The Association for the Advancement of Artificial Intelligence's New Award for the Societal Benefits of Artificial Intelligence — An Interview with Richard Tong

Conducted by Ashok Goel

■ *In this interview, conducted in early 2020 by Ashok Goel, Richard Tong, the chief architect and general manager of Squirrel AI Learning's US operations, discusses adaptive learning, challenges facing AI in education, and the Squirrel AI Award for Artificial Intelligence to Benefit Humanity.*

I n May 2019, the Association for the Advancement of Artificial Intelligence (AAAI) and Squirrel AI Learning announced the establishment of a new $1 million dollar annual award for societal benefits of artificial intelligence (AI). The award is sponsored by Squirrel AI Learning as part of its mission to promote the use of AI with lasting positive effects for society. The award, called the "Squirrel AI Award for

Artificial Intelligence for the Benefit of Humanity," was announced jointly by Derek Haoyang Li, founder and chairman of Squirrel AI Learning, and Yolanda Gil, president of AAAI, at the 2019 conference for AI for Adaptive Education, held May 24 to 25, in Beijing, China.

Established in 2014, Squirrel AI Learning Intelligent Adaptive Education by Yixue Group[1] is the first AI company in China to apply AI-powered adaptive learning technology to K12 education. Squirrel AI Learning products use a model that combines AI and human coaches to provide students with access to individualized and affordable high-quality education. Although the focus of Squirrel AI Learning is on education, Li insisted that the award must recognize AI innovations across all disciplines. The establishment of this award aims to inspire the AI community and draw attention to AI that can benefit humanity. This new international award will recognize significant contributions in the field of AI with profound societal impact that have generated otherwise unattainable value for humanity. The award nomination and selection process was designed by a committee led by AAAI that included representatives from international organizations with relevant expertise that were designated by Squirrel AI Learning.

In this edited interview, conducted by Ashok Goel with the assistance of Ida Camancho, and Richard Tong, Squirrel AI Learning chief architect and general manager of US Operations, we discuss adaptive learning, challenges facing AI in education, and the Squirrel AI Award for Artificial Intelligence to Benefit Humanity.

Can you tell us a little bit about Squirrel AI Learning?

Derek Haoyang Li is the founder of Squirrel AI Learning. Li founded his first company after graduating from college. He went on to establish two others, all in the field of education.

While heading his second company, Shanghai Only Education Group,[2] Li found that turnover among teachers was a problem of concern. Although the Shanghai Only Education Group used about 28,000 teachers, their annual turnover amounted to approximately 8,000 teachers. Li soon realized that as teachers gained experience, they were more likely to leave. The reasons varied — for instance, some teachers decided to open their own tutoring companies; others chose to jump to smaller institutions where they could be more in control of the business.

Turnover, however, Li realized, was a huge problem for after-school programs because the quality of the teachers is paramount. In after-school programs the student's parents, rather than a school district of teacher's union, control which teacher to use and what type of program they want to send their kids to. This difference makes the reputation of the institution less important than the reputation of the individual teacher. Parents and students place greater importance on individual teachers' quality and reputation.

Realizing this, Derek asked himself, "How do I maintain quality while also retaining institutional knowledge that can be reused?" He tried many approaches and made many attempts to solve the problem. He built a large product team, established curricula, and created tools that could be reused. He also worked with content providers as well as other research and development companies to standardize the best practices and training.

Li also came to the USA to look at how US companies were working. One of the companies, Knewton,[3] was the company where I used to work. From his visit to Knewton, Li saw that this was a company that was able to use AI to amass a great deal of teaching knowledge, use data to validate that knowledge, and then reuse that knowledge in a general way.

Li also analyzed an after-school learning company called Kumon,[4] which had a tremendous influence on his chosen approach. Kumon used a learning model called *manual adaptive* rather than *AI adaptive* to teach their students. In the manual adaptive model, a student comes to the school and receives a worksheet. Based on how successfully the student performs, the next time they come to school they might get a different worksheet. The teacher doesn't actually teach — they just give students practice, based on their progress. Kumon's model is very useful — especially when you're talking about fundamental skills that require a lot of practice — and it is quite targeted.

Li examined these two types of models and noted that the traditional Kumon manual adaptive model did not rely on the teachers that much, while the Newton AI adaptive model obtains instruction recommendations and learning path recommendations from a machine. Based on his study of these two companies, Li formed a new company, with some of former colleagues, and relying on the avant-garde talent that he already had, to accomplish something different and a little bit more impactful. The result was Li's new company, Squirrel AI.

