09-14-2018

# Pythia for Vizwiz



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Devi Parikh


Marcus Rohrbach


* - indicates equal contribution



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# Motivation

## Two key aspects of the Vizwiz dataset

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Requires OCR


*What does the bottle say?*

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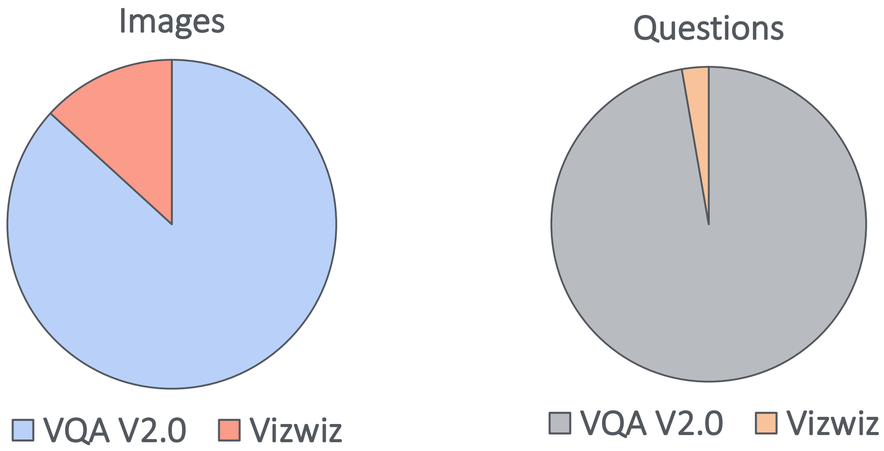
*What does the bottle say?*

Vizwiz dataset is small




Number of Images - VQA V2.0: 204721, Vizwiz: 31173
Number of Questions - VQA V2.0: 1105904, Vizwiz: 31173

# Pythia

## Our starting point to the Vizwiz Challenge

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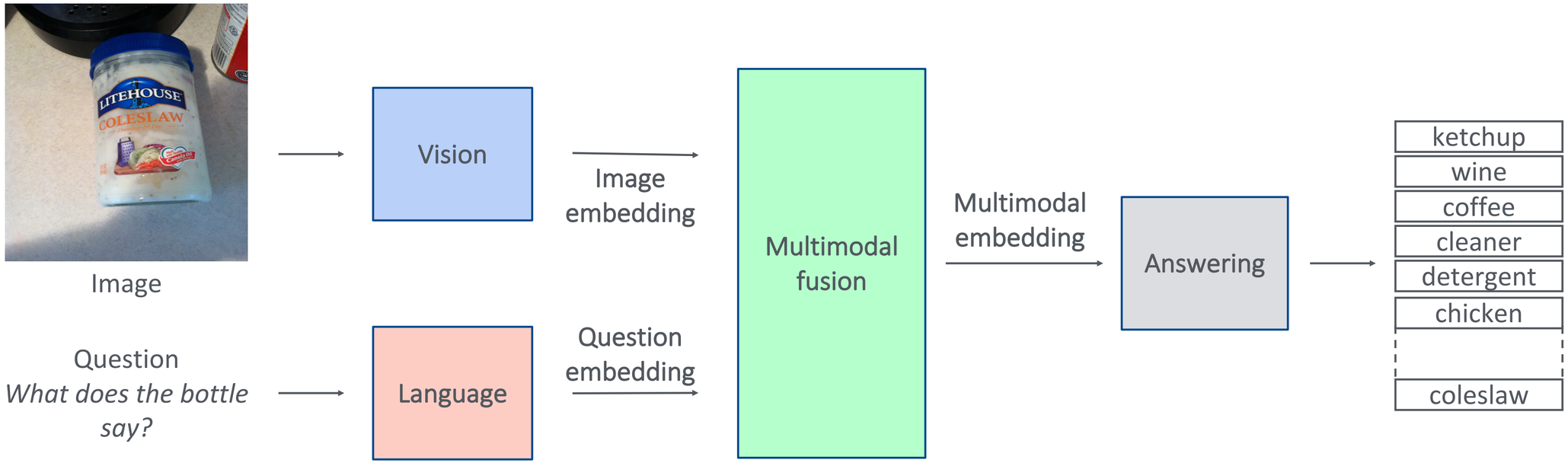

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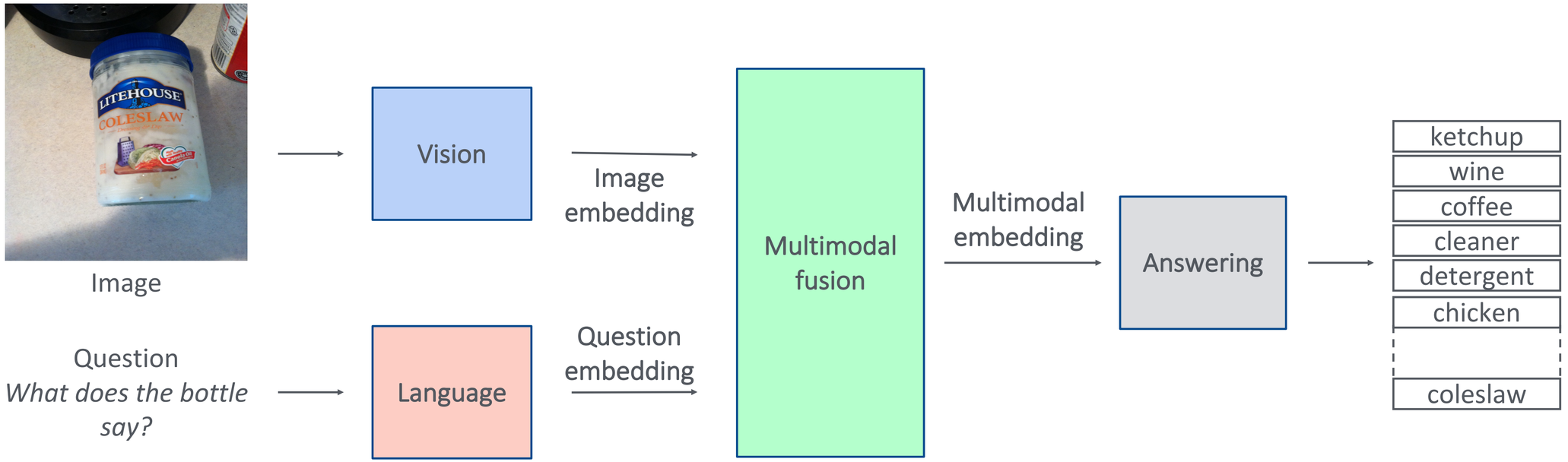


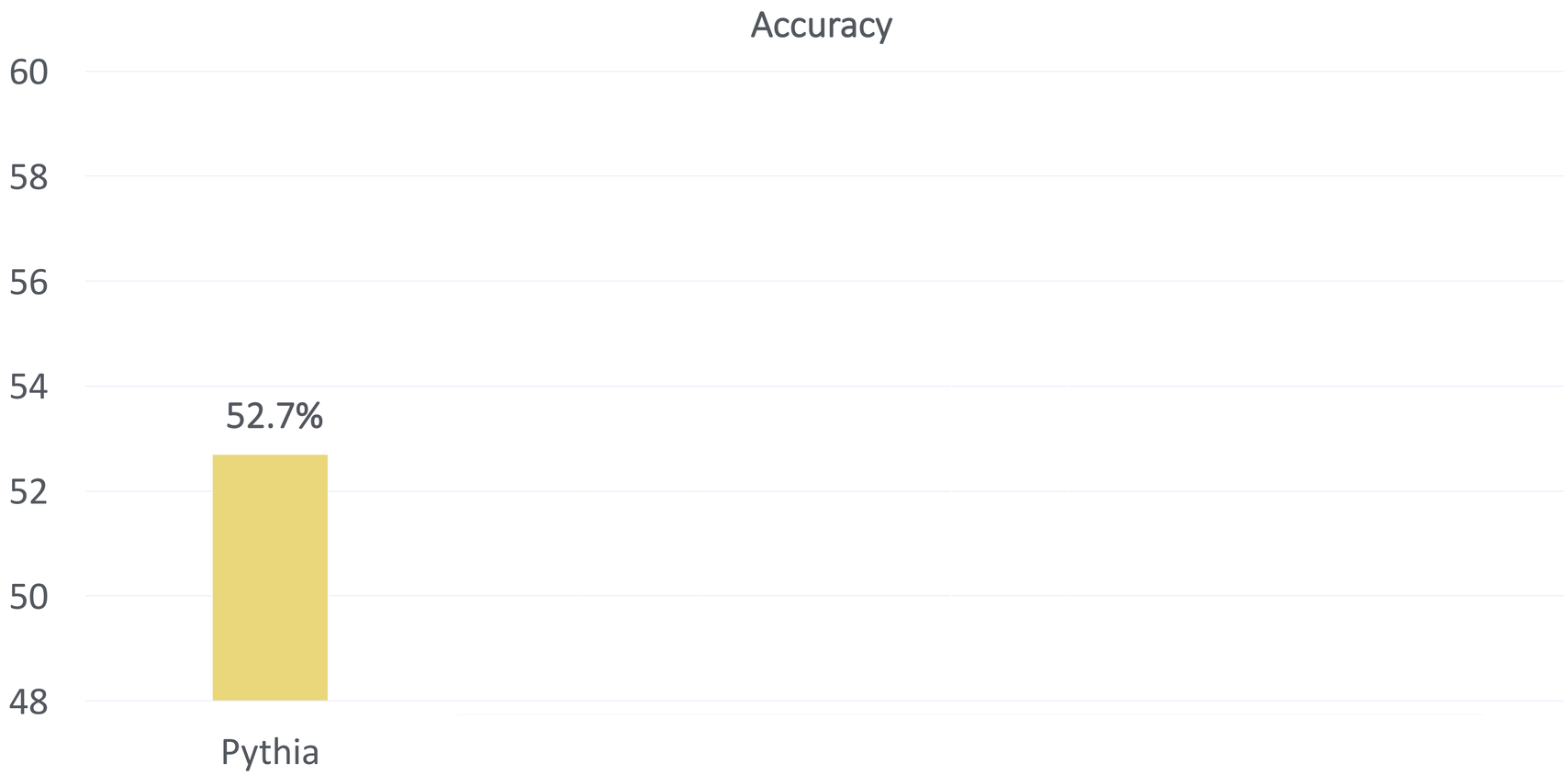

Abstract: https://arxiv.org/pdf/1807.09956.pdf
Code: https://github.com/facebookresearch/pythia

