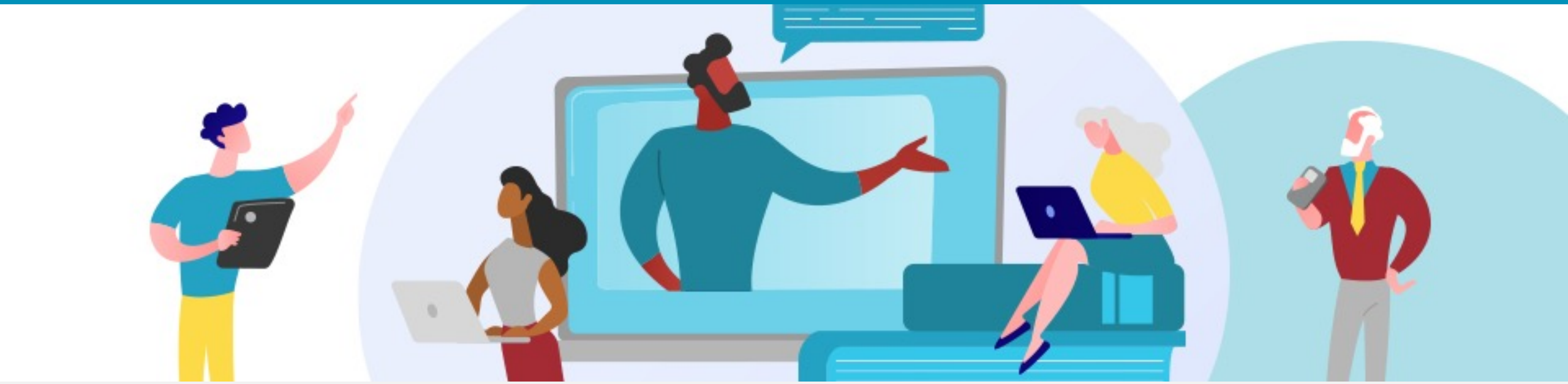
Let's Build: Create an Implementation Guide with FHIR Shorthand

Mark Kramer and Chris Moesel, MITRE Corporation



HL7 FHIR DevDays 2021, Virtual Edition, June 7–10, 2021 | @HL7 | @FirelyTeam | #fhirdevdays | www.devdays.com

ORGANIZED BY

PARTNER

Mark Kramer

- Chief Engineer, MITRE Health Innovation Center

Chris Moesel

- Principal Software Systems Engineer

MITRE

Not-for-profit R&D institution working in the public interest and funded by the US government

INFERNO

mCODE™

SYNTHEA

Clinical Quality Language

FHIR® Shorthand™

Track overview: Let's Build a FHIR specification

Monday	Tuesday	Wednesday	Thursday
Introduction to FHIR 11:00 – 11:45	Introduction Profiling 1:00 – 1:45	Accelerating your IG production 1:00 – 1:45	FHIR Registry & Packages 1:00 – 1:45
	Profiling with Forge 2:15 – 3:00	IG with IG Publisher 2:15 – 3:00	Publishing with Simplifier.net 2:15 – 3:00
	Create an IG with FHIR Shorthand 3:15 – 4:00		Advanced FHIR Shorthand and Tools 3:15 – 4:00
	Create an IG with FHIR Shorthand 4:15 – 5:00		

