

Building Knowledge Panels on the Cheap

Nathan Wiegand

Work by: Sizhu Cheng, Max Allen, and Brandon Chong





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Apple AirPods Pro

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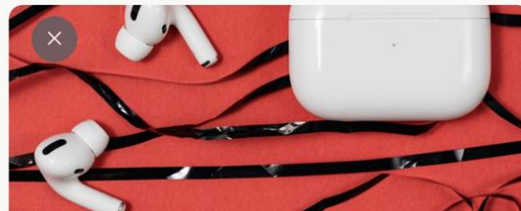
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SONY

"Sony's headph..."

\$348

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\$199⁹⁹

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Albert Einstein

Theoretical physicist



Albert Einstein was a German-born theoretical physicist, widely acknowledged to be one of the greatest physicists of all time. Einstein is known for developing the theory of relativity, but he also made important contributions to the development of the theory of quantum mechanics. [Wikipedia](#)

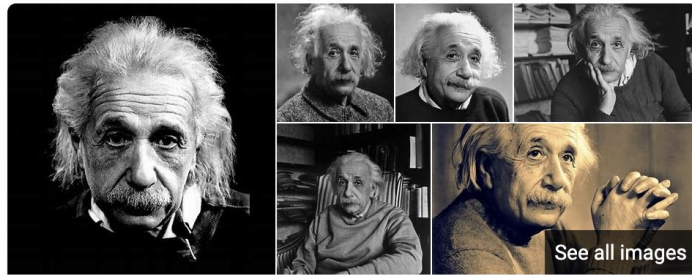
Born: March 14, 1879, Ulm, Germany

Died: April 18, 1955, [Penn Medicine Princeton Medical Center, NJ](#)

Children: [Eduard Einstein](#), [Hans Albert Einstein](#), [Lieserl Einstein](#)

Spouse: [Elsa Einstein](#) (m. 1919–1936), [Mileva Marić](#) (m. 1903–1919)

Education: [University of Zurich](#) (1905), [ETH Zürich](#) (1896–1900), [MORE](#)



Albert Einstein

Theoretical Physicist

Albert Einstein was a German-born theoretical physicist, widely acknowledged to be one of the greatest physicists of all time. Einstein is known for developing the theory of relativity, but he also made important contributions to the development of the theory of quantum mechanics. Relativity and quantum mechanics are together the two pillars of mod... +



[Wikipedia](#)



[Official site](#)

Lived: Mar 14, 1879 - Apr 18, 1955 (age 76)

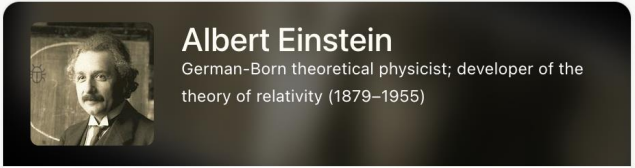
Height: 5 feet 9 inches

Spouse: [Elsa Einstein](#) (m. 1919 - 1936) · [Mileva Marić](#) (m. 1903 - 1919)

Education: [University of Zurich](#) · [Aargau Cantonal School](#) (1895 - 1896) · [ETH Zurich](#) · [Luitpold Gymnasium](#)

Siblings: [Maja Einstein](#) (Sister)

Awards: [Nobel Prize](#) (1) · [Max Planck Medal](#) (1) · [Matteucci Medal](#) (1) · [Other awards](#) (3)



Albert Einstein

German-Born theoretical physicist; developer of the theory of relativity (1879–1955)

Albert Einstein was a German-born theoretical physicist, widely acknowledged to be one of the greatest physicists of all time. Einstein is known for developing the theory of relativity, but he also made important contributions to the development of the theory of quantum mechanics. Relativity and quantum mechanics are together the two pillars of modern physics...

