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K-HIS FHIR 교육

구현중심의 FHIR 기술 시스템 구축 교육 및 실습

HealthAll 수석연구원 송 준 현
HealthAll 책임연구원 전 형 석
HealthAll 주임연구원 최 미 현

전체 목차

- **FHIR Profiling**
  - FHIR Shorthand + sushi +IG Publisher
- **FHIR Server**
  - Server configuration
  - Load conformance resources
- **FHIR Client**
  - CRUDS operation

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FHIR Profiling

with FHIR Shorthand

HealthAll 책임연구원 전 형 석

목차

- **Installation**
  - Visual Studio Code
  - JAVA
  - sushi
  - IG Publisher
- **Profiling**
  - Changing Cardinality
  - Slicing
  - ValueSet Binding
- **Validation**
  - Against KR Core IG

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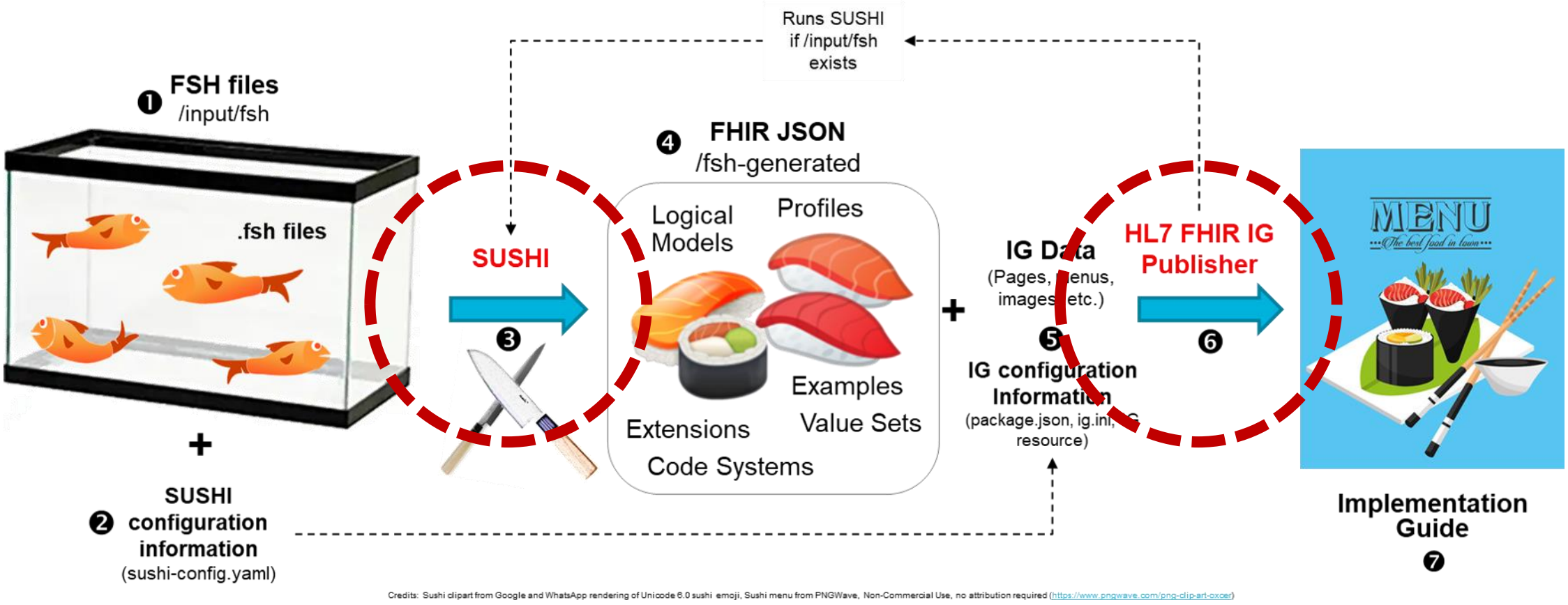
Installation Guide



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-oxoer)

- **Required Installation** : SUSHI, IG Publisher, JAVA
- **Recommended Installation** : Visual Studio Code + FHIR Shorthand Extension
- **Tutorial Project** : Implementation Guide Tutorial

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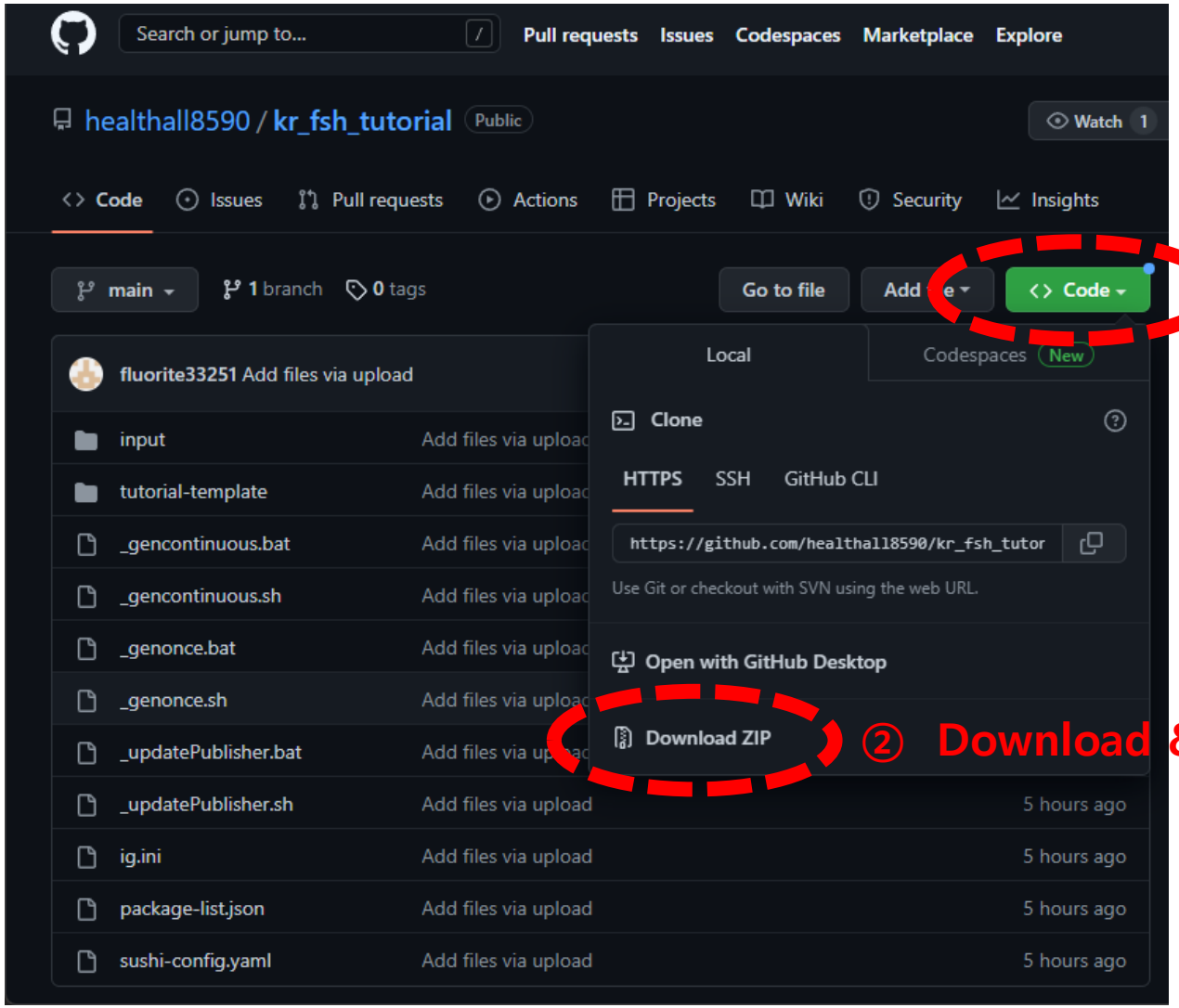
Download IG Tutorial Project (1)

- https://github.com/healthall8590/kr_fsh_tutorial



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Download IG Tutorial Project (2)

<Project Structure>

```
kr_fsh_tutorial
├── input
│   ├── fsh
│   │   ├── MyPatient.fsh
│   │   ├── MyObservation.fsh
│   │   ├── MyObsCodeSystem.fsh
│   │   └── MyObsValueSet.fsh
│   ├── images
│   │   └── ...
│   ├── pagecontent
│   │   └── ...
│   └── ignoreWarnings.txt
├── tutorial-template
│   └── ...
├── _genonce.bat
├── _updatePublisher.bat
├── ig.ini
├── sushi-config.yaml
└── ...
```

...\kr_fsh_tutorial\input\fsh

- FHIR Shorthand로 작성된 fsh 파일들이 위치한 폴더

...\kr_fsh_tutorial\tutorial-template

- Implementation Guide 생성에 사용되는 웹사이트 템플릿

...\kr_fsh_tutorial_genonce.bat

- Implementation Guide 생성에 사용되는 스크립트

...\kr_fsh_tutorial_updatePublisher.bat

- IG Publisher 및 관련 파일 다운로드/업데이트에 사용되는 스크립트

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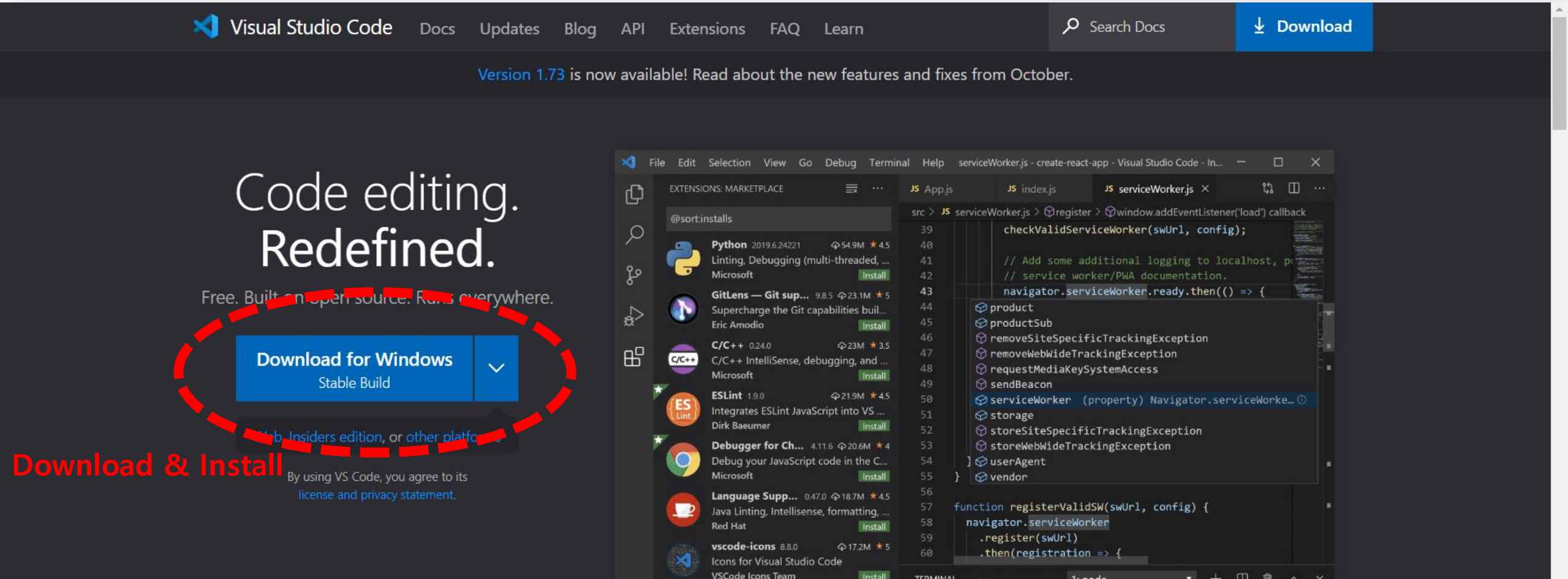
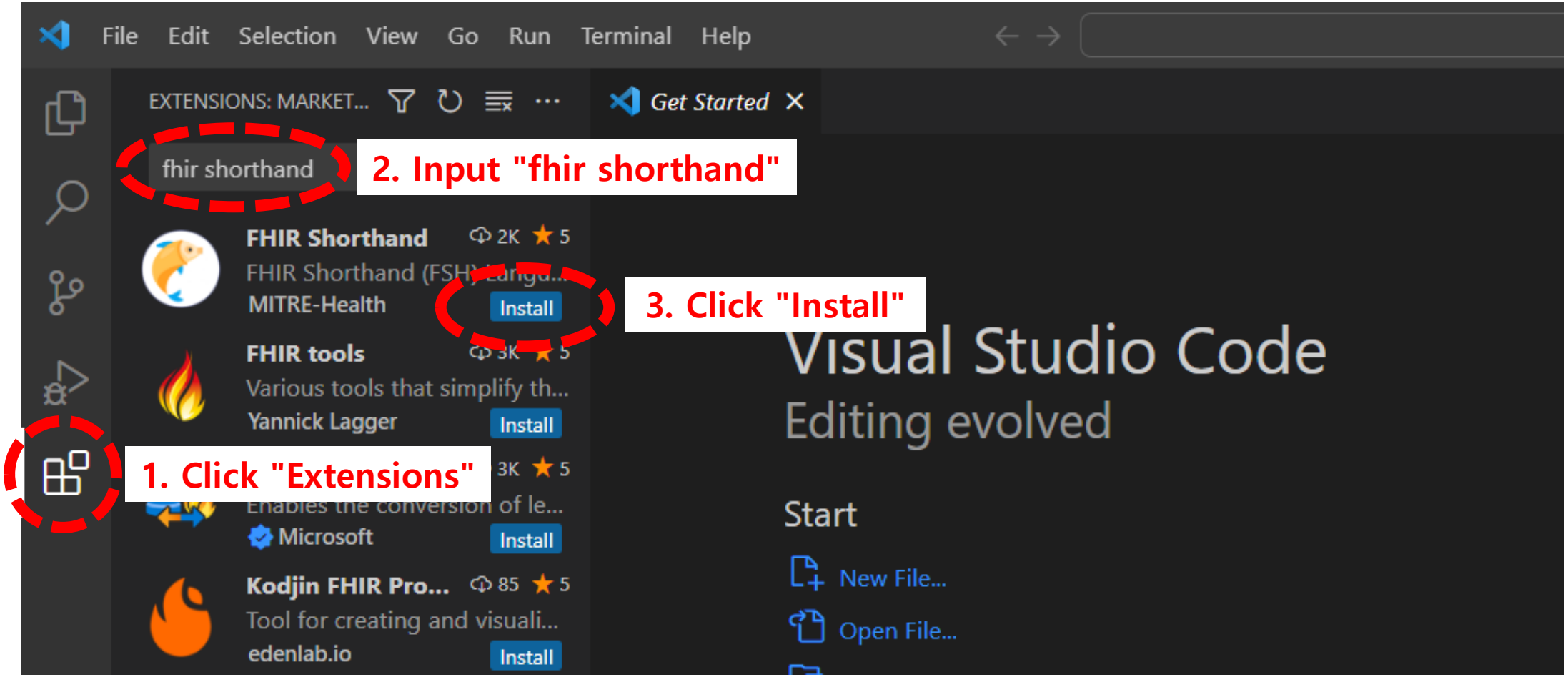
Visual Studio Code (1)

- **Step 1 – VS Code 설치**
  - https://code.visualstudio.com/



Visual Studio Code (2)

- **Step 2 – VS Code 설치**
  - VS Code 실행 – Extensions – FHIR shorthand 검색 및 설치



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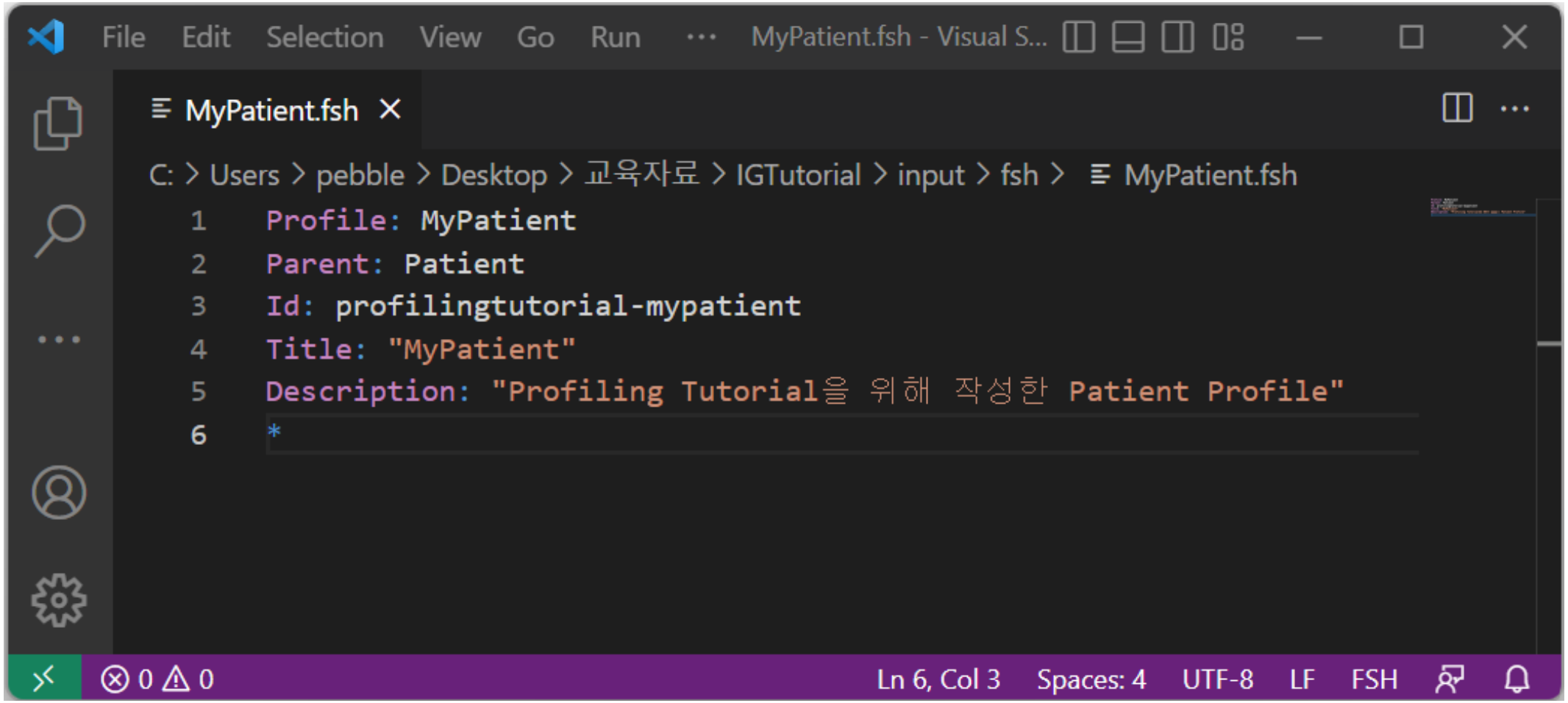
Visual Studio Code (3)

- **Step 3 – VS Code 설치 확인**
  - `...\kr_fsh_tutorial\input\fsh\MyPatient.fsh` 파일 VS Code로 열기



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JAVA Installation (1)

- **Step 1 – OpenJDK Download & Unzip**
  - https://jdk.java.net/18/
  - JAVA 17 (64-bit) 이상

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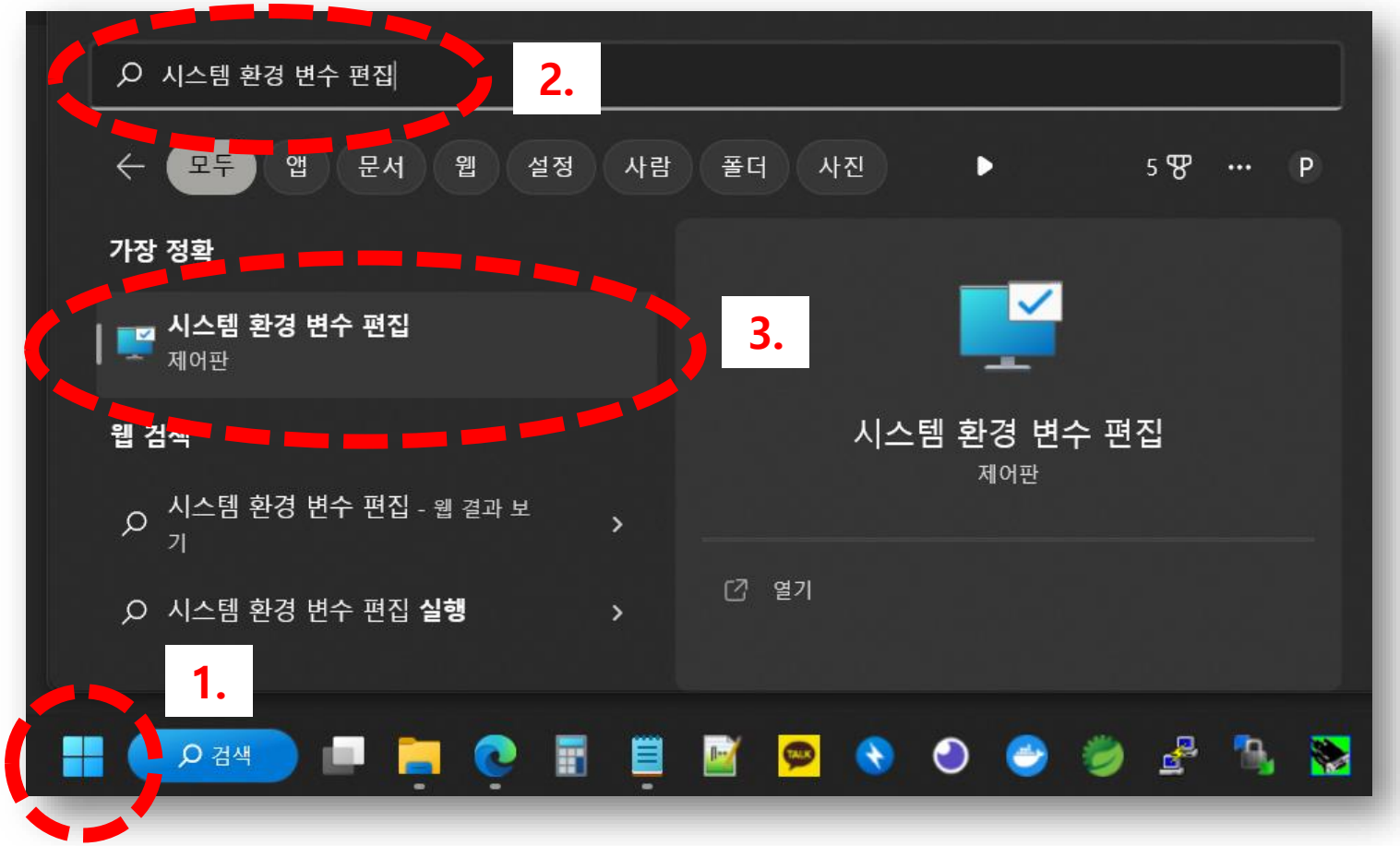
JAVA Installation (2)

- **Step 2 – System Environment Setting (1)**
  - Windows 시작 버튼 → '시스템 환경 변수 편집' 검색 → 실행
  - Example)



