

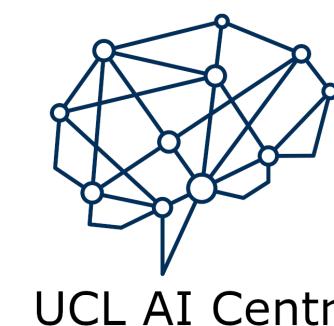
Neural Concept Formation in Knowledge Graphs

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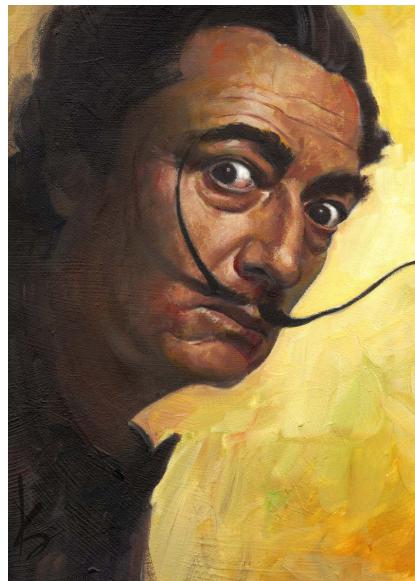
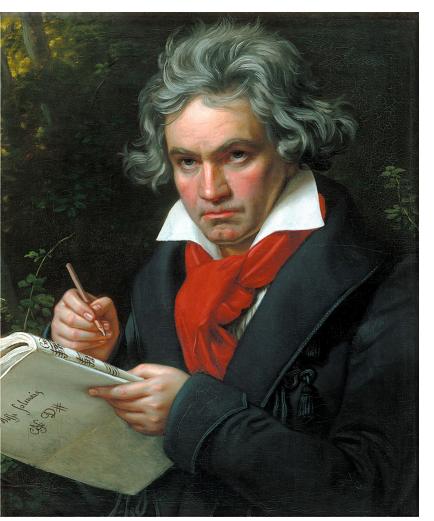
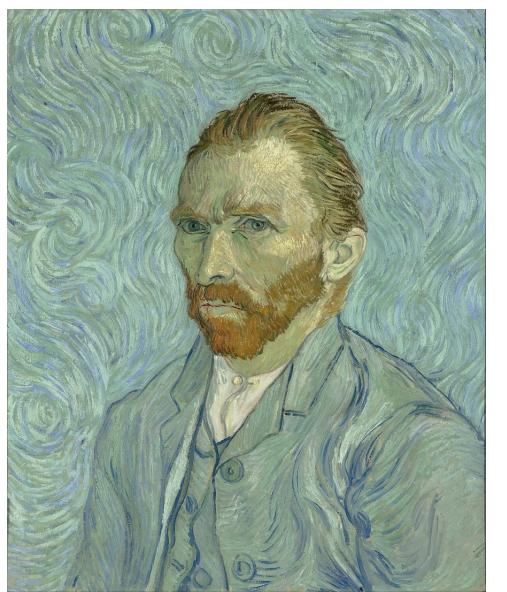
Antonio Vergari
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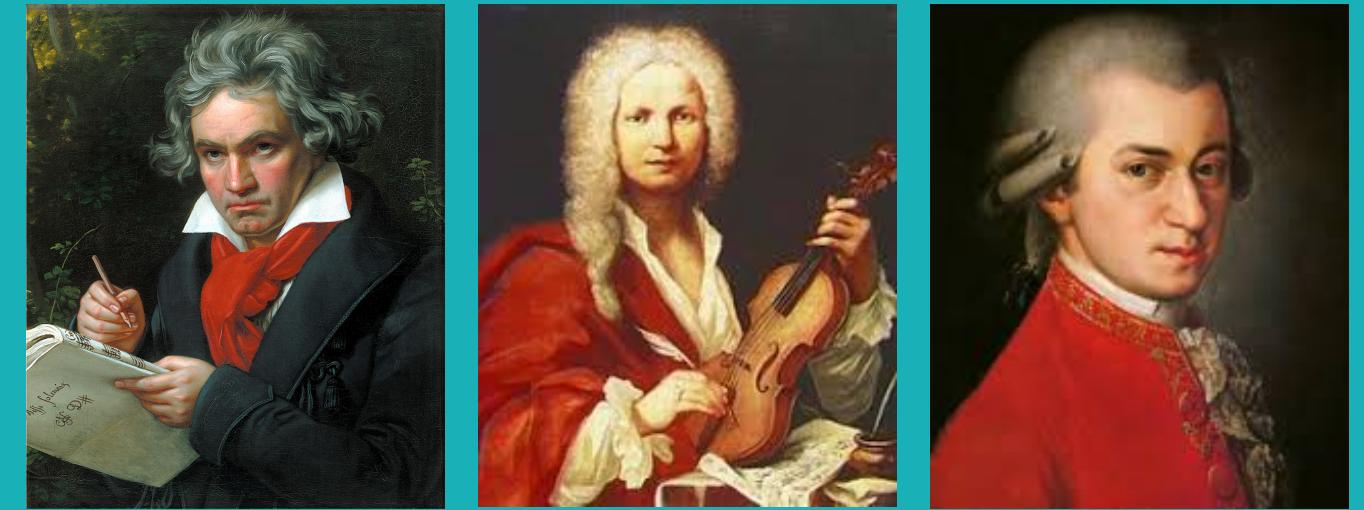


