# AI and The Evolution of Work

## Responsible AI Summit

Hi my name is Julian, it's really great to be here and get to know you all bit by bit. I work at a robotics and AI company called Kindred where my team and I are focused on the problem of robotic grasping and manipulation: how to teach robots to pick stuff up.

Today, I want to talk to you a little bit about AI: how it's evolving the work that we do, and its impact on jobs. The systems that my team and I are building, are the type of systems people typically point to when they talk about the "future" of automation. But I'd first like to ask...what even is the "future" of automation? If you asked people from the 18th century you'd get a response something like this.

[the rural postman] or [the new fangled barber] or [at school].

Looks like they were off about a few things. Predicting the future wasn't so easy, and it's no different today.

[show chart]

This chart is work done by the Machine Intelligence Research Institute on trying to decompose the various predictions being made about AI. The y-axis is the year experts and non-experts believe we will have AI with human-like intelligence, and the x-axis, when the prediction was made. Most commonly, they found that people's predictions were continually 15-25 years ahead of the date those predictions were made, and that a sizable portion of experts believed we'd of had human-like AI by now.

Yes, predicting the future is hard.

[electronic, connected, etc. image]

The path that these innovations take, and the timing of them is unpredictable, but the general direction of where they're going is perhaps not. There was a phase when humans were racing to make everything electronic, then to make them connected, then mobile. Now the race is to make everything intelligent. Some are calling it "cognification".

Now rather than speculating about the future, and almost certainly getting it wrong, I'm going to give you my perspective as someone who is actually building these systems on what I'm noticing.

What's different about this new wave of robotic automation is that we are starting to automate tasks that have unstructured input, something previously only in the realm of human capabilities.

[driving, nature image]

So much of the world around us is unstructured: our speech, our driving, art and creativity, nature... the majority of the physical world.

The work humans perform, and excel at, is dealing with this unstructured “stuff”: either making sense of it like building reports and making decisions, or interacting with it like forming relationships, or trying to put it into a structure: through sorting, or building,

In this next wave of robotic automation we’re now applying these AI systems to physical machines, enabling them to interact and influence the physical world. I believe this unlocks the largest door yet for AI, and automation as we know it.

[kindred research image]

But getting this to work is difficult and so far it’s required many breakthroughs. For example, collecting data on real hardware takes a very long time. So researchers and engineers often first train in simulation. They then have to deal with another challenge of how to map learnings from the simulation world to the real world. Another challenge is simply getting learning algorithms to work on hardware, particularly in a closed-loop setting where there’s latency, and noise in sensorimotor control.

Now if I was in the other room over there I’d tell you how we’re building these machines, but since this is the Responsible AI summit here and all the ethical people are here I’m going to answer a different question…. as we continue to work through these challenges, and eventually solve them, what will it mean for the people whose jobs now run the risk of becoming automated?

Let me tell you what I’m noticing.

[video of Sort]

Where I work at Kindred, we have machines running in production leveraging machine and reinforcement learning to solve unstructured tasks. We began with a seemingly simple-sounding one: and that’s “sorting”. We built ML and RL systems, motion planning software, drivers, and lots of software glue so these services could talk together. We bought an arm, and a depth camera, and we built our own hardware: end-effectors and grippers, chassises, circuit boards, etc.

We put these things together, we started collecting lots of data, and learning more about the problem. We eventually built something we called Kindred Sort.

[gap image]

We deployed them at customers like GAP to have them sort people’s orders,

And of course, the media said something like this.

[media article, robots taking over the world]

They also said this

[media article, good]

And this

[media article, good]

But what about the ones interacting with these robots on a daily basis - the on-site staff. What did they say?

[excerpt from Barbra].

I think this is really cool, and one of the patterns that's becoming apparent to me. Not just this human-robot interaction, or augmentation; what I'm noticing is humans moving up the stack.

[image of sort in the wild]

As robots are getting better at solving these unstructured, physical tasks, humans are now moving up to manage these intelligent machines.

Also, we don't have to wait for the machines to be better than humans for them to be deployed at scale. For example, Kindred's Sort solution hasn't reached human accuracy across all item types - and over a short time period, it may be slower than a human...but it's predictable and can be easily scaled up and down which overall gives better value for the customer.

Here's another interesting example.

[human pilots image]

When we first started running these machines in production, we would have people in our Toronto office remotely controlling them to do picking. This was a new type of job: we called it piloting, and we called this mode of control teleop - or teleoperation. On day 1, the pilots were doing 100% of picking. As we rolled out our autonomous grasping system that number became 80%. As we continued to learn from human data, human picking, we've gotten that number of human-controlled teleop picks to less than 1%.

