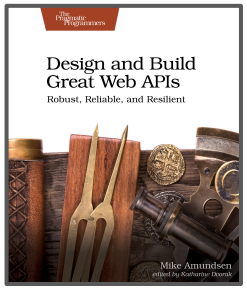
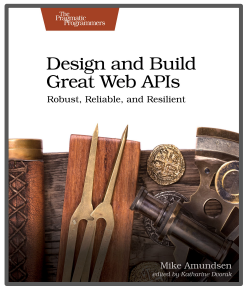
Design and Build Great APIs

GOTO Chicago

Mike Amundsen
@mamund

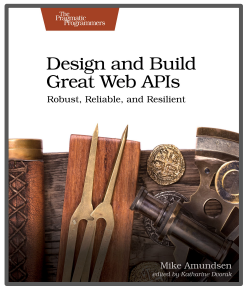


Morning


The Pragmatic Programmers
Design and Build Great Web APIs
Robust, Reliable, and Resilient
Mike Amundsen
edited by Katharine Dvorak

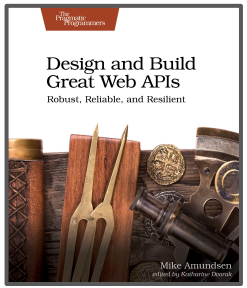
Morning -- Session One

- Web APIs
- Exploring APIs (curl)
- Tracking your Project (git)
- Managing your Project (npm)



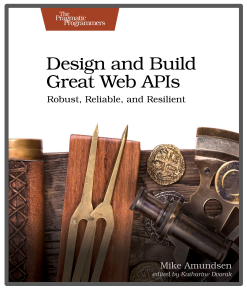
Web APIs

- HTTP
- The Web
- REST



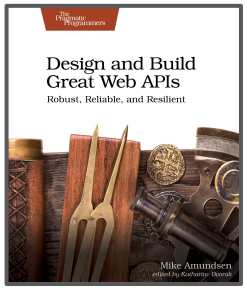
Web APIs -- HTTP (protocol)

- HTTP is an open standard protocol (IETF)
  - That means you can be WRONG!!!!<g>
- The big three:
  - Messages
  - Methods
  - Other Stuff



Web APIs -- HTTP (protocol)

- HTTP is all about messages
  - Not objects
  - Not functions
  - Just messages
- Every message has (up to) three parts
  - Start line
  - Header collection
  - Message body



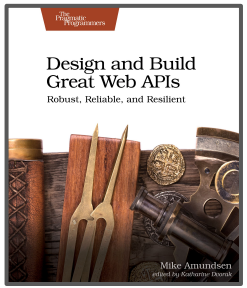
Web APIs -- HTTP (messages)

REQUEST

```
GET onboarding HTTP/1.1
User-Agent:
Host: apis.example.org
Accept: application/json
Accept-Language: en-us
Accept-Encoding: gzip, deflate
```

RESPONSE

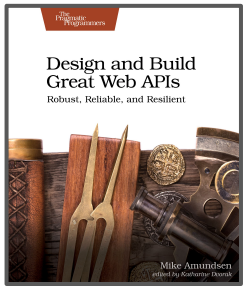
```
HTTP/2.0 200 OK
Date: Mon, 27 Jul 2019 12:28:53 GMT
Last-Modified: Wed, 22 Jul 2009 19:15:56 GMT
Content-Length: 88
Content-Type: application/json
Connection: Closed
```



Web APIs -- HTTP (methods)

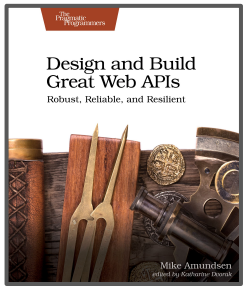
- HTTP clients use **Methods** to communicate intention
- GET, PUT, POST, DELETE ….
- Methods are NOT functions
- There are lots of registered methods

https://www.iana.org/assignments/http-methods/http-methods.xhtml



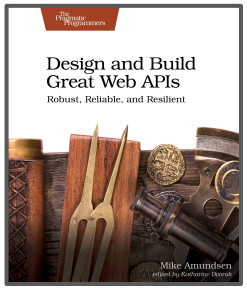
Web APIs -- HTTP (methods)

Method Name	Safe	Idempotent	Reference
ACL	no	yes	[RFC3744, Section 8.1]
BASELINE-CONTROL	no	yes	[RFC3253, Section 12.6]
BIND	no	yes	[RFC5842, Section 4]
CHECKIN	no	yes	[RFC3253, Section 4.4, Section 9.4]
CHECKOUT	no	yes	[RFC3253, Section 4.3, Section 8.8]
CONNECT	no	no	[RFC7231, Section 4.3.6]
COPY	no	yes	[RFC4918, Section 9.8]
DELETE	no	yes	[RFC7231, Section 4.3.5]
GET	yes	yes	[RFC7231, Section 4.3.1]
HEAD	yes	yes	[RFC7231, Section 4.3.2]
LABEL	no	yes	[RFC3253, Section 8.2]
LINK	no	yes	[RFC2068, Section 19.6.1.2]
LOCK	no	no	[RFC4918, Section 9.10]
MERGE	no	yes	[RFC3253, Section 11.2]
MKACTIVITY	no	yes	[RFC3253, Section 13.5]
MKCALENDAR	no	yes	[RFC4791, Section 5.3.1][RFC8144, Section 2.3]
MKCOL	no	yes	[RFC4918, Section 9.3][RFC5689, Section 3][RFC8144, Section 2.3]
MKREDIRECTREF	no	yes	[RFC4437, Section 6]
MKWORKSPACE	no	yes	[RFC3253, Section 6.3]
MOVE	no	yes	[RFC4918, Section 9.9]
OPTIONS	yes	yes	[RFC7231, Section 4.3.7]
ORDERPATCH	no	yes	[RFC3648, Section 7]
PATCH	no	no	[RFC5789, Section 2]
POST	no	no	[RFC7231, Section 4.3.3]
PRI	yes	yes	[RFC7540, Section 3.5]
PROPFIND	yes	yes	[RFC4918, Section 9.1][RFC8144, Section 2.1]
PROPPATCH	no	yes	[RFC4918, Section 9.2][RFC8144, Section 2.2]
PUT	no	yes	[RFC7231, Section 4.3.4]
REBIND	no	yes	[RFC5842, Section 6]
REPORT	yes	yes	[RFC3253, Section 3.6][RFC8144, Section 2.1]
SEARCH	yes	yes	[RFC5323, Section 2]
TRACE	yes	yes	[RFC7231, Section 4.3.8]
UNBIND	no	yes	[RFC5842, Section 5]
UNCHECKOUT	no	yes	[RFC3253, Section 4.5]
UNLINK	no	yes	[RFC2068, Section 19.6.1.3]
UNLOCK	no	yes	[RFC4918, Section 9.11]
UPDATE	no	yes	[RFC3253, Section 7.1]
UPDATEREDIRECTREF	no	yes	[RFC4437, Section 7]
VERSION-CONTROL	no	yes	[RFC3253, Section 3.5]



Web APIs -- HTTP (other stuff)

- HTTP offers two powerful assurances:
- **Safety** (GET vs. DELETE)
- **Idempotency** (PUT vs. POST)



Web APIs -- HTTP (other stuff)

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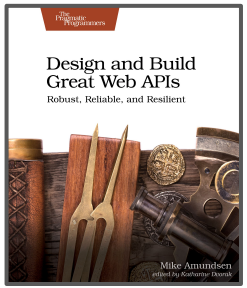
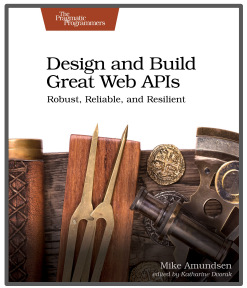


Web APIs -- HTTP (other stuff)

- **Safety** (GET vs. DELETE)

```
GET /company/delete?id=21
```

What's wrong with this HTTP request?



