IA and the Finanacial System:

(1) Will Internediaries be Disintermediated?

(2) Alternative Data For Investment

Université Paris-Dauphine - PSL, MASEF + 203 – 2023

جهـــاز أبـوظبي للاســتثمـــار
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Outline

What Is It About? Data Sciences? Intermediation?

What Is It About?

There is a lot of buzz around:

- Data Sciences
- Machine Learning
- Artificial Intelligence...
- ... Blockchain!

Are they related? Is it more than a smooth technological improvement? Is it really important to understand them when you have an executive role?

Topics For Today

Question 1. Can an easier access to larger

- digitalized datasets and recording capabilities,
- storage capacities,
- processing capabilities

change our day to day work?

Question 2. Do machine learning really provide new tools? and what are the underlying mechanisms of these technique? (ok... we may talk and Data Science and AI too...)

Question 3. Why should we change our way to work and our governance (of what?) because of all this?

Why Is It Important For Us?

Easy access to larger digitalized datasets, storage capacities, processing capabilities is changing a lot of industries. The financial industry is largely impacted.

One of the features of the innovations brought by these technological improvements is disintermediation. Examples: TV vs. youtube, taxis vs. Uber, stores vs. Amazon, newspapers vs. google news and blogs, etc.

The financial system is essentially an intermediary, A financial system provides [Merton, 1995]

- a payments system for the exchange of goods and services;
- a mechanism for the pooling of funds to undertake large-scale indivisible enterprise;
- a way to transfer economic resources through time and across geographic regions and industries;
- a way to manage uncertainty and control risk;
- price information that helps coordinate decentralized decision-making in various sectors of the economy;
- provides a way to deal with the asymmetric-information and incentive problems when one party to a financial transaction has information that the other party does not.

It is Not Just One More Small Change

Because the financial system is no more than a large intermediary, we will focus on some examples in this talk, but keep in mind it is a game changing transformation. To insist, just list some examples:

- Payments system → Payment by mobile phone [Poushter and Oates, 2015], (bitcoins) blockchain [Nakamoto, 2011], etc.

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- Information asymmetry → "Last look" trading mechanisms, automated market making [Fermanian et al., 2015], electronic brokers [Almgren, 2012] [Brandes et al., 2007], etc.

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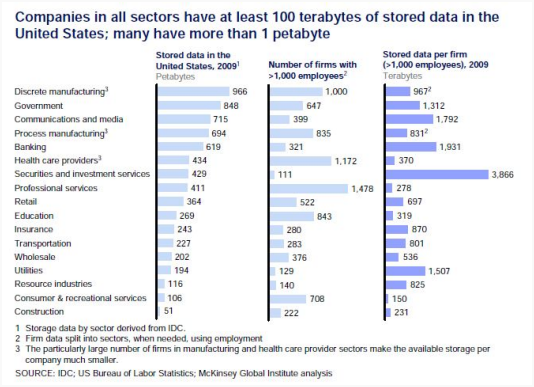
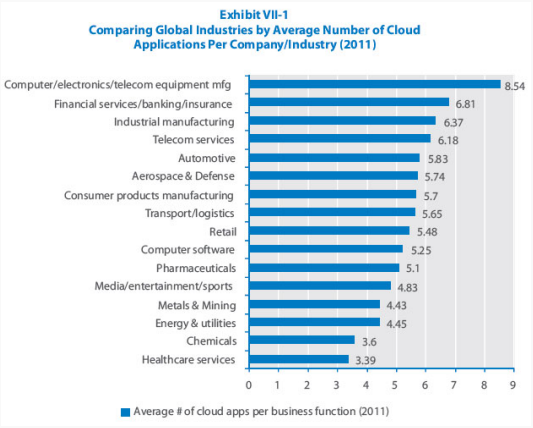
Is The Financial Sectors Ready? cf: Les données au service de la mesure des risques économiques et financiers



source: blogs.saphana.com



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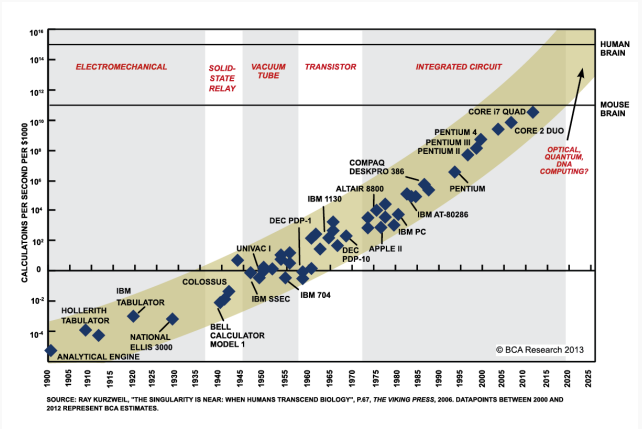
But With More CPU (and Memory)



source: extremetech.com

Recently Machine Learning had a lot of successes in Signal Processing

- Image classification
- Robot navigation
- Natural language processing
- Scene identification (xbox kinect)
- Voice recognition
- Face identification
- Object following on video

All this started with digit recognition in the 90ties.

You can easily imagine that all this targeted military applications first... This is linked to the progress of technology.

But With More CPU (and Memory)

Technology improvement	Computing	Processing
(1960) Processor	Mainframe	Scientific computing
(1970) Computer	Personal computer	Inference (A.I.)
(1980) Databases	Relational databases	Multivariate analysis
(1990) Networks	Internet	Statistical Learning
(2000) Distributed storage	Web 2.0	Data Mining
(2010) Full distributed processing	Connected devices	Deep Learning
(2020) ? Quantum computing		

With Moore's law, CPU capacities are multiplied by 1,000 every 10 years...

