

The Future of Work podcast is a weekly show where Jacob has in-depth conversations with senior level executives, business leaders, and bestselling authors around the world on the future of work and the future in general. Topics cover everything from AI and automation to the gig economy to big data to the future of learning and everything in between. Each episode explores a new topic and features a special guest.

You can listen to past episodes at www.TheFutureOrganization.com/future-work-podcast/. To learn more about Jacob and the work he is doing please visit www.TheFutureOrganization.com. You can also subscribe to Jacob's [YouTube](#) channel, follow him on [Twitter](#), or visit him on [Facebook](#).

Jacob: Hello, everyone and welcome to another episode of the Future of Work Podcast. My guest today is Luis Perez-Breva, who received his PhD from MIT and he's currently the faculty director of MIT's innovation teams program, based at the School of Engineering and the Sloan School of Management.

He's also the author of a new book called Innovating: A Doer's Manifesto for Starting From A Hunch, Prototyping Problems, Scaling Up, and Learning to Be Productively Wrong.

Today's conversation is going to be all about artificial intelligence, debunking myth from reality. Luis, thank you so much for joining me today.

Luis: Thank you for having me.

Jacob: Okay, so, why don't we get started with some information about you before we jump into our topic. So, how did you get to where we are or how did you get to where you are and studying artificial intelligence? What's your background?

Luis: That's a really interesting question. It's a bit all over the place, actually. I started out life as a chemical engineer. I moved on to do a startup in telecommunications in Silicon Valley. That's the company that locates cellphones, in case of emergency today and it's all AI. Then I did a PhD in AI after the startup. Then I sort of discovered that the AI we were doing was missing something.

I like artificial intelligence because it helps me imagine new problems to solve but we really didn't have a good way to figure out how even phrase that. So I started to work also on trying to figure out, not just artificial intelligence and new problems but also, how do we figure out what that real world problem is and how do we think of new technologies as superpowers instead of threats?

And that's what got me to where I am today, both thinking about artificial intelligence some days and also helping MIT deep tech solve real world problems.

Jacob: Where did you grow up? I'm curious about before you even got here. Are you from Spain or where did you grow up? What was your life like? What were you interested in before you got into this world of education and artificial intelligence?

Luis: I was born in Barcelona and I lived there until my early 20s. When I was in Barcelona, well, Spain had just left a dictatorship. I was born shortly after the dictatorship ended. So, I got to witness an enormous change in my country and even more when I actually left my country, I realized how different everything was outside.

The differences have diminished today but for me that was highly informative because I felt I wanted to aspire for more. I was doing startups when I was in Barcelona, even though I truly didn't know what I was doing.

The one thing that defines my passion toward my education in Spain, was that what I kept on doing throughout, ever since childhood, was trying to figure out how I could get that dumber machine, which was a computer my parents bought when we were kids, to do work for me so that I could do other stuff.

So, even though I started as a chemical engineer, I was highly social but at the same time, very invested in trying to figure out how to have this computer, that we had at home, do my work. Which translated in me having to code a lot and program a lot of programs as I was learning. So, before the computer did any work, I did a lot of it but it was kind of fun.

Jacob: What work were you trying to get the computer to do for you?

Luis: So, one of the things I did and I remember doing, while I was in Spain, was when I was studying chemical engineering, I decided I didn't want to do the problem sets. I would rather have the computer do them for me but then this translated in to me having to code every single thing I learned in my chemical engineering studies into the computer. By the way, at the time, we called these programming, not coding, so, coding is a new word.

So I end up learning a hell of a lot by actually teaching the computer how to actually do those things. So it sounds very geeky but to me, it was great because then every time a problem set came in, not only did they know how to solve it, the computer did. But also, I had learned a lot more than what the problem set was about because the computer is frankly, a very dumb machine and training it to do things the way you want them takes a lot of work. So I sort of acquired this artificial intelligence taste as a hobby, I guess.

Jacob: You must have had a lot of friends in school who were always like, "Hey, can you do my homework for me and just, you know, give it to your machine to do it?"

Luis: We coded the calculator, so we had sort of a, as soon as I coded something, we would share the program with anyone who wanted to do it. So yes, we had friends that way and also friends in many other ways, right. So I guess that became a source of

conversation, which is, "Do you know how to do these problems?" "Well, I don't but my computer does or my typewriter does."

Jacob: That's hilarious and how many years ago was that?

Luis: That's got to be close to over 20 years ago now.

Jacob: Wow. So, you were doing this stuff a long, long time ago.

Luis: Yeah.

Jacob: Before much of the conversations today. That's fascinating and Spain is a beautiful place. I've been to Barcelona and a couple other cities there and absolutely loved it. So it's a gorgeous city. What about today? What does a day in the life of Luis look like? Are you up at 6:00 in the morning, heading down to MIT every day? Or are you traveling and speaking, still doing some coding? What's your day look like?

Luis: A bit of everything. My day starts with practicing violin with my kids, actually. Every morning, we wake up, we have breakfast and all and then my daughter decided to learn violin. And I kind of love learning new things, so I started with her. So every morning we practice and I try to keep up with her rhythm. She's much more advanced than I am right now but I'm still holding up there.

Then I go to MIT. There's an insane number of emails to attend to but then I worry about two specific things, which is problems we could look at differently. So we can actually apply really advanced big data, data science machine learning and also, artificial intelligence, to tackle them differently in ways that are nontraditional. And that has defined that work in artificial intelligence over the years both in industry and academia.

Then a good other part of my time is spent teaching. This idea I mentioned earlier, which is everybody wants to figure out how to take technologies out of university and commercialize them but I rather like a slightly larger idea, which is ... We have all this fantastic technology out there. History teaches us that every time we figured out the way to bring any technology to the world, it's made us more powerful. So we're able to reach further.

So I think of new technologies as superpowers and so what I teach at MIT and what I work with colleagues here at MIT is, well, what if that new technology that just came out of the lab was actually a superpower in the raw? Our job was to figure out, where is the real world problem. We can start to figure out how to turn this into a real superpower so that we can actually reach further.

And this has become a class, a program and over the years, we've also adapted this to various regions worldwide. So I've slowly become an expert in how to take deep tech into the world by actually trying to address a question, which is the same way I tried to address artificial intelligence, which is how do we figure out how computer solve real world problems for us? And normally, that means AI and many other things.

