Congratulations! You passed!

Grade received 100% **Latest Submission Grade** 100% **To pass** 80% or higher

Go to next item

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!

1 / 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.

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

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.
- Train a basic model and proceed with error analysis.
- Start by solving pedestrian detection, since you already have the experience to do this.
- Leave aside the pedestrian detection, to move faster and then later solve the pedestrian problem alone.

Expand

Correct
Correct. As discussed in the lecture, it is better to create your first system quickly and then iterate.

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. For the output layer, which of the following gives you the most appropriate activation function?

1 / 1 point

- Sigmoid
- ReLU
- Linear
- Softmax

Expand

Correct
Correct. This works well since the output would be valued between 0 and 1 which represents the probability that one of the possibilities is present in an image.

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

1 / 1 point

- ( ) 10,000 images on which the algorithm made a mistake
- ( ) 10,000 randomly chosen images
- (•) 500 images on which the algorithm made a mistake
- ( ) 500 randomly chosen images

Expand

Correct
Focus on images that the algorithm got wrong. Also, 500 is enough to give you a good initial sense of the error statistics. There's probably no need to look at 10,000, which will take a long time.

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, when an image is not fully labeled (for example: $\begin{pmatrix} 0 \\ ? \\ ? \\ 1 \\ 0 \end{pmatrix}$) we can use it if we ignore those entries when calculating the loss function. True/False?

- ( ) False
- (•) True

Expand

Correct
Correct. We can't use the components of the labels that are missing but we can use the ones we have to train the model.

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. The best way to split the data is using the 900,000 internet images to train, and divide the 100,000 images from your car's front-facing camera between dev and test sets. True/False?

1 / 1 point

- (•) False
- ( ) True

Expand

Correct
Correct. 100,000 images are too many to use in dev and test. A better distribution would be to use 80,000 of those images to train, and split the rest between dev and test.

6. Assume you've finally chosen the following split between of 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)	8.8%
Training-Dev	20,000 images randomly picked from (900,000 internet images + 60,000 car's front-facing camera images)	9.1%
Dev	20,000 images from your car's front-facing camera	14.3%
Test	20,000 images from the car's front-facing camera	14.8%

You also know that human-level error on the road sign and traffic signals classification task is around 0.5%. Which of the following are True? (Check all that apply).

- [ ] You have a large variance problem because your training error is quite higher than the human-level error.
- [x] You have a large avoidable-bias problem because your training error is quite a bit higher than the human-level error.

✓ Correct

- [x] You have a large data-mismatch problem because your model does a lot better on the training-dev set than on the dev set

✓ Correct

- [ ] Your algorithm overfits the dev set because the error of the dev and test sets are very close.
- [ ] You have a large variance problem because your model is not generalizing well to data from the same training distribution but that it has never seen before.

Expand

Correct
Great, you got all the right answers.

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, a friend thinks that the training data distribution is much harder than the dev/test distribution. What do you think?

- ( ) Your friend is wrong. (i.e., Bayes error for the dev/test distribution is probably higher than for the train distribution.)
- (•) Your friend is probably right. (i.e., Bayes error for the dev/test distribution is probably lower than for the train distribution.)
- ( ) There's insufficient information to tell if your friend is right or wrong.

Expand

Correct
Correct. Since the training-dev error is higher than the dev and test errors, the dev/test distribution is probably "easier" than the training distribution.

8. 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:

1 / 1 point

Overall dev set error	15.3%
Errors due to incorrectly labeled data	4.1%
Errors due to foggy pictures	2.0%
Errors due to partially occluded elements.	8.2%
Errors due to other causes	1.0%

In this table, 4.1%, 8.2%, etc. are a fraction of the total dev set (not just examples of your algorithm mislabeled). For example, about 8.2/15.3 = 54% of your errors are due to partially occluded elements in the image.

Which of the following is the correct analysis to determine what to prioritize next?

- You should prioritize getting more foggy pictures since that will be easier to solve.
- You should weigh how costly it would be to get more images with partially occluded elements, to decide if the team should work on it or not.
- Since there is a high number of incorrectly labeled data in the dev set, you should prioritize fixing the labels on the whole training set.
- Since 8.2 > 4.1 + 2.0 + 1.0, the priority should be to get more images with partially occluded elements.

Expand

Correct
Correct. You should consider the tradeoff between the data accessibility and potential improvement of your model trained on this additional data.

9. You can buy a specially designed windshield wiper that helps wipe off some of the raindrops on the front-facing camera.

1 / 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%

Which of the following statements do you agree with?

- 2.2% would be a reasonable estimate of the maximum amount this windshield wiper could improve performance.
- 2.2% would be a reasonable estimate of how much this windshield wiper will improve performance.
- 2.2% would be a reasonable estimate of how much this windshield wiper could worsen performance in the worst case.
- 2.2% would be a reasonable estimate of the minimum amount this windshield wiper could improve performance.

Expand

Correct
Yes. You will probably not improve performance by more than 2.2% by solving the raindrops problem. If your dataset was infinitely big, 2.2% would be a perfect estimate of the improvement you can achieve by purchasing a specially designed windshield wiper that removes the raindrops.

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

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.

1 / 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

Correct
Correct! To successfully train a model, the dev set and test set should come from the same distribution. Also, the deep learning models are robust enough to handle a small change in distributions, but if the errors are systematic they can significantly affect the training of the model.

12. Your client asks you to add the capability to detect dogs that may be crossing the road to the system. He can provide a relatively small set containing dogs. Which of the following do you agree most with?

1 / 1 point

- You can use weights pre-trained on the original data, and fine-tune with the data now including the dogs.
- Using pre-trained weights can severely hinder the ability of the model to detect dogs since they have too many learned features.
- You should train a single new model for the dogs' task, and leave the previous model as it is.
- You will have to re-train the whole model now including the dogs' data.

Expand

Correct
Correct. Since your model has learned useful low-level features to tackle the new task we can conserve those by using the pre-trained weights.

13. One of your colleagues at the startup is starting a project to classify stop signs in the road as speed limit signs or not. He has approximately 30,000 examples of each image and 30,000 images without a sign. He thought of using your model and applying transfer learning but then he noticed that you use multi-task learning, hence he can't use your model. True/False?

1 / 1 point

- True
- False

Expand

Correct
Correct. When using transfer learning we can remove the last layer. That is one of the aspects that is different from a binary classification problem.

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

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

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).

- Multi-task learning problem.
- Large bias problem.
- (selected) Large training set
- 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.