Visual Question-Answering

GROUP 3

PARTH SHAH (20759634)

PRIYA PATEL (20787652)

PRATEETI DEB CHAUDHURI (20802005)

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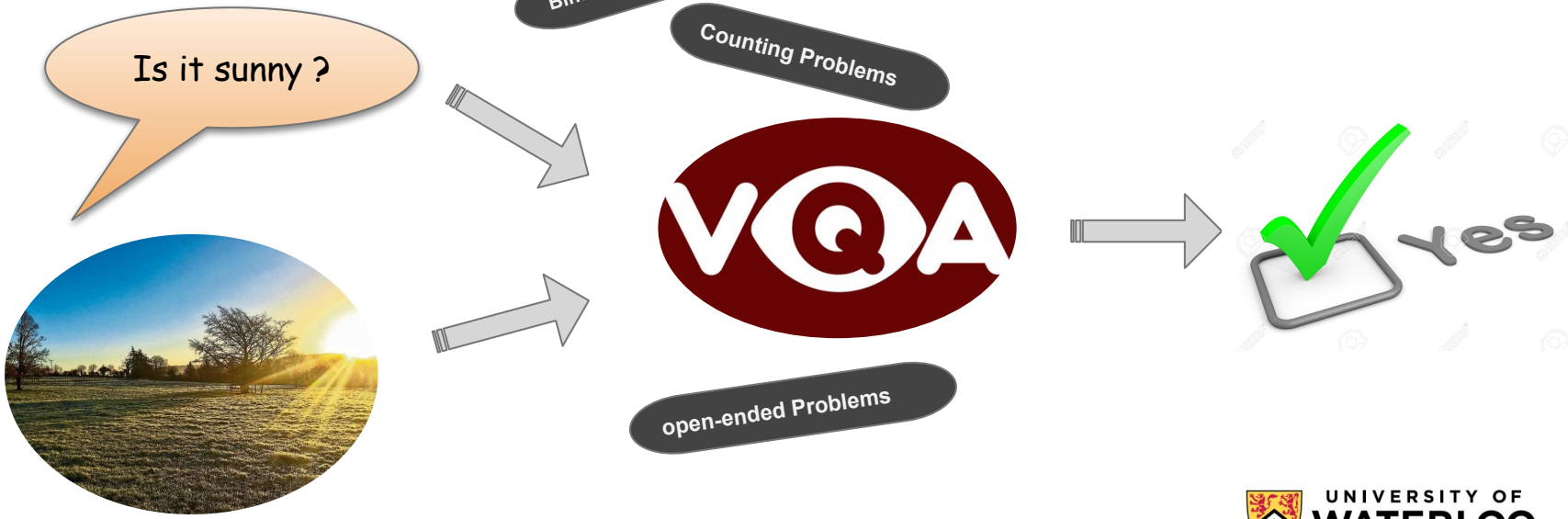
What is VQA ?

Predict the answer of given question related to an image.



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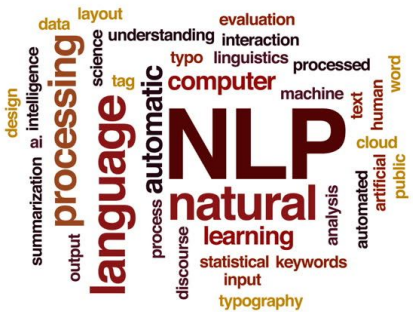
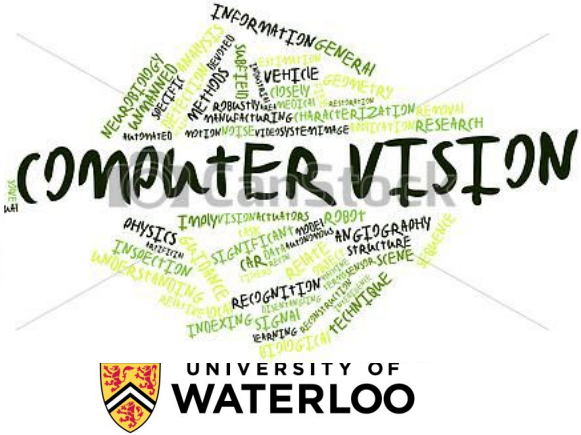
Why VQA?

