16824 Homework 3

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Task 1: Understanding VQA

1.1 Why do you think that it's computationally costly to use all answers as separate classes instead of keeping only the most frequent ones?

We have to use a large number of output neurons, that add computations on final sigmoid/softmax calculation, loss computation, and backward propagation. Keeping only the most frequent ones will largely reduce the amount of calculations.

1.2 Complete the __init__ method of the dataset class for VQA in vqa_dataset.py. Specifically, initialize the VQA API and anything you need from that.

```
self._vqa = VQA(annotation_file=annotation_json_file_path,
                question_file=question_json_file_path)
```

1.3 Implement the __len__ method of the VQADataset class. Should the size of the dataset be equal to the number of images, questions or the answers?

```
def __len__(self):
    # total number of questions
    return len(self._vqa.qqa)
```

The size of the dataset be equal to the number of questions.

1.4 Complete the __getitem__ method

```
q_anno = self._vqa.qa[idx]  # load annotation
q_str = self._vqa.qqa[idx]['question']  # question in str format
```

Task 2: Building a pipeline for VQA

2.1 What should be the output dimension of the trainable linear layer? Complete the corresponding part in the __init__ method of BaselineNet in models.py.

```
self.classifier = nn.Linear(
    self.text_encoder.config.hidden_size + 512,
    n_answers,
)
```

It should be n_answers (5127)

2.2 Implement compute_vis_feats that featurizes the image (it can be implemented as an one-liner!).

```
def compute_vis_feats(self, image):
    """Convert image tensors to feature tensors."""
    return torch.nn.functional.adaptive_avg_pool2d(self.vis_encoder(image), 1).
    ↪ squeeze() # feed to vis_encoder and then mean pool on spatial dims
```

2.3 Implement the forward pass of BaselineNet. Make sure to use compute_vis_feats and compute_text_feats.

```
def forward(self, image, question):
    """Forward pass, image (B, 3, 224, 224), qs list of str."""
    text_feats = self.compute_text_feats(question)
    vis_feats = self.compute_vis_feats(image)
    concate_feats = torch.hstack((text_feats, vis_feats))
    logits = self.classifier(concate_feats)
    return logits
```

2.4 What is the loss for multi-label classification? (Hint: in HW1 you also tackled a multi-class classification problem)

