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# COMP 4462
# Data Visualization Tutorial

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# Javascript and Observable

- Javascript
  - **Nothing to do with Java**
  - The native programming language of web browsers
    - Compile to JS, e.g. coffeescript, typescript, scala.js, elm
    - Compile to binary for performance, see WebAssembly
    - **Runs with HTML, CSS and web technologies (SVG, WebGL, HTML5 Canvas)**
    - **The programming language for data visualization**
  - The most widely used programming language
    - Both web and server (node.js)
  - Big community and a lot of libraries on GitHub / npm
    - Data visualization: D3.js, Vega-Lite, p5.js and many more
- Observable
  - **A Jupyter notebook like** environment for Javascript
  - It runs on your browser entirely! No remote runtime (server) is needed.
  - Built by Mike Bostock (the author of D3.js), Jeremy Ashkenas (the author of Coffeescript) and Tom MacWright

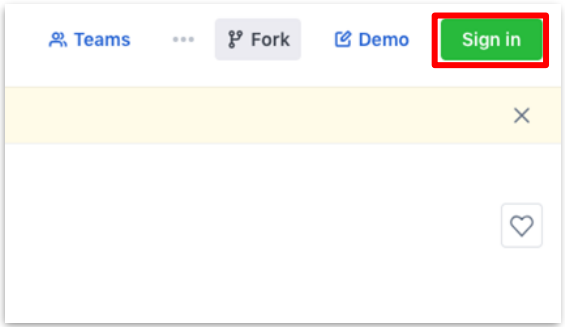
# Vega-Lite and Data Processing Libraries

- Vega-Lite
  - The library behind Altair
  - Specification based visualization tool
    - We write down the visualization we want (in JSON format), the library plots it
    - In visualization language, marks and channels, interaction idioms, etc.
  - Builds on top of D3.js
    - And D3.js is build on top of HTML5 SVG (a web standard implemented in every browser)
  - See the Vega-Lite examples to know more
- Built-in functions in Javascript
  - Javascript borrows a lot of features from functional programming paradigm
    - Passing in a function as argument into another function
    - Makes our code much more succinct and easy to understand
- Lodash
  - An utility library for Javascript, a lot of common tasks and patterns are well written for use
- Moment.js
  - A powerful library for datetime manipulation

