# Library Data ReST APIs: Design to Deploy

ELAG 2018 Bootcamp
github.com/cmh2166/cmh2166/elag18apis

github.com/cmh2166/elag18apis

Link to Slides, Datasets, & Other Workshop Materials

# Schedule (ish)

| | |
|---|---|
| **10-10:30** | Introduction, Logistics, Goals |
| **10:30-11** | Designing our API (ReST, PCDM, Swagger) |
| ***11-11:10*** | *Mini-break* |
| **11:10-12:30** | Developing our API (Go, Go-Swagger, Localstack) |
| ***12:30-13:30*** | *Lunch Break (on your own)* |
| **13:30-14:20** | Containerizing our API (Docker) |
| ***14:20-14:30*** | *Mini-break* |
| **14:30-15:30** | Deploying our API (AWS) |
| **15:30-16** | Conclusion & Bootcamp Retrospective |

# Your Bootcamp Authors

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# Introduction

# Our Expectations of You

## Personal

- Follow the Recurse Center Social Rules (a.k.a. "Hacker School Rules")

## Technical

- Have Go, Docker, `localstack`, and `aws-cli` (with free AWS account connection) ready to go on your laptop
- Be ready to participate!

# Recurse Center Social Rules
## (a.k.a. Hacker School Rules)

- No feigning surprise
- No well-actually's
- No back-seat driving
- No subtle -isms

More info:

- https://www.recurse.com/blog/38-subtle-isms-at-hacker-school
- https://www.recurse.com/manual#sub-sec-social-rules

# Technical Prep

We hope you have before this point...

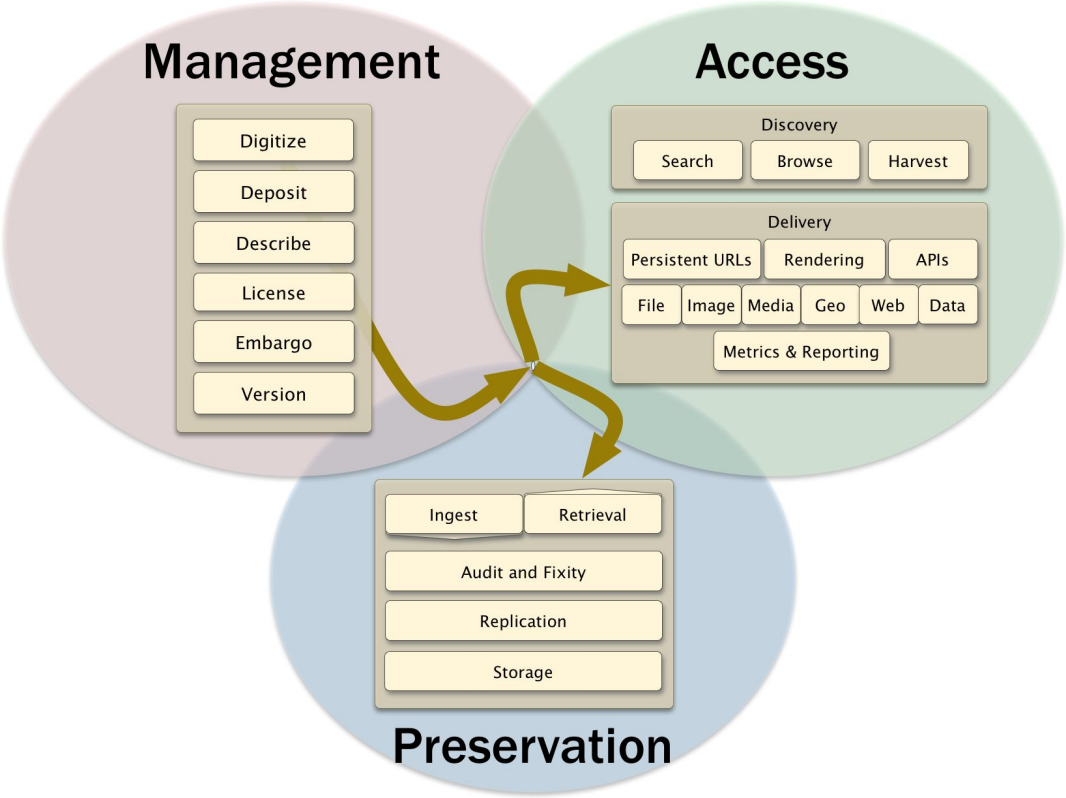
1. Brought a laptop with internet connection & modern web browser.
2. Have our workshop GitHub repository on your computer (with mechanism to update / pull down latest changes on Monday morning.
3. Installed latest stable `Go` on said laptop & set up your workspace.
4. Installed latest stable Docker Community Edition on said laptop.
5. Set up a free AWS account & `awscli` on said laptop for said account.
6. Installed `localstack` (requires python) on said laptop for your Go workspace.

