AI and other emerging ICT technologies bring new development opportunities for telecom operators.

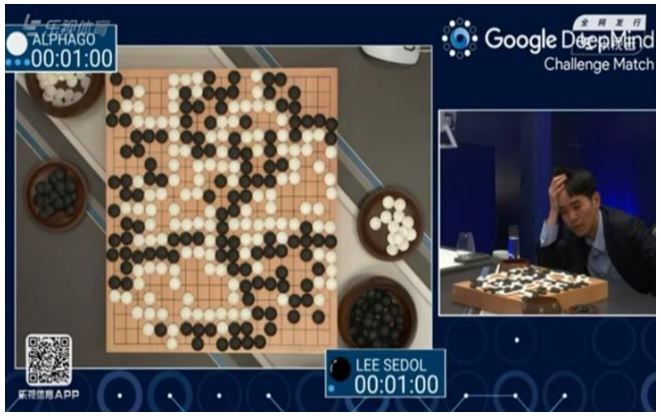
Xiaoou Liu
China Telecom
April, 2018

中国电信 CHINA TELECOM 世界触手可及

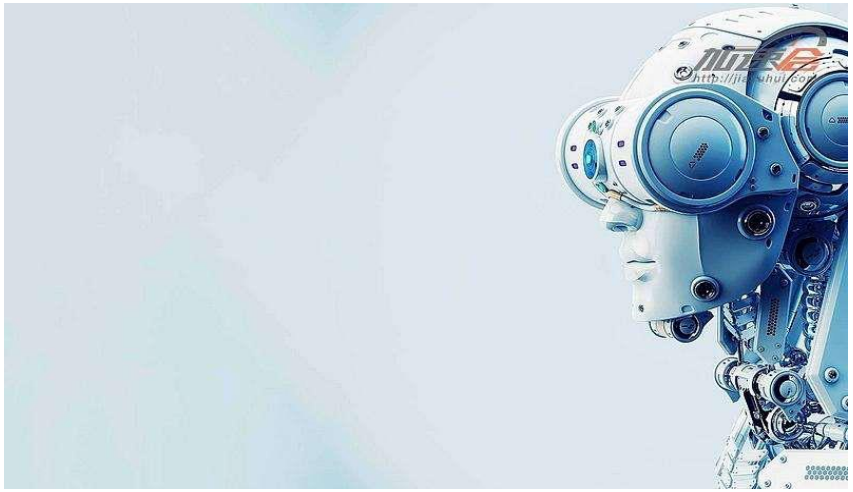
1 AI sweeps the world

THE NEW ERA OF AI HAS ARRIVED

In the past two years, the prospects presented by smart technology have attracted the attention of investors all over the world, including Google. The top global companies, including IBM, have invested in the research of artificial intelligence.



AlphaGo



The development opportunities created by artificial intelligence technologies will certainly benefit the entire industry.

With the unique resource advantages, operators will also be able to achieve breakthroughs in the development of artificial intelligence.

THE NEW ERA OF AI HAS ARRIVED

The state council issued “A new generation of AI development program”, which took AI as the most significant national development strategy.

2016

- Master defeated dozens of top Chinese, Japanese and Korean players in the 30 - second fast chess net test
- **Dec.** Lip net, an automatic lip read system, interpreted lip language more accurately than experts
- **Nov.** 18 "Cloudy" self-driving cars autonomously drived in an open city of 3.16 km
- Tesla announced that all new cars will be equipped with fully autonomous driving capabilities---Autopilot2.0
- **Oct.** Microsoft's speech recognition system matched professional with a 5.9 % word error rate
- The translation quality of Google neural machine translation system is greatly improved
- Google deepmind realized realistic speech synthesis from text to mandarin Chinese
- **Sep.** Uber launched a wide range of free driverless taxi services in Pittsburgh, USA
- **Mar.** AlphGo defeated world Go champion Li Shishi with a 4:1 score

