AIDA/MAA/KAIROS Programs: Cross-Program Ontology effort

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Do we still need ontologies in the era of Generative AI?

Models still need predictable direction from high level schema descriptions to provide reliable and controllable AI, such as:

- Replicable, consistent system performance
- Explanations of decisions made
- Accurate interpretations of novel situations

Background - Motivation

Previous approach, limited to closed-domain applications

- Create small domain specific ontologies for each new DARPA program
  - Ex. KAIROS, ONE YR in:
    - Program consensus on 54 Event primitives (21 from AIDA)
    - Less fine-grained, broader coverage , e.g., + cognitive events
  - Weekly calls (20+ persons), + 5-10 hours (x N) a week preparation

4/20 - Goals of new Cross-Program (AIDA/KAIROS/MAA) Ontology Working Group

Ideally, a general-purpose, broad-coverage upper/middle level ontology that is maintained by a community of users

Does such an ontology exist? (very little event coverage or community maintenance for SUMO, BFO, BSO, Omega, etc)

Wikidata was not planned as an ontology. However, it is a very large, growing, community maintained comprehensive knowledge base from which ontologies can be extracted - *Much better that starting from scratch!*

Issues with adapting Wikidata

Events

- Insufficient coverage of events (although thousands more)
- Lack of event structure - very few event participants

Multiple inheritance relations for entities and events

- subclass_of, instance_of, parent_taxon, etc.
- sometimes circular
  - DWD Overlay has a “parent” link that is more reliable

Cross-Program Ontology Working Group Proposal- 6/2020

1. Merge AIDA/KAIROS LDC tag set; situate within a comprehensive DWD ontology; Map to Wikidata
2. Extract DARPA relevant upper/middle level model judiciously from Wikidata . (1 + 2) → Overlay
3. DARPA Wikidata Overlay broad enough to readily adapt to specific domains - Pandemics; Riots,
4. Allow for matching of similar concepts and partial credit for near neighbors

Current XPO Json 5.4.7

Node type	Total	Top level	PB
Entities	276	68	0
Events	5,168	479	5,165
Relations	216	152	144
Temporal relations	8	8	1

Elizabeth Spaulding, Kathryn Conger, Anatole Gershman, Rosario Uceda-Sosa, Susan W. Brown, James Pustejovsky, Peter Anick, and Martha Palmer. 2023, June 20. The DARPA Wikidata Overlay: Wikidata as an ontology for NLP, The 2023 Joint ACL - ISO Workshop on Interoperable Semantic Annotation, held with IWCS, Nancy, France.

Qnode Mapping: Anatole, Rosario, Ghazaleh, Elizabeth

LDC tag	LDC Type Name	Q node description	Q node
LDC_ent_001	BAL (backoff)	political_candidate | ballot	Q19772737 | Q905151
LDC_ent_002	BAL.BallotSlate	political_candidate	Q19772737
LDC_ent_003	BAL.PaperBallot	ballot	Q905151
LDC_ent_004	COM	work_product | artificial_phy	Q15401930 | Q8205328
LDC_ent_005	COM.Document	document | written_work	~~Q19772737~~
LDC_ent_006	COM.Document.Map	map	Q4006
LDC_ent_007	COM.Document.PersonalIdentificatic	identity_document	Q47988
LDC_ent_00	COM.Equipment	equipment	Q16798631
LDC_ent_009	COM.Equipment.HumanitarianAid	humanitarian_aid	Q826745
LDC_ent_010	COM.Equipment.MedicalEquipment	medical_equipment	Q6657015
LDC_ent_011	COM.Equipment.MilitaryEquipment	military_equipment	Q18643213
LDC_ent_012	COM.Equipment.Satellite	artificial_satellite	Q26540
LDC_ent_013	COM.Flag.Flag	flag	Q14660
LDC_ent_014	COM.Wreckage.Wreckage	debris	Q637703
LDC_ent_028	FAC	artificial_geographic_entity	Q27096235
LDC_ent_029	FAC.Building	building	Q41176

Mapping KAIROS event types to Wikidata

- Most (91%) map in some way to an appropriate WD event type
  - 67% one-to-one mapping
  - 9% Qnode unions
  - 15% multiple inheritance
- Some require multiple inheritance of WD types
  - Prevarication.Correspondence → Deception + remote communication
- Some are too specific for WD
  - PreventPassage
  - GrantPassage
  - ChangeJobLocation
- Wikidata does not have enough event Qnodes
- Wikidata events do not provide participant information

Colorado: Susan Brown, Ghazaleh Kazeminejad

Computational Language and EducAtion Research
C L E A R

Examples of KAIROS events with WD mappings

KAIROS event type	**WD mapping**
IdentifyCategorize	Identification
TeachingTrainingLearning	Education
Demonstrate	Protest
Correspondence	Remote Communication
Prevarication	Deception

Examples of KAIROS events with no WD mappings - overlay opportunity?