# Pythia

test-dev accuracy

# Pythia

## test-dev accuracy



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## Qualitative results

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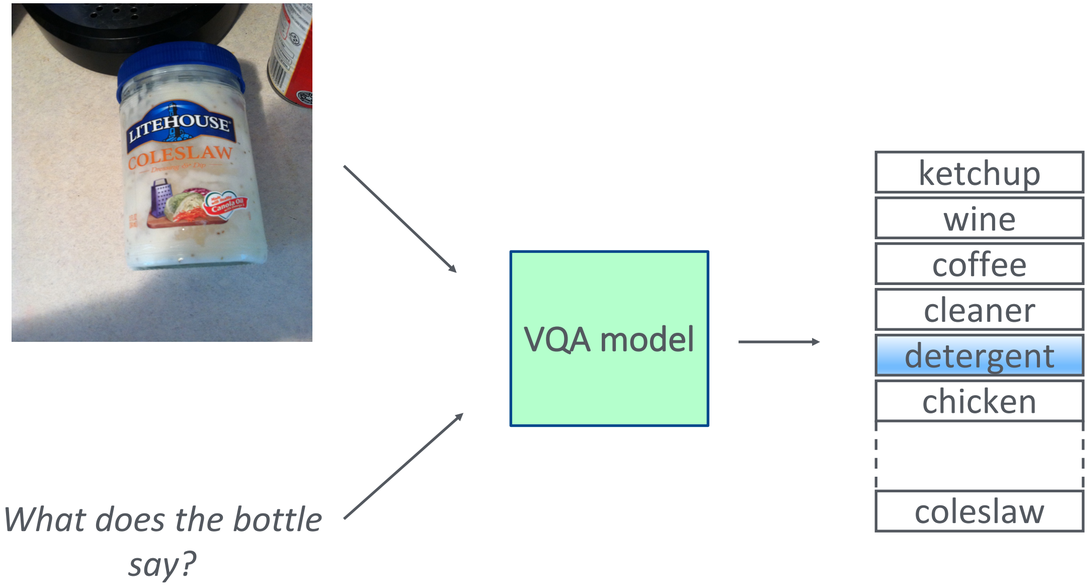
Poor performance on questions that required OCR capabilities



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*What does the bottle say?*

VQA model

- ketchup
- wine
- coffee
- cleaner
- **detergent**
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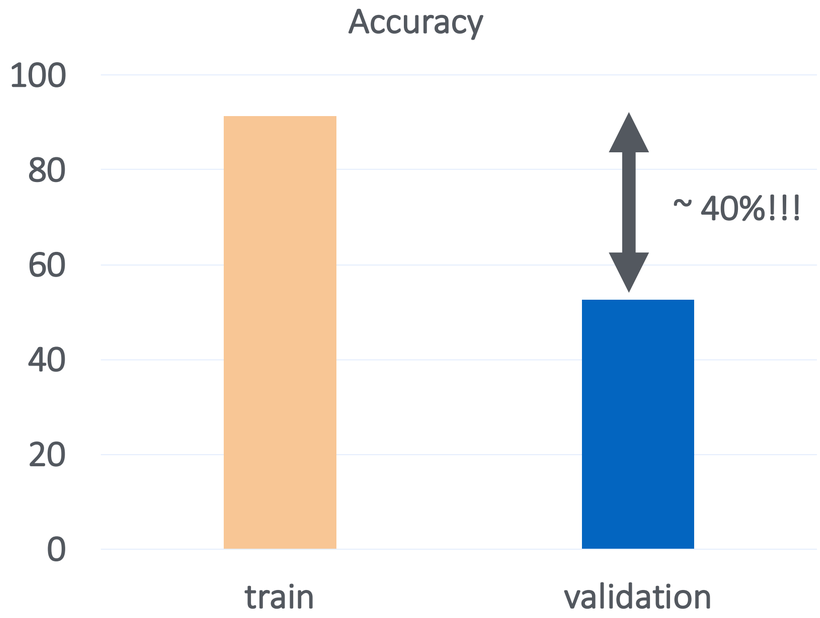
Small dataset, model overfitting



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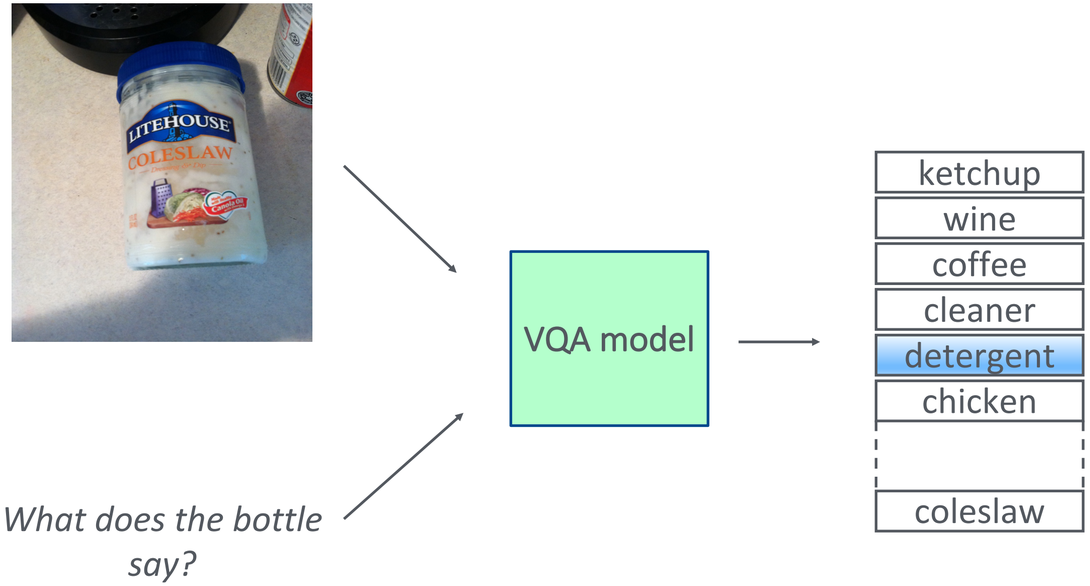


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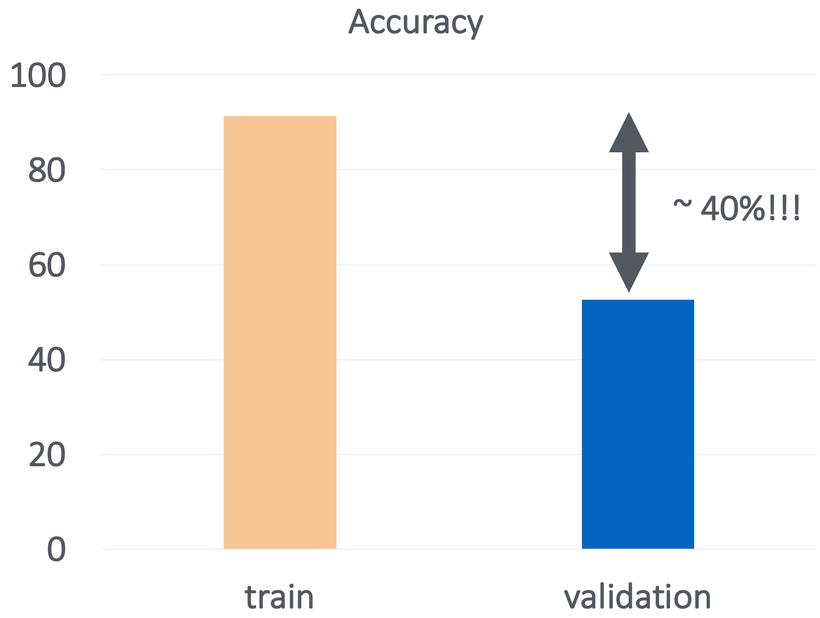


Poor performance on yes/no and number categories which had few examples in the dataset

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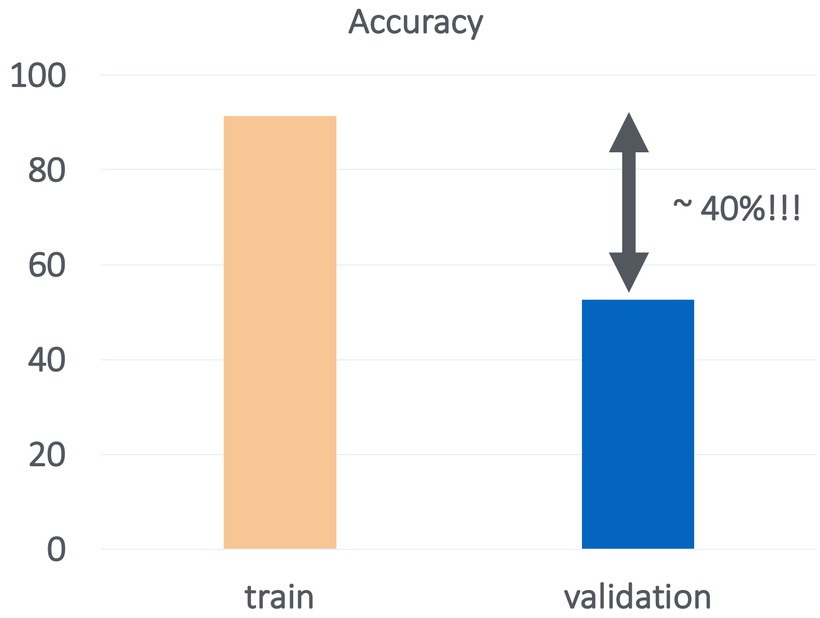


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# Pythia

Vision

Language

Multimodal fusion

Answering

Image


Resnet 152

Faster RCNN

Grid convolutional features

Object detection bottom up features

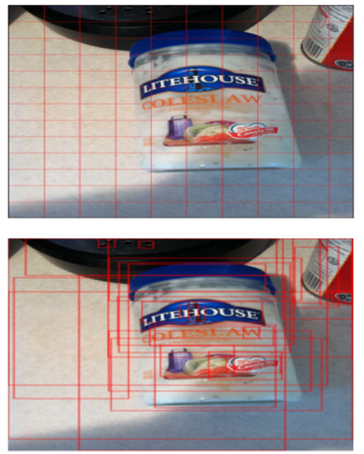


Image embedding

# Pythia for Vizwiz VQA

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Rosetta

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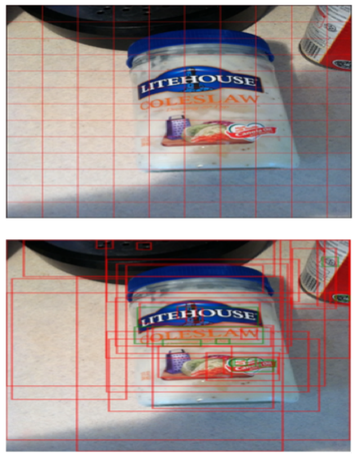


