

OpenLayers를 이용한 서비스 개발



들어가기 전에

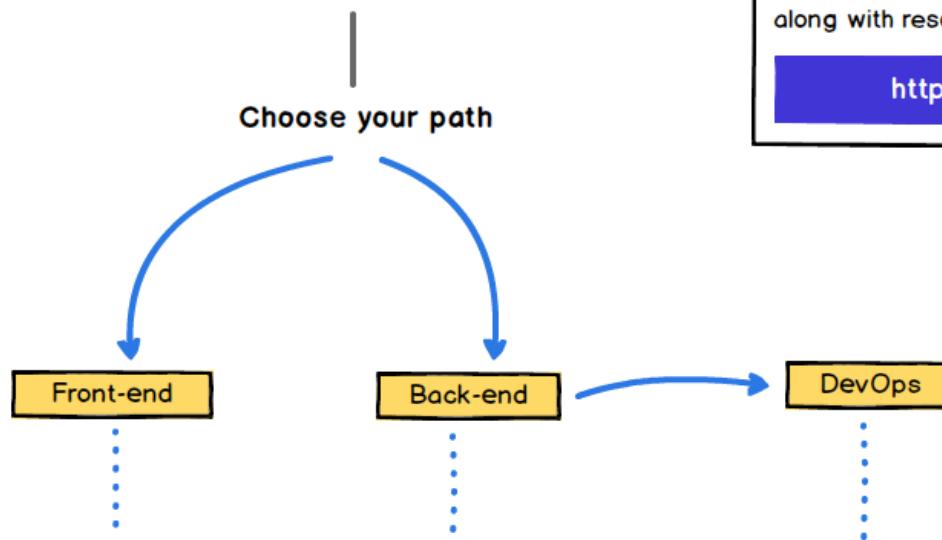
- (출처) '오픈소스 GIS 서비스 개발자 심화' 과정, 한국국토정보공사 공간정보아카데미 (<http://lxsiedu.or.kr>)
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How to become a Web Developer

Required for any path

- Git - Version Control
- Basic Terminal Usage
- Data Structures & Algorithms
- GitHub
- Licenses
- Semantic Versioning
- SSH
- HTTP/HTTPS and APIs
- Design Patterns
- Character Encodings

Web Developer in 2021

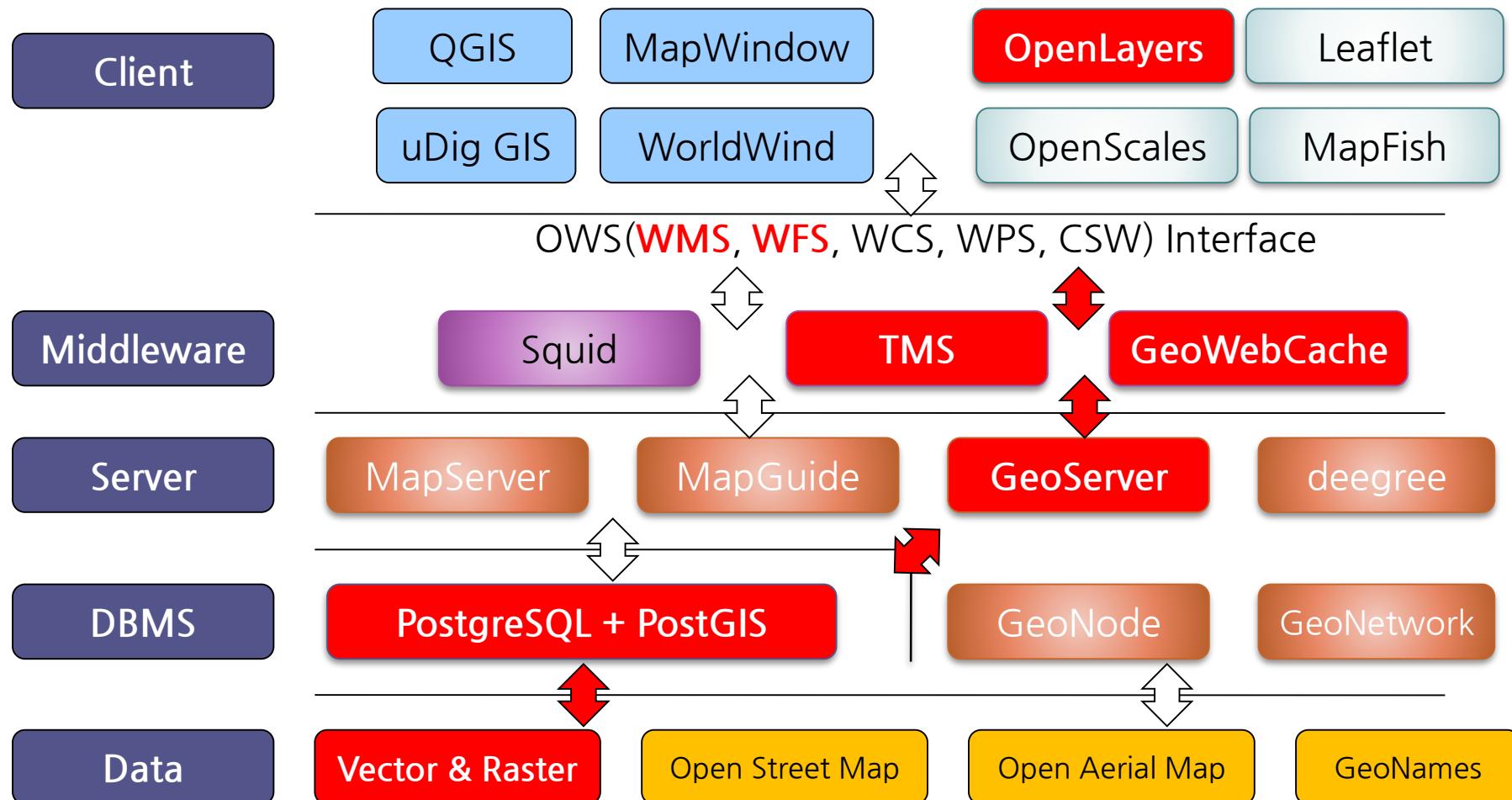


Find the detailed version of this roadmap along with resources and other roadmaps

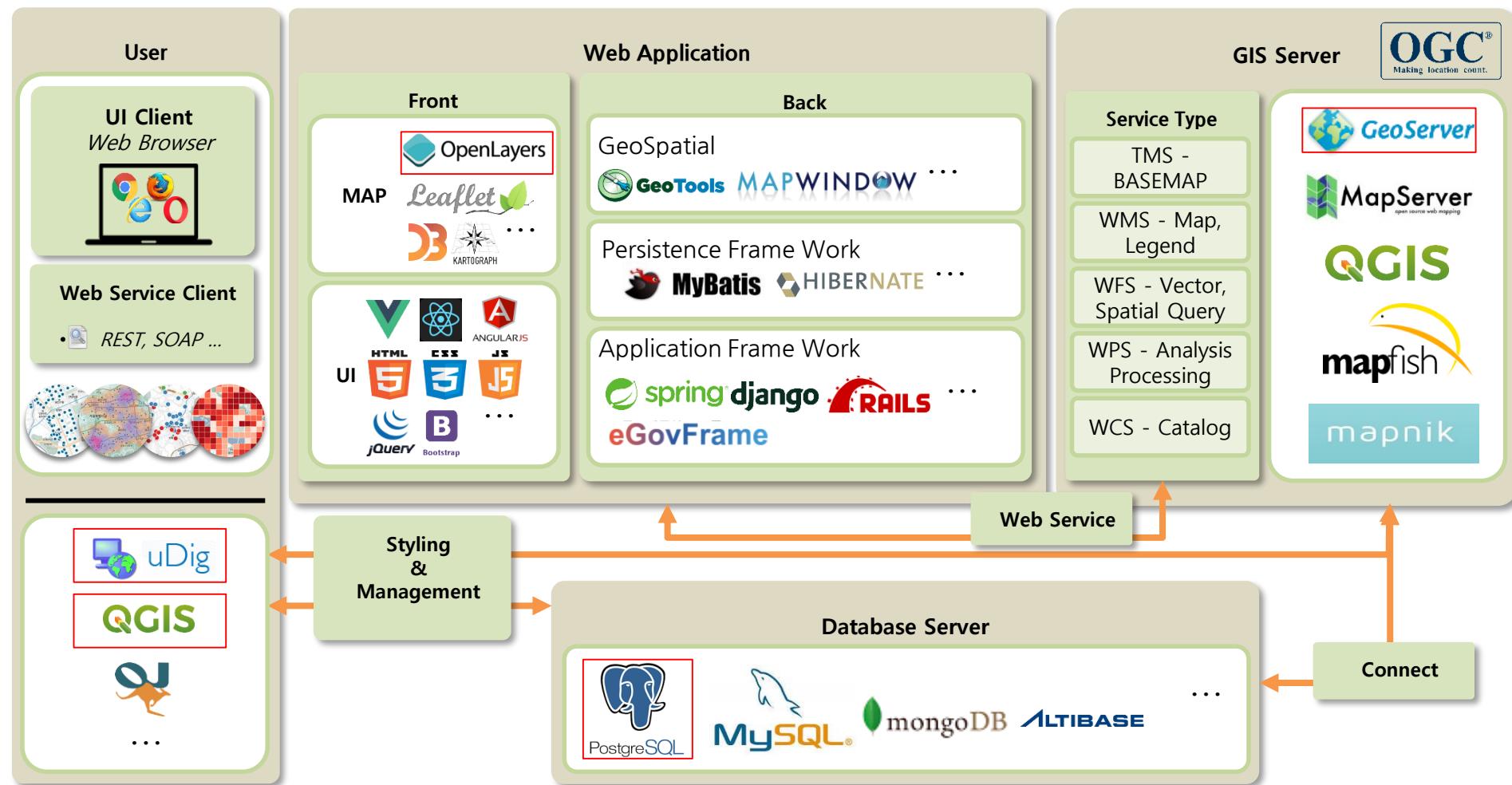
<http://roadmap.sh>

<https://roadmap.sh/>

인기있는 FOSS4G Stack



국내 인기 있는 GIS 웹 서비스 아키텍쳐



그래서 오늘은

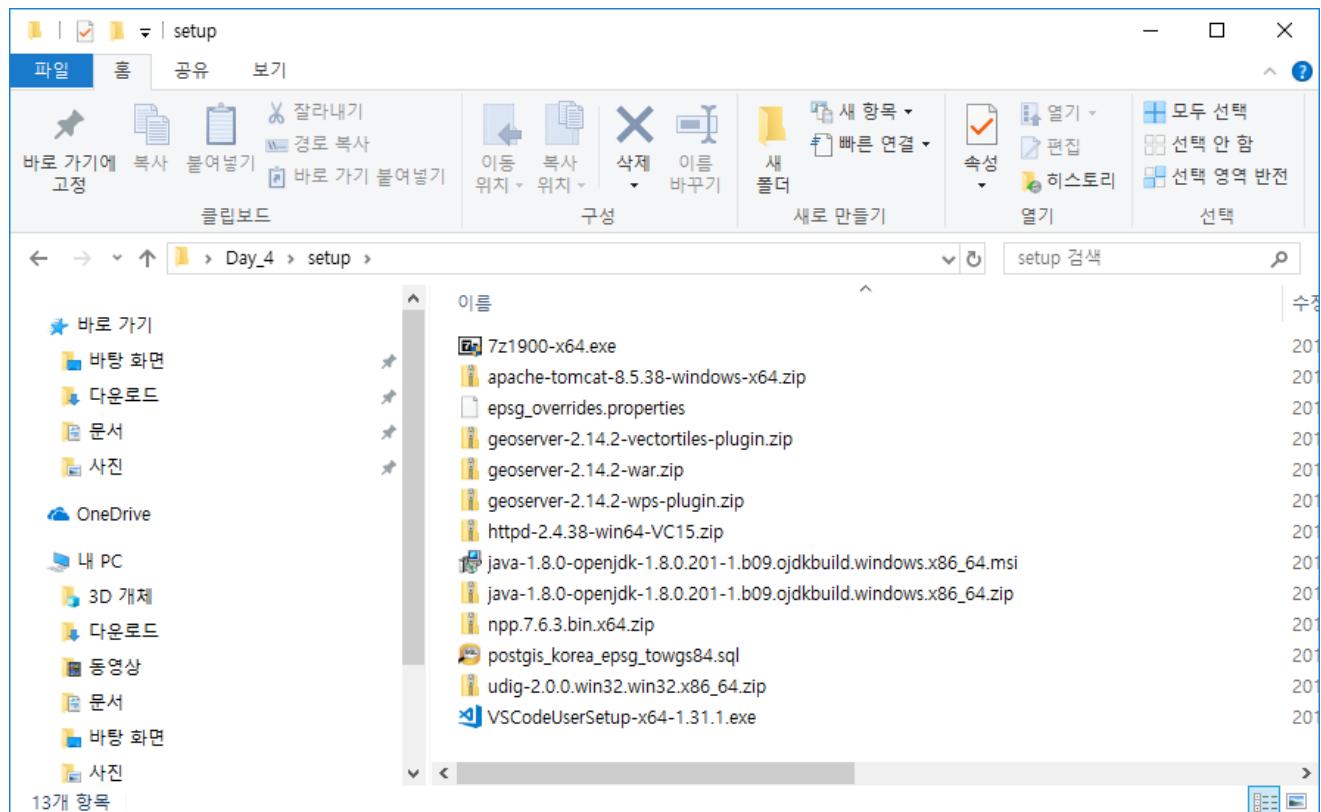
PostGIS

QGIS

GeoServer

uDig

OpenLayers



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작업공간 - 저장소 - 레이어 생성

WebGIS 테스트 환경 구성

Java - Web - WAS - GeoServer 설치

OpenLayers 시작하기 (Node.js)

Node.js - Parcel - Visual Studio Code

OpenLayers

Map

View

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Interaction

웹 GIS 실습

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OpenLayers 확장

공간 데이터 등록 및 관리

데이터베이스 준비

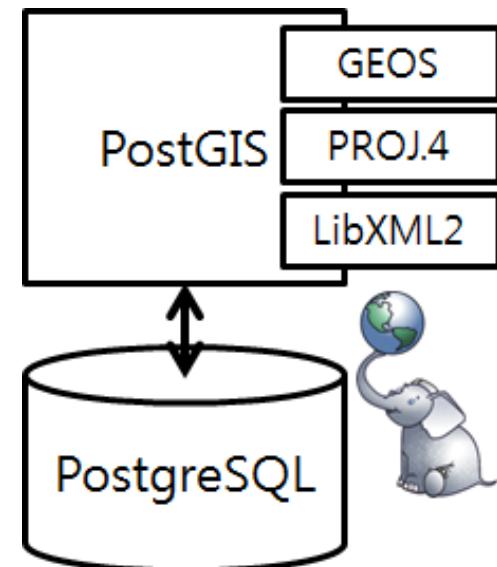
- Example DataSet

Buidling(5181) 만 활용

Shapefile	레이어명	유형	SRID	비고
admin_emd	읍면동경계	MultiPolygon	5174	
admin_sgg	시군구경계	MultiPolygon	5174	
admin_sid	시도경계	MultiPolygon	5174	
river	실풍하천	MultiPolygon	5174	
road_link2	도로	MultiLinestring	5174	
firestation	소방서	Point	5174	
healthcenter	보건소	Point	5174	
policestation	경찰서	Point	5174	
stores	대형마트	Point	5174	
wardoffice	시군구청	Point	5174	
subway	지하철노선	MultiLinestring	5174	
Subway_station	지하철역	Point	5174	

데이터베이스 준비

- Spatial & Geographic objects for PostgreSQL
 - OpenGIS 규격 (<http://www.opengeospatial.org/standards/sfs>) 을 준수하여 Geographic object를 지원 가능하게 하는 미들웨어 형태의 확장 가능
 - 오픈소스 기반의 가장 인기 있는 공간 DBMS이며 Vector 데이터 뿐만 아니라 Raster, Topology, Routing 지원
 - ESRI ArcGIS 뿐만 아니라 QGIS, uDig 등 거의 모든 오픈소스 GIS 프로그램이 편집까지 지원
 - 한글 매뉴얼 지원
(https://postgis.net/docs/manual-dev/postgis-ko_KR.htm)



데이터베이스 준비

- PostGIS 공식 홈페이지

The screenshot shows the PostGIS website at <http://postgis.net>. The page features a large "PostGIS" logo with an elephant holding a globe. A navigation bar includes links for Home, Download, Documentation, Development, Support, and OSGeo. Below the logo, there's a section titled "About PostGIS" with a SQL query example:

```
SELECT superhero.name
FROM city, superhero
WHERE ST_Contains(city.geom, superhero.geom)
AND city.name = 'Gotham';
```

The page also highlights "Spatial and Geographic objects for PostgreSQL". It lists "Upcoming Events" such as the "Postgres Conference 2019" (March 18-22, 2019, New York, NY) and "FOSS4G NA 2019" (April 16th-18th 2019, San Diego, CA, USA). It also mentions "Recent past events" like "FOSS4G 2019" (August 26th-30th 2019, Bucharest, Romania). At the bottom, there's a link to "Should you upgrade now?" and a note about version compatibility.

<http://postgis.net>

데이터베이스 준비

▪ PostGIS Support Matrix

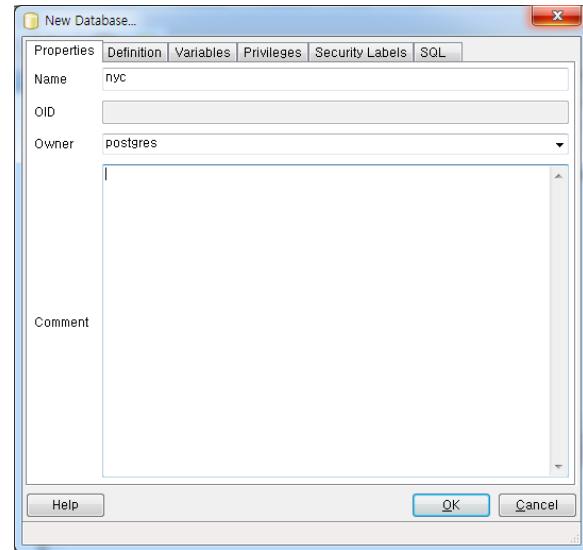
PostgreSQL version	PostGIS 2.0 EOL	PostGIS 2.1 EOL	PostGIS 2.2 EOL	PostGIS 2.3 EOL	PostGIS 2.4	PostGIS 2.5	PostGIS 3.0	PostGIS 3.1 (Master)
PostGIS release date	2012/04/03	2013/08/17	2015/10/07	2016/09/26	2017/09/30	2018/09/23	2019/10/20	2020/xx/xx
13	No	No	No	No	No	No	Yes	Yes
12	No	No	No	No	No	Yes	Yes	Yes
11	No	No	No	No	Yes	Yes	Yes	Yes
10	No	No	No	Yes	Yes	Yes	Yes	Yes
9.6	No	No	Yes	Yes	Yes	Yes	Yes	No
9.5	No	No	Yes	Yes	Yes	Yes	Yes	No
9.4 EOL	No	Yes	Yes	Yes	Yes	Yes	No	No

출처 : <https://trac.osgeo.org/postgis/wiki/UsersWikiPostgreSQLPostGIS>

데이터 등록

▪ 공간 데이터베이스 생성

- [시작메뉴] - [PostgreSQL x(버전)] - [pgAdmin] 을 실행
- [Databases] 오른쪽 마우스 선택 후 [New Database]를 선택
- [Name] - **korea** 입력
- [Owner] - postgres 선택, [ok] 선택
- [SQL] 선택, Query Tool 실행
- **CREATE EXTENSION postgis;** 입력, [F5] 실행
- (CREATE EXTENSION postgis_topology; 입력, [F5] 실행)
- SELECT postgis_full_version(); 입력, [F5] 실행



출처 : 공간정보 아카데미 교재

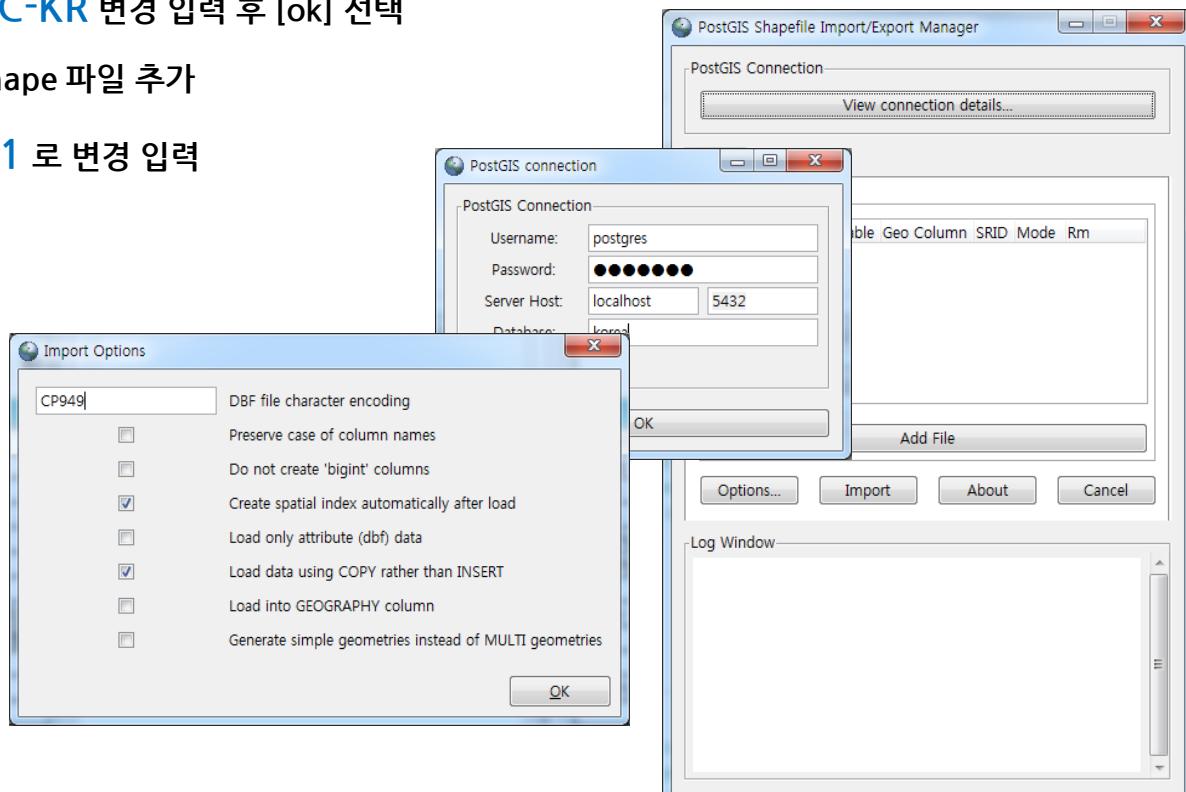
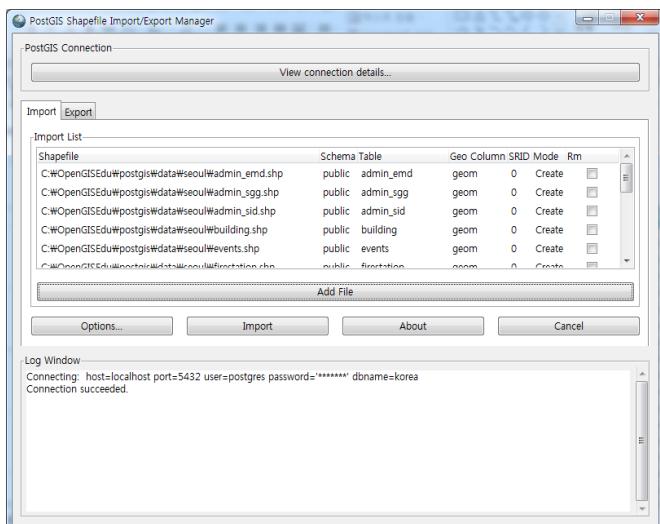
데이터 등록

▪ 공간데이터 Importing - Loader

- [시작메뉴] - [PostGIS bundle for PostgreSQL] - [PostGIS2.0 Shapefile and DBF Loader Exporter] 을 실행
- [PostGIS Connection] - [View connection details] 선택 후 아래의 내용 입력

Username : postgres | Password : postgres | Database : korea

- [Options] - encoding CP949 or EUC-KR 변경 입력 후 [ok] 선택
- [Add File] - [WdataWseoul] 폴더의 Shape 파일 추가
- Import List [SRID] 컬럼 5174 / 5181로 변경 입력
- [Import] 선택 Shape 파일 추가

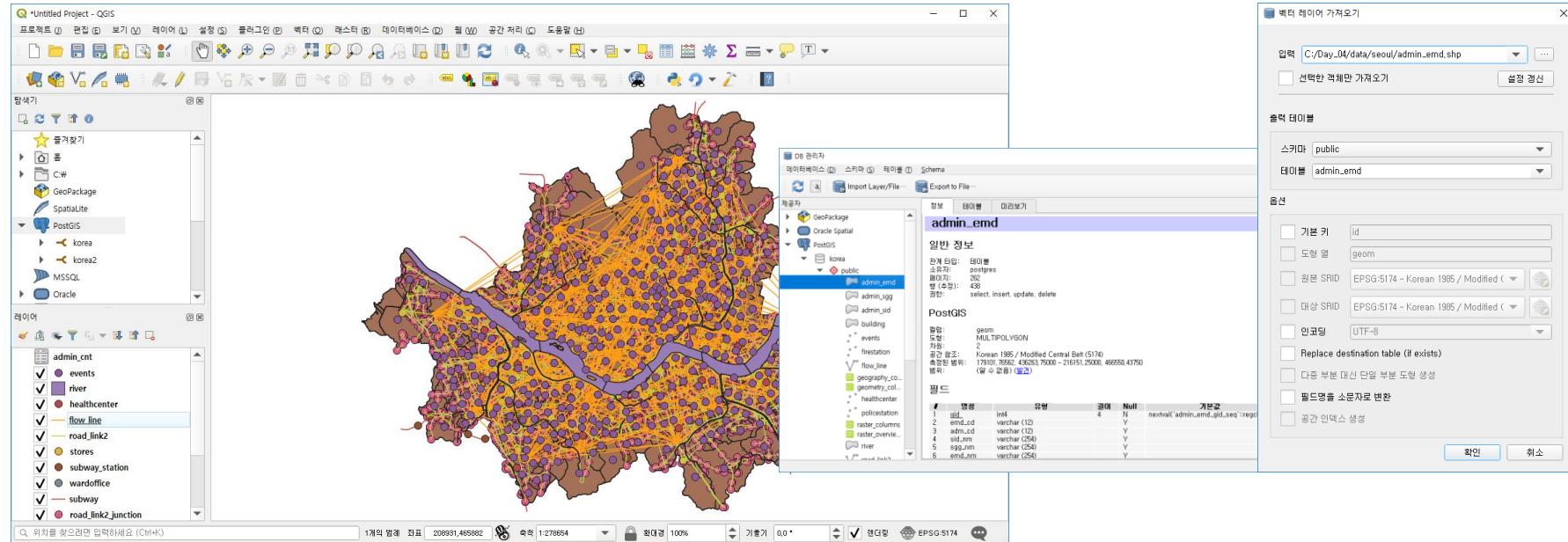


출처 : 공간정보 아카데미 교재

데이터 등록

▪ 공간데이터 Importing - QGIS

- QGIS 실행후 [보기] - [패널] - [탐색기] 체크 선택
- 탐색기 패널에서 [PostGIS] - [New Connection] 을 열어 데이터베이스 접속
- 탐색기 패널에서 [WdataWseoul] 폴더의 Shape 파일을 레이어로 추가
- [데이터베이스] - [DB 관리자] 실행후 제공자에 [PostGIS] 선택하여 서비스 되고 테이블 확인
- [Import Layer/File]에서 레이어를 선택하고 출력 테이블, 옵션 정보를 입력하여 추가

