**Objective**

Continual Learning of An Image Transformation Network for heterogeneous tasks

- **Task 1**: semantic segmentation
- **Task 2**: semantic segmentation
- **Task 3**: style transfer (Gogh)
- **Task 4**: style transfer (Munk)
- **Task 5**: edge image coloring
- **Task 6**: edge image coloring

**Method** : Piggyback [Mallya et al. ECCV 2018]

Use task-dependent weight selection masks.

No catastrophic forgetting happens with small additional binary masks and task-specific final layers.

1. For the first task, train and fix the weight of backbone network.
2. For the second task or more, train mask weights and obtain the task-specific mask.
3. At evaluation time, use effective filter by elementwise masking.

**Baseline**

- **scratch**: independent model
- **fine-tune**: a single identical network
- **decoder**: shared encoder and task-dependent decoder
- **Piggyback**: adapt Piggyback to encoder-decoder network

**Related Work**

Simultaneous training of multiple tasks
- Single encoder & task-specific decoders e.g. UberNet (Kakinou et al. CVPR 2017)
- Multiple inputs & multiple outputs e.g. One Model To Learn Them All [Kai et al. 2017]

Continual learning (approaches for overcoming “catastrophic forgetting”)
- **Rehearsal** [Hetherington et al. 1989]
  - train new samples with old samples
- **Distillation** Learning without Forgetting [Ilu and Holem 2016]
  - reproduce training labels of old tasks with trained model and use them for new training
- **Regularization** Elastic Weight Consolidation [Kirkpatrick et al. 2016]
  - train weights for new tasks according to un-importance of weights
- **Pruning** PackNet [Mallya et al. CVPR 2018]
  - fix trained weight for previous tasks and pruning un-important weights
- **Weight Selection** Piggyback [Mallya et al. ECCV 2018]
  - select task-specific weights from the fixed backbone network

In this work, we adapt “Piggyback” as a basic approach.

**Result**

“Piggyback” is effective for Encoder-Decoder network.

- **Task 2**: semantic segmentation
- **Task 3**: gray image coloring
- **Task 4**: style transfer (Gogh)
- **Task 5**: style transfer (Munk)
- **Task 6**: edge image coloring

**Baseline**

- **scratch**
- **fine-tune**
- **decoder**
- **Piggyback**

**Future work**

- Reducing the size of binary mask
- Analyzing the trained mask