

Documenting and preserving programming languages and software in Wikidata

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CPE Lyon, EaaSI

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Programming Languages

Python		Java		C	
					
Paradigm	Object-oriented, imperative, functional, procedural, reflective	Paradigm	Multi-paradigm: object-oriented (class-based), structured, imperative, generic, reflective, concurrent	Paradigm	Imperative (procedural), structured
Designed by Developer	Guido van Rossum Python Software Foundation	Designed by Developer	James Gosling Sun Microsystems (now owned by Oracle Corporation)	Designed by Developer	Dennis Ritchie Dennis Ritchie & Bell Labs (creators); ANSI X3J11 (ANSI C); ISO/IEC JTC1/SC22/WG14 (ISO C)
First appeared	1990; 28 years ago ^[1]	First appeared	May 23, 1995; 23 years ago ^[1]	First appeared	1972; 46 years ago ^[2]
Stable release	3.7.0 / 27 June 2018; 2 months ago ^[2] 2.7.15 / 1 May 2018; 4 months ago ^[3]	Typing discipline	Static, strong, safe, nominative, manifest	Stable release	C11 / December 2011; 6 years ago
Typing discipline	Duck, dynamic, strong since version 3.5: Gradual ^[4]	License	GNU General Public License, Java Community Process	Typing discipline	Static, weak, manifest, nominal
License	Python Software Foundation License	Filename extensions	.java, .class, .jar	OS	Cross-platform
Filename extensions	.py, .pyc, .pyd, .pyo (prior to 3.5), ^[5] .pyw, .pyz (since 3.5) ^[6]	Website	oracle.com/java/ 	Filename extensions	.c, .h
Website	www.python.org 				

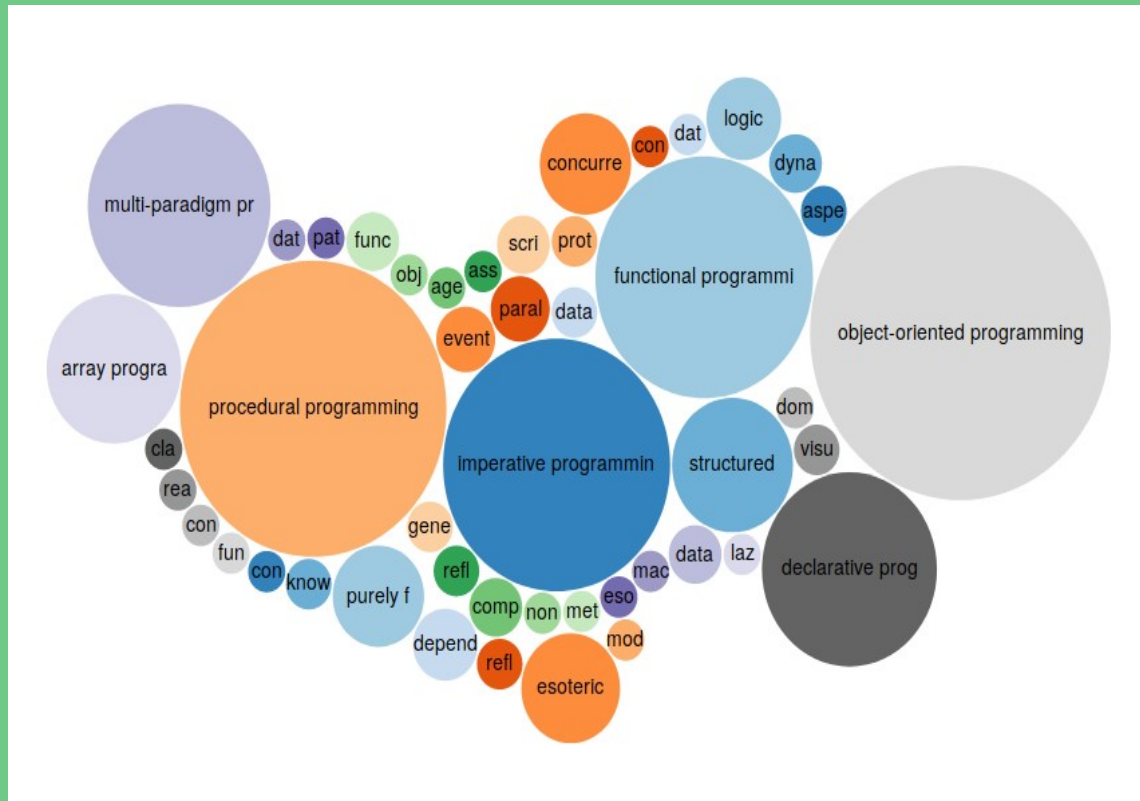
English Wikipedia Infoboxes of Programming Languages