The Squirrel AI model is business-to-consumer. We have franchisees, but we control everything. We're combining three key components for an AI solution, the AI engine itself, the content and pedagogy, and the operation and service. We want to use AI to teach. The model is not about the teacher anymore. The model has shifted the center of the learning universe to students. It's all about one-on-one instruction, feedback, practice, and personalization.

That's the Bloom's two-sigma effect?

That's correct. Bloom found that the average student tutored one-to-one using mastery learning techniques performed two standard deviations better than students who learn via conventional instructional methods. So, we shifted the focus from the teacher as a deliverer of the information to the student who is learning. If you were to compare the traditional education model and

the one-to-one teaching model, it would be like comparing a bus with a taxi or an Uber.

When using a traditional model, the biggest waste of time occurs when a teacher is teaching at a pace that is inefficient for the student. That unfortunately happens with great frequency, even when you're teaching to the middle, because every *middle* person is different.

For example, consider the example of the AAAI conference. Although attendees go to the large lectures, the most valuable interactions don't take place there; they take place one-on-one. When I attend a lecture, some of the content might be familiar, but other portions might be difficult to follow. The result? I immediately get lost. Consequently, at large lectures, I would say that only 10 percent of my time is spent efficiently, where I'm really actively learning, thinking, and absorbing content.

This circumstance is also true even with a good professor, who might be explaining things that the student might already know, or presenting concepts that might be too far ahead for the student to grasp. Although the student might not fully understand the material being presented, the professor moves on to the next topic. That occurs all the time in the traditional classroom.

This is where AI comes in. If you have AI, we can afford one-on-one teaching for everyone. In the past, the hurdle was that the teacher is a limited, and expensive resource. It's a resource that we cannot afford to give every child.

Currently, at Squirrel AI, we have an AI and coach combination model. We still have a human coach that is providing the emotional support and filling in the gaps. The majority of the time, teaching can be done very routinely, repetitively, and consistently by AI. However, when students get stuck or have trouble understanding the AI-provided instructions, human coaching comes in.

It's a complete spectrum for the age group we work with in all subject matters. Squirrel AI is not, however, a test prep company. Traditionally, many adaptive companies come from test prep where the learning goals are very clear, and it is very easy to do optimization. You can say "If I want to optimize test scores, then these are the things you have to know."

And this is an ill-defined problem …

Yes. Squirrel AI takes this approach one step further. Our learning goals are just synchronizing with what students have learned in school. It is a little bit more difficult to accomplish than test prep, but is still a lot easier to optimize than teaching creativity or computational thinking, where the goals are difficult to define and one cannot build objective functions very effectively.

So how would a school measure success?

The Squirrel AI model follows a process where you start from diagnosis, then move to recommendation, then feedback, and then collaboration. In the future, we hope also to include motivation in the process.

In our process, the two key steps are *diagnosis* and *recommendation*. We continually diagnose students as they're learning. We track keystrokes so that we know where the student is in the process, how far they have come, how fast they are solving a problem, and other relevant knowledge. Then we calculate the probability that the student will be able to solve the next question, and use that to diagnose the student learner's profile. In so doing, we build a continuous learning profile. We feed that profile into a learning map — our objective functions.

We look at the knowledge graph and say to the student, "In order to learn these concepts, you probably need to learn this other concept first. Also, these two ideas are similar. Maybe you can try this." We call this process a global positioning system for learning.

Returning to the analogy of a taxi versus a bus. Taxis must be driven by a human driver who has a great deal of mapping information. With a global positioning system, you don't need to rely on the mapping knowledge of the human driver anymore. Instead, you can have a decent driver who does not have a lot of mapping information, as long as they can rely on a global positioning system to tell them where to go and how to get there.

The notion that we can build the student profile is a very open, very hard problem. You mentioned leveraging content maps, learning trajectory, and learning progression to able to optimize the learning for every individual student. In a way, hasn't that been the dream of AI in education for the last 40 years?

It has been. However, the fundamental question is still difficult because we still don't know how humans learn — we're still struggling with that question.

