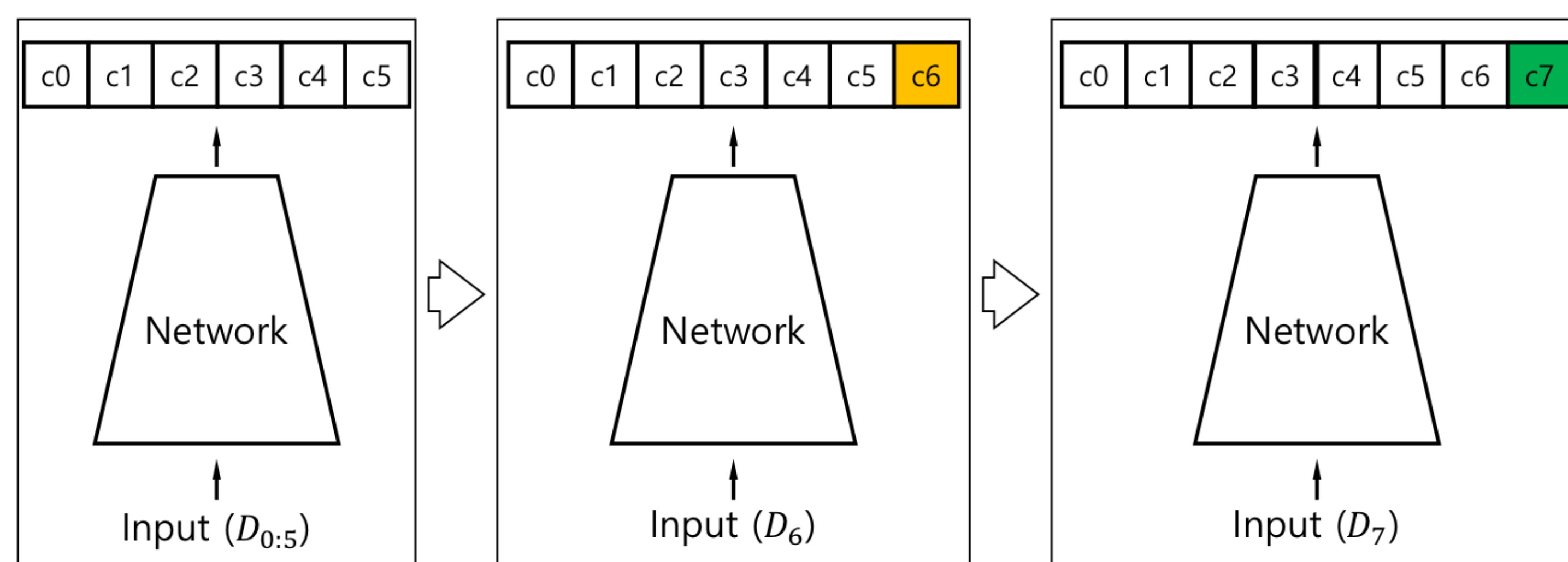


Introduction

Human learns incrementally. A common learning environment for a human is a stream of small data. If excessive amount of data is provided at once, it rather disturbs the learning efficiency. On the other hand, to train an algorithm, including DNN, it is commonly assumed that the entire training dataset is accessible throughout the training sequence. In this work, we propose Incremental Class Learning with Attribute Sharing (ICLAS) to train DNN with a stream of data.

Problem Definition



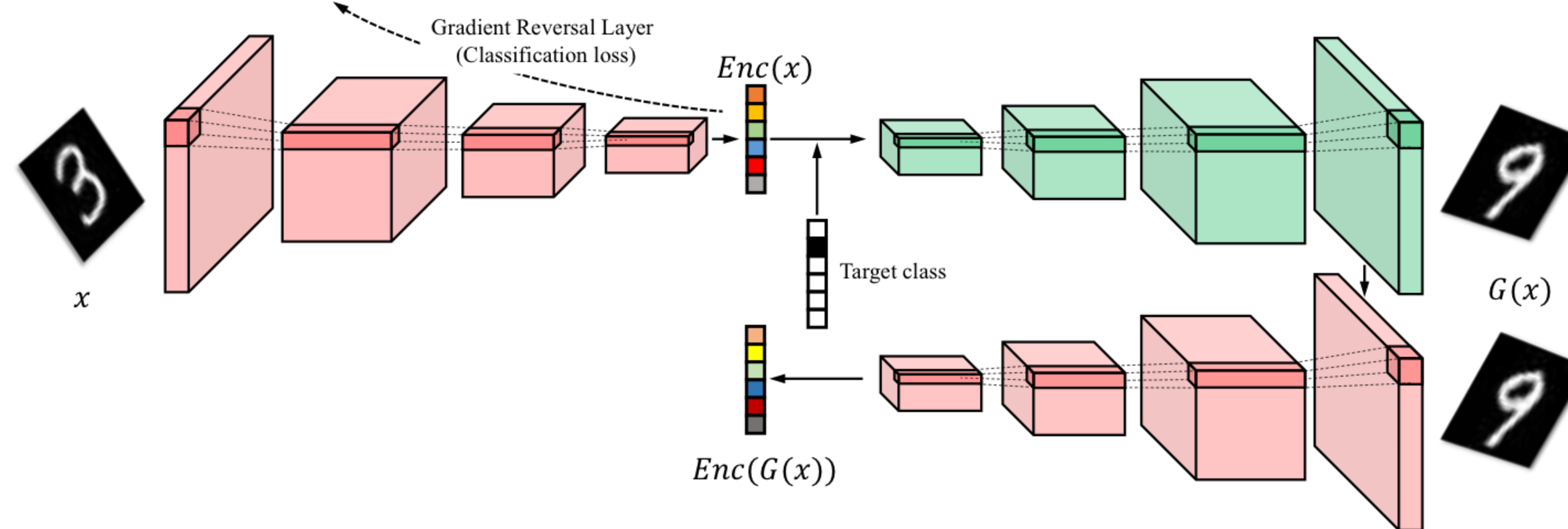
- For each class incremental situation, we provide a set of image-label pairs of the new classes that are not previously provided.
- Network predict the class label by single output layer.