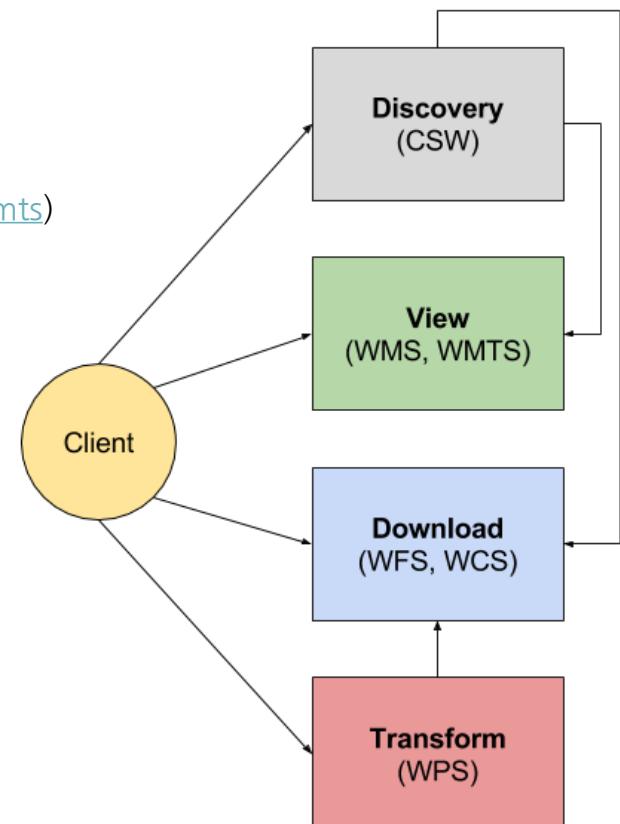


공간 데이터 배포

데이터 배포

▪ GeoServer 소개

- 지리공간 데이터를 OGC(<http://www.opengeospatial.org/>) 표준을 통해 공유하고 편집할 수 있는 Java로 개발된 오픈 소스 GIS 소프트웨어 서버
- 상호운영성 기반으로 설계되어 개방형 표준을 준수하여 개발됨
 - 카탈로그 서비스 (<https://www.opengeospatial.org/standards/cat>)
 - 지도 이미지 서비스 (<https://www.opengeospatial.org/standards/wms>)
 - 타일 지도 이미지 서비스 (<https://www.opengeospatial.org/standards/wmts>)
 - Feature 서비스(<https://www.opengeospatial.org/standards/wfs>)
 - Coverage 서비스(<https://www.opengeospatial.org/standards/wcs>)
 - Processing 서비스(<https://www.opengeospatial.org/standards/wps>)
- 커뮤니티 중심의 프로젝트 운영으로 개발, 테스트, 번역 등 기여자들의 자발적 참여를 통해 발전되어 왔음
- OSGEO(Open Source Geospatial Foundation) 프로젝트
- Web 기반의 Admin Tool을 제공하여 관리가 용의
- 한글 매뉴얼 (<https://www.osgeo.kr/149>)



이미지 출처 :
https://geoserver.geosolutions.it/edu/en/ogc_protocol_intro/index.html

데이터 배포

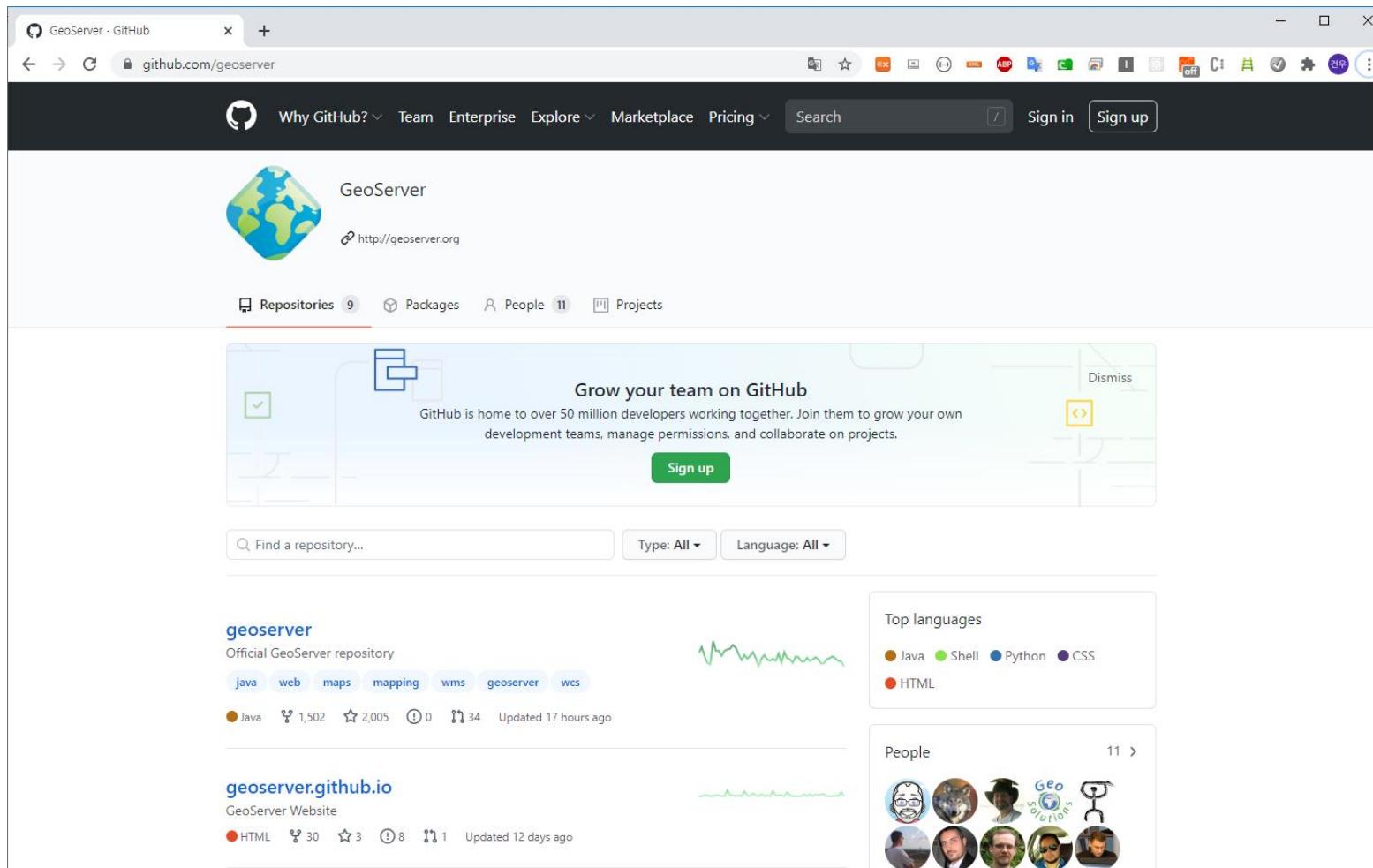
- GeoServer 공식 홈페이지

The screenshot shows the official GeoServer website. At the top, there's a navigation bar with links for About, Blog, Download, Documentation, and Community. A green banner on the right says "Fork me on GitHub". Below the header, a main heading states "GeoServer is an open source server for sharing geospatial data." followed by a subtext: "Designed for interoperability, it publishes data from any major spatial data source using open standards." To the left, there's a map visualization showing a coastline and a pink line. At the bottom of the map area, it says "Rendering GeoSolutions Data © OpenStreetMap contributors, ODbL". On the right side, there's a "Download" section with three buttons: "Stable" (green, 2.17.2 Nightly), "Maintenance" (dark blue, 2.16.4 Nightly), and "Development" (red, Master). Below that is a "News" section with announcements for GeoServer 2.17.2, 2.16.4, and 2.17.1.

<http://geoserver.org>

데이터 배포

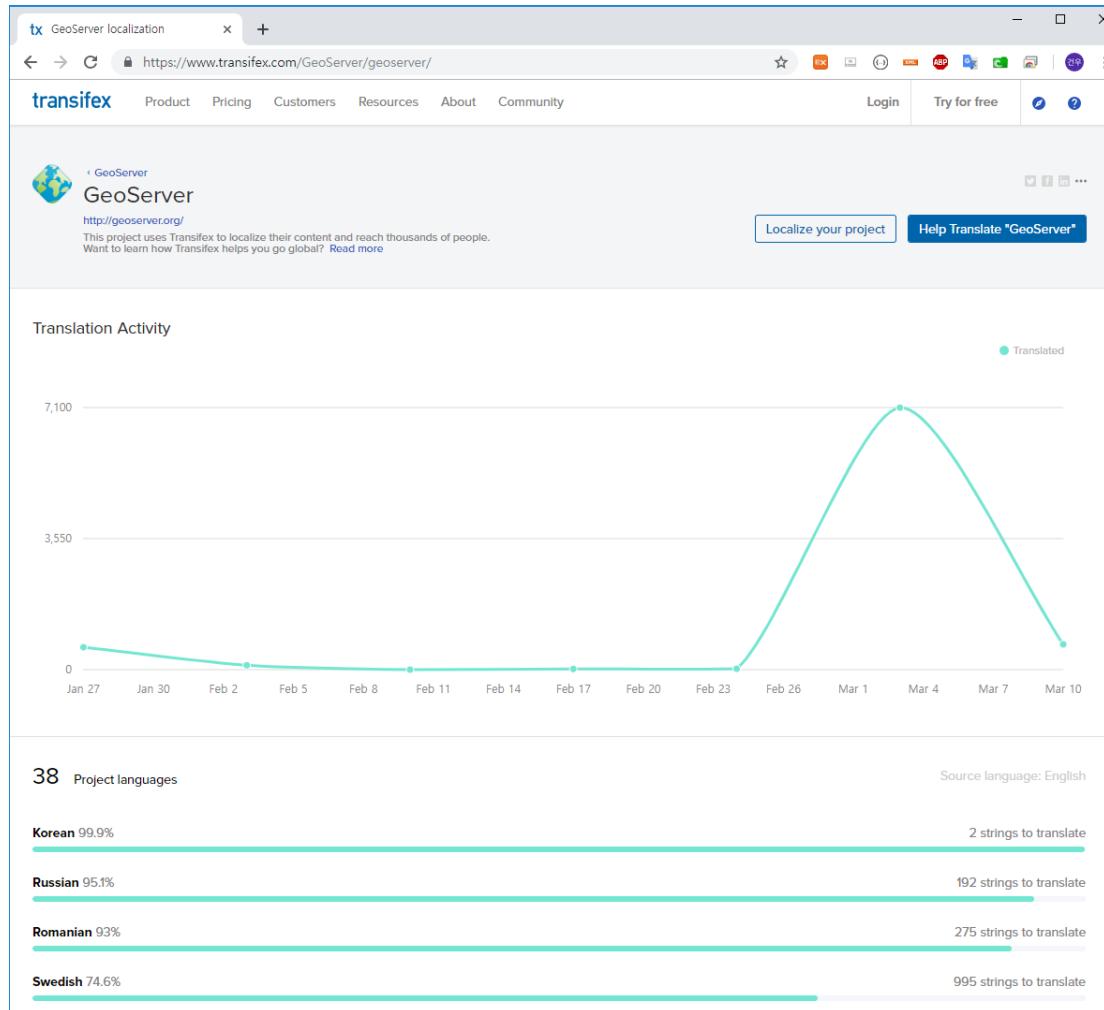
▪ GeoServer 깃 허브



<https://github.com/geoserver>

데이터 배포

▪ GeoServer 번역

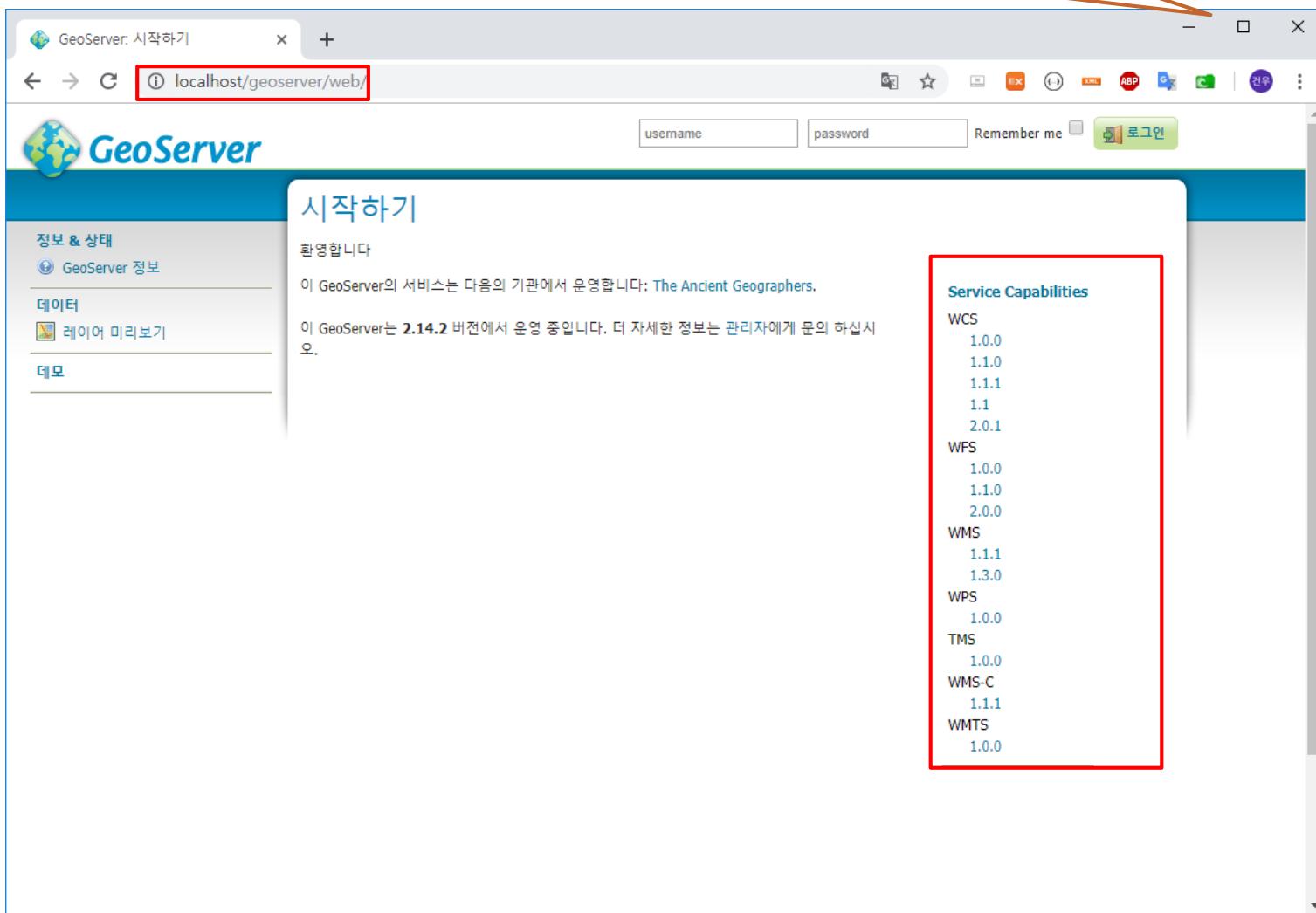


데이터 배포

▪ GeoServer 접속

<http://localhost:8080/geoserver>

<http://localhost/geoserver>



데이터 배포

- **GeoServer 관리 툴**
 - 정보 & 상태 섹션
 - GseServer의 진단과 환경을 설정할 수 있으며 특히 디버깅에 유용
 - GeoServer가 사용하는 **데이터 디렉토리** 확인
 - 환경구성 및 카탈로그 리로드 가능
 - 데이터
 - Workspace, Stores, Layers, Layer Groups, Styles 등을 설정할 수 있으며, 각각의 하위 섹션은 비슷한 설정방법을 따름
 - 서비스
 - GeoServer에서 서비스 가능한 WMS, WFS, WCS 서비스 환경 및 상태(시작/멈춤 등)나 고급 서비스 옵션 설정 가능
 - 환경설정
 - GeoWebCache 등의 GeoServer 고급 환경을 설정
 - 전역환경 설정에서 필수적으로 로그 정책 변
 - 타일캐시
 - Geowebcache에 의해 생성된 캐쉬 레이어를 관리
 - 보안
 - 사용자나 서비스에 대한 보안정책을 설정
 - 데모
 - GeoServer에서 제공하는 SRS(Spatial Reference System)정보 및 품 기반의 OGC WMS, WFS, WCS Operation에 대한 request 결과물을 확인
 - 도구
 - 관리자 도구 제공 (카탈로그 일괄 로드 도구만 있음 2.14.2 버전 현재)

데이터 배포

▪ GeoServer 데이터 배포 과정

1. 작업공간(Workspace) 생성

- 자료를 관리를 위한 그룹
- 보통 업무 프로젝트 단위로 생성

2. 저장소(Store) 생성

- 자료의 물리적 위치를 등록
- 폴더, DBMS, 파일 등 등록

3. 스타일(Style) 생성 (옵션)

- 자료를 표현하는 방법을 상세히 정의

4. 레이어(Layer) 생성

- 실제 개별 자료를 등록

5. 레이어 그룹(Layer Group) 생성 (옵션)

- 관련 자료를 묶어서 제공

6. 타일 캐시 설정 (옵션)

- 서비스 효율화

데이터 배포

■ 작업공간 생성

GeoServer: 작업공간

localhost/geoserver/web/wicket/bookmarkable/org.geoserver.web.data.workspace.WorkspaceP...

GeoServer

다음 계정으로 연결되었습니다: admin. 로그아웃

정보 & 상태

- 서버 상태
- GeoServer 로그
- 연락처 정보
- GeoServer 정보
- 프로세스 상태

데이터

- 레이어 미리보기
- 작업공간**
- 저장소
- 레이어
- 레이어 그룹
- 스타일

서비스

- WMTS
- WCS
- WFS
- WMS
- WPS

환경설정

- 전역 환경설정
- 이미지 프로세싱
- 레이스터 액세스

타일 캐시

- 타일 레이어
- 캐시 기본 설정
- 그리드셋
- 디스크 할당량

작업공간

GeoServer의 작업공간을 관리합니다

새로운 작업공간 추가하기

선택된 작업공간 제거하기

<< < 1 > >> 결과: 1에서 7(7 항목 중)

작업공간 이름	기본값
cite	✓
it.geosolutions	
nurc	
sde	
sf	
tiger	
topp	

<< < 1 > >> 결과: 1에서 7(7 항목 중)

데이터 배포

■ 작업공간 생성

The screenshot shows the 'GeoServer: 새로운 작업공간' (New Workspace) dialog box over a browser window. The browser address bar shows 'localhost/geoserver/web/wicket/bookmarkable/org.geoserver.web.data.workspace.WorkspaceN...'. The dialog title is '새로운 작업공간' (New Workspace). It contains fields for 'Name' (korea) and 'NameSpace URI' (http://osgeo.kr/korea), with a note below stating '이 작업공간과 연결된 네임스페이스 URI입니다' (This workspace is connected to the namespace URI). A checkbox labeled '기본 작업공간으로 설정하기' (Set as default workspace) is checked and highlighted with a red box. Below it is an unchecked option 'Isolated Workspace'. At the bottom are '제출' (Submit) and '취소' (Cancel) buttons.

GeoServer: 새로운 작업공간

localhost/geoserver/web/wicket/bookmarkable/org.geoserver.web.data.workspace.WorkspaceN...

GeoServer

다음 계정으로 연결되었습니다: admin. 로그아웃

새로운 작업공간

새로운 작업공간을 생성합니다

Name
korea

네임스페이스 URI
http://osgeo.kr/korea

이 작업공간과 연결된 네임스페이스 URI입니다

기본 작업공간으로 설정하기

Isolated Workspace

제출 취소

정보 & 상태

- 서버 상태
- GeoServer 로그
- 연락처 정보
- GeoServer 정보
- 프로세스 상태

데이터

- 레이어 미리보기
- 작업공간
- 저장소
- 레이어
- 레이어 그룹
- 스타일

서비스

- WMTS
- WCS
- WFS
- WMS
- WPS

환경설정

- 전역 환경설정
- 이미지 프로세싱
- 래스터 액세스

타일 캐시

- 타일 레이어
- 캐시 기본 설정
- 그리드셋
- 디스크 할당량

데이터 배포

■ 작업공간 생성 확인

The screenshot shows the GeoServer interface for managing workspaces. The left sidebar contains links for '정보 & 상태', '데이터', '서비스', '환경설정', and '타일 캐시'. The main content area is titled '작업공간' and displays a list of workspaces. A red box highlights the 'korea' workspace entry, which has a green checkmark next to it. The table columns are '작업공간 이름' (Workspace Name), '기본값' (Default), and '설정' (Settings). Other workspace entries shown include 'cite', 'it.geosolutions', 'nurc', 'sde', 'sf', 'tiger', and 'topp'. Navigation buttons like '<<', '<', '1', '>', and '>>' are at the top and bottom of the list.

작업공간 이름	기본값	설정
cite		
it.geosolutions		
korea	✓	
nurc		
sde		
sf		
tiger		
topp		

데이터 배포

■ 저장소 생성

The screenshot shows the GeoServer web interface at `localhost/geoserver/web/wicket/bookmarkable/org.geoserver.web.data.store.StorePage?13`. The left sidebar has a 'Storage' link highlighted with a red box. A red arrow points from this link to the 'New Storage' button in the central 'Storage' management panel. The central panel displays a list of existing storage resources, each with a checkbox, data type, workspace, name, type, and status. The table has columns: 데이터 유형 (Data Type), 작업공간 (Workspace), 저장소 이름 (Storage Name), 유형 (Type), and 활성화 (Active). The data is as follows:

데이터 유형	작업공간	저장소 이름	유형	활성화
ArcGrid	nurc	arcGridSample	ArcGrid	✓
WorldImage	nurc	img_sample2	WorldImage	✓
ImageMosaic	nurc	mosaic	ImageMosaic	✓
Shapefile	tiger	nyc	Shapefile	✓
Shapefile	sf	sf	Shapefile	✓
GeoTIFF	sf	sfdem	GeoTIFF	✓
Shapefile	topp	states_shapefile	Shapefile	✓
Shapefile	topp	taz_shapes	Shapefile	✓
WorldImage	nurc	worldImageSample	WorldImage	✓

데이터 배포

■ 저장소 생성

The screenshot shows the 'GeoServer: 새로운 데이터 저장소' configuration page. The left sidebar contains navigation links for '정보 & 상태', '데이터' (selected), '서비스', '환경 설정', and '타일 캐시'. The main content area is titled '새로운 데이터 저장소' and displays a list of data store types under '벡터 데이터 저장소'. The 'PostGIS - PostGIS Database' option is highlighted with a red box. Other options include 'Directory of spatial files (shapefiles)', 'GeoPackage - GeoPackage', 'PostGIS (JNDI) - PostGIS Database (JNDI)', 'Properties', 'Shapefile - ESRI(tm) Shapefiles (*.shp)', and 'Web Feature Server (NG)'. Below this is a section for '래스터 데이터 저장소' with options like 'ArcGrid', 'GeoPackage (mosaic)', 'GeoTIFF', 'ImageMosaic', and 'WorldImage'. At the bottom are sections for '기타 데이터 저장소' with 'WMS' and 'WMPS' options.

데이터 배포

■ 저장소 생성

The screenshot shows the 'GeoServer: 새로운 벡터 데이터' window, which is a 'New Vector Data Store' configuration dialog. The URL in the browser is `localhost/geoserver/web/wicket/page?19`. The top right corner shows a message: '다음 계정으로 연결되었습니다: admin.' and a '로그아웃' button.

새로운 벡터 데이터 저장소 추가

새로운 벡터 데이터 저장소를 추가합니다.

PostGIS
PostGIS Database

기본 저장소 정보

작업공간 *

korea

데이터 저장소 이름 *

korea

설명

korea-postgresql-db

활성화

연결 파라미터

host *

localhost

port *

5432

database

korea

schema

public

user *

postgres

passwd

.....

네임스페이스 *

`http://osgeo.kr/korea`

Left Sidebar (Menu)

- 정보 & 상태
 - 서버 상태
 - GeoServer 로그
 - 연락처 정보
 - GeoServer 정보
 - 프로세스 상태
- 데이터
 - 레이어 미리보기
 - 작업공간
 - 저장소
 - 레이어
 - 레이어 그룹
 - 스타일
- 서비스
 - WMTS
 - WCS
 - WFS
 - WMS
 - WPS
- 환경설정
 - 전역 환경설정
 - 이미지 프로세싱
 - 레이스터 액세스
- 파일 캐시
 - 타일 레이어
 - 캐시 기본 설정
 - 그리드셋
 - 디스크 할당량

데이터 배포

▪ 새로운 레이어 발행

The screenshot shows the GeoServer interface with the title 'GeoServer: 새로운 레이어'. The left sidebar contains sections for '정보 & 상태', '데이터', '서비스', '환경설정', and '타일 캐시'. The main content area is titled '새로운 레이어' and displays a table of existing layers. The table has columns for '발행됨', '레이어 이름', and '동작'. A search bar is located at the top right of the table area. The table lists 16 layers, each with a '발행하기' button.

발행됨	레이어 이름	동작
	admin_emd	발행하기
	admin_sgg	발행하기
	admin_sid	발행하기
	building	발행하기
	events	발행하기
	firestation	발행하기
	flow_line	발행하기
	healthcenter	발행하기
	policestation	발행하기
	river	발행하기
	road_link2	발행하기
	road_link2_junction	발행하기
	stores	발행하기
	subway	발행하기
	subway_station	발행하기
	wardoffice	발행하기

데이터 배포

▪ 새로운 레이어 발행

The screenshot shows the GeoServer interface for creating a new layer. On the left, there's a sidebar with sections like '정보 & 상태', '데이터' (with '레이어' selected), and '서비스'. A red arrow points from the '레이어' link in the '데이터' section to the dropdown menu in the 'New Layer' dialog. The 'New Layer' dialog has a title '새로운 레이어' and a sub-instruction '새로운 레이어를 추가합니다'. It includes a dropdown '다음 저장소에서 레이어 생성:' with an option '(선택)' and a list of available layers: 'nurc:arcGridSample', 'nurc:img_sample2', 'nurc:mosaic', 'nurc:worldImageSample', 'sf:sf', 'sf:sfdem', 'tiger:nyc', 'topp:states_shapefile', and 'topp:taz_shapes'. The layer 'korea:korea' is highlighted with a red box.