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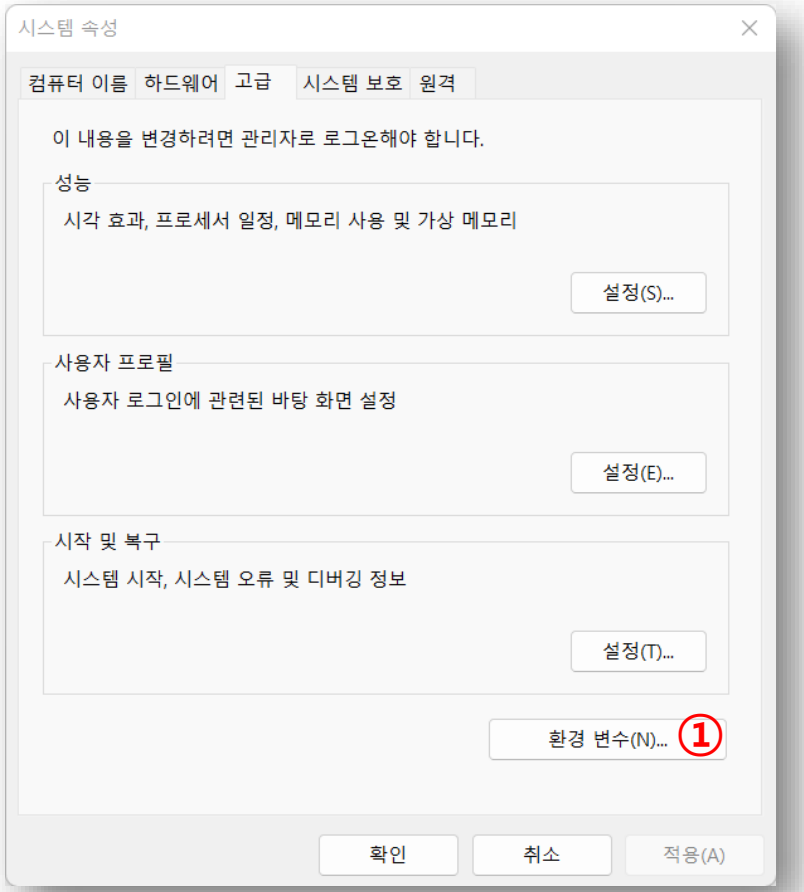
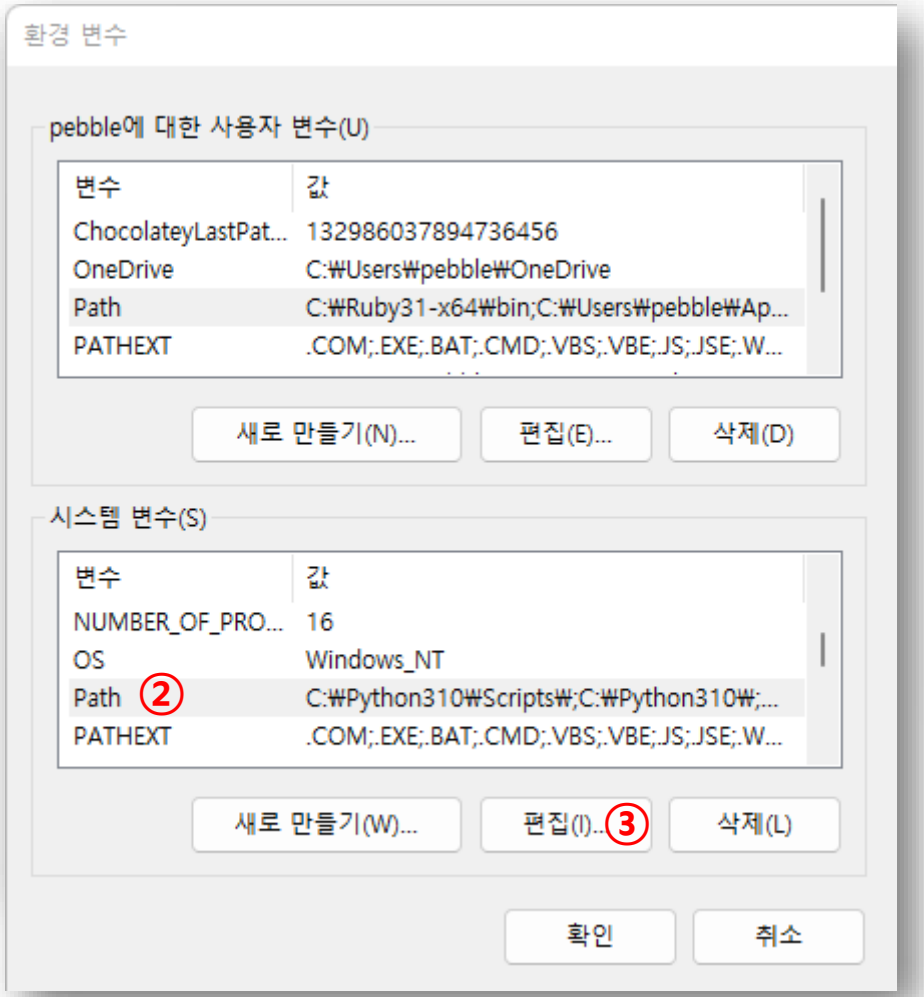
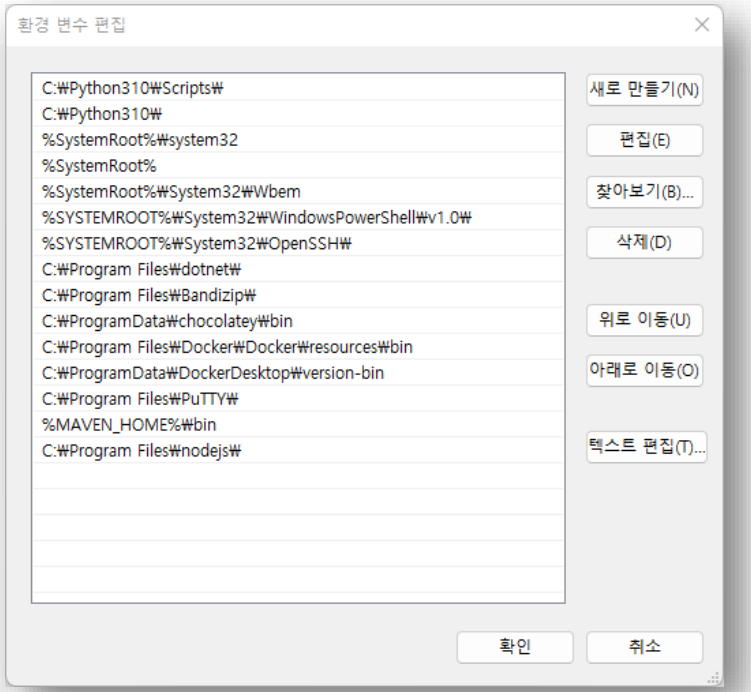
JAVA Installation (3)

- **Step 3 – System Environment Setting (2)**







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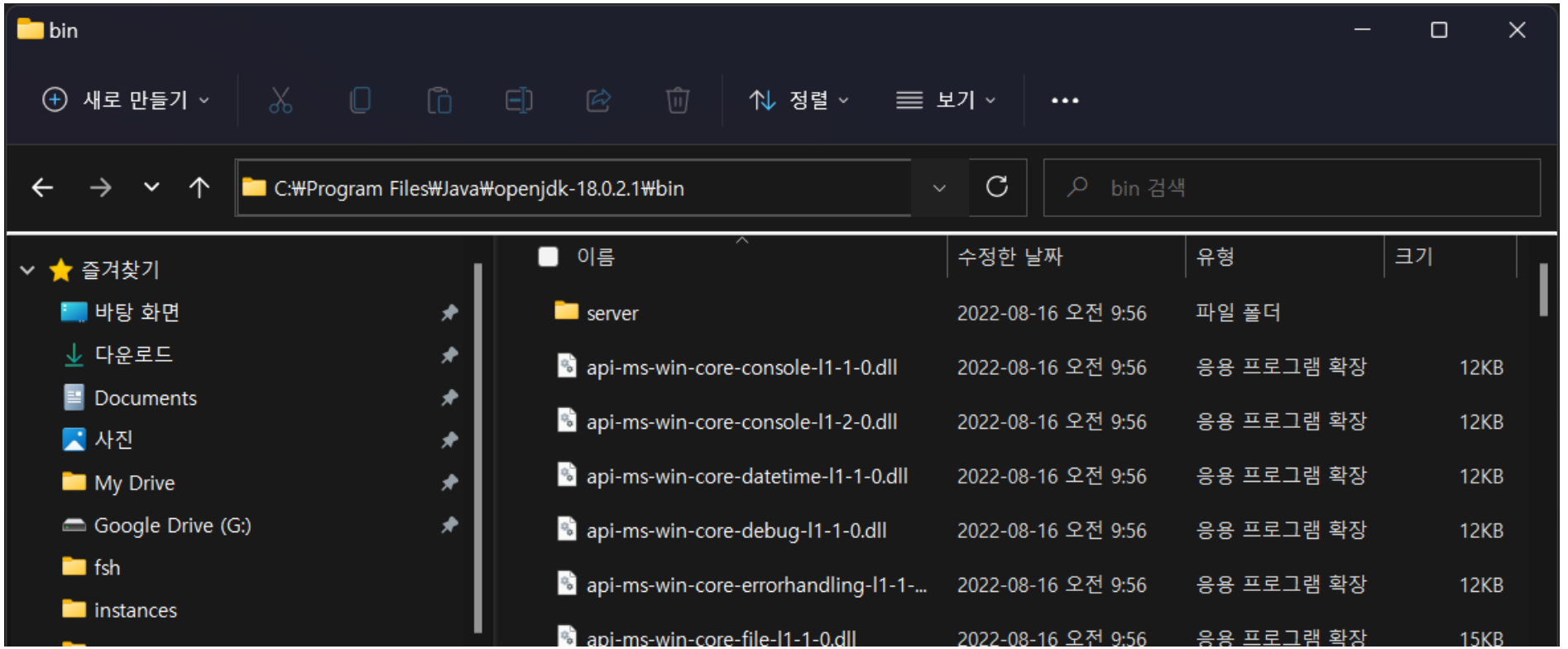
JAVA Installation (4)

- **Step 3 – System Environment Setting (3)**
  - openJDK 내 bin 폴더 까지의 경로를 복사
  - Example)
    - C:₩Program Files₩Java₩openjdk-18.0.2.1₩bin



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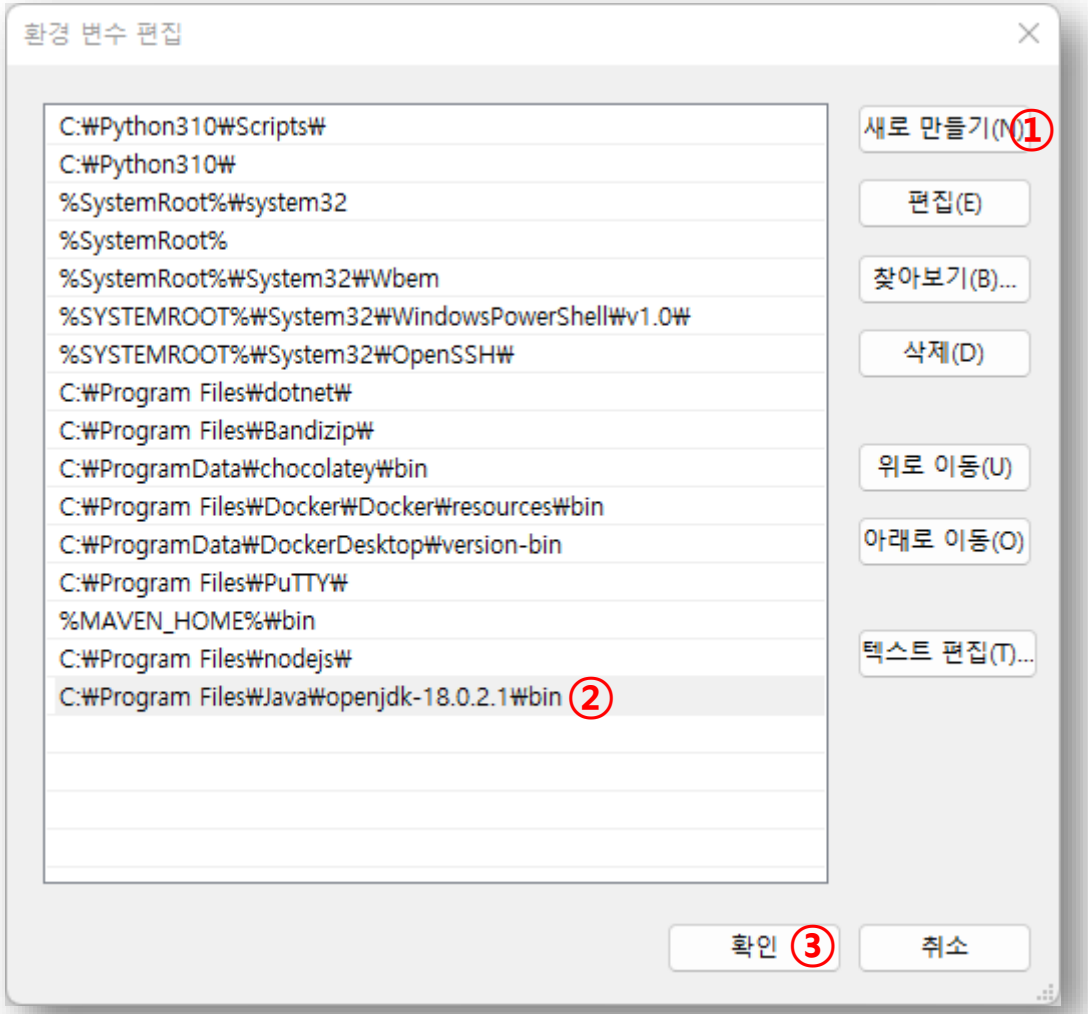
JAVA Installation (5)

- **Step 3 – System Environment Setting (3)**
  - 복사한 경로를 새로운 환경 변수로 등록



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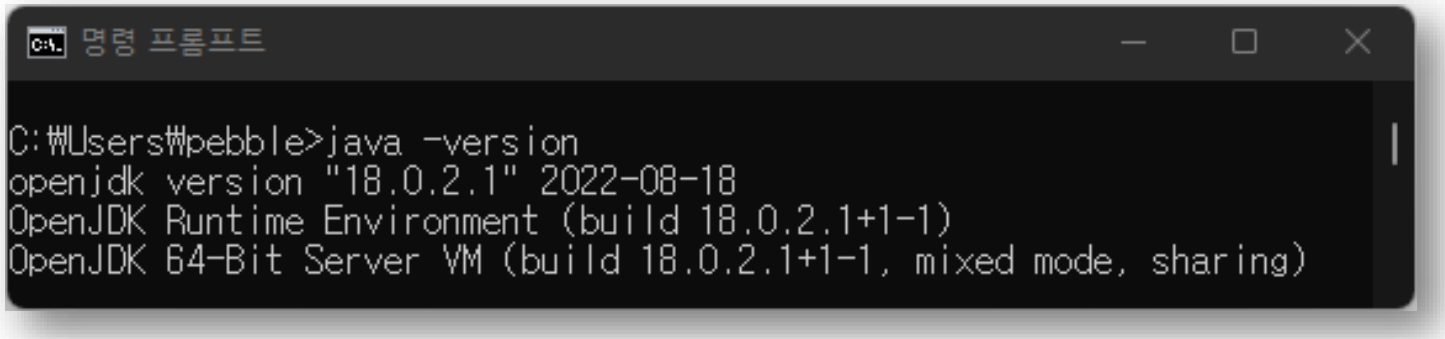
JAVA Installation (6)

- **Step 4 – JAVA 설치 확인**
  - 명령프롬프트에서 아래 커맨드입력

```
                                                    X

java -version
```

  - Example



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SUSHI Installation (1)

- **Step 1 – Node.js + NPM 설치**
  - https://nodejs.org/

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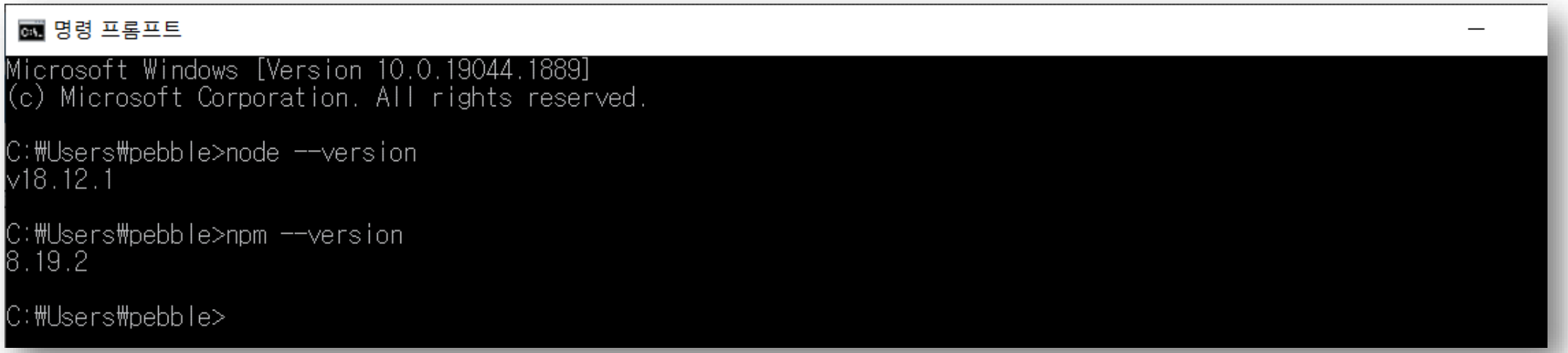
SUSHI Installation (2)

- **Step 2 – Node.j**
  - 명령프롬프트(cmd)에서 아래 커맨드 입력

```
node --version
npm --version
```

  - Example



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SUSHI Installation (3)

- **Step 3 – SUSHI 설치**
  - 명령프롬프트에서 아래 커맨드입력

```
npm install -g fsh-sushi
```

  - Example

```
C:₩Users₩pebble>npm install -g fsh-sushi

added 107 packages, and audited 116 packages in 28s

1 high severity vulnerability

To address all issues, run:
  npm audit fix

Run `npm audit` for details.
npm notice
npm notice New major version of npm available! 8.19.2 -> 9.1.2
npm notice Changelog: https://github.com/npm/cli/releases/tag/v9.1.2
npm notice Run npm install -g npm@9.1.2 to update!
npm notice
```

무시(npm 업데이트 요구)

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SUSHI Installation (4)

- **Step 4 – SUSHI 설치 확인**
  - 명령프롬프트에서 아래 커맨드입력

```
sushi -v
```

  - Example

IG Publisher Installation (1)

- **Step 1 – Ruby 설치 (1)**
  - https://rubyinstaller.org/downloads/

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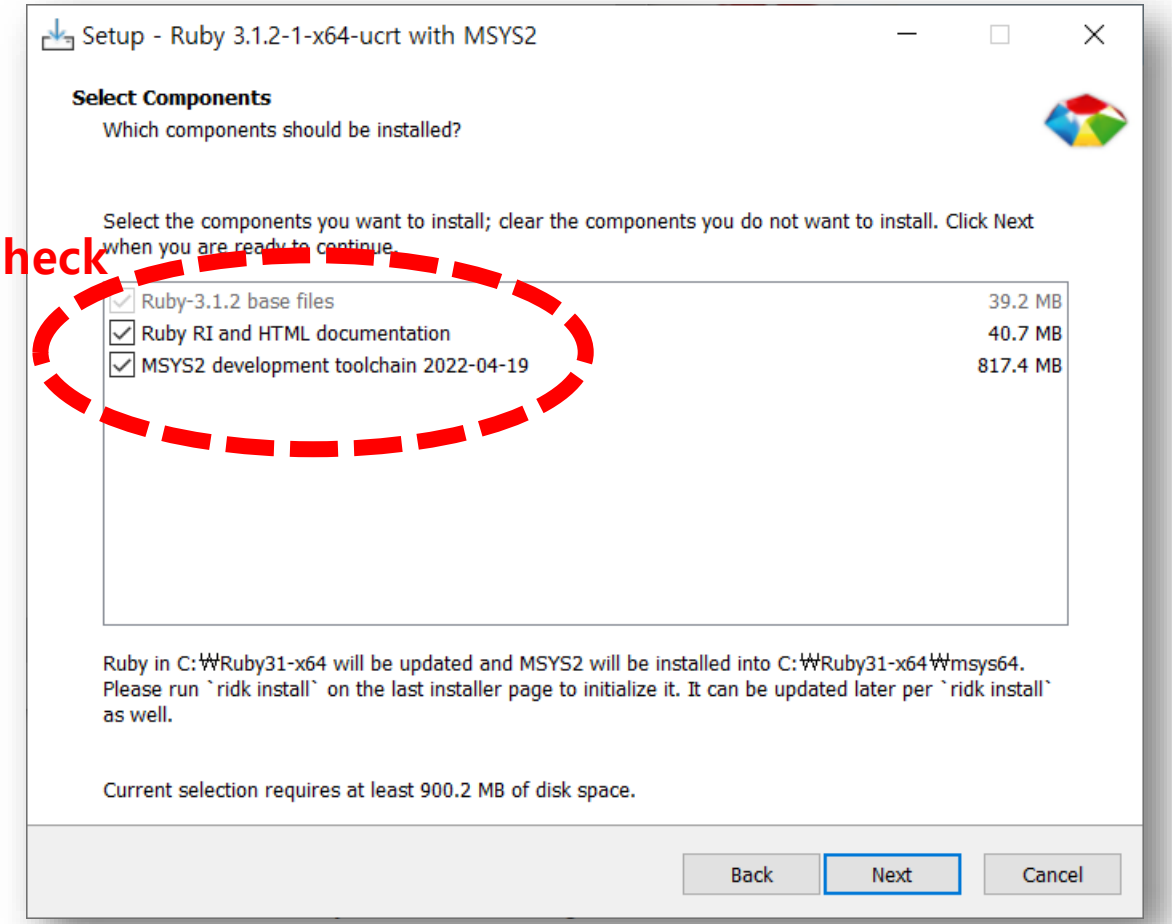
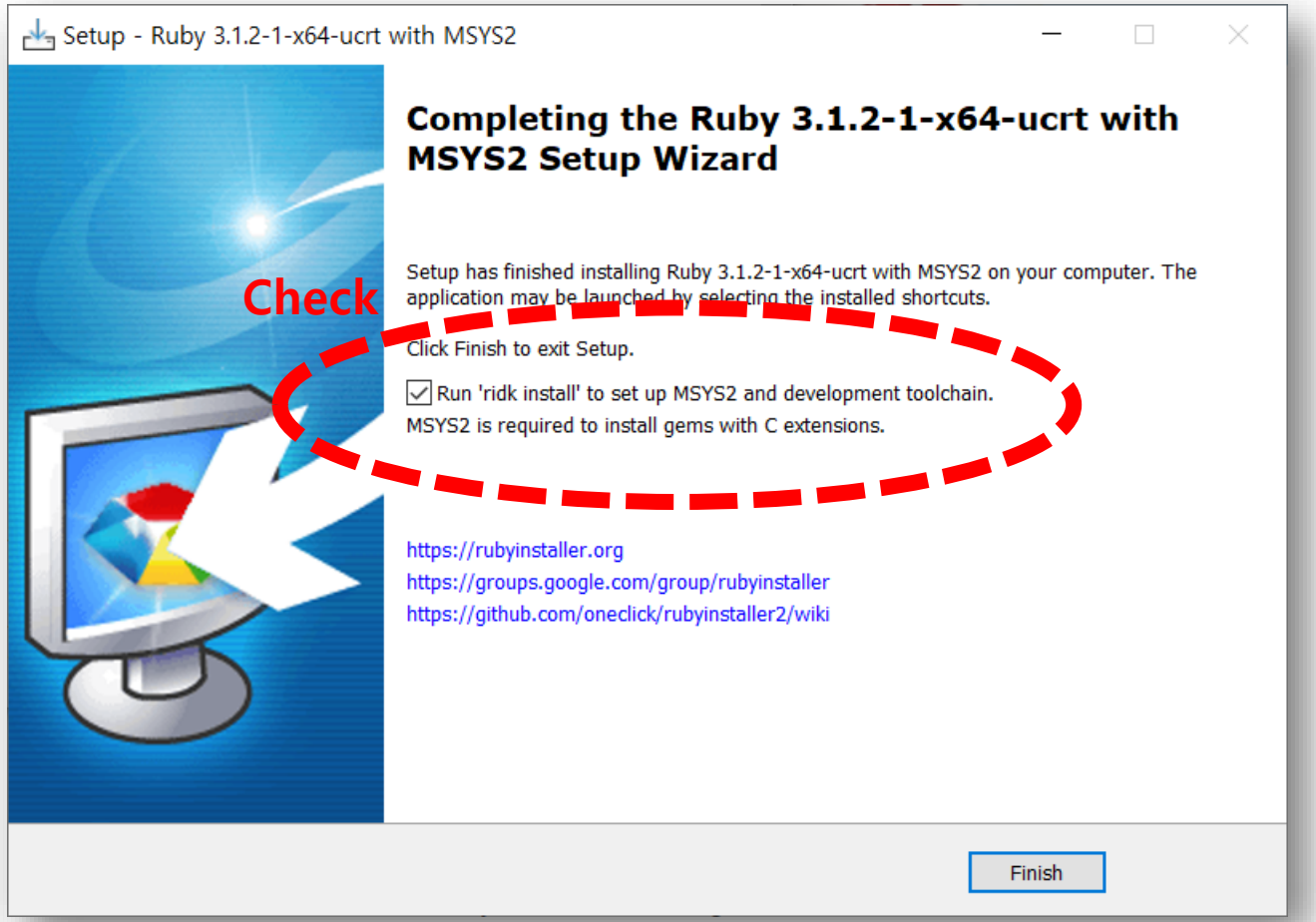
IG Publisher Installation (2)