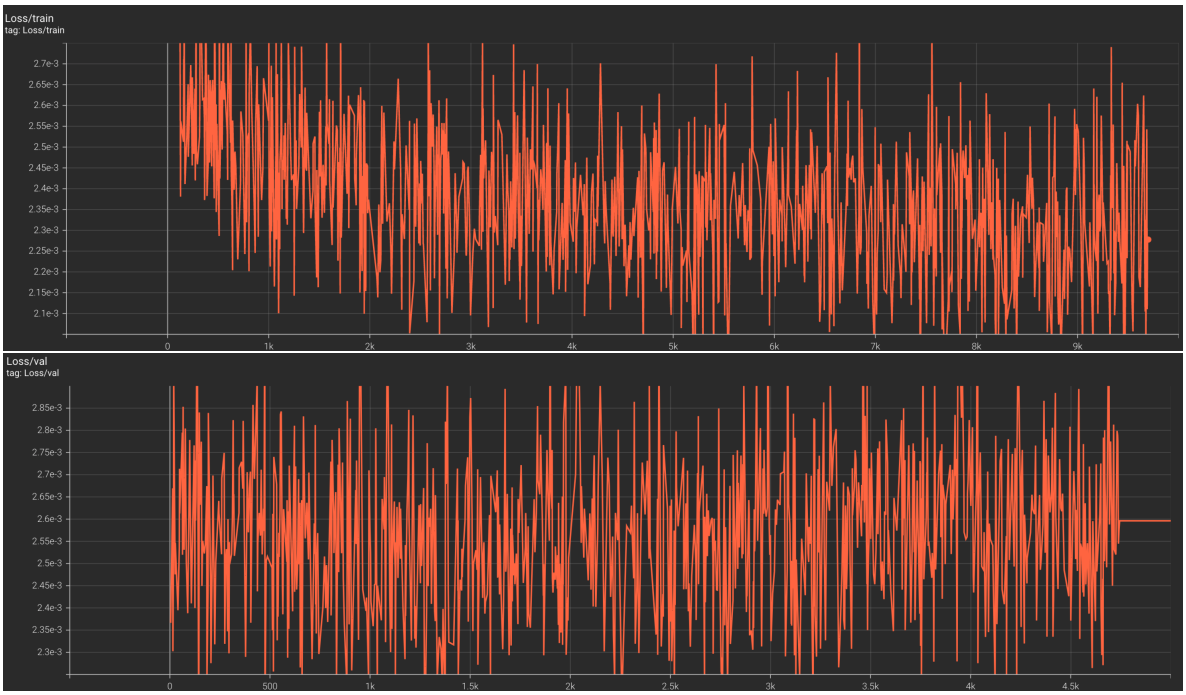
Binary Cross-Entropy Loss

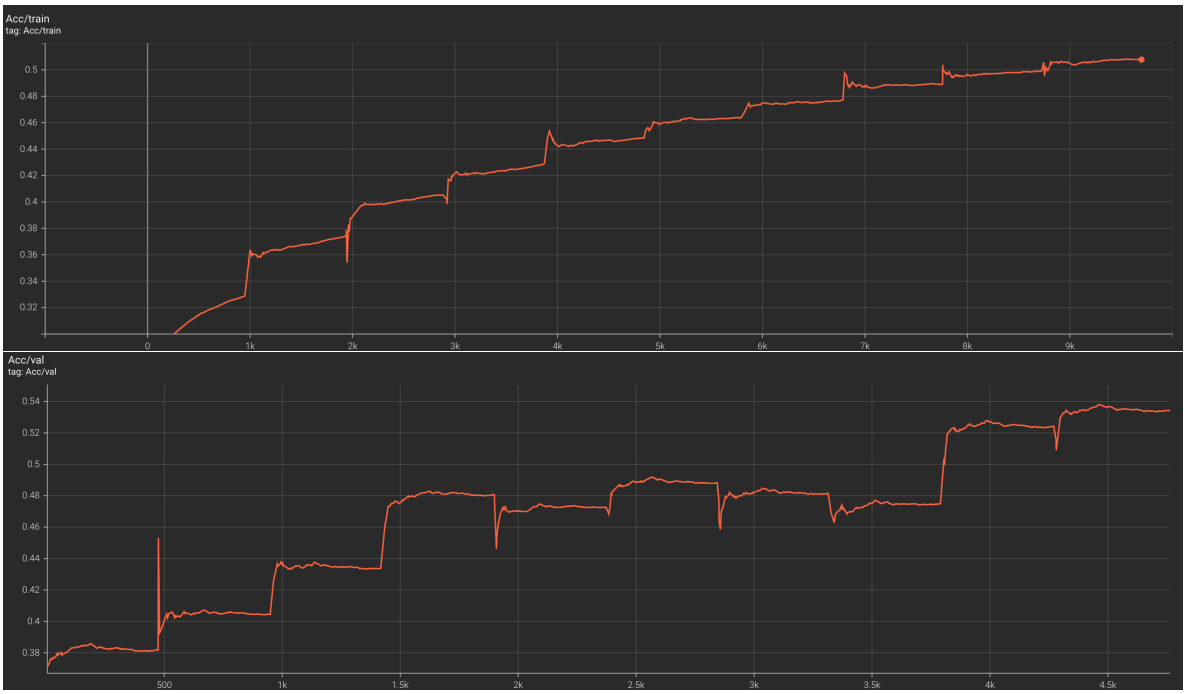
2.5 Implement the loss call and the optimization code in the train_test_loop method.

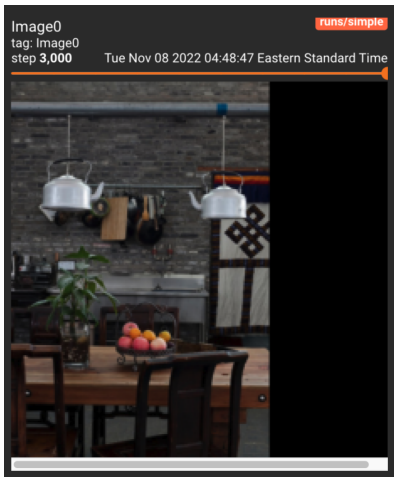
```
loss = F.binary_cross_entropy_with_logits(scores, answers)

# Update
if mode == 'train':
    # optimize loss
    loss.backward()
    self.optimizer.step()
    self.optimizer.zero_grad()
```

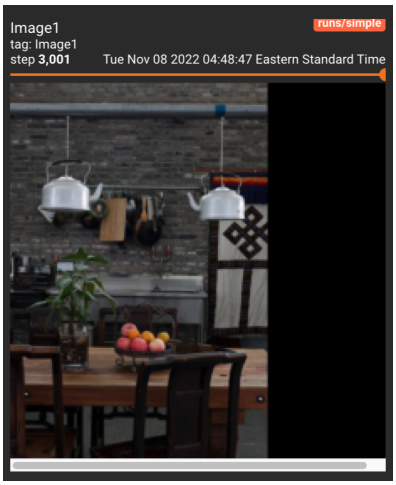
2.6 Complete the train_test_loop method to monitor the performance in Tensorboard. Plot the loss and accuracy and include these in your report. Additionally show multiple image-question pairs (at least 3) with the respective answers (predicted and ground-truth).

