Recent Technological Developments in Silicon Valley Inspirations for Hong Kong

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Feb 2015

- Trip to Stanford and Berkeley to finish a book on Quantitative Trading

- President Barack Obama addressed the White House Summit on Cybersecurity and Consumer Protection at Stanford (Feb. 13, Friday).

- Big Data Conference: Strata+Hadoop World 2015 in San Jose (Feb. 17-20)

- Developments of Translational Medicine in Stanford and Berkeley Campuses

Quantitative Trading 101

- Most students *mistook* the discipline as Algorithmic Trading and\or High Frequency Trading which focused at making trading decisions based upon (long\short term) statistical trend analysis.

- Algo Trading and HFT are just 2 (important) elements.

- Quantitative Trading includes Fundamental and Quantitative Research such as Financial Report Analysis together with Big Data Computation\Statistical Analysis.

- In additional to generating profits, Algo Trading and HFT helped in understanding the price impact.

Hand Signal

Trading Pit

Source: Michael S. Green, AP

Out Trade

- Traders shout out bids or offers and shout out an acceptance of a bid or offer. They record the details of these trades on special trading cards.

- If any one of the trade descriptors didn't match, the clearing system rejected them as an *out trade*, a trade that did not match and did not stand until the two parties resolved the differences.

- Gorham (2011): In 1980s, there was a period when as many as *25%* of all trades done in certain pits at the CME were out trades.
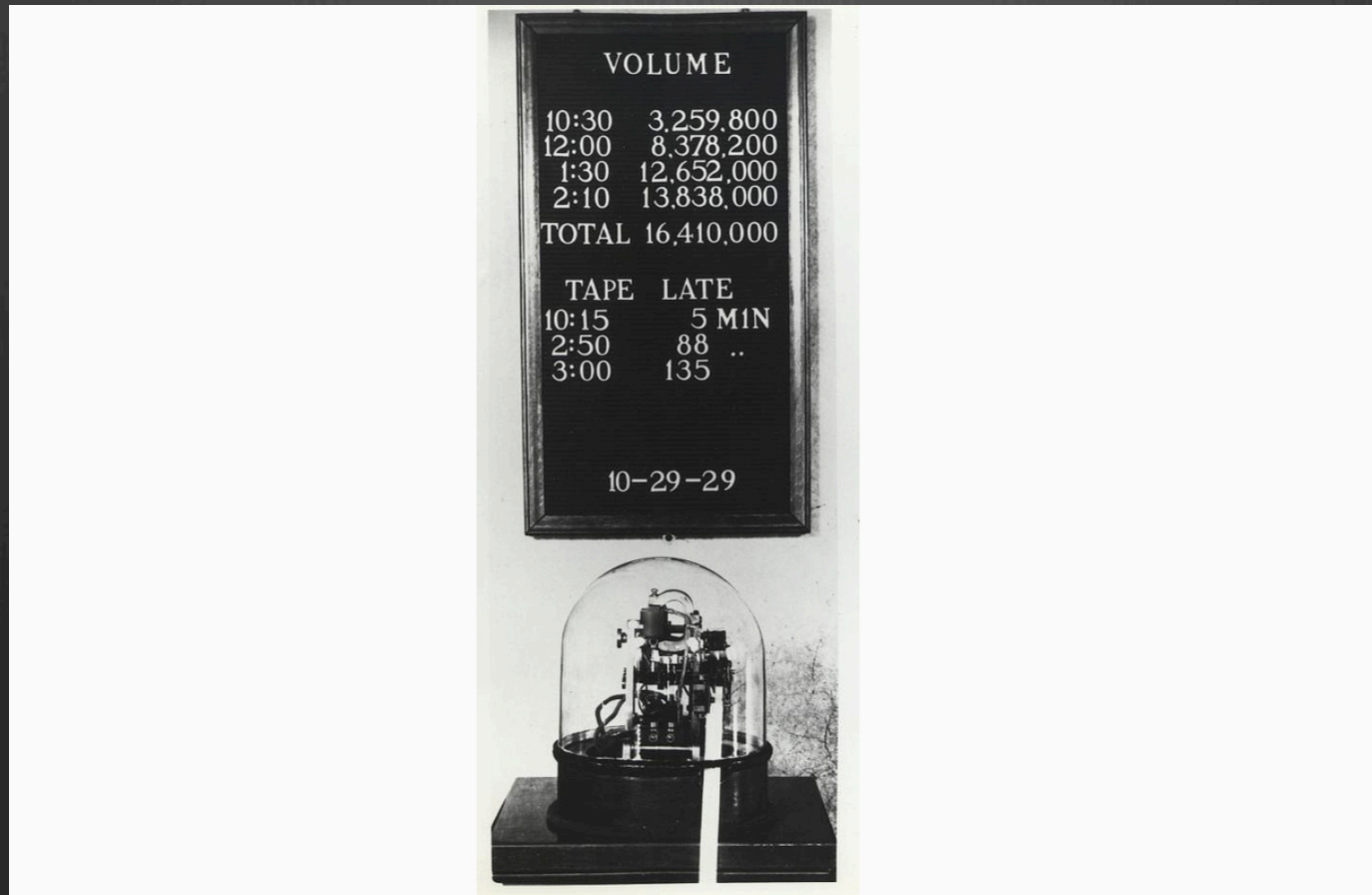
Stock Ticker in 1900
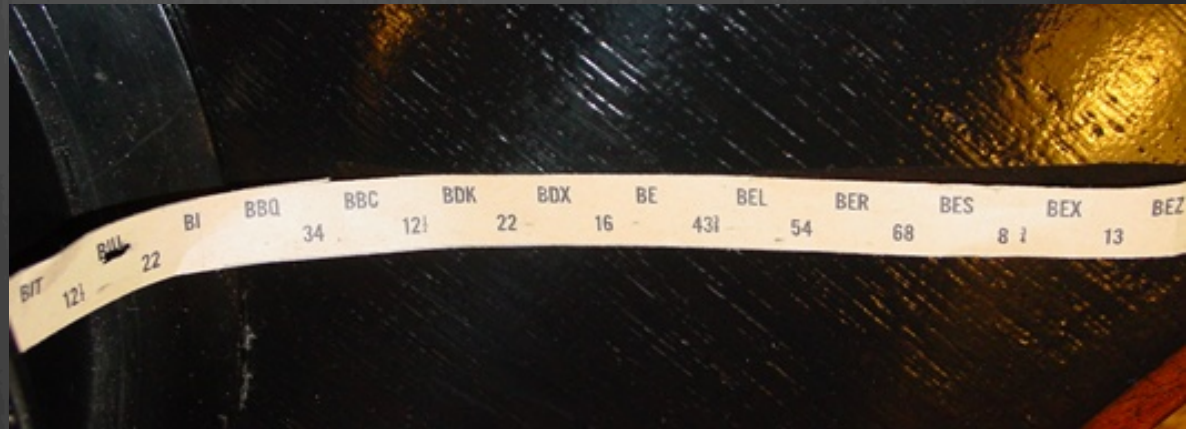
Source: Sydow's Antiques
www.sydowsantiques.com/h14620.htm

High Frequency Traders in 1930s

Source: www.dailymail.co.uk/sciencetech/article-2399953/Edisons-famous-ticker-tape-machine-gets-modern-makeover-Web-developer-invents-gadget-prints-TWEETS.html