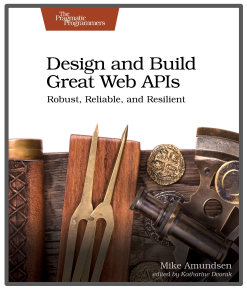
Web APIs -- HTTP (other stuff)

- **Idempotence** (PUT vs. POST)

The bank-transfer dilemma

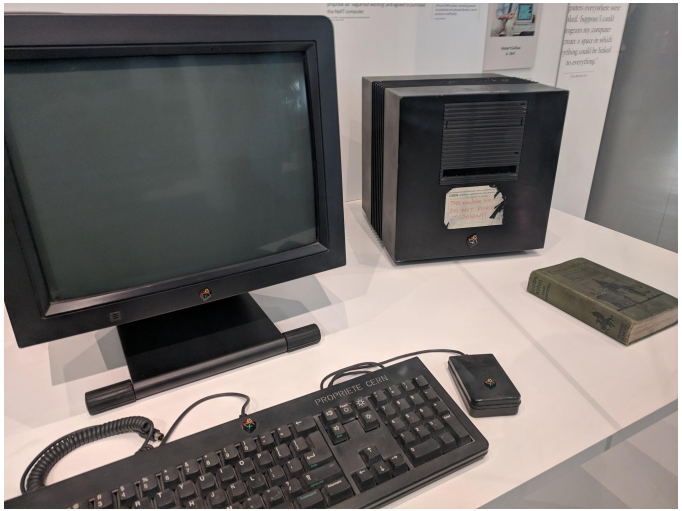
```
POST /bank-transfer HTTP/2.0
Host: apis.example.org
Accept: application/json
Content-Type: application/x-www-form-urnencoded

amount=1000&from-account=q1w2e3&to-account=zaxscd
```

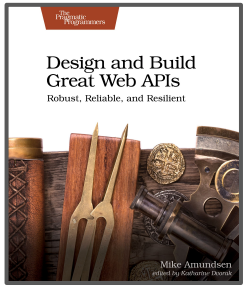
What if I never get a response?



Web APIs -- The Web

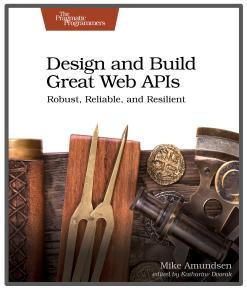
- Tim Berners-Lee built the first Web server and client in the 1980s
- HTTP & HTML
- Later CSS and Javascript was added by others





Web APIs -- The Web

- The WWW is not a standard or specification
- It is a set of common practices
- "A linked information system"
- Basic principles:
  - Pass messages
  - Include links to follow (GET)
  - Include forms to write data (POST)



Web APIs -- REST

- Roy Fielding created REST in 2000
- A list of properties and constraints
- REST not a standard or a common practice, it is a style

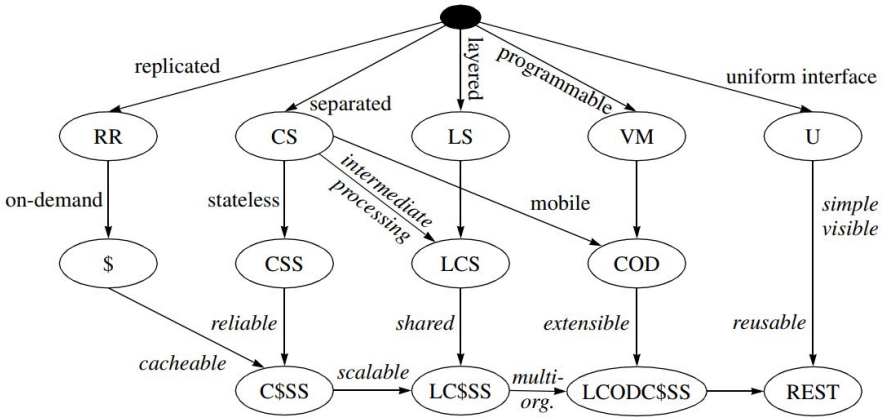
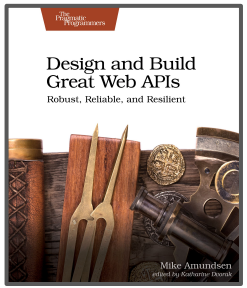


Figure 5-9. REST Derivation by Style Constraints



Web APIs -- REST

- List of System Properties
  - Performance
  - Scalability
  - Simplicity
  - Modifiability
  - Visibility
  - Portability
  - Reliability
- List of Implementation Constraints
  - Client-Server
  - Stateless
  - Caching
  - Uniform Interface
  - Layered System
  - Code on Demand

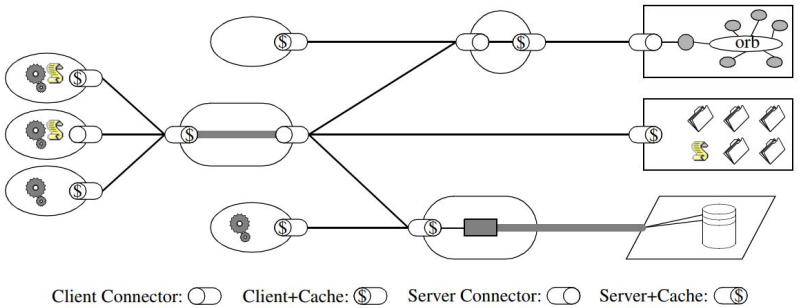
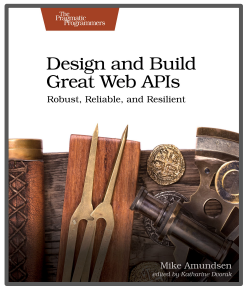
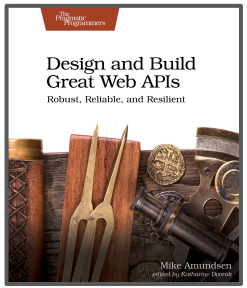


Figure 5-8. REST



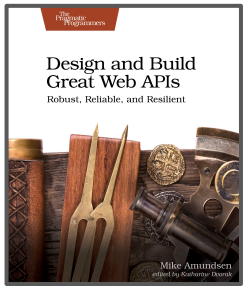
Web APIs

- HTTP (messages w/ intention)
- The Web (common practices for linking)
- REST (set of properties & constraints for building)



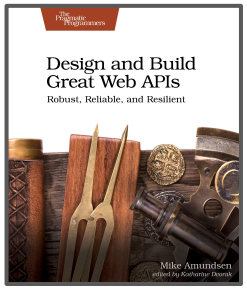
Exploring APIs

- BigCo & the Onboarding API
- Using **curl**



Exploring APIs -- BigCo, Inc

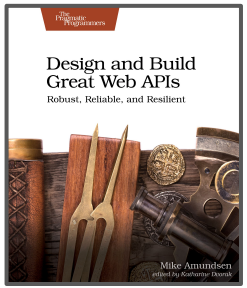
The Bayesian International Group of Companies (BigCo) was founded in 1827 in Scotland. Originally focused on demography and finance based on the work of Richard Price, by the 1900s BigCo was a manufacturer of important turn-of-the-century technologies including mobile x-ray machines and hydrophones by working with inventors Frederick Jones and Reginald Fessenden, respectively. BigCo was also one of the few non-US contractors attached to the Manhattan project, providing parts for the first nuclear reactors designed by Dr. Leona Wood.



Exploring APIs -- BigCo, Inc

We'll be helping BigCo, Inc. design, build, and deploy a brand-new API called the Onboarding API. True to the API First design ethos, we'll only be building the API and not spending time writing the services behind the API.