Jacob: Then today, AI seems to be one of the biggest topics of conversation. Pretty much any time you turn on the news, any time you speak with an executive, in fact, pretty much any time you hear the word, Future of Work, people assume it's somehow related to AI. But it also means there's a lot of noise, there's a lot of confusion around AI. And there are a lot of things that people are still having a pretty hard time understanding and grasping.

So, why don't we start off with the very basics, the very high level of what is artificial intelligence? Is there like a standard definition or how do you explain that to somebody?

Luis: So, the way I like to talk about it is that, today, artificial intelligence is essentially an aspiration. What we do have a lot of is automation, machine learning, data science and many of those things that get normally confused with artificial intelligence, even robotics gets confused with artificial intelligence. So to me the dream is to have a partner and the best example might be, or the example I give to students is Iron Man's, J.A.R.V.I.S. I don't know if you've seen the movie but J.A.R.V.I.S.-

Jacob: [crosstalk 00:12:45] great, great movie.

Luis: J.A.R.V.I.S. is the perfect example of what I hope for when I think about artificial intelligence. By the way, I've been waiting for 20 years almost, for people to start to catch the interest and the excitement about artificial intelligence. So, I'm happy to be able to dispel some of the noise because it's a great moment to be in.

So to me, what J.A.R.V.I.S. does is if you look at the movie, J.A.R.V.I.S. helps Iron Man or Stark build parts, reasons for problems, brings up knowledge when needed but also brings up discussion, helps Tony Stark build the components that he wants but also it's part of the Iron Man suit.

So you cannot think of Iron Man as a superhero without J.A.R.V.I.S. but J.A.R.V.I.S. is in so many ways a partner. It is not a threat. And that's the single most important thing I think of AI. You can bring this to the present, actually. You are already operating with computers in that level of partnership, much more often than you are actually threatened by them. And the best example I can think of is how you interact with Google.

Now, I don't think Google is yet an artificial intelligence the way I aspire it to be but it shows how you would operate with one. So before Google was there, you would have to go plan and research, you would have to go to a library and it was a significant investment of time.

Nowadays, you just go into Google. Google responds with some information. You have to go out on your own and make sense of this information then come back to Google with a better keyword. So still very narrow that you search by keywords but it shows the kind of process you'll follow when more and more powerful artificial intelligence are here, which is this partnership by which you can actually further.

Before with libraries, you would have gone who knows how often to the particular library and a few people have actually taken on that endeavor. Nowadays, almost everyone searches Google many times a day. So we all are more powerful because of that and the content gets updated more rapidly.

So that's how I'd like people to think about artificial intelligence and what we can do today is in very narrow demands, we can have that kind of conversation and never think within artificial intelligence in very narrow demands, very specific problems. We're nowhere close to having a generalistic artificial intelligence. Does that make sense?

Jacob: Yes.

Luis: That is how I feel in terms of a definition, it's more inspirational than it is being able to point at something we currently have.

Jacob: J.A.R.V.I.S. and Google, I suppose, are very, very different. It seems like Google as a search engine is maybe like the very initial stages of what J.A.R.V.I.S. could become in a decade or two. So is there like, this is artificial intelligence or it's not? Like, it's A or B? Or is it like a maturity model of artificial intelligence?

In other words, would you say a search engine is like phase one of artificial intelligence and then there's phase two and three, four, five or is it just black and white, this is AI or it's not AI?

Luis: That's a question we actually wrestle with still in academia because I don't think anybody has a good answer for what intelligence is, let alone artificial ones. So I prefer to look at it slightly differently. I think Google is teaching us ways in which we can actually interact with computers and the same Google is doing that, Siri is doing that in a slightly different way. Though, it's still pretty much a search engine just operated with a voice.

As we do that we are learning to achieve new things that we're not even able to do. Just a few years ago, just 20 years ago Google was a pipe dream in so many ways. So now think about other things. Uber, Uber is teaching you ... Uber lift all the ride-sharing apps that are also very controversial.

It's showing you how to use resources you already have in a completely different way that would be impossible without very advanced machine learning. Machine learning is there in both the resource allocation, in selecting the driver, in the navigation system, in the G.P.S., in so many places but none of those interactions are really intelligent.

So at first, 50 years ago, everyone thought that solving games, playing chess would be the path where artificial intelligence and if at all, what we've learned over the years is that intelligence turns out to be much, much harder than we thought, which doesn't mean that we can start benefiting from it and then start to learn how to operate with computers and solve real world problems with what we have today, which is far from being that intelligence.

To circle back to your initial point, I don't think we can yet talk about the progression but I'm sure that 50 years from now, people will be able to look back and in hindsight, describe you know what, yes, these all started with people being able to interact with search engines or being able to use their car and make money out of their car. Don't think I'm ready to say that we're at phase zero or phase one just yet.

Jacob: Still early stages though, it sounds like either way.

Luis: Yes, but with a lot of promise, right? I've mentioned two or three companies just to tell you how much net worth and new possibilities have been created by early approaches to use what effectively amounts to a toolkit of computational tools that are very advanced. So imagine what we can accomplish whenever computers become slightly smarter.

Jacob: Yeah, it seems like there's a lot of possibilities but what about something like, on my computer if I ever have problems with WiFi, you get a little notification that says, "Do you want to open up the WiFi utility?" or something like that. And it'll scan a WiFi network and it'll basically help you solve your WiFi connectivity issues and it'll give you suggestions and recommendations and why your WiFi might not be working.

Is that AI or is that ... What's the difference between what my computer ... And computers have been doing this for many years, right? I mean, laptops been doing this for a while. Would you classify that as a type of AI or what is that?

Luis: Early on in the field, we thought of those things as also a beginning of artificial intelligence. But what it really is a process, that it's driving you through a process, not unlike the one a technician would actually drive you through to diagnose the problem and so you're interacting with a machine.

So it has one component, which is that it, you are able to interact with the machine but the domain of interaction is really narrow. Whatever intelligence you may consider to be there it's hard coded into the process, so these tiny system will not work for anything other than that.

Now, think about yourself as intelligent human being. Things you learn in one domain often teaches you skills or approaches to look at things that actually help you elsewhere. So, a very important aspect of artificial intelligence is that we learn something to interpret the reality. And we're able to take that interpretation of reality and take it to a domain where we had never seen it before and it still works.