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Spouse	Elsa Einstein (1919–1936) · Mileva Marić (1903–1919)
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Parents	Hermann Einstein · Pauline Koch
Notable work	Special Relativity · General Relativity · Photoelectric Effect · More Notable work



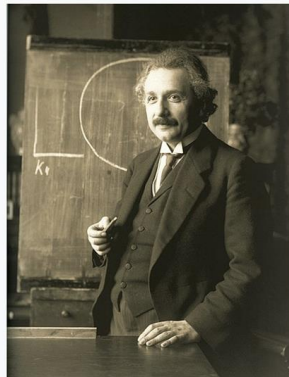
Where to get the Data?



Wikipedia

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| caption             = Einstein in 1921
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* [[Hans Albert Einstein]]
* [[Einstein family#Eduard "Tete" Einstein (Albert's second son)|Eduard "Tete" Einstein]]}
| spouse              = {{plainlist|
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* [[Switzerland]] (1901–1955)
* [[Cisleithania|Austria]], part of the [[Austro-Hungarian Empire]] (1911–1912)
* [[Kingdom of Prussia]], part of the German Empire (1914–1918)<ref group="note" name="GEcitizen" />
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* [[United States]] (1940–1955)
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| workplaces          = {{plainlist|
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* [[University of Bern]] (1908–1909)
* [[University of Zurich]] (1909–1911)
* [[Karl-Ferdinands-Universität|Charles University in Prague]] (1911–1912)
* [[ETH Zurich]] (1912–1914)
* [[Prussian Academy of Sciences]] (1914–1933)
* [[Humboldt University of Berlin]] (1914–1933)
* [[Kaiser Wilhelm Institute]] (director, 1917–1933)
* [[German Physical Society]] (president, 1916–1918)
* [[Leiden University]] (visits, 1920)
* [[Institute for Advanced Study]] (1933–1955)
* [[Caltech]] (visits, 1931–1933)
* [[University of Oxford]] (visits, 1931–1933)
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```

