Identifying Vehicle Behaviors in a Traffic Scene

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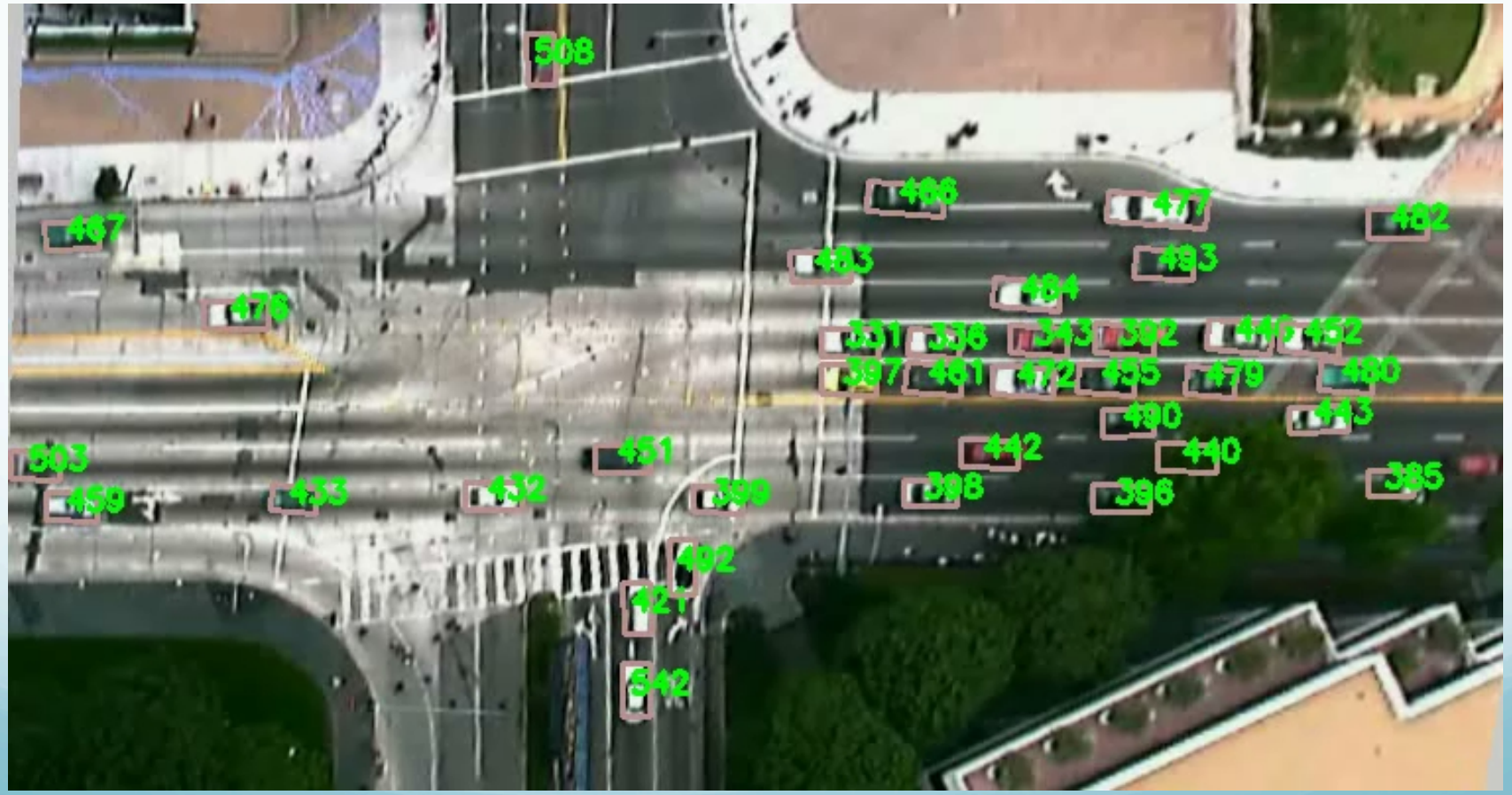
Goals

- Tracking vehicles has been done before…



Goals

- Now that we know exactly where you are, we would like to know exactly what you are doing:
  - Are you speeding?
  - Are you tailgating?
  - Are you cutting off other vehicles?
  - Do you weave through traffic?
  - Are you an aggressive driver?

- We can develop a computer program that can look at your vehicle's position over time, and answer all of the above questions.