KAIROS event type	**Closest possible WD parent**
Broadcast (one-way communication)	Communication
ChangePosition (employment)	Social procedure
AidBetweenGovernments	Gift
Disable/Diffuse	Damage?
PreventPassage	Refusal

Event hierarchy in DWD with consistent roles

Property_crime

is a parent of **Theft**

is a parent of **Robbery**

is a parent of **Armed_robbery**

This hierarchy in DWD follows the “is_subclass_of” relationships in Wikidata

Most have compatible roles in DWD: *pag_thief/robber; ppt_thing_stolen/money_or_valuables;* and *dir_source/person_robbed*

JSON v5.4.7

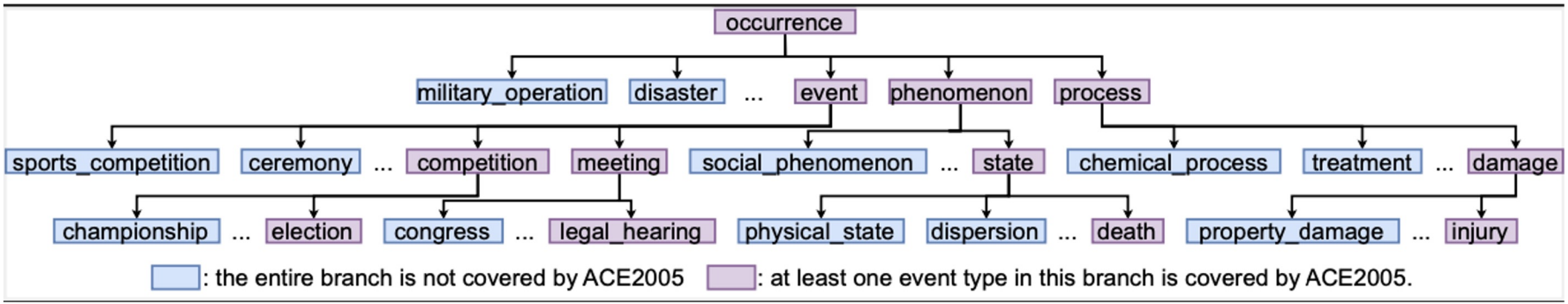
https://github.com/e-spaulding/xpo

- 1,125 human-curated mappings in the JSON
- Events have PropBank rolesets, arguments, overlay parents, and templates (some automatically generated)
- Where there is still ongoing curation work, some fields indicate the status of the curation

