FHIR Intermediate Course

ASSIGNMENTS METHODOLOGY

Assignments

Language: English

V1.0

Course Overview

Module I: Implementation Guides

Most Relevant FHIR Implementation Guides: Argonaut & IPS
Argonaut Development and Roadmap
Argonaut Data Query IG: Scope, Use Cases
Argonaut Provider Directory IG: Scope, Use Cases
IPS FHIR IG: Scope, Use Cases

Module II: FHIR Clients

General Guidelines for FHIR Clients
FHIR Clients in JavaScript / C#

Module III: FHIR Facades

Why Use FHIR Server Facade: Your System on FHIR
Specific FHIR Servers (FHIR Facade)
Facade Use Case / Scenarios
Facade Architecture / Patterns
Where to Put the FHIR Facade
System Integration / Integration Engine / Bus / Messaging
Facade in C# / Java / Node.JS [1 - Elective]

Module IV: FHIR Applications

SMART on FHIR
CDS Hooks
Integration with SMART on FHIR / CDS Hooks [1 - Elective]

Assignments Methodology

1. Assignment Variety

Our course is a learn-by-doing course, but we understand that each person has more experience and is more comfortable doing certain tasks. So we've devised a variety of assignments for each unit, adapted to diverse needs and expertise.

For this course, these are the types of assignments:
FHIR CODE REVIEWER
FHIR PROFILE GURU
BUILD YOUR OWN
CLINICAL SENSE
YOU ARE THE ARCHITECT

2. Assignment Grading and Minimal Course Completion Criteria

Each unit will have zero or more assignments of each type (not all units include all the types of assignment).

Each type of assignment will give you a maximum of 20 points, and in order to earn a Course Completion Certificate, you need to obtain a minimum of 60 points in each of the four weekly units of the course.

In this document we will introduce the assignment types and show you one example for each assignment type, so you can get acquainted with our methodology.

All assignments will refer to our assignment scenario.

For this first edition, the assignments will be manually graded by our senior tutor staff.

3. Assignment Type Descriptions and Small Examples

"FHIR Code Reviewer" - Overview

This kind of assignment has this icon and title at the beginning of the task description.

	**FHIR CODE REVIEWER**

Code review is a ubiquitous technique in these days of agile methods and extreme programming. Usually, the developer will look at the code and explain it to a colleague, and together they will determine drift from the code objectives, good practices, coding standards, etc.

For this kind of assignment, we will present a small snippet of code for you to review and identify an existing problem by inspection. The language does not matter, and we will not focus on good practices or coding standards, just on the suitability of the code to create or read FHIR Argonaut or IPS instances. So your task will be to understand the presented code and decide whether the code is doing its job or not, and why.

We use a variety of languages: JavaScript, Java, Python and C#, drawing on the available open-source libraries for FHIR R4 for our examples. This will allow you to understand how the libraries are used.

The code should be commented and self-explaining (that's what the original developers said, anyway).

"FHIR Code Reviewer" - Example

The following JavaScript code should return an Argonaut-conformant immunization resource. Review the code and answer:
Does this code return a valid Argonaut (US CORE R4) conformant immunization resource?

a. Answer Yes/No. [5 points] If your answer is "No":
b. State why the immunization resource would be non-conformant – you need to enumerate one or more error(s). [5 points]
c. State what to do to fix the error(s). [10 points]
a. Submit the corrected code. [extra 5 points]

```
function Get_Argo_Immunization_Resource (
    v_patient_reference,        //reference to a patient resource
    v_vaccine_code,            //vaccine code (snomed ct)
    v_vaccine_name,             //vaccine name (snomed ct)
    v_immunization_date          //immunization date
    )
 {

   var myVDate=new Date(v_immunization_date); // Date from input
    resource=
    [{
        "resourceType": "Immunization",
        "vaccineCode": {
            "coding": [{
                "system": "http://snomed.info/sct",
                "code": v_vaccine_code,
                "display": v_vaccine_name
            }]}
        ,
        "patient": {
            "reference": v_patient_reference
        },
        "occurrenceDateTime": myVDate.toISOString().split('T')[0],
        "primarySource": true,
        }]
    return resource;
}
```