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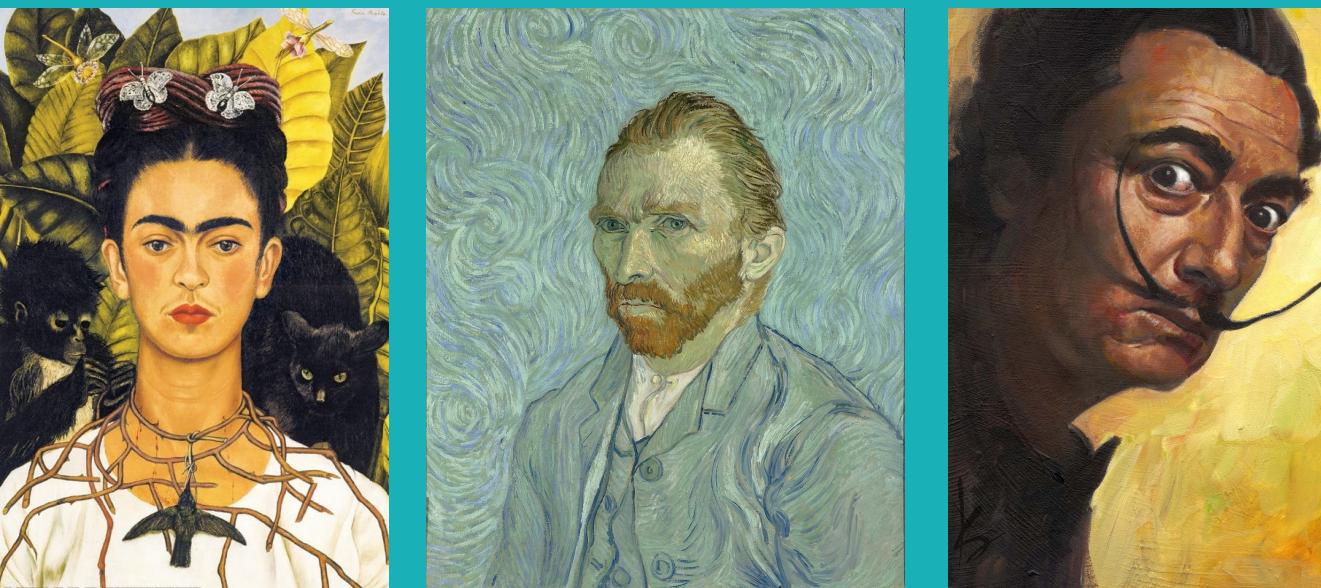
Concept Learning in