- Useful for helping blind or visually impaired persons
- Multidisciplinary task
- A Visual Turing Test





Literature Review

- **VQA: Visual Question Answering(Aishwarya Agrawal, Jiasen Lu, Et al)**
  - Presented the open-ended Visual Question Answering dataset consisting MS COCO images, open ended questions and human annotated answers.
  - Baseline model for the task

Literature Review (cont.)

- **Visual Question Answering: Datasets, Algorithms and Future Challenges(Author: Kushal Kafle and Christopher Kannan)**
  - Compared the datasets available for VQA like DAQUAR, Visual 7W, FM -IQA, VQA, etc.
  - Reported all the different types of techniques (i.e. Baseline models, attention modes, bayesian models, etc.) used to solve the VQA and compared them.

Literature Review (cont.)

- **Tips and Tricks for Visual Question Answering: Learnings from the 2017 Challenge (Damien Teney,Peter Anderson, Et al.)**
  - Used image features from bottom-up attention that provide region-specific features
  - massive exploration of architectures and hyperparameters
  - sigmoid output

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Dataset used

- COCO-VQA dataset
- ~83K training images,
- ~41K validation images,
- ~81K testing images
- Open-ended task.
- 1 Image * 3 question * 10 answer

Evaluation Metric

$$\text{Acc}(ans) = \min\left\{\frac{\#\text{humans that said } ans}{3}, 1\right\}$$

- The annotators are generated for the VQA dataset as ten answers per question.
- Where the total number of annotators is denoted by # which has the same answer as that of the algorithm.

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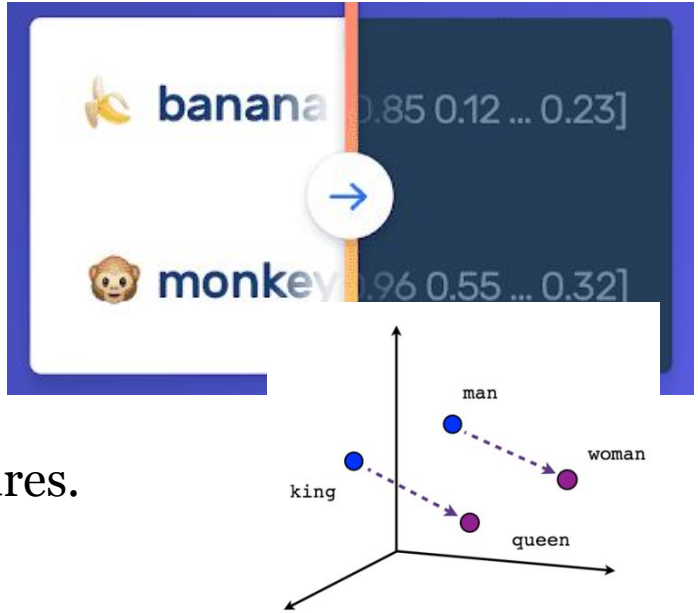
Pre-trained models used



VGG16 Pretrained weights

- very versatile, simple and relatively small.
- Remove the last 2 layers to extract the features.

GloVe word embedding

- reduces a given token into a 300 dimensional representation.
- co-occurrence matrix (words X context) that basically count how frequently a word appears in a context.

