Try again once you are ready

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Try again

1. To help you practice strategies for machine learning, this week we'll present another scenario and ask how you would act. We think this "simulator" of working in a machine learning project will give you an idea of what leading a machine learning project could be like!

0 / 1 point

You are employed by a startup building self-driving cars. You are in charge of detecting road signs (stop sign, pedestrian crossing sign, construction ahead sign) and traffic signals (red and green lights) in images. The goal is to recognize which of these objects appear in each image. As an example, this image contains a pedestrian crossing sign and red traffic lights.

$$y^{(i)} = \begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \\ 0 \end{bmatrix} \begin{matrix} \text{“stop sign”} \\ \text{“pedestrian crossing sign”} \\ \text{“construction ahead sign”} \\ \text{“red traffic light”} \\ \text{“green traffic light”} \end{matrix}$$

Your 100,000 labeled images are taken using the front-facing camera of your car. This is also the distribution of data you care most about doing well on. You think you might be able to get a much larger dataset off the internet, which could be helpful for training even if the distribution of internet data is not the same.

Suppose that you came from working with a project for human detection in city parks, so you know that detecting humans in diverse environments can be a difficult problem. What is the first thing you do? Assume each of the steps below would take about an equal amount of time (a few days).

- ○ Spend a few days collecting more data to determine how hard it will be to include more pedestrians in your dataset.
- ○ Leave aside the pedestrian detection, to move faster and then later solve the pedestrian problem alone.
- ○ Train a basic model and proceed with error analysis.
- ◉ Start by solving pedestrian detection, since you already have the experience to do this.

Expand

✗ **Incorrect**
As discussed in the lecture, it is better to create your first system quickly and then iterate. Although your guess that the pedestrian detection problem will be a source of difficulties might be right, it is better to confirm it through iterations before committing lots of resources to this.

2. Your goal is to detect road signs (stop sign, pedestrian crossing sign, construction ahead sign) and traffic signals (red and green lights) in images. The goal is to recognize which of these objects appear in each image. You plan to use a deep neural network with ReLU units in the hidden layers.

0 / 1 point

Suppose that you use a sigmoid function for the output layer, and the output $\hat{y}$ has shape (5, 1). Which of the following best describes the cost function?

- ◉ $\frac{1}{m}\sum_{i=1}^{m}\sum_{j=1}^{5}\mathcal{L}(\hat{y}_i^{(j)}, y_i^{(j)})$
- ○ $\frac{1}{m}\sum_{i=1}^{m}\left(-y^{(i)}\log\hat{y}^{(i)} - (1-y^{(i)})\log(1-\hat{y}^{(i)})\right)$
- ○ $\frac{\exp y_j^{(i)}}{\sum_{i=1}^{5}\exp y_i^{(i)}}$

Expand

✗ **Incorrect**
Notice that y_r^s indicates the component r of the example s.

3. You are working out error analysis and counting up what errors the algorithm makes. Which of the following do you think you should manually go through and carefully examine, one image at a time? 1 / 1 point

- ○ 500 images of the test set, on which the algorithm made a mistake.
- ○ 500 images of the train set, on which the algorithm made a mistake.
- ◉ 500 images of the dev set, on which the algorithm made a mistake.
- ○ 500 images of the training-dev set, on which the algorithm made a mistake.

Expand

✓ Correct
Correct. We focus on images that the algorithm got wrong from the dev set. That is the one we use to make choices between different iterations of the system.

4. After working on the data for several weeks, your team ends up with the following data: 1 / 1 point

- 100,000 labeled images taken using the front-facing camera of your car.
- 900,000 labeled images of roads downloaded from the internet.
- Each image's labels precisely indicate the presence of any specific road signs and traffic signals or combinations of them. For example, $y^{(i)} = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$ means the image contains a stop sign and a red traffic light.

Because this is a multi-task learning problem, you need to have all your $y^{(i)}$ vectors fully labeled. If one example is equal to $\begin{bmatrix} 0 \\ ? \\ 1 \\ 1 \\ ? \end{bmatrix}$ then the learning algorithm will not be able to use that example. True/False?

- ○ True
- ◉ False

Expand

✓ Correct
As seen in the lecture on multi-task learning, you can compute the cost such that it is not influenced by the fact that some entries haven't been labeled.