You are here

Prepare for Let's Build

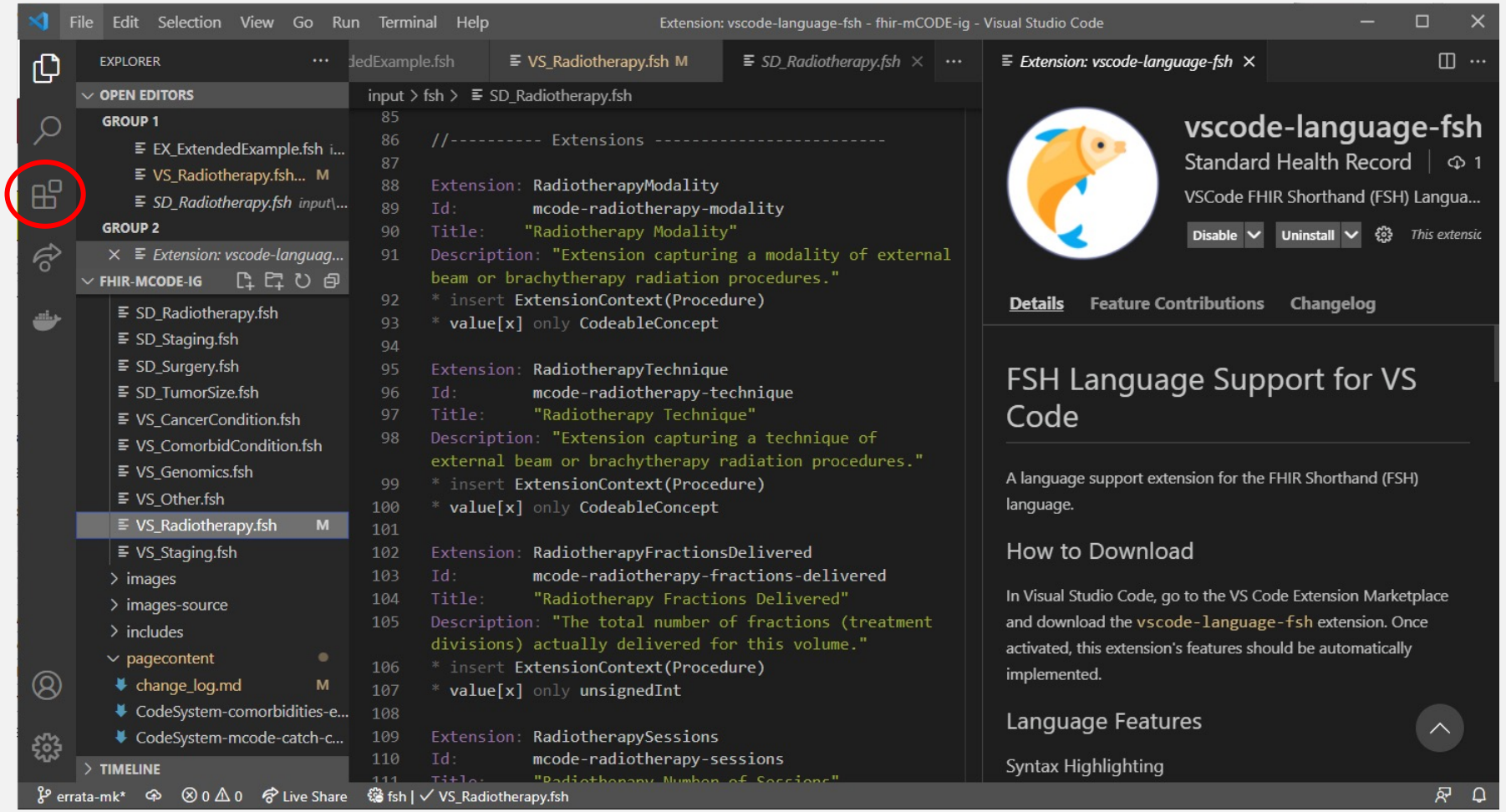
1. Install **Node.js LTS** edition from https://nodejs.org/

2. Install **SUSHI** and **GoFSH**
   - Open a terminal and run: **`npm install -g fsh-sushi`**
   - Open a terminal and run: **`npm install -g gofsh`**

3. Install **VS Code** (if text editor is needed)
   - https://code.visualstudio.com/download
   - Install the VS Code extension for FSH: vscode:extension/kmahalingam.vscode-language-fsh

(Optional) Visual Studio Code: Text Editor for **.fsh** Files

plug-in for .fsh files



Let's Build using FSH

How to Produce an IG Using FHIR Shorthand

1. Install SUSHI
2. Create a new project
3. Author your FSH
4. Run SUSHI
5. Download or Update IG Publisher
6. Run IG Publisher

1. Install SUSHI

To install SUSHI:

- First install **Node.js LTS** edition from https://nodejs.org/
- Open a terminal and run: **`npm install -g fsh-sushi`**

See https://fshschool.org/docs/sushi/installation/ for additional details.

2. Initialize your IG Project

- Open command prompt
- Choose a parent directory
- Run `sushi -i`

```
MyIG
├── ig.ini
├── sushi-config.yaml
├── input
│   ├── fsh
│   │   └── patient.fsh
│   ├── ignoreWarnings.txt
│   └── pagecontent
│       └── index.md
├── _genonce.bat
├── _genonce.sh
├── _updatePublisher.bat
├── _updatePublisher.sh
└── .gitignore
```

If script downloads are blocked by firewall, download them from https://github.com/HL7/ig-publisher-scripts

3. Create your FSH Sources

- For expedience, copy from the FSH Online example
- Replace the contents of /input/fsh/patient.fsh (the file name does not matter)

https://bit.ly/3yLJjxY →

```
Profile: CovidDiagnosis
Parent: Condition
Description: "How to report COVID"
* code = $icd#U07.1
* severity from CovidSeverityVS (required)
* subject only Reference(Patient)
* extension contains ConditionCertainty named certainty 0..1 MS

Alias: $icd = http://hl7.org/fhir/sid/icd-10-cm

ValueSet: CovidSeverityVS
Description: "Values for COVID severity"
* include codes from valueset http://hl7.org/fhir/ValueSet/condition-severity
* include $sct#442452003 "Life threatening severity (qualifier value)"

Alias: $sct = http://snomed.info/sct

Instance: DiagnosisExample
InstanceOf: CovidDiagnosis
* subject.reference = "Patient/JaneDoe"
* code = $icd#U07.1
* severity = $sct#24484000 "Severe"

Instance: JaneDoe
InstanceOf: Patient
* name.family = "Doe"
* name.given = "Jane"

Extension: ConditionCertainty
Description: "The certainty of diagnosis"
* value[x] only CodeableConcept
* value[x] from ConditionCertaintyVS

ValueSet: ConditionCertaintyVS
Description: "Degree of confidence the condition is present"
* $sct#415684004  "Suspected (qualifier value)"
* $sct#410592001  "Probably present (qualifier value)"
* $sct#41060500   "Confirmed present (qualifier value)"
```