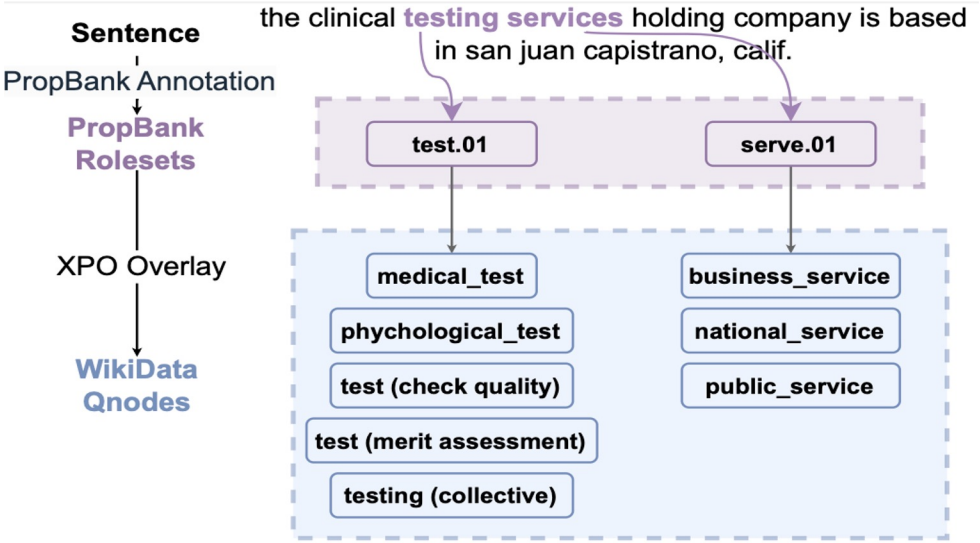

```
"DWD_Q650711": {
    "name": "combat",
    "wd_node": "Q650711",
    "wd_description": "purposeful violent conflict",
    "overlay_parents": [
        {
            "name": "conflict",
            "wd_node": "Q180684"
        }
    ],
    "pb_roleset": "combat.01",
    "curated_by": "xpo_partial",
    "arguments": [
        {
            "short_name": "A0_pag",
            "name": "A0_pag_first_fighter",
            "constraints": []
        },
        {
            "short_name": "A1_com",
            "name": "A1_com_second_fighter_if_separate",
            "constraints": []
        },
        {
            "short_name": "A2_ppt",
            "name": "A2_ppt_spoils",
            "constraints": []
        }
    ],
    "template": "<A0_pag_first_fighter> combated with <
    A1_com_second_fighter_if_separate> PREPOSITION <A2_ppt_spoils>",
    "template_curation": "auto"
},
```

UIUC - GLEN - General-Purpose Event Extraction [Zhan et al., 2023, submitted]

- Current event extraction benchmarks only focus on a few event types and limited domains
  - ACE05 has 33 event types, heavily focused on attack-related news
  - MAVEN is currently the largest event extraction dataset, has 168 types, most are military attack or natural disaster
- As a result, none of the current event extraction systems can be used as off-the-shelf tools
  - Users have to define their own ontology and collect their own data before being able to adopt any of the published models
  - *For the KAIROS evaluation, every time we add a new scenario, we need to collect data and do annotation*



GLEN Dataset Construction



- Start with available PropBank annotation
- PB- WD from DWD Overlay →each event mention (PB annotation) has 1 or more Qnodes
- Final dataset 20x larger in ontology size and 4x larger in corpus size than MAVEN

Dataset	# Docs	#Tokens	#Sentences	#Types	#Mentions
GLEN	6K	4M	200K	3.5K	200K

DWD Legacy

A new, improved Wikidata that is a better foundation for NLP

A DWD Overlay that provides a useable and concise access point for Wikidata that simplifies incorporation into NLP applications