Often, when we look at kids younger than seven years old, they are mostly using System-1 learning. After age nine, they begin using a different learning algorithm altogether. The principles that we are looking at — Bloom's two-sigma, forgetting curves, zone of proximal development — are fundamental. We could try to look at everything that is relevant, and try to solve all the detailed nuances, but even focusing on the basics will have impact. The big thing to remember is that we are working against a very inefficient competitor — the traditional system. Even if we just keep students learning with an appropriate amount of difficulty, we are already far ahead.

So instead of solving a big problem that none of us can fully grasp, what you're saying is we are here, and if and we can make a delta difference, that is already a win?

Yes, it is already a *big* win. We have demonstrated this in advocacy studies in what we call *human versus*

*Richard Tong, Chief Architect and General Manager
of US Operations, Squirrel AI Learning by Yixue Group.*

machine competitions. These competitions were conducted both for publicity and evangelism, but also because we wanted to confirm that we were able to beat human teachers and the traditional model every time, hands down.

*Do you think there is a point at which
a human teacher becomes less necessary?*

Again, going back to the taxi and Uber analogy. If you look at taxi drivers, when GPS [global positioning system] and the Uber operational system were introduced, the total number of drivers exploded. There are many more drivers because there are so many that are enabled by AI smart tools.

What we see as a society is that we benefited from much more personalized services. In the past, not as many people took taxis all the time. Today, however, many people are using Uber or Lyft.

At Squirrel AI, we are experiencing a similar trajectory. From the beginning, we have seen that people who are not qualified teachers can now actually make a difference. In our case, most of our teaching staff have just graduated from college. Traditionally, such people could not really be very effective even as a one-on-one tutor. Now, however, they can be, because we're expanding that capability for them, and in the process helping students get the same benefits at a much lower prices.

Over the longer term, we're also looking at another shift. In the past, if a parent was good at everything and knowledgeable in every field, then the teacher probably had less difficulty in teaching the child. Many of the best students also have very good parents at home providing one-on-one help. However, the degree of parental support available can be hugely different depending on family background. By adding AI, we can almost say that every parent can become much more effective.

*This is a very important point — if we
can make education more accessible and
affordable, then it helps make it more inclusive
and equitable. And everyone has an access to it.*

One of the narratives we had was about gender. If you look at the past, we see that even many good teachers hold stereotypes. My daughter often tells me that her teacher thinks that she's not good at math. I know that the teacher does not mean to be biased — the teacher simply might hold a widely held stereotype about girls and math. But when students use our artificial AI tutor, they don't experience such unintentional biases.

Instead, the AI tutors look at what the student knows and what they don't know. The tutor will simply tell the student that they arrived at a wrong answer, which is much more objective. AI actually reduces the gender gap, because if you examine much of it, you will discover that it's not because the students are not good, it is because of their surroundings; it's the people they regard as the authority figures, or the people they think are good peers. We are again leveling the playing field and reducing bias.

*How will you measure success
in five years … in ten years?*

There are several thresholds we want to cross. First, from a business model point of view, we want our approach to be become very scalable and sustainable, which means that we really hope that AI can become an important factor, or an ingredient of success, not only for us, but for the whole industry; and not only in China but throughout the globe. We feel that personalized learning using AI can be very fruitful here, and I think we could consider it success if we can make AI fifty percent of the equation.

Yolanda Gil and Derek Li.

However, in 10 years, we really feel that AI should be an integral part of the entire education system. We are involved with after-school programs, but we want public school education to also benefit from these advances. When you look at the education systems in India or in China, you see that the majority of students don't have access to quality education at all. So, we're talking about everyone — all humanity.

We believe we can make a contribution here. Because we save so much in terms of human resources, we believe we can enable teachers to become more efficient and have a much bigger impact on their student's lives. To us, that is success.

How did Squirrel AI think of the Squirrel AI Award?

This returns us to the question about how we think AI should be applied. As we're tackling these very difficult problems, we have found that AI needs four things: Good business models that can have continuous progress; data; computing power alongside good algorithms; and infrastructure.

The biggest part is really the the talents who can build the models and apply them to the business need. Who is really developing the algorithm? What type of algorithm should be applied? How do you really use data efficiently? The science of AI is already here, but take a closer look at the subfield of AI in education. If you look at the literature over the last 10 years, there has been little or no progress at all. We are still stuck with ACT-R and SOAR. Because of the focus on neural networks and deep learning, everyone seems to be concerned with images and auto-driving.