4. Run SUSHI

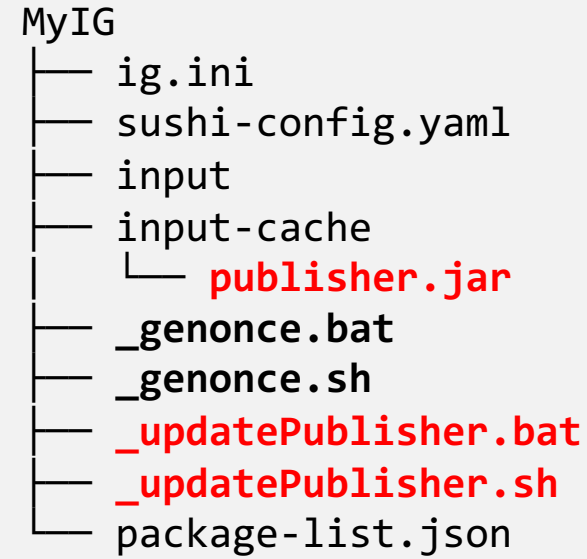
- Open command prompt
- Change to your IG directory
- Run `sushi`

- Fix any errors and re-run before the next step

```
info  Converting FSH to FHIR resources...
info  Converted 2 FHIR StructureDefinitions.
info  Converted 2 FHIR ValueSets.
info  Converted 2 FHIR instances.
info  Exporting FHIR resources as JSON...
info  Exported 6 FHIR resources as JSON.
info  Assembling Implementation Guide sources...
info  Generated ImplementationGuide-fhir.example.json
info  Assembled Implementation Guide sources; ready for IG Publisher.

SUSHI RESULTS

| Profiles | Extensions | ValueSets | CodeSystems | Instances |
|----------|------------|-----------|-------------|-----------|
|    1     |     1      |     2     |      0      |     2     |

Well hooked and landed!                    0 Errors      0 Warnings
```

5. Download or Update Publisher

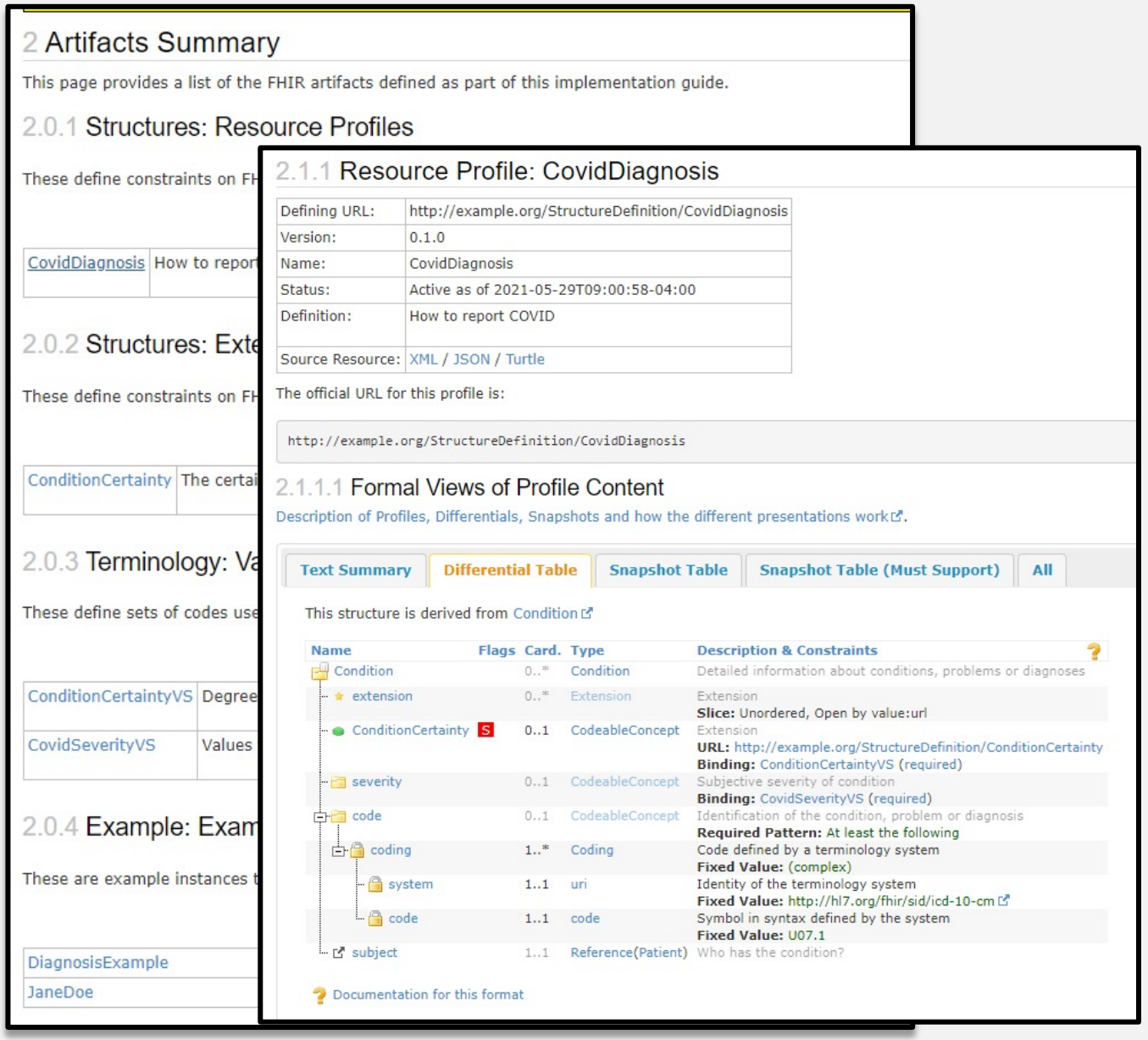
- Open command window
- run _updatePublisher script
  - Wait for ~100 MB download



