

EE448 Big Data Mining

Weinan Zhang
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<http://wnzhang.net>

Spring Semester 2018

<http://wnzhang.net/teaching/ee448/index.html>

Self Introduction – Weinan Zhang

- Position
 - Assistant Professor at CS Dept. of SJTU 2016-now
 - Apex Data and Knowledge Management Lab
 - John Hopcroft Research Center for Computer Science
 - Research on machine learning and data mining topics
- Education
 - Ph.D. on Computer Science from University College London (UCL), United Kingdom, 2012-2016
 - B.Eng. on Computer Science from ACM Class 07 of Shanghai Jiao Tong University, China, 2007-2011

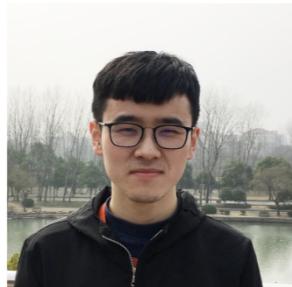
Course Administration

- No official text book for this course, some recommended books are
 - Jiawei Han, Micheline Kamber, Jian Pei. “Data Mining: Concepts and Techniques, 3rd Edition”. Morgan Kaufmann Series, 2011.
 - 范明, 孟小峰 译《数据挖掘 概念与技术》机械工业出版社, 2012.
 - Bing Liu. “Web Data Mining, 2nd Edition”. Springer, 2011.
 - 俞勇等 译《Web数据挖掘》清华大学出版社, 2012.
- 李航《统计学习方法》清华大学出版社, 2012.
- 周志华《机器学习》清华大学出版社, 2016.
- Tom Mitchell. “Machine Learning”. McGraw-Hill, 1997

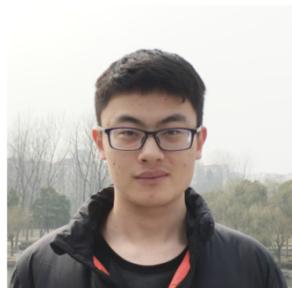
Course Administration

- A hands-on big data mining course
 - No assignment, no final exam
- Two course works (80%)
 - Kaggle-in-Class competitions on Text Classification (40%)
 - Kaggle-in-Class competitions on Recommendation (40%)
- Poster session (10%)
- Attending (10%)
 - Could be evaluated by quiz

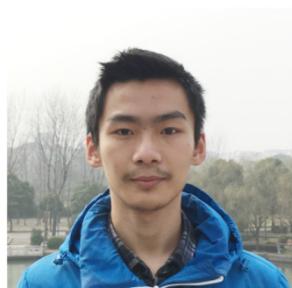
Teaching Assistants



- Yuchen Yan (严宇辰), IEEE Honored Class 2015 student, Computer Science
 - Email: xyxpzer [at] sjtu.edu.cn
 - Research on data mining, knowledge graph, network analysis



- Ruijie Wang (王睿杰), Dept. of Computer Science 2015 student
 - Email: wjerry5 [at] sjtu.edu.cn
 - Research on data mining, natural language processing
- Jialu Wang (王嘉璐), IEEE Honored Class 2015 student, Computer Science
 - Email: faldict [at] sjtu.edu.cn
 - Research on data mining, deep learning, reinforcement learning



TA Administration

- Join the mail list
 - Please send your

- Name
 - Student number
 - Email address

to Yuchen Yan [@sjtu.edu.cn](mailto:xyxpzer)

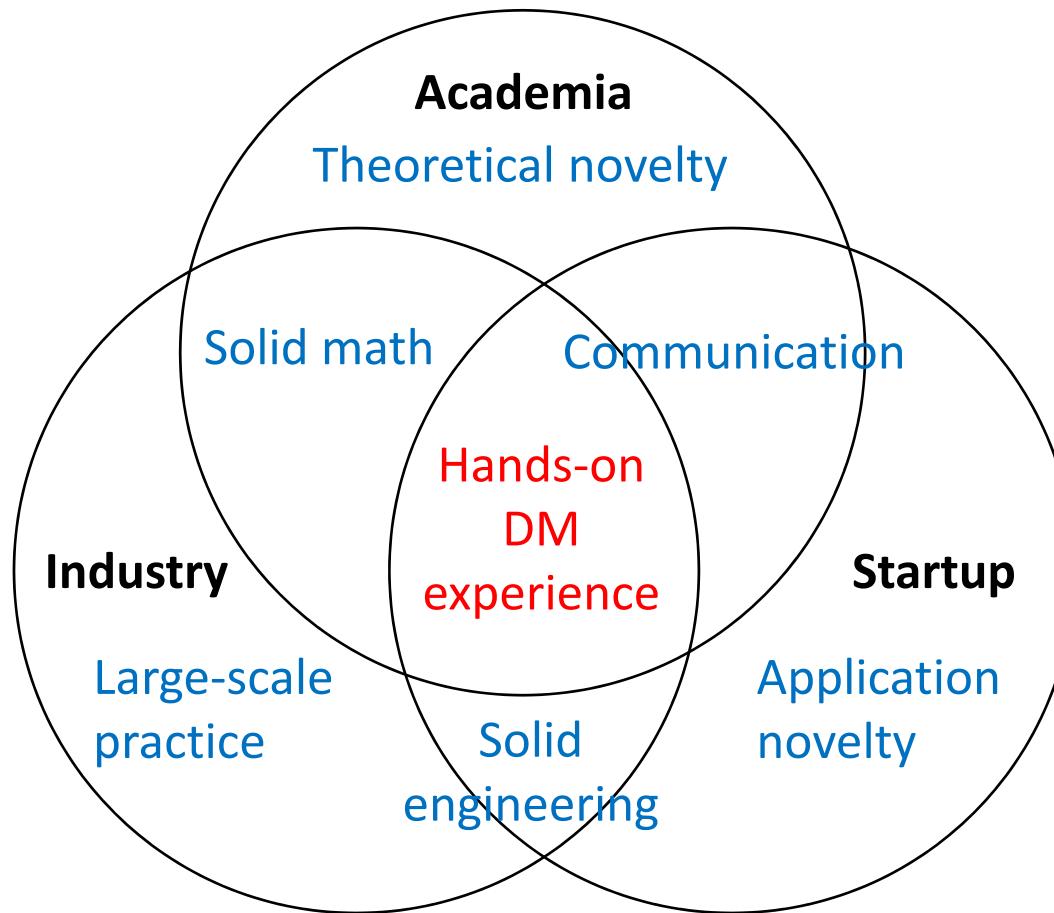
with email title “Check in EE448”

- Office hour
 - Every Thursday 8-9pm, 1-203 SEIEE Building

Goals of This Course

- Know about the big picture of data science
- Get familiar with popular data mining methodologies
 - Data representations
 - Problem formulation
 - Machine learning & data mining algorithms
 - Experimental methodologies
- Get some first-hand DM developing experiences
- Present your own DM solutions to real-world problems

Why we focus on hands-on DM



- Get familiar with various data mining applications.
- Play with the data and get your hands dirty!

Course Landscape

- 1. Data Mining Intro
- 2. Fundamentals of Data
- 3. Basic DM Algorithms
- 4. Supervised Learning 1
- 5. Supervised Learning 2
- 6. Supervised Learning 3
- 7. Unsupervised Learning
- 8. Text Mining
- 9. Search Engines
- 10. Ranking Information Items
- 11. Recommender Systems
- 12. Computational Ads
- 13. Behavioral Targeting
- 14. Knowledge Graphs
- 15. Social Networks
- 16. Poster Session

EE448, Big Data Mining, Lecture 1

Introduction to Big Data Mining

Weinan Zhang

Shanghai Jiao Tong University

<http://wnzhang.net>

<http://wnzhang.net/teaching/ee448/index.html>

Content of This Lecture

- An example as an intro of data mining
- Concepts of data mining
- Real-world examples of data mining

Display Advertising

• A display ad example

大陆



河南省公安厅彻查“封丘36人入警 35人身份不合规”

中封丘县公安局的36名受训人员，35人是公安局内部的文职或临时人员，与“民警必须具备公务员身份”的国家规定不符，引发该局内部

- 上海至成都沿江高铁提上日程 串联长江沿线22城市
- 2016号歼-20原型机曝光 已滑行测试(图)
- 日媒：中国或派万吨海警船巡钓鱼岛 打消耗战
- 外媒：中国开始研制隐身武装直升机 预计2020年交付
- 习近平关于中美关系的十个判断
- 住建部黑臭水沟整治工作指南：9成百姓满意才能达标
- 陕西：职校“校长”让女学生陪酒 学校被撤除
- 揭秘“团团伙伙”的武钢漩涡和落马高管

国际



巴塞罗那200万人游行 呼吁加泰罗尼 亚独立(图)

How likely the user is going to click the ad?