- **Step 1 – Ruby 설치 (2)**





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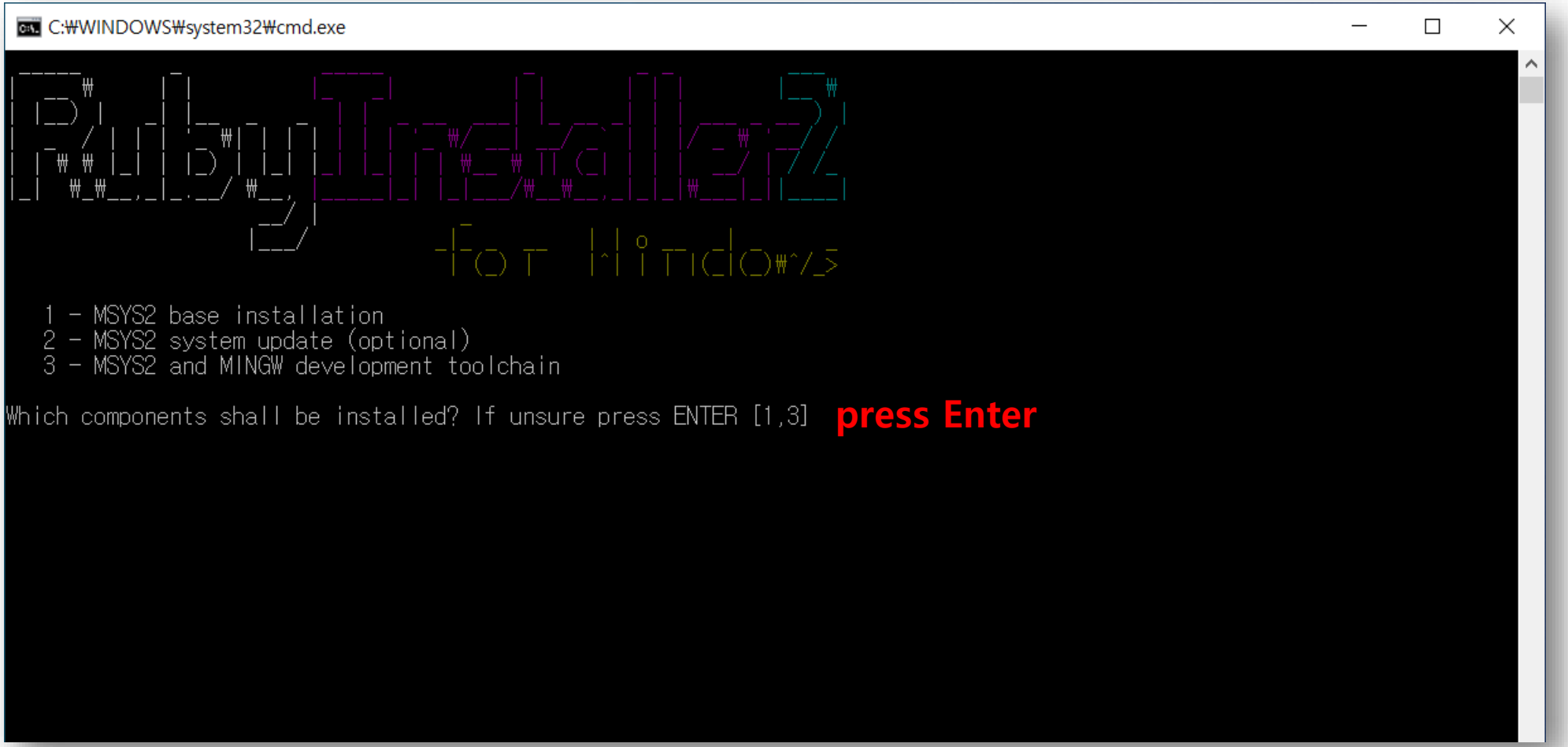
IG Publisher Installation (3)

- **Step 1 – Ruby 설치 (3)**



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IG Publisher Installation (4)

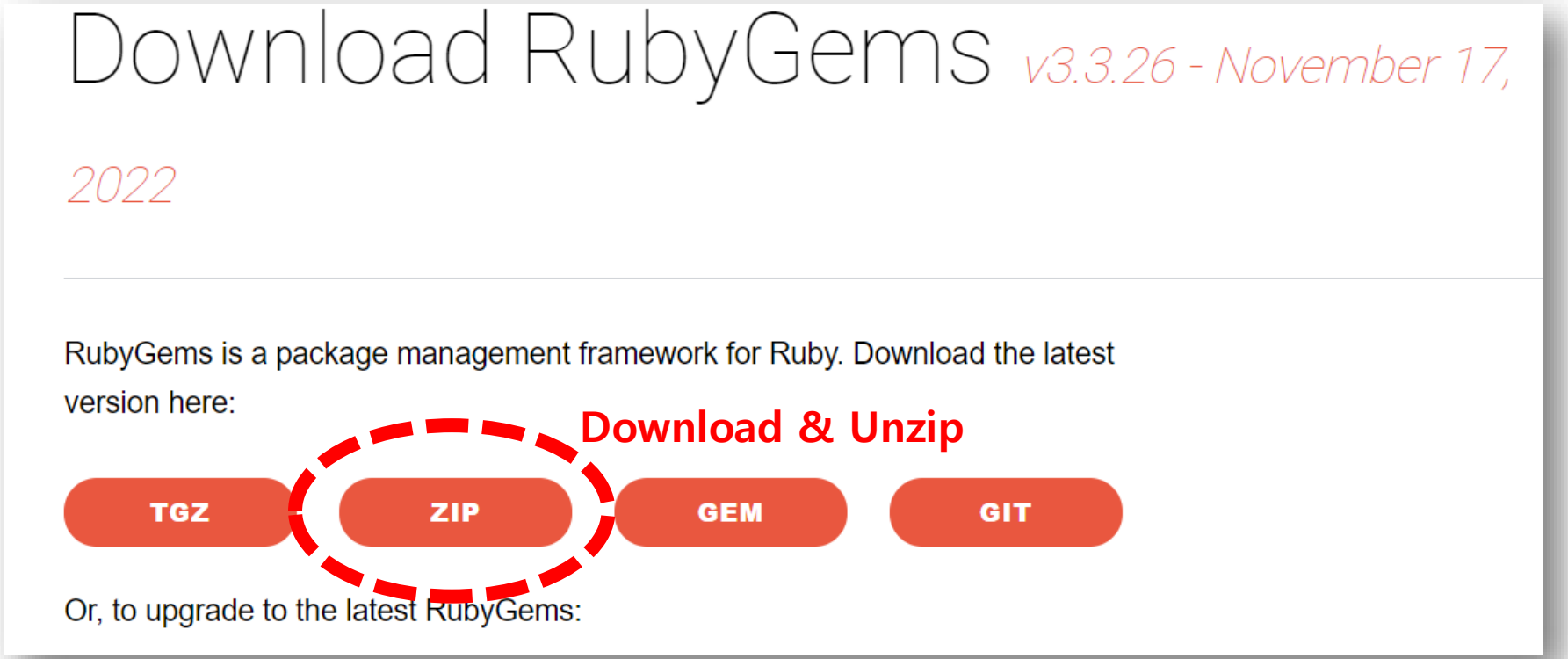
- **Step 2 – Ruby 설치 확인**
  - 명령프롬프트에서 아래 커맨드입력

```
ruby -v
```

  - Example

IG Publisher Installation (5)

- **Step 3 – RubyGems 설치 (1)**
  - https://rubygems.org/pages/download



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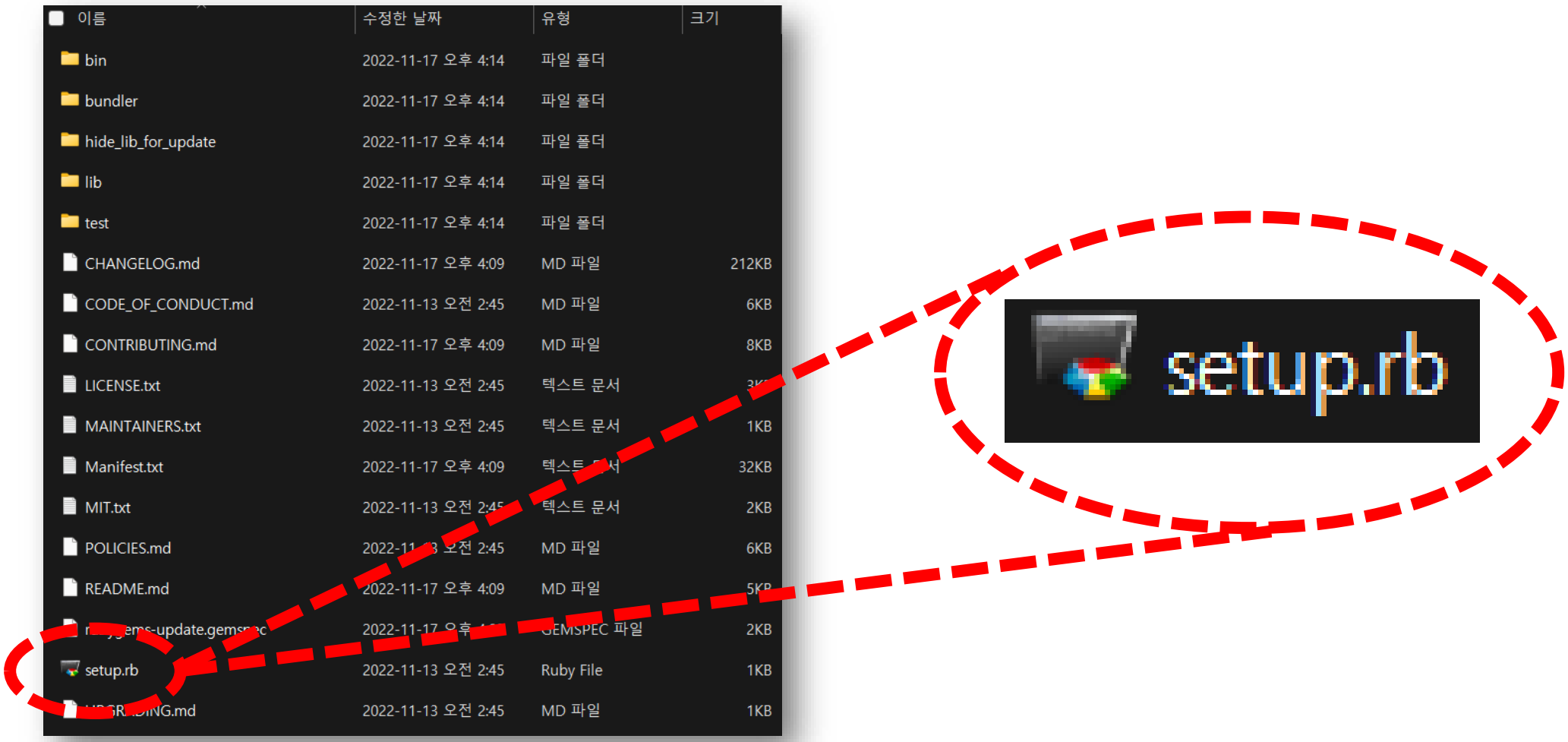
IG Publisher Installation (6)

- **Step 3 – RubyGems 설치 (2)**
  - 압축 해제 후 설치 – setup.rb



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IG Publisher Installation (7)

- **Step 4 – RubyGems 설치 확인**
  - 명령프롬프트에서 아래 커맨드입력

```
gem -v
```

  - Example

IG Publisher Installation (8)

- **Step 5 – jekyll 설치**
  - 명령프롬프트에서 아래 커맨드입력

```
gem install bundler jekyll
```

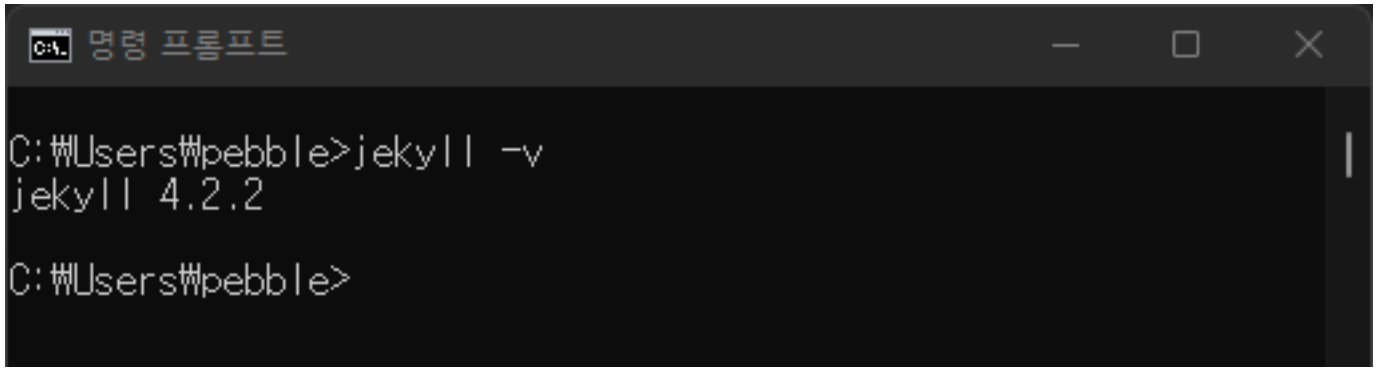
  - Example

IG Publisher Installation (7)

- **Step 6 – jekyll 설치**
  - 명령프롬프트에서 아래 커맨드입력

```
jekyll -v
```

  - Example



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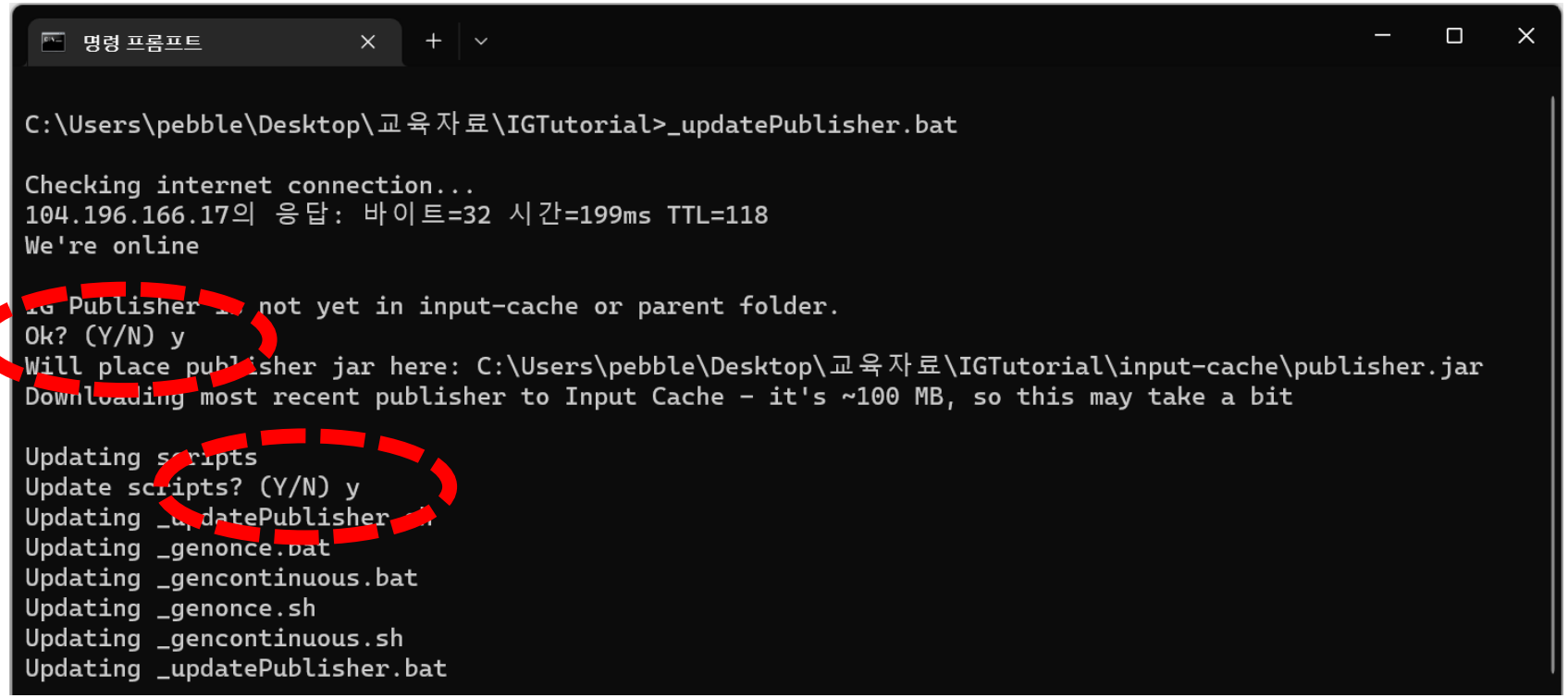
IG Publisher Installation (10)

- 명령프롬프트에서 아래 커맨드입력

※ 반드시 kr_fsh_tutorial 폴더 위치에서 입력

```
C:\...\kr_fsh_tutorial>_updatePublisher.bat
```

- Example



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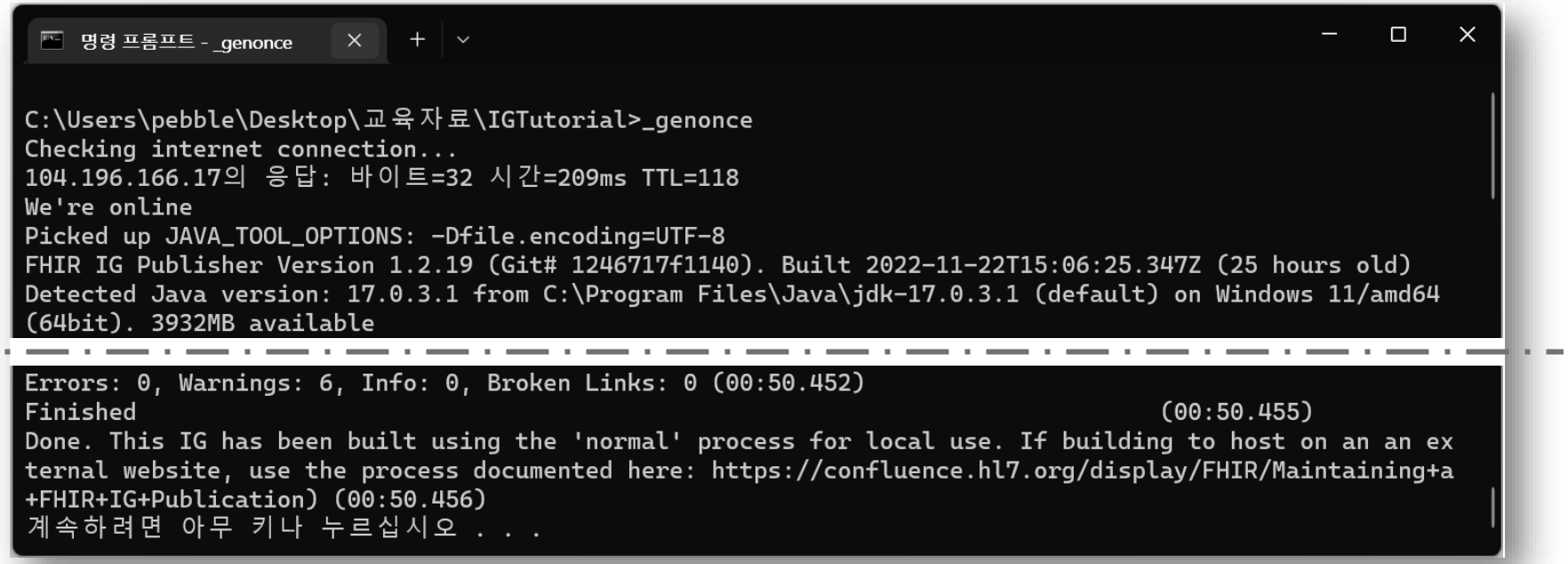
Final Check (1)

- 명령프롬프트에서 아래 커맨드입력

※ 반드시 kr_fsh_tutorial 폴더 위치에서 입력

```
C:\...\kr_fsh_tutorial>_genonce
```

- Example



Final Check (2)

<Project Structure>

```
kr_fsh_tutorial
 ├── fsh-generated New!
 │    └── ...
 ├── input
 │    ├── fsh
 │    │    ├── MyPatient.fsh
 │    │    ├── MyObservation.fsh
 │    │    └── MyObsValueSet.fsh
 │    ├── images
 │    │    └── ...
 │    ├── pagecontent
 │    │    └── ...
 │    └── ignoreWarnings.txt
 ├── input-cache New!
 │    └── ...
 ├── output New!
 │    └── ...
 ├── tutorial-template
 │    └── ...
 ├── _genonce.bat
 ├── _updatePublisher.bat
 ├── ig.ini
 ├── sushi-config.yaml
```

- 새로 생성된 폴더들 확인
  - `...\kr_fsh_tutorial\fsh-generated`
    - sushi 실행 결과로 fsh 파일에서 변환/생성된 json 형식의 FHIR 리소스들이 위치
  - `...\kr_fsh_tutorial\input-cache`
    - IG Publisher 실행 파일(publisher.jar)이 위치
    - 이 밖에 IG Publisher 실행 시 생성되는 캐시 파일들이 위치
  - `...\kr_fsh_tutorial\output`
    - IG Publisher 실행 결과로 생성된 웹 리소스들이 위치

