



# ESSENTIALS OF DATA VISUALIZATION DESIGN

Bernard Suen  
Center for Entrepreneurship  
Chinese University of Hong Kong



Center for  
Entrepreneurship

# **RECAP**

Decomposition

Pattern

Abstraction

Algorithm

Automation &  
Testing

# **JavaScript Functions that Transform Input into Output**

**We have used “decomposition” principle to understand the “DOM” and its hierarchy of “boxes”.**

**Your ability to construct the DOM and use JavaScript to manipulate the DOM requires your additional ability to “abstract” — develop system through coding (i.e. use a programming language to execute computational algorithm)**

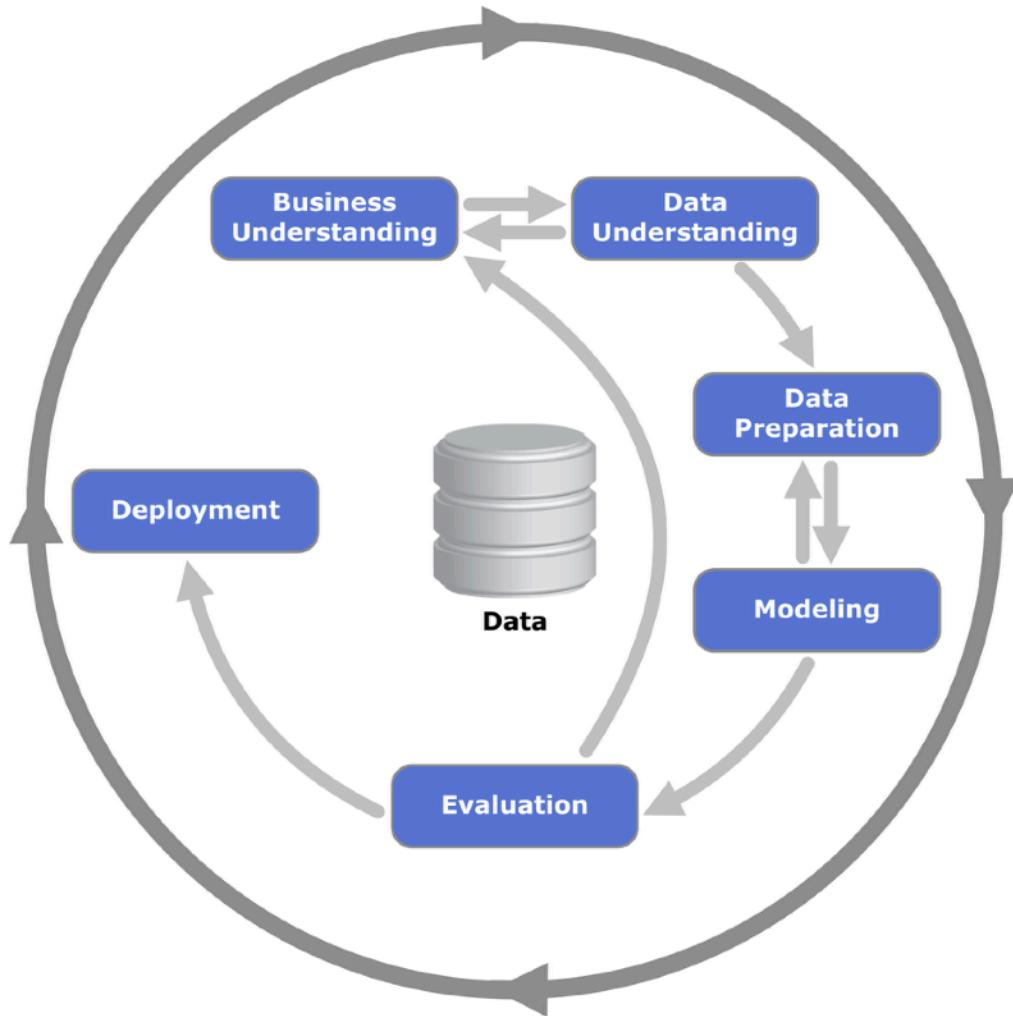
**JavaScript provides us with the capabilities  
to build system and transform data.**

# Basic Structure of a JavaScript Function

```
<head>
<script>
function function_name(parameter1, parameter 2...){
    optional parameters
    ↓
    Embed data type variables, input/output commands and
    logical and mathematical operators in the function to
    compute and return values.
```

```
}
</script>
</head>
```

**“Abstraction is the ability to identify the transformation function and the input and output required to make it work.”**



