# **Dynamic Neural Networks with Early-Exit Mechanisms**

In this project seminar, we will focus on a dynamic neural network with early-exit points (as illustrated) to reveal its layer-wise decision process. The agenda consists of four parts:

### 1. Network Construction & Training

Build a dynamic neural network that includes an early-exit classifier at every layer, then train it end-to-end so it can make predictions at varying depths.

#### 2. Exit-Layer Analysis

Feed input images of varying difficulty into the network and record the layer at which each can exit. Easy images typically exit in shallow layers, while harder ones require deeper representations.

#### 3. Failure-Mode Investigation

For the hard images that only exit at deep layers, analyze why they fail to classify accurately at shallower depths—e.g., insufficient feature representation or unusual edge distributions.

## 4. Image Modification & GAN-Based Enhancement

- **Targeted Modifications:** Apply techniques such as adversarial perturbations, style adjustments, or feature amplification to transform hard images so they can exit earlier.
- **GAN Synthesis:** Use a generative adversarial network to create "easy-to-exit" samples, testing the early-exit mechanism's sensitivity and generalization across input distributions, and further improving inference efficiency and interpretability.



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