MULTIGRID NEURAL ARCHITECTURES

**MultiGrid Layer Implementation**

- Multiplied convolution (top-most) assembled from standard components
- Upsampling: nearest neighbor, downsampling; max-pooling, concatenation & residual connection
- Residual pooling: communication, got summation - can replace explicit spatial resolution reduction stages
- Residual merged networks: apply multiplied convolution, apply batch norm (BN) per grid size (residual-log unit)

**Spatial Transformers & Learned Attention**

**Task:**
- Directly train CNNs to insert spatial transformations
- Deprive original instances of receptive field of positional cues

**Dataset:**
- Full MNIST digits: scaling, rotation, affine & translation
- ISIC training, ISIC test images: single digit in 0 ≤ x ≤ 1 image

**Results:**
- Multigrid network structure is required to learn the task!

**Image Classification**

<table>
<thead>
<tr>
<th>Model</th>
<th>Parameters</th>
<th>FLOPs</th>
<th>Error (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-NET</td>
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<td>19.67</td>
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<tr>
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<td>R-MG-34</td>
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**Semantic Segmentation (Synthetic)**

**Task:** Separate superimposed digits into pre-class channels

**Dataset:**
- Randomly deformed and superimposed MNIST digits
- URE training, 1k test images, colored 0 ≤ x ≤ 1 pixels

**Results:**
- Multigrid network structure must perform dramatically better
- Acc is classification, symmetric with residual links

**Multigrid Hierarchies**

- Grids: 10 or 1 (SPT)