Phase 1: The Intelligent Driver Model

$$\dot{v}_\alpha = a^{(\alpha)}\left[1 - \left(\frac{v_\alpha}{v_0^{(\alpha)}}\right)^{\delta} - \left(\frac{s^*(v_\alpha, \Delta v_\alpha)}{s_\alpha}\right)^2\right]$$

- The equation above was developed for simulating traffic.
  - It controls how quickly cars move based on the speed limit and number of cars on the road
  - This can be useful for testing roadway designs without building the actual roads
- The model assumes that drivers only make safe decisions:
  - Car crashes will not occur in vehicles that fit the model

How We Can Use It

- If we know where the car is at every time, then we can also tell how fast it is going, and how much it is accelerating or braking

$$\dot{v}_\alpha = a^{(\alpha)}\left[1 - \left(\frac{v_\alpha}{v_0^{(\alpha)}}\right)^{\delta} - \left(\frac{s^*(v_\alpha, \Delta v_\alpha)}{s_\alpha}\right)^2\right]$$

- If we use this information in the equation, we can tell whether a car should be slowing down, or if it is safe for them to speed up
- By comparing this to what the car actually does, we can easily identify vehicles that are showing unsafe behavior:
  - Speeding
  - Tailgating

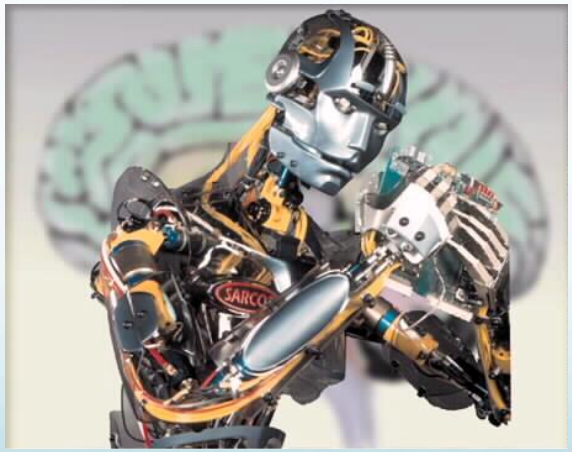
Results: The IDM in Action

Phase 2: Learning Lanes

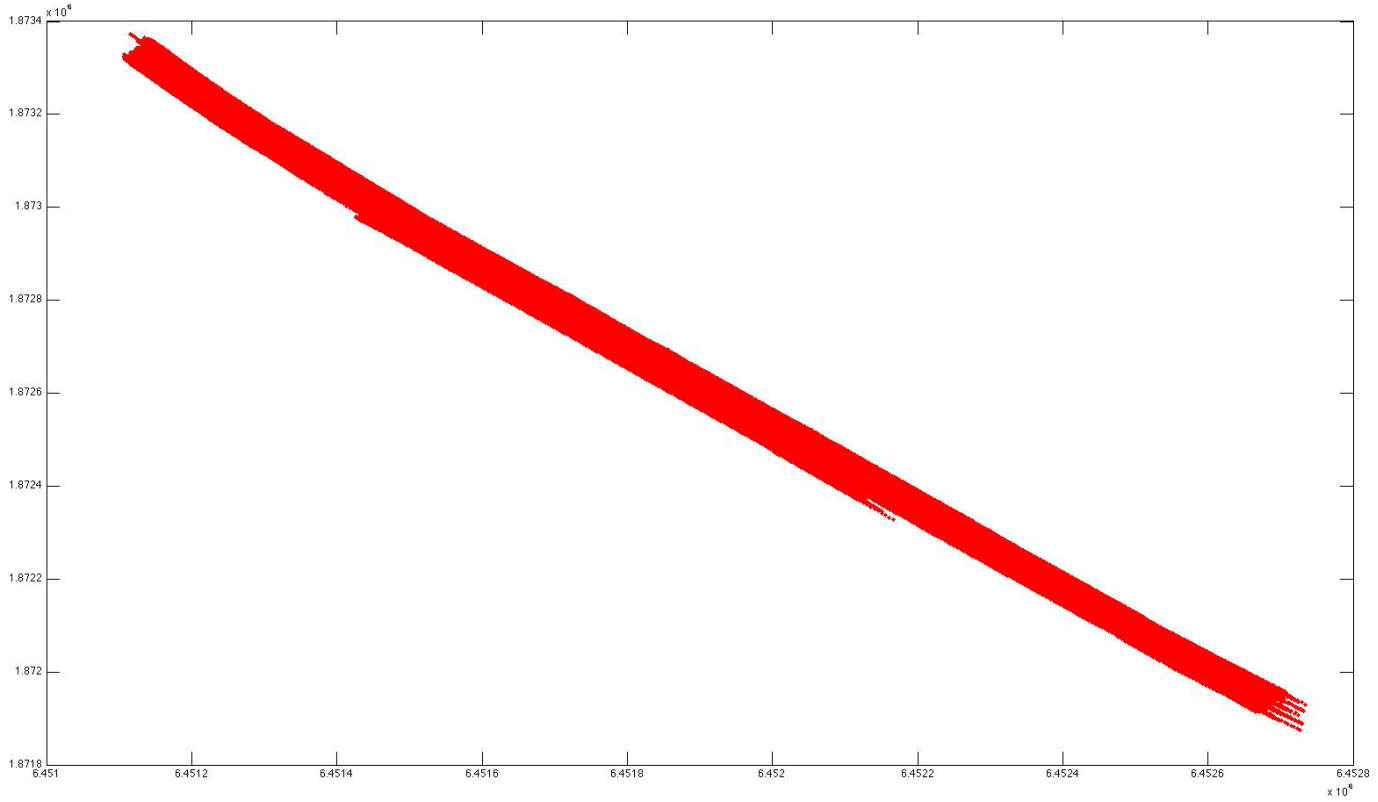
- The Intelligent Driver Model thinks there is only a single lane
  - This means that we cannot easily use it to find:
    - Drivers who weave through traffic
    - Drivers who cut off other drivers
- To accomplish these tasks, we have to find the lanes in the road.