humans



COMPOSER

ARTIST

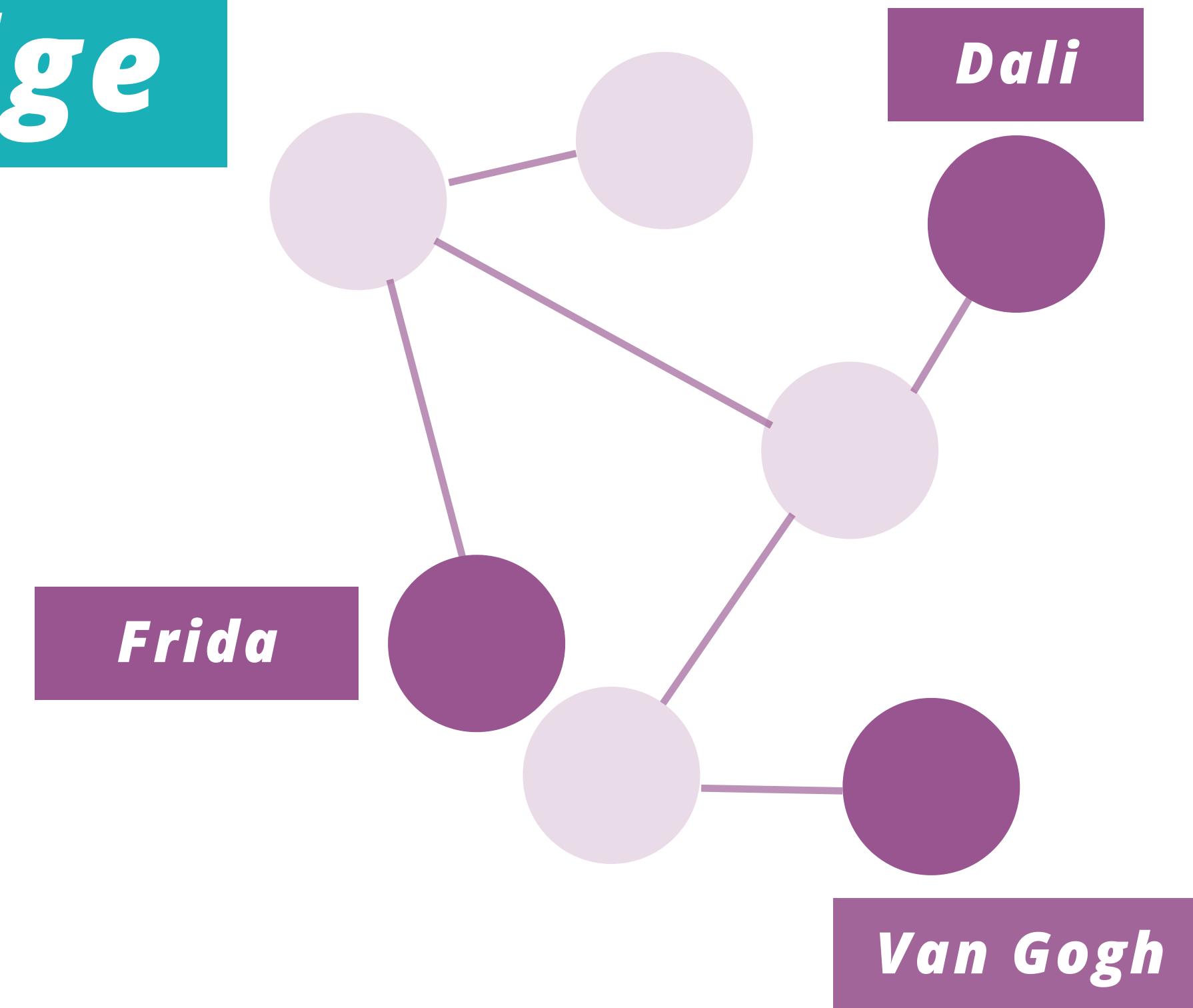


Concept Learning in

humans

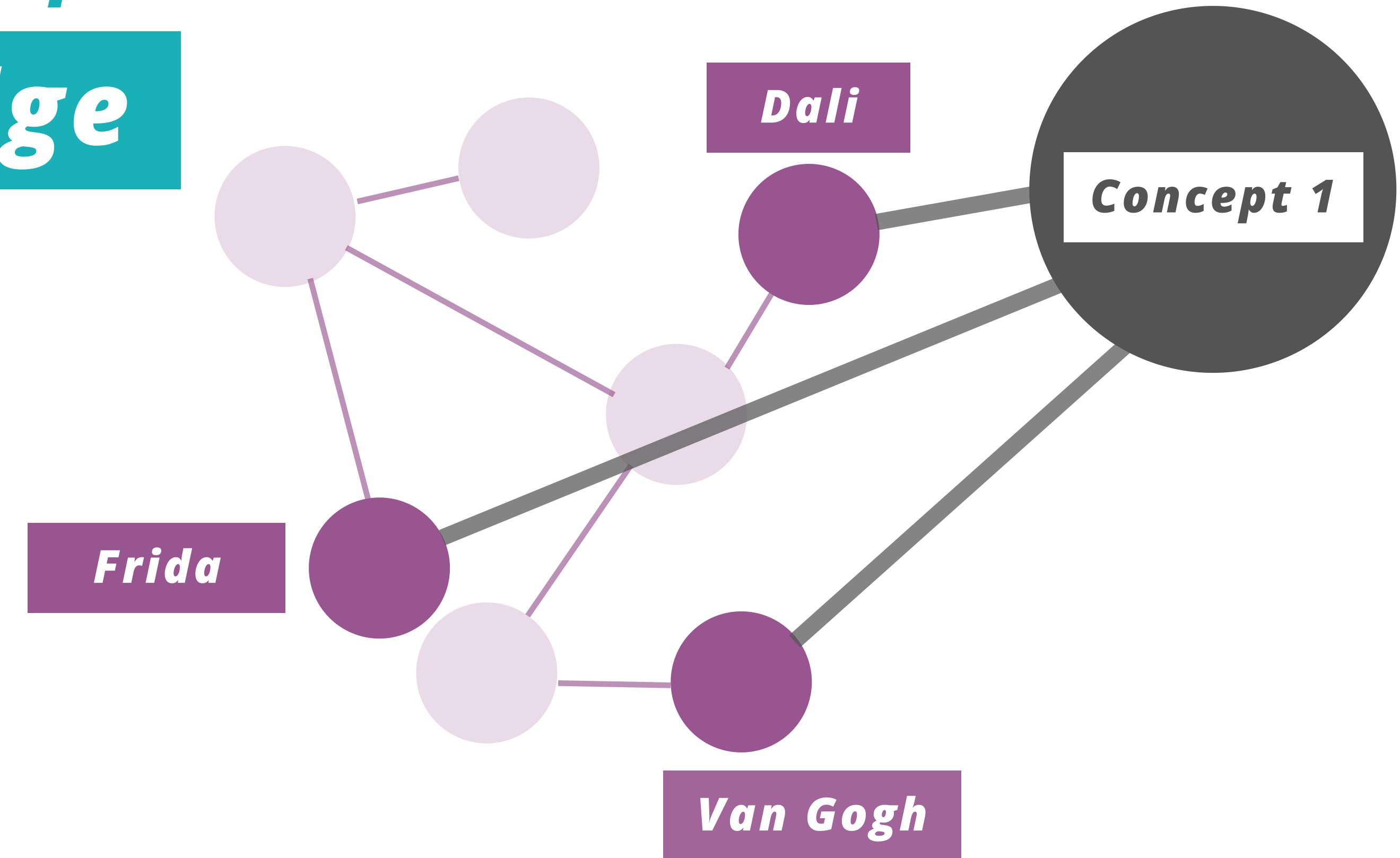
Learning Concepts in

Knowledge Graphs



Learning Concepts in