Network Architecture - IncGAN

- VAE based generative model for attribute sharing.
- Preserve attribute after reconstruction.

$$L_{share} = L_{aux} + L_{attr}$$

$$= L_{aux} + \|Enc(x_k^i) - Enc(G(x_k^i, c))\|_2,$$



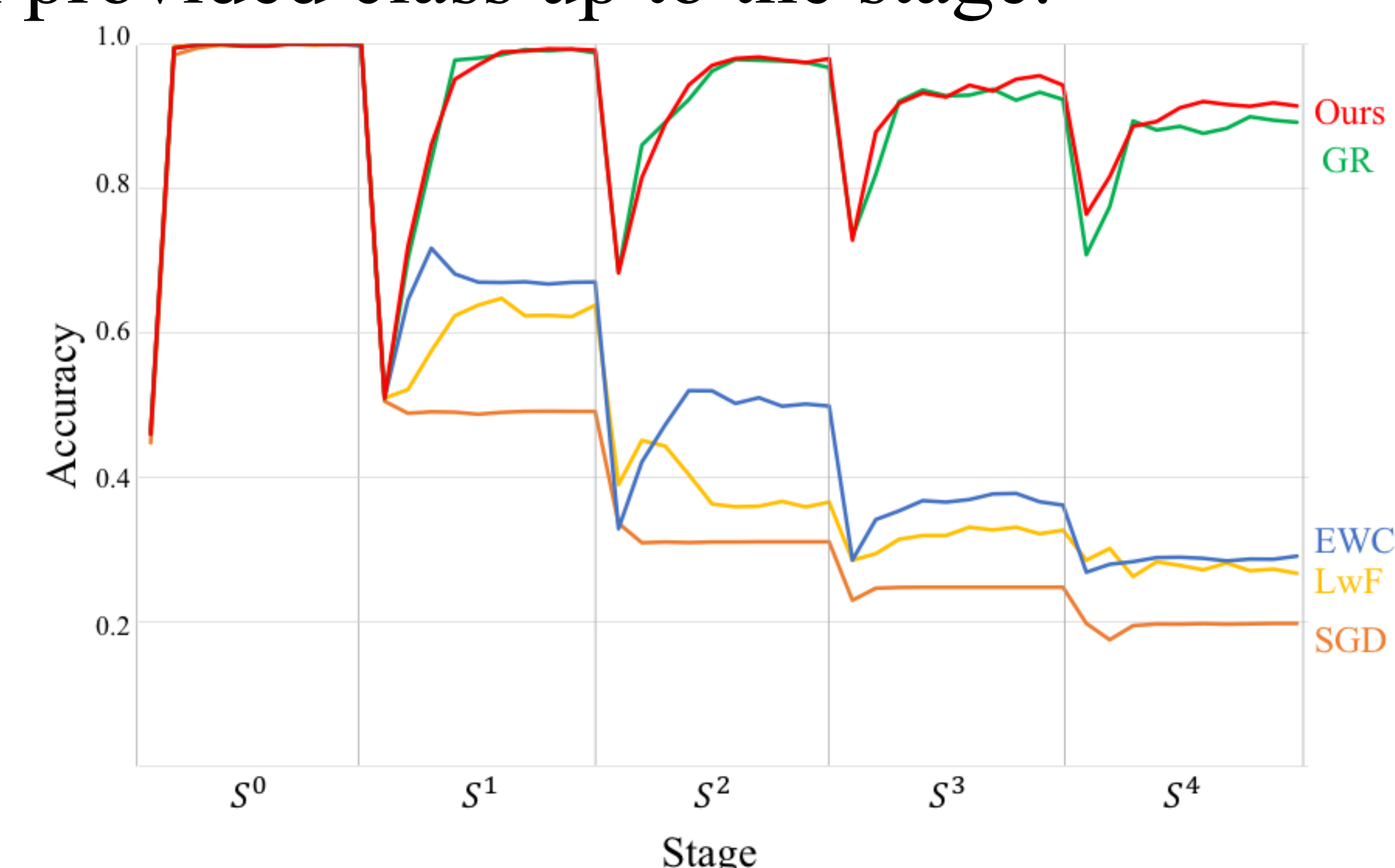
Exp. Results - Generative Model

- Generated images after incremental learning.
- Images illustrated in red box are noisy because IncGAN is not yet trained for corresponding classes.

	s ⁰					s ¹					s ²					s ³					s ⁴									
Query Image	0	0	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9
Generated Image	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Untrained	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

Exp. Results - Discriminative Model

- Classification performance comparison with other methods.
- In each stage, the accuracy is evaluated over all provided class up to the stage.



Cross-stage Attribute Sharing

- Mean pixel-wise STD of generated images.
- Images generated by IncGAN have higher variability for every class.