So I would say that those things that we thought at some point in the past, we're really intelligent and we really look smart, are just hard coded, well designed, diagnosis processes that actually free technicians to be able to tackle larger problems or more and bigger problems in a way than if your WiFi network is working or not.

Jacob: So, how do you know if you are encountering AI? There was the famous Turing test, right, where if you pass the Turing test, that was like a defining moment of something

but today, how do you know or can you even know if you're interacting with something, if it's process, if it's AI? Like when you talk to Siri or to your Amazon Echo, is that AI or if you give a command to your phone or to your TV, right? Comcast has those new voice activated remote controls. If you tell your remote control to switch to a certain channel, is that AI? How do you know what is AI and what isn't?

Luis: So, the Turing test remains the single standard we have to figure out that. It's mostly a comparison with a human and a non-human in a blind test, the same way that clinical trials are done. It turns out that we don't really even have a good answer for that, as to how do you decide in terms from an economic standpoint. We don't really have a good answer but from a user experience standpoint, the more narrow the problem that "intelligence" can solve, the less intelligent it actually is.

So, try asking your Amazon Echo a preposterous question and you'll see that it has, tongue-in-cheek programmed answers but it really doesn't amount to meaningful conversation. So the best way we have to actually think about an artificial intelligence today, is if you were to engage in a conversation with that supposed intelligence, what sort of narrative would the two of you build together? Is it just information checking? Is it just checking some process in your house or diagnosing your WiFi or is this a really meaningful conversation?

The more nuance the conversation gets, the easier it is to actually discover that you're actually not talking to anything that's really intelligent. And by the way, that's a very steep step to actually walk. Going from having a machine that does some clever or some other diagnostics to actual intelligence, that's really hard and before we even witness that, we're going to be able to engage in these narratives that are increasingly more nuanced about specific problems. We're doing that in some small domains but nowhere close to that level of general intelligence.

By the way, that's intelligence and there is awareness, right, which people always conflate-

Jacob: [crosstalk 00:23:18]

Luis: Intelligent-

Jacob: Yeah maybe you can talk about the difference between intelligence and awareness.

Luis: So, all of these by the way are questions that rapidly touch into the more philosophical nature of artificial intelligence because the more we tease some of these attributes, a part of them do realize that we don't even have good answers for awareness in the animal realm, for instance. So, we can't explain all that well how to measure awareness about other animals. We know that we are aware but we don't have a good definition for it.

It is one thing to have an intelligent computer that interacts with you in a conversation and is able to make sense of some of the information. It is another thing all together for

that computer to develop a [inaudible 00:24:04], feelings, emotions and awareness. And I'm not even sure that, that would be the best path of research going forward or the best place to get started because all are really ill defined concepts.

Jacob: Yeah, I mean, you're right. It definitely seems like a philosophical debate. How do you define intelligence and awareness? We use those terms all the time but if you had to explain that to somebody, it would be pretty tough to do so.

Now one thing that I'm personally curious about, as somebody that loves chess, one of the moments that everybody talks about as far as the progression and the evolution of AI being able to surpass a human in a certain area is I.B.M.'s Deep Blue beating Garry Kasparov and then recently, they talked about AlphaGo beating the world's number one Go player.

A lot of people say, "Oh, this is AI. AI is so great. It's progressing so quickly. It wasn't able to do this five years ago and now it's beating the world's number one player, you know, anything." Even more recently, I can't remember the game it was but there was ... or so they said, a piece of AI that was able to beat a human in a video game, which is also something that typically hasn't been done but looking at your definition, these things are nowhere near J.A.R.V.I.S.

They're not intelligent, they're not aware, they can't do anything besides ... or it seems they can't do anything besides those things, so would you say that Deep Blue is AI? Is AlphaGo AI? Or are these just massive calculators?

Luis: Interesting question. I don't want to diminish the merit of Deep Blue because it was a massive accomplishment from a technological standpoint but I don't think that with what we've come to learn after Deep Blue about artificial intelligence, that we could look back and think of that as an artificial intelligence. Rather, it taught us a lot about how to develop the toolkit for artificial intelligence further.

Nowadays, we have a slightly different definition because we think that artificial intelligence, at least, I believe strongly that artificial intelligence should be geared towards helping us solve problems, build those narratives around problems.

So to me the best example would be Garry Kasparov. I don't know him personally, so I'm going to just hypothesize. But Garry Kasparov was a chess master and mentioned in one of his last games, that he could see some quite creative moves in what Deep Blue did, when in the first game he said it was boring.

But what's really relevant is that Deep Blue cannot really use that expertise for anything else. Whereas, I imagine that the strategic thinking that Garry Kasparov acquired through playing many, many, many chess games has also informed the way he thinks about strategy in other domains and the way he uses that knowledge in other domains.

So he's sort of developed an internal language for chess that he can use elsewhere. And that's how we now think about artificial intelligence. We can make sense of stories and

news, other pieces of information and language to apply knowledge that we acquired elsewhere in the new domain. I don't think we can say Deep Blue ever achieved that, no matter how big the accomplishment it was and how much it helped IBM to progress further all the way down to Jeopardy and to the Watson after that.

Jacob: Yeah, I was just going to ask you about Watson, if you would consider ... Watson's another thing that everybody says is pioneering concept of AI. And we see the commercials now where it has a voice, and how it's talking to you and we hear stories about it being used in different fields, for lawyers, for doctors.

There's a commercial I think for IBM Watson, where I think athletes are using it to try to either figure out what they should be doing or scouts are using it to figure out, which athletes they should be recruiting. Is that AI or is that still not quite there yet? Maybe a step in the right direction but it's of course, nowhere near a J.A.R.V.I.S.

Luis: You know, I think what IBM has done pretty well, is that they've internalized this idea that for now, the best we can really do is solve one problem at a time. And so what I think, and it's hard to know what they're really doing inside their Intel IBM research, but what I think they've done is they've acquired or developed an enormous amount of artificial intelligence or machine learning to be more precise, algorithms and tools and data that they can actually use for you to develop your solution to any problem.

So to me it looks like it reproduces the aspiration of having a general intelligence that serves many purposes but it's just the aspiration. Today, right now, what they have is a very vast collection of algorithms and data that you can use for your purpose but the intelligence is contributed by the person that actually searches for or tries to recruit an athlete, for instance, to follow your example.

