Speaker 1:	00:00	This episode is sponsored by Darktrace, the world's leading AI company for cyber defense, and creator of autonomous response technology. From subtle insider threats, to machine speed ransomware, cyber attacks will inflict more than $1 trillion in damages during this year alone. Wreaking havoc before security teams have time to investigate. By using artificial intelligence, Darktrace learns while on the job to distinguish friend from foe, and when it senses an attack, the AI fights back against the bad guys within two seconds. It's time to supercharge your security stack. Start a free trial at www.darktrace.com/trial
Sean Gallagher:	00:39	Hi, this is Sean Gallagher. IT editor at Ars Technica, and welcome to our three part podcast mini series on artificial intelligence. Machine learning and artificial intelligence are working their way into nearly every aspect of our lives, whether we're aware of them or not. That's because these technologies, are doing things with data that humans never could. Advanced analytics are just one example of that. Turning massive volumes of data into insights human analysts might miss, and doing it in some cases in near real time. One place where AI analytics are becoming increasingly visible to us, is in one of the most measured of human endeavors. Sports.
Tim Wade:	01:13	In sports, applications for machine learning and AI are massive.
Sean Gallagher:	01:19	You can't watch a professional sporting event anymore, without some sort of data enhancement at play. From the virtual lines drawn on a football field to show the line of scrimmage and first down markers, to major league baseball Statcasts predicting the probability of successful base stealing. AI has become part of how we consume sports. One of the earliest adopters of live AI analytics is the Tour de France, the iconic annual 21 state cycling race. Data collected from each cyclist's bike is processed in real time by NTT's big data truck, a mobile AI driven data center, that travels with the tour each year. Lee Hutchison and I spoke with Tim Wade, the senior director of global advanced technology for sport at NTT, about how AI has changed the experience of cycling fans. So now joining us is Tim Wade. He's a vice president at NTT's advanced technology group focusing on sport. Thanks for joining us Tim.
Tim Wade:	02:17	Yeah. Hi Sean. Thanks for having me.
Sean Gallagher:	02:20	So, we spoke a little bit earlier this year and I wanted to reel back that a bit and talk to you about how NTT got involved with the Tour de France.

Tim Wade:	02:30	Back in 2014, they contacted us looking to see if we'd be interested in being a technology partner for them. We were looking to see how we could make the experience for fans better when the sports. If you look at cycling prior to us getting involved, it was very difficult to actually understand what was going on. You would basically see the directors story of what he would like you to [inaudible 00:02:59] Our vision and goal was to enhance that storytelling, take [inaudible 00:03:05] and to get more people interested in cycling as well. Sort of expand the reach for the [inaudible 00:03:10]
Sean Gallagher:	03:11	So, that involved tracking data from each of the bikes as the races proceeded?
Tim Wade:	03:18	Yeah, it did. I was part of the initial team that we had to set this up, and we kind of signed a statement of work with them around about March time, to deliver live tracking on each of the riders. Also, then some basic analytical capability and integration into broadcast. What that actually meant practically, is that we developed some designs. Hardware that would take GPS coordinates. We get three elements of data from each cycle, from each bike, every second and that's latitude, longitude and speed. We then sent that data back to the end of the race, where we can then analyze it. At that point, we have an analytics platform and a capability at the end of the race in a truck. I can tell you, having a mobile data center like that, which moved three and a half thousand kilometers through the month of July, was a whole world of fun.
Sean Gallagher:	04:10	That seems like a really insane logistical operation, just from the standpoint of moving around your IT infrastructure. How did you keep track of all the rider's? Given... There is portions of the Tour de France that go through mountains and things like that. I'm sure there were some challenges with connectivity.
Tim Wade:	04:29	Well yeah, and the main challenge as you say is, three and a half thousand kilometers that the Tour de France roughly travels every July, is through very different terrain. It can be up at the top of a mountain, it can be in a major city, it can be in rural France. There's various different levels of mobile connectivity there. The way that we actually address that is, we piggy backed on the video broadcast transmission network. The data that comes off the bicycle is sent to an airplane. The same airplane where the video transmission, so there's sort of six or seven motorcycles that are riding around in the race, and they transmit that video to the airplane, and it's sent to the end of the race by a microwave.

