Goldman Sachs Exchanges: Great Investors
A conversation with Renaissance Technologies
CEO Peter Brown
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Raj Mahajan: Welcome back to another special edition of Goldman Sachs Exchanges: Great Investors. I'm Raj Mahajan, the Global Head of the firm's Systemic Client Franchise in Global Banking & Markets and your host for today's episode.

Today I'm delighted to be speaking with Peter Brown, CEO of Renaissance Technologies, one of the world's most successful investment firms that pioneered a new way to invest using quantitative strategies and predictive models. We will be discussing Peter's career, the role that machine learning and early generative language models have played in Renaissance's growth, and how the firm has navigated through the market's most difficult and volatile periods.

Peter, it's truly a pleasure to have you on the program.

Welcome.

Peter Brown: Thanks a lot, Raj. It's a pleasure to be here.

Raj Mahajan: Let's kick it off. Peter, my understanding is that you had nothing to do with finance until age 38 and, instead, began your career working on automatic speech recognition. How did that happen?

Peter Brown: So, at one point during high school I learned about the 4A transformer. And I thought this was about the coolest thing I had ever seen. Probably because I went to an all-boys' school and had nothing better to contemplate.

Anyway, for some reason I got into my head that with the 4A transformer it should be possible to recognize speech. You just take the speech data, transform it into the frequency domain. Match it up against patterns for words. And presto, magic, HAL would be born. And this idea always stuck around in the back of my mind.

Then when I went to college I majored in math and physics. But in my senior year I had to fulfill a distribution

requirement. So, I took a course in linguistics. And one day in the back of that course I heard a couple students talking about some guy whose name was Steve Mosher who started a company called Dialogue Systems that was doing speech recognition. And I thought, wow, great, I remembered this idea from back in high school.

After class I raced over to the physics library. That's because this was before the internet, so you had to go to the library. And I looked this guy up. And I found a paper he'd written. And I tracked him down. Applied for a job. And he hired me. And when I was there, I just fell in love with the idea that through mathematics it might be possible to build machines that do what humans do.

I just loved the idea of exposing human intelligence to be nothing more than robotic computation.

Raj Mahajan: So, the class in linguistics was a springboard into you branching out into broader fields like machine learning and language, is that right?

Peter Brown: Yeah. After four years at this company, I went to graduate school at Carnegie Mellon where I studied

artificial intelligence. And my advisor there was someone named Jeff Hinton who *The New York Times* recently labeled as the godfather of AI. In fact, I was his first graduate student.

But while I was there, I had a girlfriend in New York. And so, I spent my summers working in IBM research. And then after I got my PhD, I went to work for IBM full time on speech recognition, machine translation, and the construction of what today are called large language models.

Raj Mahajan: So, when you say large language models, do you mean ChatGPT and what we're reading about today?

Peter Brown: Well, sort of. They were pre trained, like ChatGPT is. They're generative like ChatGPT is. And like with ChatGPT, the entire goal was to take a bunch of text and predict the next word of text. But remember, back then it was before the internet and before the NVIDIA gaming chips. So, we had a lot less data and a lot less computer power. And we were constantly scrounging around for data from places like the Canadian Parliament, the Federal

Register, the American Reading House for the Blind. We even got data from the depositions in the IBM anti-trust lawsuit.

We had very little data. And very little computer power. Just some time allotted to us on an IBM mainframe, which is probably less powerful than your cell phone is today. But yes, like with ChatGPT, the idea was to see if we could build a language model purely from data that would mimic human knowledge of grammar and semantics.

Raj Mahajan: How'd it work?

Peter Brown: So, 35 years ago we published a paper on one such model. But instead of using the transducer technology that's in neural networks today, we used a somewhat different technology. And whereas ChatGPT was trained from 300 billion words of text, our model was trained from around 100 million words of text.

The idea, again, was to take a bunch of text and assign probabilities to what the next word might be. So, we could use it to generate text. And I brought along an example, because you had asked me about this.

Raj Mahajan: Very cool. Let's hear it.

Peter Brown: Yeah. This is an example of text that was generated 35 years ago from a generative pre-trained language model.

"What do you mean?" "I don't know," said the man. "Is it," he asked, said the man. "They are not not to be a good idea. The first time, I was a good idea. She was a good idea." "Certainly," I said. "What's the matter?" "May I be able to get the money," said the man. "Scott was a good idea." "Mrs. King," Nick said, "I don't know what I mean. Take a look at the door. He was a good idea." "I don't know what I mean. Didn't you," he said.