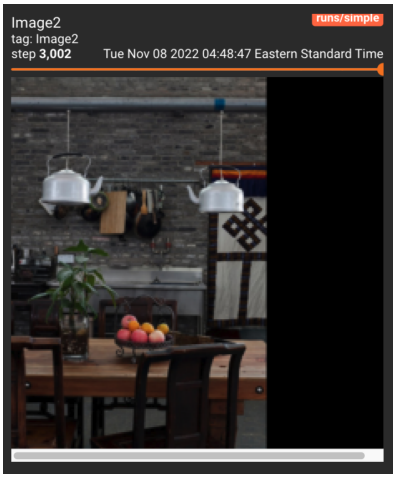
```
    # add code to show the question
    self.writer.add_text(
        'Question%d' % i, data['question'][i],
        epoch * _n_show + i
    )
    # the gt answer
    self.writer.add_text(
        'GT Answer%d' % i, self._id2answer[(data['answers'][i] == 1).nonzero(
    ↪ as_tuple=True)[0][0].item()],
        epoch * _n_show + i
    )
    # and the predicted answer
    self.writer.add_text(
        'Predicted Answer%d' % i, self._id2answer[scores.argmax(1)[i].item()],
        epoch * _n_show + i
    )
# add code to plot the current accuracy
self.writer.add_scalar(
'Acc/' + mode, n_correct / n_samples,
epoch * len(self.data_loaders[mode]) + step
)
```




Acc/train
tag: Acc/train
0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0
1k
2k
3k
4k
5k
6k
7k
8k
9k
Acc/val
tag: Acc/val
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0.4
0.38
500
1k
1.5k
2k
2.5k
3k
3.5k
4k
4.5k







GT Answer0

GT Answer0/text_summary
tag: GT Answer0/text_summary

step 3,000

wood

GT Answer1

GT Answer1/text_summary
tag: GT Answer1/text_summary

step 3,001

yes

GT Answer2

GT Answer2/text_summary
tag: GT Answer2/text_summary

step 3,002

kettle

Predicted Answer0

Predicted Answer0/text_summary
tag: Predicted Answer0/text_summary

step 3,000

Other

Predicted Answer1

Predicted Answer1/text_summary
tag: Predicted Answer1/text_summary

step 3,001

yes

Predicted Answer2

Predicted Answer2/text_summary
tag: Predicted Answer2/text_summary

step 3,002

Other

Question0

Question0/text_summary
tag: Question0/text_summary

step 3,000

What is the table made of?

Question1

Question1/text_summary
tag: Question1/text_summary

step 3,001

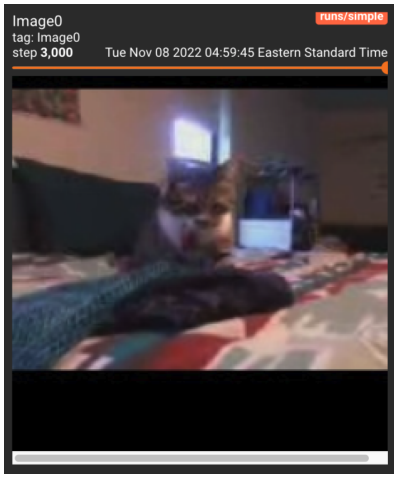
Is the food napping on the table?

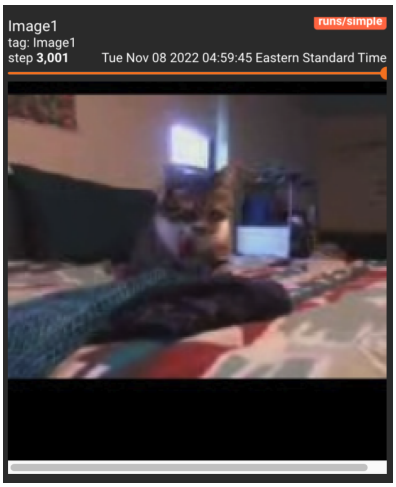
Question2

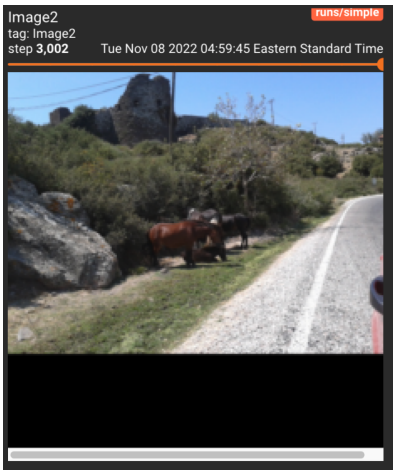
Question2/text_summary
tag: Question2/text_summary

step 3,002

What has been upcycled to make lights?