- 李伟光：收税是不公平的恶？
- 许章润：超级大国没有纯粹内政
- 刘畊宏：国外政党联系群众的路径研究

时局观



民革中央副主席：中共从未否定国民党抗战作用

- 施芝鸿：文革基础上搞改革致一个时期市场官场乱象
- 朱维群回应争议：尊重民族差异而不强化
- 伊协副会长：穆斯林不应因宗教功修忽视社会责任

领袖圈



奥巴马54岁啦，当7年
总统人苍老了头发也
白了



海绵城市 未来之城

水危机：青岛告急

探访中国绿化博览会

帝都吸引华人首富

凤凰房产 诚邀加盟

谈华山论剑与中国精神

黑龙江创新驱动三步棋

《印记》之江城夜未眠

办公环境搜查令

圈层生活尽在凤凰会

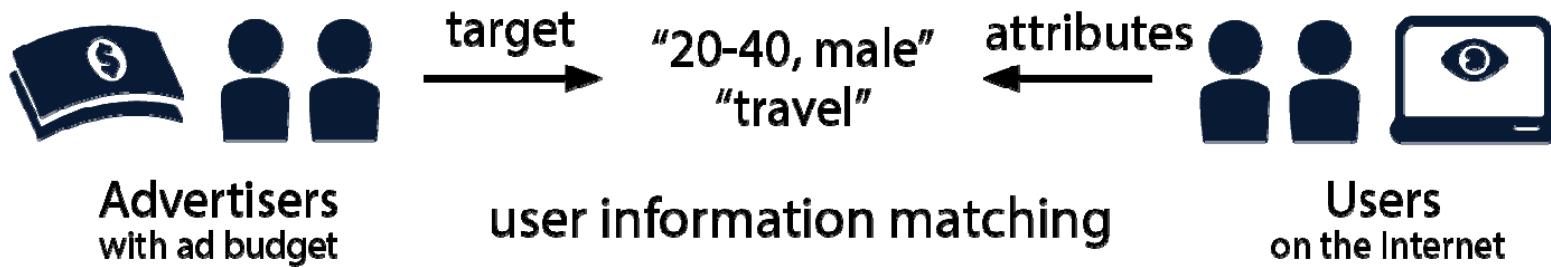
精彩视频

凤凰联播台



菲媒曝菲律宾军演针对中
国 直指南海生命线
播放数：2602282

Display Advertising



- Advertiser targets a segment of users
 - E.g. by age, gender, occupation, interest tags etc.
- Intermediary matches users and ads by user information

Internet Advertising Frontier:

Real-Time Bidding (RTB) based Display Advertising

What is Real-Time Bidding?

- Every online **ad view** can be evaluated, bought, and sold, all **individually**, and all **instantaneously**.
- Instead of buying keywords or a bundle of ad views, advertisers are now **buying users** directly.

An RTB Example

- Weinan regularly reads articles on [emarketer.com](#)

 eMarketer

Research Topics Products Why eMarketer Customer Stories Articles

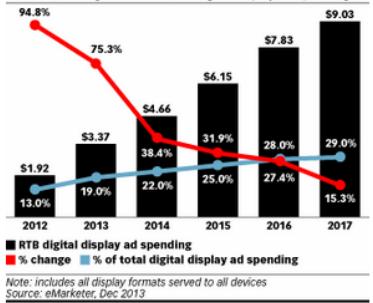
Advertisers Continue Rapid Adoption of Programmatic Buying

By 2017, advertisers will spend more than \$9 billion on RTB

Nov 26, 2013

Share Print Email

Advertisers are spending more than expected on real-time bidding, which is expected to account for a significant share of all display ad spending in the US billions, % change and % of total digital display ad spending



Year	RTB digital display ad spending (billions)	% change
2012	\$1.92	94.8%
2013	\$3.37	75.3%
2014	\$4.66	38.4%
2015	\$6.15	25.0%
2016	\$7.83	27.4%
2017	\$9.03	15.3%

eMarketer projects RTB digital display ad spending in the US will account for 29.0% of total US digital display ad spending by 2017, or \$9.03 billion. In 2013, it will account for 19.0%, or \$3.37 billion. These estimates are revised slightly upward from our previous forecast in August

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An RTB Example

- Weinan recently checked the London hotels on booking.com

Booking.com

Browse by destination theme Shopping Fine Dining Culture Sightseeing Monuments Relaxation

home → uk 16,378 properties → greater london 1,824 properties → london 1,574 properties → search results London, 2 adults, 11 nights (Jul 14 - Jul 25) Change dates

Search

Destination/Hotel Name:

Distance: 16 miles

Check-in Date: Mon 14 July 2014

Check-out Date: Fri 25 July 2014

I don't have specific dates yet

Guests: 2 Adults (1 room)

Search Search properties

Filter by:

Weinan Zhang 3  

Recently viewed Lists

London is a top choice with fellow travelers on your selected dates (48% reserved).
Tip: Prices might be higher than normal, so try searching with different dates if possible.

Try previous week Jul 7 - Jul 18 Try next week Jul 21 - Aug 1

930 out of 1857 properties are available in and around London
Showing 1 – 15

Sort by: Recommended Stars Location Price Review Score

 **Park Plaza Victoria London** ★★★★  1736
Central London, Westminster, London • 

Very good 8.5
Score from 1137 reviews

Price for 11 nights £2,353.65
We have 5 rooms left!
Book now

There are 13 people looking at this hotel.
Latest booking: 1 hour ago

 **Central Park Hotel** ★★★★  1993

6.6

An RTB Example

- The day after, he found relevant ads on facebook.com

A screenshot of a Facebook home page. On the left, there's a sidebar with links to 'Family', 'UCL', 'SJTU', 'UCL', 'Shanghai Jiao Tong', 'London, United Ki...', 'University College', 'Close Friends', and 'Intern, Beijing, Microso...'. Below that are sections for 'GROUPS' (Microsoft Research C...) and 'INTERESTS' (Pages and Public Fig...). Under 'PAGES', there are links to 'Like Pages', 'Pages feed', and 'Create a Page...'. At the bottom is a 'DEVELOPER' section.

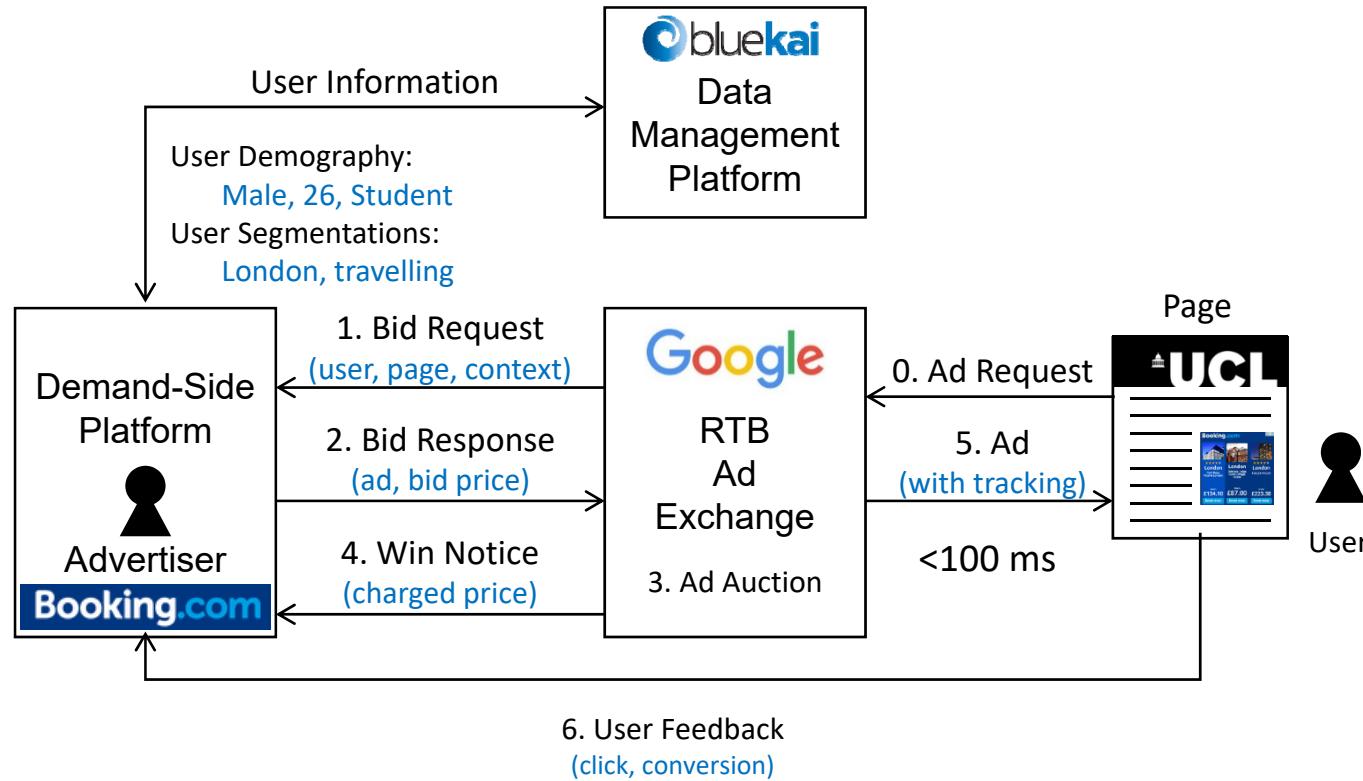
The main content area shows a news feed with several posts. One post from 'secret escapes' is highlighted with a red box. It features a photo of a luxury hotel at sunset with a swimming pool and a hot tub. The post text reads: 'Secret Escapes | Exclusive Discounts' and 'Get up to 70% off luxury hotels and holidays.' It includes a 'Sign Up' button and a link to WWW.SECRETESCAPES.COM. The post has 2,327 likes, 85 comments, and 444 shares.

Two other ads are also highlighted with red boxes:

- A post from 'Bingkai Lin' featuring a photo of a person and the text 'Find the best rates on handpicked hotels'.
- A post from 'Zhaomeng Peng' featuring a photo of a person and the text 'Book & Save! 247 London Hostel, London.'
- A post from 'Stale Marketing Stinks' featuring a logo and the text 'Freshen up with eMarketer's reports, trends & data on digital marketing. Download Today!'

