TTIC 31230, Fundamentals of Deep Learning

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Representing Choices and Knowledge

with Natural Language

Natural Langauge as a General Learning Architecture

Is natural langauage a reflection of a general learning or knowledge representation architecture?

Will some NLP-motivated memory-based Transformer-like architecture prove to be general — domain independent.

Is there ultimately an important relationship between language and logic?

Natural Language Semantics

Thousands of civilians have fled advances by Syrian government forces in eastern Ghouta as ...

Stanford Parse Tree

```
(NP (NP (NNS Thousands))
    (PP (IN of) (NP (NNS civilians))))
(VP (VBP have)
    (VP (VBN fled)
        (NP (NNS advances))
        (PP (IN by) (NP (NP (JJ Syrian)
                            (NN government)
                            (NNS forces))
                        (PP (IN in) (NP (JJ eastern)
                                        (NNP Ghouta)))))))
```

Stanford Dependencies

```
root(ROOT-0, fled-5)
  aux(fled-5, have-4)
  nsubj(fled-5, Thousands-1)
    nmod(Thousands-1, civilians-3)
      case(civilians-3, of-2)
  dobj(fled-5, advances-6)
  nmod(fled-5, forces-10)
    case(forces-10, by-7)
    amod(forces-10, Syrian-8)
    compound(forces-10, government-9)
    nmod(forces-10, Ghouta-13)
      case(Ghouta-13, in-11)
      amod(Ghouta-13, eastern-12)
```

Just Parantheses

```
(Thousands of civilians)
(have fled)
(advances (by (Syrian government forces))
          (in eastern Ghouta))
```

Reference (Entity Linking)

Thousands of civilians have fled advances by Syrian government forces in eastern Ghouta as Damascus makes rapid gains against the last major rebel enclave near the capital.

Damascus ⇒ Assad

Rapid Gains ⇒ advances-6

the last major rebel enclave ... ⇒ Ghouta

the capital ⇒ Damascus

Reference vs. Composition

Functional programming is compositional

$$x = f(y, z)$$

The meaning of x is computed by f from the meaning of y and z.

But in language we typically have that $f(y, z)$ is a mention and x is its referent.

(the last (major rebel enclave) (near (the capital)))

$$x = (\text{the last } Q \ P)$$

END