Tim Wade:	05:17	So we've removed that element of being a requirement, that any external networking outside of the race to help us transmit that data back to where we need it. Once we get to the end of the race, it's then quite a simple operation to get data back to where we needed to. The reason that's so simple is because one of the other partners are there. So there's orange, who is a disconnectivity telco, or the telco partner, and they provide [inaudible 00:05:49] connectivity to the technicals at the end of each stage, which is in itself a pretty remarkable undertaking.
Sean Gallagher:	05:54	So, how is the data that you consume out of this, how has it evolved over the past few races in terms of how you're applying technology to do analytics? And could you explain, while talking about that, how you define AI in this case, or machine learning, what types of technology are applying to this?
Speaker 4:	06:16	I was going to say before you answer, this sounds like what a few years ago we might call a big data story, but I know that the preferred terms are sort of in shift right now.
Tim Wade:	06:25	Yeah, I mean look, I think we did a rough estimation last year, and it was over [inaudible 00:06:31] billion data points that we get over the period of July. It comes from those three small pieces of data [inaudible 00:06:38] and [inaudible 00:06:38] Now, year one was proving out the technology, making sure it worked. [inaudible 00:06:43] it was analytics. Then, three years ago we then started to play around with machine learning, so predicted analytics basically. I wouldn't say we've ever doubled with full on AI, but machine learning, that predictive analytics, is where we've been playing for the last three years. What we started out doing with that is we thought, okay, so we've got this data, we've got these data sets, we understand other things like, we understand what the stage profile's going to look like. Understand what the teams, how they're performing, [inaudible 00:07:18] in those teams.
Tim Wade:	07:21	From those elements, we were then able to profile each of the riders to understand where their strengths and weakness is. What are they good at? what aren't they good at? How well did they work together in a team? And we profiled them all, and then we were able, from those profiles, to then start building up machine learning models that enabled us to make predictions. [inaudible 00:07:41] we did the stage favorites. We had the general classification favorites. Who do we think was going to win the actual race itself, was one of the things we've worked in this year. [Inaudible 00:07:54] for example. During a stage there will be a breakaway, where a small group of riders will try and get away from the main peloton to see if they can win. Then we

would predict whether we thought they were going to get caught or not.

Tim Wade: 08:06 That would be a model that would then be run live basically throughout the stage. Then we've broaden that out this year. Within NTT, we're over 40,000 people now. The 28 companies have come together in the group. There's quite a lot of untapped knowledge and resources out there within the organization that we don't know about. A few years ago we ran a competition. Sort of a [inaudible 00:08:41] competition, and we asked the people within the organization, "What ideas have you got? If this was your project, how would you help tell the story, what do you think would be cool?" A few things came back, and one of the things that we brought in this year was called [inaudible 00:08:55] Basically what [inaudible 00:08:57] was, it was a machine learning model, and it was sort of looking at the movement within the peloton for abnormalities.

Tim Wade: 09:06 And then we basically get a ping to the [inaudible 00:09:09] We think something's going to happen in the minute... Then something would either happened or it wouldn't happen, and most of the time it was right, and something did happen. Now, whether that be a crash, or somebody attacking, or it could have been anything. That was quite an interesting model that we have tried this year. There's quite a few different things, and I suppose it's all stemmed from having that clean data set right to the very beginning, because once you get that, then you can build, [inaudible 00:09:35] and [inaudible 00:09:35] some of these models that we [inaudible 00:09:37] so we [inaudible 00:09:40] But, it's been really interesting, interesting journey.

Speaker 4: 09:44 The fascinating thing for me playing the role of dumb journalist here, is watching how algorithms like this have predictive successes. Even though you as the operator may not necessarily be completely aware of all of the different items, the different factors, that the algorithm is keying off of, because that is in fact the nature of machine learning. As you look at the pelotons and the groups, and when you look at how effective the algorithm is at predicting results, are you able to divine anything, any clue about what specifically the machine learning is keying off of? Or is it all just sort of a spooky black box to you?

