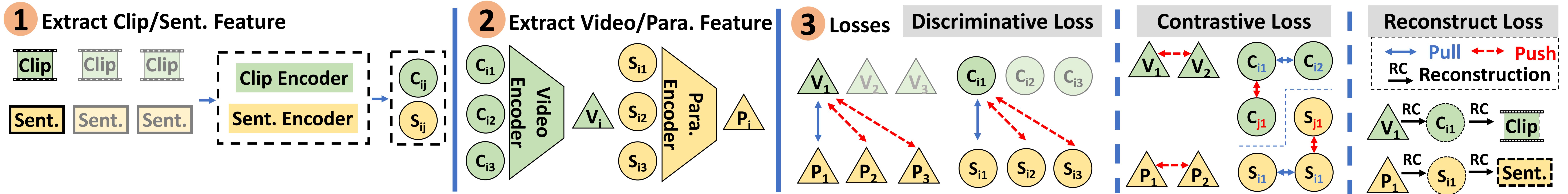




Approach



Highlights

- Propose to **hierarchically model cross-modal sequential data**.
- Preserve** correspondence of **complex structures** across modalities through discriminative losses and contrastive losses.
- State-of-the-art performance** on video and paragraph retrieval.
- Systematical study** on several tasks involving video and language.

Goal

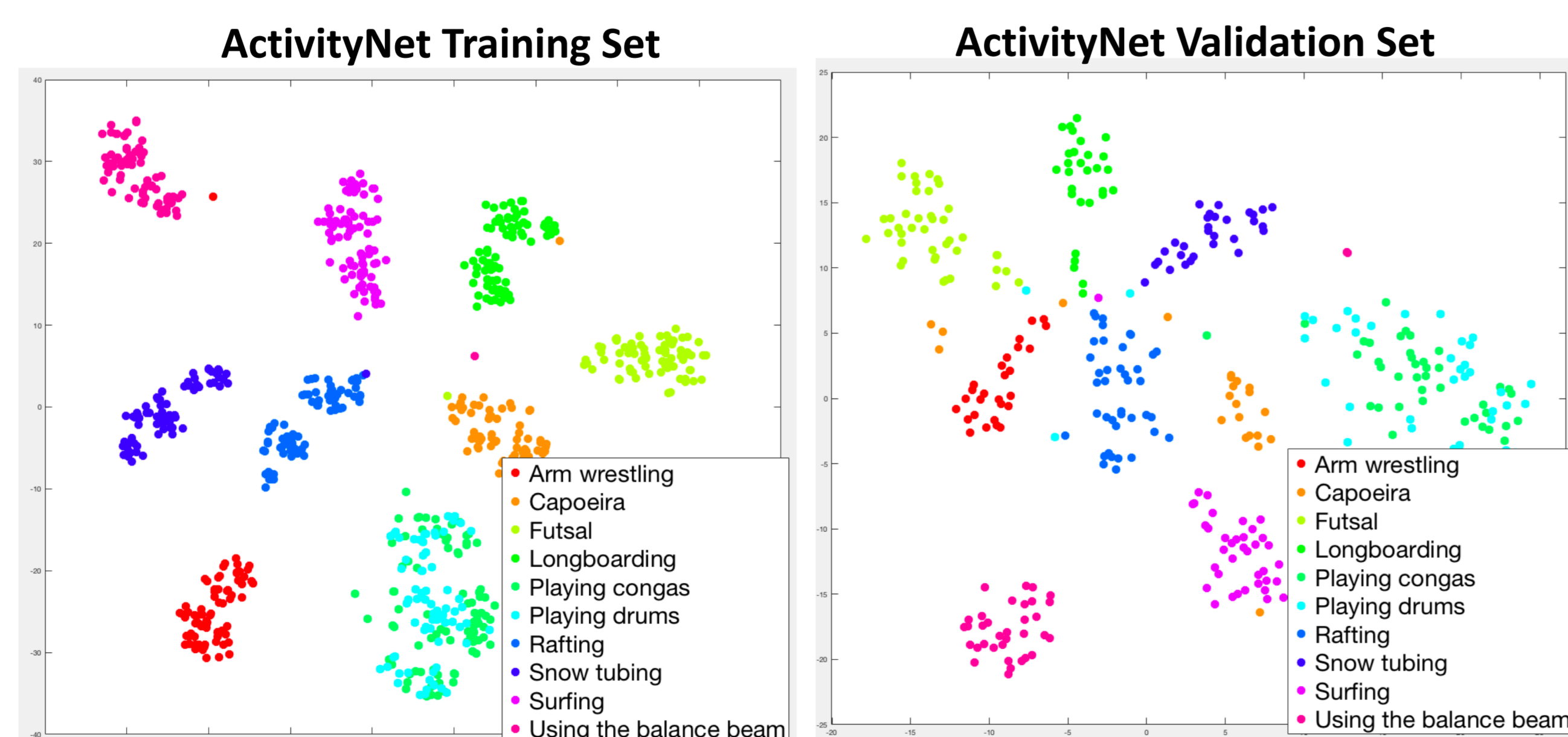
- Learn embeddings for hierarchical sequential data (**video** and **text**) where they have correspondence across multiple modalities.