So you are the person who is trying to figure out how to extract value from what Watson has to offer, to figure out whether you want to believe or not what it says. It reproduces the aspiration. It reproduces the idea of having a conversation with a machine but it's just an incredibly advanced machine learning computer or [inaudible 00:29:51] algorithms.

Jacob: How far along do you think AI is? And if you had to give maybe an estimate of how long you think it will take to achieve AI, where do you think we are in that big picture of the landscape of AI? Are we just getting started? Is it going to be like another 50 years, 100 years? Or how long is this is gonna take?

Luis: You're asking me to do something that I know we humans are awful at. We're just making a prediction about the future but okay, I'm going to try anyway. I believe that we have very limited artificial intelligences today about very, very specific problems in which we have the opportunity to give the computer a different way to look at the world and have the computer build an internal model of that world and interact with us so that we can reach further.

And we've done some work on that in genetics and in finance and also, in cellphone location in emergency situations but that's as far as we've gone. It's very limited, it's very domain oriented.

We could imagine expanding those capabilities. It takes a lot of effort from humans right now to expand those capabilities but looking at maybe 50 years down the road, could I imagine us having expanded that to have a slightly broader intelligence as we can interact with? I can easily imagine 50 years down the road as having gotten there with the kind of disclaimer that about 70 years ago, they thought it would take just 10 years to do it.

Jacob: So 70 years ago they thought it would just take 10 years to get to the AI point?

Luis: Yes, at the very beginning, they thought that solving the chess problem would actually be equivalent to creating an intelligence. And they thought it would take about 10 years to do it. Then they realized it would take more than like 20, that's when they said it would be 50. So I'm sticking with 50 because that's the last one I remember.

Jacob: As far as predictions go, that's as accurate as it can get, right?

Luis: Exactly, but notice how they also changed the meaning on the process. At some point, they thought it was the Turing test, then people have figured out how to cheat the Turing test, so the Turing test doesn't seem to be as good as we thought it was. So then we thought it would be chess and it turns out that with chess ... and it still took many years from chess to go.

So when you look at that progression, we're certainly making progress. We're also changing what it means and along the path, we're developing all these fantastic tools that already have a benefit today. So there is no reason to fear, actually. It's not about robots that are going to be more intelligent than us. It's that every time we develop a new technology, we become smarter.

Jacob: Which is, I guess, good for everybody.

Luis: I think so.

Jacob: I don't know if you would call this a myth or not, but one of the other things that we keep hearing about and I'm sure you've seen some of these research numbers and some of these statistics that say, "40% of all jobs can be automated in the next couple years." and a lot of people are saying, "We're not going to even have jobs and robots and AI are going to take away everything."

Where do you stand on this whole debate because it sounds like what most people are talking about isn't even artificial intelligence. If we go by what you're looking at, these jobs aren't being threatened by a J.A.R.V.I.S., they're being threatened by an algorithm that is able to repeat a task more efficiently than a human but that's it doesn't sound like that AI.

So, A, I'm wondering if you think this kind of job displacement will happen and B, if maybe we've confused AI with automation and AI with bots, if we're just kind of using these words interchangeably and they're really not the same thing at all.

Luis: Yeah, I think you have it down [inaudible 00:33:58] there. So, I think we are confusing AI with automation. I would like to say that we've been doing automation forever. And that automation today seems threatening to many people because jobs are being lost but we're also confusing jobs with work, right? So certain kinds of jobs disappear because of automation and this has happened forever. This automation systematization, our ability to make things easier and simpler make certain jobs disappear.

For instance, no one lights gas lamps today in the street, right? We just figured out a way to have a light bulb. I don't think that was a bad idea even though that kind of work disappeared. So one kind of work disappeared. There is the other question about whether the jobs that did those kinds of work should also disappear and that has nothing to do with automation. That's just a management position.

So, my position is a bit extreme on this front. If a kind of work disappears because of automation, we have an opportunity to imagine how we can reach further and we have a set of free hands to try to reach further but that requires imagining a new problem to solve. If we decide to make the job also disappear, then I guess we are admitting that all that matters is cost savings and people don't matter that much but that has nothing to do with automation, nothing.

Actually, I would even take it further. Hundred years ago when Ford introduced automation into manufacturing, he created the gateway into the middle class. So what we know is that automation can create gateways into the middle class. That's one thing we know for sure and that worked incredibly well, for all of us for many, many years. So the question really is, how do we make sure that we are training the right business leaders and the right innovators so that they, too, think about creating those new jobs and those new gateways into the middle class?

I stand very strongly on that thing that if you don't find a new job, it's because there is a lack of imagination, not because automation has done anything.

Jacob: I interviewed the creator of Atari, Nolan Bushnell, and he said pretty much the exact same thing. He said that the only way that we're gonna live in a world where nobody has a job anymore is that if we don't have any imagination or creativity left.

It's reassuring because a lot of people say that same thing but what about the first part of the question as far as losing a lot of jobs, human workers to automation. Do you think that that will happen and that we're gonna be in a position where many, many millions, maybe even billions of people are not going to have a job because their work is being automated?

Luis: Thank you for reminding of that part of that question, because that's also something that I think is incredibly important. It's creating an inordinate amount of alert and panic

in the population. Now, I can't predict the future but I often know that every one of those reports, I've actually seen ... for instance, I kinda-

Jacob: Can you repeat that one section really quick? You said, "Every one of those reports that I've seen ..." and then you cut out there for a second.

Luis: Oh sorry, so, many of those reports I've seen actually describe ... they do their statistics and they describe some or they lists jobs that they claim will be easy to automate. I'm not sure if it even makes energy balance sense to think that some of those jobs will be automated. And I'll give you one example, hairdressers. That's one of the jobs that keep on seeing listed as, it will be automated and there will be no more jobs for humans there.

We're not sure we can make a machine that cuts hair more efficiently than either a human or any of the razors you can buy already in any kind of convenience store to essentially shave your head.

It's also not the right discussion to be having. Most of those jobs may or may not be easy to automate but they're just measuring one thing, which is how many ... they're just looking at whether those jobs have a sort of repetitive component to it. And then they're automatically attributing it, as it can be automated.