2017

- Intel released $79 "plug in AI" devices.
- Stanford NLP group made a major breakthrough with a 10 % improvement in depth model accuracy
- **Jul.** Momenta team won imagenet object recognition with an error rate of only 2.3 %
- NVIDIA released the strongest GPU: pci-e Tesla V100.
- Deep mind's new neural network learned relational reasoning and defeated humans
- **Jun.** Primate face recognition algorithms have been deciphered and brain black boxes may not exist at all
- Cojie finally lost to alphago at 3-0.
- **May.** Facebook proposed a new CNN machine translation: nine times more accurate than Google
- Google released TPU paper with 75 co - authors,, and GPU got the strongest opponent
- **Apr.** Facebook opened source deep learning framework Caffe2 ,which brings cross-platform machine learning tools
- **Mar.** Baidu's Universal AI agents Learned Interactively Through Interactive Learning
- **Feb.** The 2017 AAAI meeting, originally scheduled for late January, was rescheduled for February due to spring changes in China
- The intelligent robot “小度" in face recognition with 3:2 defeated human's strongest brain representative.
- **Jan.** Libra tus beated the world's top poker players at German robot man-machine war,

THE NEW ERA OF AI HAS ARRIVED

2017

Aug.

- Ai model for eye disease diagnosis invented by 16 - year - old girl

- Musk's open ai self-learning robot is the strongest player in dota 2

- Cambrian company A round financed $ 100 million and became the global ai chip gianta

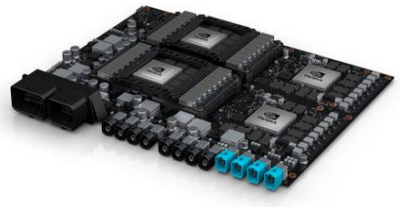
Sep

- Huawei Released World's First AI Mobile Chip

- GM Released World's First Mass-produced self-driving Car

Oct

- Nvidia Released World's First Artificial Intelligence Even Platform, Available in Second Half of Next Year



Artificial Intelligence brings disruptive change to many areas

Medical diagnosis	**IBM Watson** could diagnose a rare disease within 10 minutes with the help of AI technology, and the accuracy of lung cancer treatments recommendations could be up to 90%
	Google's deep learning algorithm based on a large number of fundus image training can detect diabetic retinopathy with more than 90 % accuracy.
	The deep learning neural network algorithm has surpassed human doctors in the diagnosis of **Alzheimer's disease**. (2017.05)
Venture investment	After 2012, AI technology centering on machine learning has been recognized and rapidly developed in the area of securities investment, including several world-renowned **asset management companies** such as Renaissance technologies, AIDYIA, Cerebellum Capital, Cmmeq, Castilium, Binatix, Sinai and KFL Capital.
	The team of 600 securities traders **at Goldman Sachs Investment Bank** has been replaced by artificial intelligence, leaving only two people.
	By using the AI technology, the **Morgan GM software** can automatically complete the 360,000 hours of work done by internal lawyers and legal consultants.
Education	**ETS** had previously used the AI technology to replace the judging officer and successfully reviewed the GRE and SAT writing questions, demonstrating that AI technology can be "trained" to accurately analyze and judge students' questions.
	In 2016, a professor at **Georgia tech** developed a robot called Gil Watson, using **IBM's supercomputer Watson system**, to answer the questions students face in their graduation thesis
	Beijing xueba jun company developed robot aidam completed the**the college entrance examination for mathematics** test in 9 minutes 47 seconds, and tested score 134, while Ai - math of Chengdu zhungxing cloud company completed the test paper in 22 minutes , ans score is 105.
Fin-tech	Google applies face recognition technology to the **payment service Android pay**. At present, the accuracy of face recognition has already exceeded the human eye. Deep id, developed by tangxiaoou team of the Chinese university of hong kong, advanced the Gaussian face recognition record, which exceeds 99 % lfw recognition rate for the first time.
	Baidu brain launched a series industry brain,, such as medical brain, traffic brain, financial brain and so on. The accuracy of face recognition has reached 99.7 %.
Customer service	In 2016, **Microsoft's speech recognition system** had a word error rate (wer) of 6.3 percent., which exposed human transcribers to the risk of unemployment.
	Antfin' s chief data scientist lacquer far revealed that at present AliPay intelligent customer service self-help rate has reached 96 % - 97 %, the solution rate of intelligent customer service reached 78 %, higher than the manual customer service solution rate is 3 percentage points.