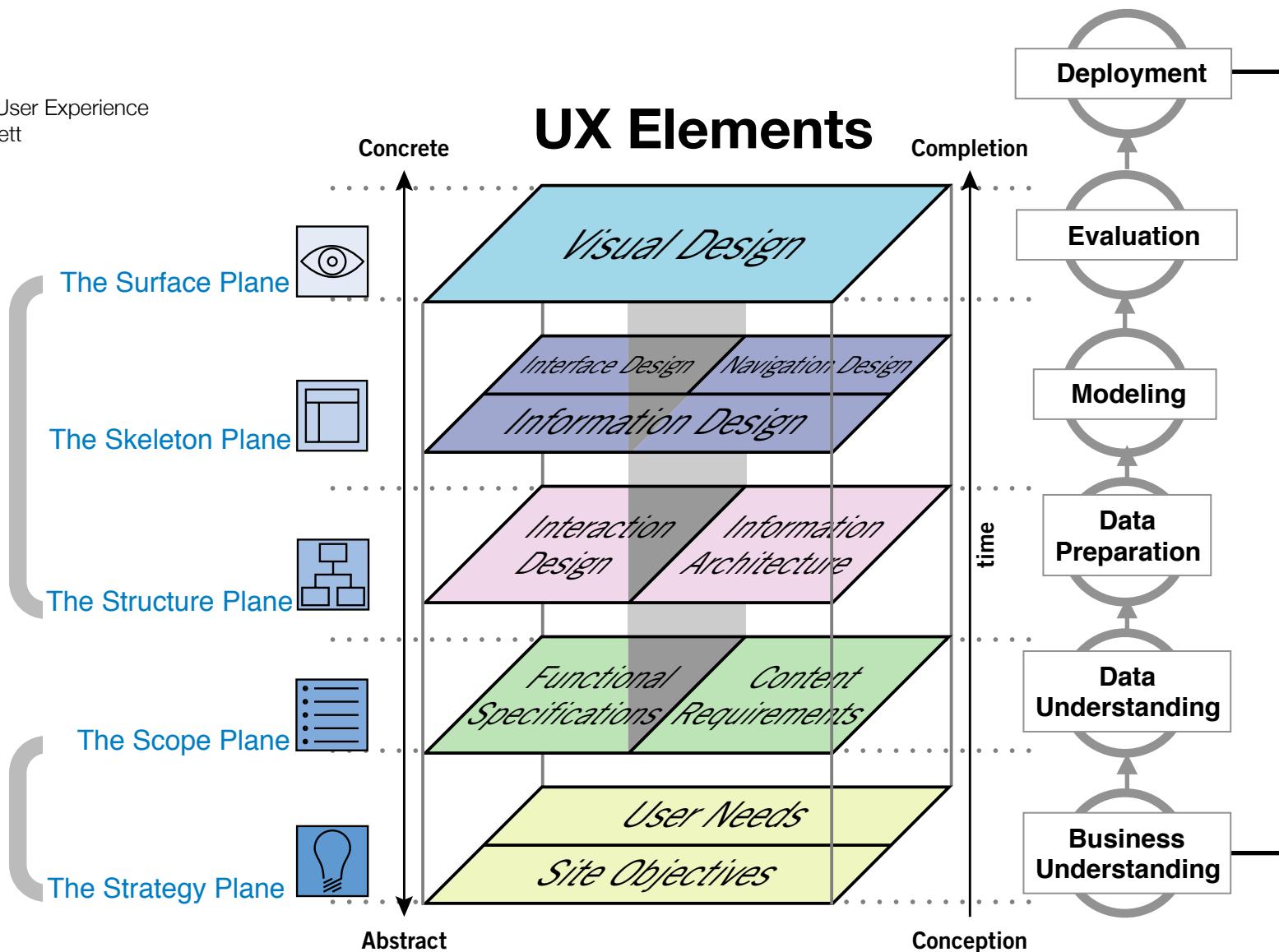
Source: Elements of User Experience  
by Jesse James Garrett

