

# DLCV 2021 Final Project Challenge 3:

## Fine-grained long-tailed food image classification

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### Problem

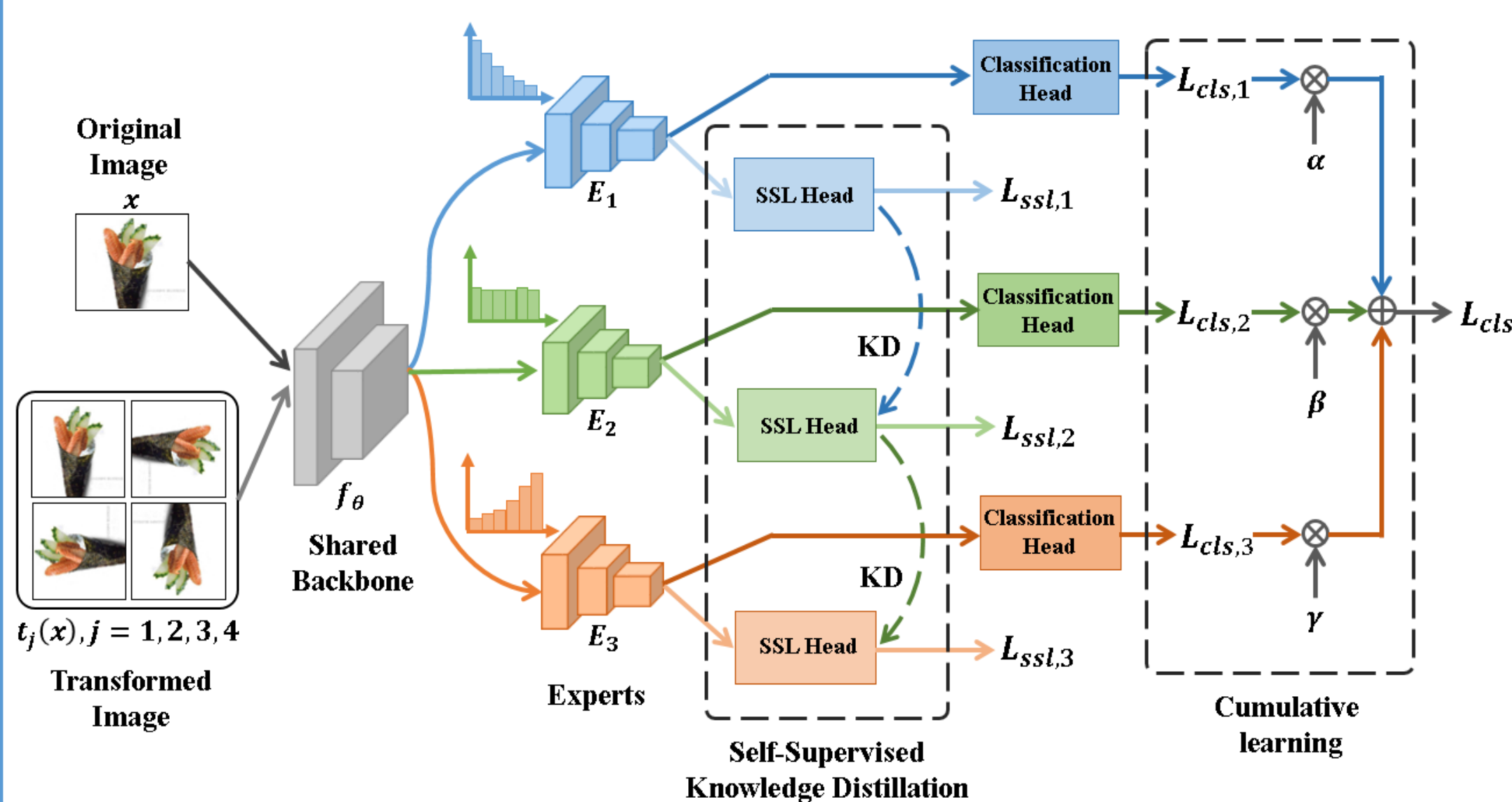
- The original TADE [1] suffers the degradation of head's accuracy due to the direct average of the outputs from different experts.
- Tail class experts tend to overfit on small classes, which is harmful to the representation ability of the backbone.