Image embedding

Rosetta: Large scale system for text detection and recognition in images, Borisyuk et al, KDD 2018

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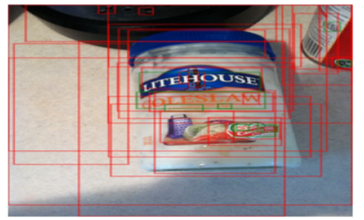
Object + text detection bottom up features

Object class/attribute + OCR text features

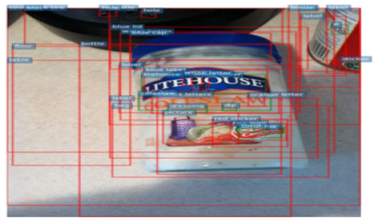




Image embedding

Fast text: Enriching word vectors with subword information, Bojanowski et al, ACL 2017

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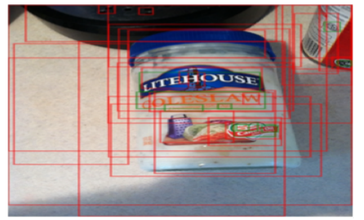


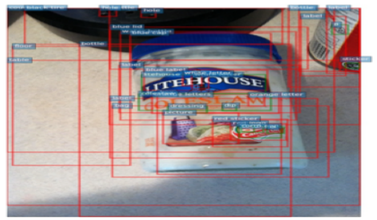


Image embedding

Character level modeling to help address OCR errors

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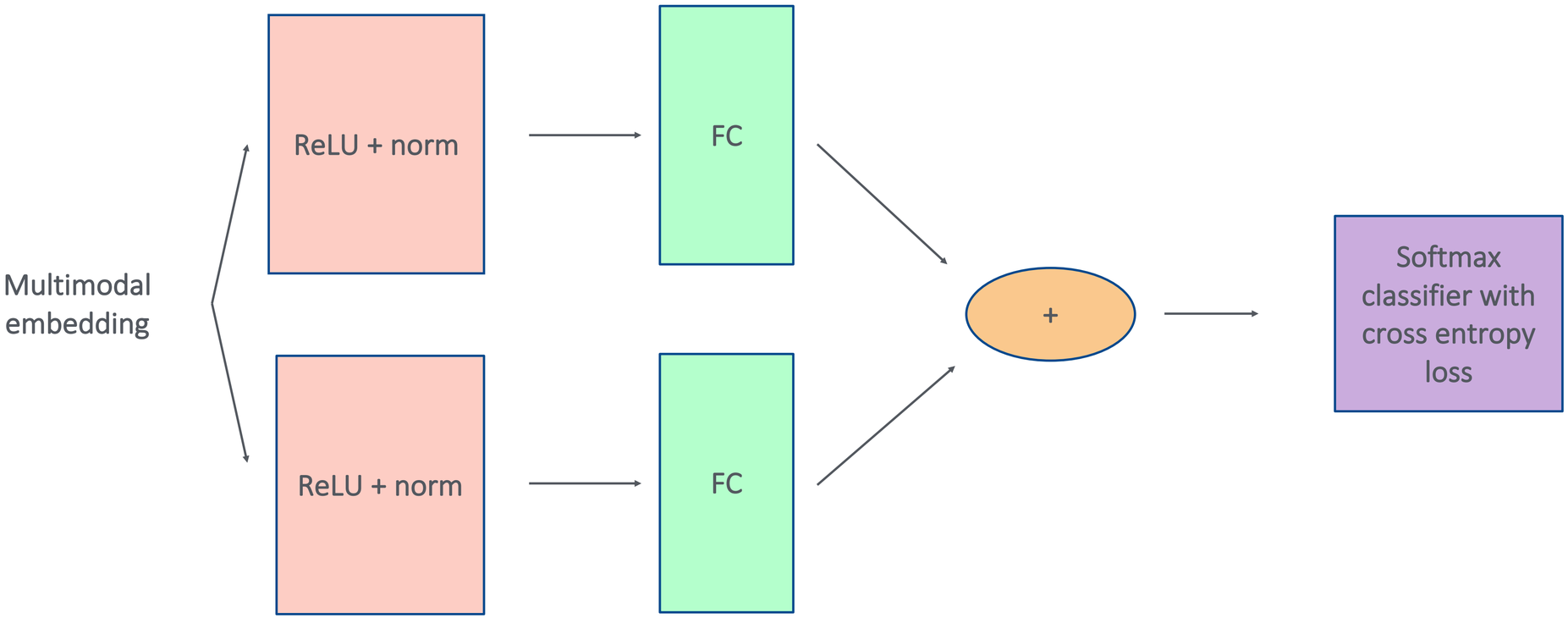

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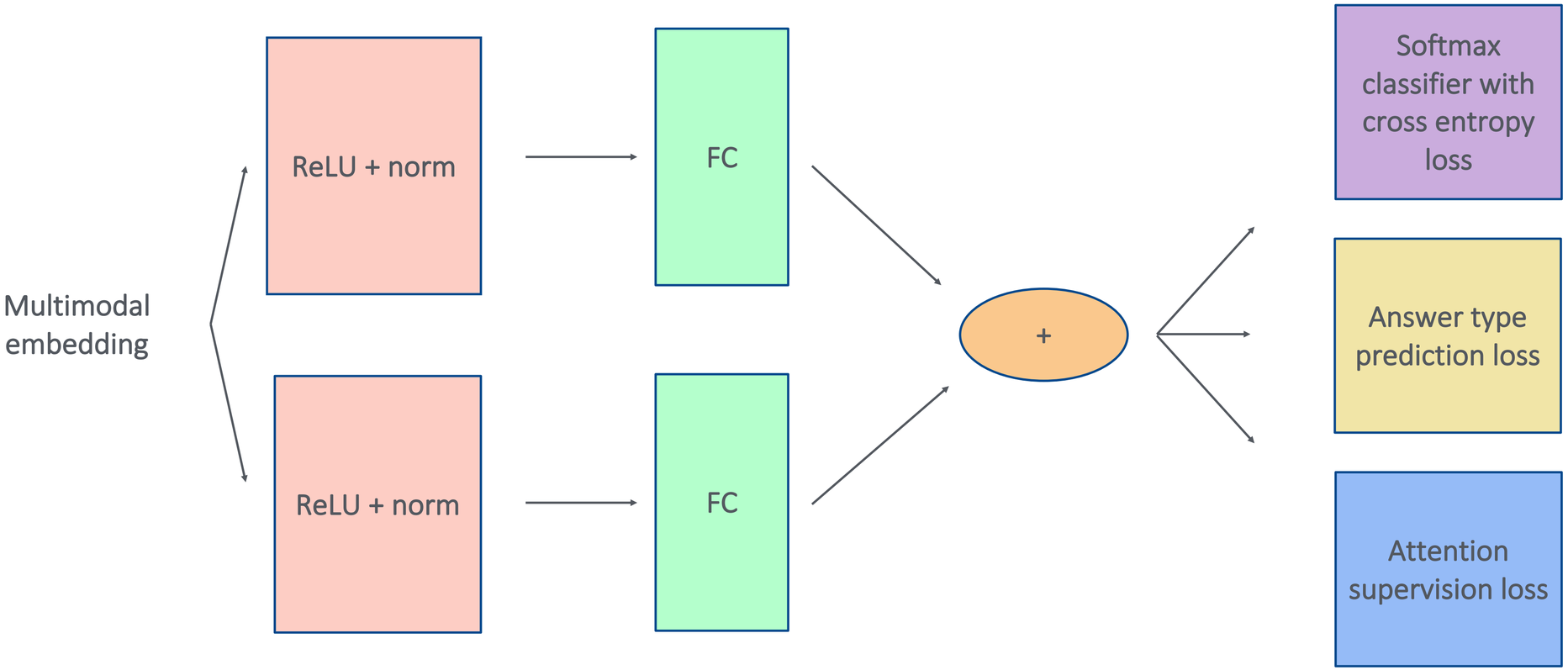
Vision | Language | Multimodal fusion | Answering



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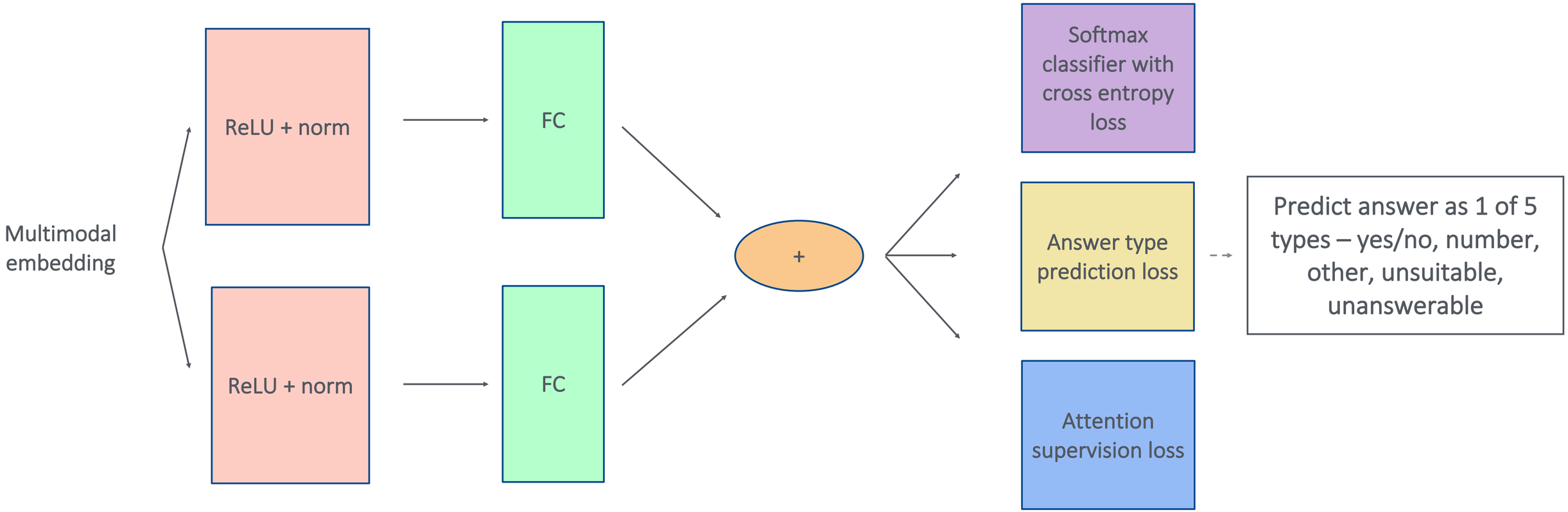

