Universal Decompositional Semantic Parsing

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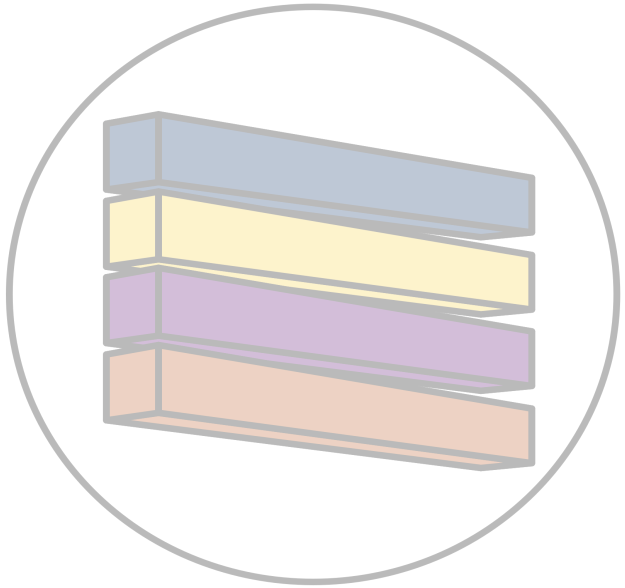
Aaron Steven White
Sheng Zhang
Benjamin Van Durme
ACL 2020



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Aaron White
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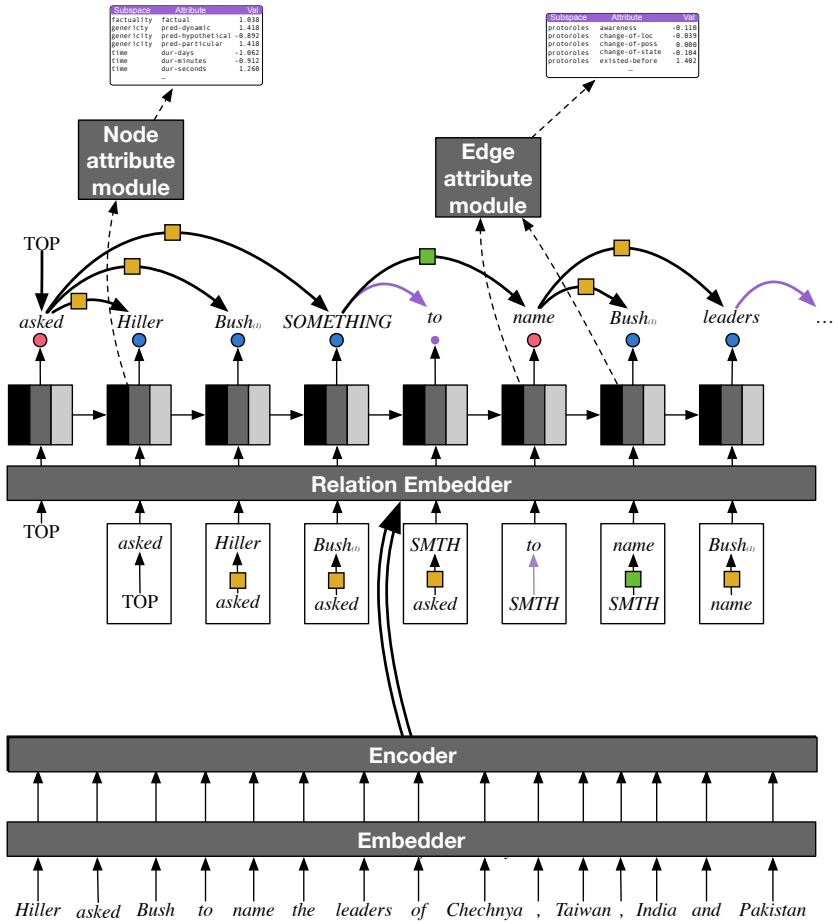
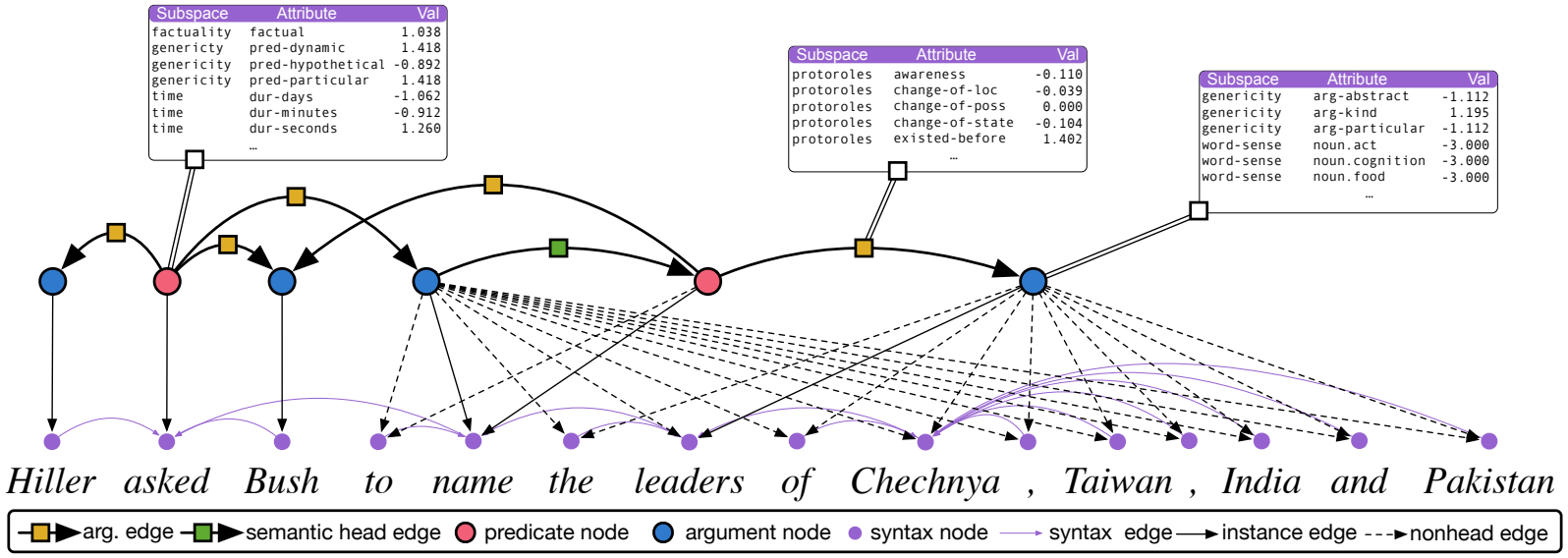
JHU 🚶 Microsoft Research

Ben Van Durme
Johns Hopkins University

Key Takeaways





First parsing model for UDS

Pipeline and end-to-end prediction

Unique task: graph structure + scalar values, jointly

Universal Decompositional Semantics (UDS)

- Semantics representations (often)
  - Hard to annotate
  - Brittle to non-prototypical instances
- UDS: decompose into simple questions
  - Scalar-valued, feature-based
  - Easy to annotate
  - Flexible

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The Universal Decompositional Semantics Dataset and Decomp Toolkit

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Abstract

We present the Universal Decompositional Semantics (UDS) dataset (v1.0), which is bundled with the Decomp toolkit (v0.1). UDS1.0 unifies five high-quality, decompositional semantics-aligned annotation sets within a single semantic graph specification—with graph structures defined by the predicative patterns produced by the PredPatt tool and real-valued node and edge attributes constructed using sophisticated normalization procedures. The Decomp toolkit provides a suite of Python 3 tools for querying UDS graphs using SPARQL. Both UDS1.0 and Decomp0.1 are publicly available at `http://decomp.io`.