Learning Lanes

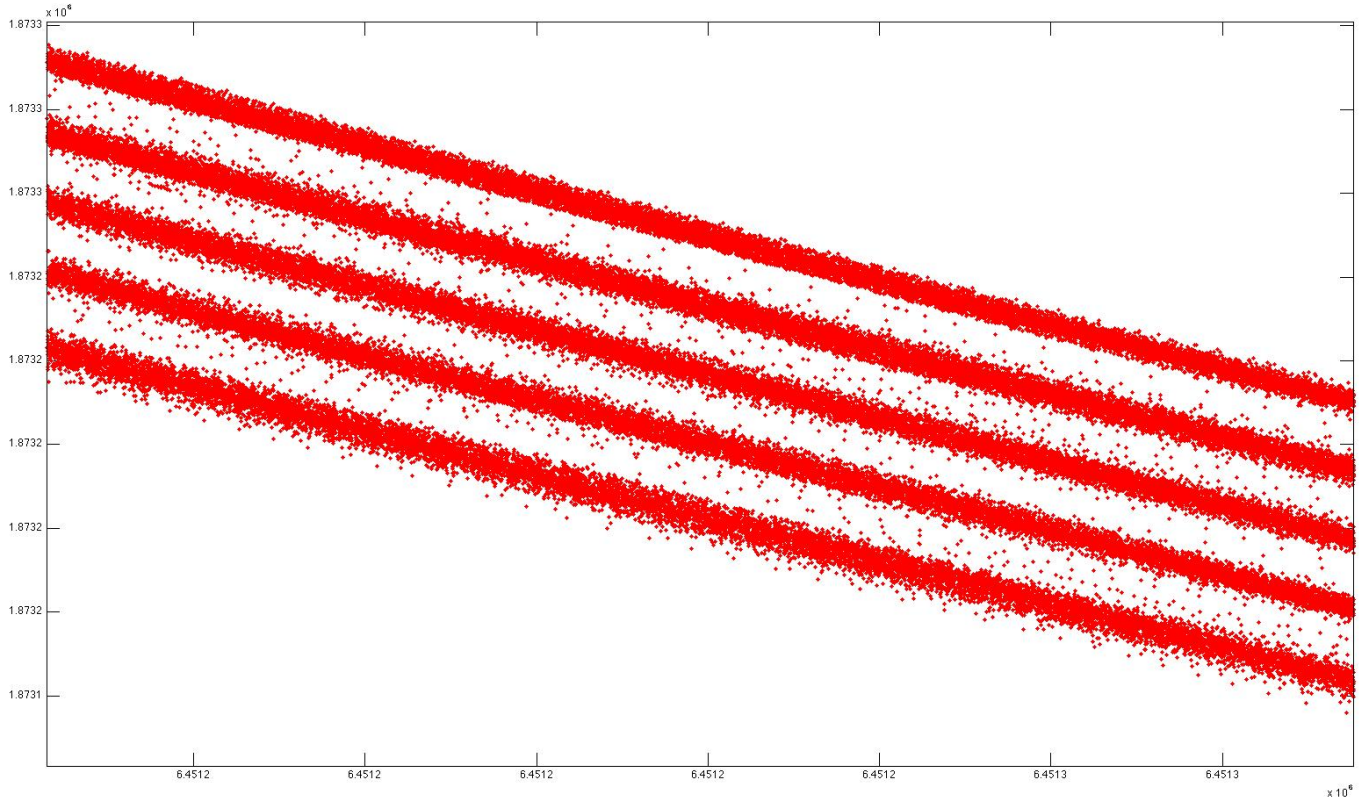
- Remember, we want a computer to be able to do this knowing only where the cars are
- We can use a type of artificial intelligence known as Machine Learning
  - This is just a way to teach a computer how to identify something