Programming Languages



Programming Languages with the most multilingual labels

Programming Languages



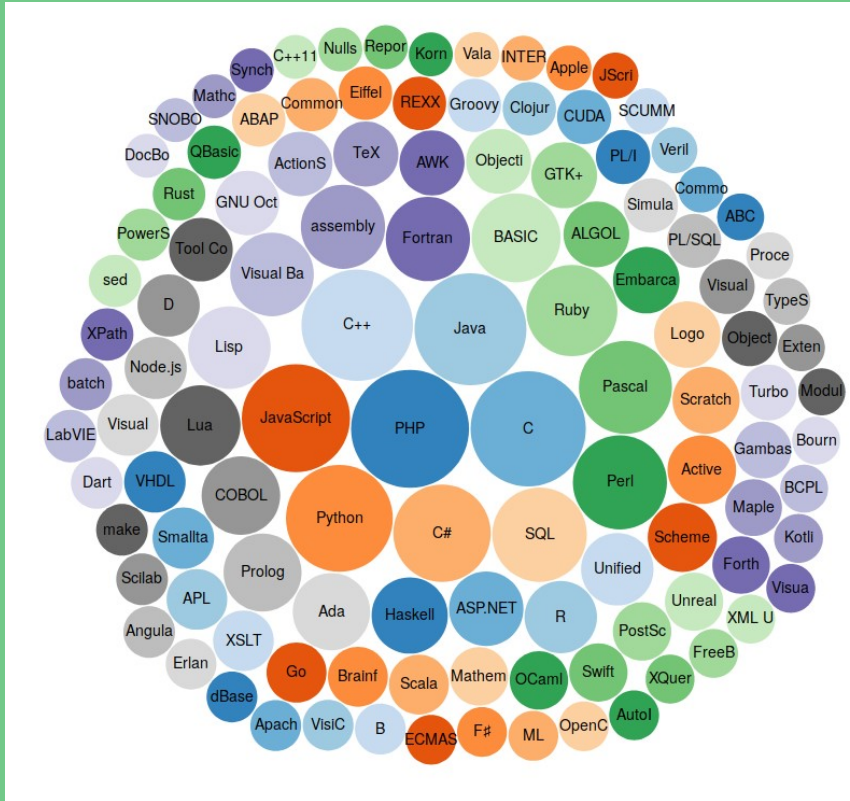
Programming Language Paradigms

Programming Languages



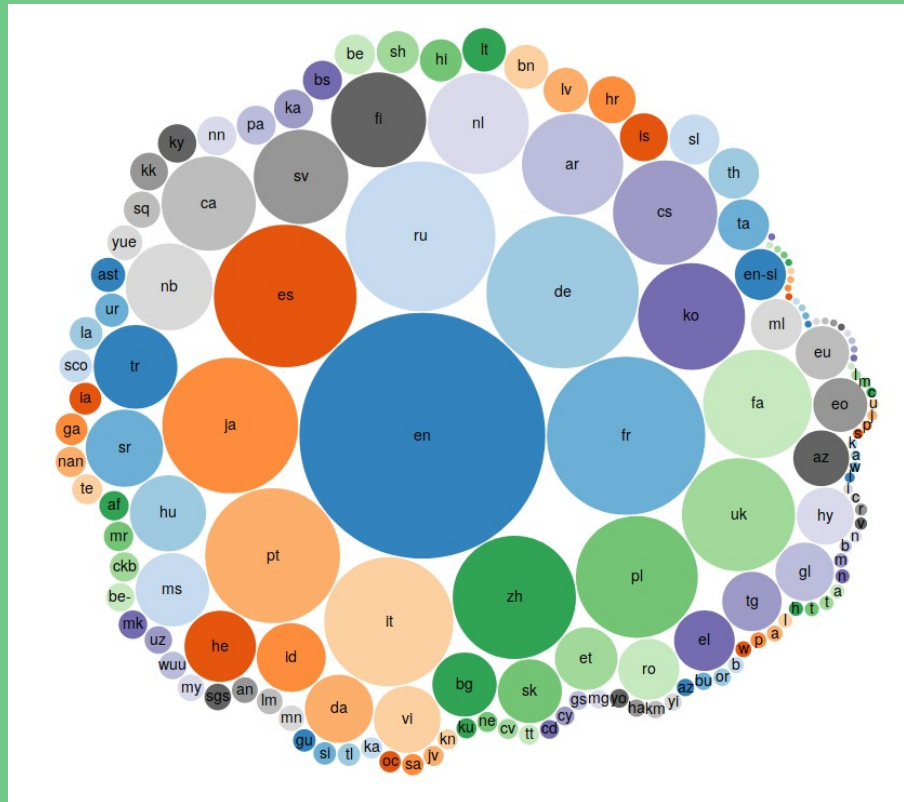
Programming Languages with the most number of different paradigms

Programming Languages



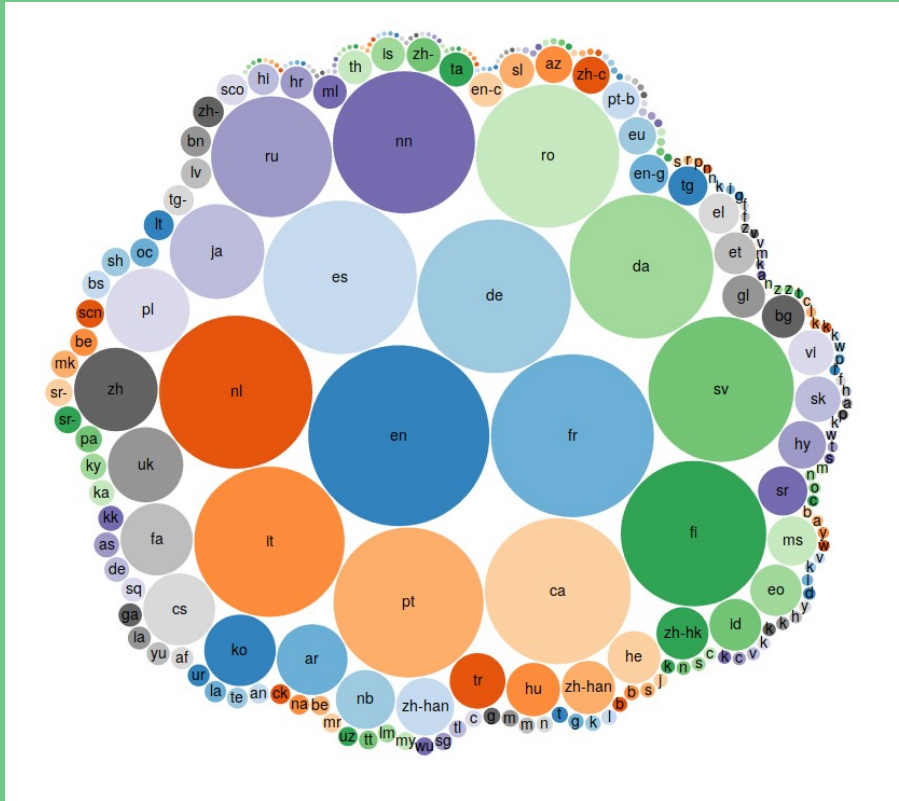
Programming languages with most number of multilingual Wikipedia articles

Programming Languages



Wikipedia languages with the most number of articles on programming languages

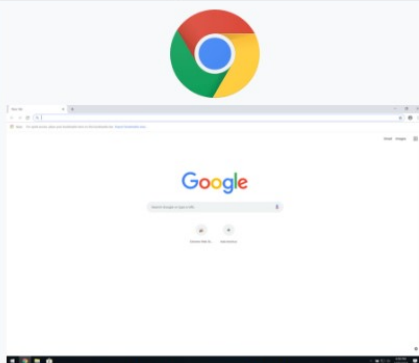
Programming Languages



Languages with the most number of labels of programming languages

Software

Mozilla Firefox	
	
Firefox 57.0 running on Windows 10	
Developer(s)	Mozilla Foundation and its contributors Mozilla Corporation
Initial release	September 23, 2002; 15 years ago
Stable release(s) [±]	
Standard	62.0 / September 5, 2018; 14 days ago ^[1]
Extended Support Release	60.2.0 / September 5, 2018; 14 days ago ^[2]
Preview release(s) [±]	
Beta & Developer Edition	63.0beta / September 5, 2018; 14 days ago ^{[3][4]}
Nightly	64.0a1 / September 5, 2018; 14 days ago ^{[5][6]}
Repository	https://hg.mozilla.org/mozilla-central/ 

Google Chrome	
	
Google Chrome on Windows 10	
Developer(s)	Google LLC
Initial release	September 2, 2008; 10 years ago
Stable release(s) [±]	
Windows, macOS, Linux	69.0.3497.100 / September 17, 2018; 2 days ago ^[1]
Android	69.0.3497.100 / September 17, 2018; 2 days ago ^[2]
iOS	69.0.3497.91 / September 11, 2018; 8 days ago ^[3]

