Lesson 4.1
Semantic 3D city models

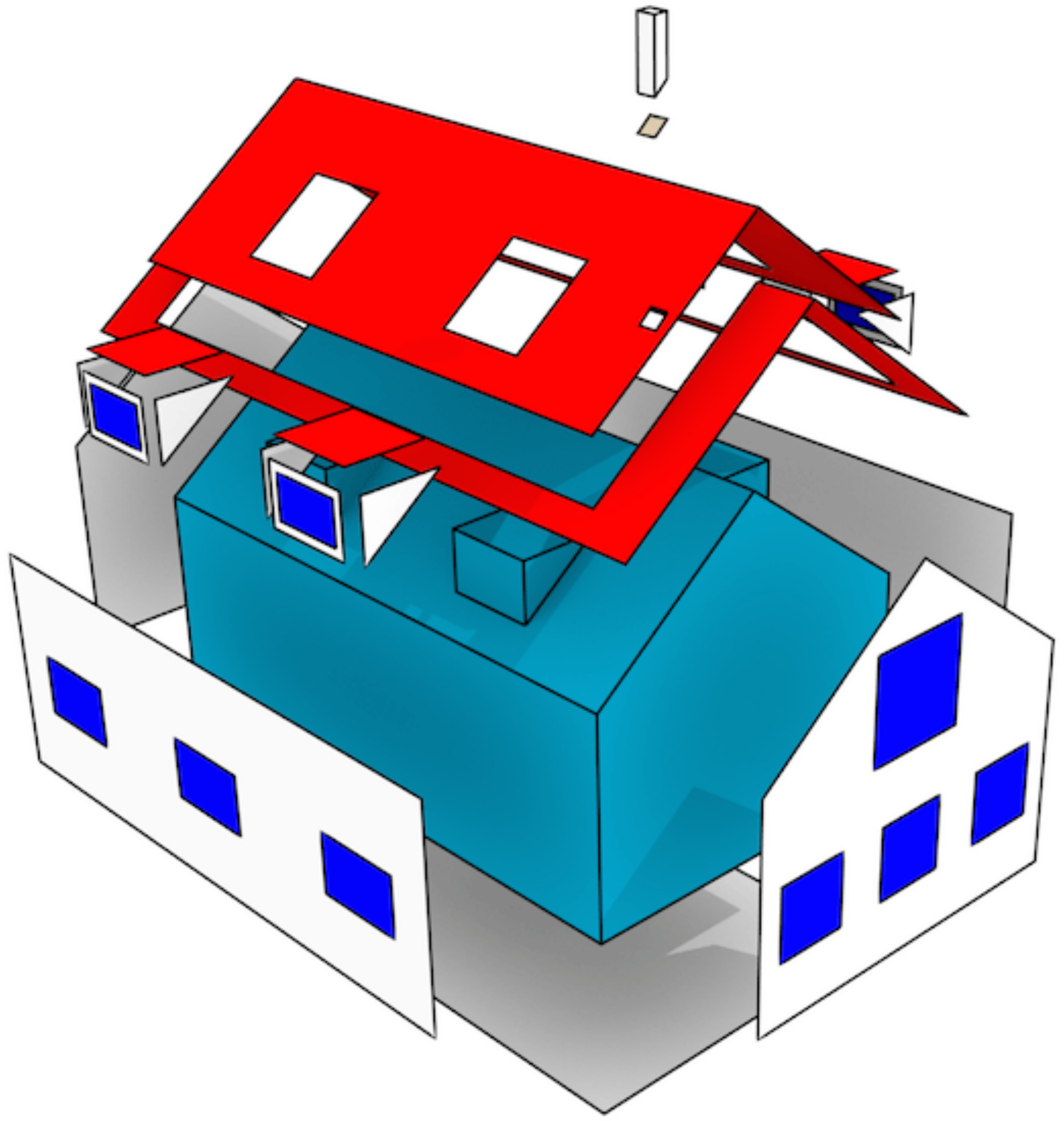
GEO1004:
3D modelling of the built environment

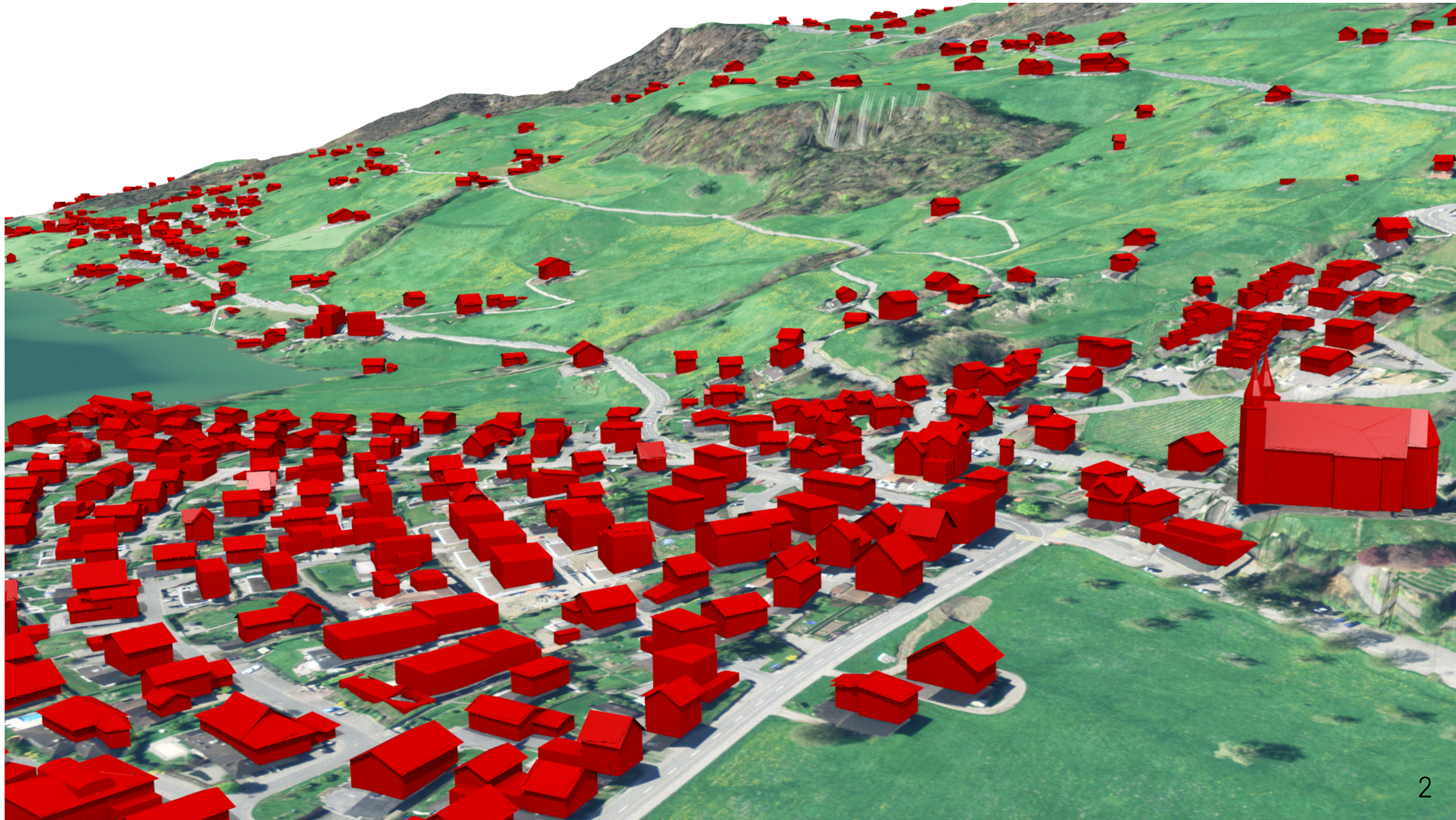
https://3d.bk.tudelft.nl/courses/geo1004