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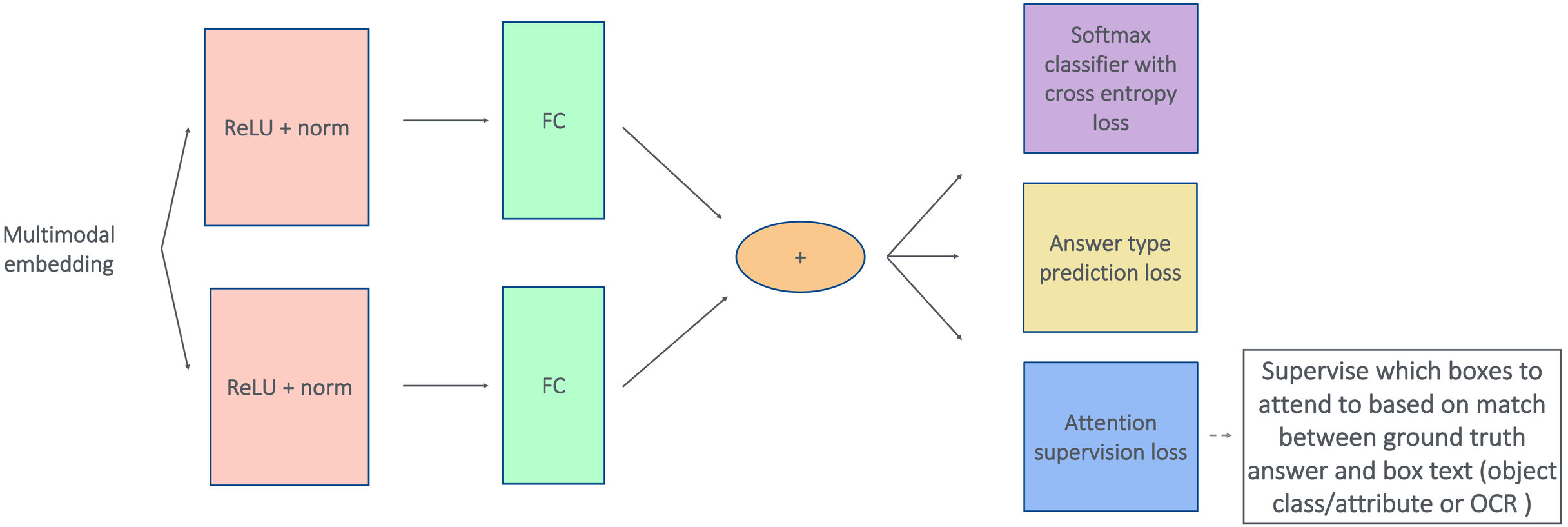

# Pythia for Vizwiz VQA

Vision

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Answering



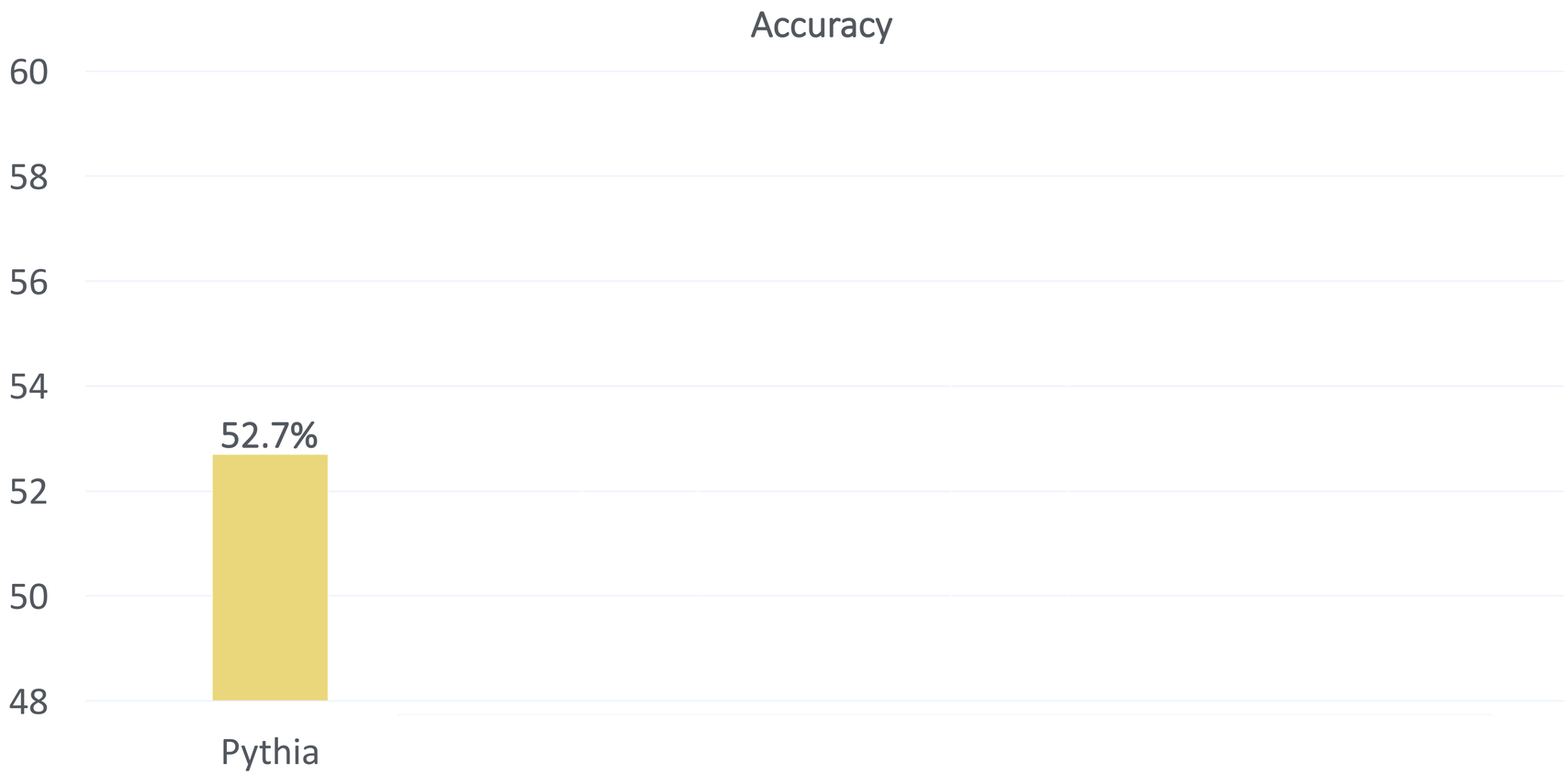

Question
*What kind of wine? Thanks.*
Ground truth answer
*Moscato*

Attention supervision loss

Supervise which boxes to attend to based on match between ground truth answer and box text (object class/attribute or OCR )

# Pythia for Vizwiz VQA

## test-dev accuracy



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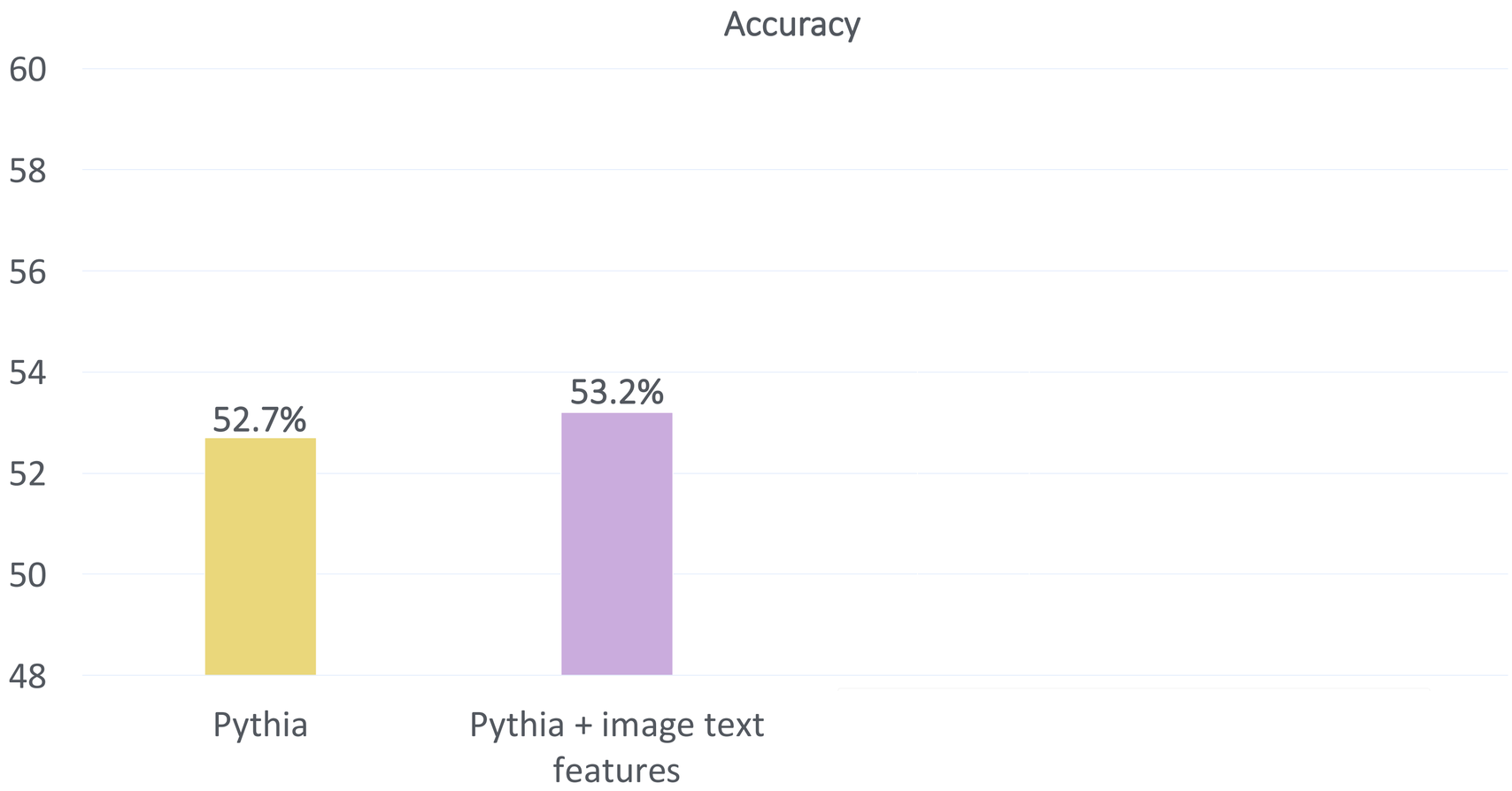

