



# Finance Intelligence

Qing Li

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# About me

- Working Experience
  - ❖ Adjunct Professor, Univ. of Arizona, AZ, USA
  - ❖ Professor, SWUFE
  - ❖ Arizona State University, AZ, USA
  - ❖ Information & Communications University (Merged into KAIST in 2009), Korea
- Education Experience
  - ❖ Kumoh National Institute of Technology, Ph.D.
  - ❖ Harbin Engineering University, Bachelor, Master

# Research Interests

- Financial & Business Intelligence
- Data Mining & Analytics
- Social Media & Management



# THE FOUR V's OF BIG DATA

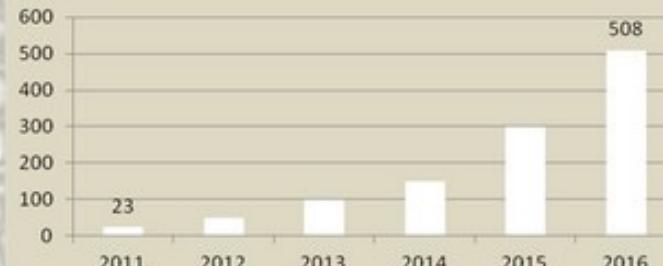
"Big data" is large datasets at rest.

But all that data got there the same way...

Over a network.

Is yours ready to handle the load?

PB per Month



## VOLUME

**6 PB**

Amount of data generated per day by a 1Gpx surveillance camera

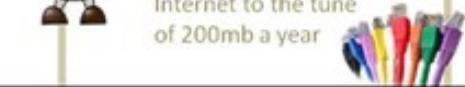


## VARIETY

Network-connected healthcare devices exploding



Cows transmit health data over the Internet to the tune of 200mb a year



## VELOCITY

**150463**

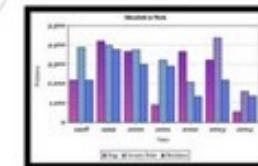
API calls per second to Google, Twitter, and Facebook alone



Credit card industry processes 32,000 TPS. Mobile expected to raise that to 1 million TPS



## VALUE



How fast can the data be analyzed and acted on to provide business value?



首页 > 新闻 > 政务联播 > 部门

## 四部门关于印发《“互联网+”人工智能三年行动实施方案》的通知

中央政府门户网站 www.gov.cn 2016-05-23 16:54 来源：发展改革委网站

【字体：[大](#) [中](#) [小](#)】  打印    +

### 关于印发《“互联网+”人工智能三年行动实施方案》的通知

发改高技[2016]1078号

各省、自治区、直辖市及计划单列市、新疆生产建设兵团发展改革委、科技厅（委、局），工业和信息化主管部门，网信办：

为落实《关于积极推进“互联网+”行动的指导意见》（国发[2015]40号），加快人工智能产业发展，国家发展改革委、科技部、工业和信息化部、中央网信办制定了《“互联网+”人工智能三年行动实施方案》。现印发你们，请认真贯彻落实。

附件：“互联网+”人工智能三年行动实施方案

国家发展改革委

科技部

工业和信息化部

中央网信办

2016年5月18日



► Deep Learning

► Application

- Google Translate
- Cancer - London Hospital

# IBM Watson



# IBM Watson



## Medical Area

THE UNIVERSITY OF TEXAS  
**MD Anderson**  
~~Cancer Center~~



DEBORAH DISANZO  
IBM Watson Health

The disclosure comes at an uncomfortable moment for IBM. Tomorrow, the company's chief executive, Ginni Rometty, will make a presentation to a plant health information technology conference detailing the progress Watson has made in hospital delivery, as well as its plans for increasing medical images and making sure hospitals deliver value for the money, as well as new partnerships it has with other companies. The rest of the MD Anderson collaboration looks bad. Even if the decision is as much a result of MD Anderson's mismanagement or red tape—which it may be—it is still a setback for a field without any big successes.

But IBM defended the MD Anderson product, known as the Oncology Expert Advisor or OEA. It says the OEA's recent problems were avoidable, and experts share that view. The OEA R&D project was a success, and likely could have been deployed had MD Anderson chosen to use it for cancer care, IBM says.

Watson, IBM's language-based computing project, gripped the world's imagination in 2011 when the supercomputer won an exhibition of the game show *Jeopardy!* against the show's two highest-rated players. In March 2012, IBM signed a deal with Memorial Sloan Kettering Cancer Center in New York to develop a commercial product that would use the same technology to analyze the medical literature and help doctors choose treatment for cancer patients.