Albert Einstein

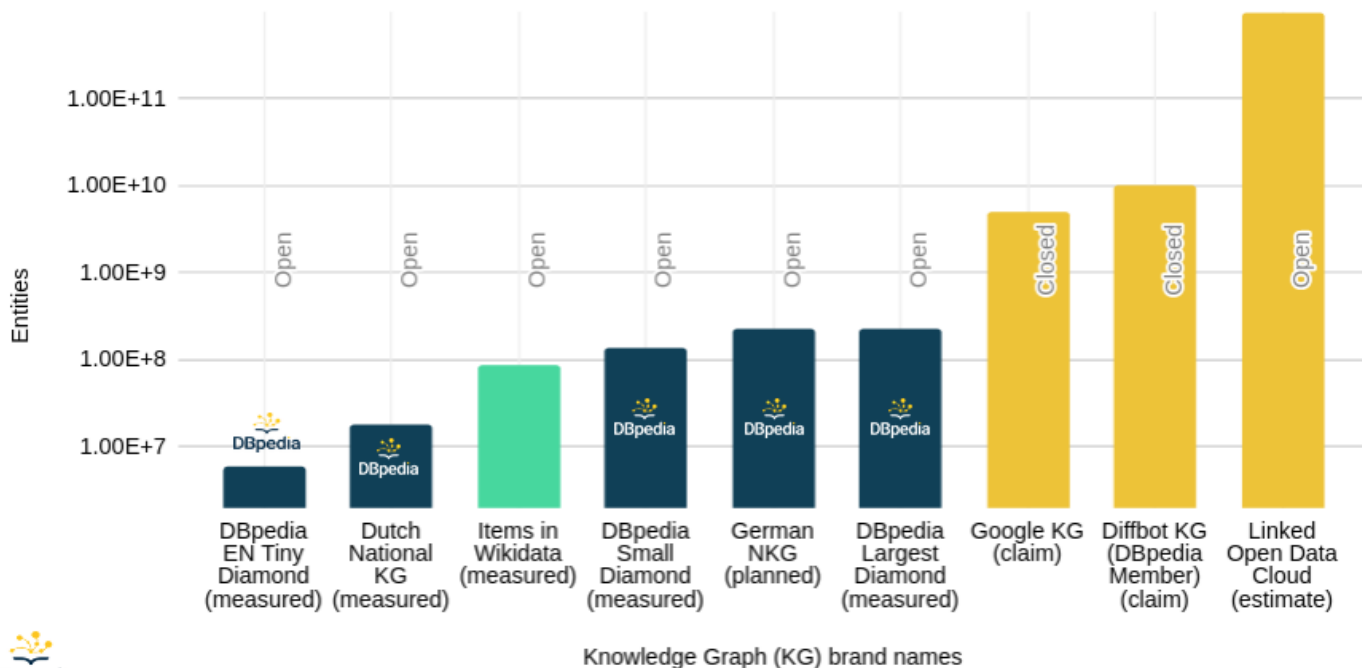


Einstein in 1921

Born	14 March 1879 <div>Ulm, Kingdom of Württemberg, German Empire</div>
Died	18 April 1955 (aged 76) <div>Princeton, New Jersey, U.S.</div>
Citizenship	<div>Kingdom of Württemberg, part of the German Empire (1879–1896)^[note 1]</div> <div>Stateless (1896–1901)</div> <div>Switzerland (1901–1955)</div> <div>Austria, part of the Austro-Hungarian Empire (1911–1912)</div> <div>Kingdom of Prussia, part of the German Empire (1914–1918)^[note 1]</div> <div>Free State of Prussia (Weimar Republic, 1918–1933)</div> <div>United States (1940–1955)</div>
Education	<div>Federal polytechnic school in Zurich (Federal teaching diploma, 1900)</div> <div>University of Zurich (PhD, 1905)</div>

DBpedia

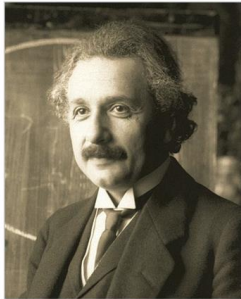
Sep 2020: Current entity size of selected KGs (open and closed), log-scale



Wikidata

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image



Einstein1921 by F Schmutzer 2.jpg
1,182 × 1,475; 392 KB

1 reference

sex or gender

male

6 references

country of citizenship

German Empire

start time

14 March 1879

Gregorian

end time

28 January 1896

Gregorian

3 references

no value

start time

28 January 1896

Gregorian

end time

21 February 1901

Gregorian

1 reference

Switzerland

start time

21 February 1901

Gregorian

end time

18 April 1955

0 references

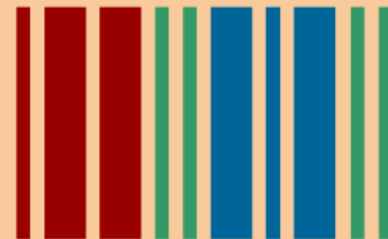
Where to get the Data?



WIKIPEDIA
The Free Encyclopedia

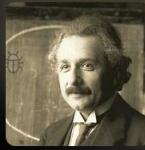


DBpedia



WIKIDATA

Wikipedia



Albert Einstein

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Requirements

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- P1: Concise summaries
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- P2: Real time updates
- P2: Complex categorical pivots (e.g. List of notable people from some city)

Achieving Low Latency

- Build vs Serve
 - flatten as much of the entity into intermediate form in build time
 - do last minute formatting (e.g. unit conversion) at serve
- Serve from KV Store
 - we use Scylla
 - key by wikipedia url
 - value is our own intermediate representation

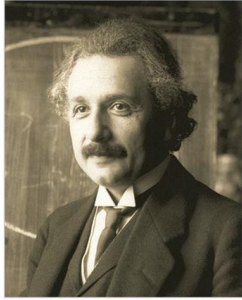
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- P2: Complex categorical pivots (e.g. List of notable people from some city)

Wikidata

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              "datavalue": {
```

image



Einstein1921 by F Schmutzer 2.jpg
1,182 × 1,475; 392 KB

1 reference

sex or gender

male

6 references

country of citizenship

German Empire

start time 14 March 1879 *Gregorian*
end time 28 January 1896 *Gregorian*

3 references

no value

start time 28 January 1896 *Gregorian*
end time 21 February 1901 *Gregorian*

1 reference

Switzerland

start time 21 February 1901 *Gregorian*
end time 18 April 1955

0 references