## Solution Space

how and  
how much

## Problem Space

who, what,  
and why



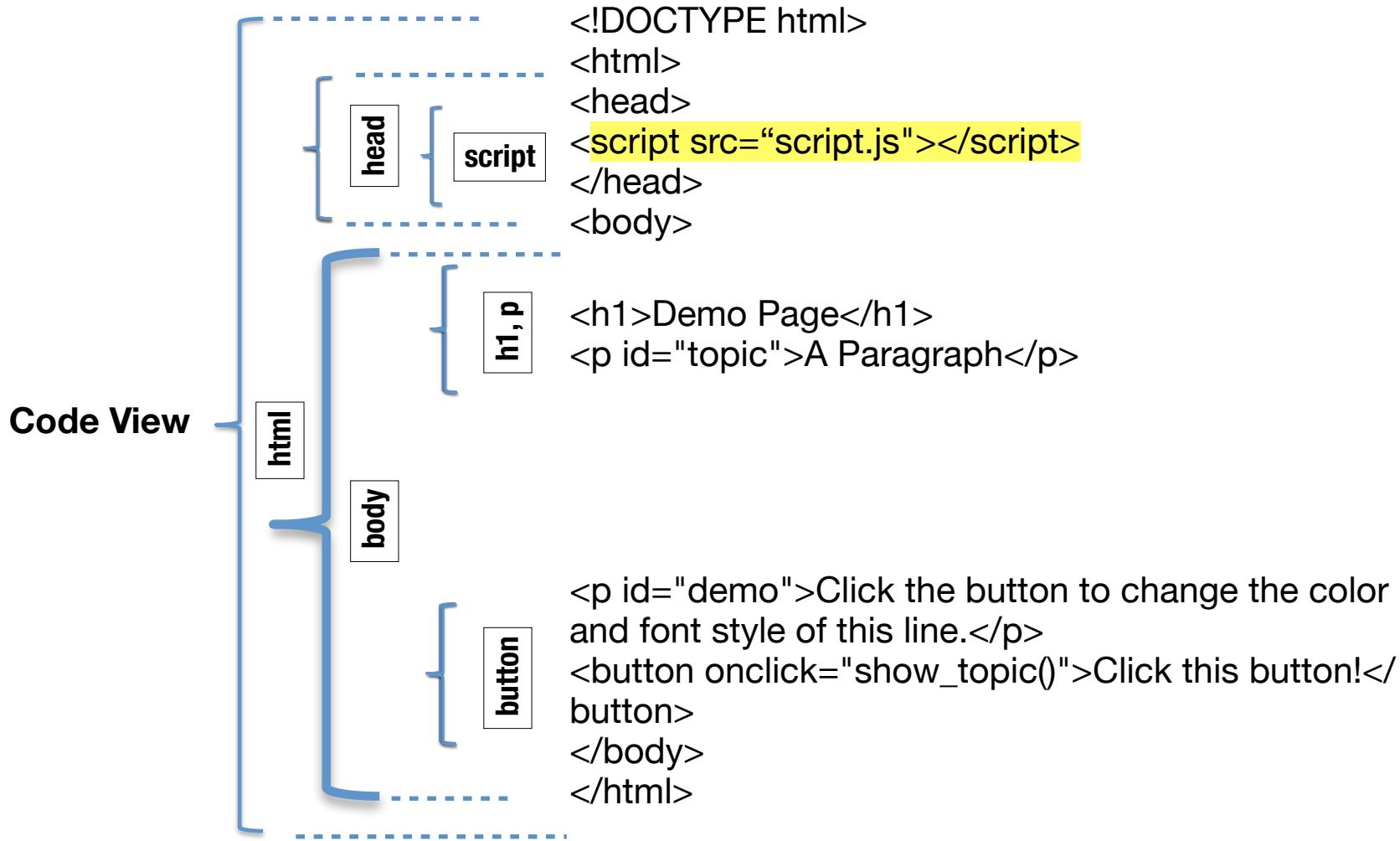
## Code View

```
<!DOCTYPE html>
<html>
<head>
<script>
function show_topic() {
    var x = document.getElementById("demo");
    x.style.fontSize = "25px";
    x.style.color = "red";
}
</script>
</head>
<body>
<h1>Demo Page</h1>
<p id="demo">Click the button to change the color and font
style of this line.</p>
<button onclick="show_topic()">Click this button!</button>
</body>
</html>
```

The diagram illustrates the hierarchical structure of the provided HTML code. On the left, vertical brackets group elements by type: 'html', 'head', 'body'. On the right, horizontal brackets group elements by name: 'head', 'script', 'h1, p', and 'button'. The 'script' block contains a function definition, which is highlighted in yellow.

**Similar to CSS, JS can be placed in  
an External File**

# **See an Example**



# Functions in JavaScript Programming

- You can look at a function as a mini-system.
- A function is designed to transform input into output.
- You can execute a function within another function.
- A program can be viewed as a collections of functions decomposed into hierarchy of functions to get things done.
- Good programmer looks for patterns in job to be done and abstract common parameters, algorithms, and outcomes to be placed inside a function for code reuse (automation).

