

# YEAR2045

## Transcription

- Rami: [00:07](#) Welcome to the first day of your new reality. Your world as you know it will never be the same. It's time to wake up and see the world as it is. Welcome to the YEAR2045 podcast. I'm your futurist and host Rami Kala, and in our podcast we're going to bring on guest speakers to talk about virtual and augmented reality, mixed reality, AI, robots, Skynet and much, much more. So, hang on and let's go. Today, I am super excited to have as my guest Sid. Sid is an assistant professor of Computer Science in the School of Computing Informatics and Decision System Engineering at Arizona State University. Professor Sid was a staff scientist at the United Technologies Research Center in Berkeley. Prior to that, he was a postdoctoral researcher in the Ruggs research group at the University of California Berkeley. He received his PhD in Computer Science from the University of Massachusetts Amherst. His research interests include robotics and AI with a focus on reasoning, planning, acting on our uncertainty. His work on household robotics has received coverage from international news media. His dissertation work received the Best Paper award at the International Conference on Automated Planning and Scheduling ICAPS, and an Outstanding Dissertation award from the Department of Computer Science at UMass Amherst. Welcome, Sid.
- Sid: [01:20](#) Pleasure to be here.
- Rami: [01:21](#) So happy to have you on the show. How's your day going so far?
- Sid: [01:25](#) Good. How about you?
- Rami: [01:26](#) Oh, it's going well. Not bad for a Wednesday. Well, cool. You know, it was very impressive resume. Is there anything that you want to give us a little bit of background about yourself or anything else that we didn't have in there that you wanted to elaborate?

- Sid: [01:38](#) So, I can tell you a little bit about my research more specifically. Um, so I'm interested in, uh, figuring out how to get at autonomous agents to reason and act to do stuff for us. So this means, for instance, let's say you have a household robot and you want it to do stuff for you. So I, some someday you might want it to do the laundry, like stay, you want it to maybe arrange the room and so on. So it sometimes you want this robot to be able to accept high level commands, right? You don't want to have to program it for every new task. So it should be generalizable in some sense. Versatile, do multiple things. And of course it should be reliable, right? So you would want to know, for instance, when it's safe to use the robot, when you're on your own out there sort of, and uh, you know, it goes beyond formal guarantees. So we want to provide formal guarantees. This is where it's safe, but you also want it to be explainable and you want it to take care of privacy issues and so on. So that's roughly the sort of problems I work on and it's a bit of a rabbit hole. The more you think about it more interesting it becomes.
- Rami: [02:41](#) Yeah. It kinda reminds me of the Jetsons robot cleaning lady. I was in Las Vegas and I was talking to some of the staff that work at some of these mansions. And they were telling me about some of the stuff that goes on in the mansions that they can't talk about. So privacy would be an issue if you have robot in there. You know, living in your home and seeing everything and not divulging it to everybody. So I don't even think about the privacy concern, but that makes sense.
- Sid: [03:06](#) [inaudible] Mhm, yeah, yeah. Even at a more minuscule level, like you said do the laundry, but then you have guests over, do you want it to drag your dirty laundry hamper across the room when they're there, you know, so.
- Rami: [03:20](#) I have one of those vacuum cleaners that, you know, the robot vacuum cleaners, we call it Tweaky, um, you know, from Buck Rogers and, uh, it's pretty good. I mean, you know, there are times I feel like I swear, like I'll be working in my Study and it'll come in and just keep, you know, ramming and me and coming around the chair and stuff. I'm like, can you get out of the room, Tweaky? Um, but you're talking about a step above that, right? This is robots can actually come in and do the laundry and make the bed. I mean, this thing is fully autonomous and that would be awesome.
- Sid: [03:46](#) Yeah. Autonomous to some extent, but you know, versatile at the least. So you don't want it to just do the laundry. You want it to go a little bit beyond.