[1] "Test-agnostic long-tailed recognition by test-time aggregating diverse experts with self-supervision." arXiv (2021).

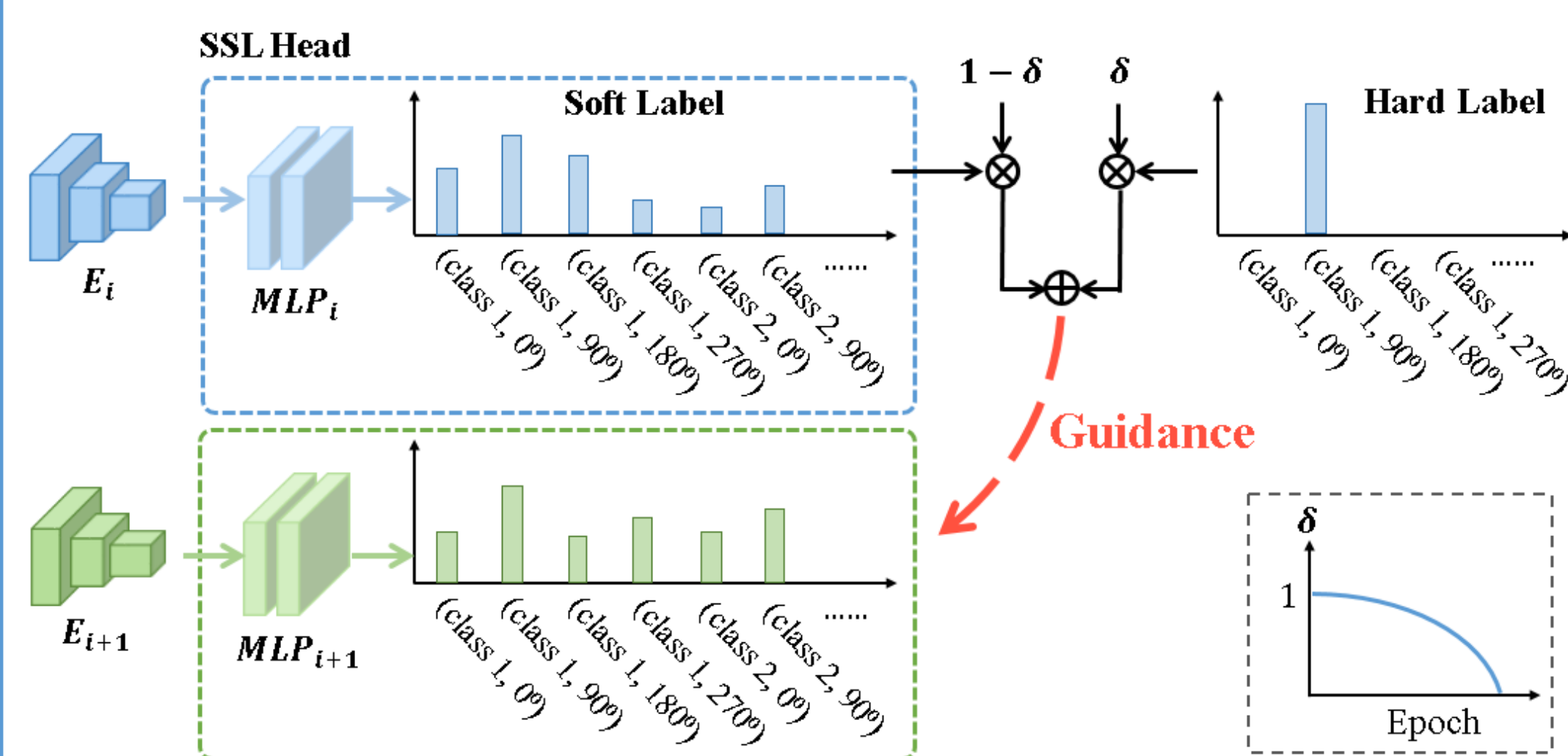
### Contribution

- Bring the *Self-Supervised Knowledge Distillation (SSKD)* into the long-tailed problem to have a better representation learning.
- *Cumulative learning (CL)* is adopted to avoid damaging the learned universal features when emphasizing the tail classes.
- Propose *Image-wise Test-time Aggregation (ITA)* to learn the aggregation weights of three experts image-wisely in test-time.

