HL7 FHIR

HL7 International

FHIR Intermediate Course

MODULE 1

Assignments

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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 Java / Node.JS [1 - Elective]

Module IV: FHIR Applications

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

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Assignments for Unit 1 / Maximum Grade

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Assignment U01-1: US CORE FHIR R4 MedicationRequest (JS)	15
Assignment U01-2: US CORE FHIR R4/IPS Medication (Mapping)	10
Assignment U01-3: US CORE FHIR R4 Vital Signs (Python)	10
Assignment U01-4: Screening Protocol Data (Terminology)	20
Assignment U01-5: FHIR Architectural Patterns (Architecture)	10
Assignment U01-6: US CORE Patient Goals Display (C#)	10
Assignment U01-7: US CORE FHIR R4 Implantable Device (C#)	10
Assignment U01-8: FHIR Architectural Patterns (Architecture)	15
	100

Minimum passing score for the unit is 35/100
You don´t need to solve all the assignments. You don´t need even to solve complete assignments. Just try all the assignments you can.

Assignment U01-1: US CORE FHIR R4 MedicationRequest (JS)

FHIR CODE REVIEWER

The JavaScript code provided with this assignment should return a US CORE FHIR R4 MedicationRequest resource for an athlete.

In case you do not remember where to find the specs, the spec for US CORE FHIR R4 is here: https://www.hl7.org/fhir/us/core/StructureDefinition-us-core-medicationrequest.html
Review the JavaScript code and:

Part 1: Quiz

Why doesn't this code return a valid Argonaut (US CORE R4) conformant MedicationRequest resource? State why the medication resource would be non-conformant. **[5 points]**

Part 2: Submission (JS Code)

Correct the code to fix your findings for Part 1 [10 points]
Submit just your JavaScript corrected code in the provided text box.

You can test the JS code here: https://jsbin.com/tiqasuyeza/edit?html,js,console,output
You can also find the complete code here:
https://gist.github.com/diegokaminker/6dbd9a9325561cddd9a17c263177a631

Assignment U01-2: US CORE FHIR R4/IPS Medication (Mapping)

	**FHIR PROFILE GURU**

Our Sport application needs to show active medications for the patient. The following mapping is needed from our simple medication display model to the Argonaut MedicationRequest resource, to extract and **display only active medication for the patient.**
Now, we also want to process IPS resources and extract the same information, but we've noted that IPS uses MedicationStatement instead of MedicationRequest.
Your job is to write the FHIRPath expressions with the Argonaut US Core [5 points] and IPS mapping [5 points].

Additional Resources for this assignment:

The FHIRPath specification can be found here: http://hl7.org/fhirpath/
A FHIRPath tutorial (video) can be found here:
https://www.youtube.com/watch?v=m0nwSwUxg58

US Core MedicationRequest Profile: http://hl7.org/fhir/us/core/StructureDefinition-us-core-medicationrequest.html
US Core MedicationRequest example at the activity page

IMPORTANT : Test your FHIRPath before submit your activity at the course website using the FHIRPath sandbox and the examples.

Examples Resources at the material tools folder.
> medicationRequestUSCORE.json
> medicationStatementIPS.json

To retrieve the prescriber in both cases, as we just ask for the requester name, you can use the "display" element. You don't need to retrieve or resolve the referenced resource.

A FHIRPath sandbox to test your FHIRPath expressions can be found here:
http://niquola.github.io/fhirpath-demo/#/

Our Medication Display

column	description	datatype
MED_NAME	Prescribed Drug Name	string(128)
MED_CODE	Prescribed Drug Code	string(128)
MED_DATE	Date of Prescription	date
MED_STATUS	Medication Status	string(50)
MED_PRESCRIBER	Full name of the prescriber	string(128)
MED_INSTRUCTION	Dosage instruction	string(max)

US CORE R4 Mapping
MedicationRequest

Display	US Core R4	Notes
MED_NAME		
MED_CODE		
MED_DATE		
MED_STATUS	MedicationRequest.status	
MED_PRESCRIBER		

IPS Mapping
MedicationStatement

Display	IPS FHIR	Notes
MED_NAME		
MED_CODE		
MED_DATE		
MED_STATUS		
MED_PRESCRIBER		

Assignment U01-3: US CORE FHIR R4 Vital Signs (Python)

BUILD YOUR OWN

The following Python* console program retrieves all the Procedures for a given patient sorted by date and code, and returns the date, status, and description (fields delimited by | and resources delimited by \r\n) (This is just a simple example we provide, and you can use to understand what to do in Python for this specific assignment).
Our customer wants to feed into the sports app all the simple numerical vital signs from the electronic health record using US Core access.