- Rami: [03:57](#) That's fascinating. Before we dive a little deeper, tell me a little about what got you into this field? What made you passionate? Why are you passionate about this?
- Sid: [04:05](#) So, initially it was, so I had started my education with a Mathematics major and that was very beautiful, and I wanted to somehow connect this with the reality. And then I started reading SciFi. So the logical conclusion of that was AI.
- Rami: [04:25](#) And this was when you'd finish your Math undergrad and then got into AI after that? Okay. That's awesome. And what, why are you passionate about it? What gets you excited about it?
- Sid: [04:34](#) So, one, puzzling. So it's a lot of curiosity. How do we reason and act, how do we reason about things? How do we figure it out, how to do laundry, how do we figure out okay, if I have to do the laundry, I have to go fetch things first. You know, find out, what's dirty, put them in, you know, there's so much of reasoning and decision making that we're doing very easily. And then if you start looking at how to get computers or autonomous systems to do that, you realize it's actually very hard to encode this sort of stuff and make it generalizable. So then, you know, the curiosity is the prime driving factor. Yeah.
- Rami: [05:13](#) That's awesome. Very cool. Let's talk a little about, um, where things are now. So, you know, in the show we go out into the future. But let's kind of start with where we are today with AI and robotics.
- Sid: [05:26](#) So, at the moment, you know, at present we are discovering some very new technology and we are discovering new tools. So AI has been, you know, the field started around the 50s. That's when the first mentions of the field, of the terminology AI, came about. And since then it's gone through lots of phases and it's been slowly gathering momentum. And we're at a stage now where we've got some of the basic building blocks or at least the big blocks that we think will be very useful. So, learning techniques have matured quite a lot. We can do stuff like facial recognition or object detection for, you know, computer vision kind of applications, and we are obviously seeing lots of advances in autonomous game play, right? Uh, so, um, and different industries have started realizing value from these previous theoretical techniques. So you see autonomous cars and that industry is taking off. So, all of them are doing post, they are, they are highlighting what the current problems are, where the gaps are. And also doing the engineering and research required to develop each of these traits into applications.

- Rami: [06:45](#) No, it's interesting. I remember as a boy I met a robot, it's probably like, I don't know, 10 years old. And it came up to me and started talking and to this day, I don't know if it was just programmed or somebody was doing it remotely, but I thought it was the coolest thing ever. And now you see things like Sophia, you know, who was granted citizenship, um, over in Saudi Arabia and what are your thoughts about something like Sophia, where you know, you hear people, there's some fear behind it. You see it all over YouTube that, you know, someone like her could turn one day and decide that they're the superior being and humans are either their slaves are not worthy. So, what are your thoughts?
- Sid: [07:22](#) Yeah, I don't know about the specific instances like this, but if we have, we have a long way to go before we can actually think of an autonomous agent at the same level as a human. And I don't know if we'd ever get there because these are devices. We are creating these devices and just like you have a car, there is no reason why you can't give a car citizenship. Right? What stops you from doing that? So, I'm not quite sure how that factors in, but it's an interesting problem of at what point do you start taking a device that you program, it's an engineered device, like a calculator or something, then you expand its level of functionality to have some automation. For instance, you have autopilots in aircraft for several years and then, okay, then where do we move to start calling something autonomous? Right? So how do we distinguish this and at what level of autonomy do you think that you'd be starting to associate something humane about it? So I don't know if that's even a good question. It's fairly defined.
- Rami: [08:38](#) So basically kind of what you're saying is, we're not quite there yet, but as far as you know, and I, and Ray Kurzweil talks about consciousness, right, at what point is something conscious? A point to something know that it exists and has that level of consciousness or that autonomy? Do you see us eventually to that point where machines or AI have some level of consciousness of their being?
- Sid: [09:00](#) So this is again one of those things where it's, it's interesting because it's not really precisely defined. We don't have a test that's, okay, here's the thing and if you answer these questions or if it meets these criteria, then yes, your conscious. So if you don't even know how to characterize consciousness very well in a human. I know you're conscious because I just call humans conscious, you know, beyond that I don't think there is a very specific meaning. So how do you answer or how do you

evaluate something for consciousness when you don't know what consciousness means, precisely.