# Pythia for Vizwiz VQA

## Qualitative results


*What does the bottle say?*

Image
+
Question

VQA model

ketchup
wine
coffee
cleaner
detergent
chicken
coleslaw

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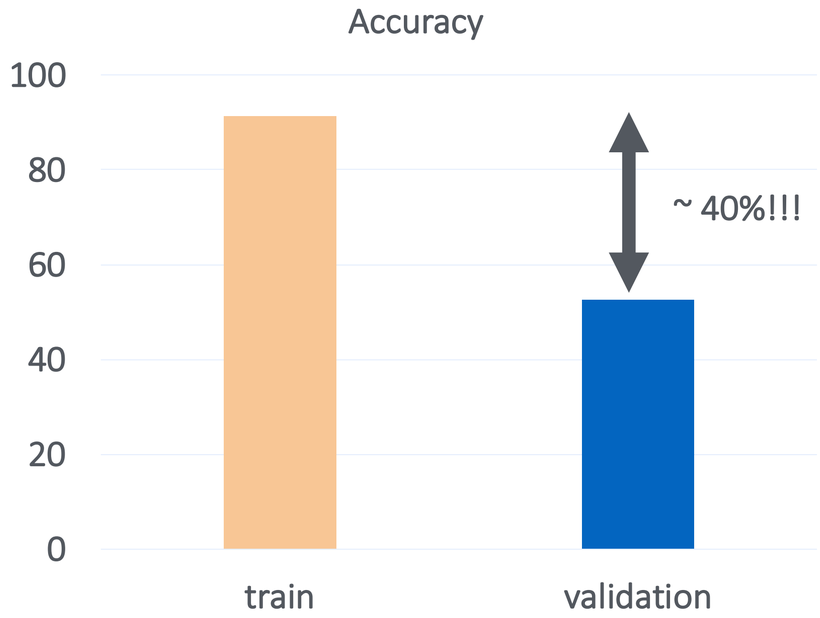


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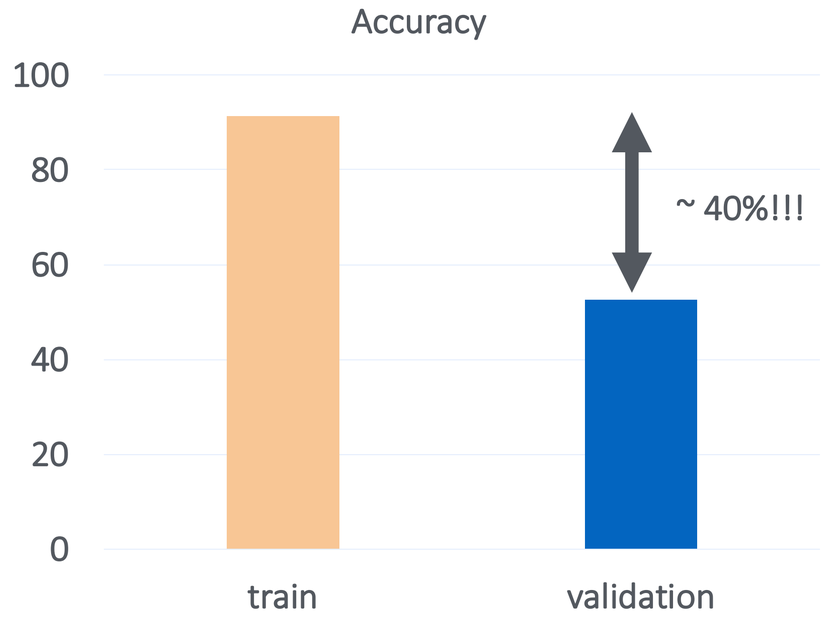
VQA pretraining

Small dataset, model overfitting

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Pretraining on VQA dataset to initialize model parameters

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## Pretraining on VQA dataset to initialize model parameters

- Vision ✅
- Language ✅
- Multimodal fusion ✅
- Answering 💔
  - The answer spaces are different

# Pythia for Vizwiz VQA

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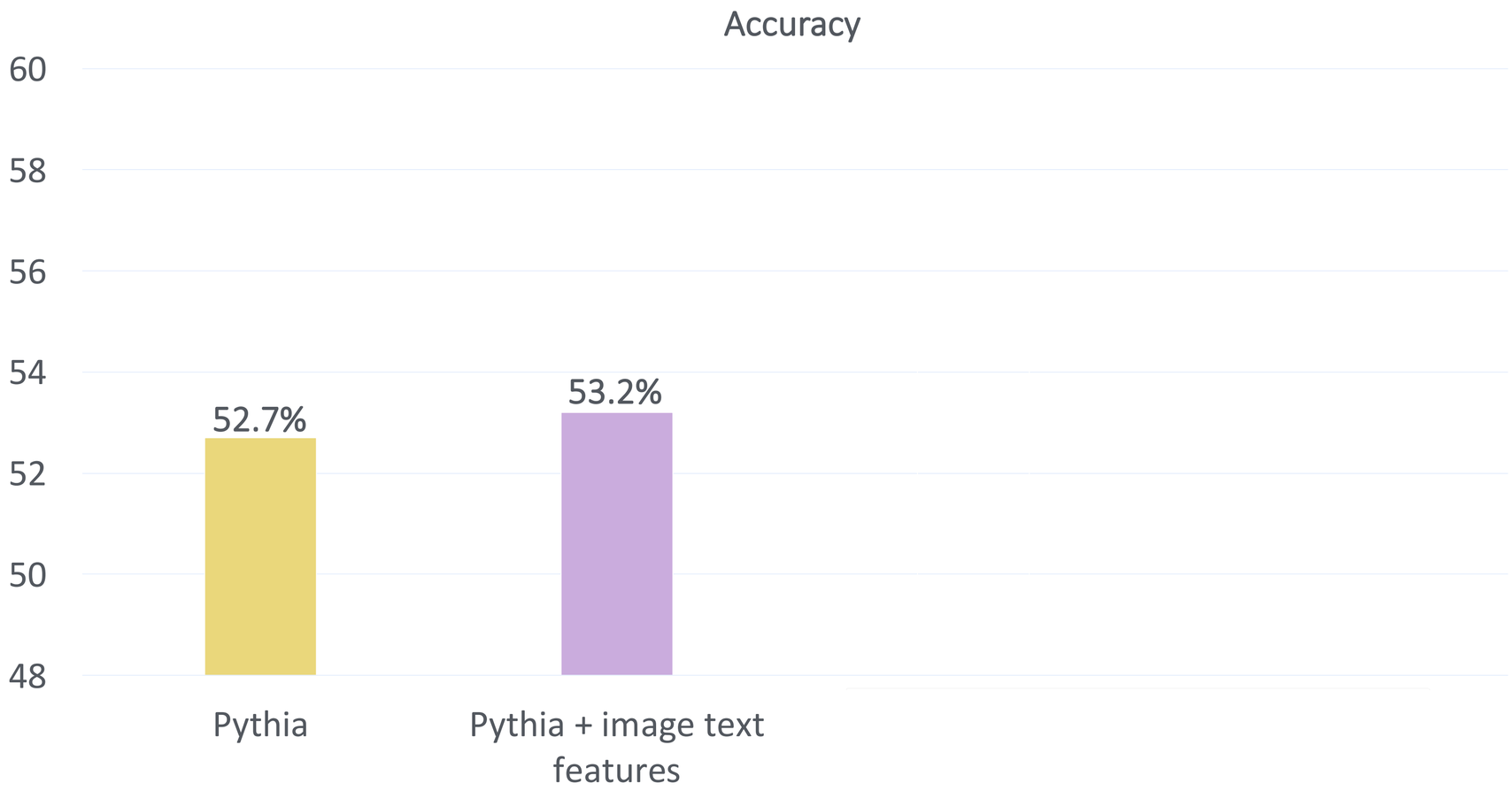

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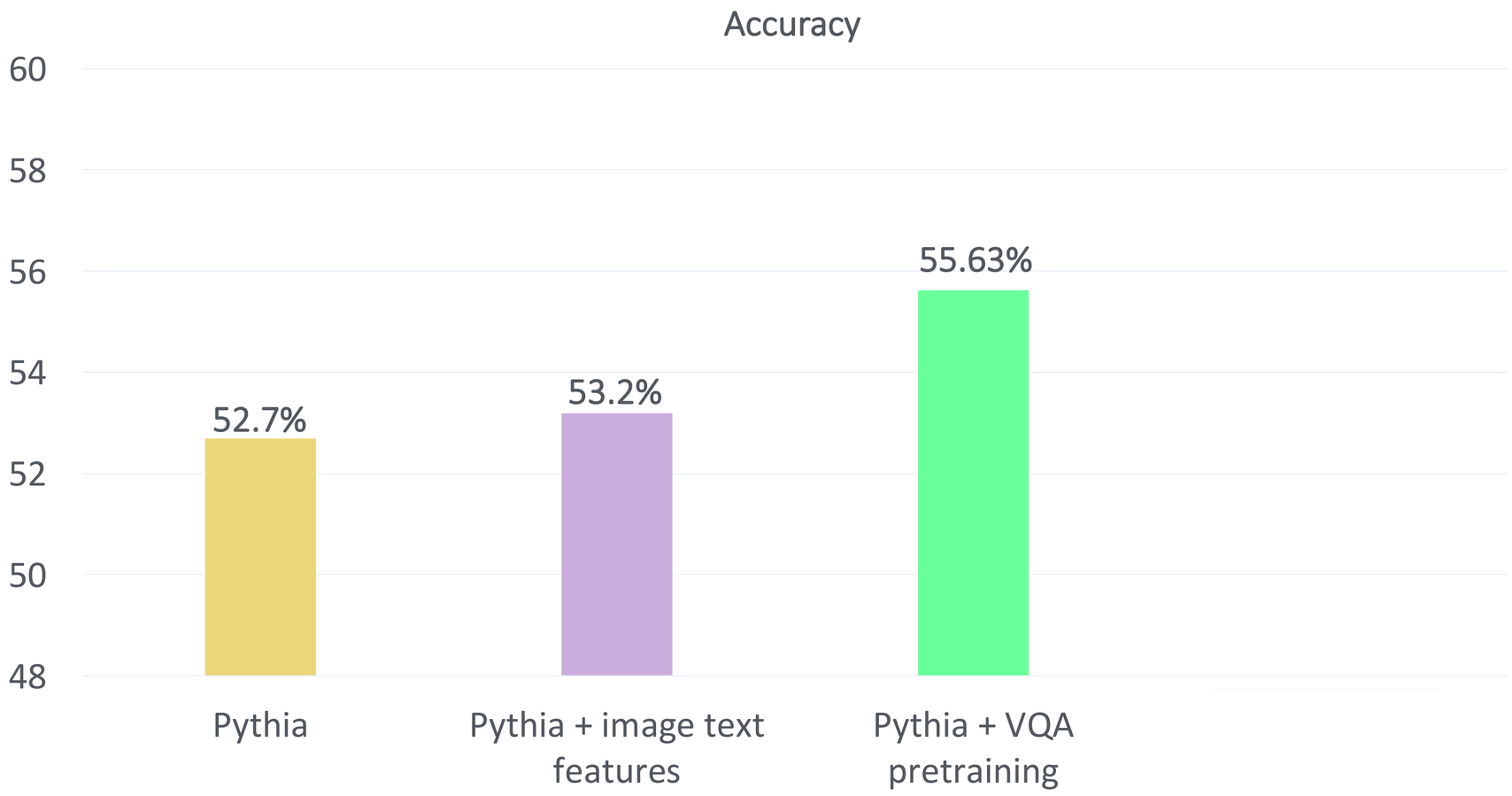