If blocked by firewall, download directly from https://github.com/HL7/fhir-ig-publisher/releases/latest/download/publisher.jar

6. Run the IG Publisher

- In command window, run _genonce
- When run completes, open /output/index.html



Improve your IG

- Add more FSH
  - One or more files
- Add Narrative Content
  - Edit /input/pagecontent/*.md
- Customize menus
  - sushi-config.yaml
  - https://fshschool.org/docs/sushi/configuration/
- Create a github repository and share your work

```
MyIG
├── ig.ini
├── sushi-config.yaml
├── fsh-generated
├── input
│   ├── fsh
│   │   └── patient.fsh
│   ├── ignoreWarnings.txt
│   └── pagecontent
│       └── index.md
├── output
├── _genonce.bat
├── _genonce.sh
├── _updatePublisher.bat
├── _updatePublisher.sh
└── .gitignore
```

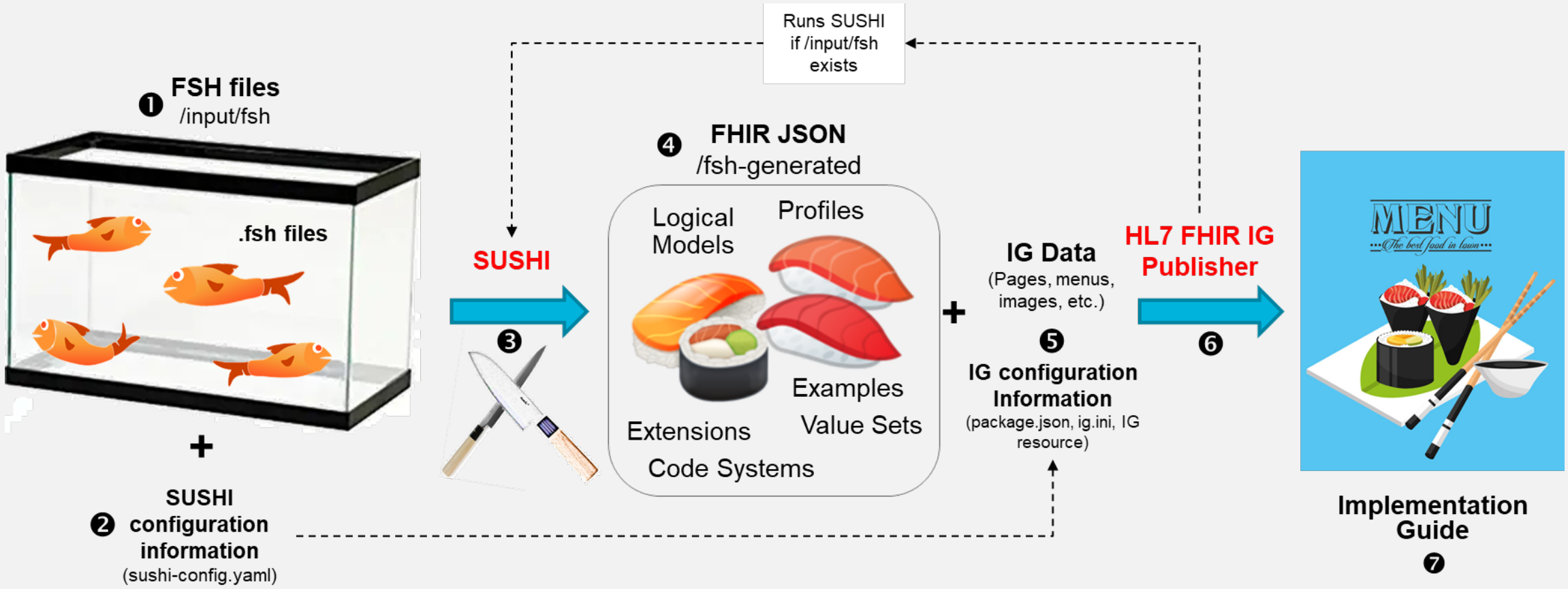
Configuration File: sushi-config.yaml

Include in top level project directory:

```yaml
id: fhir.example
canonical: http://hl7.org/fhir/example
name: ExampleIG
title: "Example IG Version 0.1.0"
description: "An example IG that demonstrates FSH grammar"
status: draft
license: CC0-1.0
version: 0.1.0
fhirVersion: 4.0.1
copyrightYear: 2020+
releaseLabel: ci-build
dependencies:
  hl7.fhir.us.core: 3.1.0
```

