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# Week 11 : Assignment 11

**The due date for submitting this assignment has passed.**

**Due on 2025-04-09, 23:59 IST.**

## Assignment submitted on 2025-04-05, 21:33 IST

1) What is the main modification that SimplE makes to DistMult-like models to handle asymmetric relations? ***1 point***

- Replacing entity embeddings with random fixed vectors
- Introducing separate entity embeddings for subject and object roles, along with inverse relations
- Restricting the rank of the relation tensor to 1
- Using negative sampling for half of the triple set

Yes, the answer is correct.
Score: 1
Accepted Answers:
*Introducing separate entity embeddings for subject and object roles, along with inverse relations*

2) Which statements correctly characterize the basic DistMult approach for knowledge graph completion? ***1 point***

- Each relation $r$ is parameterized by a full D×D matrix that can capture asymmetric relations.
- The relation embedding is a diagonal matrix, leading to a multiplicative interaction of entity embeddings.
- DistMult struggles with non-symmetric relations because score(s, r, o) = $a_s^T M_r a_o$ is inherently symmetric in s and o.

☐ DistMult's performance is typically tested only on fully symmetric KGs.

Yes, the answer is correct.
Score: 1
Accepted Answers:
*The relation embedding is a diagonal matrix, leading to a multiplicative interaction of entity embeddings.*
*DistMult struggles with non-symmetric relations because score(s, r, o) = $a_s^T M_r a_o$ is inherently symmetric in s and o.*

3) Which statements about the ComplEx extension of DistMult are true? ***1 point***

☑ It uses complex-valued embeddings to better capture asymmetric or anti-symmetric relations.
☐ It replaces the multiplication in DistMult with element-wise addition of real-valued vectors.
☑ For a perfectly symmetric relation, one could set the imaginary part of the relation embedding to zero.
☐ ComplEx requires each entity vector to be unit norm in the complex plane.

Yes, the answer is correct.
Score: 1
Accepted Answers:
*It uses complex-valued embeddings to better capture asymmetric or anti-symmetric relations.*
*For a perfectly symmetric relation, one could set the imaginary part of the relation embedding to zero.*

4) Which best describes the main advantage of using a factorized representation (e.g., DistMult, ComplEx) for large KGs? ***1 point***

○ It enforces that every relation in the KG be perfectly symmetric.
○ It ensures each entity is stored as a one-hot vector, simplifying nearest-neighbour queries.
○ It collapses the entire KG into a single scalar value.
◉ It significantly reduces parameters and enables generalization to unseen triples by capturing low-rank structure.

Yes, the answer is correct.
Score: 1
Accepted Answers:
*It significantly reduces parameters and enables generalization to unseen triples by capturing low-rank structure.*

5) Which statement best describes the reshaping of a 3D KG tensor $X \in R^{|E|\times|R|\times|E|}$ into a matrix factorization problem? ***1 point***

◉ One axis remains for subject, one axis remains for object, and relations are combined into a single expanded axis.
○ The subject dimension is repeated to match the relation dimension, resulting in a 2D matrix.
○ Each subject–relation pair is collapsed into a single dimension, while objects remain as separate entries.

**Quiz: Week 11 : Assignment 11 (assessment?name=99)**

**Week 12 ()**

**Year 2025 Solutions ()**

- ○ The entire KG is vectorized into a 1D array and then factorized with an SVD approach.

No, the answer is incorrect.
Score: 0
Accepted Answers:
*Each subject–relation pair is collapsed into a single dimension, while objects remain as separate entries.*

6) Which key property of hierarchical relationships (e.g. is-a, transitivity) motivates the exploration of specialized embedding methods over standard Euclidean KG embeddings? ***1 point***

- ○ Symmetry in the relation (A, is-a, B) implying (B, is-a, A)
- ○ Frequent presence of cycles in hierarchical graphs
- ◉ Transitivity in the form (camel, is-a, mammal) and (mammal, is-a, animal) ⟹ (camel,is-a,animal)
- ○ The high dimensionality of the entity embeddings

Yes, the answer is correct.
Score: 1
Accepted Answers:
*Transitivity in the form (camel, is-a, mammal) and (mammal, is-a, animal) ⟹ (camel,is-a,animal)*

7) Which of the following statements correctly describe hyperbolic (Poincare) embeddings for hierarchical data? ***1 point***

- ☑ They map nodes onto a disk (or ball) such that large branching factors can be represented with lower distortion than in Euclidean space.
- ☑ Distance grows slowly near the center and becomes infinite near the boundary, making it naturally suited for tree-like structures.
- ☐ They require each node to be embedded on the surface of the Poincare disk of radius 1.
- ☑ They can achieve arbitrarily low distortion embeddings for trees with the same dimension as Euclidean space.

No, the answer is incorrect.
Score: 0
Accepted Answers:
*They map nodes onto a disk (or ball) such that large branching factors can be represented with lower distortion than in Euclidean space.*
*Distance grows slowly near the center and becomes infinite near the boundary, making it naturally suited for tree-like structures.*

8) Why might a partial-order-based approach (like order embeddings) be beneficial for modelling ‘is-a’ relationships compared to purely distance-based approaches? ***1 point***

- ☑ They explicitly encode the ancestor–descendant relation as a coordinate-wise inequality or containment.
- ☐ They can represent negative correlations (i.e., sibling vs. ancestor) more easily than distance metrics.
- ☑ They inherently guarantee transitive closure of the hierarchy in the learned embedding space.

- [x] They do not rely on pairwise distances but use a notion of coordinate-wise ordering or interval containment.

No, the answer is incorrect.
Score: 0

Accepted Answers:
*They explicitly encode the ancestor–descendant relation as a coordinate-wise inequality or containment.*
*They do not rely on pairwise distances but use a notion of coordinate-wise ordering or interval containment.*

9) Which statement about box embeddings in hierarchical modelling is most accurate? ***1 point***

- ( ) Each entity or type is assigned a single real-valued vector, ignoring bounding volumes.
- (•) Containment $I_x \subseteq I_y$ across all dimensions encodes $x \prec y$ .
- ( ) They rely on spherical distances around a central node to measure tree depth.
- ( ) They cannot be used to represent set intersections or partial overlap.

Yes, the answer is correct.
Score: 1

Accepted Answers:
*Containment $I_x \subseteq I_y$ across all dimensions encodes $x \prec y$ .*

10) What is a key challenge with axis-aligned open-cone (order) embeddings for hierarchical KG data? ***1 point***

- ( ) They enforce that all sibling categories have identical cone apices, which causes overlap.
- ( ) They require symmetrical relationships for all edges.
- ( ) They do not allow partial orders to be extended to total orders.
- (•) The volume (measure) of cones is the same regardless of how “broad” or “narrow” the cone is, making sub-categories indistinguishable by volume.

Yes, the answer is correct.
Score: 1

Accepted Answers:
*The volume (measure) of cones is the same regardless of how “broad” or “narrow” the cone is, making sub-categories indistinguishable by volume.*