Using Shape Expressions (ShEx) to Share RDF Data Models and to Guide Curation with Rigorous Validation

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Link for these slides

- https://w.wiki/4dr

Our Collaboration

- 2 partially overlapping communities:
- **ShEx Community Group**
- **Wikidatans**

ShEx

- ShEx is a formal modeling and validation language for RDF graphs
- Allows humans and machines communicate unambiguously about data assets
- Supports agile development of data models
- Learn more: http://shex.io

ShEx Implementations

- shex.js (runs on n3.js)
- SHACLex (Scala)
- ShexJava
- PyShEx
- Ruby ShEx

ShEx Test Suite

- 1088 validation tests
- 99 negative syntax tests
- 14 negative structure tests
- 408 schema conversion tests between ShExC, ShExJ and ShExR

Online Validators for ShEx

- ShEx2 Simple Online Validator (JavaScript)
- RDF Shape (Scala)

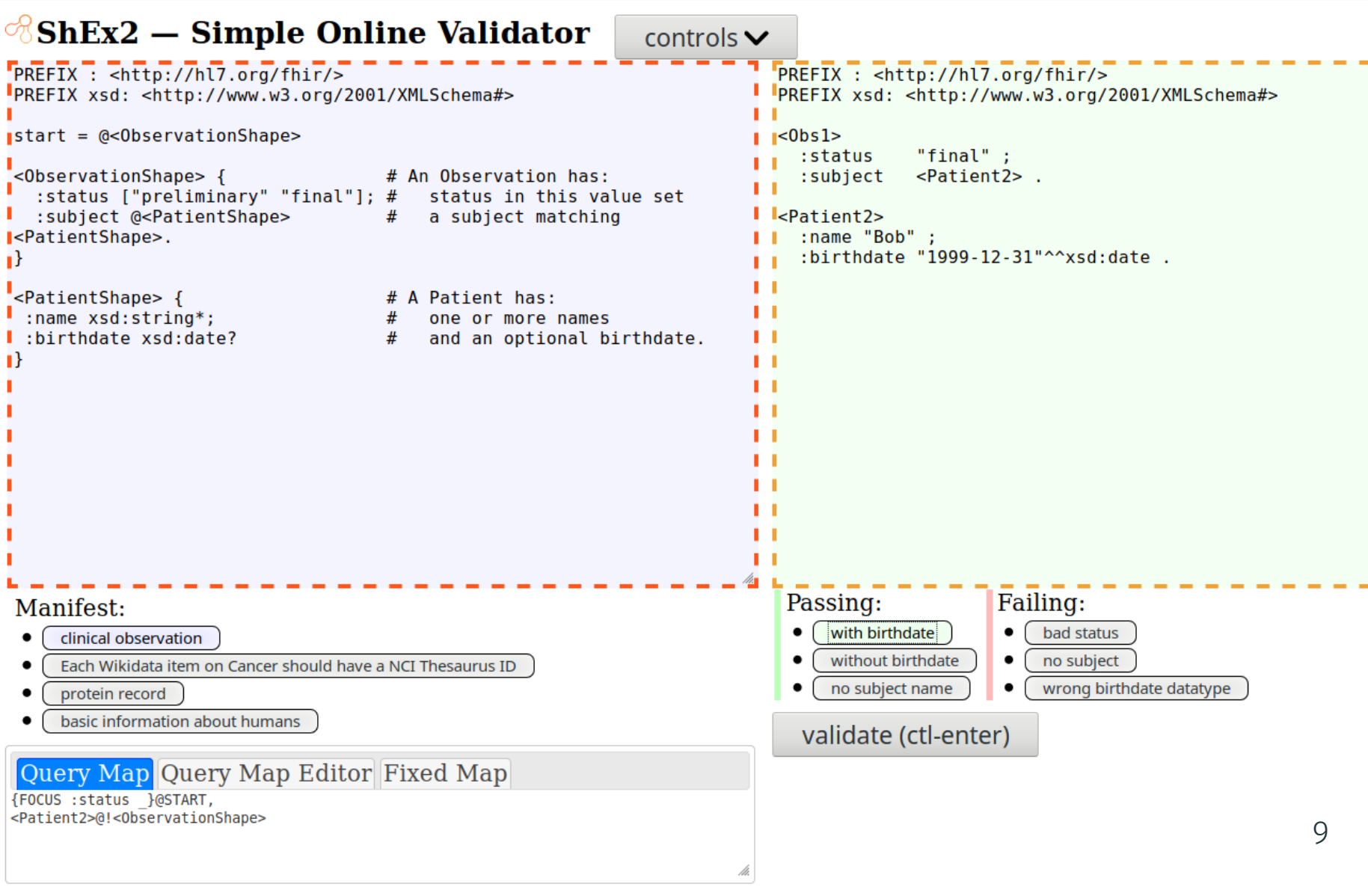
Three Use Cases

- **FHIR** (medical)
- **GeneWiki** (biomedical)
- **Digital Preservation** (computing)

Use Case One: FHIR

- Fast Healthcare Interoperability Resources (FHIR) specification defines 130+ healthcare resources and how they are represented in RDF, XML and JSON
- The FHIR documentation production framework calls the Shaclex implementation
- Exchange of electronic medical records generated in different software systems