Rami: [09:34](#) No, that makes sense. Now, I guess with a lot of your focus on right now, you'd mentioned having robotics in the home, right? To be able to clean and do different things and activities in the house. Um, talk about kind of where you see that maybe in the next, you know, 10 years if we continue on the same progress we're on now, where do you kind of see that here in the near future?

Sid: [09:57](#) So I think the scope of faculty capability or the generalized ability is going to increase. Um, and it's going to be very gradual. This is what it looks like, so, for instance, the earliest robot vacuum cleaners that came out were just doing random movements, but now you have better versions which can do some sort of mapping and remember the home's layout and actually plan out how to clean so that they don't waste a lot of time just really doing the same area. Um, going beyond that is, uh, a natural next step, but also a big leap in the sense, how do we generalize it? First, there are several aspects of the problem, so there's the mechanical aspect. How would you generate and create a robot that's safe to be around. It should be sensitive to bumps and that sort of stuff. It's, you know, when we work a walk around the homes, there are sections where you have to sort of rub against each other and it's considered safe. But it may not be that safe with a robot that's not designed for this kind of interaction or physical interaction. So there is the mechanical aspects of the problem. And then there's a lot of different pieces that need to be filled in. It's very hard to get a timeline because I think there are actually some missing discoveries that have to be made to make it truly generalizable. But I think you'd find limited-use robots coming in much more easily. So you currently have robots in hospitals that are essentially mobile portable devices, right? Uh, they carry stuff around. They can carry reports from one point to another. They can go into the elevator. But they are essentially moving desks. They don't have magic fingers, they don't have hands. So, you know, there's a bit of stuff to be done before we can get generalized ability or versatility.

Rami: [11:57](#) Yeah. My wife works in the medical field, and at the hospital she works at, she's encountered those robots. I think she was trying to get the elevator that it told her she I guess couldn't get on or it asked her to move out of the way 'cause it's trying to get to one of the rooms or something. She's like, oh excuse me. I would say be polite, be polite to the robot cause you never

know. It's going to remember. It's kind of like my wife. She remembers. So yeah, be nice. Yeah.

Sid: [12:21](#) So that's another thing, how do you get it to navigate spaces with humans, right. In some places humans are accommodating, like your wife, let it give it room. Right. But humans have a playful tendency. So sometimes they block the robot. What's the robot do at that stage? So those aspects from the side is how to get it to efficiently solve problems. Today, you ask it to do laundry. Tomorrow, you say set up the dinner table or arrange the room. These are very different tasks, although they share some commonalities. So, you'd expect that if it can do the laundry and move about the house and pick up stuff next time when you ask it to arrange the home or arrange a room, it should be easier, right? Because it knows the layout and stuff. But how does it recognize, how does it generalize that? We don't have very good answers?

Rami: [13:09](#) I spoke with a gentleman, he was talking about the Davinci Machine and how the doctor that had worked on creating it, he said that eventually it won't need me and for those who don't know what that is, it allows them to do surgeries across the country. Uh, but he said that the AI in there, it's listening, it's programming. He said, you know, it won't need them cause it's recording everything he's doing and it's kind of crazy cause you think about, you know, the high level, all the schooling that a surgeon goes through to get to that level. And that's something a robot that with the right AI could go in and do what a surgeon is doing. I guess that at another level, do you see that with, let's say I'm in the hospital, I need someone to come take my blood pressure and just check certain vitals. Do you see that being replaced here in the near future by robotics?