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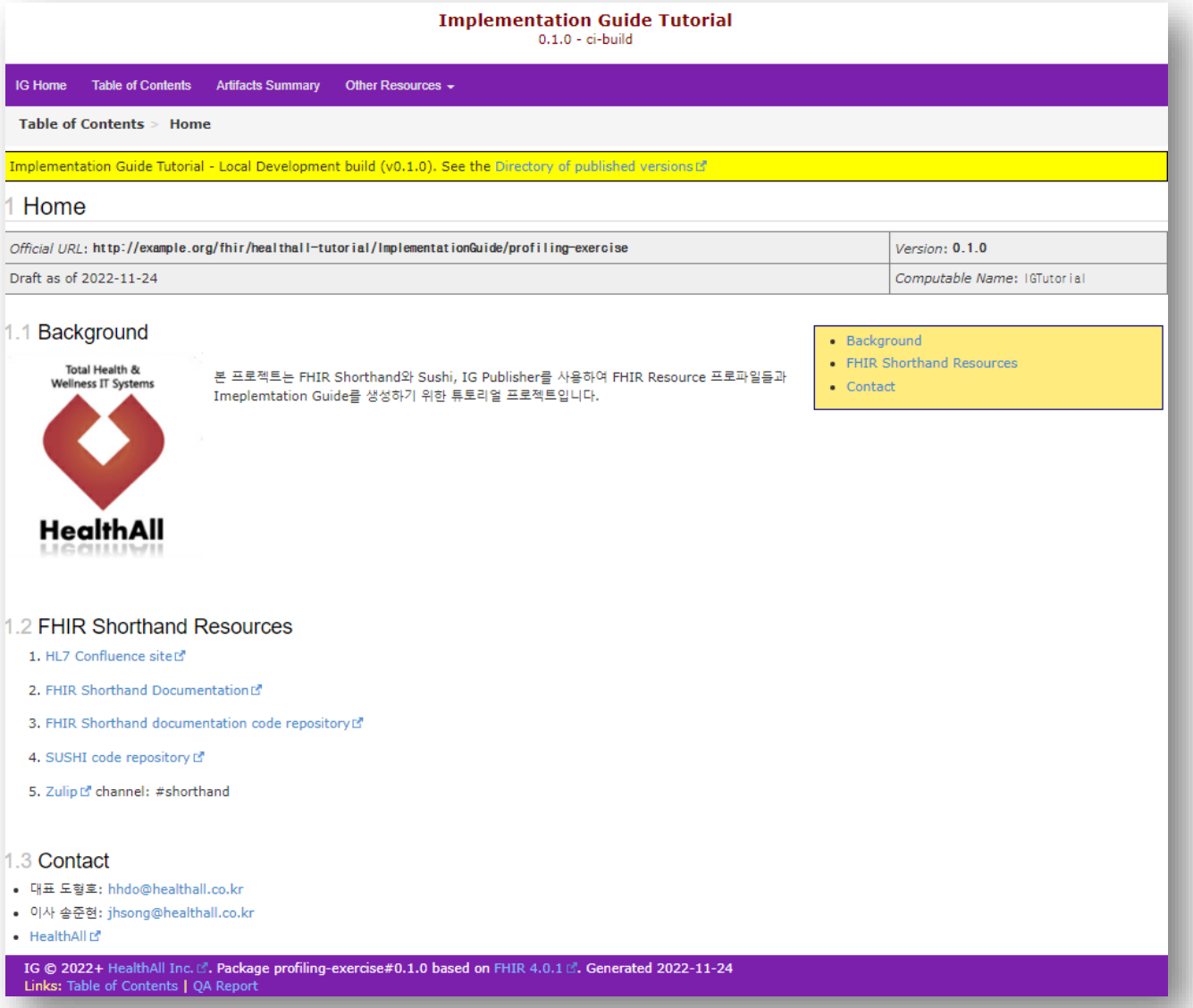
Final Check (3)

웹브라우저로 `...\kr_fsh_tutorial\output\index.html` 열기



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Profiling Tutorial

Index

- Changing Cardinality
- ValueSet Binding
- Slicing

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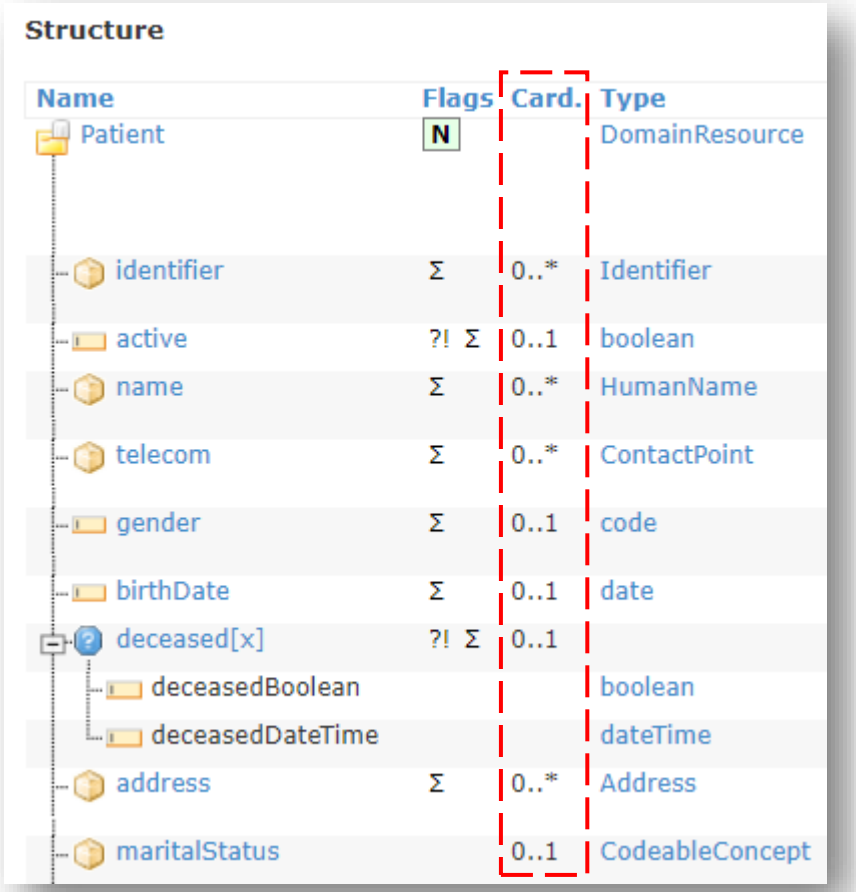
Changing Cardinality – What is Cardinality?

<Patient Resource Structure>



Structure

Name	Flags	Card.	Type
Patient	N		DomainResource
identifier	Σ	0..*	Identifier
active	?! Σ	0..1	boolean
name	Σ	0..*	HumanName
telecom	Σ	0..*	ContactPoint
gender	Σ	0..1	code
birthDate	Σ	0..1	date
deceased[x]	?! Σ	0..1	
deceasedBoolean			boolean
deceasedDateTime			dateTime
address	Σ	0..*	Address
maritalStatus		0..1	CodeableConcept

- Cardinality
  - 관계 수
  - 엘리먼트의 최소/최대 사용 횟수 정의
  - min..max
    - min : 0 or 1
    - max : 1 ~ *
  - 선택사항 엘리먼트
    - 0..n
  - 필수 엘리먼트
    - 1..1 or 1..*
  - 사용금지 엘리먼트
    - 0..0
  - Profling 과정에서 Cardinality 변경을 통해 Optionality 조정가능

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Changing Cardinality – Constraints

- Allowed Changes

base \ derived	0..0 (Not used)	0..1 (Optional)	0..n (Optional, Many)	1..1 (Required)	1..n (At least 1)
0..1	yes	-	no	yes	no
0..*	yes	yes	yes	yes	yes
1..1 (fixed)	no	no	no	-	no
1..*	no	no	no	yes	yes

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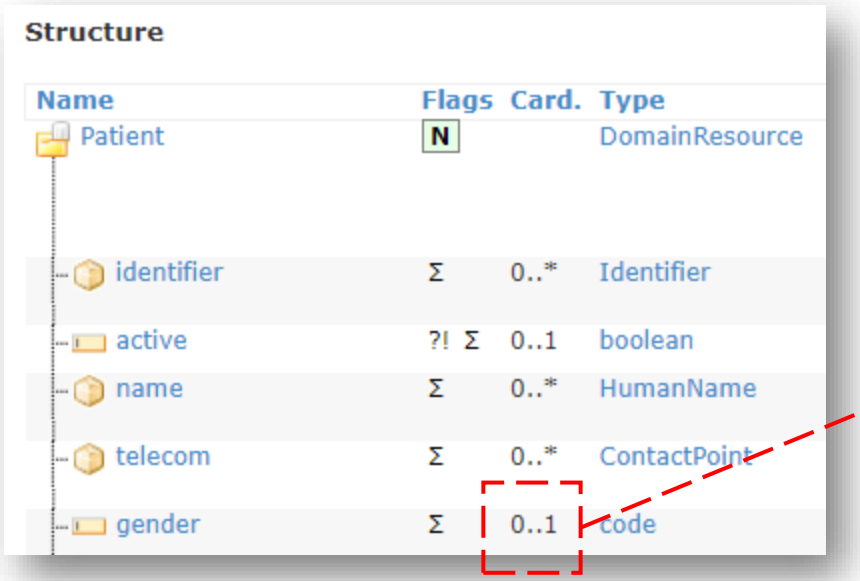
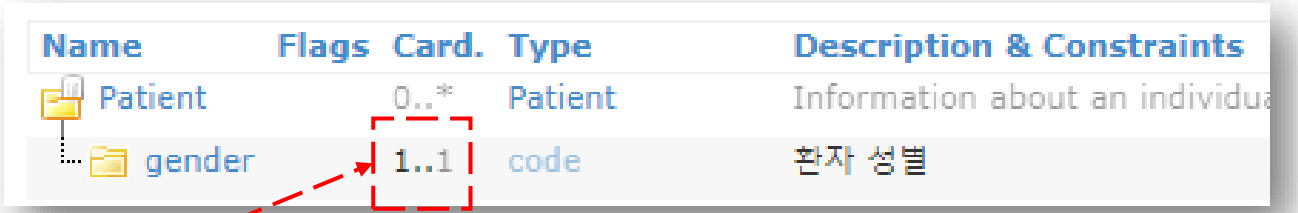
Changing Cardinality – Exercise Goal

- 실습 목표
  - Patient 리소스의 gender 엘리먼트의 최소 사용 횟수를 1로 상향
    - Patient.gender 0..* → 1..*
    - 반드시 환자 성별을 사용하도록 강제
  - +@ Patient.gender의 설명을 '환자 성별'로 수정

<Patient Resource Structure (AS-IS)>



<MyPatient Resource Structure (TO-BE)>



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Changing Cardinality – FSH (1)

MyPatient.fsh

```
Profile: MyPatient
Parent: Patient
Id: profilingtutorial-mypatient
Title: "MyPatient"
Description: "Profiling Tutorial을 위해 작성한 Patient Profile"
* gender 1.. // (== 1..1)
* gender ^short = "환자 성별"
```

```
Profile: {프로파일 명}
Parent : {프로파일링할 리소스}
* <element> {min}..{max}
* <element> ^<element of ElementDefinition> = {value}
```

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Changing Cardinality – FSH (2)

<ElementDefinition Structure>

Structure

Name	Flags	Card.	Type	Description & Constraints
ElementDefinition	Σ N		Element	Definition of an element in a resource or extension + *Rule: Min <= Max*
				Elements defined in Ancestors: id, extension, modifierExtension
path	Σ	1..1	string	Path of the element in the hierarchy of elements
representation	Σ	0..*	code	xmlAttr | xmlText | typeAttr | cdaText | xhtml PropertyRepresentation (Required)
sliceName	Σ	0..1	string	Name for this particular element (in a set of slices)
sliceIsConstraining	Σ TU	0..1	boolean	If this slice definition constrains an inherited slice definition (or not)
label	Σ	0..1	string	Name for element to display with or prompt for element
code	Σ	0..*	Coding	Corresponding codes in terminologies ElementDefinitionCode (Example)
slicing	Σ	0..1	Element	This element is sliced - slices follow
discriminator	Σ	0..*	Element	Element values that are used to distinguish the slices
type	Σ	1..1	code	value | exists | pattern | type | profile | position DiscriminatorType (Required)
path	Σ	1..1	string	Path to element value
description	Σ	0..1	string	Text description of how slicing works (or not)
ordered	Σ	0..1	boolean	If elements must be in same order as slices
rules	Σ	1..1	code	closed | open | openAtEnd SlicingRules (Required)
short	Σ	0..1	string	Concise definition for space-constrained presentation
definition	Σ	0..1	markdown	Full formal definition as narrative text
comment	Σ	0..1	markdown	Comments about the use of this element

- ElementDefinition
  - http://hl7.org/fhir/r4/elementdefinition.html
  - 엘리먼트를 정의하는 정보들

```
* gender ^short = "환자 성별"
```

  - Patient.gender의 short 값을 재정의

short Σ 0..1 string Concise definition for space-constrained presentation

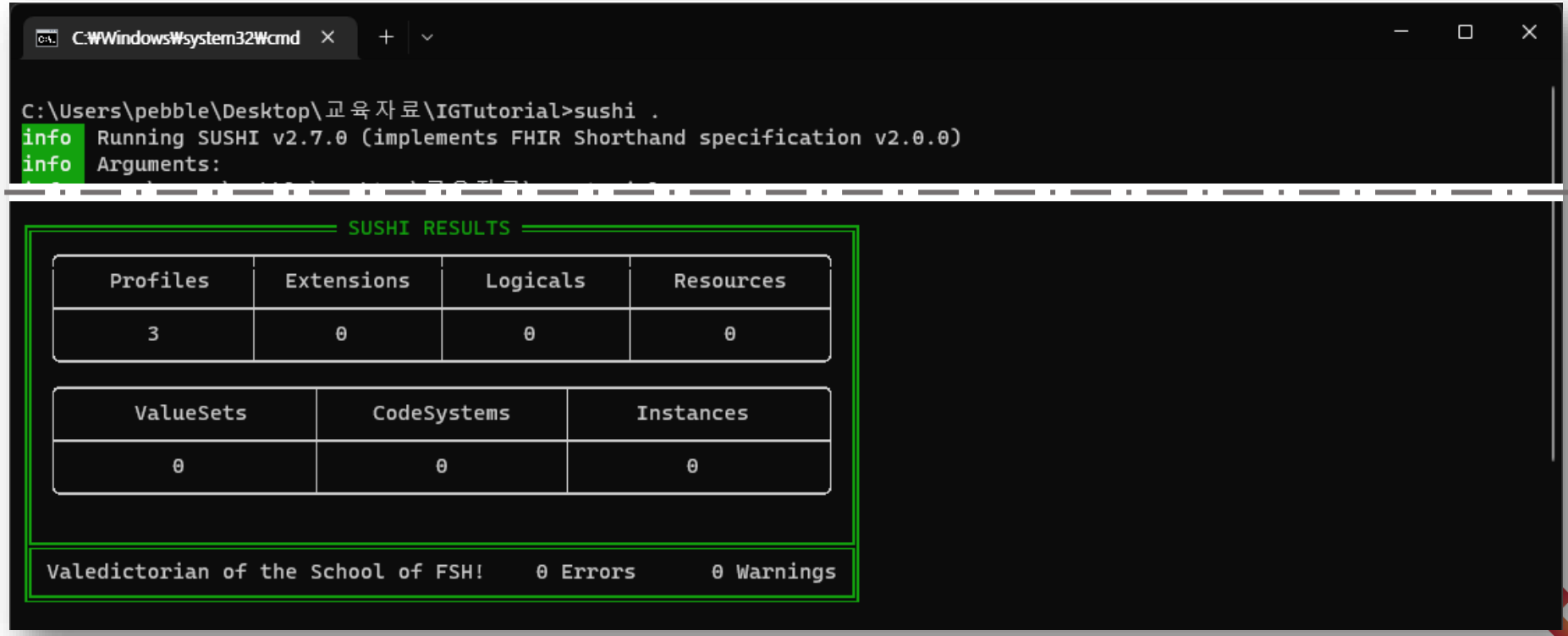
Changing Cardinality – sushi

- 명령프롬프트에서 아래 커맨드입력

※ 반드시 kr_fsh_tutorial 폴더 위치에서 입력

```
C:\...\kr_fsh_tutorial>sushi .
```

- Example



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Changing Cardinality – _genonce

- 명령프롬프트에서 아래 커맨드입력

※ 반드시 kr_fsh_tutorial 폴더 위치에서 입력

```
C:\...\kr_fsh_tutorial>_genonce
```

- Example

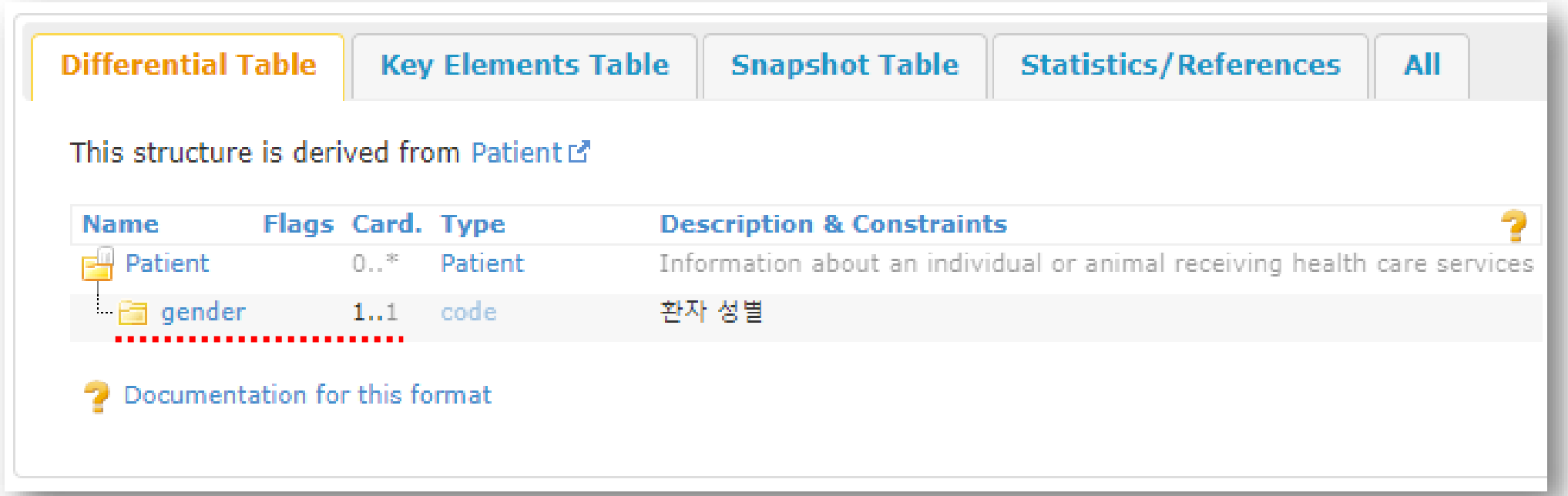
```
명령 프롬프트 - _genonce

C:\Users\pebble\Desktop\교육자료\IGTutorial>_genonce
Checking internet connection...
104.196.166.17의 응답: 바이트=32 시간=209ms TTL=118
We're online
Picked up JAVA_TOOL_OPTIONS: -Dfile.encoding=UTF-8
FHIR IG Publisher Version 1.2.19 (Git# 1246717f1140). Built 2022-11-22T15:06:25.347Z (25 hours old)
Detected Java version: 17.0.3.1 from C:\Program Files\Java\jdk-17.0.3.1 (default) on Windows 11/amd64
(64bit). 3932MB available

Errors: 0, Warnings: 6, Info: 0, Broken Links: 0 (00:50.452)
Finished                                                    (00:50.455)
Done. This IG has been built using the 'normal' process for local use. If building to host on an an ex
ternal website, use the process documented here: https://confluence.hl7.org/display/FHIR/Maintaining+a
+FHIR+IG+Publication) (00:50.456)
계속하려면 아무 키나 누르십시오 . . .
```

Changing Cardinality – Diffierntial Table in IG

- C:₩...₩kr_fsh_tutorial₩output₩index.html
  → Artifact Summary → MyPatient



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Changing Cardinality – JSON vs FSH

StructureDefinition-profilingtutorial-mypatient.json


```
{
  "resourceType": "StructureDefinition",
  "id": "profilingtutorial-mypatient",
  "extension": [
    {
      "url": "http://hl7.org/fhir/StructureDefinition/structuredefinition-category",
      "valueString": "Base.Individuals"
    },
    {
      "url": "http://hl7.org/fhir/StructureDefinition/structuredefinition-security-
category",
      "valueCode": "patient"
    }
  ],
  "url": "http://example.org/fhir/healthall-
tutorial/StructureDefinition/profilingtutorial-mypatient",
  "version": "0.1.0",
  "name": "MyPatient",
  "title": "MyPatient",
  "status": "active",
  "description": "Profiling Tutorial을 위해 작성한 Patient Profile",
  "fhirVersion": "4.0.1",
  "mapping": [
    {
      "identity": "rim",
      "uri": "http://hl7.org/v3",
      "name": "RIM Mapping"
    },
    {
      "identity": "cda",
      "uri": "http://hl7.org/v3/cda",
      "name": "CDA (R2)"
    },
    {
      "identity": "w5",
      "uri": "http://hl7.org/fhir/fivews",
      "name": "FiveWs Pattern Mapping"
    },
    {
      "identity": "v2",
      "uri": "http://hl7.org/v2",
      "name": "HL7 v2 Mapping"
    },
    {
      "identity": "loinc",
      "uri": "http://loinc.org",
      "name": "LOINC code for the element"
    }
  ],
  "kind": "resource",
  "abstract": false,
  "type": "Patient",
  "baseDefinition": "http://hl7.org/fhir/StructureDefinition/Patient",
  "derivation": "constraint",
  "differential": {
    "element": [
      {
        "id": "Patient.gender",
        "path": "Patient.gender",
        "short": "환자 성별",
        "min": 1
      }
    ]
  }
}
```


VS

MyPatient.fsh

```
Profile: MyPatient
Parent: Patient
Id: profilingtutorial-mypatient
Title: "MyPatient"
Description: "Profiling Tutorial을 위해 작성한 Patient Profile"
* gender 1.. // (== 1..*)
* gender ^short = "환자 성별"
```

ValueSet Binding – What is ValueSet?

