This is the trajectory we might predict for this car.

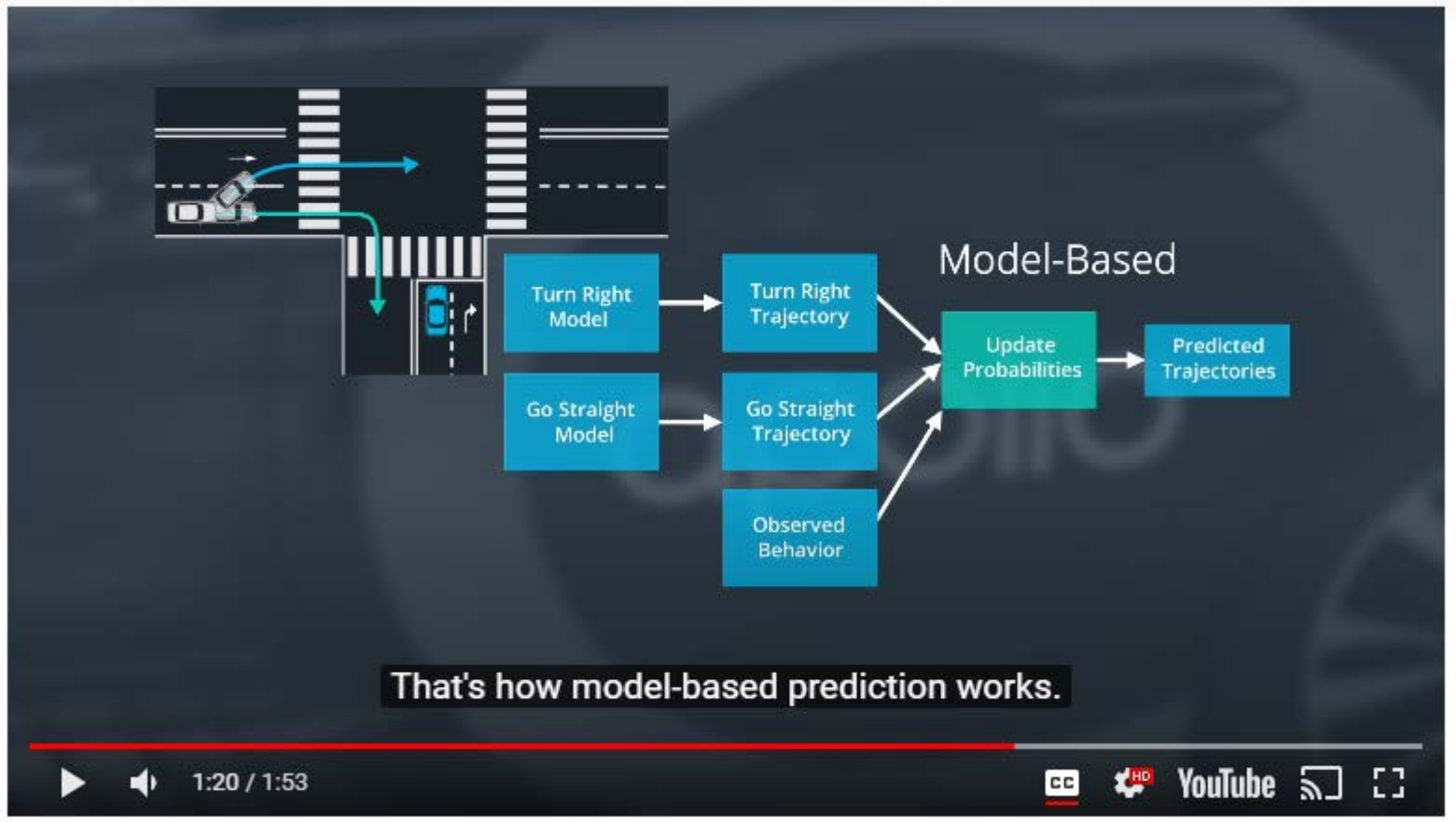
0:42 / 1:14

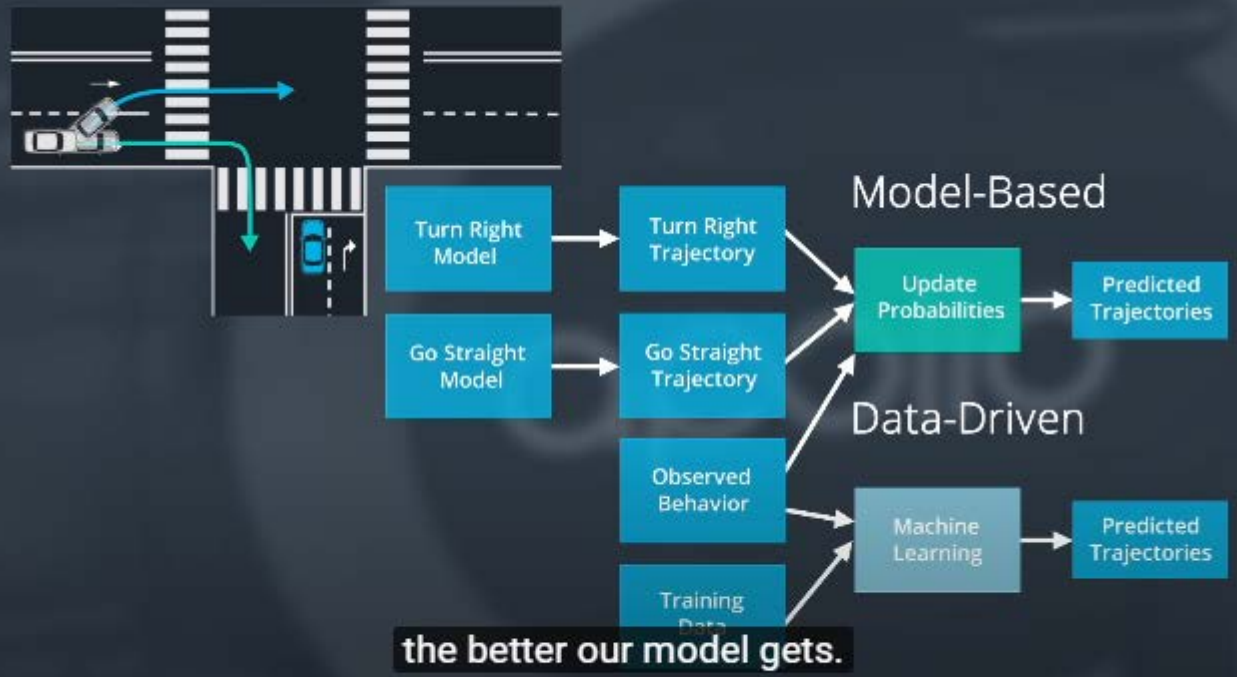
QUIZ QUESTION

In this quiz, you will need to do some research on Apollo's Github repo. Which of the following are the expected inputs for prediction?

- [x] Localization
- [ ] HD Map
- [x] Perception
- [ ] Planning

free of obstacles and safe to traverse before we drive into it.


Model-Based
Turn Right Model
Turn Right Trajectory
Go Straight Model
Go Straight Trajectory
Observed Behavior
Update Probabilities
Predicted Trajectories
That's how model-based prediction works.
1:20 / 1:53
YouTube


Model-Based
Turn Right Model
Turn Right Trajectory
Go Straight Model
Go Straight Trajectory
Update Probabilities
Predicted Trajectories
Data-Driven
Observed Behavior
Machine Learning
Predicted Trajectories
Training
the better our model gets.
1:39 / 1:53
YouTube

Thanks for completing that!

Correct! In this situation we could use a model based approach to incorporate our knowledge of physics (friction, forces, etc...) to figure out exactly (or almost exactly) when a vehicle would begin to skid on a wet road.