# Our Goals for this Bootcamp

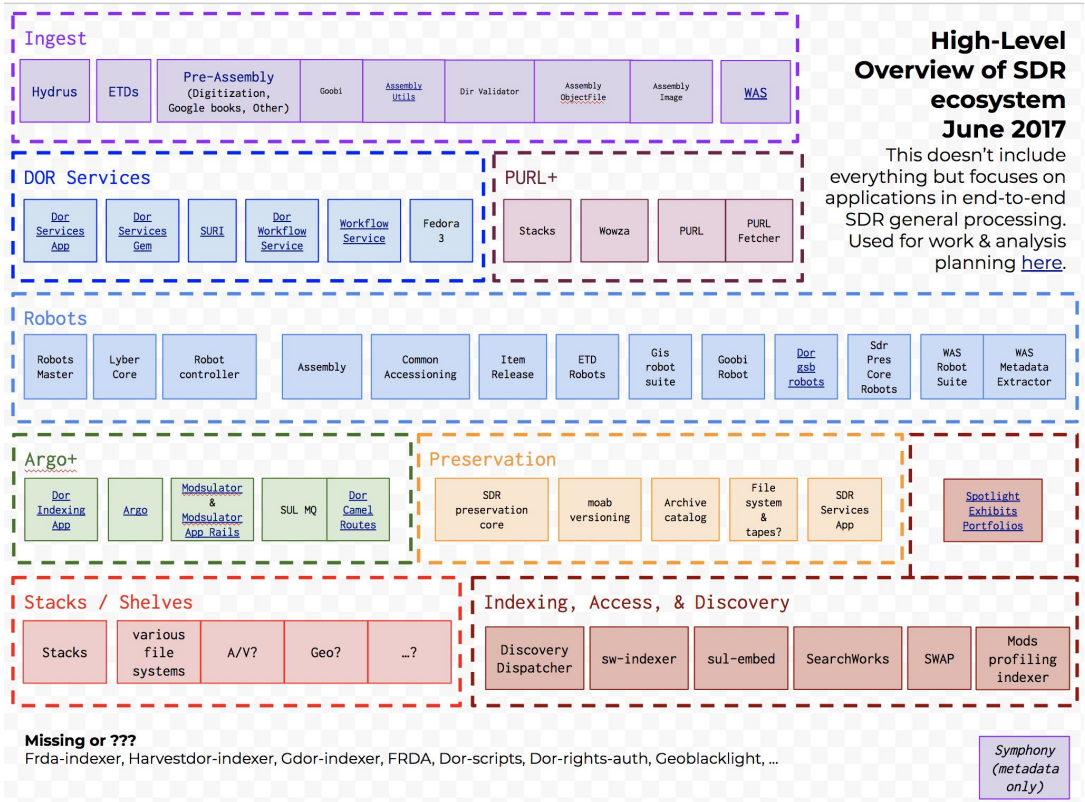
- Share Stanford's recent work on a Fedora 3 replacement, aka TACO
- Go end to end in this API process
  - We aren't experts in any single part of this
  - I'm especially not an expert in any of this
  - We don't want to deep dive today on any particular issue, but share the sum
- Learn enough to discuss Pros / Cons of
  - ReSTful API selection for what parts of our system
  - Data models & validation mechanisms
  - Go as our language selection
  - Docker as our container / deployment unit selection
  - AWS ECS versus local, serverless, other options
- Get feedback from you on our work so far

# Your Goals for this Bootcamp?

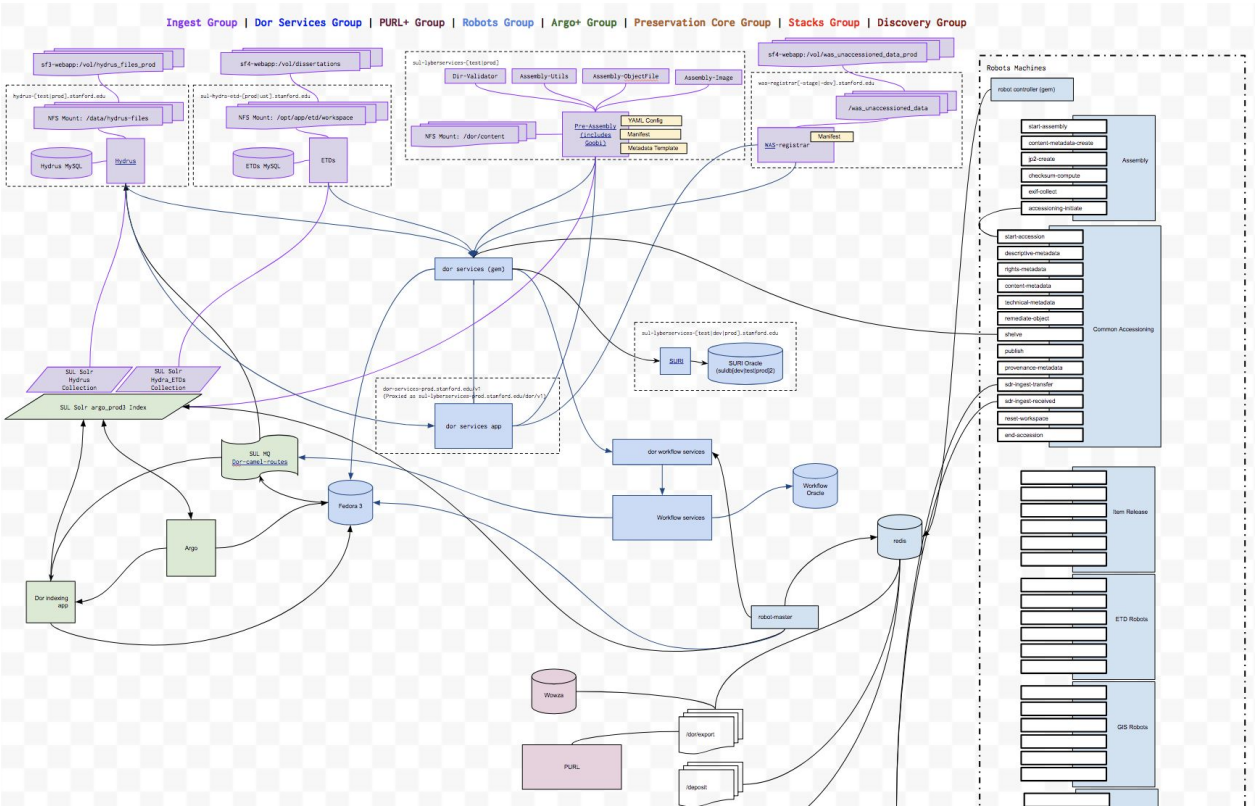
# Some Context: Stanford Digital Repository