# **JavaScript Has Become the Most Popular Front-end Language with Pre-packaged Framework and Library Support**

e.g. jQuery,  
AngularJS, React,  
Vue

e.g. jQuery  
DataTable, D3,  
C3D3, Leaflet



Plugins Contribute Events Support JS Foundation



Your donations help fund the continued development and growth of jQuery.

SUPPORT THE PROJECT

Download API Documentation Blog Plugins Browser Support

Search



#### Lightweight Footprint

Only 30kB minified and gzipped. Can also be included as an AMD module



#### CSS3 Compliant

Supports CSS3 selectors to find elements as well as in style property manipulation



#### Cross-Browser

Chrome, Edge, Firefox, IE, Safari, Android, iOS, and more



#### Download jQuery

v3.3.1

The 1.x and 2.x branches no longer receive patches.

[View Source on GitHub →](#)

[How jQuery Works →](#)

## What is jQuery?

jQuery is a fast, small, and feature-rich JavaScript library. It makes things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers. With a combination of versatility and extensibility, jQuery has changed the way that millions of people write JavaScript.

## Other Related Projects



## Resources

- [jQuery Core API Documentation](#)
- [jQuery Learning Center](#)
- [jQuery Blog](#)
- [Contribute to jQuery](#)
- [About the jQuery Foundation](#)
- [Browse or Submit jQuery Bugs](#)

## A Brief Look

# **Basic jQuery Structure & Syntax**

This means:

When the HTML document (i.e. DOM) is loaded,  
add the following jQuery functions (**in orange**) to  
your javascripts

```
$(document).ready(function() {
```

Your jQuery functions go inside here.

```
});
```

The following code demonstrates the basic structure of a jQuery function. The **selector** and **method** are two ingredients used to define a jQuery function:

```
$("<selector>").<method>('event',function(){  
    The actual script goes here.  
});
```