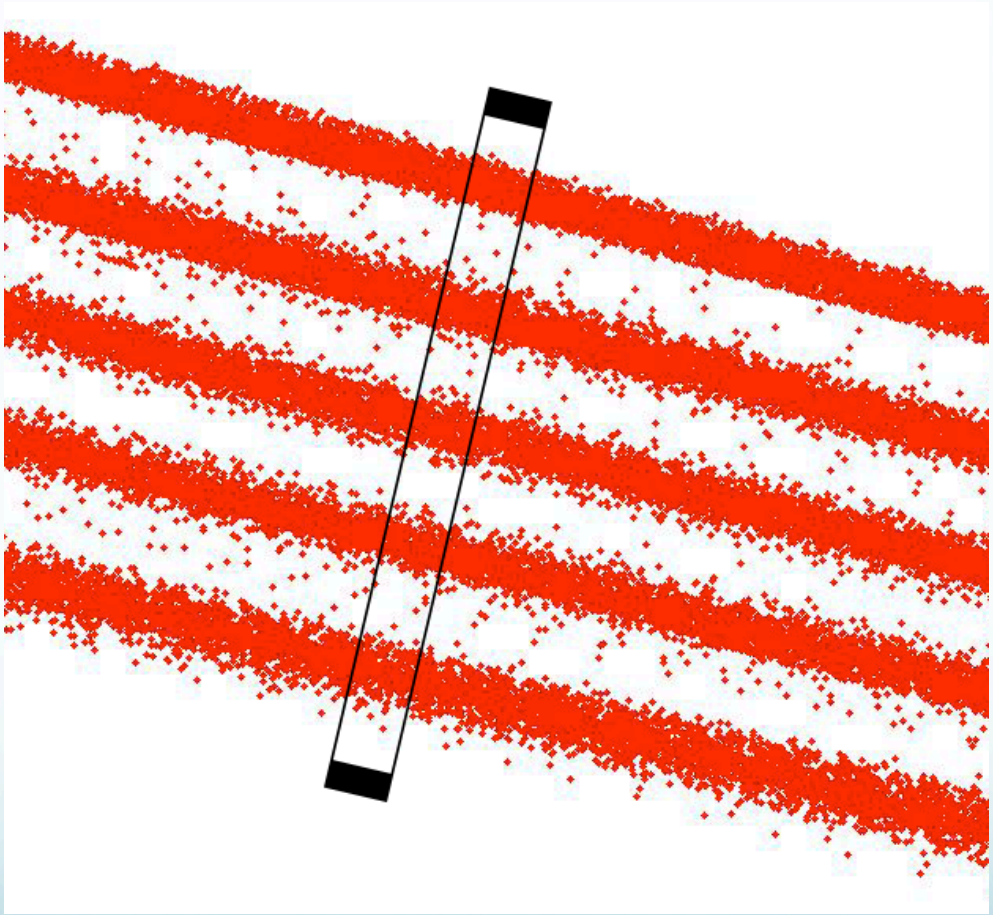
Lets Take a Look at Our Data

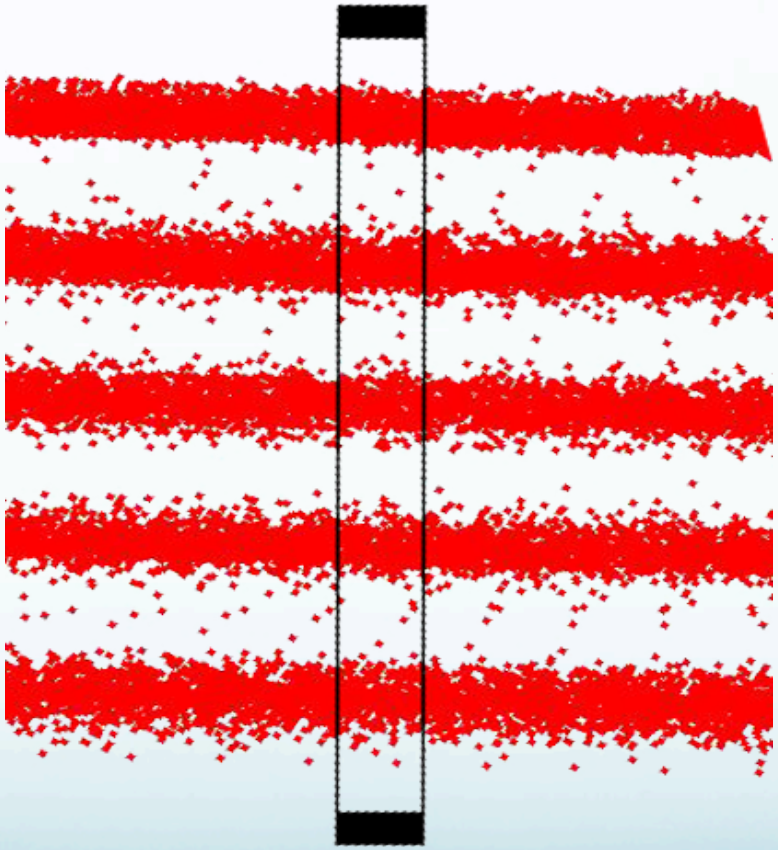


