

Bachelor's thesis defence

# Exploiting Argumentation Knowledge Graphs for Argument Generation

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March 30, 2020

# Outline

1. Motivation
2. Argumentation Knowledge Graph
3. Argument Generation
4. Evaluation
5. Future Work

# 1. Motivation

# Motivation

Knowledge Graph



([https://janzz.technology/?attachment\\_id=9960&lang=de](https://janzz.technology/?attachment_id=9960&lang=de))

# Motivation

## Knowledge Graph



([https://janzz.technology/?attachment\\_id=9960&lang=de](https://janzz.technology/?attachment_id=9960&lang=de))

## Arguments

PRO

[Abortion is the ending of pregnancy by the removal or...](#)

► Show full argument

**Abortion** is the ending of pregnancy by the removal or forcing out from the womb of a fetus or embryo before it is able to survive on its own. An **abortion** can occur spontaneously, in which ...

<https://www.debate.org/debates/abortion/350/> score ▼

CON

[In 2011 there were about 730,322 abortions reported to...](#)

► Show full argument

In 2011 there were about 730,322 abortions reported to the centers for disease control. There are about 1.7% of **abortion** of women's ages from 15-44 each year. Women who already had **abortion** ...

<https://www.debate.org/debates/Abortion/545/> score ▼

# Motivation

## Knowledge Graph



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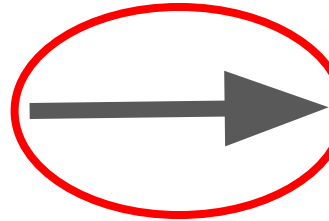
# Motivation

## Knowledge Graph



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## Arguments



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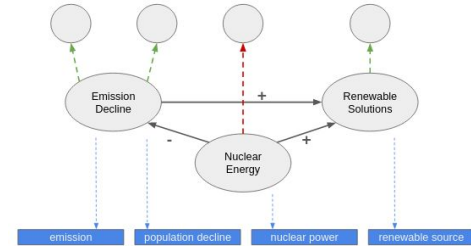
<https://www.debate.org/debates/Abortion/545/> score ▼

## 2. Argumentation Knowledge Graph



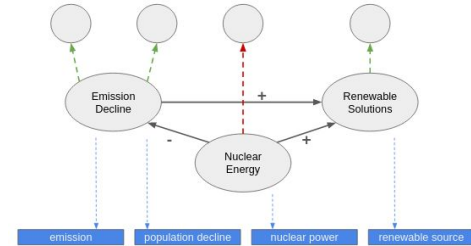
# Argumentation Graph Construction

## 1. Modeling argumentative knowledge



# Argumentation Graph Construction

## 1. Modeling argumentative knowledge



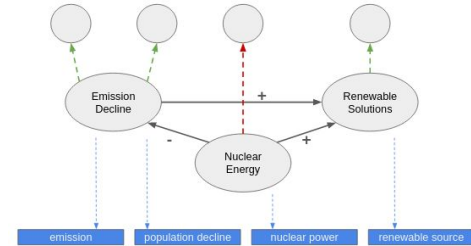
## 2. Graph population

	Relation	Concept 1	Groundings 1	Effect	Concept 2	Groundings 2	Consequence Relation	Consequences
0	Relation	legalizing drugs	['legalization', 'drug']	positive	state can regulate the sale	['state (polity)', 'drug', 'regulation']	good	['citizens', 'public health']
1	NoRelation							
2	Relation	legalizing drugs	['state (polity)', 'legalization']	positive	regulation	['regulation']	neutral	
3	Relation	legalizing drugs	['legalization', 'drug']	positive	state can regulate the sale	['state (polity)', 'regulation']	good	['state', 'government', 'public safety']
4	Relation	legalizing drugs	['legalization', 'drug', 'recreational drug use']	positive	regulate the sale	['state (polity)', 'regulation']	good	['taxes', 'budgets', 'sales']

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# Argumentation Graph Construction

## 1. Modeling argumentative knowledge

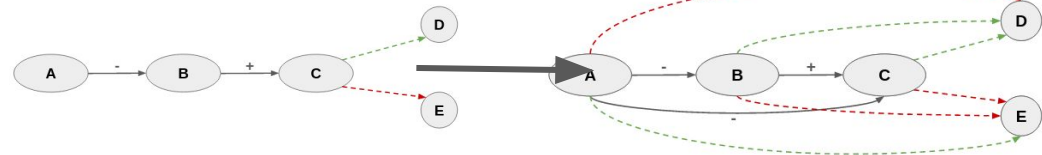


## 2. Graph population

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## 3. Graph completion



# Argumentative Graph Model

# Argumentative Graph Model

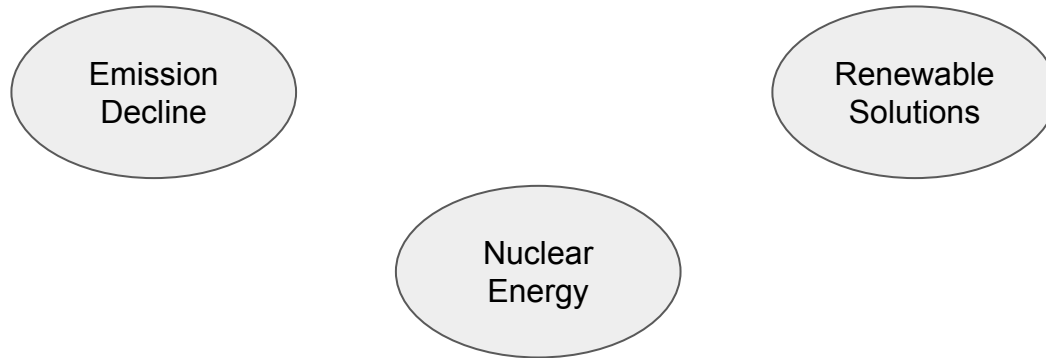
- Modification of the model proposed by Al-Khatib et al. [2020]
- We model knowledge in arguments as relations between concepts

# Argumentative Graph Model

## Concept Instance:

- Node in the graph
- Phrase expressing an entity, event or an abstract principle or idea
- Example:
  - Entity >> “Angela Merkel”
  - Event >> “smoking in public area”
  - Principle >> “society”