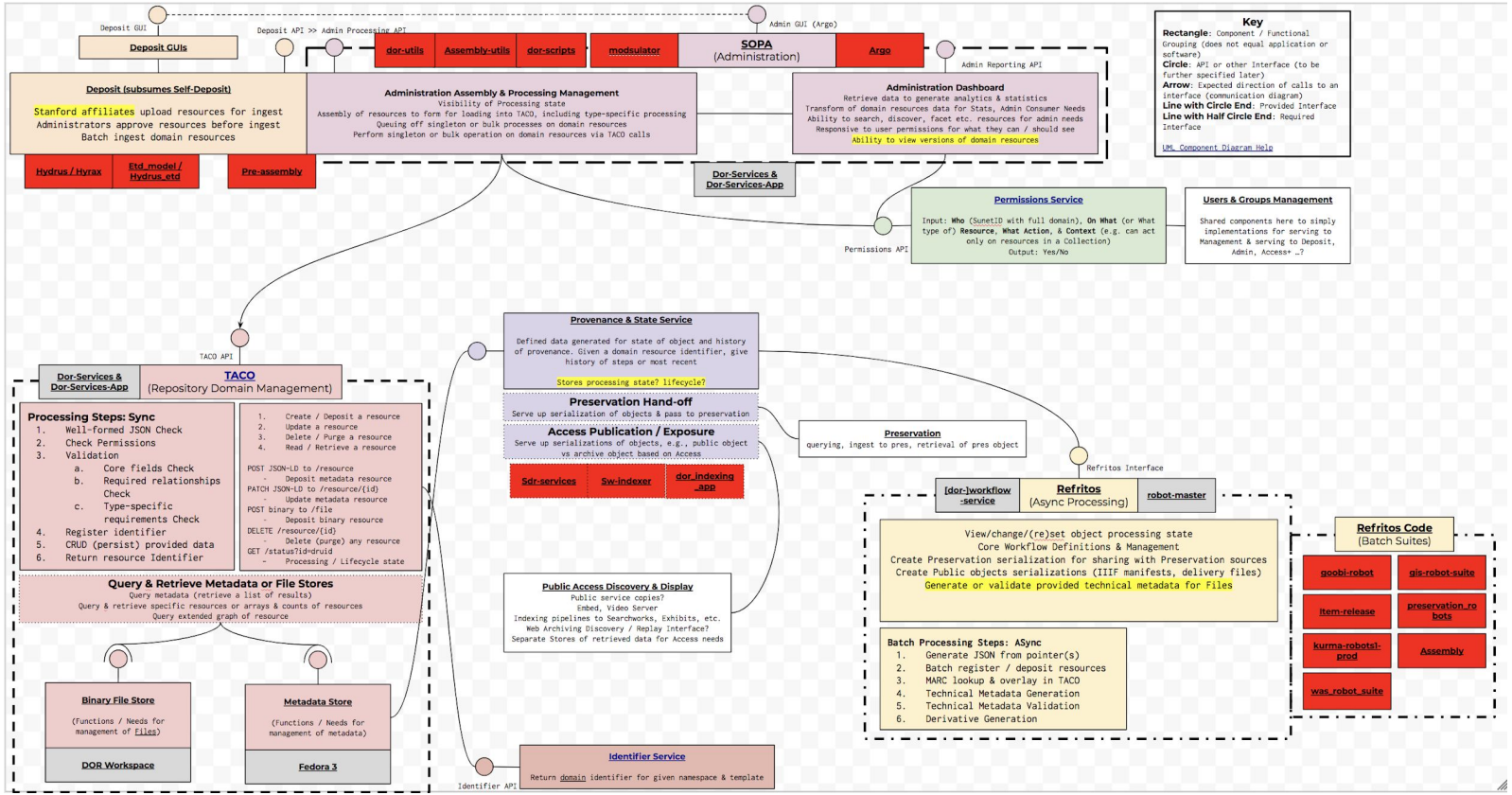
# Stanford Digital Repository



# Stanford Digital Repository



# Stanford Digital Repository Use Case



# Today's Example: TAQUITO (little TACO)

*TAQUITO, a Simple Digital Repository Management Layer API*

*Based on TACO (a prototype & WIP): https://github.com/sul-dlss-labs/taco/*

*TACO is meant to make database selections indepedent from more involved repository business logic*

# For TAQUITO, we will work through...

**ReST API** for the new service interface

**JSON[-LD]** for the service's data representation

**Swagger** for the API specification

**Go** for the service's programming language

**Docker** for deployment

**AWS** for infrastructure (ECS primarily)

# For TAQUITO, we