CONTINUE

Playground for Quiz :

Neither approach (model-based or data-driven) is strictly better than the other but there are certain situations in which one is more useful than the other. Think about the following situations and whether model-based or data-driven approaches would be more useful.

QUESTION 1 OF 3

Determining maximum safe turning speed on a wet road.

- ✓ Model-Based
- Data-Driven

SUBMIT

Thanks for completing that!

That's right. Even with data driven approaches this would still be a very hard problem but since we don't even know what this object is, a model based approach to prediction would be nearly impossible.

CONTINUE

QUESTION 2 OF 3

Predicting the behavior of an unidentified object sitting on the road.

- Model-Based
- ✓ Data-Driven

Thanks for completing that!

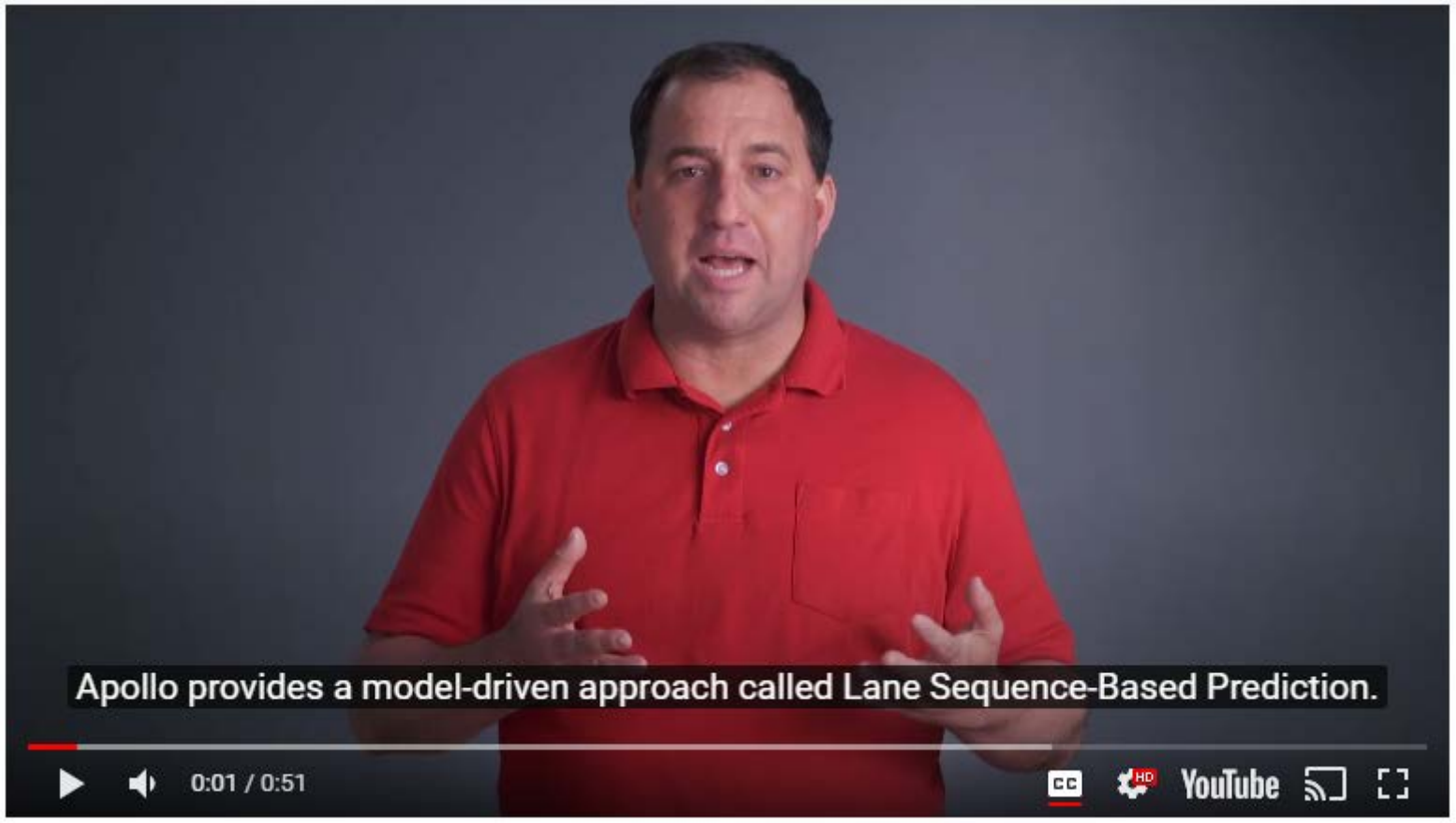
You could really use either approach (or a hybrid approach) in this situation. On the one hand there are very few behaviors we need to model in a highway driving situation and the physics are all very well understood so model based approaches could work. On the other hand it would be relatively easy to collect a lot of training data in similar situations so a purely data driven approach could work too.