### Self-Supervised Knowledge Distillation (SSKD)

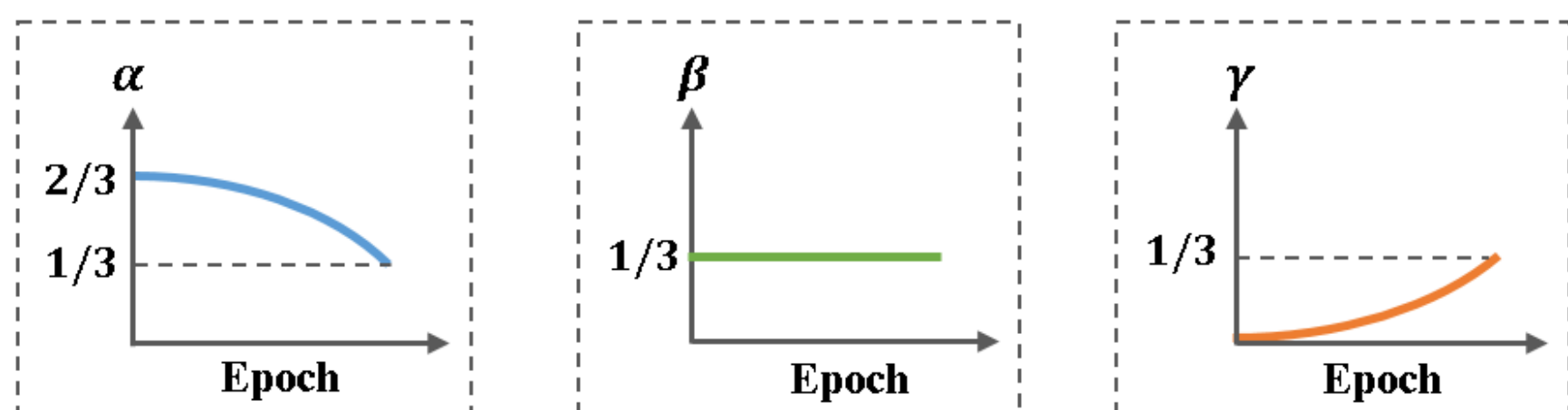


- Utilize self-supervised learning as an auxiliary task (SSL Head) for each expert to mine the dark knowledge.
- Transfer the representational knowledge of head class experts into tail class experts by knowledge distillation (KD).
- Adopt the SSL method of jointly learning the original classification task and self-supervised auxiliary task