will work through…

**ReST API** for the new service interface

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**Docker** for deployment

**AWS** for infrastructure (ECS primarily)

**… aka A LOT OF STUFF. That we are learning as we go.**

# API Design

# TAQUITO’s contract within our system

What does this TAQUITO API promise to do?

- Really simple / ‘stupid’ CRUD for our core digital repository object models.
- Keep the database selection separate from the rest of the system.
- Manage our canonical metadata & metadata store.

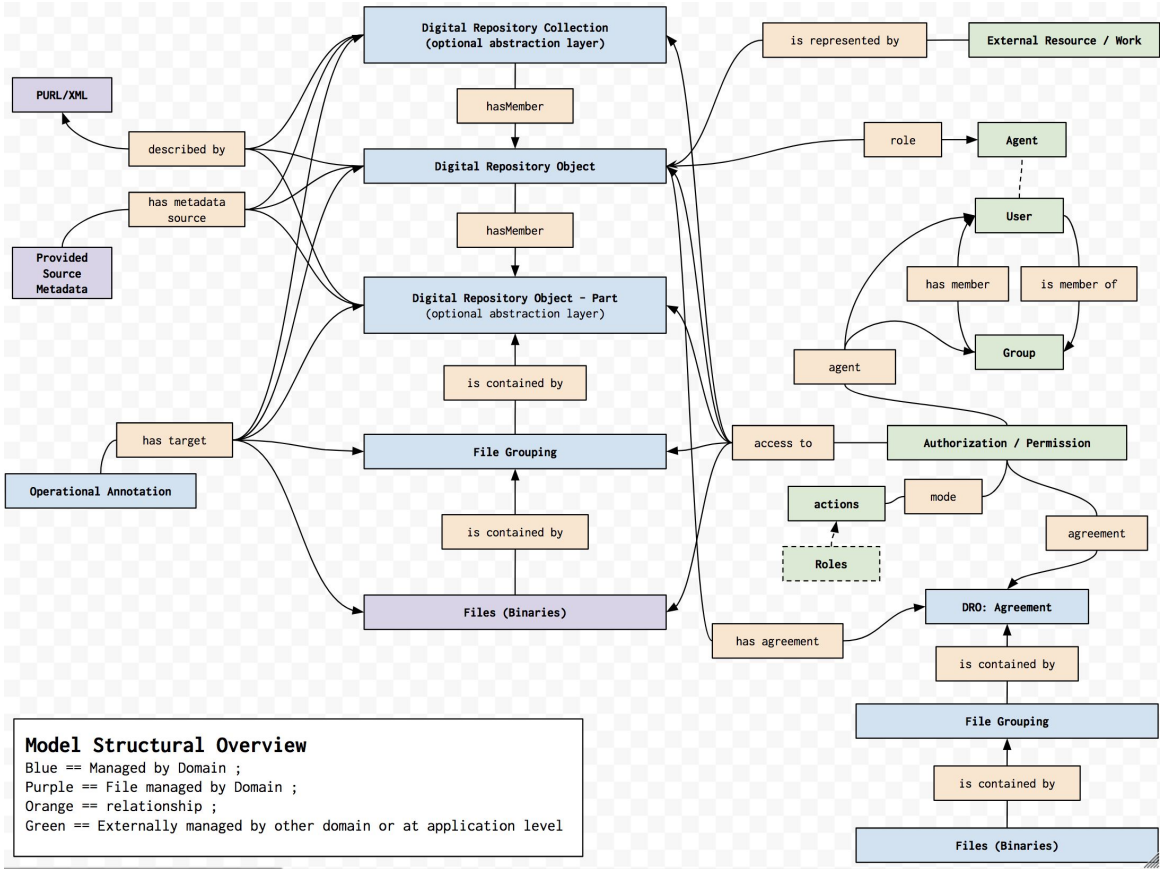
# Representational State Transfer (ReST)

ReST is an architectural style that gives some constraints. These constraints include but are not limited to...