Now, I don't know where all this "I don't know what I mean" is coming from. And I don't know where this "good idea" stuff is coming from. Maybe that's the way they talked in these IBM depositions. They constantly talked about good ideas. I don't know. Anyway, you can see there's been a lot of progress in the past 35 years.

Raj Mahajan: Nevertheless, it's still pretty amazing you

were working on this back then. Obviously, you didn't get the reaction to that paper that ChatGPT is receiving today. I'm curious, what did people think of your work at the time?

Peter Brown: Well, back then the party line was that to have a computer do tasks that humans do, you had to feed the computer with a bunch of domain-specific knowledge. So, for example, if you wanted to do French to English translation, you had to tell the computer about French grammar.

And we came along and were feeding it nothing but data. And that approach was really frowned upon. In fact, our first paper on translation received a two-sentence review, which I have posted on the wall in my home study. And remember what that review said. It said, "The information theoretic approach to machine translation was, indeed, first suggested by Warren Weaver in 1949. And was universally rejected by 1950. The paper is simply beyond the scope of COOLING.

Now, COOLING was the name of the conference that we submitted it to. Amazingly, despite this rather scathing

review, the paper was actually accepted.

Raj Mahajan: That's like the news article in a locker room that motivates the team for next week's game. I want to zoom out a little bit just to give some perspective on the impact of this work. How does your work on translation relate to what we might see today in Google Translate?

Peter Brown: Well, when we got the Canadian Parliament data, we found it came in both French and in English. Our thought was to see if we could build a translation system entirely from that data. We did this by imagining that translation was a statistical process and we would estimate the parameters from the data. And I thought the thing worked surprisingly well. It was nothing like translation by today's standards. And Google and other firms have taken this to an entirely different level. But still, it was a start. And I was quite happy with it.

We had a contract to do machine translation from the Defense Advanced Research Projects agency. But we were always looking around for an application that would convince the IBM brass that we weren't completely wasting our time.

At one point we decided to create a spelling corrector. And we thought we could create this fantastic spelling corrector because we could take context into account, which currently spelling correctors, current at that time, did not do. They didn't do it because they didn't have language models and they didn't have the computational power to be able to do it before then.

So, we took the Canadian House of Parliament data, and we built a big language model from the English side of that data. And then we built a little model of keystroke errors and used it to create a spelling corrector. And we demonstrated it to IBM management.

And what we found was, and what they found was no matter what they typed in, the system would clean up all their mistakes and produce English text. They were amazed by this. So, at one point, one of them went up to the keyboard and just typed in a bunch of random keystrokes. And out came the sentence, "Politics cost Canada more than bear hunting." Which, I guess, is the kind of random statement a Canadian Parliamentarian would make back then.

Raj Mahajan: Seems that you were right at the vanguard of the machine learning movement in 1993. So, why did you leave an exciting career at IBM for a small financial company in Long Island that no one had ever heard of?

Peter Brown: Bob Mercer and I had each consulted for IDA in Princeton. And Jim Simons used to work at IDA. And he had hired an IDA cryptographer named Nick Paterson. And Nick recommended us to Jim. And so, Jim then sent us some letters.

I threw mine out because I was very happy with my job at IBM. But Bob decided to go out and check the place out. When he came back, he told me I should go out there too.

Now, I had no idea who Jim was. But I learned that his original partner was someone named Lenny Baum who had invented the EM algorithm. And we knew all about the EM algorithm because we used it heavily in our work on machine translation and in speech recognition. So, I figured if Lenny was Jim's partner, Jim had to be a serious customer.

Then three things happened. First, Bob had a second daughter accepted to Stanford. But he couldn't afford to pay for her to go to Stanford on his IBM salary. So, she had to go to the agricultural school at Cornell, which offered scholarships to New York State residents.

The second thing that happened is we had a daughter born. And a third thing was that Jim then offered to double my compensation. After that offer, I came home. I took one look at our newborn daughter and realized I had no choice in the matter. So, the decision to leave computational linguistics for a small hedge fund that no one had ever heard of was made purely for financial reasons.

Raj Mahajan: So, when you arrived at Renaissance in 1993 with no background in money management, what did of actually do there? And what did you decide to do?