3D geoinformation
Department of Urbanism
Faculty of Architecture and the Built Environment
Delft University of Technology

CityGML

International standard (from OGC) for representing and storing 3D city models





CityGML files are very complex

- files are deeply nested, and large
- many “points of entry”
- many diff ways to do one thing

James Fee
@jamesmfee

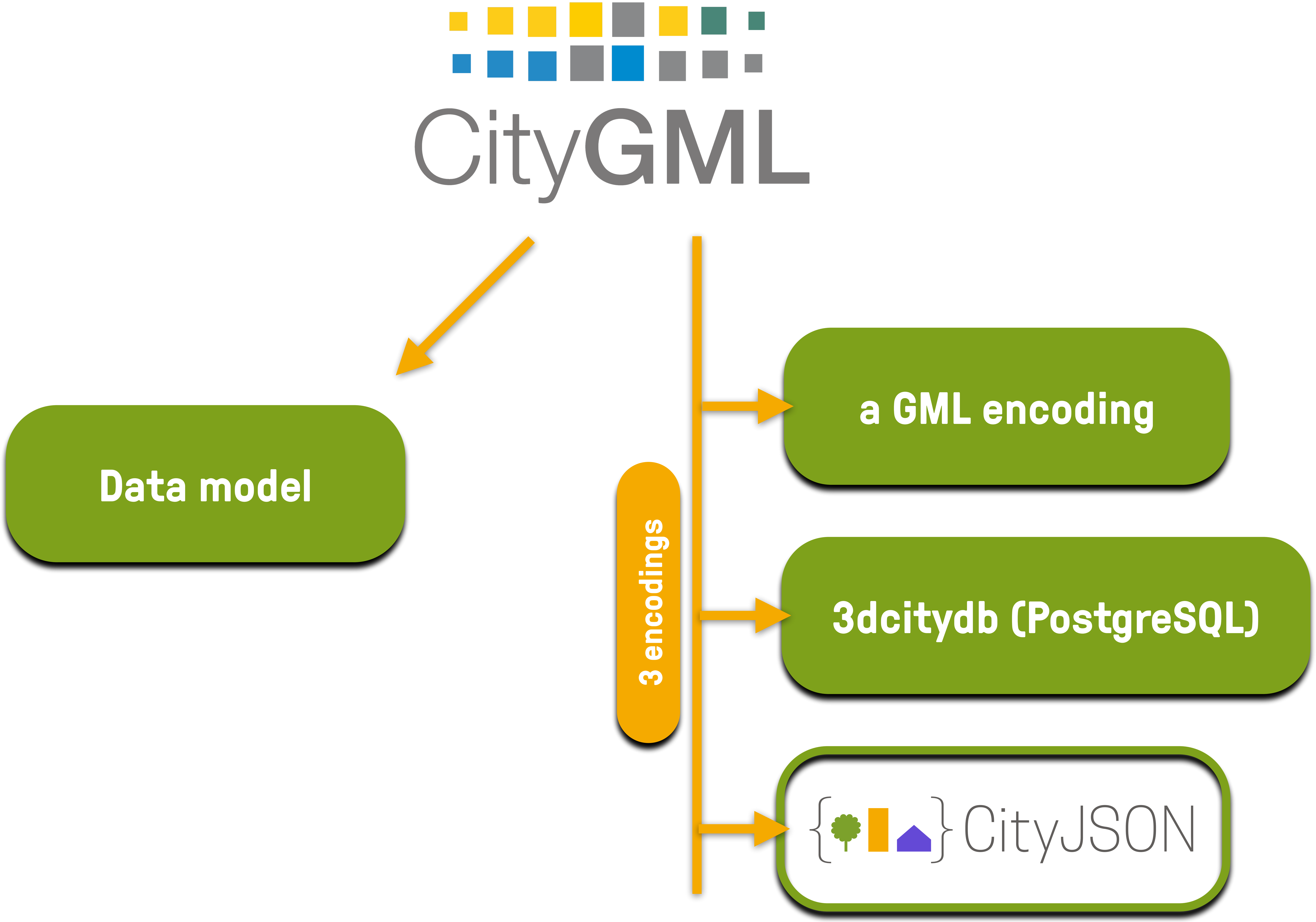
I just got sent a CityGML file.