Tim Wade: 10:26 I'm just going to say it's a spooky black box, but what I will say is I also agree. We can train it. [Inaudible 00:10:35] sports inherently unpredictable. You can't predict everything. Whilst you'll have a series of quantifiable elements in sports, which is the same in any sport, a series of [inaudible 00:10:51] elements. You can't take into consideration everything. We've noticed that

last year, for stage favorites for example, we were having around the 70% accuracy rate, which is really, really good. This year isn't looking [inaudible 00:11:09] it wasn't quite as accurate this year, but if you look at the difference between the actual race last year and this year, this year was deemed to be one of the best Tour de France's, but if it's so unpredictable, and they created it in a way that they wanted it to be unpredictable, the models that we've created have to work on quite a [inaudible 00:11:31] because of the unpredictability. It's interesting. I look at the developers in our team creating these models, and I can't quite wrap my head around it sometimes, but it's fascinating as well, to watch.

Sean Gallagher: 11:47 So, the technology you've developed around Tour de France, is there any other sport realm where you're applying this sort of data collection, and machine learning based analytics?

Tim Wade: 12:00 Yeah. As you may know, we are also title sponsors of [inaudible 00:12:04] data, which will very soon have a new name, I think in a few days. The profiling that we did on the riders previously for the [inaudible 00:12:14] to use as part of the machine learning models [inaudible 00:12:17] We used a similar methodology and sets of models to work on a... I'm sure you know you guys have seen Moneyball, but work on a Moneyball model selecting your riders, which is going to be interesting because if you look at some of the teams within the ProTour, they [inaudible 00:12:38] huge budget. So the focus for us has been to use the knowledge and the models again in cycling, but to help the team select the best riders to get the best outcome based on the ratios that are in the calendar for next year.

Tim Wade: 12:43 [inaudible 00:12:43] If I look across the industry though? In sports, the applications for this sort of machine learning and AI are a massive. I was reading an article a few days ago about an AI model that had been created [inaudible 00:13:15] sticking sensors on your body, and it was basically telling you the position for weightlifters, and based on the angle and till and hue on the sensors that you've stuck on yourself. It was then feeding back in real time, and giving you performance, and coaching tips to help you lift better. Which is unbelievable, but what that tells you is, wherever these quantifiable elements and metrics are in sport, there's an opportunity to use these models to give performance tips and coaching tips.

Tim Wade: 13:51 I think there's more though, that's just the tip of the iceberg. Again, if we look back at the Moneyball sort of scenario. We can then use AI again. Once we've got those clean data sets, which is what we're getting through IT technologies now. We have

		been able to apply those and create models to give Scouts the best information on which person to pick in baseball for example. With so many different angles and facets to this whole thing. From my perspective it's a fascinating area to be working in.
Speaker 4:	14:26	Two comments from me here. First one is that it sounds like something that might actually be able to help me perfect my golf swing finally. The other though, and maybe this is a little more insidious, although maybe insidious isn't the right word. It seems like, especially since there is an apparent predictive ability, that seems to have some validation in real life, it seems like that bookmakers and bettors might be extremely interested in eventually adopting AI technology to assist, both on the betting side with predicting winners, and also potentially on the odds making side, with real time odds adjustment during sporting events as things unfold.
Tim Wade:	15:07	Yeah, from the perspective of helping you with your golf, I'm not sure I could do that, but regarding the batting, there's been quite a lot of discussion around this, and the different chats that we've had with media. There seems to be... The magic number for the bookies is around 72%. If you can get above 72% on your predictions, then there seems to be an opening for that kind of technology. Now, that's not something that we're interested in or focused on at all, but I think there's definitely potential there and as this evolves over the next few years, which is rapidly evolving now. You can see different players going into different sports and doing this kind of stuff. Those doors are going to start opening up and I think I'm not fooling myself, thinking that the bookies aren't playing around with this stuff already and using it already.
Sean Gallagher:	16:05	I know that there's some examination of AI or machine learning technologies in fantasy sports, in terms of helping to do things like pick draft picks or things like that. I don't know if there's such a thing as fantasy cycling, but I know that there is a-
Tim Wade:	16:21	There is.
Sean Gallagher:	16:21	There is?
Tim Wade:	16:21	Yeah. It's fun to see cycling on the Tour de France this year. There's were a couple of 100,000 [inaudible 00:16:38] that were engaged with us. I think that will grow, and there is definitely... If I look at the natural linkup between the stuff that we've done around machine learning and creating those stage favorites and GC favorites, it's obviously a natural feed into that kind of stuff