Tasks & Datasets

- Tasks**: Video/Text Retrieval, Video Captioning, Zero-shot Action Recognition
- Datasets**: ActivityNet Dense Caption; ActivityNet V1.3; DiDeMo

Qualitatively Results

- T-SNE visualization of video embedding of **HSE** on ActivityNet V1.3



Experiments & Analysis

- Video and Text Retrieval: With Ground-truth clip proposal**

Table1. Performance on ActivityNet Dense Caption

	Paragraph => Video			Video => Paragraph		
	R@1	R@5	R@50	R@1	R@5	R@50
C3D with Dimension Reduction						
DENSE	14.0	32.0	65.0	18.0	36.0	74.0
FSE	12.6	33.2	77.6	11.5	31.8	77.7
HSE	32.7	63.2	90.8	32.8	63.2	91.2
Inception-V3						
FSE	18.2	44.8	89.1	16.7	43.1	88.4
HSE	44.4	76.7	97.1	44.2	76.7	97.0

Table2. Performance on DiDeMo

	Paragraph => Video			Video => Paragraph		
	R@1	R@5	R@50	R@1	R@5	R@50
Inception-V3						
S2VT	11.9	33.6	76.5	13.2	33.6	76.5
FSE	13.9	36.0	78.9	13.1	33.9	78.0
HSE	29.7	60.3	92.4	30.1	59.2	92.1

Our approach **HSE** outperforms SotA by a large margin.