See https://fshschool.org/docs/sushi/configuration/

Overview: Creating an IG with FSH



Credits: Sushi clipart from Google and WhatsApp rendering of Unicode 6.0 sushi emoji, Sushi menu from PNGWave, Non-Commercial Use, no attribution required (https://www.pngwave.com/png-clip-art-oxcer)

Convert an Existing IG to FSH using GoFSH

General Tips:

- Conversion to FSH works best on a clean IG (few errors on QA report)
  - Use the JSON IG package downloaded from the published IG
  - Use the artifacts in the **`/output`** folder after running the IG Publisher
  - Use the sources in Github
- GoFSH and SUSHI will often find latent problems
- GoFSH may not be 100% perfect in all cases (but it is getting there)

Convert an Existing IG using GoFSH

1. Install GoFSH
2. Create a local copy of the IG
3. Run GoFSH and correct any problems
4. Run SUSHI and correct any problems
5. Replace IG sources with FSH files
6. Run IG Publisher

1. Install GoFSH

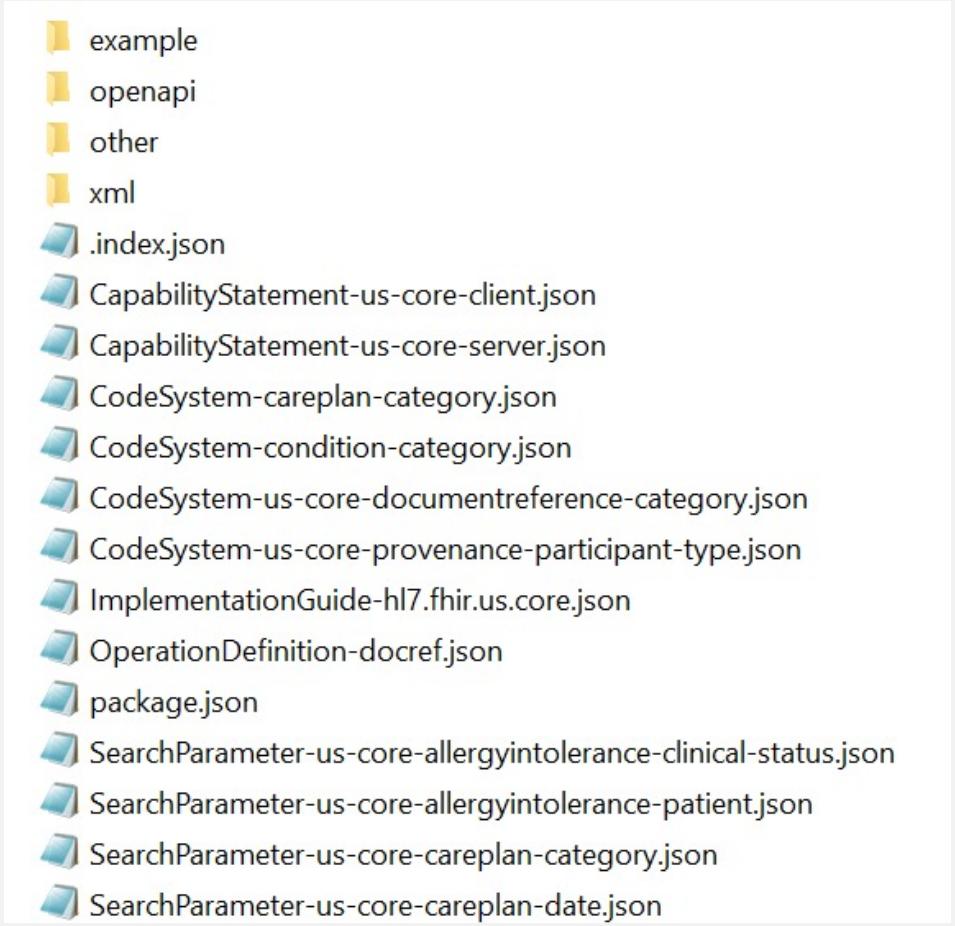
- Open a terminal window and run: **`npm install -g gofsh`**

(If you haven't, first install **Node.js LTS** edition from https://nodejs.org/)

2. Create a Local Copy of the IG

- Let's convert the US Core IG
- Download the US Core versioin 3.2 Package:

  http://hl7.org/fhir/us/core/2021Jan/downloads.html
- Unzip to a new directory



3. Run GoFSH and Correct Any Errors

- Review optional arguments: **`gofish -h`**
- Run (for example): **`gofsh -s file-per-definition`**
- A **`/gofsh`** directory will be created:
  - **`/input`** contains all generated definitions and examples
  - **sushi-config.yaml** -- needed for running sushi

