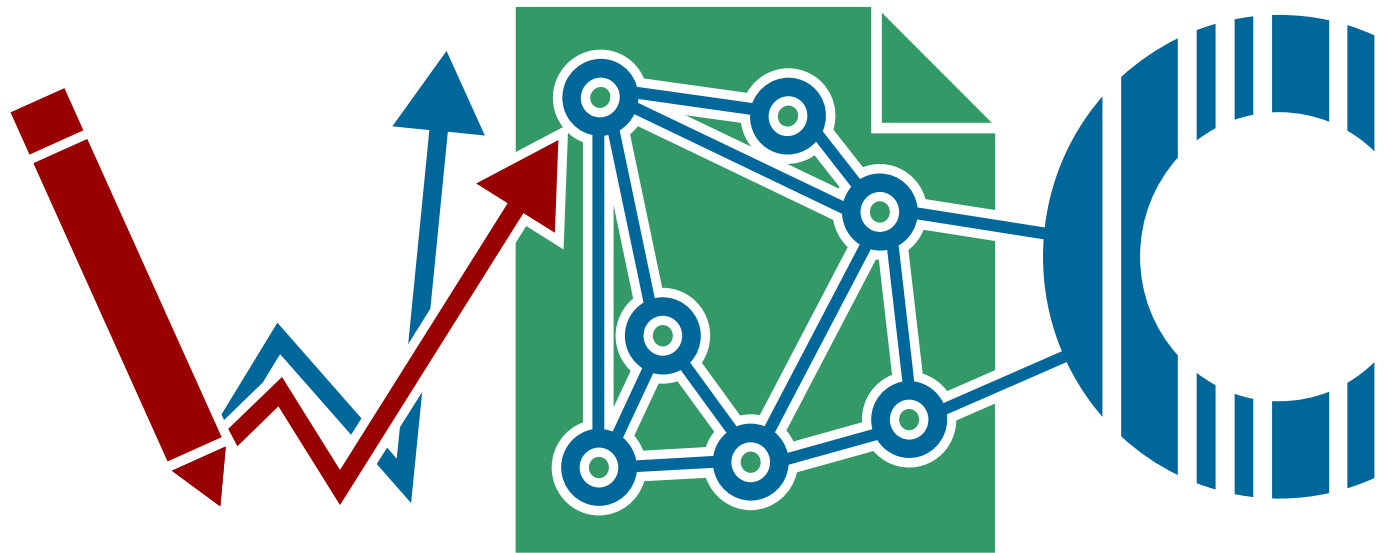


# Wikidata fact annotation for Wikipedia across languages





**WIKI DATA CON**

**Wikidata  
& languages**

**2019**

# Wikidata fact annotation for Wikipedia across languages

Michael Ringgaard & Anders Sandholm (me)  
{ringgaard, sandholm}@google.com

# Wikidata fact annotation for Wikipedia across languages

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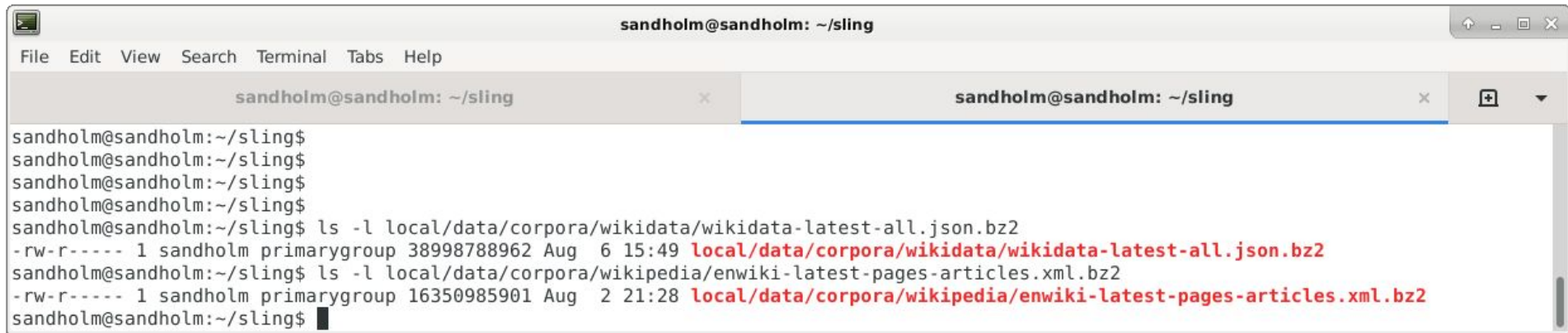