11:41 PM - Jun 29, 2016

➡ few software packages use CityGML

➡ no parsers in JavaScript

➡ I personally get 😩 each time I get a new file



CityGML

Data model

3 encodings

a GML encoding

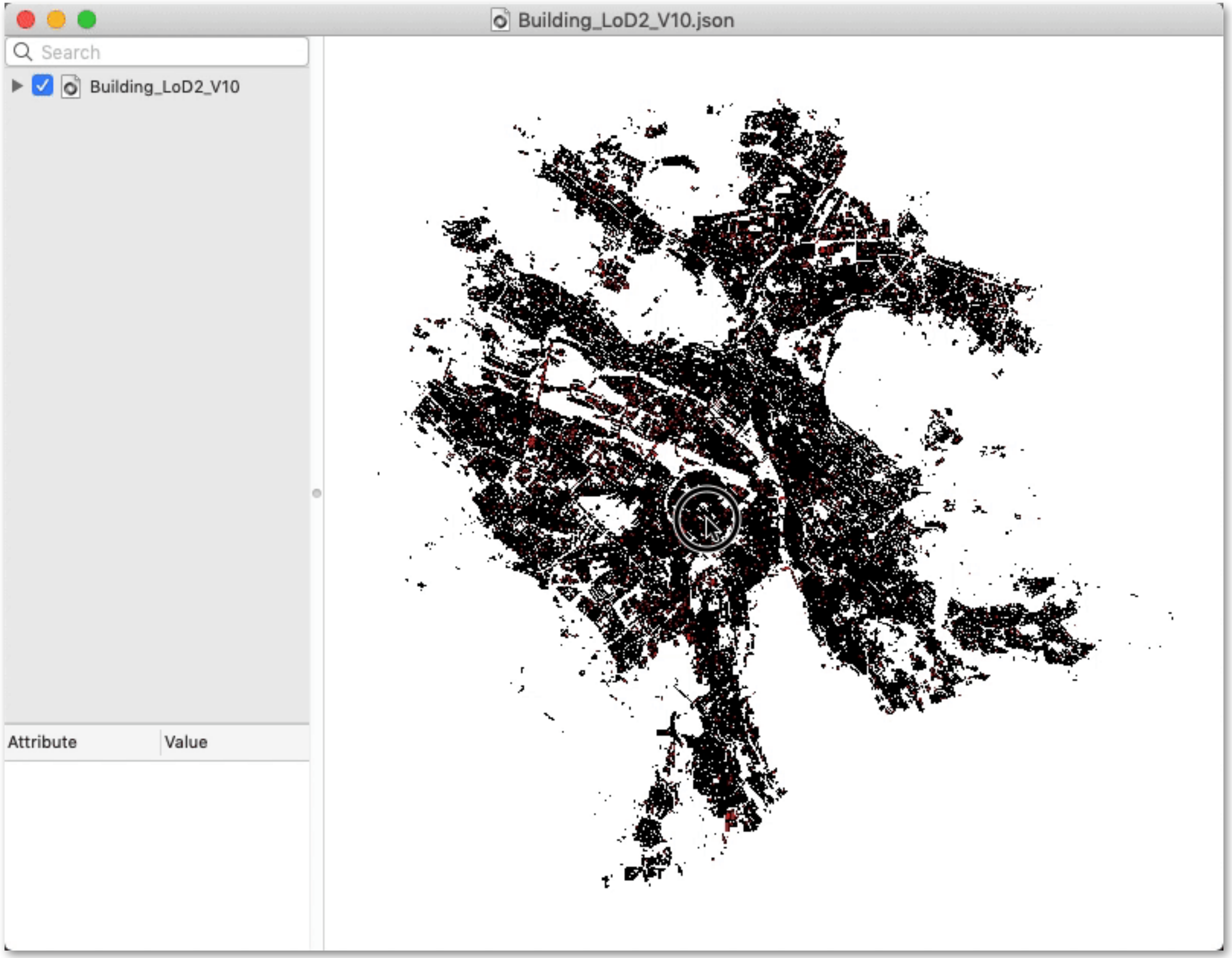
3dcitydb (PostgreSQL)

CityJSON

Compression factor == ~6X

file	CityGML size (original)	CityGML size (w/o spaces)	textures?	CityJSON	CityJSON compressed	compression factor
CityGML demo "GeoRes"	4.3MB	4.1MB	yes	582KB	524KB	8.0
CityGML v2 demo "Railway"	45MB	34MB	yes	4.5MB	4.3MB	8.1
Den Haag "tile 01"	23MB	18MB	no, material	3.1MB	2.9MB	6.2
Montréal VM05	56MB	42MB	yes	5.7MB	5.4MB	7.8
New York LoD2 (DA13)	590MB	574MB	no	110MB	105MB	5.5
Rotterdam Delfshaven	16MB	15MB	yes	2.8MB	2.6MB	5.4
Vienna	37MB	36MB	no	5.6MB	5.3MB	6.8

One example: Zürich LoD2 buildings



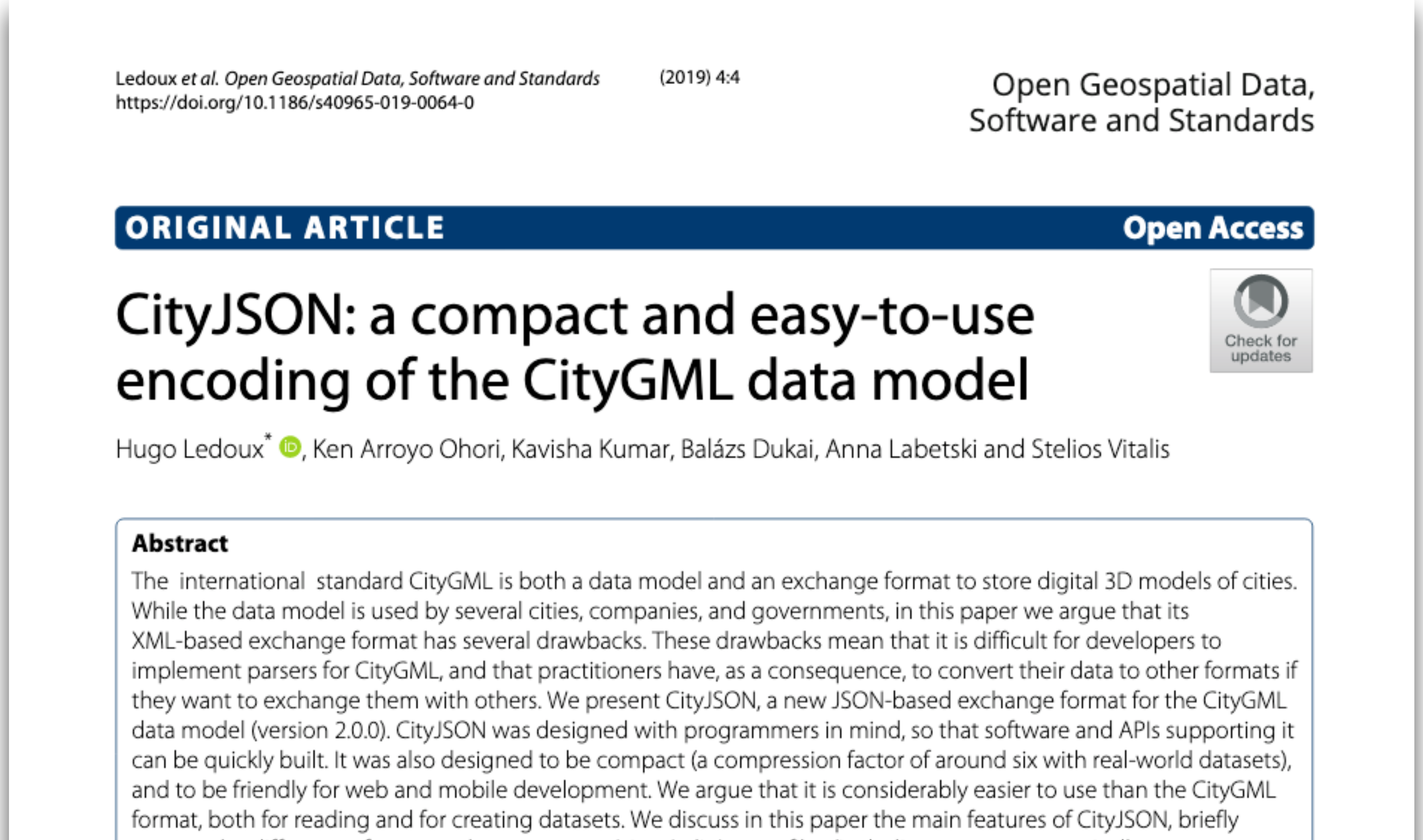
CityGML = 3.0GB

(but 1GB of spaces/CRs/tabs!)