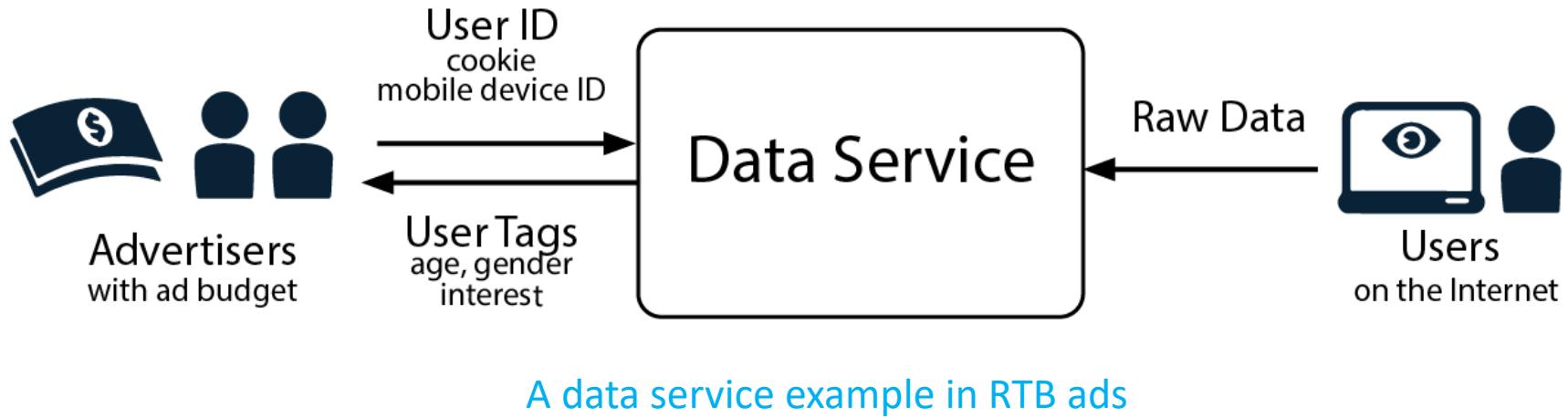
At the bottom right, there are links for 'English (UK)', 'Privacy', 'Terms', 'Cookies', and 'More'.

Players Interaction in RTB



- A demand-side platform buys ads via real-time bidding (RTB) 10 billion per day
- A data management platform analyzes and maintains the information billions of Internet users

Data Technology as a Service



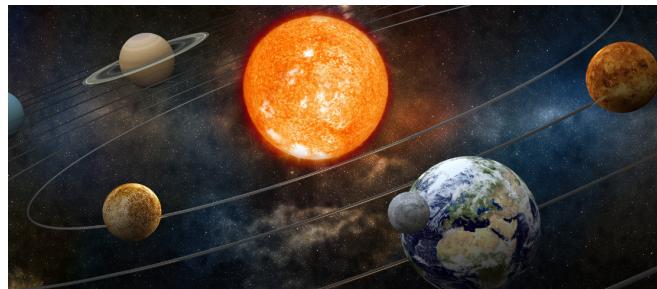
- The data service (or DaaS) is a cousin of software as a service (SaaS)
 - takes the input of high-quality data request based on raw data
 - returns the requested high-quality data for higher-level (intelligent) applications

Content of This Lecture

- An example as an intro of data mining
- Concepts of data mining
- Real-world examples of data mining

The Underlying Data Science

- Data science is the subject concerned with the methodology of discovering the underlying principles and patterns from massive amount of data.
- Physics
 - **Goal:** discover the underlying principle of the world



- **Solution:** build the model of the world

$$F = G \frac{m_1 m_2}{r^2}$$

Example: Newton's gravity law

- Data Science
 - **Goal:** discover the underlying principle of the data



- **Solution:** build the model of the data

$$p(x) = \frac{e^{f(x)}}{\sum_{x'} e^{f(x')}}$$

Example: Energy-based distribution

- In fact, data science could be a more general concept for natural science.

Evolution of Sciences

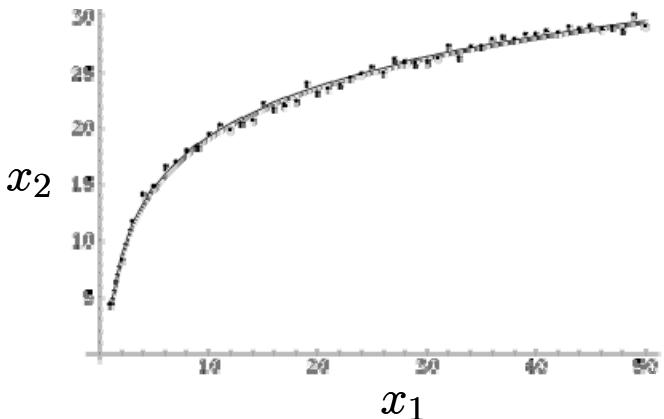
- Before 1600, **empirical science**
- 1600-1950s, **theoretical science**
 - Each discipline has grown a *theoretical* component. Theoretical models often motivate experiments and generalize our understanding.
- 1950s-1990s, **computational science**
 - Over the last 50 years, most disciplines have grown a third, *computational* branch (e.g. empirical, theoretical, and computational ecology, or physics, or linguistics.)
 - Computational Science traditionally meant simulation. It grew out of our inability to find closed-form solutions for complex mathematical models.
- 1990-now, **data science**
 - The flood of data from new scientific instruments and simulations
 - The ability to economically store and manage petabytes of data online
 - The Internet and computing Grid that makes all these archives universally accessible
 - Scientific info. management, acquisition, organization, query, and visualization tasks scale almost linearly with data volumes. **Data mining** is a major new challenge!

Data Science

- A deterministic view
 - For a high-dimensional data \mathbf{x}
 - Find the underlying function

$$\mathbf{x}_i = f(\mathbf{x}_{\neq i})$$

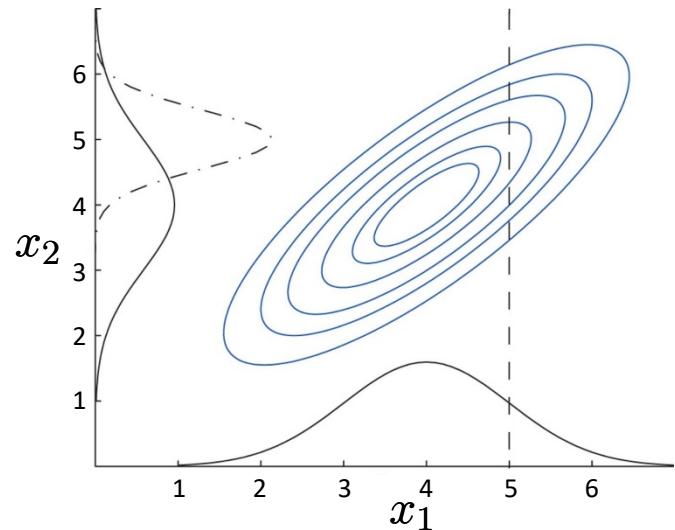
for a certain target dimension data \mathbf{x}_i



- A probabilistic view
 - For a high-dimensional data \mathbf{x}
 - Find joint data distribution $p(\mathbf{x})$
 - Then the conditional distribution

$$p(\mathbf{x}_i | \mathbf{x}_{\neq i})$$

for a certain target dimension data \mathbf{x}_i



An Example in User Behavior Modeling

Interest	Gender	Age	BBC Sports	PubMed	Bloomberg Business	Spotify
Finance	Male	29	Yes	No	Yes	No
Sports	Male	21	Yes	No	No	Yes
Medicine	Female	32	No	Yes	No	No
Music	Female	25	No	No	No	Yes
Medicine	Male	40	Yes	Yes	Yes	No

- A 7-field record data
 - 3 fields of data that are expensive to obtain
 - Interest, gender, age collected by user registration information or questionnaires
 - 4 fields of data that are easy or cheap to obtain
 - Raw data of whether the user has visited a particular website during the last two weeks, as recorded by the website log

An Example in User Behavior Modeling

Interest	Gender	Age	BBC Sports	PubMed	Bloomberg Business	Spotify
Finance	Male	29	Yes	No	Yes	No
Sports	Male	21	Yes	No	No	Yes
Medicine	Female	32	No	Yes	No	No
Music	Female	25	No	No	No	Yes
Medicine	Male	40	Yes	Yes	Yes	No

- **Deterministic view:** fit a function

Age = f(Browsing=BBC Sports, Bloomberg Business)

- **Probabilistic view:** fit a joint data distribution

$p(\text{Interest}=\text{Finance}, \text{Gender}=\text{Male}, \text{Age}=29, \text{Browsing}=\text{BBC Sports, Bloomberg Business})$

- Then build the conditional data distribution

$p(\text{Interest}=\text{Finance} \mid \text{Browsing}=\text{BBC Sports, Bloomberg Business})$