GT Answer0

GT Answer0/text_summary
tag: GT Answer0/text_summary

step 3,000

camera

GT Answer1

GT Answer1/text_summary
tag: GT Answer1/text_summary

step 3,001

no

GT Answer2

GT Answer2/text_summary
tag: GT Answer2/text_summary

step 3,002

3

Predicted Answer0

Predicted Answer0/text_summary
tag: Predicted Answer0/text_summary

step 3,000

yes

Predicted Answer1

Predicted Answer1/text_summary
tag: Predicted Answer1/text_summary

step 3,001

yes

Predicted Answer2

Predicted Answer2/text_summary
tag: Predicted Answer2/text_summary

step 3,002

2

Question0

Question0/text_summary
tag: Question0/text_summary

step 3,000

What is causing the picture to be blurry?

Question1

Question1/text_summary
tag: Question1/text_summary

step 3,001

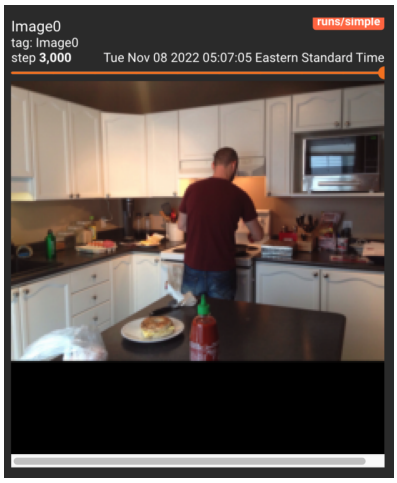
Is it night time?

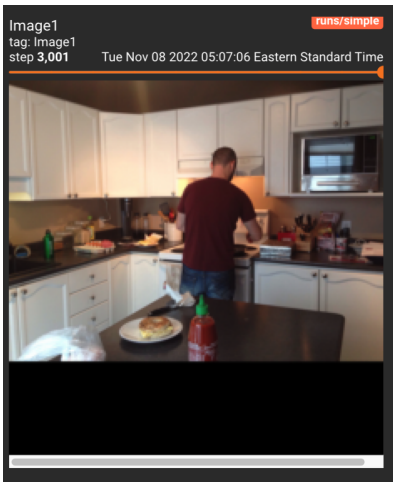
Question2

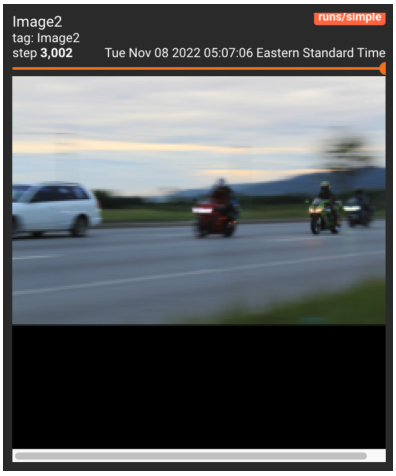
Question2/text_summary
tag: Question2/text_summary

step 3,002

How many horses are shown?







GT Answer0

GT Answer0/text_summary
tag: GT Answer0/text_summary

step 3,000

ketchup

GT Answer1 GT Answer0

GT Answer1/text_summary
tag: GT Answer1/text_summary

step 3,001

yes

GT Answer2

GT Answer2/text_summary
tag: GT Answer2/text_summary

step 3,002

yes

Predicted Answer0

Predicted Answer0/text_summary
tag: Predicted Answer0/text_summary

step 3,000

kitchen

Predicted Answer1

Predicted Answer1/text_summary
tag: Predicted Answer1/text_summary

step 3,001

kitchen

Predicted Answer2

Predicted Answer2/text_summary
tag: Predicted Answer2/text_summary

step 3,002

2

Question0

Question0/text_summary
tag: Question0/text_summary

step 3,000

What is in the bottle on the kitchen Isle?

Question1

Question1/text_summary
tag: Question1/text_summary

step 3,001

Is the sauce spicy?

Question2

Question2/text_summary
tag: Question2/text_summary

step 3,002

How many headlights are visible?

Final Val Acc: 0.5341694647442228