# Argumentative Graph Model



Concept  
Instance

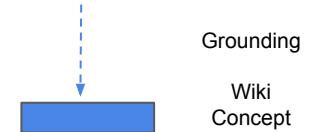
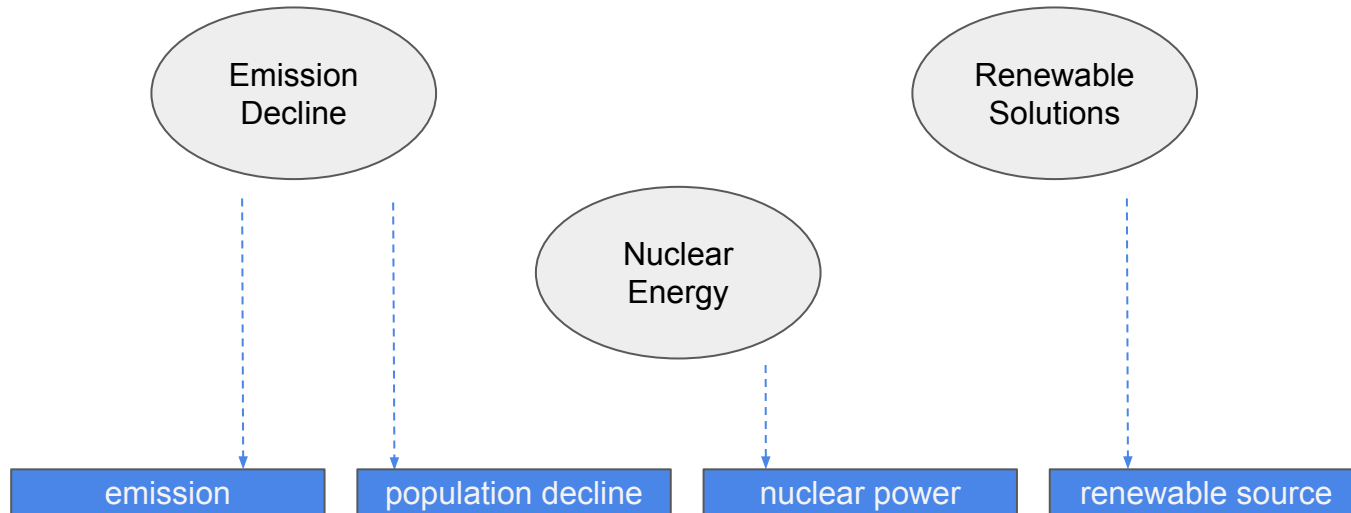
# Argumentative Graph Model

## Concept Grounding:

- Attribute of the nodes
- Concept instances are grounded in concepts from a knowledge base



# Argumentative Graph Model

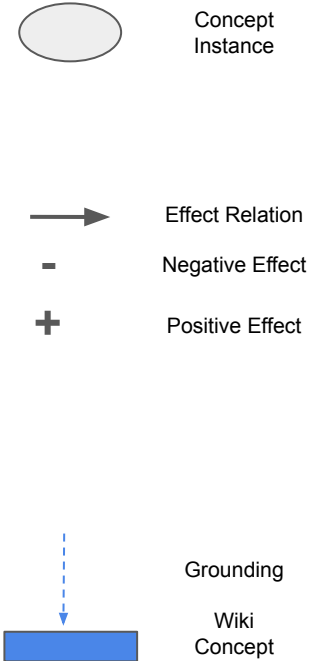
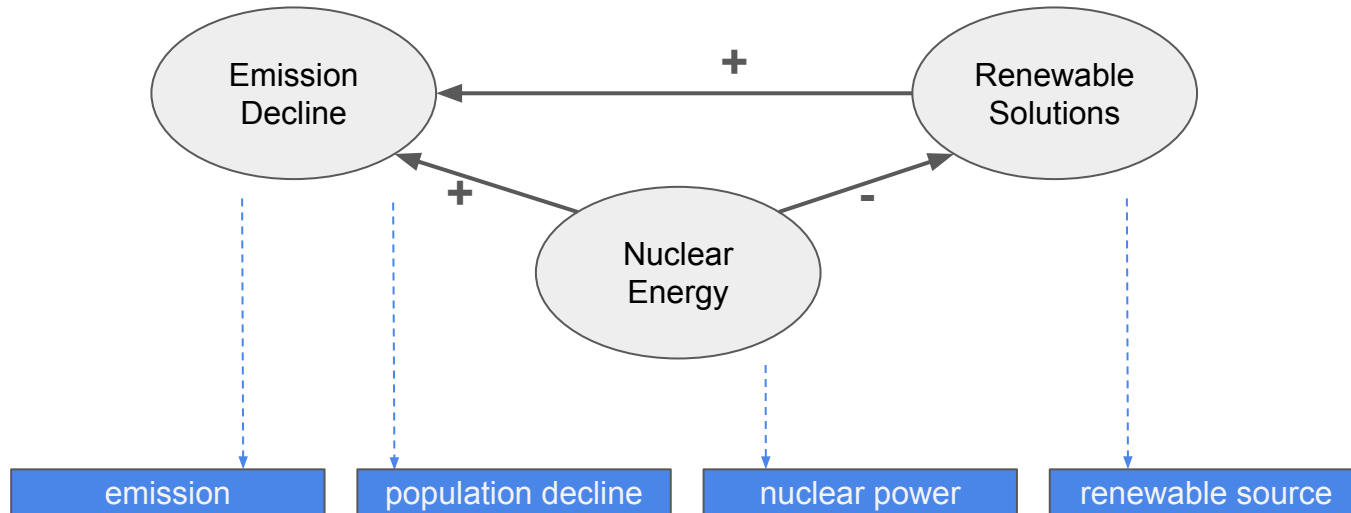


# Argumentative Graph Model

## Effect Relation:

- Edges in the graph
- Source concept instance (A) affects a target concept instance (B), either positively (+) or negatively (-)
  - Positive: A promotes/leads to/causes B
  - Negative: A stops/suppresses/avoids B