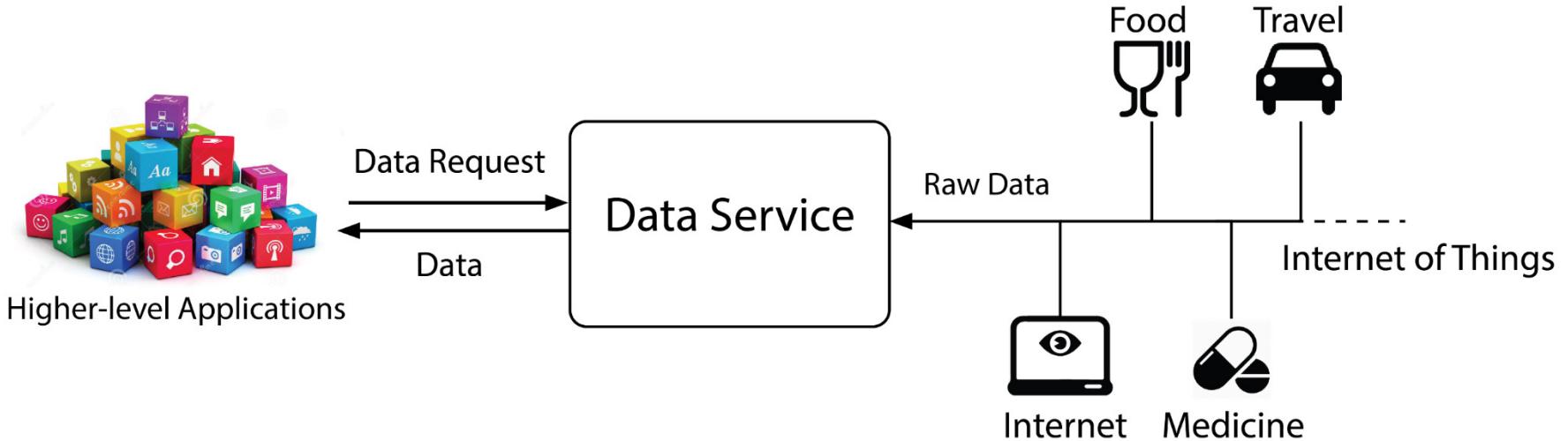
$p(\text{Gender}=\text{Male} \mid \text{Browsing}=\text{BBC Sports, Bloomberg Business})$

Data Technology as a Service



- The data service is just like a data processing factory that
 - collects raw and cheap data
 - supports the higher-level (intelligent) applications with quality data

Data Technology Everywhere

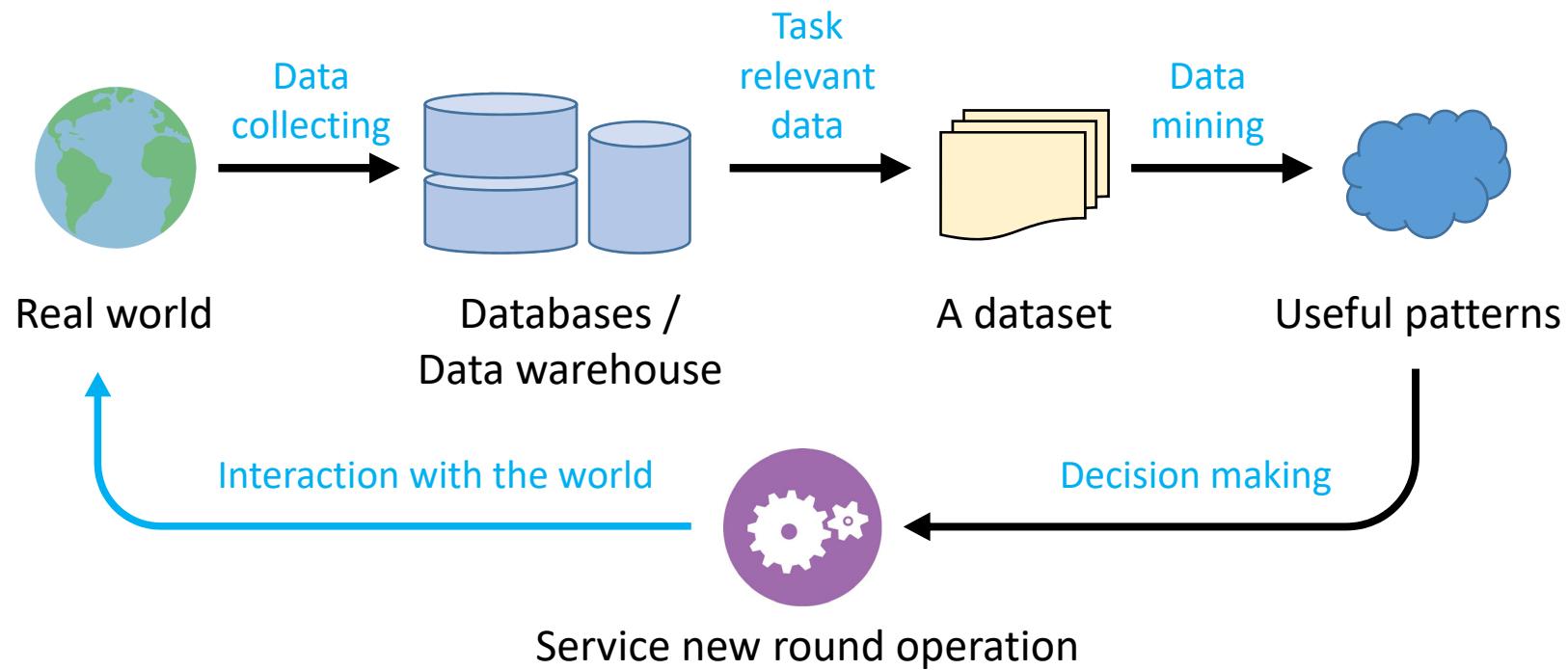


- The data itself is not valuable without the data service!
- How to perform proper and effective mining for the principles, patterns and knowledge from massive amount of data is what we focus in this course.

What is Data Mining?

- Data mining is about the extraction of **non-trivial, implicit, previously unknown and potentially useful** principles, patterns or knowledge from **massive amount** of data.
- Data Science is the subject concerned with the scientific methodology to properly, effectively and efficiently perform data mining
 - an interdisciplinary field about scientific methods, processes, and systems

A Typical Data Mining Process



- Data mining plays a key role of enabling and improving the various data services in the world
- Note that the (improved) data services would then change the world data, which would in turn change the data to mine

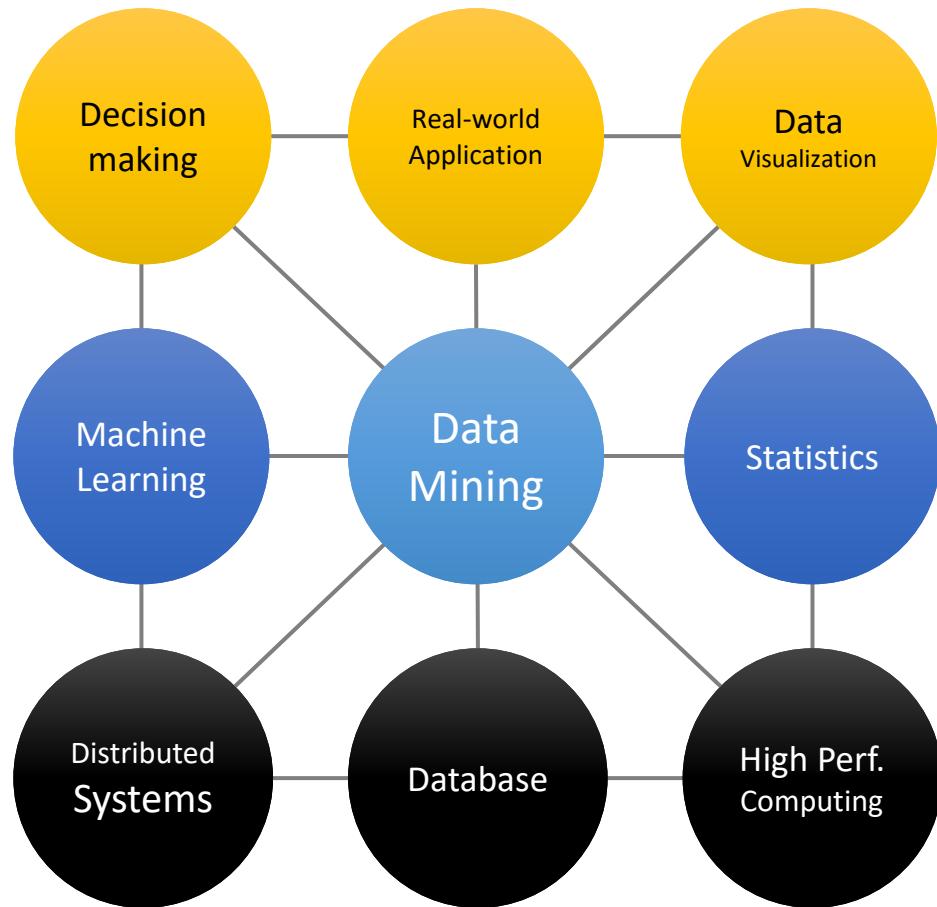
A Multi-Dimensional View of Data Mining

- Data to be mined
 - Database data (extended-relational, object-oriented, heterogeneous, legacy), data warehouse, transactional data, stream, spatiotemporal, time-series, sequence, text and web, multi-media, graphs & social and information networks
- Knowledge to be mined (or data mining functions)
 - Characterization, discrimination, association, classification, clustering, trend/deviation, outlier analysis, etc.
 - Descriptive vs. predictive data mining
 - Multiple/integrated functions and mining at multiple levels
- Techniques utilized
 - Data warehouse, **machine learning**, statistics, pattern recognition, visualization, distributed computing, high-performance, etc.
- Applications adapted
 - Retail, telecommunication, banking, fraud analysis, bio-data mining, stock market analysis, text mining, Web mining, etc.

More application examples will be provided.