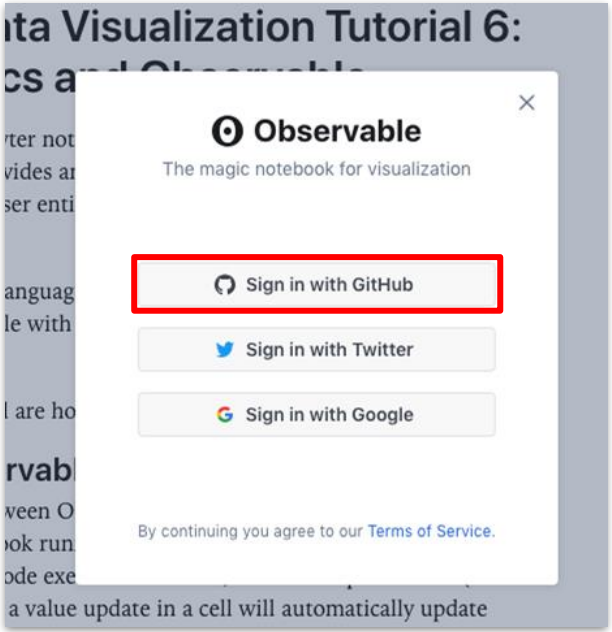
# Sign in Observable

1. Go to the notebooks of this tutorial (Part-I, Part-II)

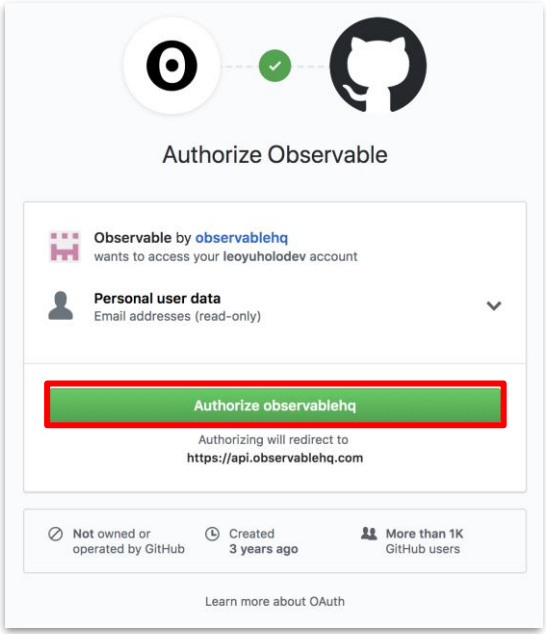
2. Click Sign in




3. Sign in with GitHub (recommended)



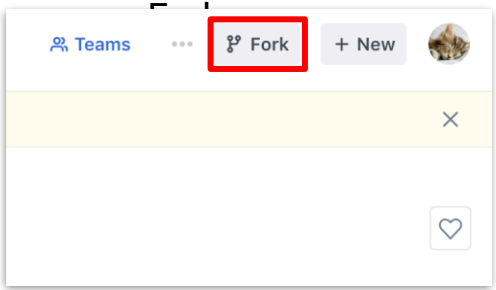

4. Authorize observablehq



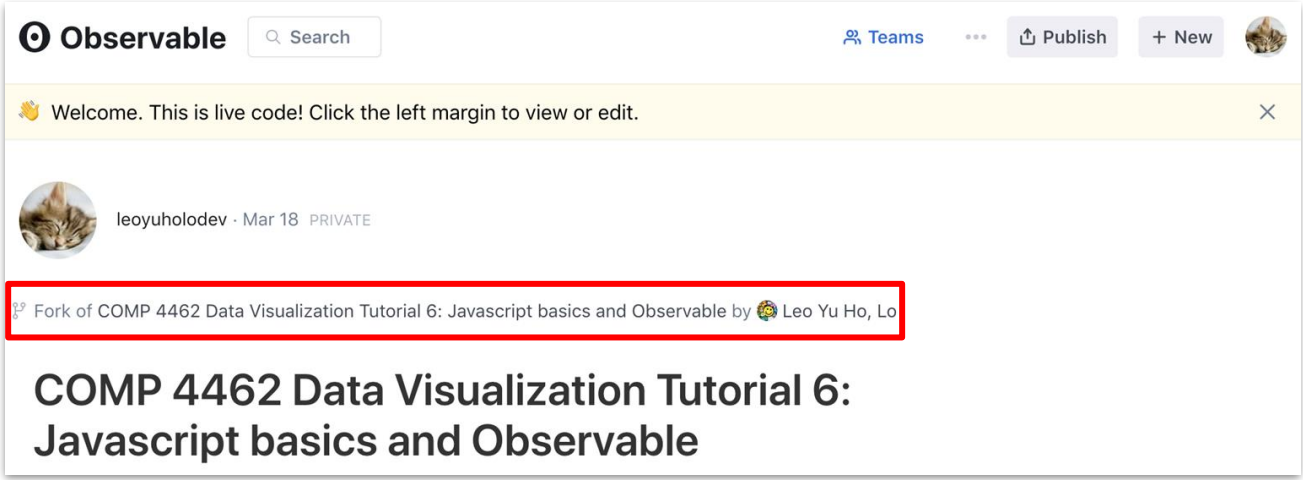
# Fork Observable notebook

1. Go to the notebooks of this tutorial (Part-I, Part-II)

2. Click




3. Check if you're working on your copy of the notebook (**otherwise, your work will not be saved**)



# Part-I: Javascript and Observable Basics

- See the Part-I Observable notebook
- Topics:
  - Javascript
    - Data types: number, string, array, object, date
    - Logic flow/loop
    - Function/arrow function
    - Callback/asynchronous
    - Datetime
  - Observable:
    - Expressions/blocks
    - Import libraries
    - Import data
    - Basic plot with Vega-Lite

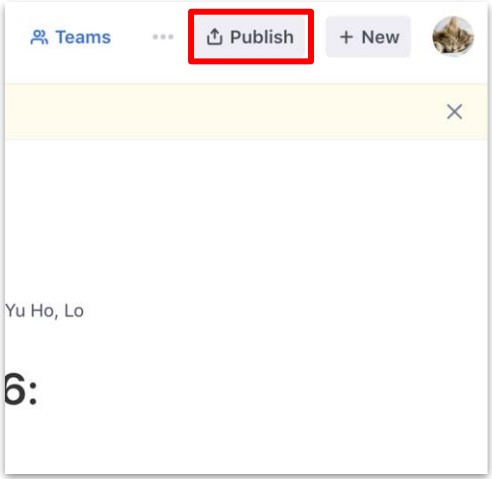
# Part-II: Data processing with Javascript