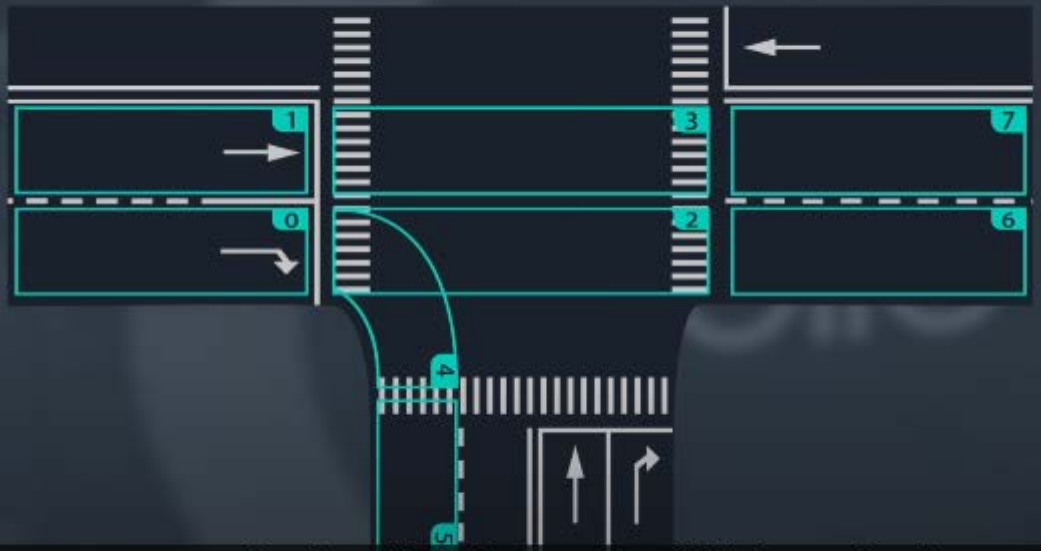
CONTINUE

QUESTION 3 OF 3

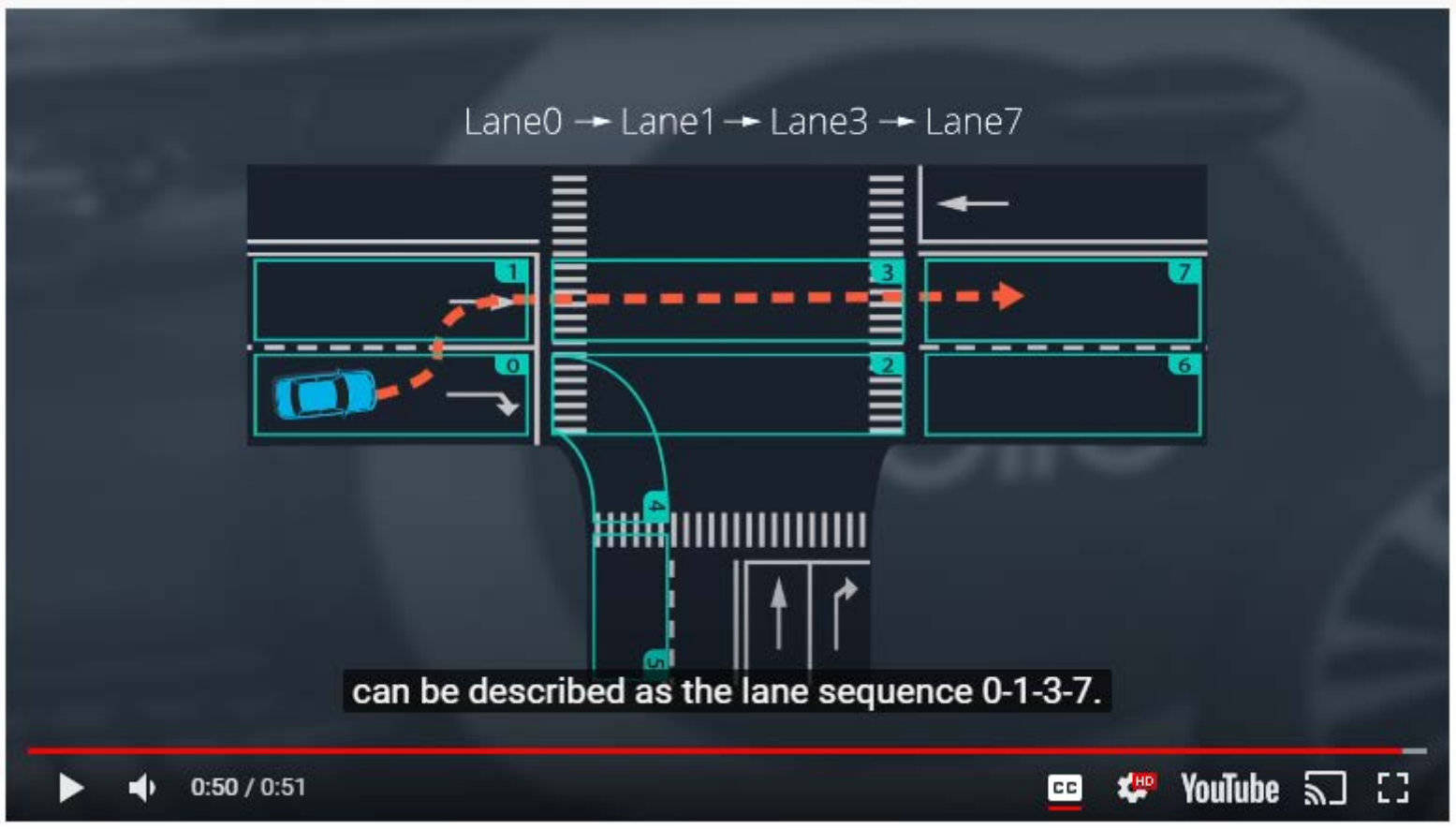
Predicting the behavior of a vehicle on a two lane highway in light traffic.

- [x] Model-Based
- [ ] Data-Driven


Apollo provides a model-driven approach called Lane Sequence-Based Prediction.
0:01 / 0:51
YouTube

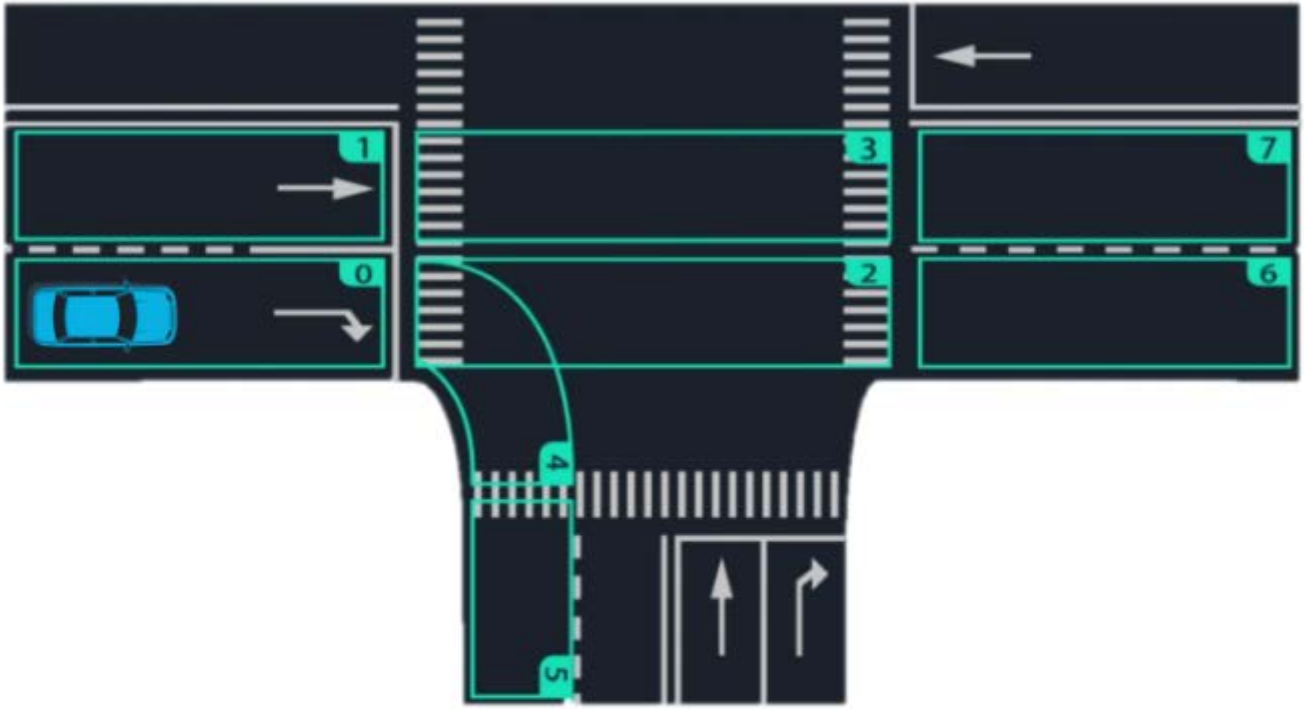


Each segment covers a region in which the target vehicle's motion is easy to describe.

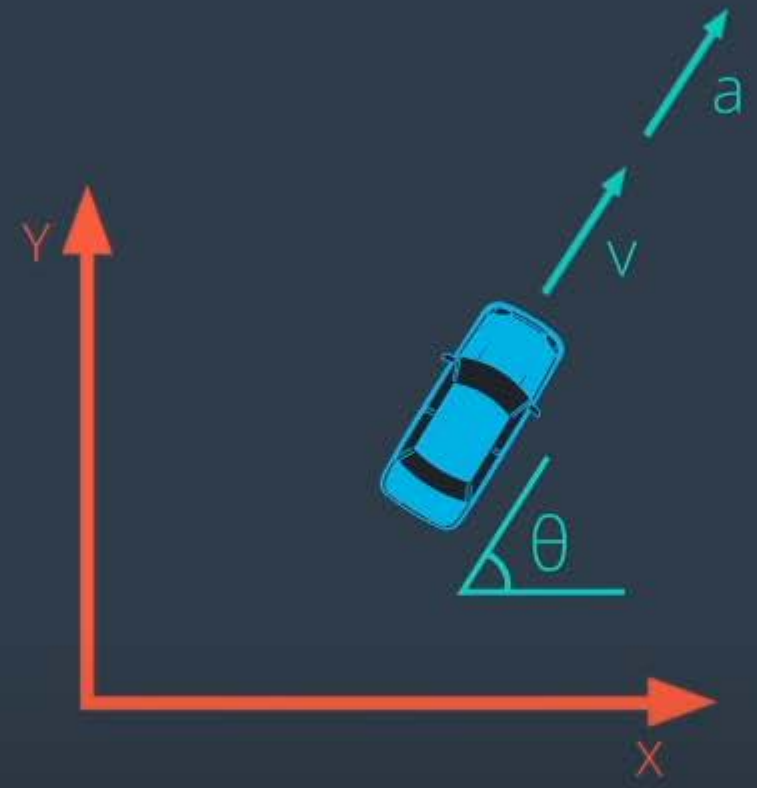

Lane0 → Lane1 → Lane3 → Lane7
1
3
7
0
2
6
4
5
can be described as the lane sequence 0-1-3-7.
0:50 / 0:51
CC
HD
YouTube

