

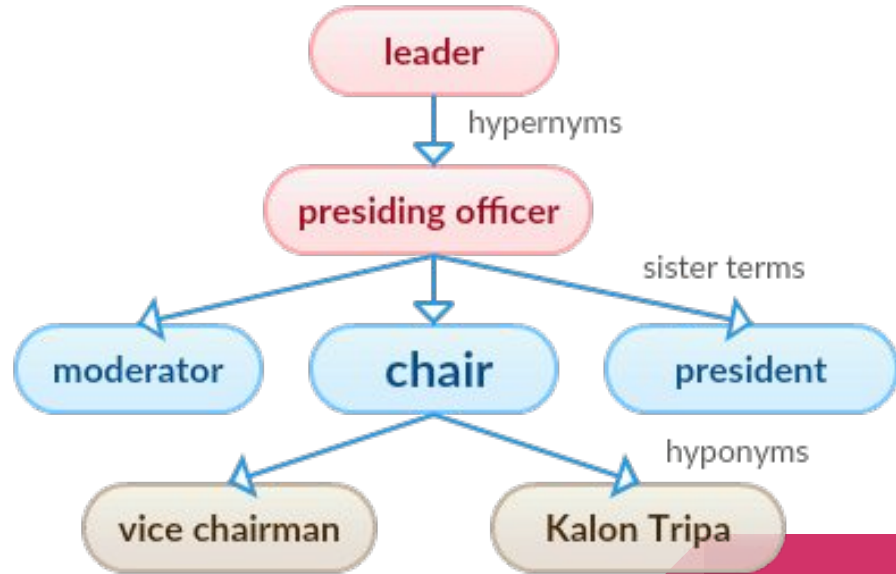
Structural Linguistics 3: the *meaning*

Mariana Romanyshyn, *Grammarly, Inc.*

Contents

A word is its...

1. form
2. function
3. *meaning*



1. Units of meaning

Meaning

- ***Lexeme***
 - a word in all of its forms
 - can be divided into ***morphemes***



Meaning

- ***Lexeme***
 - a word in all of its forms
 - can be divided into ***morphemes***
- ***Sememe***
 - each individual meaning of a word
 - can be divided into ***semes***



Semes

- **Walk** - to move forwards using your legs and feet
- **Run** - to move forwards quickly using your legs and feet
- **Boat** - a small vessel for travelling over water
- **Ship** - a large vessel for transporting people or goods by
sea



Semes in polysemous words

- ***Read***

- (*a book*) to look at and understand written words
- (*music*) to understand the written marks that represent musical sounds
- (*a situation*) to understand something in a particular way



Semes in polysemous words

- *Пити*

- ковтати яку-небудь рідину для вгамування спраги
- вживати спиртне
- вбирати в себе вологу



Polysemy vs Homonymy

- Homonymous “*bank*”
 - a financial institution
 - an area of land along the side of a river
- Polysemous “*man*”
 - the humanity
 - male part of the humanity
 - adult male part of the humanity



Polysemy vs Homonymy

- Homonymous “**bank**”
 - a financial institution
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- Polysemous “**man**”
 - the humanity
 - male part of the humanity
 - adult male part of the humanity
 - ~~a person~~



Is it serious?

- ~40% of English words are polysemous
- most polysemous - verbs (~55%)
- resources disagree
 - “**head**” has 10-40 meanings in different dictionaries
- solved by word sense disambiguation algorithms (e.g., [Babelify](#))



2. Lexical Semantics

Lexical semantic relations

- Synonyms - share the same (or similar) meaning
 - *big house - large house*
 - *великий мороз - сильний мороз*
- Antonyms - have the opposite meaning
 - *big house - small house*
 - *велика сім'я - маленька сім'я*



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Lexical semantic relations

- Hypernym - a more generic term
- Hyponym (for verbs: troponym) - a more specific term
 - *couch => bed => bedroom furniture => furniture*
 - *trot => run => move*
 - *викрутка => інструмент <= молоток*



Lexical semantic relations

- Hypernym - a more generic term
- Hyponym (for verbs: troponym) - a more specific term
 - *Mom is slicing an eggplant. => A woman is cutting a vegetable.*