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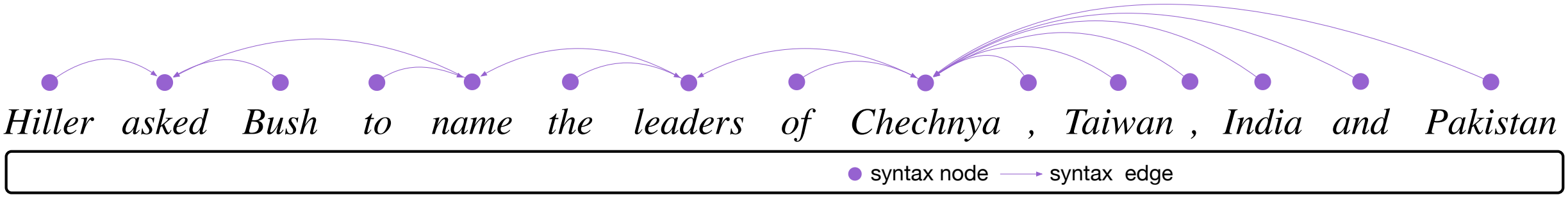
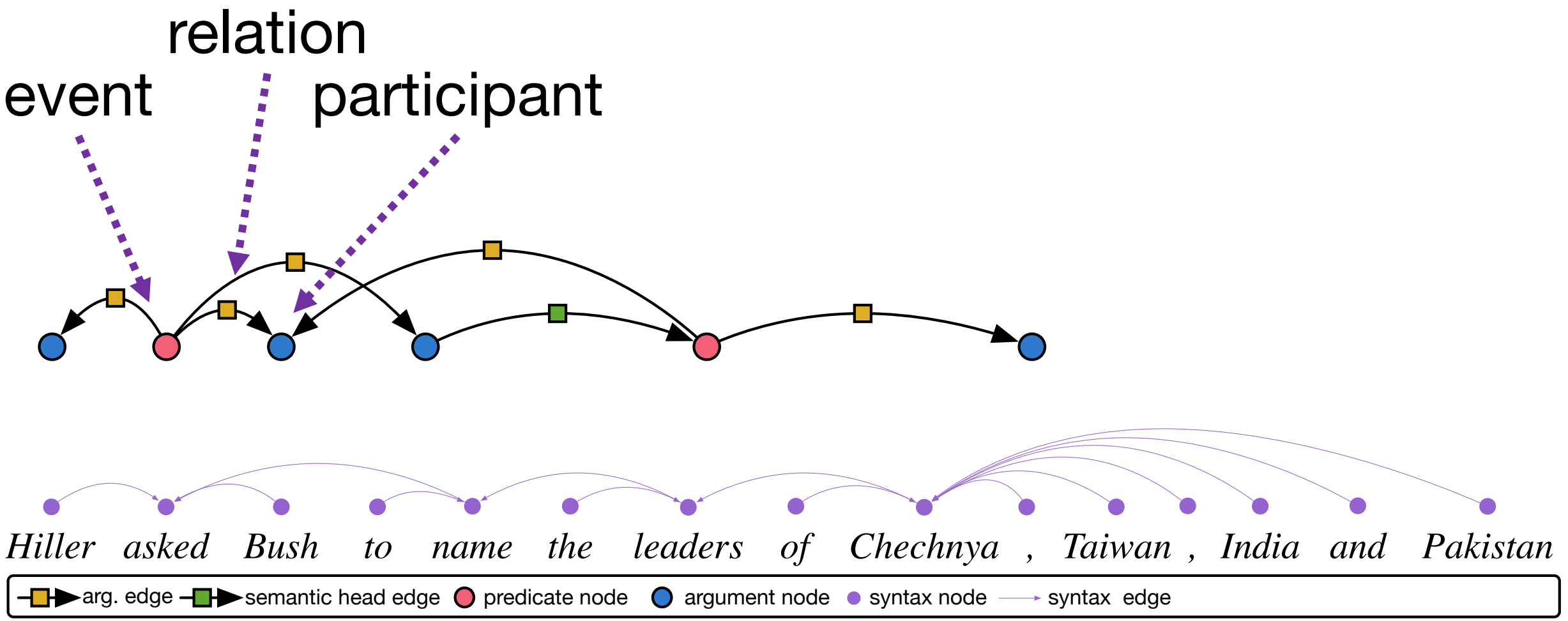
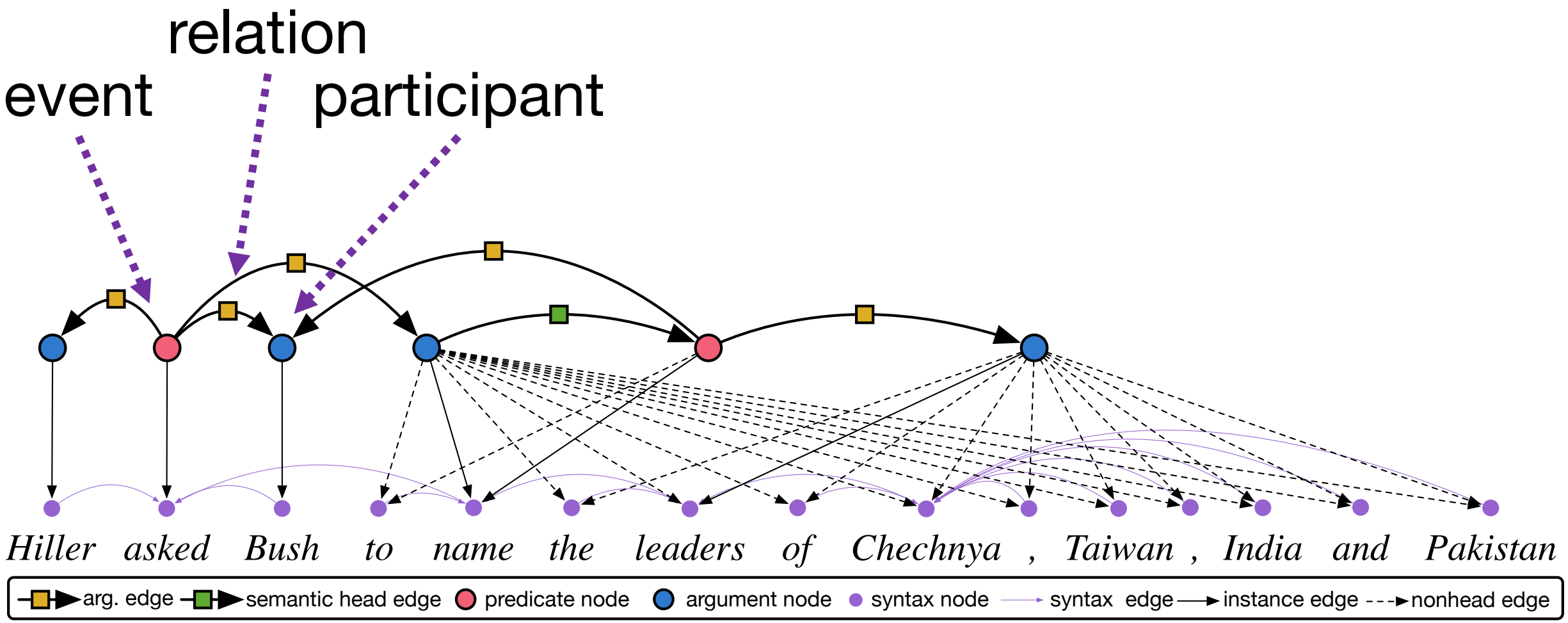
Hiller asked Bush to name the leaders of Chechnya , Taiwan , India and Pakistan


Hiller asked Bush to name the leaders of Chechnya , Taiwan , India and Pakistan
syntax node
syntax edge


relation
event
participant
Hiller asked Bush to name the leaders of Chechnya , Taiwan , India and Pakistan
arg. edge
semantic head edge
predicate node
argument node
syntax node
syntax edge


relation
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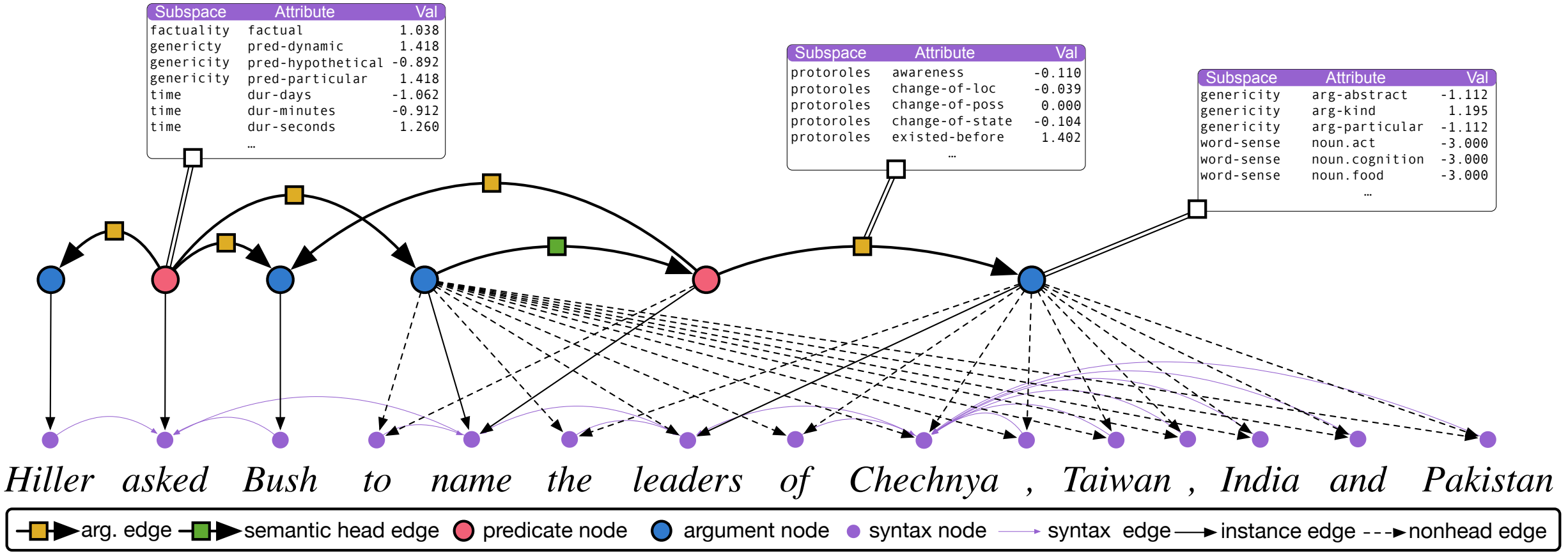
arg. edge
semantic head edge
predicate node
argument node
syntax node
syntax edge
instance edge
nonhead edge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factuality factual 1.038
genericty pred-dynamic 1.418
genericity pred-hypothetical -0.892
genericity pred-particular 1.418
time dur-days -1.062
time dur-minutes -0.912
time dur-seconds 1.260
…
Subspace Attribute Val
protoroles awareness -0.110
protoroles change-of-loc -0.039
protoroles change-of-poss 0.000
protoroles change-of-state -0.104
protoroles existed-before 1.402
…
Subspace Attribute Val
genericity arg-abstract -1.112
genericity arg-kind 1.195
genericity arg-particular -1.112
word-sense noun.act -3.000
word-sense noun.cognition -3.000
word-sense noun.food -3.000
…
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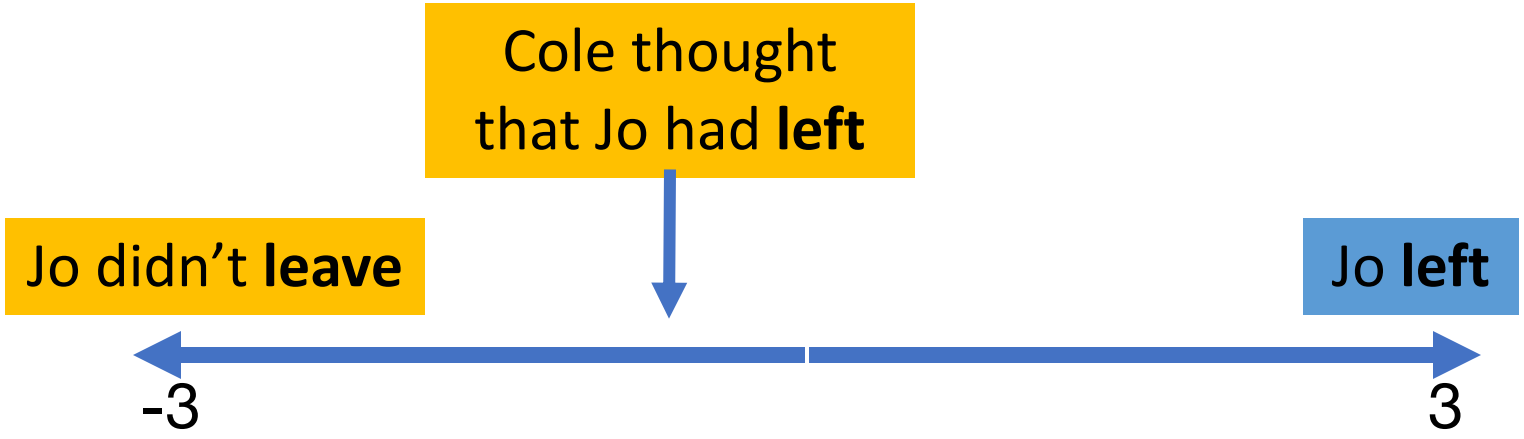
arg. edge
semantic head edge
predicate node
argument node
syntax node
syntax edge
instance edge
nonhead edge