# Argumentative Graph Model



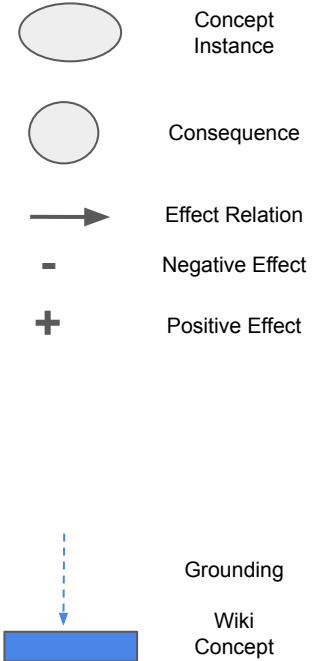
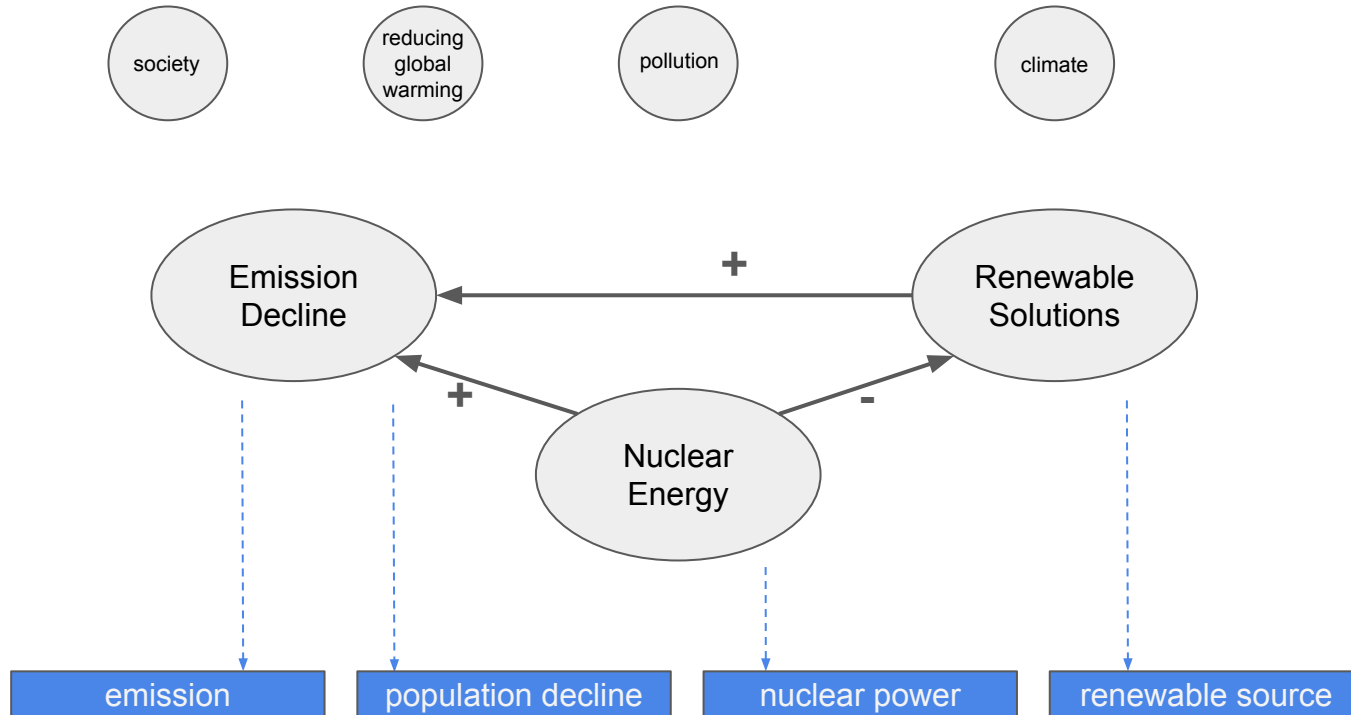
# Argumentative Graph Model

## Consequence:

- Node in the graph
- Concept instances, for which another concept is either good or bad for
- Example:

“having good health” is a good consequence of “doing sport”

# Argumentative Graph Model

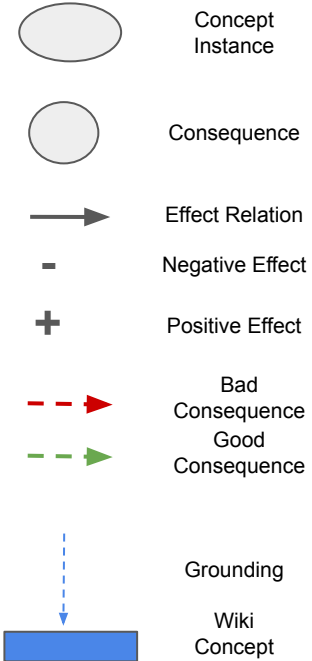
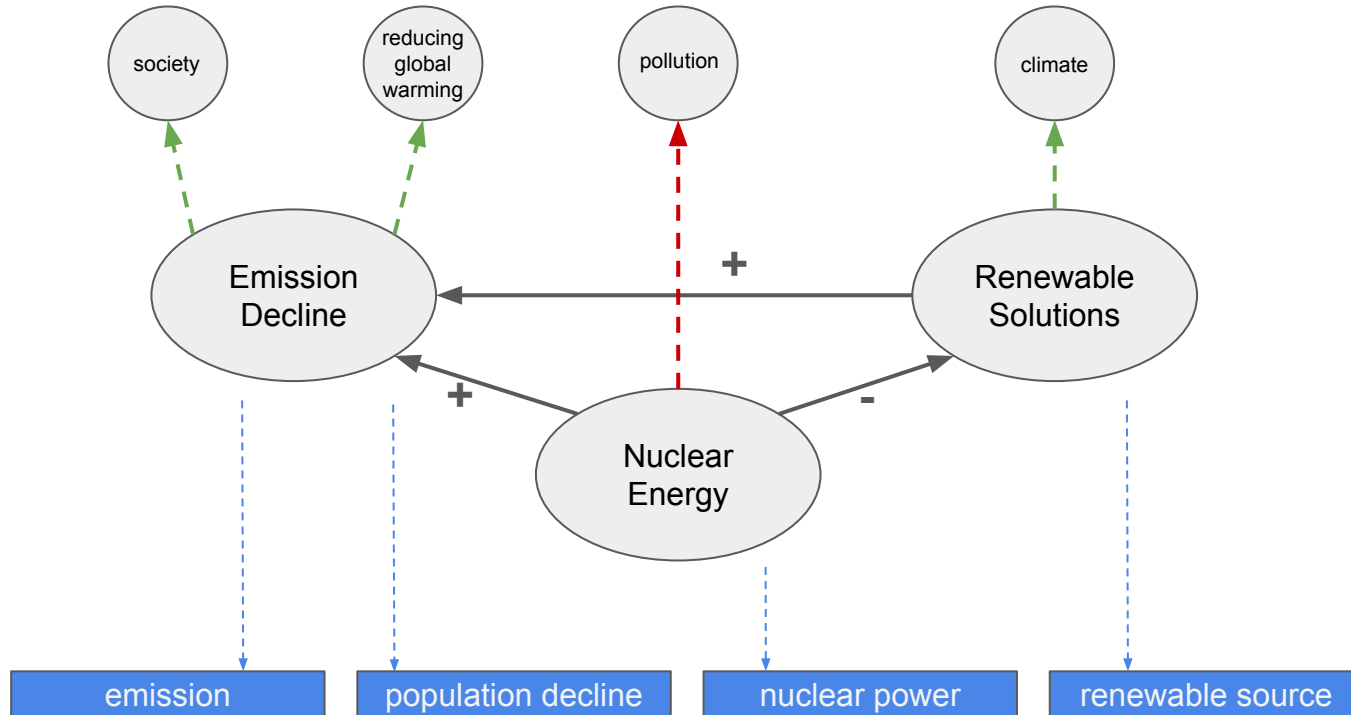


# Argumentative Graph Model

## Consequence Relation:

- Edge in the graph
- Source concept instance is generally good/bad for a target concept instance (consequence)

# Argumentative Graph Model



# Knowledge Graph Population



# Argumentation Corpus

## Source of argument knowledge:

- The corpus of Al-Khatib et al. [2020]
- Manual annotation of 4740 argumentative texts from debatepedia
- Input: Claim
- Annotation: The elements of the graph model
- Five annotations per claim

# Argumentation Corpus

“By legalizing drugs, the state can regulate the sale.”