데이터 배포

▪ 새로운 레이어 발행

The screenshot shows the 'New Layer' page in the GeoServer interface. On the left, there's a sidebar with sections for '정보 & 상태', '데이터', '서비스', '환경설정', '타일 캐시', and '보안'. The main area has a title '새로운 레이어' and a sub-instruction '새로운 레이어를 추가합니다'. It includes dropdowns for '저장소' (set to 'korea:korea') and '필드 이름과 유형' (set to 'korea:korea'). Below these are links for '새로운 피처 타입 생성하기...' and '새로운 SQL 뷰 설정하기...'. A note says '다음은 저장소에 포함된 레이어 목록입니다: "korea". 환경을 구성할 레이어를 클릭하세요.' A red box highlights a table titled '발행됨' (Published) containing a list of layers:

레이어 이름	동작
admin_sid	다시 발행하기
admin_emd	발행하기
admin_sgg	발행하기
building	발행하기
events	발행하기
firestation	발행하기
flow_line	발행하기
healthcenter	발행하기
policestation	발행하기
river	발행하기
road_link2	발행하기
road_link2_junction	발행하기
stores	발행하기
subway	발행하기
subway_station	발행하기
wardoffice	발행하기

At the bottom, there are navigation buttons (<<, <, >, >>) and a note '결과: 0 에서 0 (0 항목 중)'.

데이터 배포

■ 레이어 확인

GeoServer: 레이어 미리보기 x + localhost/geoserver/web/wicket/bookmarkable/org.geoserver.web.demo.MapPreviewPage... ☰ ☆ EX XML ABP G 다음 계정으로 연결되었습니다: admin. 로그아웃

GeoServer

레이어 미리보기

GeoServer에 설정된 모든 레이어의 목록 각각에 대해 다양한 형식의 미리보기를 제공합니다.

유형	제목	이름	공통 포맷	모든 포맷
admin_emd	korea:admin_emd		OpenLayers KML GML	선택하세요 ▾
admin_sgg	korea:admin_sgg		OpenLayers KML GML	선택하세요 ▾

레이어 미리보기

작업 공간

저장소

레이어

레이어 그룹

스타일

WMTS

WCS

WFS

WMS

WPS

환경 설정

전역 환경 설정

이미지 프로세싱

레이터 액세스

Scale = 1 : 273K

road_link2

korea:road_link2

OpenLayers KML GML

선택하세요 ▾

road_link2_junction

korea:road_link2_junction

OpenLayers KML GML

선택하세요 ▾

stores

korea:stores

OpenLayers KML GML

선택하세요 ▾

지도 이미지

지도 설정

지도 확장자

지도 캐시

타일 레이어

캐시 기본 설정

그리드셋

디스크 할당량

FeatureCollection xsi:schemaLocation="http://www.opengis.net/wfs http://localhost:8080/geoserver/korea/wfs?service=WFS&version=1.0.0&request=DescribeFeatureType&typeName=korea:Admin_end" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:wfs="http://www.opengis.net/wfs" xmlns:korea="http://osgeo.kr/korea" xmlns:gml="http://www.opengis.net/gml">1101051500 37144549911010722 37144550011101051500서울특별시</korea:adm_nm>100000000000000000000000000000001687400000000000000000000000000016874000000000000000000000000000168744000000000000000000000000007435.50630330002427942.64356999806760</korea:pop_dens>01101051500,371445499,11010722,371445500,1101051500,3714454991101051500,371445499,11010722,371445500,1101051500,371445499

WebGIS 테스트 환경 구성

Java - Web - WAS - GeoServer 설치

- **GeoServer supported Java**

- Java 11 - GeoServer 2.15.x and above (OpenJDK tested)
- Java 8 - GeoServer 2.9.x and above (OpenJDK and Oracle JRE tested)
- Java 7 - GeoServer 2.6.x to GeoServer 2.8.x (OpenJDK and Oracle JRE tested)
- Java 6 - GeoServer 2.3.x to GeoServer 2.5.x (Oracle JRE tested)
- Java 5 - GeoServer 2.2.x and earlier (Sun JRE tested)



출처 : <https://docs.geoserver.org/latest/en/user/production/java.html>

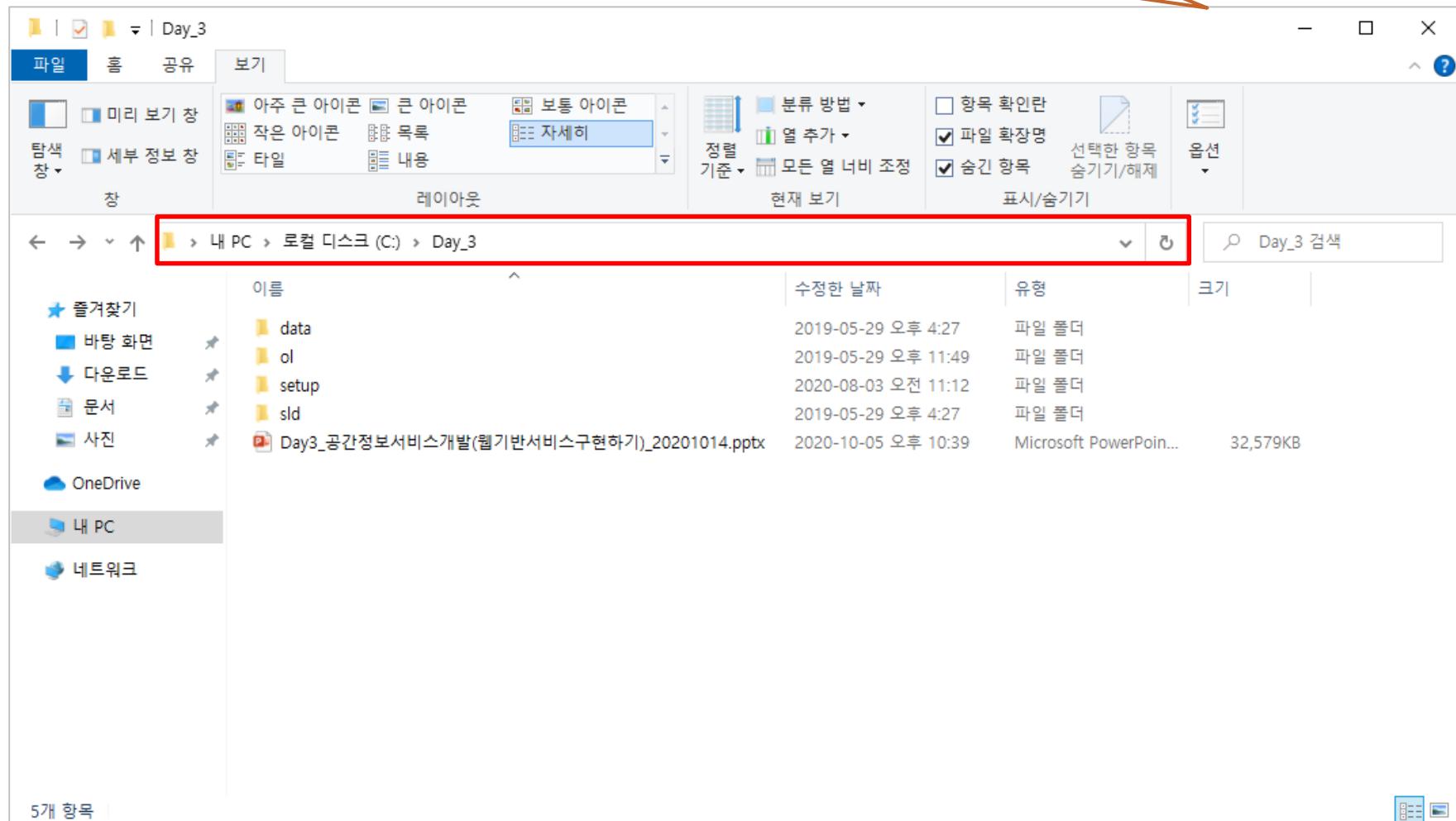
Java - Web - WAS - GeoServer 설치

- JAVA 설치 (<https://github.com/ojdkbuild/ojdkbuild>)
- Apache HTTPD 설치 (<https://httpd.apache.org/>)
- Apache Tomcat 설치 (<http://tomcat.apache.org/>)
- HTTPD, Tomcat 설정 (80 포트로 접근시 GeoServer 연결)
- GeoServer Web Archive Version 설치(<http://geoserver.org/release/maintain/>)
- GeoServer Plugin 설치 (<http://geoserver.org/release/maintain/>)

Java - Web - WAS - GeoServer 설치

▪ 소프트웨어 설치 디렉토리

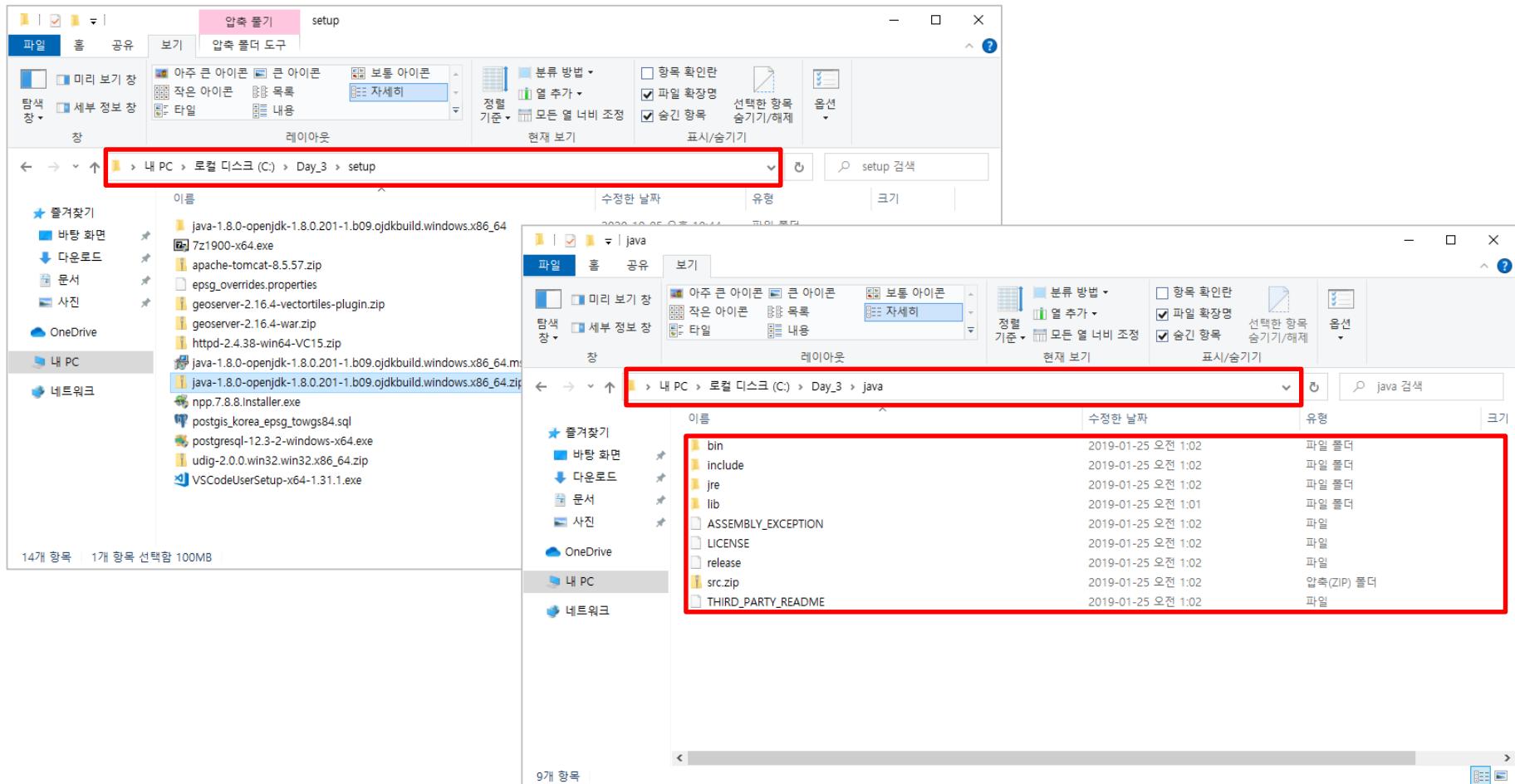
C:\₩Day_3



Java - Web - WAS - GeoServer 설치

■ JAVA 설치

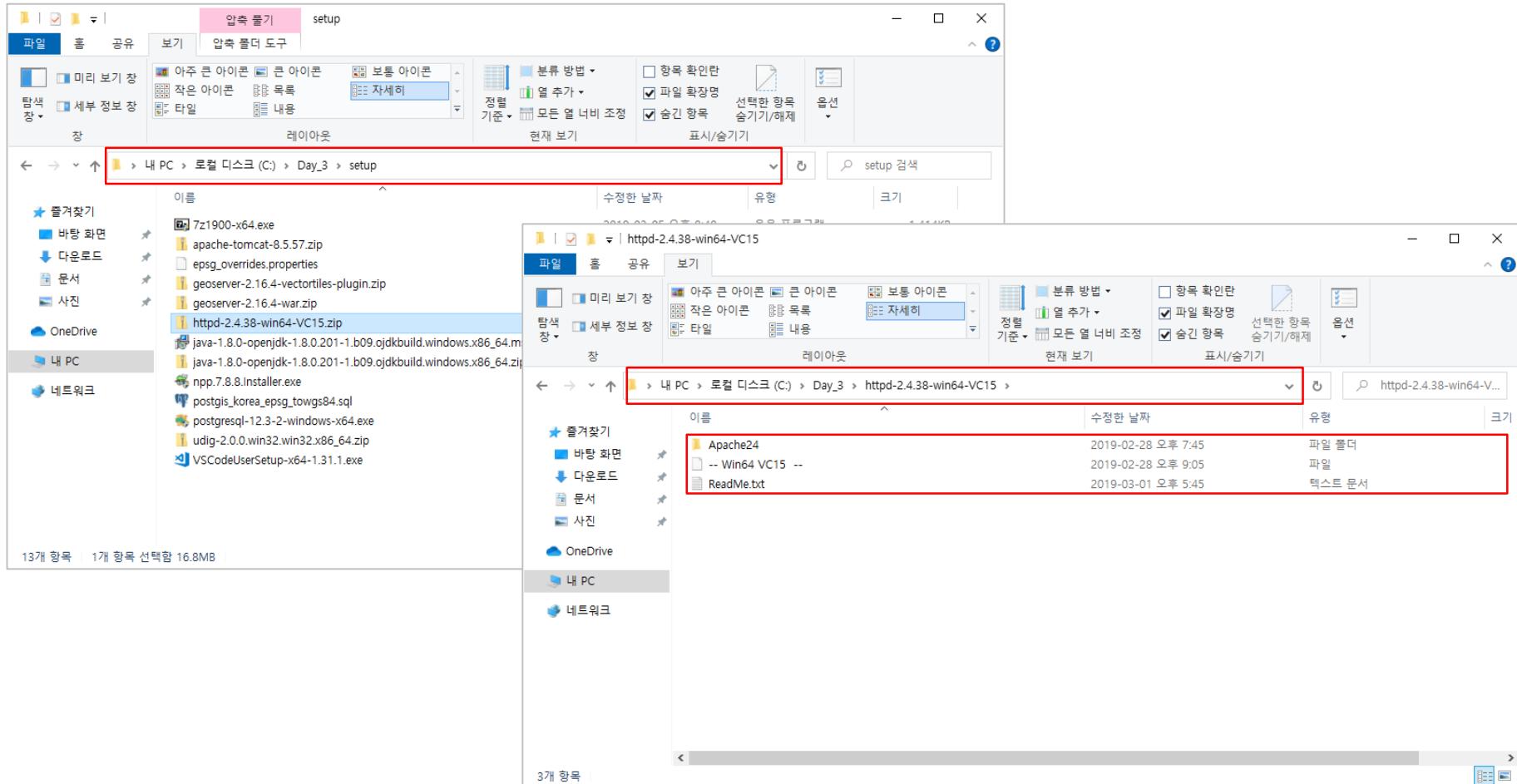
- java-1.8.0-openjdk-1.8.0.201-1.b09.ojdkbuild.windows.x86_64.zip 파일 압축해제
- %java 폴더를 생성하여 압축해제한 파일 이동



Java - Web - WAS - GeoServer 설치

■ Apache HTTPD 설치

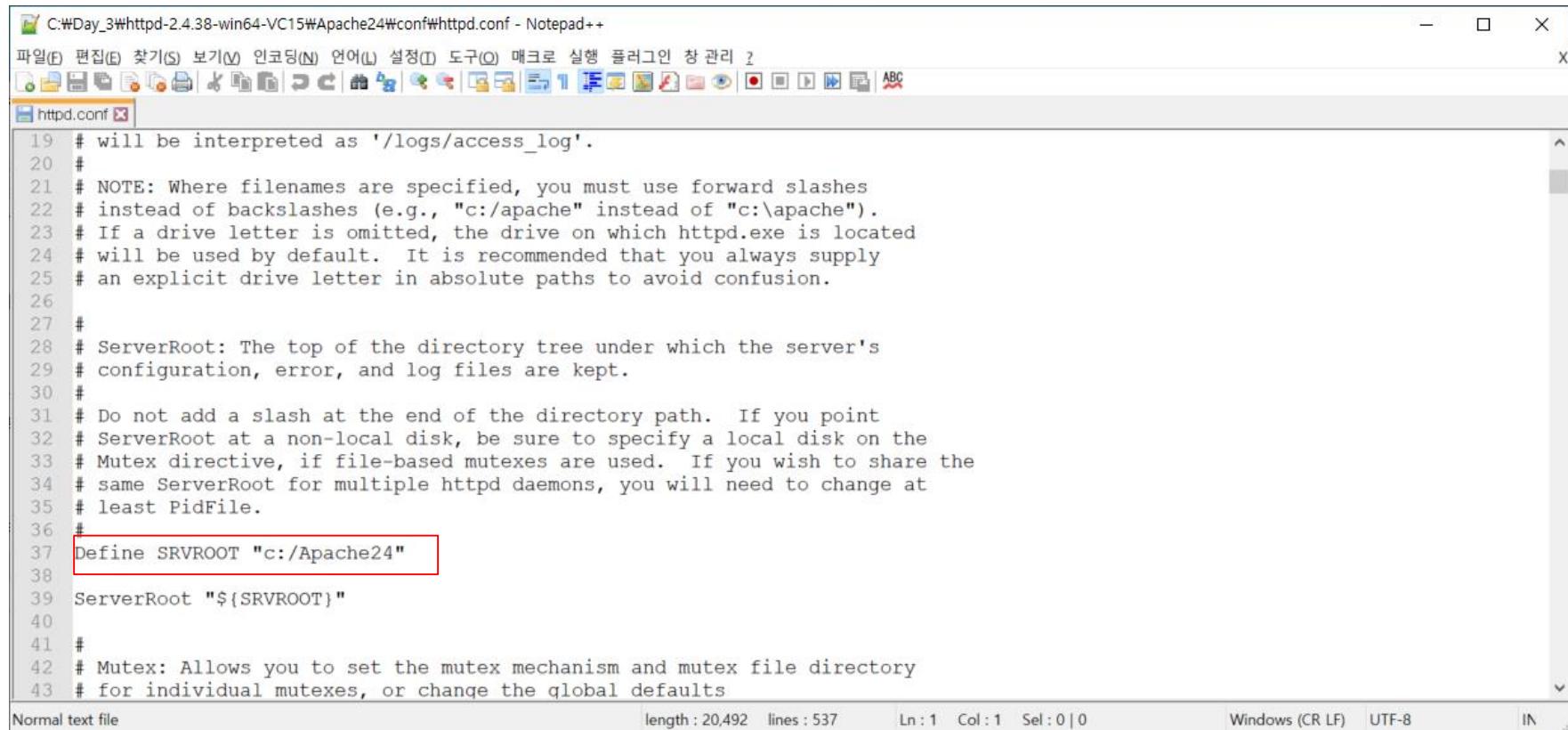
- httpd-2.4.38-win64-VC15.zip 파일 압축해제
- C:\ 폴더에 압축해제한 파일 이동



Java - Web - WAS - GeoServer 설치

▪ Apache HTTPD 설정

- C:\Day_3\httpd-2.4.38-win64-VC15\Apache24\conf\httpd.conf 파일 편집
- 37라인 수정 (C:/Day_3/httpd-2.4.38-win64-VC15/Apache24)

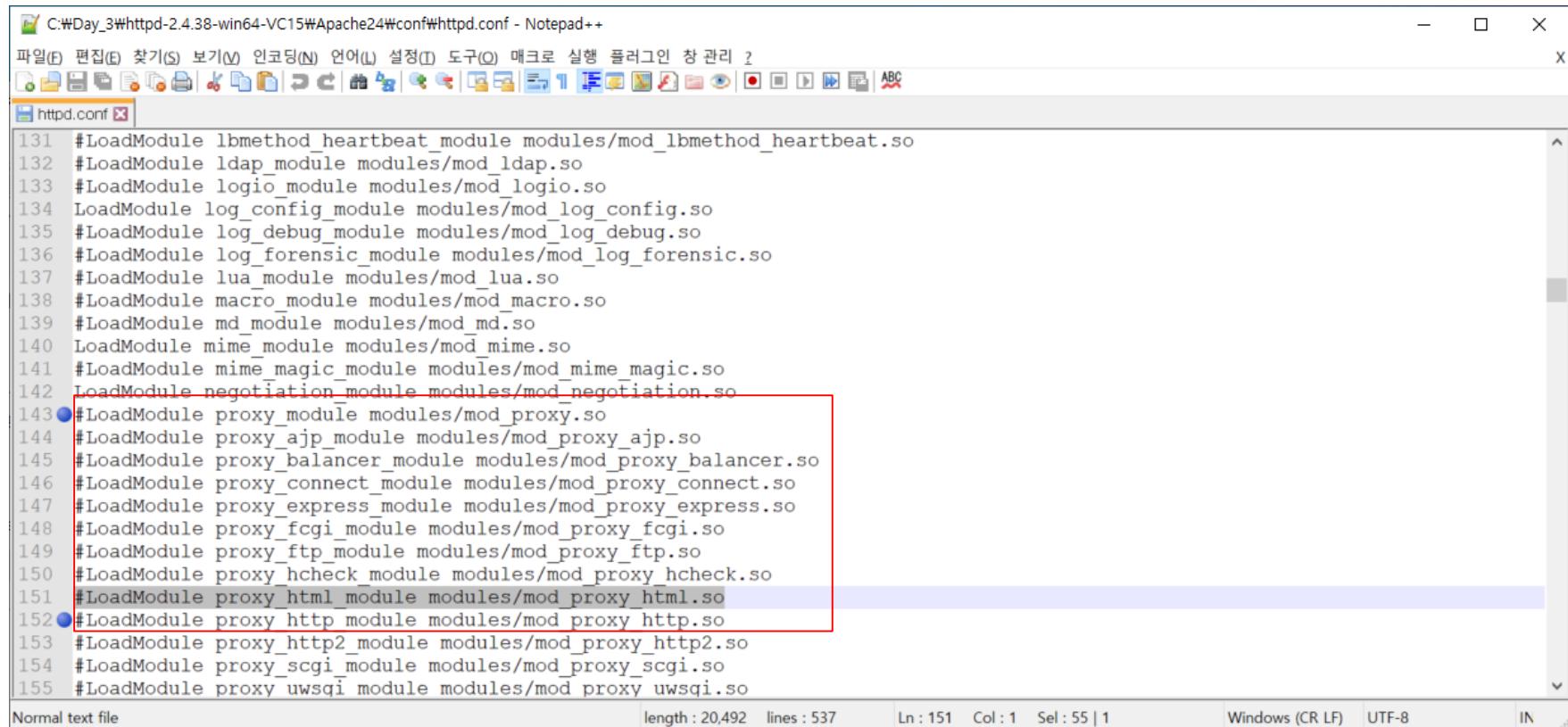


```
C:\Day_3\httpd-2.4.38-win64-VC15\Apache24\conf\httpd.conf - Notepad++
파일(F) 편집(E) 찾기(S) 보기(V) 인코딩(N) 언어(L) 설정(I) 도구(O) 매크로 실행 플러그인 창 관리 ?
파일(F) 편집(E) 찾기(S) 보기(V) 인코딩(N) 언어(L) 설정(I) 도구(O) 매크로 실행 플러그인 창 관리 ?
httpd.conf [x]
19 # will be interpreted as '/logs/access_log'.
20 #
21 # NOTE: Where filenames are specified, you must use forward slashes
22 # instead of backslashes (e.g., "c:/apache" instead of "c:\apache").
23 # If a drive letter is omitted, the drive on which httpd.exe is located
24 # will be used by default. It is recommended that you always supply
25 # an explicit drive letter in absolute paths to avoid confusion.
26 #
27 #
28 # ServerRoot: The top of the directory tree under which the server's
29 # configuration, error, and log files are kept.
30 #
31 # Do not add a slash at the end of the directory path. If you point
32 # ServerRoot at a non-local disk, be sure to specify a local disk on the
33 # Mutex directive, if file-based mutexes are used. If you wish to share the
34 # same ServerRoot for multiple httpd daemons, you will need to change at
35 # least PidFile.
36 #
37 Define SRVROOT "c:/Apache24"
38 
39 ServerRoot "${SRVROOT}"
40 #
41 #
42 # Mutex: Allows you to set the mutex mechanism and mutex file directory
43 # for individual mutexes, or change the global defaults
```

Java - Web - WAS - GeoServer 설치

▪ Apache HTTPD 설정

- C:\Day_3\httpd-2.4.38-win64-VC15\Apache24\conf\httpd.conf 파일 편집
- 143, 152 라인의 #주석 해제