QUIZ QUESTION

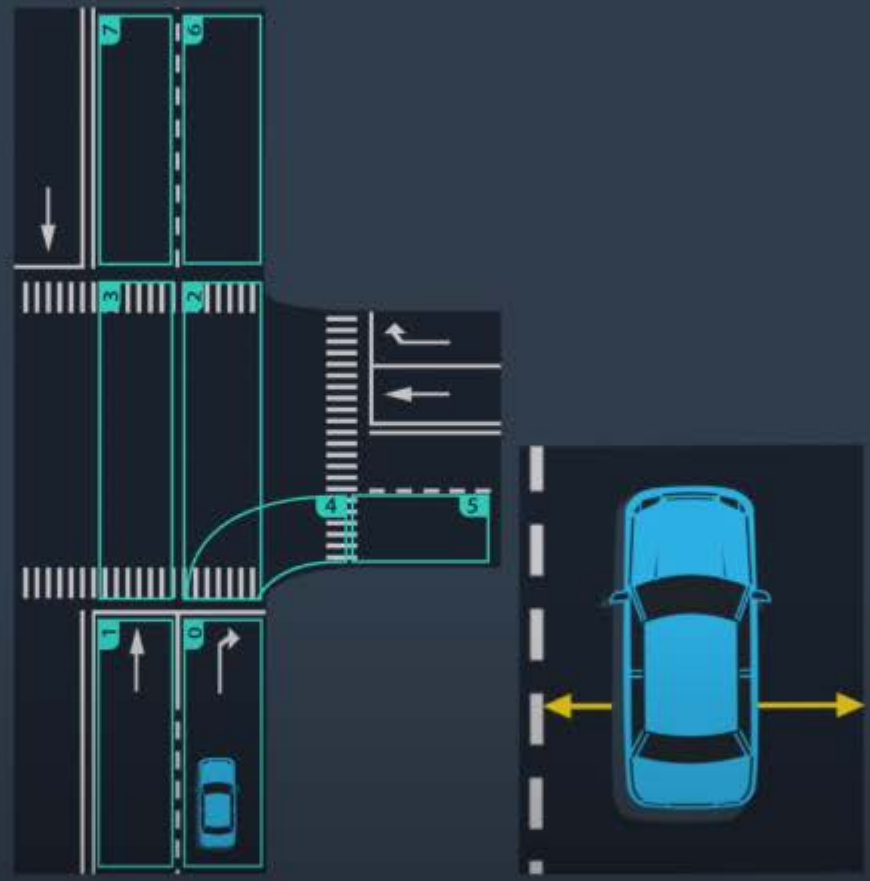
In the picture we show below, what sequence the vehicle will take if it wants to turn right?



- [x] 0 > 4 > 5
- [ ] 1> 3 > 7
- [ ] 0 > 2 > 6

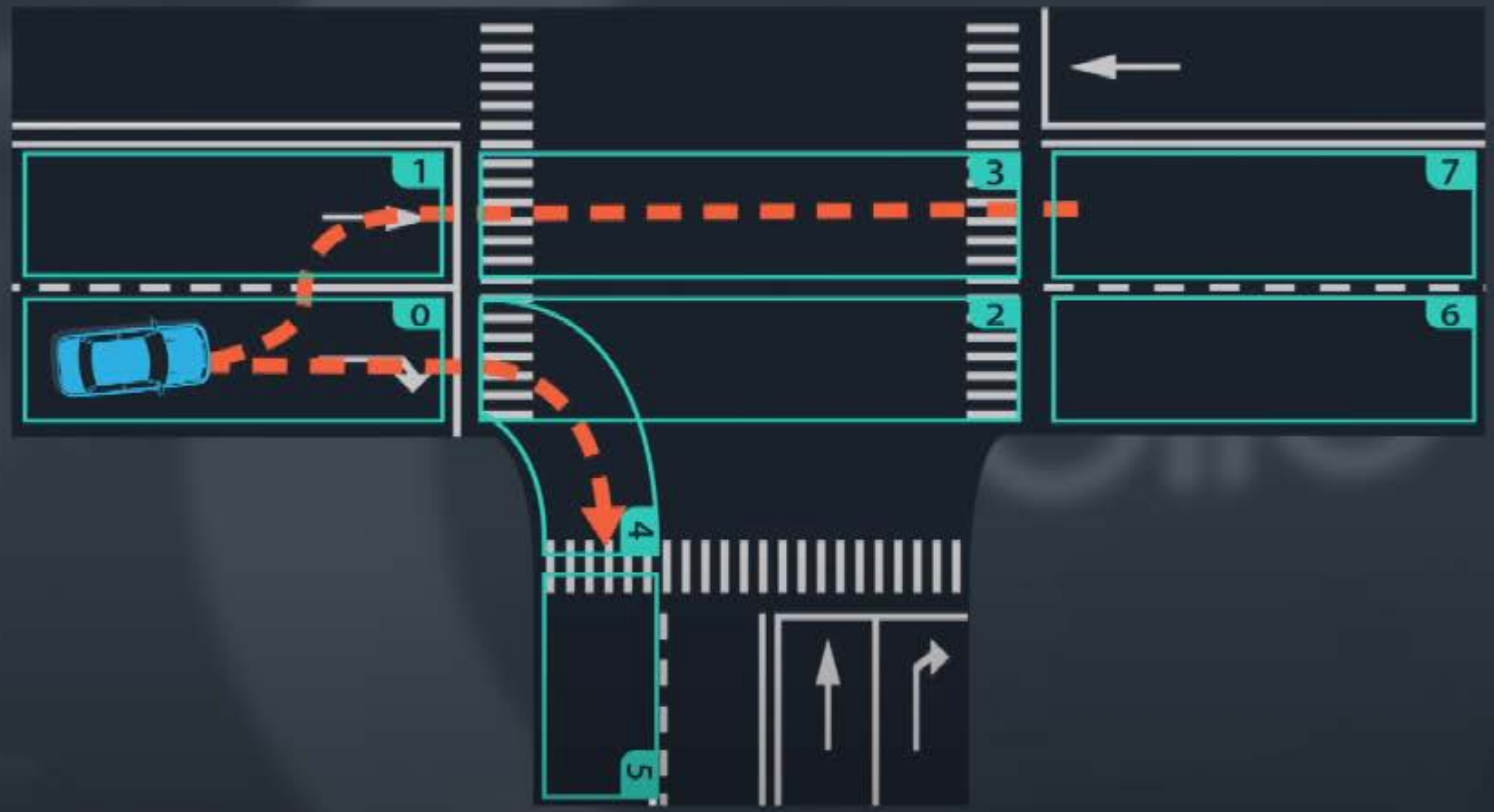


position, speed, and acceleration.