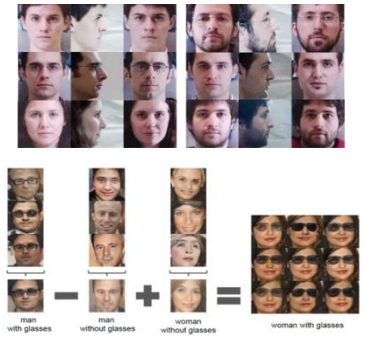
Artificial Intelligence brings disruptive change to many areas

AlphaGo

Artificial intelligence go
DNN
Reinforcement learning
Monte Carlo search

Libratus

Texan poker
Counterfactual regret minimized
end-game solver
Strategy rejection



Computer vision

Generate against network （GAN）
Transfer learning

Natural language understanding

word2vec
Knowledge map

Artificial intelligence is surpassing **the highest human level** in **many professional fields**!

AI development strategy of top enterprises

Google Inc. released a series of new products and services based on AI technology at the annual developer conference held on May 17,2017, announced that the AIdevelopment strategy transform from **"mobile first" to "artificial intelligence first".** In the speech of Peking University on September 12, AlphaGo was used as an example to describe Google's exploration in the field of artificial intelligence.

1、Machine Learning and AI

- AlphaGo
- Released in 2016, TPU (Tension Processing Unit) customized for machine learning will provide users with second-generation TPU through its cloud service in 2017

• 2、AR/VR

- Hardware： Google Glass (AR), Google Lens
- Platform：Daydream(VR), Tango(AR)

3、Transportation and logistics

- Self-driving car
- Google Express same day delivery service
- Wing drone project

AI development strategy of top enterprises

In the first half of this year, Baidu announced that it was no longer a search engine company, but an **artificial intelligence company**. On July 5th, the first Baidu AI Technology Developers Conference, opened at the National Convention Center with 4,000 people, including developers, participated.