**Example:**

```
$("button#hide_h2").on('click',function(){  
    $("h2").hide();  
});
```

Base

Selector

body

ADJECTIVE

CSS

Declaration

Declaration

{ color:purple; font-size:12px; }

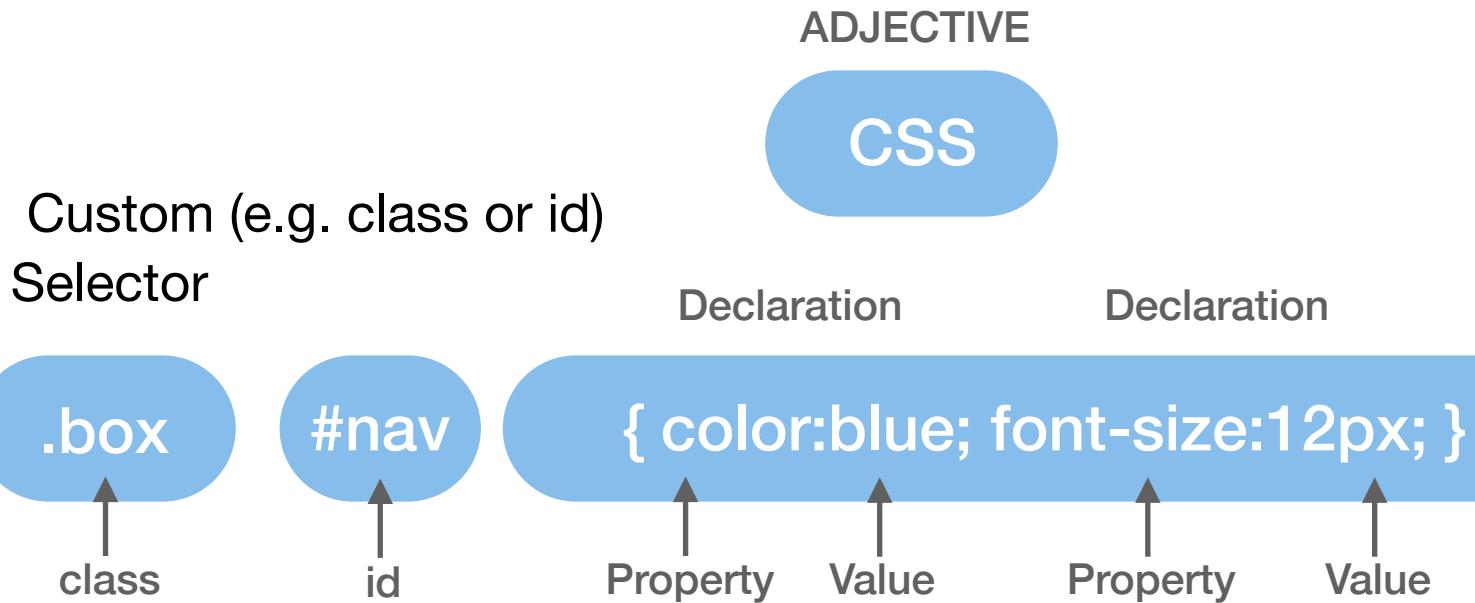
Property

Value

Property

Value





# **Putting Everything Together**

```
$(document).ready(function() {  
    $("button#hide_h2").on('click',function(){  
        $("h2").hide();  
    });  
  
    $("button#show_h2").on('click',function(){  
        $("h2").show();  
        $("h2").css("color","blue");  
        $("h2").html("You clicked me.");  
    });  });
```

# **Lab Time**

# **The HTML Form and Input Objects(Tags)**

<https://getbootstrap.com/>



# Bootstrap

Build responsive, mobile-first projects on the web with the world's most popular front-end component library.

Bootstrap is an open source toolkit for developing with HTML, CSS, and JS. Quickly prototype your ideas or build your entire app with our Sass variables and mixins, responsive grid system, extensive prebuilt components, and powerful plugins built on jQuery.

[Get started](#)

[Download](#)

Currently v4.1.3



# **Using Bootstrap Form and Button to Make Browser UI Look Better**

Source: <https://getbootstrap.com/docs/4.0/components/forms/>

Email address

Enter email

We'll never share your email with anyone else.

Password

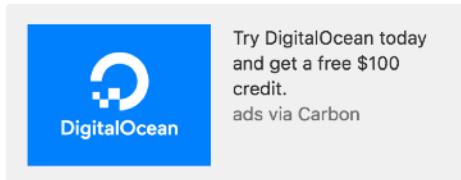
Password

Check me out

Submit

# Buttons

Use Bootstrap's custom button styles for actions in forms, dialogs, and more with support for multiple sizes, states, and more.



## Examples

<https://getbootstrap.com/docs/4.0/components/buttons/>

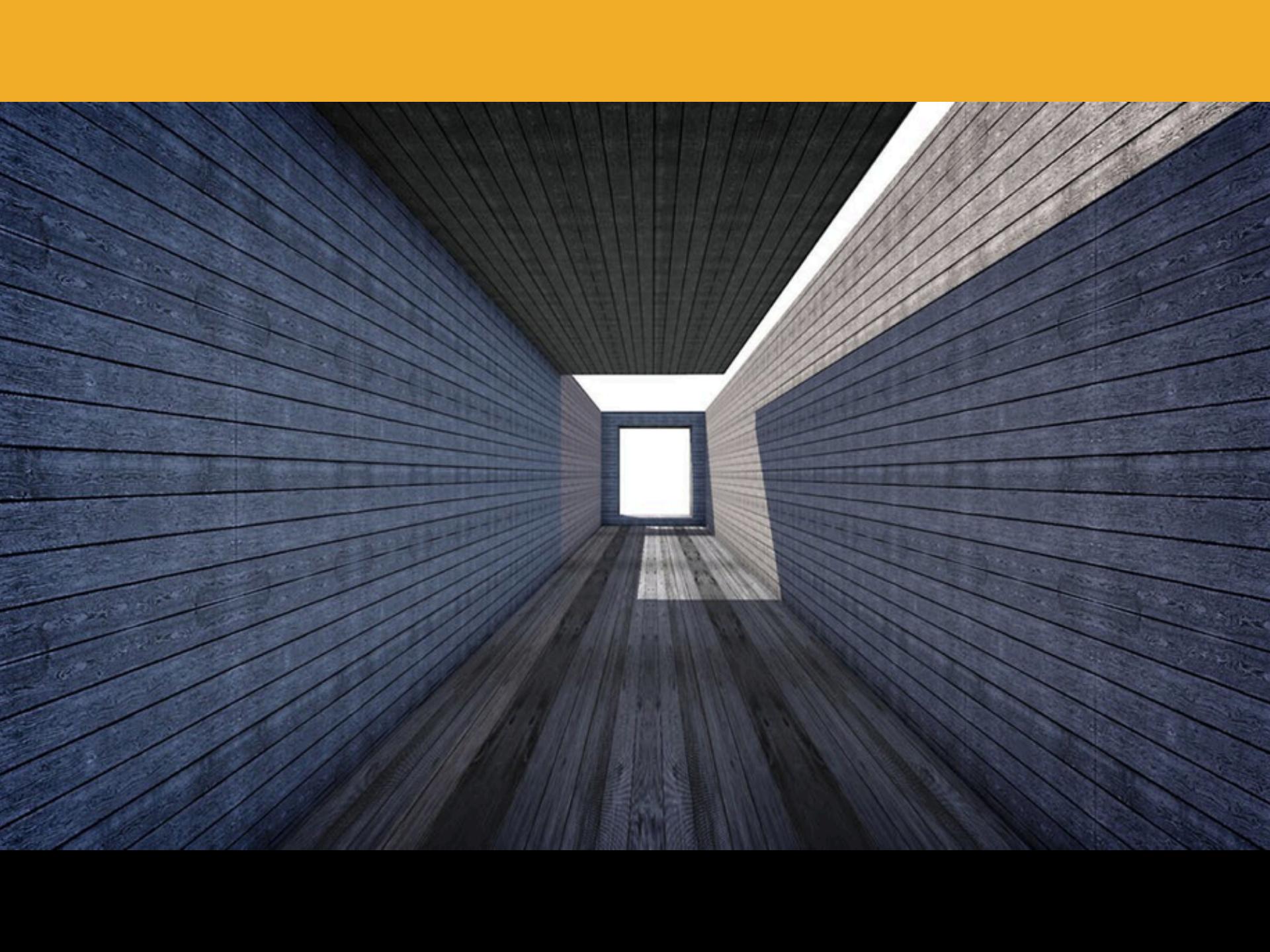
Bootstrap includes several predefined button styles, each serving its own semantic purpose, with a few extras thrown in for more control.