## Finance

 **PROMONTORY**  
an IBM Company

News room > News releases  
**IBM Announces Planned Acquisition of Promontory to Transform Regulatory Compliance with Watson**

Promontory's 600 professionals and offerings will form the foundation of new Watson Financial Services portfolio from IBM's Industry Platforms business

Select a topic or year

↓ News release

↓ Contact(s) information

↓ Related XML feeds

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ARMONK, N.Y. - 29 Sep 2016: IBM (NYSE: IBM) today announced plans to acquire Promontory Financial Group, a leading provider of risk management and compliance consulting firm. Upon close, the capabilities of Promontory combined with IBM's deep industry expertise and Watson's cognitive capabilities will directly address the massive operational effort and manual cost of escalating regulation and risk management requirements.



Promontory's team of 600 professionals will train Watson to help manage financial risk and compliance. (Credit: IBM)

# What this course about:

- ❖ AI techniques
  - Machine Learning
  - Data Mining
  - Statistics
- ❖ Finance
  - Investment
- ❖ Background Story
  - stock markets



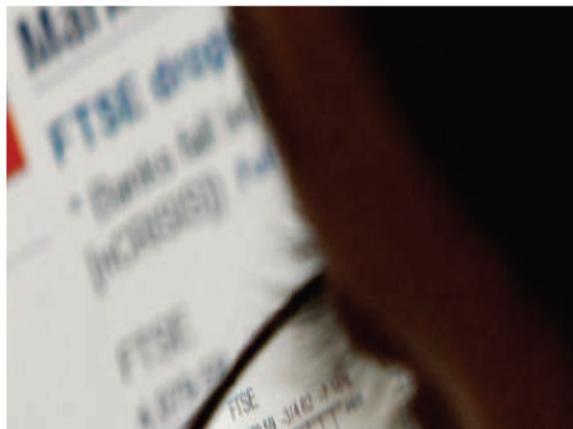
# OPINION

## The economy needs agent-based modelling

The leaders of the world are flying the economy by the seat of their pants, say **J. Doyne Farmer** and **Duncan Foley**. There is, however, a better way to help guide financial policies.

In today's high-tech age, one naturally assumes that US President Barack Obama's economic team and its international counterparts are using sophisticated quantitative computer models to guide us out of the current economic crisis. They are not.

The best models they have are of two types, both with fatal flaws. Type one is econometric: empirical statistical models that are fitted to past data. These successfully forecast a few quarters ahead



pull society out of a recession; that, as rising prices had historically stimulated supply, producers would respond to the rising prices seen under inflation by increasing production and hiring more workers. But when US policy-makers increased the money supply in an attempt to stimulate the economy, it didn't work — they ended up with high inflation and little growth, leaving the economy in a miserable state.

P. NOBLE/REUTERS



### Meltdown modelling

Could agent-based computer models prevent another financial crisis? **Mark Buchanan** reports.

# Science

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52

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## Artificial intelligence steals money from banking customers

By Adrian Cho | Apr. 1, 2016, 3:00 AM

**\*Update, 4 April, 7:51 a.m.: This story was posted on 1 April as an April Fools' joke.**

A breakthrough year for artificial intelligence (AI) research has suddenly turned into a breakdown, as a new automated banking system that runs on AI has been caught embezzling money from customers. The surprising turn of events may set back by years efforts to incorporate AI into everyday technology.

"This is the nightmare scenario," says Len Meha-Döhler, a computer scientist at the Massachusetts Institute of Technology in Cambridge who was not involved in the work.

# DELIA

## Stanford & Google

# What we will talk about

## 1. Current applications

- Portfolio Management
- Algorithmic Trading
- Fraud Detection
- Load & Insurance Underwriting

## 2. Potential future applications

- Customer Service
- Security 2.0
- Sentiment / News Analysis
- Sales / Recommendations of Financial Products

# Portfolio Management

- Scenario :  
Users enter their goals (for example, retiring at age 65 with \$250,000.00 in savings), age, income, and current financial assets. The advisor (which would more accurately be referred to as an “allocator”) then spreads investments across asset classes and financial instruments in order to reach the user’s goals. The system then calibrates to changes in the user’s goals and to real-time changes in the market, aiming always to find the best fit for the user’s original goals.