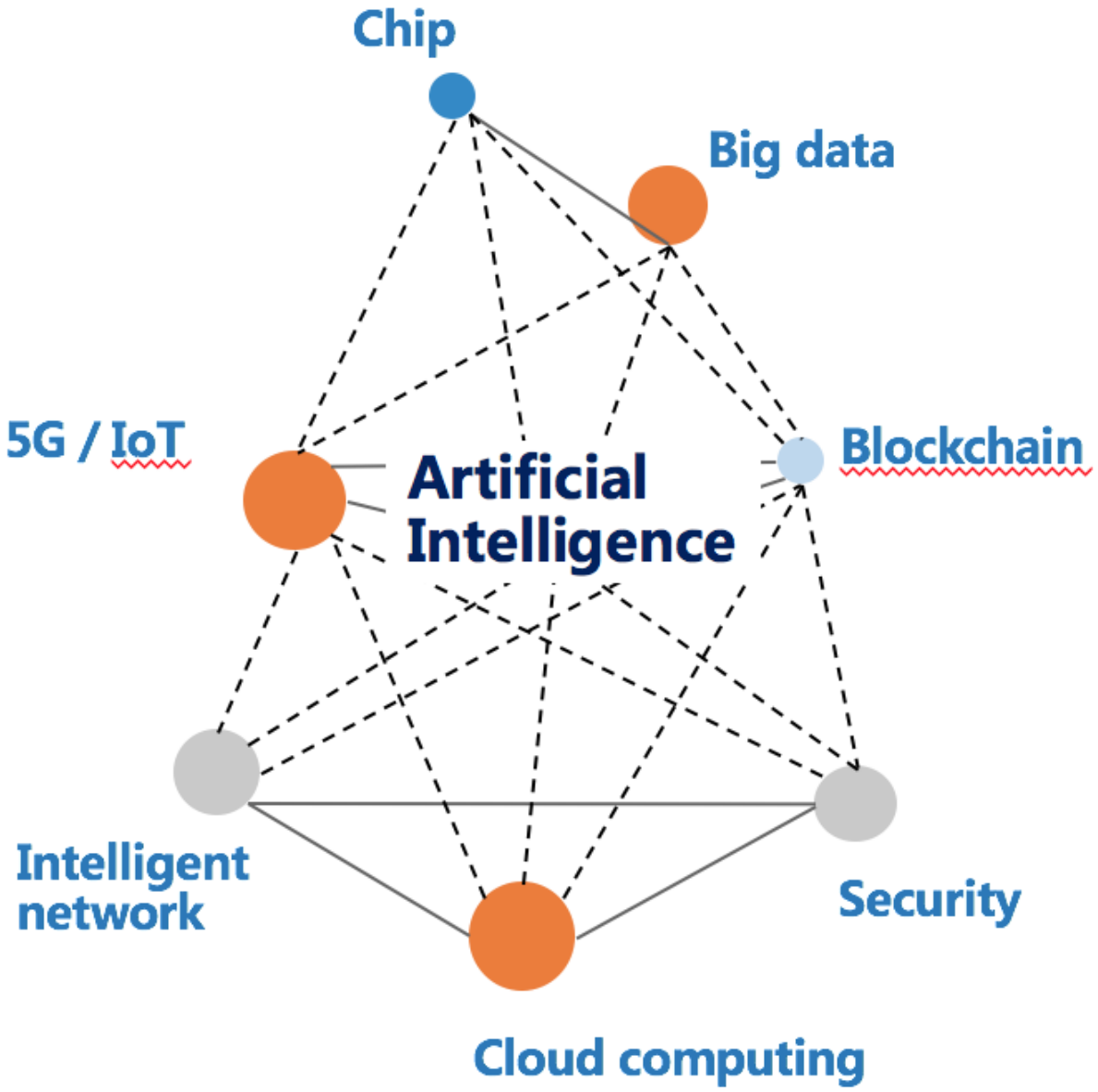
1、R & D investment

To develop AI, Baidu has invested more than 20 billion dollars, successively set up in-depth learning laboratory (IDL), Baidu big data laboratory (bdl) and silicon valley Baidu artificial intelligence laboratory (sva il), and set up the augmented reality laboratory (ar lab) last year, which integrated the voice technology department and artificial intelligence product application part.

2、Talent strategy

Baidu has more than 2,000 AI R&D personnel, and has many of the world's leading experts in AI. Not long ago, Forbes magazine published the article "These 20 Leading Technologists Are Driving China's AI Revolution" (20 people who promoted China's artificial intelligence revolution). In the 20 Chinese AI leaders' election, the elected person served in Baidu was up to 7.