- CodeSystem
  - 코드 체계
  - ex) LOINC, SNOMED-CT, MDC(11073-10101)

- Code
  - 개념을 코드화 시킨 것
  - ex) Code: 85354-9
    Display: Blood pressure panel with all children optional
    CodeSystem: LOINC

- ValueSet
  - 하나 이상의 코드 체계의 부분 집합

- ValueSet Binding
  - 코드 값을 사용하는 엘리먼트에 사용할 ValueSet을 묶어두는 것

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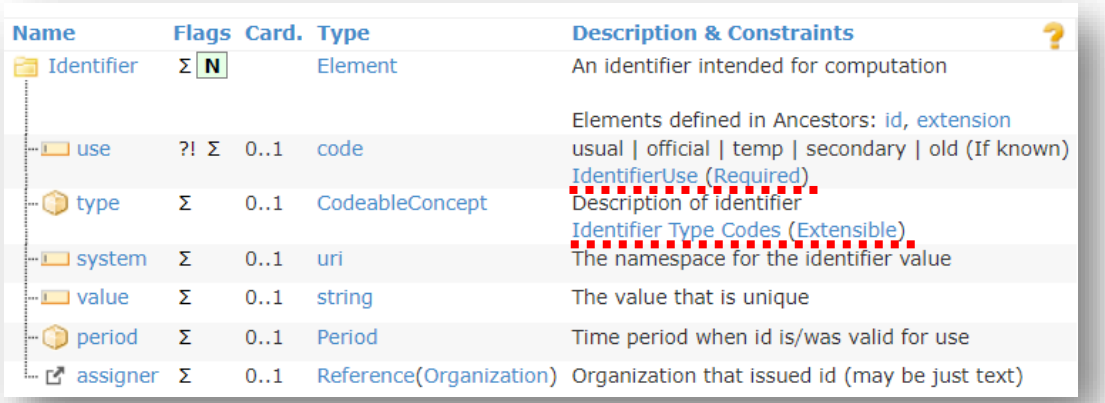
ValueSet Binding – Binding Strength

- Binding Strength
  - required - ValueSet 내 코드만 사용할 수 있음
  - extensible - ValueSet 내 코드 + 그 외 코드 사용 가능
    - 단, 기본 ValueSet 내 코드와 의미가 겹치는 다른 코드는 사용 불가능
  - preferred - ValueSet 내 코드 사용 선호
  - example - 코드 사용 예로 ValueSet을 제시한 것

<Identifier>



Name	Flags	Card.	Type	Description & Constraints
Identifier	Σ N		Element	An identifier intended for computation Elements defined in Ancestors: id, extension
use	?! Σ	0..1	code	usual | official | temp | secondary | old (If known) IdentifierUse (Required)
type	Σ	0..1	CodeableConcept	Description of identifier Identifier Type Codes (Extensible)
system	Σ	0..1	uri	The namespace for the identifier value
value	Σ	0..1	string	The value that is unique
period	Σ	0..1	Period	Time period when id is/was valid for use
assigner	Σ	0..1	Reference(Organization)	Organization that issued id (may be just text)

- Allowed Changes

base \ derived	required	extensible	prefered	example
required	yes	no	no	no
extensible	yes	yes	no	no
prefered	yes	yes	yes	no
example	yes	yes	yes	yes

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ValueSet Binding – Exercise Goal

- 실습 목표
  - Observation.code에 ValueSet 바인딩
  - Tutorial Project 내 MyObsCodeSystem, MyObsValueSet 사용

<Observation Resource Structure (AS-IS)>

Name	Flags	Card.	Type	Description & Constraints
Observation	I N		DomainResource	Measurements and simple assertions + *Rule: dataAbsentReason SHALL only be*
code	Σ	1..1	CodeableConcept	Type of observation (code / type) LOINC Codes (Example)

<MyObservation Resource Structure (TO-BE)>

Name	Flags	Card.	Type	Description & Constraints
Observation		0..*	Observation	Measurements and simple assertions
code		1..1	CodeableConcept	생체징후 측정 코드 **Binding:** Observation Codes for Tutorial (extensible): Observation Codes for Tutorial
coding		0..*	Coding	정의된 코드
system		1..1	uri	코드체계 식별자
code		1..1	code	코드값
display		0..1	string	코드명칭

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CodeSystem – FSH

MyObsCodeSystem.fsh

```
CodeSystem: MyObsCodeSystem
Id: profilingtutorial-myobscodesystem
Title: "Observation CodeSystem for Tutorial"
Description: "Profiling Tutorial을 위해 작성한 CodeSystem"
* ^experimental = false
* ^caseSensitive = false
* ^content = #complete

* #heart_rate "심박수"
* #body_temperature "체온"
* #sp_o2 "산소포화도"
* #blood_pressure "혈압"
* #body_weight "체중"
* #body_height "신장"
```

```
* #{code} "{display string}"
```

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ValueSet – FSH

MyObsValueSet.fsh

```
ValueSet: MyObsValueSet
Id: profilingtutorial-myobsvalueset
Title: "Observation ValueSet for Tutorial"
Description: "Profiling Tutorial을 위해 작성한 ValueSet"

* include MyObsCodeSystem#heart_rate
* include MyObsCodeSystem#body_temperature
* include MyObsCodeSystem#sp_o2
* include MyObsCodeSystem#blood_pressure
* include MyObsCodeSystem#body_weight
* include MyObsCodeSystem#body_height "키"
```

```
* include {Coding}
```

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ValueSet Binding – FSH

MyObservation.fsh

```
Profile: MyObservation
Parent: Observation
Id: profilingtutorial-myobservation
Title: "MyObservation"
Description: "Profiling Tutorial을 위해 작성한 Observation Profile"
* code ^short = "생체징후 측정 코드"
* code from MyObsValueSet (extensible)
* code ^binding.description = "Observation Codes for Tutorial"
* code.coding ^short = "정의된 코드"
* code.coding.system 1..
* code.coding.system ^short = "코드체계 식별자"
* code.coding.code 1..
* code.coding.code ^short = "코드값"
* code.coding.display ^short = "코드명칭"
```

```
* <bindable element> from {ValueSet} ({strength})
```

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ValueSet Binding – Diffierntial Table in IG

- C:₩...₩kr_fsh_tutorial₩output₩index.html
  → Artifact Summary → MyObservation

Name	Flags	Card.	Type	Description & Constraints
Observation		0..*	Observation	Measurements and simple assertions
code		1..1	CodeableConcept	생체징후 측정 코드 **Binding:** Observation Codes for Tutorial (extensible): Observation Codes for Tutorial
coding		0..*	Coding	정의된 코드
system		1..1	uri	코드체계 식별자
code		1..1	code	코드값
display		0..1	string	코드명칭

<MyObsValueSet>

2.3.1.1 Logical Definition (CLD)

- Include these codes as defined in `http://example.org/fhir/healthall-tutorial/CodeSystem/profilingtutorial-myobscodesystem`

Code	Display
heart_rate	심박수
body_temperature	체온
sp_o2	산소포화도
blood_pressure	혈압
body_weight	체중
body_height	키

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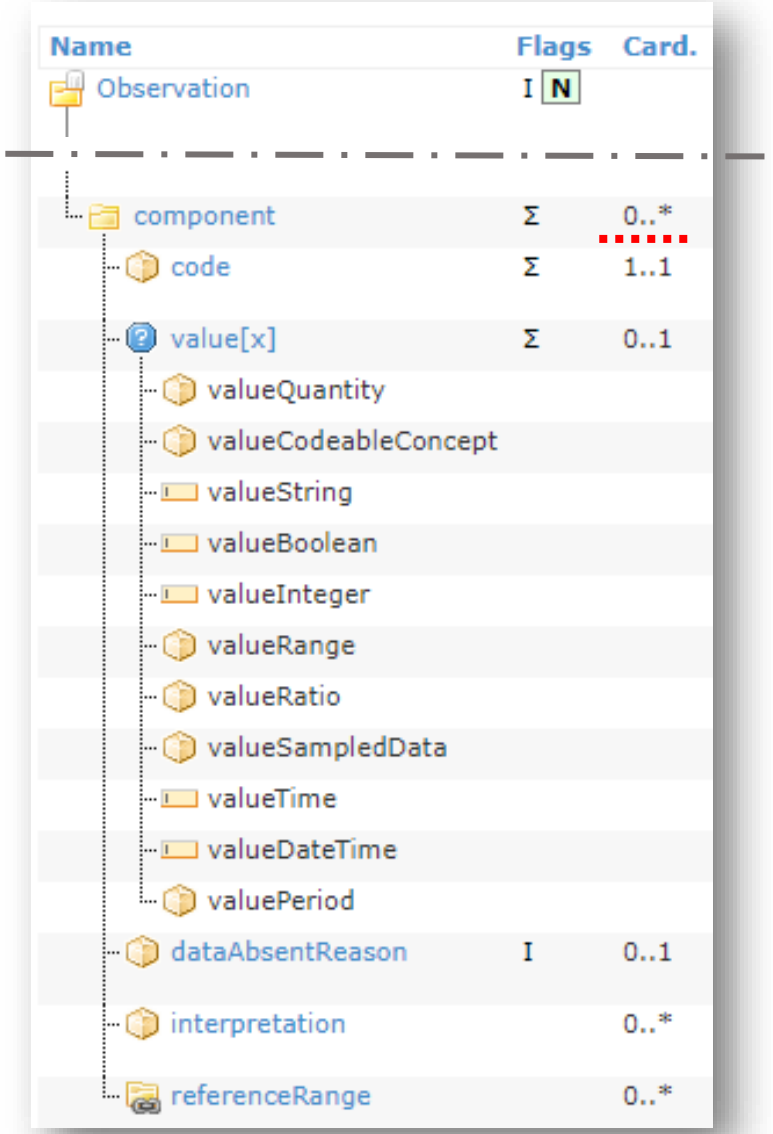
Slicing – What is Slicing?

- Slicing
  - 여러 번 사용할 수 있는 엘리먼트의 세부 유형을 분할하여 정의

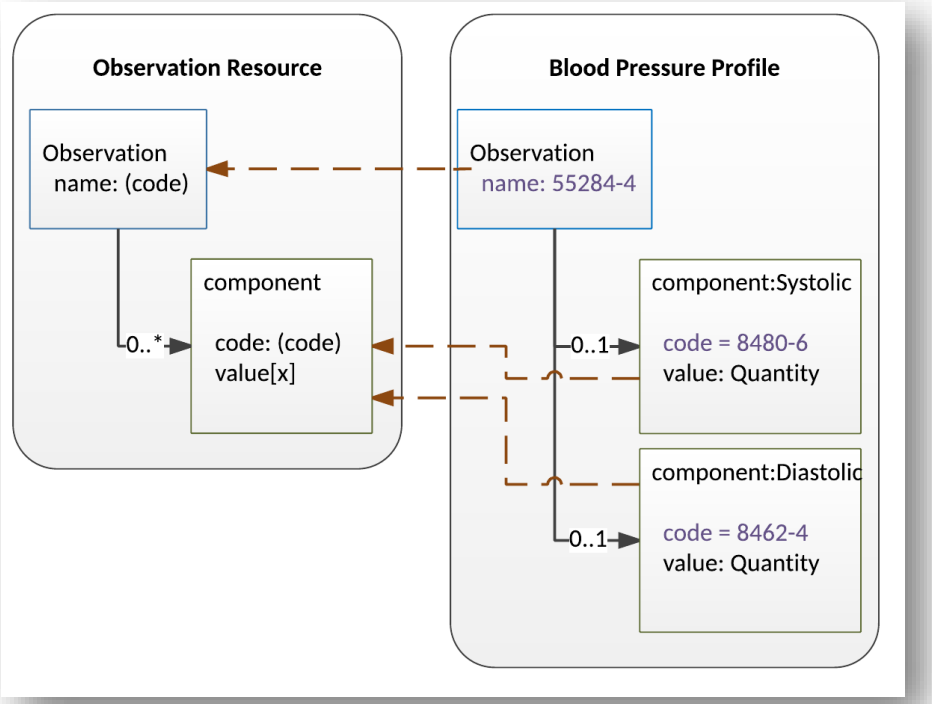
  - list:Any
    ↓
    list:String
    list:Integer

  - 예) 혈압 측정 결과
    - 혈압 측정시 최대 혈압(Systolic)과 최소 혈압(Diastolic)이 동시에 측정됨
    - component를 component:Systolic component:Diastolic 두 개의 유형으로 정의

<Observation Resource Structure>



<Slicing>



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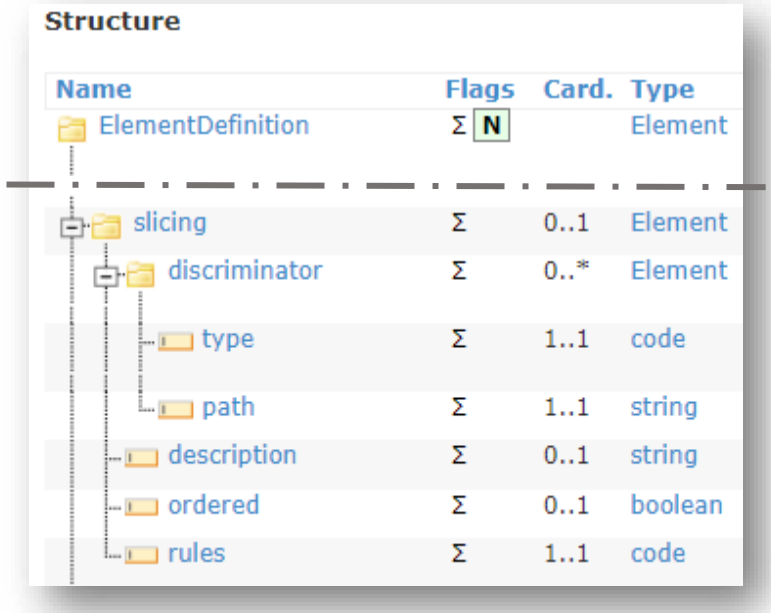
Slicing – parameters

- discriminator.path
  - FhirPath
  - 슬라이싱 기준 엘리먼트의 위치를 설명

<ElementDefinition Structure>



- discriminator.type

  value | *exists* | *pattern* | *type* | *profile*
  - 슬라이싱 기준. 어떤 기준으로 원본과 차별화를 할 것인가?

- rules

  closed | *open* | *openAtEnd*
  - 엘리먼트를 기본 정의(default slicing) 대로 사용하는 것을 허용할 것인지?
    + 프로파일에서 정의한 슬라이싱 외에 다른 슬라이싱을 허용할 것인지?

- ordered (default: false)

  true or false
  - 프로파일에서 정의한 슬라이싱의 순서대로 사용하도록 강제할 것인지?

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Slicing – Exercise Goal

- 실습 목표
  - Observation.componenet를 Systolic과 Diastolic으로 슬라이싱

<Patient Resource Structure (AS-IS)>

Name	Flags	Card.
Observation	I N	
component	Σ	0..*
code	Σ	1..1
value[x]	Σ	0..1
valueQuantity		
valueCodeableConcept		
valueString		
valueBoolean		
valueInteger		
valueRange		
valueRatio		
valueSampledData		
valueTime		
valueDateTime		
valuePeriod		
dataAbsentReason	I	0..1
interpretation		0..*
referenceRange		0..*

<MyPatient Resource Structure (TO-BE)>

Name	Flags	Card.	Type	Description & Constraints
Observation		0..*	Observation	Measurements and simple assertions
Slices for component		*1..**	*BackboneElement*	*혈압 측정 결과.* **Slice:** *Unordered, Open by value:code.coding.code*
component:Systolic		0..1	BackboneElement	수축기 혈압 측정.
code				
coding				
system		0..1	uri	Identity of the terminology system **Fixed Value:** urn:iso:std:iso:11073:10101
code		1..1	code	Symbol in syntax defined by the system **Fixed Value:** 150021
value[x]		0..1	Quantity	Actual component result
value		1..1	decimal	Numerical value (with implicit precision)
system		1..1	uri	System that defines coded unit form **Fixed Value:** http://unitsofmeasure.org
code		1..1	code	Coded form of the unit **Fixed Value:** mm[Hg]
component:Diastolic		0..1	BackboneElement	이완기 혈압 측정.
code				
coding				
system		0..1	uri	Identity of the terminology system **Fixed Value:** urn:iso:std:iso:11073:10101
code		1..1	code	Symbol in syntax defined by the system **Fixed Value:** 150022
value[x]		0..1	Quantity	Actual component result
value		1..1	decimal	Numerical value (with implicit precision)
system		1..1	uri	System that defines coded unit form **Fixed Value:** http://unitsofmeasure.org
code		1..1	code	Coded form of the unit **Fixed Value:** mm[Hg]

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Slicing – FSH (1)

MyObservation.fsh

```
Profile: MyObservation
Parent: Observation
/* 생략... */
* component 1..
* component ^short = "혈압 측정 결과."
* component ^slicing.discriminator.type = #value
* component ^slicing.discriminator.path = "code.coding.code"
* component ^slicing.rules = #open
* component contains
    Systolic 0..1 and
    Diastolic 0..1
//  Systolic: 수축기
* component[Systolic] ^short = "수축기 혈압 측정."
* component[Systolic].code.coding.system = "http://loinc.org" (exactly)
* component[Systolic].code.coding.code 1..1
* component[Systolic].code.coding.code = #8480-6 (exactly)
* component[Systolic].value[x] only Quantity
* component[Systolic].value[x].value 1..1
* component[Systolic].value[x].system 1..1
* component[Systolic].value[x].system = "http://unitsofmeasure.org" (exactly)
* component[Systolic].value[x].code 1..1
* component[Systolic].value[x].code = #mm[Hg] (exactly)
//  Diastolic: 이완기
* component[Diastolic] ^short = "이완기 혈압 측정."
* component[Diastolic].code.coding.system = "http://loinc.org" (exactly)
* component[Diastolic].code.coding.code 1..1
* component[Diastolic].code.coding.code = #8462-4 (exactly)
* component[Diastolic].value[x] only Quantity
* component[Diastolic].value[x].value 1..1
* component[Diastolic].value[x].system 1..1
* component[Diastolic].value[x].system = "http://unitsofmeasure.org" (exactly)
* component[Diastolic].value[x].code 1..1
* component[Diastolic].value[x].code = #mm[Hg] (exactly)
```

- component는 반드시 1회 이상 사용되어야 함
- `Observation.component.code.coding.code`의 값(`value`)를 기준으로 슬라이싱
- component를 기본 정의 대로 사용하는 것도 허락함(`open`)
- 슬라이싱의 이름은 `Systolic`과 `Diastolic`
- Systolic과 Diastolic은 각각 최대 1회 사용가능

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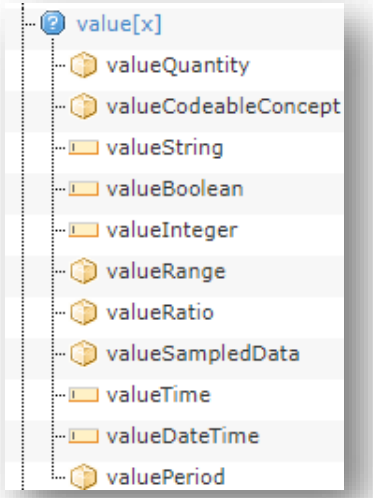
Slicing – FSH (2)

MyObservation.fsh

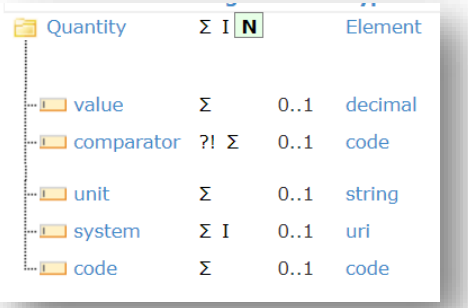
```
Profile: MyObservation
Parent: Observation
/* 생략... */
* component 1..
* component ^short = "혈압 측정 결과."
* component ^slicing.discriminator.type = #value
* component ^slicing.discriminator.path = "code.coding.code"
* component ^slicing.rules = #open
* component contains
    Systolic 0..1 and
    Diastolic 0..1
//  Systolic: 수축기
* component[Systolic] ^short = "수축기 혈압 측정."
* component[Systolic].code.coding.system = "http://loinc.org" (exactly)
* component[Systolic].code.coding.code 1..1
* component[Systolic].code.coding.code = #8480-6 (exactly)
* component[Systolic].value[x] only Quantity
* component[Systolic].value[x].value 1..1
* component[Systolic].value[x].system 1..1
* component[Systolic].value[x].system = "http://unitsofmeasure.org" (exactly)
* component[Systolic].value[x].code 1..1
* component[Systolic].value[x].code = #mm[Hg] (exactly)
//  Diastolic: 이완기
* component[Diastolic] ^short = "이완기 혈압 측정."
* component[Diastolic].code.coding.system = "http://loinc.org" (exactly)
* component[Diastolic].code.coding.code 1..1
* component[Diastolic].code.coding.code = #8462-4 (exactly)
* component[Diastolic].value[x] only Quantity
* component[Diastolic].value[x].value 1..1
* component[Diastolic].value[x].system 1..1
* component[Diastolic].value[x].system = "http://unitsofmeasure.org" (exactly)
* component[Diastolic].value[x].code 1..1
* component[Diastolic].value[x].code = #mm[Hg] (exactly)
```

- 측정 종류(Systolic)를 식별하기 위한 코드 체계는 http://loinc.org를 사용
- 측정 종류 식별 코드는 8480-6
- 측정 값 유형은 Quantity를 사용
  - valueQuantity: 측정 값(value)과 측정 단위(unit)로 구성

<Choice of Datatype>



<Quantity>



- 측정 단위를 식별하기 위한 코드 체계는 http://unitsofmeasure.org를 사용
- 측정 단위 식별 코드는 mm[Hg]

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Slicing – Diffierntial Table in IG

- C:₩…₩kr_fsh_tutorial₩output₩index.html
  → Artifact Summary → MyObservation

Name	Flags	Card.	Type	Description & Constraints
Observation		0..*	Observation	Measurements and simple assertions
Slices for component		*1..**	*BackboneElement*	*혈압 측정 결과.* ***Slice:*** *Unordered, Open by value:code.coding.code*
component:Systolic		0..1	BackboneElement	수축기 혈압 측정.
code				
coding				
system		0..1	uri	Identity of the terminology system **Fixed Value:** urn:iso:std:iso:11073:10101
code		1..1	code	Symbol in syntax defined by the system **Fixed Value:** 150021
value[x]		0..1	Quantity	Actual component result
value		1..1	decimal	Numerical value (with implicit precision)
system		1..1	uri	System that defines coded unit form **Fixed Value:** http://unitsofmeasure.org
code		1..1	code	Coded form of the unit **Fixed Value:** mm[Hg]
component:Diastolic		0..1	BackboneElement	이완기 혈압 측정.
code				
coding				
system		0..1	uri	Identity of the terminology system **Fixed Value:** urn:iso:std:iso:11073:10101
code		1..1	code	Symbol in syntax defined by the system **Fixed Value:** 150022
value[x]		0..1	Quantity	Actual component result
value		1..1	decimal	Numerical value (with implicit precision)
system		1..1	uri	System that defines coded unit form **Fixed Value:** http://unitsofmeasure.org
code		1..1	code	Coded form of the unit **Fixed Value:** mm[Hg]

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Download Package

- Package
  - StructureDefinition, CodeSystem, ValueSet, Example 등이 포함 된 압축파일
  - `...\kr_fsh_tutorial\output\package.tgz`
  - 또는 index 페이지에서 다운로드 (IG 별로 다름)

  - 이어지는 실습에서, Package에 포함된 파일들로 FHIR Server에 IG 로드 예정

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FHIR Server

with HAPI FHIR

HealthAll 책임연구원 전 형 석

목차

- **Installation**
  - Postman
  - Spring Tool Suite
- **HAPI FHIR JPA Server:**
  - Download
  - Import & Configuration
  - Run
- **FHIR Server Test (Postman)**
  - Import the tutorial collection
  - CRUDS Operation
- Upload Tutorial IG on a FHIR Server
  - Upload conformance resources
  - Resource instance validation against Profiles