Schwab Intelligent  
Portfolios®

 Betterment

# Algorithmic Trading

- Scenario :

With origins going back to the 1970's, algorithmic trading (sometimes called "Automated Trading Systems," which is arguably a more accurate description) involves the use of complex AI systems to make extremely fast trading decisions. Algorithmic systems often making thousands or millions of trades in a day, hence the term "high-frequency trading" (HFT), which is considered to be a subset of algorithmic trading.

Most hedge funds and financial institutions do not openly disclose their AI approaches to trading (for good reason), but it is believed that machine learning and deep learning are playing an increasingly important role in calibrating trading decisions in real time.



# Load & Insurance Underwriting

- Scenario :

At large companies (big banks and publicly traded insurance firms), machine learning algorithms can be trained on millions of examples of consumer data (age, job, marital status, etc...) and financial lending or insurance results (did this person default, pay back the loan on time, get in a car accident, etc...?). The underlying trends that can be assessed with algorithms, and continuously analyzed to detect trends that might influence lending and insuring into the future (are more and more young people in a certain state getting in car accidents? Are there increasing rates of default among a specific demographic population over the last 15 years?). These results have a tremendous tangible yield for companies – but at present are primarily reserved for larger companies with the resources to hire data scientists and the massive volumes of past and present data to train their algorithms.