English Wikipedia Infoboxes of Software

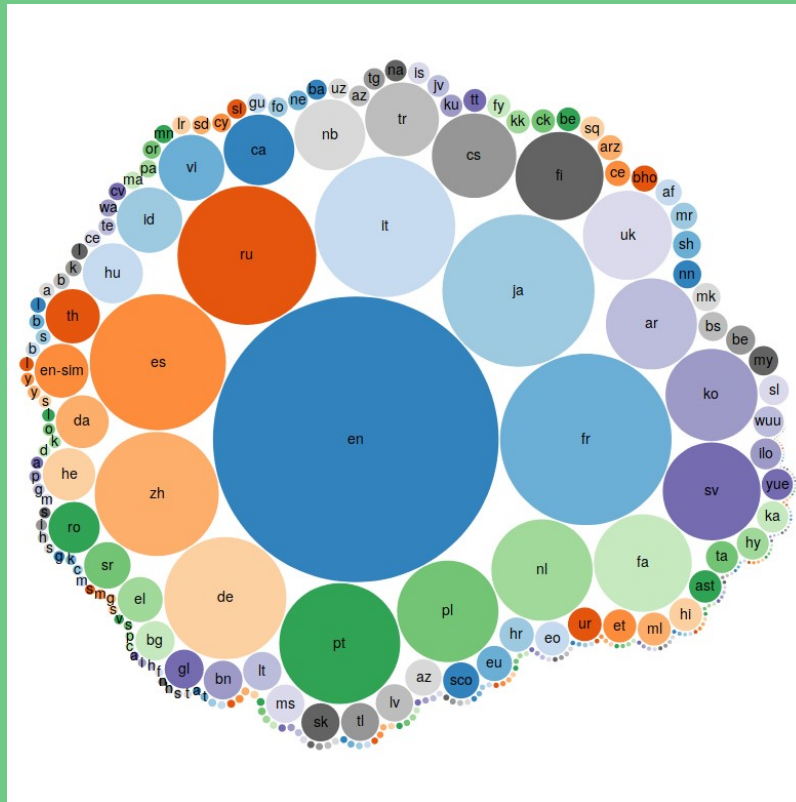


Software with the most number of labels on Wikidata

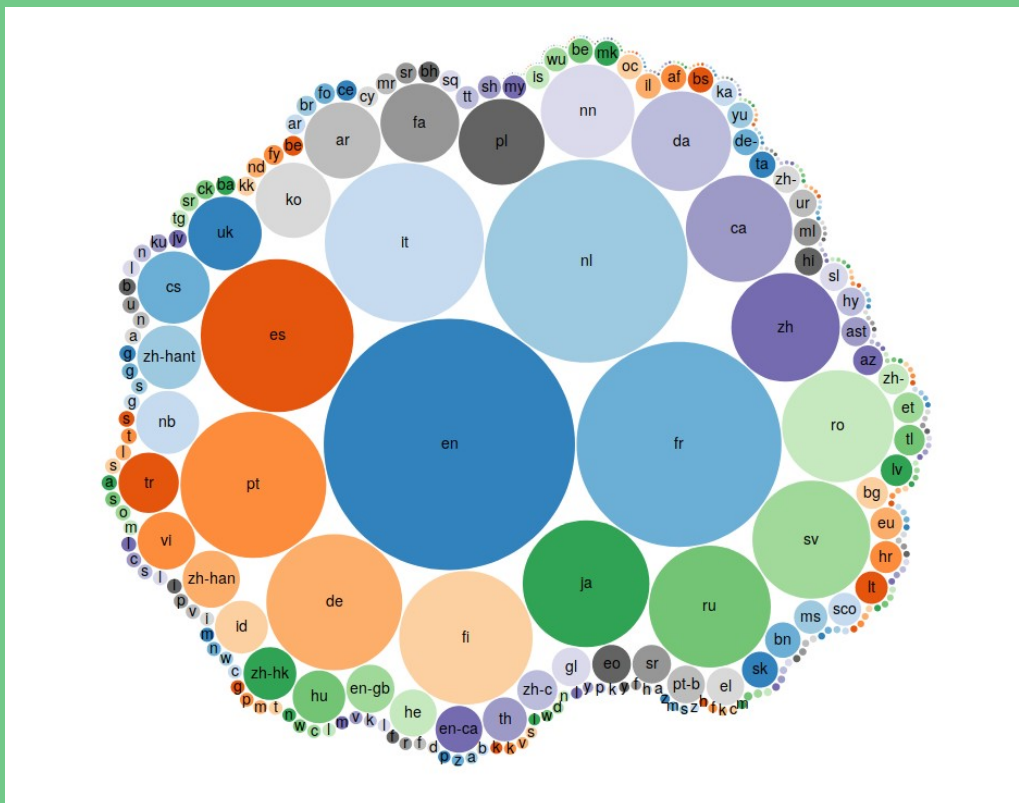
Software



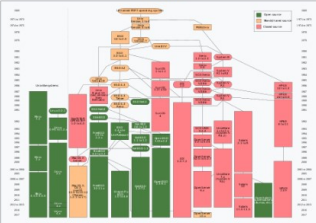
Software with the most number of articles on Wikipedia



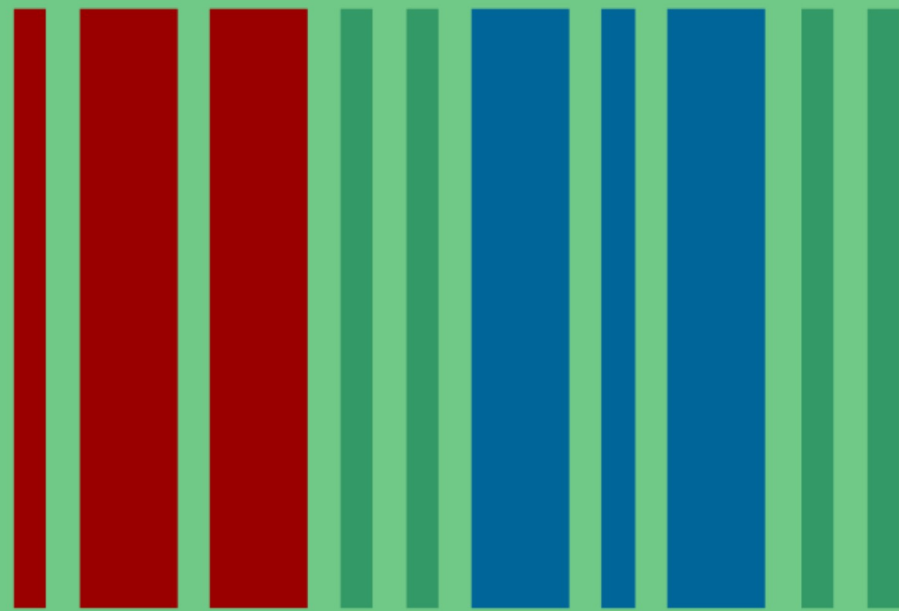
Languages with the most number of articles on Wikipedia



Operating Systems

Unix		Linux	
 Evolution of Unix and Unix-like systems		 Tux the penguin, mascot of Linux^[1]	
Developer	Ken Thompson, Dennis Ritchie, Brian Kernighan, Douglas McIlroy, and Joe Ossanna at Bell Labs	Developer	Community Linus Torvalds
Written in	C and assembly language	Written in	Primarily C and assembly
OS family	Unix	OS family	Unix-like
Working state	Current	Working state	Current
Source model	Historically closed-source, while some Unix projects (including BSD family and illumos) are open-source	Source model	Mainly open-source, proprietary software is also available.
Initial release	Development started in 1969; 49 years ago First manual published internally in November 1971 ^[1] Announced outside Bell Labs in October 1973 ^[2]	Initial release	September 17, 1991; 27 years ago
Available in	English	Marketing target	Personal computers, mobile devices, embedded devices, servers, mainframes, supercomputers
Kernel type	Varies; monolithic, microkernel, hybrid	Available in	Multilingual