CityJSON = 292MB

Compression == 7.1X

Why an alternative encoding? Read this.



Ledoux *et al. Open Geospatial Data, Software and Standards* (2019) 4:4
https://doi.org/10.1186/s40965-019-0064-0

Open Geospatial Data,
Software and Standards

ORIGINAL ARTICLE **Open Access**

CityJSON: a compact and easy-to-use encoding of the CityGML data model

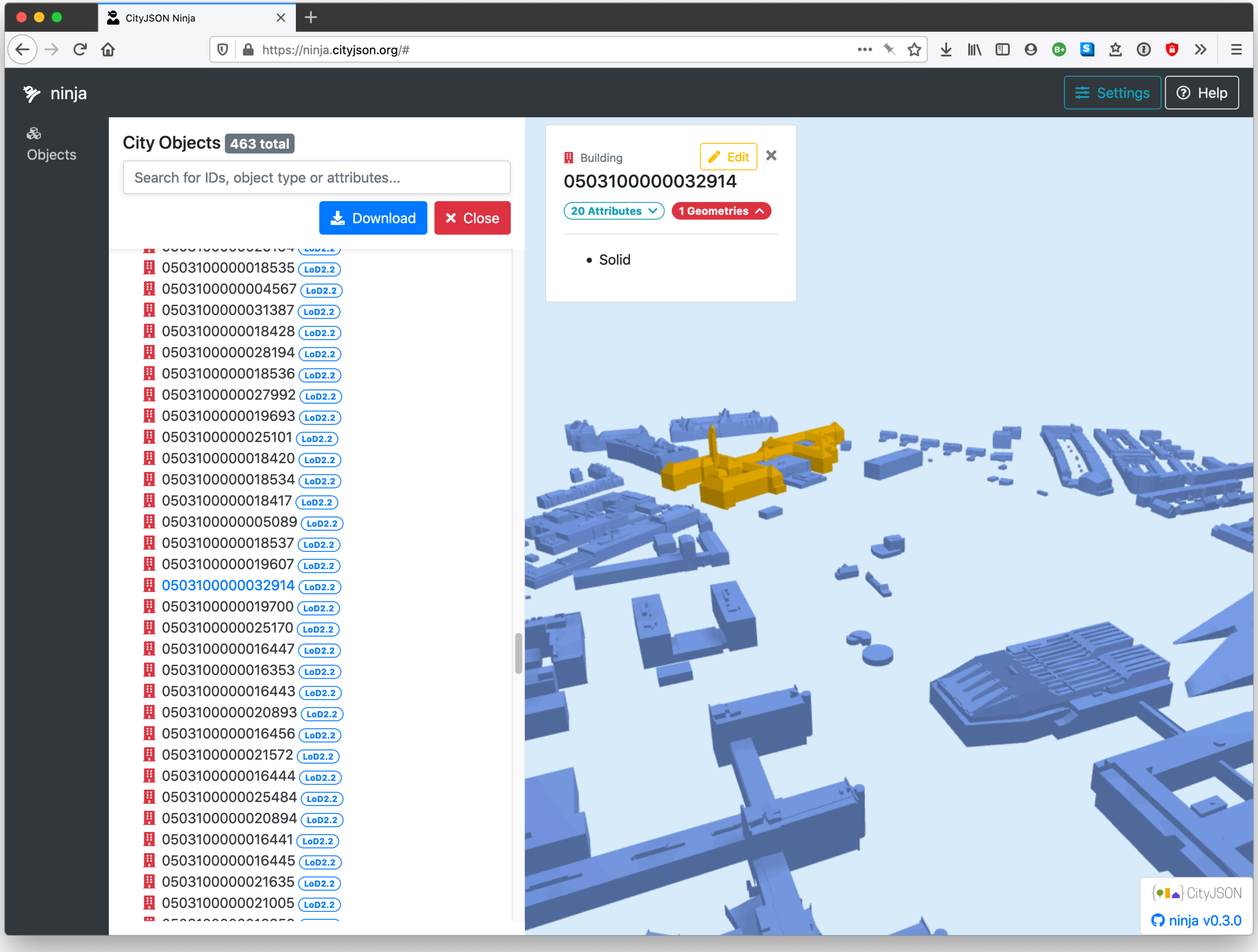
Hugo Ledoux*, Ken Arroyo Ohori, Kavisha Kumar, Balázs Dukai, Anna Labetski and Stelios Vitalis

Abstract

The international standard CityGML is both a data model and an exchange format to store digital 3D models of cities. While the data model is used by several cities, companies, and governments, in this paper we argue that its XML-based exchange format has several drawbacks. These drawbacks mean that it is difficult for developers to implement parsers for CityGML, and that practitioners have, as a consequence, to convert their data to other formats if they want to exchange them with others. We present CityJSON, a new JSON-based exchange format for the CityGML data model (version 2.0.0). CityJSON was designed with programmers in mind, so that software and APIs supporting it can be quickly built. It was also designed to be compact (a compression factor of around six with real-world datasets), and to be friendly for web and mobile development. We argue that it is considerably easier to use than the CityGML format, both for reading and for creating datasets. We discuss in this paper the main features of CityJSON, briefly

CityJSON software

web-viewer



City Objects 463 total

Search for IDs, object type or attributes...

Download | Close

0503100000018535	LoD2.2
0503100000004567	LoD2.2
0503100000031387	LoD2.2
0503100000018428	LoD2.2
0503100000028194	LoD2.2
0503100000018536	LoD2.2
0503100000027992	LoD2.2
0503100000019693	LoD2.2
0503100000025101	LoD2.2
0503100000018420	LoD2.2
0503100000018534	LoD2.2
0503100000018417	LoD2.2
0503100000005089	LoD2.2
0503100000018537	LoD2.2
0503100000019607	LoD2.2
0503100000032914	LoD2.2
0503100000019700	LoD2.2
0503100000025170	LoD2.2
0503100000016447	LoD2.2
0503100000016353	LoD2.2
0503100000016443	LoD2.2
0503100000020893	LoD2.2
0503100000016456	LoD2.2
0503100000021572	LoD2.2
0503100000016444	LoD2.2
0503100000025484	LoD2.2
0503100000020894	LoD2.2
0503100000016441	LoD2.2
0503100000016445	LoD2.2
0503100000021635	LoD2.2
0503100000021005	LoD2.2