[The SLING Project](#) | [Fully Open Source](#) | [Using Wikidata](#)

 [github.com/google/sling](https://github.com/google/sling) ▾

**SLING** - A natural language parser. Read and understand Wikipedia across many languages.

# In the beginning...

A terminal window titled 'sandholm@sandholm: ~/sling' with a menu bar (File, Edit, View, Search, Terminal, Tabs, Help) and two tabs. The terminal shows the following commands and output:

```
sandholm@sandholm:~/sling$  
sandholm@sandholm:~/sling$  
sandholm@sandholm:~/sling$  
sandholm@sandholm:~/sling$  
sandholm@sandholm:~/sling$ ls -l local/data/corpora/wikidata/wikidata-latest-all.json.bz2  
-rw-r----- 1 sandholm primarygroup 38998788962 Aug  6 15:49 local/data/corpora/wikidata/wikidata-latest-all.json.bz2  
sandholm@sandholm:~/sling$ ls -l local/data/corpora/wikipedia/enwiki-latest-pages-articles.xml.bz2  
-rw-r----- 1 sandholm primarygroup 16350985901 Aug  2 21:28 local/data/corpora/wikipedia/enwiki-latest-pages-articles.xml.bz2  
sandholm@sandholm:~/sling$
```

...there were two files

- Can we dramatically **improve natural language understanding** (which is generally considered really hard) **just using Wikipedia and Wikidata?**



# Deep Learning has shown great potential

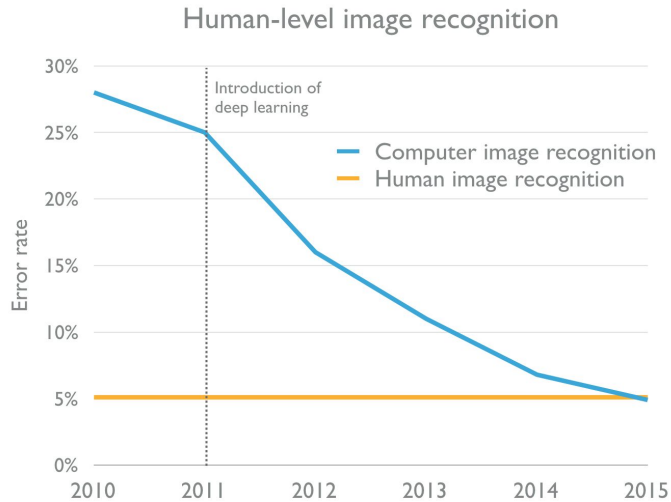


Figure 9

**Computers already perform as well as or better than humans in some specific image recognition tests**

# Natural language understanding remains a real challenge, though

A screenshot of a chatbot interface for Expedia. The chatbot's messages are in light grey bubbles, and the user's messages are in blue bubbles. The chatbot asks for check-in and check-out dates, the user provides "11/17 - 11/23", the chatbot responds that no hotels are available and offers to start a new search or provide customer care. The user then says "Actually, I want to stay in antarctica" and the chatbot responds "No dates yet".

Expedia  
Got it! When will you be checking in and out? For example, 11/17 - 11/23.

Actually, I want to stay in antarctica

No dates yet

Sorry, there are no hotels available for the dates you've requested. Would you like to start a new search?

