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High-frequency trading ruled the stock exchange—until in May the Dow Jones inexplicably crashed within just a few minutes. The guilty party: an algorithm, it was claimed. Ever since debate has raged as to how smart of an idea is the trend to automated trading?

At a handful of locations, the future is as near as in Hoboken. Tomorrow’s financial elite are being trained right here in New Jersey at the Stevens Institute of Technology’s Babbio Center, housed in an ultramodern block-style building of orange brick, green glass and steel.

Professor Khaldoun Khashanah lifts the roller shutters in his office. The skyscrapers of downtown Manhattan loom nearby across the Hudson River. For a long time though it was a different world at Hoboken, which used to turn out mainly engineers. Then along came Khashanah, eight years ago. “When I saw this skyline, I asked my colleagues if they were preparing students for Wall Street? The answer was no. I thought, that simply cannot be.” So, the amiable and densely dark-haired prof established the “Financial Engineering” program at the school. Today over one hundred Hoboken students study how to write and program algorithms to steer international capital flows.

Computer science as industry qualification
Gone are the days when a messenger boy’s job could evolve into a career on Wall Street. Anybody looking to work on the Street today has to know their way around with computers. For computer programs are the tools used by traders, hedge funds, banks and pension funds today—or to be precise, algorithms. Long a staple of global securities trading, algorithms have accelerated trading and made it more efficient, being prerequisite to the rapid execution of complex transactions within a short period of time spans.

In the US, over 90 percent of the securities trades are now executed by computer. And algorithms are increasingly being employed for this purpose, albeit not universally. Beyond the confines of Wall Street, they are also being used throughout the world wherever there are complex data flows to be

Algo-what?
Basically, an algorithm is just a process for reaching a goal, structured in a finite sequence of precise steps. In an IT or financial setting this process is a computer program, although a conference organizer’s checklist or paramedic procedures for helping heart attack victims can also be considered algorithms. The term derives from the Persian mathematician and scholar Muhammed al-Khowarizmi (~783-850 AD). Over the centuries, corrupt recordings and other confusion about his name led to emergence of the word as it is known today. The later Latin translation of the instructional work he authored in around the year 825, originally entitled “On Calculating with Indian Numbers”, bore the title “Deit Algorismi,” meaning “Algorismi Said”.

Man versus machine? Automated technologies like algo trading always meet with skepticism. Outside the financial sector, however, the use of algorithms is uncontroversial.
managed. By search engines for example—Google and Bing are nothing but elaborate search algorithms. In aviation and space flight, reception algorithms help suppress interference and identify navigation errors. Climate research modeling would be inconceivable without them. “Algos” are even used in digital advertising to adapt ads to user behavior at lightning speed.

**Tremendous untapped potential**

Many financial market strategies are based on the highly complex analysis of market movements. Algorithms “read” news, reacting to the frequency of and correlations between certain keywords by triggering flash buy and sell transactions. They compare historical data and analyze the behavior of other traders. Simple algorithms only exploit micro-differences between exchanges, while “learning” algos evaluate the success of their own decisions. And they still have tremendous untapped potential, which is why Khashanah and his students are constantly working on new approaches to algorithmic programming; such as having the computer analyze multiple price movement time frames in parallel. That can be done by converting ‘wavelets’ into algorithms.

Supercomputers with huge storage capacity also allow the execution of more and larger orders within milliseconds or microseconds, which is referred to as high-frequency trading. This has many advantages, and has boosted liquidity and trading volumes considerably. Investors benefit from orders being executed much faster than before, and more cheaply as well, as spreads have shrunk from 25 cents a few years ago to only a few pennies.

Transactions are increasingly being conducted fully automatically, which professionals now consider the norm. “Human intervention is not necessary, as the computer does the trading on the basis of pre-calculated probabilities,” explains Dirk Bergemann, a game theory economist at the elite Yale University. “The fund managers only have to decide how much money to allocate to a given strategy.”

It is probably human nature however to be skeptical about machines acting with autonomy. Indeed, algo trading progressed so rapidly in recent years that even experts have been wondering if trading is still under control, and how much control is actually needed. The method is not the problem; demonizing algos makes about as much sense as blaming formulas or equations. It depends on the context of their usage. Anonymous trading venues referred to as dark pools, which in the US now account for over ten percent of trading volume, are

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Algotrading expert Bernard Donefer on market confidence, trading controls and good sneakers.