- Uniform Interface
- Stateless
- Cacheable
- Client-Server
- Layered System

We selected ReST here for the ability to work across machines as well as keeping components boundaries clear.

# TAQUITO’s Data Model (leveraging PCDM)



# TAQUITO's Metadata Application Profiles


```
{
    $schema: "http://json-schema.org/draft-06/schema#",
    title: "Digital Repository Object",
    description: "Domain-defined abstraction of a 'work'. Digital Repository Objects' abstraction is describable for our domain's purposes, i.e. for management needs within our system.",
    type: "object",
  - required: [
        "@context",
        "@type",
        "externalIdentifier",
        "label",
        "tacoIdentifier",
        "version",
        "administrative",
        "access",
        "identification",
        "structural"
    ],
  - properties: {
      - @context: {
            description: "URI for the JSON-LD context definitions.",
            type: "string"
        },
      - @type: {
            description: "The content type of the DRO. Selected from an established set of values.",
            type: "string",
          - enum: [
                "http://sdr.sul.stanford.edu/models/sdr3-object.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-3d.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-agreement.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-book.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-document.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-geo.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-image.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-page.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-photograph.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-manuscript.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-map.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-media.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-track.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-webarchive-binary.jsonld",
                "http://sdr.sul.stanford.edu/models/sdr3-webarchive-seed.jsonld"
            ]
        },
```


https://github.com/sul-dlss-labs/sdr3-models/

# TAQUITO Routes

- `POST /resource` : Deposit New TAQUITO Resource.
  operationId: depositResource, consumes JSON or JSON-LD in body
- `PATCH /resource/{ID}` : Update TAQUITO Resource.
  operationId: updateResource, consumes JSON or JSON-LD in body
- `GET /resource/{ID}?version=#` : Retrieve TAQUITO Resource Metadata.
  operationId: retrieveResource, produces: JSON
- `DELETE /resource/{ID}` : Delete a TAQUITO Resource.
  operationId: deleteResource
- `GET /healthcheck` : Health Check.
  operationId: healthCheck

# TAQUITO API Data Models

- Resource (ResourceResponse | DepositResource)
  - Relation to our Data Models & MAPs
  - Relation to JSON, JSON Schema
- Agent
  - For Permissions more than Authorization
  - Logging information like Depositor
- Sequence
  - Handing multiple orders of resources
- HealthCheckResponse
- ErrorResponse
- Error

# Quick Introduction to Swagger / OpenAPI

OpenAPI Specification (formerly, Swagger) is API description format or API definition language. Basically, OpenAPI Specifications let you describe:

- General information about the API
- Available paths (/resources)
- Available operations on each path (get /resources)
- Input/Output for each operation

OpenAPI / Swagger is a subset (though not entirely faithful) of JSON Schema.

# TAQUITO SimpleDev Swagger Walk Through

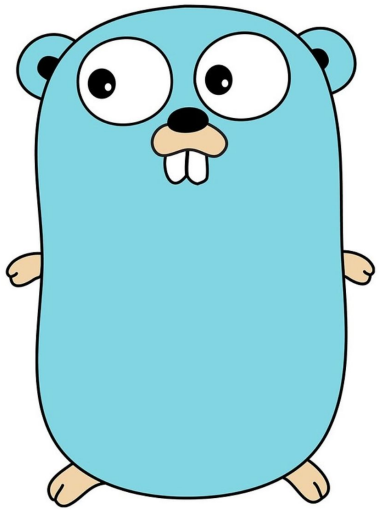
Take a few minutes
to find, review &
add update &
delete routes to our
Swagger Spec.

# Coffee Break (10 minutes)

# Development

# Go quick intro

- Go is a concurrent programming language introduced by Google in 2009
- Originally developed as a language for servers, but has grown to have a more general purpose
- “Go is a statically typed compiled language in the tradition of C” (thanks wikipedia)
- It is fast(er than ruby, but still fast) hence our usage



# Check Your Go Development Environment

1. Install go (I hope already done!).
2. Setup your Go workspace (where your Go code, binaries, etc. are kept together. See some helpful docs here):

```
$ mkdir -p ~/go
$ export GOPATH=~/go
$ export PATH=~/go/bin:$PATH
$ cd ~/go
```

3. Go code repositories will reside within `~/go/src/...` in `$GOPATH`. Name these paths to avoid library clash, for example Bootcamp Go code could be in `~/go/src/github.com/cmh2166/elag18apis`

# 2 Go Projects in Our Repo in Your Workspace

In our repository, we have 2 go projects:

- **`simpleDev`** just lets us get a handle on Swagger & Go-Swagger
- **`taquito`** is a stripped down version of TACO

Start with **`simpleDev`** first
(go ahead & cd into that directory)

# Populate SimpleDev’s Dependencies

Handle Go project dependencies with the Go `dep` package:

1. Install Go Dep via `brew install dep` then `brew upgrade dep` (if Mac OSX)
2. If your project's `Gopkg.toml` & `Gopkg.lock` aren’t populated, add an inferred list of dependencies via `dep init`.
3. If your project has those files populated, sync dependencies via `dep ensure`.
4. To add new dependencies, run `dep ensure -add github.com/pkg/errors`.
5. This adds dependency & put new dependency in your `Gopkg.*` files.