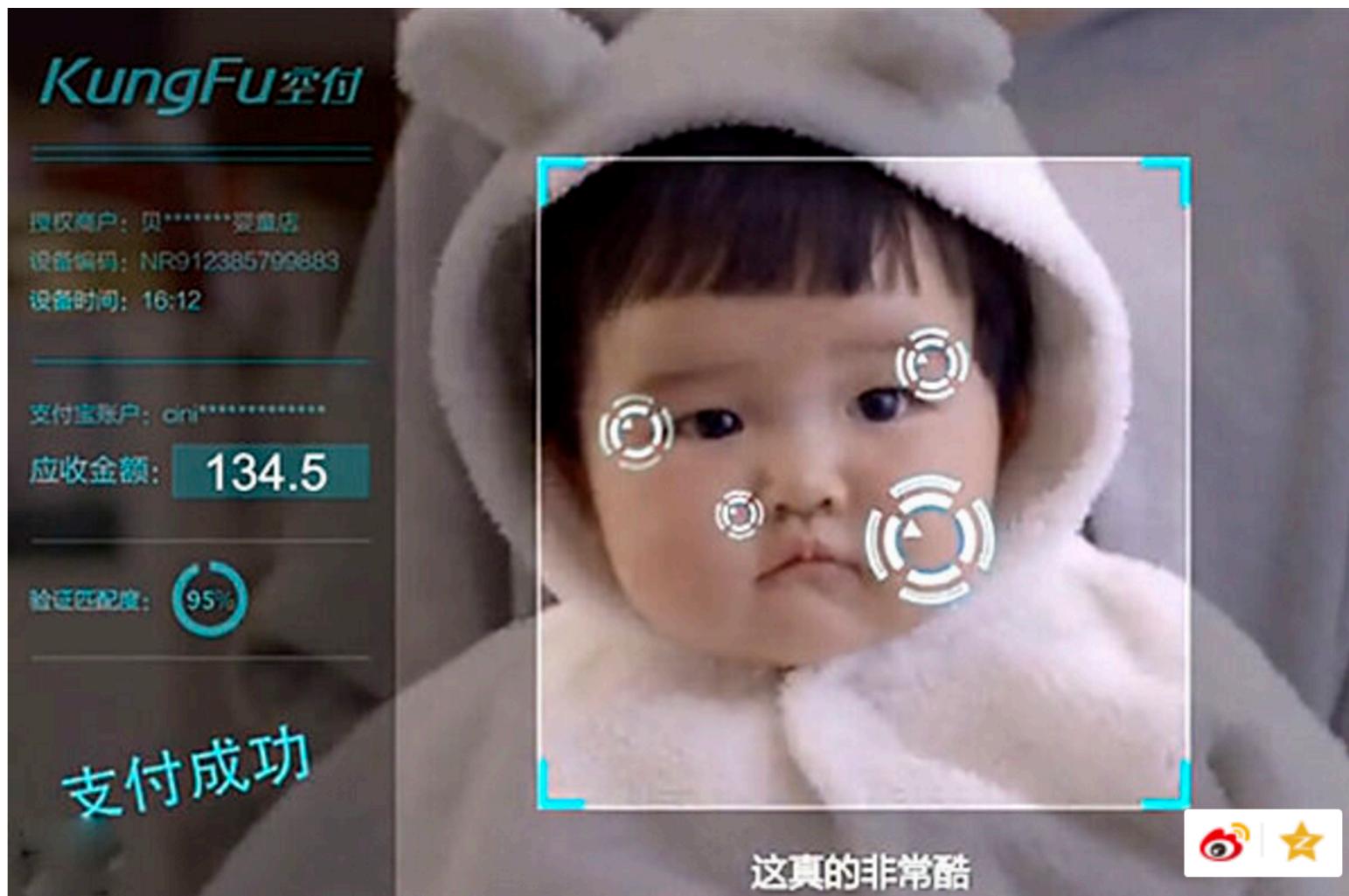
# Customs Services

- Scenario :

Chat bots and conversational interfaces are a rapidly expanding area of venture investment and customer service budget. Companies like Kasisto are already building finance-specific chat bots to help customers ask questions via chat such as “How much did I spend on groceries last month?” and “What was the balance of my personal savings account 60 days ago?” These assistants have had to be built with robust natural language processing engines as well as reams of finance-specific customer interactions. Banks and financial institutions that allow for such swift querying and interaction might pick up customers from stodgy banks that require people to log onto a traditional online banking portal and do the digging themselves. This kind of chat (or in the future – voice) experience is not the norm today in banking or finance, but may be a viable option for millions in the coming five years. This application goes beyond machine learning in finance, and is likely to manifest itself as specialized chat bots in a variety of fields and industries.



# Security 2.0



# Sentiment / News Analysis

- Scenario :

Hedge funds hold their cards tight to their chest, and we can expect to hear very little by way of how sentiment analysis is being used specifically. However, it is supposed that much of the future applications of machine learning will be in understanding social media, news trends, and other data sources – not just stock prices and trades. The stock market moves in response to myriad human-related factors that have nothing to do with ticker symbols, and the hope is that machine learning will be able to replicate and enhance human “intuition” of financial activity by discovering new trends and telling signals.

Ben Goertzel provides some interesting insight into the world of AI hedge funds in [this recent WIRED article](#). Goertzel shares the belief of many others that machine learning in finance will be far from limited to stock and commodity data – and that the AI hedge funds who come out of top will need to do much more than study ticker symbols alone.



[Twitter mood predicts the stock market](#)

[J Bollen, H Mao, X Zeng - Journal of computational science, 2011 - Elsevier](#)

... also suggests that news may be unpredictable but that very early indicators can be extracted from online [social media](#) (blogs, Twitter feeds, etc.) to predict changes in various economic and commercial indicators. This may conceivably also be the case for the [stock market](#). ...

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Learn how at engineering



A View from **Christopher Mims**

## AI That Picks Stocks Better Than the Pros

A computer science professor uses textual analysis of articles to beat the market.

June 10, 2010

**T**he ability to predict the stock market is, as any Wall Street quantitative trader (or quant) will tell you, a license to print money. So it should be of no small interest to anyone who likes money that a new system that works in a radically different way than previous automated trading schemes appears to be able to be Wall Street's best quantitative mutual funds at their own game.

It's called the Arizona Financial Text system, or AZFinText, and it's built by ingesting large quantities of financial news stories (in initial tests from Yahoo Finance) along with minute-by-minute stock price data, then using the former to figure out how to predict the latter. Then it buys, or shorts, every stock it believes will move more than 1% of its current price in the next 20 minutes - and it never holds a stock for longer.

The system was developed by **Robert P. Schumaker** of Iona College in New Rochelle and and **Hsinchun Chen** of the University of Arizona, and

THE WALL STREET JOURNAL.

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BREAKING NEWS Donald Trump declares himself freed from GOP 'shackles,' attacks 'disloyal' Republicans

DIGITS

## Using Artificial Intelligence to Digest News, Trade Stocks

By **JENNIFER VALENTINO-DEVRIES**

Jun 21, 2010 1:45 pm ET

0 COMMENTS

Watch out, stock pickers.

Researchers have been working on an artificial-intelligence computer program designed to mimic the way an analyst uses financial news. In simulated trading, the program beat the S&P 500, and when combined with quantitative stock-picking techniques, it saw a return on trades of more than 20%.