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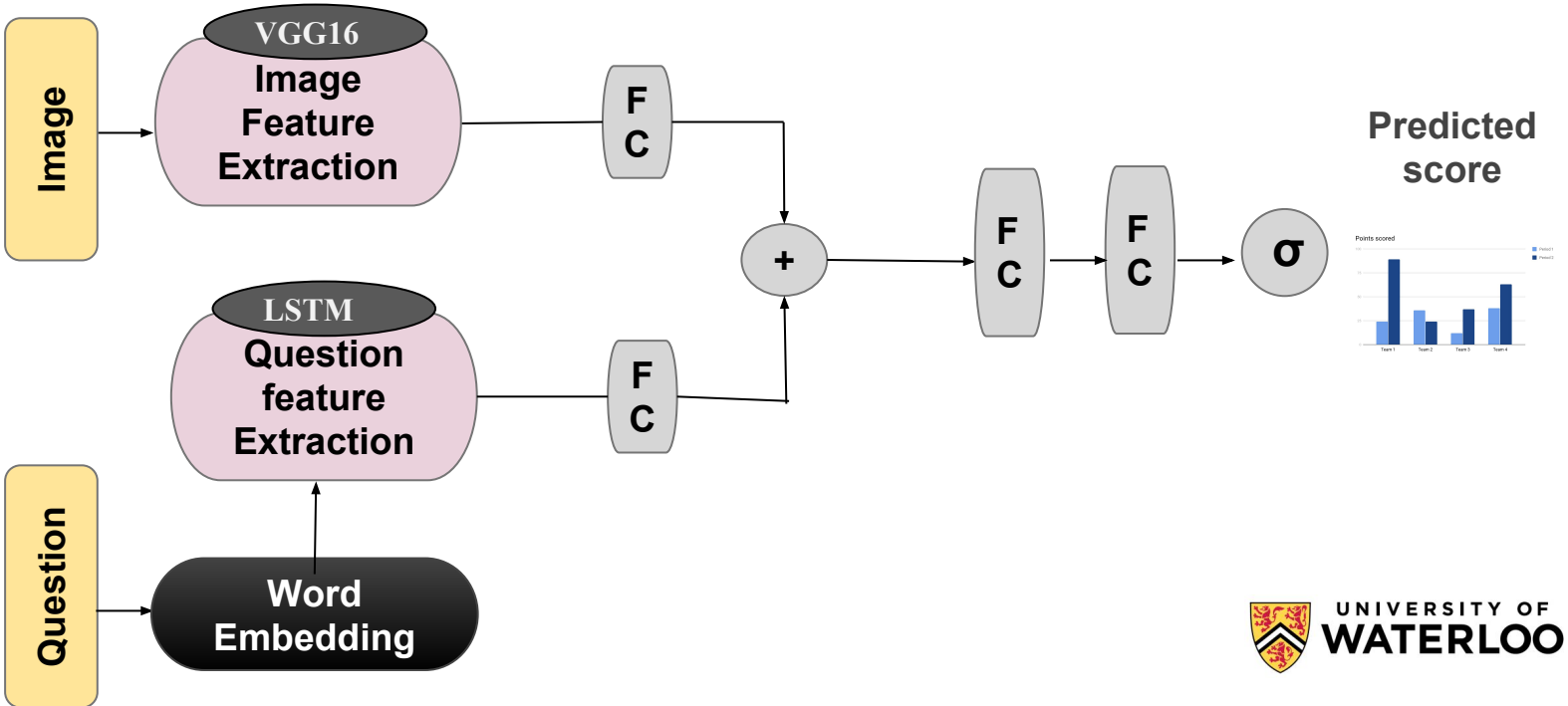
Let's start with Basic Model

- Built a basic model using
  - **Convolutional Neural Network (CNN)** for image recognition and,
  - **Long Short Term Memory (LSTM)** for natural language processing
  - Then, combining the results to deliver the final answer for VQA.

Basic Model for VQA



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VQA DEMO

Question

Which animals are there?

Output

```
64.17 % ['birds']!
5.91 % ['soccer']!
4.09 % ['eagle']!
2.45 % ['bears']!
2.13 % ['cows']!
```

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VQA DEMO

Question

Is it raining?

Output

```
80.14 % ['no']!
19.85 % ['yes']!
0.0 % ['summer']!
0.0 % ['in air']!
0.0 % ['green']!
```

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VQA DEMO

Question

Is there a baby?

Output

```
90.58 % ['yes']!
9.41 % ['no']!
0.0 % ['boy']!
0.0 % ['christmas']!
0.0 % ['girl']!
```

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VQA DEMO

Question

What is the color of the car?

Output

```
63.77 % ['red']!
12.73 % ['silver']!
6.82 % ['red and white']!
4.19 % ['blue']!
3.86 % ['white']!
```

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VQA DEMO

Question

How many children are there?