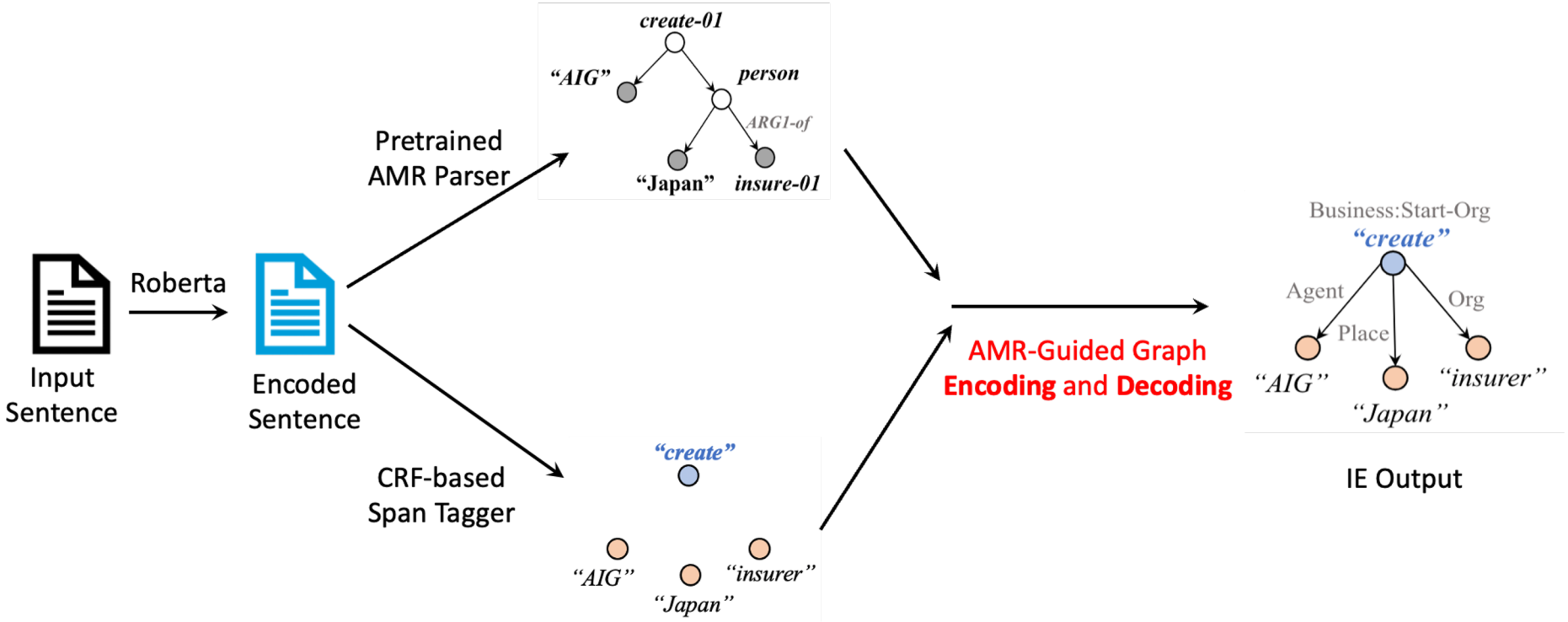
A DWD based approach to domain specific ontology induction that provides a rapid spin-up for new DARPA programs or general NLP applications

Practically, specification of a few high level concepts should enable extraction of a more comprehensive domain specific ontology from Wikidata.

The mapping to PB roleset ID's means ready addition to AMR/UMR

Applications

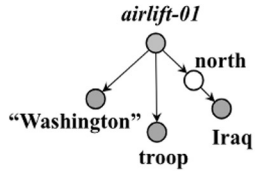
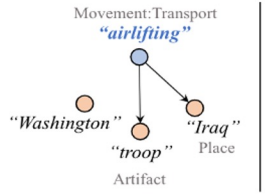
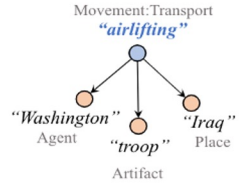
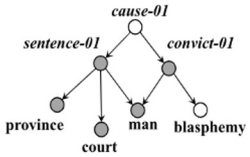
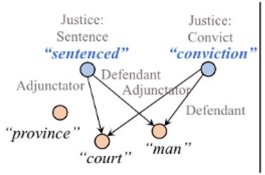
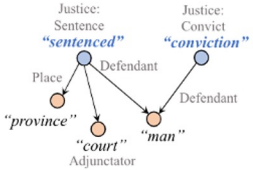
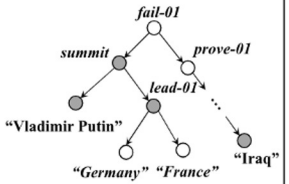
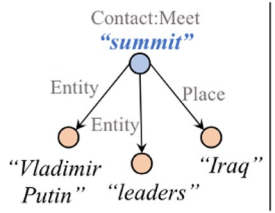
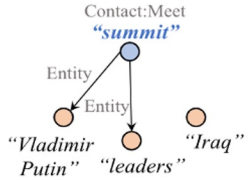
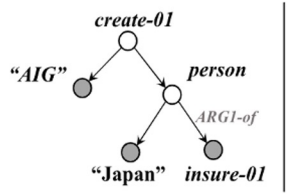
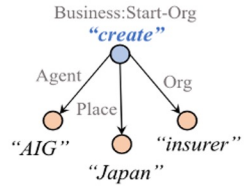
AMR-IE



Zixuan Zhang, Heng Ji. **AMR-IE: An AMR-guided encoding and decoding framework for IE.** NAACL'2021