Peter Brown: Yeah, so Bob and I did different things. He wanted to work on futures, which was how they were making their money at the time. But I wanted to work on equities. They had just started an equities system. But it had only lost money. But I figured with all those stocks,

there had to be some way of making money. Unbeknownst to my wife, I put our life savings into the company's funds as a way of motivating me and set to work.

Now, when we arrived, we found a half a dozen mathematicians who were very smart and very creative. But they'd learned to program by reading the computer language models. And as I'm sure you can imagine, Raj, that's no way to learn how to program. They had no idea how to build large systems. So, part of what we did was to introduce what was then considered modern computer science to Renaissance.

They also had a problem. Their equities simulator made money. But their trading system consistently lost money. At one point, I had an improvement to the simulator, and they were going to code it into the trading system. And I asked, "How are we going to be sure that the trading system produces the same answers as the simulator?" And they said, "Oh, that's not a problem. We'll just read over the code very carefully." At that point I realized what the problem was. Because you can't verify how a computer program gets the right answers simply by reading it over.

I relayed this message to Bob who then joined me on the equities project. And he said to me, "Peter, the way to gain control of this company is to take over the code." So, that's pretty much what we did. We rewrote the entire equities system and then, just as Bob predicted in, I think, 1996, we were put in charge of equities trading at Renaissance.

Raj Mahajan: Fascinating. Okay. So, by 1996 you and Bob are running the equities side of Renaissance. How is it that you also branched into commodities, options, futures, and currencies, the other parts of the business?

Peter Brown: I think it was in May of 2002, Jim said he wanted to go out to lunch. Now, this is kind of weird because we always at lunch in the cafeteria. I thought, I don't know, maybe he wants to get a nice meal or something like that. I didn't know. But he took me to a greasy hamburger place down to the road because I guess that's what he liked to eat. But it was weird because I was largely a vegetarian.

Any rate, at that lunch he told me that he was planning to retire soon, and he wanted Bob and I to take over the company. His plan was to put us in charge of all the

money-making activities at the firm, that is everything except marketing, legal, HR, accounting, and so forth, at the end of 2002. And then retire a year later.

So, at the end of 2002, Bob and I also took over the rest of the technical side of the firm, which included the trading of currencies, bonds, options, and futures. Now, our plan was to use the equities code that we and others had developed to trade these other instruments. But we recognized they would not be so great for morale to tell, say, one of the futures researchers, "You know all that code you spent the last decade of your life developing, guess what, we're going to throw it out." So, we had to spend quite a bit of time getting everyone to buy into our plan.

To do this we used an approach that I learned from a biography I'd recently read of Abe Lincoln, which was to get them to come up with our plan themselves. Now, that took some time, but eventually it all worked out.

Raj Mahajan: So, you're reading presidential biographies, obviously preparing for leadership. Then did you become co-CEO in 2003?

Peter Brown: Yeah, so that was the plan. The schedule was for Jim to retire at the end of 2003. But then tragedy struck. Jim's son, Nick, drowned while diving off of Indonesia. A few years earlier, another one of Jim's sons, Paul, had been killed when he was hit while riding his bicycle by a car.

Raj Mahajan: That's tragic.

Peter Brown: It was really tragic. This is an understatement. It was a tragedy of immeasurable proportion. And it came shortly before Jim was about to retire. Everything was put on hold. Given what had taken place, Jim felt that he needed to continue working. So, he put off his retirement plans and focused instead on raising money for our institutional funds. He did this for another seven years. And then retired at the end of 2009. And at that point, Bob and I became co-CEOs.

Raj Mahajan: I'm really glad you brought up the institutional funds. Why did you create them? And how have they performed?

Peter Brown: Our investment strategy across all of our

funds is to maximize return, which we call mu, at an acceptable level of risk, which we call sigma.

I remember early on there was a guy at Renaissance named Andrew Mullhaupt who taught Bob and me about investing. He told us a story about a trader at some large firm who had evidently done a fantastic job at finding opportunities to make money. But he ended up blowing up. As Andrew put it, this guy was great at finding mu, but he had a problem with sigma.

That story really resonated with me. So, we put a huge amount of effort into controlling risk. Then at some point, I think it was in 2000, Jim came back from a meeting of the investment committee at MIT. He walked over to my office and asked me to imagine that I had married a Rockefeller. I said, "Okay." Thinking about that. Then he said, "What would you tell her to invest in? In particular, would you suggest that she put her money into the S&P 500?" I couldn't quite figure out where he was going with this.