Sid: [13:55](#) Okay. So that's an interesting set of points that you raised there. Uh, first of all, the learning aspect, right? How is it learning from the surgeon? And then you can ask, is it learning? Especially, the important thing is, how generalizable is it, what it's learning. So it could learn exactly the maneuvers that the surgeon performed. But nobody's internals are the same, right? Will it adapt gracefully to somebody who has a different structure of pancreas? And, the surgeon figured out what needs to be done, and they took into account all sorts of things like maybe even which procedures this patient could afford, what is best for them, that sort of stuff. So there's a lot of background and context and decision making that goes, it goes on even before the robot starts, the surgeon starts operating. And then, so you mentioned something about the initial tasks, which are more routine in some sense. So that raises this broader point about

what's happening to the workforce and how it's going to be affected by automation and so on. So there are lots of studies on this and it looks like what we know for sure is many jobs are going to be transformed by automation and not necessarily replaced. So, yeah, some parts of it you could imagine that there is a machine, where even if it's not fully automated, you say, okay, I'm going to put my arm here and measure the blood pressure. Right. Right. So that, that sort of stuff might happen sooner. Um, but then every time you see this kind of automation coming in, it's not that the jobs are going away, they're just transforming into something else.

Rami: [15:45](#) Well, and that's what I've read about, is certain jobs, like you go to the bank and you've got the tellers and then they're doing repetitive tasks, they're taking your check, depositing it. And I keep thinking, you know, this would be something that could be done or solved with AI and giving it a certain routine set of tasks that it has to do and reprogrammed. Um, kind of like in the hospital taking blood pressure.

Sid: [16:06](#) ATMs do these sorts of things. And you can see that the bankers there are now doing the higher decision making tasks. They're telling you where to go for different kinds of services that you might need and maybe giving you financial advice and that sort of stuff.

Rami: [16:23](#) Yeah. And that's where, you know, we talk about kind of where those workers are going to go. Like even in the grocery store you have self-checkout. And probably about, I don't know, 20-15% of people actually use it, but eventually we'll have it. I know Whole Foods is working on something. You put it in, it scans automatically, you walk out, it automatically runs your card. Where you don't have to go through and scan everything individually and all those routine mundane tasks that will be automated. That what happens, a lot of those people in that are in that workforce, they're going to have to there, you know, I guess get additional education to do higher-skilled level worker or be out of a job.

Sid: [16:57](#) So that's another interesting point. So, automation has been increasing for several years. This is quite independent of the field of AI and in some cases they're related, but sometimes it's very uh, going on its own. And with AI, there is something slightly different, which is actually better from the point of view of the workers. Because when you have an adaptive autonomous system, let's say you're in a factory and you just get a robot and now you have to work with this robot, right? What happens when the robot does something unexpected? So,

you're using robots as force multipliers in some sense, right? So you're saying, okay, there is this one person who is now saying, I'm going to create the designs and see how they actually work and the robots are going to maybe create the devices. So if it does something unexpected, what you do at that point? With an automated system functionality is very limited. It's very well understood. Every time you hit a button, it's going to do the same thing. And it's easier to feed support calls for instance, because you know, this is the machine, this is how it's programmed. But with an autonomous system that has adapted to the situation, nobody is going to be an expert on that. You know, you can't go always to PhD's in computer science to say or you know, is this wrong what the robot is doing or is it right? And so in some sense, in order for autonomous systems to be even feasible as broad wide-scale deployments, we need a slightly different paradigm where the autonomous system can explain itself. So it should be able to interact with this factory worker and you know, the factory workers should be able to say, hey, why did you do this? Why did you move out of the way when I asked you to bring me the spot?

Rami:

[18:49](#)

That's kind of what makes us, I mean I think right now, what makes us human. I mean a lot of the machines we work with have certain programming, but as humans we're able to adapt and make decisions quickly. Like you said, a doctor was able to decide; okay, can the patient afford this surgery, what are options are there? And be able to just really adapt to their environment, and having that emotional piece to how we think and being emotionally sensitive in those environments. So, that'll be interesting to see kind of where that goes with the autonomous AI and robotics. Are, they gonna have those human capabilities. And at that point, will we say, "okay, they're, they're cautious", because they act like humans? I guess that'll be kind of, I think of like iRobot, all of a sudden the robot started acting more human, and being aware of itself. They said, "okay, this is an anomaly".