Generalized AI is a combination of new ICT technologies



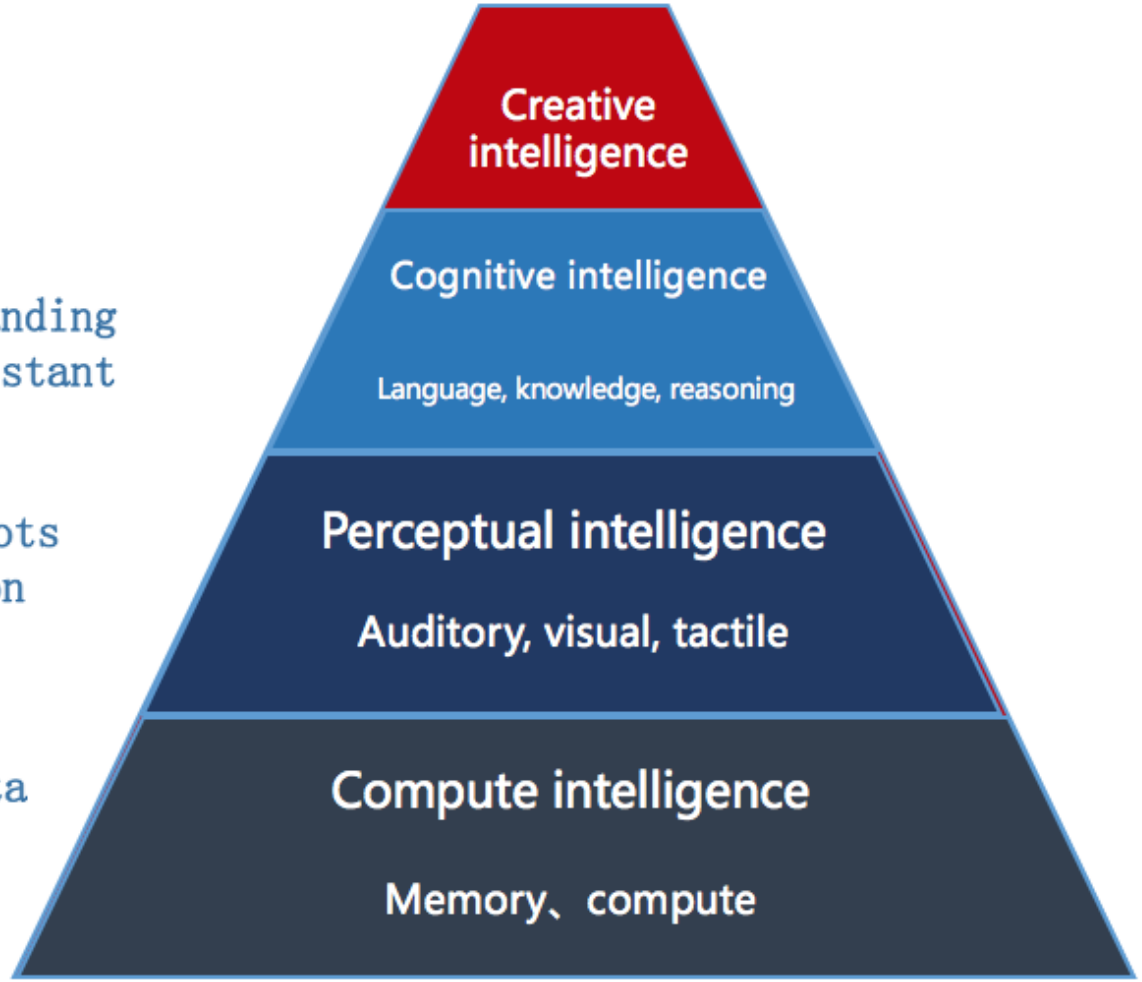
Artificial intelligence development architecture

General Intelligence

Natural language understanding
Machine Translation, Assistant

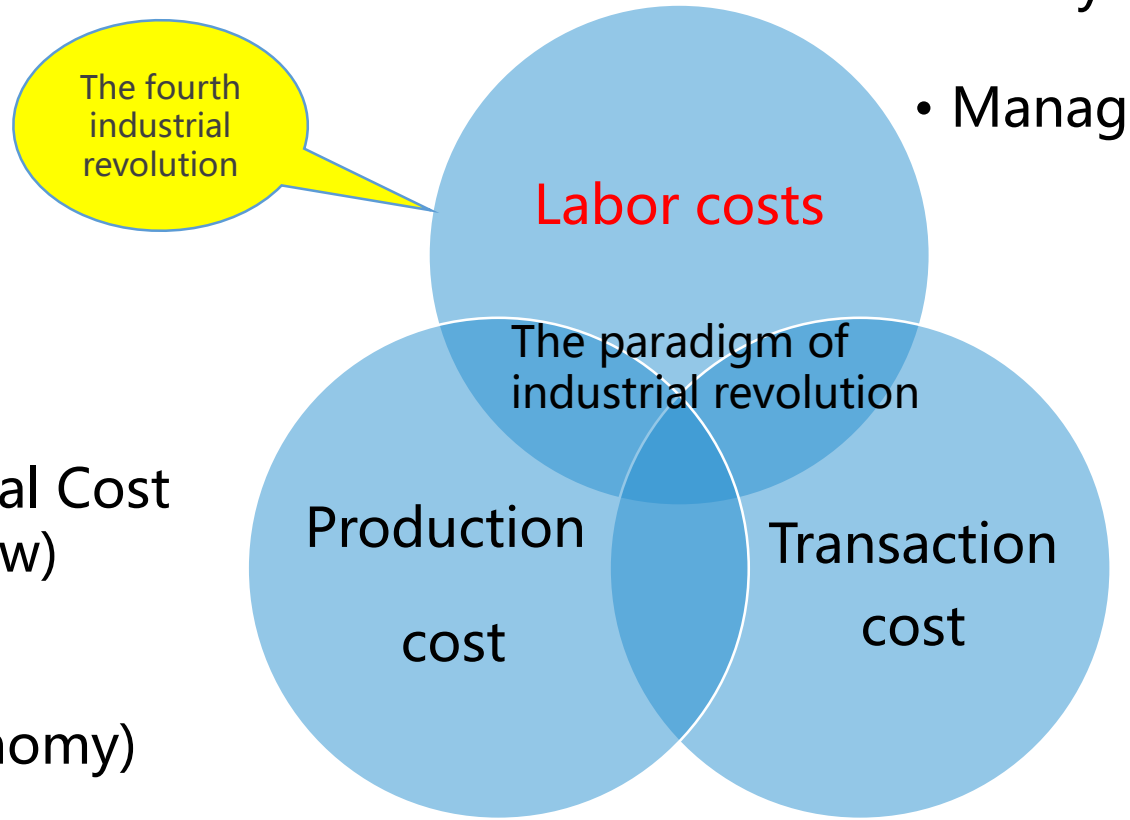
Internet of Things, Robots
AR/VR, face recognition
speech recognition