Black Tuesday Oct. 29,1929

Electronic Stock Tickers in 1960s

"At that time in 1960 the average volume on the NYSE was about one million shares per day. If the volume went much over that then the last sale ticker would run late. On a five million share day the last sale ticker would be about fifteen minutes late"
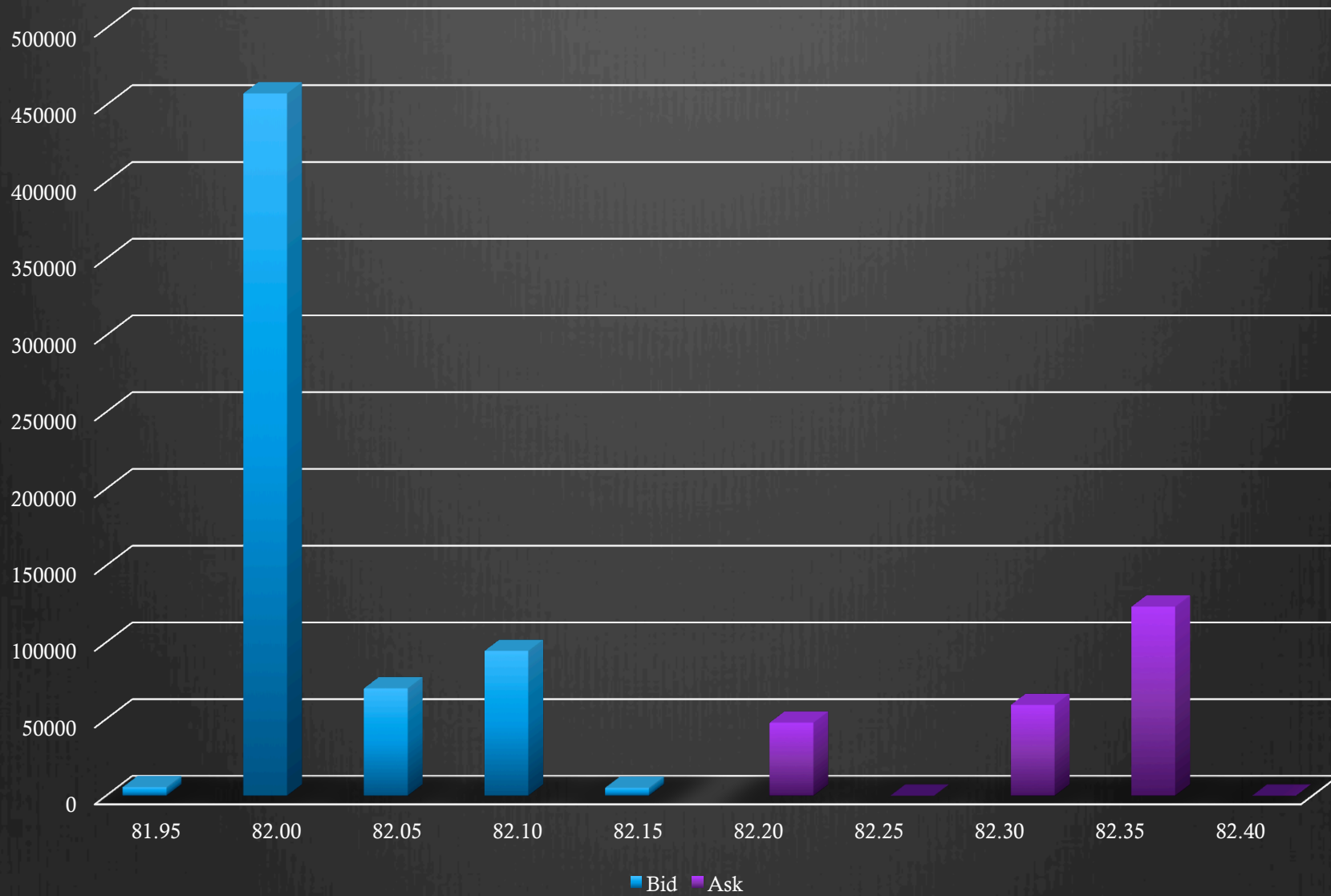
–Sinn (2009)