Raj Mahajan: Yeah, where's he going with this?

Peter Brown: But I answered the question. I said, "No."

And he asked, "Why not?" And I explained, "Jim, you know the S&P is not a great investment from the point of view of mu over sigma in risk adjusted terms." He said, "Exactly." And then said, "Okay, suppose there was a vehicle that had S&P-like returns, but with significantly lower risk, would you advise her to invest in that?" I said, "Of course." He said, "Okay. So, get cracking and build it."

So, that was the genesis of the institutional funds. The goal was to create products with attractive, risk adjusted returns.

Raj Mahajan: How did the company change at that point?

Peter Brown: Well, when Jim stepped down, Bob and I had been running the money-making side of the business for seven years. And we had been running the equities area for 16 years. Not much really changed on that side of the firm.

But when he stepped down, we got control of the New York office. And the first thing I did was to walk around that office, find out what everyone was doing. And what I found

was that many people were doing jobs that could be automated. So, we set out on a massive campaign to automate our back-office operations.

We moved from checks and wires to SWIFT and ACH. We replicated counterparties margin calculations. We built a large legal database that could be accessed by computers to fill out regulatory forms. We brought in AI systems to automatically read and pay invoices. We automated the treasury department so that cash and margin needs could be managed by computers instead of humans.

My point of view was that Stony Brook produces a huge list of transactions and New York City produces monthly statements, K1s, and government filings. And I just didn't see why humans need to be involved in the process of translating trades to monthly statements.

Now, 13 years later, we're not done yet. And I'm embarrassed to admit that we still even have a few people who use Excel. But we're getting there. In fact, I was told recently that we've eliminated 97 percent of the spreadsheets that had originally been used in the company. So, that was the main area in which things

changed when Jim retired.

Raj Mahajan: That's a really high bar. Is it true that while Bob Mercer and you have different politics, you work closely for nearly 40 years at IBM and Renaissance?

Peter Brown: Yes. It's true. Bob and I began working together at IBM 40 years ago. And for most of the time, we've had offices right next to one another. So, we've done a lot together. And we're still really close.

In general, I find no better way of building friendships than through the collective creative process of building something together. And I see no reason why politics should interfere with friendship.

Raj Mahajan: At the start of 2018, Bob Mercer stepped down. And since, you've been the sole CEO of Renaissance. What effect did that have on the company and on you personally?

Peter Brown: So, Bob is an incredibly intelligent person. But he's a bit of a loner. In fact, I think when he was in high school, they asked him to take some test to see what

he should be when he grows up. And it came back recommending that he become a forest ranger so he could sit alone in a tower all day overlooking a forest.

Raj Mahajan: It didn't say a quant researcher?

Peter Brown: No. Thank goodness he didn't take their advice to become a forest ranger. At any rate, because Bob tends to be relatively quiet, I've always done most of the management. And as a result, what I did on a day-to-day basis really didn't change all that much.

But still, it was a huge change not to have Bob as co-CEO. When it was the two of us, we'd consult with one another and there was enormous comfort in knowing that we both took responsibility for what was going on. And that disappeared the day Bob stepped down. And since then, knowing that if something goes wrong it's all on me is quite stressful in a way that it wasn't when Bob and I were in it together.

Raj Mahajan: Aren't there others now at Renaissance with whom you can share those responsibilities?

Peter Brown: Certainly. We have an incredibly deep bench at Renaissance. And I'm continually astounded by the quality of our employees. Our Stony Brook office is chockablock full of highly accomplished physicists, mathematicians, and computer scientists. And our New York office is staffed with accountants and lawyers who make it clear to me every single day that scientists don't have a monopoly on brain power. So I'm surrounded and supported by an amazing retinue of outstanding colleagues.

Raj Mahajan: Peter, I want to explore risk for a few minutes. You mentioned 2020. But during your time at Renaissance, there've been other occasions when the markets have become quite volatile. For example, in 2000 when the dotcom bubble burst. Then during the 2007 August quant quake. The 2008 financial crisis. The 2010 flash crash. Can you tell us what it was like at Renaissance during each of these episodes of risk and volatility?

Peter Brown: Let me start with March of 2000 when the dotcom bubble burst. We were doing extremely well back then. And we had large positions in the internet stocks. They were traded on NASDAQ. At one point the

head of risk control came to me and said he was worried about the size of our NASDAQ positions. But I told him not to worry, the computer knew what it was doing.

