

**SDS PODCAST  
EPISODE 810:  
FIVE-MINUTE  
FRIDAY:  
THE FIVE LEVELS OF  
SELF-DRIVING CARS**



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This is Five-Minute Friday on The Five Levels of Self-Driving Cars.

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Welcome back to The Super Data Science Podcast. I'm your host, Jon Krohn. Let's start off with a couple of reviews. Our first one today is a five-star review from Apple Podcasts and it's by Harcharan Kabbay, who's a Senior Machine Learning Engineer based in St. Louis, Missouri. Harcharan says "Thank you for being such a great mentor through your podcast. I can't tell you how much it has benefited me and shaped my career. Your insights and advice have been invaluable and I always look forward to each new episode." Nice, so glad to have you listening, Harcharan. And actually, it was great to meet you in person at ODSC East earlier this year.

Harcharan was in the front row. I had two full day trainings that I was giving and was extremely attentive, had great questions the whole time. So no doubt, a great data science career already behind for Harcharan and a great machine learning career ahead as well.

(01:18):

Our second comes from Adriana Salcedo, who's earlier in her data science journey. She's actually a flight attendant in Bavaria, Germany. She has been teaching herself hands-on data science and AI, she's got an active Kaggle and Hugging Face profile, where she's learning those skills in her time around being a full-time flight attendant. So very cool. Adriana says: "This one is my weekly podcast ritual! It dives deep into the world of Data Science and AI with expert interviews that blow my mind every time. I love how they break down all the complex topics, making them accessible and offer practical tips." Nice. I'm so glad that you enjoy the show, Adriana, and I'm looking forward to seeing how your career journey progresses in data science. Thanks to everyone out there for all the recent ratings and feedbacks on whatever platform you enjoy the show on.



(02:08):

If you do leave Apple podcast reviews, I'll be sure to read those on air like these ones because they are helpful to us, I think, to allow people to see that there's people out there enjoying the show and why you enjoy the show, and so hopefully they check out the Super Data Science podcast as well.

(02:26):

All right, onto the meat of today's episode: Back in Episode #748 earlier this year, I covered the five levels of Artificial General Intelligence. Well, today, inspired by my first-ever experience in an autonomous vehicle, a Waymo ride while I was recently in San Francisco, I've got an episode for you today on the five levels of motor-vehicle automation.

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These five levels were first devised in 2014 by a standards organization called SAE International. Their classification system was revised most recently in 2021 and I've provided a link to the full document in the show notes for you to check out if you'd like to. The first thing to note about these five levels of automation is that there are actually six levels because there is a Level 0. Level 0 vehicles have no driving automation, meaning that the human driver is always in full control of the car. Until recent years, vehicles at Level 0 were the only kinds of cars out there and the kind of car that I personally learned to drive on. Something to note here is that Level 0 vehicles can still have sensors that provide automated warnings to the driver such as beeping when you veer out of your driving lane or even engage in automated braking.

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Level 1 is what we can call the "driver assistance" level. At Level 1, the car can control either speed or steering, but it can't control both speed and



steering. So, here, you might have lane assist technology that adjusts your steering wheel slightly to keep you in your lane or you might have radar that allows your cruise control to be adaptive and slow down automatically based on how quickly the vehicle is moving in the lane ahead of you. This Level 1 automation is what I enjoy in the car I drive most frequently. On the highway, when I put on cruise control, I may not need to touch the gas or the brake at any point on the highway because the car automatically slows down when it needs to and accelerates up to the level I set the cruise control to when it can.

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Unlike Level 1, Level 2 automated cars control both speed and steering at the same time. This is what Tesla's marketing-department named "Fully Self-Driving" (FSD) offers. I've also driven a new Ford SUV that had this capability. Vehicles in this Level 2 seem to be more or less fully autonomous under particular conditions, such as while driving on the highway, when you are in a traffic jam or even sometimes self-parking. As such, this level, Level 2 is called "partial automation". As a human driver, I find driving cars at this level a little bit annoying because it seems like you shouldn't need to do anything in so many circumstances, but the driver is required to be alert because you need to take over at any moment and so my experience is that if you try to let go of the steering wheel for more than a few seconds, a Level 2 car will start to make lots of annoying warnings and forces you to take back control. And it's, I don't know, it's a weird thing when the car's doing all the driving, but I still have to be attentive and have my hands on the wheel. There's some weird dissonance there that I don't enjoy.

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Anyway, so Levels 0, 1 and 2, those all require a human to be alert and at least actively monitoring the driving at all times. From Level 3 upward, humans don't need to be in control at all times. Specifically, Level 3 is



known as the “conditional automation” level, meaning that the car can control its speed and steering and monitor its surroundings independently such that it can drive on its own under certain conditions. A human still needs to be sitting in the driver’s seat, but doesn’t need to be holding the wheel and the car will alert the human in the driver’s seat if the car needs the human to take over. From videos I’ve seen online, there are certainly some Tesla FSD drivers out there using their Tesla at this level. Self-driving taxi companies like Waymo also use their vehicles at this level prior to receiving full clearance from authorities, so there’s a driver in the seat when the car picks you up, but they don’t necessarily seem to do anything on most trips. So this was the case for Waymo in San Francisco and other regions for quite some time where the car was pretty much driving on its own, but due to regulatory requirements, there was a human in the front seat that could take over if necessary.

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Level 4, that’s where things start to get really interesting and this is the state of the art in the real world today. A Level 4-automated car does not require a human in the driver’s seat; indeed, the car may not even have a steering wheel or pedals. So when I was recently in San Francisco and my Waymo picked me up, the Jaguar did have a steering wheel and pedals, but there was nobody in the front seat and I had a really great and reassuring ride. Level 4 automation then involves complete autonomy, but critically, only under certain conditions. Waymo vehicles in San Francisco, for example, are limited today to driving only in certain neighborhoods and they don’t drive on the highway where collisions are more likely to be serious or fatal. Another example of a Level 4 limitation might be extreme weather. In a scenario like that, the vehicle might pull over and stop rather than require a human driver to take over.

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Finally, Level 5 automation — the highest tier — may not be long away now. It certainly no longer seems like science fiction, as recently is 10 years ago, 20 years ago, it might have been. In this tier, the vehicle is truly fully autonomous: It can drive without a human, perhaps again without a steering wheel or pedals, and it can do this in any kind of driving situation. It can do this on a highway, it can do this in New York City, it can do it in a parking garage and it can do it in any kind of weather that a human could drive in. I'm excited for the flexibility that this level of automation will afford us. We could sleep during a long overnight commute, we could have a front seat that faces the back seat so that we could play games with our friends like we do on a train, and we could have our kids picked up for school or extra-curricular activities safely and at low cost. The future is near and lots of possibilities beckon.

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All right, that's it for today's episode. If you enjoyed today's episode or know someone who might, consider sharing this episode with them, leave a review of the show on your favorite podcasting platform, tag me in a LinkedIn or what I still call Twitter post with your thoughts, I'll respond to those, and if you aren't already, be sure to subscribe to the show. Most importantly, I just hope you'll just keep on listening however. Until next time, keep on rockin' it out there and I'm looking forward to enjoying another round of the Super Data Science podcast with you very soon.