Infrastructure 101
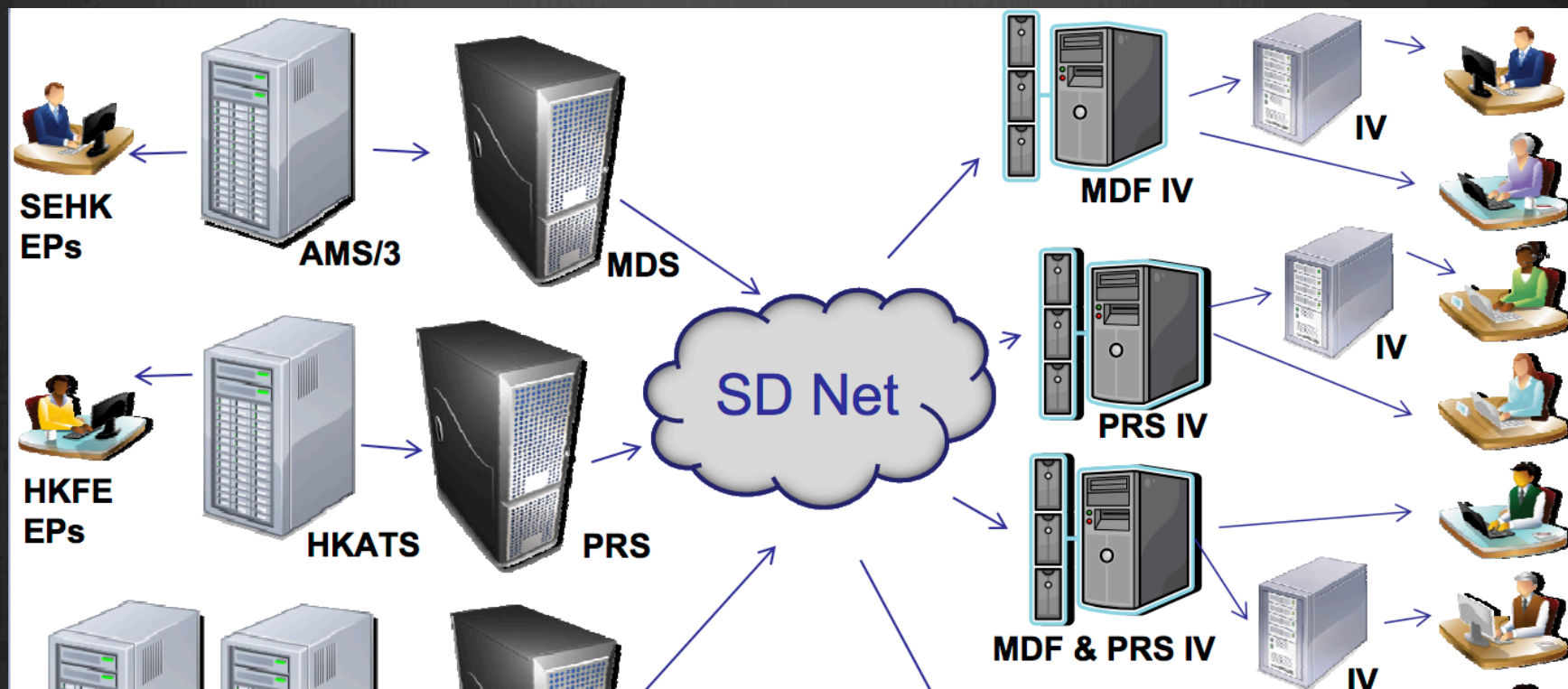
Source: HKEx

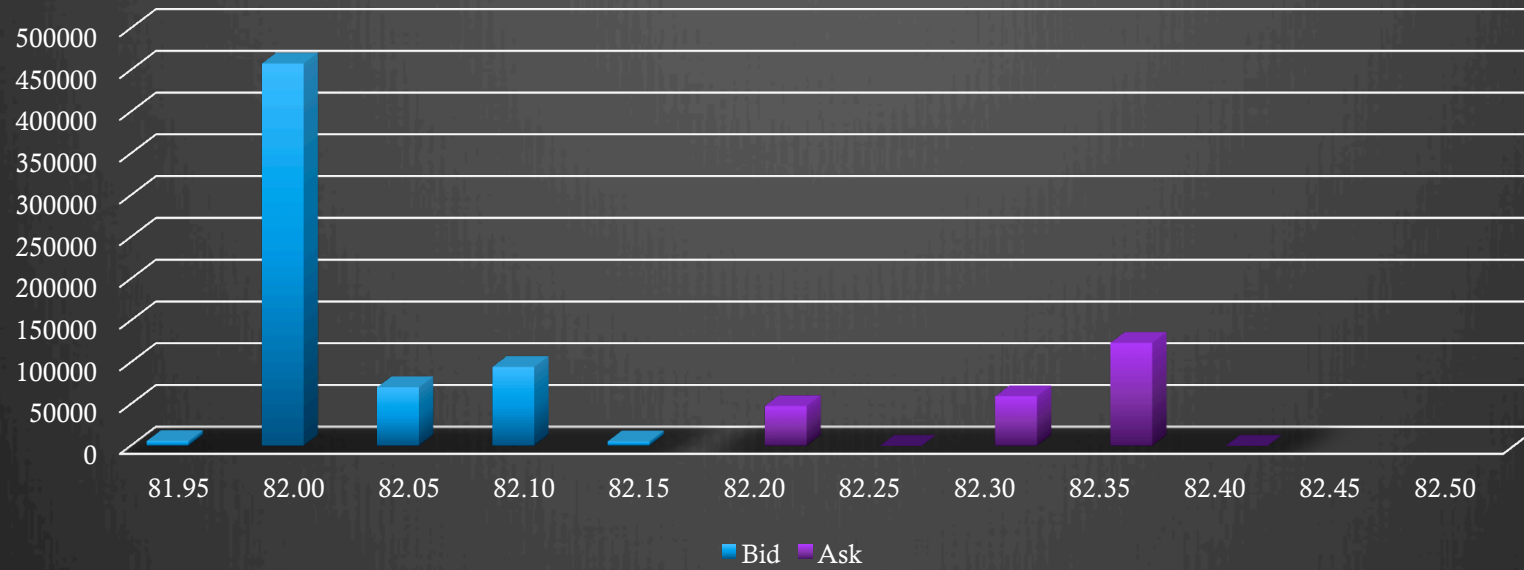# Trading Mechanism (Order Driven Market)