Output

```
66.53 % ['2']!
9.49 % ['3']!
6.78 % ['4']!
5.47 % ['5']!
3.87 % ['1']!
```

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Results

- Achieved 52.87% accuracy on the validation set after 18th epoch
- Training Time: 10-11 mins/epoch on single NVIDIA K80

Moving Ahead

- Models built using only question/answer pair have shown 45.06% of accuracy.
- Using global features alone may obscure task-relevant regions of the input space.
- certain visual regions in an image and certain words in a question are more informative than others for answering a given question.

Attention Network

- Helps the algorithm decide which parts of the image to focus on
- It uses an output from one model to focus on specific sections of another neural network.

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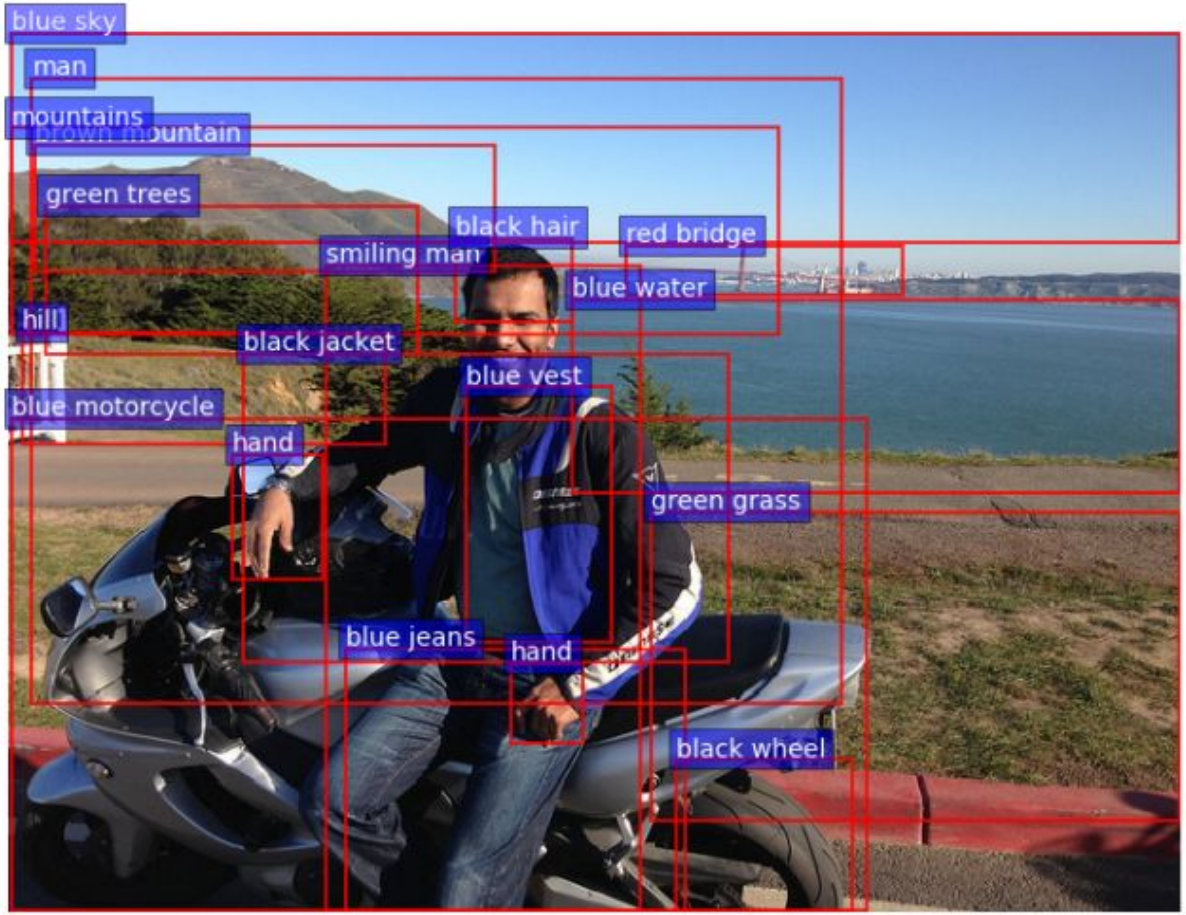
Pretrained Feature