saying, here's what our machine learning algorithms or models have picked. That can help guide people [inaudible 00:17:07] So interestingly enough, I didn't mention this, but our GC prediction, which we ran at the beginning of the tour, actually picked [inaudible 00:17:18] the winner. We were all sitting there through the whole tour going "Nah, that's never going to happen. Nah, nah, nah." Then he won. That was mind blowing, to be fair.

Sean Gallagher: 17:29 Predicting. What we would normally see as unpredictable events is... It's one thing to predict a winner of a race based on a long set of data, but to pick up on a particular trend of data at a given moment, I would guess it's based on density of the riders, and changes in speed and things like that, but how that kind of ability to pick up on a series of seemingly unrelated events, and then output that something is going to happen. That's not something that humans can do very well. I would think, so that's an-

Tim Wade: 18:08 Yeah, sorry. It's [inaudible 00:18:15] matching isn't it? It's seeing that there's a [inaudible 00:18:17] folding in the Peloton. It may be a rider that's moving or, or a team that's moving from the back of the Peloton, to the front of the Peloton. It's understanding that a movement, any erratic movements, for examples that could trigger it. It's definitely fascinating. From [inaudible 00:18:38] perspective, the practical usage of that in the races, you can imagine if you were a commentator, to turn the lights on or ping a buzzer and say you know what something's going to happen, is kind of an amazing thing to have in your arsenal, whilst reporting. I'm looking forward to our conversion of that next year.

Sean Gallagher: 19:04 So, what other sport areas do you work in? Are you strictly in cycling or are you doing anything in other sporting events?

Tim Wade: 19:12 We've done a lot of cycling, but we've done Triathlon, we've done some [inaudible 00:19:20] races, we've done some boat racing. We've been looking at motor racing, so we've doubled in various different sports. A lot of it is [inaudible 00:19:33] data. It's a very [inaudible 00:19:37] oriented company. There's a lot of cyclists in the company. So it's been a natural fit for us. As we look in the wider NTT nowadays, nowadays there's been deals that have gone on with basketball for example, which is in transmitting live video. It's almost like holographic video in another place. So, there's been work around that, but it's not around AI. I've seen that we are doing stuff at NASCAR as well. The wider group's doing quite a lot. NTT is one of the sponsors of the 2020 Olympics. There might be some cool stuff to come

		out there, which you'll have to wait and see. We haven't been limited to cycling, when other opportunities have come up, we've definitely engaged with them.
Speaker 1:	20:33	There's a battle happening right now for the world's most sensitive data, and cyber criminals are gaining ground. Their sophisticated attacks are scanning for the slightest cracks in the digital perimeter, an employee falling for a phishing email, a cloud application left up without a firewall, or even a smart refrigerator using a default password. Once they get inside, it's only a matter of minutes before your data is encrypted, stolen, or erased entirely. At this point, for most organizations, it's game over. Darktrace has changed that game for thousands of smart cities, international nonprofits, and fortune 500 companies. With the first ever AI powered autonomous response technology, Dark trace instantly neutralizes in progress cyber attacks that are already inside the enterprise. Containing the threat without interrupting your normal workflow. Autonomous response is on guard 24 seven, on weekends and on holidays, intelligently defending your data on your behalf. The reality is that the next automated attack will strike too fast for humans to mount a defense, but with Darktrace, the machine is fighting back. Find out how on darktrace.com
Sean Gallagher:	21:39	So, have the data points changed? You've started off with basic lat-long and speed type data. Are you doing things like, motions detection and things like that, on sensors or things like, to determine the angle the bike is canted at or things like that, and when it's in a turn or any other sort of more fine grain data?
Tim Wade:	22:04	No, not at the Tour de France. In other events we've used other data sources. If you look at the technology that's around cycling and that's growing around cycling, there's quite a lot of off the shelf sensors that you can buy. You can measure somebodies heart rate, how fast they're pedaling, how fast their wheel's spinning and how fast they're going. You can even get off the shelf sensors that are giving you things like drag [inaudible 00:22:32] so how much wind resistance. Also rider position so you can understand how they're sitting on the bike. When you start to take all these things together, there's some really interesting stuff that you can do. What you find in professional cycling is that people don't want to share that information live during an event.
Tim Wade:	22:53	Because it could be used as a competitive advantage. If it was live on TV, for example. All you would need is somebody from another team watching, and you'd see your riders heart rate is