Lexical semantic relations

- Meronym - a part or a member of something
- Holonym - the whole
 - *car => bumper, seat, door, window, engine, etc.*
 - *eye => eyelid, eyeball, iris, pupil, etc.*
 - *faculty => professor*
 - *water => oxygen*



Lexical semantic relations

- Entailment - X entails Y if X cannot be done unless Y is done.
 - *snore => sleep*
 - *listen => hear*
 - *buy => sell*
 - *молодший => старший*
 - *ліворуч => праворуч*
 - *винахід => винахідник*



Lexical semantic relations

- Entailment - X entails Y if X cannot be done unless Y is done.
 - *Учора ми витратили останні гроші. => Учора гроші закінчилися.*
 - *Іра розмовляє з Іваном. => Іван розмовляє з Ірою.*
 - *Іра говорить до Івана. !=> Іван говорить до Іри.*

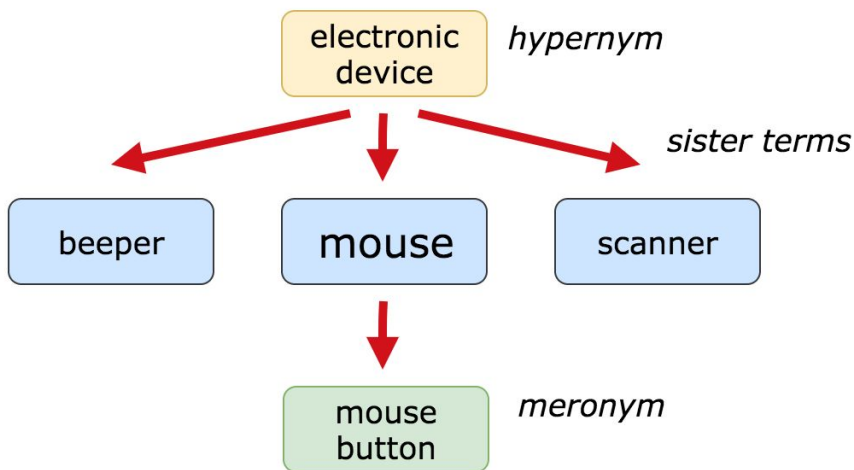
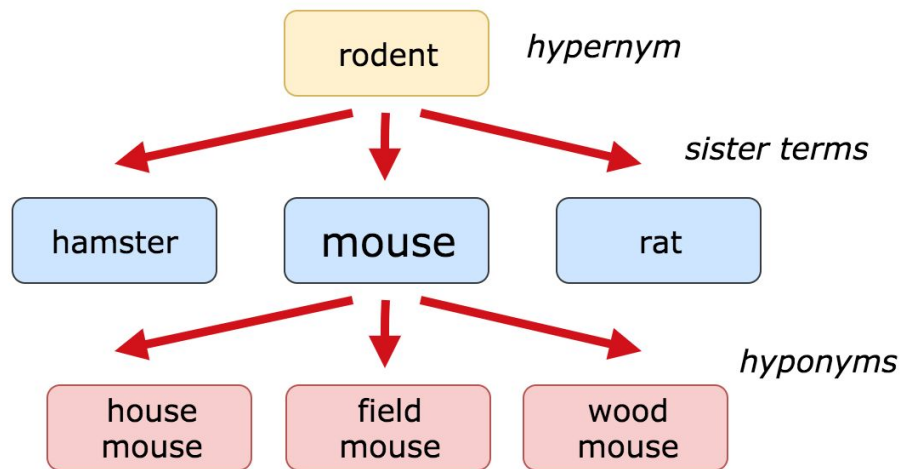