Example of features extracted from the image using attention model



Attention Model Architecture

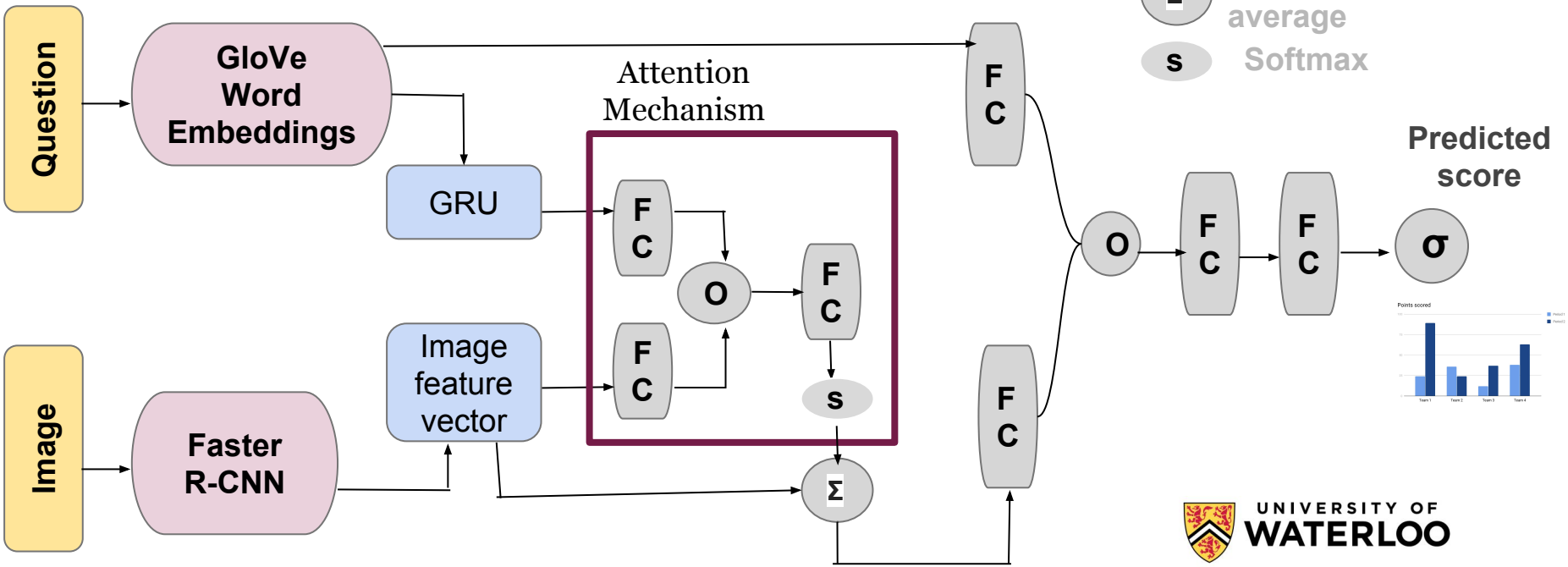
FC: Fully Connected

O Element wise multiplication

σ Sigmoid

Σ Weighted sum of average

s Softmax



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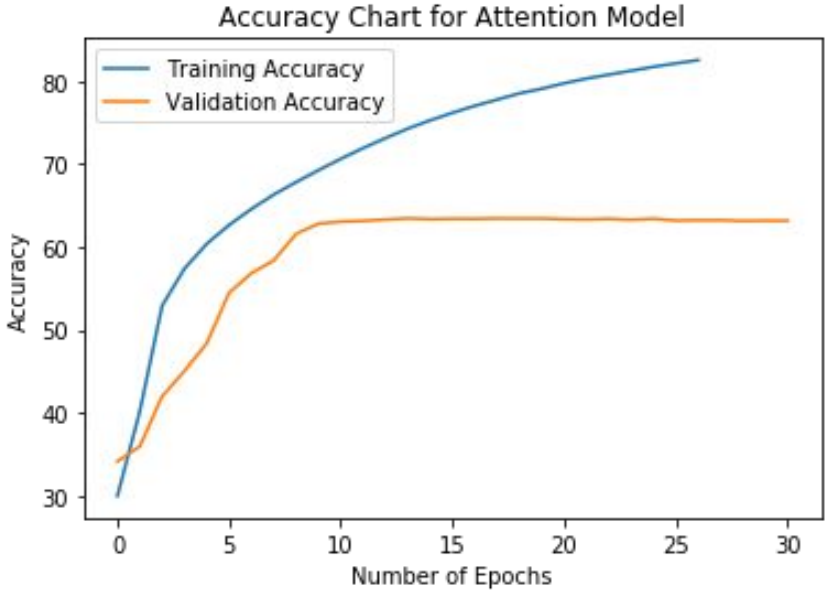
Accuracy Charts