[Start A New Search](#)

[Customer Care](#) 🗣️



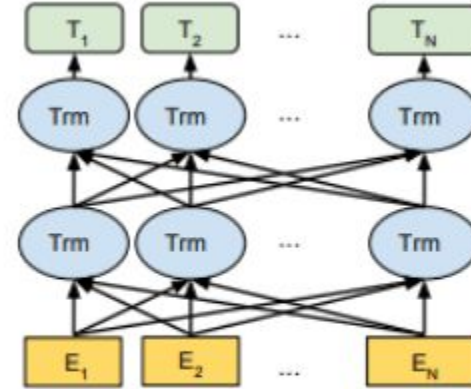
Most NLU/  
NLP work  
focuses on  
the text and  
on having a  
lot of it

## Open Sourcing BERT: State-of-the-Art Pre-training for Natural Language Processing

Friday, November 2, 2018

Posted by Jacob Devlin and Ming-Wei Chang, Research Scientists, Google AI Language

One of the biggest challenges in [natural language processing](#) (NLP) is the shortage of training data. Because NLP is a diversified field with many distinct tasks, most task-specific datasets contain only a few thousand or a few hundred thousand human-labeled training examples. However, modern deep learning-based NLP models see benefits from much larger amounts of data, improving when trained on millions, or *billions*, of annotated training examples. To help close this gap in data, researchers have developed a variety of techniques for training general purpose language representation models using the enormous amount of unannotated text on the web (known as *pre-training*). The pre-trained model can then be *fine-tuned* on small-data NLP tasks like [question answering](#) and [sentiment analysis](#), resulting in substantial accuracy improvements compared to training on these datasets from scratch.



BERT Architecture



# Why is NLP so hard?

- Knowledge of the world is needed in order to understand natural language

# Why is NLP so hard?

- Knowledge of the world is needed in order to understand natural language



# Alternative: Understand text in the context of existing knowledge

- Seems closer to how humans understand and interact
- When you mention Angela Merkel, my internal representation of Q567 lights up...
- We believe Wikidata is a key component in unlocking better natural language understanding

# Alternative: Understand text in the context of existing knowledge



- Seems closer to how humans understand and interact
- When you mention Angela Merkel, my internal representation of Q567 lights up...
- We believe Wikidata is a key component in unlocking better natural language understanding