To make stock predictions, the program does what is known as "text mining" — scanning large volumes of content and analyzing the words in it. Computer-aided quantitative funds already are plentiful, but they analyze numerical data rather than text. The new program is different because it attempts to simulate what has traditionally been a human activity.

"Our approach is more like the analyst approach, simulated by a program," said **Hsinchun Chen**, director of the University of Arizona's Artificial Intelligence Lab, in an interview with **Wired**. "You have an analyst reading papers, looking for clues that others have not observed."

The program, which was first reported by MIT's **Technology Review**, scans stock prices and financial news and buys or shorts stocks it believes will move more than 1% in the next 20 minutes. The system sells the stocks after 20 minutes.

"When you do long-term predictions, there are many variables," Dr. Chen said. "But ... you can have an advantage if you look at five minutes, 10 minutes."

In evaluating the meaning of a single news item, "the system won't be as accurate as an individual analyst," Dr. Chen said. "The computer is maybe 80 to 85% accurate when analyzing text, but it can read maybe 100,000 times the amount of data." He said the amount of data being analyzed is one thing that would make it difficult to game the system.

The system's creators tested it using data from five weeks in the fall of 2005 — more than 9,000 news articles and 10 million stock quotes. During that test, the system, called AZFinText, had an 8.5% return on trades, beating the S&P 500 index as well as six of the top 10 quantitative funds. When the researchers used quantitative strategies to select a

## A Tensor-Based Information Framework for Predicting the Stock Market

**QING LI**, *Southwestern University of Finance and Economics, China*

**YUANZHU CHEN**, *Memorial University of Newfoundland, Canada*

**LILING JIANG and PING LI**, *Southwestern University of Finance and Economics, China*

**HSINCHUN CHEN**, *University of Arizona, USA, and Tsinghua University, China*

To study the influence of information on the behavior of stock markets, a common strategy in previous studies has been to concentrate the features of various information sources into one compound feature vector, a process that makes it difficult to distinguish the effects of different information sources. We find that exploring the intrinsic relations among multiple information sources is important for predicting stock trends. The challenge lies in modeling the complex space of various sources and types of information and studying the effects of this information on stock market behavior. For this purpose, we introduce a tensor-based information framework to predict stock movements. Specifically, our framework models the complex investor information environment with tensors. A global dimensionality-reduction algorithm is used to capture the links among various information sources in a tensor, and a sequence of tensors is used to represent information gathered over time. Finally, a tensor-based predictive model to forecast stock movements, which is in essence a high-order tensor regression learning problem, is presented. Experiments performed on an entire year of data for China Securities Index stocks demonstrate that a trading system based on our framework outperforms the classic Top-N trading strategy and two state-of-the-art media-aware trading algorithms.

Categories and Subject Descriptors: I.2.6 [Artificial Intelligence]: Learning; H.4.2 [Information Systems Applications]: Types of Systems

General Terms: Design, Algorithms, Performance

Additional Key Words and Phrases: Tensor, predictive model, stock, trading strategy, news, social media

This work has been supported by grants awarded to Dr. Qing Li from the National Natural Science Foundation of China (NSFC) (91218301,61171013,60803106,71401109), the Sichuan National Science Foundation for Distinguished Young Scholars (2013JQ0004), and the Fundamental Research Funds for the Central Universities (JBK151128, JBK120505). It also has been partially funded by grants awarded to Dr. Hsinchun Chen from the U.S. National Science Foundation (ACI-1443019, DUE-1303362, CMMI-1442116, SES-1314631) and the University of Arizona and the China National 1000-Talent Program at the Tsinghua University. Authors' addresses: Q. Li, Collaborative Innovation Center for the Innovation and Regulation of Internet-based Finance, School of Economic Information Engineering, Southwestern University of Finance and Economics, Chengdu, Sichuan, China; email: liq\_@swufe.edu.cn; Y. Z. Chen, Computer Science Department, Memorial University of Newfoundland, St. John's, NL, Canada; email: yzchen@mun.ca; L. L. Jiang, Alibaba Group, Zhejiang, China; email: liling.jiangling@alibaba-inc.com; P. Li, International Exchange and Cooperation, Southwestern University of Finance and Economics, Chengdu, Sichuan, China; email: pingli@swufe.edu.cn; H. Chen, Management Information System Department, University of Arizona, Tucson, USA; and the Chinese Academy of Sciences (Professor Chen is a Chinese National 1000-Talent Professor in the Department of Computer Science and Technology at the Tsinghua University of China.) Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made distributed for profit or commercial advantage and that copies show this notice on the first page or initial screen of a display along with the full citation. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or to publish, to post on servers, to redistribute in print, or to use any component of this work in other works requires prior specific permission and a fee. Permissions may be requested from Publications Dept., ACM, Inc., 2 Penn Plaza, Suite 701, New York, NY 10121-0701 USA, fax +1 (212) 869-0481, or permissions@acm.org.