Lexical semantic resources

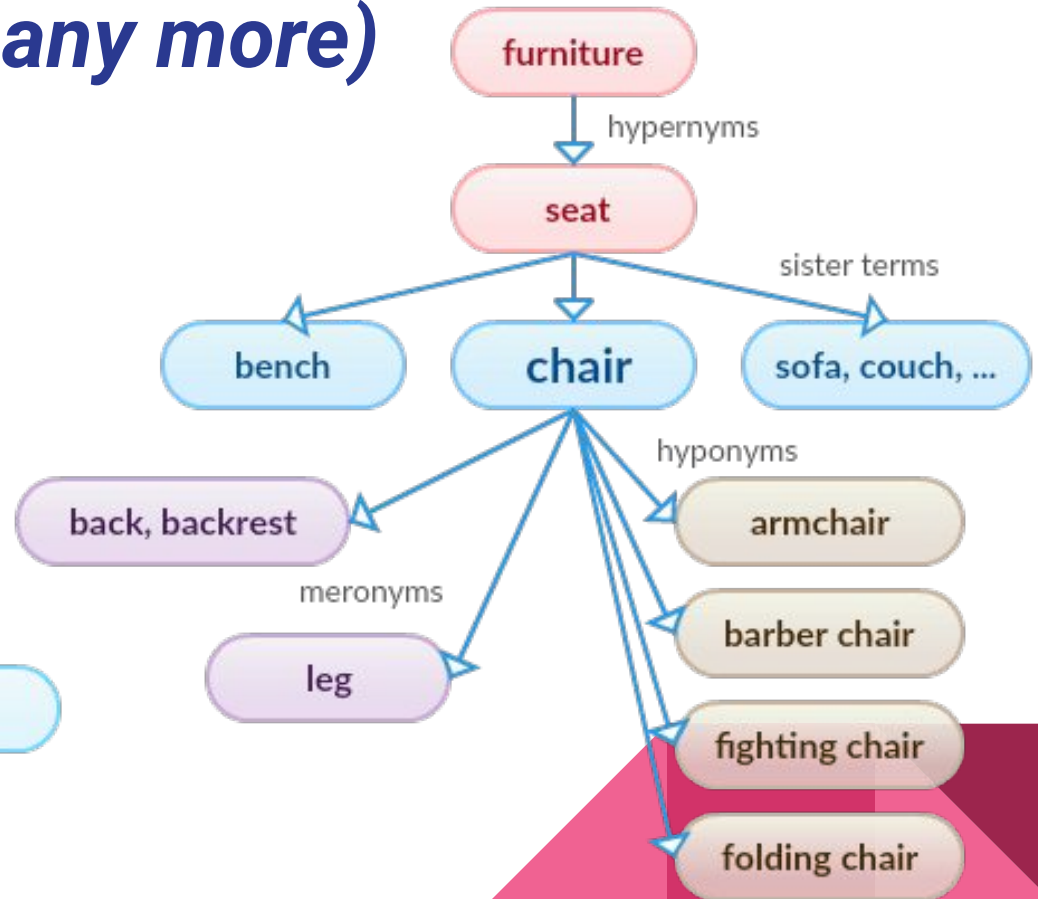
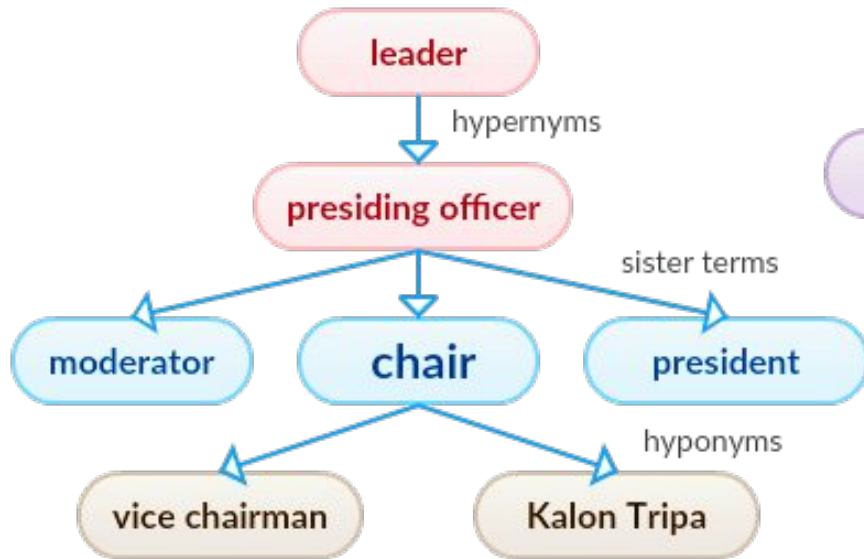
- Thesauri
 - word level
 - synonyms, antonyms, related terms
- Ontologies
 - concept level
 - lexical semantic relations