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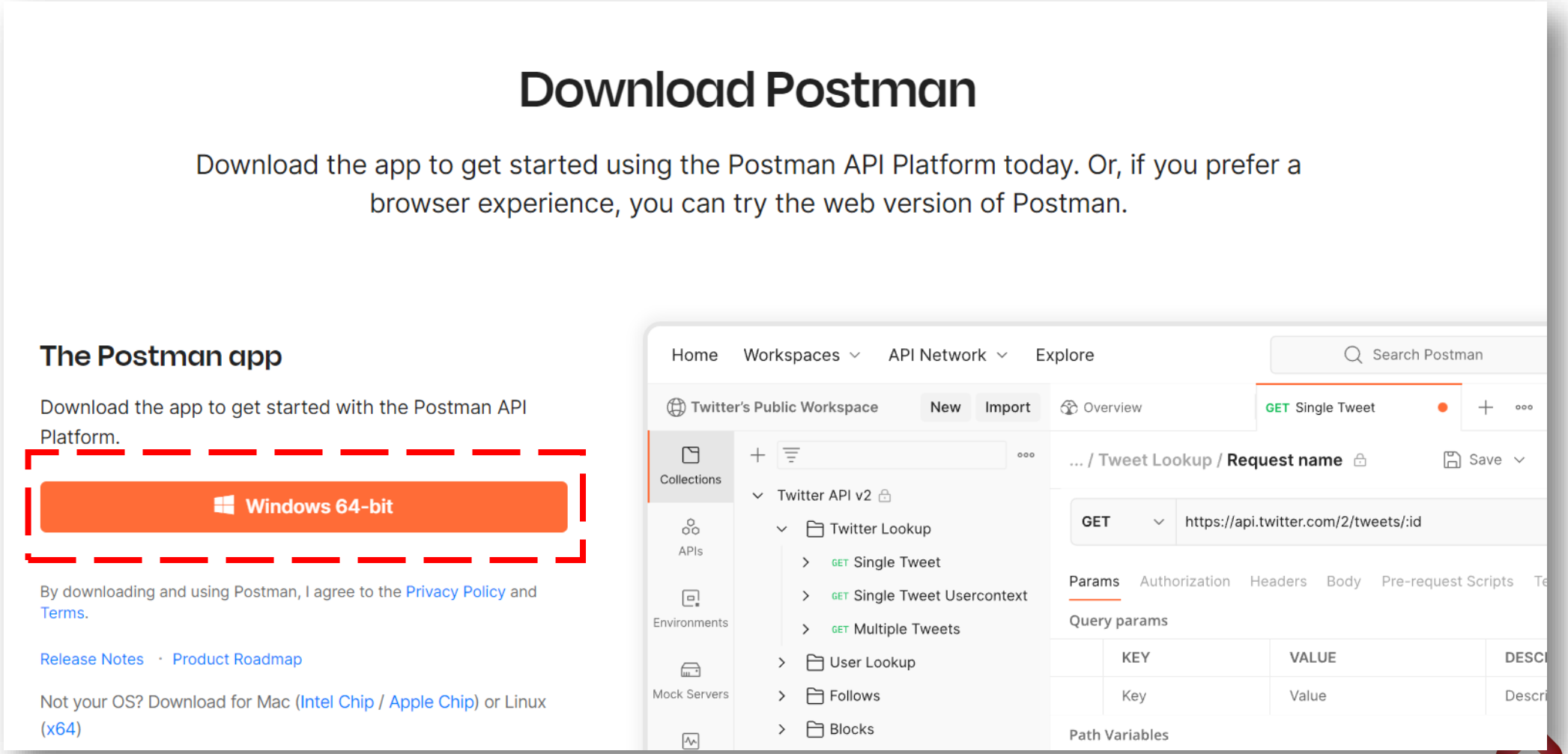
Download & Install Postman

- https://www.postman.com/downloads/



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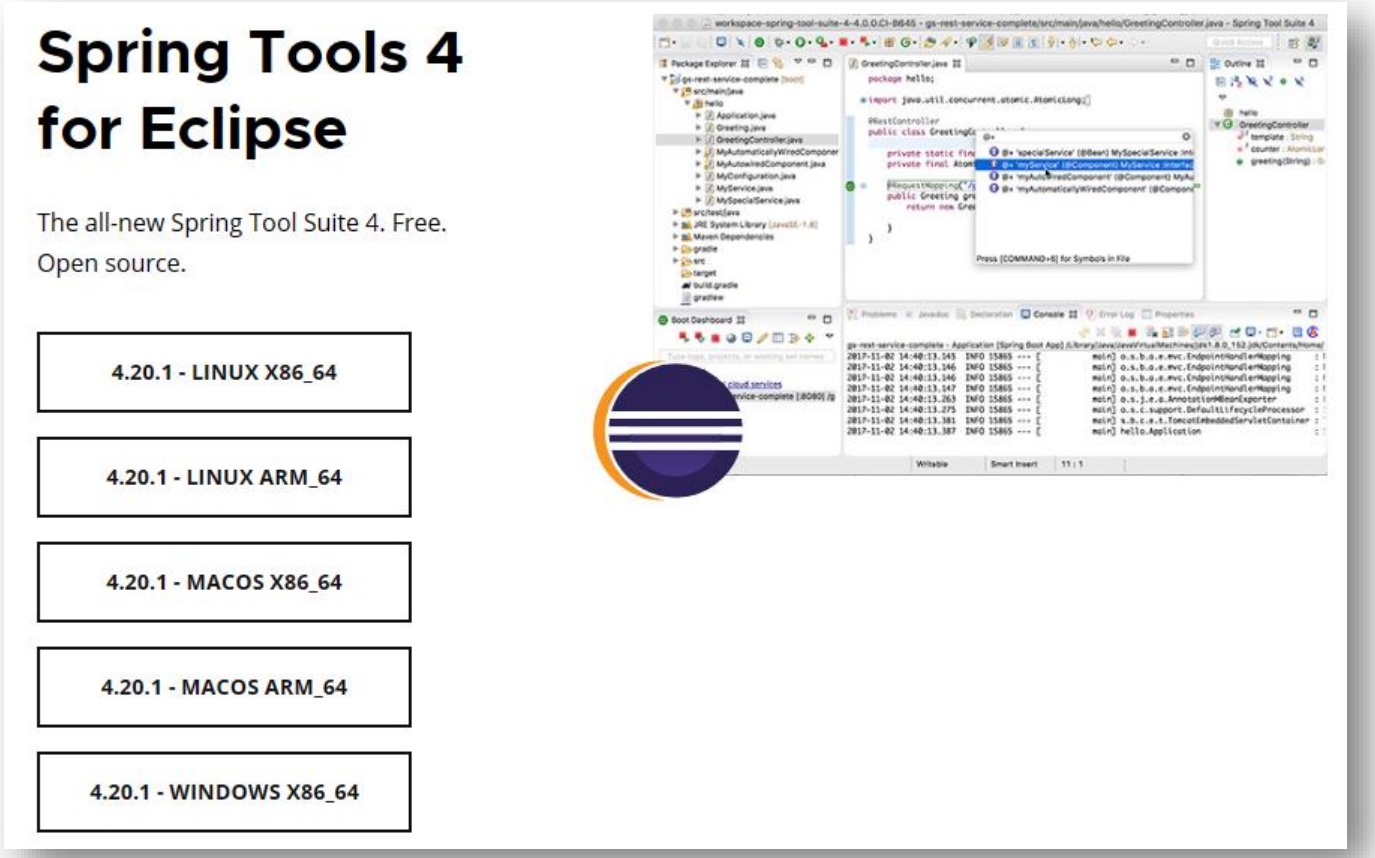
Download Spring Tool Suite (STS)

- Spring Tool Suite
  - Eclipse 기반 IDE
  - Spring Framework 기반 서버 프로그래밍에 최적화
  - 링크: https://spring.io/tools



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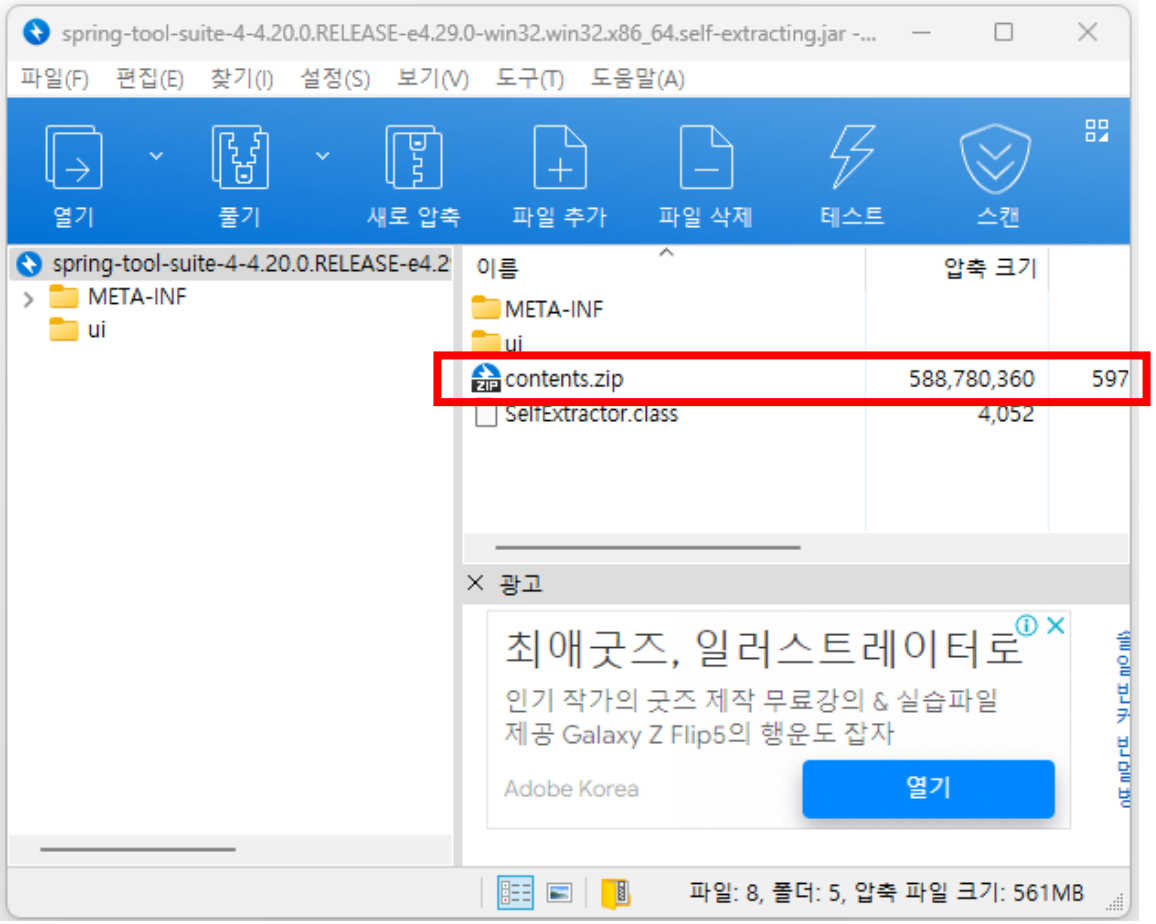
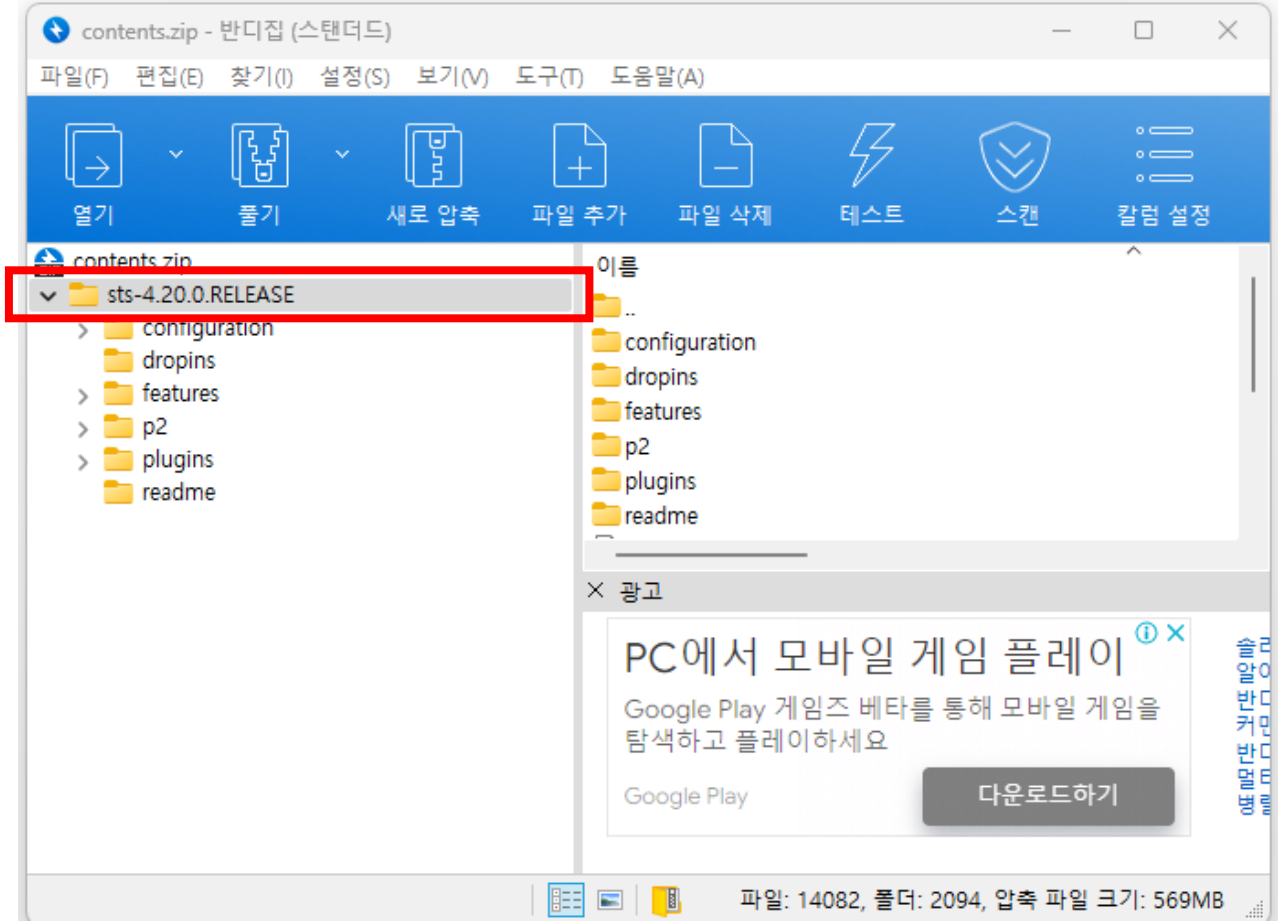
STS 압축 해제





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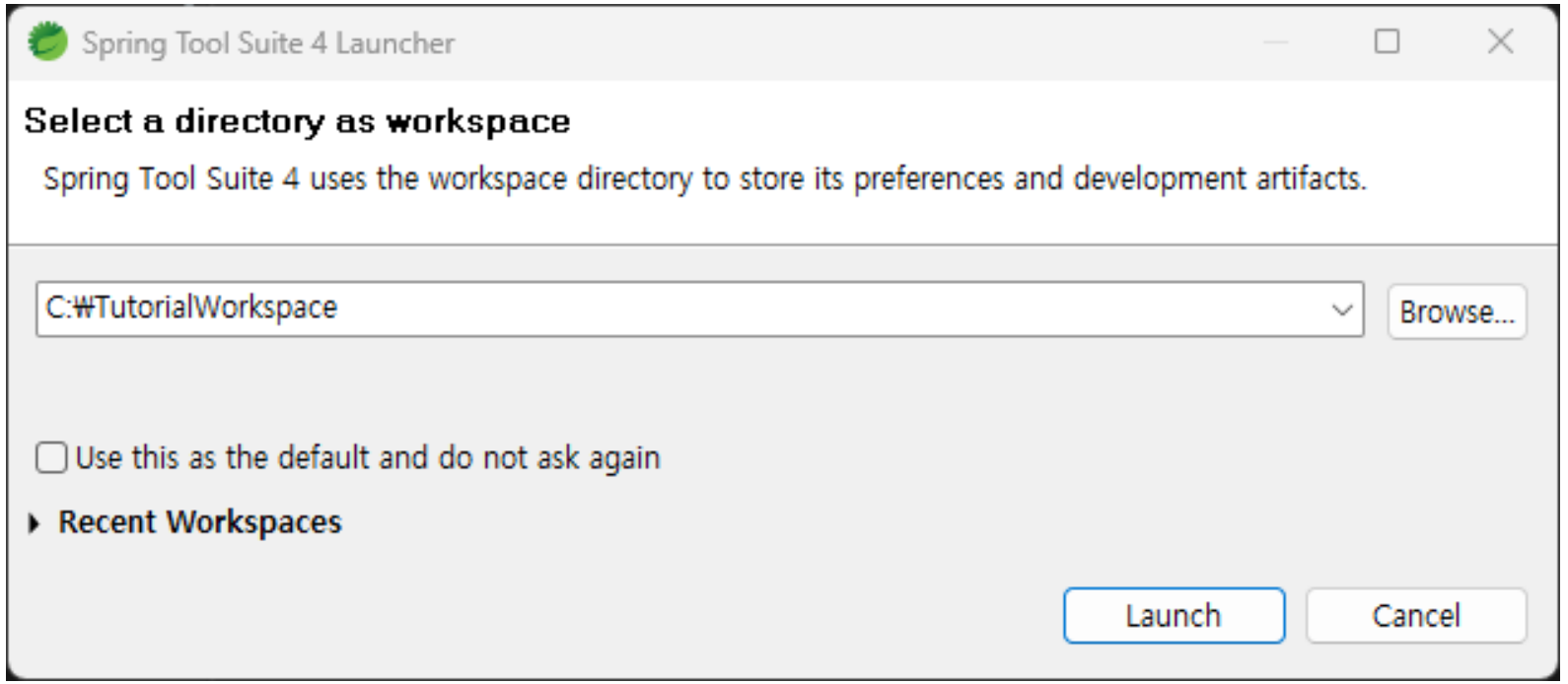
STS Workspace 설정



- 한글이 들어가거나 지나치게 긴 경로 사용은 가급적 피할 것

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Download HAPI FHIR JPA Server

- HAPI FHIR JPA Server
  - HAPI FHIR Library, Java Persistence API 기반 FHIR Server
  - 기본적인 FHIR RESTful Operation 모두 구현됨
  - Database 포함
  - HAPI FHIR JPA Server Github Link:
    - https://github.com/hapifhir/hapi-fhir-jpaserver-starter
  - Download v6.6.0
    - https://github.com/hapifhir/hapi-fhir-jpaserver-starter/archive/refs/tags/image/v6.6.0.zip

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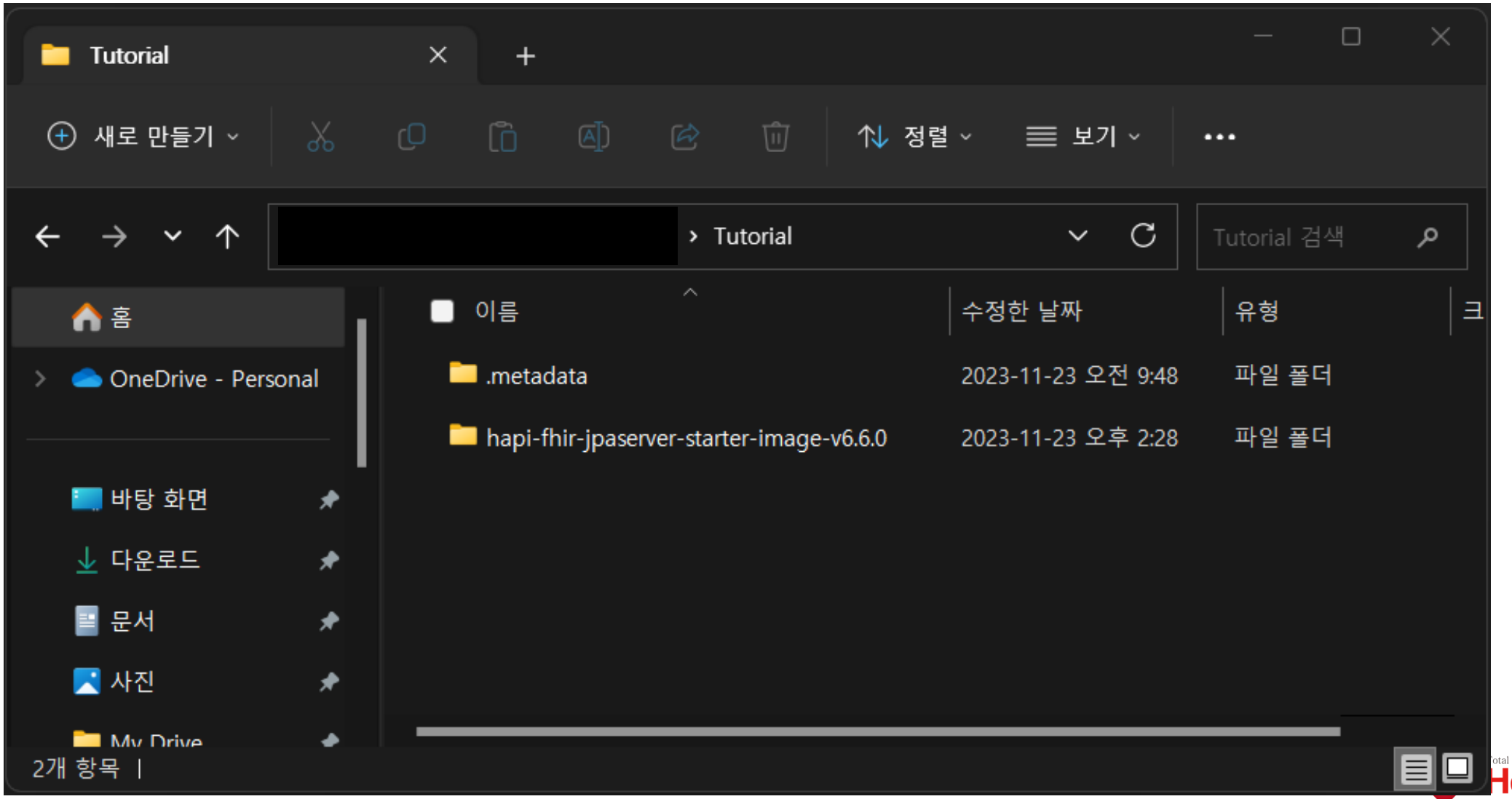
Unzip HAPI FHIR JPA Serve