[autograsp image]

In other words, autonomous grasping happens nearly 99% of the time; and we're In other words, autonomous grasping happens nearly 99% of the time; and we're autonomously picking millions of units per week. Now our pilots are rarely picking. So what are they doing instead?

They're managing entire fleets of robots. They're working more closely with the customer. They're building relationships. They're working with our on-site associates to help carry out maintenance of the machines. Another way workers move up the stack is by teaching robots through labelling efforts.

These are entirely new jobs that were created by robotics and AI. But what about the job that this robot is now performing, that used to be done by a human. I think this part is particularly interesting, but requires some context.

[photo of gap inside]

In many industries, like retail for example, there is seasonality to their sales. Towards the end of the year, sales can peak to 10x the average. Trying to find temporary workers that quickly, train them, and then have to let them go, is a strain on everyone. And, frankly, some of these jobs have unpleasant aspects like stopwatched-timed breaks, and human speed requirements forcing people to operate like a machine.

We took the approach of "robots as a service". The customer simply pays per pick, and there's no capital investment upfront.

Instead of having workers standing all day sorting through thousands of items - they're being retrained to interface with the robot, handle item anomalies, and do basic maintenance - all higher-skilled and more interesting forms of work. Meanwhile, with the help of the machines their sorting at a much higher throughput.

[team after a deployment]

It's been amazing to see how quickly they've onboarded to do these more technical tasks, and they really like it. Many went from "warehouse associate" to "robot technician" and "robot production manager", and they wear that badge with pride

Now we were able to retrain these employees in a reasonable amount of time. However, this general topic of "retraining" and how much this next phase of automation requires - I found was rife with disagreement. The reason why I believe is two-fold.

[displacement and productivity effect image]

The first reason is that there are several competing effects going on that make estimations very difficult. There's the displacement effect: automation can directly displace workers from performing specific tasks. Then there's the productivity effect: automation can also expand labour demand through the efficiencies it brings to production. The interplay between both

effects predetermines the overall impact on jobs and makes it very hard to predict. I won't go into all the studies, and estimates published but it was all over the map. Some were saying 14% of our jobs would be impacted, others estimating 47%.

This disparity has a second reason. Not all labour markets are obviously the same.

Countries and industries all vary in their use of tech, their availability of infrastructure, the skills and education level of their workforce.

This leads me to my next observation: there'll be short-term disruption and augmentation as we've been discussing, but long-term societal shifts.

What do I mean by that?

[agriculture, manufacturing, etc. image]

In the 18th and 19th century there was a first wave of automation that took place in agriculture. In Europe employment of agriculture went from 54% of the entire labour market to 17% over 100 years. Where did it go? To manufacturing. Then another wave of automation came. If we look at the United States this time: employment in manufacturing went from 26% in 1960 to less than 10% over the past 60 years. Where did the workers go? To the services sector.

So, the increased automation in one sector led to a boost in productivity and reduced the need for workers there, allowing resources to migrate to other sectors and goods. However, this time it's almost certainly going to happen faster than previous waves. Technology and network effects have an exponential behaviour. How it will be managed is going to be crucial since it's not spanning generations of people, it's happening mid-flight in their career. And it's not just affecting low-skill labour, but medium-to-high as well.

[open loop and linear image]

How do we best manage this transition going on right now? Many will need to change the way we think about their jobs. Linear career paths and one job for life are not supported in this new model of automation. Neither is the approach to education of "being done" once you've graduated. Some schools, like Stanford, are looking into an open-loop model to education where it's a fixed number of years of schooling, but those years span over one's lifetime interlaced with their work. This way they can continue being trained. Some larger corporations are experimenting with a similar principle. They're offering internal education platforms for employees company-wide, allowing them to change their internal career prospects instead of just continuing with the linear career path.

These are just some of the ideas being pursued, stressing the importance for more attention to be placed on the retraining effort.

...If I haven’t stressed it enough, this next phase of automation is happening. Even without additional breakthroughs, there’s a huge impact to be had with just more time to implement and bring existing AI solutions to market. Though, we know breakthroughs will continue.

With more and more organizations deploying these AI-powered robots my sense is we’ll continue to see organic cases of “humans moving up the stack”.

A final thought to leave you with, that’s been inspiring to me… apparently… even some 2300 years ago Aristotle pondered on what would happen if machines could become sufficiently advanced. Though we are still on that same quest to find out, this generation we may get the opportunity to finally answer it as the builders of it.