super high and you'd know they were about to cracks, so you could tell your team over the radio, "Okay, go and break him." It's a slow process I think. We did something recently, it was a joint innovation project projects between [inaudible 00:23:24] where we were supporting a guy called James MacDonald. He was attempting to beat the 24 hour record in a velodrome, so he was going to ride around in circles for 24 hours. There we basically... We wanted to support him and his performance team, make the right decisions throughout the 24 hours, so that he would be as successful as he could be.

Tim Wade: 23:50 He trains with his trainers. They'd be training and they'd been really working him at this specific heart rate zone, this specific cadence zone, which is how fast he's peddling, and power zone. They knew that if he sat at those particular numbers, he could sustain that speed for 24 hours in a velodrome, which would be enough to beat the record. We then made this velodrome intelligent by equipping it with network infrastructure and wireless, and then all the data capture elements to capture data off his bike, and then the 3D tracking system, and then put some [inaudible 00:24:30] analysis that was basically giving all that information back [inaudible 00:24:35] so within a second, that information was back at track side with his coach and his performance team.

Tim Wade: 24:39 but also giving them information about how many calories he's burnt, so that they knew whether he needed to feed or not, and giving information about the current record holder, I think it's Christoph Strasser, I probably pronounced his name wrong there, but how in front or behind James was to him, so that they could say, "Okay, you're in front, you can back off a little bit." Or "If you need to go and have a break, you can do that." Unfortunately James fell off. It was so very, very hot in this velodrome this day, and he tipped water on his head, and the water had gone on the track and about an hour later he slipped off on the water he used to cool himself down. Yeah, it was awful. He went down for 20 minutes and then, big kudos to the guy, he got back on his bike and rode for another five or six hours. We could then see his support team had to make a decision.

Tim Wade: 25:35 And you could see from the data that he wasn't going to make it. Then it's like, do we want to get him off the bike now, seeing as though he's [inaudible 00:25:45] off. He was injured, or do we want to just try and push it and he'll fail anyway. So they had to make a decision based on that data, that they would pull him off the bike. [inaudible 00:25:54] there was a lot of people there from both companies and James family there. Everybody was

very emotionally invested in the whole thing. It was an amazing experience. But yeah, It's like, you can use those different data points then make decisions and help support an event like that, or people like that. It's kind of fascinating.