Data Mining Techniques

- Application level
 - Intelligent systems & applications with further feedbacks
- Methodology level
 - Machine learning & statistics techniques based on large amount of formatted data
- System level
 - Scalable systems & architectures for hosting, retrieving and computing big data

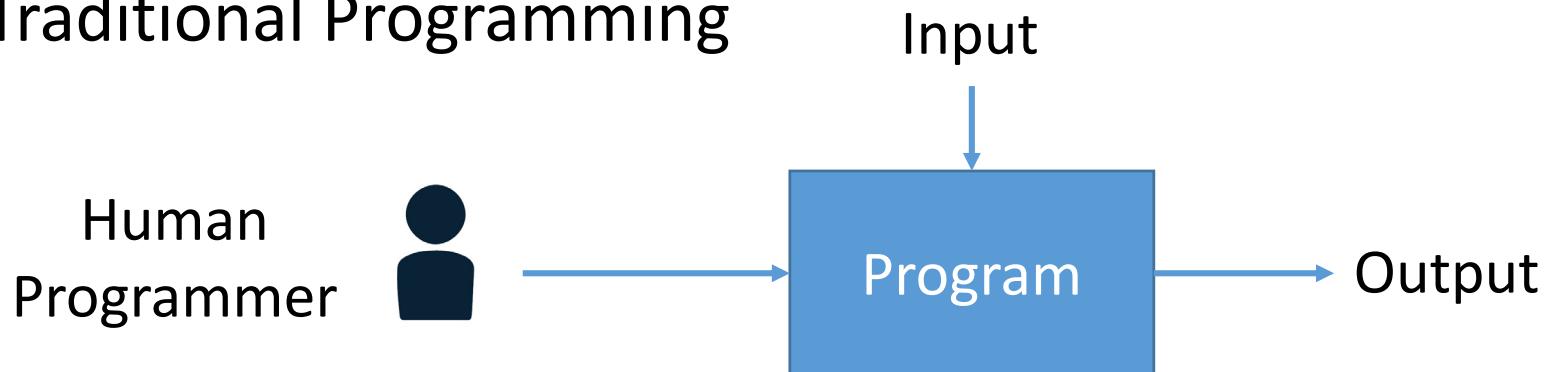


Data Mining and Machine Learning

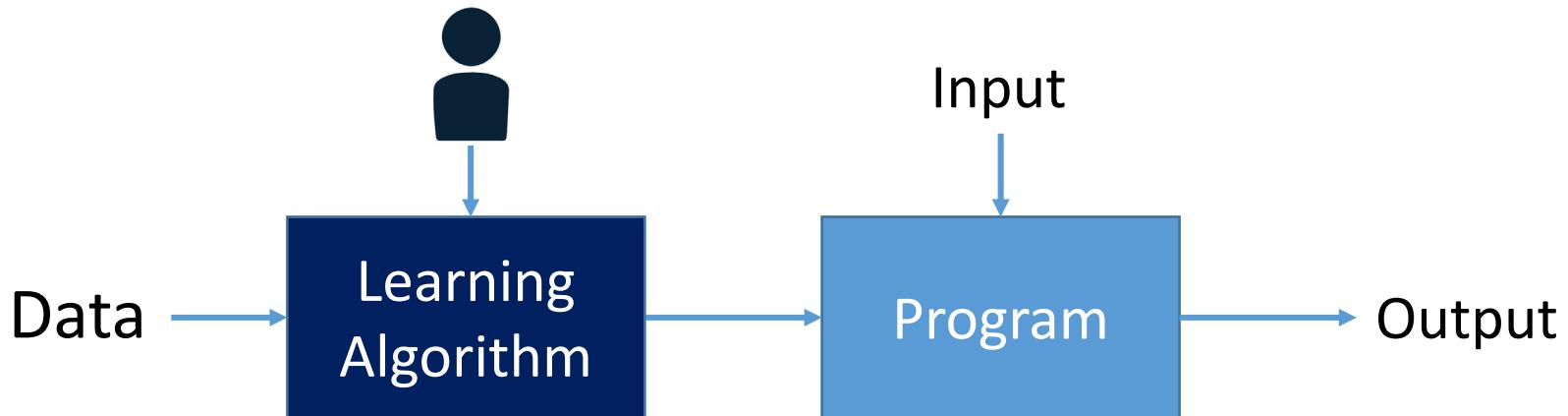
- What is the difference between data mining and machine learning?
- Data mining is about the extraction of **non-trivial, implicit, previously unknown and potentially useful principles, patterns or knowledge from massive amount of data.**
- Machine learning is the study of algorithms that improves a particular quantitative performance at some task based on data **with non-explicit programming.**

Programming vs. Machine Learning

- Traditional Programming

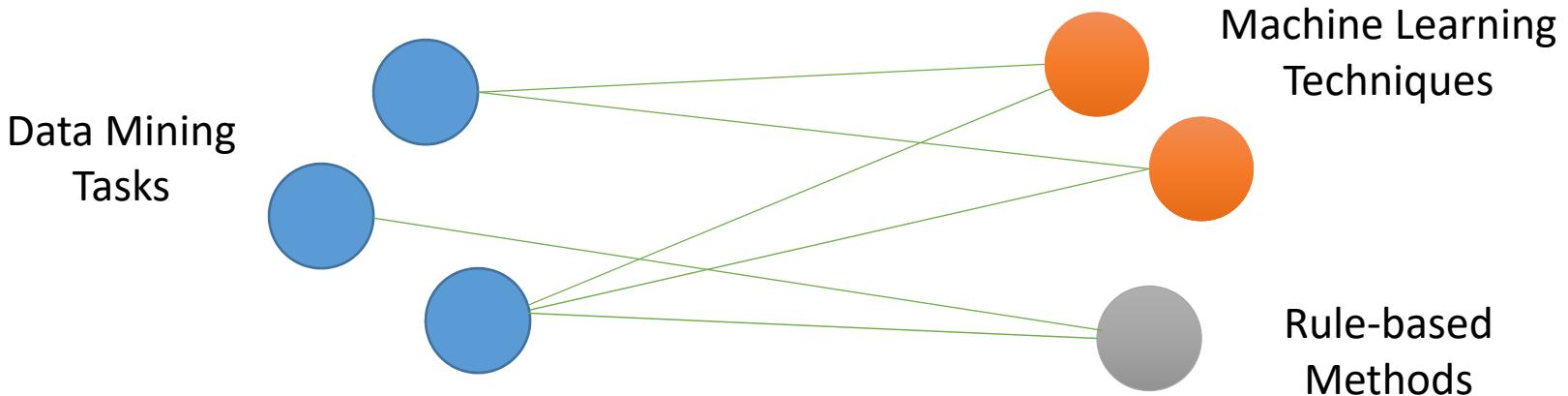


- Machine Learning



Data Mining and Machine Learning

- What is the difference between data mining and machine learning?
 - They are solving similar tasks with different focuses
 - Data mining focuses on solving the problems
 - Solving an DM problem could involve different methodologies including ML
 - Machine learning focuses on modeling based on the data
 - An ML model could be applied to various DM tasks



A Brief History of Data Mining Society

- 1989 IJCAI Workshop on Knowledge Discovery in Databases
 - Knowledge Discovery in Databases (G. Piatetsky-Shapiro and W. Frawley, 1991)
- 1991-1994 Workshops on Knowledge Discovery in Databases
 - Advances in Knowledge Discovery and Data Mining (U. Fayyad, G. Piatetsky-Shapiro, P. Smyth, and R. Uthurusamy, 1996)
- 1995-1998 International Conferences on Knowledge Discovery in Databases and Data Mining (KDD'95-98)
 - Journal of Data Mining and Knowledge Discovery (1997)
- ACM SIGKDD conferences since 1998 and SIGKDD Explorations
- More conferences on data mining
 - PAKDD (1997), PKDD (1997), SIAM-Data Mining (2001), (IEEE) ICDM (2001), etc.
- ACM Transactions on KDD starting in 2007

Conferences and Journals on Data Mining

- KDD Conferences
 - ACM SIGKDD Int. Conf. on Knowledge Discovery and Data Mining ([KDD](#))
 - SIAM Data Mining Conf. ([SDM](#))
 - (IEEE) Int. Conf. on Data Mining ([ICDM](#))
 - Int. Conf. on Web Search and Data Mining ([WSDM](#))
 - European Conf. on Machine Learning and Principles and practices of Knowledge Discovery and Data Mining ([ECML-PKDD](#))
 - Pacific-Asia Conf. on Knowledge Discovery and Data Mining ([PAKDD](#))
- Other related conferences
 - DB conferences: ACM SIGMOD, VLDB, ICDE, EDBT, ICDT, ...
 - Web and IR conferences: WWW, SIGIR, CIKM
 - ML conferences: ICML, NIPS
 - PR conferences: CVPR
- Journals
 - IEEE Trans. On Knowledge and Data Eng. ([TKDE](#))
 - KDD Explorations
 - ACM Trans. on KDD ([TKDD](#))

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DM Use Case 1: Frequent Item Set Mining



WRAPPING PAPER	0.99
INSTANT COFFEE GOLD	1.99
INSTANT COFFEE GOLD	1.99
ORANGE JUICE 1.5L	0.79
ORANGE JUICE 1.5L	0.79
RICE CRACKERS SALT	0.29
RICE CRACKERS SALT	0.29
PLAIN MARGARINE	0.44
GARDEN GLOVES	1.49
FREE RANGE EGGS	1.05
ASSORTED MUESLI	1.49
COOKIES	1.05
MACARONI	0.42
BUTTERMILK DESSERT	0.29
<hr/>	
TOTAL	14.23
CASH	20.00
CHANGE	5.77

THANK YOU AND GOODBYE

Some intuitive patterns:

{milk, bread, butter}
{onion, potatoes, beef}

Some non-intuitive ones:

{diaper, beer}

DM Use Case 1: Association Rule Mining



WRAPPING PAPER	0.99
INSTANT COFFEE GOLD	1.99
INSTANT COFFEE GOLD	1.99
ORANGE JUICE 1.5L	0.79
ORANGE JUICE 1.5L	0.79
RICE CRACKERS SALT	0.29
RICE CRACKERS SALT	0.29
PLAIN MARGARINE	0.44
GARDEN GLOVES	1.49
FREE RANGE EGGS	1.05
ASSORTED MUESLI	1.49
COOKIES	1.05
MACARONI	0.42
BUTTERMILK DESSERT	0.29
<hr/>	
TOTAL	14.23
CASH	20.00
CHANGE	5.77

THANK YOU AND GOODBYE

Some intuitive patterns:

$$\{\text{milk, bread}\} \Rightarrow \{\text{butter}\}$$
$$\{\text{onion, potatoes}\} \Rightarrow \{\text{burger}\}$$

Some non-intuitive ones:

$$\{\text{diaper}\} \Rightarrow \{\text{beer}\}$$

DM Use Case 2: Web Search

A screenshot of a Google search results page. The search bar at the top contains the query "shanghai jiao tong university". Below the search bar, a dropdown menu shows several suggestions: "shanghai jiao tong university ranking", "shanghai jiao tong university international students", "shanghai jiao tong university school of medicine", and "shanghai jiao tong university admission". The last suggestion, "shanghai jiao tong university admission", is highlighted with a red rectangular box. Below the suggestions, the text "About 1,000,000 results (0.34 seconds)" is visible.