# How? Wikidata -> better NLP

Parse Wiki files and  
extract gold  
annotations

Generate silver  
annotations

Supervised  
learning on  
silver data

Train  
plausibility  
model

Reinforcement  
learning with  
plausibility

# How? Wikidata -> better NLP

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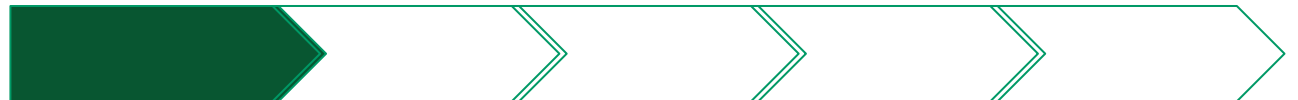
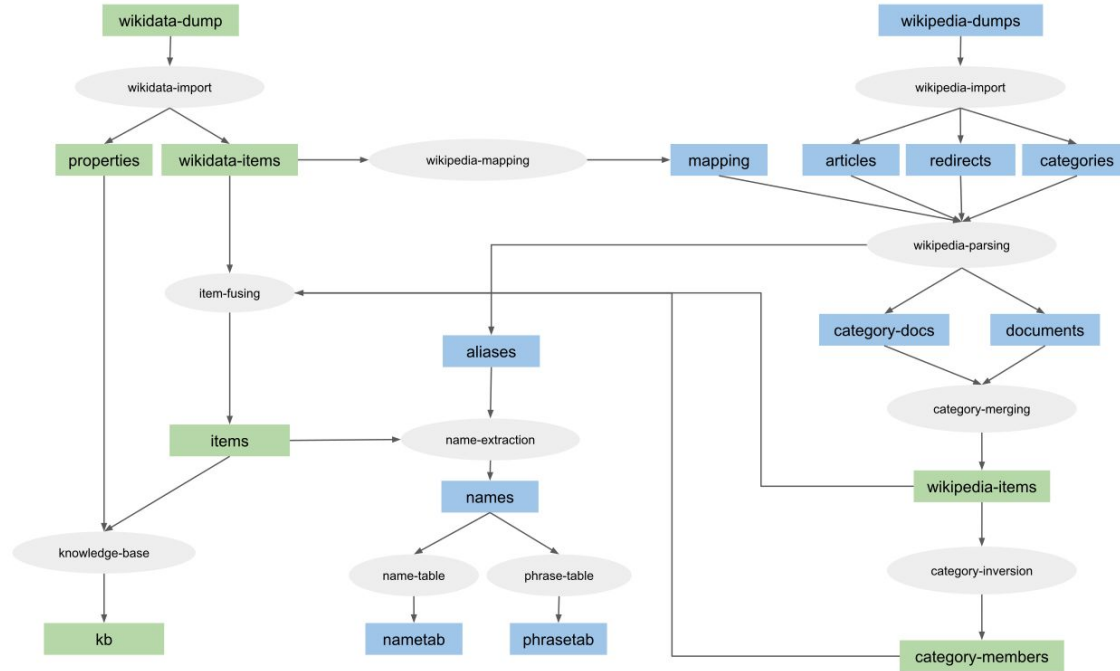
Parse Wikipedia and  
Wikidata dump files.

Represent contents  
efficiently in memory.

Extract gold  
annotations from  
Wikipedia articles via  
links.



# Parse and process Wiki files



# Extract gold annotations

The screenshot shows the Wikipedia page for Angela Merkel. A yellow box with the CDU logo is overlaid on the text. A red box highlights the URL [https://en.wikipedia.org/wiki/Christian\\_Democratic\\_Union\\_of\\_Germany](https://en.wikipedia.org/wiki/Christian_Democratic_Union_of_Germany) in the text. The article text includes: "Merkel" redirects here. For other uses, see Merkel (disambiguation). Angela Dorothea Merkel (/məˈrɪkəl, ˈmɛərkal/, German: [aŋˈɡeːla doʁoˈteːa ˈmɛʁkɪ];<sup>[a]</sup> née Kasner; born 17 July 1954) is a German politician serving as Chancellor of Germany since 2005. She served as the leader of the centre-right Christian Democratic Union (CDU) from 2000 to 2018.<sup>[10]</sup> Merkel has been widely described as the "most powerful woman in the world"<sup>[12]</sup>, and "leader of the free world"<sup>[13]</sup>. Merkel was born in Hamburg in then-West Germany and moved to GDR Germany in 1963. She received a pastorate in Perleberg. She obtained a doctorate in quantum chemistry from the University of Leipzig in 1990. Merkel entered politics in the wake of the Revolutions of 1989, and was elected to the Bundestag in 1990. She was elected as a member of the East German Government headed by Lothar de Maizière in 1990. She was appointed as the Federal Minister for Women and Youth in 1991. She was appointed as the Federal Minister for the Environment, Nature Conservation and Nuclear Safety in 1994. She was appointed as the Secretary-General of the CDU before becoming the party's first female leader in 1998, succeeding Wolfgang Schäuble. Following the 2005 federal election, Merkel was appointed German Chancellor, replacing Gerhard Schröder. The CDU, its Bavarian sister party the Christian Social Union (CSU), and the Free Democratic Party (FDP) formed the CDU/CSU/FDP coalition government. In the 2009 federal election, the CDU obtained the largest share of the vote, at 33%. In the 2013 federal election, Merkel's CDU/CSU/FDP coalition lost to the Social Democratic Party (SPD), after the FDP lost all of its seats. In the 2017 federal election, Merkel's CDU/CSU/FDP coalition won a second grand coalition with the SPD, after the FDP lost all of its seats. In the 2021 federal election, the CDU/CSU/FDP coalition won a second grand coalition with the SPD, after the FDP lost all of its seats. In 2007, Merkel was President of the European Council and played a central role in the negotiation of the Treaty of Lisbon and the Berlin Declaration. One of Merkel's consistent priorities has been to strengthen transatlantic economic relations. Merkel played a crucial role in managing the financial crisis at the European and international level, and she has been referred to as "the decider". In domestic policy, her government's approach to the ongoing health care reform, problems concerning future energy development and more recently her government's approach to the ongoing refugee crisis have been widely discussed. During her Chancellorsip.<sup>[17]</sup> She has served as senior G7 leader since 2014, and previously from 2007 to 2013. She was the longest-serving incumbent head of government in the European Union, in October 2018. Merkel was the longest-serving incumbent head of government in the European Union, in October 2018. Merkel was the longest-serving incumbent head of government in the European Union, in October 2018.