Then we took a big loss one day. So, I worked through the night trying to understand what was going on. The next day we took another big loss. And I, again, worked through that night. So, now it's the third day and I hadn't slept for, I don't know, 48 or 50 hours. And I was sitting in a meeting with Jim and a few others when the head of production knocked on the door and asked to speak with me. I walked out of the meeting, and he told me we were down again by a large amount.

So, I walked back in the meeting, and I must have turned white or something because Jim took one look at me and said, "It doesn't look good." Now, not having slept the previous two nights, I remember thinking I'm not sure I can get through this. But I really didn't have much choice in the matter. And so, we got back to work and eventually we did get through it.

A couple days later I went into Jim's office and told him that I'd screwed up in not appreciating the risk we were

taking and said that if he wanted me to resign, I would resign. But he responded, "Peter, quite the opposite. Now that you've been through such a stressful losing period, you're far more valuable to me and to the firm than you were before." Now, that response really tells you something about Jim Simons.

Raj Mahajan: That's extraordinary. How about 2007?

Peter Brown: I suppose you're talking about the quant quake in 2007? August? When that happened, I was on vacation, and I was on a very long flight back to Newark Airport. And the moment the plane landed, my phone went nuts with all kinds of texts and missed phone calls.

So, I called into work when it was going on and I got Kim, Jim's assistant. And she said, "Jim wants you to get back here as soon as you're physically able." So, I raced out. I found a taxi, leaving my family to fend for themselves at Newark Airport. And pushed the driver to drive as fast as he could from Newark to Long Island. I ran into my office, and I found Jim, Bob, Paul Broder, who was head of risk control, all holed up. And the office was full of cigarette smoke. I could barely breathe. And then there was this, I

remember seeing this, 16 oz cup full of Jim's cigarette butts. And I'm thinking, like, why do they have to do this in my office?

And they were all staring through the haze at the computer screens trying to figure out what was going on. And Jim was interpreting every little wiggle and various graphs. He was really scared. And he wanted to cut back and hard. Paul also wanted to cut back.

Raj, I'm sure you know, the head of risk control always wants to cut back.

Raj Mahajan: Always.

Peter Brown: Because he doesn't get paid to make money. He gets paid to make sure you don't lose money. And Bob, you know, Bob's always very calm. But he wasn't against cutting back.

But I looked at the data and saw that the model had these enormous predictions, the likes of which I had never seen before. It was clear to me what was going on. People were dumping positions that were correlated with their own

positions. And they were driving prices to ridiculous levels. I felt they had to come back. I argued that we should not cut back. That this was going to be the greatest money-making opportunity we'd ever seen. And if anything, we should increase our positions.

But it was three against one. And so, we continued cutting back. But I succeeded somewhat because we cut back at a slower pace. And then at one point, miraculously, the whole thing came roaring back. And indeed, it was an incredible money-making opportunity.

Now, what we learned from that was to always make sure we have enough on reserve to just hang on. Later, when Jim was about to retire, I reminded him of this period and asked if he was concerned that I was going to be so aggressive that I was going to blow the place up. But Jim responded that the only reason I was so aggressive was because I knew he was determined to reduce risk, another example of Jim's insight into human nature.

Raj Mahajan: Wow. That's fascinating. Let's go to 2008 and the global financial crisis.

Peter Brown: Right. In the fall of 2008. In October, I think it was, we had more reserves on hand. And so, we were secure in our own positions. But others with whom we did business may not have been. At least we feared they may not have been.

Remember, in August of 2007, it was only the quants who were affected by the quant quake. In the fall of 2008, the whole financial system was stressed. So, we were concerned with the stability of our counterparties. So, we spent a lot of time with those counterparties and examined their CDS rates and so forth.

I remember at one point, two senior executives from some firm we did business with came into our New York City office to meet with us. They assured us that the funds we had in our margin account were safe with them. And I was inclined to believe them. Why not? But after the meeting, Jim said, "Peter, they wouldn't have come to our office. They wouldn't have requested the meeting unless they were in real trouble. It's time to get out." So, we did. And Jim was right because shortly thereafter, that firm just disappeared.