Maybe, maybe not, maybe no one will try. Maybe someone will do a robot that cuts hair and then there will be all those new jobs to actually create that robot. Actually making a robot is a really complicated thing, so you do need jobs to actually create those but most importantly, you can already get your hair cut with a machine. So the repeatable part has already been solved years ago.

But hairdressers do more than just simply operate the pair of scissors. They think about what you want, they talk with you. There's a whole experience surrounding that and that experience, it's not automation. It cannot be replaced or considered to be repetitive even though some of the motion is repetitive, so I think they're exaggerating the repetitive component of jobs and then assuming that they will be easily automated. And I think it's a bit exaggerated on their part, so that's why the statistics come out so dramatic and they create panic.

Jacob: Yeah, oh I know, there's so much panic, it's unbelievable. Two jobs that I wanted to ask you about that are pretty different and I've heard automation discussions in both of them. One is a barista, so somebody that makes your coffee. And I know there's a cafe in San Francisco. I think it's called Cafe X, where you show up to this cafe and there's basically this big robot there that makes your coffee.

Every time I have a friend that goes to this cafe or anytime somebody in the media goes to this café, I always see an article, a posting on LinkedIn, something that says, "Oh my God, there's this robot in San Francisco. It can make your coffee for you, there's no human involved. If you're a barista, you're going to be out of a job."

And part of me thinks we have had coffee makers for decades now, right? I mean, little machines where you push a button and it makes your coffee, right? We have those in all of our offices. We have them at home, yet Starbucks is still growing like crazy.

The second part you touched on which is the the experience. There's something to be said about somebody writing your name on a cup, somebody asking you how you want your coffee, seeing your coffee being made. So that's one job I'm curious about and that's more, I guess you can call it, an entry level job and the second is around something like accounting. I recently spoke with the chief innovation officer at EY, one of the world's largest accounting firms.

Luis: Yes.

Jacob: I'm sure a lot of the reports that you've seen, one of the top jobs that they always say is going to be automated is tax and accounting professionals and I talked to the chief innovation officer at EY and I said, "Are you seeing this inside of EY at all?" He says, "Nope." And I said, "Well, what do you do when you see these reports that say all of your jobs are going to be gone?" He says, "We just keep thinking of new things for these people to do. They focus on more strategic aspects. They focus on more of the advisory stuff."

So, let me stop there and get your comments, if you have any there, on those two different areas. One, a robot that might make you coffee and the second is a piece of software or a piece of, I don't even know if I would call it AI anymore, something that can crunch numbers versus a human and kind of how that job is shifting. Any thoughts on that?

Luis: Yeah, I love your comment about ... I'll start with the second. I love your comment about EY because that's exactly a way to go. Think about the accounting profession 50 years ago before you had actual spreadsheets. Most of the time was spent just doing additions and writing things in a ledger. You would still trust that person because that person had an entire view of the company.

It was not the ledger. It was the person who had the view of the entire company or the organization, and the advice they could provide because they had that holistic view. That's where the real value of content lies.

So, all we're seeing is that new technologies come in, that free the expert from the more tedious aspects of the job. So they can actually focus on the part that makes them really, really, really valuable. So, I think that the comments from chief innovation officer of EY is spot on, is that the more automation that comes in, that frees the time, the more that person can contribute to strategy, to understanding a very mechanical understanding of the company from its finances and so on. And the more you can actually make those finances work for the organization.

So, I fully agree with what EY chief innovation officer told you. That's just a perfect example of how the trajectory of the work changes but the job does not disappear.

Now, back to the robot that makes coffee. Let me ask you a question, is that a real robot like with arms? A humanoid robot?

Jacob: You know, I think so. I believe it is. I'm actually googling it rained out. Cafe X, Francisco. If you Google it, it says Cafe X, robotic café in San Francisco and you go to this website and it's exactly that. It's a big robotic arm. You go to this little tablet and you put in what you want and then it has this big robotic arm that's moving around that is grinding beans or whatever it's doing and then it hands you your cup of coffee. I mean that's that's essentially what it is.

Luis: So the engineer in me, thinks that that's got to be highly inefficient because if you're going to do it automated, why not just have a conveyor belt and move things around? Which would be way more efficient in terms of energy output than having a robot hand move around. So I think that those things ... Actually, to me, every time I see one of those things, I don't think that's actually going to make those jobs disappear.. I think that they actually showcase.

Some things ... A level of precision you can't achieve with robotic arms but I'm not really sure that the best application for that robotic arm would be to replace baristas.

Jacob: Maybe just to look cool versus having like real practical ... replacing baristas. Like maybe it's better in a doctor's office to do surgery.

Luis: And how much does coffee cost in that store?

Jacob: Oh, I'm actually gonna look that up right now. That's a good question. I'm willing to bet it's at some kind of a premium. So you're probably paying more money to get coffee and it's not even ... Yeah, I'm gonna look right now. I'm actually looking at the menu. Let's see a cappuccino is 2.75, an Americano is 2.25, so I guess it's similar.

Luis: Oh, it's similar.

Jacob: Yeah. Similar to probably what you would get in a coffee shop, I guess, but part of me also wonders, how many can this thing make it once? How fast it ... I agree with you. It seems like it's a good nearing feat but maybe not that great for efficiency, right? Like how was this gonna deal with 20 customers at a time?

Luis: By the way, we see these incredibly often when we actually look and examine a deep tech coming out of MIT lab. So it includes all sorts of things from anything you can imagine, like anything nano that you can imagine, software to robots, to chemicals you name it.

And so we look at this and the first idea people have, students as well as faculty, for what that thing will be able to solve in the world, tends to be completely off. It makes for a great story in the news. It makes for a news clipping here or there. And it's good that people actually learn of things and we get inspired but it turns out that the place where these things have a potential for really creating an organization or sustaining an

organization in the long run, are things that look less flashy than the robots that you would see in a coffee shop. And we see these over and over.

So we've looked at now at over 170 technologies. People come with these sci-fi dreams that got them inspired and it's great but when it comes time to actually look at some place in the world where this can actually create a meaningful impact, what we see is people creating jobs. We see these technologies creating value. We see these technologies targeting problems that are way different from the ones that could give you a marketing edge on a news clipping to say this. And that's something we see over and over. [crosstalk 00:47:29]-

Jacob: More than optimistic, good things will happen instead of bad things will happen.