# Extract gold annotations

The screenshot shows the Wikipedia page for the Christian Democratic Union of Germany. The main text describes the party's history and its role in German politics. A notice indicates that the article may be expanded with text translated from the German version. The infobox on the right provides key details about the party, including its abbreviation, leadership, and membership.

**Christian Democratic Union of Germany**

From Wikipedia, the free encyclopedia

→ This article may be expanded with text translated from the corresponding article in German. (April 2018) Click [show] for important translation instructions.

**The Christian Democratic Union of Germany** (German: *Christlich Demokratische Union Deutschlands* or **CDU**; German pronunciation: [ˈkʁɪstlɪç ˈdɛmoˈkʁaːtʃə ʔuˈnjɔːn ˈdɔʏtʃlantʃ]) is a Christian-democratic,<sup>[2][3]</sup> liberal-conservative<sup>[4]</sup> political party in Germany. It is the major catch-all party of the centre-right in German politics.<sup>[1][9][20]</sup> The CDU forms the CDU/CSU grouping, also known as the Union, in the Bundestag with its Bavarian counterpart the Christian Social Union in Bavaria (CSU). Founded in 1945 as an interdenominational Christian party, the CDU effectively replaced the pre-war Catholic Centre Party, but also included politicians of other backgrounds, liberal and conservative.<sup>[21]</sup> The party therefore claims to represent "Christian-social, liberal and conservative" elements.<sup>[22]</sup>

The leader of the CDU is Annegret Kramp-Karrenbauer. She is the successor of the former party leader Angela Merkel, who is the current Chancellor of Germany. The CDU is a member of the Centrist Democrat International, International Democrat Union and European People's Party (EPP).

**Contents** [hide]

- History
  - 1.1 Founding period
  - 1.2 Adenauer era (1949–1963)
  - 1.3 Opposition against social-liberal governments (1969–1982)
  - 1.4 Kohl era (1982–1998)
  - 1.5 Link to connected data repository item [alt-shift-g] [16]
  - 1.6 Kramp-Karrenbauer (2018–present)
- Voter base
- Internal structure
  - 3.1 Members
  - 3.2 **Qualification in the CSU**

**Christian Democratic Union of Germany**  
Christlich Demokratische Union Deutschlands

**CDU**

**Abbreviation** CDU

**Chairperson** Annegret Kramp-Karrenbauer

**Vice Chairpersons** Volker Bouffier  
Ursula von der Leyen  
Julia Klöckner  
Armin Laschet  
Thomas Strobl

**Secretary General** Paul Ziemiak

**Founded** 26 June 1945; 74 years ago

**Headquarters** Klingelhofstraße 8 10785 Berlin, Germany

**Newspaper** *Union*

**Youth wing** Young Union

**Membership (January 2019)** ▼ 415,000<sup>[1]</sup>

**Ideology** Christian democracy<sup>[2][3]</sup>  
Liberal conservatism<sup>[4]</sup>  
Pro-Europeanism<sup>[5]</sup>  
**Factions:** Centrist<sup>[6][7]</sup>  
Conservatism<sup>[8][9]</sup>



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Parse Wiki files and  
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plausibility

Use alias/phrase table  
and Wikidata to  
produce silver  
annotations for  
Wikipedia articles.