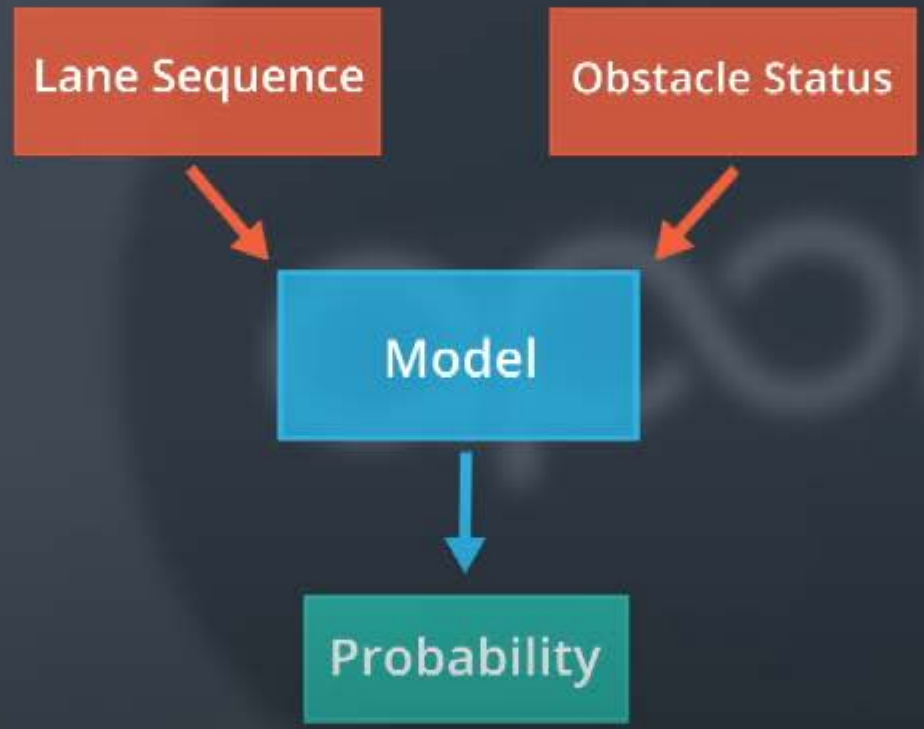


the longitudinal and lateral distances from the object to the lane segment boundaries.

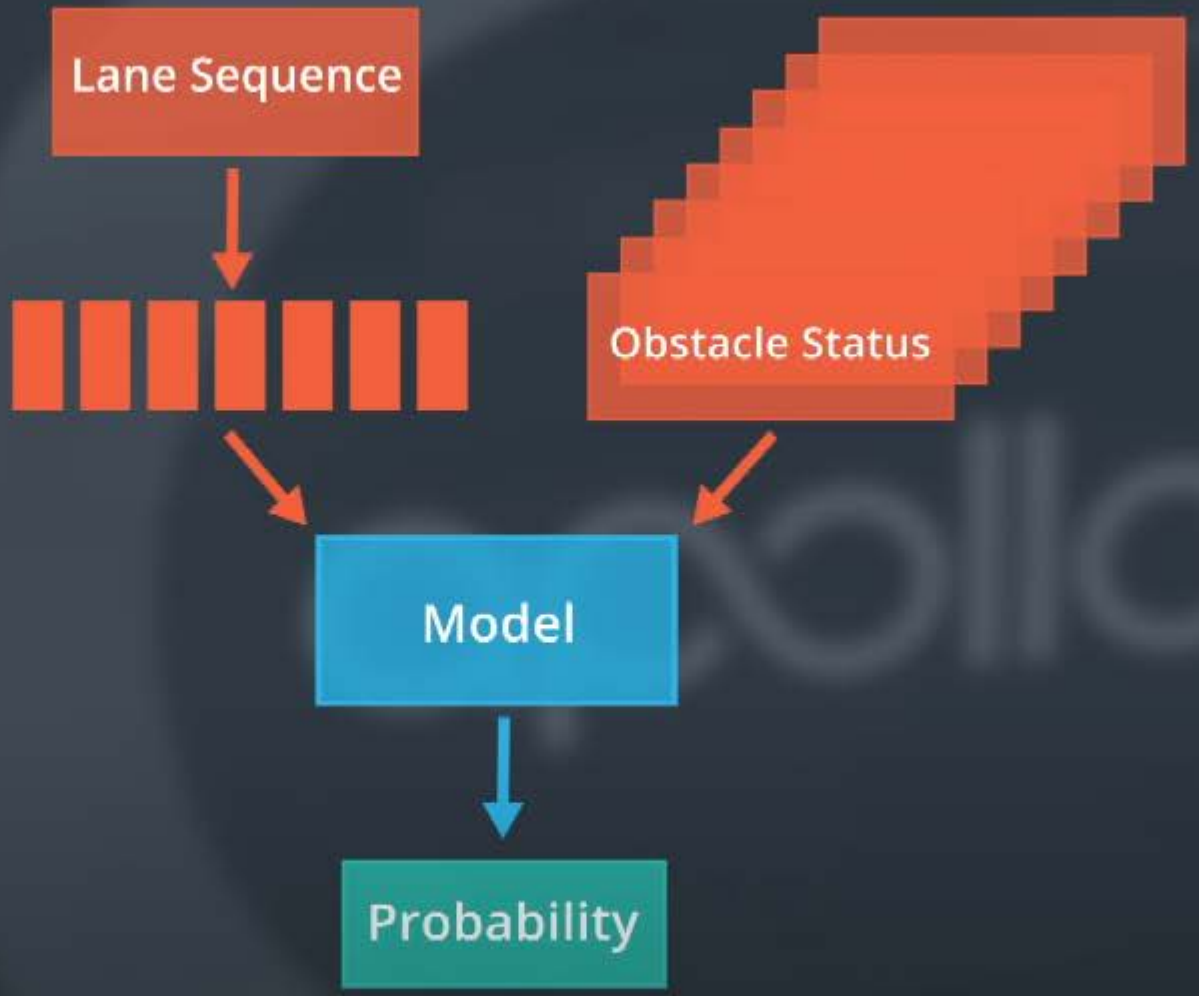
previous timesteps in order to make more accurate predictions.



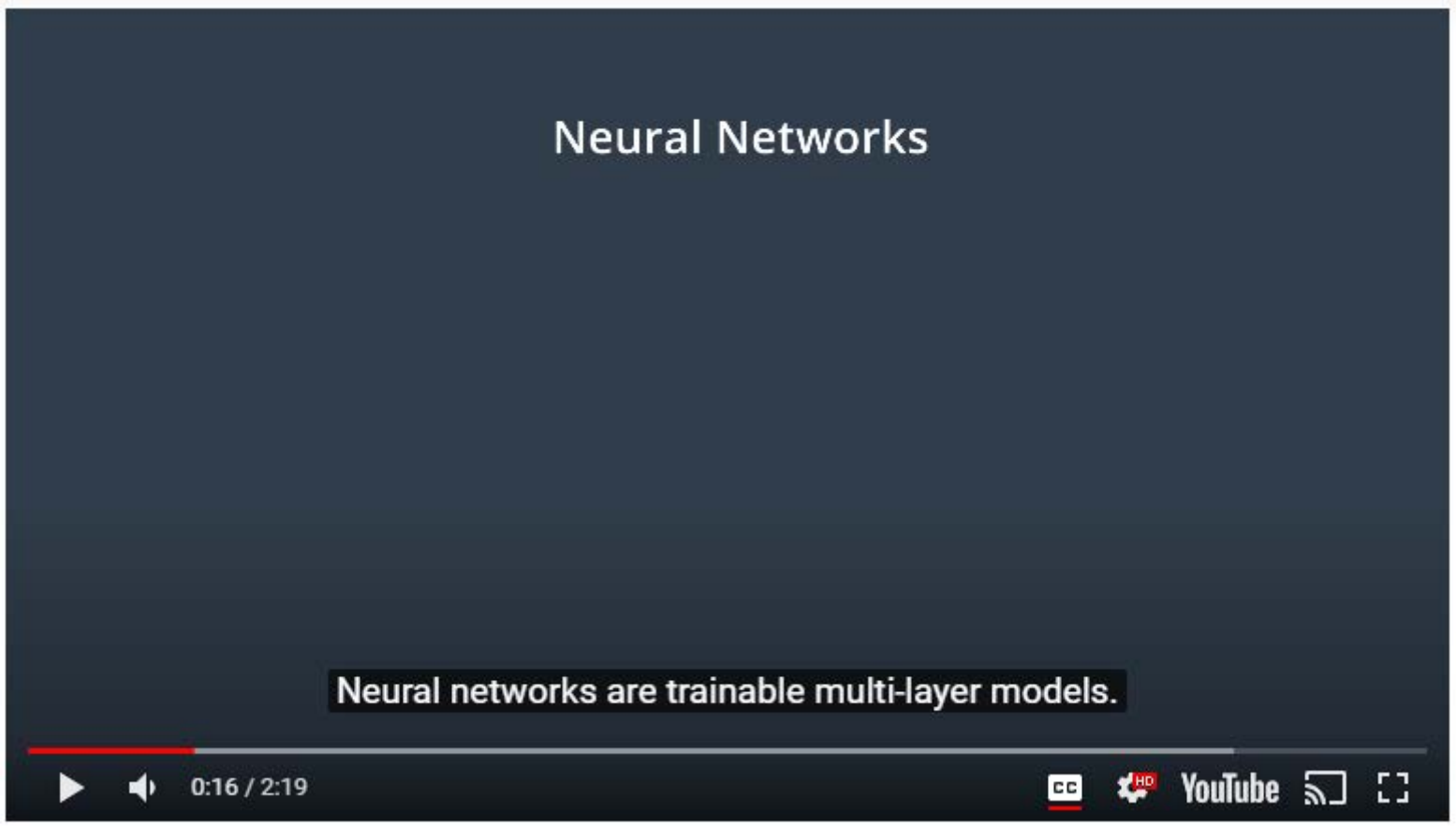
right or it might shift to lane segment one and then go straight.