English Wikipedia Infoboxes of Operating Systems



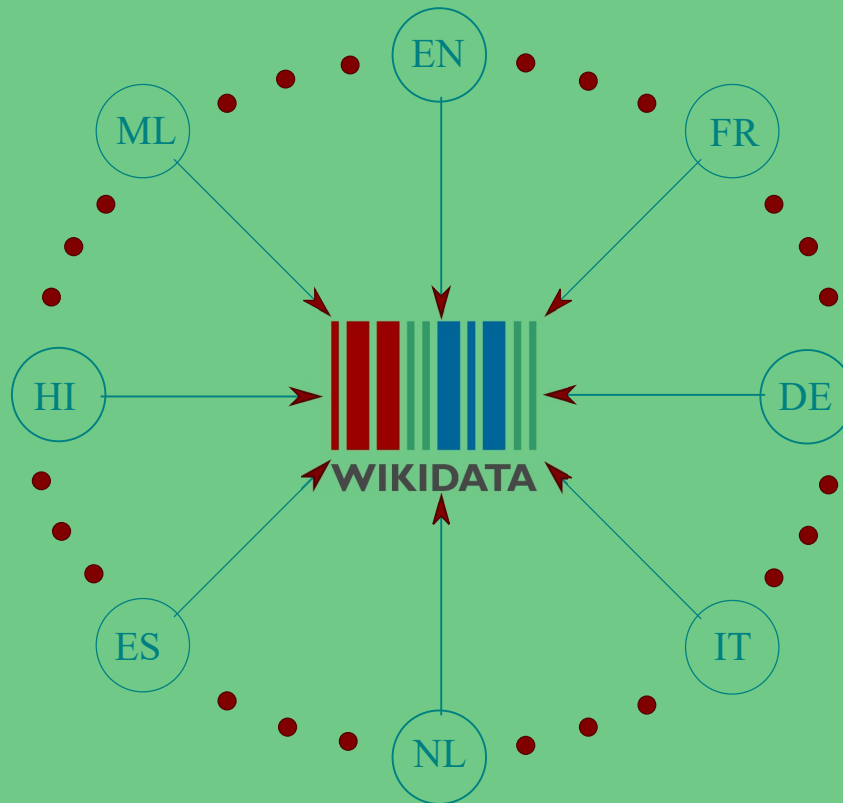
WIKIDATA

- Digital Preservation
 - OPF
 - Software Heritage
 - EaaS



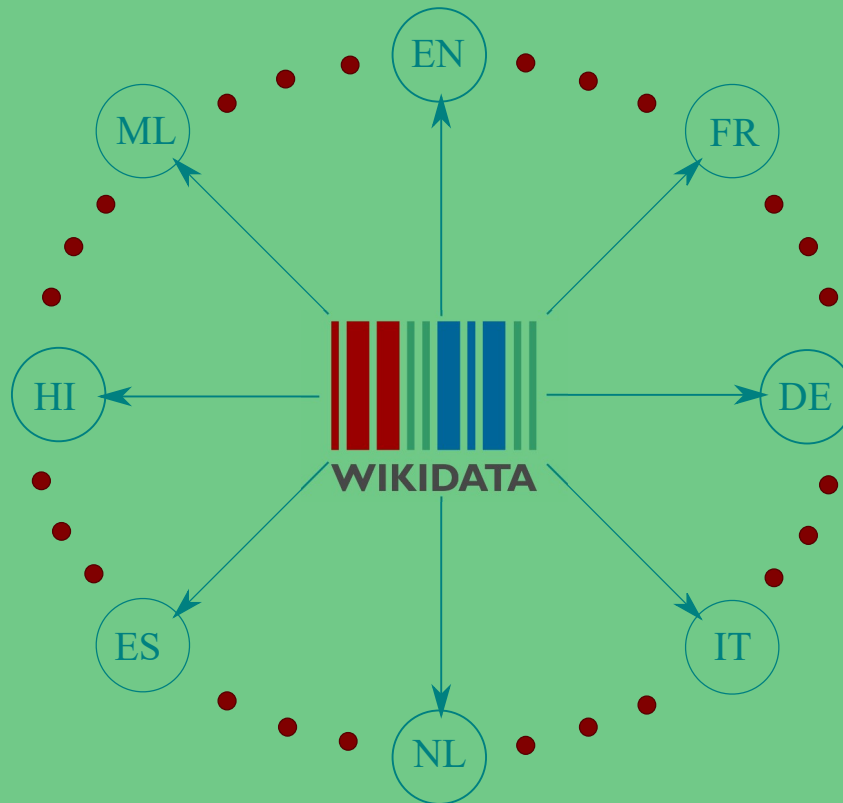
- Wikidata
 - Started in 2012
 - is free, open, linked, structured, collaborative and **multilingual** knowledge base
 - From multi-(sub)domain multilingual Wikipedia sites to a single-domain multilingual website
 - Collaborative Multilingual Multi-domain Ontology development

Wikipedia to Wikidata



Importing structured data from Wikipedia Infoboxes to Wikidata

Wikidata to Wikipedia



Exporting data from Wikidata to multiple multilingual
Wikipedia articles

Wikipedia Infobox Properties

Python		C	
	python™		THE PROGRAMMING LANGUAGE
Paradigm	Object-oriented, imperative, functional, procedural, reflective	Paradigm	Imperative (procedural), structured
Designed by	Guido van Rossum	Designed by	Dennis Ritchie
Developer	Python Software Foundation	Developer	Dennis Ritchie & Bell Labs (creators); ANSI X3J11 (ANSI C); ISO/IEC JTC1/SC22/WG14 (ISO C)
First appeared	1990; 28 years ago ^[1]	First appeared	1972; 46 years ago ^[2]
Stable release	3.7.0 / 27 June 2018; 2 months ago ^[2] 2.7.15 / 1 May 2018; 4 months ago ^[3]	Stable release	C11 / December 2011; 6 years ago
Typing discipline	Duck, dynamic, strong since version 3.5: Gradual ^[4]	Typing discipline	Static, weak, manifest, nominal
License	Python Software Foundation License	OS	Cross-platform
Filename extensions	.py, .pyc, .pyd, .pyo (prior to 3.5), ^[5] .pyw, .pyz (since 3.5) ^[6]	Filename extensions	.c, .h
Website	www.python.org ^[7]		

Existing English Wikipedia Infobox Properties of Programming Languages

Python (Q28865)

general-purpose, high-level programming language  edit

Python language | Python programming language

▼ In more languages Configure

Language	Label	Description	Also known as
English	Python	general-purpose, high-level programming language	Python language Python programming langu...
French	Python	langage de programmation objet, multi-paradigme et multi-plateformes	langage Python langage de programmation ...
Spanish	Python	lenguaje de programación de alto nivel	Python 3.0 Código python Lenguaje python Piton Pitón .py Codigo python Lenguaje de programacion ... URBI Lenguaje de programación ... Python 3 0
German	Python	Programmiersprache	Programmiersprache Python

[All entered languages](#)

Wikidata entry of Python Programming Language (labels)

Wikidata Properties

inception	 20 February 1991 » 3 references
named after	 Monty Python » 2 references
movement	 free software movement ▼ 0 references
publisher	 Core Python Programming ISBN-139789351199427 ▼ 0 references
influenced by	 ALGOL 68 » 1 reference