- Bid and Ask Limit Order: Price and Quantity

- Best Bid and Ask Prices

- Buy and Sell Market Order

- Order Cancellation

- Price-Time Priority

- Limit Order Book Data

Limit Order Book 09:31:01.703

Limit Order Book 09:31:01.703

Bid ■ Ask

Limit Order Book 09:31:02.260

Bid ■ Ask
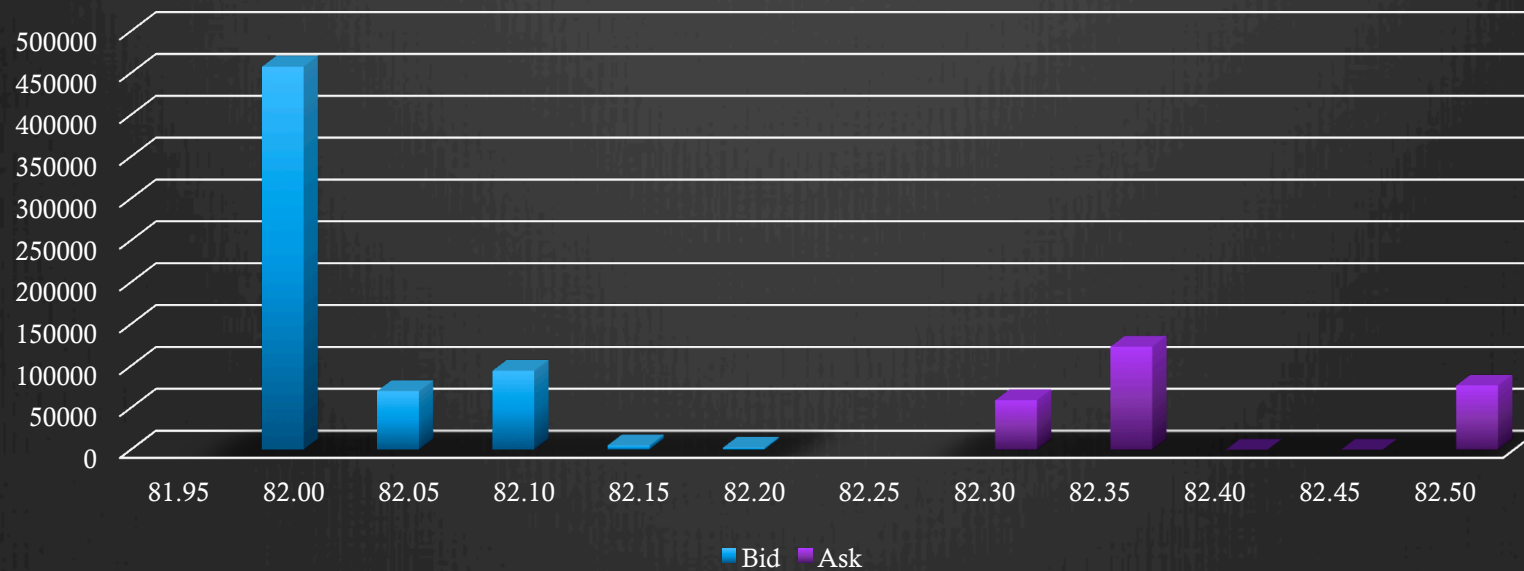
Buy Low and Sell High

Cont and de Larrard (2012) is able to compute the following quantities from the diffusion approximation

- Duration until the next price change.
- Probability of a price increas.