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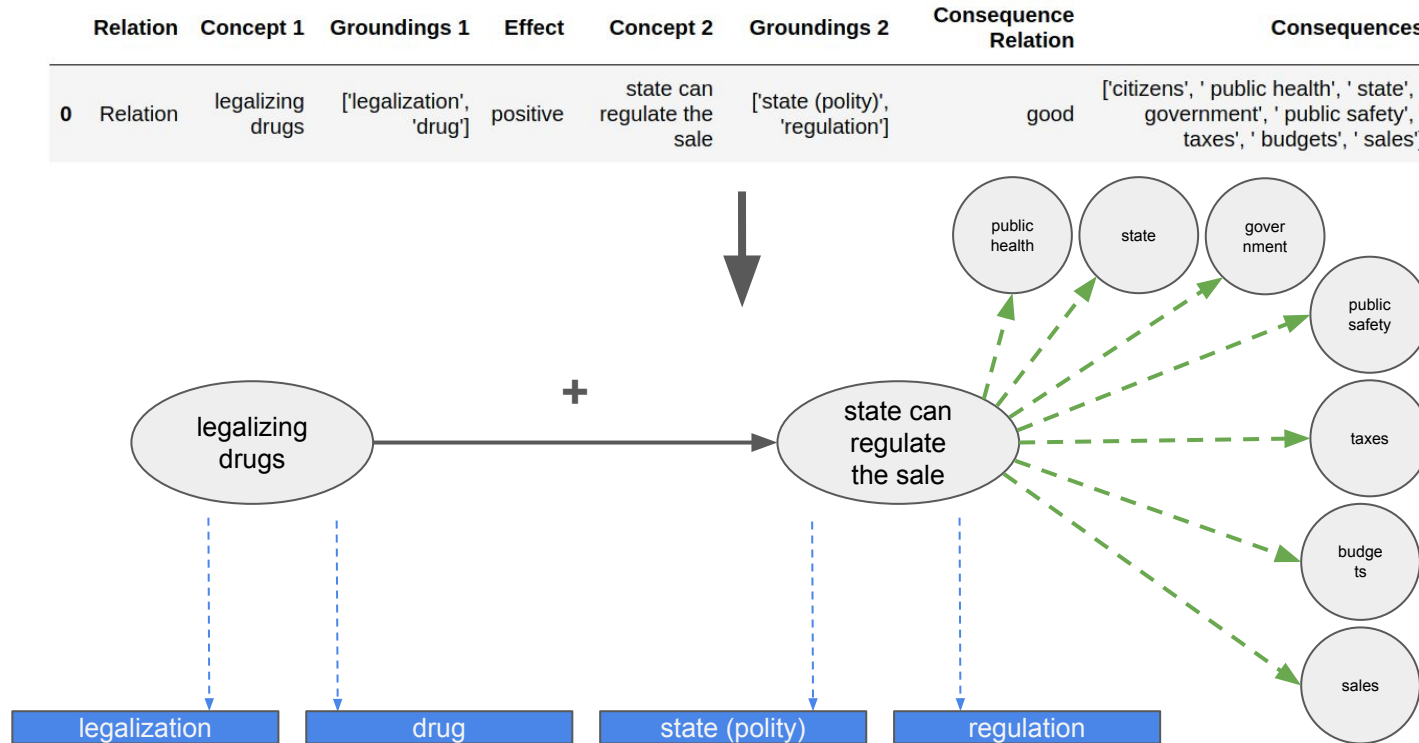
# Data Aggregation

	Relation	Concept 1	Groundings 1	Effect	Concept 2	Groundings 2	Consequence Relation	Consequences
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# Data Aggregation



# Graph Completion

# Graph Completion

## Goal:

- Find missing (implicit) relations in the graph

## Approach:

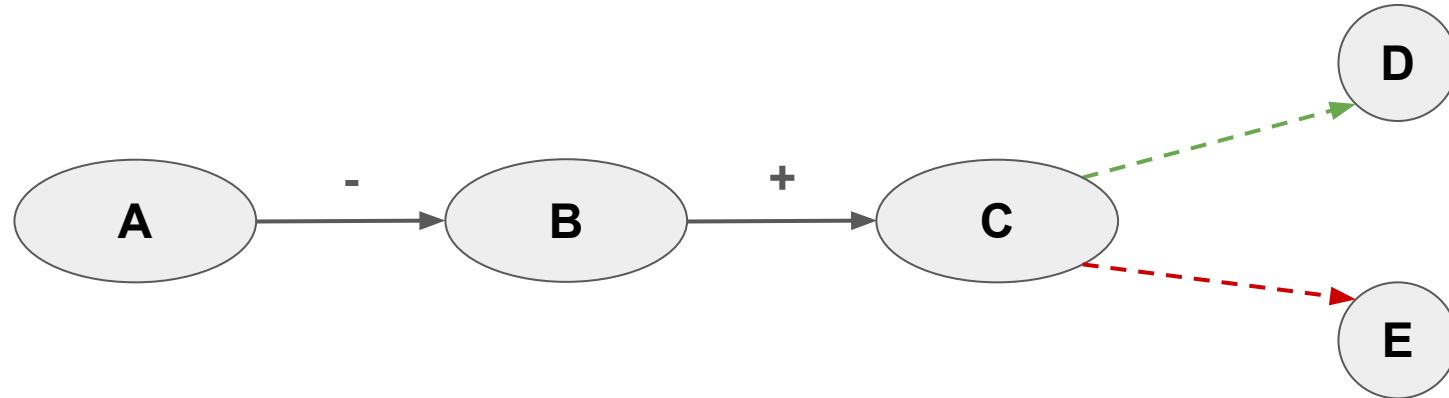
- We rely on the transitive property of the effect and consequence relations

# Graph Completion

Implicit Effect Relations		
First Relation	Second Relation	Resulting Relation
positive	positive	positive
positive	negative	negative
negative	positive	negative
negative	negative	positive

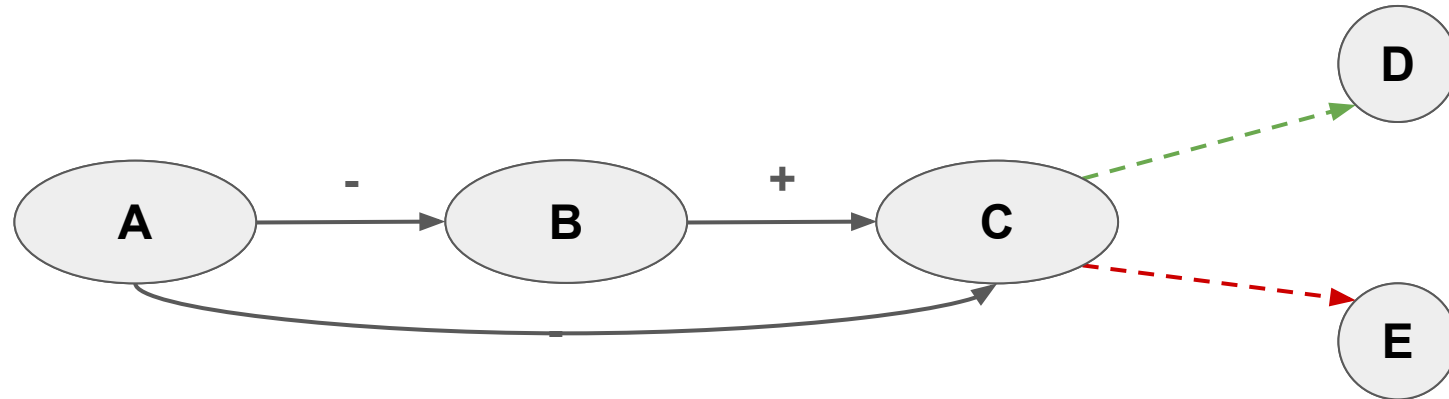
Implicit Consequence Relations		
First Relation	Second Relation	Resulting Relation
positive	good	good
positive	bad	bad
negative	good	bad
negative	bad	good