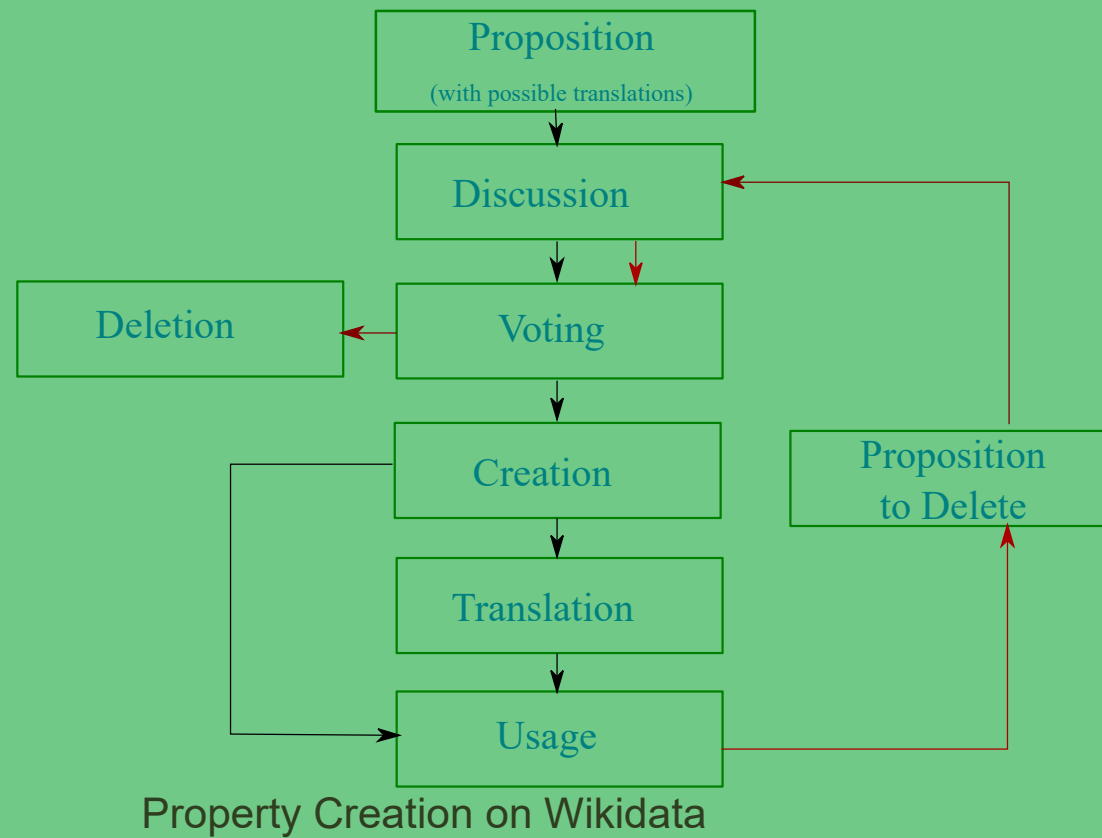
Wikidata entry of Python Programming Language (property values)

Wikidata Properties

country (P17)		
sovereign state of this item; don't use on humans		
sovereign state state land		
▼ In more languages Configure		
Language	Label	Description
English	country	sovereign state of this item; don't use on humans
French	pays	État souverain de cet élément
Spanish	país	estado soberano de este elemento
German	Staat	souveräner Staat, in dem sich das Objekt befindet
All entered languages		
Data type		
Item		

<https://www.wikidata.org/wiki/Property:P17>
Example of Wikidata Property

Wikidata Properties



Wikidata Projects

Wikidata:WikiProject Informatics/Programming Language

[< Wikidata:WikiProject Informatics](#)

The aim of of the **WikiProject Informatics/Programming Language** is to map properties of [Infobox programming language](#) to existing properties of Wikidata and to programming languages can be found [here](#).

Contents [\[hide\]](#)

1 [Key Properties](#)

2 [Additional Properties](#)

3 [External Identifiers](#)

4 [Mapping](#)

5 [Participants](#)

6 [See also](#)

Key Properties [\[edit \]](#)

Title	ID	Data type	Description
image	P18	Commons media file	illustration : image of relevant illustration of the subject; if available, use more specific properties (sample: coat of arms image, locator map, flag image, signature image, logo image, collage image); only images which exist on Wikimedia Commons are acceptable
instance of	P31	Item	instance of and set membership : that class of which this subject is a particular example and member (subject typically an individual member with a proper name label); different from P279 ; using this property as a qualifier is deprecated—use P2868 or P3831 instead
programming paradigm	P3966	Item	programming paradigm : programming paradigm in which a programming language is classified

Example Wikidata WikiProject

Digital Preservation | John Samuel, Katherine Thornton

25 < | >

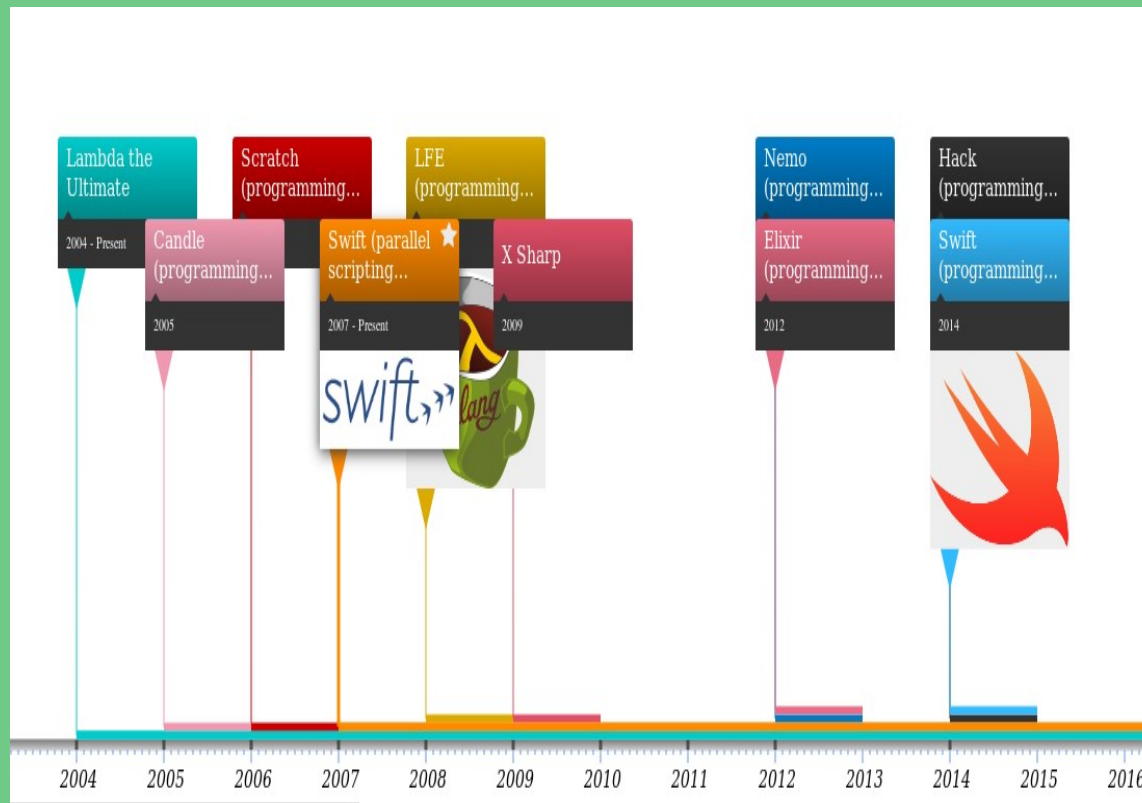
Wikidata Projects

Properties [\[edit \]](#)

Title	ID	Data type	Description
Arch Linux package	P3454	External identifier	name of the official Arch Linux package
based on	P144	Item	based on : the work(s) used as the basis for subject item
based on with qualifier removed feature	P756	Item	software feature : which feature was removed by this version of a product item
binding of software library	P1372	Item	language binding : software library in another programming language provided by the subject software binding
bug tracking system	P1401	URL	bug tracking system : bug report page where bugs, issues, and feature requests are filed for a particular software
creator	P170	Item	creator : maker of this creative work or other object (where no more specific property exists)
Debian stable package	P3442	External identifier	deb : name of the official Debian stable package
depends on software	P1547	Item	subject software depends on object software
developer	P178	Item	organisation or person that developed the item
developer with qualifier instance of	P31	Item	instance of and set membership : when the business model of the developer (P178) of a software is different than the business model of the company considered as a whole, it should be set to an instance of (P31) subclass of (P279) business model (Q815823)
DistroWatch ID	P3112	External identifier	identifier for an operating system at DistroWatch.com