FHIR schema example



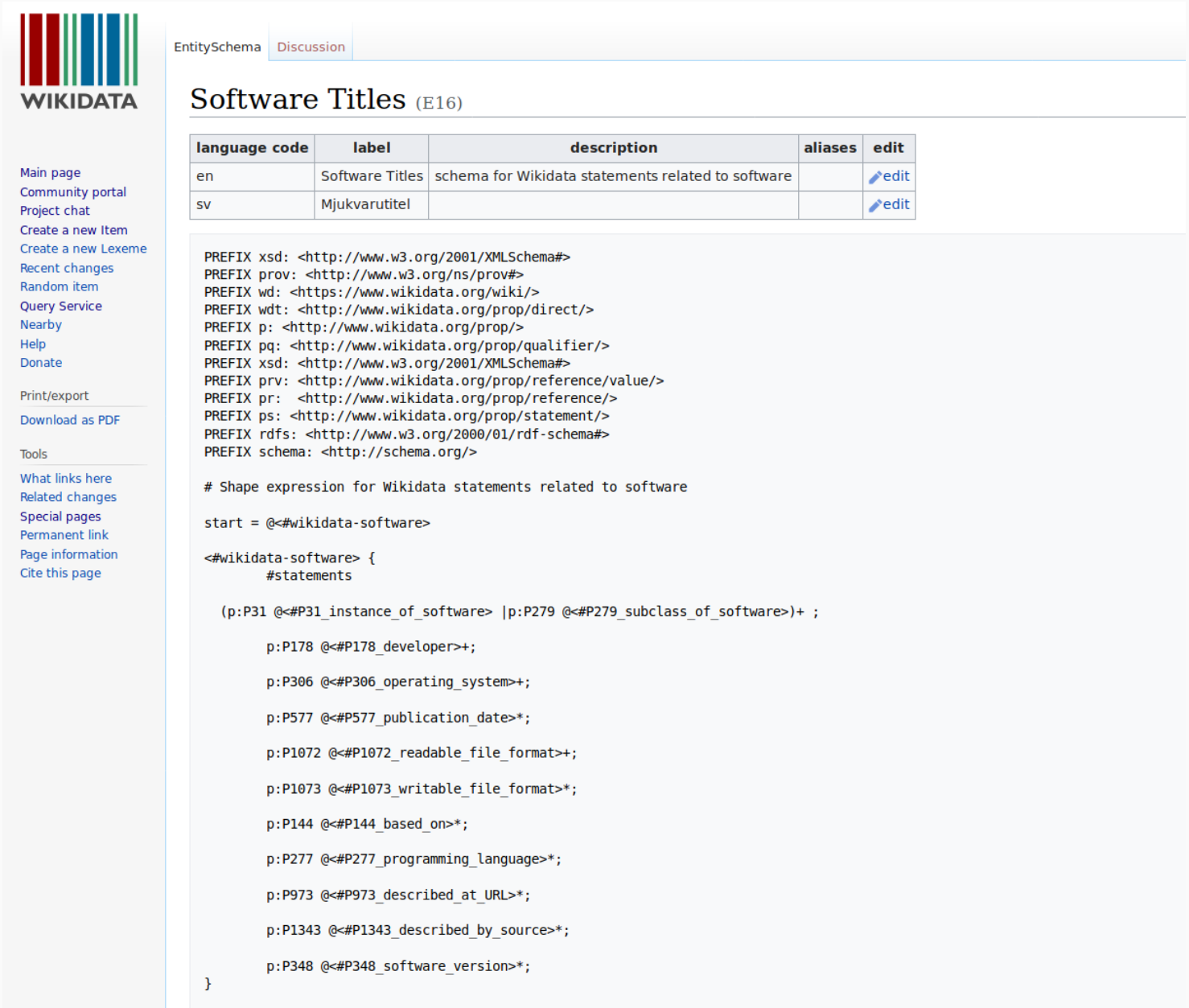
Use Cases Two and Three with Wikidata

- Wikidata does not have pre-defined data models
- ShEx schemas are used to share data models
- ShEx schemas are used to validate entity data, relevant for data quality

ShEx on Wikidata

- 28 May new namespace in Wikidata for schemas (E)
- Store schemas in Wikidata
- Use schemas for validation in a version of ShEx2 Simple Online Validator
- Discuss and extend schemas where the Wikidata community works
- Support for multilingual labels and descriptions
- Talk pages and revision history per schema

E namespace on Wikidata



WIKIDATA

Main page
Community portal
Project chat
Create a new Item
Create a new Lexeme
Recent changes
Random item
Query Service
Nearby
Help
Donate

Print/export
Download as PDF

Tools
What links here
Related changes
Special pages
Permanent link
Page information
Cite this page

EntitySchema | Discussion

Software Titles (E16)

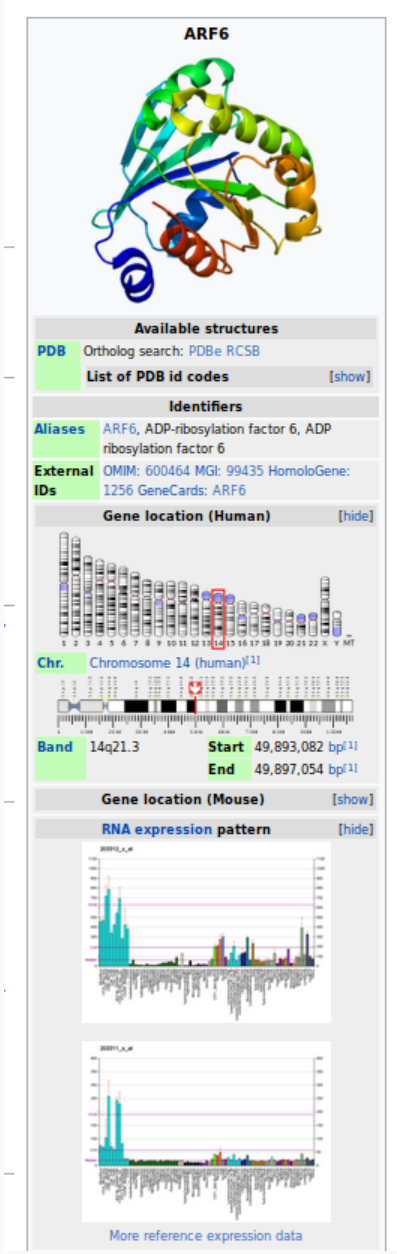
language code	label	description	aliases	edit
en	Software Titles	schema for Wikidata statements related to software		edit
sv	Mjukvarutitel			edit

```
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX prov: <http://www.w3.org/ns/prov#>
PREFIX wd: <https://www.wikidata.org/wiki/>
PREFIX wdt: <http://www.wikidata.org/prop/direct/>
PREFIX p: <http://www.wikidata.org/prop/>
PREFIX pq: <http://www.wikidata.org/prop/qualifier/>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX prv: <http://www.wikidata.org/prop/reference/value/>
PREFIX pr:  <http://www.wikidata.org/prop/reference/>
PREFIX ps: <http://www.wikidata.org/prop/statement/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX schema: <http://schema.org/>

# Shape expression for Wikidata statements related to software

start = @<#wikidata-software>

<#wikidata-software> {
        #statements

  (p:P31 @<#P31_instance_of_software> |p:P279 @<#P279_subclass_of_software>)+ ;

        p:P178 @<#P178_developer>+;

        p:P306 @<#P306_operating_system>+;

        p:P577 @<#P577_publication_date>*;

        p:P1072 @<#P1072_readable_file_format>+;

        p:P1073 @<#P1073_writable_file_format>*;

        p:P144 @<#P144_based_on>*;

        p:P277 @<#P277_programming_language>*;

        p:P973 @<#P973_described_at_URL>*;

        p:P1343 @<#P1343_described_by_source>*;

        p:P348 @<#P348_software_version>*;
}
```