You can test the JS code here: https://jsbin.com/gukuqezato/edit?html,css,js,console

The proposed solution for this assignment is as follows:

a) The generated instance is NOT conformant to the profile, so the answer is **NO**

b) What is wrong:
   a. The profile declaration is not present and it's mandatory to represent resource conformance to the profile.
   b. The vaccine.coding.system should be CVX, because it's mandatory for US-CORE immunization in the US-CORE profile (of course the code should be a CVX code).
   c. The status code is not present, and it's mandatory in the US-CORE profile.
   d. The text element is not present, and it's mandatory in the FHIR standard.

c) How to correct it:

   a. The **profile declaration is not present.** It should look like this:

```
"meta" : {
   "profile" : [
    "http://hl7.org/fhir/us/core/StructureDefinition/us-core-immunization"
   ]
 }
```

   b. The **vaccineCode.coding.system** should be CVX to be conformant, like this

```
"system" : "http://hl7.org/fhir/sid/cvx"
```

   c. The **status code is mandatory**. Should be something like this:

```
"status" : "completed"
```

   d. The **text element is mandatory for FHIR resources**. Should be something like this:

```
"text" : {
   "status" : "generated",
   "div" : "<div xmlns=\"http://www.w3.org/1999/xhtml\">
   <p><strong>Generated Narrative with Details</strong></p>
   <p><strong>status</strong>: completed</p>
   <p><strong>vaccineCode</strong>: vaccineCode and Name</p>
   <p><strong>patient</strong>: <a>Text for Patient Details</a></p>
   <p><strong>occurrence</strong>: VaccineDate</p>
   <p><strong>primarySource</strong>: true</p>
   </div>"
}
```

You can review and test the corrected JS code here:
https://jsbin.com/qesehez/edit?html,css,js,output

"FHIR Profile Guru" - Overview

This kind of assignment has this icon and title at the beginning of the task description.

	**FHIR PROFILE GURU**

One of the common tasks you will face when confronted with interoperability projects will be to determine whether a certain instance is conformant with a specific implementation guide, and drilling down further, determine whether a particular use of an element is the intended use or not. This kind of assignment will test your (brand new) knowledge of the implementation guides, by simulating a colleague asking these kinds of questions about specific FHIR instances.

"FHIR Profile Guru" - Example

The following mapping was made for a Hospital database system to the Argonaut Immunization resource, to extract information answering immunization-specific searches.
The questions are:

a) Is this mapping enough to cover Argonaut US Core R4 requirements? Yes/No [5 points]
b) What would you change? [15 points]

Vermont Community Hospital EHR (VCH)

Local Database Dictionary for Table: IMMUNIZATIONS

column	description	datatype
patient_id	Patient id in VCH system	long
code	Local Immunization Code	varchar(50)
imm_date	Date / Time of Immunization	datetime
source_id	Source System ID (0=VCH)	long
given	false if not-given	boolean
reason_not_done	if given=false, reason code	varchar(50)
lot_number	Lot number applied	varchar(256)
applier_id	Applier id in VCH system	long
dose	Dose number	long
trade_name	trade name for the vaccine	varchar(256)
reaction	text for patient reaction, if any	varchar(256)

Proposed Mapping

Local Database	Argonaut US Core R4	Notes
code	vaccineCode	Convert from local codes to CVX
patient_id	patient	Include fixed reference to selected patient
imm_date	occurrenceDateTime	FHIR Format YYYY-MM-DD
source_id	primarySource	(set to boolean "false" if the source_id doesn't match VCH System)

The proposed solution for this assignment is as follows:

a) The generated mapping is **NOT** enough to cover Argonaut R4 US Core requirements.

b) What is wrong:

1. The element **status** is labeled as must-support, so if the originating system knows the status it should be populated, hence mapped from the local system record.
2. The element **statusReason** is labeled as must-support, so if the originating system knows the statusReason it should be populated, hence mapped from the local system record.