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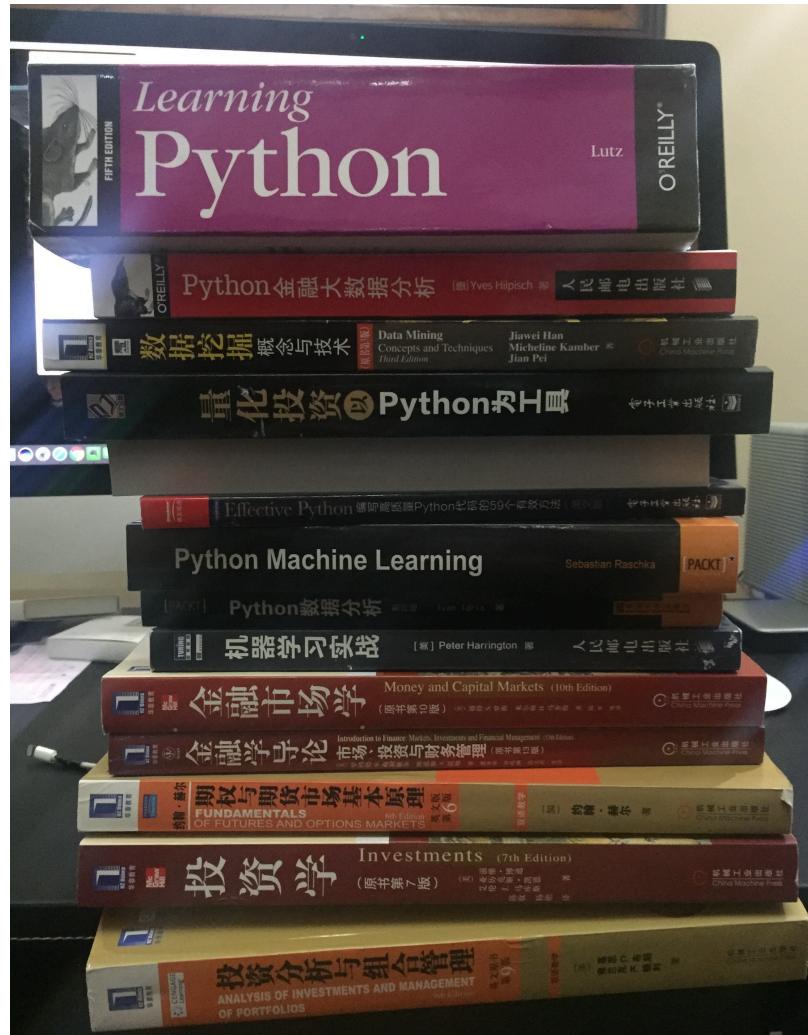
DOI: <http://dx.doi.org/10.1145/2838731>

# Sales / Recommendations of Financial Products

- Scenario :

Applications of automated financial product sales exist today, some of which may not involve machine learning (but rather, other rule-based systems). A robo-advisor might suggest portfolio changes, and there are plenty of insurance recommendation sites this might use some degree of AI to suggest a particular car or home insurance plan. In the future, increasingly personalized and calibrated apps and personal assistants may be perceived (not just by millennials) as more trustworthy, objective, and reliable than in-person advisors. Just as Amazon and Netflix can recommend books and movies better than any living human “expert,” ongoing conversations with financial personal assistants might do the same for financial products, as we see beginning to happen in the **insurance industry**.