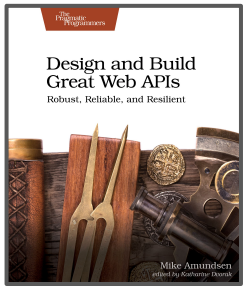
- Company
- Accounts
- Activity



Exploring APIs -- Using **curl**

curl://

command line tool and library
for transferring data with URLs



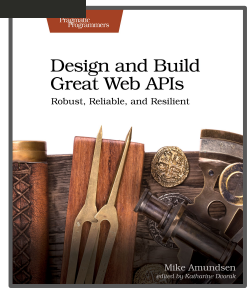
Exploring APIs -- Using **curl**

- Download & Install: https://curl.haxx.se
- Documentation: https://curl.haxx.se/docs/

```
http://company-atk.herokuapp.com/company/list

https://account-atk.herokuapp.com/account/list

https://activity-atk.herokuapp.com/activity/list
```

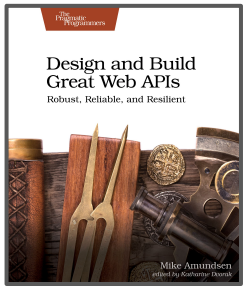
curl://

command line tool and library
for transferring data with URLs



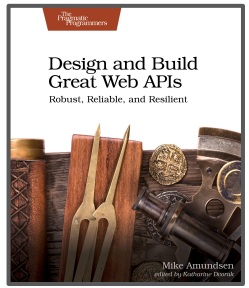
Tracking your Project

- Project Folder Layout
- Using **git**



Tracking your Project - Folder Layout

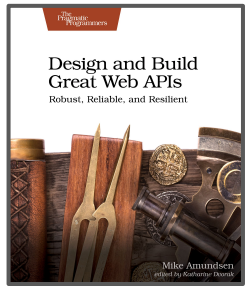
- Organize your API projects using folders on disk
- Root folder is the project name (onboarding)
- Common subfolders are:
  - **assets** (design documents, notes, etc.
  - **tests** (test scripts and results)
  - **data** (local/captive data -- files, db, etc.)
  - Other folders per framework conventions, etc.
    - config
    - views
    - controllers
    - models
    - etc.



Tracking your Project -- Using **git**

- Download & Install
  https://git-scm.com/downloads

- Documentation
  https://git-scm.com/doc

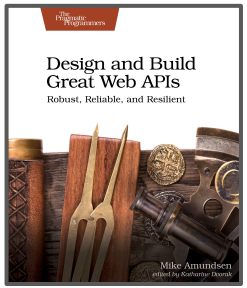


Tracking your Project -- Using **git**

- Create root folder
- Initialize as a git repo

```
mca@mamund-ws:~$ mkdir onboarding
mca@mamund-ws:~$ cd onboarding/
mca@mamund-ws:~/onboarding$ git init
Initialized empty Git repository in /home/mca/onboarding/.git/
mca@mamund-ws:~/onboarding$
```

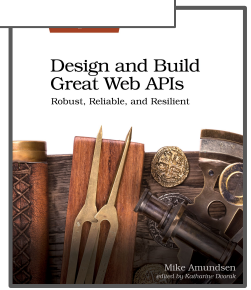
git



Tracking your Project -- Using **git**

- Check repo status

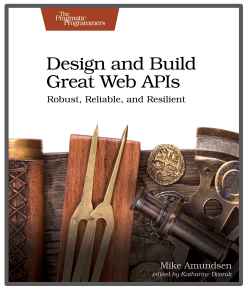
```
mca@mamund-ws:~/onboarding$ git status
On branch master

Initial commit

nothing to commit (create/copy files and use "git add" to track)
mca@mamund-ws:~/onboarding$
```



Tracking your Project -- Using **git**

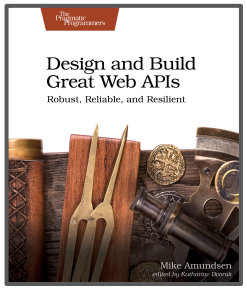
- Add new files to the repo & commit

```
mca@mamund-ws:~/onboarding$ git add --all
mca@mamund-ws:~/onboarding$ git commit -m"add README to the repo"
[master (root-commit) 6f509d4] add README to the repo
 1 file changed, 4 insertions(+)
 create mode 100644 README.md
mca@mamund-ws:~/onboarding$
```



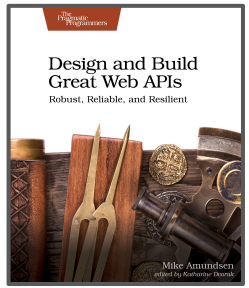
Managing your Project

- Project Elements
- Code Dependencies
- Using **npm**



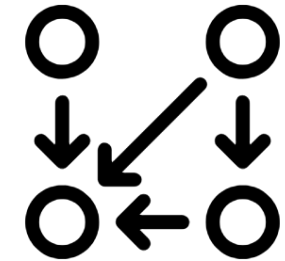
Managing your Project -- Elements

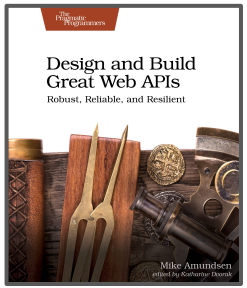
- Every project has its own metadata (data about the project)
- Typical values:
  - Name
  - Version
  - Description
  - Repo
  - Keywords
  - Author
  - License
  - Bug reporting
  - Docs page



Managing your Project -- Code Dependencies

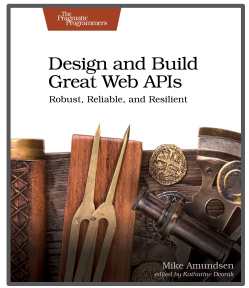
- Code dependencies are a challenge
- They are other people's work
- Often they are provided free of charge on the open web
- You don't control these projects
- Your project may not work without them
- Tracking use (and tracking their changes) is a big job





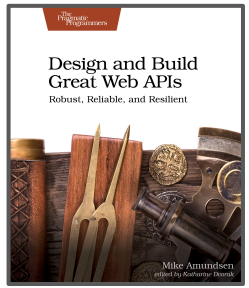
Managing your Project -- Using **npm**

- In the NodeJS world, this info is handled by **npm**
- Similar to git
- Understood by a wide range of tools
- Build, test, & deployment, etc.
- Usually installed when you install NodeJS



Managing your Project -- Using **npm**

- Download & Install (NodeJS/npm)
  https://www.npmjs.com/get-npm
- Documentation
  https://docs.npmjs.com/
- Create an Account (optional)
  https://docs.npmjs.com/creating-a-new-npm-user-account



Managing your Project -- Using **npm**

Running a CLI questionnaire

To create a **`package.json`** file with values that you supply, use the **`npm init`** command.

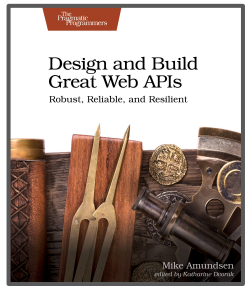
1. On the command line, navigate to the root directory of your package.

```
cd /path/to/package
```

2. Run the following command:

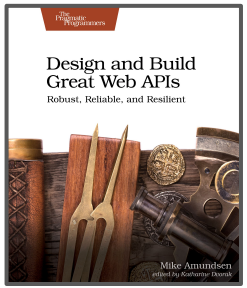
```
npm init
```

3. Answer the questions in the command line questionnaire.



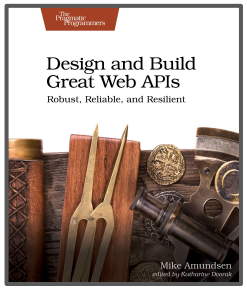
Session One -- Summary

- Web APIs
  - HTTP, WWW, REST
- Exploring APIs (curl)
  - Use **curl** to explore other APIs
- Tracking your Project (git)
  - Use **git** to track changes in your project
- Managing your Project (npm)
  - Use **npm** to manage project metadata



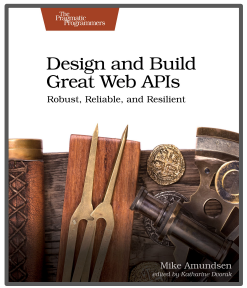
Morning -- Session Two

- Designing APIs
- Diagramming (wsd)
- Describing (alps)
- Sharing your Project (github)



Designing APIs

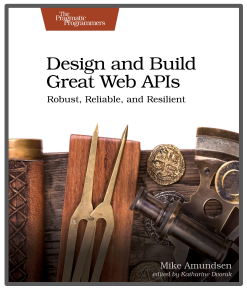
- Design Thinking
- API Design Process
- Using **schema.org**



Designing APIs - Design Thinking

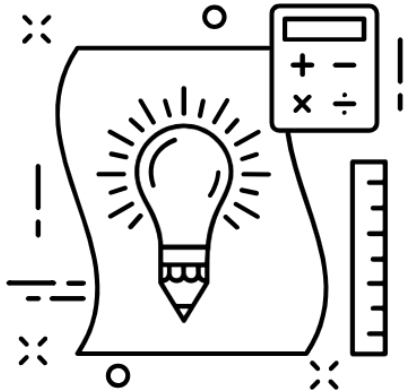
"A design discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity."