5. The distribution of data you care about contains images from your car's front-facing camera, which comes from a different distribution than the images you were able to find and download off the internet. Which of the following are true about the train/dev/test split? 1 / 1 point

- ☑ The dev and test set must come from the front-facing camera.

✓ Correct
Correct. This is the distribution we care about most, thus we should use this as a target.

- ☐ The dev and test sets must contain some images from the internet.
- ☑ The dev and test sets must come from the same distribution.

✓ Correct
Correct. This is required to aim the target where we want to be.

- ☐ The train, dev, and test must come from the same distribution.

Expand

Correct
Great, you got all the right answers.

6. Assume you've finally chosen the following split between the data: 0 / 1 point

Dataset:	Contains:	Error of the algorithm:
Training	940,000 images randomly picked from (900,000 internet images + 60,000 car's front-facing camera images)	1%
Training-Dev	20,000 images randomly picked from (900,000 internet images + 60,000 car's front-facing camera images)	5.1%
Dev	20,000 images from your car's front-facing camera	5.6%
Test	20,000 images from the car's front-facing camera	6.8%

You also know that human-level error on the road sign and traffic signals classification task is around 0.5%. Which of the following is true?

- ○ You have a high variance problem.
- ○ The size of the train-dev set is too high.
- ◉ You have a high bias.
- ○ You have a large data-mismatch problem.

Expand

Incorrect
Although not at human-level, the training error is not that high to say we have a high bias.

7. Assume you've finally chosen the following split between the data: 1 / 1 point

Dataset:	Contains:	Error of the algorithm:
Training	940,000 images randomly picked from (900,000 internet images + 60,000 car's front-facing camera images)	2%
Training-Dev	20,000 images randomly picked from (900,000 internet images + 60,000 car's front-facing camera images)	2.3%
Dev	20,000 images from your car's front-facing camera	1.3%
Test	20,000 images from the car's front-facing camera	1.1%

You also know that human-level error on the road sign and traffic signals classification task is around 0.5%. Based on the information given you conclude that the Bayes error for the dev/test distribution is probably higher than for the train distribution. True/False?

- ○ True
- ◉ False

Expand

Correct

8. You decide to focus on the dev set and check by hand what are the errors due to. Here is a table summarizing your discoveries: 0 / 1 point

Overall dev set error	15.3%
Errors due to incorrectly labeled data	4.1%
Errors due to foggy pictures	8.0%
Errors due to rain drops stuck on your car's front-facing camera	2.2%
Errors due to other causes	1.0%

Errors due to other causes	1.0%

In this table, 4.1%, 8.0%, etc. are a fraction of the total dev set (not just examples of your algorithm mislabeled). For example, about 8.0/15.3 = 52% of your errors are due to foggy pictures.

The results from this analysis implies that the team's highest priority should be to bring more foggy pictures into the training set so as to address the 8.0% of errors in that category. True/False?

Additional note: there are subtle concepts to consider with this question, and you may find arguments for why some answers are also correct or incorrect. We recommend that you spend time reading the feedback for this quiz, to understand what issues that you will want to consider when you are building your own machine learning project.

- First start with the sources of error that are least costly to fix.
- True because it is the largest category of errors. We should always prioritize the largest category of errors as this will make the best use of the team's time.
- True because it is greater than the other error categories added together $8.0 > 4.1 + 2.2 + 1.0$.
- False because it depends on how easy it is to add foggy data. If foggy data is very hard and costly to collect, it might not be worth the team's effort.

Expand

Incorrect
Incorrect. Even though it is better to prioritize larger sources of error, all else being equal, that is not the only thing to consider. Another important consideration is how difficult and costly it would be to access the additional foggy data.

9. You decide to focus on the dev set and check by hand what the errors are due to. Here is a table summarizing your discoveries: **0 / 1 point**

Overall dev set error	15.3%
Errors due to incorrectly labeled data	4.1%
Errors due to foggy pictures	3.0%
Errors due to partially occluded elements.	7.2%
Errors due to other causes	1.0%

In this table, 4.1%, 7.2%, etc. are a fraction of the total dev set (not just examples of your algorithm mislabeled). For example, about 7.2/15.3 = 47% of your errors are due to partially occluded elements in the image.