# Graph Completion

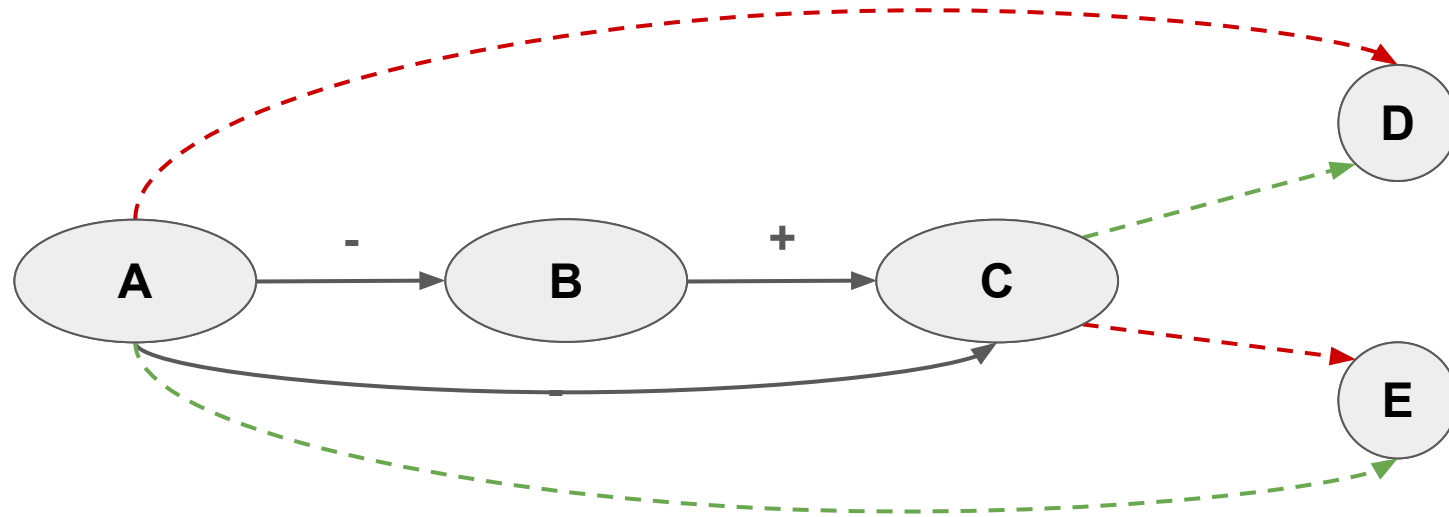




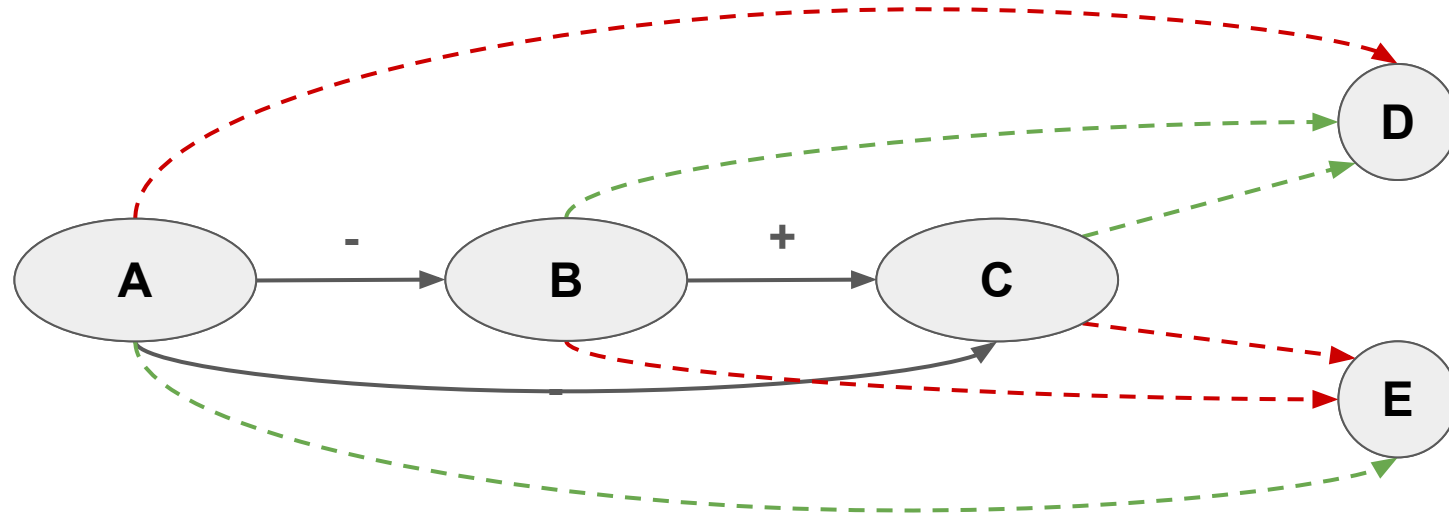
# Graph Completion



# Graph Completion



# Graph Completion



# Knowledge Graph Statistics

# Knowledge Graph Statistics

	#Nodes
Concept Instances	2720
Consequences	2296
$\Sigma$	<b>5016</b>

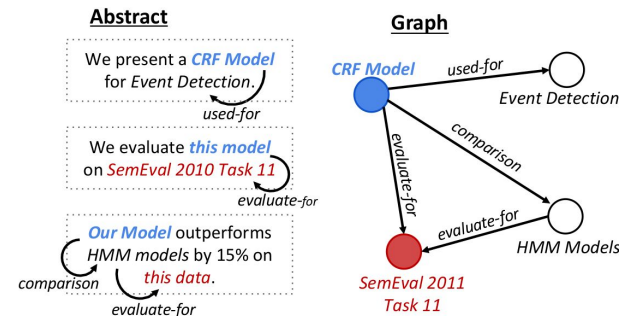
# Knowledge Graph Statistics

Edge Type	Edge Value	Explicit	Implicit	$\Sigma$
Effect	positive	1282	38	1320
Effect	negative	388	25	413
Consequence	good	3214	1962	7176
Consequence	bad	3558	4762	8320
$\Sigma$		8442	8787	<b>17229</b>

# 3. Argument Generation

# Argument Generation

- **Task:** Generate an argument from a path in the graph
- There are some previous approaches for knowledge-to-text (Koncel-Kedziorski et al. [2019])
- Those approaches require as training data annotated pairs of graph and text



(Koncel-Kedziorski et al. [2019])