- Workspace에 hapi-fhir-jpaserver-starter-image-v6.6.0.zip 압축 풀기



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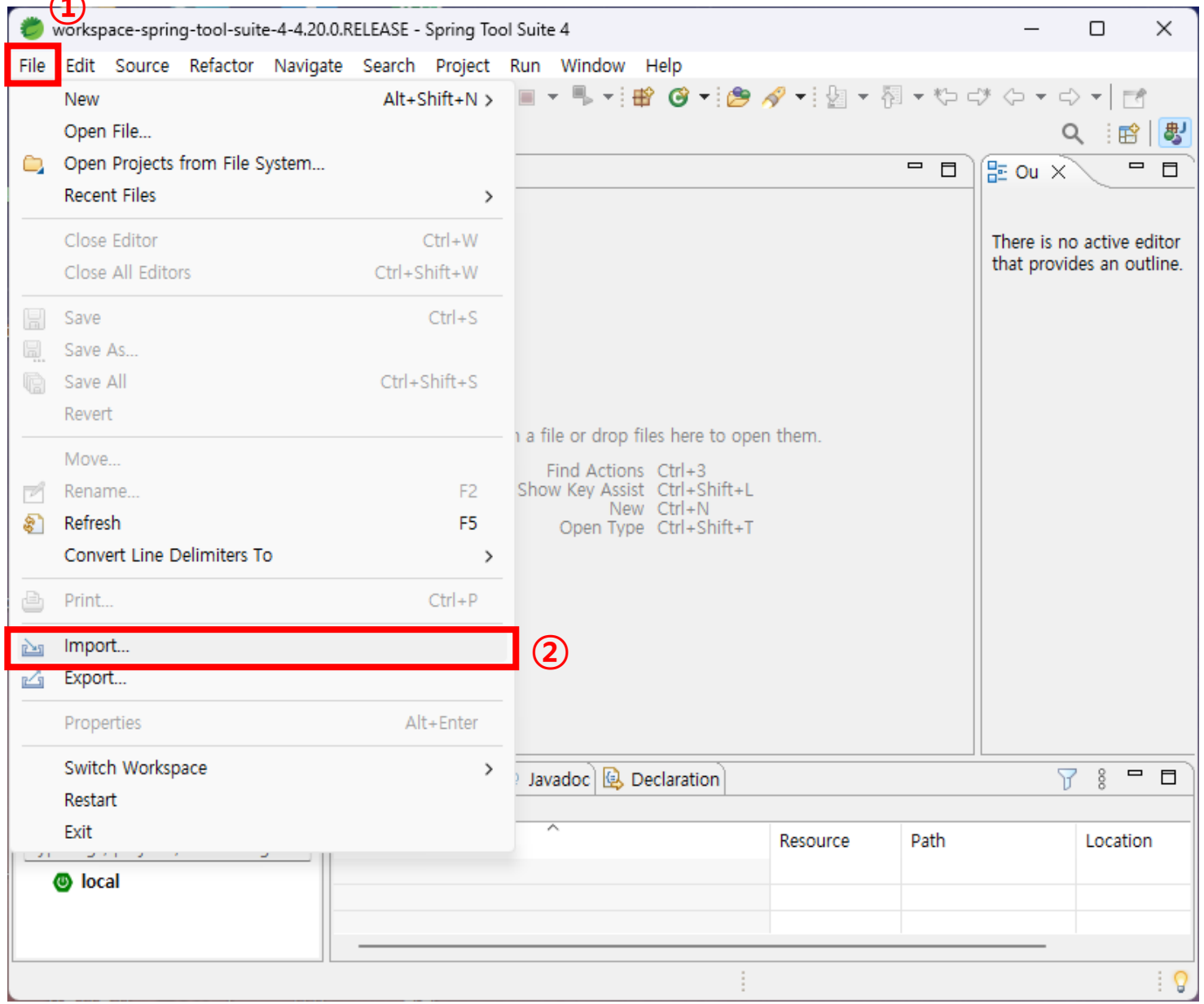
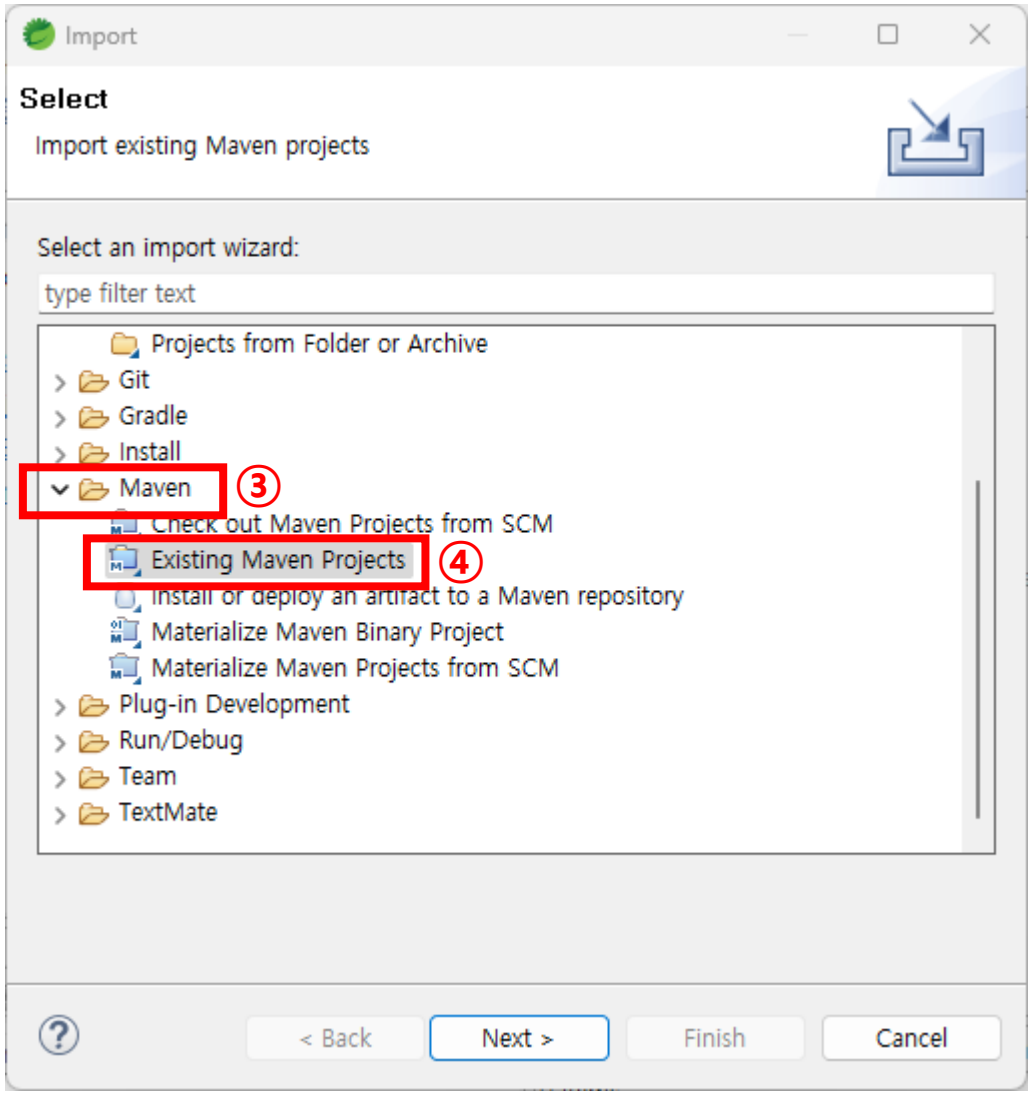
HAPI FHIR JPA Server Project Import (1)





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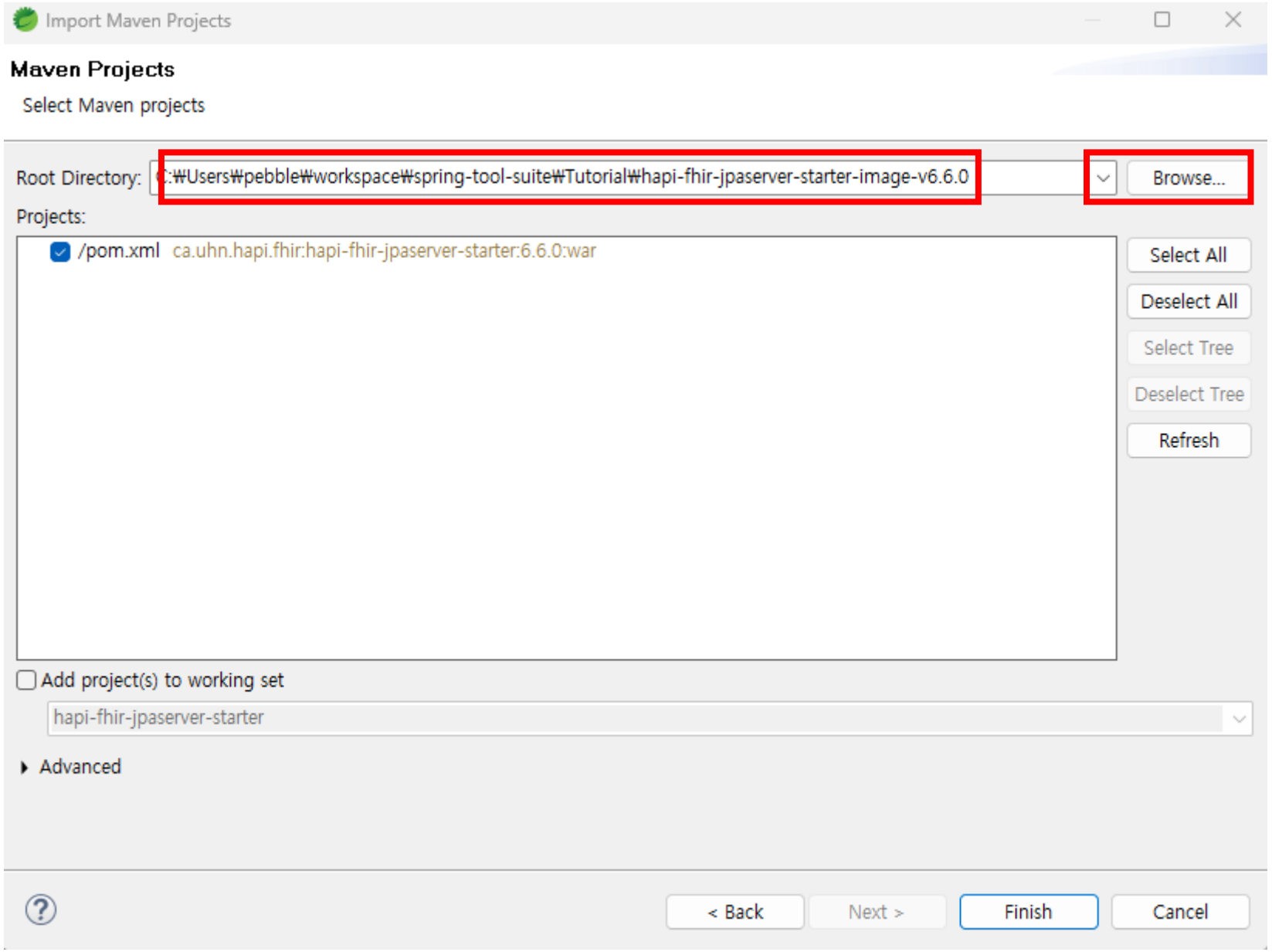
HAPI FHIR JPA Server Project Import (2)



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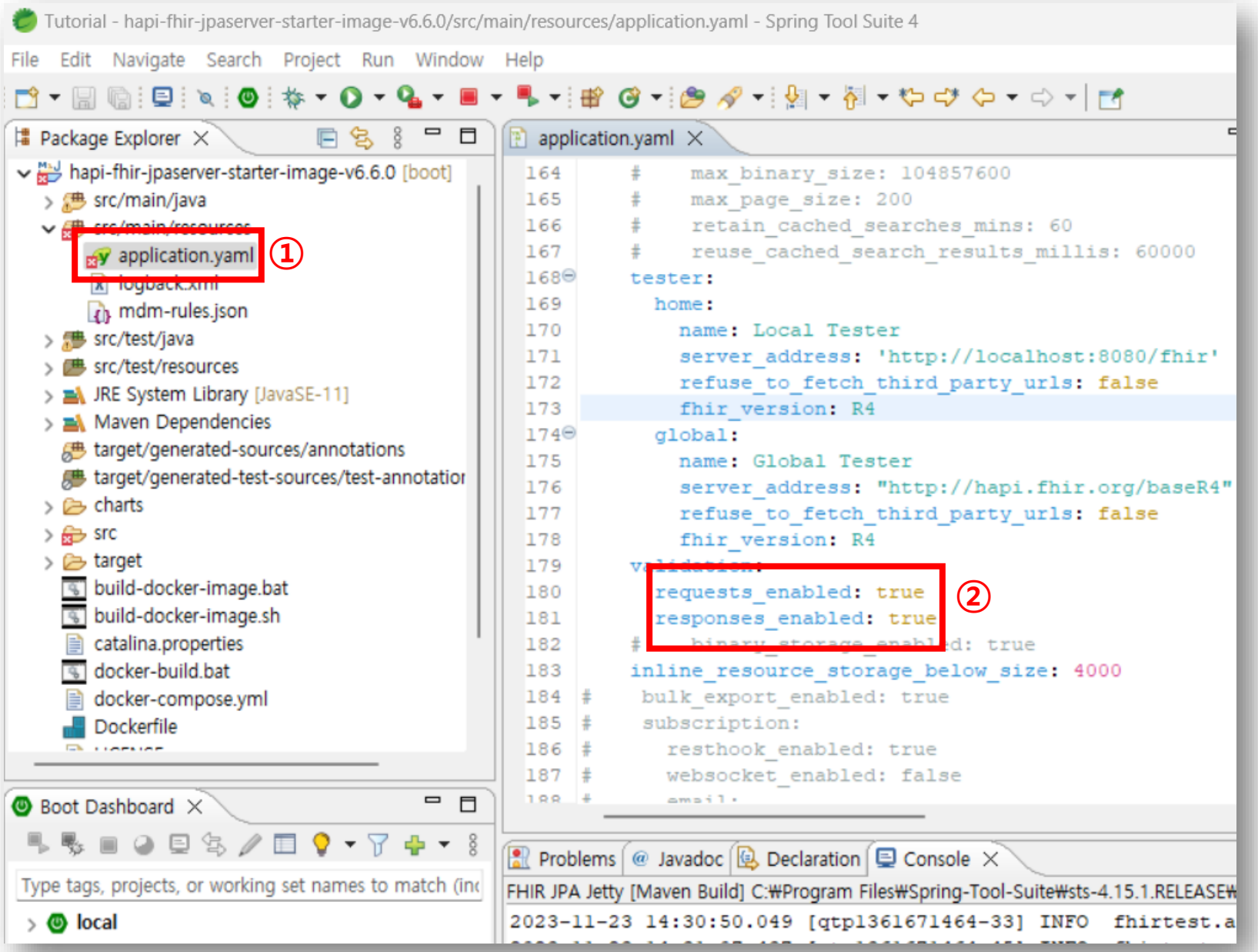
설정 파일 수정



- 아래 설정 주석 해제

```
validation:
    requests_enabled: true
    responses_enabled: true
```

- Indentation에 주의 할 것
- test: 설정과 동일한 hierachy로 설정

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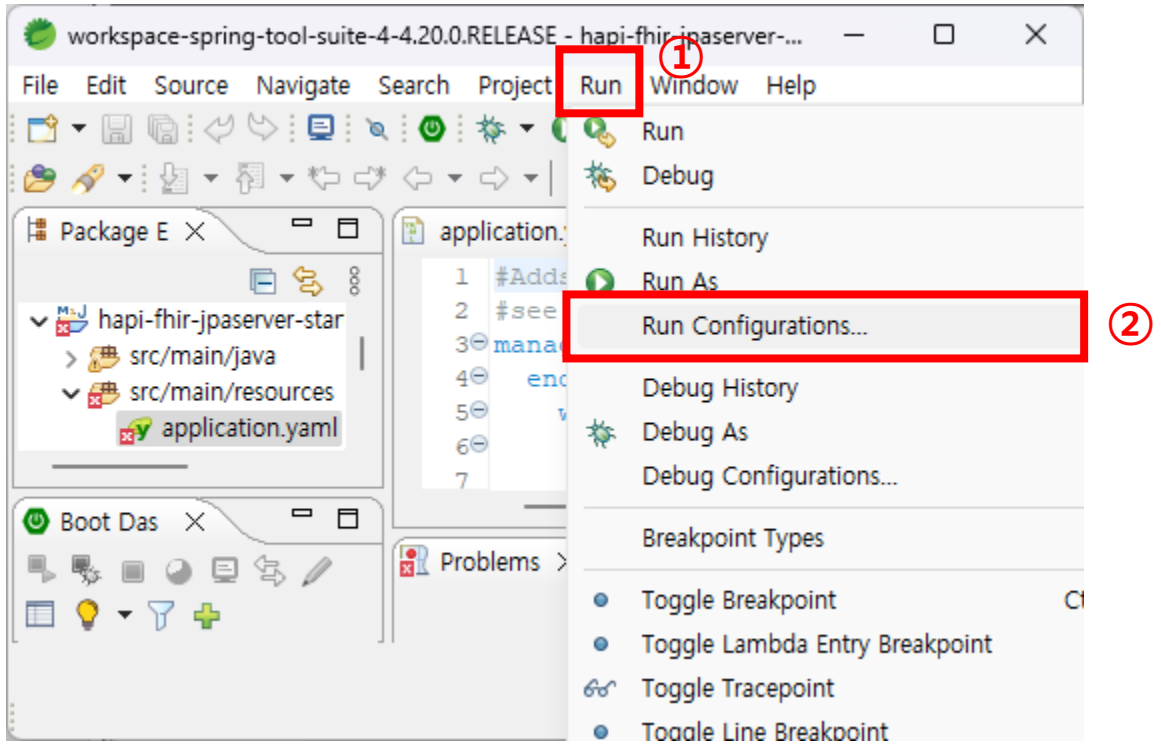
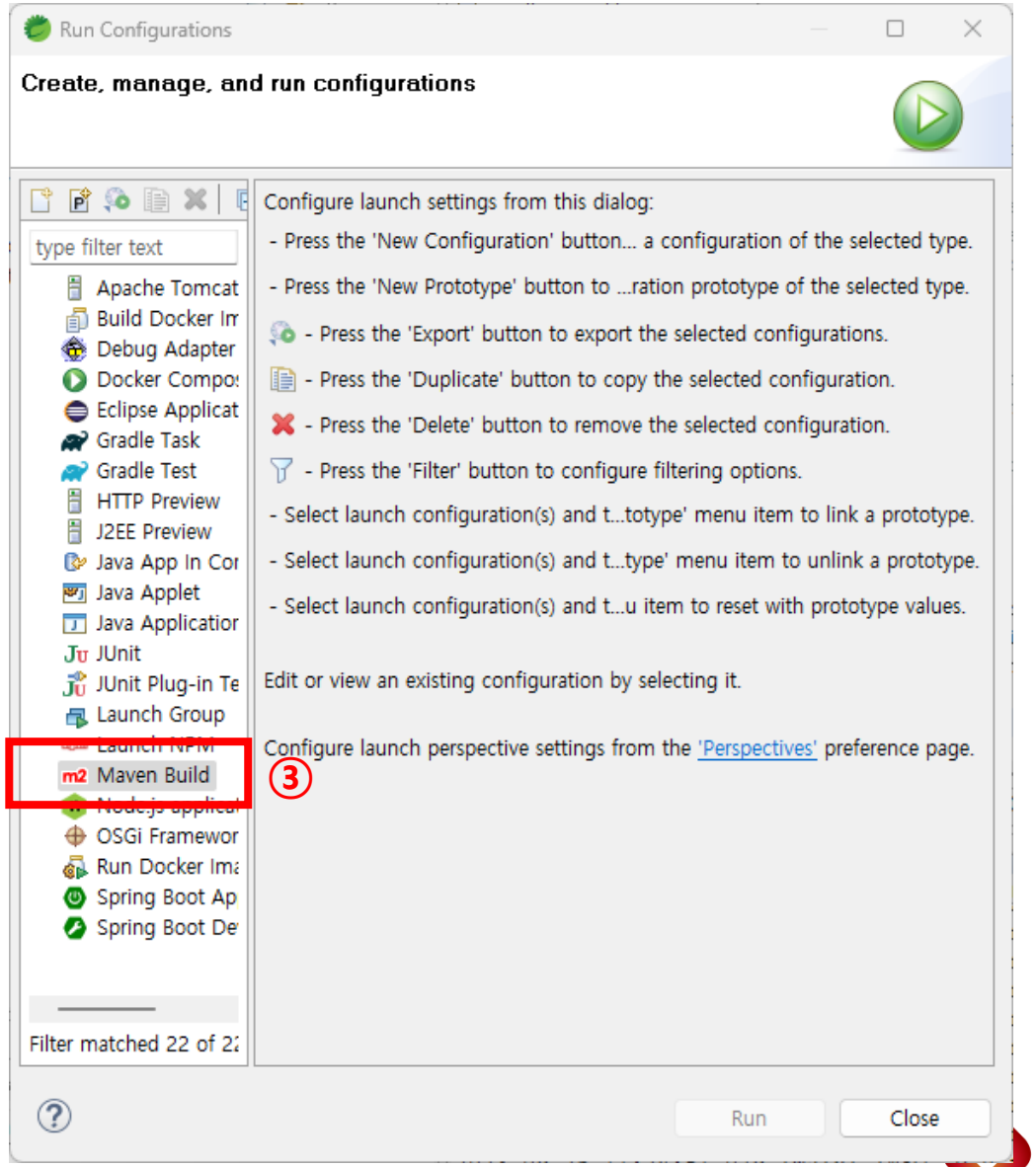
실행 설정





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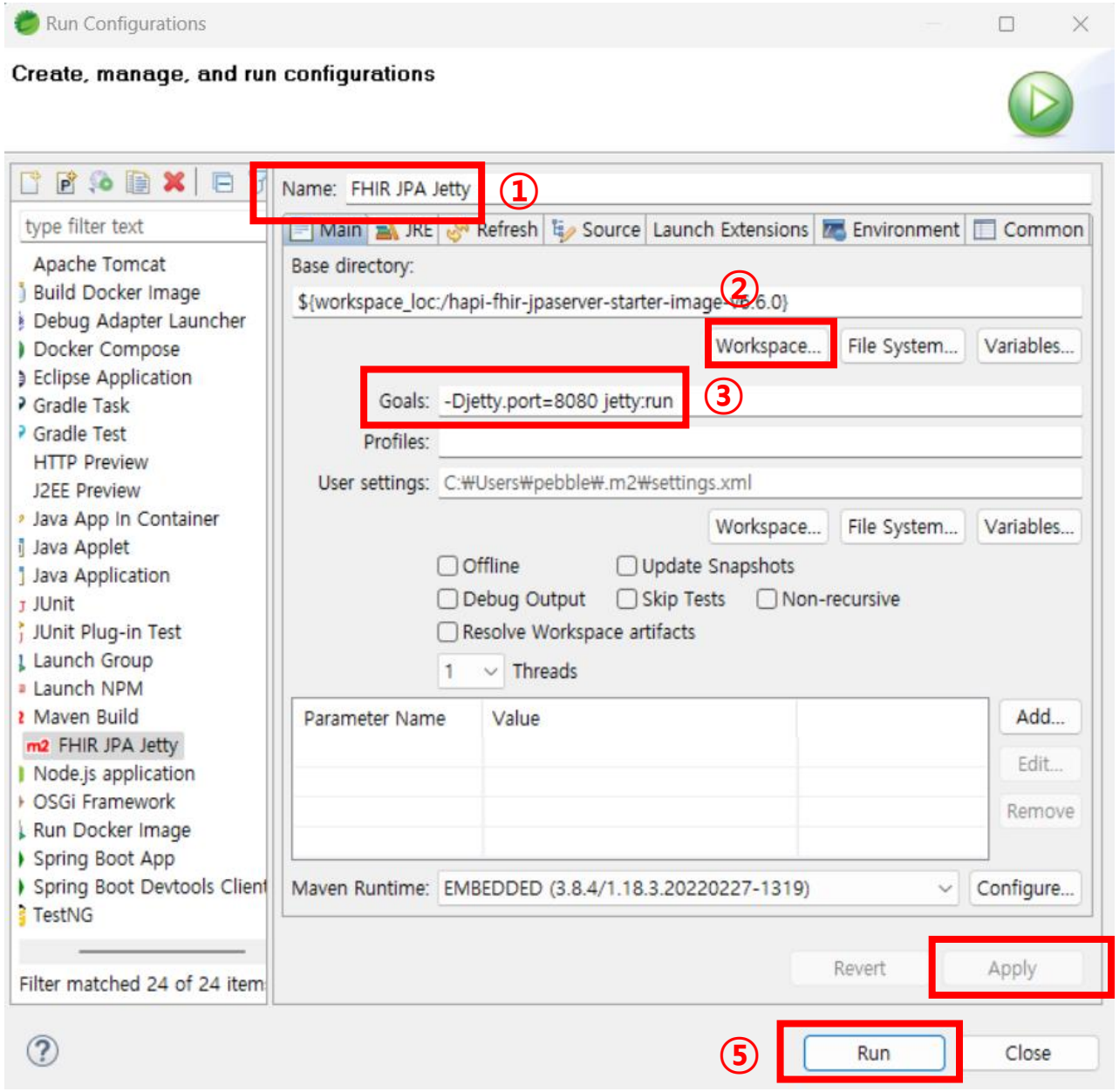
실행 설정



