**Problem & Prediction**
- Analytical methods exist for predicting aircraft weight based on size of various components
- These methods require a full-featured aircraft model within a conceptual design suite
- By training a neural network we can make these predictions without the overhead of the conceptual design suite

**Data Format**
- $1E6$ data points were generated via uniform random sampling of the design space for aircraft with estimated MTOW from $2E3$ to $2E4$ kg:

**Models – FCNN**
- FCNN as Baseline:
  - 32-128 Hidden Units
  - 3-9 Layers
  - Softmax or ReLU Output Layer
  - Adam Optimizer
  - $\alpha$: 1E-4 to 1E-1
  - Batch Size from 32 to 1024
  - Training Epochs from 10 to 10000

**Categorical vs. Regressor**
- Problem can be posed as either regression using 1-D output w/ MSE Loss or 100-D output w/ CCE Loss:
  - $L_{MSE} = \frac{1}{m} \sum_{i=1}^{m} (y_i - \hat{y}_i)^2$
  - $L_{CCE} = \frac{1}{m} \sum_{i=1}^{m} \sum_{j=1}^{n} (- (y_{ij} \log \hat{y}_{ij} + (1 - y_{ij}) \log (1 - \hat{y}_{ij}))$

**Results & Discussion**

<table>
<thead>
<tr>
<th></th>
<th>Training (95%)</th>
<th>Test (5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categorical</td>
<td>3.6%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Regressor</td>
<td>2.7E7</td>
<td>4.5E7</td>
</tr>
</tbody>
</table>

- Overall performance was poor, Regressor errors on the order of 5000 kg. Categorical accuracy only marginally better than random guessing
- Models typically reached this performance in $<500$ epochs, insensitive to longer training
- Improved with size of dataset, not with size of network (tested with subsets of $1E3$ to $1E5$ points)

**Future Work**
- Generate larger dataset, exclude outliers
- Consider wider range of architectures (e.g. HRNN)
- Implement simulated annealing optimizer