- Validation Accuracy:63.46 after 12 Epoch
- Training Time: Approx 8-9 mins/epoch on Single NVIDIA Tesla K80



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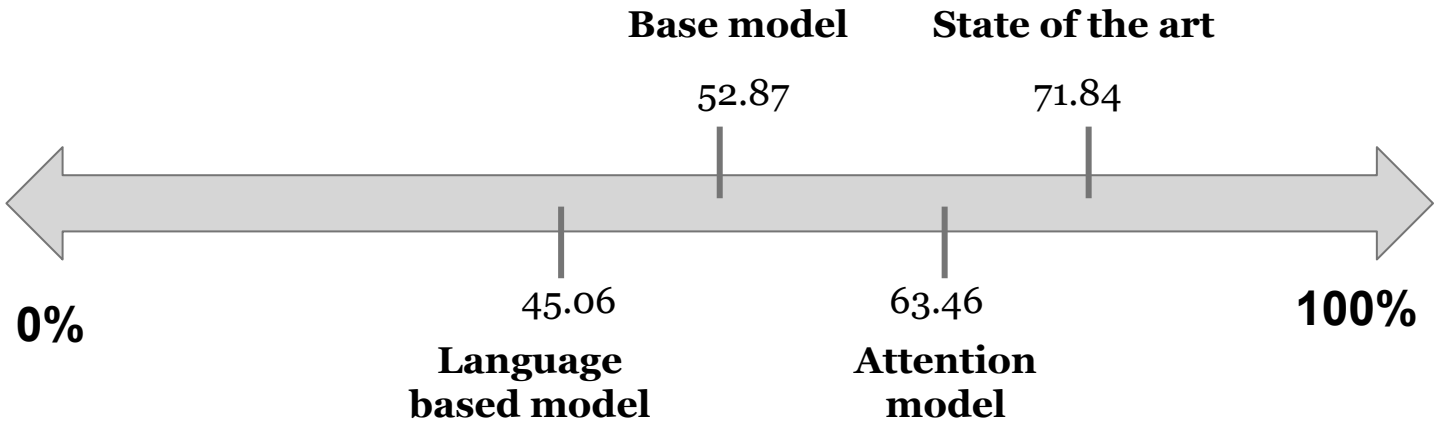
Comparison of Results



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Interesting Observation

- Difficult to predict effects of hyperparameters.
- Fancy tweaks may just add more capacity to network May be redundant with other improvements.
- By only using a fixed number of objects per image (K=36) and We don't use extra data from Visual Genome(Another dataset for VQA), we still getting similar results compared to the paper.

Challenges

- Performance ≈ (# Ideas) * (# GPUs) / (Training time)
- Experimenting with reduced training data does not translate into improved performance while training on the whole data set using same architecture and parameters
- Model tend to learn language biases.
- Model is inefficient (~39% accuracy in base model and ~49.7% accuracy) when it is asked to count something.