- See the Part-II Observable notebook
- Javascript built-in functions
  - map/reduce/filter
  - trim/split/indexOf/substring/replace
- Lodash
  - map over objects
  - groupBy / minBy / maxBy / meanBy
  - zip
- Moment.js
  - parse / format / datetime arithmetic
- Vega-Lite
  - Heatmap
  - Scale
  - Built-in aggregation
  - Datetime

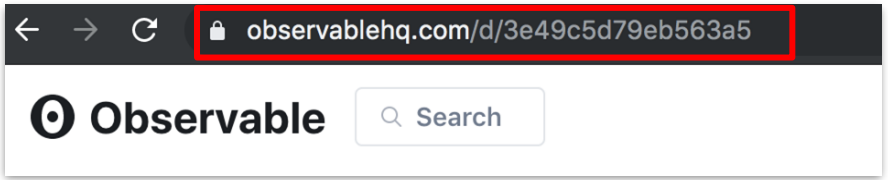
# Publish your Observable notebook (*optional this week)

1. In your working copy of the notebook

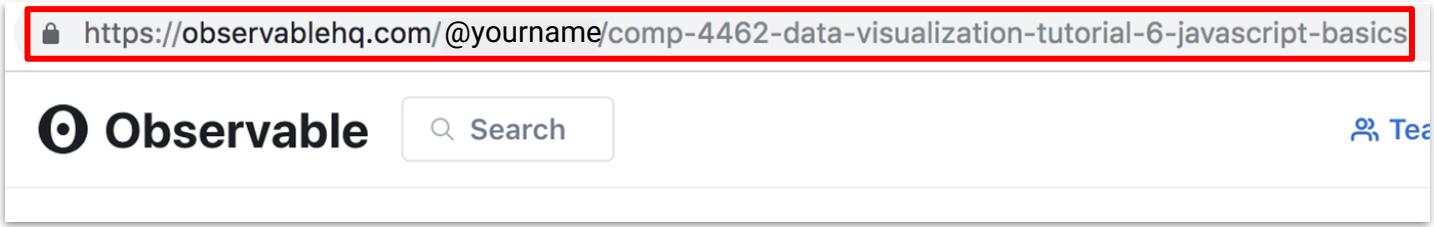
2. Click Publish




3. The URL changes from a hash...




4. To a meaningful URL, this URL is publicly accessible



# More topics on Javascript and Observable

- **A lot** more about Javascript
  - Promise / async / await / generator / iterator / delegation / asynchronous generator / variable scope / immutability / prototypal inheritance / event loop / “this” keyword / class / object destructuring / web worker
  - Compile to JS languages
    - Babel / Typescript / Coffeescript / Elm / Scala.js
  - Frontend development
    - Frameworks like React / Vue.js / AngularJS
    - Webpack module bundler
  - Backend development: Node.js and npm
  - Use Javascript to build desktop/mobile apps: Electron / React Native
- More on Observable features
  - See the "Observable: The User Manual" notebook
  - Streaming data / latex / files / viewof / mutable / different kinds of input / tables / saving SVG / presentation slides / streaming shapefiles / create animated gif

# More on Vega-Lite and data processing libraries

- More on Vega-Lite
  - View composition / layering / horizontal/vertical concatenate / interactions / zoom / filter / highlight / customize axis/ticks / maps (plotting geographic data)
- Notable functions of Lodash
  - sortBy / partition / transform / shuffle / sample / meanBy / sumBy / countBy / flatten / flattenDeep / mapKeys / mapValues / invoke / default / assign / merge / uniq / union / difference / repeat / deburr / split / words / chain
- More on Moment.js
  - Parsing and formatting / comparing / durations / handling timezone
- Other libraries:
  - apache-arrow: A future standard for in-memory data processing
  - JS libraries try to provide functionalities as Pandas to Python:
    - Data-Forge, Zebras, DataFrame-js

# Next tutorial

Visualization and Interaction with D3.js

- We will use Observable again
- And learn about D3.js!