Zoom in a Little…

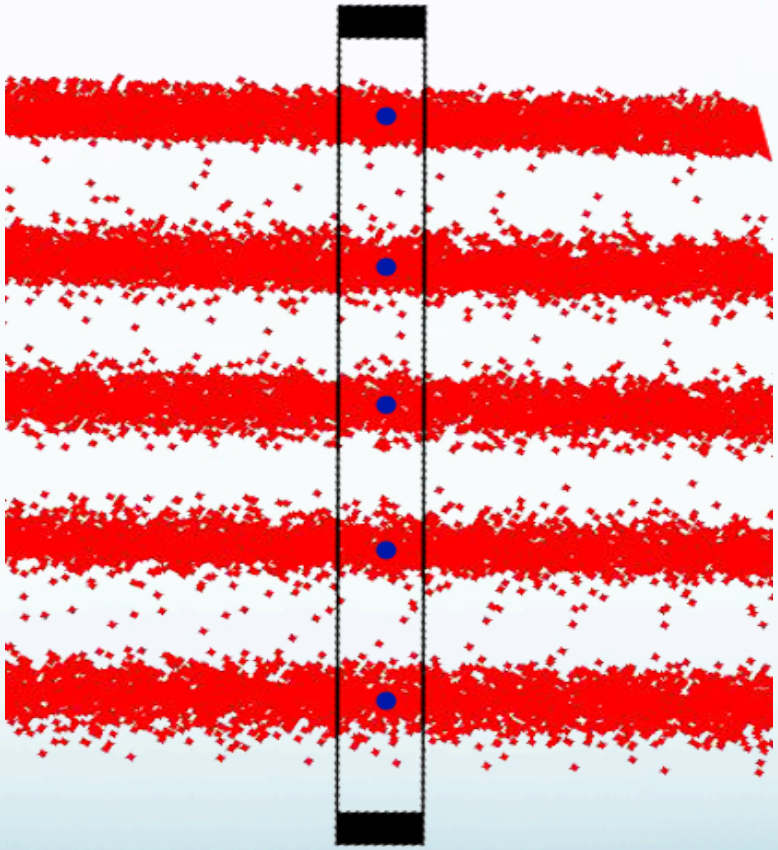


What if we take just a small chunk?