Luis: Yeah, but we see these [inaudible 00:47:36] ... This is not just believe ... I have grown convinced of this through sheer seeing it happen one time and again. It's like there is so much stuff we can accomplish with every new technology that really all I can think of is like every technology that we see has potential to create not just one but multiple different companies. So what I see is an explosion of opportunities if at all, if people were trained to see these things the right way.

I also want to break one in favor of the barista. Biological machines as we all are, are amazingly efficient. There is millions of years of evolution to gain our level of efficiency, terms of energy consumption, movements, economy of movements, thinking while you do it and so on and so forth. So it takes more than a robot that moves an arm to replace a person that cares about their job.

Jacob: Yeah, I mean what do you do if you don't like the way the coffee taste with this automated ... Are you're gonna get in an argument with the robotic machine and try to get a refund? I don't think.

Luis: That will be an interesting experiment to try. Are you close to the coffee shop yourself to try it out?

Jacob: It is in San Francisco and I go there all the time for meetings. I might go there one time and then just see what happens if I'm unhappy with something and what that process is like because yeah, I mean I can't imagine. The other thing is I can't imagine ... It's sort of like and you touched on this, the kind of the practical applications.

If you see something like this, a robotic arm that makes coffee, the sheer ... just kind of conceptually thinking, okay, you see this one robotic arm in San Francisco. You think all baristas are gonna get replaced, the coffee shops around the world. Walk me through the process of how this robotic arm is going to get into thousands of coffee shops around, even the United States.

It has to be purchased and how the sheer logistics and the practicality of how a Starbucks would roll out thousands of these mechanical arms into their stores just

doesn't make any sense. The transportation cost, the logistics costs, the buying the arm, the still having to have humans on-site to deal with any issues.

It's one thing to see something on the fringes but when you extrapolate that into kind of the mainstream, like there's a lot of stuff that we just don't think about. And I think that we need to do a better job of thinking some of these practical applications.

Luis: I completely agree. That's part of what we teach students to think for when they are actually thinking about their applications is that if your reasoning is spotless, it's exactly that. The actual thing about the endeavor, the organization need to build behind having one of each of these in every single store, it's their function, let alone manufacturing those many robots, maintaining them.

And then there's the question as to whether those are really even less expensive than just paying a human well, because it's a robot. It will break. It needs energy, and so on and so forth.

I'm not saying that we cannot do very good robots. NASA is excellent proof that we can do very good robots but the question is whether it makes even economic sense to actually ... That is an application. It's just a good image for something of the future.

So I think that part of what's happening to us these days is because these things spread enormously through the internet, Twitter and whatever. We very quickly see these in many places. As you said, many people talk about it. and we start to extrapolate way beyond what has been demonstrated.

And one robot in one coffee store that looks fancy is demonstration of human prowess but building an organization that can sustain itself building such robots and spreading it all over the country is a massive endeavor that may not be the best use of neither money nor people's time but it would certainly create lots of jobs.

Jacob: Yeah, yeah. Okay. So I'm glad we agreed there and I'm not crazy because it seems to happen all the time with things. And I just look at these people and I say, "How is this absolutely gonna happen? It just seems crazy.

So I have a couple questions that people asked me to ask you but before I get to that, I selfishly have maybe one or two more than I wanna ask.

Luis: Okay.

Jacob: One of the other big areas were the role of AI is we touched on jobs, which is one big one. Another area where we hear a lot about AI is autonomous vehicles, self-driving cars and the the reality of that sort of hitting our roads. Can you maybe talk a little bit about AI in the autonomous car world? Is that truly AI as well or are we still looking at algorithms in just one specific area that these things can do?

Luis:

That's a great topic. In the last month, I've heard all sorts of rumor about who thought first of the idea of autonomous cars and so on. And I've got to tell you like DARPA has been having a project for self-driving cars. It used to be called that way. For years, there's been a competition every year about creating autonomous cars that drive on their own. MIT has participated many, many times many years. And so this is not new.

Also, various car companies have been exploring different technologies for cars to drive on their own. Now that often is just a motivation. What these really achieves for them is better algorithms to do things that are already near acquired today. All of the sensors that the car has, pedestrian detections in the next cars, braking systems that stop [inaudible 00:54:01] you're going to walk into an accident.

All those things emerged from that research and that work that has been going on for as far as I could tell because I've seen it more than 25 years and I'm sure I did not see the first of it. So this has been going on for a long, long, long time. So the real question today is whether all of the technologies required to make one such car that could drive on its own are finally ready to drive on the streets?

So if you ask anybody in Boston, they will tell you no because driving here is awful. So the level of powers that the machine would have to drive in Boston, people claim is enormous but this means that your car will be equipped with an enormous amount of equipment. So a lot of expensive equipment, so we're not talking about a cheap car at all.

And then by normal types of equipment, I mean there's a [inaudible 00:54:52] in this system. There are all sorts of sensors. There is all sorts of software. So it's a really complex piece of machinery what we're envisioning as a self-driving car. So people still showcase one example but there is no clear path to manufacturing these at the mass scale where people could actually use those.

So are we close to being able to achieve the dream of having a self-driving car? Yeah, we've seen those drive in certain constrained environments. Is this ready for primetime? I don't think it is. And everything I've read on the topic both academic and non-academic seems to point that this is many years away. And that before this even comes to be, we'll have plenty of time to enjoy the developments of technology and invent new jobs with those technologies that will sort of make the dream that looks so scary.

Now, is it AI? I don't know. I mean, I don't think it is AI. It is a very advanced use of all the toolkit of things we have in terms of data processing, machine learning, robotics for one specific purpose, which is to have a car that drives on its own. I am not so unhappy about it. They could just commute and the car drove like Minority Report cars drive on their own. And I could just simply read a book or work, that would be awesome.

I don't think it's that far [inaudible 00:56:17] or that's dramatically bad as people claim and I don't think this will replace overnight every single driver on Earth either. If at all, what we're seeing is that more people are making money out of their cars today than ever before.

Jacob: Yeah, I mean I just took an Uber to the city. So I definitely agree in that regard. All right, so I need to stop asking my questions and ask you some questions that other people wanted me to ask you. One is from Bertrand [Dousert 00:56:47] who says, "Who's right, Musk or Hawking or Zuckerberg?" And he's referring to the debate that you may have heard where you have people like Mark Zuckerberg who say that AI, like you said is a huge opportunity. And other people like Elon Musk who say AI is the biggest threat to humanity.