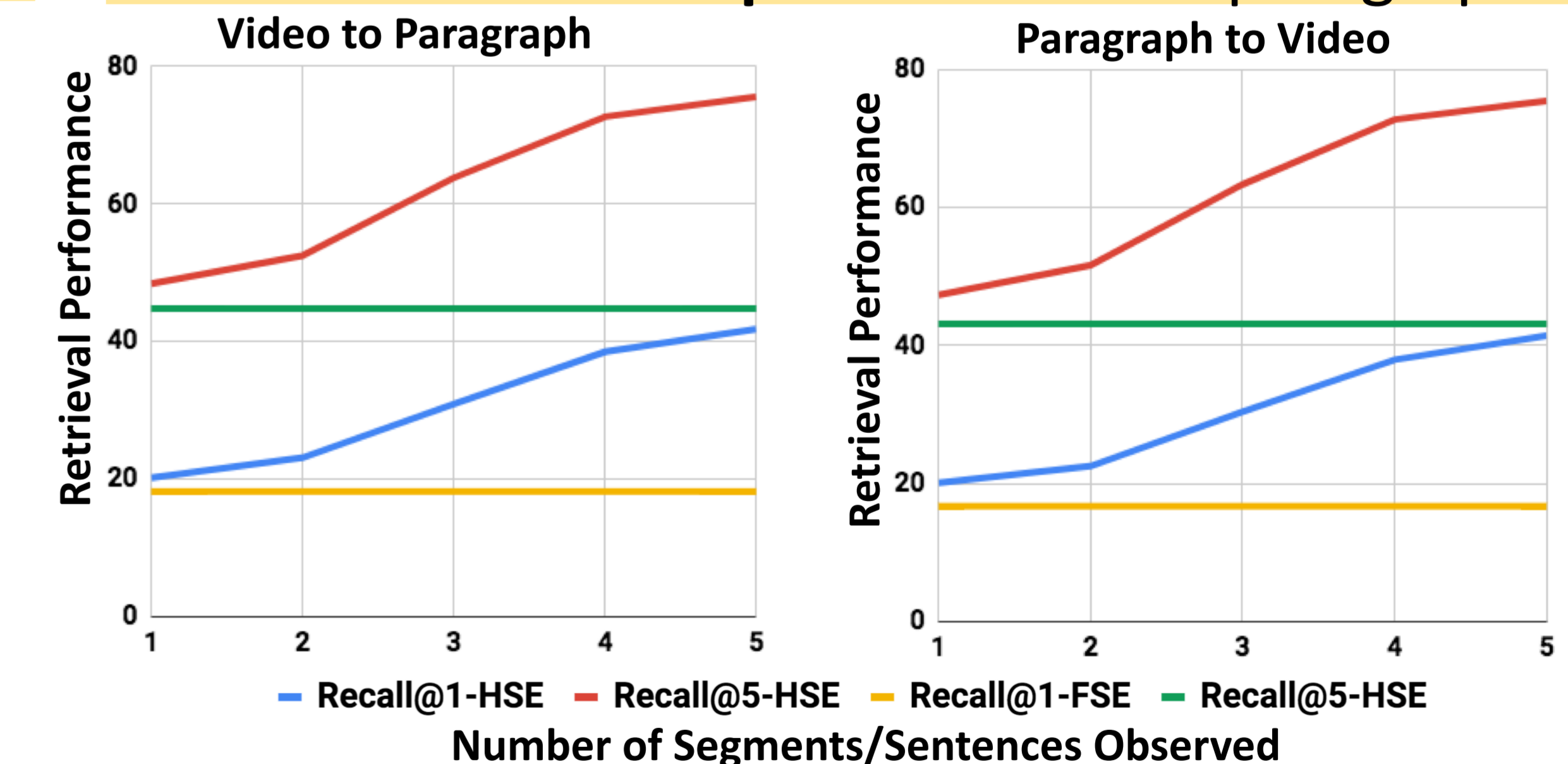
- Ablations: With heuristic clip proposal**

Table3. Performance on ActivityNet Dense Caption w/o clip proposal

Proposal Method	#Seg.	Paragraph => Video		Video => Paragraph	
		R@1	R@5	R@1	R@5
Inception-V3					
FSE	-	18.2	44.8	16.7	43.1
HSE+GT	-	44.4	76.7	44.2	76.7
HSE + Uniform	3	20.0	48.6	18.2	47.9
HSE + Uniform	4	20.5	49.3	18.7	48.1

With a poor uniform proposal, **HSE** can already outperform **FSE** methods.

- Retrieval with **incomplete** video and paragraph



- Video Captioning and Zero-shot Action Recognition:**

Table 4. Results for video captioning on ActivityNet

	B@1	B@2	B@3	Meteor	CiDER
DENSE	26.5	13.5	7.1	9.5	24.6
DVC	19.6	9.9	4.6	10.3	25.2
FSE	17.9	8.2	3.6	8.7	32.1
HSE	19.8	9.4	4.3	9.2	39.8

Table 5. Results for action recognition on ActivityNet

	Zero-shot Transfer		Train Classifier	
	Top-1	Top-5	Top-1	Top-5
FV-VAE	-	-	78.6	-
TSN	-	-	88.1	-
FSE	48.3	79.4	74.4	94.1
HSE	51.4	83.8	75.3	94.3

- Check paper for more results and ablations studies!