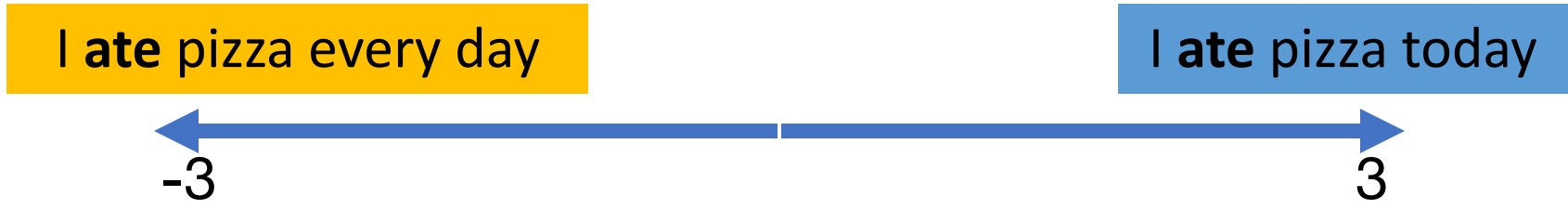
Universal Decompositional Semantics

- Factuality



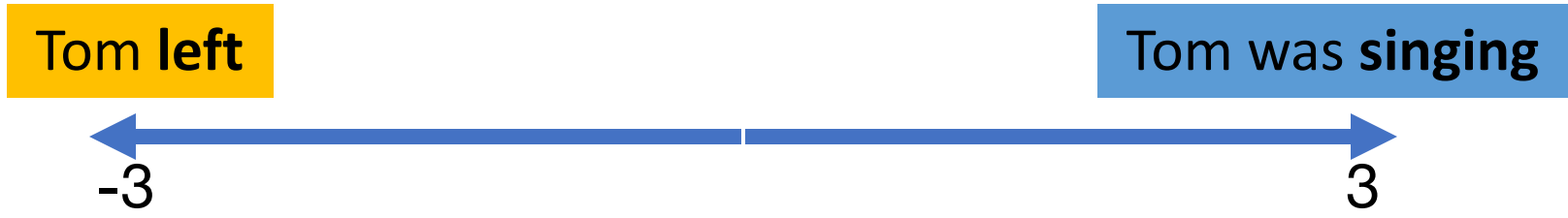
Universal Decompositional Semantics

- Factuality
- Genericity
  - E.g. pred-particular



Universal Decompositional Semantics

- Factuality
- Genericity
- Time
  - E.g. dur-minutes



Universal Decompositional Semantics

- Factuality
- Genericity
- Time
- Wordsense
  - E.g. sup.person

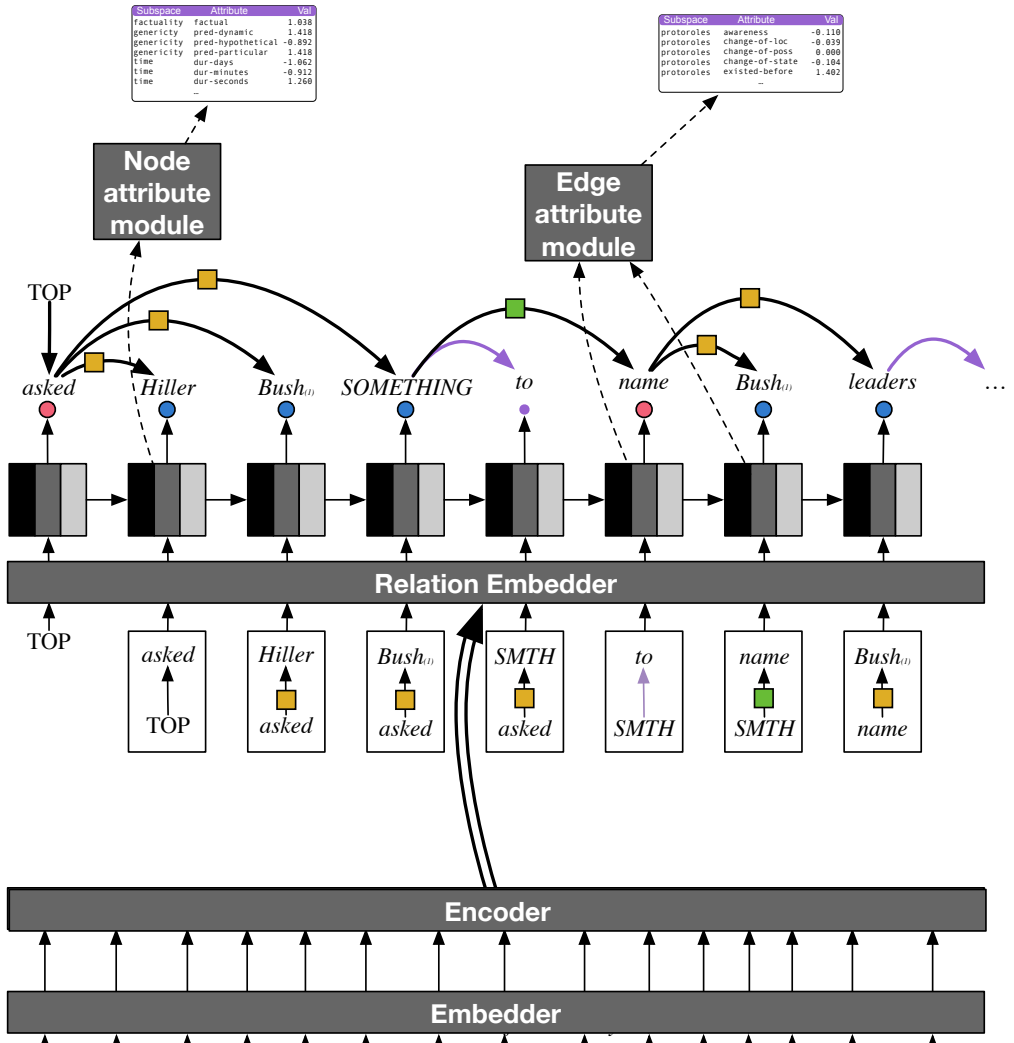
Universal Decompositional Semantics

- Factuality
- Genericity
- Time
- Wordsense
- Semantic proto-roles
  - E.g. volition

Why UDS?

- Annotation flexibility
  - Crowdsourced
  - Simple questions
- Rich meaning representation
  - Flexible inferences
  - Richer analysis

What's Transductive Parsing?