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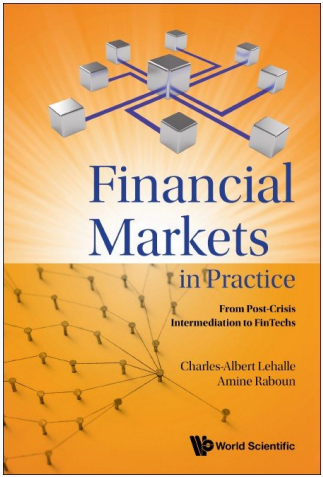

[Lehalle and Raboun, 2022]

Next Subsection – Applications?

What Is It About? Data Sciences? Intermediation?

Applications?

- Statistical Learning is how to perform statistics “online”
- Machine Learning uses statistical Learning to estimate the optimal parameters of Universal Approximators
- Artificial Intelligence is an overset of Machine Learning that put around it “helpers” to perform tasks.
  A.I. is a General Purpose Technology: it needs secondary innovations to find applications.

Luciano Floridi used to say that what we call artificial intelligence is “the ability to solve complex tasks without being intelligent”. The complexity of the tasks that these new machines can solve is nevertheless relative; it is limited to three types of use.

1. neural networks can reproduce the perception functions of most animals:
   identifying what they see, hear or read.
2. neural networks can make statistics “along very large databases”.
3. neural networks can solve combinatorial problems approximately.

They come with a toolset to perform partial derivatives very efficiently.

I will need two dimensions to describe innovations driven by recent technological advances:

Methodologies →			

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Methodologies →	Decision Support (3)		

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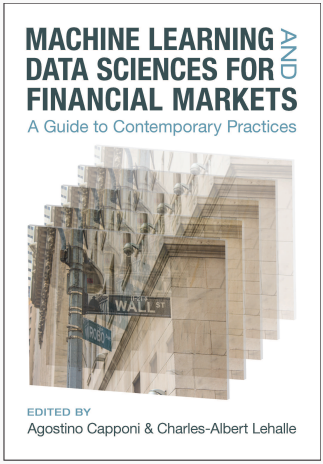
I will need two dimensions to describe innovations driven by recent technological advances:

	Decision Support (3)	Information (2)	Infrastructure
Towards clients	✔	✔	✔
Towards the real economy	✔	✔	✔
Towards the financial ecosystem	✔	✔	✔

All applications will not really be located on the diagonal, but it is expected to find most of them there.



[Lehalle and Capponi, 2023]

Thank You For Your Attention – Any Question?

Almgren, R. (2012).
High-Frequency Event Analysis in Eurex Interest Rate Futures.
Technical report.

Azencott, R., Beri, A., Gadhyan, Y., Joseph, N., Lehalle, C.-A., and Rowley, M. (2014).
Realtime market microstructure analysis: online Transaction Cost Analysis.
Quantitative Finance, pages 0–19.

Belleflamme, P., Lambert, T., and Schwienbacher, A. (2010).
Crowdfunding: an industrial organization perspective.
In Digital Business Models: Understanding Strategies, Paris, pages 25–26.

Brandes, Y., Domowitz, I., Jiu, B., and Yegerman, H. (2007).
Algorithms, Trading Costs, and Order Size.
Technical report, Investment Technology Group.

Deville, J.-C., Särndal, C.-E., and Sautory, O. (1993).
Generalized raking procedures in survey sampling.
Journal of the American statistical Association, 88(423):1013–1020.

Fermanian, J.-D., Guéant, O., and Rachez, A. (2015).
Agents' Behavior on Multi-Dealer-to-Client Bond Trading Platforms.

Froot, K., Kang, N., Ozik, G., and Sadka, R. (2015).
Private information and corporate earnings: Evidence from big data.
Technical report, Harvard Business School.

Geeraert, S., Lehalle, C.-A., Pearlmutter, B., Pironneau, O., and Reghai, A. (2017).
Mini-symposium on automatic differentiation and its applications in the financial industry.

Lehalle, C.-A. and Capponi, A. (2023).
Machine Learning and Data Sciences for Financial Markets: A Guide to Contemporary Practices.
Cambridge University Press.

Lehalle, C.-A., Laruelle, S., Burgot, R., Pelin, S., and Lasnier, M. (2013).
Market Microstructure in Practice.
World Scientific publishing.

Lehalle, C.-A. and Raboun, A. (2022).
Financial Markets in Practice: From Post-Crisis Intermediation to FinTechs.
World Scientific.

Merton, R. C. (1995).
A Functional Perspective of Financial Intermediation.
Financial Management, 24(2):23+.

Mittelstadt, B. D., Allo, P., Taddeo, M., Wachter, S., and Floridi, L. (2016).
The ethics of algorithms: Mapping the debate.
Big Data & Society, 3(2):2053951716679679.

Nakamoto, S. (2011).
Bitcoin: A Peer-to-Peer Electronic Cash System [Illustrated].
Prequel Books.

Pages, G., Pironneau, O., and Sall, G. (2015).
Vibrato and Automatic Differentiation for High Order Derivatives and Sensitivities of Financial Options.
working paper or preprint.

Poushter, J. and Oates, R. (2015).
Cell Phones in Africa: Communication Lifeline.
Technical report, Pew Research.


Zhang, L.-C. (2000).
Post-stratification and calibrationa synthesis.
The American Statistician, 54(3):178–184.