Knowledge Graphs

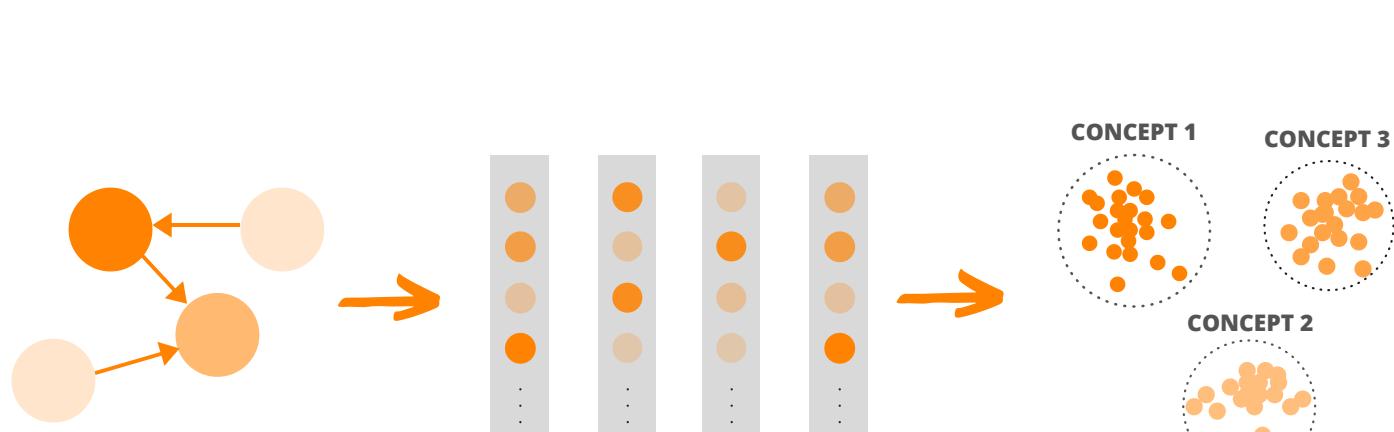


Concept Learning in KGs:

performing ***unsupervised clustering*** of entities
to learn new concepts and explicitly
augmenting the Knowledge Graph with them.