Use Case Two: ShEx is used in GeneWiki

- Started in 2008, goal to create and maintain **infoboxes** in English-language Wikipedia articles about **human genes**
- In 2012, shifted from curating infoboxes on Wikipedia pages to curating the corresponding items on Wikidata
- **24k** human genes and **20k** mouse genes
- **8,700** disease concepts from the **Disease Ontology**
- **2,700** FDA-approved drugs

Infobox populated by structured data from Wikidata



Validation example for GeneWiki

- Schema E37 on Wikidata

Validation in Wikidata's Toolforge implementation

ShEx2 — Simple Online Validator

```
    # that expresses the requirement that both properties are not mandatory:
        (
                p:P644 @<#P644_genomic_start> ; # Its genomic start location
                p:P645 @<#P645_genomic_end> ; # Its genomic end location
        )* ; # Zero or more start and end locations.

        p:P684 @<#P684_ortholog>* ; # Zero or more known orthologs.
        p:P688 @<#P688_encodes>* ; # Zero or more known geneproducts.
        p:P703 @<#P703_found_in_taxon_human> ; # In which taxonomy and where in that taxonomy this gene is found
        p:P1057 @<#P1057_chromosome>* ;  # Zero or more known chromosomes the gene is located on.
        p:P2888 @<#P2888_exact_match>+ ; # One or more external Internationalized Resource Identifiers of a node on the
                                         # semantic web, describing the same concept as linked data.
        p:P2548 @<#P2548_strand_orientation> ; # Its strand orrientation

        # IDENTIFIER STATEMENTS
        p:P351 @<#P351_ncbi_gene_id> ; # Exactly one ncbi gene identifier
        p:P353 @<#P353_hgnc_gene_symbol> ; # Exactly one hgnc gene symbol
        p:P354 @<#P354_hgnc_gene_id> ; # Exactly one hgnc gene identifier
        p:P594 @<#P594_ensembl_gene_id>* ; # Zero or more Ensembl gene identifier
        p:P639 @<#P639_refseq_rna_id>* ; # Zero or more RefSeq RNA identifiers
        p:P704 @<#P704_ensembl_transcript_id>* ; # Zero or more Ensembl Transcript identifiers.
        p:P593 @<#P593_homologene_id> ; # Exactly one homologene identifier

        # Negative shapes
        p:P352 @<#P352_uniprot_id_wor>{0} ; # A gene can't have a uniprot identifier.
}
```

validate (ctl-enter)

Query Map | Entities to check

```
SELECT ?item WHERE { ?item wdt:P351 ?geneid ; wdt:P703 wd:Q15978631 .} LIMIT 10
```