And obviously, these are both smart people. They're both running big global organizations that are changing the way that we work, changing the way that we live. They both have access to the same information but they have very different perspectives. So how can we have these two world global leaders with access to all the same stuff that have the exact same opinions? And who do you think is right?

Luis: Oh, that's a tricky question.

Jacob: No pressure.

Luis: Certainly, it's also spot on. So yeah, I don't think they're talking about the same thing. When I hear Zuckerberg and I read about what he said about artificial intelligence, I hear him talk in a trajectory of increased data analytics, information retrieval and so on, so forth.

When I hear Elon Musk talk about artificial intelligence, I hear him thinking or sorry I can't hear him thinking but I imagine he's thinking about machines, like the car seat manufacturers that kind of all of a sudden gain awareness or could be hacked. And so I don't hear that artificial intelligence is the threat when Elon Musk talks about it. What I hear, and I don't know if this is what he means, is that once these machines pervade our reality if they can be hacked, that would be a problem.

And of course, there are trajectories for the development of any technology that are dangerous. And nuclear weapons is kind of a constant reminder of that. When I hear Zuckerberg talk about artificial intelligence, I see it. I agree with him that it's a field ripe with opportunity but I don't think he's talking about the same artificial intelligence that Musk is talking about.

So I think both might be right about what they're thinking about. I don't think they would agree on a single definition of artificial intelligence. I should also say that I think Elon Musk endorsed or commented on the book from Nick Bostrom about super intelligence. And if he's thinking in that trajectory, well, some people claim that the day you invent something that's as smart as you are, then it will be only a tiny step for it to become smarter than you are.

But then again, Elon Musk seem to seems to be protecting himself against that by actually creating a newer link in which any advance in artificial intelligence will also become an advance for the human species. I'm not sure that that's going to happen but

all I see is people have different visions for artificial intelligence that they are trying to solve different problems. I don't think either of them is right.

Jacob: Yes, I mean we can't even define ... There's not even like a single definition of what artificial intelligence is. So I think there's tons of different perspectives and thoughts and ideas and it's kind of hard to know what to believe, so to speak. But in general, yeah, I've interviewed so many executives and have spoken at so many conferences and I can tell you that the vast majority of people that I speak with, whether it's somebody like yourself or the chief innovation officer at EY or the creator of Atari, Nolan Bushnell or even people officers, the chief people officer at McDonalds.

They all tell me that they are more optimistic about AI. They see more opportunity with AI and their respective organizations are not doing anything that is replacing human workers but they are replacing maybe a task that a human does but just helping that human do something else.

So it's very contradictory to the research, I think, that we see, and even the media outlets, which paints this very big panicky world that we're all gonna be in but the practicality of it just doesn't seem to match with what some of the numbers are saying. And you probably see this all the time as well.

Luis: Yeah, absolutely. As we're speaking, like the comment that Jack Ma did a few months back about how in 30 years we'll be working on it four days a week four hours a day and he sort of paint that that's not clear whether he was for that or against that. But then I would say that if that's true and we're still making an income, hey, the entertainment industry is going to go skyrocket all the way up.

There's a way to paint any of these arguments as bad or good, right? And that people paint them based on what they want to write about and then they forget what's actually being accomplished. And so it creates a lot of panic but then what I see is ripe with opportunity.

Actually, I want one thing really badly for them to develop as much closure, which is every time I buy something online, the ads that presumably use artificial intelligence or really, I should say machine learning that serve me with information keep on showing me the product that you already bought from like three weeks. So I would rather it showed me something else. So then just improve that, I would be happy.

I know it can be done, so I would be happy with that. How about we have a smaller, simpler objective as opposed to kind of panicking about that wild dream that looks a lot like a movie because all the evidence I have, all the conversations I have like yours, point to a lot of opportunity and people that are more carefully now than ever, trying to think about not losing workers but rather having those workers kind of promote to be able to do more high-value job. Because automation and beginnings of artificial intelligence help us attack problems in ways we could not attack before.

Jacob: I couldn't agree more. So I wanna respect of your time. I had like another question or two that somebody wanted me to ask you but I know we're a couple of minutes over 1:30. Do you have a few minutes or do you have to jump off?

Luis: No, I'm okay.

Jacob: Okay, perfect. So the next question comes from Sarah Kennedy and she said, "My interest is in the application of AI to the call center space. It seems to me that there are two areas, supporting call center representatives to be better or eliminating call center representatives through enhanced self-service. Perhaps it's first one and then the other? But what are your thoughts?" And of course, that's another big area where we see AI, right? Call service representatives, customer service and the introduction of AI. Any thoughts on that?

Luis: So I see the path of having cost and the representatives improve much more likely to make economic sense than the alternative because what I do today, every time I get a semi-robotic call center response is I immediately speak out very loud, representative. And I ignore their prompts.

Jacob: Or you push zero like 50 times, that's what I do.

Luis: Exactly, because I just don't ... I mean I have a problem. I really want my problem solved and all their efforts to save cost just annoy me. So if they do that ... I've actually even changed suppliers or service companies because they would just push me through these kinds of processes. What might happen, and that would be bad, is that if people do automate some of those call centers and reserve the humans for the higher paying customers, that would be bad. In the long term, that would be horrible but again, that's not an AI problem. It really is a management problem.

Jacob: Maybe that's another good area that we need to think about, is the difference between an AI problem versus kind of a human decision-making problem because at the end of the day, it still comes down to choice, right? I mean we can decide if we wanna replace these workers or not. Nobody's gonna force us to do it.

Luis: Actually, you wrote about that in a piece recently that you mentioned that maybe ... I think I'm going to paraphrase you so I apologize in advance for getting it wrong but I think you mentioned that a lot of effort has gone into proceduralizing and process-oriented thinking and so what has resulted is people creating jobs are actually very boring. And so those jobs are the ones that are being automated, which actually creates inputs to actually think about better jobs.

But the way I read what you wrote, it looks to me, a lot like a management problem, we need to train better managers that think less process and think more solving real problems because when you solve a real-world problem, you actually really create jobs. An organization that survives and thrives. When you just start at tactical about saving cost here or there, like their process and so on so forth, it looks efficient for a little while that the organization eventually has problems.