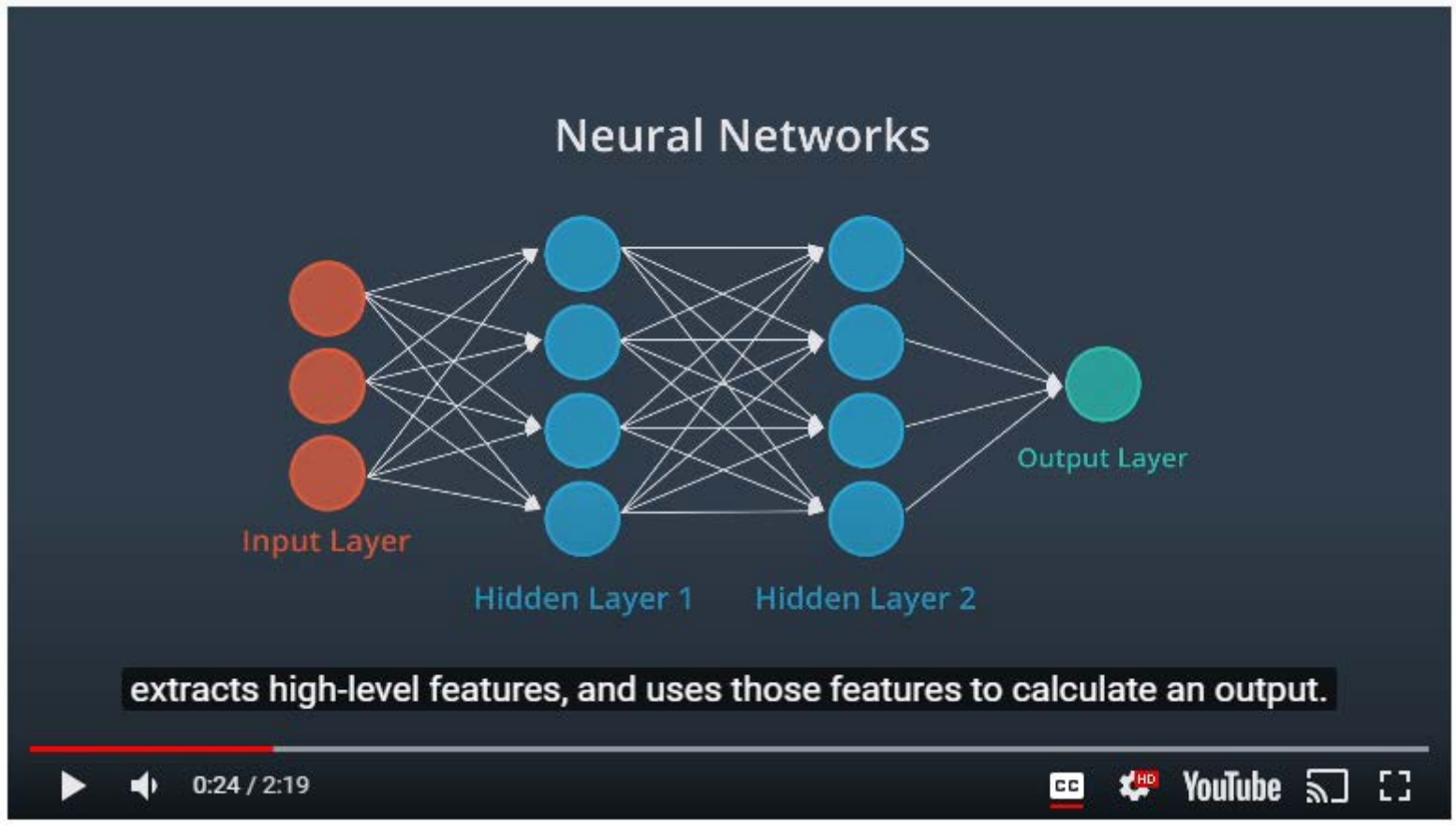


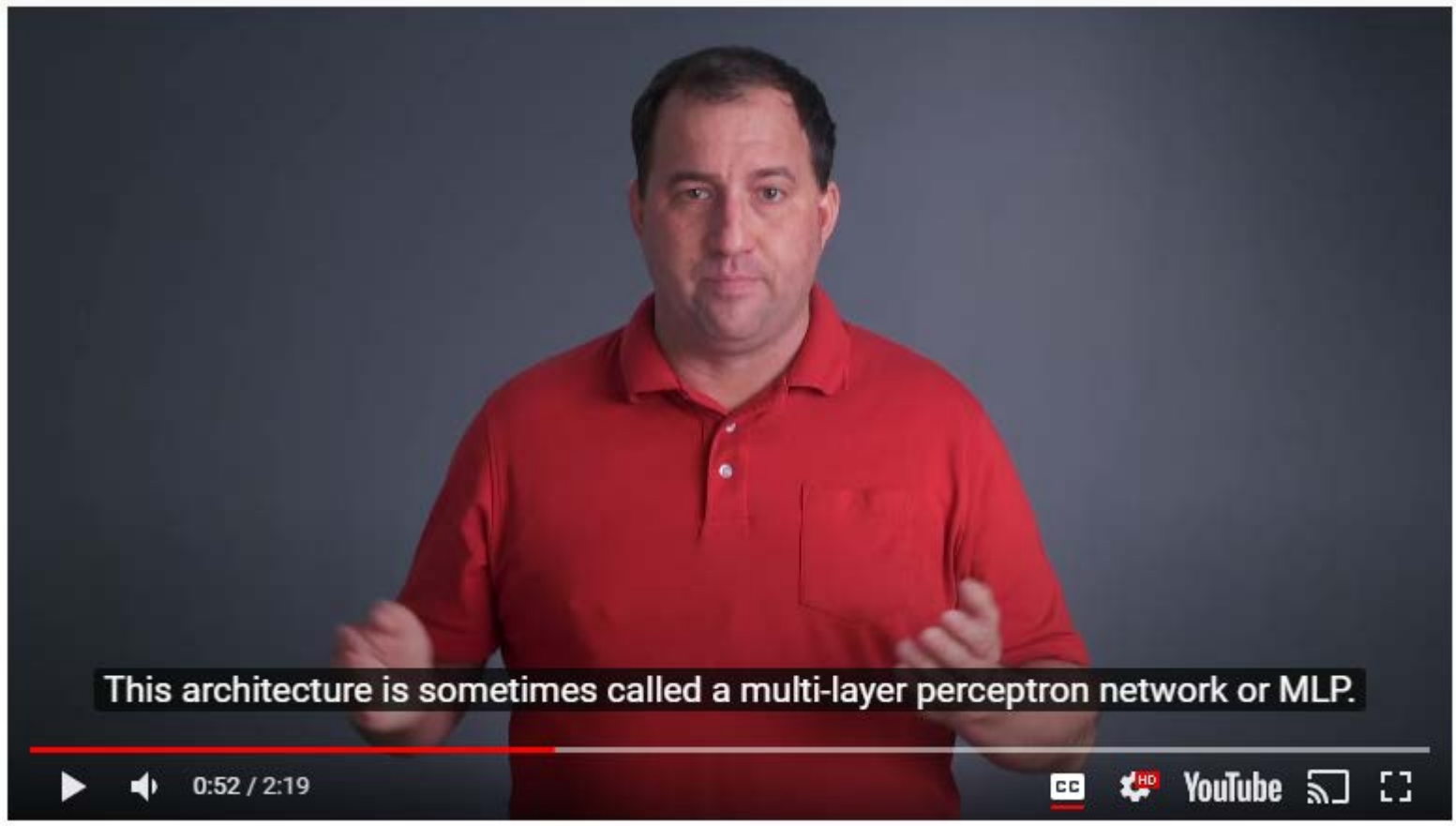
the vehicle will take each of the lane sequences.