3. Run GoFSH and Correct Any Errors

```
error Encountered profile with a duplicate name, USCoreRespiratoryRateProfile, which
GoFSH cannot make unique. Fix the source file to resolve this error or update the
resulting FSH definition.
```

```
Profile: USCoreRespiratoryRateProfile
Parent: USCoreVitalSignsProfile
Id: us-core-bmi
Title: "US Core BMI Profile"
```


```
Profile: USCoreBMIProfile
Parent: USCoreVitalSignsProfile
Id: us-core-bmi
Title: "US Core BMI Profile"
```

Typical Generated FSH File

USCore Condition in FSH

```
Profile: USCoreCondition
Parent: Condition
Id: us-core-condition
Title: "US Core Condition Profile"
Description: "Defines constraints and extensions on the Condition resource for the minimal set of data to query and retrieve concerns information."
* ^version = "3.2.0"
* ^status = #active
* ^experimental = false
* ^date = "2020-06-27"
* ^publisher = "HL7 International - US Realm Steering Committee"
* ^contact.name = "HL7 International - US Realm Steering Committee"
* ^contact.telecom.system = #url
* ^contact.telecom.value = "http://www.hl7.org/Special/committees/usrealm/index.cfm"
* ^jurisdiction = urn:iso:std:iso:3166#US
* ^copyright = "Used by permission of HL7 International, all rights reserved Creative Commons License"
* obeys us-core-1
* . ^definition = "The US Core Condition Profile is based upon the core FHIR Condition Resource and created to meet the 2015 Data Set 'Problems' and 'Health Concerns' requirements."
* . ^constraint[8].extension.url = "http://hl7.org/fhir/StructureDefinition/elementdefinition-bestpractice"
* . ^constraint[=].extension.valueBoolean = true
* . ^mustSupport = false
* clinicalStatus 0..1 MS
* clinicalStatus only CodeableConcept
* clinicalStatus from ConditionClinicalStatusCodes (required)
* verificationStatus 0..1 MS
* verificationStatus only CodeableConcept
* verificationStatus from ConditionVerificationStatus (required)
* category 1..* MS
* category only CodeableConcept
* category from $us-core-condition-category (extensible)
* category ^short = "problem-list-item | encounter-diagnosis | health-concern"
* category ^condition = "us-core-1"
* code 1..1 MS
* code only CodeableConcept
* code from USCoreConditionCode (required)
* code ^binding.description = "Valueset to describe the actual problem experienced by the patient"
* subject 1..1 MS
* subject only Reference(USCorePatientProfile)
```

(Optional) Check Translation with FSHing Trip

- FSHing Trip is a round-trip analysis, JSON → FSH → JSON, to validate the correctness of the generated FSH
- Use the GoFSH `-f` option

FSHing Trip JSON Comparison

```
"differential": {
  "element": [
    {
      "id": "Condition",
      "path": "Condition",
      "definition": "The US Core Condition Profile is based upon the core FHIR Condition Resource and crea
      "constraint": [
        {
          "extension": [
            {
              "url": "http://hl7.org/fhir/StructureDefinition/elementdefinition-bestpractice",
              "valueBoolean": true
            }
          ],
          "key": "us-core-1",
          "severity": "warning",
          "human": "A code in Condition.category SHOULD be from US Core Condition Category Codes value set
          "expression": "where(category.memberOf('http://hl7.org/fhir/us/core/ValueSet/us-core-condition-c
          "xpath": "(no xpath equivalent)"
        }
      ],
      "mustSupport": false,
      "mapping": [
-103,15 +115,8 @@
    },
    {
      "id": "Condition.clinicalStatus",
      "path": "Condition.clinicalStatus",
      "min": 0,
      "max": "1",
      "type": [
        {
          "code": "CodeableConcept"
        }
      ],
      "mustSupport": true,
```

```
  "differential": {
    "element": [
      {
        "id": "Condition",
        "path": "Condition",
        "definition": "The US Core Condition Profile is based upon the core FHIR Condition Resourc
        "constraint": [
          {
+           "key": "us-core-1",
+           "severity": "warning",
+           "human": "A code in Condition.category SHOULD be from US Core Condition Category Codes
+           "expression": "where(category.memberOf('http://hl7.org/fhir/us/core/ValueSet/us-core-c
+           "xpath": "(no xpath equivalent)",
+           "source": "http://hl7.org/fhir/us/core/StructureDefinition/us-core-condition",
            "extension": [
              {
                "url": "http://hl7.org/fhir/StructureDefinition/elementdefinition-bestpractice",
                "valueBoolean": true
              }
+           ]
          }
        ],
        "mustSupport": false,
        "mapping": [

      },
      {
        "id": "Condition.clinicalStatus",
        "path": "Condition.clinicalStatus",
        "mustSupport": true,
```

re-ordered statements

new statement

unnecessary statements

4. Run SUSHI and Correct Any Problems

- In terminal window, run **`sushi`**
- SUSHI will flag data type and other errors
- The file name and line number will be reported

```
error Cannot bind value set to xhtml; must be coded (code, Coding, CodeableConcept, Quantity, CodeableReference),
 or the data types (string, uri).
  File: C:\Users\mkramer\Documents\GitHub\us-core-3.2-package\gofsh\input\fsh\USCoreCarePlanProfile-Profile.fsh
  Line: 22
```

```
22    * text.div from NarrativeStatus (required)
```

it is illegal to bind a value set to an xhtml element

element definition invariants:

eld-11	Rule	(base)	Binding can only be present for coded elements, string, and uri