✓wd:Q40108@START

✗wd:Q227339@!START

```
validating http://www.wikidata.org/entity/Q227339 as //www.wikidata.org/wiki/Special:EntitySchemaText/E37#wikidata-human-gene:
    validating http://www.wikidata.org/entity/statement/Q227339-b0607ff1-4570-23cc-85b4-c2fa23121060:
      validating http://www.wikidata.org/entity/Q422445:
        NodeConstraintError: expected to match [<http://www.wikidata.org/entity/Q7187> <http://www.wikidata.org/entity/Q20747295> <http://www.wikidata.org/entity/Q427087> <http://www.wikidata.org/entity/Q284578> <http://www.wiki
```

✓wd:Q238509@START

✓wd:Q248215@START

✓wd:Q282418@START

✓wd:Q286987@START

✓wd:Q289013@START

✗wd:Q305481@!START

```
validating http://www.wikidata.org/entity/Q305481 as //www.wikidata.org/wiki/Special:EntitySchemaText/E37#wikidata-human-gene:
    validating http://www.wikidata.org/entity/statement/Q305481-22FAA446-1278-45CA-AD9C-6480517DA189:
      validating http://www.wikidata.org/reference/503d708cd6c6cc9d3acfc20457905a4eb5c8961e: exceeds cardinality
  OR
  validating http://www.wikidata.org/entity/statement/Q305481-B4865C3A-9CA2-47D5-A87C-BE92AC525F44:
    validating http://www.wikidata.org/reference/4e41b08d50ba1b8f572908a35e4a88a28e3feade:
      Missing property: http://www.wikidata.org/prop/reference/P854
      validating http://www.wikidata.org/entity/Q16335166:
        Error validating http://www.wikidata.org/entity/Q16335166 as {"type":"NodeConstraint","values":["http://www.wikidata.org/entity/Q20641742"]}: value http://www.wikidata.org/entity/Q16335166 not found in set ["http://www.w
```

✓wd:Q410688@START

✓wd:Q414043@START

Wikidata Integrator (WDI)

- WDI was created by the GeneWiki team within the Su Lab
- Used to write the bots that populate data in the biomedical domain
- PyShEx has now been combined with WDI
- Power tool for working with ShEx in the Wikidata ecosystem

Use Case Three: ShEx is used in Digital Preservation

- Many cultural heritage organizations have **legacy software** in their collections
- The software stored on CD-ROMs and floppy disks at risk of **deterioration**
- If people would like to use the software, the organization might not have **relevant computing environments**

Describing Software and File formats in Wikidata

- Creating items in Wikidata for resources in the domain of computing
- Creating machine-actionable metadata to describe configured emulated environments
- Proposing data models to be discussed with the community
- Testing entity data for conformance to schemas

Screenshot of Validation

ShEx2 — Simple Online Validator controls

```
#Shape Expression for file formats on Wikidata

#BASE <http://base.example/#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX prov: <http://www.w3.org/ns/prov#>
PREFIX wd: <http://www.wikidata.org/entity/>
PREFIX wdt: <http://www.wikidata.org/prop/direct/>
PREFIX p: <http://www.wikidata.org/prop/>
PREFIX pq: <http://www.wikidata.org/prop/qualifier/>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX prv: <http://www.wikidata.org/prop/reference/value/>
PREFIX pr:  <http://www.wikidata.org/prop/reference/>
PREFIX ps: <http://www.wikidata.org/prop/statement/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX schema: <http://schema.org/>

# Shape expression for Wikidata statements related to file formats

start = @<#wikidata-file_format> # Indicates which shape to use to start iterating over the graph if none is provided.

# wikidata-file_format> is the shape for a file format data model in Wikidata. Each line between the brackets
# represents the structure that can be enforced to validate data from file format items.
#
# We distinguish between value statements, and identifier statements.
# Value statements contain either actual values, or pointers to other Wikidata items. Identifier statements capture
# external identifiers
```

```
Endpoint: https://query.wikidata.org/sparql
```

Manifest:

- Fileformats in Wikidata

Passing:

- Get 10 file formats from Wikidata
- Get 100 file formats from Wikidata
- Get all file formats from Wikidata

validate (ctl-enter)