Jacob: Yeah, no and that's I say pretty good paraphrasing. The other thing that I always talk about is one thing that you mentioned. With all the AI debates, it seems that one thing that's very common that's missing is the humans still want an experience.

If I go in a car somewhere, if I get a car service or if I'm working with an assistant, or if I go to a coffee shop to order something, there's still the experience of interacting with a human. "Hey, how are you?" They write your name on the cup but they make something the way you want it because they know who you are.

There's something about that versus just assuming that all I want is efficiency in getting me from point A to point B. Sometimes, I do just want a problem solved, sometimes, I do just want you know the coffee waiting for me but sometimes, I also want that experience. I want the driver while we're going through the city to tell me what's next to me. I want somebody to say, "Hey, how are you? How's your day going?"

I don't just wanna just be taken from point A to point B. And it seems like a lot of the discussions around AI make that very big assumption that we only care about efficiency and we don't care about the experience of what that's actually like.

And there's a really good quote that I always use from Magnus Carlsen who's the number-one chess player in the world. And somebody asked him in an interview, they said, "Well, what do you think about AI in chess?" And he said, "Well, I fully accept that if I play a piece of software, that the software will beat me. I don't pretend that I'm gonna beat the software. But when I sit across the board, it still feels like I'm playing somebody stupid."

And I thought that was a really great quote because there's something to be said about an algorithm or a piece of software that can do something versus truly understanding that it knows what it's doing and why it's doing it. So I think the experience piece is still very, very important and that's kind of what you mentioned earlier.

Luis: I agree and to me that was a major revelation when back in the day when I finished my PhD, I realized I didn't want to produce more algorithms that felt stupid. And I have a lot of respect for people that do those algorithms. I don't mean to offend any of my colleagues but I wanted more and what I crave for is that conversation.

So to me, when all these interest in AI picked up, which it started about a year, two years ago depending on where you are. To me, it was finally the opportunity to have a real meaningful discussion about there's an AI that's possible today, which really helps us solve problems but engage in those very limited conversations.

And we've got a lot of work on that anywhere from genetics, to finance, to software location where you are actually building a narrative over the AI and the result, what matters is the narrative you've built together, which is the experience that you are talking about.

We humans are awesome at storytelling and we're awesome at taking in stories and we're awesome at interpreting those stories and what you really wanted AI do have to do is make sense of the world surrounding you back there with models that you could not have thought of before but not really replaces you, that makes you only smarter because you are the super, super intelligent storyteller or sense maker if you want to say that.

So I agree it's the experience and my hope is that we see that there is a lot of problems out there for which the way we were approaching things do not really make sense. And that angling it on the experience, on the problem you're solving, on the entire thing you want to change is actually so much easier than just going for tactical one-off problems, like a great chess player.

Jacob: Yeah, no. Very well said and it seems like we're definitely aligned and on the same page, which is great. Well, I could keep talking about this for hours but we've been talking for over an hour and you've been very generous with your time. Any last parting words of wisdom when it comes to AI? Is there anything that you want people to know about? And after that, I'll ask you where people can go to find you and some of the research that you're doing. But any last parting words of wisdom on AI?

Luis: My take is that AI is a path to solve problems in ways we have not done before. It is not a threat. It is not the Terminator. It is not Ex Machina. Those are movies. We're pretty good at figuring out ways to destroy ourselves already without AI. So the real opportunity here is really inventing new problems and with that new jobs.

And that to me is the thing that's been kind of motivating me for 20 years and like me, many of my colleagues here, we started with the problem first. We didn't start with just trying to build a better algorithm. And there's hope because everything we've developed over the years has actually already helped a lot of people get new jobs.

The companies we have today would be unimaginable without the advances we've done in machine learning, data science and so on. I mean Amazon, Apple, Facebook, Uber, and I'm just mentioning big companies and you see how big those have become and how far we have yet to go to even create a minute artificial intelligence.

So not only there's hope, there's plenty of opportunity but what we need to do is imagine these problems ... new problems to solve, not continue to further on the dystopian AI discussion.

Jacob: But those are fun movies though.

Luis: Oh no, don't get me wrong, I love every single one of the movies I quoted. And I'm a sci-fi geek like the best of them.

Jacob: Yeah.

Luis: So [inaudible 01:11:51].

Jacob: Yeah, I love sci-fi as well. Where can people get ... First actually, now you have to tell me what's your favorite sci-fi movie.

Luis: Oh gosh, that's such a hard question.

Jacob: Or a good one that you recommend people should check out.

Luis: By the way, that's the hardest question you've asked me today, to choose among so many. So I've seen Blade Runner probably 20 times.

Jacob: Great movie.

Luis: I loved it and it's one of the first movies to talk about robots but it does so in such a different way. Robots and augmentation, that's what was already there in the '80s but that's such a great movie. [crosstalk 01:12:36]-

Jacob: New one is coming out too.

Luis: I know. I'm so excited about that.

Jacob: Sequel will be great. All right, so that's everyone's homework assignment is to go watch Blade Runner if you haven't seen it. And lastly, where can people go to learn more about you, some of the research that you're doing and any of the work that you're involved with?

Luis: So the best place I've been most active at keeping up to date is my LinkedIn profile. It's easier to reach me out through there. And then a lot of my thinking has actually made it into into the book, and a lot of it is also appearing in my LinkedIn profile but recently, I decided that LinkedIn is the best place as of today to start to share some of my professional activity. So I'm starting there mostly.

And then there is a spread of things on MIT websites where you can find my name there. I would start with Google and start the conversation with Google since we talked about [inaudible 01:13:29] with machines to find out more.

Jacob: That's a good place to start, I agree. Well, Luis, thank you so much for taking time out of your day to speak with me. This has been a lot of fun. I learned a lot and thank you for being so gracious with your time.

Luis: Thank you so much for having me. I had a lot of fun as well.

Jacob: And thanks everyone for tuning in to this week's episode of the podcast. My guest again has been Luis Perez-Breva. He's the faculty director at MIT's Innovation Teams Program at the School of Engineering and Sloan School of Management. And make sure to check out his new book it's called, Innovating: A Doer's Manifesto for Starting From A Hunch, Prototyping Problems, Scaling Up, and Learning to Be Productively Wrong. I'll see you guys next week.