Sid:

[19:40](#)

This is where the problem becomes more interesting. Right. So how would you distinguish something that's just a mock, right? How do you distinguish it from the original, like the Mechanical Turk, which was like a robot, but there was a person sitting inside it and operating it. So how do you, how do you distinguish it from something that's just designed to mimic dialogue or just designed to make expressions in a natural way but doesn't have anything sophisticated going on?

Rami:

[20:11](#)

Yeah, no, it definitely adds a lot of questions. Um, one of the things I wanted to ask too was when we do a lot of, because our



company is virtual reality, 3d animation and augmented reality, holograms and things, and my artists always talk about the uncanny valley, right? You know, between fake and realistic, right? Am I going to create something that the I will recognize right away that that's not real. The uncanny valley, that place in between where it's like, it kind of looks real, but it's not really, and you can tell. But then you come out the other end, where it actually looks very realistic, and you're starting to see that now with even Sophia. I mean, her skin, they're trying to give her that realistic human look. We're seeing that a lot more with, with animation and films and videos. Do you see with robotics, at least what you're doing, like, you know, you're talking about like the household work, things like that. Do you think people will want, I guess the uncanny valley going to be an issue? Are people going to want something that looks very robotic or something looks very human. Because that middle ground, I think it would be kind of odd.

Sid:

[21:08](#)

That's right, that's right, and it's not clear to me that in order for a robot or an autonomous system to be helpful, it has to look like a human or act like a human or behavioral like a human. You know, we've worked with smartphones. We really find them very useful. They have nothing to do with being human or having any kind of conscious output interface. So, in that sense, I think there are some places where people are actually doing research to create robots as companions for disabled community. So, especially for children who have some sort of issues and there that there is some interesting research, you know, the robot can act as a companion and it makes some sort of sense to try to get the robot to mimic expressions or to smile at the right times, and so on, just to make the interaction easier. But for a household robot in a regular setting, the important thing is safety and task ability, right? You don't really, in fact, in some sense it would be unethical to make it seem like the robot is a human. In those situations you should know that it's a device, you bought it, here's your service agreement, here are its safety conditions, and don't go beyond these refined specifications. So, in some sense in that particular application, at least, it makes perfect sense to not even approach the uncanny valley.

Rami:

[22:37](#)

It's interesting, Yeah, no, I think you kind of have to pick because I think that if you get an uncanny valley, it's almost a little bit freaky, I guess, if it's something is trying to look real, but it's not. But talking about mimicking, I have a 10 month old at home right now. And it's funny, I told my wife, he's always smiling and happy cause we're always smiling and happy to him. And last night, I was playing with him, I made a crying face and

he started to cry. But it's kind of like what AI does, it's going to pattern us and recognize certain expressions and then probably put it in some memory bank, build it, and pull those out when it needs to and as it learns like humans do at some point. So it's interesting.

Sid: [23:14](#) Yeah, it's fascinating. In fact, different cultures have different ways of responding, different points at which they smile, and children have been growing up in those cultures and learning it very differently. So clearly, yeah, they draw from what they see.

Rami: [23:28](#) Yeah. Some cultures don't smile as much as us Americans. You made a good point about having robots as caregivers and possibly having them with you. And I mean like elderly people. I've know I've gone to nursing homes and just having that companion, there's somebody to talk to. A lot of times they just want someone to talk to. And if you had a robot in there with AI that looked human and they could sit by their bedside and let them tell their stories, that could really make a big difference for a lot of people. So that's a really good point. But I think in that case, yeah, it would have to probably have more of a human look to it.