Part 1: Quiz
Explain which is the FHIR resource and which are the mandatory elements for the US Core Vital Signs Profile [5 points]
The Vital Signs US Core profile is described here:
http://hl7.org/fhir/us/core/StructureDefinition-us-core-vital-signs.html

Part 2: Submission Text
Create a program in Python to retrieve only the patient's numeric vital signs which has no components, sorted by date and code (include the result value rounded to 2 decimals and other mandatory elements) [5 points]
Just like in our small program, you need to separate the elements using a pipe and issue a new line after each vital sign.

1) The order of the elements is the order in which they appear in the US Core Profile
2) DO NOT INCLUDE patient or category information, since they are our search parameters.
3) For numeric data, only include the value and the unit separated by spaces (eg.: '18 g/l')
4) For CodeableConcept elements, only include the text element.

The output of your program should be your submission
Example / each line is a different Vital Sign:

```
mandatory_element_1|…|mandatory_element_n|… \r\n
mandatory_element_2|…|mandatory_element_n|… \r\n
```

You need to use our server @ http://fhirserver.hl7fundamentals.org/fhir /
Patient Id is 12984.

Part 3: Submit Your Code – We Will Verify It

** We use standard Python 3 (no FHIR libraries required)*
You can run the provided program here:
https://replit.com/@fhirinterm/FHIRSearchProcedures?v=1
Or download it from here:
https://gist.github.com/diegokaminker/35282deafa39da46eb51028b373d8d66
You can use your own Python installation or these free Python sandboxes:

- https://replit.com
- https://trinket.io

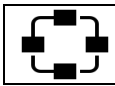
Assignment U01-4: Screening Protocol Data (Terminology)

CLINICAL SENSE ON FHIR

Analyze the screening protocol for new athletes on pages 176-177 of the attached document **SportScreeningPaper.PDF**
For **labs, vitals and immunizations**, our application needs to provide all the items that can be downloaded automatically from an Argonaut or IPS server
Your job as the clinical interface consultant for the company is to resolve these issues.

1) **Section 0 – Profiles/Resources [3 points]**
Which Argonaut profiles will you use for each category (lab, vitals, immunization)?
2) **Section 1 - Immunization [6 points]**
Define **code/code system** for Immunization to download from the FHIR server for the vitals required by the paper. (Measles, mumps and rubella (combination vaccine), influenza, typhoid, Hepatitis A and B and yellow fever vaccine).
3) **Section 2 - Vitals [7 points]**
Define **code/code system** for Vital Signs to download from the FHIR server for the vitals required by the paper. (Blood pressure, heart rate, body height, body weight and the BMI)
4) **Section 3 - Labs [4 points]**
Define **code/code system** to download from the FHIR server for the clinical/microbiological results required by the paper.

Assignment U01-5: FHIR Architectural Patterns (Architecture)



YOU ARE THE ARCHITECT

Read the attached article in PDF format "FHIR Architectural Patterns – Helios Software."
The original article is here: https://blog.heliossoftware.com/fhir-architectural-patterns-ae828b13d40c

We will present 8 interoperability scenarios and you must assign the most appropriate pattern from the article to each scenario.
Options:
1 - Interoperability Interface
2 - FHIR Broker Adapter
3 - FHIR/Proprietary API Mixed Use
4 - FHIR Encapsulating a Vendor-Neutral Clinical Repository
5 - FHIR-Based Clinical Data Repository
6 - FHIR-Based Integration Hub
7 - FHIR-Based Analytical Solution
8 - Rapid FHIR-Based Endpoint