Building

0503100000032914

Edit

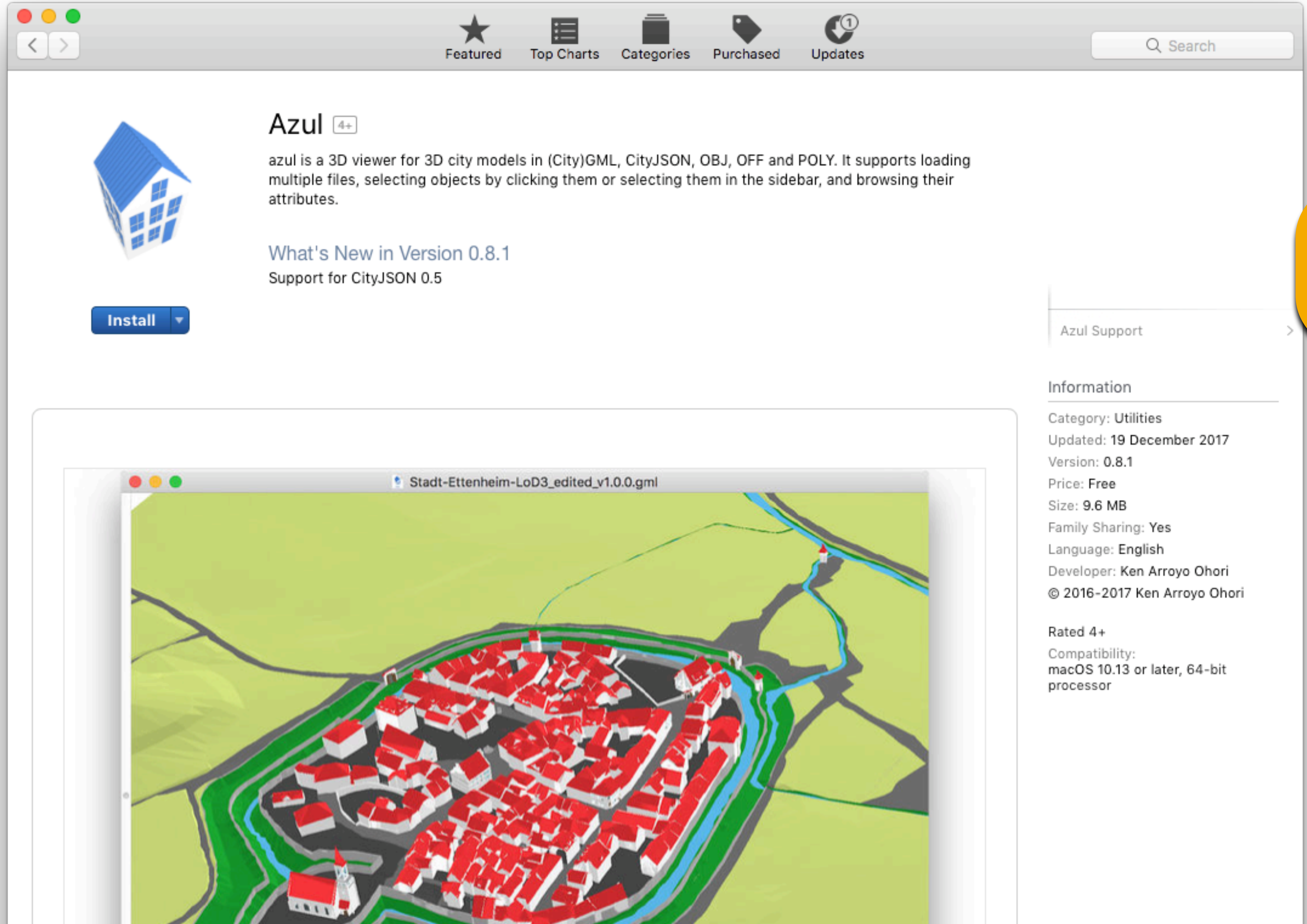
20 Attributes | 1 Geometries

- Solid

Fun fact: programmed mostly by 2 Geomatics students, as projects for GEO5010

You can do the same (or similar!)

azul



Azul 4+

azul is a 3D viewer for 3D city models in (City)GML, CityJSON, OBJ, OFF and POLY. It supports loading multiple files, selecting objects by clicking them or selecting them in the sidebar, and browsing their attributes.

What's New in Version 0.8.1

Support for CityJSON 0.5

Azul Support

Information

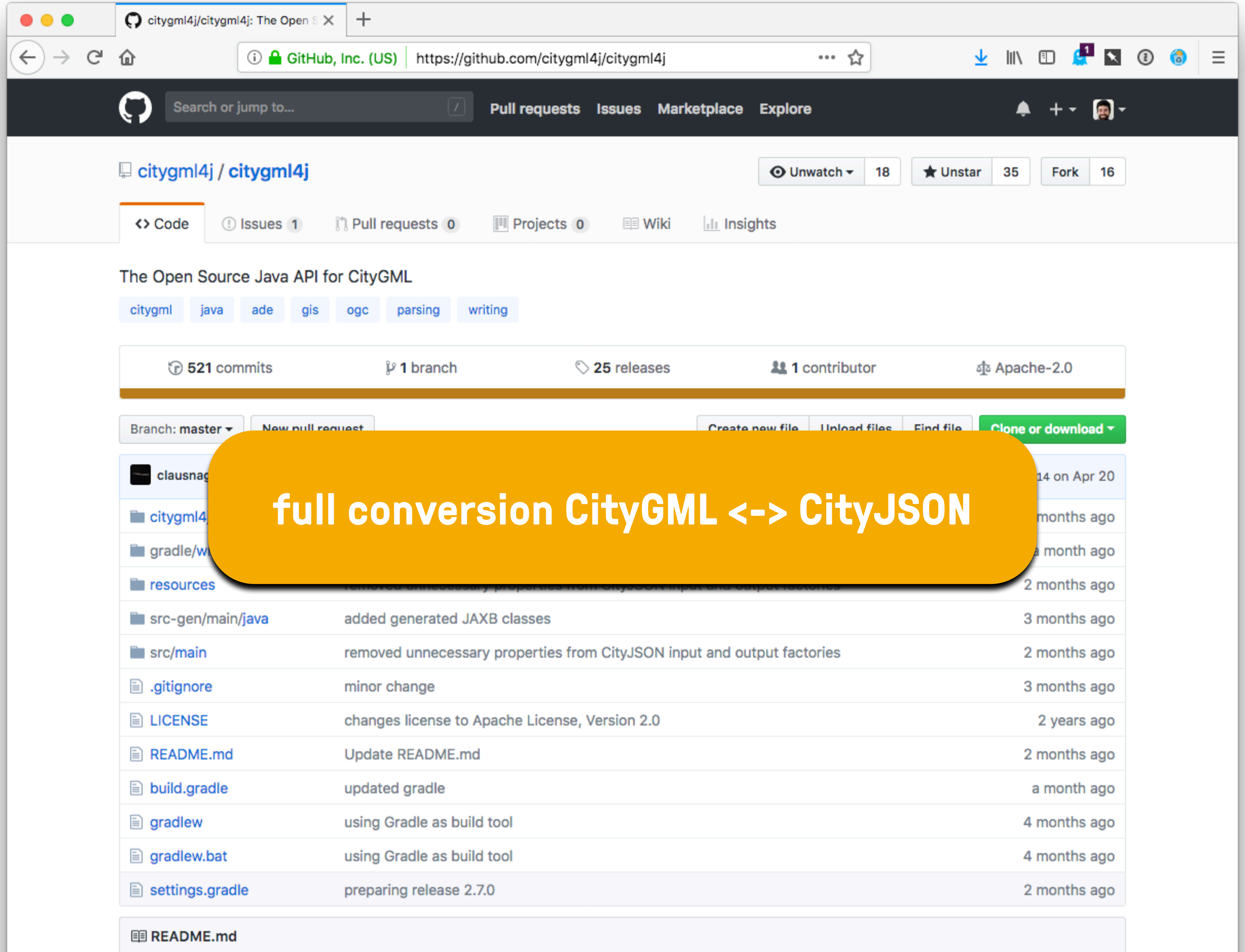
Category: Utilities
Updated: 19 December 2017
Version: 0.8.1
Price: Free
Size: 9.6 MB
Family Sharing: Yes
Language: English
Developer: Ken Arroyo Ohori
© 2016-2017 Ken Arroyo Ohori