- Query suggestion

Scholarly articles for **shanghai jiao tong university**

[Shanghai Jiao Tong University](#) - Wang - Cited by 21

[Shanghai Jiao-Tong University](#) - Xue - Cited by 14

[Nanosheet-constructed porous TiO₂-B for advanced ...](#) - Liu - Cited by 206

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en.sjtu.edu.cn/ ▾

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全面介绍上海交通大学新闻的网站。

- Page ranking

[Shanghai Jiao Tong University - Wikipedia](#)

https://en.wikipedia.org/wiki/Shanghai_Jiao_Tong_University ▾

Shanghai Jiao Tong University is a public research university located in Shanghai, China.

Established in 1896 by an imperial edict issued by the Guangxu ...

[Name](#) · [History](#) · [Academics](#), enrollment, and staff · [Organization](#)

DM Use Case 3: News Recommendation

美国大选 + 关注

“特朗普时代”的中美新局

周浩：美国在经济上强势可能带来外交上相对弱势，美国可能给予中国在亚太更大的主动权，以为经济发展蓄势。



更新于2016年11月16日 07:07 德国商业银行首席中国经济师 周浩 为英国《金融时报》中文网撰稿

特朗普强势当选美国总统，给全市场留下了一个费解的难题：到底这位特立独行的美国白人会给世界带来怎样的变化，而未来世界格局中，中美两大经济体又将会以怎样的方式来进行互动。

到目前为止，我们只能通过特朗普在竞选过程中的讲话，部分了解未来美国政策的走向。比如说，特朗普反对TPP，认为目前的全球化策略并没有能够解决美国企业的困境，并表示要对中国商品征收45%的关税，同时要在美墨边境建造“长城”来防止非法移民。特朗普也反对美国目前的世界警察角色，认为这给美国普通家庭带来了负担和悲痛，这意味着美国在全球战略布局中将更多采取收缩策略。此外，特朗普认为美国的能源政策和医疗保险制度是个灾难，认为政府插手太多，造成了巨大的浪费。

- Predict whether a user will like a news given its reading context

您可能感兴趣的文章除了：



焦点与希望——选后华盛顿侧记

这是特朗普的1966年



特朗普能被政治精英驯服吗？



从特朗普胜选看美国政治

DM Use Case 4: Sponsored Search

Google search results for "iphone 6s case".

Web Shopping News Images Videos More ▾ Search tools

About 16,900,000 results (0.33 seconds)

iPhone 6s Cases - case-mate.com
Ad www.case-mate.com/iPhone-6s-Cases ▾
4.6 ★★★★☆ rating for case-mate.com
Shop The iPhone 6s Case Collection. Free Standard Shipping!
Refined Protection · Slim & Tough · Genuinely Crafted · Premium Designs

iPhone 6s
Ad www.apple.com/ ▾
The only thing that's changed is everything. Learn more.
A9 chip · Two sizes · Now in rose gold
Pre-order 9.12 · iPhone Upgrade Program · 3D Touch · Cameras

In the news

 Speck's iPhone 6s CandyShell + MightyShell cases bring best-of-breed protection to Apple's latest iPhones
9 to 5 Mac - 1 day ago
With the iPhone 6s and iPhone 6s Plus debuting next week, it's important to start thinking ...

Moshi's iPhone 6s and 6s Plus cases offer premium protection
iMore - 23 hours ago

Top 5 Best Leather iPhone 6s Cases
Heavy.com - 12 hours ago

More news for iphone 6s case

Shop for iphone 6s case on Google Sponsored

Image	Name	Price	Rating	Source
	Case-mate - Karat Case Fo...	\$49.99	★★★★★ (163)	Best Buy
	Moshi - Iglate Armour Case...	\$39.99	★★★★★ (161)	Best Buy
	Logitech - Protection...	\$21.99	★★★★★ (90)	Best Buy
	Moshi - Overture Wall...	\$49.99	★★★★★ (18)	Best Buy
	Case-mate - Brilliance Cas...	\$44.99	★★★★★ (294)	Best Buy
	Case-mate - Wallet Folio C...	\$54.99	★★★★★ (173)	Best Buy
	Marc by Marc Jacobs Metall...	\$38.00	★★★★★ (173)	shopbop
	Case-mate - Karat Hard Sh...	\$49.99	★★★★★ (34)	Best Buy

- Whether the user likes the ads
- How advertisers set bid price

DM Use Case 5: Displayed Advertising

大陆



河南省公安厅彻查“封丘36人入警 35人身份不合规”

中封丘县公安局的36名受训人员，35人是公安局内部的文职或临时人员，与“民警必须具备公务员身份”的国家规定不符，引发该局内部

- 上海至成都沿江高铁提上日程 串联长江沿线22城市
- 2016号歼-20原型机曝光 已滑行测试(图)
- 日媒：中国或派万吨海警船巡钓鱼岛 打消耗战
- 外媒：中国开始研制隐身武装直升机 预计2020年交付
- 习近平关于中美关系的十个判断
- 住建部黑臭水沟整治工作指南：9成百姓满意才能达标
- 陕西：职校“校长”让女学生陪酒 学校被撤除
- 揭秘“团团伙伙”的武钢漩涡和落马高管

国际



巴塞罗那200万人游行 呼吁加泰罗尼亚独立(图)

- 李伟光：收税是不公平的恶？
- 许章润：超级大国没有纯粹内政
- 刘昀献：国外政党联系群众的路径研究

时局观



民革中央副主席：中共从未否定国民党抗战作用

- 施芝鸿：文革基础上搞改革致一个时期市场官场乱象
- 朱维群回应争议：尊重民族差异而不强化
- 伊协副会长：穆斯林不应因宗教功修忽视社会责任

领袖圈



奥巴马54岁啦，当7年总统人苍老了头发也白了



海绵城市 未来之城

水危机：青岛告急

探访中国绿化博览会

帝都吸引华人首富

凤凰房产 诚邀加盟

谈华山论剑与中国精神

黑龙江创新驱动三步棋

《印记》之江城夜未眠

办公环境搜查令

圈层生活尽在凤凰会

精彩视频

凤凰联播台



菲媒曝菲律宾军演针对中国 直指南海生命线

播放数：2602282

- Whether the user likes the ads
- How advertisers set bid price

DM Use Case 6: Information Extraction

Kinect - Fastest Selling Electronic Product in History

Posted on: 3/10/2011 1:09:45 PM by David Lewis

Microsoft's Kinect sensor system has been officially recognised as the fastest selling electrical device in history.



Manufactured to give wireless interactivity with the company's Xbox game platform, the device has sold eight million units in its first two months, outstripping the sales of Apple's iPhone and iPad when they were launched.

The news comes as a welcome relief for Microsoft who have been trailing Apple in the technology stakes over the last few years with the Apple brand being seen as more cool and sexy than Microsoft.

The figures, which have been verified by the Guinness Book of World Records, represent

sales of the camera add-on which uses infrared technology to track the movement of the participant and translate their movements to action in the game.

For some time Microsoft's Xbox was at a disadvantage to Nintendo's Wii system because of the lack of a motion detector but the Kinect addresses the issue well. Microsoft were keen on using a different technological base for their system to avoid being accused of copyright infringement and so the solution was built around infrared technology.

Microsoft says that sales of the Kinect reflect the popularity of the games platform in comparison with the Wii and hope that the availability of Kinect will also boost sales of the Xbox itself.

It notes that sales of games for the Xbox have also rocketed since the device became available with total sales now exceeding ten million.

In January Microsoft reported profits of \$6.63bn (£4.1bn) for the last three months of 2010, down from \$6.66bn a year earlier despite the excellent sales performance of Kinect.