# Argument Generation

- **Problem:** No corpus available for knowledge-to-text model
- **Our Solution:**
  1. Construct a training corpus
    - a. Collect training texts
    - b. Heuristically extract relations (knowledge) in the texts
    - c. Encode extracted relations (knowledge) as text
  2. Train a text-to-text model with the training corpus

# 1. Collecting Training Texts

## Argumentative Text

**PRO** There are many good and bad sides to abortion, But just...

There are many good and bad sides to **abortion**, But just like everything, There is no black and white, Just a whole range of gray. **Abortion** is one way that poverty can decrease. Most unplanned teen pregnancies that lead to child birth, Lead to either the child being sent to adoption, Or the family being sent into poverty. That is because raising a child is expensive and some parents are just not mature enough. I would not want to live in a world where children are living their entire sad lives in poverty instead of less children living in more richness. **Abortion** also has its consequences. The parents who get an **abortion** are usually called out by their friends for killing their own child. That alone is enough to discourage **abortion** for most. That leads us to the ethical values of **abortion**. Even though **abortion** is logical in every way, The rules of ethics say that killing an unborn child is bad because it is like killing a child. Just like how Thanos (from Avengers: Infinity War) wanted to kill half the universe so that the other half can live a life filled with happiness, **Abortion** prevents entire families from going broke and allows them to have children later in life that can live a rich life. But like I said, There is not black and white, Just a range of gray. **Abortion** should be the choice of the parents, Not others. Good luck to you.

Supports: Abortion

<https://www.debate.org/debates/Abortion/741/> score ▼

[Back to search results](#)

## Non-Argumentative Text

### Abortion

From Wikipedia, the free encyclopedia

*For other uses, see [Abortion \(disambiguation\)](#).*

**Abortion** is the ending of a [pregnancy](#) by removal or expulsion of an [embryo](#) or [fetus](#) before it can [survive outside the uterus](#).<sup>[note 1]</sup> An abortion that occurs without intervention is known as a [miscarriage](#) or spontaneous abortion. When deliberate steps are taken to end a pregnancy, it is called an [induced abortion](#), or less frequently "induced miscarriage". The unmodified word *abortion* generally refers to an induced abortion.<sup>[1][2]</sup> A similar procedure after the fetus has potential to survive outside the [womb](#) is known as a "[late termination of pregnancy](#)" or less accurately as a "late term abortion".<sup>[3]</sup>

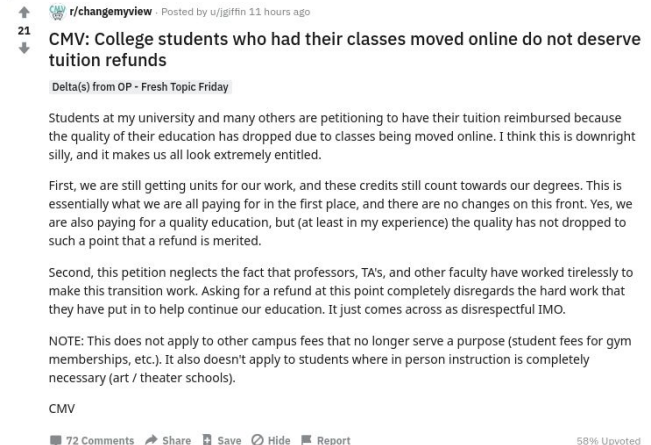
# Args.me Corpus

- 387606 arguments from 4 online debate portals
- We filter out arguments from “debate.org” due to their low quality
- In total, we got **33864** arguments




# r/Changemyview Corpus

- 20626 Reddit Posts
- We split content of top-level post into paragraphs
- In total, we got **28705** paragraphs



# Wikipedia Corpus

- Only **articles relevant** to the topics in the **graph**
- We found 2050 relevant articles
- In total, we got **81872** paragraphs



WIKIPEDIA  
The Free Encyclopedia

Main page  
Contents  
Featured content  
Current events  
Random article  
Donate to Wikipedia  
Wikipedia store

Interaction  
Help  
About Wikipedia  
Community portal  
Recent changes  
Contact page

Tools  
What links here  
Related changes  
Upload file  
Special pages  
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Page information  
Wikidata item  
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In other projects  
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Languages

Deutsch  
English

Article · Talk

**Global warming**  
(Redirected from Climate Change)

From Wikipedia, the free encyclopedia  
(Redirected from Climate Change)

For other uses, see *global warming* (disambiguation).

"Climate change" redirects here. For a broader discussion of climate trends throughout Earth's history, see *climate change (general concept)*. For the album by Pitbull, see *Climate Change (album)*.

**Global warming** is the mostly human-caused rise of the average temperature of the Earth's climate system and has been demonstrated by direct temperature measurements and by measurements of various effects of the warming.<sup>[1]</sup> It is a major aspect of **climate change** which, in addition to rising global surface temperatures,<sup>[2]</sup> also includes its effects, such as changes in precipitation.<sup>[3]</sup> While there have been prehistoric periods of global warming,<sup>[4]</sup> observed changes since the mid-20th century have been unprecedented in rate and scale.<sup>[5]</sup>

The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report concluded, "It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century."<sup>[6]</sup> The largest human influence has been the emission of greenhouse gases such as carbon dioxide, methane, and nitrous oxide. Fossil fuel burning is the dominant source of these gases, with agricultural emissions and deforestation also playing significant roles.<sup>[3]</sup> These findings have been recognized by the national science academies of the major industrialized nations<sup>[7]</sup> and are not disputed by any scientific body of national or international standing.<sup>[3]</sup>

The effects of global warming include rising sea levels, regional changes in precipitation, more frequent extreme weather events such as heat waves, and expansion of deserts.<sup>[8]</sup> Surface temperature increases are greatest in the Arctic, which have contributed to the retreat of glaciers, permafrost, and sea ice. Overall, higher temperatures bring more rain and snowfall, but for some regions droughts and wildfires increase instead.<sup>[3]</sup> Climate change threatens to diminish crop yields, harming food security, and rising sea levels may flood coastal infrastructure.<sup>[9]</sup> Environmental impacts include the extinction or relocation of many species as their ecosystems change, most immediately in coral reefs, mountains, and the Arctic.<sup>[10]</sup> Some impacts, such as loss of snow cover, increased water vapour, and melting permafrost, cause feedback effects that further increase the rate of global warming.<sup>[11]</sup> Ocean acidification caused by increased CO<sub>2</sub> levels is commonly grouped with these effects even though it is not driven by temperature.

Mitigation efforts to address global warming include the development and deployment of low carbon energy technologies, policies to reduce fossil fuel emissions, reforestation, forest preservation, as well as the development of potential climate engineering technologies. Societies and governments are also working to adapt to current and future global warming impacts, including improved coastline protection, better disaster management, and the development of more resistant crops.