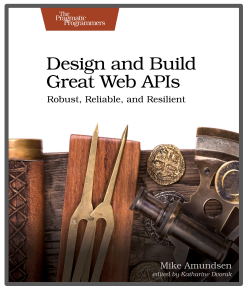
-- Tim Brown, CEO of IDEO



Designing APIs - Design Thinking

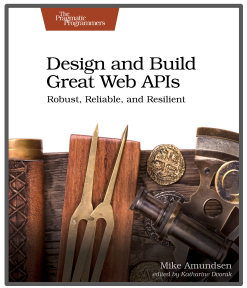
- Match people's needs
- Technologically feasible
- Viable business
- Customer value





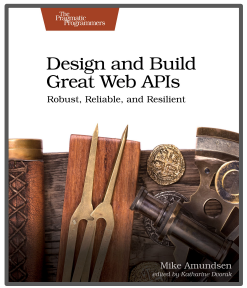
Designing APIs - API Design Process

- List all data and action names
- Create a workflow diagram
- Normalize your naming
- Write up an API Profile document



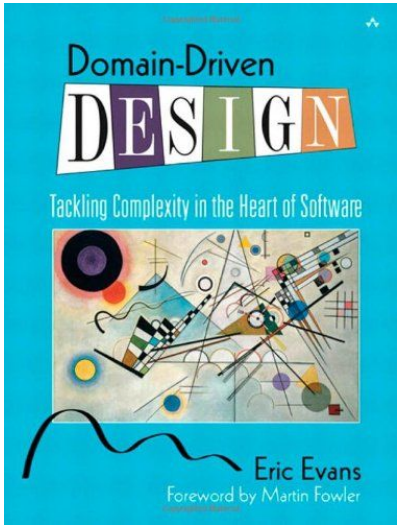
Designing APIs - List data and elements

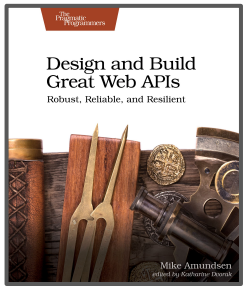
- Refer to the supplied onboarding-story.md
- What are the "things" or "properties"?
- What are the "tasks" or "actions"?
- Are any properties required?
- Are any properties enumerated?



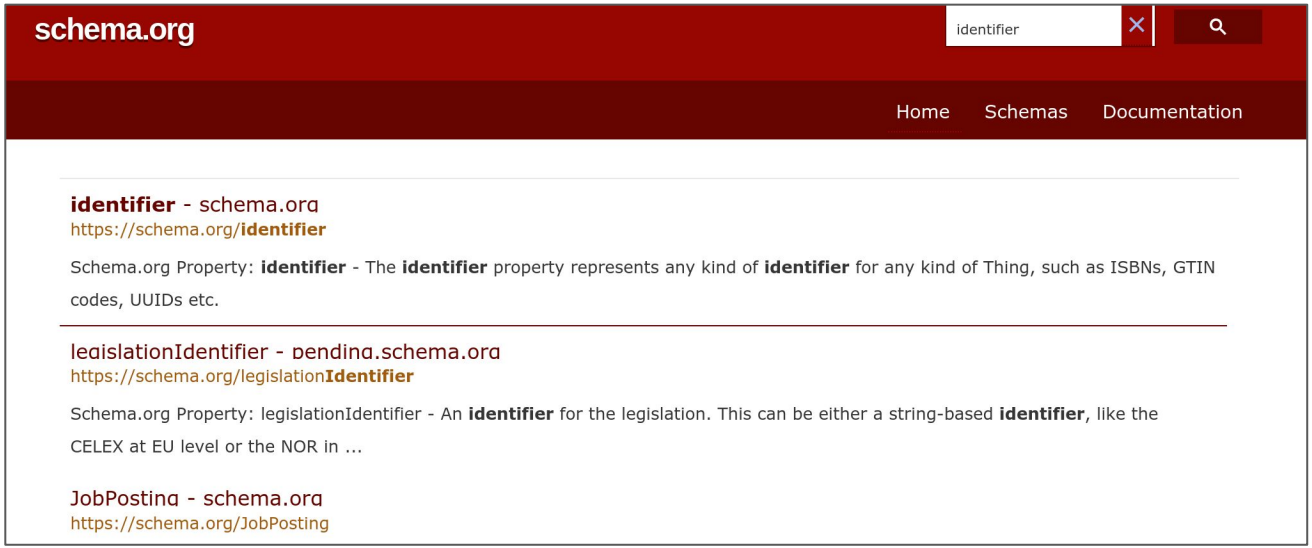
Designing APIs - Using **schema.org**

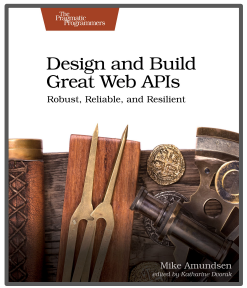
- Schema.org is an open web vocabulary
- Launched in 2011 by Google, Yahoo, Microsoft, Yandex
- Common vocabulary/glossary/terms
- Domain-Driven Design calls it "ubiquitous language"
- Use schema.org to "reconcile names" in your API





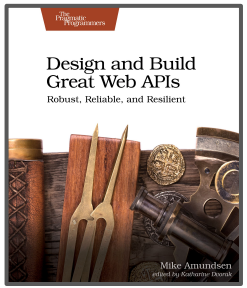
Designing APIs - Using **schema.org**





Diagramming APIs

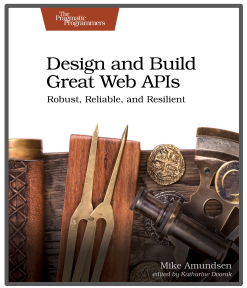
- API Workflow
- Using **websequencediagrams.com**