# Populate SimpleDev's Dependencies

```
## Install Go Dep via (if Mac OSX)

$ brew install dep
$ brew upgrade dep

## Add an inferred list of dependencies via

$ dep init
$ dep ensure

add new dependencies, run

$ dep ensure -add github.com/pkg/errors
```

Take a few minutes to check your simpleDev workspace & install dependencies.

# SimpleDev's Swagger Spec & Go-Swagger

The API code is generated from `swagger.json` using `go-swagger` library. You'll need to install `go-swagger` (for Mac OSX):

```
$ brew tap go-swagger/go-swagger
$ brew install go-swagger
$ brew upgrade go-swagger
```

This should give you the `swagger` binary command in your `$GOPATH` and allow you to manage versions better. Try running swagger validation then docs generation:

```
$ swagger validate swagger.json
$ swagger serve swagger.json
```

# SimpleDev's Swagger Spec & Go-Swagger

Now generate the start of our API code from our Swagger spec by running:

```
$ git rm -rf generated
$ mkdir generated
$ swagger generate server -t generated --exclude-main --principal
    authorization.Agent
```

(there appears to be no best way to handle specification-based re-generation of the `generated/` API code)

# Generated Code Deep Dive

Add info / pointers to the generated code to explain:

- `Models` (leveraging JSON Schema to become Go structs with validation functions and marshal/unmarshal interfaces)
- Configurations for the server
- `Operations` (based off the routes, operation per route & action)
  - OperationName
  - URL Builder
  - Responses
  - Parameters
- Operation for Primary API

Take a few minutes to validate your Swagger.json & generate your Go code from Swagger.

# Write main.go

`func main()` actually runs the server

`func createServer(port int) *restapi.Server` takes that Server instance, and add ours handlers (which then are called by the handlers generated for each route with the Swagger-generated portion)

# Our SimpleDev Deposit Handler

*Note: Deposit doesn't actually persist that metadata yet, it just prints it out to stdout.*

`Handler` files are what run for each Handler / route.

We put interfaces in front of them to help pass any server-wide context (like database connections) to these handlers.

You have generated code to help with data models, HTTP call Params, & responses.

# Running the simpleDev Go Code

Running the Go Code locally without a build / binary:

```
$ go run main.go
```

Build Go binary for the local OS & Running that binary:

```
$ go build -o simpleDev main.go
$ ./simpleDev
```

Take a few minutes to add a simple stupid stub Return handler (with static data) & test run.

Move to TAQUITO now (go ahead & cd into that directory)

# TAQUITO has infrastructure (database) ideas

- AWS DynamoDB for our JSON metadata
- To then do local development, we need localstack (hoping you have this installed!)
- awscli (aws) can use profiles to point to localstack for querying it directly (or you can use awslocal)
- Go AWS SDK for our Handler code to connect to DynamoDB

# Side Note: Why DynamoDB?

- Something simple & fast (simple being relative)
- Anecdotally, best up-time
- AWS SDK for Go already existed
- RDS (AWS) / PostGRES (local) is our fall back plan

Amazon DynamoDB

# Using LocalStack with TAQUITO

```
## Start localstack & leave this running in terminal

$ SERVICES=dynamodb localstack start

## In new terminal, Make Localstack resources

$ make resources

## You can now interact with Localstack DynamoDB

$ aws --endpoint-url=http://localhost:4569 dynamodb list-tables

$ awslocal dynamodb describe-table --table-name 'resources'
```

Take a few minutes
to run LocalStack
with DynamoDB.

# TAQUITO Deep Dive: Main.go / Server.go

# TAQUITO Deep Dive: “Full” Handlers

# TAQUITO Deep Dive: Internal Services (Identifier, Permissions)

# TAQUITO Deep Dive: Data is Hard (aka what validation where & validators)

Take some time to generate dependencies, start TAQUITO & call some routes using cURL.