Countries work together on climate change under the umbrella of the United Nations Framework Convention on Climate Change (UNFCCC), which entered into force in 1994 and has near-universal membership. The ultimate goal of the convention is to "prevent dangerous anthropogenic interference with the climate system."<sup>[12]</sup> Although the parties to the UNFCCC have agreed that deep cuts in emissions are required<sup>[13]</sup> and that global warming should be limited to well below 2 °C (3.6 °F) in the Paris Agreement of 2016,<sup>[24]</sup> the Earth's average surface temperature has already increased by about half this threshold.<sup>[14]</sup> With current policies and pledges, global warming by the end of the century is expected to reach just over 2 °C to 4 °C, depending on how sensitive the climate is to emissions.<sup>[15]</sup> The IPCC has stressed the need to keep global warming below 1.5 °C compared to pre-industrial levels in order to avoid irreversible impacts.<sup>[16]</sup> At the current greenhouse gas (GHG) emission rate, the carbon budget for staying below 1.5 °C would be exhausted by 2028.<sup>[17]</sup>

**Contents** [hide]

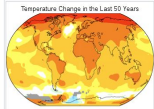
1 Observed temperature rise

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**Temperature Change in the Last 50 Years**

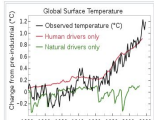


2010–2019 average vs 1961–1990 (°C)

-1.0° -0.5° -0.2° 0.2° 0.5° 1.0° 2.0° 4.0°

Average global temperatures from 2010 to 2019 are compared to a baseline average from 1961 to 1990. Source: NASA.

**Global Surface Temperature**



1.2°  
1.0°  
0.8°  
0.6°  
0.4°  
0.2°  
0°  
-0.2°  
-0.4°  
-0.6°  
-0.8°  
-1.0°  
-1.2°

1880 1900 1920 1940 1960 1980 2000 2020

— Observed temperature (°C)  
— Human drivers only  
— Natural drivers only

# Training Texts Statistics

	#Paragraphs	#Documents
Args.me	33,864	33,864
r/changemyview	28,705	20,626
Wikipedia	81,872	2,050

## 2. Knowledge/Relation Extraction

### **Goal:**

Extract knowledge similar to knowledge in the graph

This process consists of two steps:

1. Identification of concepts
2. Identification of relations

## 2.1 Concept Identification

### DBpedia Spotlight





## 2.2 Relation Identification

### Verb Indicators:

- Verbs, that potentially indicate an effect-relation
- List of 3440 verb-indicators

'make',	'kill',
'include',	'lose',
'see',	'stop',
'tell',	'accuse',
'begin',	'force',
'think',	'break',
'hold',	'refuse',
'lead',	'charge',
'help',	'oppose',
'believe',	'fall',
'add',	'reduce',
'continue',	'arrest',
'run',	'cut',
'move',	'reject',
'expect',	'prevent',
'...']	'...']

## 2. Knowledge/Relation Extraction

### Goal:

Extract knowledge similar to knowledge in the graph

Marijuana by definition meets the criteria for an addictive drug;  
animal studies suggest marijuana causes physical dependence,  
and some people report withdrawal symptoms.

## 2. Knowledge/Relation Extraction

### Goal:

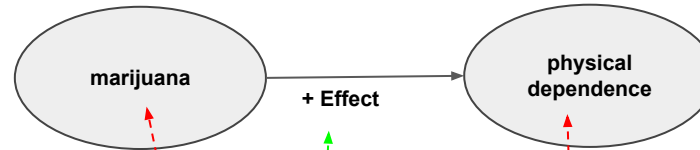
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## 2. Knowledge/Relation Extraction

### Goal:

Extract knowledge similar to knowledge in the graph



Marijuana by definition meets the criteria for an addictive drug;  
animal studies suggest marijuana causes physical dependence,  
and some people report withdrawal symptoms.

# Corpus Statistics

	#Paragraphs (with relations)	#Paragraphs (Total)
Args.me	11,744	33,864
r/changemyview	10,254	28,705
Wikipedia	46,958	81,872
$\Sigma$	<b>68,956</b>	144,441

# Corpus Statistics

	#Paragraphs (with relations)	#Paragraphs (Total)
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Wikipedia	46,958	81,872
$\Sigma$	<b>68,956</b>	144,441

# Training Process

- Encode extracted knowledge as a text

Marijuana by definition meets the criteria for an addictive drug;  
animal studies suggest marijuana causes physical dependence,  
and some people report withdrawal symptoms.



<|startoftext|>~^[**marijuana**]==(**causes**)=>[**physical-dependence**]~@M  
arijuana by definition meets the criteria for an addictive drug; animal  
studies suggest marijuana causes physical dependence, and some  
people report withdrawal symptoms.<|endoftext|>

# Training Process

- Finetune pre-trained GPT-2 model for 1000 epochs

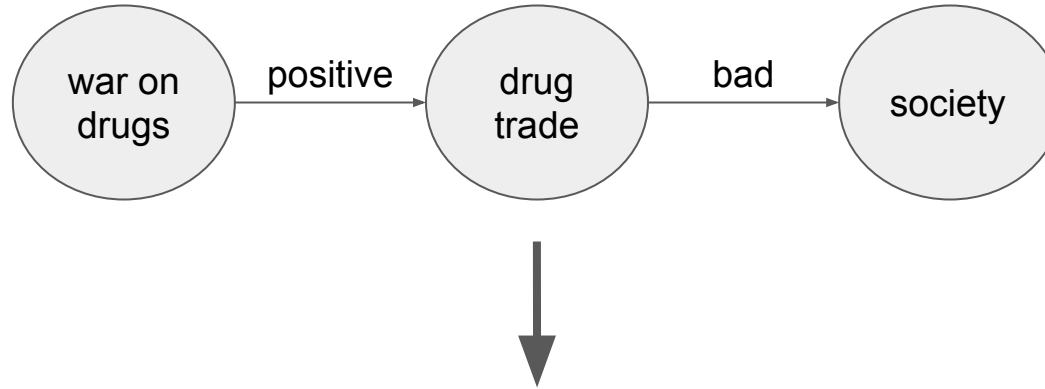
<|startoftext|>~^[marijuana]==(causes)=>[physical-dependence]~@  
Marijuana by definition meets the criteria for an addictive drug; animal  
studies suggest marijuana causes physical dependence, and some  
people report withdrawal symptoms.<|endoftext|>



**GPT-2**



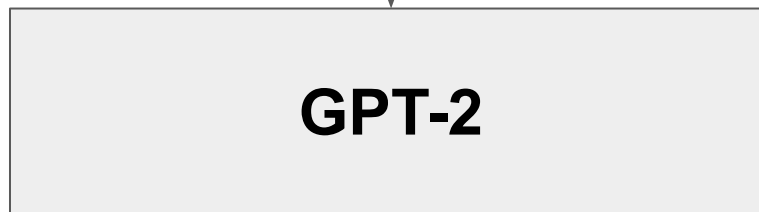
# Argument Generation Process



<|startoftext|>~^[war-on-drugs]==(promotes)=>[drug-trade]==(is-bad-for)=>[society]~@

# Argument Generation Process

<|startoftext|>~^[war-on-drugs]==(promotes)=>[drug-trade]==(is-bad-for)=>[society]~@