Cloud Computing, Big Data
Blockchain, SDN



AI leads the industrial revolution

Paradigm of industrial revolution



- Salary cost（AI）
- Management costs

Replace-ment

- Raw Material Cost (Moore's Law)
- Land cost (virtual economy)
- Energy cost
- Circulation costs

- Institutional costs
- Credit System (blockchain)
- Collaboration costs (Internet+)

If one or more of these costs change precipitously, the industrial revolution will come.
Artificial intelligence is replacing people themselves!

2 Can operators develop AI?

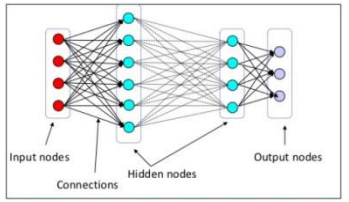
Transformation strategy in intelligent times

Software strategy

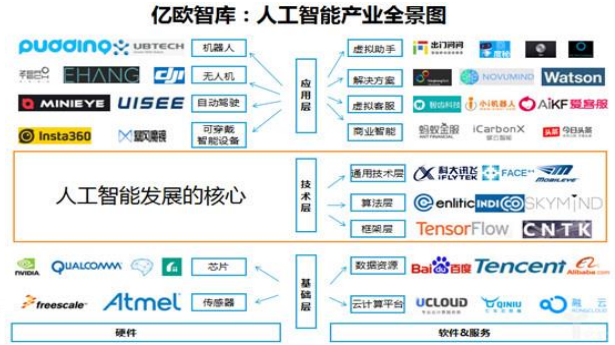
Global cloud computing market: 22 % growth, steady growth

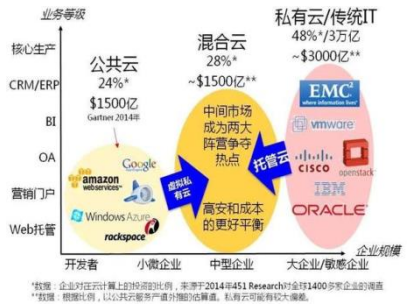
Cloud Strategy

Big data strategy



AI strategy





The four key advantages

The four key advantages: big data, excellent computing power, algorithms, wide applications

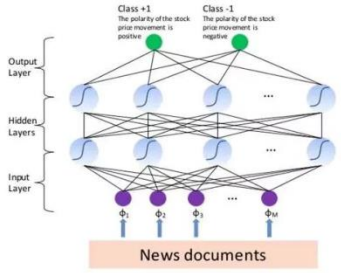
Big data
——
The Input

Data Fusion
Data upsizing
Data annotation

Excellent computing power
——
The Basis

cloud computing
Edge calculation

Algorithm
——
The Key



Algorithm framework
Algorithmic innovation
Algorithm fusion

Application scenarios and requirement
——
Driving force

Scenes!
Scenes!
Scenes!

