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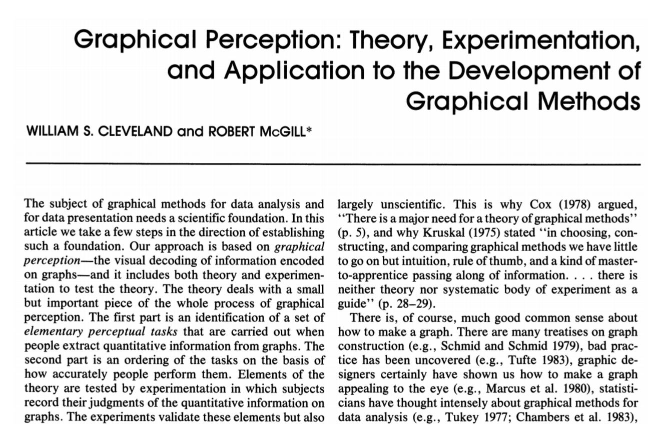
BROWN Computer Science

Can CNNs model human graphical perception?

We replicate **Cleveland and McGill's 1984** human perception experiments with Convolutional Neural Networks.


Graphical Perception: Theory, Experimentation, and Application to the Development of Graphical Methods

WILLIAM S. CLEVELAND and ROBERT McGILL

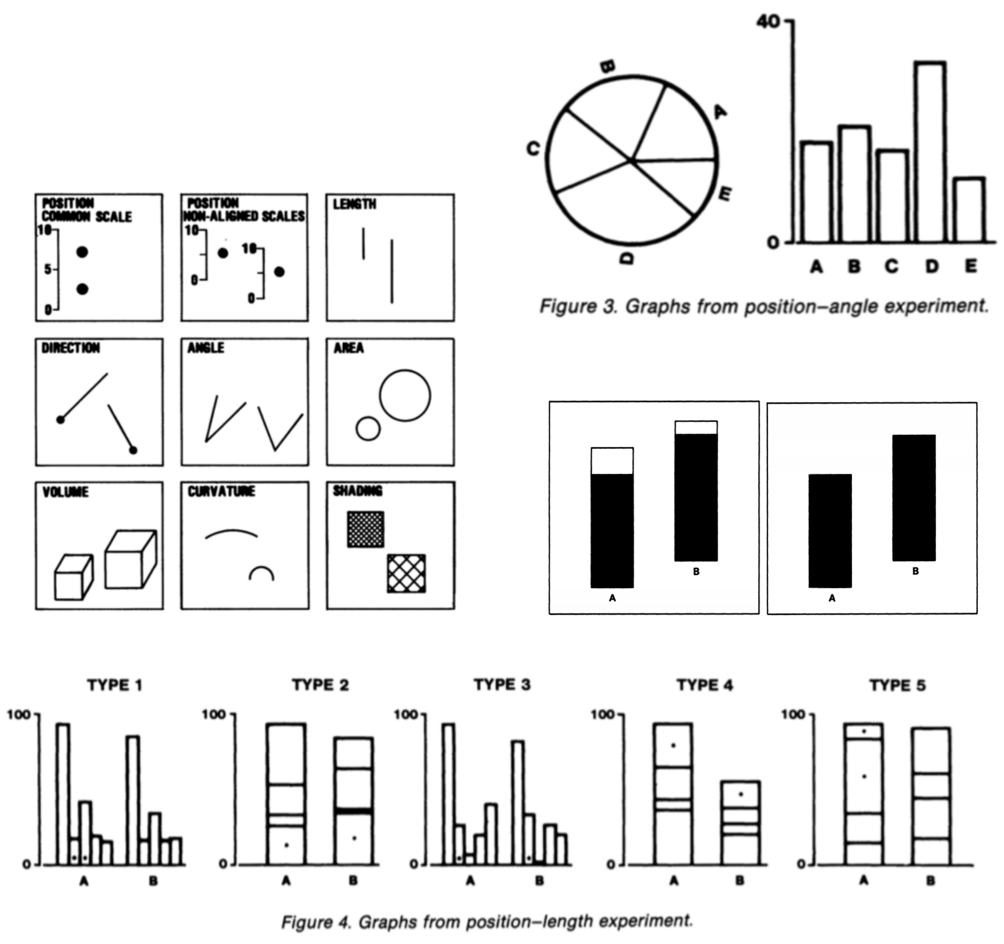
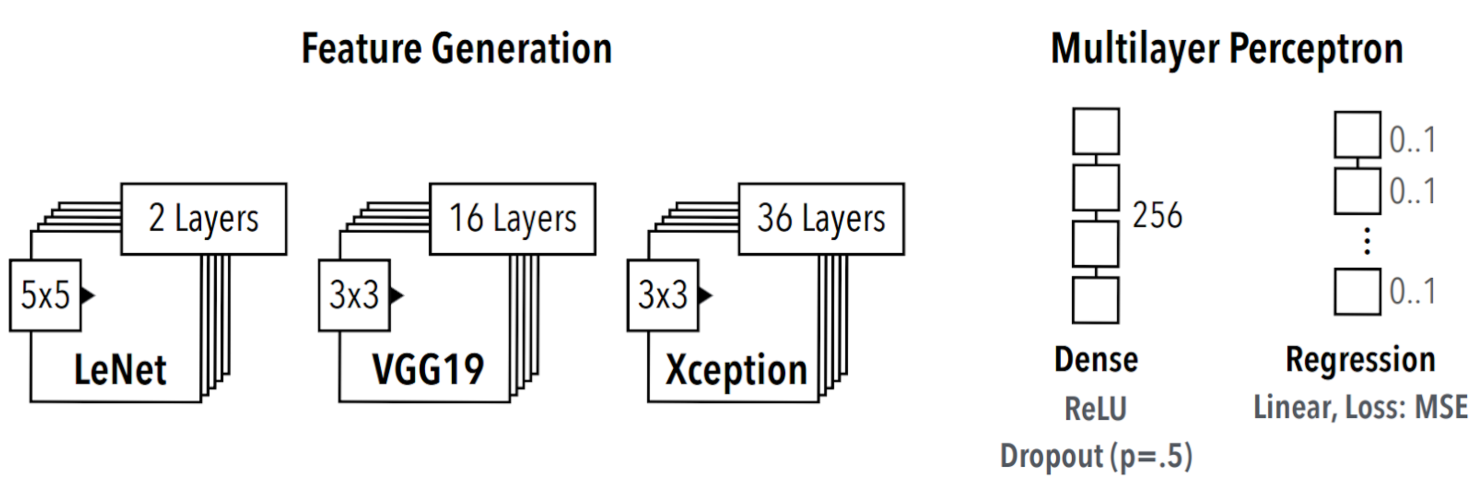