<|startoftext|>~^[war-on-drugs]==(promotes)=>[drug-trade]==(is-bad-for)=>[society]~@This war on drugs, promoted by many governments, is bad thing for society.<|endoftext|>

# Argument Generation Process

<|startoftext|>~^[war-on-drugs]==(promotes)=>[drug-trade]==(is-bad-for)=>[society]~@This war on drugs, promoted by many governments, is bad thing for society.<|endoftext|>



**This war on drugs, promoted by many governments,  
is bad thing for society.**

# 4. Evaluation

# Evaluation - Setup

- Given 100 pairs of knowledge and automatically generated argument
- 50 of the pairs based on explicit knowledge, and 50 on implicit (after the completion step) knowledge
- Four annotators assess the arguments in three aspects

Argument 1 of 100		Scores for Argument						
This war on drugs, promoted by many governments, is a bad thing for society.			1	2	3	4	5	
<b>Knowledge</b>		not proper English	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	Argument fluent; no grammatical error
		no information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	full of useful information
war on drugs (promotes/causes/leads to) drug trade, and drug trade is (generally bad) for society		no information related to knowledge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	fully representing knowledge

# Evaluation - Criteria

- **Fluency**, describes whether the argument is grammatically correct

The current human rights situation in the world is bad for humanity. It is not a case of a country being pro-human rights while it is at war with another country. A country which is at war with another country is at war with its own. It is not a case of countries being pro-human rights while at war with each other. A country is at war with its own, as well as the other country.<|state that is at war with itself is at war with itself.<|other country that is at war with itself.<|other country that is at war with itself is at war with itself.<|other country that is at war with itself is at war with itself.<|other country that is at war with itself is at war with itself.<|other country that is at war with itself is at war with itself.<|other country that is at war with itself is at war with itself.<|other country that is at war with itself is at war with itself.<|other country that is at war with itself is at war with itself.<

**VS.**

The financial crisis and the Great Recession promoted a new form of job loss and financial downturn in the United States, resulting in the recession and the Great Recession. Many of the jobs lost during the financial crisis were in the auto industry, the area in which the financial crisis and the Great Recession were most widely used to promote job creation. The recession was particularly devastating for many young people. Jobs were lost in nearly every major job category, including in manufacturing, construction, educational, and scientific areas.

# Evaluation - Criteria

- **Informativeness**, describes whether the argument contains useful information

As for the civil same-sex marriage, the law is bad for gays and lesbians and for straight people, particularly for those who prefer to marry people of the opposite sex. Many marriage laws in the world, including civil unions, are not only against same-sex marriage, but against same-sex marriage. In countries like Australia, Belgium, Belgium, Denmark, Italy, Luxembourg, Malta, Malta, Luxembourg, Israel, Italy, Israel, Ireland, Italy, Italy, Luxembourg, Malta, Luxembourg, Malta, Malta, Italy, Liechtenstein, Malta, Luxembourg, Malta, Malta, Israel, Liechtenstein, Luxembourg, Malta, Italy, Malta, Liechtenstein, Malta, Liechtenstein, Malta, Liechtenstein, Malta, Liechtenstein, Luxembourg, Liechtenstein, Malta, Liechtenstein, Malta, Liechtenstein, Malta, Liechtenstein, Malta, Liechtenstein, Malta, Liechtenstein, Malta, Liech

vs.

Military placement exams are a form of promotion of school work, is good for students who want to join the military ranks. They may also be used to determine if a student should pursue a career in a particular area. These exams are not only used to help students identify the needs of their school, but to help students identify the skills and talents they should pursue in order to become a professional in their chosen field. In a school setting, a student would be required to take a comprehensive examination which is often a multiple-choice test, and in a military setting, these exams would be used to determine if a student should pursue a career as a soldier or civilian, or pursue a career in the military or civilian fields.

# Evaluation - Criteria

- **Relevance**, describes whether the argument contains knowledge relevant to the input knowledge

**needle exchanges** (suppresses/prevents/stops) **community cleanliness**, and **community cleanliness** is (generally bad) for **economy**

It is a fact of life that people have a right to make their own choices regarding health. However, the desire to make choices may be hindered by the desire to comply with societal norms. The most important of these norms is the one of the right to make choices. The most obvious example of this is the way that in many countries where women have been permitted to leave the house without wearing the hijab, they have a right to make their own choice of whether or not to wear the hijab, but the social norms may be that women should make sure that they conform to the prescribed norms. This is, in a sense, the opposite of the right to make choices.

VS.

**cloning** is (generally bad) for **future generations**

There are also many more examples of **cloning** that is bad for the **future generations** of humankind. In the case of **cloning**, it is bad for **future generations** of humankind, because it cannot be done in a legal and ethical framework that is in place. In the case of the use of **cloning**, it is a form of theft, because the clones are created without any protection for the **future generations** of humankind. Because the future is not in place, we are not able to protect the **future generation** of those who are harmed by **cloning**, and we are not able to protect **future generations** of those who are harmed by the **cloning**. Therefore, **cloning** without protection for **future generations** of humankind creates a situation that is worse than theft.



# Evaluation - Results

## Inter-Annotator Agreement:

	All Samples			Explicit Knowledge			Implicit Knowledge		
	F	I	R	F	I	R	F	I	R
Percent (2)	0.93	0.82	0.90	0.92	0.84	0.90	0.94	0.80	0.90
Percent (3)	0.27	0.10	0.27	0.28	0.12	0.26	0.26	0.08	0.28
Percent (4)	0.03	0.00	0.09	0.02	0.00	0.08	0.04	0.00	0.10
Alpha	0.11	-0.09	0.29	0.06	0.11	0.25	0.16	-0.06	0.31

# Evaluation - Results

## Results:

	All Samples			Explicit Knowledge			Implicit Knowledge		
	F	I	R	F	I	R	F	I	R
Mean	3.71	3.22	2.52	3.67	3.24	2.59	3.75	3.195	2.45
Std	0.59	0.55	0.93	0.50	0.50	0.85	0.68	0.68	1.01
25%	3.25	2.75	2.00	3.25	3.00	2.00	3.50	2.75	1.75
50%	3.75	3.25	2.25	3.63	3.25	2.5	3.75	3.13	2.25
75%	4.00	3.50	3.00	4.00	3.50	3.00	4.19	3.50	2.75
#Samples	100			50			50		

# Evaluation - Results

## Results:

	Fluency	Informativeness	Relevance
Hua and Wang [2018]	2.5 ( $\pm 0.59$ )	1.6 ( $\pm 0.8$ )	1.8 ( $\pm 0.8$ )
Our model	3.7 ( $\pm 0.8$ )	3.2 ( $\pm 0.6$ )	2.5 ( $\pm 0.9$ )

# 5. Future Work

# Future Work

- **Improve the knowledge graph**
  - Construct large-scale knowledge graph
  - Increase the topic-coverage of the graph
  - Incorporate knowledge on current controversial issues
- **Improve the language generation model**
  - Replace GPT-2 model with a graph-to-text model
- **Incorporate argument generation into args.me**

# Thank you for your attention!

Any questions ?

# References

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