Posted: 3/10/2011 1:09:45 PM by David Lewis | with 0 comments

Webpage



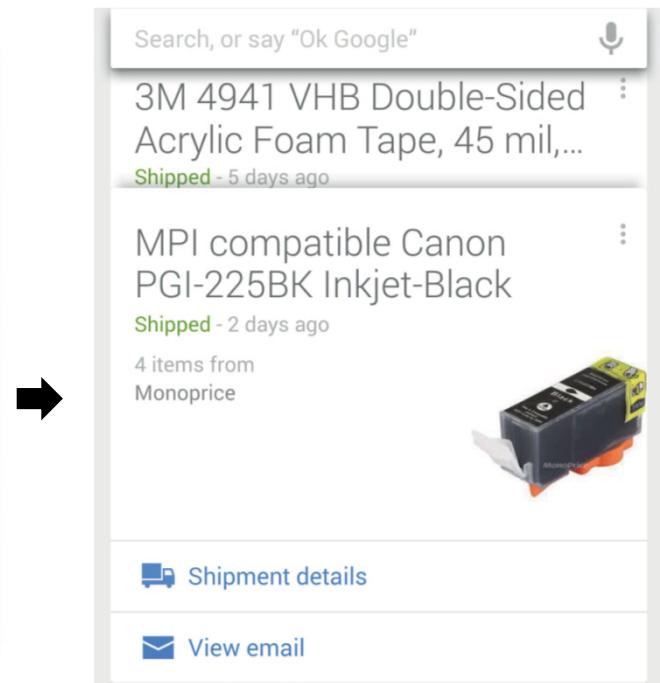
Kinect
Electronic Product
Microsoft's Xbox
Games
Xbox Game Platform

-
-
-

Keywords

DM Use Case 7: Information Extraction

- Structural information extraction and illustration



Gmail

Google Now

DM Use Case 7: Information Extraction

- Structural information extraction and illustration

Google Now

eTicket Itinerary and Receipt for Confirmation G316SQ Inbox x

The card displays flight details: United Airlines Flight 862, 17 Oct - Confirmation no. G316SQ. Departure: Hong Kong HKG 11:30, Arrival: San Francisco SFO 08:45. Below the main card, two smaller cards show connecting flights: United Airlines 869 from SFO to HKG on 10 Oct at 13:00, and United Airlines 862 from HKG to SFO on 17 Oct at 11:30.

United Airlines, Inc. <unitedairlines@united.com>
to me

Gmail



Confirmation:
G316SQ
[Check-In >](#)

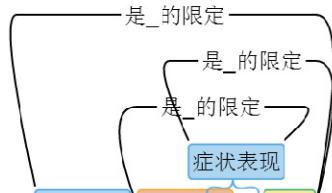
Issue Date: September 08, 2013

Traveler ZHANG/WEINANMR	eTicket Number 0162379365028	Frequent Flyer UA-VH67XXXX	Seats 48K/49C
FLIGHT INFORMATION			
Day, Date Thu, 10OCT13	Flight UA869	Class S	Departure City and Time SAN FRANCISCO, CA (SFO) 1:00 PM
Arrival City and Time HONG KONG (HKG) 6:15 PM (11OCT)	Aircraft 747-400	Meal Lunch	
Thu, 17OCT13	UA862	S	HONG KONG (HKG) 11:30 AM
			SAN FRANCISCO, CA (SFO) 8:45 AM
			747-400 Lunch

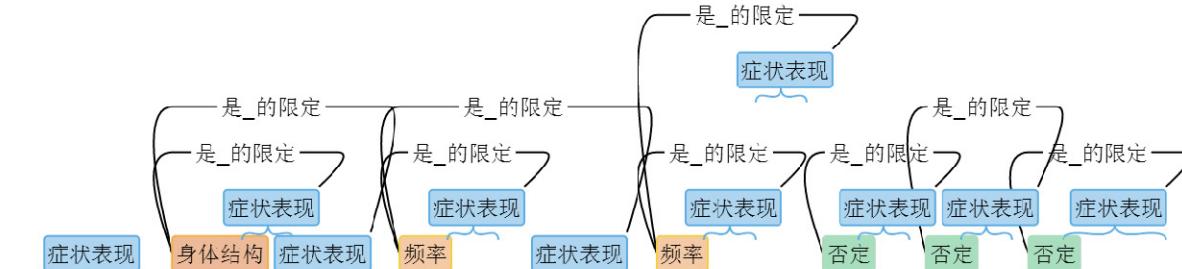
DM Use Case 7: Information Extraction

- Synyi.com medical structural information extraction

出院记录



入院情况：因“神志不清伴左肢乏力50天”入院。



出院情况：患者对言语无反应，全身消瘦衰竭状，偶有睁眼及眼球活动，偶有咳嗽咳痰，无发热，无呕吐，无肢体抽搐，



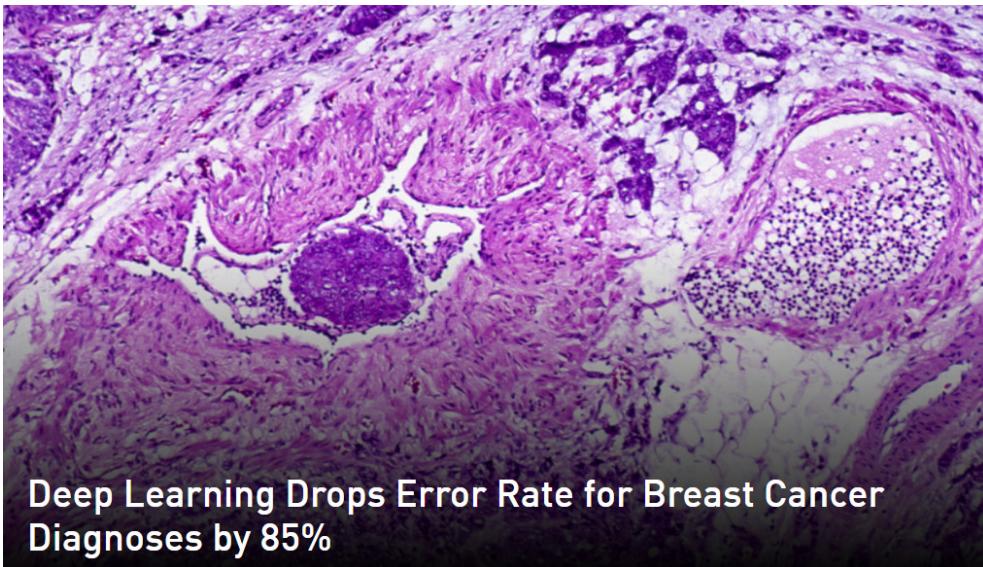
出院诊断：1.脑梗死2.高血压病3.肺部感染4.心律失常5.心功能IV级6.重度营养不良



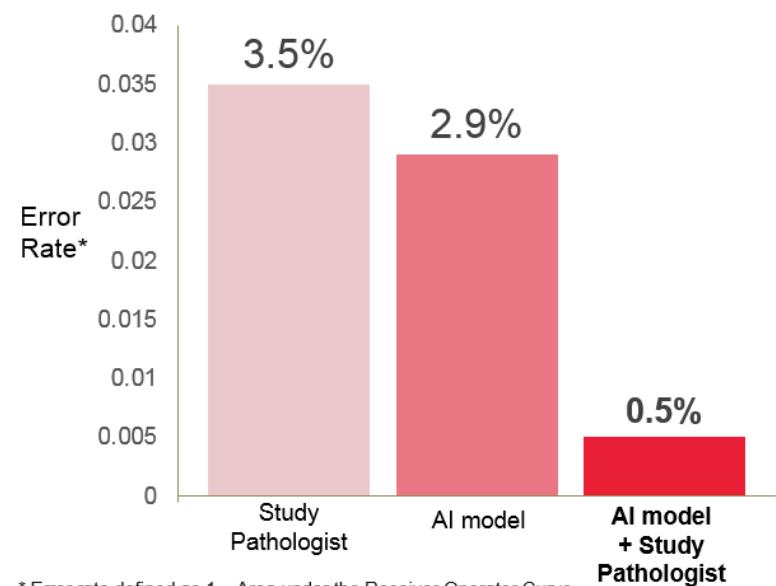
诊治经过：完善相关检查,予吸氧, 抗血小板聚集, 保护脑细胞, 营养神经, 保护胃黏膜, 改善脑循环及补液对症支持治疗。

DM Use Case 8: Medical Image Analysis

- Breast Cancer Diagnoses



(AI + Pathologist) > Pathologist



* Error rate defined as $1 - \text{Area under the Receiver Operator Curve}$

** A study pathologist, blinded to the ground truth diagnoses, independently scored all evaluation slides.

© 2016 PathAI

Wang, Dayong, et al. "Deep learning for identifying metastatic breast cancer." arXiv preprint arXiv:1606.05718 (2016).
<https://blogs.nvidia.com/blog/2016/09/19/deep-learning-breast-cancer-diagnosis/>

DM Use Case 8: Clinic Medicine Data Mining

- Predict the patient's health (e.g. diabetes) after 3 years given the current internal secretion test results



Clinic tests

Factors Associated With Patients' Adherence To Anti-Diabetic Medications

I. Baseline characteristics:

Age: Gender: Male/Female Education: Occupation: Nationality: Marital status:

II. Profile of Diabetes Mellitus

1. Duration of diabetes mellitus 2. Age at onset:: 3. Family history of diabetes: Yes/No

III. Patient adherence to drug therapy

1. Do you take the anti-diabetic drugs as advised by your doctor? Yes/No If No, please tick the options [✓]

Items	Yes	No	Items	Yes	No
Lack of finance			Side effects		
Feeling drug is not effective			Feeling the dose given is high		
Interferes with my meal plan			Complexity of drug regimen		
Taking them since many years			Multiple medications		
I forget			Poor family support		