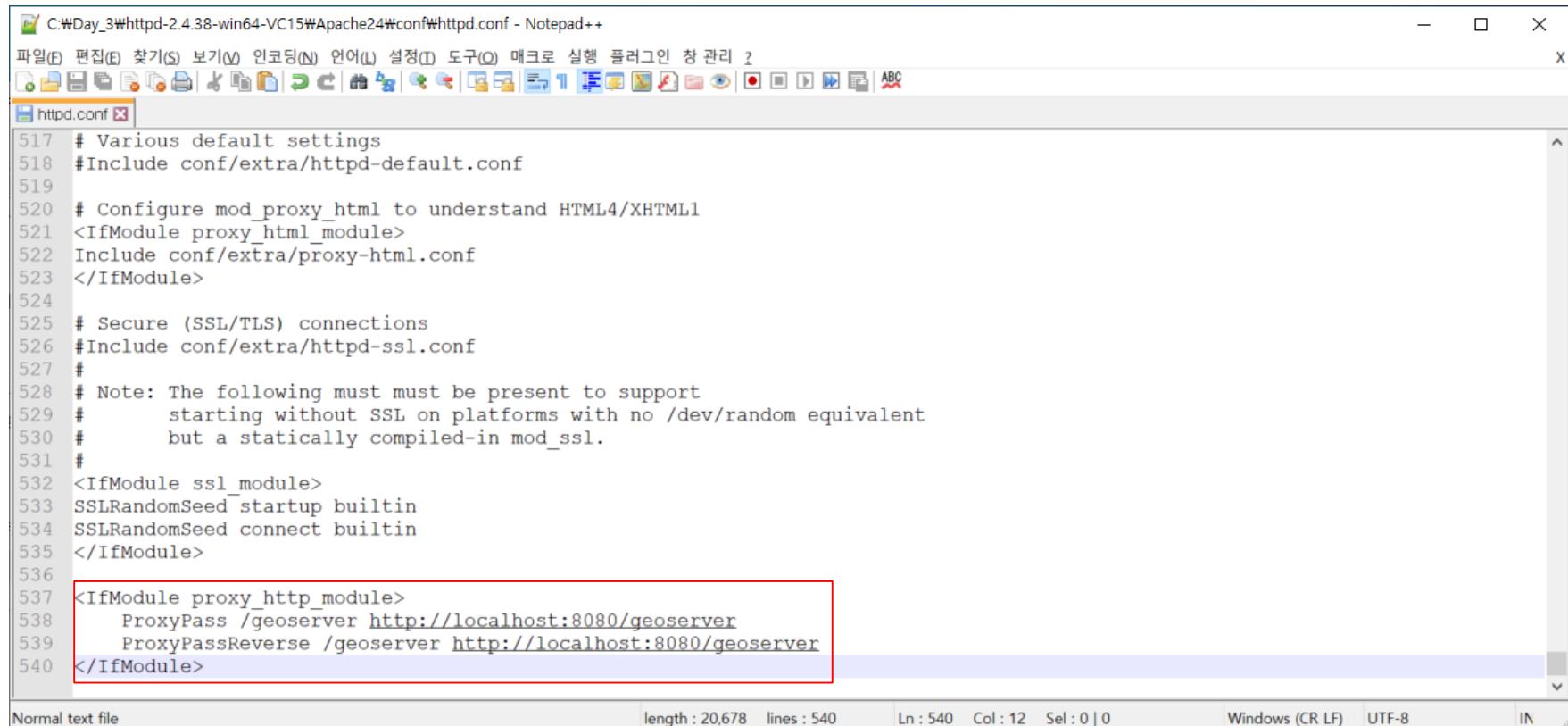


```
C:\Day_3\httpd-2.4.38-win64-VC15\Apache24\conf\httpd.conf - Notepad++
파일(F) 편집(E) 찾기(S) 보기(V) 인코딩(N) 언어(L) 설정(I) 도구(Q) 매크로 실행 플러그인 창 관리 ?
파일(F) 편집(E) 찾기(S) 보기(V) 인코딩(N) 언어(L) 설정(I) 도구(Q) 매크로 실행 플러그인 창 관리 ?
httpd.conf
131 #LoadModule lbmethod_heartbeat_module modules/mod_lbmethod_heartbeat.so
132 #LoadModule ldap_module modules/mod_ldap.so
133 #LoadModule logio_module modules/mod_logio.so
134 LoadModule log_config_module modules/mod_log_config.so
135 #LoadModule log_debug_module modules/mod_log_debug.so
136 #LoadModule log_forensic_module modules/mod_log_forensic.so
137 #LoadModule lua_module modules/mod_lua.so
138 #LoadModule macro_module modules/mod_macro.so
139 #LoadModule md_module modules/mod_md.so
140 LoadModule mime_module modules/mod_mime.so
141 #LoadModule mime_magic_module modules/mod_mime_magic.so
142 LoadModule negotiation_module modules/mod_negotiation.so
143 #LoadModule proxy_module modules/mod_proxy.so
144 #LoadModule proxy_ajp_module modules/mod_proxy_ajp.so
145 #LoadModule proxy_balancer_module modules/mod_proxy_balancer.so
146 #LoadModule proxy_connect_module modules/mod_proxy_connect.so
147 #LoadModule proxy_express_module modules/mod_proxy_express.so
148 #LoadModule proxy_fcgi_module modules/mod_proxy_fcgi.so
149 #LoadModule proxy_ftp_module modules/mod_proxy_ftp.so
150 #LoadModule proxy_hcheck_module modules/mod_proxy_hcheck.so
151 #LoadModule proxy_html_module modules/mod_proxy_html.so
152 #LoadModule proxy_http_module modules/mod_proxy_http.so
153 #LoadModule proxy_http2_module modules/mod_proxy_http2.so
154 #LoadModule proxy_scgi_module modules/mod_proxy_scgi.so
155 #LoadModule proxy_uwsqi_module modules/mod_proxy_uwsqi.so
```

Java - Web - WAS - GeoServer 설치

▪ Apache HTTPD 설정

- C:\Day_3\httpd-2.4.38-win64-VC15\Apache24\conf\httpd.conf 파일 편집
- 537~540 라인추가



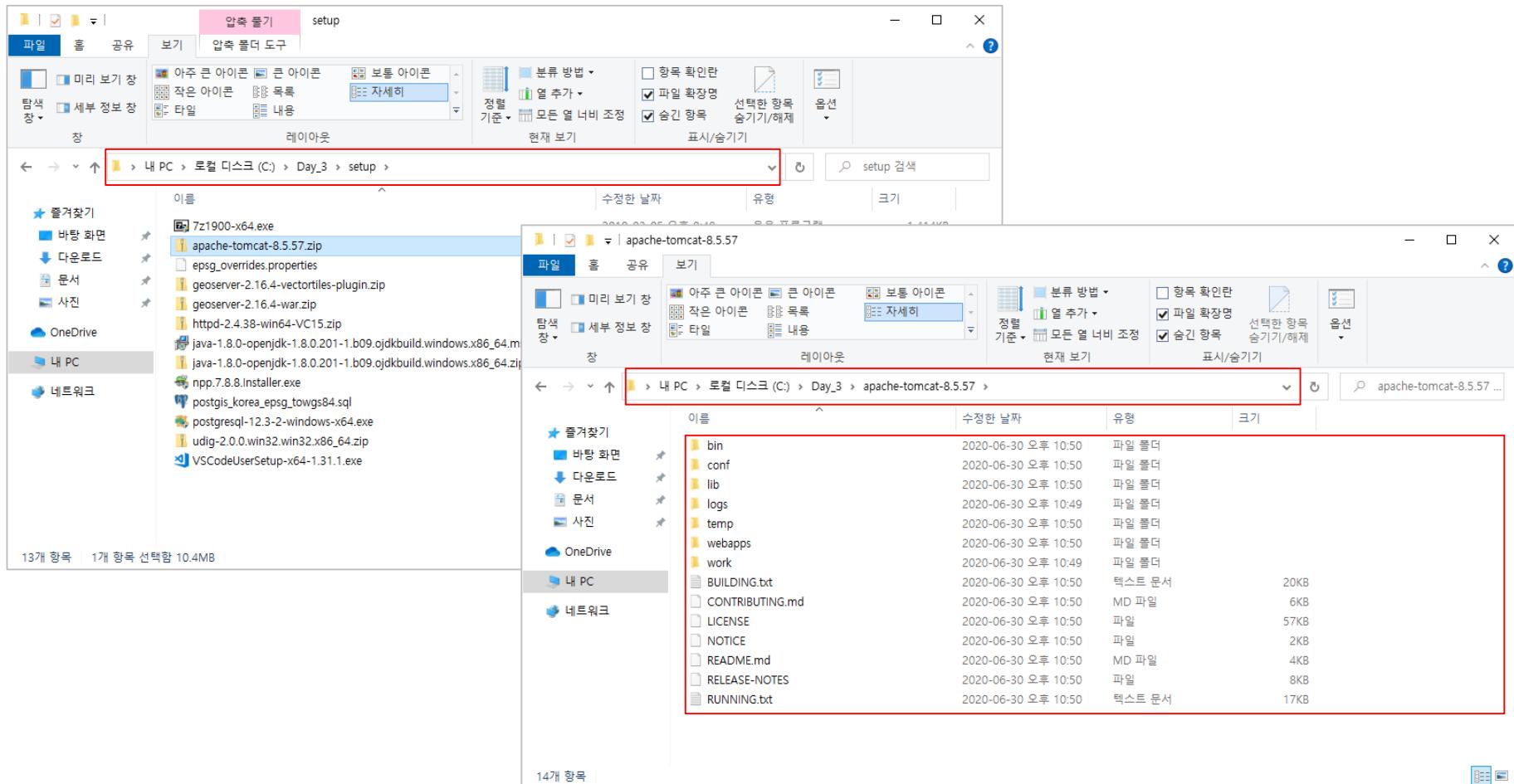
```
C:\Day_3\httpd-2.4.38-win64-VC15\Apache24\conf\httpd.conf - Notepad++
파일(F) 편집(E) 찾기(S) 보기(V) 인코딩(N) 언어(L) 설정(I) 도구(Q) 매크로 실행 플러그인 창 관리 ?
httpd.conf
517 # Various default settings
518 #Include conf/extra/httpd-default.conf
519
520 # Configure mod_proxy_html to understand HTML4/XHTML1
521 <IfModule proxy_html_module>
522     Include conf/extra/proxy-html.conf
523 </IfModule>
524
525 # Secure (SSL/TLS) connections
526 #Include conf/extra/httpd-ssl.conf
527 #
528 # Note: The following must be present to support
529 #        starting without SSL on platforms with no /dev/random equivalent
530 #        but a statically compiled-in mod_ssl.
531 #
532 <IfModule ssl_module>
533     SSLRandomSeed startup builtin
534     SSLRandomSeed connect builtin
535 </IfModule>
536
537 <IfModule proxy_http_module>
538     ProxyPass /geoserver http://localhost:8080/geoserver
539     ProxyPassReverse /geoserver http://localhost:8080/geoserver
540 </IfModule>
```

Normal text file length : 20,678 lines : 540 Ln : 540 Col : 12 Sel : 0 | 0 Windows (CR LF) UTF-8 IN

Java - Web - WAS - GeoServer 설치

■ Apache Tomcat 설치

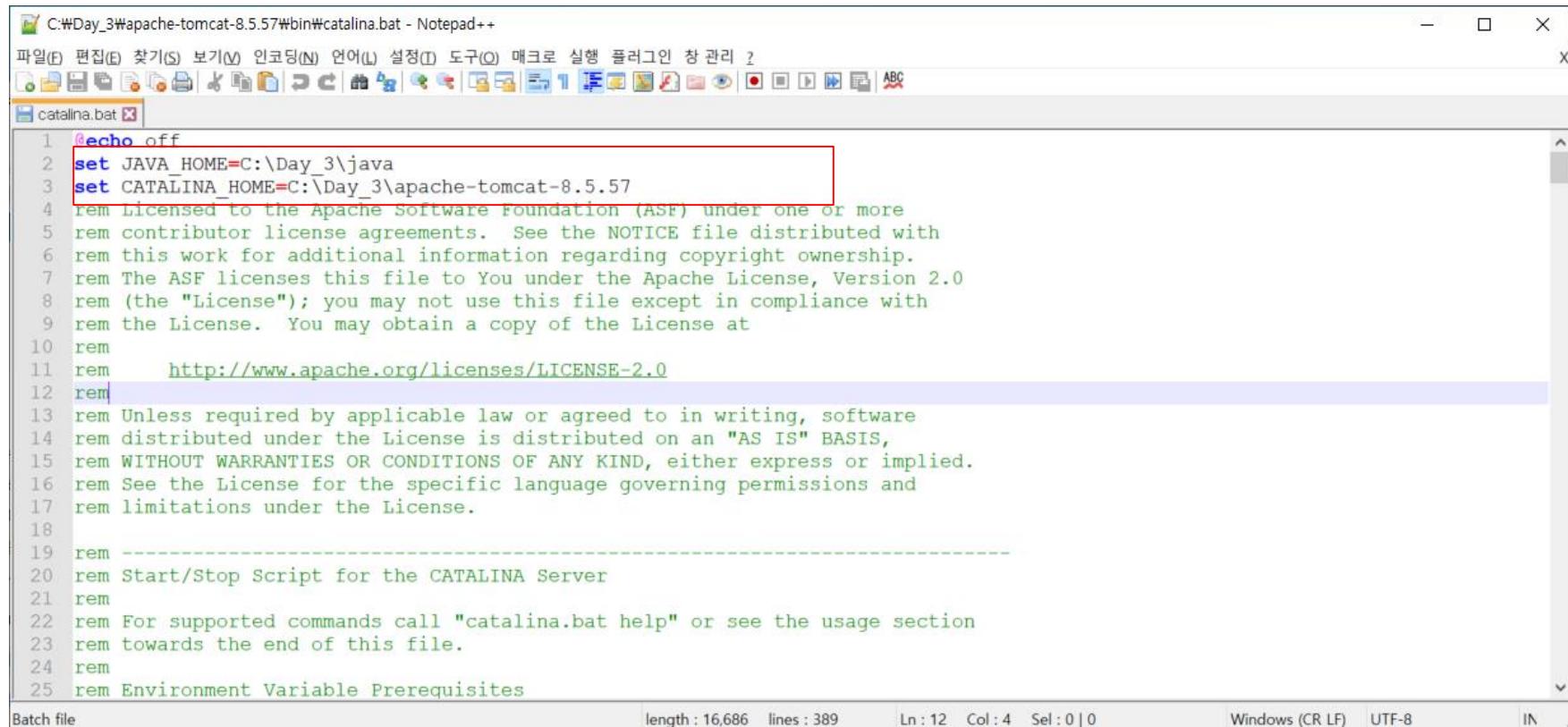
- apache-tomcat-8.5.57.zip 파일 압축해제
- C:\Day_3 폴더에 압축해제한 파일 이동



Java - Web - WAS - GeoServer 설치

■ Apache Tomcat 설정

- C:\Day_3\apache-tomcat-8.5.57\bin\catalina.bat 파일 편집
- 2,3 라인추가



The screenshot shows the Notepad++ application window with the file 'catalina.bat' open. The code editor displays the contents of the batch file. A red box highlights the first two lines of the file:

```
1 echo off
2 set JAVA_HOME=C:\Day_3\java
3 set CATALINA_HOME=C:\Day_3\apache-tomcat-8.5.57
```

The rest of the file contains standard Tomcat license and configuration comments.

Java - Web - WAS - GeoServer 설치

▪ GeoServer 설치시 유의사항

- Httpd 설치시 C:\Apache24 외 다른 경로에 설치 할 경우 SRVROOT 설정 필요함 (conf\httpd.conf)
- Tomcat 설치시 CATALINA_HOME, JRE_HOME 환경변수 잡혀 있어야 startup.bat으로 실행 가능
- Tomcat 설치시 JRE_HOME 이 Program Files 또는 Program Files(x86) 를 사용하는 경우 PROGRA~1, PROGRA~2 등으로 변경하여 설정하거나 따옴표(“)제거하여 설정

https://www.ibm.com/support/knowledgecenter/ko/SSYMRC_6.0.0/com.ibm.jazz.install.doc/topics/t_run_rqm64_win_service.html

- Httpd, Tomcat 연계 설정시 mod_proxy.so, mod_proxy_http.so 의 주석을 제거하여 활성화 하는데 이때 mod_proxy_http.so 와 mod_proxy_html.so 바뀌지 않도록 주의 (conf\httpd.conf)
- ProxyPass 와 ProxyPassReverse 등록

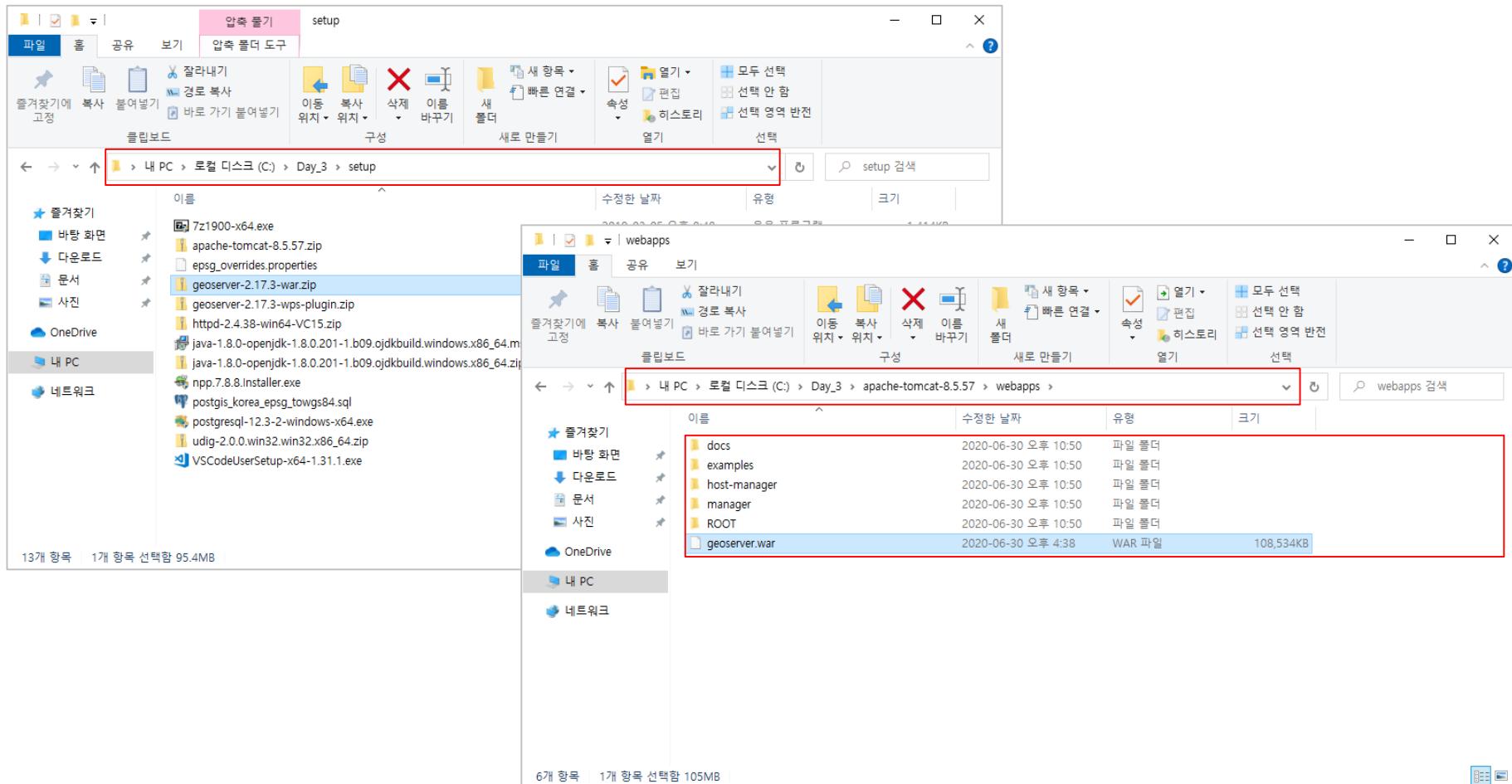
```
<IfModule proxy_http_module>
    ProxyPass /geoserver http://localhost:8080/geoserver
    ProxyPassReverse /geoserver http://localhost:8080/geoserver
</IfModule>
```

- Tomacat 에 JSONP 설정 (web.xml 에 주석으로 되어 있는부분 활성화)

Java - Web - WAS - GeoServer 설치

▪ GeoServer 설치

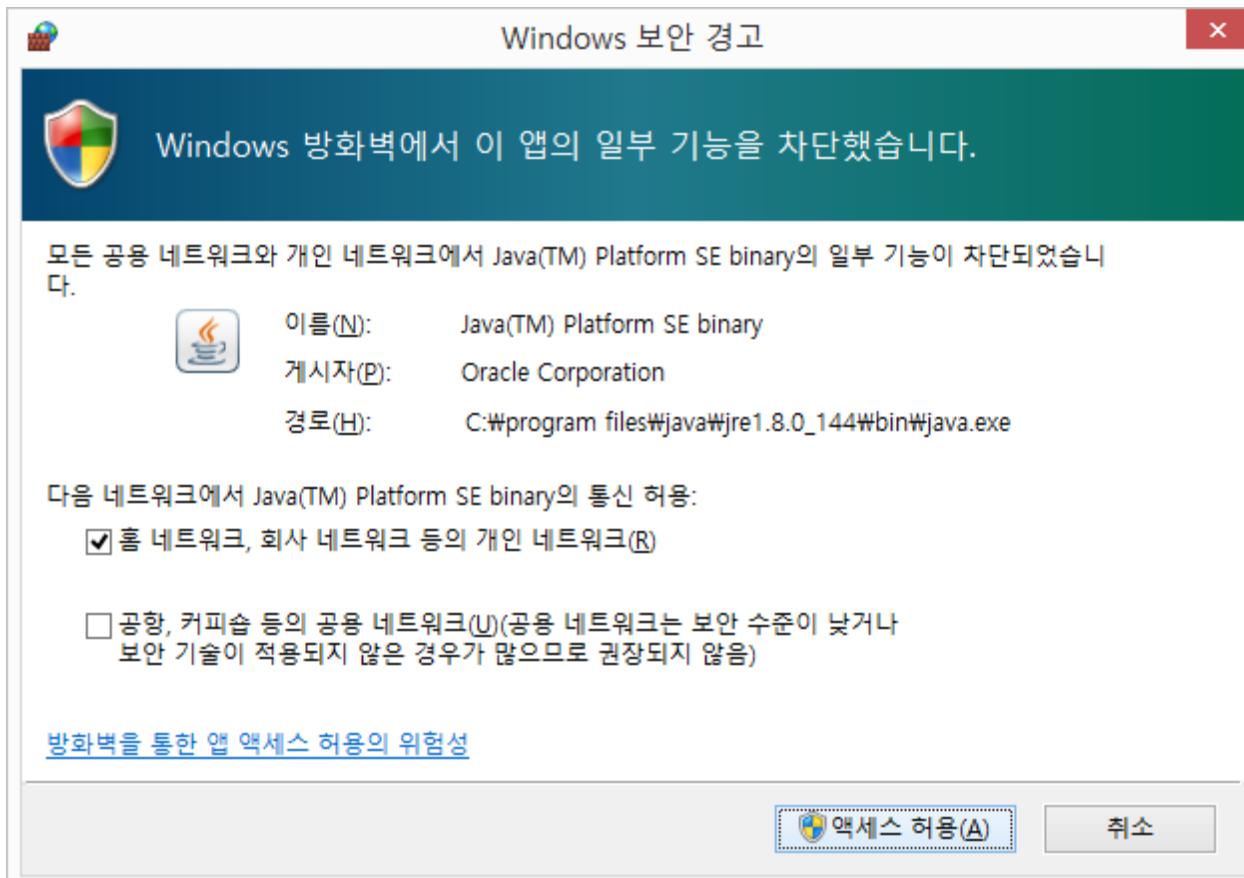
- geoserver-2.17.3-war.zip 파일 압축해제
- C:\Day_3\apache-tomcat-8.5.57\webapps 폴더에 압축해제한 파일중 geoserver.war 파일 이동



Java - Web - WAS - GeoServer 설치

▪ GeoServer 설치시 유의사항

- 윈도우 보안 경고 팝업시 액세스 허용 실행하기



OpenLayers 시작하기

소개

▪ OpenLayers 소개

The screenshot shows the official OpenLayers website at <https://openlayers.org>. The main page features a large map of the world with a green-to-blue gradient. Below the map, a banner reads "A high-performance, feature-packed library for all your mapping needs." To the left, there's a sidebar titled "OpenLayers Examples" with various links like "View Animation", "Tiled ArcGIS MapServer", "Bing Maps", "Smoothing lines using Chalkins algorithm", "d3 Integration", "Device Orientation", and "Draw and Modify Features". The main content area has sections for "OVERVIEW", "FEATURES" (with "Tiled Layers" and "Vector Layers" sub-sections), "Cutting Edge, Fast & Mobile Ready", and "Easy to Customize and Extend". On the right, there's a detailed "View" section, "Interactions", "Sources and formats", "Observable objects", and "Other components". A cookie consent banner at the bottom asks for permission to use cookies.