In particular, under some "equilibrium" assumptions, the probability of price going up is:

$$p_{up}(x, y) = \frac{1}{2} - \frac{\arctan(\sqrt{\frac{1+\rho}{1-\rho}\frac{y-x}{y+x}})}{2\arctan(\sqrt{\frac{1+\rho}{1-\rho}})}$$

The bid size is x and the ask size is y.

Probability of the price going up before going down is lower than 0.5 according to the formula
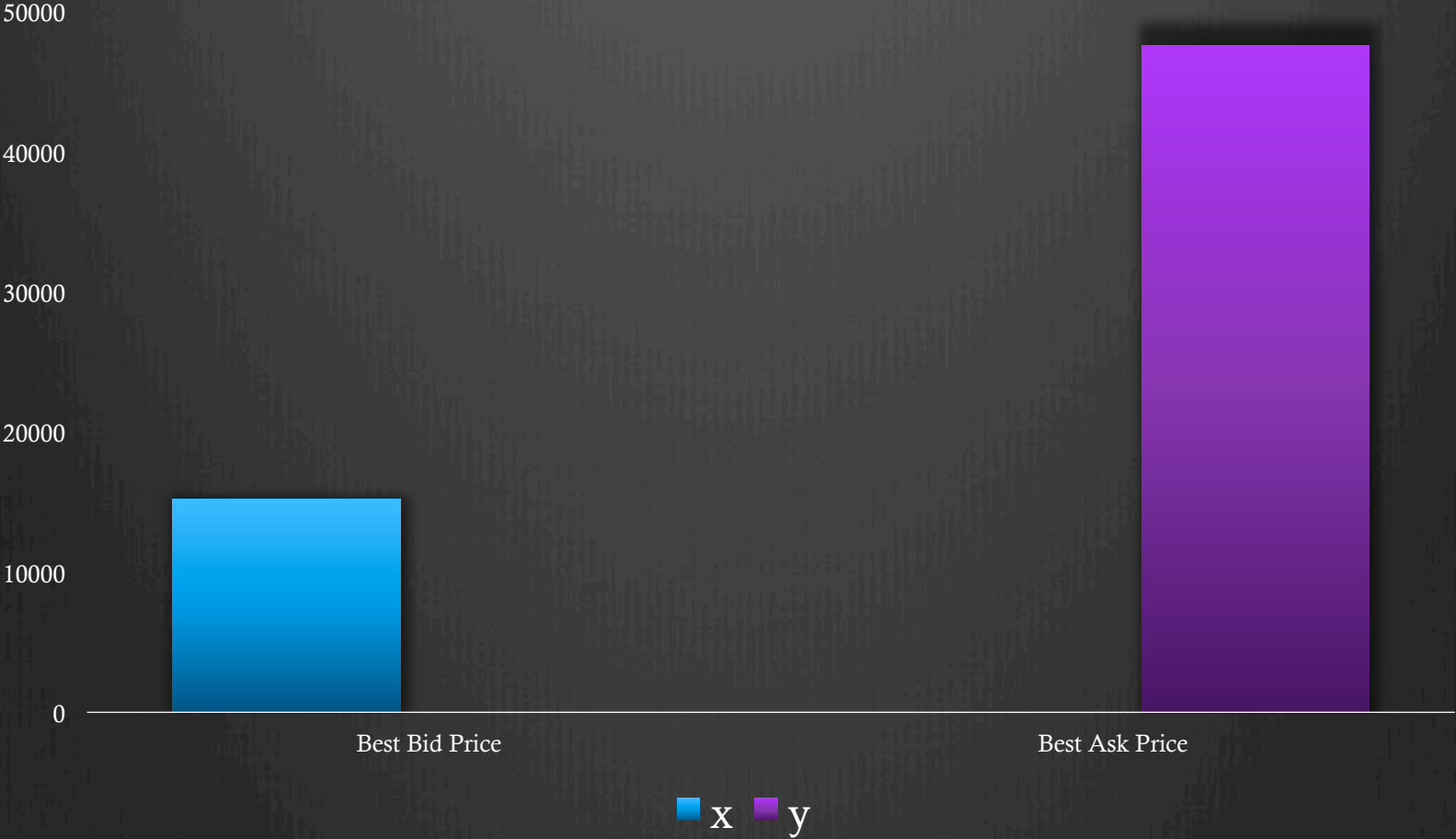
Other Issues Related to Algo Trading\HFT