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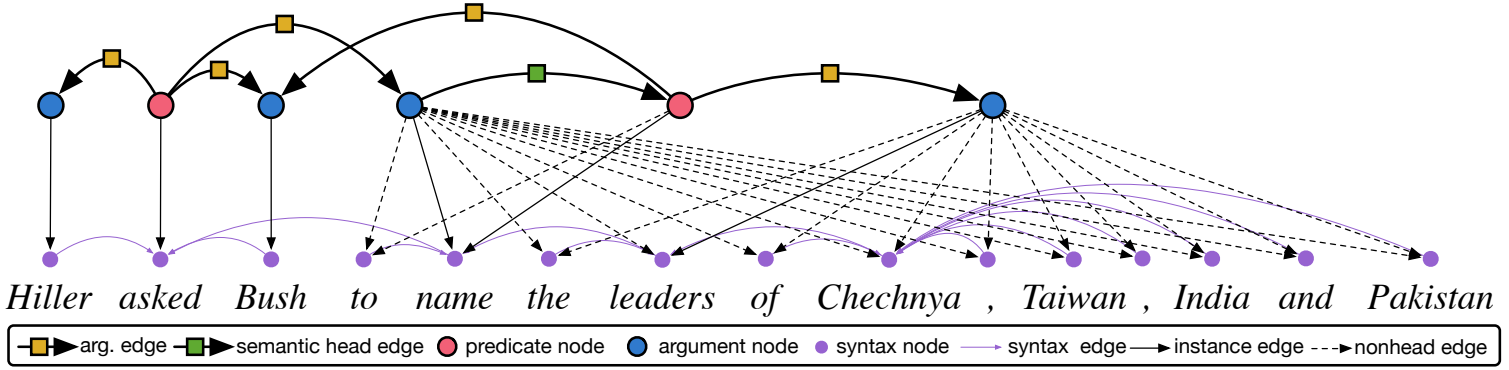
Arborescence

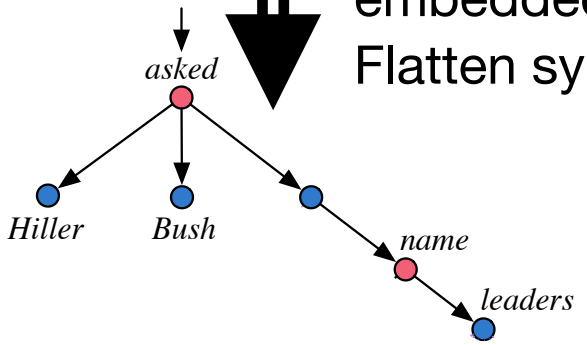


Assign head labels

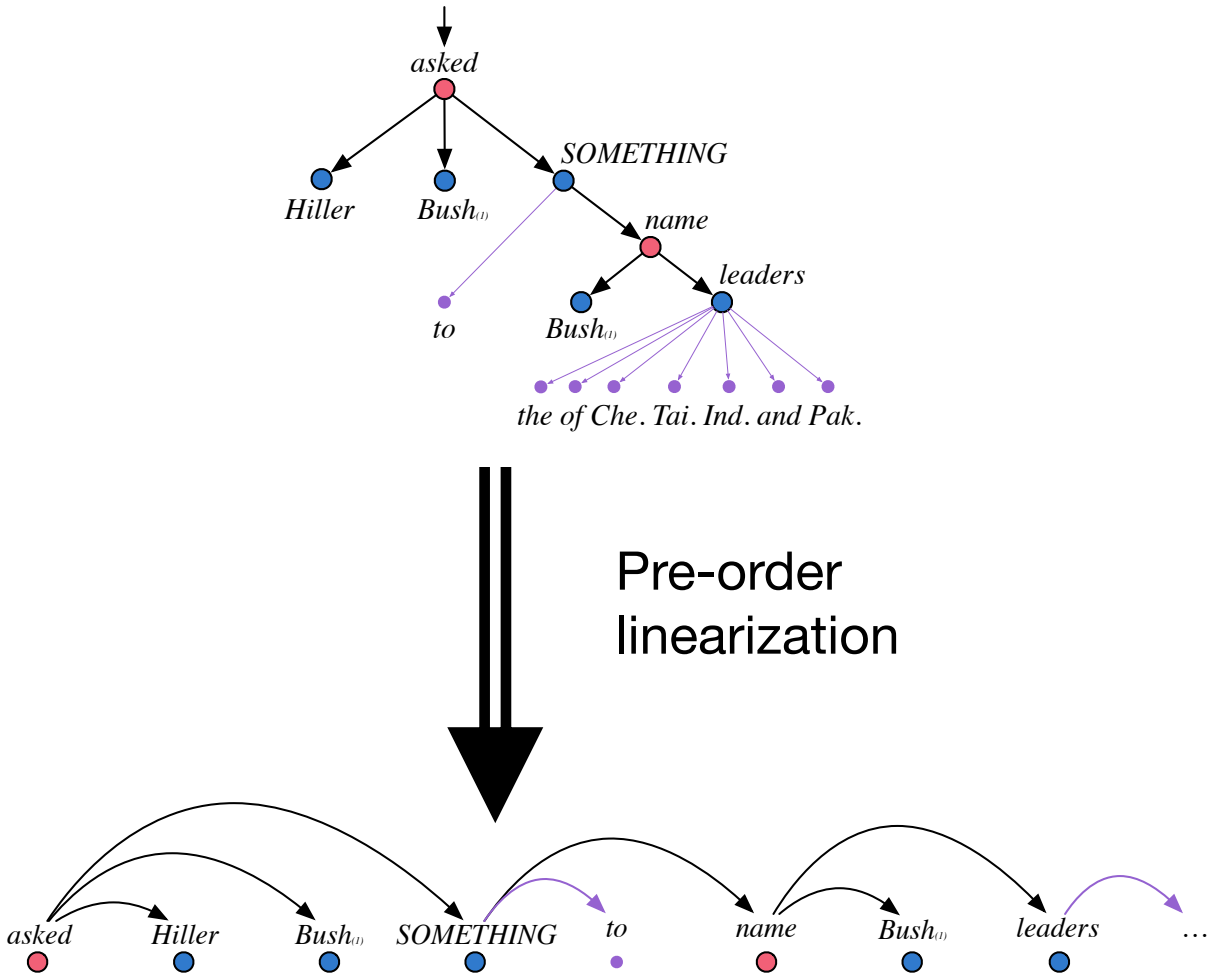
Copy re-entrant nodes

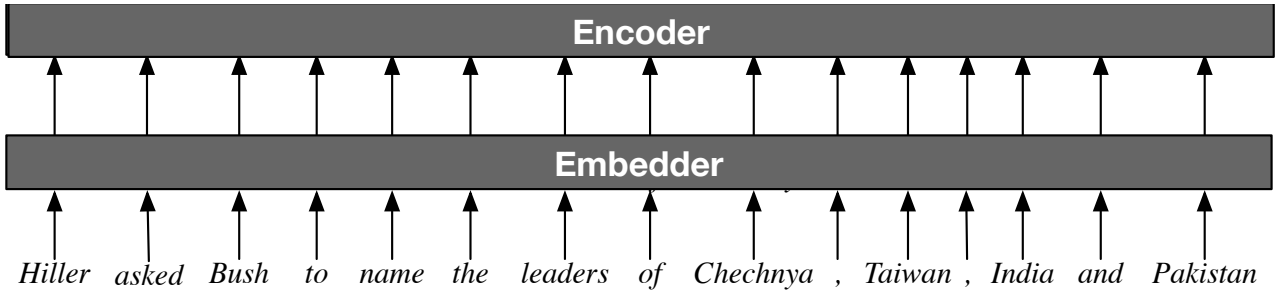
Explicitly represent embedded predicates

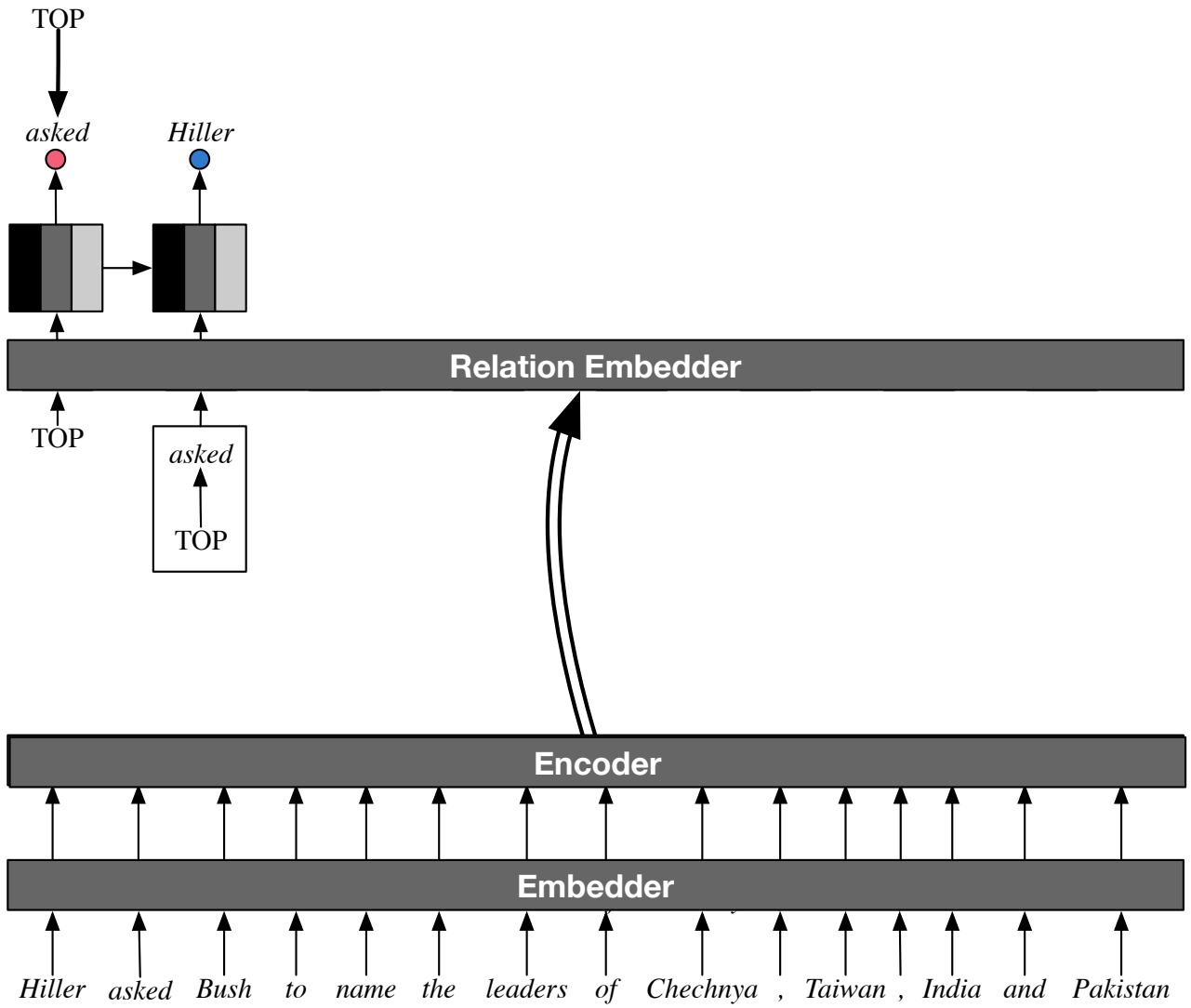
Flatten syntax graphs



Linearization




Encoder
Embedder
Hiller asked Bush to name the leaders of Chechnya , Taiwan , India and Pakistan


