

# Supplementary Material

## Searching for Actions on the Hyperbole

### 1. More implementation details

Different from Nickel *et al.* [4], which updates the prototypes sparsely, i.e., updating one column of  $\mathbf{P}$  per iteration, we update prototypes  $\mathbf{P}$  globally. The reason that we don't update sparsely is that  $\mathbf{P}$  and its gradients are small enough to fit into one GPU's memory.

For constructing the hyperbolic space, we use *geoopt*<sup>1</sup> library, which is equipped with  $\mathbb{D}_c^n$ ,  $\mathbb{R}^n$ ,  $\mathbb{S}^{n-1}$  and corresponding distance metrics, for hyperbolic manifold implementation.

### 2. Dataset hierarchy

Without losing semantic consistency, we slightly revise the hierarchy of ActivityNet[2] and Kinetics[1] to make the tree structure flat. We also construct hierarchy for Moments-in-Time[3] according to VerbNet[5]. Those hierarchies are listed in Fig.1, Fig.2 and Fig.3.

### References

- [1] Joao Carreira and Andrew Zisserman. Quo vadis, action recognition? a new model and the kinetics dataset. In *CVPR*, 2017. 1
- [2] Bernard Ghanem Fabian Caba Heilbron, Victor Escorcia and Juan Carlos Niebles. Activitynet: A large-scale video benchmark for human activity understanding. In *CVPR*, 2015. 1
- [3] Mathew Monfort, Alex Andonian, Bolei Zhou, Kandan Ramakrishnan, Sarah Adel Bargal, Yan Yan, Lisa Brown, Quanfu Fan, Dan Gutfreund, Carl Vondrick, et al. Moments in time dataset: one million videos for event understanding. *IEEE TPAMI*, 2019. 1
- [4] Maximilian Nickel and Douwe Kiela. Poincaré Embeddings for Learning Hierarchical Representations. *NIPS*, 2017. 1
- [5] Karin Kipper Schuler. Verbnets: a broad-coverage, comprehensive verb lexicon. 2005. 1

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<sup>1</sup><https://github.com/geoopt/geoopt>





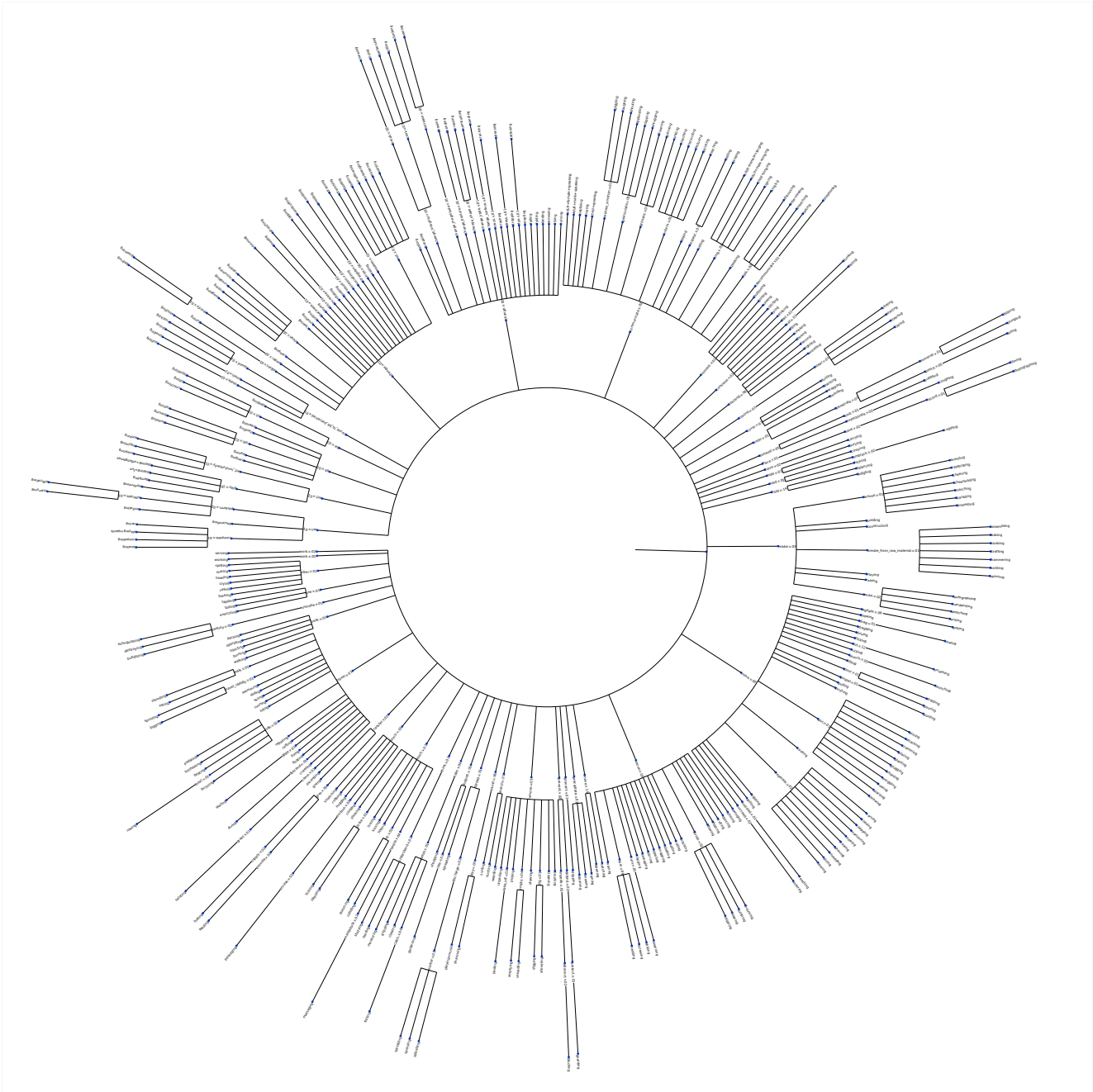


Figure 3. The hierarchy of Hierarchical Moments.