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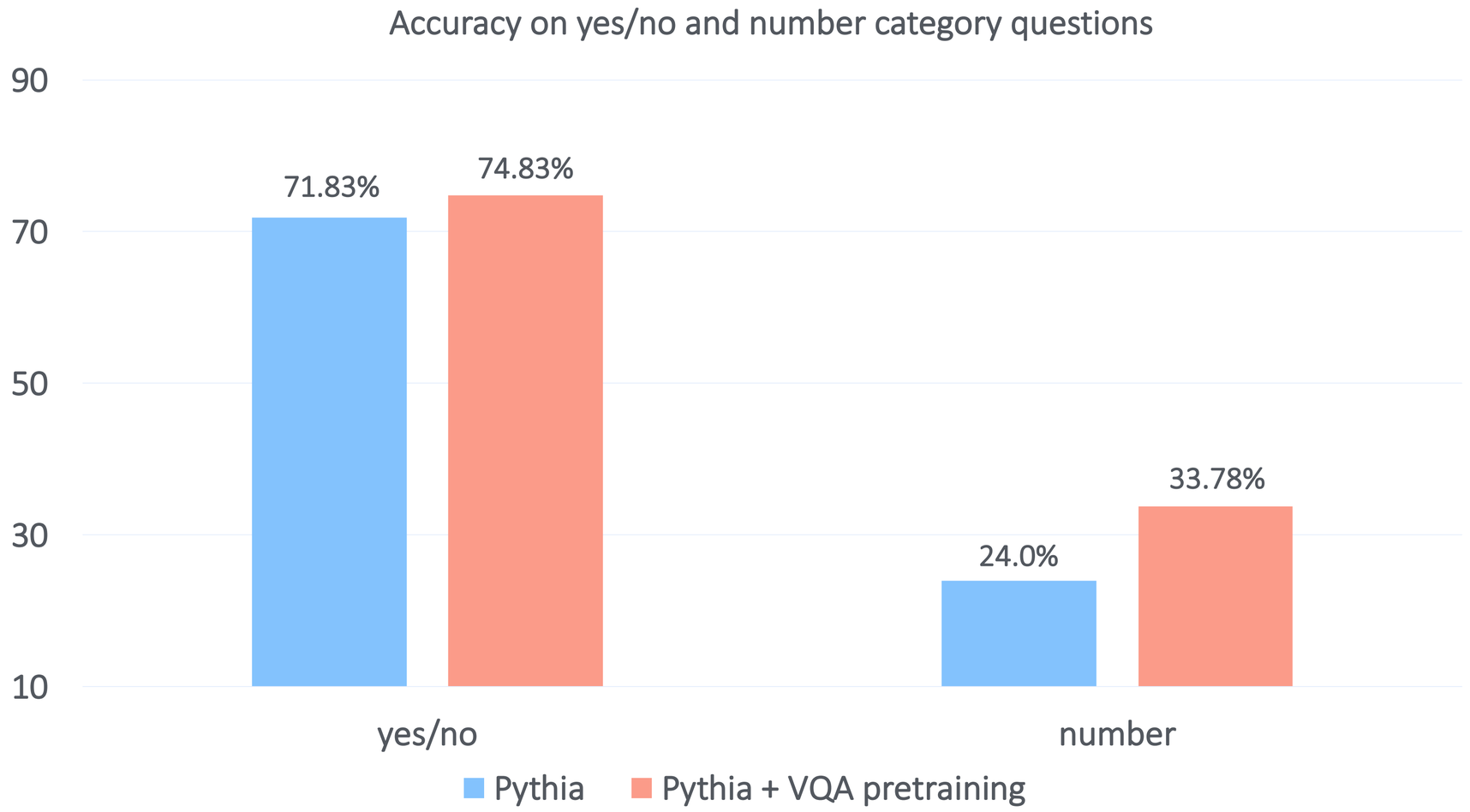

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## Recipes used in VQA Challenge 2018

- Diversified model ensemble

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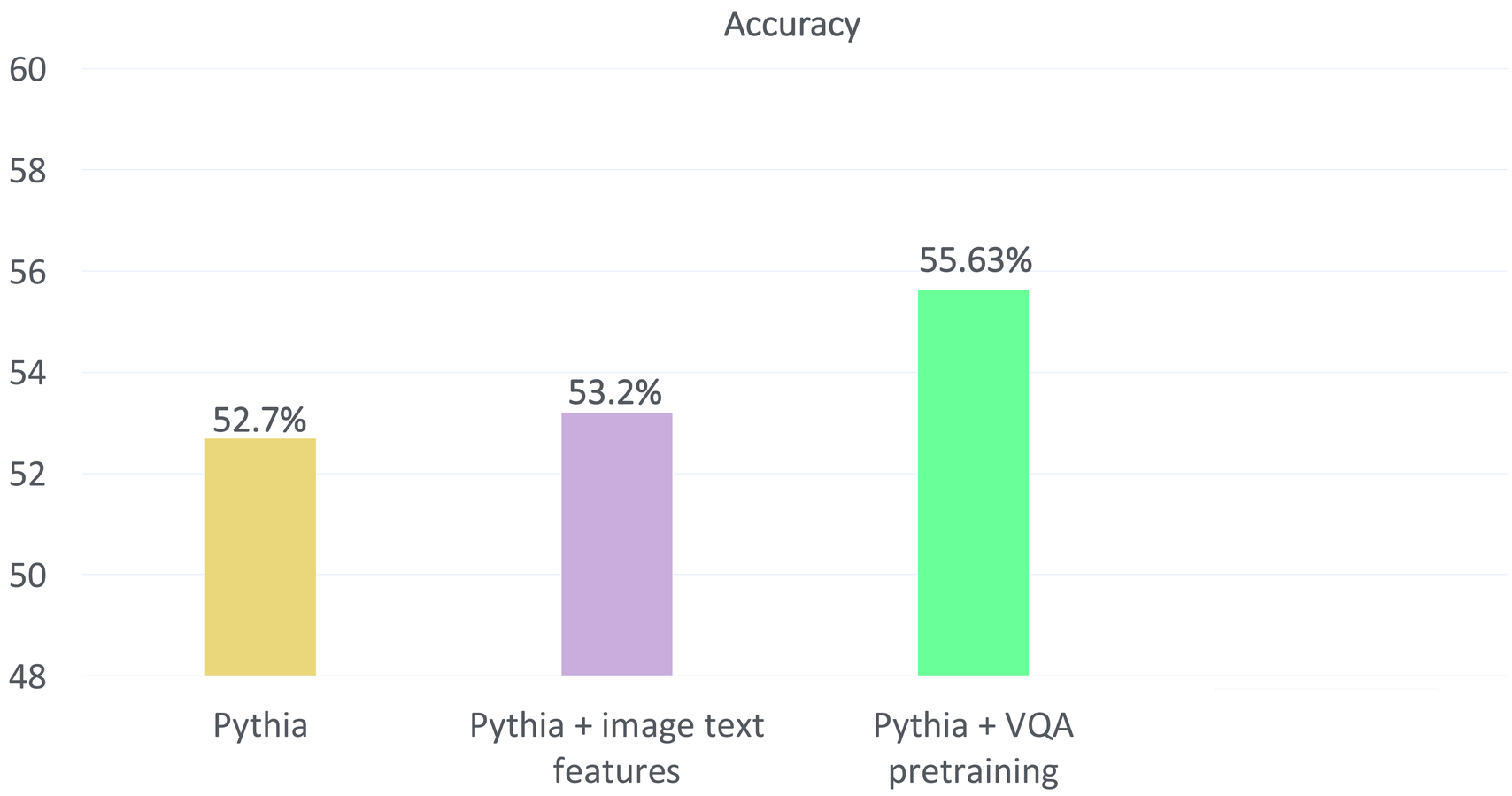