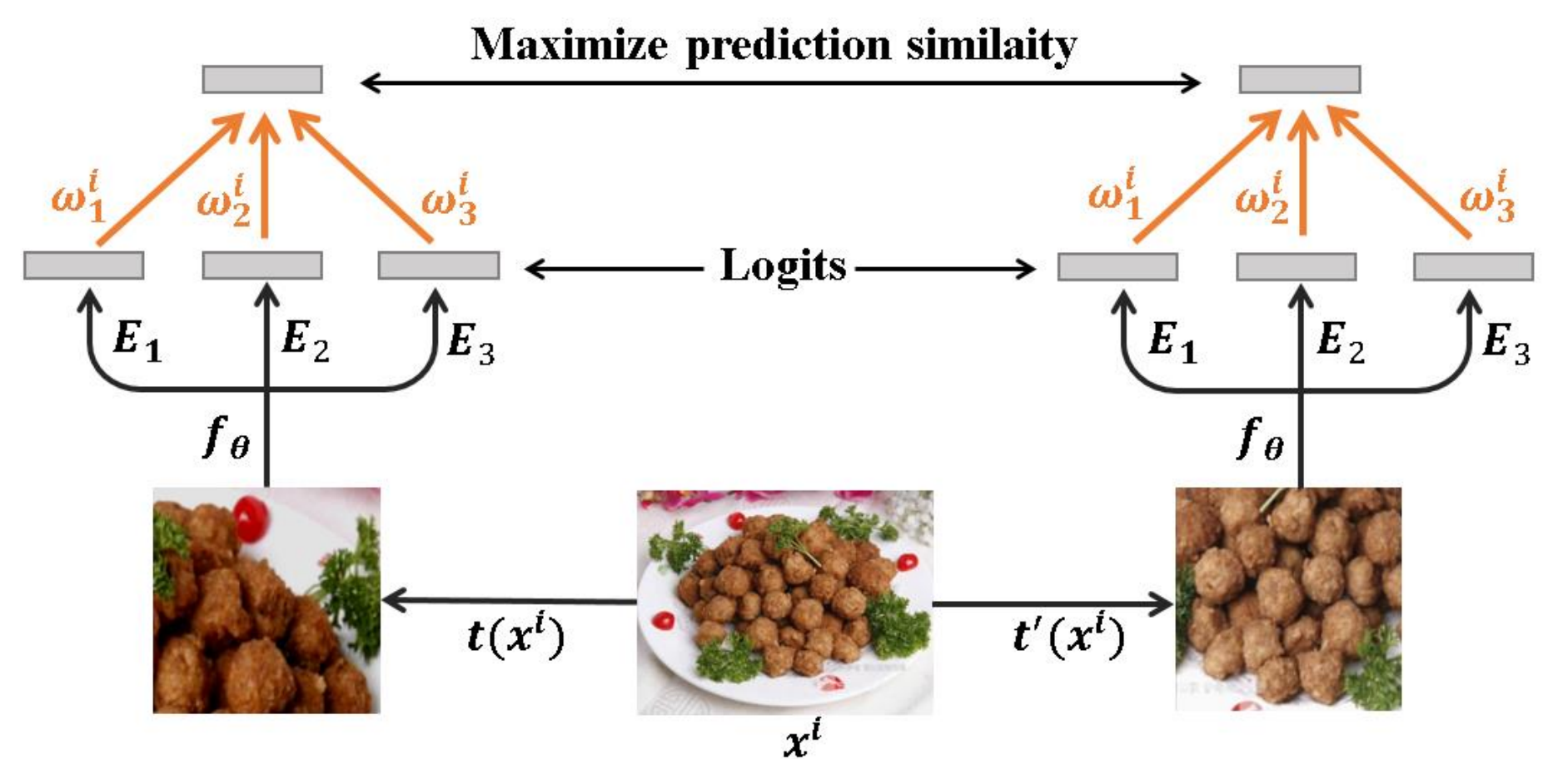
### Cumulative Learning (CL)

- Adjust the weights of loss function from different experts in a way that model learns the universal representations first, then transition to focus on the tail classes.



### Image-wise Test-time Aggregation (ITA)

- Propose that testing images have to be assigned their own aggregation weights of three experts.
- Assign larger aggregation weight for the expert such that it can produce similar predictions for two different augmented inputs.



### Experiment

- Comparison with SOTA

	All	Frequent	Common	Rare
TADE	0.745	0.754	0.762	0.582
Ours	<b>0.792 (+0.047)</b>	<b>0.821 (+0.067)</b>	<b>0.792 (+0.03)</b>	<b>0.587 (+0.005)</b>

- Ablation Study

	All	Frequent	Common	Rare
TADE	0.745	0.754	0.762	0.582
+SSKD	0.780 (+0.035)	0.799 (+0.045)	0.792 (+0.03)	0.587 (+0.005)
+CL	0.790 (+0.01)	0.819 (+0.02)	0.791 (-0.001)	0.588 (+0.001)
+Test-time	0.792 (+0.002)	0.821 (+0.002)	0.792 (+0.001)	0.587 (-0.001)

- Effectiveness of SSKD

	All	Frequent	Common	Rare
TADE	0.745	0.754	0.762	0.582
SSL	0.771 (+0.026)	0.783 (+0.029)	0.791 (+0.029)	0.572 (-0.01)
SSKD	0.780 (+0.035)	0.799 (+0.045)	0.792 (+0.03)	0.587 (+0.005)

- Choices of KD

	All	Frequent	Common	Rare
From $E_1$	0.769	0.780	0.789	0.588
From $E_{i-1}$	0.790 (+0.021)	0.819 (+0.039)	0.791 (+0.002)	0.588