# Generate silver annotations

## Angela Merkel (Q567)

Angela Dorothea Merkel (.; **Kasner**; born 17 July 1954) is a German politician serving as Chancellor of Germany since 2005. She served as the leader of the centre-right Christian Democratic Union (CDU) from 2000 to 2018. Merkel has been widely described as the *de facto* leader of the European Union, the most powerful woman in the world, and by many commentators as the leader of the Free World.

Merkel was born in Hamburg in then-West Germany and moved to East Germany as an infant when her father, a Lutheran clergyman, received a pastorate in Perleberg. She obtained a doctorate in quantum chemistry in 1986 and worked as a research scientist until 1989. Merkel entered politics in the wake of the Revolutions of 1989, and briefly served as a deputy spokesperson for the first democratically elected East German Government headed by Lothar de Maizière in 1990. Following German reunification in 1990, Merkel was elected to the Bundestag for the state of Mecklenburg-Vorpommern, and has been reelected ever since. As the protégée of Chancellor Helmut Kohl, Merkel was appointed as the Federal Minister for Women and Youth in Kohl's government in 1991, and became the Federal Minister for the Environment, Nature Conservation and Nuclear Safety in 1994. After her party lost the federal election in 1998, Merkel was elected Secretary-General of the CDU before becoming the party's first female leader two years later in the aftermath of a donations scandal that toppled Wolfgang Schäuble.

Following the 2005 federal election, Merkel was appointed Germany's first female chancellor at the head of a grand coalition consisting of the CDU, its Bavarian sister party the Christian Social Union (CSU), and the Social Democratic Party of Germany (SPD). In the 2009 federal election the CDU obtained the largest share of the vote, and Merkel was able to form a coalition government with the Free Democratic Party (FDP). At the 2013 federal election, Merkel's CDU won a landslide victory with 41.5% of the vote and formed a second grand coalition with the SPD, after the FDP lost all of its representation in the Bundestag. After the 2017 federal election the CDU was again the largest party, and she was reelected to her fourth term on 14 March 2018.

In 2007, Merkel was President of the European Council and played a central role in the negotiation of the Treaty of Lisbon and the Berlin Declaration. One of Merkel's consistent priorities has been to strengthen transatlantic economic relations. Merkel played a crucial role in managing the financial crisis at the European and international level, and she has been referred to as "the decider." In domestic policy, health care reform, problems concerning future energy development and more recently her government's approach to the ongoing migrant crisis have been major issues during her Chancellorship. On 26 March 2014, Merkel became the longest-serving incumbent head of government in the European Union and she is currently the senior G7 leader. In October 2018, Merkel announced that she would not seek reelection as leader of the CDU at the party convention in December 2018 and as Chancellor in 2021.

### "Chancellor of Germany"

Chancellor of Germany

is: Q567 Chancellor of Germany [Wikidata item](#)

subclass of: Q567 Chancellor [Wikidata item](#)

is: P129 chancellor [Wikidata item](#)

Germany

country: Q567 Germany [Wikidata item](#)