Speaker 4:	26:13	You've actually, you brought up something that I wanted to ask about here. We've spoken with a number of other folks in this special podcast series we're doing. All about different aspects of AI and machine learning, and we spoke yesterday to a couple of people about adversarial AI and the concept of potentially using machine learning algorithms, or autonomous AI systems to perform security attacks on your own IT infrastructure to sort of train your operators. The concept of red teaming with AI. And it sounds like those concepts translate almost directly over into AI in sport. With the idea of using machine learning algorithms, potentially to simulate opponents or simulate optimal opponents that you can then train yourself against. Is that something that you guys are doing?
Tim Wade:	27:01	It's not something we're doing but it's a great idea. Let me just make a note of that quick. No, I mean that's a really good idea, and like I just had said with the velodrome attempt. We were using real data to gauge performance against... With real data in a virtual way against a real rider. I know we've done some... We did a demo a while ago, which was a virtual race against the pro. So we've got pros data, and then you could just race against that on the [inaudible 00:27:38] trainer, but we've never taken it any further into the field, but I don't see why that's not a... It's a way to enhance performance, because that's your benchmark isn't it, really? If you can do this well, then you have the capability or the capacity to be a pro. So it's definitely... That will sure come through in coaching applications.
Speaker 4:	28:03	Sure. Or you analyze your athlete's performance and train machine learning on him to generate an opponent that isn't a perfect opponent, but an opponent that is perhaps iterating a bit more towards perfection, and then the human iterates on the machine learning algorithm. The machine learning algorithm iterates on the humans performance, and then we have the singularity and then we're all machines slaves.
Tim Wade:	28:26	Yeah, if you've got those [inaudible 00:28:28] to start with. You understand the athlete's physiology, and where their strengths and weaknesses are. You'd almost... It sounds cool doesn't it?You'd almost focus on their weaknesses to make them stronger in the areas that they're not strong. Sounds like people are tortured to me. Would be where we're going for sure.

Sean Gallagher:	28:50	Well, the same sort of predictive analytics that we're looking at here, in terms of being able to take the data and predict how someone will perform. These are the same sorts of things that say... Facebook uses to figure out what to put in front of you, based on your previous clicks. I mean it's not the same algorithms [inaudible 00:29:08], but it's the same concept.
Tim Wade:	29:14	Same principle. Yeah, definitely. Same principles isn't it? Understanding it's a [inaudible 00:29:18] as well. [inaudible 00:29:20] program about all the [inaudible 00:29:22] analytic [inaudible 00:29:22] and I'd never realized that those guys have got 1600 data points on each person, which is-
Speaker 4:	29:30	Obscene.
Tim Wade:	29:30	Mind boggling. Yeah, it's unbelievable. With that amount of data points, they're able to predict what you would be interested in at a particular time. They quote on that documentary around if you ever sat there... Or there's a teacher talking to her students saying, [inaudible 00:29:51] been talking to your new family saying, "You know what, we need to get a new mattress." And the next thing there's at mattress ad that pops up on your Facebook, or on Google, or wherever [inaudible 00:30:03] and it's kind of like, well are they listening to me? Or have they just got somebody [inaudible 00:30:08] for me that they think this is the time that I would need that? Which is kind of crazy, really.
Speaker 4:	30:14	Could be a little bit of column A, a little bit of column B.
Tim Wade:	30:22	I'm not close to that at all, but it's kind of amazing that if that's what they've got, they've got so many data points, that they're able to predict what you do in your life. That's crazy, isn't it?It's a whole nother level.
Speaker 4:	30:35	Yeah, absolutely.
Tim Wade:	30:36	Maybe one day we'll have that in sports.
Speaker 4:	30:39	Yeah, well you bring up one more interesting point, and we've discussed it again with the other folks that we've been talking to. It's the role of ethics in machine learning and AI. Although focusing purely here, on the role of machine learning in sports and AI in sports, there's less an obvious ethical mandate. Oh, that sounds weird now that I say it out loud, "You don't have to worry about ethics as much when it's sports." But, you're operating essentially within sort of a very fixed area of

operation, and you don't necessarily have broader ethical implications of setting a goal seeking algorithm loose. If you're deciding hugely important political things, you don't necessarily want your goal seeking algorithm to be unconstrained, and to decide that the fastest way to get from point A to point B, to its goal, is to cut straight through and do some sort of horrifically unethical thing, because it satisfies the goal, but that's less of potentially a concern when you're discussing optimizing athletic performance, or predicting an events outcome, I would imagine.