Prof. Donefer, algorithm trading has come under fire. Are the criticisms justified? High-speed platforms have to do a better job creating transparency about how they work. The strategies for making money are the same; today’s computer technology just makes it possible to execute them much faster. Arbitrage trades that used to take half a day to implement, can now be executed in a second. That is all.

Critics say trading used to be based on fundamentals. That argument does not hold water. There have always been and still are individual investors who follow a long-term strategy. It would be absurd for them to see themselves in competition with algo traders who realize gains and losses in split seconds. But twenty years ago these investors were unable to compete with floor traders.

Others see it as unfair for traders to be able to make profits simply because of being one millisecond faster than the other guy. The flow of information has accelerated, but the struggle for the competitive edge remains. In the old days brokers used to outfit their runners with good sneakers so they could get orders down to the floor faster. Was that unfair? Today it is all about having the fastest computer.

What does the future hold? Algos will be playing an even larger role. It would be desirable, however, for the US securities regulator, the SEC, to have more information on electronic trading programs. The organization should be able to know for example that a particular order stems from a high-frequency trader, another from a fund employing a quant strategy. The regulator should not publish this information, but should have it for evaluation purposes, allowing intervention in extreme cases.

Why are such data not already being collected? Because it would be very ex-
“ALGOS ARE NOT INTELLIGENT. THEY ARE USEFUL FOR CRISIS DIAGNOSTICS, BUT CANNOT ADEQUATELY REACT TO CRISSES.”

Prof. Dirk Bergemann, Yale University

The lightning crash on May 6 of this year the Dow Jones fell by 1,000 points within minutes in a ‘lightning crash’ the origin of which is still debated. “Investor confidence will be eroded if this type of thing should happen with any frequency. That is a systemic risk,” says Khanashah. For him it’s just a matter of time until regulators move to implement failsafe measures. “Every innovation tests the limits, and poses challenges for regulators.”

New rules and restrictions have been in the works for some time now. And the SEC has already implemented a circuit breaker that temporarily suspends trading in a stock if it falls by more than ten percent within five minutes. Xetra and Eurex have had this type of failsafe mechanism in place for a long time already. The circuit breaker model they employ is, however, more sophisticated, as described by Edward Backes, Head of Department of Market Supervision at Deutsche Börse: “We have defined individual time and percentage movement parameters for all securities on Xetra, and for the most liquid index and interest rate futures contracts. These trading curbs give market participants a window in which to reassess risk and change or cancel orders accordingly. This system has worked well in practice for years. We regularly review the parameters and adapt them to new conditions, such as faster trading driven by algorithms.”

Whether circuit breakers or trading curbs, safety precautions are simply essential, as algorithms have their limits. “Algos are designed on the assumption of stable markets; they are not programmed for exceptional situations,” says Bergemann. “Algos are not intelligent. They are useful for crisis diagnostics, but cannot adequately react to crises.” Whether or not people are really better at it is a different question.

Thus on September 8, 2008 United Airlines shares dropped after a news agency reported they had filed for bankruptcy. The problem was that the report was six years old. Some experts blamed the plunge on algorithms sensitive to the word “bankruptcy” that instantly triggered a selloff. But would people have immediately realized this error? Bergemann comments: “The stock market has always reacted to rumors. But the speed of communication has increased.”

Outside the financial sector however, algorithms are scarcely a concern; it would never occur to anyone to criticize search techniques employed by Google or Bing for example. And in climate modeling, shortcomings merely provide an incentive to improve the algorithms even further. Not so on the stock markets, “Risk protection will definitely remain a big issue,” Khahashanah agrees. Accordingly, he believes no one will be turning their back on a technology that makes markets so much more efficient. The main advantage of using algorithms will outweigh concern: the fact that they operate strictly logically at all times, in contrast to flesh- and-blood traders. “The beauty of the machine is that it is never guided by irrationality,” says Khahashanah, proudly showing us his computer lab, a brightly-lit room with 30 PCs. “There will be a lot more to come out of this lab!”

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