- -Djetty.port=8080 jetty:run

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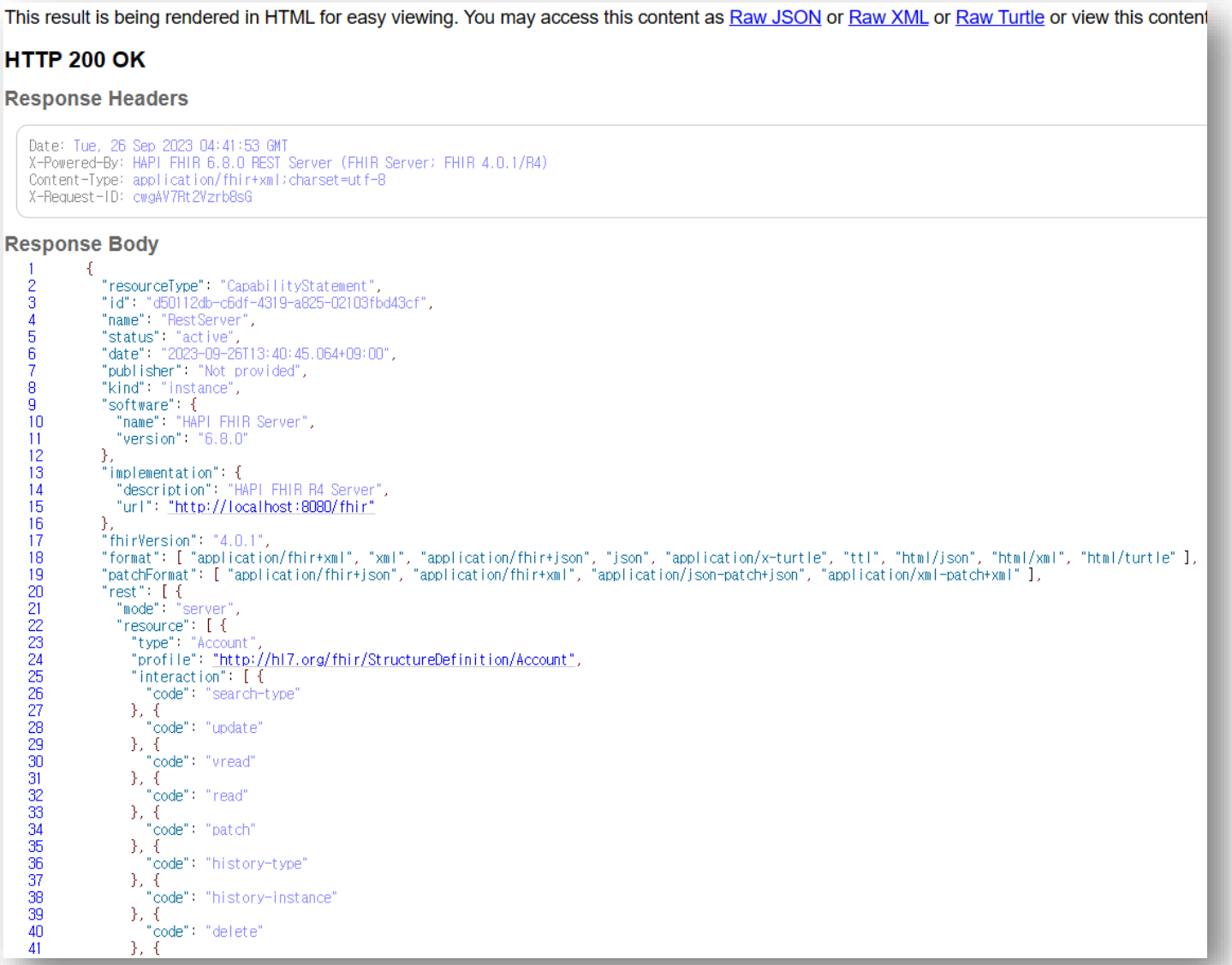
Get metadata

- http://localhost:8080/fhir/metadata



This result is being rendered in HTML for easy viewing. You may access this content as Raw JSON or Raw XML or Raw Turtle or view this content

HTTP 200 OK

Response Headers

```
Date: Tue, 26 Sep 2023 04:41:53 GMT
X-Powered-By: HAPI FHIR 6.8.0 REST Server (FHIR Server; FHIR 4.0.1/R4)
Content-Type: application/fhir+xml;charset=utf-8
X-Request-ID: cwgAV7Rt2Vzrb8sG
```

Response Body


```
{
  "resourceType": "CapabilityStatement",
  "id": "d50112db-c6df-4319-a825-02103fbd43cf",
  "name": "RestServer",
  "status": "active",
  "date": "2023-09-26T13:40:45.064+09:00",
  "publisher": "Not provided",
  "kind": "instance",
  "software": {
    "name": "HAPI FHIR Server",
    "version": "6.8.0"
  },
  "implementation": {
    "description": "HAPI FHIR R4 Server",
    "url": "http://localhost:8080/fhir"
  },
  "fhirVersion": "4.0.1",
  "format": [ "application/fhir+xml", "xml", "application/fhir+json", "json", "application/x-turtle", "ttl", "html/json", "html/xml", "html/turtle" ],
  "patchFormat": [ "application/fhir+json", "application/fhir+xml", "application/json-patch+json", "application/xml-patch+xml" ],
  "rest": [ {
    "mode": "server",
    "resource": [ {
      "type": "Account",
      "profile": "http://hl7.org/fhir/StructureDefinition/Account",
      "interaction": [ {
        "code": "search-type"
      }, {
        "code": "update"
      }, {
        "code": "vread"
      }, {
        "code": "read"
      }, {
        "code": "patch"
      }, {
        "code": "history-type"
      }, {
        "code": "history-instance"
      }, {
        "code": "delete"
      }, {
```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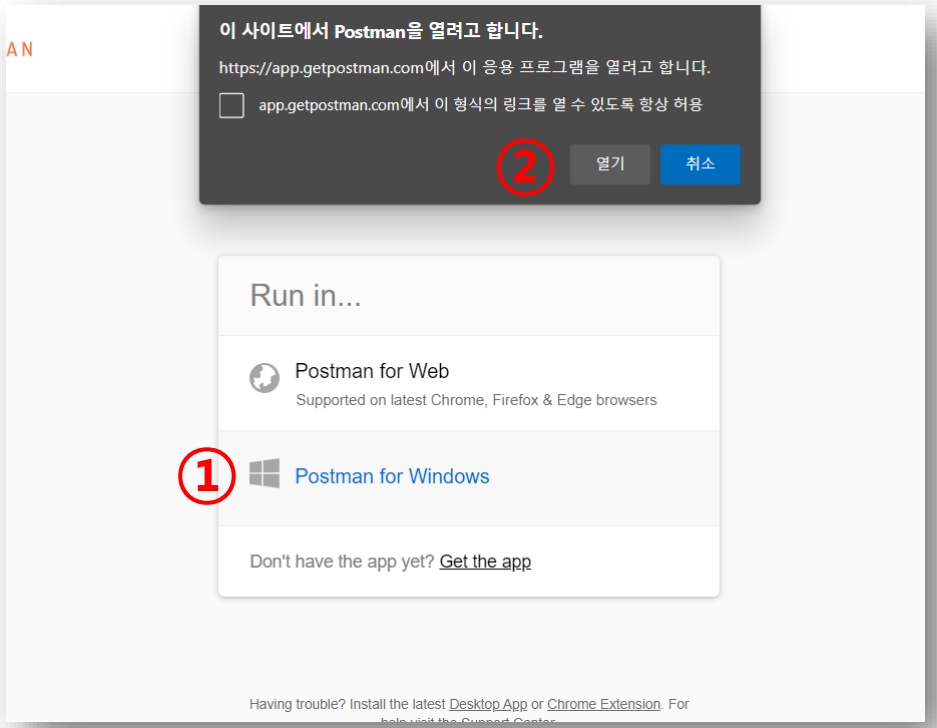
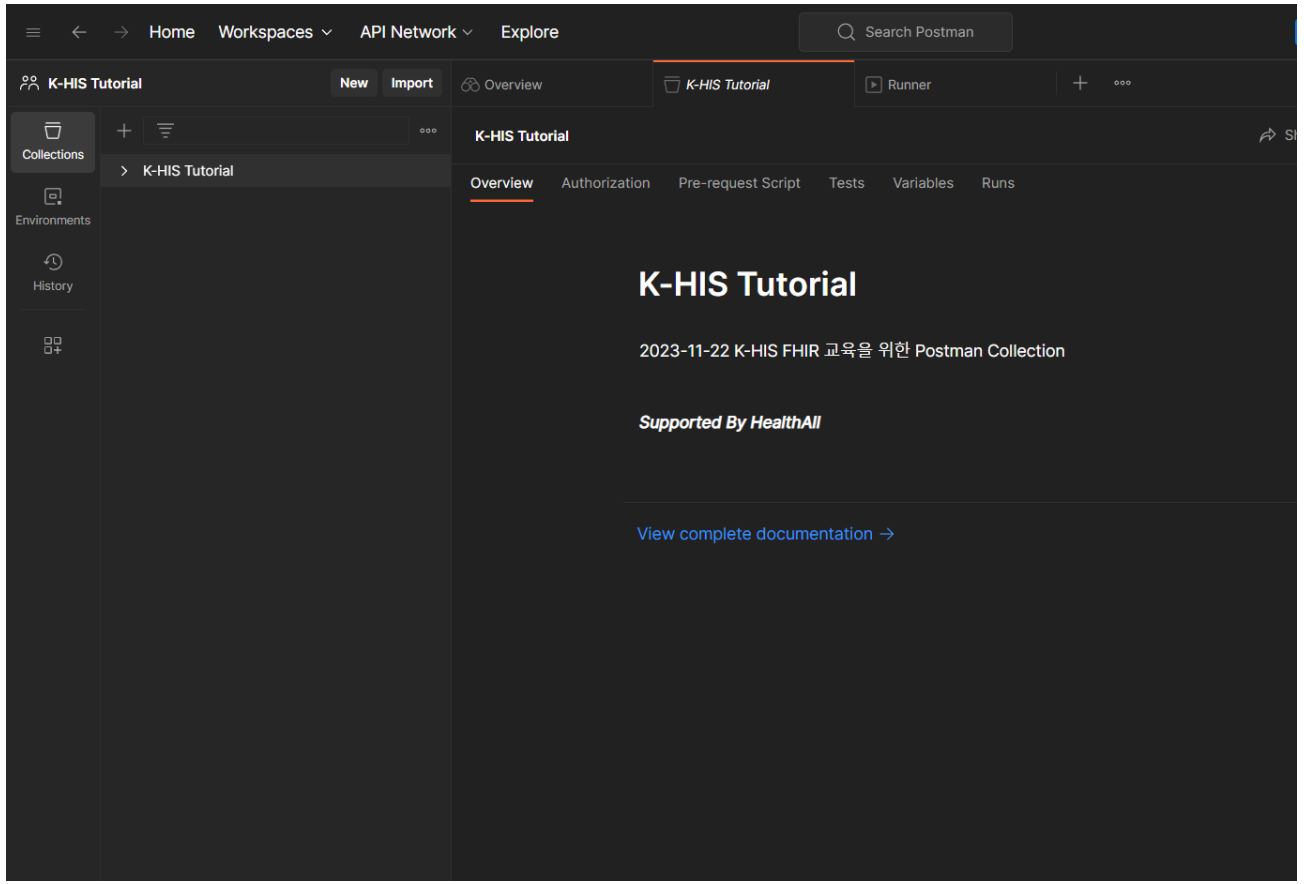
KR Core Resource Example Link with Postman

- https://app.getpostman.com/run-collection/22568473-8fc9837a-0c3c-4b24-bf10-bd0346ab0fc4?action=collection/import





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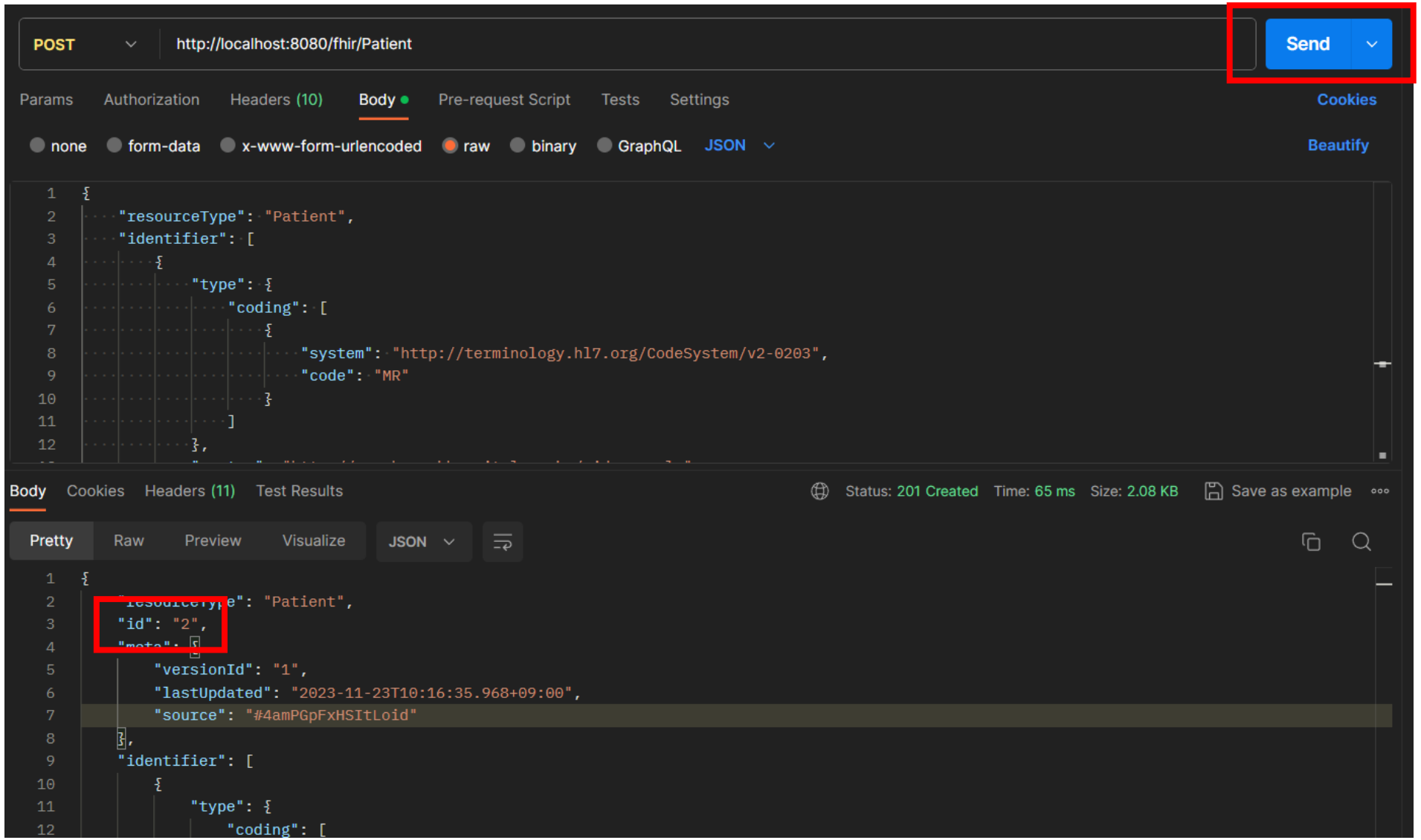
Create a Patient

- CRUDS
  - Create a Patient
  - Response 메시지의 id 확인



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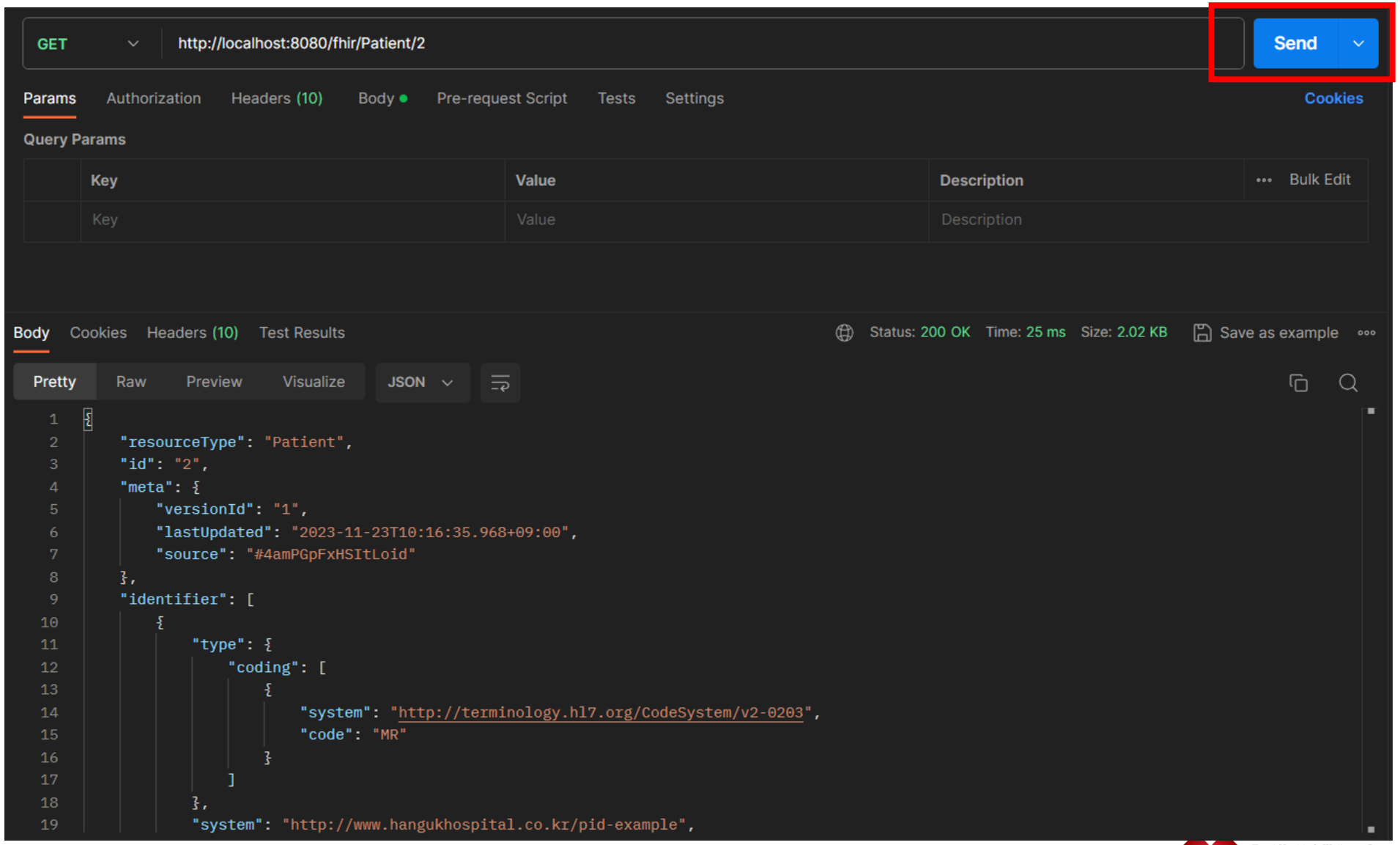
Read the Patient

- CRUDS
  - Read the Patient
  - Request Url 값으로 {{baseUrl}}/Patient/{{patient_id}} 사용



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Search Patients

- 기본 Search Parameter는 각 리소스 설명 페이지에 정의되어 있음
  - http://hl7.org/fhir/R4/patient.html#search
  - http://hl7.org/fhir/R4/observation.html#search

- Search Parameter 유형에 따라 검색 방법이 다름
  - string
  - token
  - date
  - reference 등
  - http://hl7.org/fhir/R4/search.html

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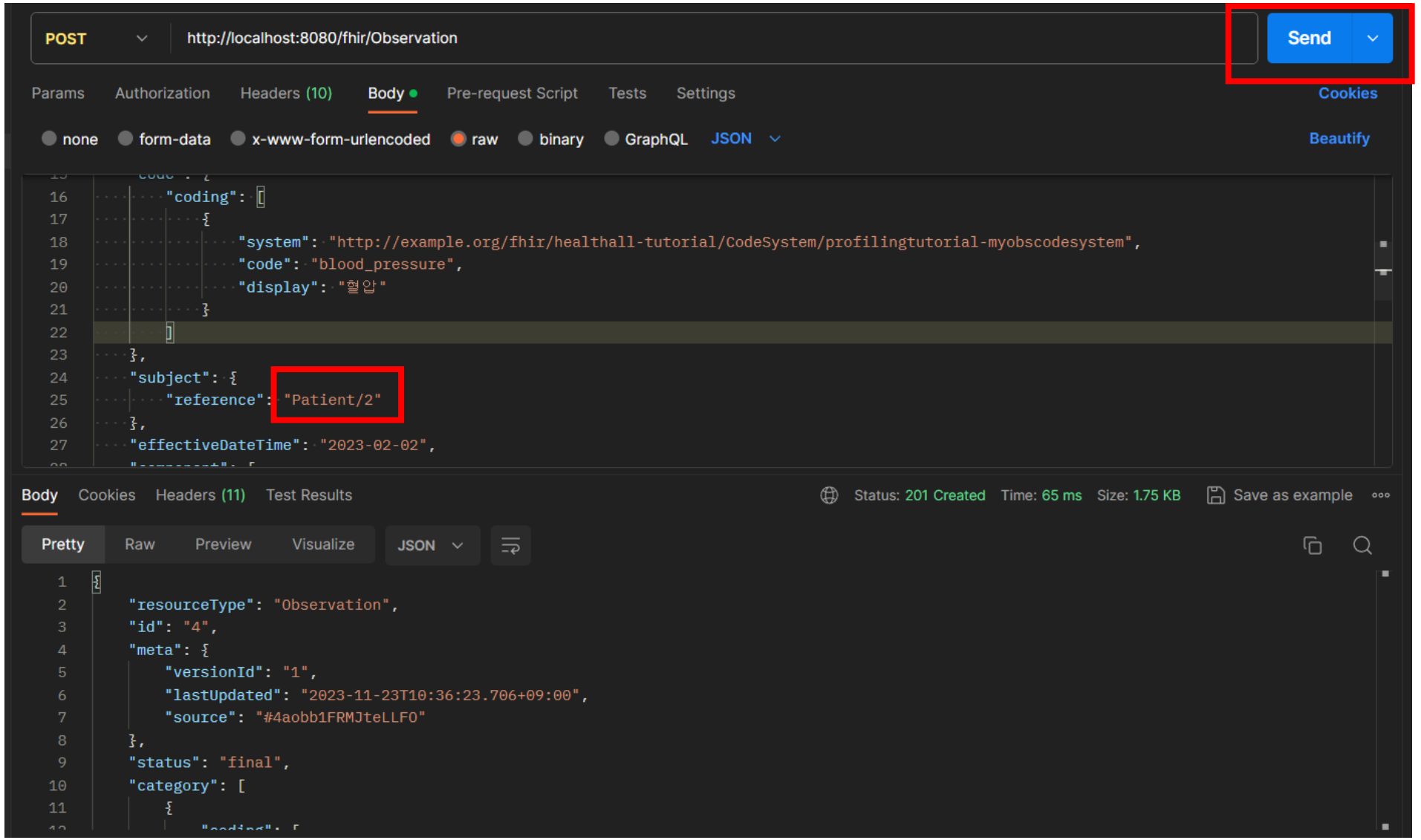
Create an Observation

- CRUDS
  - Create an Observation
  - Request 메시지의 subject.reference 값으로 Patient/{patient_id} 입력



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Upload Conformance Resources

- 이전 실습을 통해 개발한 Tutorial IG의 Conformance Resource들을 Postman을 통해 HAPI FHIR JPA Server에 등록(Create)

  - CodeSystem (MyObsCodeSystem)
  - ValueSet (MyObsValueSet)
  - StructureDefinition (MyPatient)
  - StructureDefinition (MyObservation)

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Resource Validation

- Tutorial IG의 Profile에 적합하지 않은 리소스 등록을 FHIR Server가 거부할 수 있는지 확인

  - Patient (Default)
  - Patient (MyPatient)(Error)
  - Patient (MyPatient)(Correct)
  - Observation (MyObservation)(Error)
  - Observation (MyObservation)(Correct)

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감사합니다