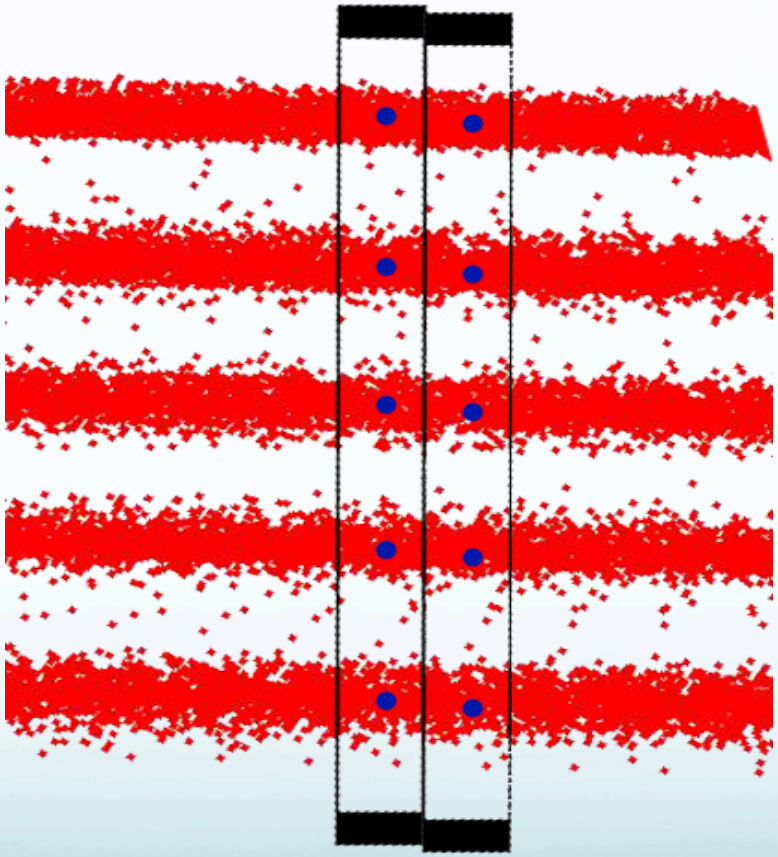




We can find the centers using Expectation Maximization



And repeat this several times



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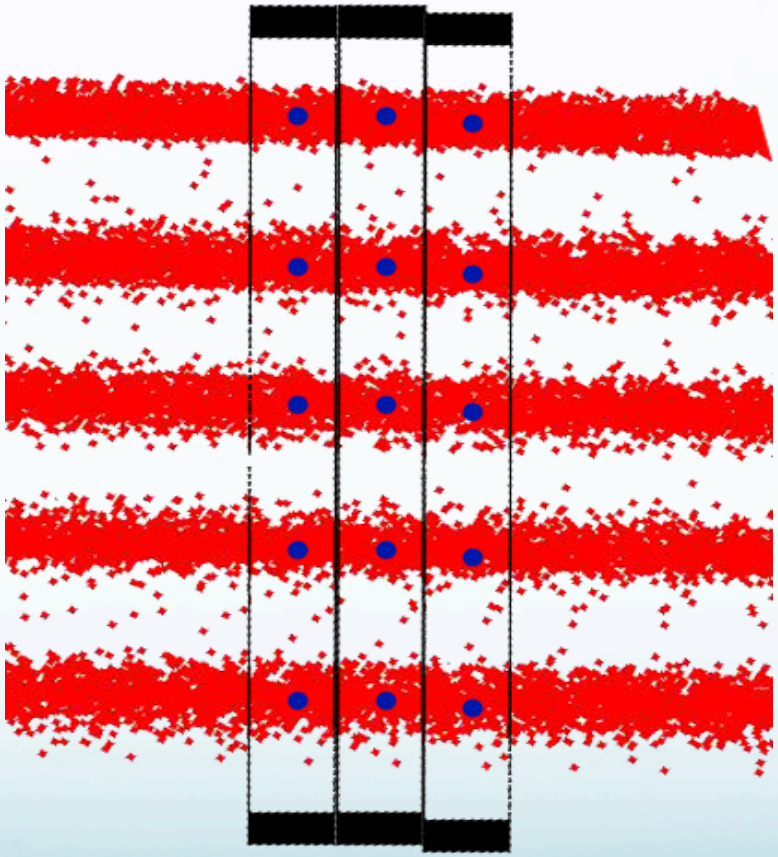