Diagramming APIs - API Workflow

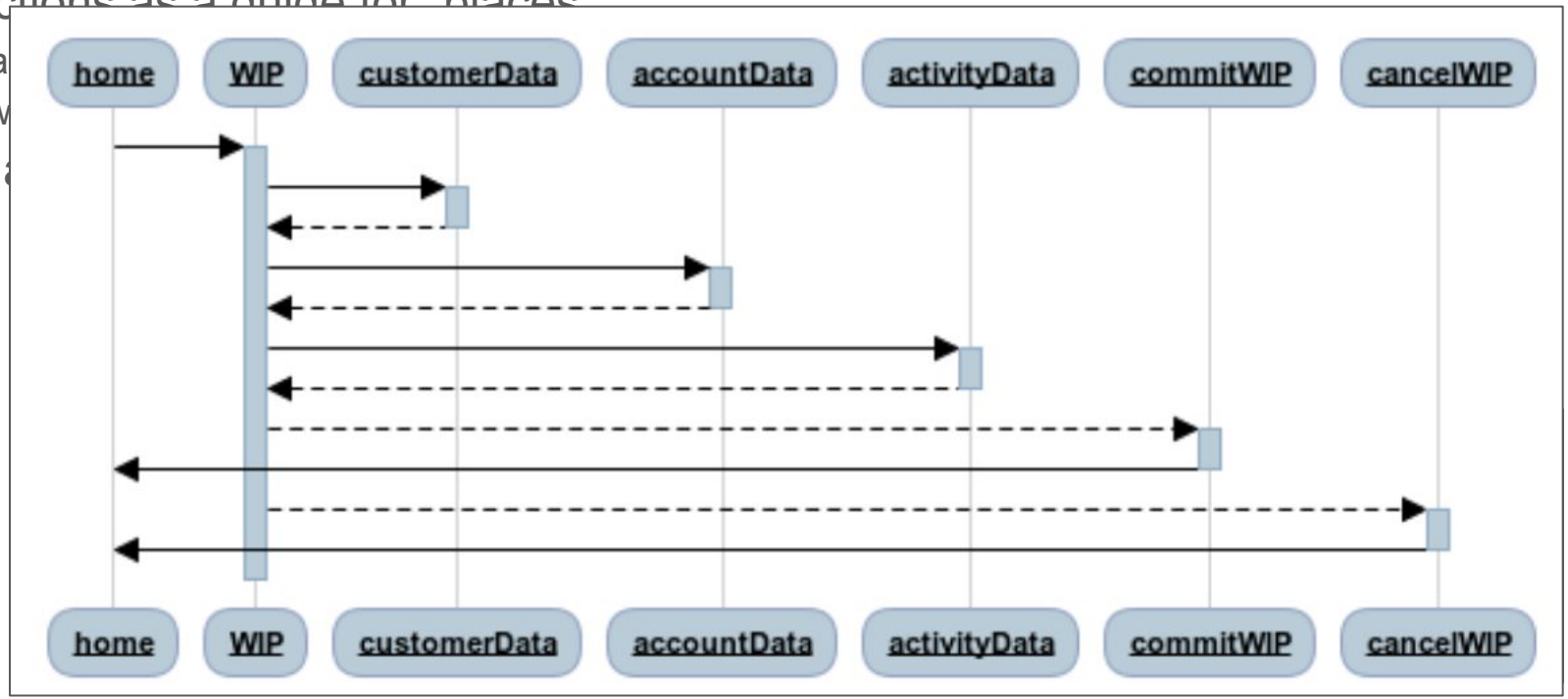
- Establish a "home"
- Use actions as a guide for "places"
  - Each action happens at a place
  - Always return "home"
- Rinse and repeat

```
home->+WIP:
WIP->+customerData:
customerData-->-WIP:
WIP->+accountData:
accountData-->-WIP:
WIP->+activityData:
activityData-->-WIP:
WIP-->+commitWIP:
commitWIP->-home:
WIP-->+cancelWIP:
cancelWIP->-home:
```



Diagramming APIs - API Workflow

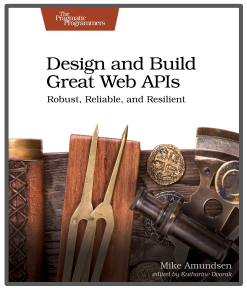
- Establish a "home"
- Use actions as a guide for "places"
  - Ea
  - Alw
- Rinse a



Diagramming APIs - API Workflow

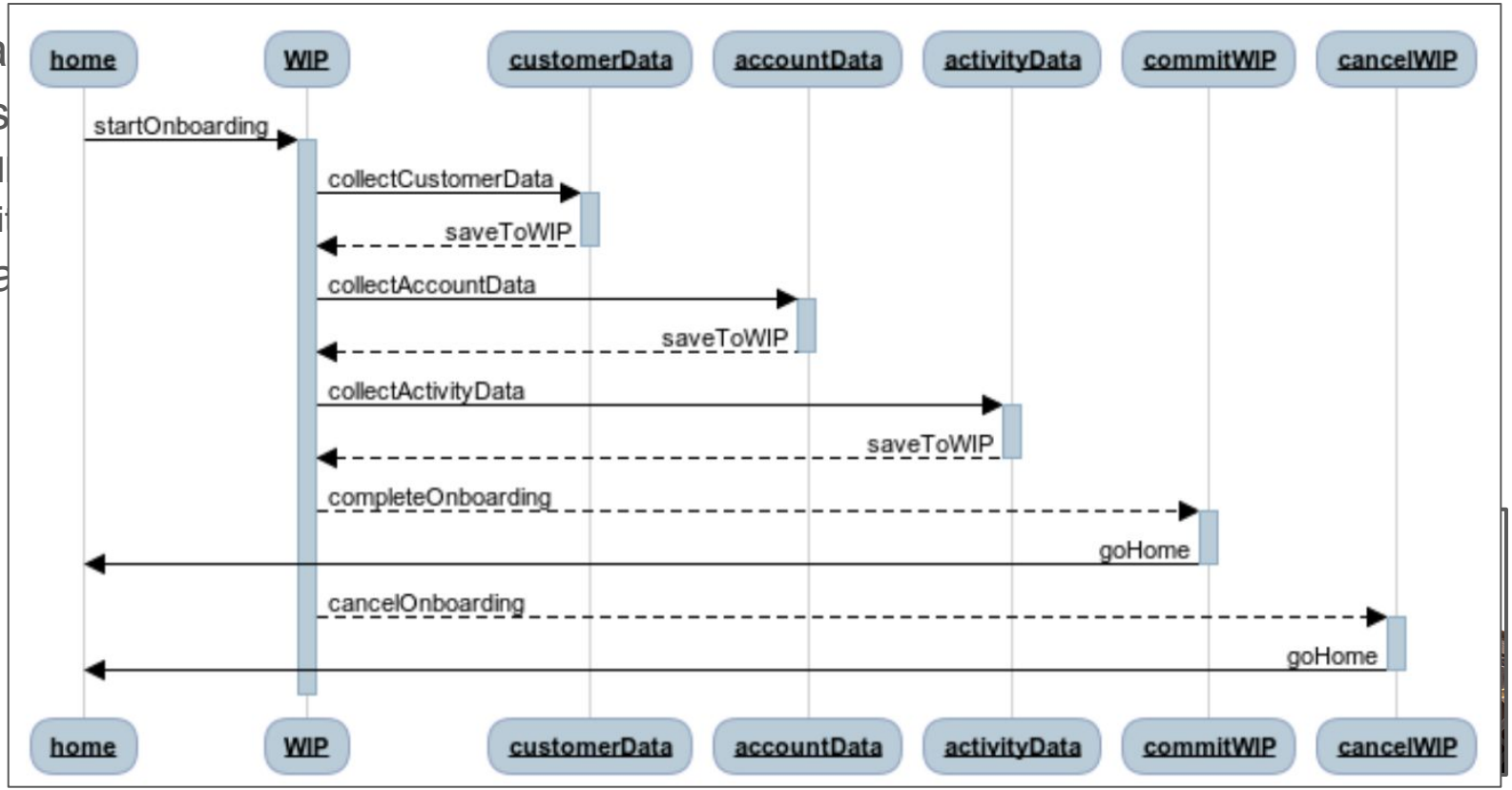
- Decorate each transition with an action
- Actions have two parts
  - Collect data
  - Write/send data
- Rinse and repeat

```
home->+WIP: startOnboarding
WIP->+customerData: collectCustomerData
customerData-->-WIP: saveToWIP
WIP->+accountData: collectAccountData
accountData-->-WIP:saveToWIP
WIP->+activityData: collectActivityData
activityData-->-WIP:saveToWIP
WIP-->+commitWIP:completeOnboarding
commitWIP->-home:goHome
WIP-->+cancelWIP:cancelOnboarding
cancelWIP->-home:goHome
```



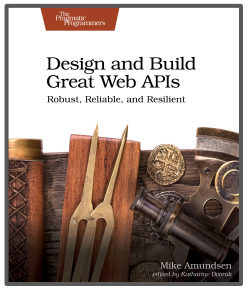
Diagramming APIs - API Workflow

- Decora
- Actions
  - Col
  - Writ
- Rinse a



Diagramming APIs - API Workflow

- Add arguments to each action
  - List args for reading
  - List args for sending
- Rinse and repeat