- ❖ 웹 환경에서 지도 데이터의 시각화와 조작을 할 수 있도록 자바스크립트 라이브러리로 제공하는 오픈소스 프로젝트
- ❖ OpenStreetMap과 같은 오픈 데이터 지도와 BingMap, Carto 등 상용 지도의 사용이 가능하도록 라이브러리 제공
- ❖ 지도서버로의 접근을 OGC 표준에 의해 요청하고 지도서버와는 독립적으로 동작
- ❖ 다수의 샘플 예제를 통해 기능을 학습할 수 있음

- ❖ 플랫폼
 - Web Browser
- ❖ 언어
 - Javascript
- ❖ 라이센스
 - FreeBSD (2-clause BSD License)
- ❖ 최신버전
 - V6.5.0

소개

▪ OpenLayers 소개

2004년 여름

- OpenStreetMap 재단설립
(by Steve Coast)

2005년 2월 8일

- 구글지도 처음으로 발표

2006년 봄

- MetaCarta 사내 그룹에 의해
OpenLayers Release 1.0 발표

2006 6월 27일

- Release 1.0

2006년 8월 25일

- Release/2.0

2006년 10월 2일

- Release/2.1

2007년 11월

- OpenLayers is an Open Source
Geospatial Foundation project

2014년 2월

- OpenLayers 3 beta.1 Release

2017년 2월

- OpenLayers 4 beta.1 Release

2018년 4월

- OpenLayers 5 beta.1 Release

2019년 2월

- OpenLayers 6 beta.1 Release

[OpenLayers6 call for funding](#)

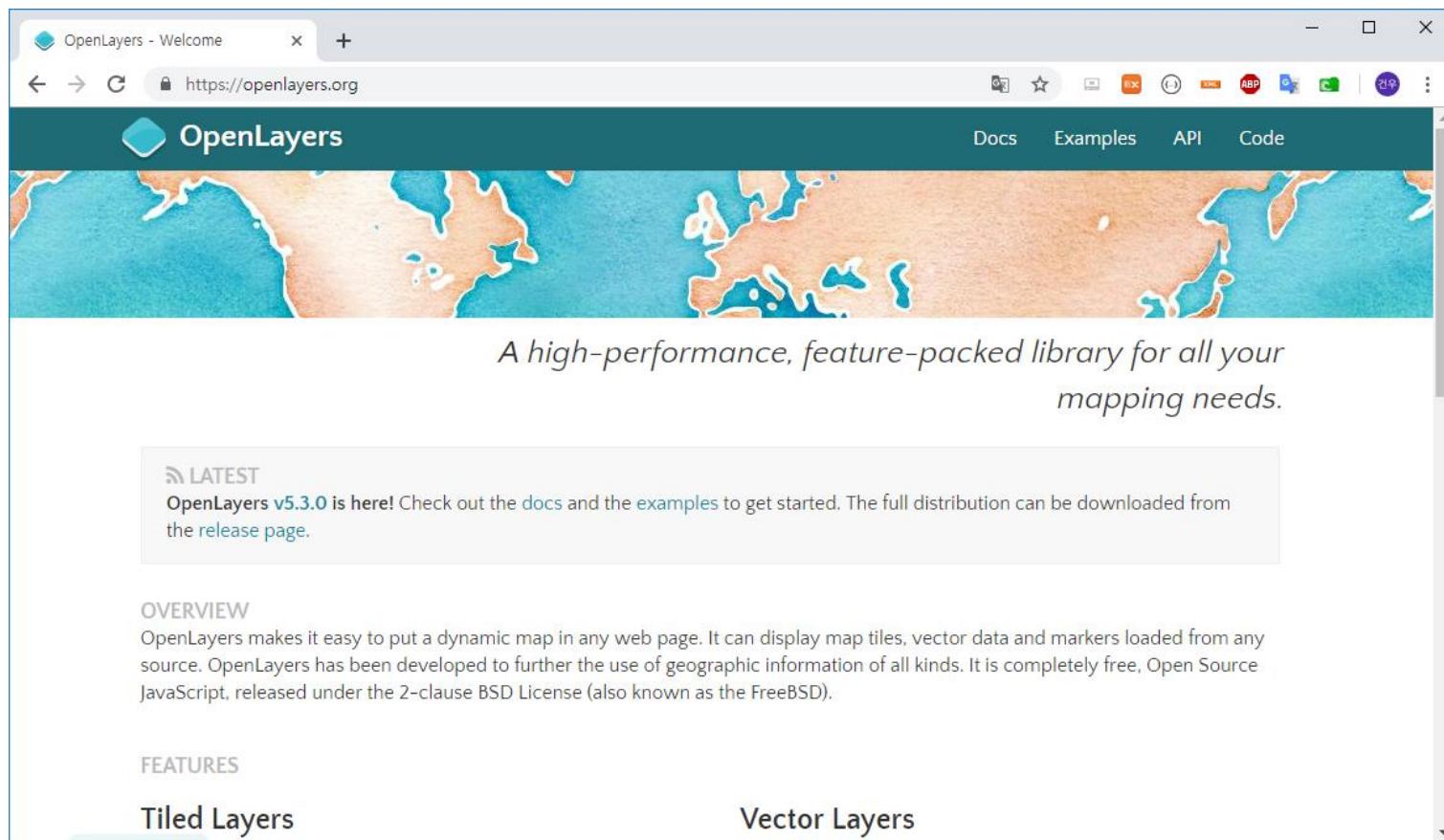
<http://trac.osgeo.org/openlayers/wiki/History>

<https://github.com/openlayers/openlayers/releases>

소개

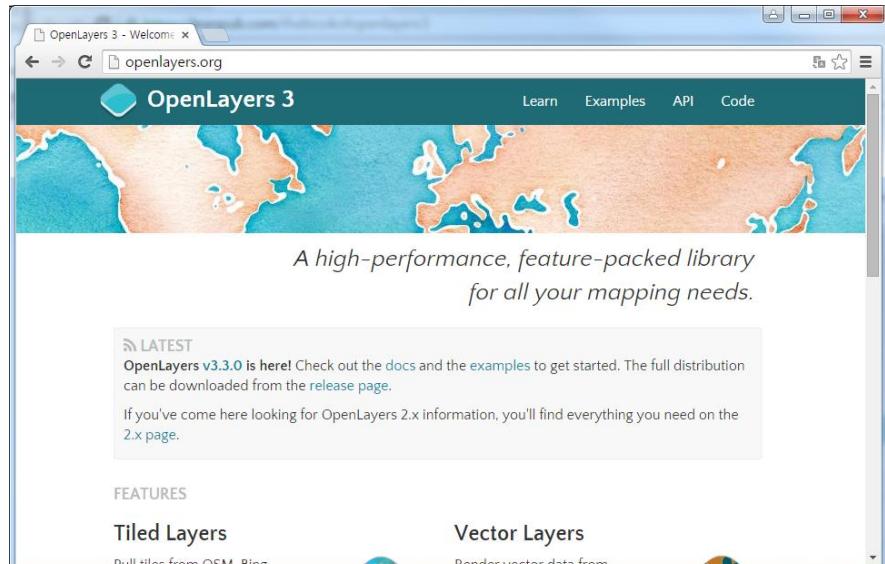
▪ 이전버전과의 차이

- 2.x 버전에서 3.x 으로 업그레이드때 가장 많이 달라짐
- 3.x 이후 주로 네이밍 방법, 신기술 적용, 종속성 제거 위주로 업그레이드 됨



소개

■ 2.x 버전과 3.x 버전 차이



❖ OpenLayers 2

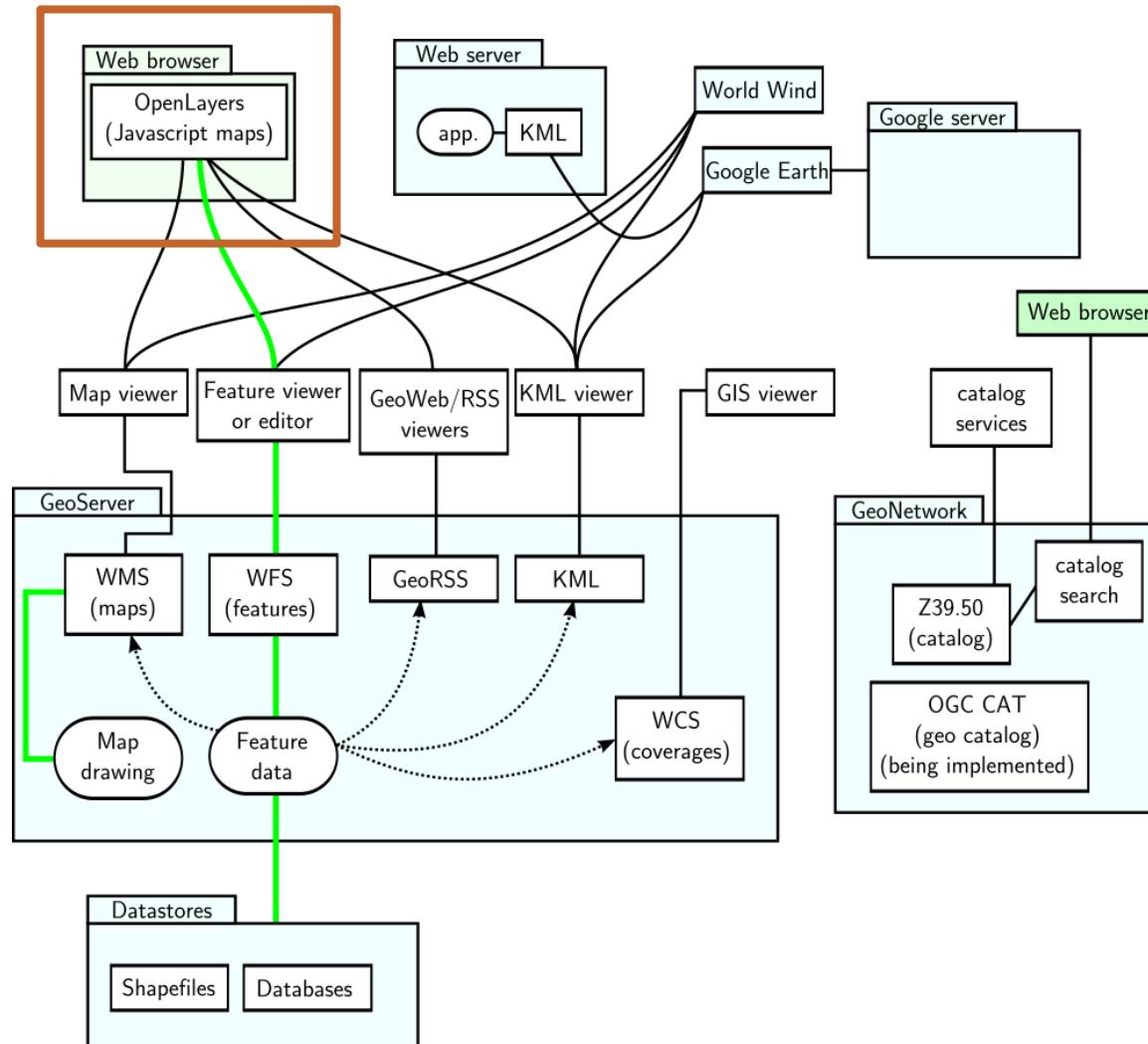
- ❖ 다년간에 걸쳐 운영된 검증된 Library
- ❖ 많은 Project 에 사용되고 있음
- ❖ 많은 사용자로 인해 공개된 예제와 어려움에 대한 개선 방법이 많이 공개 되어있음

❖ OpenLayers 3

- ❖ OpenLayers 2.x 버전과 호환되지 않음
- ❖ HTML5, CSS3등 최신 기술 지원
- ❖ 더욱 빠른 이미지, 벡터 처리
- ❖ 모바일 지원

소개

- OpenLayers can communicate through several protocols



출처 : [wikipedia](#)

소개

<https://openlayers.org>

Quick Start

▪ OpenLayers 미리보기

- Cdn 서버의 script, css 를 이용하여 OpenLayers 를 시작하는 가장 빠른 방법
- OpenLayers 5.x 버전부터 개발하기 위해선 npm 패키지로 제공되고 ECMAScript5를 지원하는 브라우저에 작동하며 이를 위해 Babel 같은 변환툴을 이용해 변환 해야함

```
1.  <!doctype html>
2.  <html lang="en">
3.    <head>
4.      <link rel="stylesheet"
5.        href="https://cdn.rawgit.com/openLayers/openLayers.git
6.          hub.io/master/en/v5.3.0/css/ol.css" type="text/css">
7.      <style>
8.        .map {
9.          height: 400px;
10.         width: 100%;
11.       }
12.     </style>
13.     <script
14.       src="https://cdn.rawgit.com/openLayers/openLayers.git
15.          hub.io/master/en/v5.3.0/build/ol.js"></script>
16.   <title>OpenLayers example</title>
17.   <head>
18.     <body>
19.       <h2>My Map</h2>
20.       <div id="map" class="map"></div>
21.     <script type="text/javascript">
22.       var map = new ol.Map({
23.         target: 'map',
24.         layers: [
25.           new ol.layer.Tile({
26.             source: new ol.source.OSM()
27.           })
28.         ],
29.         view: new ol.View({
30.           center: ol.proj.fromLonLat([37.41, 8.82]),
31.           zoom: 4
32.         });
33.       </script>
34.     </body>
35.   </html>
```

소개

- OpenLayers 미리보기

- 제공하고 있는 cdn 서버를 이용하여 OpenLayers 라이브러리 추가(ol.js, ol.css)

```
<script  
src="https://cdn.rawgit.com/openLayers/openLayers.github.io/master/en/v5.3.0/build/ol.js">  
</script>  
  
<link rel="stylesheet"  
href="https://cdn.rawgit.com/openLayers/openLayers.github.io/master/en/v5.3.0/css/ol.css"  
type="text/css">
```

- <body>에 지도영역이 될 <div> 태그 설정하고 <head>에 div 스타일 설정

```
<head>  
<style>  
    .map {  
        height: 400px;  
        width: 100%;  
    }  
</style>  
</head>  
<body>  
<div id="map" class="map"></div>
```

소개

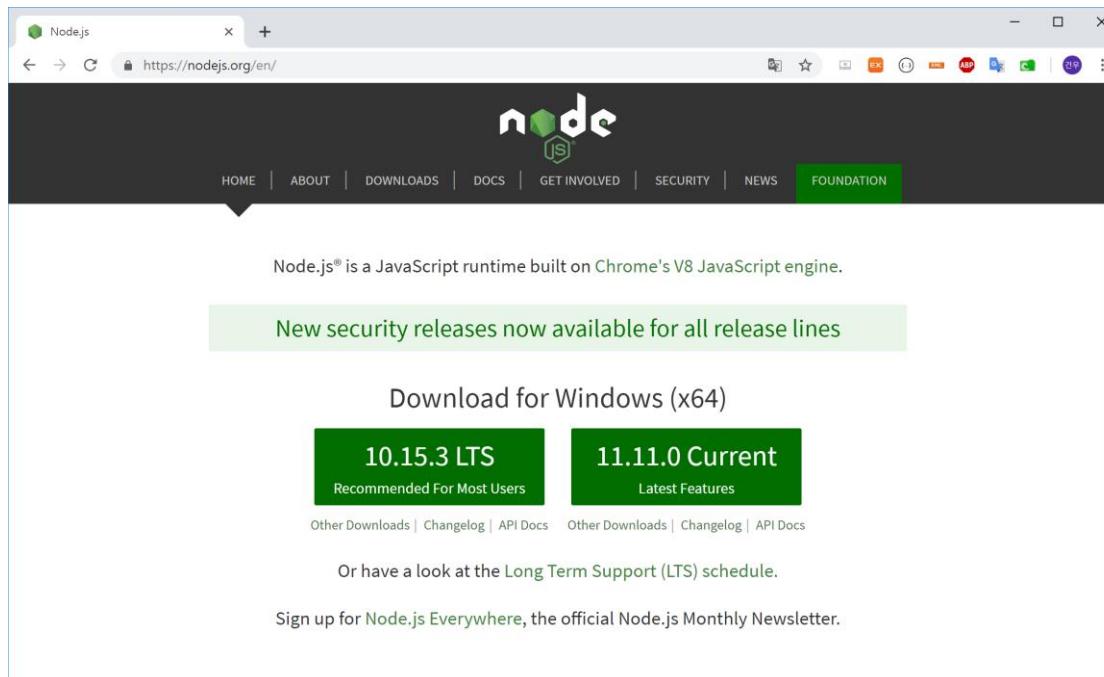
- OpenLayers 미리보기
 - target은 생성한 <div>의 id
 - layers는 map에 들어갈 layer를 배열형식으로 설정
 - ol.layer.Tile은 Tile Layer를 말하며 OpenLayers에서 제공하는 ol.source.OSM()을 사용함으로써 OpenStreetMap 사용 가능
 - view는 map의 center(중심점), zoom(크기 레벨)을 입력

```
var map = new ol.Map({  
    target: 'map',  
    layers: [  
        new ol.layer.Tile({  
            source: new ol.source.OSM()  
        })  
    ],  
    view: new ol.View({  
        center: ol.proj.fromLonLat([37.41, 8.82]),  
        zoom: 4  
    })  
});
```

개발환경

▪ Node.js 설치

- Node.js® is a JavaScript runtime built on Chrome's V8 JavaScript engine
- 확장성 있는 네트워크 애플리케이션(특히 서버 사이드) 개발에 사용되는 소프트웨어 플랫폼
- 작성 언어로 자바스크립트를 활용하며 Non-blocking I/O와 단일 스레드 이벤트 루프를 통한 높은 처리 성능을 가지고 있음
- 내장 HTTP 서버 라이브러리를 포함하고 있어 웹 서버에서 아파치 등의 별도의 소프트웨어 없이 동작하는 것이 가능하며 이를 통해 웹 서버의 동작에 있어 더 많은 통제 가능



개발환경

- Node.js 설치
 - 설치후 node -v 명령어로 설치확인

```
C:\Users\JohnDoe>node -v  
v11.6.0
```

- node.js를 설치하게 되면 npm(Node Package Modules)이 같이 설치 된다. npm -v 명령어로 확인

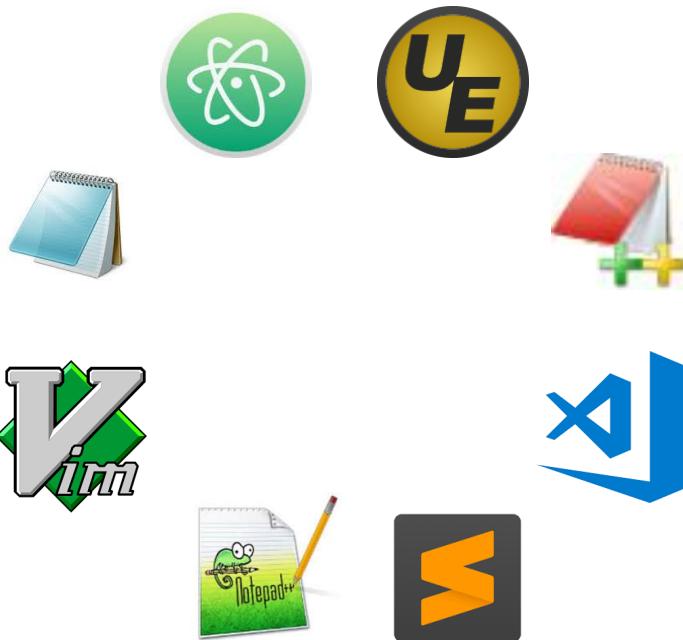
```
C:\Users\JohnDoe>npm -v  
6.13.6
```

- <https://docs.npmjs.com/>

개발환경

■ Text Editor 설치

- 개발 생산성 향상이 목적임
- 윈도우에서 제공하는 메모장은 기능이 너무 적음
- 개발 편의 기능 제공(인코딩 변환, 포맷팅 등)
- 서버사이드 개발을 위한 IDE가 따로 있다면 같이 사용
- Wsetup 에 Visual studio code, NorePad++ 설치



이미지 출처 : <https://www.vim.org/>

개발환경

■ 프로젝트 생성

- C드라이브의 Day_03\Day_3\Day_3\work 디렉토리로 이동 하여 work(프로젝트) 디렉토리 생성

```
C:\Users\JohnDoe>cd C:\Day_3\Day_3
```

```
C:\Day_3\Day_3>mkdir work && cd work
```

```
C:\Day_3\Day_3\work>
```

- npm init 명령어로 프로젝트를 초기화

```
C:\Day_3\Day_3\work>npm init
```

- npm install ol

```
C:\Day_3\Day_3\work>npm install ol
```

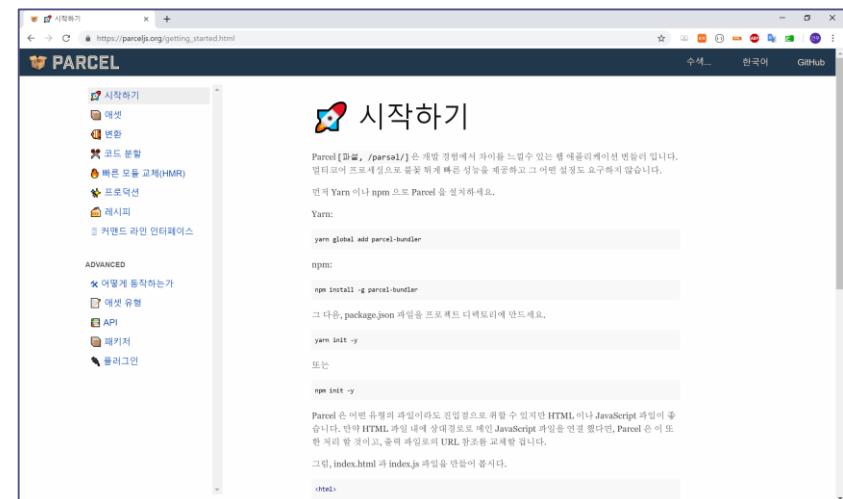
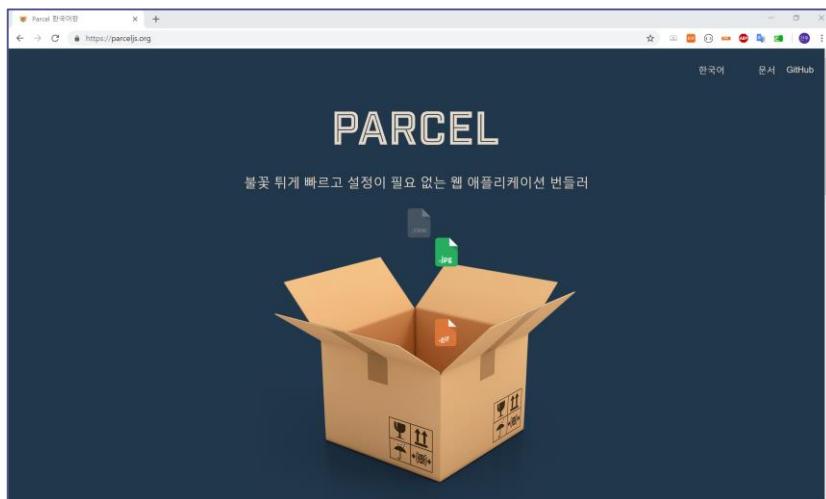
개발환경

- **Bundler 설치**
 - OpenLayers에서 여러 Bundler를 통해 시작하는 방법 제공
(<https://www.npmjs.com/package/ol>)
 - Parcel Bundler를 설치 해서 사용

```
C:\WDay_3\Wol\Wwork> npm install --save-dev parcel-bundler
```

또는

```
C:\WDay_3\Wol\Wwork>npm install -g parcel-bundler
```



사용하기

- **Index.js 작성**
 - OpenLayers 시작을 위한 기본 Map 작성
 - Parcel bundler에 내장되어 있는 babel 사용

```
1. import 'ol/ol.css';
2. import {Map, View} from 'ol';
3. import TileLayer from 'ol/layer/Tile';
4. import OSM from 'ol/source/OSM';
5.
6. const map = new Map({
7.   target: 'map',
8.   layers: [
9.     new TileLayer({
10.       source: new OSM()
11.     })
12.   ],
13.   view: new View({
14.     center: [0, 0],
15.     zoom: 0
16.   })
17. });
```

사용하기

- **Html Page 작성**
 - OpenLayers 를 실행해 보기 위한 Html Page 작성
 - Index.js 의 target 속성에 정의된 map id를 가진 div 작성

```
1.  <!DOCTYPE html>
2.  <html>
3.  <head>
4.    <meta charset="utf-8">
5.    <title>Using Parcel with OpenLayers</title>
6.    <style>
7.      #map {
8.        width: 400px;
9.        height: 250px;
10.      }
11.    </style>
12.  </head>
13.  <body>
14.    <div id="map"></div>
15.    <script src=".//index.js"></script>
16.  </body>
17. </html>
```

사용하기

- package.json 설정 및 시작
 - npm run build, npm start로 간단히 실행 하기 위한 설정
- npm start 명령어로 실행 (기본 Prot :1234)

```
C:\Day_3\ol\work>npm start
Server running at http://localhost:1234
✓ Built in 1.95s.
```

- npm run build 명령어로 build하여 생긴 dist/ 사용 가능

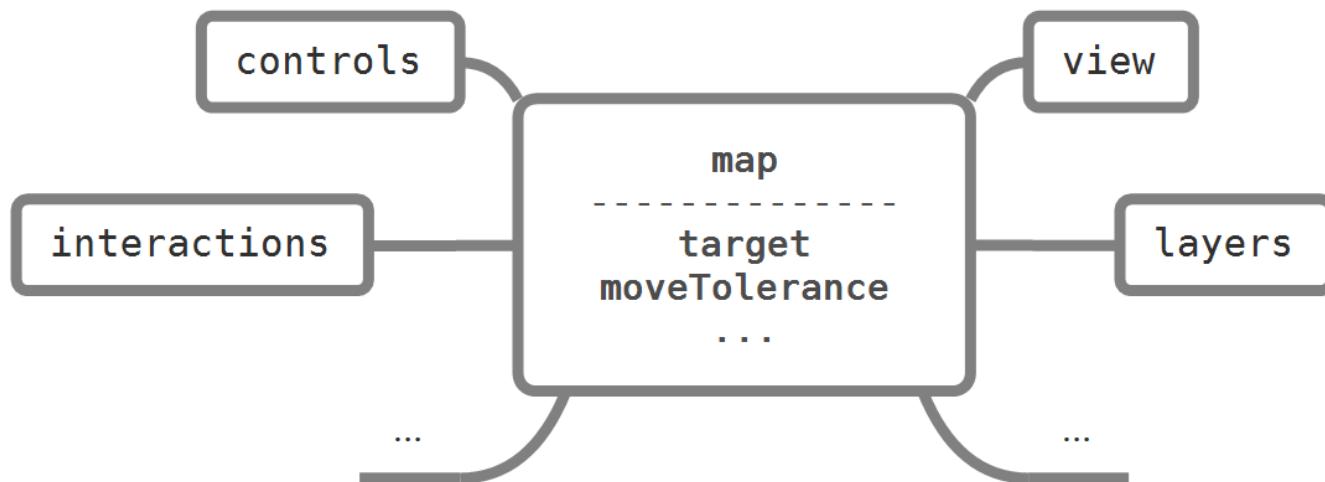
```
C:\Day_3\ol\work>npm run build
> work@1.0.0 build C:\ol\work
> parcel build --public-url . index.html
✓ Built in 85.06s.
```

OpenLayers

Map

▪ Map

- {map} 모듈로 인터랙티브한 지도가 웹브라우저를 통해 생성하는데 view, layers, controls, interactions 등의 모듈과 함께 구성됨
- {view} 모듈을 통해 지도를 구성하고, {layers}를 설정 하여 하나 또는 그 이상의 지도를 표현
- {interaction} 모듈로 사용자와 지도가 상호 작용하여 콘텐츠를 수정 및 시각화
- {control}을 통해 지도 구성요소를 통제



Map

- **Map**

- layers, controls, interaction 등을 미리 정의 하며 런타임 중에 추가, 변경, 삭제 될 경우 get, add, set, remove 같은 Method등을 이용
- 디바이스 환경이나 지도의 사용목적에 따른 내용이 주로 설정
- https://openlayers.org/en/latest/apidoc/module-ol_Map-Map.html

```
import 'ol/ol.css';
import {Map, View} from 'ol';

const map = new Map({
  target: 'map',
  layers: [],
  controls: [],
  interaction: [],
  overlays: [],
  moveTolerance: 1,
  loadTilesWhileAnimating: false,
  loadTilesWhileInteracting: false,
  view: new View({center: [-10997148, 4569099],
    zoom: 4})
});
```

Map

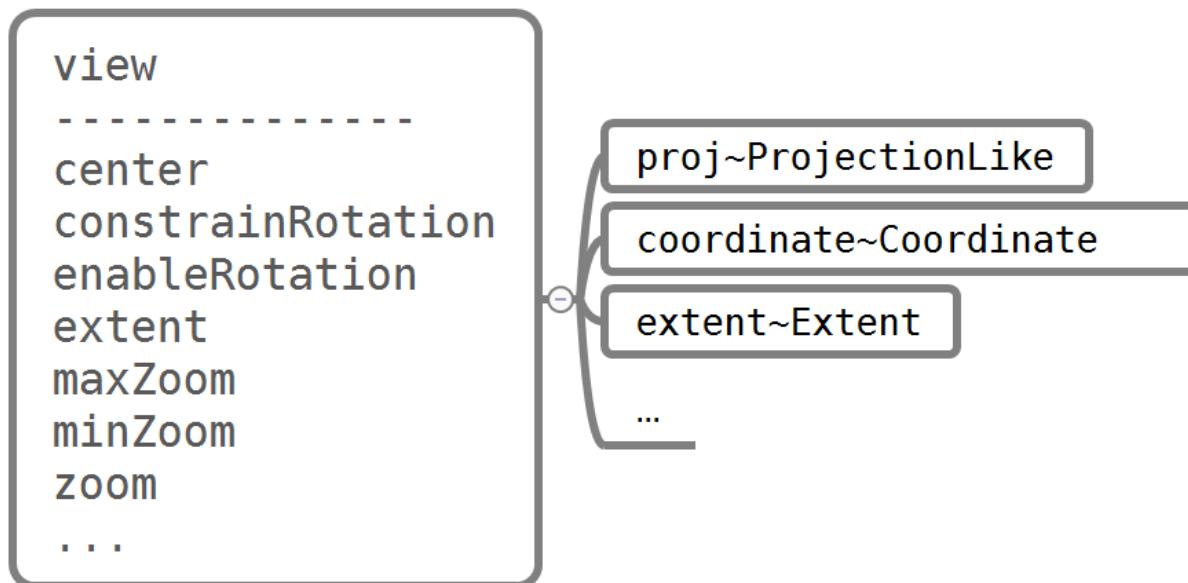
▪ Map properties

Name	Type	Description
controls	Array	Controls initially added to the map. If not specified, module:ol/control~defaults is used.
pixelRatio	number	The ratio between physical pixels and device-independent pixels (dips) on the device.
interactions	Array	Interactions that are initially added to the map. If not specified, module:ol/interaction~defaults is used.
keyboardEventTarget	HTMLElement Document string	The element to listen to keyboard events on. This determines when the KeyboardPan and KeyboardZoom interactions trigger. For example, if this option is set to document the keyboard interactions will always trigger. If this option is not specified, the element the library listens to keyboard events on is the map target (i.e. the user-provided div for the map). If this is not document, the target element needs to be focused for key events to be emitted, requiring that the target element has a tabindex attribute.
layers	Array	Layers. If this is not defined, a map with no layers will be rendered. Note that layers are rendered in the order supplied, so if you want, for example, a vector layer to appear on top of a tile layer, it must come after the tile layer.
maxTilesLoading	number	Maximum number tiles to load simultaneously.
loadTilesWhileAnimating	boolean	When set to true, tiles will be loaded during animations. This may improve the user experience, but can also make animations stutter on devices with slow memory.
loadTilesWhileInteracting	boolean	When set to true, tiles will be loaded while interacting with the map. This may improve the user experience, but can also make map panning and zooming choppy on devices with slow memory.
moveTolerance	number	The minimum distance in pixels the cursor must move to be detected as a map move event instead of a click. Increasing this value can make it easier to click on the map.
overlays	Array	Overlays initially added to the map. By default, no overlays are added.
target	HTMLElement string	The container for the map, either the element itself or the id of the element. If not specified at construction time, module:ol/Map~Map#setTarget must be called for the map to be rendered.
view	module:ol/View~View	The map's view. No layer sources will be fetched unless this is specified at construction time or through module:ol/Map~Map#setView .