- Spoofing and Flash Crash 2010: Navinder Singh Sarao

- James Simon (Founder of Renaissance Tech): Mathematics, Common Sense, and Good Luck: My Life and Careers [MIT, Dec, 2010] (See this on YouTube)

- Optimal Execution of a Basket

- Price Impact

- Synchronization Issue for HFT (NBBO)

- Regulation related to Big Data: Public market-structure analytics database MIDAS of SEC

- Gregg Berman (who was a fund manager and a founding-partner of RiskMetrics) just left SEC a few days ago.

White House Summit on Cybersecurity and Consumer Protection (Friday Feb. 13)

Source: James Martin/CNET

- Upset about the lack of reforms to surveillance programs, the CEOs of Google, Facebook and Yahoo stayed away .
- Tim Cook, Apple's chief executive, gave an address and CEOs from PayPal, Intel Corporation, Visa and other financial services companies attended, where Cook warned about unspecified threats to privacy.

What is "Big Data"?

- Unstructured Data vs Structured Data (usually handled by classical "relational" database system such as Oracle.)

- Data from many sources

- "Relational" Database and Indexing

- Unstructured Big Data and Distributed (Parallel) System

- Example: VIP Recognition for Fashion House

- Example of Hardware Infrastructure: Amazon Elastic Compute Cloud (Amazon EC2) [with GPU]

- aws.amazon.com/ec2/

More Examples

- Examine if Inventory Control Problem is true for some Sportsware Companies

- Fraud Detection for Credit Card Companies – Change in Behaviors

- Business Intelligence for Consumer Behavior and Retail Risk Estimation

- Trading Strategies – Professor Kin Lam's Largest Change Before Reversal . (Discuss More in HKU Stat. Dept. Conference on May 30, 2015)

- Personalized Fitness\Medicine\Insurance (Apple Watch): More in the final section

Beware

- Big Data Scientists are not only programmers.

- Big Data Scientists also rely on Good System Analysts (who are again not only programmers).

- *"And expertise in performance comes from experience, especially experience with large-scale hardware and large-scale usage - exactly what most 20-year-old geeks lack. Many talented kids might write great apps for your iPhone, but very few have serious access to large-scale, distributed hardware, and even fewer have written apps that require such large systems"* -- Norm Matloff

- www.newsday.com/opinion/oped/computer-geeks-aren-t-going-to-save-obamacare-norman-matloff-1.6463675

Beware

- Various terminologies in Machine Learning and Big Data Science (e.g. "Deep Learning", "Stochastic Gradient Boosting" and "Hadoop") are almost used like slogans in the Bay Area as well as in the universities\corporates.

- Domain Knowledge is ***PIVOTAL***

- Specific infrastructure for specific applications\businesses. To be efficient, the systems should not be designed for "general" purpose.

- Upgrade, Power Consumption and Competition

- The Stanford Center for Computational, Evolutionary and Human Genomics
  - http://cehg.stanford.edu
  - Big Data and Medicine in Stanford: https://www.youtube.com/watch?v=bmqlxwRemhY

- Fortune Magazine March 9, 2015
  - Biotech pros' top 8 stock picks
  - Breakthroughs in the lab are driving big returns — but beware the meltdowns.

Translational Medicine

- Turning the results in molecular biology\medicine into FDA approved treatments and diagnostic procedures.

- FDA Approvals: Average 12 years and over US$350 million

- Laboratory testing: 3.5 years before an application to FDA. Only one in 1000 of the compounds that enter laboratory testing will ever make it to human testing.