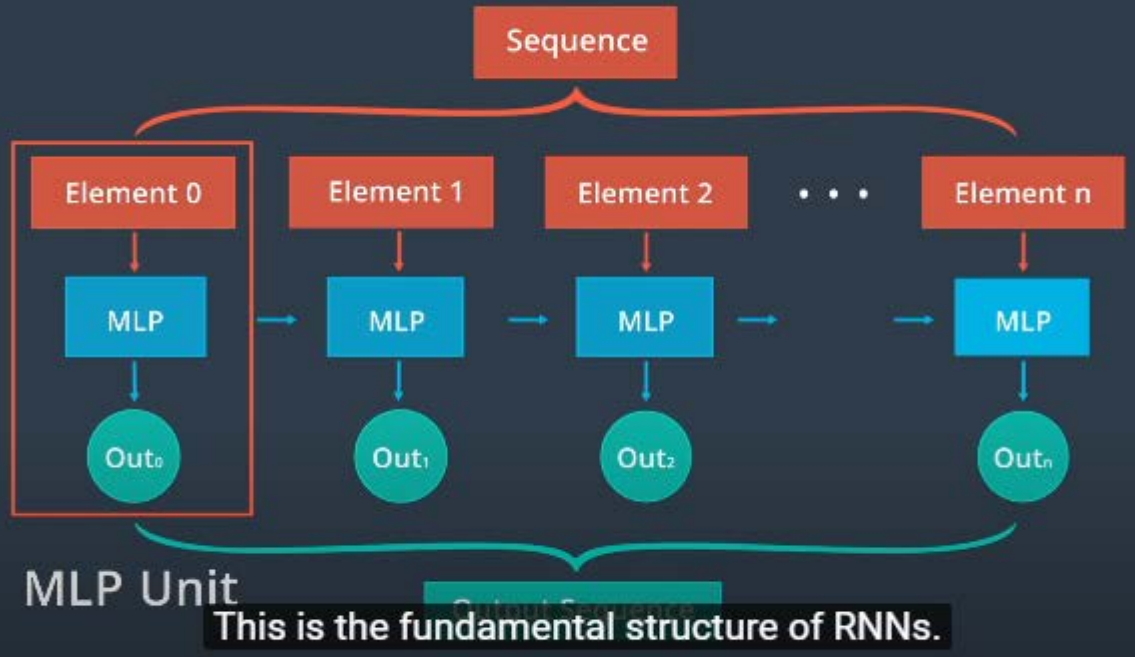


lane segments and the associated states of the object.


Neural Networks
Neural networks are trainable multi-layer models.
0:16 / 2:19
YouTube


Neural Networks
Input Layer
Hidden Layer 1
Hidden Layer 2
Output Layer
extracts high-level features, and uses those features to calculate an output.
0:24 / 2:19
YouTube

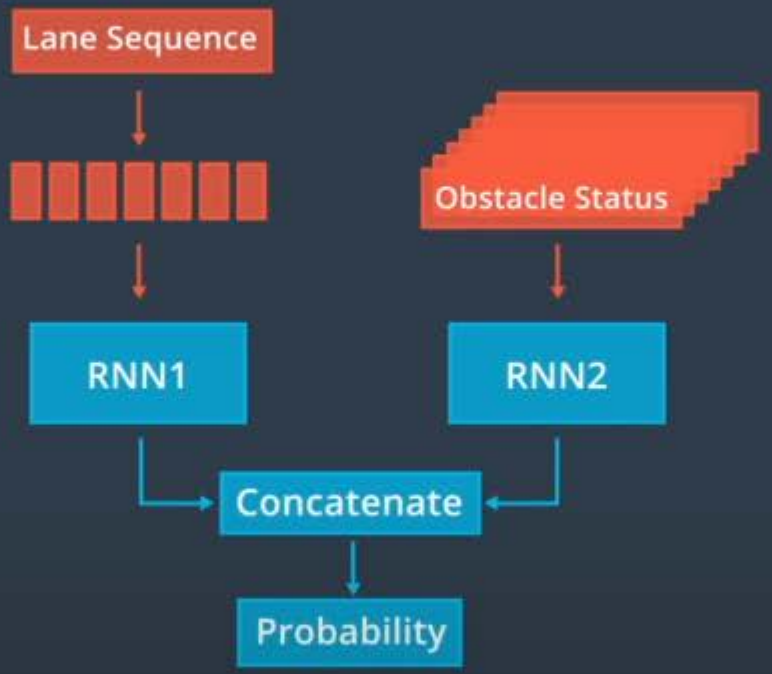

This architecture is sometimes called a multi-layer perceptron network or MLP.
0:52 / 2:19
YouTube


Sequence
Element 0
Element 1
Element 2
Element n
MLP
MLP
MLP
MLP
Out0
Out1
Out2
Outn
MLP Unit
This is the fundamental structure of RNNs.
2:18 / 2:19
YouTube