Future Scope

- Training on task-specific datasets may help enable practical VQA applications.
- Trying different embedding For questions
  - FastText embedding
  - ELMo (Deep Contextualized word representations)
- Bilinear Attention Networks

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- https://visualqa.org/evaluation.html
- Tips and Tricks for Visual Question Answering: Learnings from the 2017 Challenge, Damien Teney, Peter Anderson, Xiaodong He, Anton van den Hengel
- VQA: Visual Question Answering, Aishwarya Agrawal, Jiasen Lu, Stanislaw Antol.
- An Analysis of Visual Question Answering Algorithms, Kushal Kafle Christopher Kanan
- https://github.com/GT-Vision-Lab/VQA_LSTM_CNN
- https://github.com/peteanderson80/bottom-up-attention

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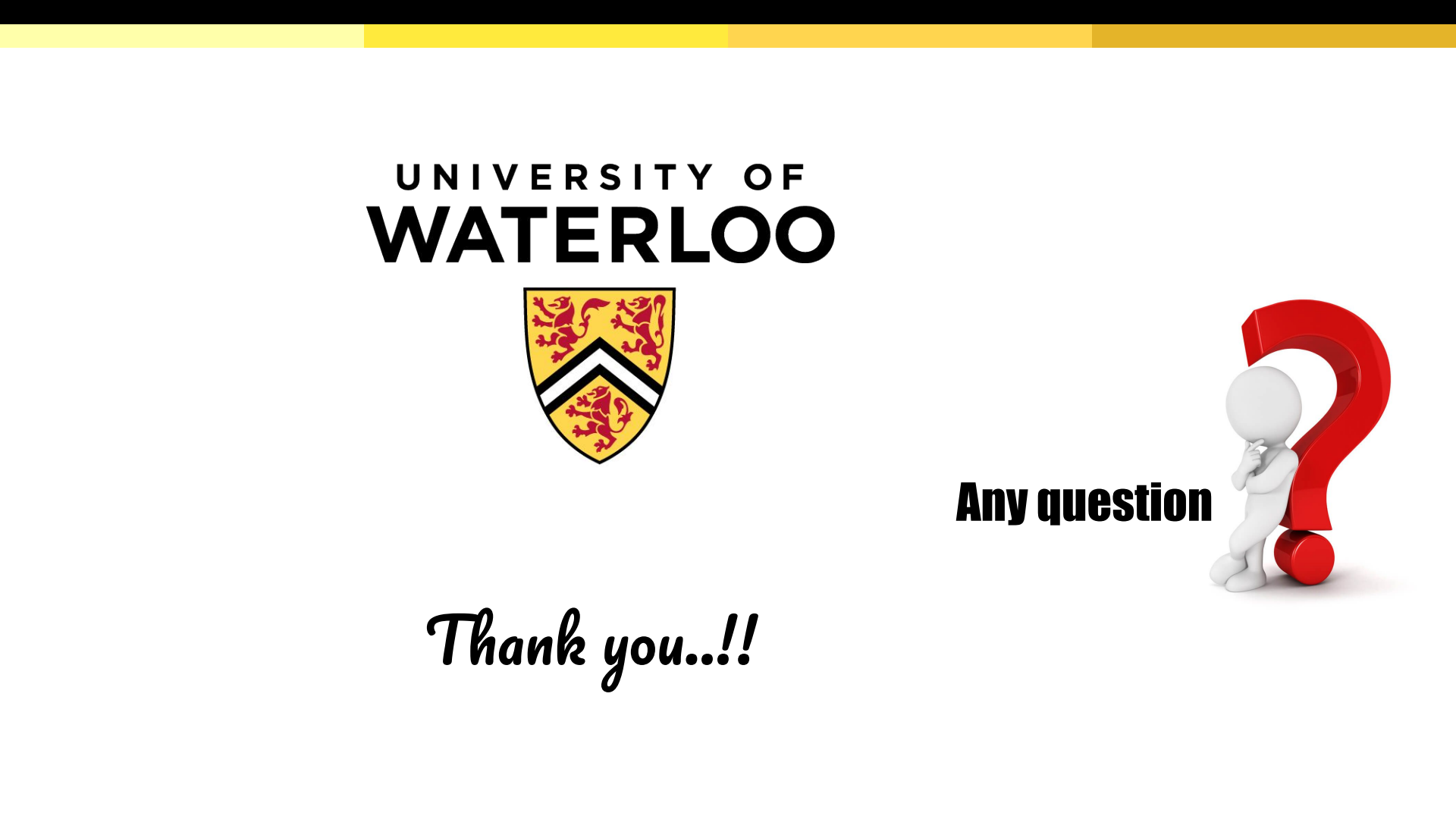

Thank you..!!