And then finally, I remember the final one, yes, it was the flash crash. That was May 6th, 2010, if I remember correctly. The Dow dropped a lot, like 9 or 10 percent and recovered, you know, a half an hour later. If you'd gone to lunch, Raj, or maybe didn't go to lunch, I don't know, you would have missed the whole thing.

For us, it was just another lesson in staying calm. We saw trades being executed at absurd prices. We also noticed large delays in the price feeds. So, we sat out for a little while waiting for sanity to return. It did. And then we went back to business.

For me, the most important takeaway from the flash crash was that exchanges needed to increase their capacity to handle spikes in volume. They've done this. And since then, things have been better.

I think that historically there are going to be disruptions like this from time to time. And I think the regulators have done a lot to prevent panic selling. But I also don't think they should get carried away because if you try to eliminate volatility, you'll also do a lot of damage to the markets and their ability to efficiently allocate capital.

Raj Mahajan: Peter, that's an excellent survey of the market risk events over the past ten years. I want to move to a different kind of risk, and that's Covid. How did you and Renaissance respond to Covid?

Peter Brown: Like everybody else, we sent everyone home during Covid. And with just a skeleton crew left in Stony Brook to keep the computer running and to man the trading desk. I suppose you guys did the same thing.

For about two years then we were working largely remotely. But unlike other firms, I don't know how you guys did it, I had no interest in seeing my colleagues' faces while we were at home. And I wasn't sure I trusted the security of Zoom or other video call services. So, we built our own conference call system that enabled us to hold meetings in which people could make presentations, post comments, raise their hands to speak and so forth. That really worked out well. So well that we continue to use it even when we're back in the office.

So, we got a lot during Covid. Probably because there wasn't much else to do. People couldn't leave their homes

and stuff. But I felt we weren't as creative working at home as we were when we're together. I also felt that the esprit de corps was better in person. So, spring, we all came back to Stony Brook. And since then, things have been pretty much back to normal.

Raj Mahajan: All right, here goes the understatement of the podcast. Looking back, it's been well known that Renaissance has been wildly successful. My question is, how come? Do you have a secret sauce or recipe that you can share with our listeners?

Peter Brown: Okay, Raj, I really don't know how successful-- you probably do better than I do. I really don't know how successful we've been in comparison to other firms because I just don't pay attention to what others are doing.

I guess there are some firms that make it their business to learn how others make money and try to learn their secrets. That's not our style. We just hire mathematicians, physicists, computer scientists with no background in finance and no connections with Wall Street. So, we really don't have any insight into how others stack up compared

to us.

Now, as for our secret sauce, of course there's nothing I'd rather do than disclose in great detail all the intellectual property that we've spent decades and billions of dollars creating. But what time-- I worry we don't have enough time for that.

Well, instead I propose that I'll just mention a few principles we follow. So, let's see. First. Science. The company was founded by scientists. It's owned by scientists. It's run by scientists. We employ scientists. Guess what, we take a scientific approach to investing and treat the entire problem as a giant problem in mathematics.

Second. Collaboration. Science is best done through collaboration. If you go to a physics department, it would be absurd to imagine that the scientist in one office doesn't speak to the scientist in the office next door about what he or she is working on. So, we strongly encourage collaboration between our scientists. For example, we encourage people to work in teams. We constantly change those teams up so that people get to know others within

the firm. We pay everyone from the same pot instead of paying different groups in accordance with how much money they've made for us and so forth.

Third. Infrastructure. We want our scientists to be as productive as possible. And that means providing them with the best infrastructure money can buy. I remember when I was at IBM, there was this attitude that programmers were like plumbers. If you need a big project done, just get more programmers. But I knew that some programmers were, like, ten times or more productive than others. I kept pushing IBM management to recognize this fact. But it did not.

I remember being in an IBM managers meeting and some guy from corporate headquarters was explaining how they created something called their headlights program. The goal of which was to identify the best programmers in the company and pay them 20 percent more than the other programmers. Now, I figured this guy from corporate was making, like, $300,000 a year. So, I raised my hand and suggested they increase the pay of their best programmers to $400,000 a year. And he was stunned. He said, "What? More than me? You've got to be kidding me. Well, if the

guy's Bill Gates." I said, "No, Bill Gates was making, like, 400 million per year. Not 400,000." Anyway, they just didn't get it.

We don't make that mistake. We pay our programmers a ton in accordance with the value we place on the infrastructure they produce.