5. Move FSH files into IG

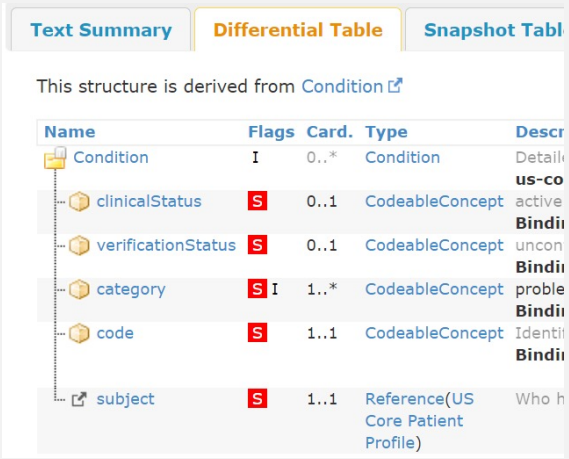
- Clone a copy of the US Core github sources
  - https://github.com/HL7/US-Core.git
  - Use git clone command or Github desktop
- Remove the current definition sources: **`/input/examples`** and **`/input/resources`**
- Copy your **/fsh** folder into the **/input** folder of the IG

6. Run the IG Publisher

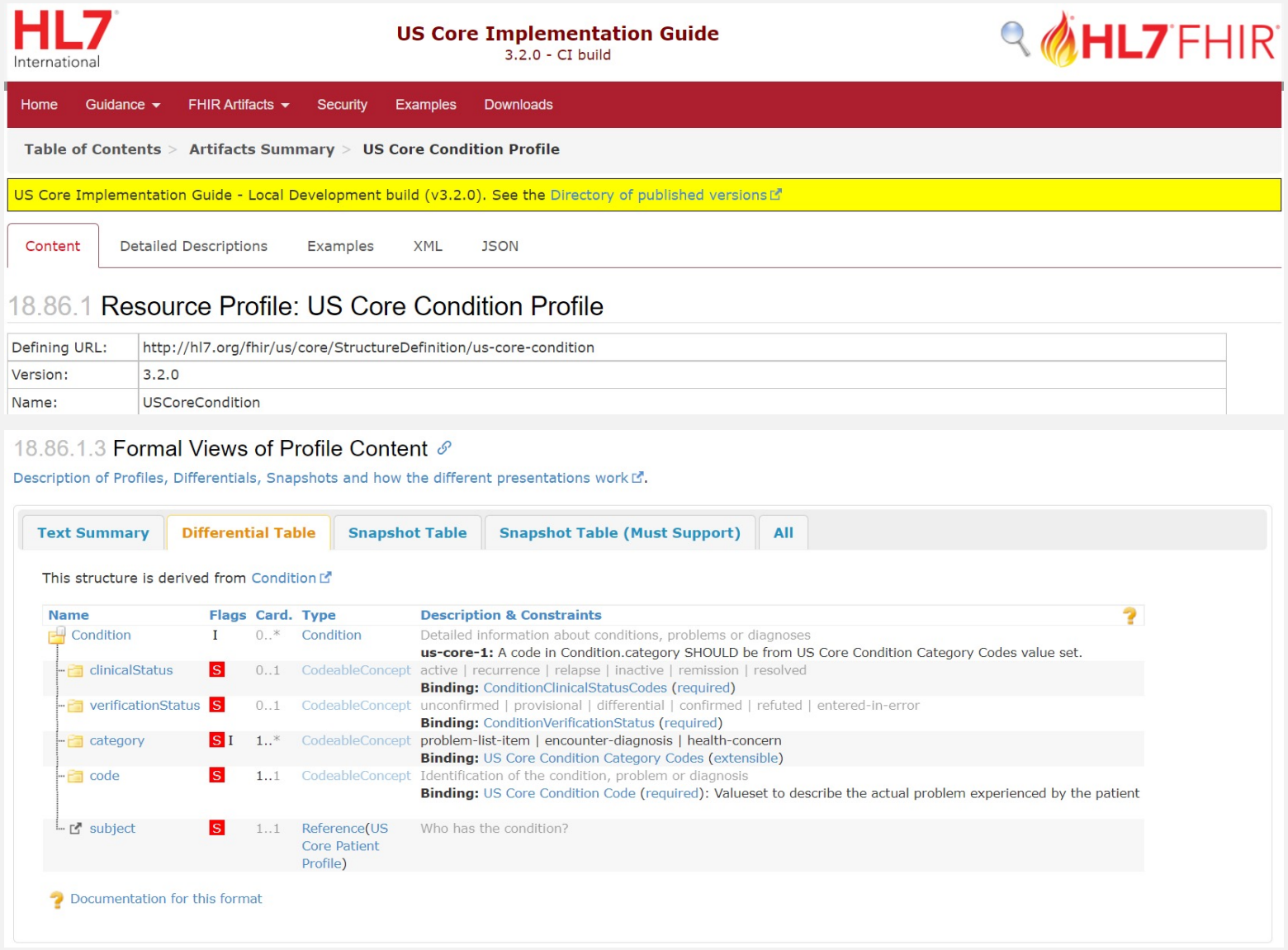
- Get the publisher scripts and publisher.jar are present (using instructions on previous slide)
- Run **_genonce**
- When complete, open **/output/index.html**

Result: US Core IG produced from FSH sources

US Core 3.2.0



Bonus points: See any differences?



