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Institute of Media,
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Efficient Decoder for Learned Image Compression via Structured Pruning

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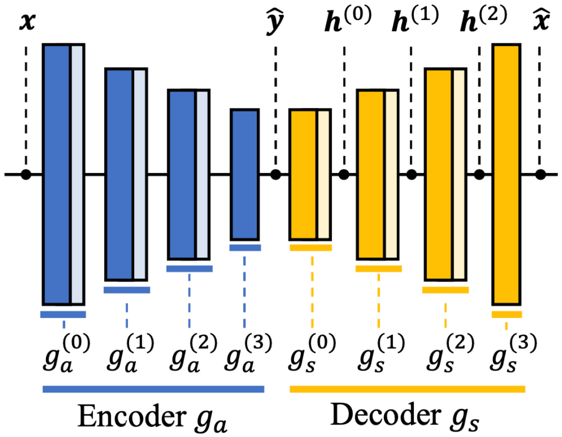
Background & Motivations

- Symmetric architecture in Learned Image Compression:



- Varying computational resources in different decoding devices:



- Customize models to accommodate different decoding platforms;

Methodology

- Effectiveness evaluation via activation range estimation:

Algorithm 1 Network Pruning on Learned Decoder

Input: A pre-trained learned compression model with encoder g_a and decoder g_s, the initial value for input $\boldsymbol{x}_0$, the number of iterations for gradient ascent N, the number of pruned channels on each layer s_i.

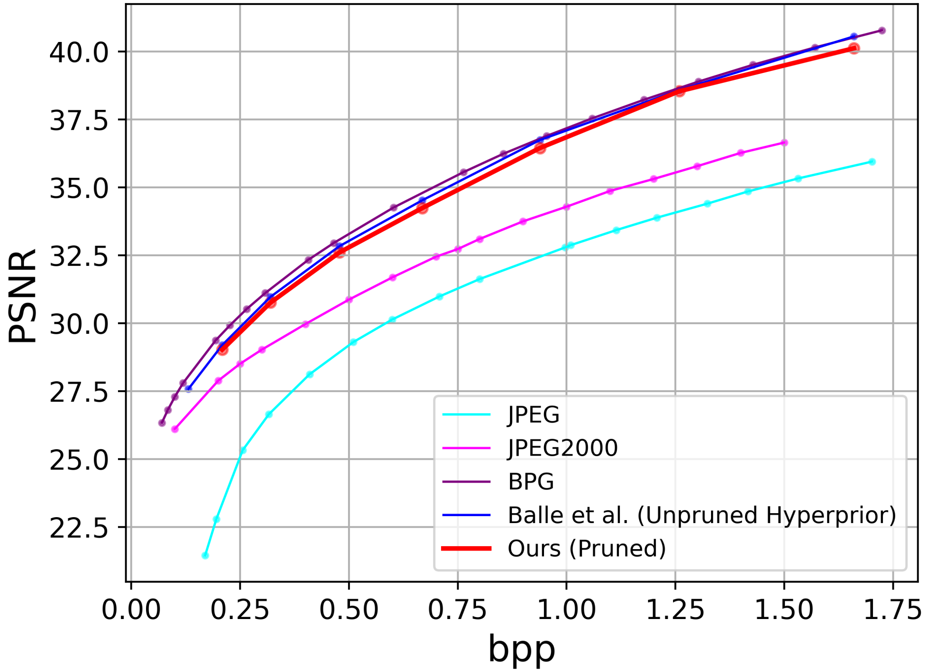
Output: A pruned decoder $\tilde{g}_s$.

for $i \leftarrow 2$ to 0 **do** ▷ Each layer in the decoder.
  for $j \leftarrow 1$ to q **do** ▷ Each channel of i-th layer.
    $n \leftarrow 0, \boldsymbol{x} \leftarrow \boldsymbol{x}_0$
    while $n \leq N$ and not converged **do** ▷ Loop for gradient ascent.
      $\boldsymbol{x} \leftarrow \boldsymbol{x} + \eta \cdot (\partial \dot{\boldsymbol{h}}_j^{(i)} / \partial \boldsymbol{x})$
      $n \leftarrow n + 1$
    end while
    while $n \leq N$ and not converged **do** ▷ Loop for gradient descent.
      $\boldsymbol{x} \leftarrow \boldsymbol{x} - \eta \cdot (\partial \ddot{\boldsymbol{h}}_j^{(i)} / \partial \boldsymbol{x})$
      $n \leftarrow n + 1$
    end while
    $e_j^{(i)} \leftarrow \dot{\boldsymbol{h}}_j^{(i)} - \ddot{\boldsymbol{h}}_j^{(i)}$ ▷ Record the effectiveness.
  end for
  for $k \leftarrow 1$ to s_i **do**
    Remove the j^*-th ineffective channel.
  end for
end for
Fine-tune the pruned model and return $\tilde{g}_s$.

Experimental Results

- Pruning performance:

Pruning Ratio r	Unpruned	0.20	0.33	0.40	0.55
Model Size (MB)	1.49	1.20	0.99	0.88	0.70
PSNR (dB)	32.84	32.75	32.66	32.61	32.43
PSNR decay (dB/MB)	-	-0.31	-0.32	-0.37	-0.52
Inference Time (s)	0.71	0.60	0.55	0.53	0.48
FLOPS (M)	3618	2656	1899	1533	1141



Outlook

- Pruning methods for image compression:
  - This paper focus on pruning pre-trained model to produce light-weighted models;
  - Design one-stage methods perform pruning and training simultaneously;
  - Novel light-weighted architecture;

- General network acceleration methods:
  - Quantization;
  - Distillation;
  - …

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Thank You!

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