TOP
asked
Hiller
Relation Embedder
TOP
asked
TOP
Encoder
Embedder
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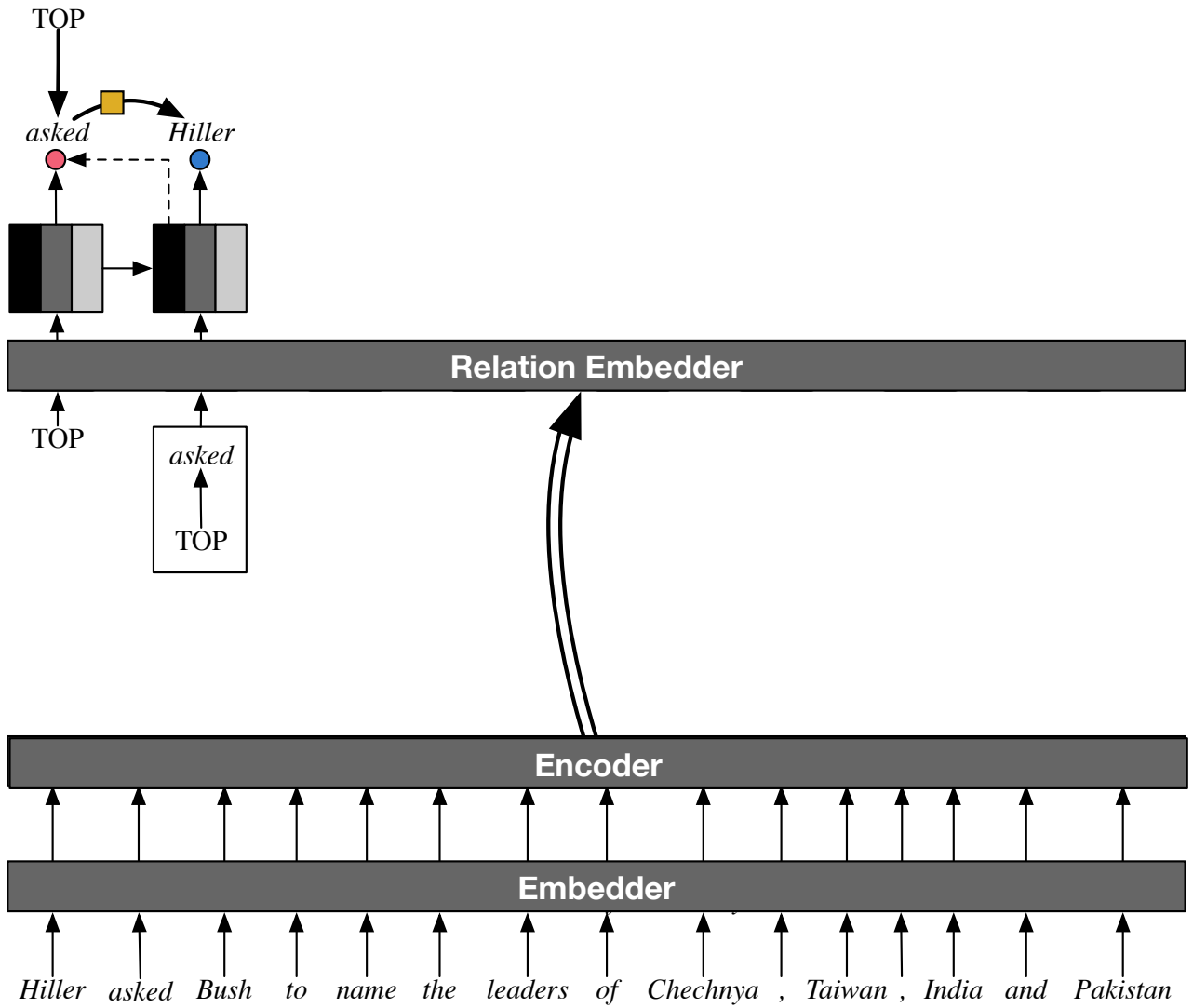
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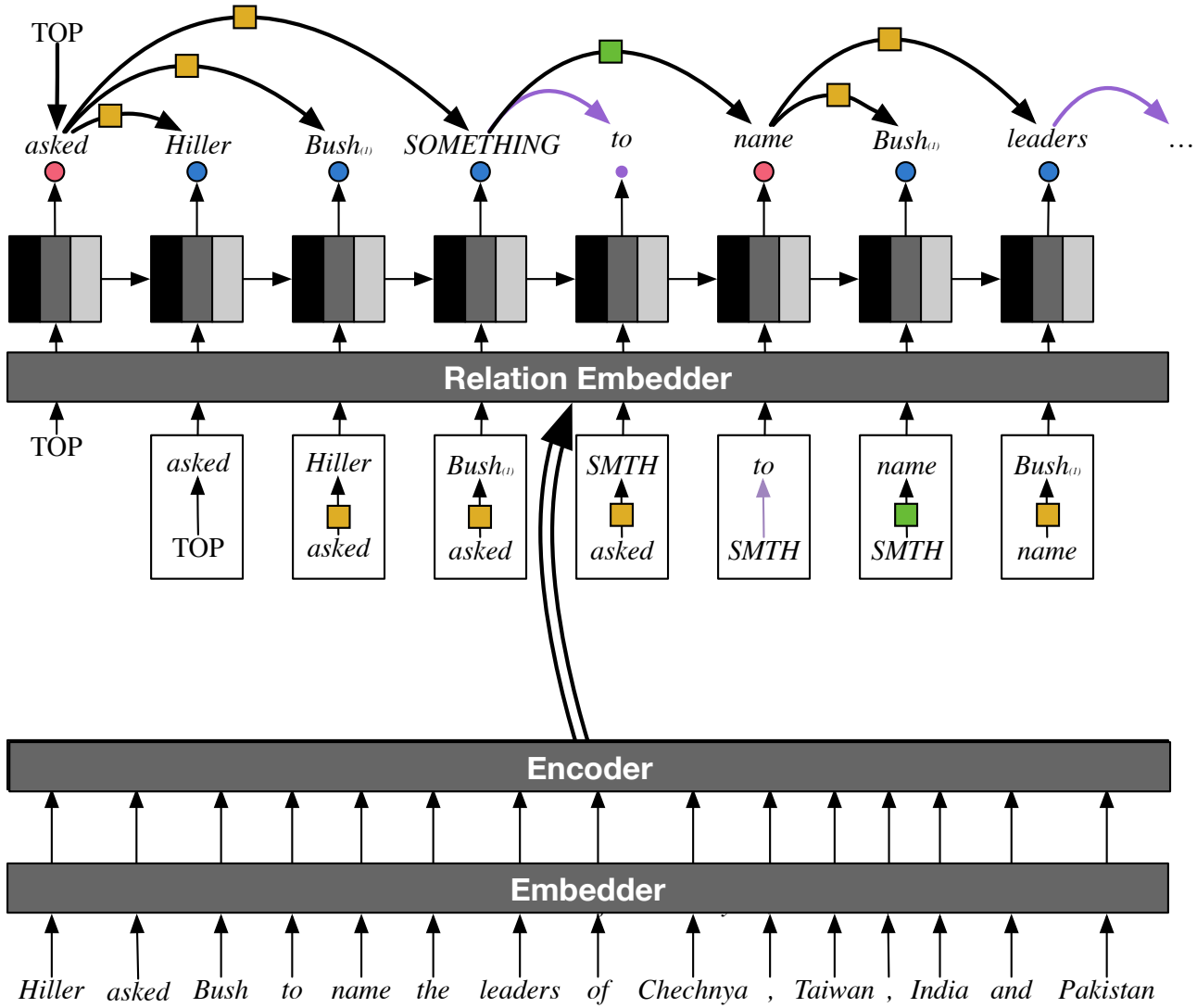
TOP
asked
Hiller
Bush(1)
SOMETHING
to
name
Bush(1)
leaders
…
Relation Embedder
TOP
asked
TOP
Hiller
asked
Bush(1)
asked
SMTH
asked
to
SMTH
name
SMTH
Bush(1)
name
Encoder