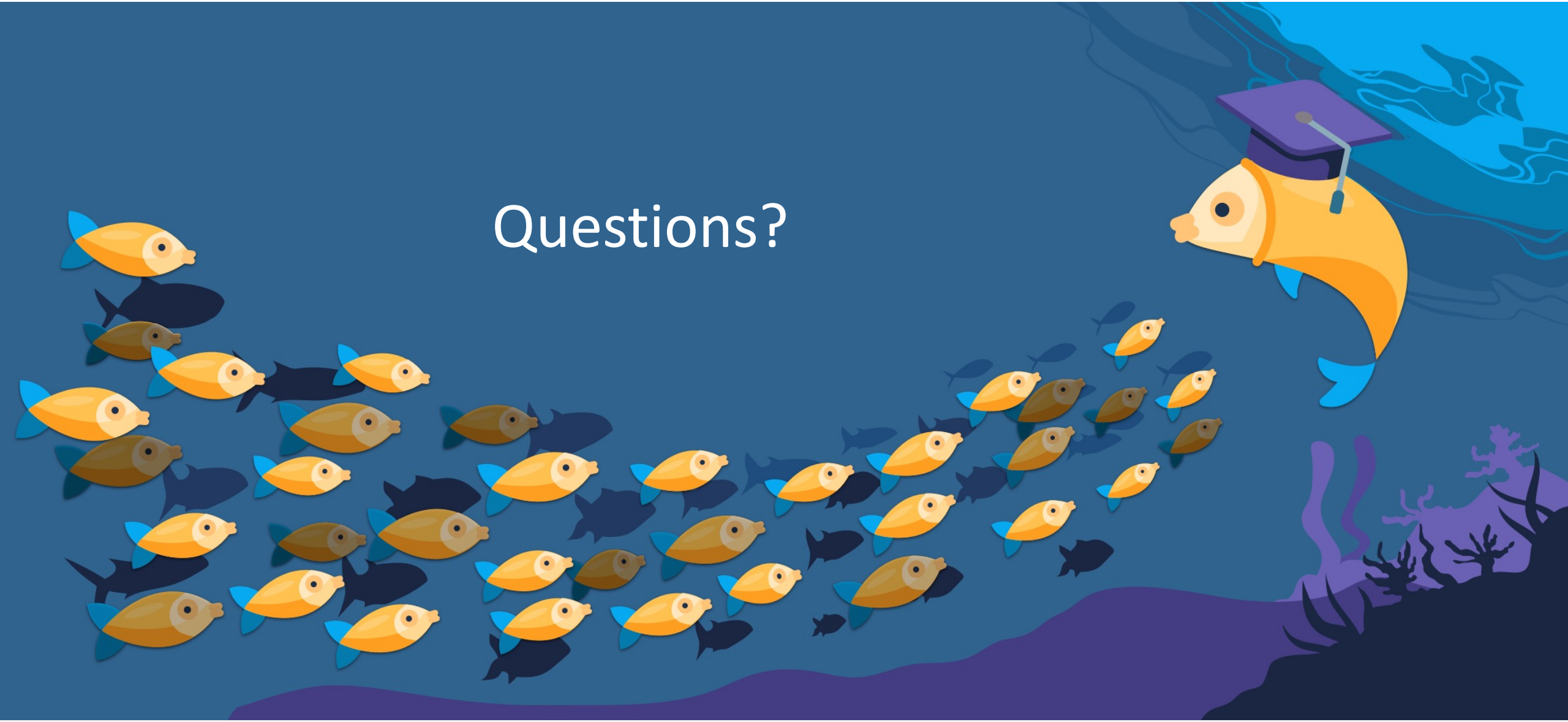
Advantages of FHIR Shorthand Profiling Language

- Concise, readable, understandable
- Rapid changes via text operations: copy, paste, search, and replace
- Perfect for source code control (branching, merging, diffs)
- Error checking and incorporation of best practices
- Complete: FSH does everything you can do by manually editing
  - Profiles, extensions, value sets, code systems, invariants, mappings
  - Resources and logical models (NEW!)
- HL7 Standard and integrated with HL7 FHIR IG Publisher

FSH Resources and Tools

- FSH Language Specification -- HL7 FHIR Standard
- SUSHI -- compile FSH into FHIR Artifacts
- FSH School -- web site with documentation, tools, examples
- FSH Online -- interactive FHIR Shorthand with examples
- GoFSH -- convert existing implementation guides into FSH (beta)
- FSH Finder -- web crawler to find FSH projects
- VS Code extension -- code highlighter for VS Code editor

Questions?



ORGANIZED BY

PARTNER