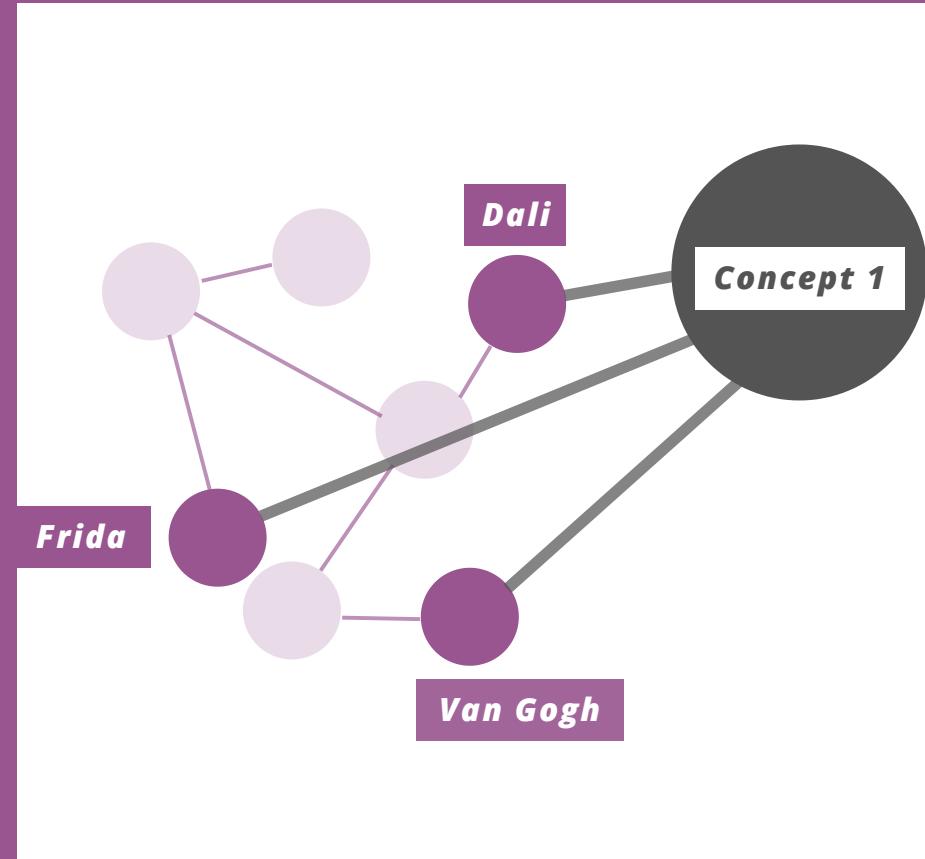
ConFormA

1. Learn concepts as **entity clusters**



Propositionalize and cluster

2. Augment KG with reified concept triples



3. Train a neural link predictor

**ComplEx,
DistMult,
RotatE,
NTP,
...**

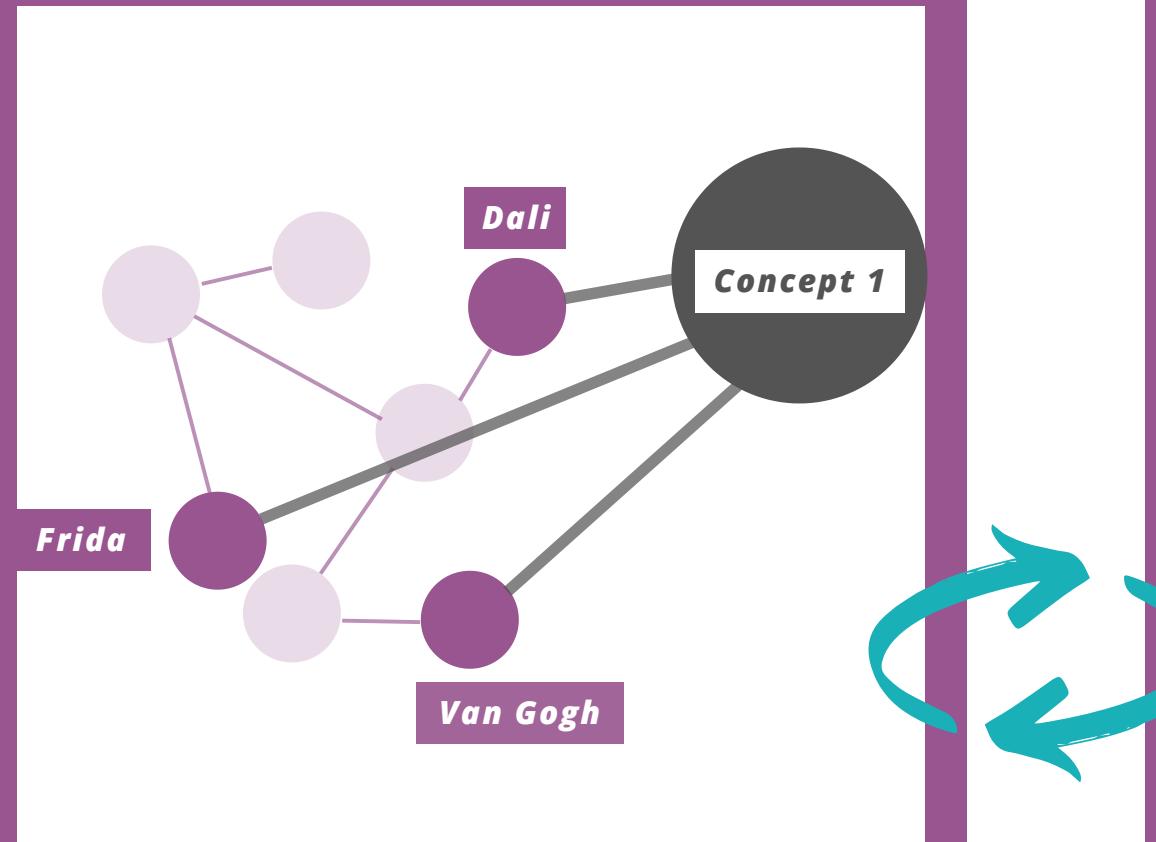
ConFormAE

1. Learn concepts as **entity clusters**

$$\hat{c} = \arg \max_{c \in \mathcal{C}} \log p(Z = c \mid e_i)$$

***Assign entities to concepts
maximising the log-posterior***

2. Augment KG with
reified concept triples



3. Train a neural
link predictor

**ComplEx,
DistMult,
RotatE,
NTP,
...**

Concept 1

- political satire
- absurdism
- experimental film
- Surrealism
- independent film

Concept 2

- hypothyroidism
- Crohn's disease
- yellow fever
- angina pectoris
- pancreatitis

Concept 3

- Royal College of Music
- Royal Academy of Music
- Moscow Conservatory
- Manhattan School of Music
- Milan Conservatory