WordNet (... and many more)



WordNet (... and many more)



Usage in NLP

- Word sense disambiguation
- Information retrieval
- Question answering
- Textual entailment
- Error correction
- Text classification
- Paraphrasing/deduplication
- and any other NLU task



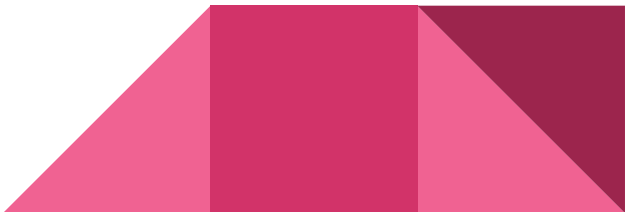
3. Semantic Analysis

Semantic Analysis

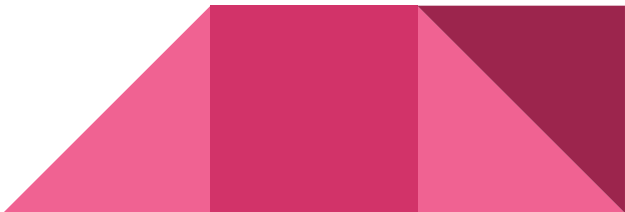
- Semantic role labelling
 - *a.k.a. shallow semantic parsing*
- Semantic parsing
 - *language as a graph*



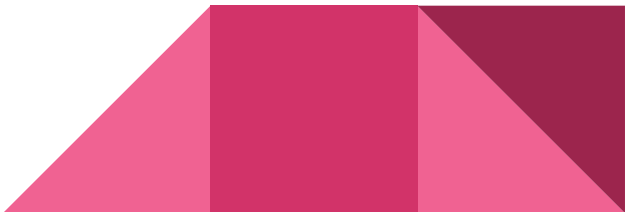
Who did what to whom?

- *TimTim sued TomTom for \$13 mln.*
 - *TimTim filed a lawsuit against TomTom for \$13 mln.*
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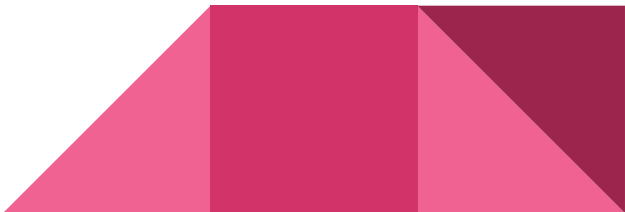
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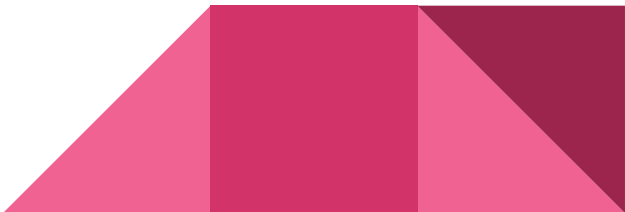
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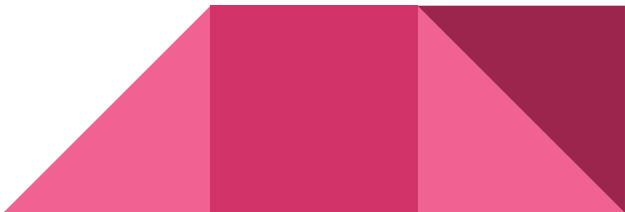
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Semantic Roles

- Causer: Agent (acts consciously) or Force
 - ***Kim** signed the letter.*
 - ***The rain** ruined the crops.*
- Instrument
 - *Kim cut the cake with **the knife**.*
- Result (appears in the process)
 - *They made **a hole** in the roof.*



Semantic Roles

- Patient (animate, affected by the action)
 - *Kim kicked **the little boy**.*
 - *John finally kissed **her**.*
- Theme (affected by the action and changed)
 - *He gave me **the key**.*
 - ***The letter** was signed by Kim.*
 - ***She** woke up.*

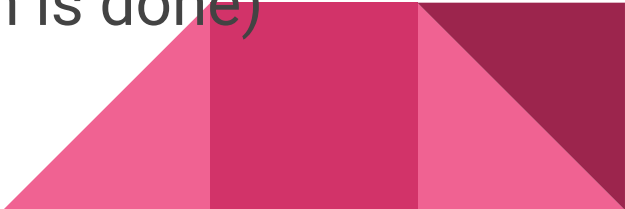
Semantic Roles

The Theme can change the location (in space or time), the owner, its properties, etc.