### Angela Dorothea Merkel

is: Q567 Angela Merkel [Wikidata item](#)

given name: Q567 Angela [Wikidata item](#)

is: P2336 Angela [Wikidata item](#)

given name: Q567 Dorothea [Wikidata item](#)

is: P2330 Dorothea [Wikidata item](#)

family name: Q567 Merkel [Wikidata item](#)

is: P2330 Merkel [Wikidata item](#)

officeholder: Q567 Kasner

family name: Q567 Kasner [Wikidata item](#)

is: P2331 Kasner [Wikidata item](#)

date of birth: Q567 17 July 1954 [Time](#)

is: P569 19540717

country of citizenship: Q567 German [Wikidata item](#)

is: P27 head of government: Q567 politician [Wikidata item](#)

is: P27 politician [Wikidata item](#)

position held: Q567

country: Q567

subclass of: Q567

# Angela Merkel (Q567)

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## "Chancellor of Germany"

### Chancellor of Germany

is: 5865 **Chancellor of Germany** [Wikidata item](#)

### Chancellor

subclass of: 4621 **Chancellor**  
is: 6120 **chancellor** [Wikidata item](#)

### Germany

country: 4623 **Germany** [Wikidata item](#)

### Angela Dorothea Merkel

is: 5854 **Angela Merkel** [Wikidata item](#)

### Angela

given name: 4615 **Angela**  
is: 14538 **Angela** [Wikidata item](#)

### Dorothea

given name: 4617 **Dorothea**  
is: 14539 **Dorothea** [Wikidata item](#)

### Merkel

family name: 4619 **Merkel**  
is: 14540 **Merkel** [Wikidata item](#)

### Kasner

family name: 8 **Kasner**  
is: 5861 **Kasner** [Wikidata item](#)

date of birth: 10 **17 July 1954** [Time](#)  
is: 19540717

### German

country of citizenship: 12 **German**  
is: 3001 **German**  
head of government: 6 **Chancellor of Germany**

### politician

occupation: 14 **politician**

officeholder: 6 **Chancellor of Germany**

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**Chancellor of Germany**

- is: 5865 **Chancellor of Germany** [Wikidata item](#)
- subclass of: 4621 **Chancellor**
  - is: 6120 **chancellor** [Wikidata item](#)
- country: 4623 **Germany**
  - is: 3001 **Germany** [Wikidata item](#)

**Angela Dorothea Merkel**

- is: 5854 **Angela Merkel** [Wikidata item](#)
- given name: 4615 **Angela**
  - is: 14538 **Angela** [Wikidata item](#)
- given name: 4617 **Dorothea**
  - is: 14539 **Dorothea** [Wikidata item](#)
- family name: 4619 **Merkel**
  - is: 14540 **Merkel** [Wikidata item](#)
- officeholder: 6 **Kasner**
  - family name: 8 **Kasner**
    - is: 5861 **Kasner** [Wikidata item](#)
  - date of birth: 10 **17 July 1954** [Time](#)
    - is: 19540717
  - country of citizenship: 12 **German**
    - is: 3001
    - head of government: 6
  - occupation: 14 **politician**

# How? Wikidata -> better NLP

Parse Wiki files and  
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annotations