Fragments of example concepts
learned for FB15K-237

yields meaningful concepts

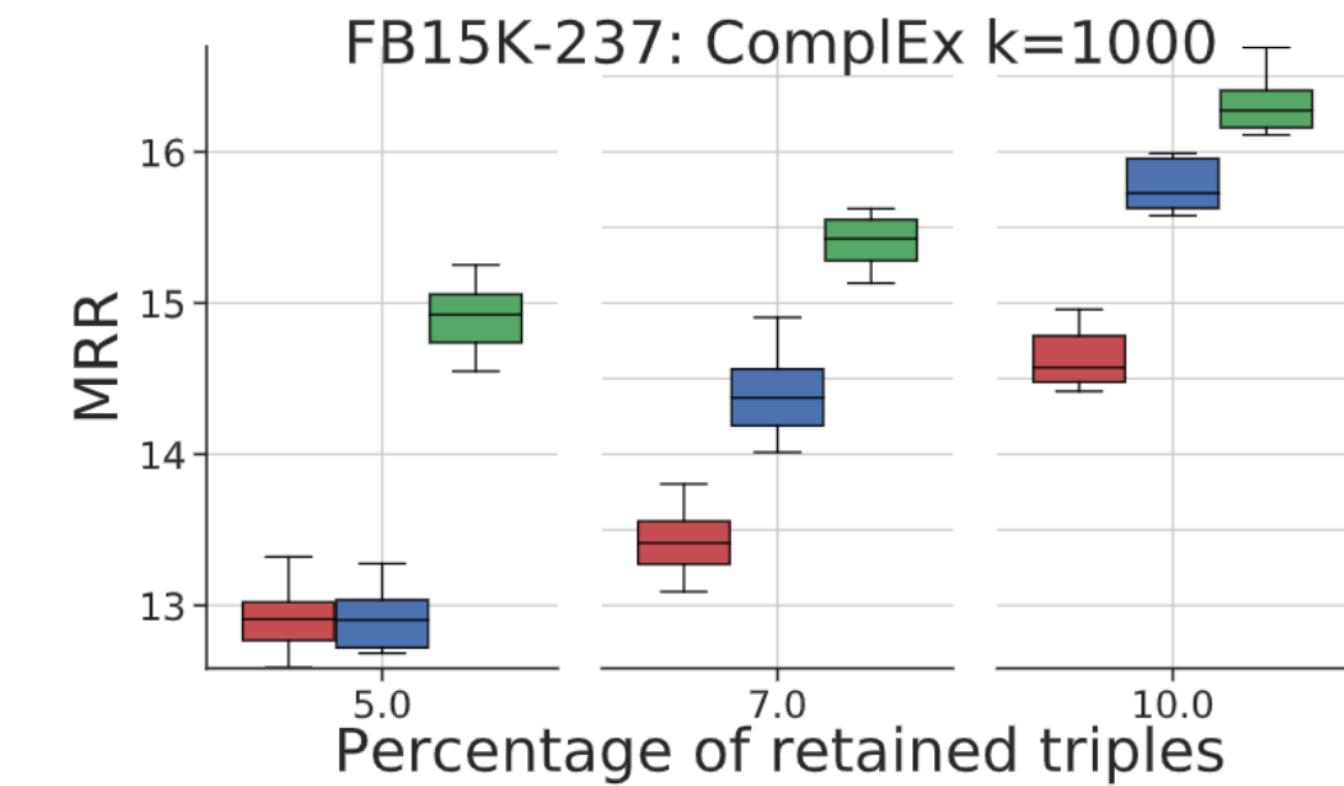
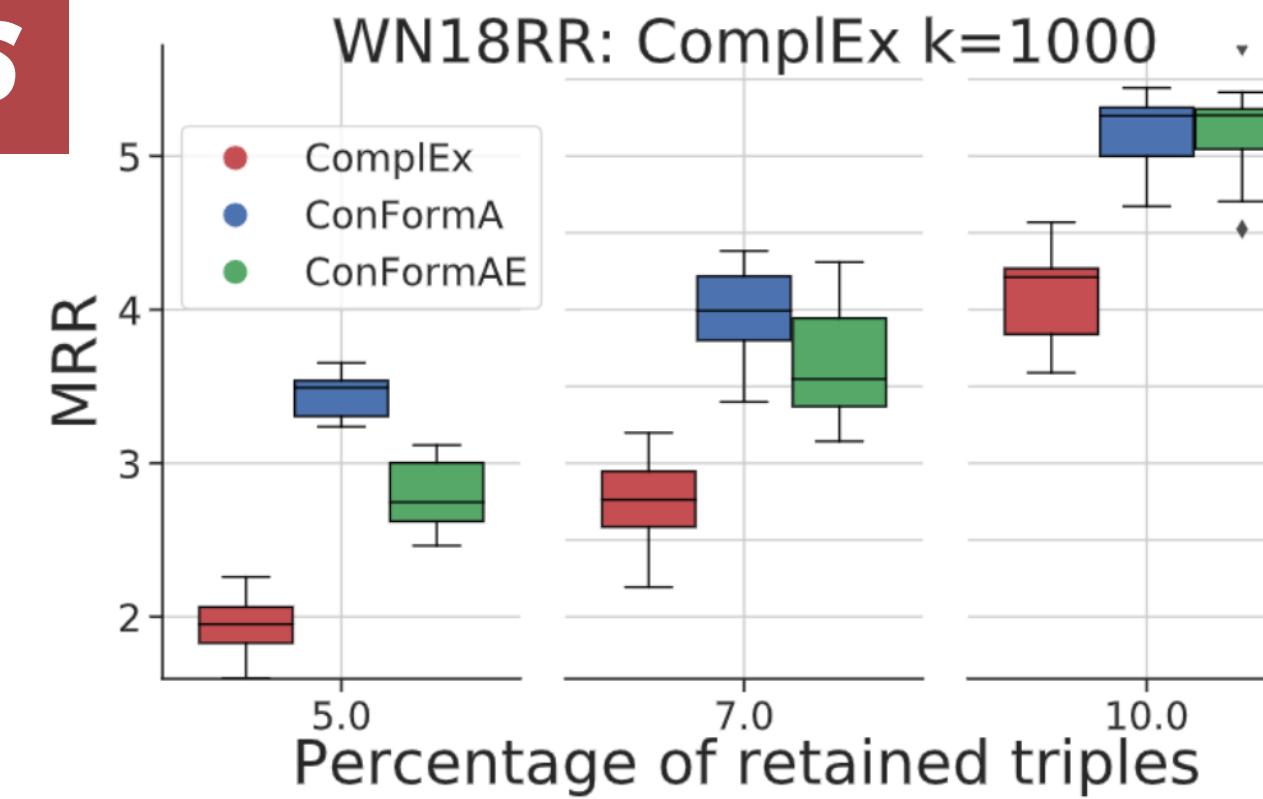
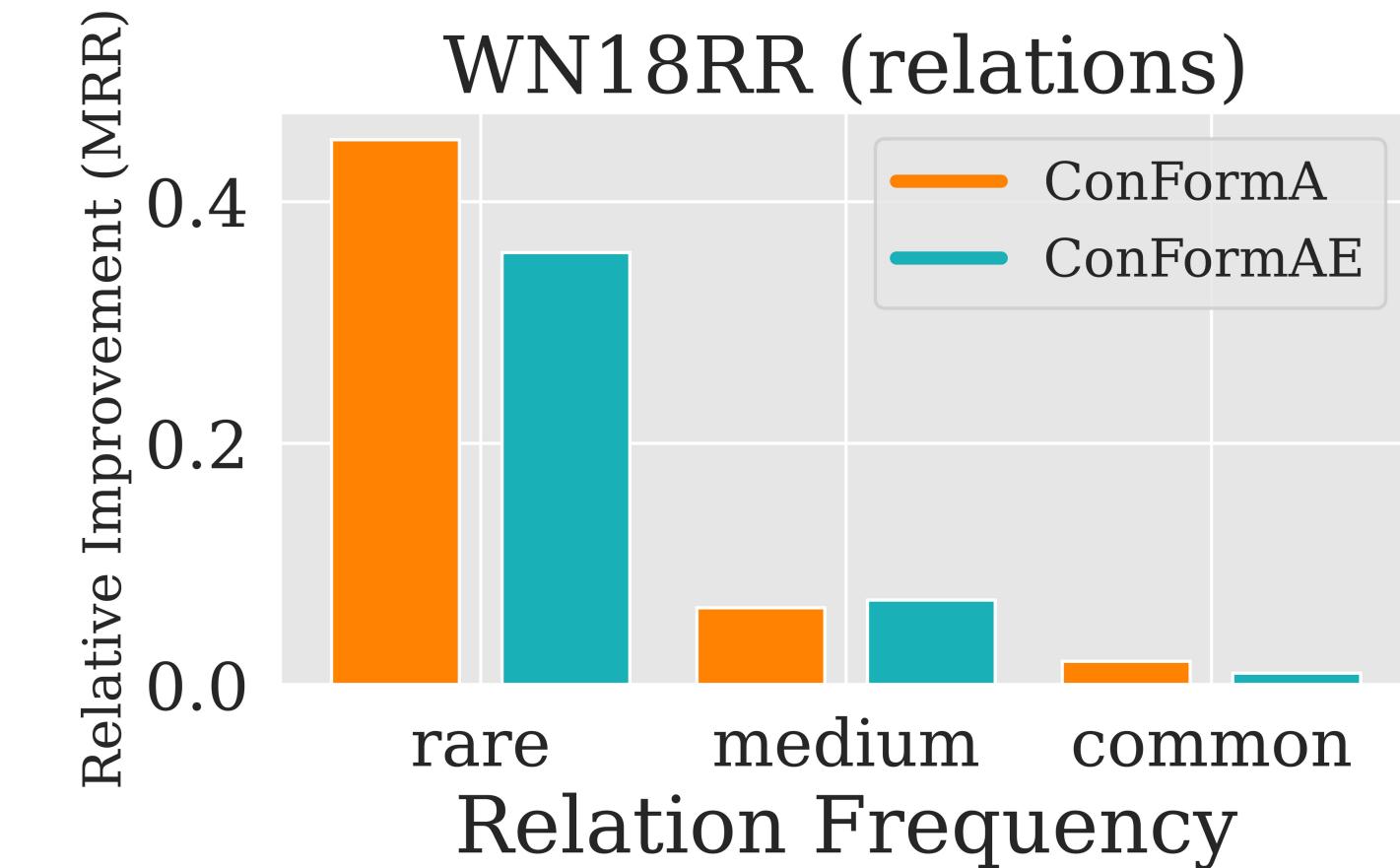
NMI between the learned clusters
and ground- truth (*notable_type*) for
FB15K-237

MODEL	K	BASELINE	CONFORMA	CONFORMAE
COMPLEX	500	0.214	0.251	0.311
	1000	0.213	0.251	0.294
	2000	0.181	0.251	0.242
DISTMULT	500	0.175	0.251	0.367
	1000	0.187	0.251	0.276
	2000	0.176	0.251	0.360

*improves
generalisation for*

& *rare predicates*

sparse KGs



thank you

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