#	Scenario Description – or "this was what we heard at the meeting with their IT people"
01	"We don't have a FHIR/REST API server, but you can listen to our ongoing HL7 v2 pipeline and convert the messages to FHIR for your repository."
02	"We have our own read/write API – here are the 350 pages of the spec: www.bigehrvendor/proprietaryAPI/hugespecs. We can also provide you with an Argonaut FHIR read-only facade."
03	"You can use Argonaut bulk-data interface against our server for any dataset for your large dataset analysis. We support conditions, observations and patients out-of-the-box, but we can implement any specific request in two months" (this one was lying).
04	"We store all the information on a FHIR-based server. You can query our server using FHIR, but we also support HL7 V2.x, V3 and other formats."
05	"You can extract/update the information from our server for any purpose you want: EMR, labs, PACS and even research. We don't care which vendor provided the system, as long as they have a FHIR client."
06	Any Argonaut-compatible legacy EHR queried by a SMART on FHIR app.
07	Any Argonaut-compatible EHR with native FHIR-resources-based storage.
08	"No need to use HL7 V2 ORUs. We will post the lab report as a FHIR resource directly to your FHIR API endpoint."

Assignment U01-6: US CORE Patient Goals Display (C#)

BUILD YOUR OWN

The simple C# program https://dotnetfiddle.net/DaIoM3 retrieves all the allergies for a Patient and shows the display name, clinical status, and verification status. You can run it using dotnetfiddle.
Your mission:

Part 1: Quiz

Write which are the mandatory elements defined for FHIR US CORE Goal as described here: http://hl7.org/fhir/us/core/StructureDefinition-us-core-goal.html [5 points]

Part 2: Text Submission

1. Create a C# program to retrieve the patient's clinical goals (include all mandatory elements with the exception of the 'subject' element) and return them separated by | (pipe). **The output of your program should be your submission [5 points]**
2. Example / each line is a different Goal:
   ```
   mandatory_element_1|…|mandatory_element_n|… \r\n
   mandatory_element_2|…|mandatory_element_n|… \r\n
   ```
3. You need to use our server @ http://fhirserver.hl7fundamentals.org/fhir / Patient Id is 12984.

Part 3: Code – We Will Verify It

We used only the nuget package hl7.fhir.r4 version 4.3.0

Assignment U01-7: US CORE FHIR R4 Implantable Device (C#)

FHIR CODE REVIEWER

Our company closed a deal with the site Cardiac Athletes and is providing support to recovering cardiac patients on running teams. So we have added support for Implantable Devices.
The C# code provided with this assignment, located at https://dotnetfiddle.net/EAuZTx should search for all the US CORE FHIR R4 Implantable Devices resources for an athlete on the Cardiac Athletes team and display all mandatory/must-support elements. In case you do not remember where to find the specs, the spec for US CORE FHIR R4 is here: http://www.hl7.org/fhir/us/core/StructureDefinition-us-core-implantable-device.html

Part 1: Quiz - Review the C# code and answer:
a. Why does this code fail in searching the Implantable Devices for an athlete? [2 points]
b. Which mandatory/must-support elements is the program not showing? [3 points]

Part 2: Text Submission
Correct the C# code to retrieve the mandatory /must support elements [5 points]
You need to return the mandatory/must support elements for each resource related to the patient, in the order they appear in the Device resource definition, separated by | (pipe). The output of your program should be your submission
For CodeableConcept elements, only include the display element.
Example / each line is a different Device resource:

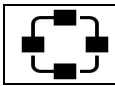
```
mandatory_ms_element_1|…|mandatory_ms_element_n|… \r\n
mandatory_ms_element_2|…|mandatory_ms_element_n|… \r\n
```

You need to use our server @ http://fhirserver.hl7fundamentals.org/fhir / Patient Id is 1.

Part 3: Submit Your Code – We Will Verify It

We used only the nuget package hl7.fhir.r4 version 4.3.0

Assignment U01-8: FHIR Use Case Proposal (Architecture)



YOU ARE THE ARCHITECT

Read the article in PDF format "FHIR Use Case Proposal" by CareQuality at the Material tools folder.
Starting on page 10, there are descriptions of proposed scenarios called Vignettes 1, 2 and 3.
Which FHIR endpoints/resource types will be required to fulfill each scenario? [15 points]