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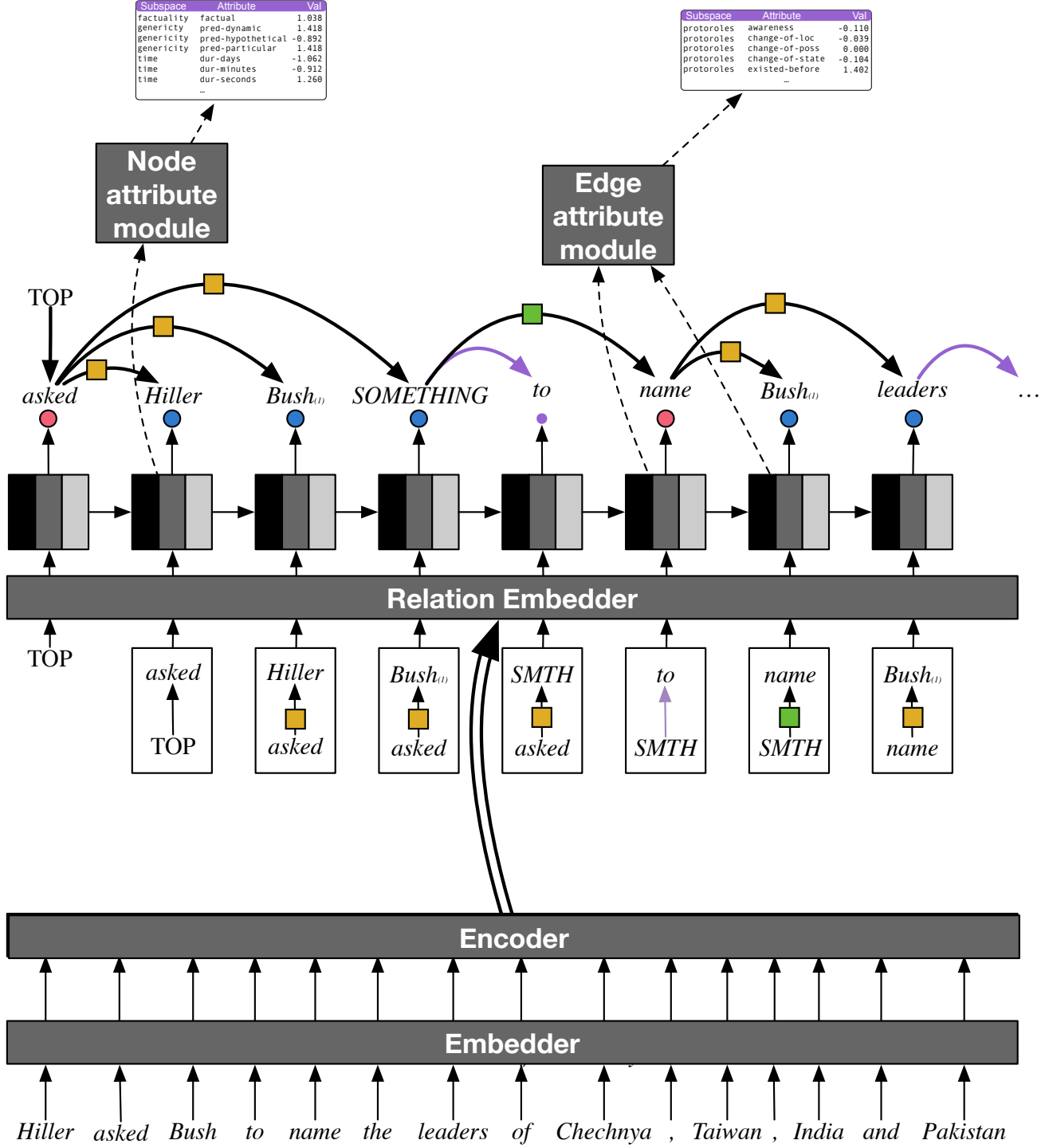
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…
Node attribute module
Edge attribute module
TOP
asked
Hiller
Bush(1)
SOMETHING
to
name
Bush(1)
leaders
…
Relation Embedder
TOP
asked TOP
Hiller asked
Bush(1) asked
SMTH asked
to SMTH
name SMTH
Bush(1) name
Encoder
Embedder
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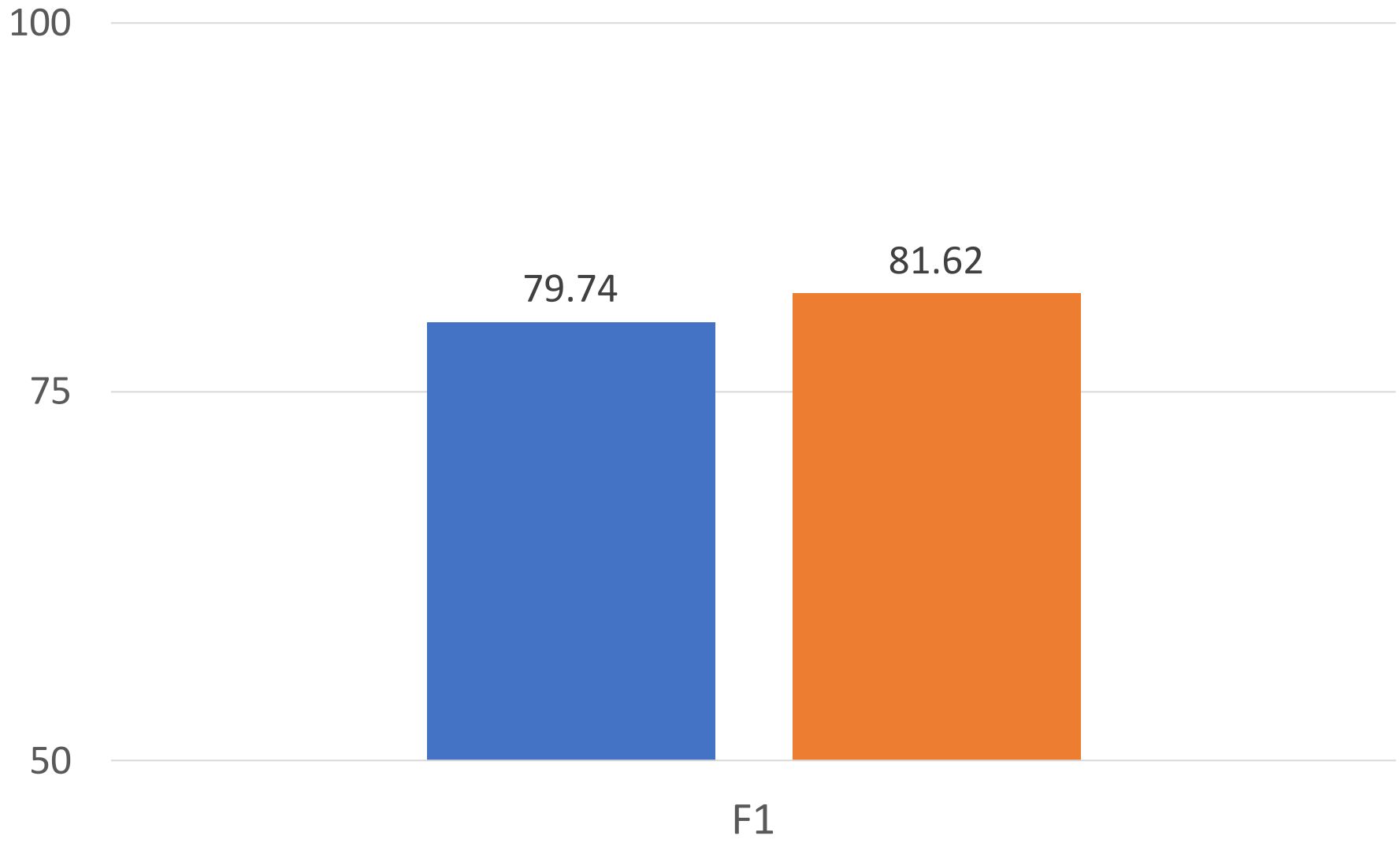
Evaluation Metrics