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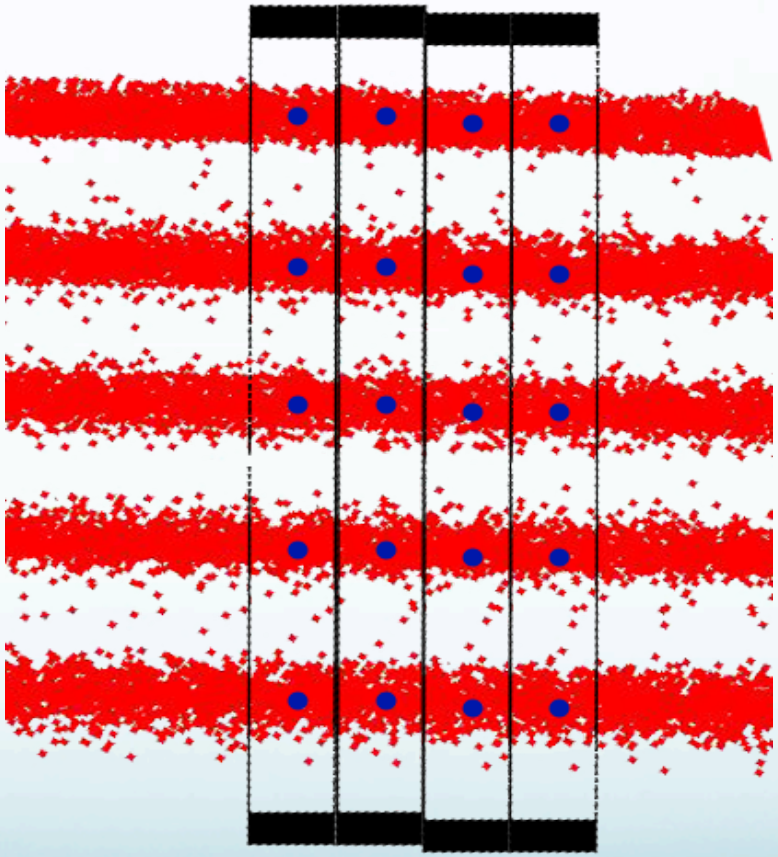
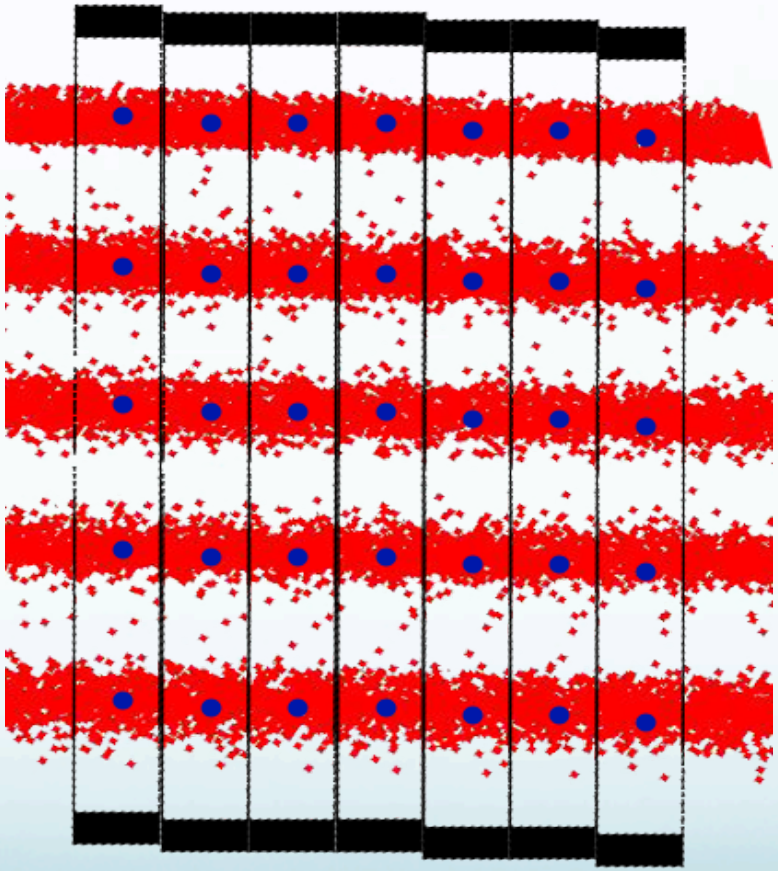
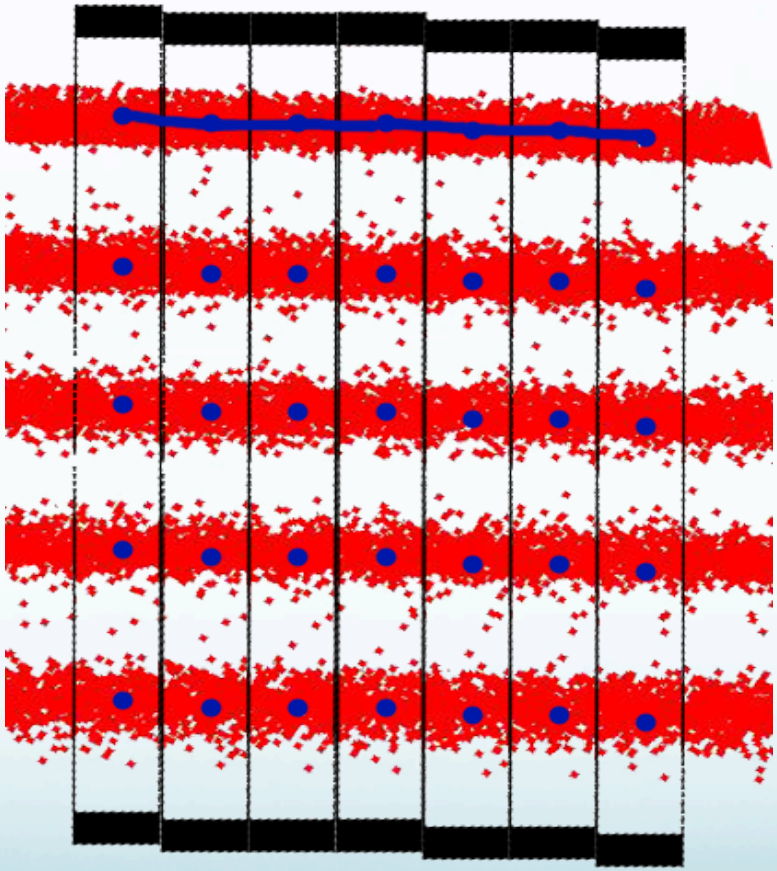