# Textbook



# **Grade**

- |                           |      |
|---------------------------|------|
| 1. Quiz                   | 20%  |
| 2. Assignments            | 30 % |
| 3. Project & Presentation | 20 % |
| 4. Final Exam             | 30%  |

# Blackboard

The screenshot shows the Blackboard interface for managing users in a course. The top navigation bar includes the university logo, the name '西南财经大学 课程中心' (Sichuan University of Finance and Economics Course Center), and links for '经济信息工程学院-教师 李庆' (Economics and Information Engineering College - Teacher Li Qing), '注销' (Logout), '我的主页' (My Home Page), and '课程' (Courses). On the left, a sidebar menu lists various administrative functions: '讨论' (Discussions), '小组' (Groups), '工具' (Tools), '帮助' (Help), '课程管理' (Course Management), '控制面板' (Control Panel) with '文件' (Files) selected, '课程工具' (Course Tools), '评估' (Assessment) with '成绩指示板' (Grade Dashboard), '课程报告' (Course Report), and '预警系统' (Warning System); '评分中心' (Grading Center) is also listed; '用户和小组' (Users and Groups) with '小组' (Groups) and '用户' (Users); '定制' (Customization); '数据包和实用工具' (Data Pack and Useful Tools); and '帮助' (Help). The main content area displays a table titled '从课程中删除用户' (Delete User from Course) with the following data:

用户名	名字	院系/角色	电子邮件	角色	观察员	可用
41424018	谢雅依	人文学院-学生	mnbvcxz9753@qq.com	学生	是	
41416129	李欣静	公共管理学院-学生		学生	是	
41419114	金杨妮	国际商学院-学生		学生	是	
41413103	林英	工商管理学院-学生		学生	是	
41412040	邹锦岸	工商管理学院-学生		学生	是	
41413040	冉昕	工商管理学院-学生	565640524@qq.com	学生	是	
41413001	余苏朋	工商管理学院-学生	41413001@2014.swufe.edu.cn	学生	是	
41413016	刘文茹	经济与信息学院		学生	是	
41427048	袁禄	经济信息学院-学生		学生	是	
41408035	朱昱成	经济信息工程学院		学生	是	
41423018	兰后	经济信息工程学院-学生	294078290@qq.com	学生	是	
41411046	李彦瑾	经济信息工程学院-学生	41411046@2014.swufe.edu.cn	学生	是	

# Prerequisite:

- Python
- Data Mining Techniques
  1. Association rule
  2. Decision tree
  3. K-means clustering
  4. Collaborative Filtering
- Here we go ....

The figure shows a PyCharm interface with a script named `stock.py` open. The script uses pandas and matplotlib to read CSV data and plot stock trends. A plot window titled "Figure 1" displays a line graph of stock price from October 8, 2016, to November 23, 2016.

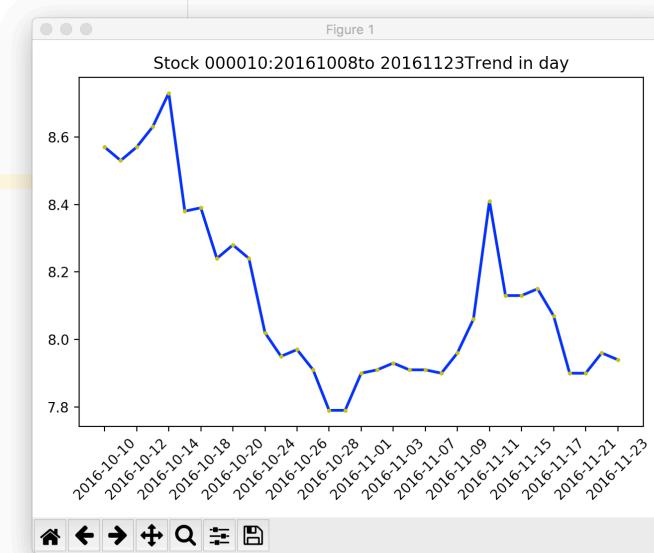
**Code Snippet:**

```
stocks ~/PycharmProjects/
Project stock x painting.py
stocks ~/PycharmProjects/
  stock
  External Libraries

stock x
painting.py x

6   """
7
8     import pandas as pd
9     import matplotlib
10    import matplotlib.pyplot as plt
11    from matplotlib.ticker import FuncFormatter, MaxNLocator
12    import os
13    from datetime import *
14
15
16    def mplot(a, title):
17        x = list(range(len(a.time)))
18        fig = plt.figure()
19        ax1 = fig.add_subplot(1, 1, 1)
20        ax1.plot(x, a.close, 'b-', linewidth=2)
21        ax1.plot(x, a.close, 'yo', markersize=2)
22
23    def format_fn(tick_val, tick_pos):
24        if int(tick_val) in a:
25            return a['time'][a.index[int(tick_val)]]
26        else:
27            return ''
28
29    ax1.xaxis.set_major_formatter(FuncFormatter(format_fn))
30    ax1.xaxis.set_major_locator(MaxNLocator(nbins=30, integer=True))
31    ax1.set_title(title)
32    plt.xticks(rotation=45)
33    plt.tight_layout()
34    plt.show()
35
36
37 # code = input('请输入您想查询的股票代码\n')
38 # sel = input('请输入基本单位, 查看每天数据输入\'d\',若为高频数据输入\'m\'\n') # \n为转行
39 # print('友情提醒: 输入的区间时间为20141008-20161123')
40 # s_time = input('请输入起始时间, 格式为20150921\n')
41 # f_time = input('请输入结束时间, 格式同上\n')
42
43
44 code = "000010"
45 sel = "d"
46 s_time = "20161008"
47 f_time = "20161123"
48
49
50 if code[0] == '6':
51     code += '.SH'
52 else:
53     code += '.SZ'
54
55 print(code)
56 assert os.path.exists('smdata/' + code + '.txt'), 'No Stock'
57
58 df = pd.read_csv('smdata/' + code + '.txt', parse_dates=[0]).sort_values('time', ascending=True)
59 start_time = s_time[0:4] + '-' + s_time[4:6] + '-' + s_time[6:]
60 final_time = f_time[0:4] + '-' + f_time[4:6] + '-' + f_time[6:]
61
62 matplotlib.rcParams['font.sans-serif'] = ['SimHei']
```