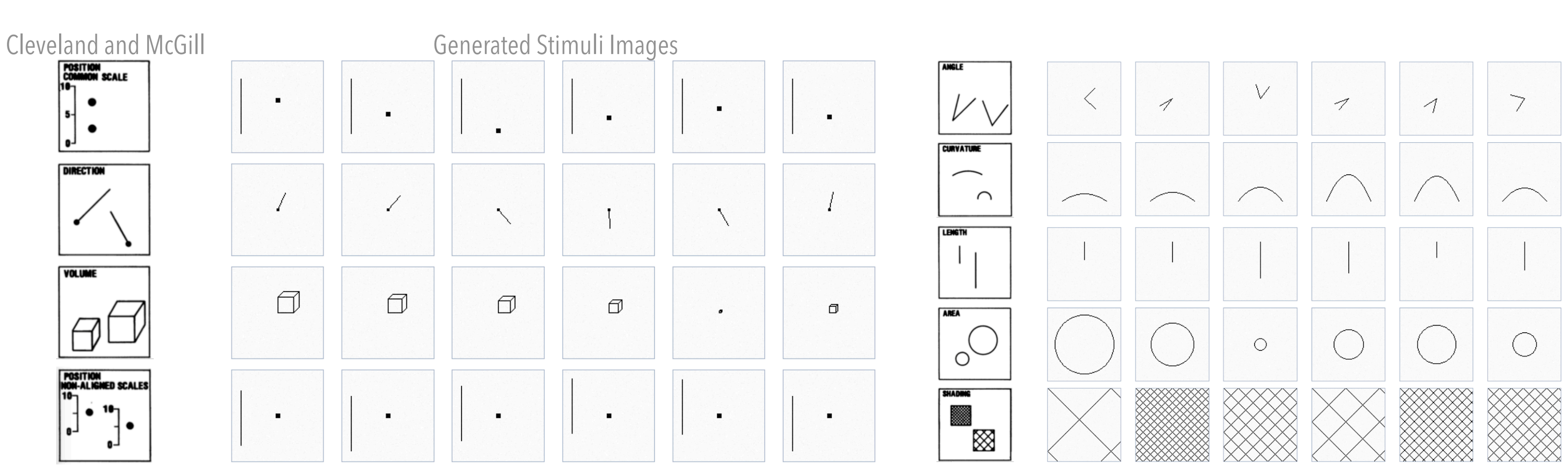
Figure 3. Graphs from position–angle experiment.