From this table, we can conclude that if we fix the incorrectly labeled data we will reduce the overall dev set error to 11.2%. True/False?

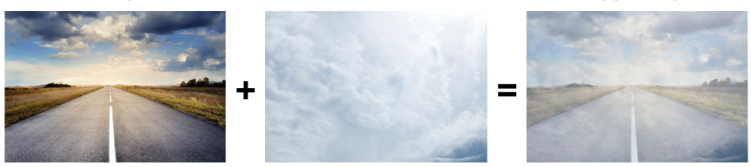
- True
- False

Expand

Incorrect
The 4.1 only gives you an estimate of the ceiling of how much the error can be improved by fixing the labels.

10. You decide to use data augmentation to address foggy images. You find 1,000 pictures of fog off the internet, and "add" them to clean images to synthesize foggy days, like this: **1 / 1 point**

image from front-facing camera + foggy image from the internet = synthesized foggy image



We can't use this data since they have a different distribution from the ones we used (internet and front-facing camera). True/False?

- False

- True

Expand

Correct
Correct. The new synthesized images are added to the training set and as long as they look realistic to the human eye this will be useful data to train the model.

11. After working further on the problem, you've decided to correct the incorrectly labeled data. Your team corrects the labels of the wrongly predicted images on the dev set. **0 / 1 point**

You have to correct the labels of the test so test and dev sets have the same distribution, but you won't change the labels on the train set because most models are robust enough they don't get severely affected by the difference in distributions. True/False?

- False, the test set shouldn't be changed since we want to know how the model performs in real data.
- False, the test set should be changed, but also the train set to keep the same distribution between the train, dev, and test sets.
- True, as pointed out, we must keep dev and test with the same distribution. And the labels at training should be fixed only in case of a systematic error.

Expand

Incorrect
When correcting the labels we are not creating false data we are eliminating unreal data from the set.

12. One of your colleagues at the startup is starting a project to classify road signs as stop, dangerous curve, construction ahead, dead-end, and speed limit signs. Given how specific the signs are, he has only a small dataset and hasn't been able to create a good model. You offer your help providing the trained weights (parameters) of your model to transfer knowledge. **1 / 1 point**

But your colleague points out that his problem has more specific items than the ones you used to train your model. This makes the transfer of knowledge impossible. True/False?

- True
- False

Expand

Correct
Correct. The model can benefit from the pre-trained model since there are many features learned by your model that can be used in the new problem.

13. Another colleague wants to use microphones placed outside the car to better hear if there are other vehicles around you. For example, if there is a police vehicle behind you, you would be able to hear their siren. However, they don't have much to train this audio system. How can you help? **0 / 1 point**

- Either transfer learning or multi-task learning could help our colleague get going faster.
- Transfer learning from your vision dataset could help your colleague get going faster. Multi-task learning seems significantly less promising.
- Multi-task learning from your vision dataset could help your colleague get going faster. Transfer learning seems significantly less promising.
- Neither transfer learning nor multi-task learning seems promising.

Expand

Expand

Incorrect

14. When building a system to detect cattle crossing a road from images taken with the front-facing camera of a truck, the designers had a large dataset of images. Which of the following might be a reason to use an end-to-end approach? 1 / 1 point

- That is the default approach on computer vision tasks.
- There is a large dataset available.
- It requires less computational resources.
- This approach will make use of useful hand-designed components.

Expand

Correct
Correct. To get good results when using an end-to-end approach, it is necessary to have a big dataset.

15. Consider the following two approaches, A and B: 1 / 1 point

· **(A)** Input an image (x) to a neural network and have it directly learn a mapping to make a prediction as to whether there's a red light and/or green light (y).

· **(B)** In this two-step approach, you would first (i) detect the traffic light in the image (if any), then (ii) determine the color of the illuminated lamp in the traffic light.

Approach A tends to be more promising than approach B if you have a _____ (fill in the blank).

- Large training set
- Large bias problem.
- Multi-task learning problem.
- Problem with a high Bayes error.

Expand

Correct
Yes. In many fields, it has been observed that end-to-end learning works better in practice, but requires a large amount of data.