View

- **View**

- {view} 모듈은 2D 기반의 지도의 해상도, 회전, 보여지는 위치, 좌표계 등의 시각적 요소를 정의
- 여러 {map}모듈이 같은 {view} 모듈을 사용가능
- 지도의 다양한 이동, 확대와 축소, 표시를 위한 애니메이션 효과를 지원



View

- **View**

- 지도의 중심점, 좌표체계, 확대와 축소, 이동등 정의
- zoom 과 resolution은 같이 사용 될 수 없음
- https://openlayers.org/en/latest/apidoc/module-ol_View-View.html

```
import 'ol/ol.css';
Import View from 'ol';

const view = new View({
  center: [0, 0],
  zoom: 0,
  minZoom: 0,
  maxZoom: 0,
  constrainRotation: true,
  enableRotation: true,
  extent: [minx, miny maxx, maxy],
  resolution: 0,
  minResolution: 0,
  maxResolution: 0,
  resolutions: [],
  projection: 'EPSG:3857'
});
```

View

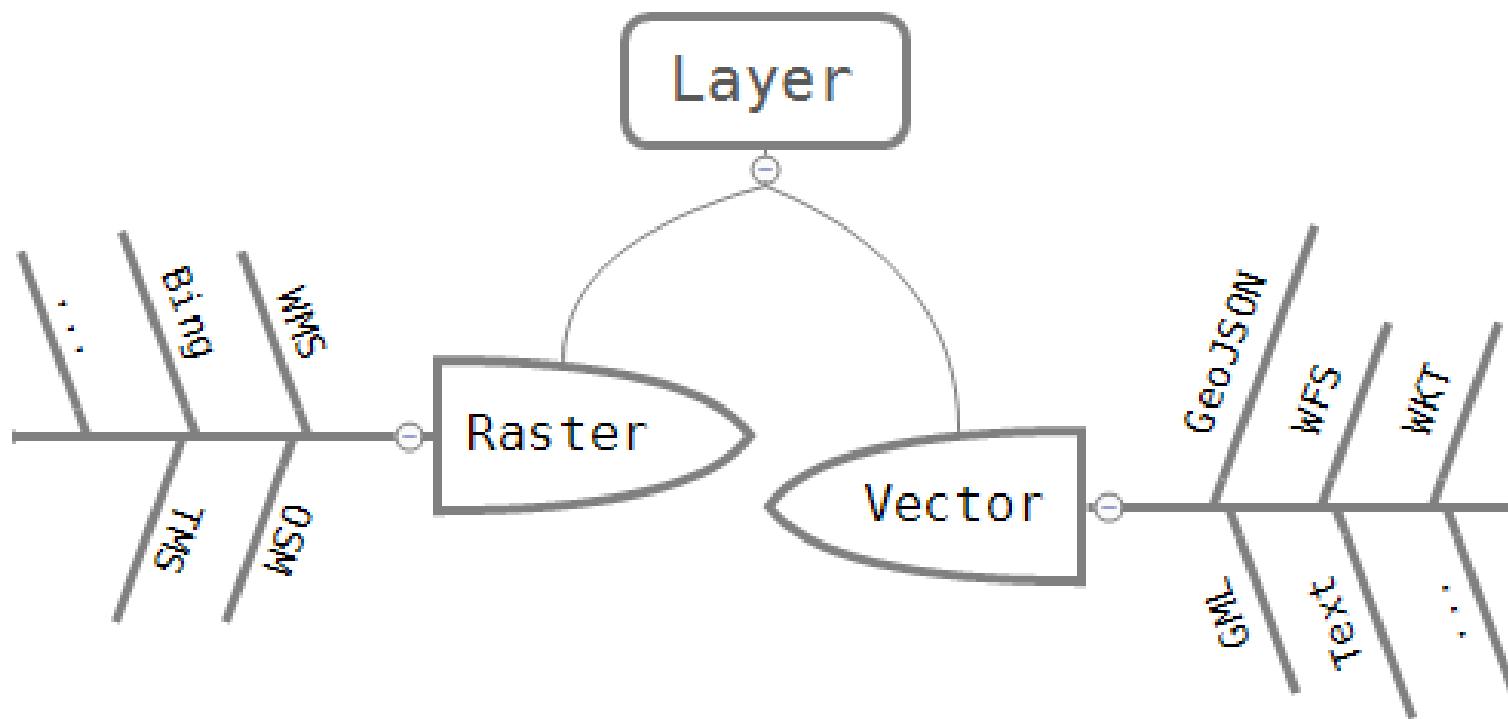
▪ View properties

Name	Type	Description
center	coordinate~Coordinate	The initial center for the view. The coordinate system for the center is specified with the projection option. Layer sources will not be fetched if this is not set, but the center can be set later with #setCenter.
constrainRotation	boolean number	Rotation constraint. false means no constraint. true means no constraint, but snap to zero near zero. A number constrains the rotation to that number of values. For example, 4 will constrain the rotation to 0, 90, 180, and 270 degrees
enableRotation	boolean	Enable rotation. If false, a rotation constraint that always sets the rotation to zero is used. The constrainRotation option has no effect if enableRotation is false.
extent	extent~Extent	The extent that constrains the center, in other words, center cannot be set outside this extent.
maxResolution	number	The maximum resolution used to determine the resolution constraint. It is used together with minResolution (or maxZoom) and zoomFactor. If unspecified it is calculated in such a way that the projection's validity extent fits in a 256x256 px tile. If the projection is Spherical Mercator (the default) then maxResolution defaults to $40075016.68557849 / 256 = 156543.03392804097$.
minResolution	number	The minimum resolution used to determine the resolution constraint. It is used together with maxResolution (or minZoom) and zoomFactor. If unspecified it is calculated assuming 29 zoom levels (with a factor of 2). If the projection is Spherical Mercator (the default) then minResolution defaults to $40075016.68557849 / 256 / \text{Math.pow}(2, 28) = 0.0005831682455839253$.
maxZoom	number	The maximum zoom level used to determine the resolution constraint. It is used together with minZoom (or maxResolution) and zoomFactor. Note that if minResolution is also provided, it is given precedence over maxZoom.
minZoom	number	The minimum zoom level used to determine the resolution constraint. It is used together with maxZoom (or minResolution) and zoomFactor. Note that if maxResolution is also provided, it is given precedence over minZoom.
projection	ProjectionLike	The projection. The default is Spherical Mercator.
resolution	number	The initial resolution for the view. The units are projection units per pixel (e.g. meters per pixel). An alternative to setting this is to set zoom. Layer sources will not be fetched if neither this nor zoom are defined, but they can be set later with #setZoom or #setResolution.
resolutions	Array.<number>	Resolutions to determine the resolution constraint. If set the maxResolution, minResolution, minZoom, maxZoom, and zoomFactor options are ignored.
rotation	number	The initial rotation for the view in radians (positive rotation clockwise, 0 means North).
zoom	number	Only used if resolution is not defined. Zoom level used to calculate the initial resolution for the view. The initial resolution is determined using the #constrainResolution method.
zoomFactor	number	The zoom factor used to determine the resolution constraint.

Layer

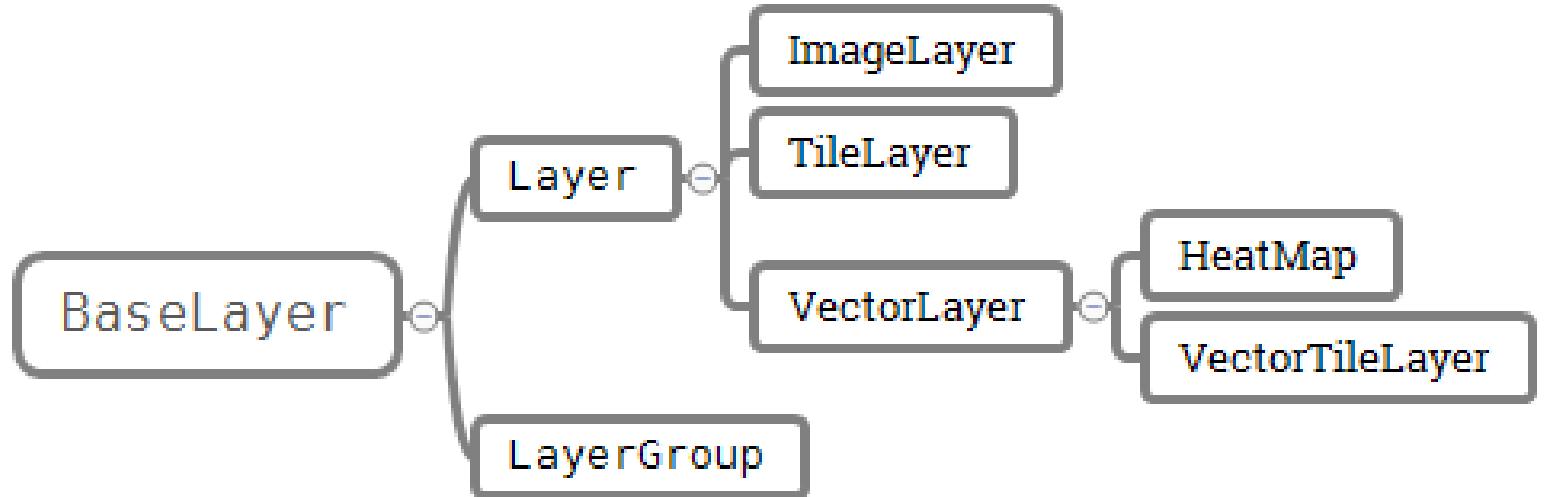
- **Layer**

- layer는 크게 2가지로 나눌 수 있음
 - Raster Layer (Image Data)
 - Vector Layer (Vector Data)



Layer

- Layer
 - layer는 Image Layer, TileLayer, VectorLayer, VectorTileLayer, HeatMap으로 구성
 - LayerGroup은 여러 layer를 하나의 layer처럼 관리
 - 각 layer는 z Index가 존재하여 중첩 할 수 있음
 - Raster Layer : Image Layer, Tile Layer
 - Vector Layer : Vector Layer, Vector Tile Layer
 - HeatMap은 벡터 데이터를 바탕으로 렌더링



Layer

- Layer, Group Layer 예제

```
const layer = new TileLayer({  
    opacity: 1,  
    visible: true,  
    extent : [0, 0, 0, 0],  
    zIndex: 0,  
    minResolution: 20,  
    maxResolution: 2000,  
    source: new OSM()  
});  
  
const groupLayer = new LayerGroup({  
    layers: [  
        new TileLayer({  
            source: new Stamen({ layer : 'watercolor' })  
        }),  
        new TileLayer({  
            source: new Stamen({ layer : 'terrain-labels' })  
        })  
    ]  
});
```

Layer

- **BaseLayer properties**

Name	Type	Description
opacity	number	Opacity (0, 1).
visible	boolean	Visibility.
extent	module:ol/extent~Extent	The bounding extent for layer rendering. The layer will not be rendered outside of this extent.
zIndex	number	The z-index for layer rendering. At rendering time, the layers will be ordered, first by Z-index and then by position. When undefined, a zIndex of 0 is assumed for layers that are added to the map's layerscollection, or Infinity when the layer's setMap() method was used.
minResolution	number	The minimum resolution (inclusive) at which this layer will be visible.
maxResolution	number	The maximum resolution (exclusive) below which this layer will be visible.

- **Layer Properties**

Name	Type	Description
source	module:ol/source/Source~Source	The layer source (or null if not yet set).

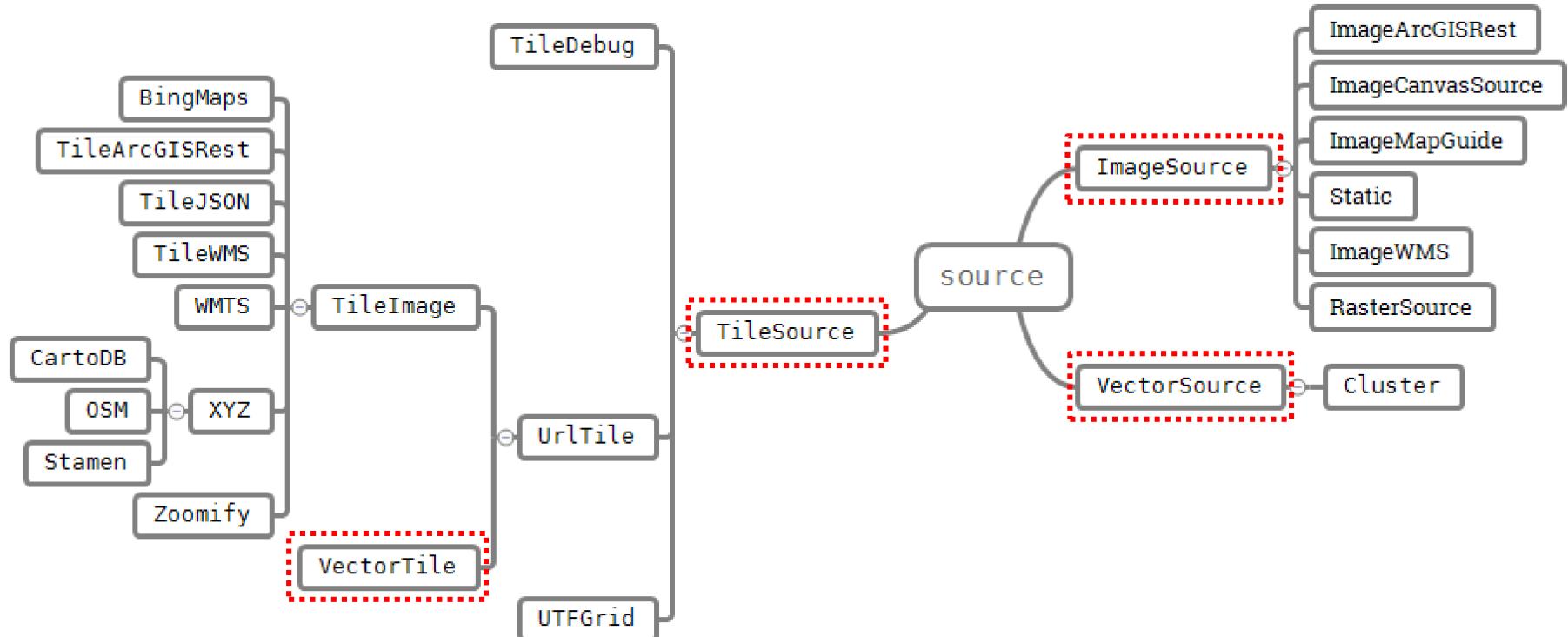
- **Group Layer Properties**

Name	Type	Description
layers	<code><module:ol/layer/Base~BaseLayer></code>	Child layers.

Source

- **Source**

- source는 layer에서 데이터를 가져오는 컨테이너
- ImageSource, TileSource, VectorSource, VectorTileSource로 구성



Source

- Source Properties

Name	Type	Default	Description
attributions	module:ol/source/Source~AttributionLike		
attributionsCollapsible	boolean	true	Attributions are collapsible.
projection	module:ol/proj~ProjectionLike		
state	module:ol/source/State	'ready'	
wrapX	boolean	false	

- Image Source Properties

Name	Type	Description
resolutions	Array.<number>	

- Tile Source Properties

Name	Type	Description
cacheSize	number	
Opaque	boolean	
tilePixelRatio	number	
tileGrid	module:ol/tilegrid/TileGrid~TileGrid	
Transition	number	
Key	string	

Source

▪ Vector Source Properties

Name	Type	Description
features	Array.< module:ol/Feature~Feature >	Features. If provided as module:ol/Collection , the features in the source and the collection will stay in sync.
format	module:ol/format/Feature~FeatureFormat	The feature format used by the XHR feature loader when url is set. Required if url is set, otherwise ignored.
loader	module:ol/featureloader~FeatureLoader	The loader function used to load features, from a remote source for example. If this is not set and url is set, the source will create and use an XHR feature loader.
overlaps	boolean	This source may have overlapping geometries. Setting this to false (e.g. for sources with polygons that represent administrative boundaries or TopoJSON sources) allows the renderer to optimise fill and stroke operations.
strategy	module:ol/source/Vector~LoadingStrategy	The loading strategy to use. By default an module:ol/loadingstrategy~all strategy is used, a one-off strategy which loads all features at once.
url	module:ol/featureloader~FeatureUrlFunction	Setting this option instructs the source to load features using an XHR loader (see module:ol/featureloader~xhr). Use a string and an module:ol/loadingstrategy~all for a one-off download of all features from the given URL. Use a module:ol/featureloader~FeatureUrlFunction to generate the url with other loading strategies. Requires format to be set as well. When default XHR feature loader is provided, the features will be transformed from the data projection to the view projection during parsing. If your remote data source does not advertise its projection properly, this transformation will be incorrect. For some formats, the default projection (usually EPSG:4326) can be overridden by setting the dataProjection constructor option on the format. Note that if a source contains non-feature data, such as a GeoJSON geometry or a KML NetworkLink, these will be ignored. Use a custom loader to load these.
useSpatialIndex	boolean	By default, an RTree is used as spatial index. When features are removed and added frequently, and the total number of features is low, setting this to false may improve performance. Note that module:ol/source/Vector~VectorSource#getFeaturesInExtent , module:ol/source/Vector~VectorSource#getClosestFeatureToCoordinate and module:ol/source/Vector~VectorSource#getExtent cannot be used when useSpatialIndex is set to false, and module:ol/source/Vector~VectorSource#forEachFeatureInExtent will loop through all features. When set to false, the features will be maintained in an module:ol/Collection , which can be retrieved through module:ol/source/Vector~VectorSource#getFeaturesCollection .

Source

▪ Vector Tile Source Properties

Name	Type	Default	Description
extent	module:ol/extent~Extent		
format	module:ol/format/Feature~FeatureFormat		Feature format for tiles. Used and required by the default.
overlaps	boolean	true	This source may have overlapping geometries. Setting this to false (e.g. for sources with polygons that represent administrative boundaries or TopoJSON sources) allows the renderer to optimise fill and stroke operations.
tileClass	Class.< module:ol/VectorTile~VectorTile >		Class used to instantiate image tiles. Default is module:ol/VectorTile .
maxZoom	number	22	Optional max zoom level.
minZoom	number		Optional min zoom level.
tileSize	number module:ol/size~Size	512	Optional tile size.
tileLoadFunction	module:ol/Tile~LoadFunction		Optional function to load a tile given a URL.
tileUrlFunction	module:ol/Tile~UrlFunction		Optional function to get tile URL given a tile coordinate and the projection.
url	string		URL template. Must include {x}, {y} or {-y}, and {z} placeholders. A {?-?} template pattern, for example subdomain{a-f}.domain.com, may be used instead of defining each one separately in the urls option.
urls	Array.<string>		An array of URL templates.

Source

- **Image Source 예제**

```
import {Image as ImageLayer, Tile as TileLayer} from 'ol/layer.js';
import Static from 'ol/source/ImageStatic.js';
import ImageWMS from 'ol/source/ImageWMS.js';

const staticImageLayer = new ImageLayer({
  source: new Static({
    url: 'https://upload.wikimedia.org/wikipedia/commons/thumb/1/18/' +
      'British_National_Grid.svg/2000px-British_National_Grid.svg.png',
    projection: 'EPSG:27700',
    imageExtent: [0, 0, 700000, 1300000]
  })
})

const geoserverImageLayer = new ImageLayer({
  extent: [-13884991, 2870341, -7455066, 6338219],
  source: new ImageWMS({
    url: 'https://ahocevar.com/geoserver/wms',
    params: {'LAYERS': 'topp:states'},
    ratio: 1,
    serverType: 'geoserver'
  })
})
```

Source

- Tile Source 예제

```
import XYZ from 'ol/source/XYZ.js';
import {Image as ImageLayer, Tile as TileLayer} from 'ol/layer.js';
const groupLayer = new LayerGroup({
  layers: [
    new TileLayer({
      source: new OSM()
    }),
    new TileLayer({
      extent: [-13884991, 2870341, -7455066, 6338219],
      source: new TileWMS({
        url: 'https://ahocevar.com/geoserver/wms',
        params: {'LAYERS': 'topp:states', 'TILED': true},
        serverType: 'geoserver',
        transition: 0
      })
    }),
    new TileLayer({
      source: new XYZ({
        url: 'https://{a-c}.tiles.mapbox.com/v3/mapbox.blue-marble-topo-jan/{z}/{x}/{y}.png'
      })
    })
  ]
})
```

Source

- **Vector Source 예제**

```
import GeoJSON from 'ol/format/GeoJSON.js';
import VectorLayer from 'ol/layer/Vector.js';
import VectorSource from 'ol/source/Vector.js';

const vectorLayer = new VectorLayer({
  source: new VectorSource({
    url: 'data/seoul_sgg.geojson',
    format: new GeoJSON()
  })
});
```

Source

- Vector Tile Source 예제

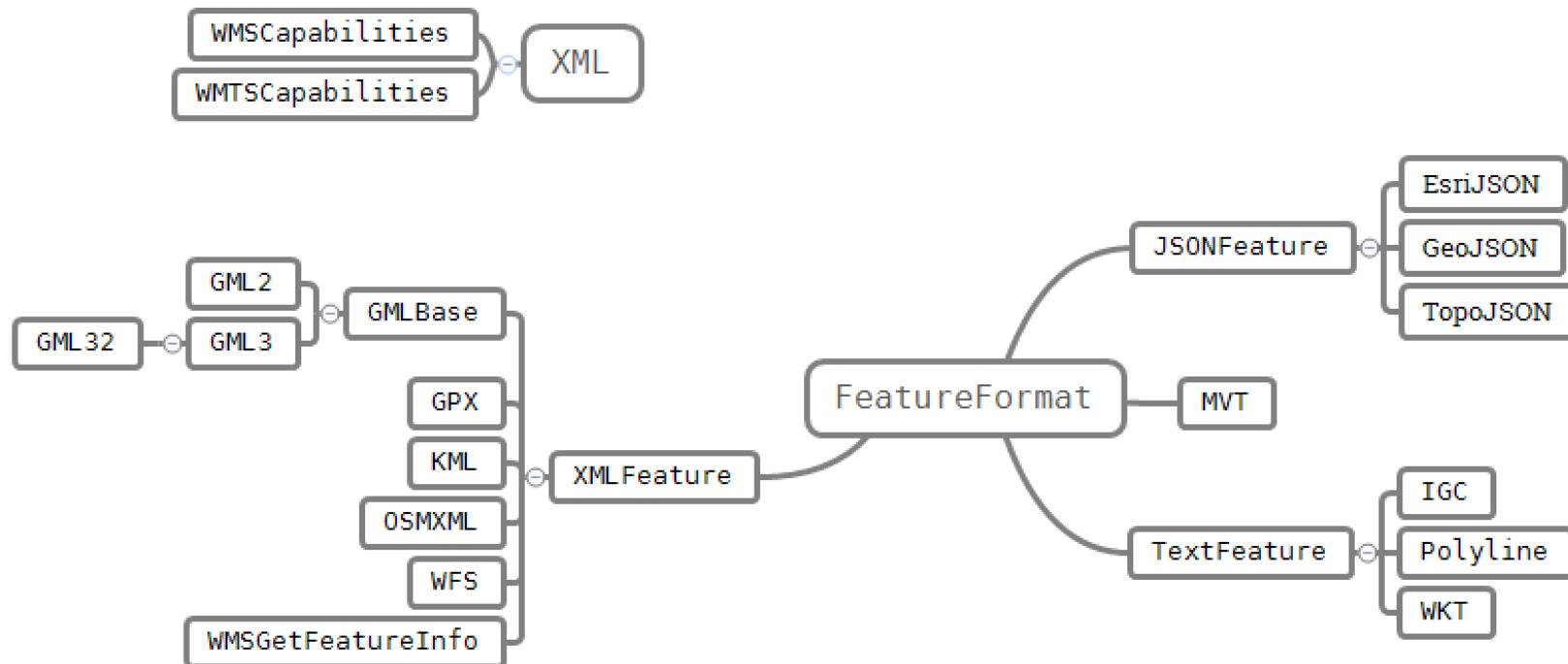
```
import MVT from 'ol/format/MVT.js';
import VectorTileLayer from 'ol/layer/VectorTile.js';
import VectorTileSource from 'ol/source/VectorTile.js';
import {Fill, Stroke, Style} from 'ol/style.js';

const style_simple = new Style({
  fill: new Fill({
    color: '#ADD8E6'
  }),
  stroke: new Stroke({
    color: '#880000', width: 1
  })
});
const vectorTileLayer = new VectorTileLayer({
  style:simpleStyle,
  source: new VectorTileSource({
    tilePixelRatio: 1,
    format: new MVT(),
    url: '/geoserver/gwc/service/tms/1.0.0/' + layer_name +
      '@EPSG%3A'+projection_epsg_no+'@pbf/{z}/{x}/{-y}.pbf'
  })
})
```