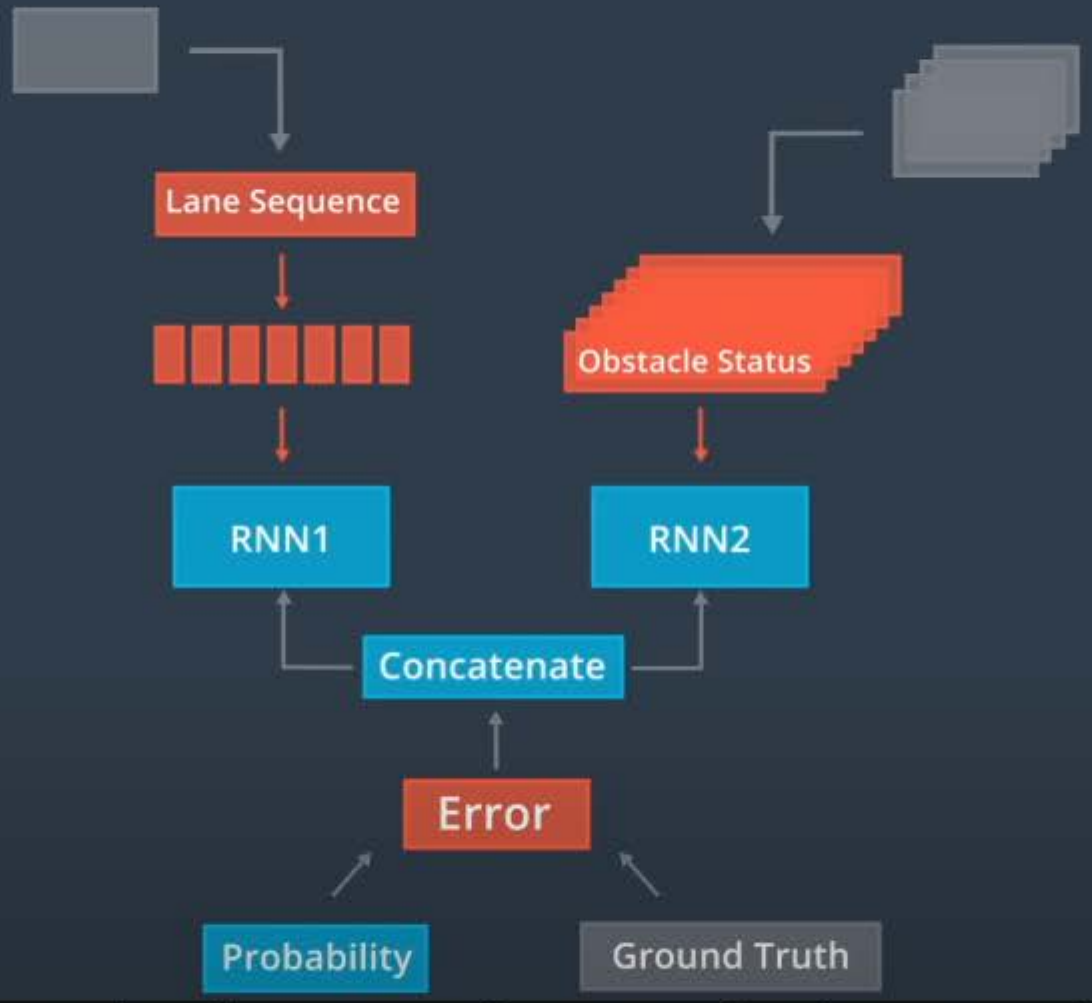
QUIZ QUESTION

Select all of the problems that you think can be best solve by RNNs.

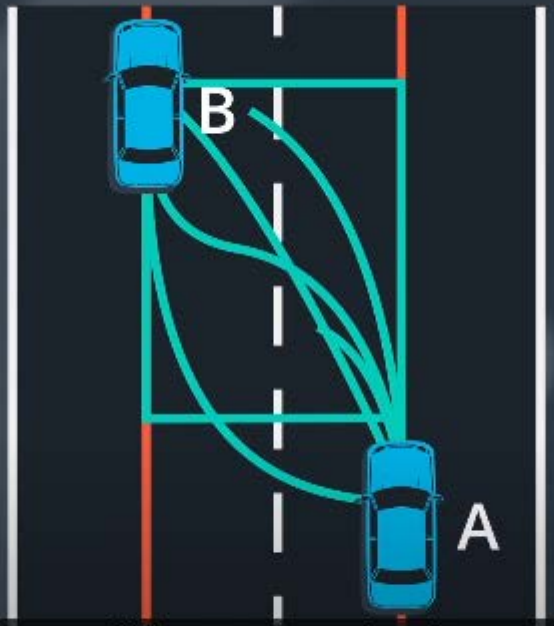
- [x] Translate an English sentence to other languages
- [ ] Classifier an image to tell if it is a cat or a dog
- [x] Caption a video without human talking, describe every frame of the video in natural language
- [x] Recognize a series of characters from a sentence in an image.



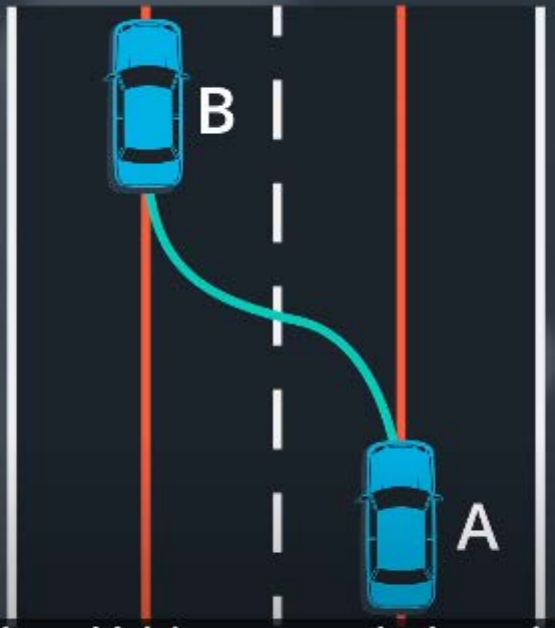
another neural network which estimates a probability for each lane sequence.



and use backpropagation to train the network.



there are infinite candidate trajectories for an object to travel.

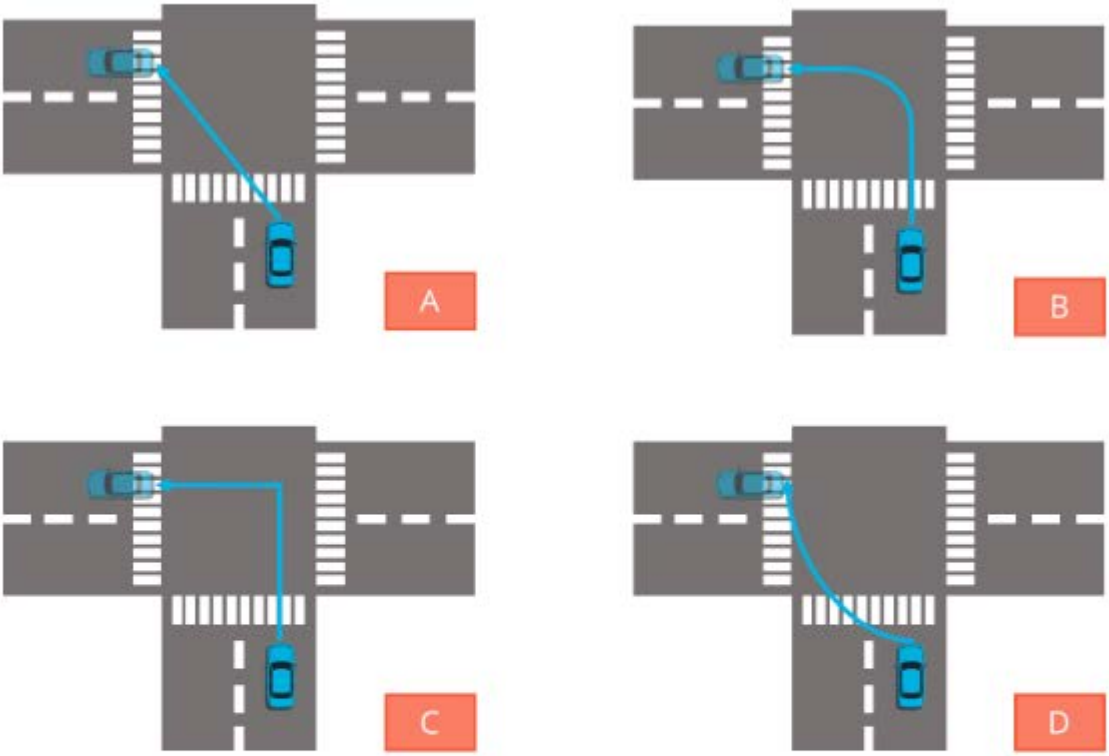


considering the vehicle's current velocity and acceleration.

0:44 / 1:15

QUIZ QUESTION

Suppose using the lane-sequence method, we predict a car will turn left in an intersection, which of the following trajectories is the best for describe its behavior?



- A
- ✓ B
- C
- D