Figure 4. Graphs from position–length experiment.

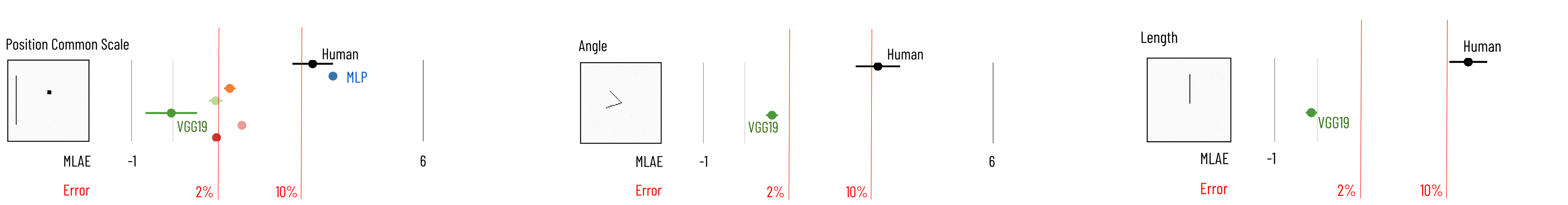


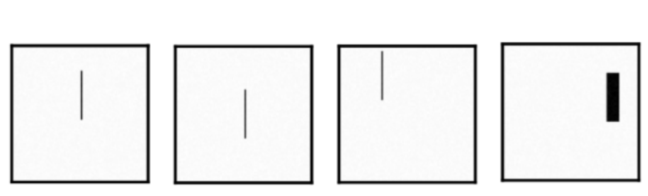
We evaluate **4 CNN architectures** with **2500+ configurations** (4.7 GPU years) on generated stimuli images.

Experiment 1: Elementary Perceptual Tasks



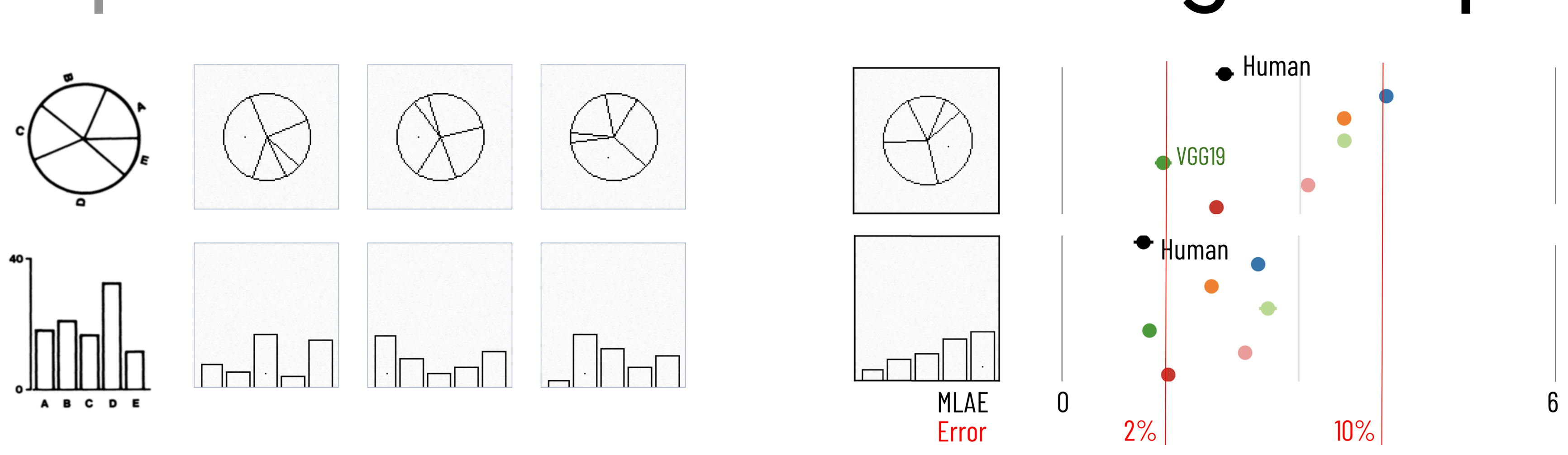
VGG19 performs much better than humans when estimating elementary perceptual visual stimuli.