Primary   Secondary   Success   Danger   Warning   Info   Light   Dark   Link

```
<button type="button" class="btn btn-primary">Primary</button>
<button type="button" class="btn btn-secondary">Secondary</button>
<button type="button" class="btn btn-success">Success</button>
<button type="button" class="btn btn-danger">Danger</button>
<button type="button" class="btn btn-warning">Warning</button>
<button type="button" class="btn btn-info">Info</button>
<button type="button" class="btn btn-light">Light</button>
<button type="button" class="btn btn-dark">Dark</button>

<button type="button" class="btn btn-link">Link</button>
```

# **THE POWER OF VISUAL COMMUNICATION**



**Develop Your Ability to Detect Patterns**  
**- both conceptual and visual**

## **BASIC VISUAL ELEMENTS**

- **Line**
- **Shape**
- **Form**
- **Texture**
- **Balance**
- **Composition**

<https://www.youtube.com/watch?v=YqQx75OPRa0>

## **BASIC COMPOSITION PRINCIPLES**

- **Proximity**
- **White Space**
- **Alignment**
- **Contrast**
- **Repetition**

<https://www.youtube.com/watch?v=a5KYIHNKQB8>

## **BASIC CHART TYPES**

- **Line Chart**
- **Bar Chart**
- **Pie Chart**
- **Scatter Plot**
- **Box and Whisker Graph**

# Nuts *and* Bolts *of* Chart Types

Created by

allonlinebehavior.com



## PIE CHART

Extremely useful when creating a well-designed document that is intended for people that will not read the data (e.g. management)



## HISTOGRAM

Chart used by responsible analysts who understand the power of segmentation and the sadness that comes from aggregating data.



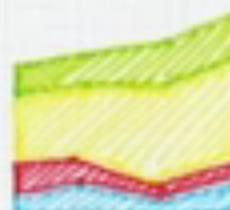
## LINE CHART

Useful to show trends, especially upwards (the downwards trends people tend to see more obscure charts, like the waterfall chart, see below)



## BAR CHART

Safe choice. But make sure you read Joseph Pone before you show the chart to your boss, it will increase the probability of getting a raise.



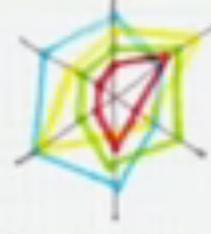
## AREA CHART

Please don't use this chart, I beg you! And please buy one of Tufte books.



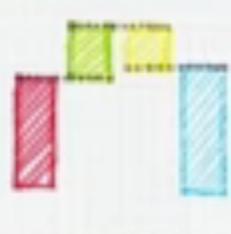
## BUBBLE CHART

If you manage to extract insights from this graph your name is Mario Rosting.