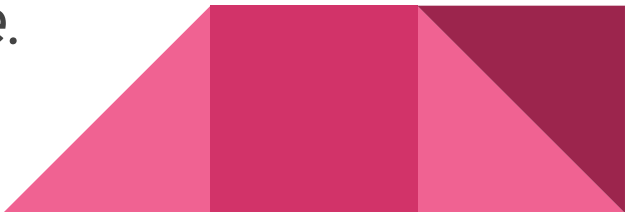
- Source, path, goal/recipient, location
 - *She ran from **the post office** down **the Main Street** to the **bus stop**.*
 - *The meeting is at **noon**.*
 - *He gave **me** the key.*



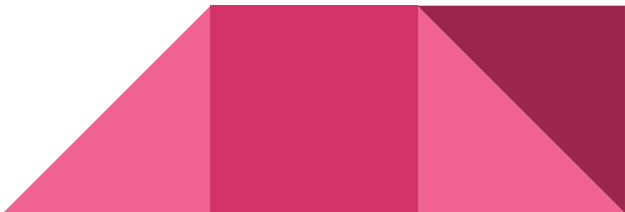
Semantic Roles

- Experiencer (feels or perceives)
 - ***We** heard a bang.*
 - Stimulus (arouses a feeling or is perceived)
 - *We heard a **bang**.*
 - Beneficiary (obtains sth or for whom sth is done)
 - *I bought **you** a present.*
- 

Practice

- *The hurricane produced a 25-foot storm surge on Martinique, which destroyed all houses in Saint-Pierre.*
 - *The police officer kept the suspect at the station.*
 - *This thought scares me.*
 - *I have to make reservations for my boss.*
 - *The robbers stole money from my house.*
- 

VerbNet

- Verb group:
 - *deal, lend, loan, pass, peddle, refund, render*
 - Syntactic frames:
 - *"NP V NP PP.recipient"*
 - *"NP V NP-Dative NP"*
 - *"NP V NP"*
 - *"NP V PP.recipient"*
- 

PropBank

- *increase.01 “go up incrementally”*
 - *Arg0: causer of increase*
 - *Arg1: thing increasing*
 - *Arg2: amount increased by*
 - *Arg3: start point*
 - *Arg4: end point*
- ***The government increased taxes by 5%.***
- ***Taxes increased.***

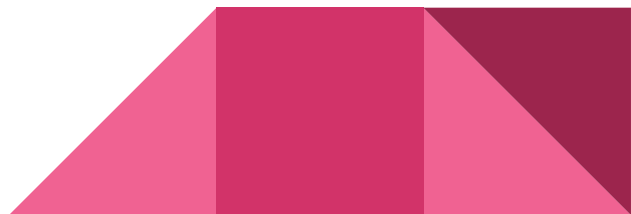


PropBank

	<input type="checkbox"/> SRL
The	causer of increase [A0]
government	
increased	
taxes	
by	
5	V: increase.01
%	thing increasing [A1]
because	amount increased by, EXT or MNR [A2]
of	
economic	
decline	
.	cause [AM-CAU]