```
- !!python/tuple
- Human
  name: Human
  predicates:
    - Obj: Q5          # human
      Pred: P31        # instance of
  rules:
    - Pred: P569       # date of birth
      Shape: Singleton
      field: Born
    - Pred: P570       # date of death
      Shape: Singleton
      field: Died
    - Pred: P26        # spouses
      Shape: List
      field: Spouse
    - Pred: P40        # children
      Shape: List
      field: Children
    - Pred: P800       # notable works
      Shape: List
      field: Notable work
    - Pred: P69        # educated at
      Shape: List
      field: Education
  ...
```

```
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      "title": "Q937",
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      "labels": {
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          "value": "Albert Einstein"
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          "value": "German-born theoretical physicist; developer of"
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}
```



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- !!python/tuple
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  name: Human
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      Shape: Singleton
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      Shape: Singleton
      field: Died
    - Pred: P26        # spouses
      Shape: List
      field: Spouse
    - Pred: P40        # children
      Shape: List
      field: Children
    - Pred: P800       # notable works
      Shape: List
      field: Notable work
```

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Parents	Hermann Einstein · Pauline Koch
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Generate Expansions

Name

Predicate +

Fields


Founded	Field Predicate (options)	P571	Instance constraint (o)	Singleton ▼ + -
Developers	Field Predicate (options)	P178	Instance constraint (o)	List ▼ + -
Programming Language	Field Predicate (options)	P277	Instance constraint (o)	List ▼ + -
Copyright License	Field Predicate (options)	P275	Instance constraint (o)	Singleton ▼ + -

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[Business](#)
[Enterprise](#)
[Website](#)
[City](#)
[Fictional Human](#)
[Town of the US](#)
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freely editable world geographic database

OSM | Open Street Map | openstreetmap.org

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Language	Label	Description	Also known as
English	OpenStreetMap	freely editable world geographic database	OSM Open Street Map openstreetmap.org

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Matching rules: [Free Software](#) · [Organization](#)

Q936

[OpenStreetMap](#)

freely editable world geographic database

Founded [FactValue(is_entity=False, property_id=2004', url=None)]
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Programming Language FactValue(is_entity=False, property_id=, url=None), FactValue(is_entity=True, p text='Ruby', url='https://en.wikipedia.org/wiki/Ruby [FactValue(is_entity=True, property_id= Database License', url='https://en.wikipedia.org/wiki/Open FactValue(is_entity=False, property_id= url=None)]

Copyright License



California

State of the United States of America



California is a state in the Western United States. With over 39.5 million residents across a total area of approximately 163,696 square miles, it is the most populous and the third-largest U.S. state by area. It is also the most populated subnational entity in North America and the 34th most populous in the world. The...

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- [Official Website](#)

Founded	September 09, 1850
Population	39,250,017 (2016)
Area	163,696 mi ²
Governor	Gavin Newsom (Since 2019)
Capital	Sacramento
Senator	Dianne Feinstein · Alex Padilla

Dianne Feinstein

position held



United States senator



edit

parliamentary term

117th United States Congress

electoral district

California Class 1 senate seat

parliamentary group

Democratic Party

start time

3 January 2021

elected in

2018 United States Senate election
in California

California Class 1 senate seat

located in the administrative
territorial entity



California



edit

▼ 0 references



add reference

- EdgePath:

- P39 # position held
- Q4416090 # United States senator
- P768(q) # electoral district
- P131 # in the administrative territorial entity