- S score (Zhang et al. 2016)
  - Extension of SMATCH (Cai et al. 2013)
  - How well do two graphs match?
  - Structure and attributes
- For attributes under oracle setting
  - Pearson's R between predicted and gold attributes
  - F1 score on binarized values (> threshold, <= threshold)

Graph Structure Matching (Syntax included)



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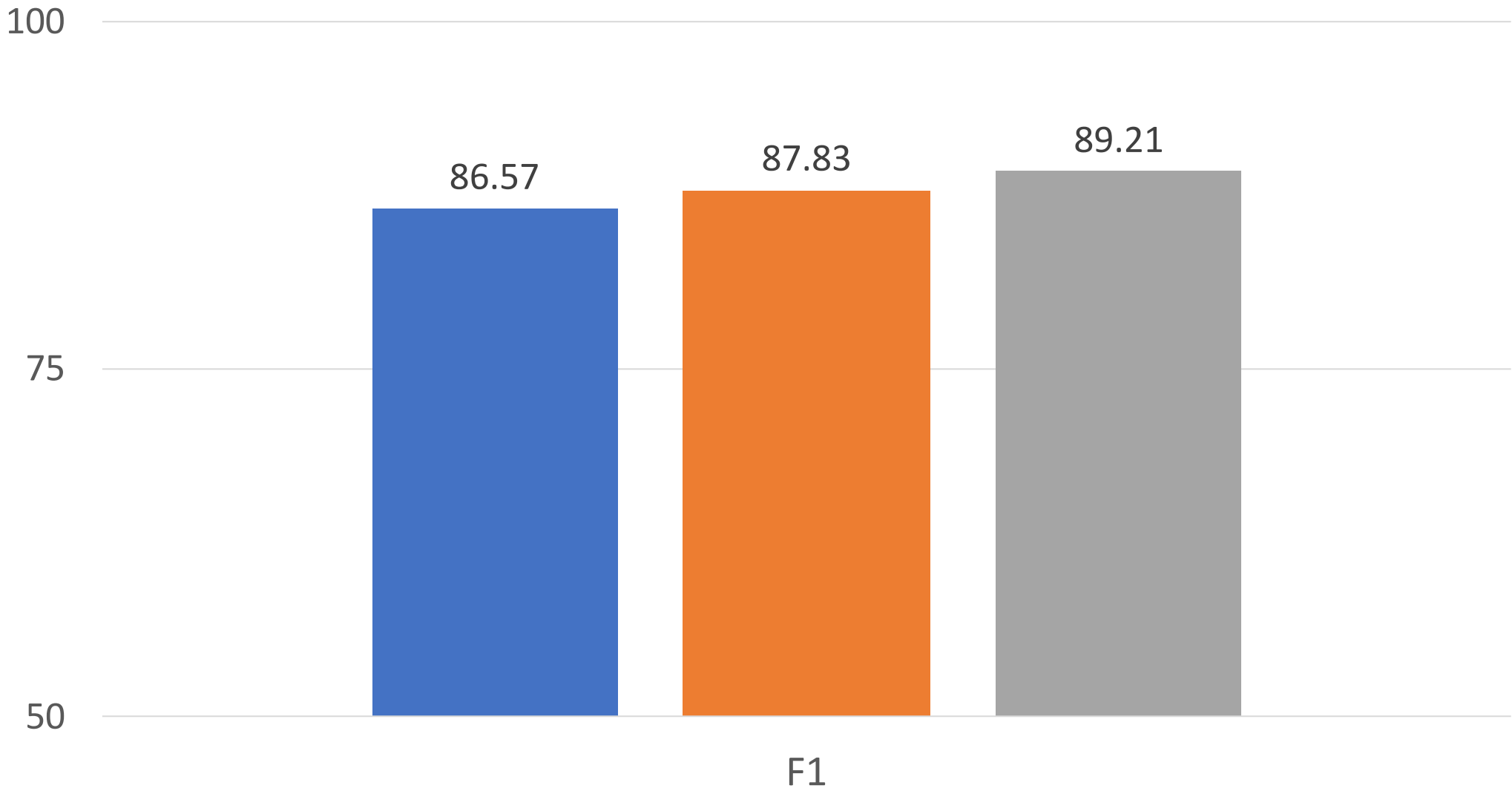
Graph Structure Matching (Semantics only)



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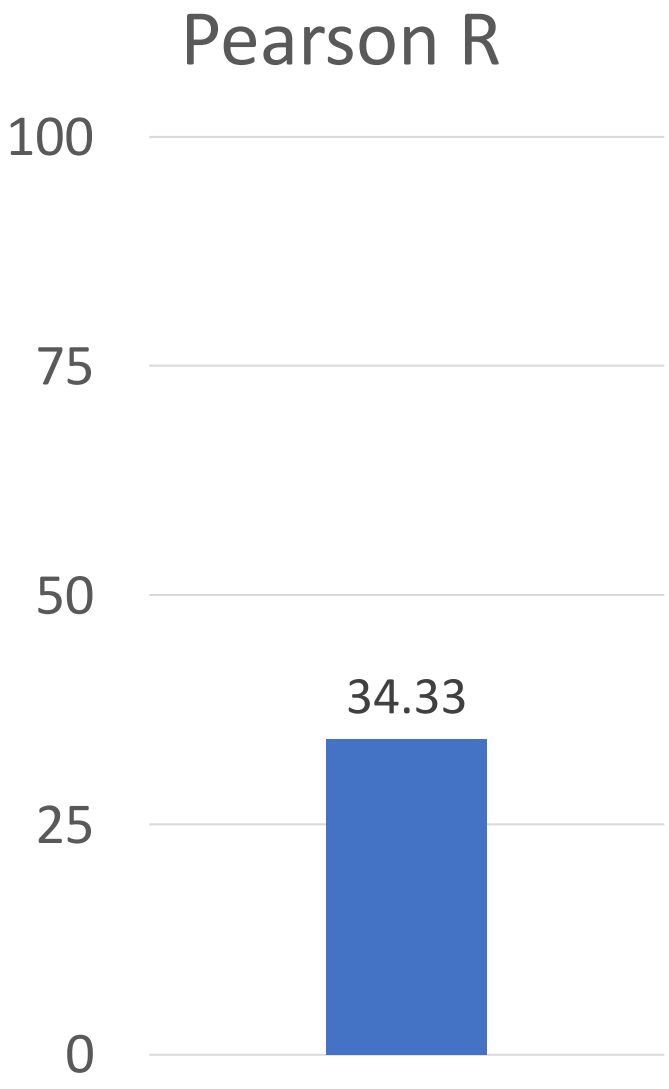

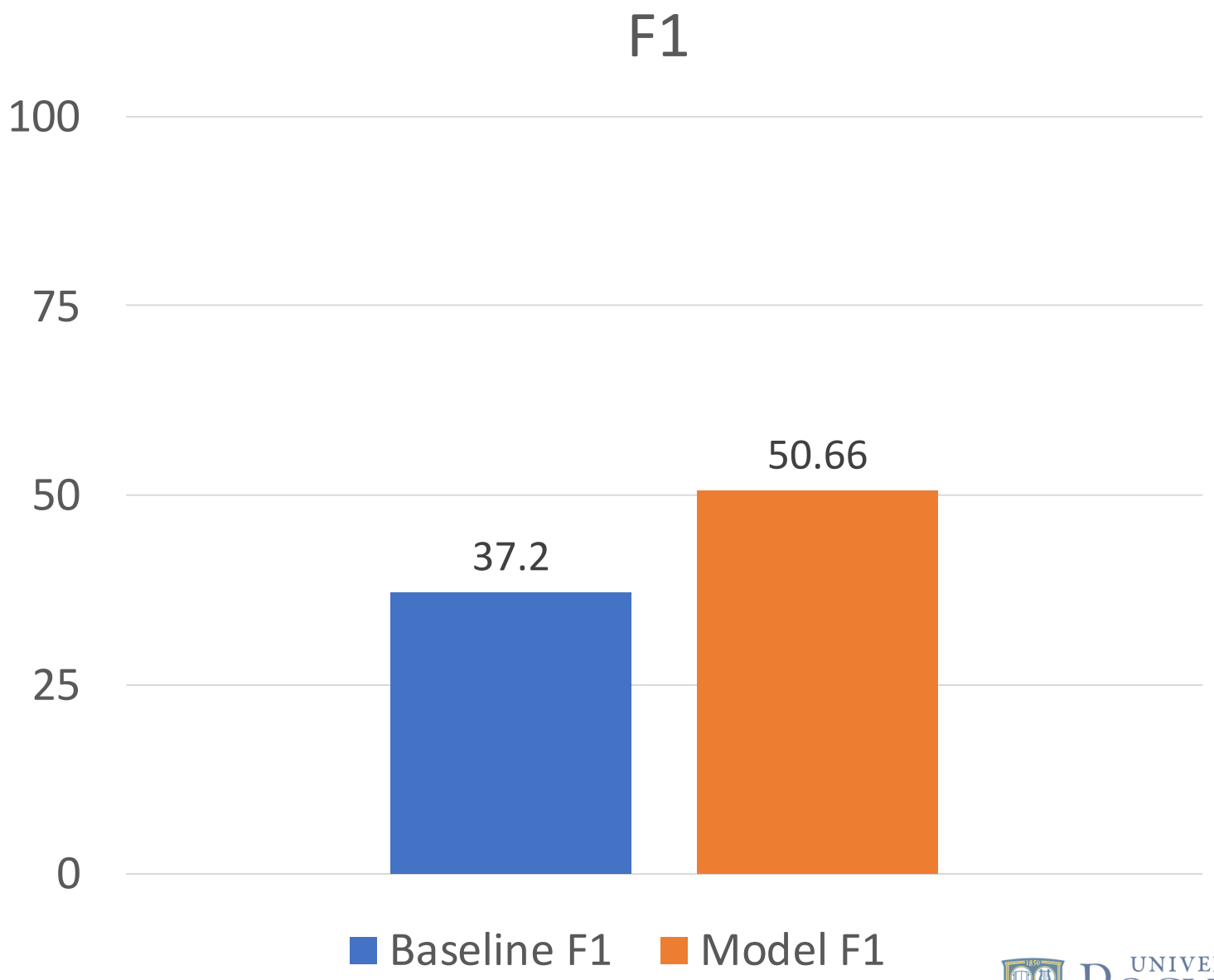

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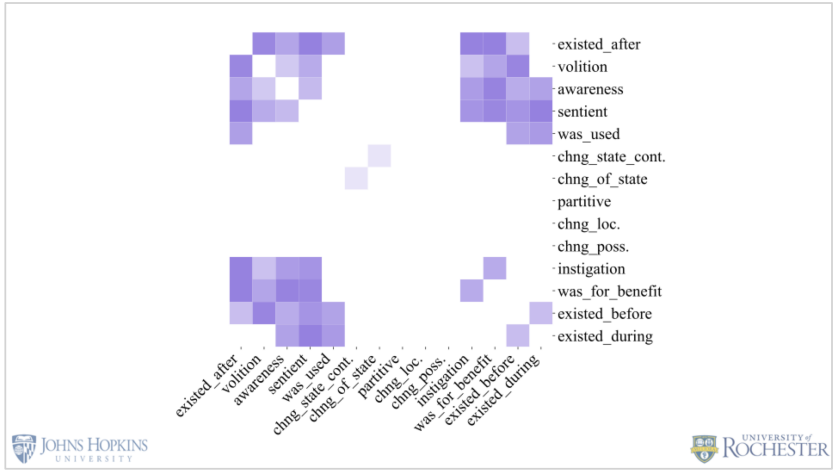
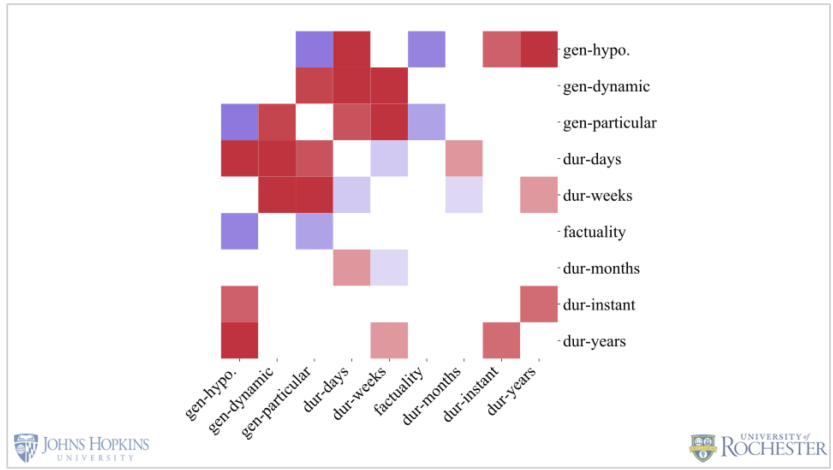
$$\psi(j,k) = \tanh\left(1 - \frac{|\mathrm{corr}(\nu^j - \nu^{j*}, \nu^k - \nu^{k*})|}{|\mathrm{corr}(\nu^{j*}, \nu^{k*})|}\right)$$