Example Wikidata WikiProject and Property Suggestions

Tools: Histropedia

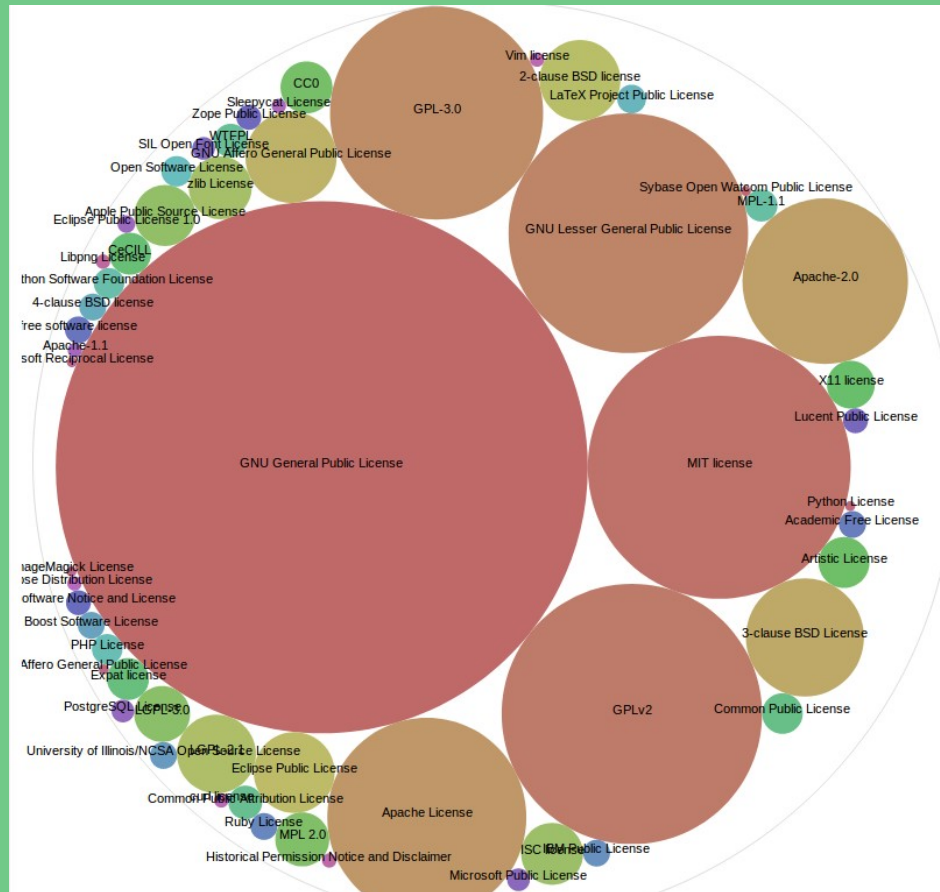


Timeline of Programming Languages

<http://histropedia.com/timeline/d98rtpg9bg0t/Programming-languages>

- Wikidata
 - 85,000
 - desktop applications
 - research software
 - FLOSS

Licenses approved by the Free Software Foundation



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UNIX utilities

item	itemLabel	LCNAF	GND
Q wd:Q283302	grep		7692411-7
Q wd:Q300867	make	n92090404	4334388-0
Q wd:Q1047966	UUCP	n91047280	4303684-3
Q wd:Q305932	yacc		4293012-1
Q wd:Q305876	sed		4262086-7
Q wd:Q2141501	Source Code Control System		4247001-8
Q wd:Q213970	AWK	sh87003812	4242961-4
Q wd:Q214743	vi		4195682-5

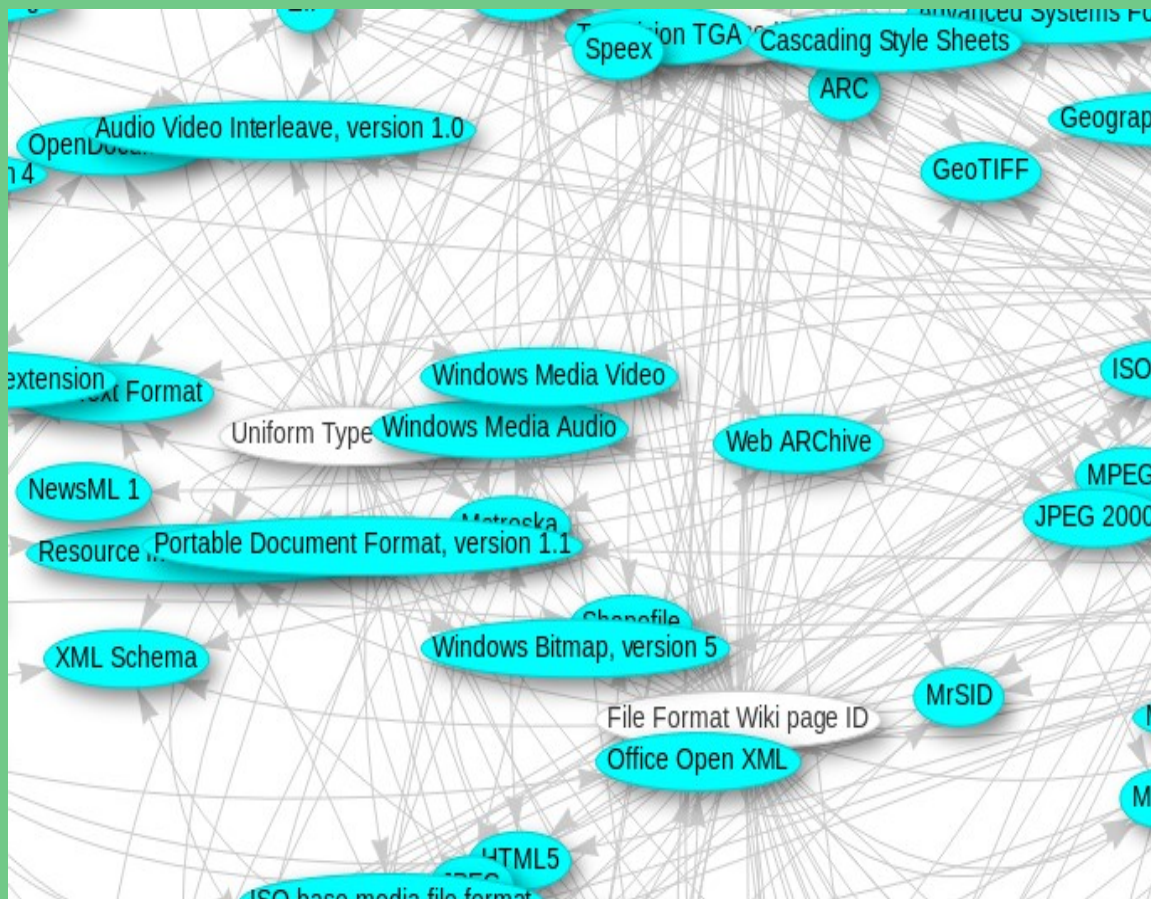
Some unix utilities have their own identifiers in the LoC
Name Authority File or in the GND