Format

▪ Format

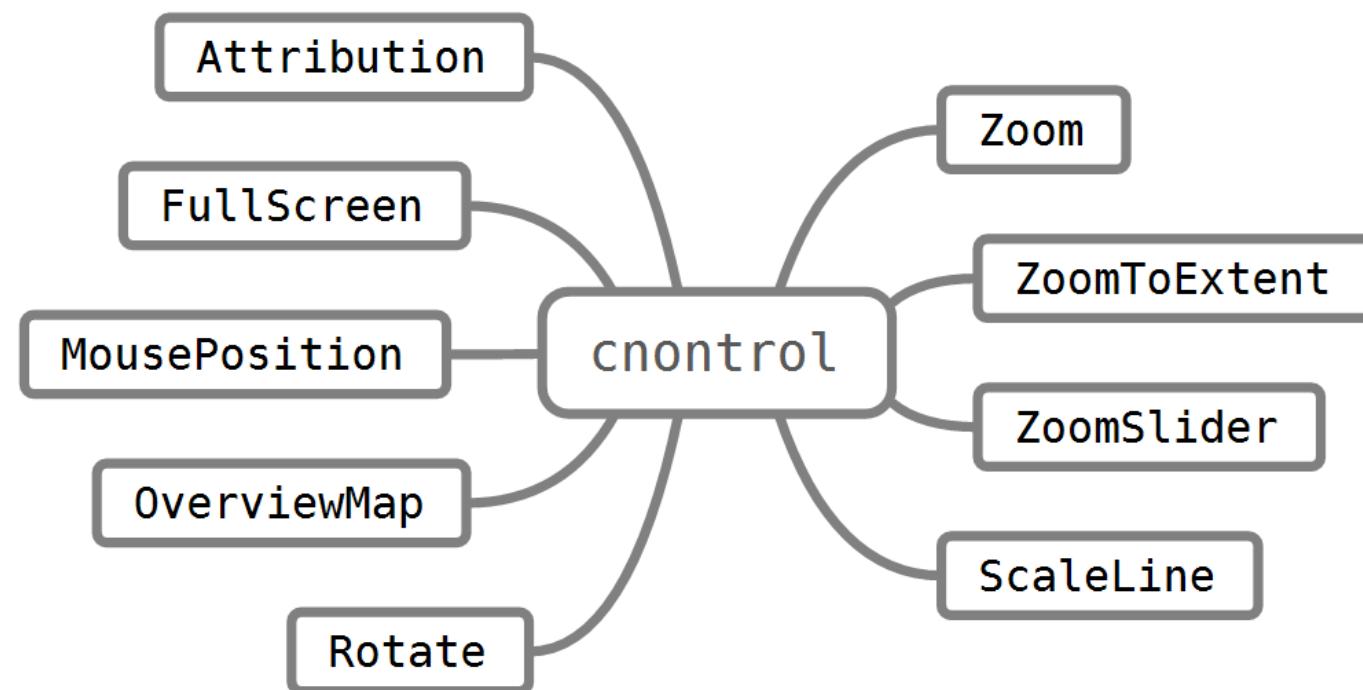
- Vector 데이터 읽고 쓰는데 사용
- Vector Source과 Vector Tile Source에서 사용
- OGC WebService 의 이미지 관련인 WMS의 WMSCapabilities, WMSGetFeatureInfo 와 WMTS의 WMTSCapabilities 지원



Control

- Control

- 사용자가 지도를 조작하기 위한 컴포넌트
- Interaction 을 이용하여 Custom Component 제작 가능
- `defaultControls()` Method로 attribution, rotate, zoom 설정하고 추가 `extend([])`로 추가 가능



Control

- Control 추가

- Map Object 생성시 (기본 컨트롤 확장)

```
const overviewControl = new OverviewMap();
const zoomControl = new Zoom();
const map = new Map ({
  ...
  controls: defaultInteractions().expand([overviewControl, zoomControl])
});
```

- addControl 함수 사용

```
map.addControl(new OverviewMap());
```

Control

- Control 삭제

- Control이 변수로 선언되어 있을때

```
const overviewControl = new OverviewMap();
map.addControl(overviewControl);
map.removeControl(overviewControl);
```

- 인스턴스 이름 찾아 삭제하기

```
const controlList = map.getControls().getArray();
controlList.forEach(function(item, index) {
    if (item instanceof Zoom) {
        map.removeControl(item);
        console.log('removed !');
    }
})
```

Control

- **Attribution**

- 지도 저작권 정보를 표시하는 컨트롤로 기본적으로 지도 우측 하단에 열고 닫을 수 있는 버튼형 태로 추가되어 정보 확인

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import {defaults as defaultControls, Attribution} from 'ol/control.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const attribution = new Attribution({
  collapsible: false
});

const map = new Map({
  layers: [ new TileLayer({ source: new OSM() }) ],
  controls: defaultControls({attribution: false}).extend([attribution]),
  target: 'map',
  view: new View({
    center: [0, 0],
    zoom: 2
  })
});
```

Control

▪ Attribution Properties

Name	Type	Default	Description
className	string	'ol-attribution'	CSS class name.
target	HTMLElement string		Specify a target if you want the control to be rendered outside of the map's viewport.
collapsible	boolean		Specify if attributions can be collapsed. If not specified, sources control this behavior with their attributionsCollapsible setting.
collapsed	boolean	true	Specify if attributions should be collapsed at startup.
tipLabel	string	'Attributions'	Text label to use for the button tip.
label	string	'i'	Text label to use for the collapsed attributions button. Instead of text, also an element (e.g. a span element) can be used.
collapseLabel	string HTMLElement	'>>'	Text label to use for the expanded attributions button. Instead of text, also an element (e.g. a span element) can be used.
render	function		Function called when the control should be re-rendered. This is called in a requestAnimationFrame callback.

Control

- **FullScreen**
 - 지도가 위치한 캔버스가 화면을 가득 채우는 기능이 실행

```
import Map from 'ol/Map.js';
import {defaults as defaultControls, FullScreen} from 'ol/control.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const map = new Map({
  controls: defaultControls().extend([
    new FullScreen()
  ]),
  layers: [
    new TileLayer({
      source: new OSM()
    })
  ],
  target: 'map',
  view: view
});
```

Control

▪ FullScreen Properties

Name	Type	Default	Description
className	string	'ol-full-screen'	CSS class name.
label	string Text	'\u2922'	Text label to use for the button. Instead of text, also an element (e.g. a span element) can be used.
labelActive	string Text	'\u00d7'	Text label to use for the button when full-screen is active. Instead of text, also an element (e.g. a span element) can be used.
tipLabel	string	'Toggle full-screen'	Text label to use for the button tip.
keys	boolean	false	Full keyboard access.
target	HTMLElement string		Specify a target if you want the control to be rendered outside of the map's viewport.
source	HTMLElement string		The element to be displayed fullscreen. When not provided, the element containing the map viewport will be displayed fullscreen.

Control

- **MousePosition**
 - 지도위 마우스 위치를 2차원의 좌표값으로 반환

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls } from 'ol/control.js';
import MousePosition from 'ol/control/MousePosition.js';
import { createStringXY } from 'ol/coordinate.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const mousePositionControl = new MousePosition({
  coordinateFormat: createStringXY(4),
  projection: 'EPSG:4326',
  target: 'coordinateDivId',
  undefinedHTML: ' '
});

const map = new Map({
  controls: defaultControls().extend([mousePositionControl]),
  layers: [ new TileLayer({ source: new OSM() }) ],
  target: 'map',
  view: new View({center: [14135193.892664503, 4512192.435216382], zoom: 13 })
});
```

Control

▪ MousePosition Properties

Name	Type	Default	Description
className	string	'ol-mouse-position'	CSS class name.
coordinateFormat	module:ol/coordinate~CoordinateFormat		Coordinate format.
projection	module:ol/proj~ProjectionLike		Projection. Default is the view projection.
render	function		Function called when the control should be re-rendered. This is called in a requestAnimationFrame callback.
target	HTMLElement string		Specify a target if you want the control to be rendered outside of the map's viewport.
undefinedHTML	string	' '	Markup to show when coordinates are not available (e.g. when the pointer leaves the map viewport). By default, the last position will be replaced with ' ' () when the pointer leaves the viewport. To retain the last rendered position, set this option to something falsey (like an empty string '').

Control

- **OverviewMap**

- 기본 지도에서 확대된 위치정보를 제공하는 미니맵을 생성하는 컨트롤

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls, OverviewMap } from 'ol/control.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const map = new Map({
  controls: defaultControls().extend([
    new OverviewMap({
      collapsed: false
    })
  ]),
  layers: [
    new TileLayer({
      source: new OSM()
    })
  ],
  target: 'map',
  view: new View({center: [14135193.892664503, 4512192.435216382], zoom: 13 })
});
```

Control

▪ OverviewMap Properties

Name	Type	Default	Description
className	string	'ol-overviewmap'	CSS class name.
collapsed	boolean	true	Whether the control should start collapsed or not (expanded).
collapseLabel	string HTMLElement	'<<'	Text label to use for the expanded overviewmap button. Instead of text, also an element (e.g. a span element) can be used.
collapsible	boolean	true	Whether the control can be collapsed or not.
label	string HTMLElement	'>>'	Text label to use for the collapsed overviewmap button. Instead of text, also an element (e.g. a span element) can be used.
layers	Array.< module:ol/layer/Layer~Layer > module:ol/Collection~Collection .< module:ol/layer/Layer~Layer >		Layers for the overview map. If not set, then all main map layers are used instead.
render	function		Function called when the control should be re-rendered. This is called in a requestAnimationFrame callback.
target	HTMLElement string		Specify a target if you want the control to be rendered outside of the map's viewport.
tipLabel	string	'Overview map'	Text label to use for the button tip.
view	module:ol/View~View		Custom view for the overview map. If not provided, a default view with an EPSG:3857 projection will be used.

Control

- **Rotate**

- view의 rotation 또는 사용자가 Interaction을 통해서 지도를 돌렸을 때 원래 위치로 돌려주는 버튼이 나타나며 지도가 원래대로 돌아가면 버튼을 사라진다.

```
import 'ol/ol.css';
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';
import Rotate from 'ol/control/Rotate.js';
import { defaults as defaultControls } from 'ol/control.js';

const map = new Map({
  layers: [ new TileLayer({ source: new OSM() }) ],
  controls: defaultControls().extend([
    new Rotate()
  ]),
  target: 'map',
  view: new View({center: [14135193.892664503, 4512192.435216382], zoom: 13,
    rotation: Math.PI / 6,
  })
});
```

Control

▪ Rotate Properties

Name	Type	Default	Description
className	string	'ol-rotate'	CSS class name.
label	string HTMLElement	'↑'	Text label to use for the rotate button. Instead of text, also an element (e.g. a span element) can be used.
tipLabel	string	'Reset rotation'	Text label to use for the rotate tip.
duration	number	250	Animation duration in milliseconds.
autoHide	boolean	true	Hide the control when rotation is 0.
render	function		Function called when the control should be re-rendered. This is called in a requestAnimationFrame callback.
resetNorth	function		Function called when the control is clicked. This will override the default resetNorth.
target	HTMLElement string		Specify a target if you want the control to be rendered outside of the map's viewport.

Control

- **ScaleLine**

- 축척바를 화면 좌측하단에 나타나게 한다. 지원하는 축척의 단위는 'degrees', 'imperial', 'nautical', 'metric', 'us' 가 있고 기본 단위는 'metric' 이다

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls, ScaleLine } from 'ol/control.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const map = new Map({
  controls: defaultControls().extend([
    new ScaleLine({ units: 'metric' }) // degrees, imperial, us, nautical
  ]),
  layers: [
    new TileLayer({ source: new OSM() })
  ],
  target: 'map',
  view: new View({center: [14135193.892664503, 4512192.435216382], zoom: 13})
});
```

Control

- **ScaleLine Properties**

Name	Type	Default	Description
className	string	'ol-scale-line' '	CSS Class name.
minWidth	number	64	Minimum width in pixels.
render	function		Function called when the control should be re-rendered. This is called in a requestAnimationFrame callback.
target	HTMLElement string		Specify a target if you want the control to be rendered outside of the map's viewport.
units	Units string	'metric'	Units.

Control

- **ZoomSlider**

- 슬라이더바를 이용한 확대/축소 기능을 지도에 추가

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls, ZoomSlider } from 'ol/control.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const map = new Map({
  controls: defaultControls().extend([
    new ZoomSlider()
]),
  layers: [
    new TileLayer({ source: new OSM() })
],
  target: 'map',
  view: new View({center: [14135193.892664503, 4512192.435216382], zoom: 13
})
});
```

Control

- **ZoomSlider Properties**

Name	Type	Default	Description
className	string	'ol-zoomslider'	CSS class name.
duration	number	200	Animation duration in milliseconds.
render	function		Function called when the control should be re-rendered. This is called in a requestAnimationFrame callback.

Control

- **ZoomToExtent**
 - 전체보기

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls, ZoomToExtent } from 'ol/control.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const map = new Map({
  controls: defaultControls().extend([
    new ZoomToExtent()
  ]),
  layers: [
    new TileLayer({ source: new OSM() })
  ],
  target: 'map',
  view: new View({ center: [14135193.892664503, 4512192.435216382], zoom: 13
  })
});
```

Control

▪ ZoomToExtent Properties

Name	Type	Default	Description
className	string	'ol-zoom-extent'	Class name.
target	HTMLElement string		Specify a target if you want the control to be rendered outside of the map's viewport.
label	string HTMLElement	'E'	Text label to use for the button. Instead of text, also an element (e.g. a span element) can be used.
tipLabel	string	'Fit to extent'	Text label to use for the button tip.
extent	module:ol/extent~Extent		The extent to zoom to. If undefined the validity extent of the view projection is used.

Control

- **Zoom**
 - 기본 컨트롤으로 확대, 축소 기능을 처리할 수 있는 두개의 버튼을 추가

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls, Zoom } from 'ol/control.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const map = new Map({
  controls: defaultControls().extend([
    new Zoom()
  ]),
  layers: [
    new TileLayer({ source: new OSM() })
  ],
  target: 'map',
  view: new View({center: [14135193.892664503, 4512192.435216382], zoom: 13
})
});
```

Control

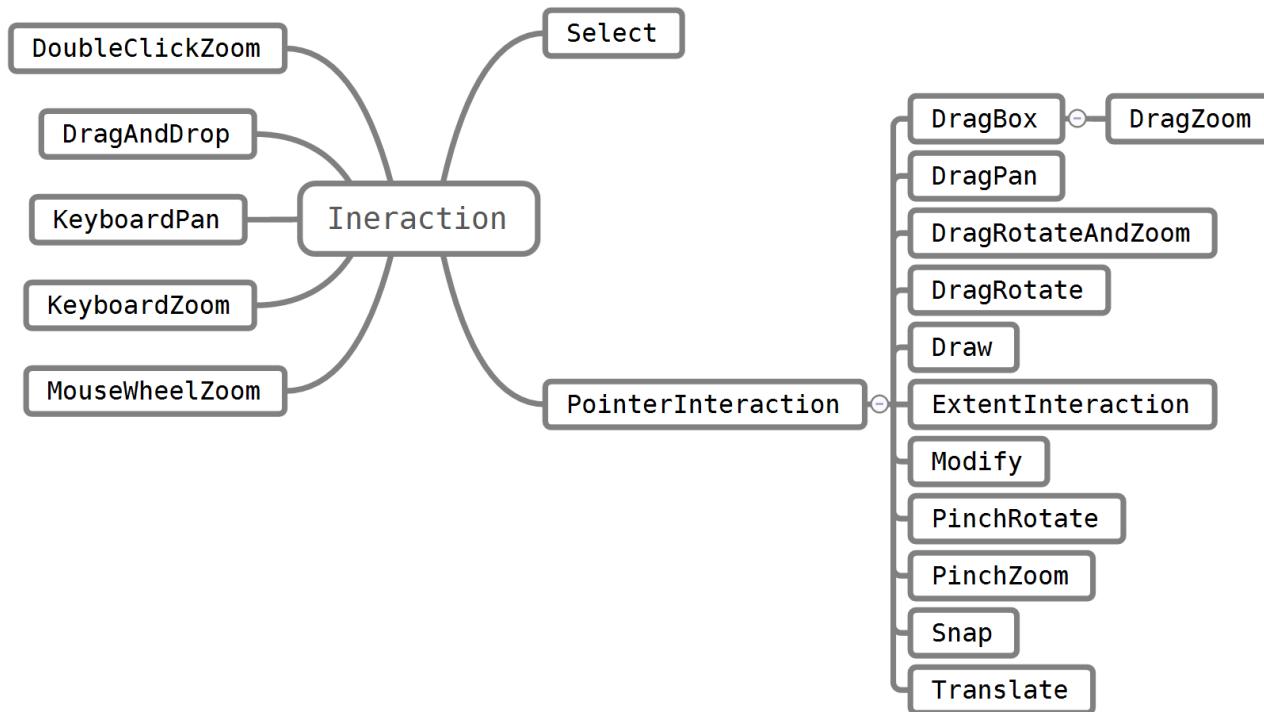
- **ZoomToExtent Properties**

Name	Type	Default	Description
duration	number	250	Animation duration in milliseconds.
className	string	'ol-zoom'	CSS class name.
zoomInLabel	string HTMLElement	'+'	Text label to use for the zoom-in button. Instead of text, also an element (e.g. a span element) can be used.
zoomOutLabel	string HTMLElement	'-'	Text label to use for the zoom-out button. Instead of text, also an element (e.g. a span element) can be used.
zoomInTipLabel	string	'Zoom in'	Text label to use for the button tip.
zoomOutTipLabel	string	'Zoom out'	Text label to use for the button tip.
delta	number	1	The zoom delta applied on each click.
target	HTMLElement string		Specify a target if you want the control to be rendered outside of the map's viewport.

Interaction

▪ Interaction

- 키보드, 마우스, 화면터치 등 이벤트 발생과 관리를 통해 사용자에게 지도 제어 가능
- 인터렉션의 종류로는 주밍, 드래그앤파인트, 선택, 편집, 터치, 키보드 컨트롤 등이 있고 각 인터렉션은 각각의 목적에 맞게 이벤트가 포함
- OpenLayers2 버전에서의 컨트롤이 OpenLayers 3 이후 버전에서는 컨트롤, 인터렉션으로 분리되어 사용



Interaction

- Interaction 추가
 - Map Object 생성시

```
const mouseWheelZoom = new MouseWheelZoom();

const map = new ol.Map ({
  ...
  interactions: [mouseWheelZoom, new DragZoom()],
});
```

- addControl 함수 사용

```
map.addInteraction(new MouseWheelZoom());
```

Interaction

- **Interaction 삭제**

- Interaction이 변수로 선언되어 있을때

```
const dragAndDrop = new DragAndDrop();
map.addControl(dragAndDrop);
map.removeControl(dragAndDrop);
```

- 인스턴스 이름 찾아 삭제하기

```
const interactionList = map.getInteractions().getArray();
interactionList.forEach(function(item, index) {
  if (item instanceof KeyboardZoom) {
    map.removeInteraction(item);
    console.log('removed !');
  }
})
```

Interaction

- **DoubleClickZoom**
 - 마우스 더블클릭으로 지도를 확대축소 (기본값 : 활성화)

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls} from 'ol/control.js';
import { defaults as defaultInteractions} from 'ol/interaction.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const map = new Map({
  controls: defaultControls(),
  interactions: defaultInteractions({
    doubleClickZoom : false
}),
  layers: [ new TileLayer({ source: new OSM() }) ],
  target: 'map',
  view: new View({
    center: [14135193.892664503, 4512192.435216382], zoom: 13
  })
});
```

Interaction

- DoubleClickZoom Properties

Name	Type	Default	Description
duration	number	250	Animation duration in milliseconds.
delta	number	1	The zoom delta applied on each double click.

Interaction

- **DragAndDrop**
 - 마우스 드래그 & 드롭으로 벡터파일을 지도에 추가
 - 벡터레이어에 DragAndDrop Interaction을 추가하여 벡터 소스(GeoJSON Format)를 사용해야 하므로 다음과 같이 Import

```
import VectorLayer from 'ol/layer/Vector';
import VectorSource from 'ol/source/Vector';
import DragAndDrop from 'ol/interaction/DragAndDrop';
import GeoJSON from 'ol/format/GeoJSON';
```

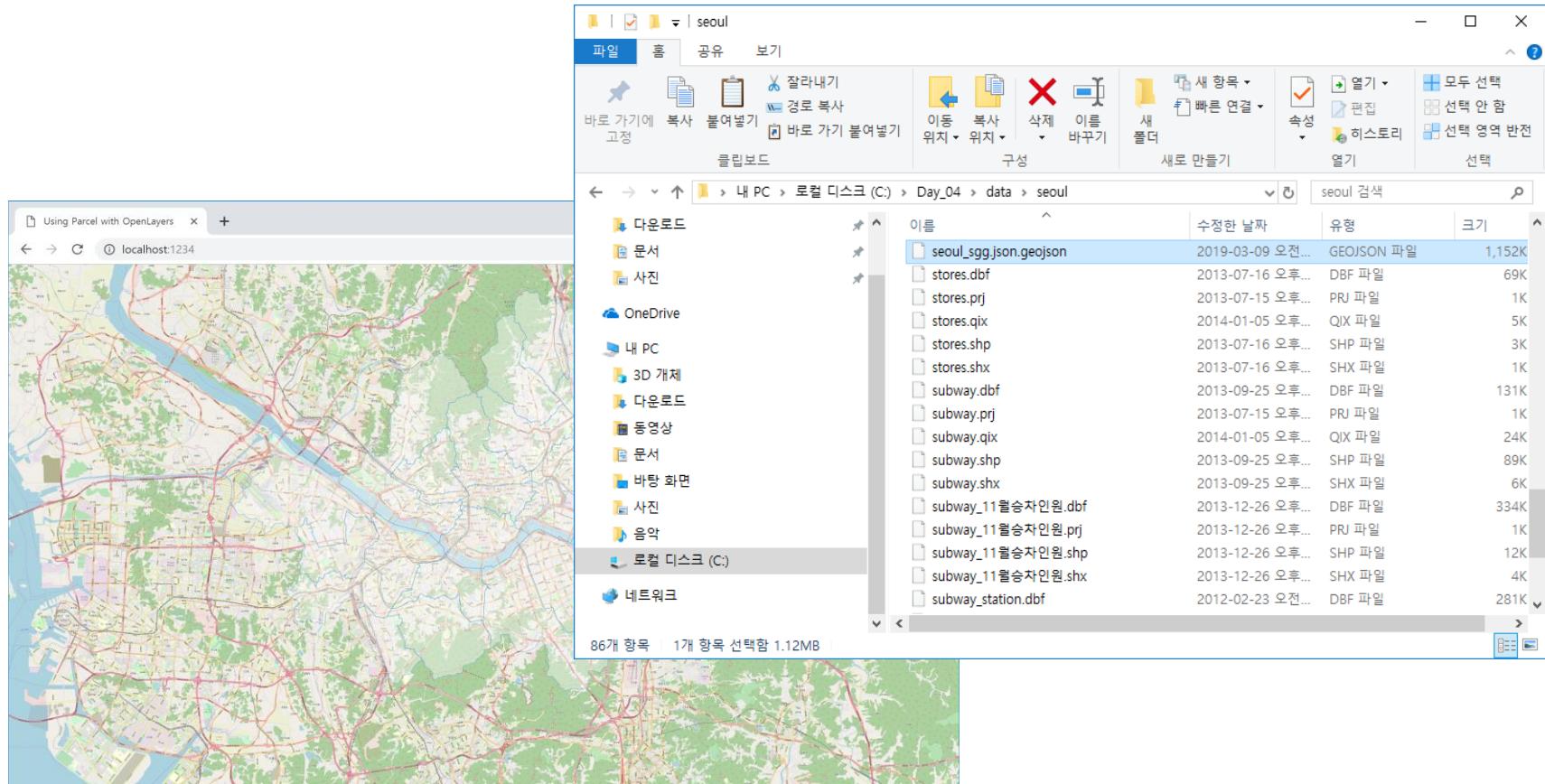
- 마우스 드래그 & 드롭으로 벡터파일(admin_sgg.geojson)을 지도에 추가

```
const source = new VectorSource();
const layer = new VectorLayer({
  source: source
});

map.addInteraction(new DragAndDrop({
  source: source,
  formatConstructors: [GeoJSON]
}));
```

Interaction

- DragAndDrop (example)
 - 웹 example dragndrop.js 내용을 편집기에 가져온 후 저장



Interaction

▪ DragAndDrop Properties

Name	Type	Description
formatConstructors	Array.<Class.< module:ol/format/Feature~FeatureFormat >>	Format constructors.
source	module:ol/source/Vector~VectorSource	Optional vector source where features will be added. If a source is provided all existing features will be removed and new features will be added when they are dropped on the target. If you want to add features to a vector source without removing the existing features (append only), instead of providing the source option listen for the "addfeatures" event.
projection	module:ol/proj~ProjectionLike	Target projection. By default, the map's view's projection is used.
target	HTMLElement	The element that is used as the drop target, default is the viewport element.

Interaction

- **KeyboardPan**

- 키보드 방향기로 지도를 이동

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls } from 'ol/control.js';
import { defaults as defaultInteractions } from 'ol/interaction.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';
import KeyboardPan from 'ol/interaction/KeyboardPan';

const map = new Map({
  controls: defaultControls(),
  interactions: defaultInteractions().extend([
    new KeyboardPan()
]),
  layers: [new TileLayer({ source: new OSM() })],
  target: 'map',
  keyboardEventTarget: document,
  view: new View({
    center: [14135193.892664503, 4512192.435216382], zoom: 13
  })
});
```

Interaction

- **KeyboardPan Properties**

Name	Type	Default	Description
condition	module:ol/events/condition~Condition		A function that takes an module:ol/MapBrowserEvent~MapBrowserEvent and returns a boolean to indicate whether that event should be handled. Default is module:ol/events/condition~noModifierKeys and module:ol/events/condition~targetNotEditable.
duration	number	100	Animation duration in milliseconds.
pixelDelta	number	128	The amount of pixels to pan on each key press.

Interaction

- **KeyboardZoom**
 - 키보드 +, - 키로 지도 확대 및 축소

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls } from 'ol/control.js';
import { defaults as defaultInteractions } from 'ol/interaction.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';
import KeyboardZoom from 'ol/interaction/KeyboardZoom';

const map = new Map({
  controls: defaultControls(),
  interactions: defaultInteractions().extend([
    new KeyboardZoom ()
]),
  layers: [new TileLayer({ source: new OSM() })],
  target: 'map',
  keyboardEventTarget: document,
  view: new View({
    center: [14135193.892664503, 4512192.435216382], zoom: 13
  })
});
```

Interaction

▪ KeyboardZoom Properties

Name	Type	Default	Description
duration	number	100	Animation duration in milliseconds.
condition	module:ol/events/condition~Condition		A function that takes an module:ol/MapBrowserEvent~MapBrowserEvent and returns a boolean to indicate whether that event should be handled. Default is <code>module:ol/events/condition~targetNotEditable</code> .
delta	number	1	The zoom level delta on each key press.