- Phase 1 uses 20-80 healthy volunteers to establish a drug's safety and profile. (about 1 year). Phase 2 employs 100-300 patient volunteers to assess the drug's effectiveness. (about 2 years)

- Phase 3 involves 1000-3000 patients in clinics and hospitals who are monitored carefully to determine effectiveness and identify adverse reactions. (about 3 years)

- Recently on CBS 60 minutes: Treat Cancer by Polio: http://www.cbsnews.com/news/polio-cancer-treatment-duke-university-60-minutes-scott-pelley/

Personalized Medicine

- Gene Profiling Cost: In the range of thousands (USD) and is going down

- Example: Angelina Jolie

- President Obama Outline New Plan For Personalized Medicine on Jan. 30, 2015 in his State of The Union Address. www.newsy.com/videos/obama-to-outline-new-plan-for-personalized-medicine/

- Imatinib, the first drug to target the genetic defects of a particular cancer while leaving healthy cells unharmed.

- June 1998: A Phase I clinical trial treating Chronic Myeloid Leukemia. Within six months remissions had occurred in all patients as determined by their white blood cell counts returning to normal.

- In a subsequent five-year study on survival, which followed 553 CML patients who had received imatinib as their primary therapy, only 5% of the patients died from CML and 11% died from all causes during the five-year period. Moreover, there were few significant side effects.

Non-molecular Personalized Medicine

- Apple Watch and possibly subsequent medical\insurance products. (Big Data)

- Diabetes Monitor : www.discoverymedicine.com/Kavita-Kumareswaran/2012/02/23/closed-loop-insulin-delivery-towards-improved-diabetes-care/

Source: AlphaGlitch via BGR

Translational Medicine Issues

⊛ Amgen (Thousand Oaks, CA) studied 53 landmark papers in 2011. Only 6 (11%) were reproducible. But the non-reproducible papers keep on generating many academic descendants. [Published in *Nature*. See Begley & Ellis (2012)]

REPRODUCIBILITY OF RESEARCH FINDINGS

Preclinical research generates many secondary publications, even when results cannot be reproduced.

Journal impact factor	Number of articles	Mean number of citations of non-reproduced articles*	Mean number of citations of reproduced articles
>20	21	248 (range 3–800)	231 (range 82–519)
5–19	32	169 (range 6–1,909)	13 (range 3–24)

Results from ten-year retrospective analysis of experiments performed prospectively. The term 'non-reproduced' was assigned on the basis of findings not being sufficiently robust to drive a drug-development programme.
*Source of citations: Google Scholar, May 2011.

More Issues

- The Supreme Court in US recently decided some found genes unpatentable.

- Please see *ASSOCIATION FOR MOLECULAR PATHOLOGY v. MYRIAD GENETICS, INC.* (June 2013).

- http://www.supremecourt.gov/opinions/12pdf/12-398_1b7d.pdf

- Such movement has gradually threatened the molecular diagnostics industry.

Conclusion/Discussion

- Technology is evolving in an unprecedented speed.

- Specialization [in modern sense] (with big picture in mind) is possibly a solution.

- 荃者所以在魚，得魚而忘荃；蹄者所以在兔，得兔而忘蹄；言者所以在意，得意而忘言。吾安得忘言之人而與之言哉?
--莊子

- Where can I find a man who has forgotten words so I can have a word with him ?

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⊛ Gorham, M. (2011) "The long, promising evolution of screen-based trading," *Focus*, The World Federation of Exchanges, 223, p. 12-19.

⊛ Gorham, M. & Singh, N. (2009) *Electronic Exchanges: The Global Transformation from Pits to Bits*.

⊛ Sinn, R.S. (2009) "Reminiscences of a Stock Quotation System: The Real Story of Ultronic Systems Corporation."

Glossary

- Reuters translated **Quantitative Trading** as **量化交易**.

    - Please see:高盛将结束Global Alpha基金,量化交易策略明星产品殒落 http://cn.reuters.com/article/2011/09/16/idCNnCT039937220110916

- **Translational Medicine** is usually translated as **转化医学**. Please see:

    1. http://zh.wikipedia.org/wiki/轉譯醫學

    2. 首个转化医学重大科技基础设施在沪揭牌 (人民网2014年10月13日) http://scitech.people.com.cn/n/2014/1013/c1007-25820270.html