IsInstance: Q5 # Human

Shape: Invert

field: Senator

Requirements

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Getting pretty pictures



wd:Q134773 wdt:P18 ?pic



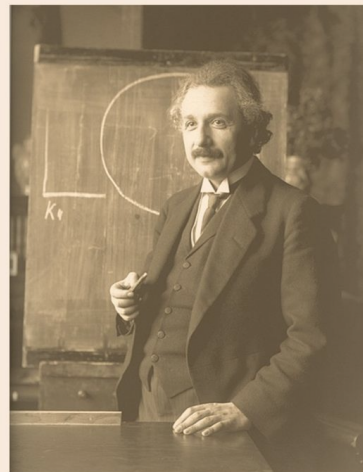
en.wikipedia.org/wiki/Forrest_Gump

Getting pretty pictures

Albert Einstein (/ˈaɪnʃtaɪn/ *AYNstayn*; EYEN-styne; albɛɛt German: [ˈalbɛʁt ˈʔaɪnʃtaɪn] ⓘ listen); 14 March 1879 – 18 April 1955) was a German-born **theoretical physicist**,^[5] widely acknowledged to be one of the greatest physicists of all time. Einstein is known for developing the **theory of relativity**, but he also made important contributions to the development of the theory of **quantum mechanics**. Relativity and quantum mechanics are together the two pillars of **modern physics**.^{[3][6]} His **mass–energy equivalence** formula ***E* = *mc*²**, which arises from relativity theory, has been dubbed "the world's most famous equation".^[7] His work is also known for its influence on the **philosophy of science**.^{[8][9]} He received the 1921 **Nobel Prize in Physics** "for his services to theoretical physics, and especially for his discovery of the law of the **photoelectric effect**",^[10] a pivotal step in the development of quantum theory. His intellectual achievements and originality resulted in "Einstein" becoming **synonymous** with "genius".^[11]

In 1905, a year sometimes described as his *annus mirabilis* ('miracle year'), Einstein published **four groundbreaking papers**.^[12] These outlined the theory of the photoelectric effect, explained **Brownian motion**, introduced **special relativity**, and demonstrated mass-energy equivalence.

Albert Einstein



Einstein in 1921

Born	14 March 1879 Ulm, Kingdom of Württemberg, German Empire
Died	18 April 1955 (aged 76) Princeton, New Jersey, U.S.
Citizenship	Kingdom of Württemberg, part of the German Empire (1879–1896) ^[note 1] Stateless (1896–1901)

Requirements

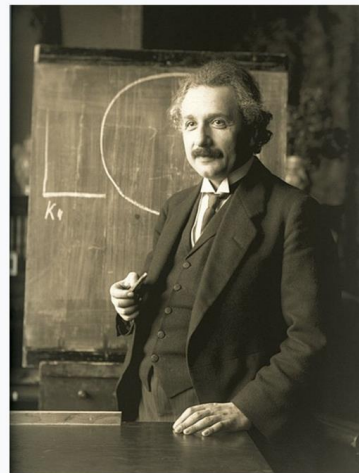
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Getting concise summaries

Albert Einstein (/ˈaɪnˌstaɪn/ *EYEN-styne*;^[4] German: [ˈalbɛʁt ˈʔaɪnʃtaɪn] (ⓘ) listen); 14 March 1879 – 18 April 1955) was a German-born **theoretical physicist**,^[5] widely acknowledged to be one of the greatest physicists of all time. Einstein is known for developing the **theory of relativity**, but he also made important contributions to the development of the theory of **quantum mechanics**. Relativity and quantum mechanics are together the two pillars of **modern physics**.^{[3][6]} His **mass–energy equivalence** formula $E = mc^2$, which arises from relativity theory, has been dubbed "the world's most famous equation".^[7] His work is also known for its influence on the **philosophy of science**.^{[8][9]} He received the 1921 **Nobel Prize in Physics** "for his services to theoretical physics, and especially for his discovery of the law of the **photoelectric effect**",^[10] a pivotal step in the development of quantum theory. His intellectual achievements and originality resulted in "Einstein" becoming **synonymous** with "genius".^[11]