**Plot Description:** Figure 1 shows the daily trend of Stock 000010 from October 8, 2016, to November 23, 2016. The y-axis represents the price, ranging from 7.8 to 8.6. The x-axis shows dates from 2016-10-10 to 2016-11-23. The price starts around 8.55, peaks at approximately 8.7 on October 12, and then generally declines to about 7.9 by November 23.



<https://www.jetbrains.com/pycharm/>

The PyCharm website homepage features a large, stylized graphic composed of overlapping triangles in yellow, green, and blue. In the center of this graphic, the text "PC PyCharm" is displayed, with "PC" in a smaller square and "PyCharm" in a larger, bold font. Below this, the text "Python IDE for Professional Developers" is shown, along with a "DOWNLOAD NOW" button and a note about full-fledged Professional or Free Community editions. At the bottom left, there's a small black box with the text "WHY PYCHARM". The main headline "ALL PYTHON TOOLS IN ONE PLACE" is prominently displayed in large, bold, black capital letters. On the right side, a screenshot of the PyCharm IDE interface shows code in a Python file named "tests.py". The interface includes toolbars, a code editor with syntax highlighting, and a navigation pane.

ALL PYTHON TOOLS  
IN ONE PLACE

WHY PYCHARM

Be More Productive

Save time while PyCharm takes care of the routine. Focus on bigger things and embrace the keyboard-centric approach to get the most of PyCharm's many productivity features.

PC PyCharm

Python IDE for Professional Developers

Coming in 2017.1   What's New   2016.3   Features   Docs & Demos   Buy   Download

ALL PYTHON TOOLS IN ONE PLACE

tests.py

```
20     response = self.client.get(reverse('polls:index'))
21     self.assertEqual(response.status_code, 200)
22     self.assertContains(response, 'No polls are available.')
23     self.assertQuerysetEqual(response.context['latest_question_list'], [])
24
25     # Test index view with a future question
26     def test_index_view_with_a_future_question(self):
27         QuestionViewTests
28         QuestionViewTests
29         QuestionViewTests
30         QuestionViewTests
31         QuestionViewTests
32         TestCase
33         TestCase
34         TestCase
```

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# Quiz

1. write a function to compute  $n!$  in Python
  - the value of  $n$  is input
  - put the result in a file
2. write down your known data mining techniques
  - algorithm name
  - intuition of the algorithm
  - its application areas
  - Anything you know about

# Assignment 1

1. Prepare a PPT to introduce Financial Intelligence
  - What is financial Intelligence
  - Current application
  - Future Trends  
  - ❖ Case Study is preferred
  - ❖ Chinese or English acceptable

# **AI+ Era**

*Deep Knowledge & Big Knowledge*

# Is Coming