Deutsches Forschungsnetz



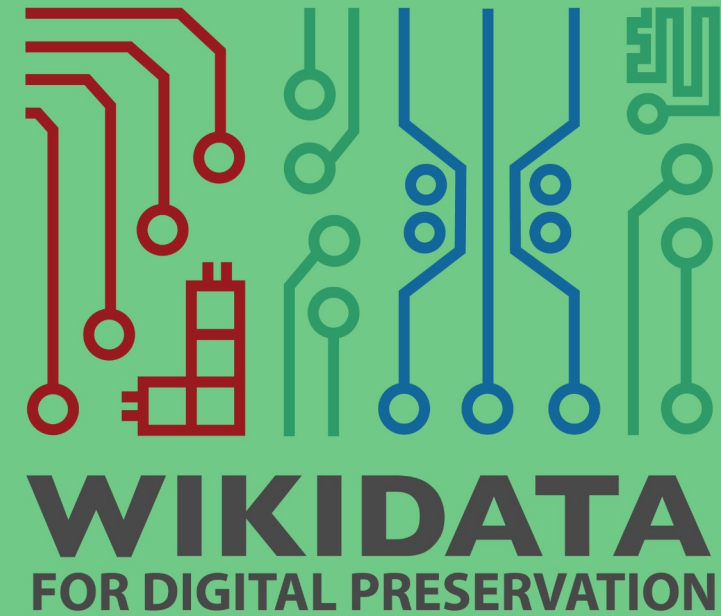
Software developed by members of Deutsches
Forschungsnetz

File format items

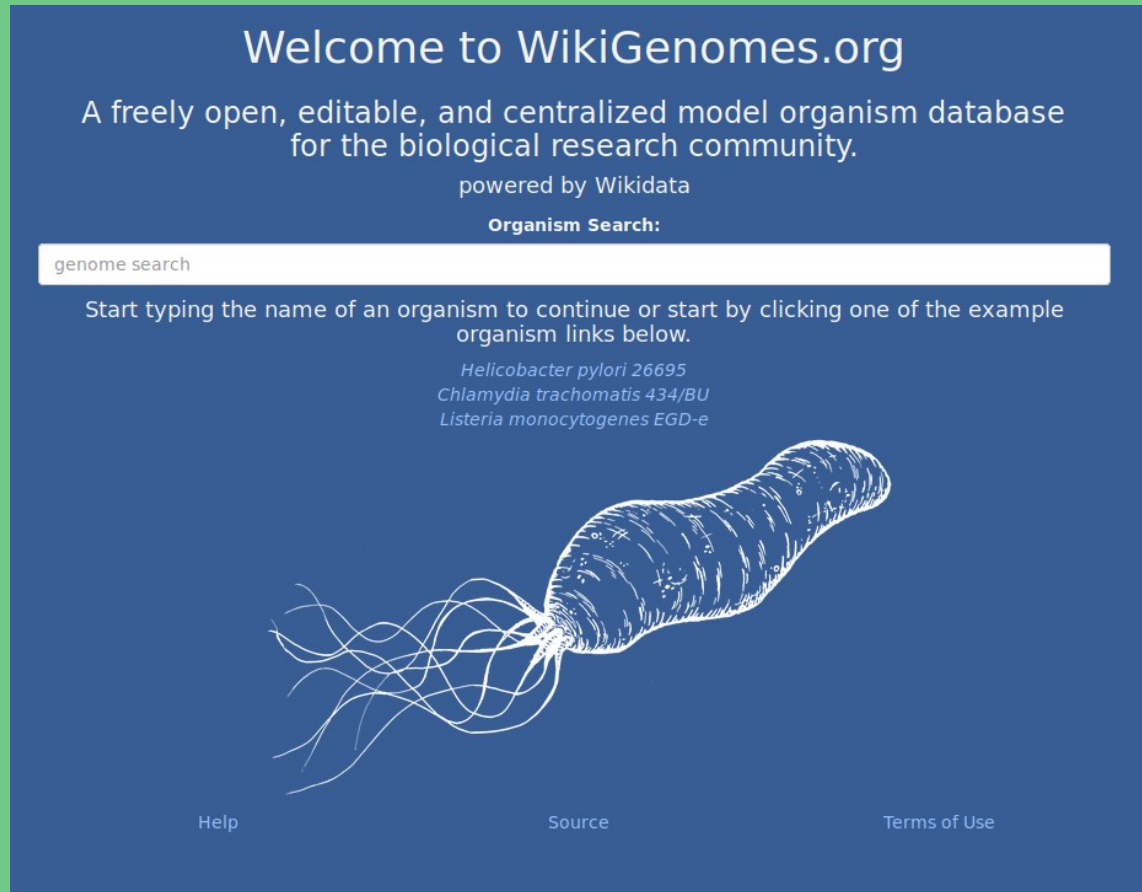


File format items that have a LoC FDD identifier, along with all other identifiers

- Wikidata
 - Inspired by WikiGenomes
 - Streamlined interface
 - Property checklists tailored to digital preservation
 - Specialty searches (PUID, mimetype)



- Development Team
 - Kenneth Seals-Nutt: software engineer
 - Katherine Thornton: Data curation, data models, SPARQL queries
 - Carl Wilson: technical mentor
 - Euan Cochrane: digital preservation program of work



wikigenomes.org

- About **5,000** properties in Wikidata
- Data models are not pre-defined
- Portal has a domain-specific property checklist

Technologies

- Python
- Flask
- SPARQL
- Wikidata Integrator
- MediaWiki API

The screenshot shows the WikiDP.org interface for the item 'Ogg (Q188199)'. The page is divided into several sections:

- Header:** Includes the WikiDP.org logo and navigation links: about, reports, news, support.
- Left Sidebar:** Contains a 'selected item' dropdown showing 'Ogg (Q188199)', a 'property checklist' with various properties (License, Software Version, Official Website, etc.), and 'actions' (explore, preview).
- Main Content Area:**
 - Ogg (Q188199) digital container format:** The main title and description.
 - Current Data About Ogg:** A table showing properties and values.

Property	Value
Instance Of (P31)	file format (Q235557)
Reference Url (P854)	http://www.digitalpreservation.gov/formats/idd/idd000026.shtml
Retrieved (P813)	Friday, October 7, 2016
	digital container format (Q167772)
Reference Url (P854)	https://xiph.org/ogg/
Retrieved (P813)	Friday, October 7, 2016
	multimedia container (Q28379876)
 - Logo Image (P154):** A large image of the Ogg logo.
 - Other Details:** A table showing additional information.

Property	Value
Aliases	.ogg
Description	digital container format
External Links	
File Format Wiki Page Id (P3381)	Ogg
Freebase Id (P646)	/m/05mxd
Locfdd Id (P3266)	idd000026

Screenshot of search results in the WikiDP portal

1. WDPProp:

- Collaborative Multilingual Multi-domain Ontology development: is it possible to achieve a truly multilingual experience?