# Notes on this TAQUITO Development

- Testing
- Middleware
- Validators
- Database interface

Lunch Break (60 minutes)

# Infrastructure & Deployment: Docker

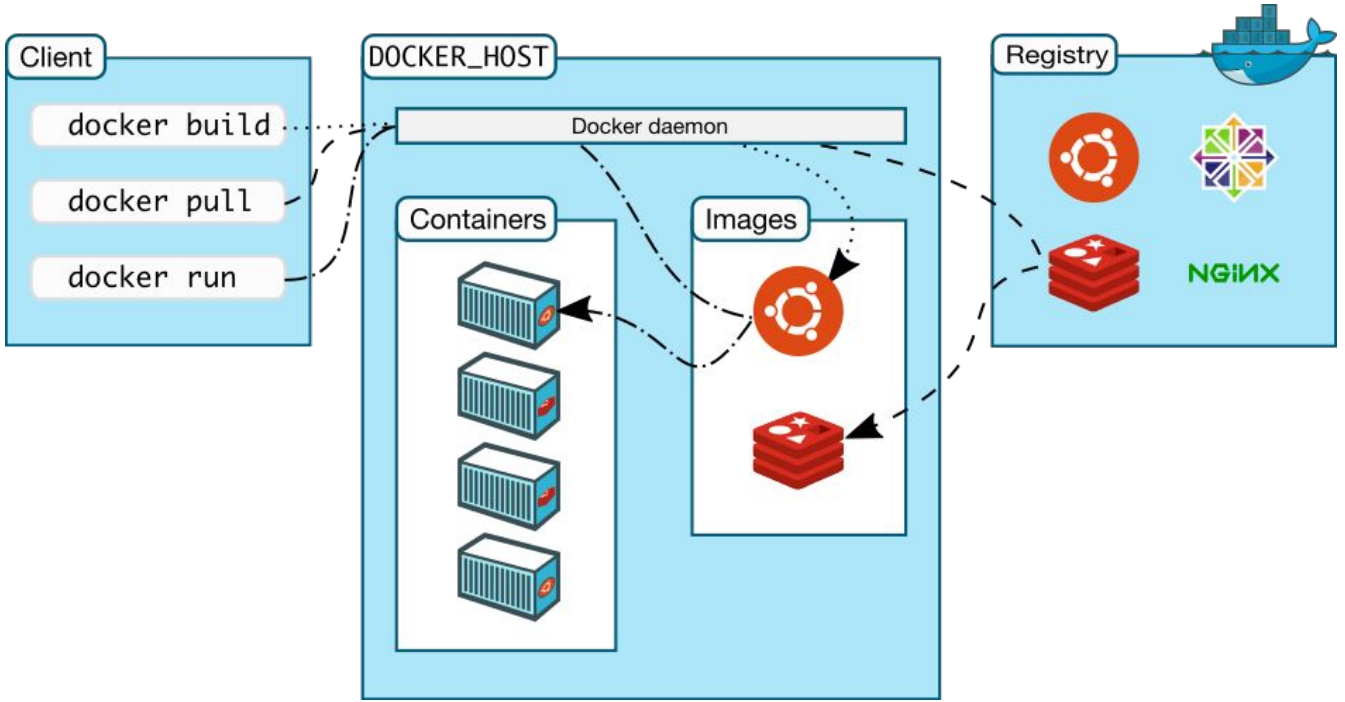
# Docker quick intro

“Docker is an open platform for developing, shipping, and running applications. Docker enables you to separate your applications from your infrastructure so you can deliver software quickly.”

“Docker provides the ability to package and run an application in a loosely isolated environment called a container. The isolation and security allow you to run many containers simultaneously on a given host. Containers are lightweight because they don’t need the extra load of a hypervisor, but run directly within the host machine’s kernel.”

https://docs.docker.com/engine/docker-overview

# Docker quick intro

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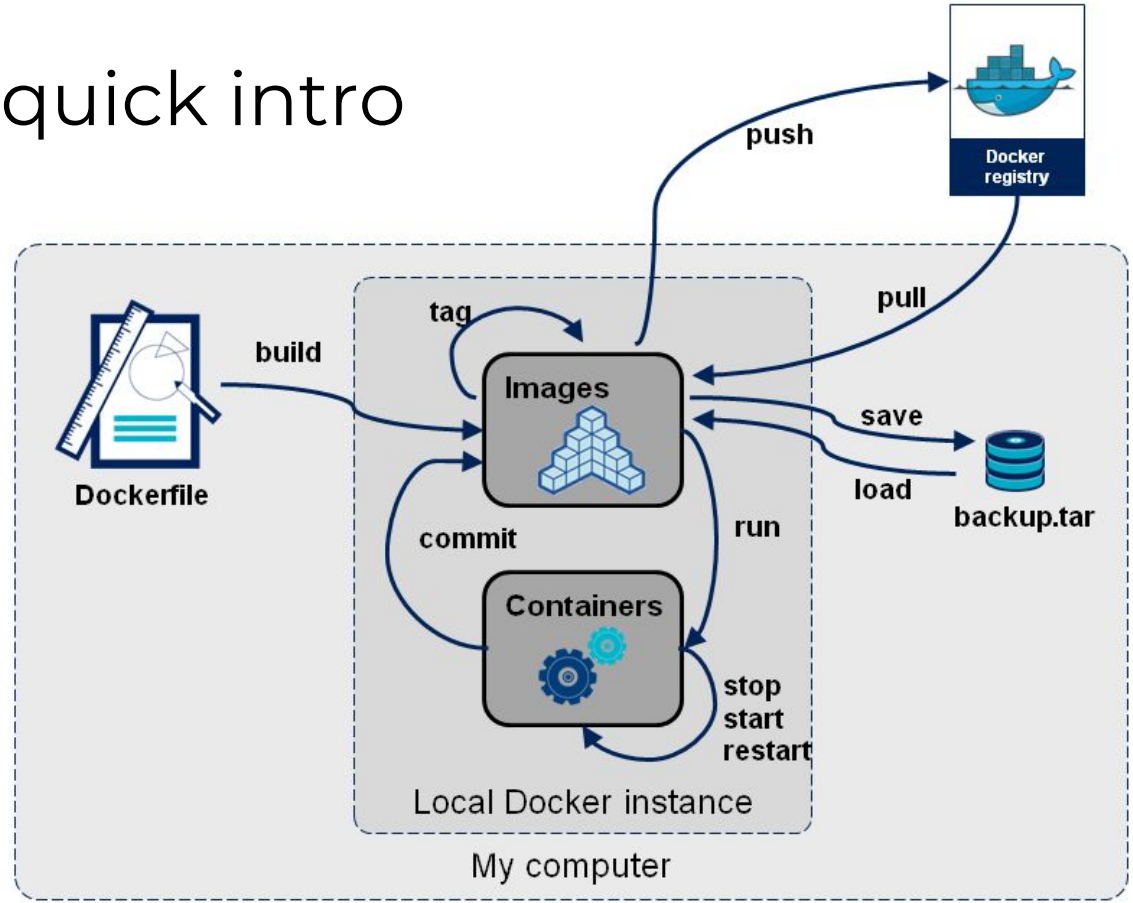
# Docker quick intro