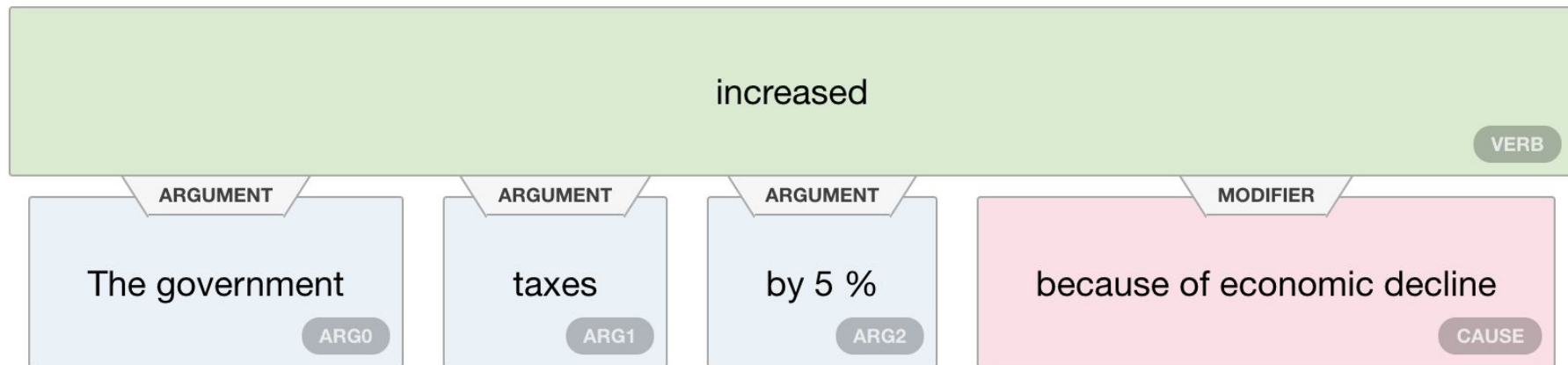
PropBank

TMP	when?	yesterday evening, now
LOC	where?	at the museum, in San Francisco
DIR	where to/from?	down, to Bangkok
MNR	how?	clearly, with much enthusiasm
PRP/CAU	why?	because ... , in response to the ruling
REC		themselves, each other
ADV	miscellaneous	
PRD	secondary predication	...ate the meat raw



Semantic Role Labelling in AllenNLP

The government increased taxes by 5 % because of economic decline .



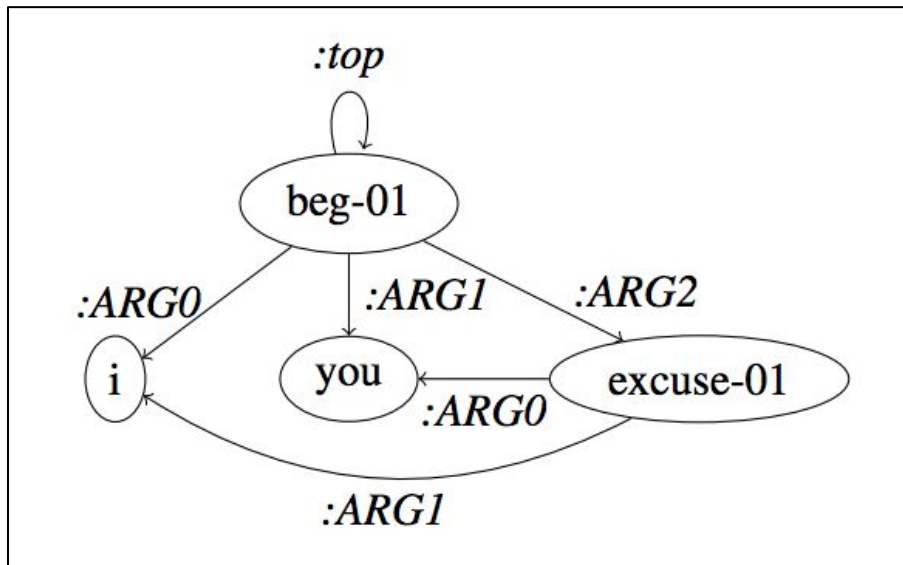
FrameNet

- Abandonment:
 - *abandon, abandoned, abandonment, leave, forget*
- An **Agent** leaves behind a **Theme** effectively rendering it no longer within their control or as one's property...
- examples:
 - ***Carolyn** abandoned **her car** and jumped on a bus.*
 - *Abandonment of **a child** is considered to be a serious crime in many jurisdictions.*
 - *Perhaps **he** left **the key** in the ignition.*

Abstract Meaning Representation

I beg you to excuse me.

```
(b / beg-01  
  :ARG0 (i / i  
    :ARG1 (y / you)  
    :ARG2 (e / excuse-01  
      :ARG0 y  
      :ARG1 i))
```



Usage in NLP

- Natural Language Understanding tasks:
 - Information retrieval
 - Event extraction
 - Question answering
 - Textual entailment
 - Paraphrasing/deduplication





Questions?