Rated 4+

Compatibility:
macOS 10.13 or later, 64-bit processor

Fun fact: programmed by Ken

citygml4j



citygml4j/citygml4j: The Open

GitHub, Inc. (US) https://github.com/citygml4j/citygml4j

citygml4j / citygml4j

The Open Source Java API for CityGML

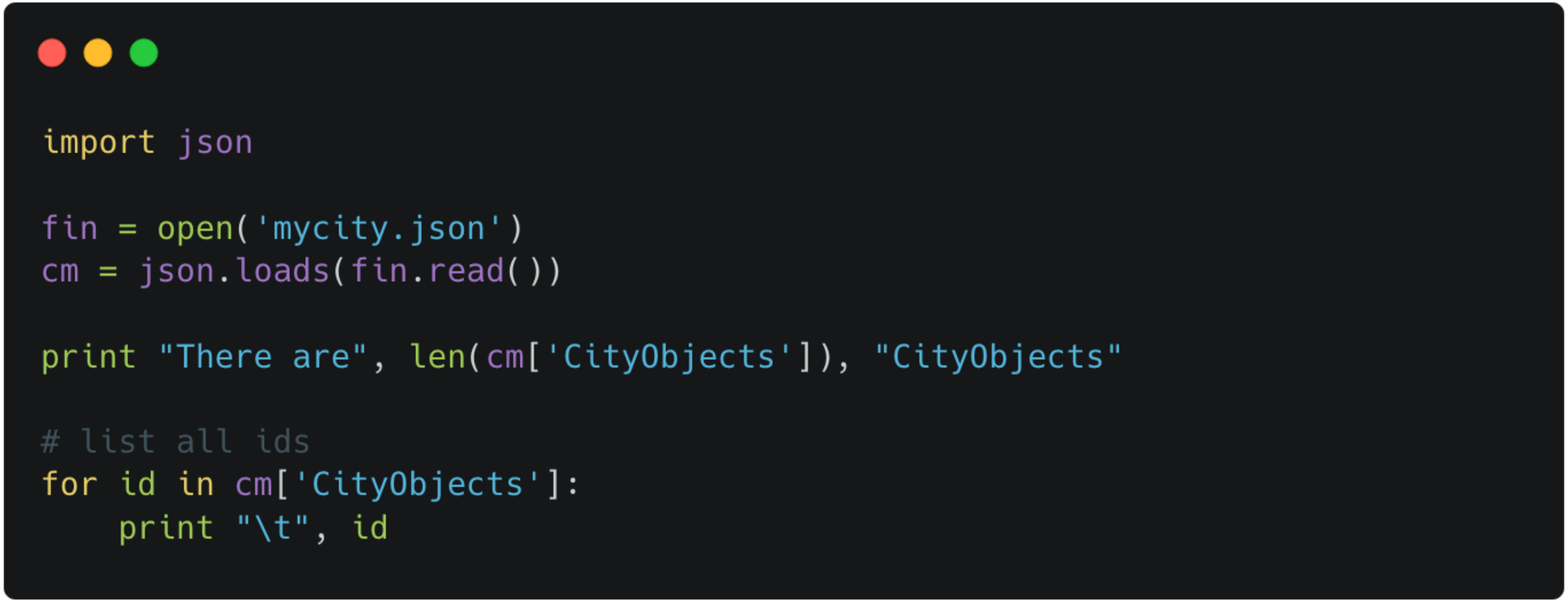
521 commits · 1 branch · 25 releases · 1 contributor · Apache-2.0

clausnag		14 on Apr 20
citygml4		months ago
gradle/w		a month ago
resources	removed unnecessary properties from CityJSON input and output factories	2 months ago
src-gen/main/java	added generated JAXB classes	3 months ago
src/main	removed unnecessary properties from CityJSON input and output factories	2 months ago
.gitignore	minor change	3 months ago
LICENSE	changes license to Apache License, Version 2.0	2 years ago
README.md	Update README.md	2 months ago
build.gradle	updated gradle	a month ago
gradlew	using Gradle as build tool	4 months ago
gradlew.bat	using Gradle as build tool	4 months ago
settings.gradle	preparing release 2.7.0	2 months ago