The four key advantages are basically available
but do not constitute a competitive advantage for operators.

China Telecom's Approach to AI

“1+3 Strategy”

AI Infrastructure

By strengthening upstream and downstream cooperation in the industry chain, China telecom will continue to explore new development opportunities.

网络智能化

运营智慧化

业务生态化

Business-driven adaptive network

AI based data center energy saving

Intelligent learning based log analysis and root fault diagnosis

Case analysis, crime prediction

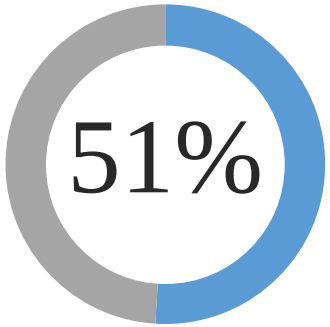
AI+ Medical

Blockchain tracing

3 Our AI projects and achievements

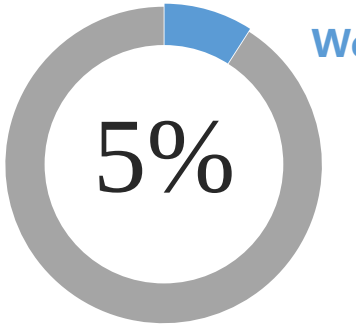
1、 Energy-saving system based AI for data centers

Data center power consumption remains high



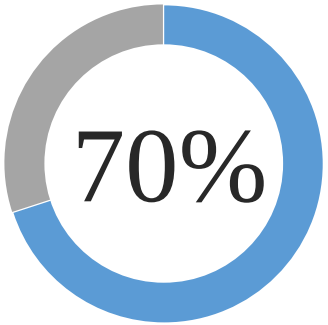
Data centers continue to increase

China has more than 700 million internet users, and data centers are growing with more users and business needs. China telecom, an operator based on data centers, currently has more than 350 DC and will continue to grow with the introduction of NFV.



Weak energy saving mechanism

Hardware auto-power saving mechanisms are weak and most software power saving mechanisms provide only about 5 % power savings.