Tim Wade: 31:45 Yeah. No, I think, I think you're right. I mean the ethical side is, you've got a set of constraints to work with, and you've got the rules, they're very clearly defined. People will always try to push the boundaries, but it's like really, how far couldn't you push the boundaries with AI and machine learning in sports? I like... How fast can yo get to the goal? It's having enough data points from the other people to be able to predict what they're going to do as well, isn't it? And I don't think that they're anywhere near that at the moment.

Sean Gallagher: 32:19 How far off do you think we are from using the kind of data points you collect in sports right now for officiating?

Tim Wade: 32:26 Yeah, I don't think we're that far away from that. [inaudible 00:32:28] What I will say is that a lot of sports have different levels of maturity at the moment. Even within cycling, if you look there's events that have zero technology involved, and there's events that got machine learning involved, so there's quite a broad spectrum of maturity and how people are using information. If you look in football for example, and I'm sure in American football as well, there's quite a lot of data use in there. Then you've got those [inaudible 00:33:02] that all measuring people's movements around the pitch, and also measuring accelerometer data, basic acceleration data. They have quite a good understanding of actually what's going on there already, so how far are they away from being used to make [inaudible 00:33:20] judgements?

Tim Wade: 33:22 I think that comes down to the accuracy. If we look at it some of the events that we've done where we [inaudible 00:33:29] GPS tracking, and we can get it down to 10 centimeters. If you think about a bike race, I remember three years ago when there was a photo finish, and it involved one of the riders on our team, [inaudible 00:33:42] and he lost the race by one pixel in the photo. [inaudible 00:33:48] took 10 centimeters, then again it's not going to come to that because it's not accurate enough, How would you ever get down to that one pixel? How must is that? It must be a millimeter or something, a couple of

millimeters. It's nothing. I think if technology advances, as it will do exponentially, then it will get to the point where you can do that.

Speaker 4: 34:15 That's fascinating. Although I can see potentially that for both European and American football, if you don't have a referee to scream at anymore, that takes like two thirds of the fun out of the sport.

Tim Wade: 34:29 I think that's always going to need to be that human element, not just to scream at, but to validate. At least in the foreseeable future. I've seen some of the technologies that basically can analyze the video and audio of an event and then can kind of almost be a virtual reporter on that. [inaudible 00:34:58] Technology is not there yet, but does that mean that when that capability comes through, we don't have any journalists anymore, that are reporting on it? They're recruiter on it. I don't think it will because what kind of personality is an AI going to have compared to the reporter that's been doing that job for 20 years who people like, not just because he's reporting it, but because of his personality, so there's that element to it I think as well.

Speaker 4: 35:22 Yeah, absolutely. Sean has actually done some reporting on algorithmically written stories, news stories, and it's been a fascinating experience.

Sean Gallagher: 35:31 Yeah, we got some interesting output.

Tim Wade: 35:34 Yeah. There's not that kind of same filter is there, really? That a human would have.

Speaker 4: 35:41 So, where do you think this is going for next year as far as the Tour de France goes? Are you going to try and up the data points at all, or are you sticking to the proven model so you can keep a consistent data set?

Tim Wade: 35:55 Well look, the data that we capture won't change, right? Our [inaudible 00:36:00] data won't change. We constantly strive to improve the models that we have, and help tell the story in the best way that we can. The way that it works for us is, I'm getting a long way around to tell you, you'll have to wait and see by the way, but the way that it works for us, is we leave the tour at the end of July and then we kind of take August off and then we basically come back into analyzing the experience for everybody. So we get feedback from the general public. We get

feedback from the [inaudible 00:36:34] from within the organization, from within our teams that have delivered this.

Tim Wade: 36:39 We then understand. Try to take a holistic look at what's happening across the sports world in general. We create a roadmap, and then we start executing on the new items in the roadmap. There are things that are in there that might not be general public view, but the things that we've trialed with the tour this year. [inaudible 00:37:01] innovation like we have. We [inaudible 00:37:03] see the value in it? Does the general public see the value in it? And then we'll start rolling that out, and it's sort of a good few years cycle to do that.