README.md

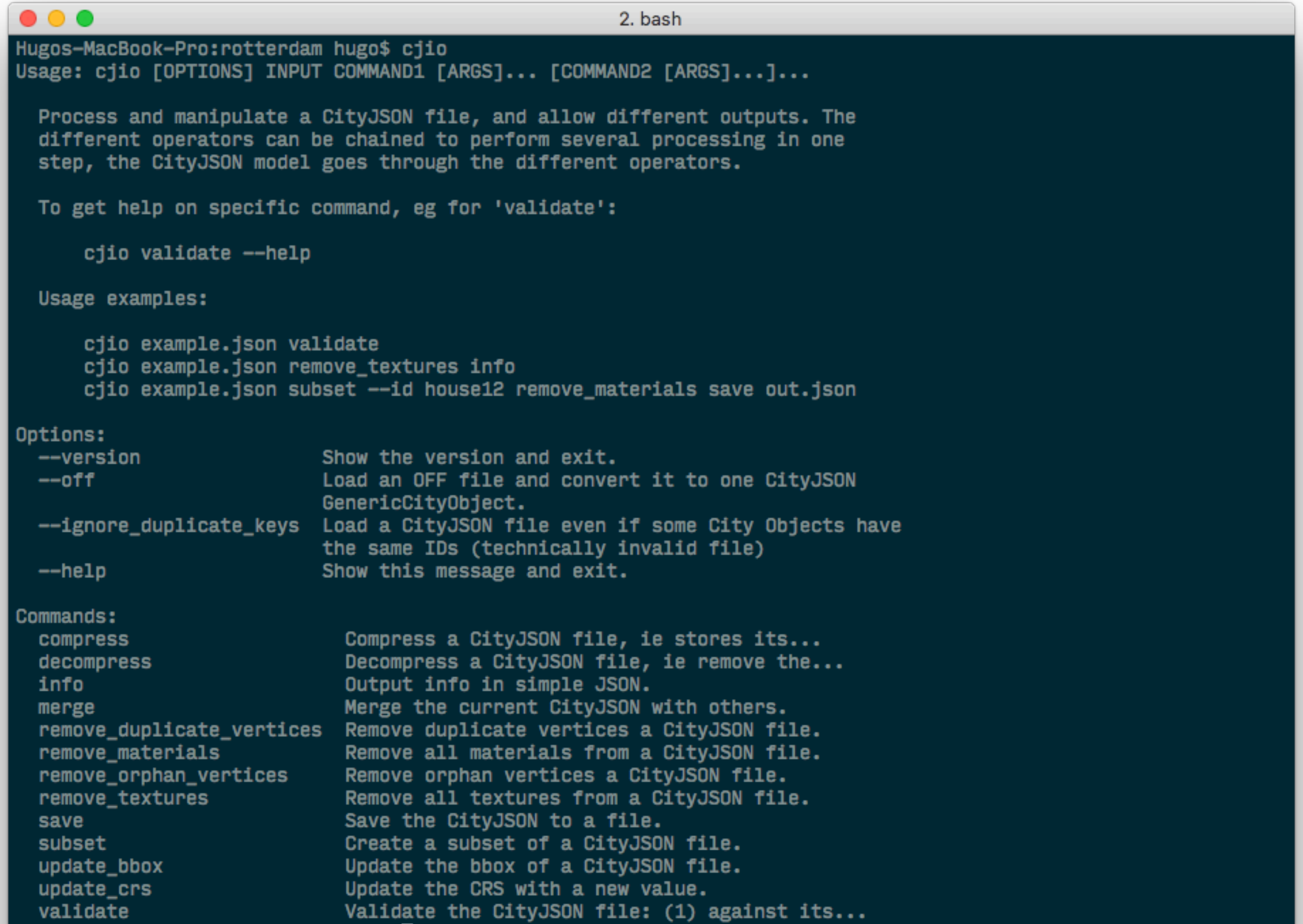
full conversion CityGML <-> CityJSON

Python parser is simple



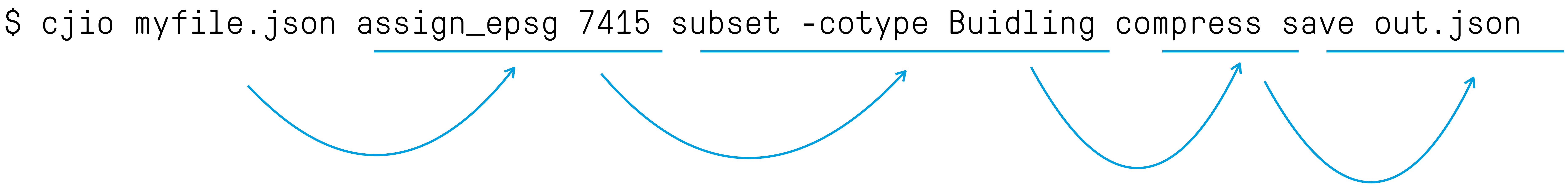
```python
import json

fin = open('mycity.json')
cm = json.loads(fin.read())

print "There are", len(cm['CityObjects']), "CityObjects"

# list all ids
for id in cm['CityObjects']:
    print "\t", id
```

cjio (CityJSON/io)



```
Hugos-MacBook-Pro:rotterdam hugo$ cjio
Usage: cjio [OPTIONS] INPUT COMMAND1 [ARGS]... [COMMAND2 [ARGS]...]...

  Process and manipulate a CityJSON file, and allow different outputs. The
  different operators can be chained to perform several processing in one
  step, the CityJSON model goes through the different operators.

  To get help on specific command, eg for 'validate':

      cjio validate --help

  Usage examples:

      cjio example.json validate
      cjio example.json remove_textures info
      cjio example.json subset --id house12 remove_materials save out.json

Options:
  --version                Show the version and exit.
  --off                    Load an OFF file and convert it to one CityJSON
                           GenericCityObject.
  --ignore_duplicate_keys  Load a CityJSON file even if some City Objects have
                           the same IDs (technically invalid file)
  --help                   Show this message and exit.

Commands:
  compress                   Compress a CityJSON file, ie stores its...
  decompress                 Decompress a CityJSON file, ie remove the...
  info                       Output info in simple JSON.
  merge                      Merge the current CityJSON with others.
  remove_duplicate_vertices  Remove duplicate vertices a CityJSON file.
  remove_materials           Remove all materials from a CityJSON file.
  remove_orphan_vertices     Remove orphan vertices a CityJSON file.
  remove_textures            Remove all textures from a CityJSON file.
  save                       Save the CityJSON to a file.
  subset                     Create a subset of a CityJSON file.
  update_bbox                Update the bbox of a CityJSON file.
  update_crs                 Update the CRS with a new value.
  validate                   Validate the CityJSON file: (1) against its...
```

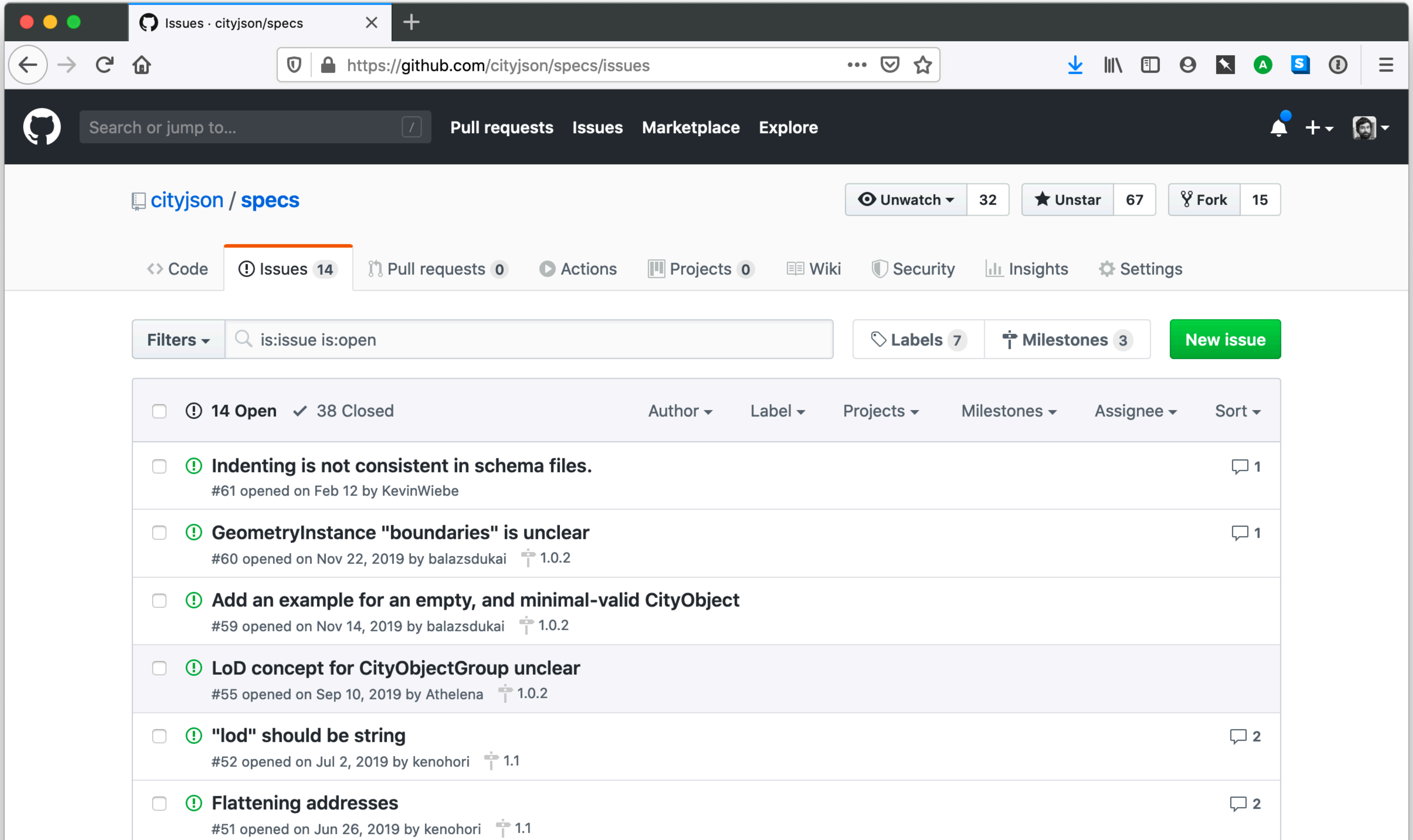
cjio (CityJSON/io)



```
$ cjio myfile.json assign_epsg 7415 subset -cotype Buidling compress save out.json
```