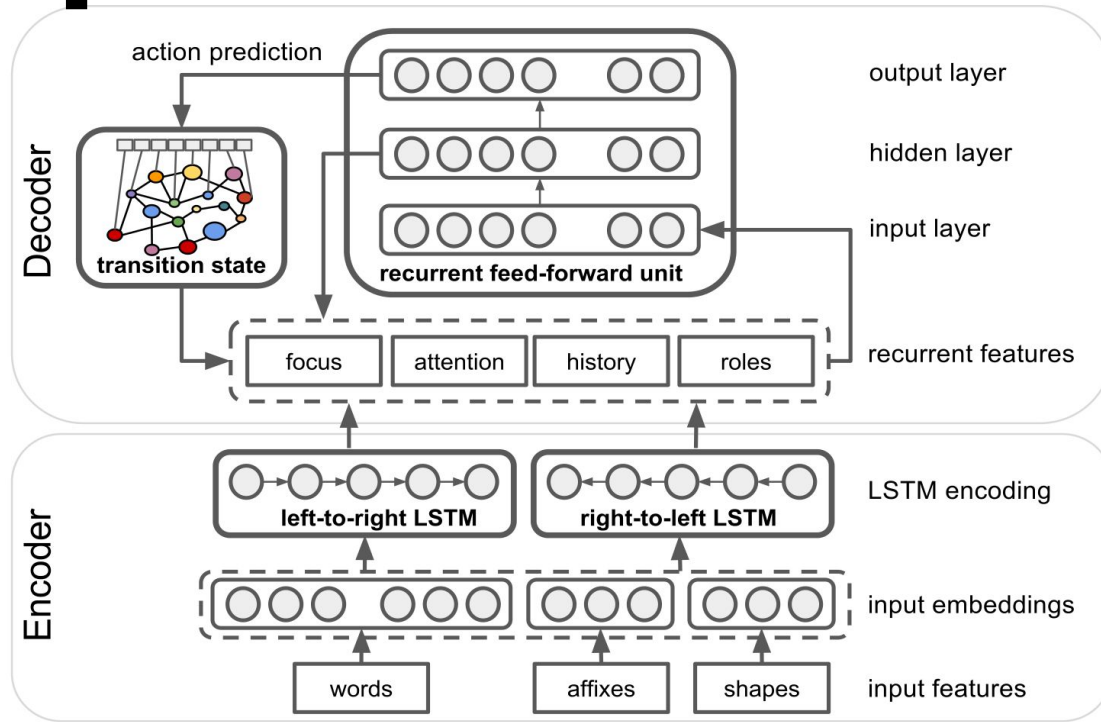
Supervised  
learning on  
silver data

Train  
plausibility  
model

Reinforcement  
learning with  
plausibility

Train a Wikipedia  
parser using  
supervised learning on  
the silver annotation.

# Train parser with silver ann.



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Use supervised learning to build a plausibility model by training it on existing Wikidata knowledge.



# Plausibility Model

Two inputs:

1. List of all known facts about a given item
2. One additional fact

Given all the known facts about an item, how plausible is it that the one additional fact is also true for that same item.

Train model by masking known facts from existing items.



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Use reinforcement learning to fine-tune the Wikipedia parser.

The trained plausibility model serves as reward function.

# Reinforcement learning FTW

- Use reinforcement learning to fine-tune the Wikipedia parser.
  - The trained plausibility model serves as a reward function.
- Can we learn to predict true facts that are not already in Wikidata?



# Current status & next steps

## Parse Wiki files and extract gold annotations

Parse Wikipedia and Wikidata dump files.

Represent contents efficiently in memory.

Extract gold annotations from Wikipedia articles via links.

## Generate silver annotations

Use alias/phrase table and Wikidata to produce silver annotations for Wikipedia articles.

## Supervised learning on silver data

Train a Wikipedia parser using supervised learning on the silver annotation.

## Train plausibility model

Use supervised learning to build a plausibility model by training it on existing Wikidata knowledge.

## Reinforcement learning with plausibility

Use reinforcement learning to fine-tune the Wikipedia parser.

The trained plausibility model serves as reward function.

# Current status & next steps

Parse Wiki files and extract gold annotations

**Done**

Parse Wikipedia and Wikidata dump files.

Represent contents efficiently in memory.

Extract gold annotations from Wikipedia articles via links.

Generate silver annotations

**Started**

Use alias/phrase table and Wikidata to produce silver annotations for Wikipedia articles.

Supervised learning on silver data

**Started**

Train a Wikipedia parser using supervised learning on the silver annotation.

Train plausibility model

**Started**

Use supervised learning to build a plausibility model by training it on existing Wikidata knowledge.

Reinforcement learning with plausibility

...

Use reinforcement learning to fine-tune the Wikipedia parser.

The trained plausibility model serves as reward function.

# Thanks

Questions?

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[github.com/google/sling](#)

SLING - A natural language parser. Read and understand Wikipedia across many languages.

