **`import tick{} from 'svelte'`**
- Call from an **`async`** function with **`await tick();`**
- Then access the DOM and make updates

Transition Events

- Listen for these events to execute code at specific points in a Svelte transition
  - **`introstart`** - when an “in” transition starts
  - **`introend`** - when an “in” transition ends
  - **`outrostart`** - when an “out” transition starts
  - **`outroend`** - when an “out” transition ends
- One use case is moving focus into an **`input`** that transitioned into view
  - listen for **`introend`** event

Hooks

- Advanced feature of SvelteKit
- Defined by functions defined in **`src/hooks.js|ts`** or **`src/hooks/index.js|ts`**
- All run on server
- **`handle`** can modify response headers and bodies
- **`handleError`** can customize error messages and/or log them
- **`getSession`** returns session object that client code can access
- **`externalFetch`** can "modify or replace a fetch request for an external resource that happens inside a **`load`** function that runs on the server or during pre-rendering"

Provided Modules - `$app/env`

- Object with these properties
  - **`amp`** - boolean indicating if AMP mode is enabled
    - see https://amp.dev
  - **`browser`** - boolean indicating if code is running in browser
  - **`dev`** - boolean indicating if running in development mode
  - **`mode`** - the Vite mode; "development" or "production"
    - configured by **`config.kit.vite.mode`** property
  - **`prerendering`** - boolean indicating if prerendering is being used

most useful of these

Provided Modules - `$app/navigation`

- Object with these properties
  - **`goto(`*`href`*`, `*`options`*`)`** most useful of these
    - function that navigates to given URL
    - returns **`Promise`** that resolves if navigation succeeds or rejects if it fails
    - typically options are not supplied
  - **`invalidate(`*`href`*`)`**
    - function that causes the **`load`** function of the **`href`** to run again when navigating to that page
  - **`prefetch(`*`href`*`)`**
    - function that programmatically prefetches a given page
  - **`prefetchRoutes(`*`pathArray`*`?)`**
    - function that programmatically prefetches multiple pages

Provided Modules - `$app/paths`

- Object with these properties
  - **`assets`**
    - path from where assets like images are served
    - value comes from **`config.kit.paths.assets`** property
    - defaults to same as **`base`** property
  - **`base`**
    - path from where app is served

Provided Modules - `$app/stores`

- Object with these properties
  - **`getStores()`**
    - function that doesn't seem valuable
  - **`navigating`** most useful of these
    - readable store with value **`{from, to}`** while navigating and **`null`** otherwise
    - can use to set/unset wait cursor or show/hide loading spinner
  - **`page`**
    - readable store with value **`{host, path, params, query}`**
    - same as **`page`** property in object passed to **`load`** functions
  - **`session`**
    - writable store that holds data passed from server such as current user id

Provided Modules - `$lib`

- Path alias to **`src/lib`**
- Can add more path aliases
  - edit **`svelte.config.js`**
  - set **`kit.vite.resolve.alias`** to an object whose keys are aliases and whose values are calls to **`path.resolve`**
- If using TypeScript
  - also edit **`compilerOptions.path`** property in **`tsconfig.json`**

```
import path from 'path';
...
  kit: {
    ...
    vite: {
      resolve: {
        alias: {
          $routes: path.resolve('src/
routes'),
          $src: path.resolve('src'),
          $view: path.resolve('src/view')
        }
      }
    }
  }
```

```
"paths": {
  "$routes/*": ["src/routes/*"],
  "$src/*": ["src/*"],
  "$view/*": ["src/view/*"]
}
```

Provided Modules - `$service-worker`

- Only available in service workers,
  so only need to learn about this if using them
- One use is to make navigation faster
  by precaching some JavaScript and CSS files
- Can import an object from this that has these properties
  - **`build`** - array of URLs for generated files that can be cached
  - **`files`** - array of URLs for static files that can be cached
  - **`timestamp`** - value of **`Date.now()`** at build time,
    useful for generating a unique cache name

Adapters ...

as of September 2021, not very mature

- Adapt a SvelteKit app for deployment to a specific target
  - take files of the built app as input and output files needed for deployment
- Adapters currently provided by Svelte team
  - **`cloudflare-workers`**, **`netlify`**, **`node`**, **`vercel`**
  - **`static`** (use when entire site is static)
- Adapters currently provided by the community
  - **`begin`**, **`deno`**, **`firebase`**

… Adapters

- Steps to use
  - install with **`npm install -D /@sveltejs/adapter-`*`name`*`@next`**
    - in the future, **`@next`** part won't be needed
  - edit **`svelte.config.js`**
    - add **`import `*`name`*` from '@sveltejs/adapter-`*`name`*`'`**
    - set **`kit.adapter`** property in **`config`** object to a call to the imported function ***`name`***
    - documentation for the adapter will describe options that can be passed

Custom Adapters

- Can write your own adapters
  for other deployment targets
- See https://kit.svelte.dev/docs#writing-an-adapter