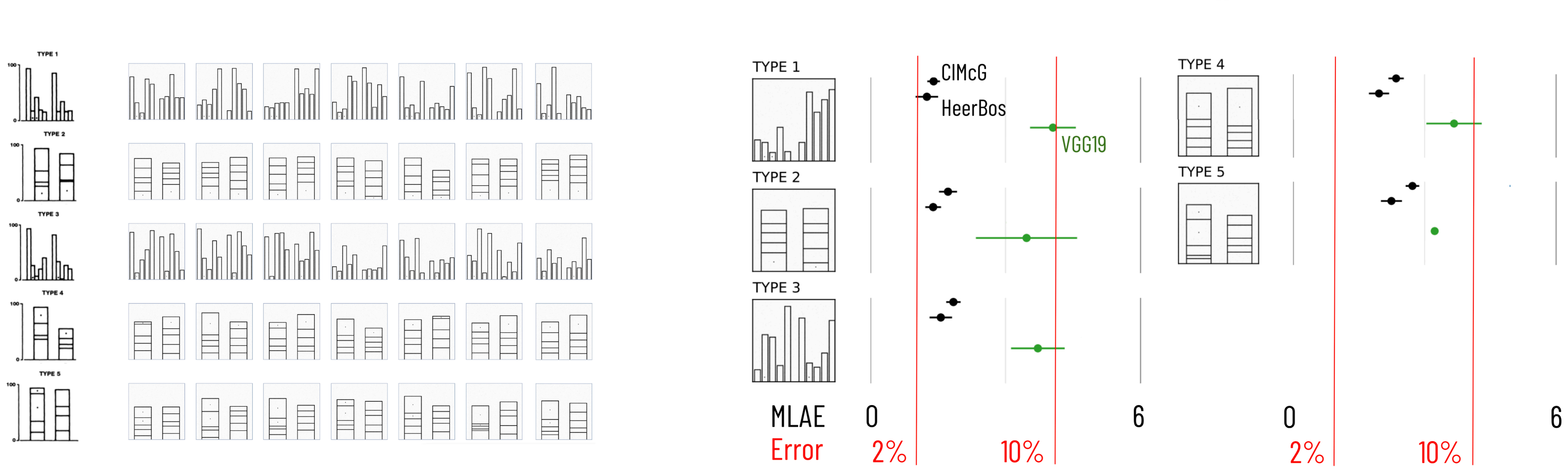
But slight visual **variations throw the networks off**.

Experiment 2: Position-Angle Experiment



Neural networks are able to estimate simple diagrams and, like humans, prefer bar charts over pie charts.

Experiment 3: Position-Length Experiment



Humans are better at comparing two different marked visual encodings. This **task seems too complex for CNNs** - even with increased training samples.

More experiments and results in our paper:

Evaluating 'Graphical Perception' with CNNs

in *IEEE Transactions on Visualization and Computer Graphics, 2018.*

Code / Data / Results available at https://bit.ly/machineperception

So can they..?

Not quite yet.

Are ResNet or CORNet the answer?