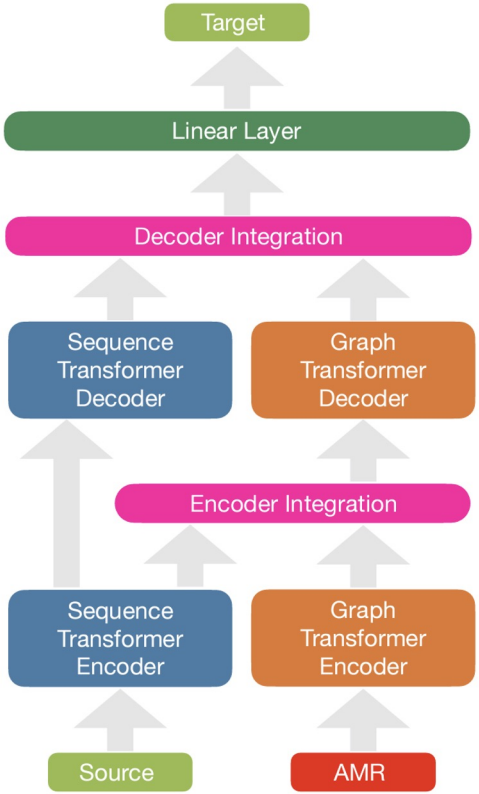
Slide credit: Heng Ji

Examples on how AMR graphs help

Sentence	AMR Parsing	*OneIE outputs*	*AMR-IE outputs*
If the resolution is not passed, **Washington** would likely want to use the airspace for strikes against Iraq and for **airlifting troops** to northern **Iraq**.			
A Pakistani **court** in central Punjab **province** has **sentenced** a Christian **man** to life imprisonment for a blasphemy **conviction**, police said Sunday.			
Russian President **Vladimir Putin**'s **summit** with the **leaders** of Germany and France may have been a failure that proves there can be no long-term "peace camp" alliance following the end of war in **Iraq**.			
Major US insurance group **AIG** is in the final stage of talks to take over General Electric's Japanese life insurance arm in a deal to **create Japan**'s sixth largest life **insurer**, reports said Wednesday.			

Slide credit: Heng Ji

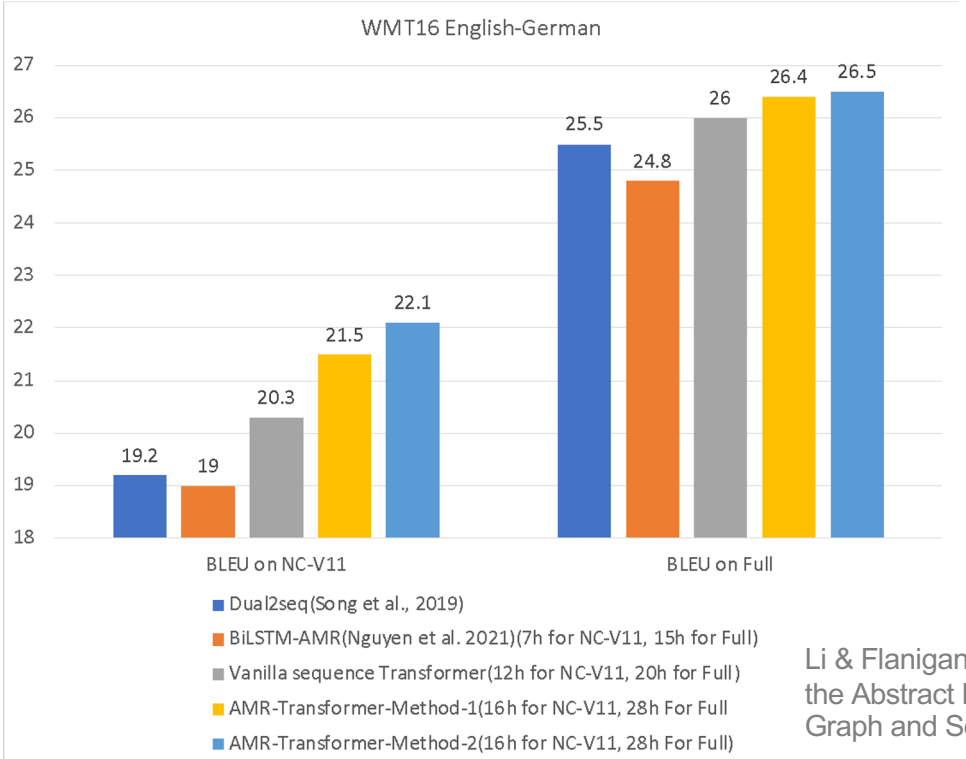
Machine Translation



Li & Flanigan. Improving Neural Machine Translation with the Abstract Meaning Representation by Combining Graph and Sequence Transformers. DLG4NLP 2022.