## RADAR CHART

If you want to build a complex model around which you have done a ton of research, that's your choice but only PhDs will understand you.



## WATERFALL CHART

Perfect if you want to hide information or misguide other people. Seriously, can you think a chart that is also known as a "Flying Bridge Chart" or "Marsel Chart"? No.



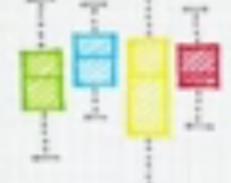
## TREE MAP

I have seen trees and I have seen maps, but how many? This map is a combination of both! If you use it, good for you.



## SCATTERPLOT

Very useful to find outliers, just like the people that commonly create them. Human beings that know more than PhDs in math by the age of 10.



## BOX PLOT

This one is for pros. If you use it successfully, you will get a raise in houses between Ronald Fisher and Adhara Carl Friedrich Gauss.

# GRAPHING

<https://www.youtube.com/watch?v=2RCy5hTxuYA>

## VISUAL ENCODING

- **Choosing the right chart type to fit its purpose**
- **Use of titles and legends**
- **Length or height and line weight**
- **Position, Angle, and Area**
- **Color, Hue and Shade**

<https://www.youtube.com/watch?v=TQPvC1cHztg&list=PLZjMPS3ukEMdHFVUR-32et72NrWgJlobj&index=40>

## **BASIC HCI PRINCIPLES**

- **Affordance**
- **Mental models**
- **Signifiers**

<https://www.youtube.com/watch?v=tZkP9evOAtI>

# **COMMON DESIGN PATTERNS**



[https://www.youtube.com/watch?v=aB6us\\_txi54&t=173s](https://www.youtube.com/watch?v=aB6us_txi54&t=173s)

## **COMMON DESIGN PATTERNS**

- **TOOLBAR**
- **APP BAR**
- **TAB**
- **DROPDOWN**
- **APPLICATION DRAWERS**
- **LIST TO DETAILS**
- **MULTI PLANE**

# **DESIGN PATTERNS IN BOOTSTRAP**

[Getting started](#)[Layout](#)[Overview](#)[Grid](#)[Utilities for layout](#)[Content](#)[Components](#)[Utilities](#)[Extend](#)

# Overview

Components and options for laying out your Bootstrap project, including wrapping containers, a powerful grid system, a flexible media object, and responsive utility classes.

## Containers

Containers are the most basic layout element in Bootstrap and are **required when using our default grid system**. Choose from a responsive, fixed-width container (meaning its `max-width` changes at each breakpoint) or fluid-width (meaning it's `100%` wide all the time).

[Getting started](#)[Layout](#)[Overview](#)[Grid](#)[Utilities for layout](#)[Content](#)[Components](#)[Utilities](#)[Extend](#)

# Grid system

Use our powerful mobile-first flexbox grid to build layouts of all shapes and sizes thanks to a twelve column system, five default responsive tiers, Sass variables and mixins, and dozens of predefined classes.

## How it works

Bootstrap's grid system uses a series of containers, rows, and columns to layout and align content. It's built with [flexbox](#) and is fully responsive.

## Components

[Alerts](#)[Badge](#)[Breadcrumb](#)[Buttons](#)[Button group](#)[Card](#)[Carousel](#)[Collapse](#)[Dropdowns](#)[Forms](#)

# Alerts

Provide contextual feedback messages for typical user actions with the handful of available and flexible alert messages.

## Examples

Alerts are available for any length of text, as well as an optional dismiss button. For proper styling, use one of the eight **required** contextual classes (e.g., `.alert-success`). For inline dismissal, use the [alerts jQuery plugin](#).

<https://getbootstrap.com/docs/4.3/components/alerts/>

Search...

Input group

Jumbotron

List group

Media object

Modal

Navs

Navbar

Pagination

Popovers

Progress

Scrollspy

# Alerts

Provide contextual feedback messages for typical user actions with the handful of available and flexible alert messages.

## Examples

Alerts are available for any length of text, as well as an optional dismiss button. For proper styling, use one of the eight **required** contextual classes (e.g., `.alert-success`). For inline dismissal, use the [alerts jQuery plugin](#).

[Popovers](#)[Progress](#)[Scrollspy](#)[Spinners](#)[Toasts](#)[Tooltips](#)[Utilities](#)[Extend](#)[Migration](#)[About](#)

Bootstrap “spinners” can be used to show the loading state in your projects. They’re built only with HTML and CSS, meaning you don’t need any JavaScript to create them. You will, however, need some custom JavaScript to toggle their visibility. Their appearance, alignment, and sizing can be easily customized with our amazing utility classes.