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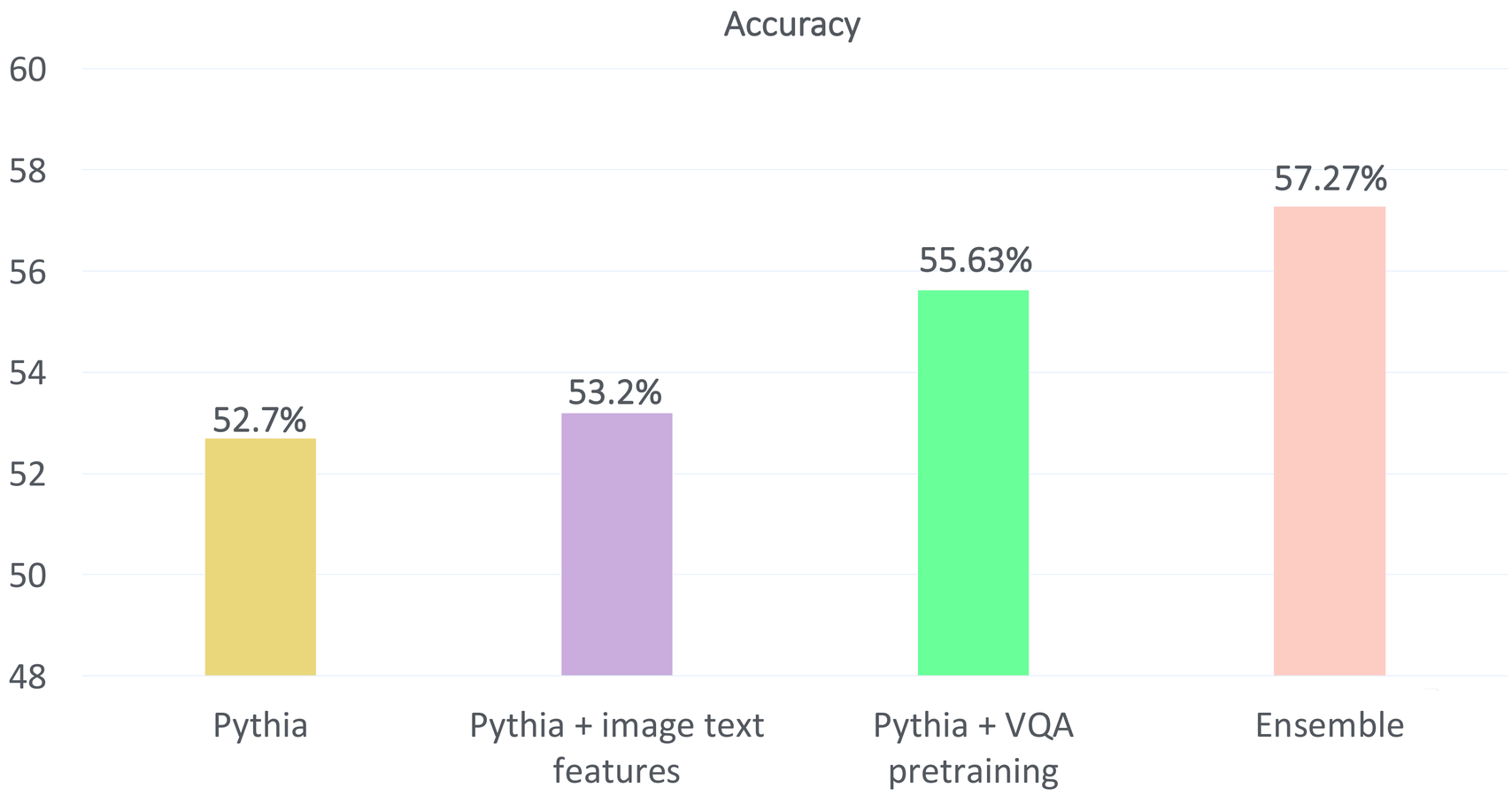


# Pythia for Vizwiz Answerability

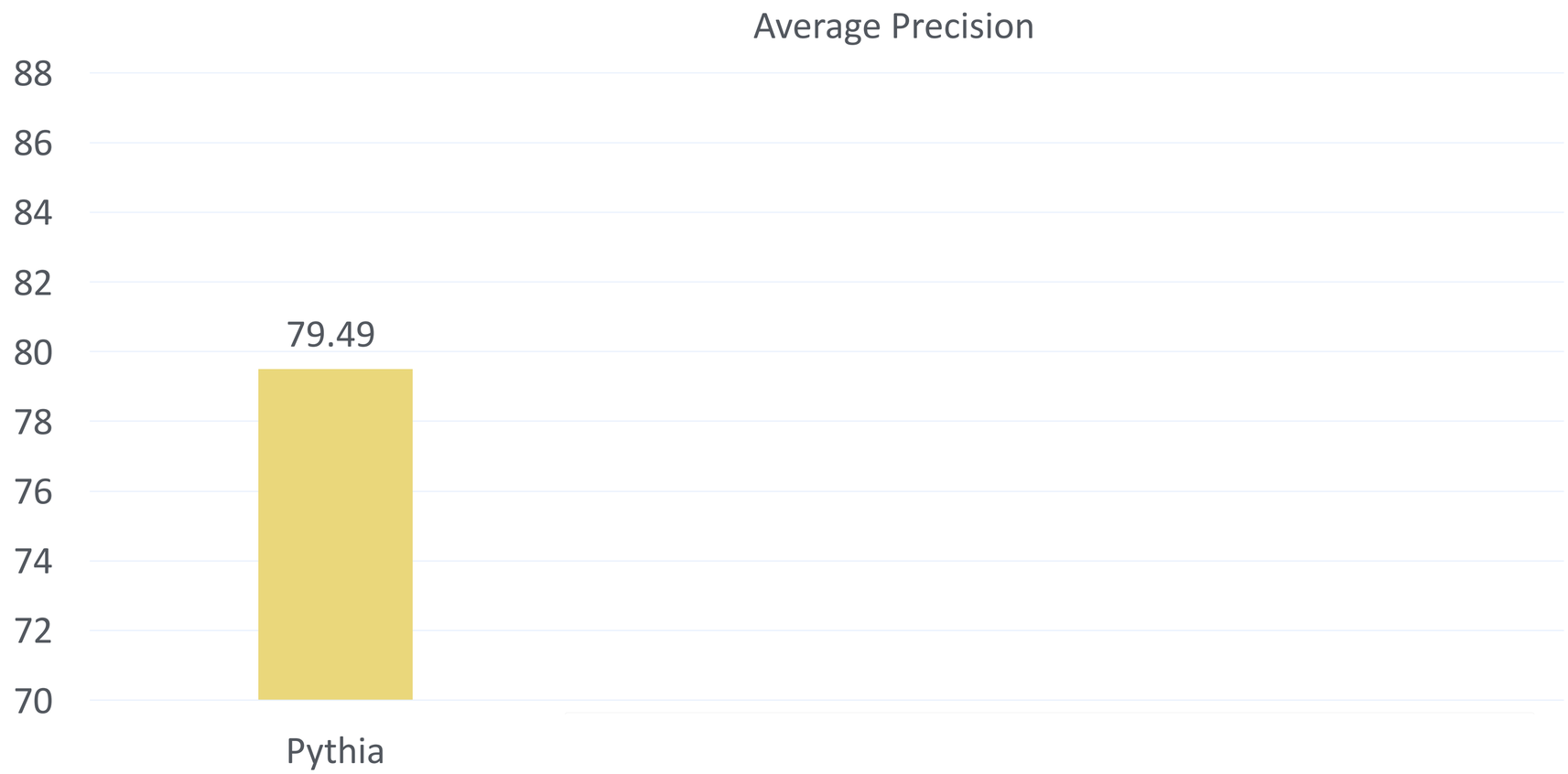
## Details

- Same model architecture as for the VQA track except answering classifier module

- Answering classifier predicts one of 3 classes – unanswerable, unsuitable or answerable

# Pythia for Vizwiz Answerability

## test-dev average precision



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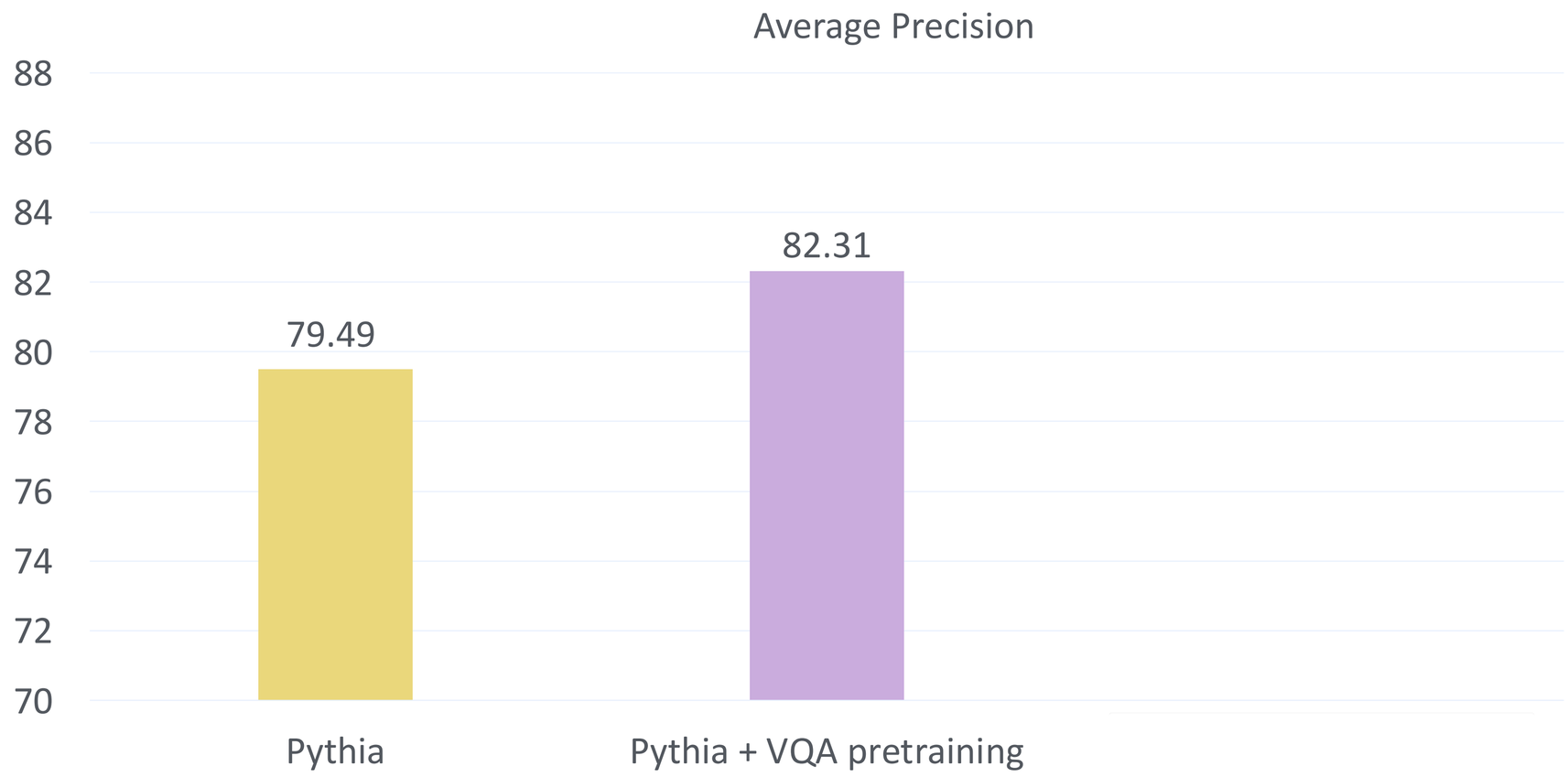