Tim Wade: 37:14 The same that happened for the machine learning, and some of those things will trickle through, but there's more things that are coming, which is more around the fun experience, and people that are at the events. How do we improve their experience? One of the other models that we've got is an ETA model. Basically it's the... [inaudible 00:37:35] at the side of the road and he's sitting there with the mobile app and he's like, "I'm waiting." Because people sit there and wait all day for the race to come back and then, boom, boom, boom, boom. It's gone. Well, I missed a day. I was getting a beer out of my camper van or something. So, we've created a model that will give them information, basically ping them five minutes before the riders get there, so that they're ready, and they're in the right position. They can watch [inaudible 00:37:55]. It's going to be things like that. The rest of it... We haven't declined everything yet and we're working through that. Then after Christmas for us, it gets extremely busy for six months and then [inaudible 00:38:08]

Sean Gallagher: 38:12 Well looking forward to seeing what you can do with it.

Speaker 4: 38:15 Yeah. We're rounding the bend here. We're just about out of time. But I wanted to ask Tim, before we close, if there is anything of particular interest or anything that's particularly cool, that you wanted to talk about that we didn't get a chance to ask you about.

Tim Wade: 38:32 The areas that I'm really interested in is, how do we capture the maximum amount of data from athletes, that we can then use all this cool technology to understand what's going on. There's one cool thing that I've seen in the industry, and it's not just going to be around cycling, so we've seen some companies, or a company in the UK that have been basically [inaudible 00:39:00] if I think about all the challenges that I've seen, and [inaudible 00:39:04] to get some sports. Everybody wants to have the

		lightest motorbike, or the lightest bicycle, the lightest car [inaudible 00:39:12] you don't want to add additional weight to it because it's a disadvantage for you compared to everybody else. [inaudible 00:39:19] in this company that are printing, graphing, [inaudible 00:39:24] and circuit boards into bicycle frames and into car panels.
Tim Wade:	39:32	They're kind of going around the side and going, okay, so you know what, instead of adding additional technology into whatever it may be, they're making the technology [inaudible 00:39:42] I'm just looking at it with a keen fascination, because I think that's going to be a game changer, because once you can do something like that, your data sets are going to grow massively, because it's not a case of, well, we just want to have one sensor on here for the weight. [inaudible 00:39:59] now we've got all this additional information about [inaudible 00:40:02] strengths [inaudible 00:40:04] and then that feeds back into multiple things. It feeds back into how me as a fan would watch an event and understand what's really going on. A [inaudible 00:40:17] for example, or how much it's bending or twisting, or getting information [inaudible 00:40:22] performance and take it back into the people that are manufacturing products. Actually, if we made this a little stiffer here, we reckon we could [inaudible 00:40:28]a little bit more performance out of it.
Speaker 4:	40:28	At a certain point, it sounds almost like it might be circumventing rules that are in place to prevent [inaudible 00:40:35] active technology inside of bikes and cars and stuff in races like this.
Tim Wade:	40:39	Yeah, I know. And then UCI obviously again you can't use [inaudible 00:40:43] ergonomic technology in a bike race, but as a cyclist I'd be pretty keen to. That's something to talk about while you're have a coffee on a local bike ride.
Speaker 4:	41:00	Okay, well I think that just about wraps it for us, Sean, if you don't have anything else.
Sean Gallagher:	41:05	Nope. I want to thank you, Tim, for joining us on this. This [inaudible 00:41:07] been really interesting. Look forward to seeing how the Olympics go, and now the next Tour to France goes, as far as what you're able to bring to the table, and thanks again for your time on this.
Tim Wade:	41:18	No, no. You're welcome. Thanks for the invite, it's been really interesting.

Sean Gallagher:	41:26	AI has many other applications in sports, but next time we'll be looking at another way of using artificial intelligence, to track another sort of human behavior. Trying to spot insider threats in organizations information security, before they can happen. I hope you'll join us.
Speaker 1:	41:44	Once again, this episode was sponsored by Darktrace, the world's leader in AI cyber-defense. With more than 3000 organizations relying on its AI technology around the globe. Darktrace is transforming security from the inside out. Start your 30 day free trial by visiting darktrace.com/trial.