For accessibility purposes, each loader here includes `role="status"` and a nested `<span class="sr-only">Loading...</span>`.

## Border spinner

Use the border spinners for a lightweight loading indicator.



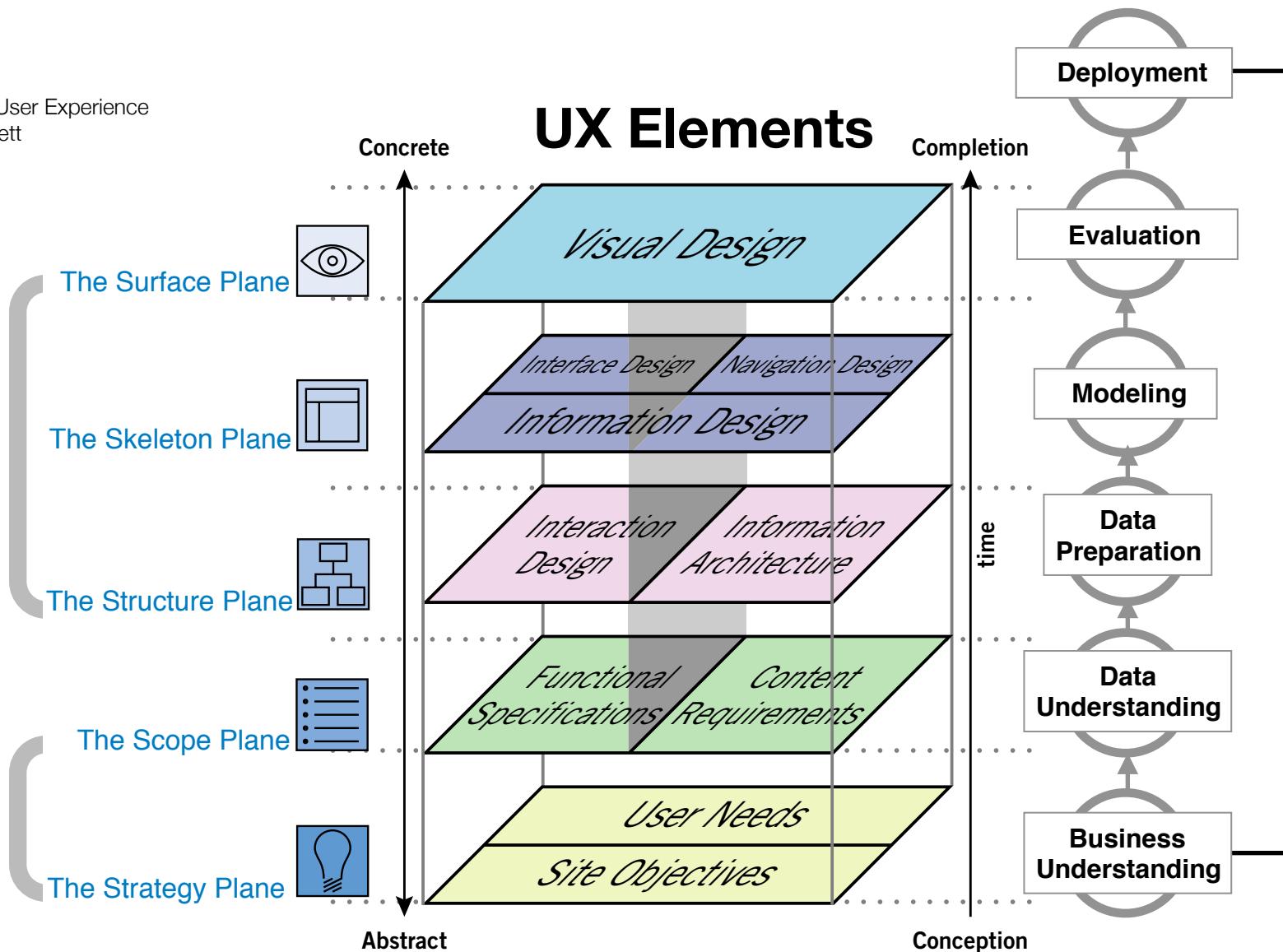
Source: Elements of User Experience  
by Jesse James Garrett

## Solution Space

how and  
how much

## Problem Space

who, what,  
and why



**THANK YOU FOR YOUR TIME!**