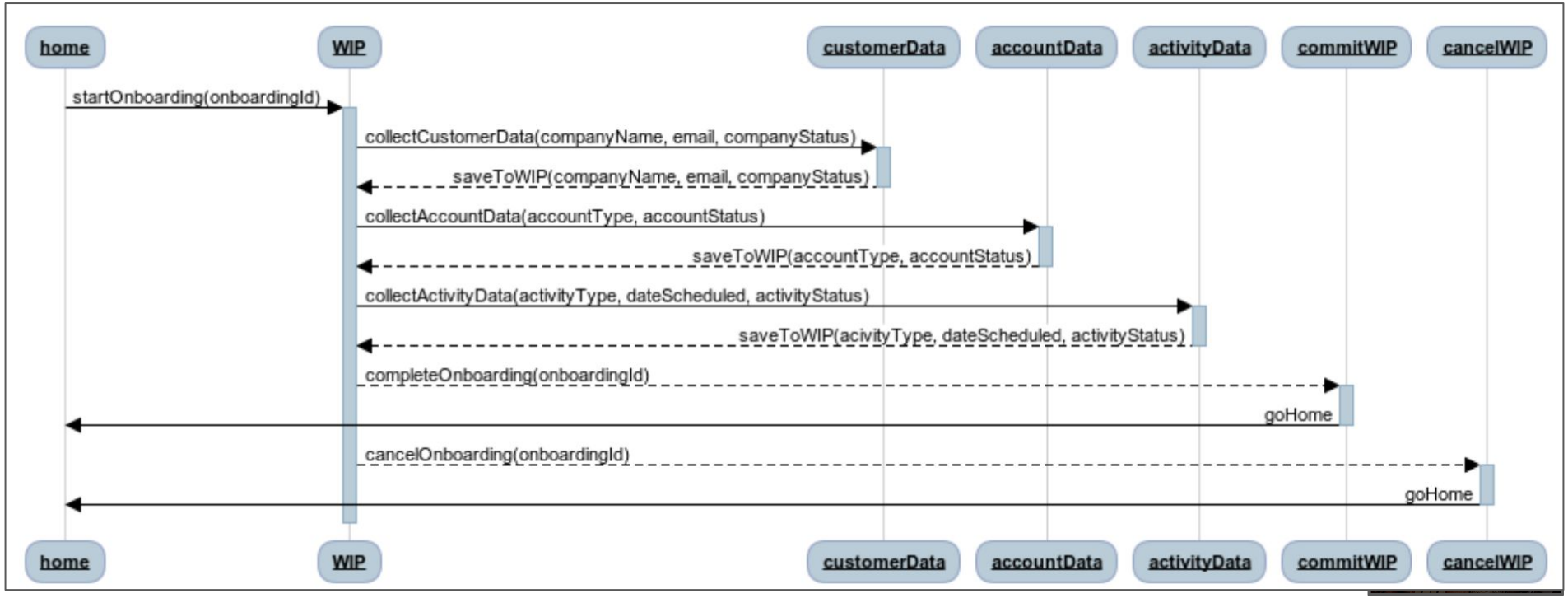
Diagramming APIs - API Workflow

- Add arguments to each action
  - List args for reading
  - List args for sending
- Rinse and repeat

```
home->+WIP: startOnboarding(onboardingId)
WIP->+customerData: collectCustomerData(companyName, email, companyStatus)
customerData-->-WIP: saveToWIP(companyName, email, companyStatus)
WIP->+accountData: collectAccountData(accountType, accountStatus)
accountData-->-WIP:saveToWIP(accountType, accountStatus)
WIP->+activityData: collectActivityData(activityType, dateScheduled, activityStatus)
activityData-->-WIP:saveToWIP(acivityType, dateScheduled, activityStatus)
WIP-->+commitWIP:completeOnboarding(onboardingId)
commitWIP->-home:goHome
WIP-->+cancelWIP:cancelOnboarding(onboardingId)
cancelWIP->-home:goHome
```

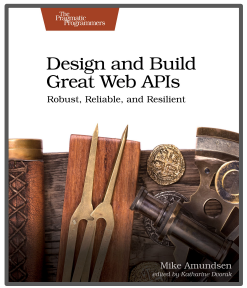
Diagramming APIs - API Workflow

- Add arguments to each action

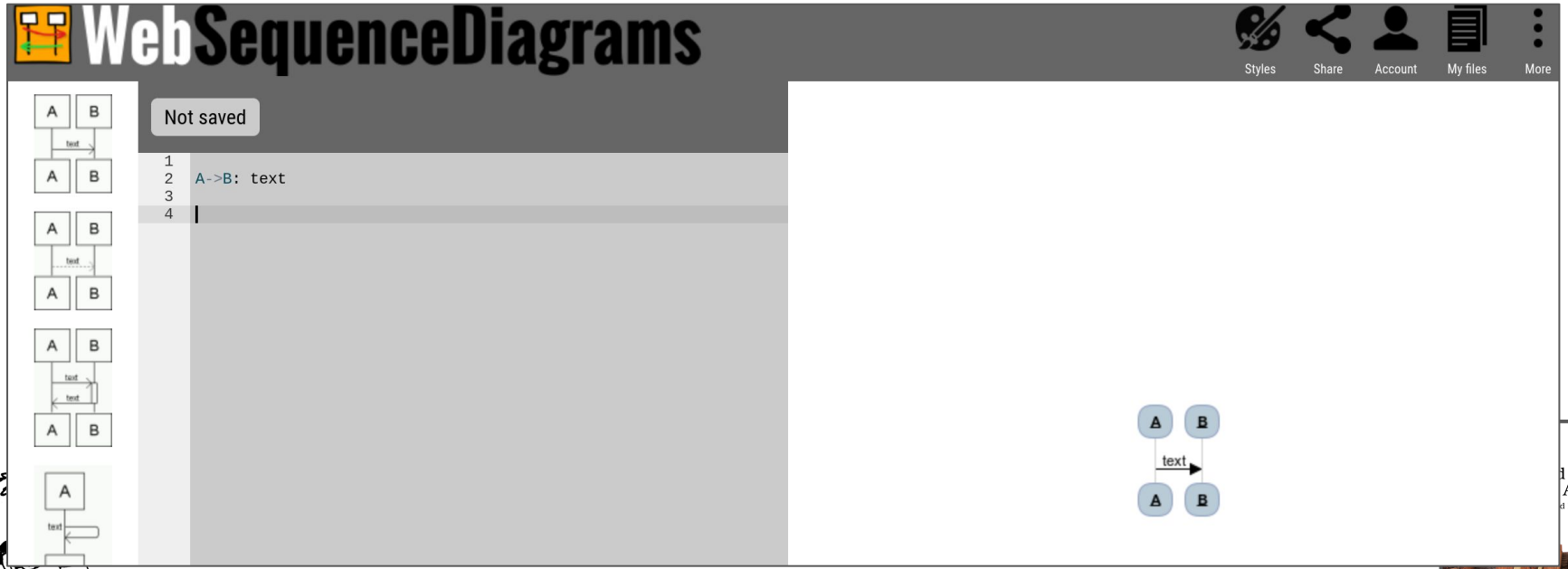


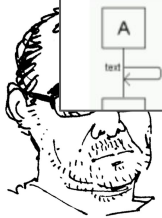
Diagramming APIs - Using WSD

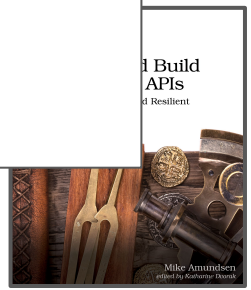
- No need to install
  https://www.websequencediagrams.com/
- Documentation
  https://www.websequencediagrams.com/examples.html
- Create an account (optional)
  https://www.websequencediagrams.com/ (and select "account")



Diagramming APIs - Using WSD





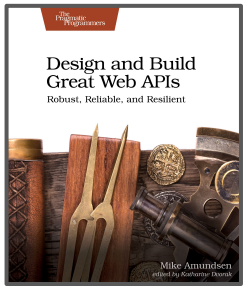


Diagramming APIs - Bonus Utility **`wsdgen`**

- Generates WSD images from command-line
- Download repo from github
  https://github.com/mamund/wsd-gen