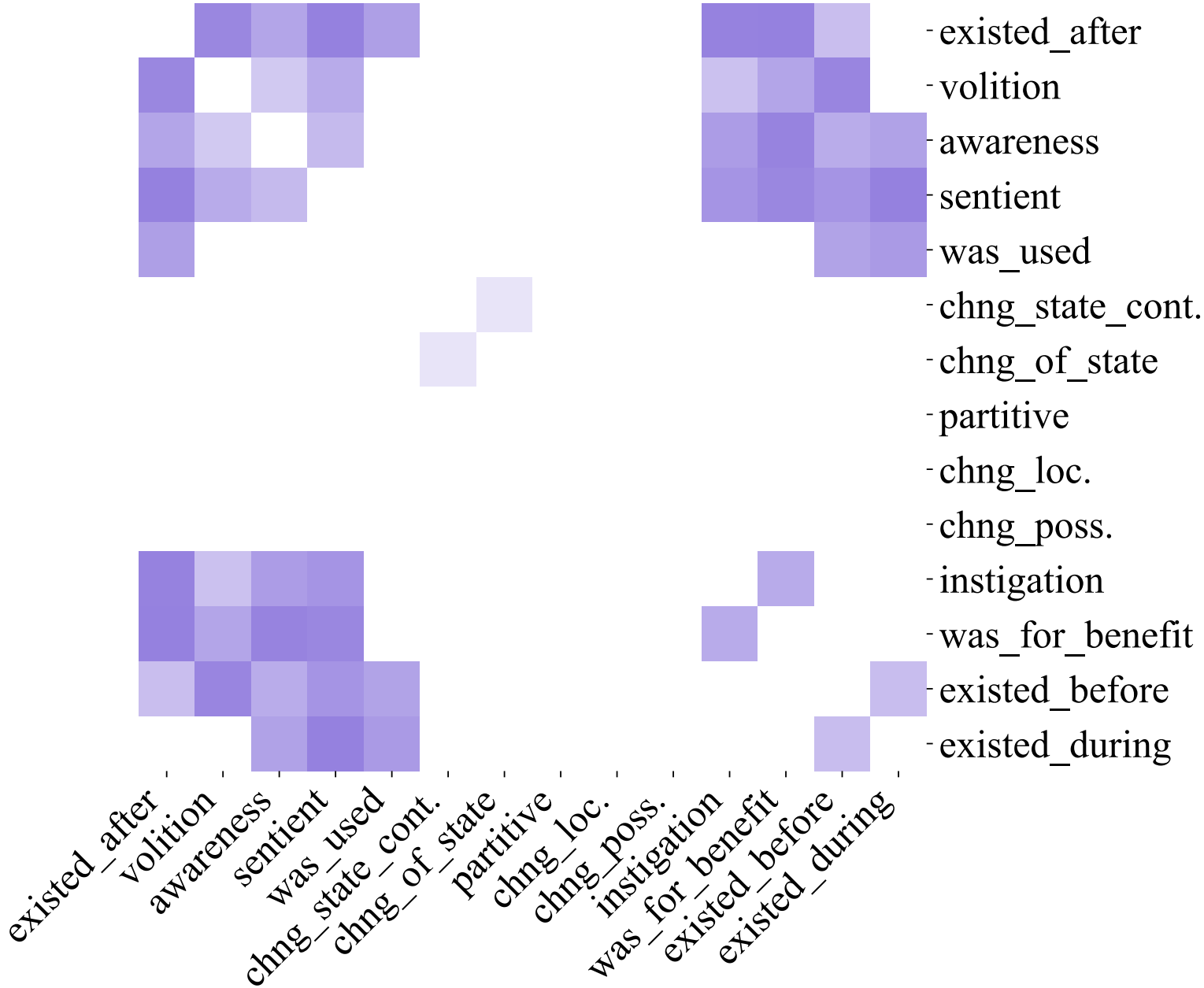
Pearson's R between true attributes

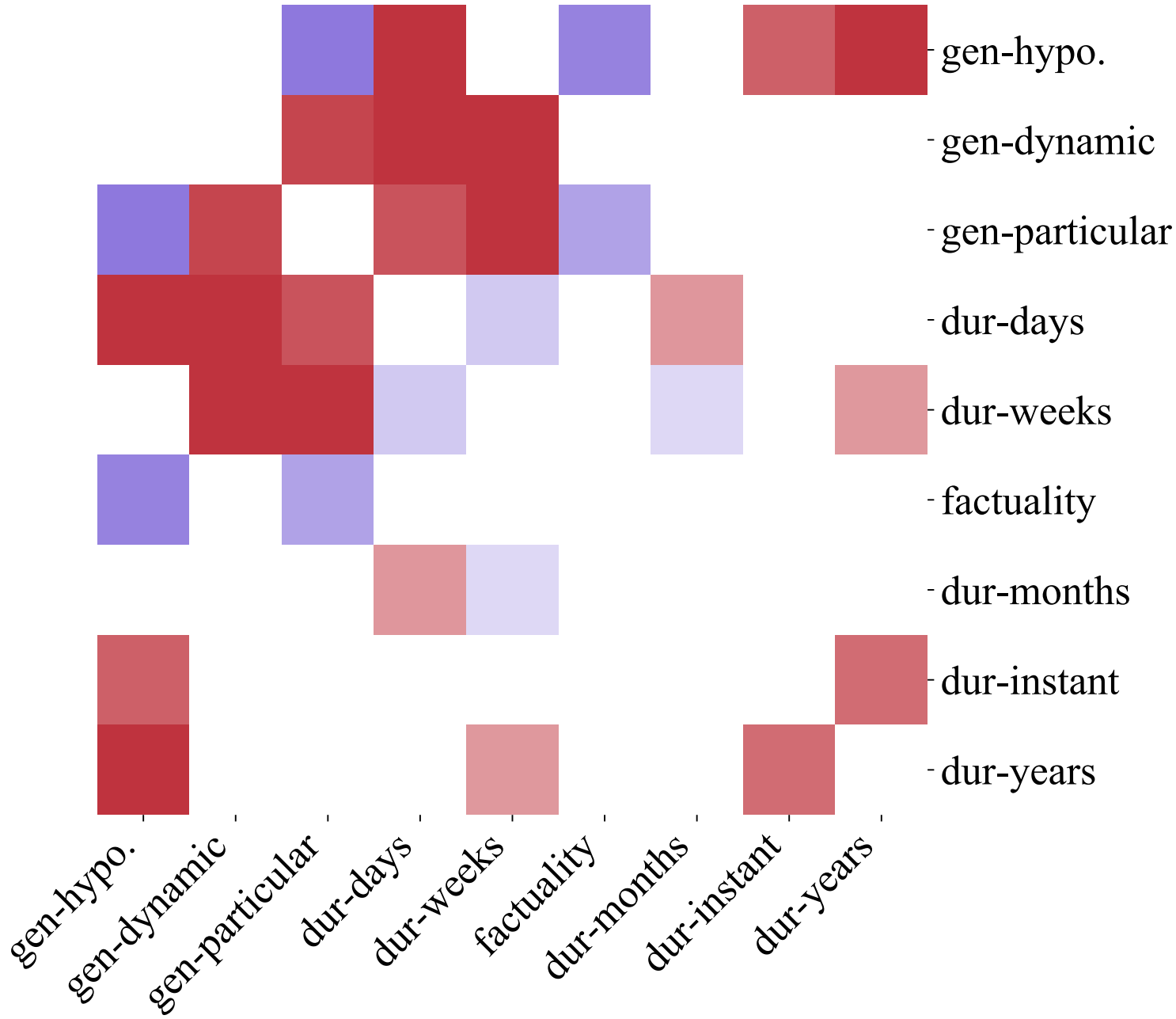
Pearson's R between residuals

-1 ← systematic over/ under prediction — no significant correlation present/ captured — correlation well-captured → 1






existed_after
volition
awareness
sentient
was_used
chng_state_cont.
chng_of_state
partitive
chng_loc.
chng_poss.
instigation
was_for_benefit
existed_before
existed_during



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Conclusions

- Motivating
  - UDS as a dataset and task
  - Transductive paradigm for parsing
- Showing
  - Challenges of UDS parsing (scalar + structure)
  - Benefits of end-to-end transductive system
- Analyzing
  - interactions between UDS subspaces