2. Goals:

- Understanding Wikidata property proposal, creation and translation
- Available templates and their usage
- Providing real-time statistics to (multilingual) contributors

WDPProp

- Languages
- Data types
- Properties
- Property Classes
- Provenance
- Search
- Compare
- Property Discussion
- Wikiprojects
- About

Translation statistics by languages

- [Supported languages](#)
- [Translated Labels](#)
- [Translated Descriptions](#)
- [Translated Alias](#)
- [Overall Translation Statistics](#)
- [Missing Translation Statistics](#)

Navigate properties

- [Browse all properties](#)
- [Browse by datatype](#)

Information on Wikidata Properties

- **WDProp**

- Get real-time translation statistics
- Navigate supported languages, properties, datatypes, classes
- Compare translation statistics
- Find available properties for an entity
- Uses Wikidata SPARQL endpoints and Mediawiki API

- **URL**

- <https://tools.wmflabs.org/wdprop>

- Digital Heritage

- Wikidata: Multilingual, Structured Knowledge Base
- Need for Digital Preservation
- Digital Preservation on Wikidata
- Community participation: Property proposition, translation and item description
- Tools using SPARQL endpoints and/or MediaWiki API

- Tools

- Wikidata SPARQL query endpoint
- MediaWiki API
- Wikidata Integrator
- Histropedia
- wdtaxonomy
- WDProp
- WikiDP
- WikiDP Portal (Github)

- **WikiProjects**
 - WikiProjects
 - WikiProject Informatics
 - WikiProject Informatics/Programming Language
 - WikiProject Informatics/Software/Properties
 - WikiProject Informatics/Operating System

References

1. Kaffee, L. A., Piscopo, A., Vougiouklis, P., Simperl, E., Carr, L., & Pintscher, L. (2017, August). A glimpse into Babel: an analysis of multilinguality in Wikidata. In Proceedings of the 13th International Symposium on Open Collaboration (p. 14). ACM.
2. Müller-Birn, C., Karran, B., Lehmann, J., & Luczak-Rösch, M. (2015, August). Peer-production system or collaborative ontology engineering effort: What is Wikidata?. In Proceedings of the 11th International Symposium on Open Collaboration (p. 20). ACM.
3. Samuel, J. (2017) Collaborative Approach to Developing a Multilingual Ontology: A Case Study of Wikidata. In : Research Conference on Metadata and Semantics Research. Springer, Cham, 2017. p. 167-172.
4. Samuel, J. (2018). Towards Understanding and Improving Multilingual Collaborative Ontology Development in Wikidata. In: WikiWorkshop 2018
5. Thornton, K., Cochrane E., Ledoux T. (2017). Modeling the Domain of Digital Preservation in Wikidata . In: iPRES 2017

Thank you

Questions?

Programming paradigms with the count of programming languages

```
SELECT ?paradigmLabel (count(?prog) as ?count)
{
  ?prog wdt:P31 wd:Q9143;
        wdt:P3966 ?paradigm.
  SERVICE wikibase:label { bd:serviceParam
    wikibase:language "[AUTO_LANGUAGE],en". }
}
GROUP by ?paradigmLabel
HAVING (?count>1)
```

Programming languages with the count of programming paradigm

```
SELECT ?progLabel (count(?paradigm) as ?count)
{
  ?prog wdt:P31 wd:Q9143;
        wdt:P3966 ?paradigm.
  SERVICE wikibase:label { bd:serviceParam
    wikibase:language "[AUTO_LANGUAGE],en". }
}
GROUP by ?progLabel
HAVING (?count>2)
```


Programming languages with the count of multilingual labels

```
SELECT ?languageLabel (count(?label) as ?count) {  
  {  
    SELECT DISTINCT ?languageLabel ?label (lang(?label) as ?langLabel) {  
      ?language wdt:P31/wdt:P279* wd:Q9143;  
      rdfs:label ?label.  
      SERVICE wikibase:label { bd:serviceParam  
        wikibase:language "[AUTO_LANGUAGE],en". }  
    }  
  }  
  
}  
  
GROUP by ?languageLabel  
HAVING (?count > 50)  
ORDER by DESC(?count)
```

Software with the count of multilingual labels

```
SELECT ?softwareLabel (count(?label) as ?count) {  
  {  
    SELECT DISTINCT ?softwareLabel ?label (lang(?label) as ?langLabel) {  
      ?software wdt:P31/wdt:P279 wd:Q7397;  
      rdfs:label ?label.  
      SERVICE wikibase:label { bd:serviceParam  
        wikibase:language "[AUTO_LANGUAGE],en". }  
    }  
  }  
  
}  
  
GROUP by ?softwareLabel  
HAVING (?count > 40)  
ORDER by DESC(?count)
```

Programming language with the count of multilingual labels

```
SELECT ?langLabel (count(?language) as ?count) {  
  {  
    SELECT DISTINCT (lang(?label) as ?langLabel) ?language {  
      ?language wdt:P31/wdt:P279* wd:Q9143;  
      rdfs:label ?label.  
    }  
  }  
}  
GROUP by ?langLabel  
ORDER by DESC(?count)
```

Language with the count of software labels

```
SELECT ?langLabel (count(?software) as ?count) {  
  {  
    SELECT DISTINCT (lang(?label) as ?langLabel) ?software {  
      ?software wdt:P31/wdt:P279* wd:Q7397;  
      rdfs:label ?label.  
    }  
  }  
  
}  
  
GROUP by ?langLabel  
ORDER by DESC(?count)
```

Languages with the count of Wikipedia articles on programming languages

```
SELECT DISTINCT ?languageLabel ?sitelinks {  
  ?language wdt:P31/wdt:P279* wd:Q9143;  
            wikibase:sitelinks ?sitelinks.  
  FILTER(?sitelinks > 20)  
  SERVICE wikibase:label { bd:serviceParam  
    wikibase:language "[AUTO_LANGUAGE],en". }  
}  
ORDER by DESC(?sitelinks)
```

Languages with the count of Wikipedia articles on software

```
SELECT DISTINCT ?softwareLabel ?sitelinks {  
    ?software wdt:P31/wdt:P279* wd:Q7397;  
    wikibase:sitelinks ?sitelinks.  
    FILTER(?sitelinks > 100)  
    SERVICE wikibase:label { bd:serviceParam  
        wikibase:language "[AUTO_LANGUAGE],en". }  
}  
ORDER by DESC(?sitelinks)
```

Languages with the count of Wikipedia articles on programming languages

```
SELECT ?lang (count(?progLanguage) as ?count) {  
  {  
    SELECT DISTINCT ?progLanguage ?lang {  
      ?progLanguage wdt:P31/wdt:P279* wd:Q9143.  
      [] schema:about ?progLanguage;  
        schema:inLanguage ?lang.  
    }  
  }  
}  
GROUP BY ?lang  
ORDER BY DESC(?count)
```

Languages with the count of Wikipedia articles on Software

```
SELECT ?lang (count(?software) as ?count) {  
  {  
    SELECT DISTINCT ?software ?lang {  
      ?software wdt:P31/wdt:P279* wd:Q7397.  
      [] schema:about ?software;  
          schema:inLanguage ?lang.  
    }  
  }  
}  
GROUP BY ?lang  
ORDER BY DESC(?count)
```


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```
SELECT ?item ?itemLabel (COUNT(DISTINCT ?software) AS ?count) WHERE {  
  ?software (wdt:P31/wdt:P279*) wd:Q7397.  
  ?software wdt:P275 ?item.  
  ?item wdt:P790 wd:Q48413.  
  SERVICE wikibase:label { bd:serviceParam  
    wikibase:language "[AUTO_LANGUAGE],en". }  
}  
GROUP BY ?item ?itemLabel  
ORDER BY DESC(?count)
```

UNIX utilities with identifiers in the LoC Name Authority File or in the GND

```
SELECT ?item ?itemLabel ?LCNAF ?GND
WHERE
{
  ?item wdt:P31 wd:Q18343316.
  OPTIONAL {?item wdt:P244 ?LCNAF}.
  OPTIONAL {?item wdt:P227 ?GND}.
  SERVICE wikibase:label { bd:serviceParam
    wikibase:language "[AUTO_LANGUAGE],en". }
}
```

Software developed by members of Deutsches Forschungsnetz

```
SELECT ?member ?memberLabel ?software ?softwareLabel WHERE {  
  ?member wdt:P463 wd:Q2514863.  
  ?software wdt:P178 ?member.  
  SERVICE wikibase:label { bd:serviceParam  
    wikibase:language "[AUTO_LANGUAGE],en". }  
}
```