Okay, our fourth principle is no interference. We don't impose our own judgment on how the markets behave. Now, there's a danger that comes along with success. To avoid this, we try to remember that we know how to build large mathematical models and that's all we know. We don't know any economics. We don't have any insights in the markets. We just don't interfere with our trading systems.

Yes, of course there are a few occasions where something's going on in the world and so we'll cut back because we think the model doesn't appropriately appreciate the risk of what's going on. But those occasions are pretty rare.

And finally, and most importantly, the last principle is time. We've been doing this for a very long time. For me,

this is my 30th year with the firm. And Jim and others were doing it for a decade before I arrived. This is really important because the markets are complicated and there are a lot of details one has to get straight in order to trade profitably. If you don't get those details straight, the transaction costs will just eat you alive. So, time and experience really matters.

Raj Mahajan: Notwithstanding what you just said about not intervening in markets, how do you see the markets evolving from where we are today?

Peter Brown: Well, I hope, and I assume the markets will become more automated with time. I'm pleased to see the plan to go to one day settlement. I wish they'd move to continuous settlement. I'd love to see around the clock trading in all kinds of instruments. I'd like to see more securitization, tokenization, and more digital contracts. Although, there I feel the FTX mess will set those processes back for a while.

Raj Mahajan: Related, how do you see Renaissance evolving?

Peter Brown: Well, my primary goal is to keep improving our existing systems. That has to do more with the same but do it better. We have a strong track record and that's good, of course, but all it really means is that we know how to do one thing well, or at least have known how to do one thing well. I think it's important that we not get overconfident, and we stick to our knitting.

Of course, if other opportunities in our wheelhouse come along, we'll explore them. But not at the expense of our primary responsibility, which is to keep our eye on the mothership.

Raj Mahajan: If it's okay, Peter, maybe we'll do a little bit of a speed round. Is it true that although you have no prior background in finance, your father invented the money market fund?

Peter Brown: Yes. My father and his partner. I was a rebellious kid who wanted nothing to do with my father's business. So, I went into computer science and machine learning.

Raj Mahajan: Is it true that at one point you went to

IBM to suggest that the statistical methods you were using in speech recognition could be applied to finance, and asked to be given an opportunity to manage some fraction of IBM's corporate cash?

Peter Brown: Yes. I think that was in 1993. But IBM corporate had absolutely no interest. So, instead we went to Renaissance where we did the same thing we had in mind for IBM, but instead with money Jim Simons had raised.

Raj Mahajan: Quite an inflection point in financial markets. Is it true that since you first joined Renaissance you have spent nearly 2,000 nights sleeping in your office?

Peter Brown: Yes. My wife works in Washington DC. And my experience has been that when a husband and a wife work in two different towns, the husband commutes. Psychologically, if I'm going to be away from my family, I have to work. I sleep in my office when I'm in Long Island.

Raj Mahajan: Incredible. I mean, how does that work for you?

Peter Brown: Well, for me, productivity wise it's really fantastic being able to spend nearly 80 straight hours each week with no interruptions except sleep thinking about work before spending three more normal days at home. Of course, I really miss my family. But the freedom to concentrate nonstop on work while surrounded by my colleagues is hugely valuable. And the job is so demanding, I really don't see how I could do it otherwise.

Raj Mahajan: Is it true that you sleep very little, and you will contact your colleagues at all hours of the night?

Peter Brown: Yes. I guess every question you have asked so far, I have a yes answer. Yes. I'm just one of those types who can't sleep. Not by choice. I just can't sleep. So, I often am on the computer by around 2 am. And it's true, I tend to send a lot of emails out in the middle of the night.

Raj Mahajan: It's what you say after the yes that's actually more interesting. Is it true that you once gave someone a raise so that you could call him in the middle of the night?

Peter Brown: Sort of. I was working late with a

colleague named Jim. Not Jim Simons, another Jim. At any rate. Jim and I were working away, and we needed an answer to some question which some other guy knew the answer to.

So, it was around 1 o'clock in the morning and I picked up the phone to call him. And Jim says to me, "Wait. You can't call this guy in the middle of the night. He doesn't make enough money." So, I said, "Fine. How about this? I'll call him. I'll tell him we're going to give him a raise. And then ask him our question." And so, that's what we did.

Raj Mahajan: Is it true that you almost exclusively hire people with zero background and finance?