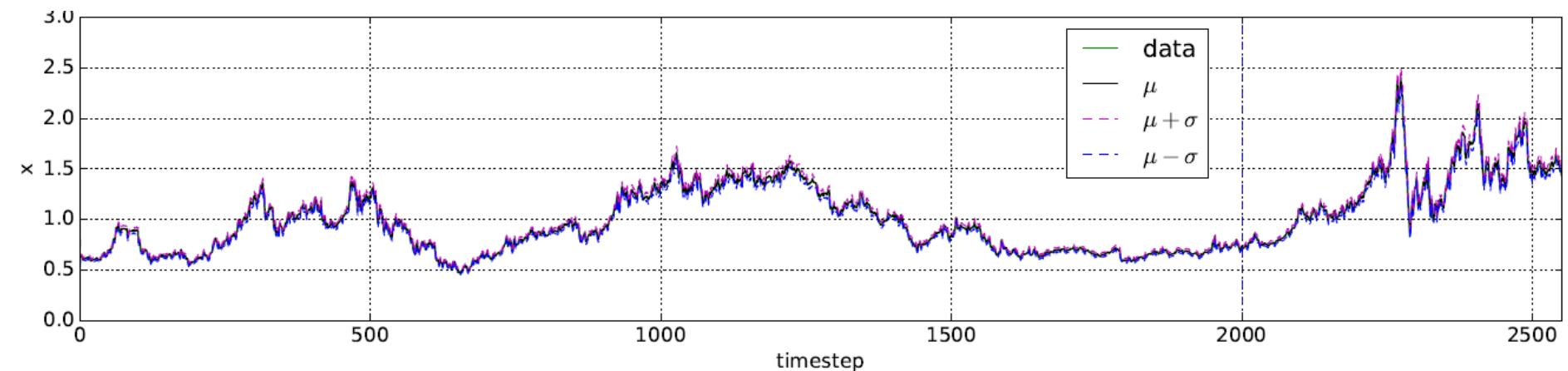
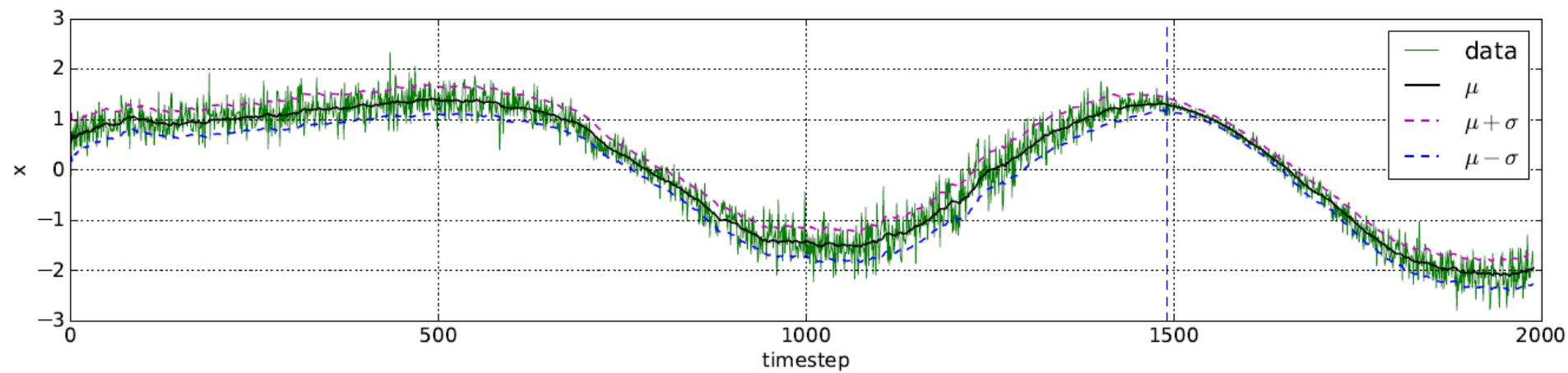
Items	Yes	No
Do you regularly monitor your blood glucose?		
Do you make your own modification in the dose of drugs prescribed?		
Do you make your own modification in the timing of anti-diabetic drugs?		
Do you have good knowledge about anti-diabetic medications prescribed to you?		
Do you know the importance of anti-diabetic medication		
Did your physician give information on diabetes		
Did your physician give information on anti-diabetic medications		
Were you involved in treatment decisions		
Do you feel comfortable to ask questions to your doctor		

Questionnaires

- Explainable patterns are always desirable for clinic medicine to provide informative guidance to doctors

DM Use Case 9: Financial Data Prediction

- Predict the trend and volatility of financial time series data

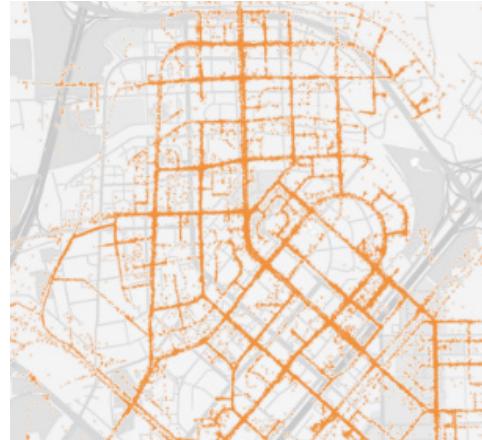


DM Use Case 10: Social Networks

- Community detection / node classification
- Information diffusion modeling
- Friends/Tweets/Job Candidates suggestion



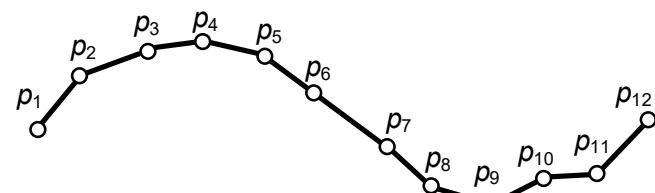
DM Use Case 11: Spatio-Temporal DM



- A spatio-temporal trajectory

$$p_1 \rightarrow p_2 \rightarrow \dots \rightarrow p_n$$

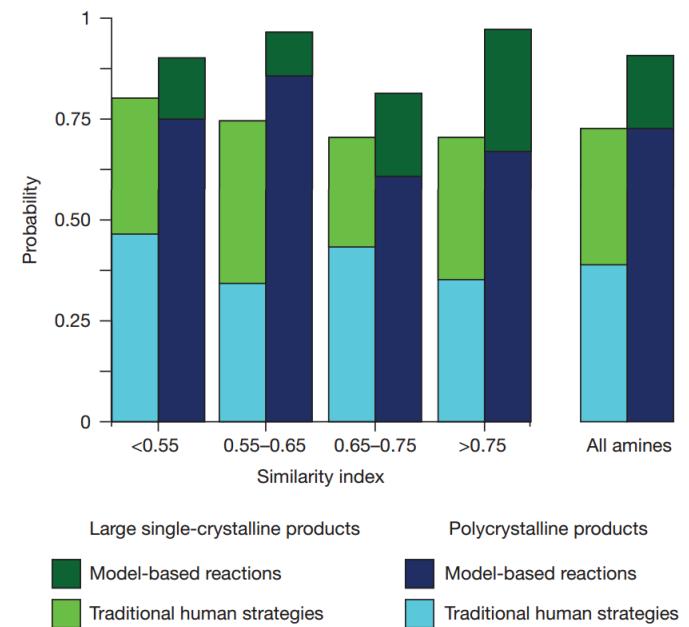
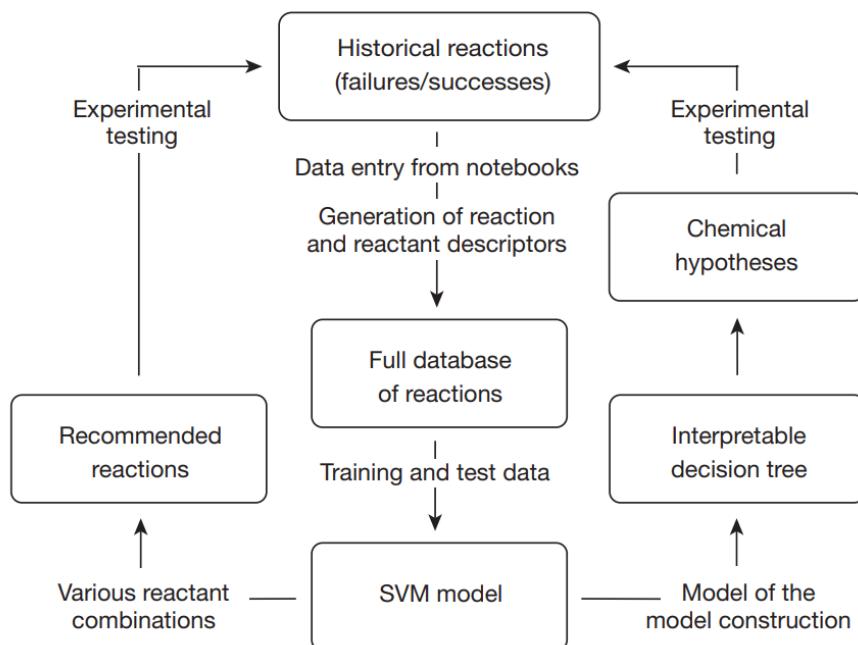
$$p_i = (x, y, t)$$



- Behavior modeling of humans and vehicles in the cities
- Prediction of human / vehicles / environment in a certain spatio-temporal point
- Optimization including car route scheduling, lane design, factory relocation

DM Use Case 12: New Material Discovery

- Driven by Materials Genome Initiative
 - Mine the underlying patterns between the experiment conditions and the properties of the resulted material



DM Use Case 13: Interactive Recommendation

- Douban.fm music recommend and feedback
 - The machine needs to make decisions, not just prediction

The screenshot shows a music player interface. At the top left, it says "我的私人 MHz". Below that is a button labeled "快速切换收听其他常用频道" with a "我知道啦" link. The main title is "Best of Me" by Daniel Powter. The play bar shows "-03:28" and a volume icon. To the right of the play bar are lyrics ("詞"), lyrics off ("歌"), and navigation buttons (+, <, >). Below the play bar are heart and trash bin icons. In the center, there are double arrows (for repeat) and a single arrow (for next). To the right is a circular album cover for "DANIEL POWTER TURN ON THE LIGHTS" featuring Daniel Powter sitting on a white chair.

Summary of This Lecture

- An example as an intro of data mining
- Concepts of data mining
- Real-world examples of data mining
- Data mining is about the extraction of non-trivial, implicit, previously unknown and potentially useful principles, patterns or knowledge from massive amount of data.