For example, look at the problem Squirrel AI is addressing in education. If you make a little progress, the benefits are enormous for society and also for kids — especially the children in poorer neighborhoods where they might not have access to good teachers at all, let alone personalized teaching for them. If we can apply AI to the education field, it is a huge win for humanity.

While Squirrel AI focuses on education, you have chosen to make the Squirrel AI Award open to innovations across all domains. Tell us about this decision and how it relates to your motivations for sponsoring this award.

Tom Mitchell, our chief AI officer, said "I want to do something that would have a lasting impact on humanity." So, we want to broaden the focus and apply AI to the benefit of humanity. One of

the reasons that we wanted to set up this award was to attract good researchers — especially top AI researchers — to pay attention to things in AI that may not be fancy or as deep as image recognition or translation. Mitchell originally suggested focusing on fields such as healthcare, education, the environment, and smart cities.

*Have you considered how this award
will shape the average person's view of AI?*

At Squirrel AI learning, we've discovered that parents are apprehensive to a lot of the nonhuman parts. We believe this award can help us do a better job of educating the entire public. Right now, there is much that is said about the negative aspects of AI. Biases and deep fake have become the narrative, and we don't often hear about the good the science can accomplish. This award is not about profit or smarter weapons or smarter surveillance tools. With this award, we hope to shift the narrative to AI successes.

Why did you pick AAAI as a partner?

The first reason is probably more coincidence than anything. The idea of AAAI as a partner came up originally when AAAI's president Yolanda Gil attended one of our conferences. We were initially thinking of organizations that have a large presence in the research community, and already have succeeded in promoting these contributions. That's a good place to start having these types of conversations.

We also looked at the way that we could make the biggest impact. Although we don't necessarily want to create another Turing Award, Derek thinks that what the AI field lacks is a high-profile AI award such as the Turing Award or the Nobel Prize. Also, there are no awards that really focus on the benefit of the science to humanity. Former AAAI presidents Yolanda Gil and Tom Mitchell helped us brainstorm how we could combine these two things and who we could partner with.

Another mandate was that the award had to be international; not just US-focused or China-focused or European-focused. We want to bring good organizations together, so we created a three-organization core with AAAI in the lead, along with European AI and China AI (again, we are a China-based company and would like some home support). Our goal is to create an award for the entire international community. When we look at how to benefit humanity, we aren't focused on a single race or a single country; we're really talking about the whole human race.

Take, for example, healthcare. Healthcare is something that is indiscriminate. Education is also indiscriminate. When education improves, anyone can benefit, so that is the object of our focus. Yolanda Gil has been quite supportive of our efforts, and helped drive the planning of the award as well as the nomination process.

*What can you tell us about the
award and nomination process?*

First and foremost, we want this to be an AAAI award. Although we are very honored to have our name associated with it, we really want this award to be about goals that are much bigger than what our single company is all about.

As for the process, it is handled by the seven people on the Award Committee — Yoshua Bengio, Tara Chklovski, Edward Feigenbaum, Yolanda Gil, Xue Lan, Robin Murphy, and Barry O'Sullivan.[5]

*How will you know that you have succeeded
with the Squirrel AI Award 5 years from now?*

If we are able to influence only one percent of the PhD students getting into AI into thinking about their impact on humanity in a beneficial way — we would consider that a huge success. If in any of the four fields that I've mentioned — healthcare, education, the environment, and smart cities — we can see that AI researchers are thinking not just about profit or competing in big AI competitions but also about humanity, the award will have had an impact. We are a small part of this effort, however; it takes a whole community to think that way.

Notes

1. www.aaai.org/Awards/squirrel-ai-award-call.php

2. www.onlycollege.com.cn

3. www.knewton.com

4. www.kumon.com

5. Regina Barzilay, the first Squirrel AI Award for Artificial Intelligence for the Benefit of Humanity recipient, was presented with her prize at the 35th AAAI Conference on Artificial Intelligence in February 2021.[6] An announcement of the award was published in the December (volume 41 no. 4) issue of *AI Magazine*.

6. aaai.org/Conferences/AAAI-21/

Acknowledgments

Richard Tong is the chief architect and general manager of US Operations, Squirrel AI Learning by Yixue Group. He is also the chair of the Institute of Electrical and Electronics Engineers Learning Technology Standards Committee, and the vice-chair of the IEEE Artificial Intelligence Standards Committee.

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