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Albert Einstein



Einstein in 1921

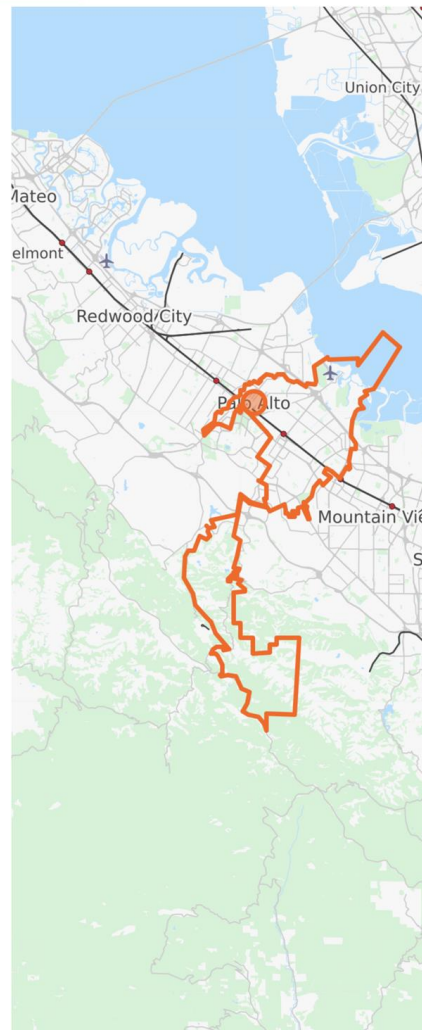
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Maps on Entities

name:hi	पॅलो अल्तो
name:ja	パロアルト
name:ko	팔로앨토
name:lv	Paloalto
name:nv	Tsin Łichí'ínééz
name:ru	Пало-Альто
name:sr	Пало Алто
name:uk	Пало-Альто
name:ur	منیپالٹو
name:uz	Palo-Alto
name:zh	帕羅奧圖
name:zh-Hans	帕罗奥图
name:zh-Hant	帕羅奧圖
place	city
population	64403
population:date	2010
source	TIGER/Line© 2009 Place Shapefiles (http://www.census.gov/geo/www/tiger/) josm simplified to 0.023
type	boundary
website	https://www.cityofpaloalto.org/
wikidata	Q47265
wikipedia	en:Palo Alto, California



Requirements

- P0: Low latency at serve time
- P0: Customizable templates(weight matters for boxers and football players)
- P1: Pretty pictures
- P1: Concise summaries
- P1: Maps for Cities/States
- P2: Real time updates
- P2: Complex categorical pivots (e.g. List of notable people from some city)



albert einstein



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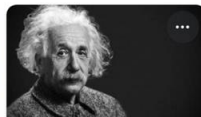
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Albert Einstein - HISTORY

Albert Einstein, the German-born Nobel prize-winning physicist, became an outspoken civil rights advocate after immigrating to the United States in the 1930s to...

Einstein's Early Life

Born on March 14, 1879, in the southern German city of Ulm, Albert Einstein grew up in a middle-class Jewish family in Munich. As a child, Einstein became fascinated by music (he played the violin), mathematics and science. He dropped out of school in 1894 and moved to Switzerland, where he resumed his schooling and later gained...



Albert Einstein

German-Born theoretical physicist; developer of the theory of relativity (1879–1955)

Albert Einstein was a German-born theoretical physicist, widely acknowledged to be one of the greatest physicists of all time. Einstein is known for developing the theory of relativity, but he also made important contributions to the development of the theory of quantum mechanics. Relativity and quantum mechanics are together the two pillars of modern physics...

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Born	March 14, 1879
Died	April 18, 1955
Spouse	Elsa Einstein (1919-1936) · Mileva Marić (1903-1919)
Children	Hans Albert Einstein · Eduard Einstein · Lieserl (Einstein)
Parents	Hermann Einstein · Pauline Koch
Notable work	Special Relativity · General Relativity · Photoelectric Effect · More Notable work
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Summary

- Shift work from serve time to build time
 - Used PySpark for build processing over Wikidata JSON dumps
- Build scrappy tools for defining presentation layer
 - Defined a simple DSL for representing the transforms
 - Complex transforms (inversions) require preprocessing
 - Built a WYSIWYG editor for defining tools to minimize effort in adding rules
- Serve super fast
 - Used Scylla for key/value lookup by wikipedia URL
 - Transform the intermediate representation last minute using locale and device info
- Fill in gaps with other datasets
 - Wikipedia for thumbnails and summaries
 - OpenStreetMaps for political boundaries

Reach out

- Email me: nathan@neeva.co
- Sign up: <https://neeva.com>