pip install cjio

Help? Feedback? All development is open



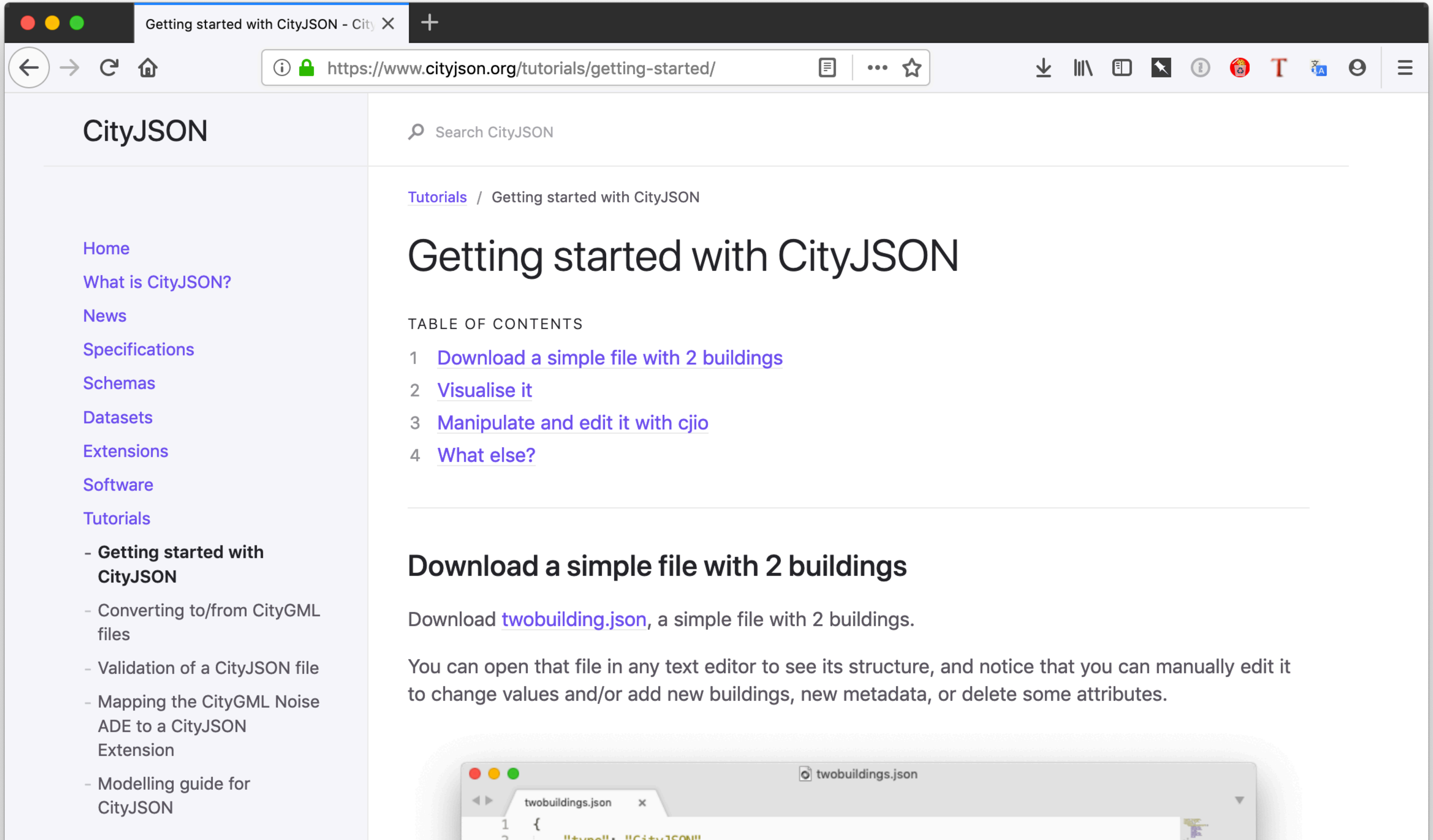
cityjson / specs

is:issue is:open

14 Open ✓ 38 Closed

Indenting is not consistent in schema files. #61 opened on Feb 12 by KevinWiebe	1
GeometryInstance "boundaries" is unclear #60 opened on Nov 22, 2019 by balazsdukai 1.0.2	1
Add an example for an empty, and minimal-valid CityObject #59 opened on Nov 14, 2019 by balazsdukai 1.0.2	
LoD concept for CityObjectGroup unclear #55 opened on Sep 10, 2019 by Athelena 1.0.2	
"lod" should be string #52 opened on Jul 2, 2019 by kenohori 1.1	2
Flattening addresses #51 opened on Jun 26, 2019 by kenohori 1.1	2

Getting started?



Getting started with CityJSON - City
https://www.cityjson.org/tutorials/getting-started/

CityJSON

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Getting started with CityJSON

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Download a simple file with 2 buildings

Download twobuilding.json, a simple file with 2 buildings.

You can open that file in any text editor to see its structure, and notice that you can manually edit it to change values and/or add new buildings, new metadata, or delete some attributes.

```
{
  "type": "CityJSON"
```