Sid: [24:06](#) Right. And they did some experiments, and this is a very active area of research, so it turns out that many times they don't really care about the look being human and so on. So it can be a screen, but if it's providing the right kind of interaction, like playing a game with them or engaging them in dialogue, that also helps. In some sense it's more of a honest perspective to the person. Like this is a machine. We all understand it's a machine, but it's still entertainment, it's still interactive, and it's still useful.

Rami: [24:41](#) I know we talked a little bit briefly about things get out of control and our housekeeper decides to turn on us and decides that we're not worth being here. Do we have controls? Do we have ability to turn it off? And I guess essentially unplug AI?

Sid: [24:56](#) So, yes, at the moment. Yes. For now, we are nowhere near any kind of these disaster scenarios and everything. Yes. Everything is very much in the control. In fact, it takes a lot of control to get it to go. To get it to work. So, we're not at that point. So, does that answer your question?

Rami: [25:20](#) Yeah. You know, it's good. I think there's a lot of talk about nanotechnology and replicating itself. And I think of like terminator, they started building more terminators, but it's funny and people make fun of some of these movies. But more

and more I'm seeing, life imitating art, and sometimes the other way around, but things like Minority Report, and some of these SciFi movies that we're seeing now. We're seeing holograms being able to project with glasses on. And so it's really facial recognition and things that we saw in movies a long time ago.

Sid: [25:47](#) That's right. it's certainly a time where AI has matured to the point where ethics in AI and responsible research and all of these become really relevant issues. And I'm glad that these are actually being recognized. There are people who are looking specifically on these kinds of problems. And in general, there's a much greater awareness that, yeah, okay, even when you're educating students, for instance, to be mindful of ethics, what privacy issues are and safety issues. To basically create more responsible researchers.

Rami: [26:20](#) That's a great point. Last two questions. One, where do you see things, obviously the name of the podcast is YEAR2045, so just using your imagination a little bit, staying on this trajectory, where do you see things out in the year 2045? And then the last question is, what are you most excited about?

Sid: [26:36](#) Okay, so, 2014, yeah, it's a very hard thing, speculate for exact timeline, but I think there are some discoveries that have to be made. It's very hard to predict when exactly they happen. But specific applications where, for instance, autonomous cars, this is something where I think we could actually see autonomous cars on the road. And as you can see now, it's a gradual shift. You have cruise control and lane keeping, then, you know, more likely lane changing and so on. So it's on the right track. That sort of stuff hopefully would occur by then. In robotics, I think there's good progress on grasping manipulation, these final movements. So, hopefully we'd have at least in some restricted scenarios, actual robots like humanoid robots that can help out, that have some sort of explain-ability and you know, they're not fully versatile yet, but for some range of tasks you can use them and they are helping. I think we should be there. Most exciting things, can we get a handle on addressing the explain-ability, reliability, and generalizable aspects of the problem and common to all of these, there's this thing called abstraction. How do we generate abstractions efficiently? So, for instance, if you watched me just cleaning up the room and then I asked you to describe it to me, you'd probably say something like, well, you picked up these objects and you put them there and you intuitively create this abstraction versus what you saw actually was, you know, if we described it in a video, it was 60 frames per second or whatever. And I was just executing some procedures. So you would have this abstraction generating

mechanism and that's very helpful in generalizing tasks because the same kind of pickups and placements are required to clean up, to arrange, to do all sorts of things. It's also very good to explain, right? What am I doing? I'm picking up things and it's easy for people to understand. So there is this common trait of how do we generate that abstractions. I'm excited about what might happen on that theoretical problem in the next few years.

- Rami: [28:50](#) Awesome. Well, I could talk to you all day, but we're trying to keep the show under a half hour. But I could do this all day. So really awesome having you on, Sid. This was a really fun conversation. I hope you enjoyed yourself, and just thank you for being a guest on our show.
- Sid: [29:01](#) Yeah, it was a lot of fun for me. Thank you for having me.
- Rami: [29:03](#) Awesome. All right, take care. Buh bye.
- Sid: [29:06](#) Okay, bye.