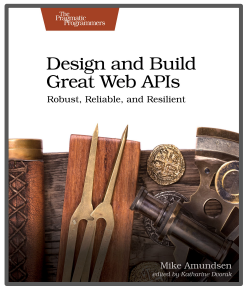
- Install using npm:
  `npm install -g wsdgen`

- Usage:
  `wsdgen onboardingAPI.wsd`



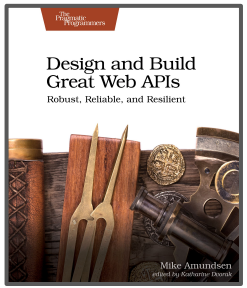
Describing APIs

- Descriptions vs. Definitions
- Data and Actions
- Using **ALPS**



Describing APIs - Descriptions vs. Definitions

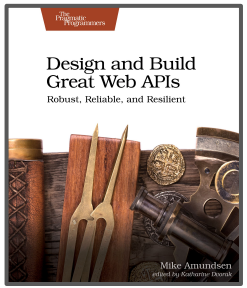
- Descriptions are implementation-agnostic
- Descriptions are the bridge between design and implementation
- Examples of API description formats
  - Dublin Code Application Profile (DCAP), 2009
  - Application-Level Profile Semantics (ALPS), 2011
  - JSON Home, 2012
  - Profiled Hypertext Application Language (PHTAL), 2019



Describing APIs - Data and Actions

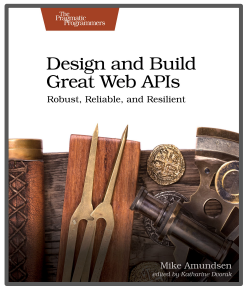
- List actions and properties
- Indicate action intentions
- DO NOT document
  - URLs
  - Protocol Methods
  - Message Formats

BTW - We'll deal with definition languages this afternoon!



Describing APIs - Using ALPS

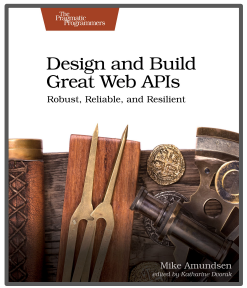
- Comes in two flavors (XML and JSON)
- Simple model
  - `<alps> <doc>...</doc> <descriptors /> </alps>`
  - `{"alps" : {"doc" : {"text" : "..."}, "descriptors" : [] } }`
- Descriptors detail actions or properties
  - `<descriptor id="..." name=""... type="..." href="..." />`
- Descriptor types are:
  - `semantic`
  - `safe`
  - `unsafe`
  - `idempotent`



Describing APIs - Using ALPS

- Start with a minimal ALPS XML doc

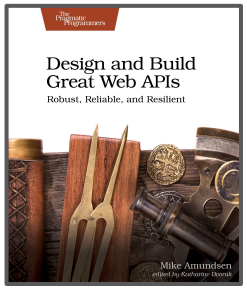
```
<alps version="1.0">
    <doc>Sample ALPS Document</doc>

    <!-- properties -->

    <!-- actions -->
</alps>
```



Describing APIs - Using ALPS

- List properties (API vocabulary)

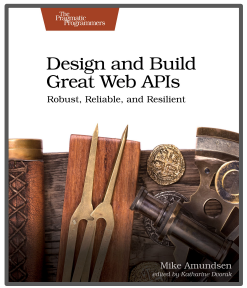
```
<alps version="1.0">
    <doc>Sample ALPS Document</doc>

    <!-- properties -->
    <descriptor id="onboardingId" />
    <descriptor id="status" />
    <descriptor id="dateCreated" />
    <descriptor id="dateUpdated" />

    <!-- actions -->
</alps>
```



Describing APIs - Using ALPS

- List Actions (API vocabulary)

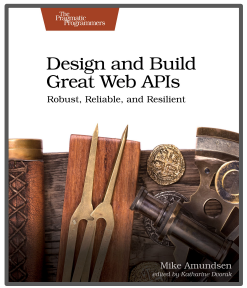
```
<alps version="1.0">
    <doc>Sample ALPS Document</doc>

    <!-- properties -->
    <descriptor id="onboardingId" />
    <descriptor id="status" />
    <descriptor id="dateCreated" />
    <descriptor id="dateUpdated" />

    <!-- actions -->
    <descriptor id="StartOnboarding" type="unsafe" />
    <descriptor id="CollectionCompanyData" type="safe" />
    <descriptor id="SaveCompanyData" type="unsafe" />

</alps>
```



Describing APIs - Using ALPS

- Optionally, add resources and containers

```
<!-- actions -->
<descriptor id="StartOnboarding" type="unsafe" rt="work-in-progress" />
<descriptor id="CollectionCompanyData" type="safe" />
<descriptor id="SaveCompanyData" type="unsafe" rt="work-in-progress"/>

<!-- containers -->
<descriptor id="work-in-progress">
    <descriptor href="#onboardingId" />
    <descriptor href="#status" />
    <descriptor href="#dateCreated" />
    <descriptor href="#dateUpdated" />
<descriptor>

<!-- resources -->
<descriptor id="home">
    <descriptor href="#work-in-progress" />
    <descriptor href="StartOnboarding" />
</descriptor>
```

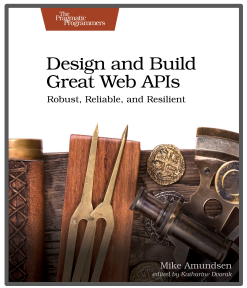


Diagramming APIs - Bonus Utility `wsd2alps`

- Generates ALPS (JSON) from WSD on command-line
- Download repo from github
  https://github.com/mamund/wsd-util

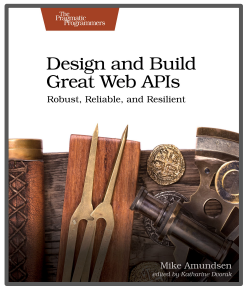
- Install using npm:
  ```
  npm install -g ./
  ```

- Usage:
  ```
  wsd2alps onboardingAPI.wsd
  ```



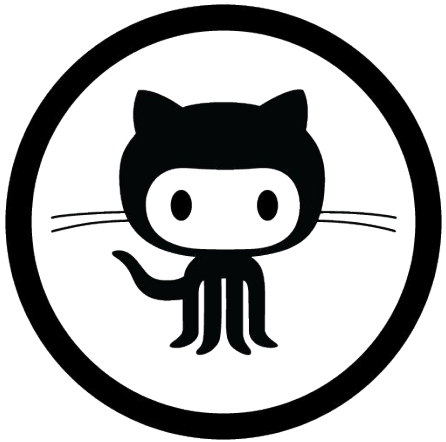
Sharing your Project

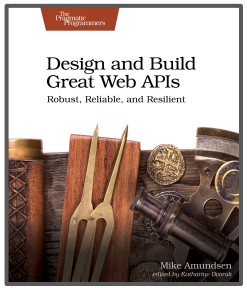
- More than one machine/programmer
- Using **Github**



Sharing your Project - More than One

- Sometimes you work in a team
- Sometimes you work on multiple devices
- Sometimes you work in multiple locations
- Git is cool, github is cool -> shared
- Also see bitbucket, gitlab, etc.