Interaction

- **MouseWheelZoom**
 - 마우스의 훨을 이용하여 지도 확대 및 축소

```
import Map from 'ol/Map.js';
import View from 'ol/View.js';
import { defaults as defaultControls} from 'ol/control.js';
import { defaults as defaultInteractions} from 'ol/interaction.js';
import TileLayer from 'ol/layer/Tile.js';
import OSM from 'ol/source/OSM.js';

const map = new Map({
  controls: defaultControls(),
  interactions: defaultInteractions({
    mouseWheelZoom : false
}),
  layers: [ new TileLayer({ source: new OSM() }) ],
  target: 'map',
  view: new View({
    center: [14135193.892664503, 4512192.435216382], zoom: 13
  })
});
```

Interaction

▪ MouseWheelZoom Properties

Name	Type	Default	Description
condition	module:ol/events/condition~Condition		A function that takes an module:ol/MapBrowserEvent~MapBrowserEvent and returns a boolean to indicate whether that event should be handled. Default is module:ol/events/condition~always.
duration	number	250	Animation duration in milliseconds.
timeout	number	80	Mouse wheel timeout duration in milliseconds.
constrainResolution	boolean	false	When using a trackpad or magic mouse, zoom to the closest integer zoom level after the scroll gesture ends.
useAnchor	boolean	true	Enable zooming using the mouse's location as the anchor. When set to false, zooming in and out will zoom to the center of the screen instead of zooming on the mouse's location.

웹 GIS 실습

편집도구

- 소스 데이터베이스에 피쳐를 추가하거나 편집(수정, 삭제) 기능을 처리하기 위해 WFS 서비스로 WFS-T(Transactional Web Feature Service)를 사용
- OpenLayers에서는 벡터데이터의 추가와 편집을 위해 WFS-T 기능을 구현할 수 있는 인터페이스를 제공하는데 벡터 레이어의 피쳐 상태에 따라 WFS Transaction 서비스 요청문을 간단히 생성하여 실제 소스 데이터베이스에 적용될 수 있도록 지원
- WFS Protocol 요청시 다음의 프로퍼티를 정확히 명시해야 함
 - **featureType, featureNS, featurePrefix, geometryName**
 - **{ol/format/WFS} 클래스에서 WFS Transaction 관련 요청문 생성 가능**

편집도구

- Cross Domain 이슈 (No 'Access-Control-Allow-Origin' header is present on the requested resource)
 - 다른 도메인에 있는 Vector Data를 브라우저에서 접근할 때 나타나는 오류
 - JSONP 요청으로 또는 같은 도메인이 되도록 서비스 하게 하여 해결
- GeoServer를 Tomcat에 설치 하였고 HTTP에 ProxyPass 및 ProxyPassRevers 설정 완료됨
- 실습 파일을 HTTPD 의 서비스 포트인 80 에 연결
- 아래의 명령어를 차례대로 입력후 HTTPD 서비스 재시작

```
C:\Day_3\ol\work>cd C:\Day_3\httpd-2.4.38-win64-VC15\Apache24  
C:\Day_3\httpd-2.4.38-win64-VC15\Apache24>ren htdocs htdocs_bak  
C:\Day_3\httpd-2.4.38-win64-VC15\Apache24>mklink /D htdocs C:\Day_3\ol\work\dist
```

- 브라우저를 열어 <http://127.0.0.1> , <http://127.0.0.1/geoserver> 확인

편집도구

- <Insert> 요청문

```
<?xml version="1.0" encoding="UTF-8"?>
<wfs:Transaction xmlns:wfs="http://www.opengis.net/wfs"
    service="WFS" version="1.1.0"
    xsi:schemaLocation="http://www.opengis.net/wfs http://schemas.opengis.net/wfs/1.1.0/wfs.xsd"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:seoul="http://geoserver.org/korea">
    <wfs:Insert>
        <seoul:building>
            <seoul:the_geom>
                <gml:MultiSurface xmlns:gml="http://www.opengis.net/gml"
                    srsName="EPSG:900913">
                    <gml:surfaceMember>
                        <gml:Polygon>
                            <gml:exterior>
                                <gml:LinearRing>
                                    <gml:posList> ... ... </gml:posList>
                                </gml:LinearRing>
                            </gml:exterior>
                        </gml:Polygon>
                    </gml:surfaceMember>
                </gml:MultiSurface>
            </seoul:the_geom>
        </seoul:building>
    </wfs:Insert>
</wfs:Transaction>
```

편집도구

- <Update> 요청문

```
<?xml version="1.0" encoding="UTF-8"?>
<wfs:Transaction xmlns:wfs="http://www.opengis.net/wfs"
    service="WFS" version="1.1.0"
    xsi:schemaLocation="http://www.opengis.net/wfs http://schemas.opengis.net/wfs/1.1.0/wfs.xsd"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <wfs:Update typeName="seoul:building" xmlns:seoul="http://geoserver.org/seoul">
        <wfs:Property>
            <wfs:Name>the_geom</wfs:Name>
            <wfs:Value>
                <gml:MultiSurface xmlns:gml="http://www.opengis.net/gml"
                    srsName="EPSG:900913">
                    <gml:surfaceMember>
                        <gml:Polygon>
                            <gml:exterior>
                                <gml:LinearRing>
                                    <gml:posList>... ...</gml:posList>
                                </gml:LinearRing>
                            </gml:exterior>
                        </gml:Polygon>
                    </gml:surfaceMember>
                </gml:MultiSurface>
            </wfs:Value>
        </wfs:Property>
        <ogc:Filter xmlns:ogc="http://www.opengis.net/ogc">
            <ogc:FeatureId fid="building.24647" />
        </ogc:Filter>
    </wfs:Update>
</wfs:Transaction>
```

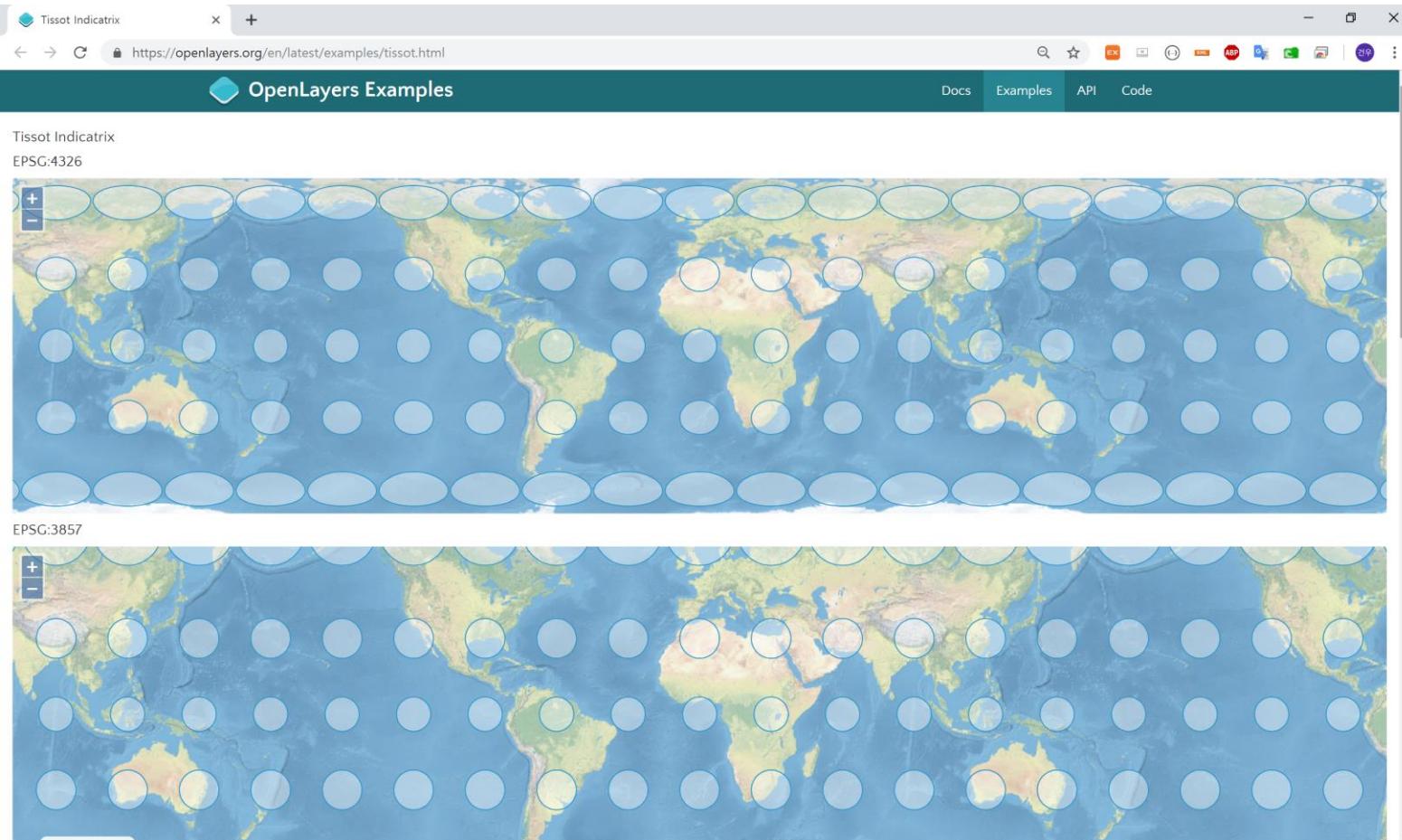
편집도구

- <Delete> 요청문

```
<?xml version="1.0" encoding="UTF-8"?>
<wfs:Transaction xmlns:wfs="http://www.opengis.net/wfs"
    service="WFS" version="1.1.0"
    xsi:schemaLocation="http://www.opengis.net/wfs http://schemas.opengis.net/wfs/1.1.0/wfs.xsd"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <wfs:Delete typeName="seoul:building" xmlns:korea="http://geoserver.org/koreal">
        <ogc:Filter xmlns:ogc="http://www.opengis.net/ogc">
            <ogc:FeatureId fid="building.25537" />
        </ogc:Filter>
    </wfs:Delete>
</wfs:Transaction>
```

True Size

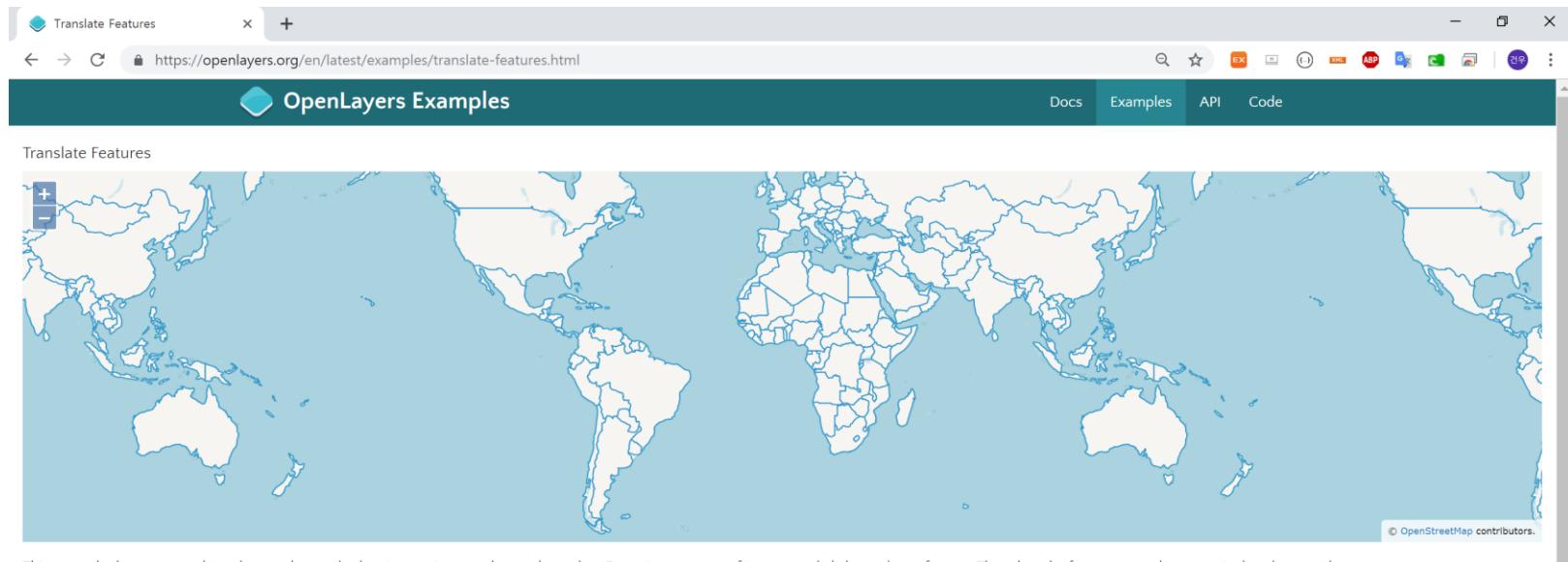
- True Size 실습
 - <https://openlayers.org/en/latest/examples/tissot.html>



True Size

▪ True Size 실습

- <https://openlayers.org/en/latest/examples/translate-features.html>



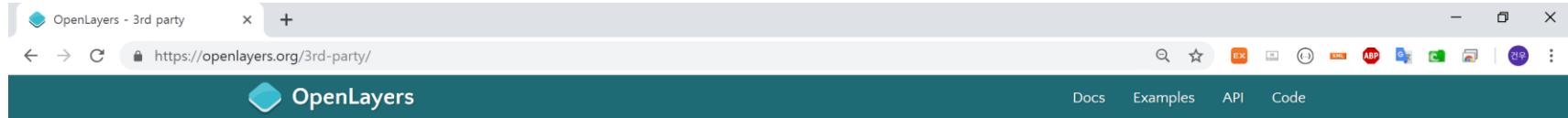
This example demonstrates how the translate and select interactions can be used together. Zoom in to an area of interest and click to select a feature. Then drag the feature around to move it elsewhere on the map.

```
<!DOCTYPE html>
<html>
  <head>
    <title>Translate Features</title>
    <link rel="stylesheet" href="https://openlayers.org/en/v5.3.0/css/ol.css" type="text/css">
    <!-- The line below is only needed for old environments like Internet Explorer and Android 4.x -->
    <script src="https://cdn.polyfill.io/v2/polyfill.min.js?features=requestAnimationFrame,Element.prototype.classList,URL"></script>
  </head>
  <body>
    <div id="map" class="map"></div>
    <script>
      import Map from 'ol/Map';
      import View from 'ol/View';
      import GeoJSON from 'ol/format/GeoJSON';
      import {defaults as defaultInteractions, Select, Translate} from 'ol/interaction';
      import {Tile as TileLayer, Vector as VectorLayer} from 'ol/layer';
      import OSM from 'ol/source/OSM';
    </script>
```

Copy

OpenLayers 확장

- 3rd Party 라이브러리 사용하기
 - <https://openlayers.org/3rd-party/>



The screenshot shows a web browser window with the title "OpenLayers - 3rd party". The URL in the address bar is "https://openlayers.org/3rd-party/". The page content is titled "Useful 3rd party libraries" and contains a table listing various third-party libraries, their descriptions, and maintainers.

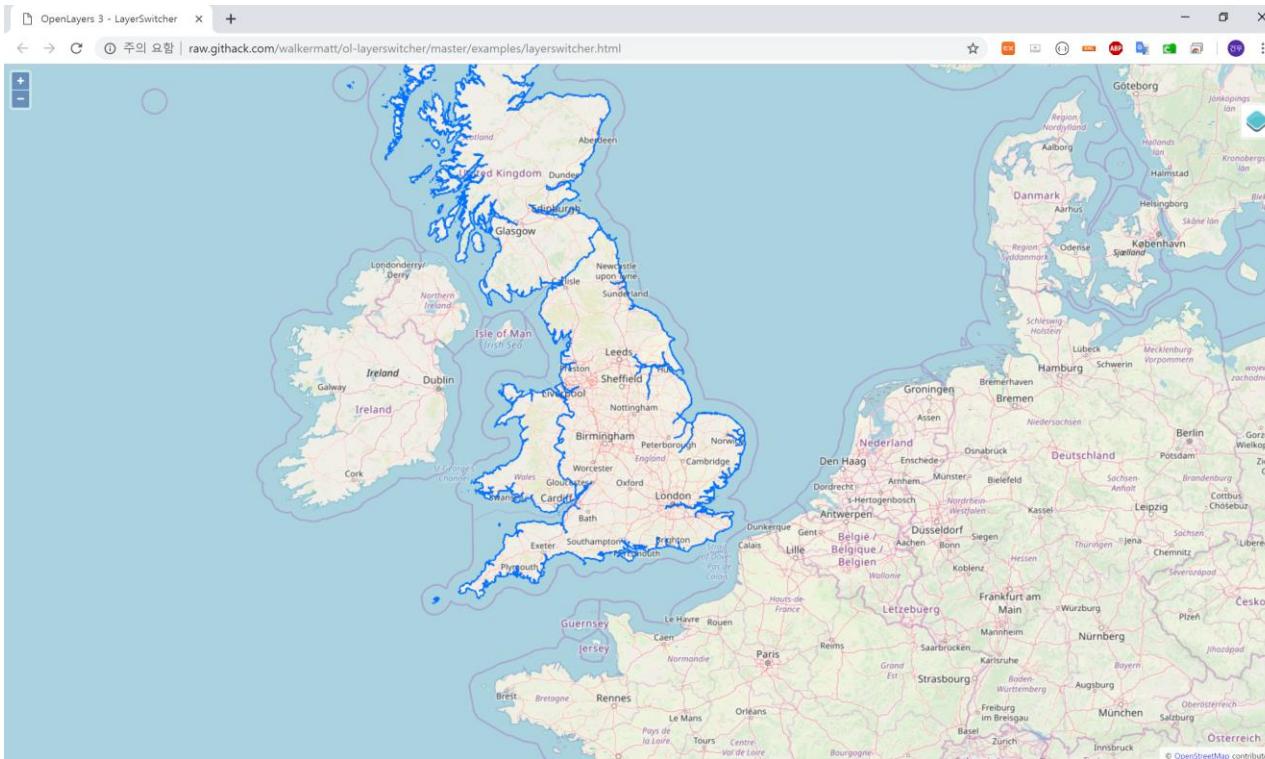
Library	Description	Maintainer
OL-Cesium	Cesium integration library.	OpenLayers
ol-mapbox-style	Create OpenLayers maps from Mapbox Style objects.	OpenLayers
OL-LayerSwitcher	Layer control for OpenLayers.	Matt Walker
OL-Popup	Basic popup overlay for OpenLayers.	Matt Walker
JSTS	JavaScript Topology Suite.	Björn Harrtell
OL-Geocoder	Geocoder Nominatim for OpenLayers.	Jonatas Walker
OL3-Photon	Photon geocoder for OpenLayers.	Thomas Gratier
OL-ContextMenu	Custom Context Menu for OpenLayers.	Jonatas Walker
OL-Google-Maps	Google Maps integration library.	Mapgears
OL3-PanZoom	PanZoom and PanZoomBar controls for OpenLayers.	Mapgears
OL-Ext	Miscellaneous classes and functions for OpenLayers.	Jean-Marc Viglino
OL3-Projection-Switcher	An OpenLayers Control to switch between projections.	NSIDC
Olé	Integration of OpenLayers and Esri ArcGIS REST services.	Boundless
React OpenLayers	A minimal React wrapper of OpenLayers 3+ written in TypeScript	Allen Kim
GWT-OpenLayers 3	A GWT wrapper for OpenLayers 3+ written in Java	Tino Desjardins
react-geo	A set of geo related modules to use in combination with React, Ant Design UI and OpenLayers	terrestris

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OpenLayers 확장

- **walkermatt/ol-layerswitcher**

- 레이어 ON/OFF 컨트롤
- <https://github.com/walkermatt/ol-layerswitcher>
- <https://github.com/walkermatt/ol-layerswitcher-examples>



OpenLayers 확장

- walkermatt/ol-layerswitcher

- 설치

```
C:\\ol\\work>npm install ol-layerswitcher --save
```

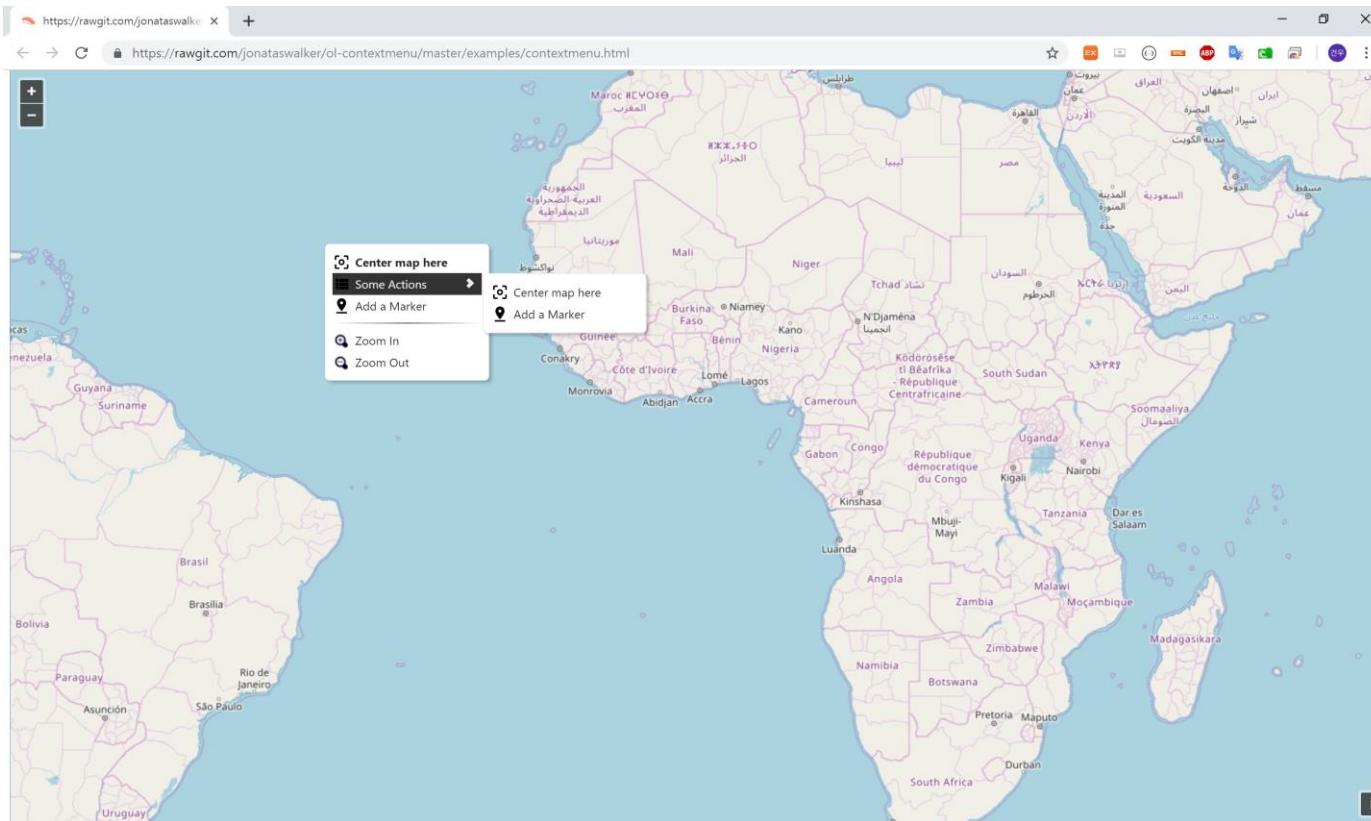
```
import 'ol-layerswitcher/src/ol-layerswitcher.css';
import LayerSwitcher from 'ol-layerswitcher';

new LayerGroup({
  'title': 'Base maps',
  layers: [
    new LayerTile({
      title: 'Water color', type: 'base', visible: true,
      source: new SourceStamen({ layer: 'watercolor' })
    }),
  ...
  new LayerGroup({
    title: 'Overlays',
    layers: [
      new VectorLayer({
        title: '전세계경계',
        source: new Vector({ url: 'data/countries.json', format: new GeoJSON() })
      }),
  ...
}
```

OpenLayers 확장

■ [jonataswalker/ol-contextmenu](#)

- 지도화면에서 컨텍스트 메뉴 컨트롤
- <https://github.com/jonataswalker/ol-contextmenu>
- <https://rawgit.com/jonataswalker/ol-contextmenu/master/examples/contextmenu.html>



OpenLayers 확장

- [jonataswalker/ol-contextmenu](#)

- 설치

```
C:\\ol\\work>npm install ol-contextmenu --save
```

```
import 'ol-contextmenu/dist/ol-contextmenu.css';
import ContextMenu from 'ol-contextmenu';

const contextmenu = new ContextMenu({
  width: 170,
  defaultItems: true, // defaultItems are (for now) Zoom In/Zoom Out
  items: [
    {
      text: 'Center map here',
      callback: e => {
        ...
      }
    },
    {
      text: 'Add a Marker',
      callback: e => {
        ...
      }
    },
    '-' // this is a separator
  ]
});
map.addControl(contextmenu);
```

OpenLayers 확장

■ ol-ext

- 다양한 확장 라이브러리 모음
- <http://viglino.github.io/ol-ext/>

The screenshot shows the homepage of the ol-ext project. At the top, there's a navigation bar with tabs for 'map', 'style', 'photo', 'chart', 'pattern', 'flowline', 'gpxline', 'textpath', and 'scribble'. Below the navigation, there's a search bar and a '11 NEWS' badge. The main content area is titled 'ol-ext: Extensions for OpenLayers (ol)' and features a brief introduction: 'Cool extensions for OpenLayers (ol). - For more information see the online API documentation.' It also mentions examples for 'webpack', 'parcel', and 'Angular'. A note says 'If you like this, you may like ol-games.' Below this, there are several sections demonstrating different styles:

- Styles**
 - Font style** (map.style.font.html)
Draw points using an iconic font (font Awesome) gives you scalable vector icons that can instantly be customized (form, size, color, drop shadow) using attributes..
style, vector, font, fontawesome, icon,
 - Photo style** (map.style.photo.html)
The ol.style.Photo is an image style to show photos or images on a map. The photos are drawn in a box and can be anchored.
style, vector, photo
 - Statistic charts style** (map.style.chart.html)
The ol.style.Chart is an image style to draw statistical graphics (bar, donut or pie charts) on a map.
style, vector, statistic, chart, pie, donut, animation
 - Statistic charts style + values** (map.style.chart+text.html)
This example show how to show values using a ol.style.Chart.
style, vector, statistic, chart, pie, text
 - Fill pattern style** (map.style.pattern.html)
The ol.style.FillPattern is a fill style with a set of cartographic patterns to use in your maps.
style, vector, fill, pattern, hatch
 - Stroke pattern style** (map.style.strokepattern.html)
The ol.style.StrokePattern is a stroke style with a set of cartographic patterns to use in your maps.
style, vector, stroke, pattern, hatch
 - FlowLine style** (map.style.flowline.html)
The ol.style.FlowLine is a line style to draw LineString with variable colors and widths to display flows or Sankey diagram on a map.
style, vector, flow, color, sankey, new
 - FlowLine style** (map.style.gpxline.html)
This example displays a GPX track using a ol.style.FlowLine to symbolize elevation along the line as a color.
style, vector, flow, color, gpx, new
 - Textpath style** (map.style.textpath.html)
The ol.vector.setTextPathStyle() is a function to draw text along a linear feature (ol.geom.lineString) on postcompose.
style, vector, textpath, text, along
 - Hash lines style**
 - Scribble fill**



함께 성장하는 새로운 방법,
오픈 소스 소프트웨어!!

감사합니다

Q&A