Query Map | Query Map Editor | Fixed Map

```
SPARQL '''PREFIX wdt: <http://www.wikidata.org/prop/direct/>
PREFIX wd: <http://www.wikidata.org/entity/>

SELECT ?item WHERE { ?item wdt:P31 wd:Q235557 .} LIMIT 10'''@START
```

✓wd:Q684554@START

✓wd:Q691652@START

✓wd:Q719519@START

✓wd:Q722609@START

✓wd:Q723030@START

✓wd:Q726218@START

✓wd:Q731135@START

✓wd:Q737207@START

✓wd:Q741654@START

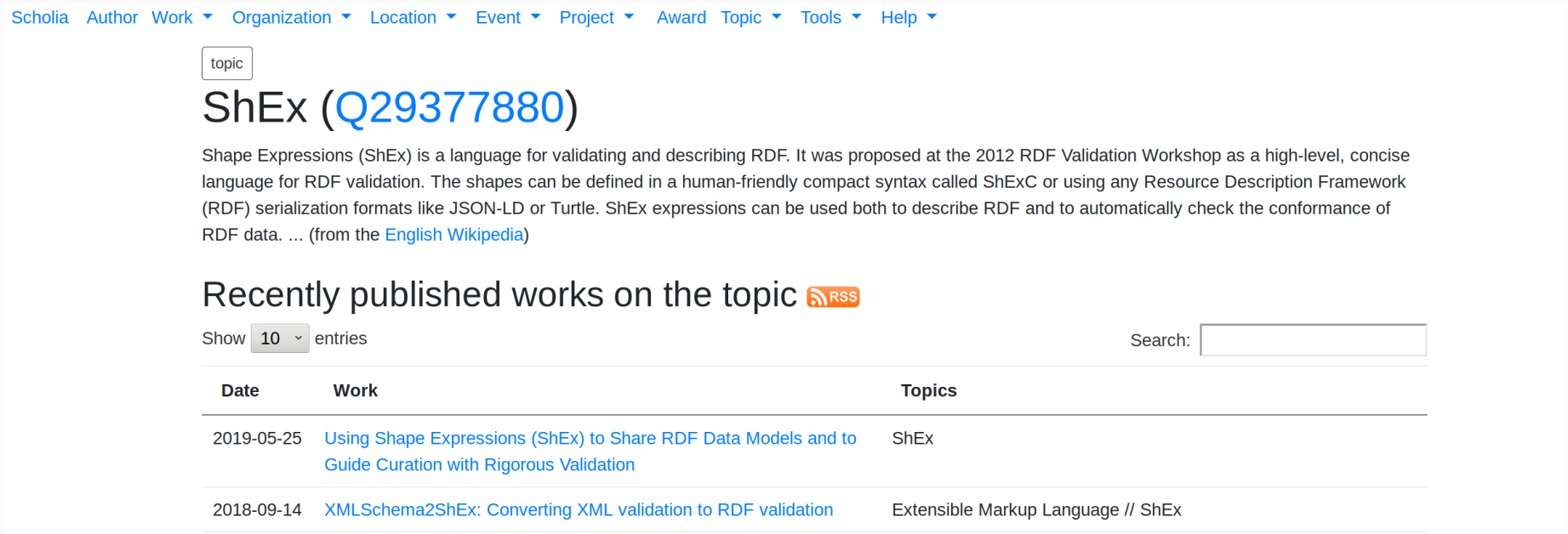
✓wd:Q743275@START

Why ShEx?

- Implementations in multiple languages under open source licenses
- Concise, human-readable syntax
- Comprehensive test suite

Find ShEx Papers

- Scholia is a Wikidata-based service that generates scholarly profiles
- Scholia for shex



Quick Start

- Primer: http://shex.io/shex-primer/

Getting started with ShEx on Wikidata

- Wikidata Wikiproject ShEx
- Schema namespace

Join the conversation

- ShEx Gitter

ShEx Community Group

- W3C Community Group
- You are welcome to join if ShEx is of interest to you

Questions?