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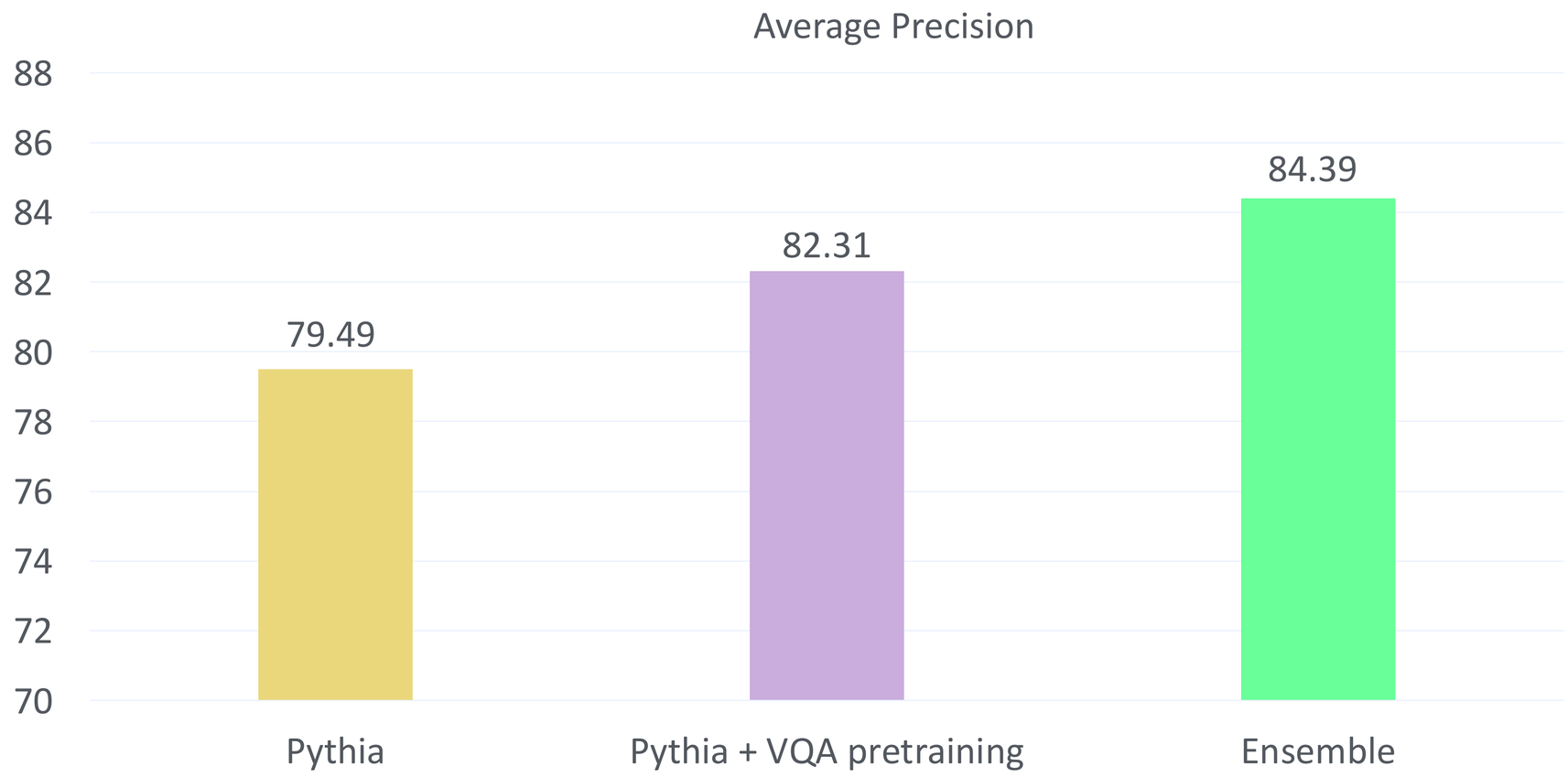
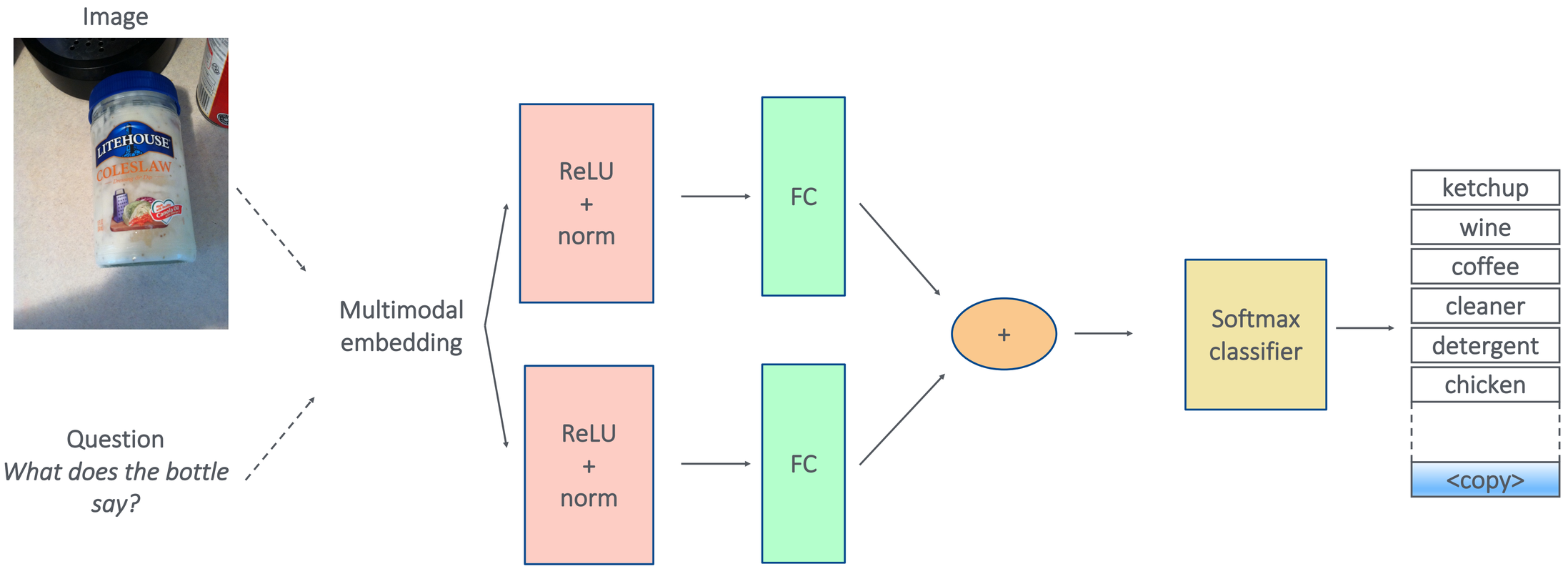


# Observations

- Dataset a tad too small to train more complex models
    - Prone to overfitting and high variance in runs
- VQA accuracy not ideal as it penalizes long tail answers even if only one or two tokens differ with ground truth
- Human performance on the validation dataset is quite poor – 57.49% while the best possible performance using the most common answer is 93.16%

# Ongoing research

## Dynamic answer generation with copy mechanism



# Ongoing research

## Dynamic answer generation with copy mechanism

Image


Question
*What does the bottle say?*

Model

<copy>

Use attention on bounding box text

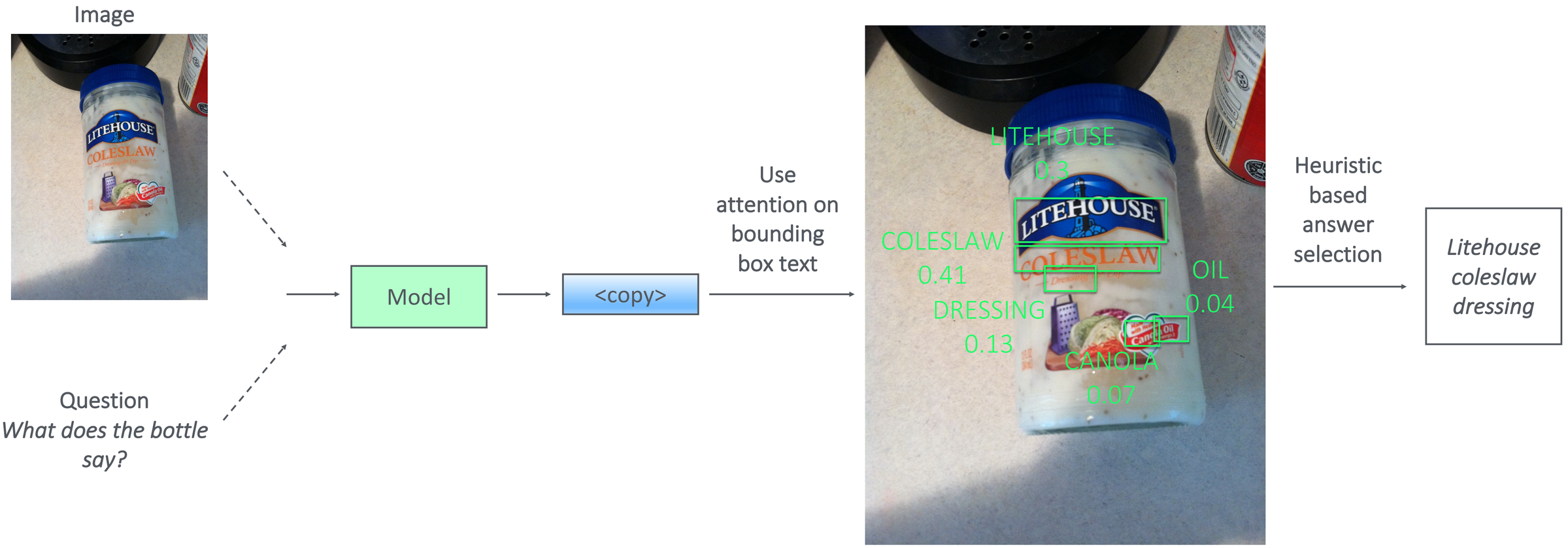

Heuristic based answer selection

*Litehouse coleslaw dressing*

# Ongoing research

## Dynamic answer generation with copy mechanism

Accuracy: 54.21% with no VQA pretraining
(Baseline: 53.2%)



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- Data augmentation

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Question rephrasings:
*What product is this? -> What does the label say?*

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- Diversified model ensemble ✅
- Data augmentation 💔

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More work needed to ensure distribution of augmented data matches that of the Vizwiz dataset distribution

# Conclusions

- Pythia is awesome!
- OCR text features and VQA pretraining – the two key ingredients of our challenge entry
- However open questions remain on reading text to answer questions, incorporating external knowledge sources and generating tail answers