c) How to correct it:

Local Database	Argonaut US Core R4	Notes
code	vaccineCode	Convert from local codes to CVX
patient_id	patient	Include fixed reference to selected patient
imm_date	occurrenceDateTime	FHIR Format YYYY-MM-DD
source_id	primarySource	(set to boolean "false" if the source_id doesn't match VCH System)
given	**status**	**“complete” if given=true / “not-done” if given=false**
reason-not-done	**status_reason**	**Mapping to Code System for status reason PATOBJ: Patient Objection MEDPREC: Medical precaution**

"Build Your Own" - Overview

This kind of assignment has this icon and title at the beginning of the task description.

BUILD YOUR OWN

Some of the presented techniques to create or read FHIR resources in servers and/or clients are just too complex to ask you to create a full solution, so we will ask you to COMPLETE an existing solution by adding new capabilities to code that already does its intended job.

For instance, if the code is already displaying procedures for a patient from a FHIR Argonaut server, we may ask you to extend the functionality to also display the immunizations for the patient. In this way you can familiarize yourself with the code to understand what it does, and prove that you can extend the functionality for a new scope.

This assignments can be in a variety of programming languages: JavaScript, Java, Python, C# or Node.JS.

Note: There is no need to master any of these languages in order to complete the assignments. We used a very small portion of the languages' capabilities to perform the required tasks, so the focus is really on FHIR, not on the languages being used. We have not mastered the languages completely either.

"Build Your Own" - Example

The following Python* program searches a Patient using given/family name, and after retrieving the patient's server assigned id, retrieves all the Procedures and shows the date, status and description.
Your mission:

a) Change the program to search using the patient's identifier instead of given/family names. [10 points]

b) Change the program to display the patient's Immunizations: status, date, vaccine. [10 points]

** We use standard Python 3 (no FHIR libraries required)*

- The Python program is available at https://repl.it/@fhirinterm/FHIRSearchPatientAndProcedures

and also in this attached file: FHIR_SearchPatientProcedures.py

- You can use your own Python installation or these free Python sandboxes.
  - https://repl.it/repls
  - https://trinket.io/features/python3
  - https://www.onlinegdb.com/

The proposed solution can be found here:
https://repl.it/@fhirinterm/FHIRSearchByIdentifierAndImmunizations

Or in this attached file: FHIR_SearchPatientByIdentifier_Immunizations.py

"Clinical Sense on FHIR" - Overview

This kind of assignment has this icon and title at the beginning of the task description.

	**CLINICAL SENSE ON FHIR**

For this kind of assignment we will present you a problem or use-case/scenario that may include reasoning about how to map certain clinical information, specific terminology, a combination of both, or comparing terminologies for a certain goal, or deciding whether a specific combination of resources covered (or not covered) by the Argonaut or IPS guide will serve the purposes of your job. You will need to specify the combinations of resources and terminology for the specific task at hand. These are the less technically oriented assignments. Sometimes the format of the answer is just a short essay.

"Clinical Sense on FHIR" - Example

Analyze the questionnaire for new athletes on page 175 of the attached document SportScreeningPaper.PDF.
Our application's needs are:
a) Provide/Update the questionnaire to EHRs.
b) Receive the answers from EHRs every time a new/prospective athlete fills out the questionnaire.

Your job as the clinical interface consultant for the company is to solve these issues:

1) **Section 1 [10 points]**
a) Is the scope of the guide enough to communicate the answers? Why?
b) Which actors and use cases would best represent our application and the hospital EHR?

2) **Section 2 [10 points]**
c) Review the Questionnaire Sample available here https://www.fhir.org/guides/argonaut/questionnaire/Questionnaire-questionnaire-example-sampler.html and ONLY the "Female" section of the questionnaire on page 175 of the attached document.