Slide Credit, Jeff Flanigan

Machine Translation



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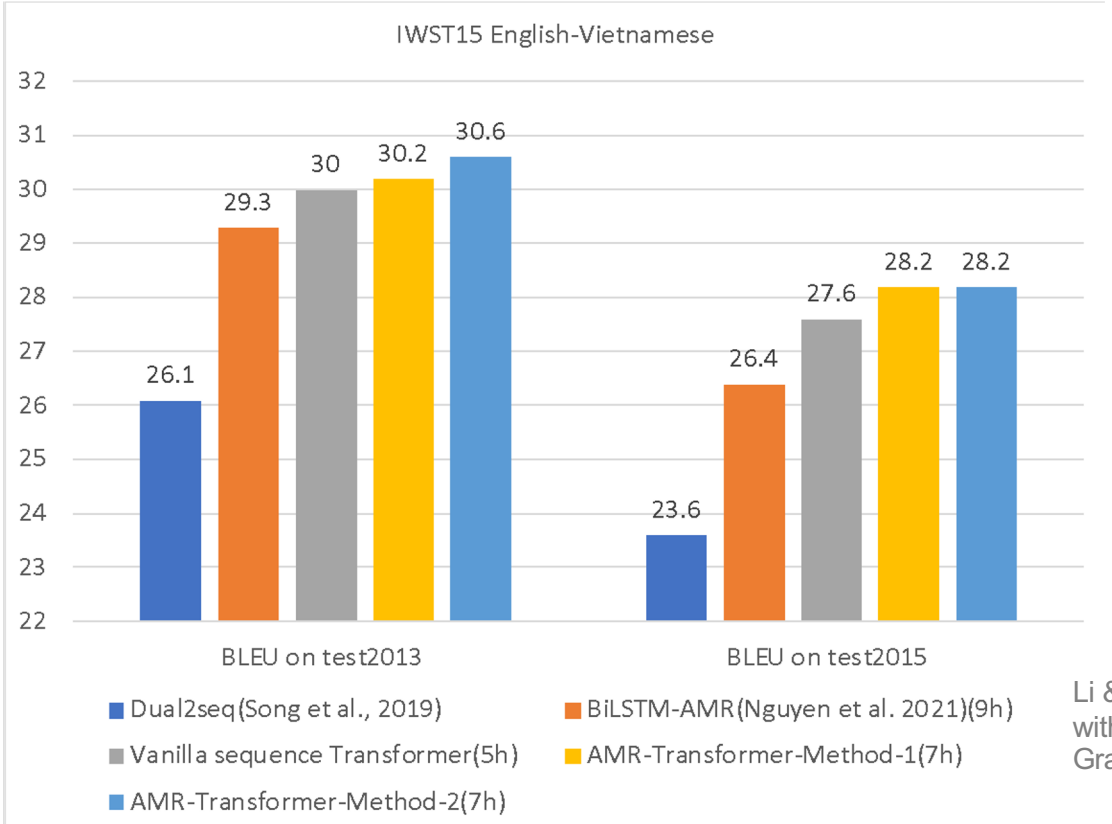

Li & Flanigan. Improving Neural Machine Translation with the Abstract Meaning Representation by Combining Graph and Sequence Transformers. DLG4NLP 2022.

Slide Credit, Jeff Flanigan

Summary: Value of Meaning Representation

SRL
AMR

	Work Out-of-box	Deeper understanding of text		
	Overcome Low-resource Challenges	Robustness against linguistics variants & complexity	Better model generalization	Explainability & Interpretability
Information Extraction	✓	✓	✓	
Text Classification	✓	✓	✓	✓
Natural Language Inference			✓	
Question Answering		✓		✓
Dialog			✓	
Machine Translation	✓	✓		

Slide Credit, Yunyao Li & Jeff Flanigan, EMNLP 2022 Tutorial

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  - Ying Lin, Heng Ji, Fei Huang, and Lingfei Wu. 2020. A Joint Neural Model for Information Extraction with Global Features. pages 7999–8009, ACL 2020
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