Peter Brown: Yes. We find it much easier to teach mathematicians about the markets than it is to teach mathematics and programming to people who know about the markets. Also, everything we do we figured out for ourselves. And I really like it that way. So, unlike some of our competitors, we try to avoid hiring people who have been at other financial firms.

Raj Mahajan: In that case, what do you actually look

for in applicants?

Peter Brown: Math ability. Programming ability. A love for data. A work ethic. And most importantly, the ability and desire to work will in a collegial environment.

Raj Mahajan: How do you actually assess those qualities?

Peter Brown: I think probably the same way other firms do. First, we get resumes. Those that look promising we give them phone interviews and we ask them for references. If those pan out, then we invite the promising applicants to give research talks. Talks like if you're applying for a job at a university or something like that. And then we put them through a grueling day of solving problems in math, physics, statistics, computer science, and so forth at a blackboard.

Raj Mahajan: All right, so now, is it also true that your staff had to install mirrors in the corners of the office to prevent you from flying into people as you rode a unicycle around the office?

Peter Brown: Where did you get all these questions from? Yes, it's true. Although, I don't ride a unicycle anymore because at one point I crashed and the unicycle broke.

Raj Mahajan: So, it was true. And there's one thing we've got to ask before we stop which is hearkening back to your days at IBM. I recently heard that in a talk you give at Harvard Business School you mentioned that you had a role in starting up the Deep Blue project at IBM. Can you tell us about that?

Peter Brown: Wow. Okay. I had been at IBM for a year or two. And I was standing in the men's room one day when the vice president of computer science, a man named Abe Peled walked up next to me. I thought to myself, now's my chance. I turned to him and said, "Dr. Peled, do you realize that for a million dollars we could build a chess machine that would defeat the world champion? Think of the advertising value to IBM."

He turned to me, looking kind of annoyed, and said, "What's your name?" So, I told him. And then he said, "Could you please let me finish up here?" And so, I

thought, wow, I had made a big mistake. So, I apologized, and I high tailed it out of there as fast as I could hoping he'd forget my name even faster. But a half hour later, he called me in my office and told me that if I wanted to build a chess machine, he'd put up the million dollars. I told him that I was occupied with speech recognition. I have three friends from graduate school who could build it. He said, "Okay, hire them."

So, we did. They built the machine. I named it Deep Blue. In the first match, the IBM machine was a very weak machine. Weak physically. You know, I think only one special purpose chip in it. And we lost. The final match, however, was a different story. IBM had a much, much stronger machine with hundreds of special purpose chess chips. IBM won that match and IBM's stock jumped $2 billion afterwards. Of course, it fell back down later.

Now, a few years ago I was asked to speak at the Harvard Business School. And when I arrived, outside the auditorium, I could see all these protesters. And I thought, oh no, why are they protesting me? What have we done? Is there something I'm not aware of? I really didn't want to do that.

But as I got closer, I could see they were all holding signs about investing in Puerto Rico. And I thought, what is this all about? I was totally confused because I didn't think we had anything to do with Puerto Rico. Then it turned out that the speaker before me was some guy named Seth Klarman from some firm named Baupost. Evidently, that firm had some investments in Puerto Rico and the protesters were protesting him.

So, I went in to see Klarman's talk, or at least the end of Klarman's talk, to find out what all the hullabaloo was about. At the end of his talk, someone asked him his thoughts on quantitative investing. I suppose it was a set up for my talk. I don't know. And I carefully noted his answer which was, "To do what I do takes a certain amount of creativity and finesse that a computer will never have." And all those Harvard Business School MBAs seemed to really like that response.

So, when it was my time to speak, right after him, I began by pointing out that after defeating Deep Blue in the first match, Kasparov was elated and gave a press conference at which he said, "To play chess at my level takes a certain

amount of creativity and finesse that a computer will never have."

Raj Mahajan: Oh boy.

Peter Brown: I then went on to point out that two years later we crushed him. Now, I'm not sure that's how things will evolve. But whether it's speech recognition, machine translation, or building large language models, or chess, or making investment decisions, I continue to love the process of showing that human intelligence, intuition, creativity, and finesse are nothing more than computation.

Raj Mahajan: Peter, that's an excellent point to conclude on. It's always such a pleasure to speak with you.

Peter Brown: Thanks a lot, Raj.

Raj Mahajan: And thank you for listening to this special episode of Goldman Sachs Exchanges: Great Investors. This podcast was recorded on July 27th, 2023.

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