https://stackoverflow.com/questions/23735149/what-is-the-difference-between-a-docker-image-and-a-container

# Docker quick intro

```
## List Docker CLI commands
docker
docker --help
docker container --help

## Display Docker version and info
docker --version
docker version
docker info
```

# Docker quick intro

```
## Execute Docker image
docker run hello-world

## List Docker images
docker image ls

## List Docker containers (running, all, all in quiet mode)
docker container ls
docker container ls --all
```

# Build our Docker container

```
FROM golang:alpine as BASE
WORKDIR /go/src/github.com/sul-dlss-labs/taco
COPY . .
RUN apk update && apk add --no-cache ca-certificates && \
   apk add --no-cache --virtual .build-deps git && \
   go get -u github.com/golang/dep/cmd/dep && \
   dep ensure && \
   apk del .build-deps
RUN CGO_ENABLED=0 GOOS=linux go build -ldflags "-s" [...] main.go
```

# Build our Docker container

```
FROM scratch
EXPOSE 8080
COPY --from=BASE /etc/ssl/certs/ca-certificates.crt
/etc/ssl/certs/
COPY --from=BASE /go/src/github.com/sul-dlss-labs/taco/api .
CMD ["./api"]
```

# Build our Docker container

```
## Build TACO Docker image
docker build -t taco .


## With a configured AWS cli, run the image
docker run -p 8080:8080 taco


## cURL the running container
curl http://localhost:8080/v1/healthcheck
```

Take a few minutes to build & run your docker container, then do simple test calls with cURL.

# Bonus Points: Getting Docker to talk with Localstack - how would you do it?

# Some Notes on TACO’s Deployment

- Circle-CI usage
- Docker-compose used for local testing
- Docker set-ups able to:
  - Run with localstack in its own container
  - Run with access to localstack’s endpoints on local machine
- Continuous Deployment via Docker Registry & GitHub repository branches management & tagging

# Coffee Break (10 minutes)

# Infrastructure & Deployment: AWS

# AWS Infrastructure Needs

So we know we need in AWS:

- ECS with appropriate task loaded
- DynamoDB with appropriate indices
- IAM Policies / Roles for the two to talk

Then after building that, we need a way to deploy our Docker container to that ECS cluster and test it.

# Overview of the following steps

- Check your AWS Environment
- Check you are an admin (you should have done this already for AWS setup)
- Review our ECS Task
- Create an appropriate security group
- Create a cluster
- Launch a container instance
    - Select an AMI, t2.micro (*free tier eligible)
    - Check configurations, make sure its in your subnet, security group, etc.

# Set up our AWS Environment

```
aws --version
## See your profiles via ~/.aws/config
aws [--profile profile-name] configure list
aws [--profile profile-name] ecs list-clusters
```

# Set up ECS Cluster & Service

- Go through the steps in /aws directory in GitHub repository

# AWS Deployment

```
## Update the service

aws ecs update-service --cluster "$cluster_arn" --service taco
--task-definition "$revision_arn" --region us-east-1
```

# Notes on TACO’s Infrastructure

- Terraform
- CircleCI (again)
- Continuous Deployment via ECS setup

# Conclusion & Retro

# Mini-Retro or Plus / Delta on this Bootcamp

| Pros (what you appreciated) | Deltas (what you would change) |
| --- | --- |
| | |

Share your take-aways or feedback on our work so far?

# Thanks!