Female:

❑	❑		Hve you started your periods? If so, what age _____?
			Date of your last gynecological examination /PAP smear _____/_____/_____
❑	❑	❑	Have you every missed your period for more than 6 months?
❑	❑	❑	Does your menstruation affect your performance?

a) Which question types would you use for each question?
b) Can the first two questions be mapped to a controlled vocabulary (terminology) like SNOMED CT or LOINC? Which one would you use?
c) Which Concepts in your selected terminology would you use to represent the questions and the answers?

Proposed Solution

1) **Section 1 Answers**
a) Yes, the Argonaut Questionnaire IG covers the use case. Why: The IG covers the creation and answering of questionnaires with a basic workflow, including simple, text-based questions (see https://www.fhir.org/guides/argonaut/questionnaire/index.html#scope)

b) Actors and Use-Cases (see https://www.fhir.org/guides/argonaut/questionnaire/static.html)

Actors

a. Form Author/Assessment Bank (where the questionnaires can be accessed)
b. Provider EHR/Client Application (application where the questionnaire is filled)
c. Subject: The patient filling out the questionnaire

d. Practitioner/Provider Administrator: The provider administering the questionnaire
e. Answer Bank (our app database)

Use Cases (Static Forms)

a. Form Author Posts New/Modified Assessment to the Assessment Bank
b. Provider EHR/Client Application fetches form
c. End User Completes the Assessment
d. Provider EHR/Client Application posts to Answer Bank

2) Section 2 Answers

a) Question Types for the Female section of the questionnaire

Question	Question Type
Have you started your period	Boolean
If so, at what age	Integer
Date of last gynecological examination/Pap smear	Date
Have you ever not had your period for more than 6 months	Boolean
Does your menstrual cycle affect your performance	Boolean

b) Terminology: both SNOMED CT and LOINC can be used

Using LOINC

Question	LOINC Question
Have you started your period	Boolean
If so, at what age	`https://fhir.loinc.org/CodeSystem/$lookup?system=http://loinc.org&code=LP116900-4` (How old were you when your menstrual periods began)
Date of last gynecological examination/Pap smear	`https://fhir.loinc.org/CodeSystem/$lookup?system=http://loinc.org&code=60432-2` (Date of previous Pap smear test)

"You are the architect" - Overview

This kind of assignment has this icon and title at the beginning of the task description.

	**YOU ARE THE ARCHITECT**

For this kind of assignment we will present you a problem where you need to define/select a variant of a specific architecture or set of components to cover the proposed scope.

"You are the architect" - Example

Read this discussion between Tim, our app's chief architect (Arch), and his colleague Nicholas from Kansas Interhospital Group (KIG), a big hospital chain in Kansas City.

Tim: *So, we need access to our athletes' records in the KIG system. We will be accessing them using Argonaut REST APIs. Can you explain the process to me?*
Nicholas: *I'm afraid not. You'd better read it here. This is our EHR vendor spec:* *https://fhir.cerner.com/authorization/authorization-specification/#contextless-flow*

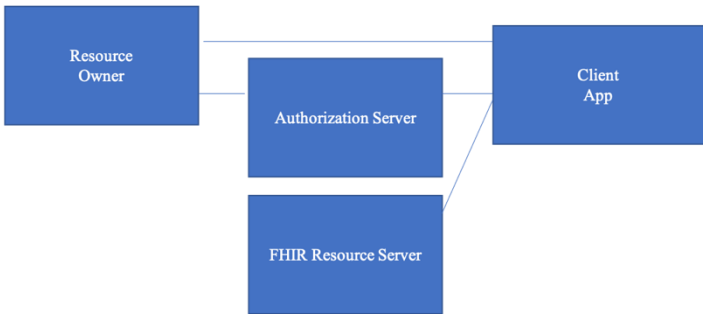
Please read the document and answer the following questions:

a) How many endpoints do you need to access as a client to leverage this flow? [5 points]
b) What names do they have? Please create a diagram. The diagram cannot be copy-pasted from the reference document. [10 points]
c) What is the first task when a client needs to use a FHIR endpoint? [5 points]

Proposed Solution

a) 3 Endpoints

b) Resource Owner, Authorization Server, FHIR Resource Server



c) ‘discovery’ (Requesting the Server Conformance Statement)