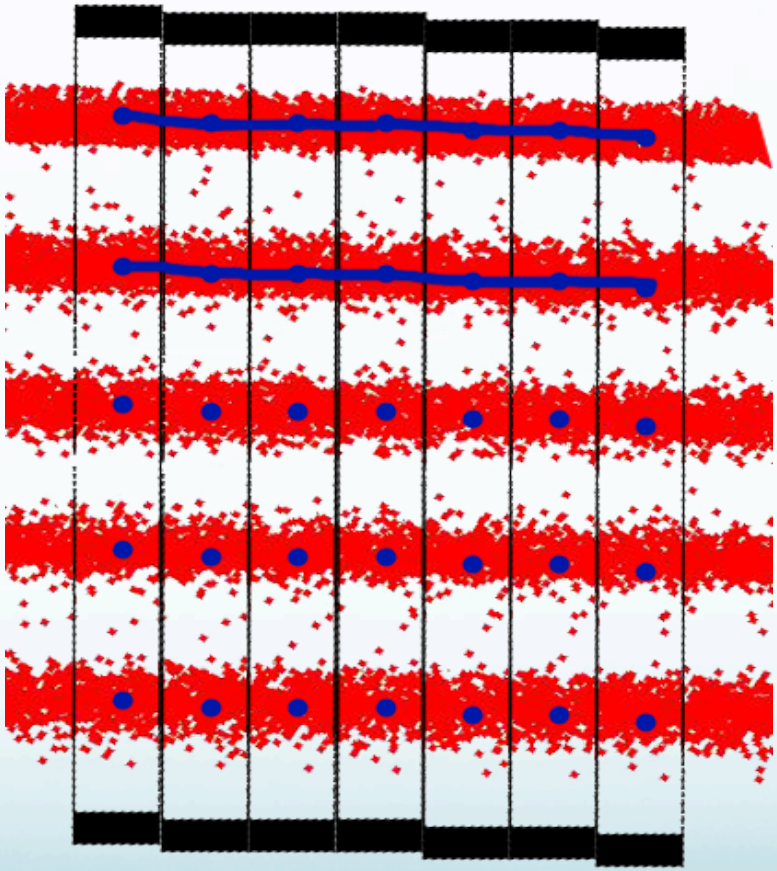
Until we have done this for the whole length of road



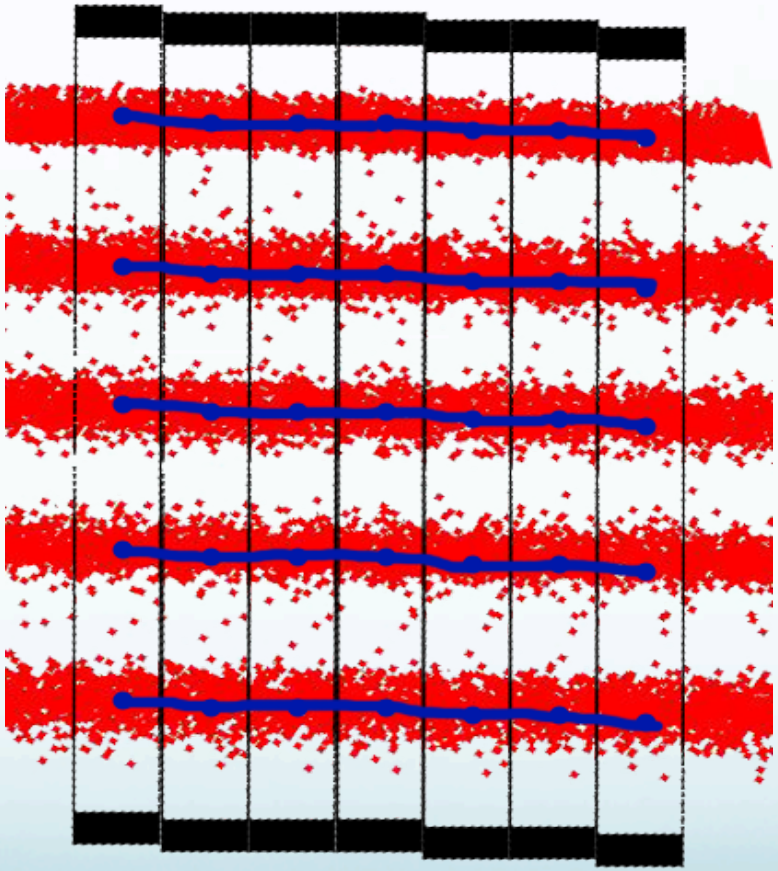
Then we can connect the dots



For each lane



For each lane



Learning Lanes

- Now that we have identified the centers of the lanes, we can easily:
  - Tell which car a lane is in based on its position
- Expectation Maximization also tells us how much the cars tend to move away from the centers of lanes
  - We can judge how likely it is that a car is changing lanes
  - We can also identify cars that swerve around in lanes (drunk/careless drivers)

Once we have lanes…

- We will be able to accurately detect many other behaviors
  - Rapid lane changing
  - Cutting people off
  - Weaving through traffic
  - And more…
- There are many other behaviors we can explore using vehicle tracking…