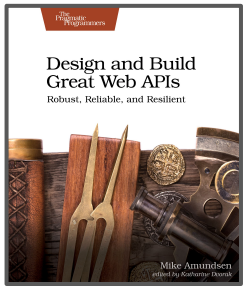


Sharing your Project - Using **github**

- Nothing to download
- Documentation
  https://guides.github.com/

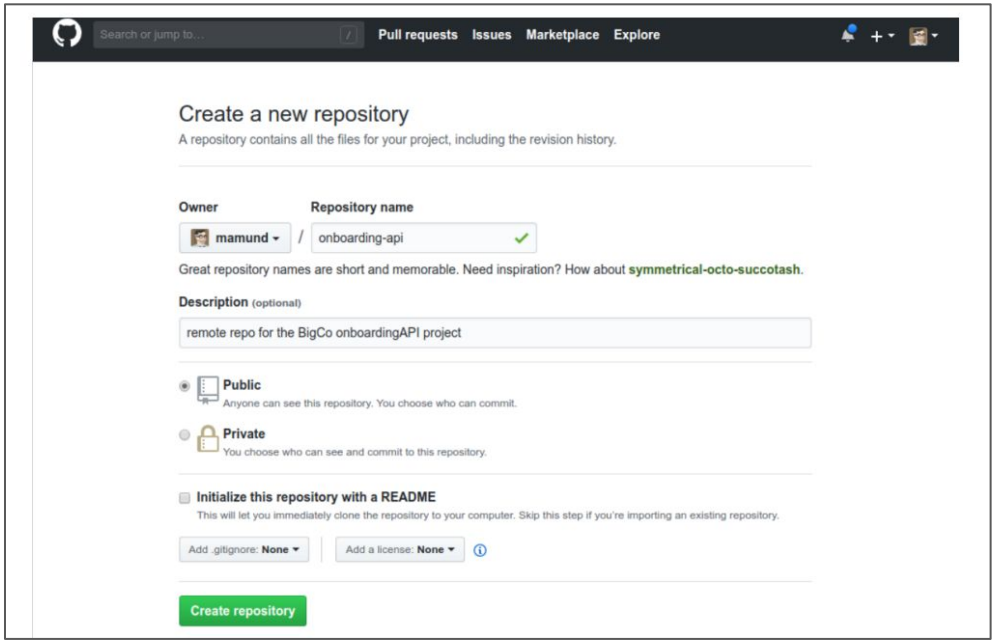
- Create an Account (required)
  https://github.com/

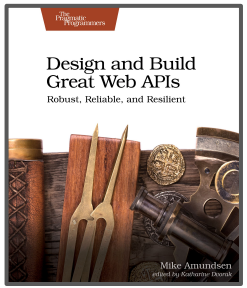
- Using SSH (recommended)
  https://help.github.com/en/articles/connecting-to-github-with-ssh



Sharing your Project - Using **github**

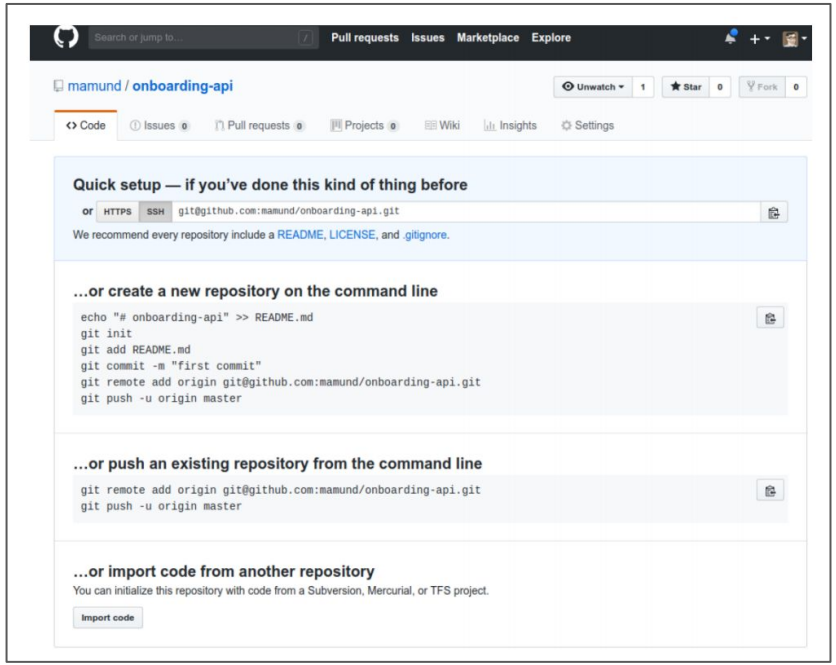
- Create an empty repo on Github

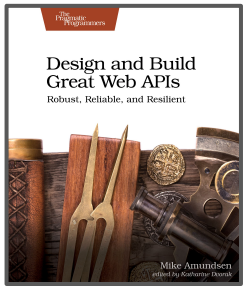




Sharing your Project - Using **github**

- Copy git commands to connect github and your local repo



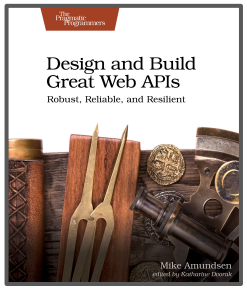


Sharing your Project - Using **github**

- Commit changes after adding the remote github connection

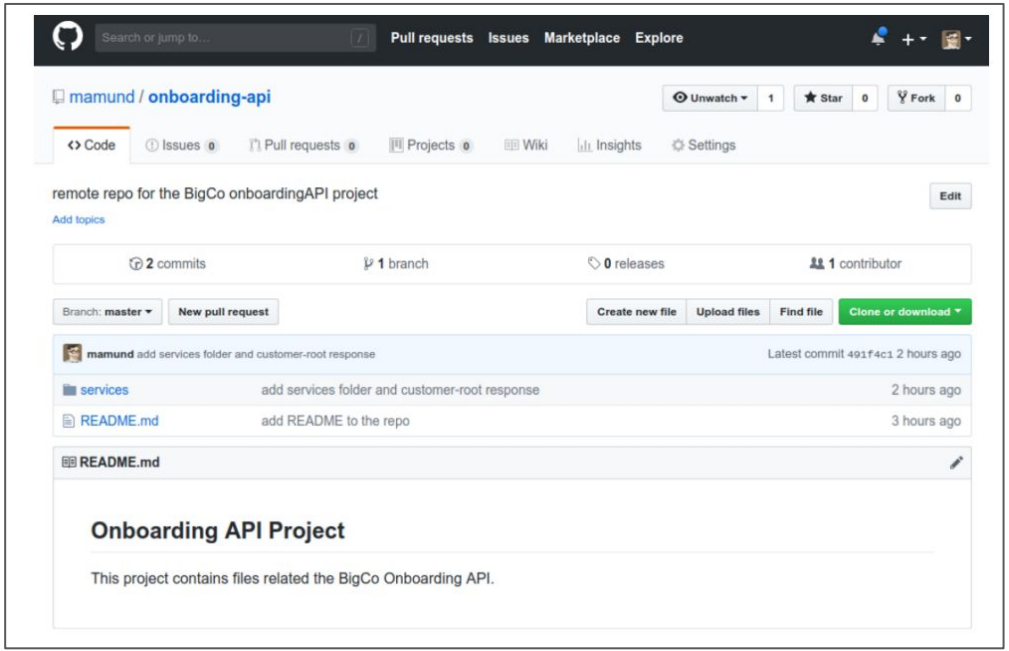
```
git remote add origin git@github.com:mamund/onboarding-api.git
```

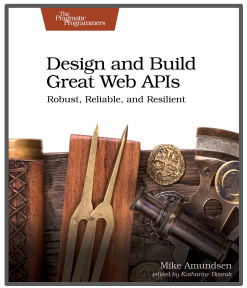
```
mca@mamund-ws:~/onboarding$ git push -u origin master
Counting objects: 7, done.
Delta compression using up to 4 threads.
Compressing objects: 100% (5/5), done.
Writing objects: 100% (7/7), 790 bytes | 0 bytes/s, done.
Total 7 (delta 0), reused 0 (delta 0)
To git@github.com:mamund/onboarding-api.git
 * [new branch]      master -> master
Branch master set up to track remote branch master from origin.
mca@mamund-ws:~/onboarding$
```



Sharing your Project - Using **github**

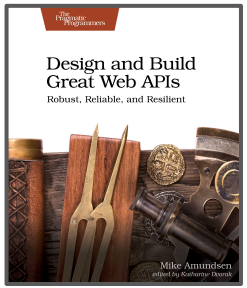
- Now your local repo should be duplicated at Github!





Morning -- Summary

- Session One
  - Web APIs (HTTP, WWW, REST)
  - Exploring APIs (curl)
  - Tracking your Project (git)
  - Managing your Project (npm)
- Session Twp
  - Designing APIs (Design Process)
  - Diagramming (wsd)
  - Describing (alps)
  - Sharing your Project (github)



Design and Build Great APIs

Morning

Mike Amundsen
@mamund