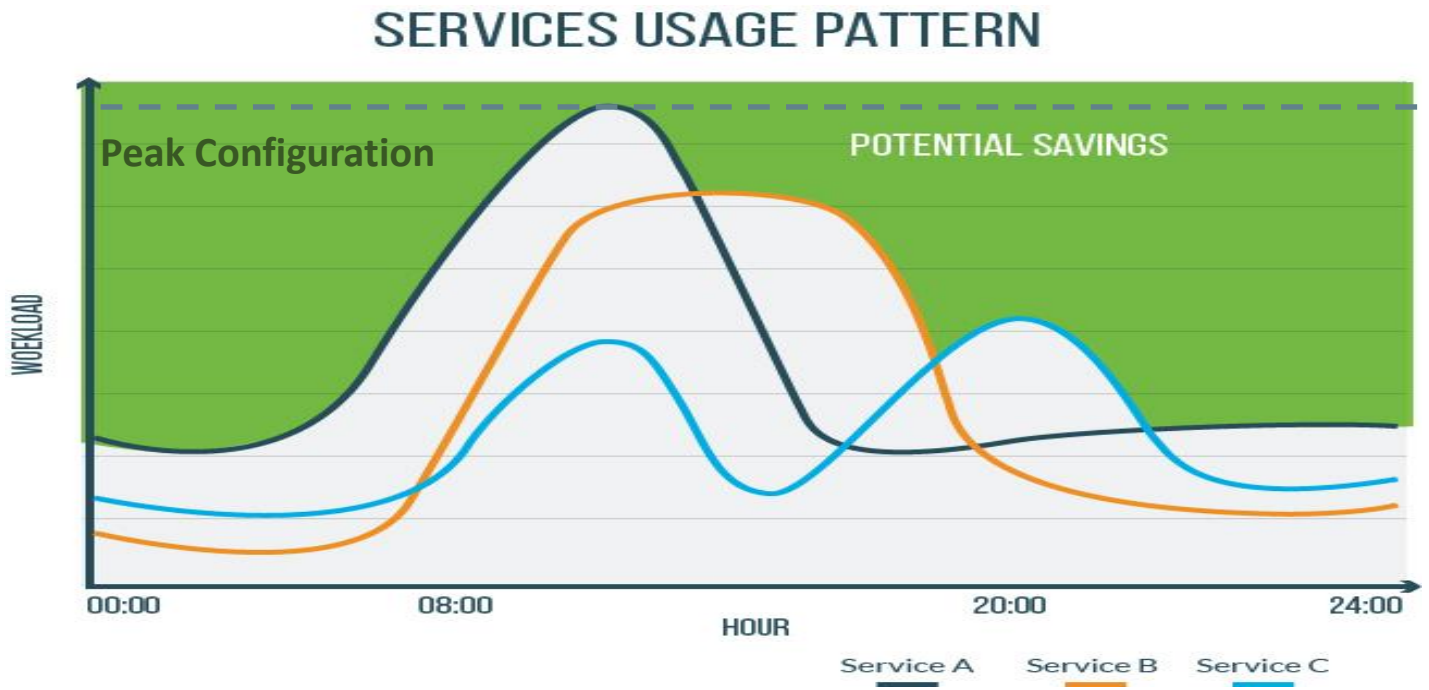
Servers are the main consumers of power

In a typical data center, the server consumes about 70 % of power; while communications equipment, storage and air conditioning consume only 30 % of the electricity. It energy consumption is increasing year by year。

Resources are designed to peak demand

Resources are deployed based on peak demand, while business development is phased; The server is 100 % powered up even during off-peak periods.

2、 Energy-saving system based AI for data centers

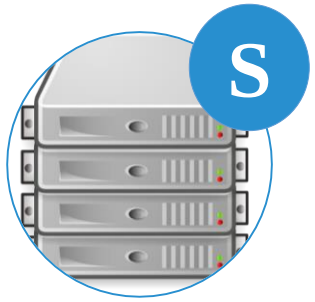


Huge potential hidden in data center

Each business has its own usage type for a certain period of time, whether it is a 24 - hour time period or a weekday / weekend period.

Learn each service and **discover** green areas, i.e. non-peak periods of the service. Take advantage of the " hidden potential" of large data centers to generate significant energy savings.

The Potential

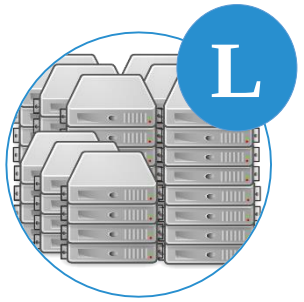


640servers
96 kw/h
2304 kw/day

84,0960 KWH
Annual power consumption
25,2288 KWH
To be saved

6666servers
1000 kw/h
2,4000 kw/day

876,0000 KWH
Annual power consumption
262,8000 KWH
To be saved



66660servers
4000kw/h
9,6000 kw/day

3504,0000 KWH
Annual power consumption
1051,2000 KWH
To be saved

2、Energy-saving system based AI for data centers

Google’s Data Center Energy Consumption Model Based on Neural Network

Google's use of AI technology to help data centers save energy by 40 % and improve energy efficiency by 15 %

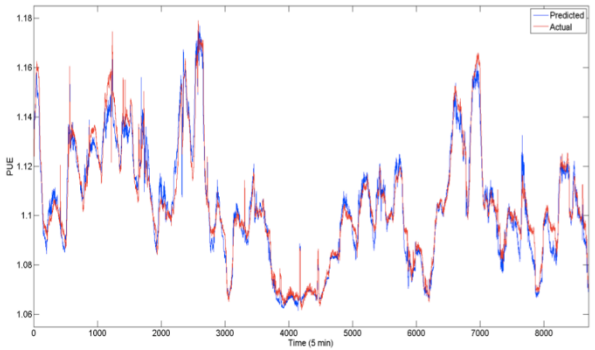
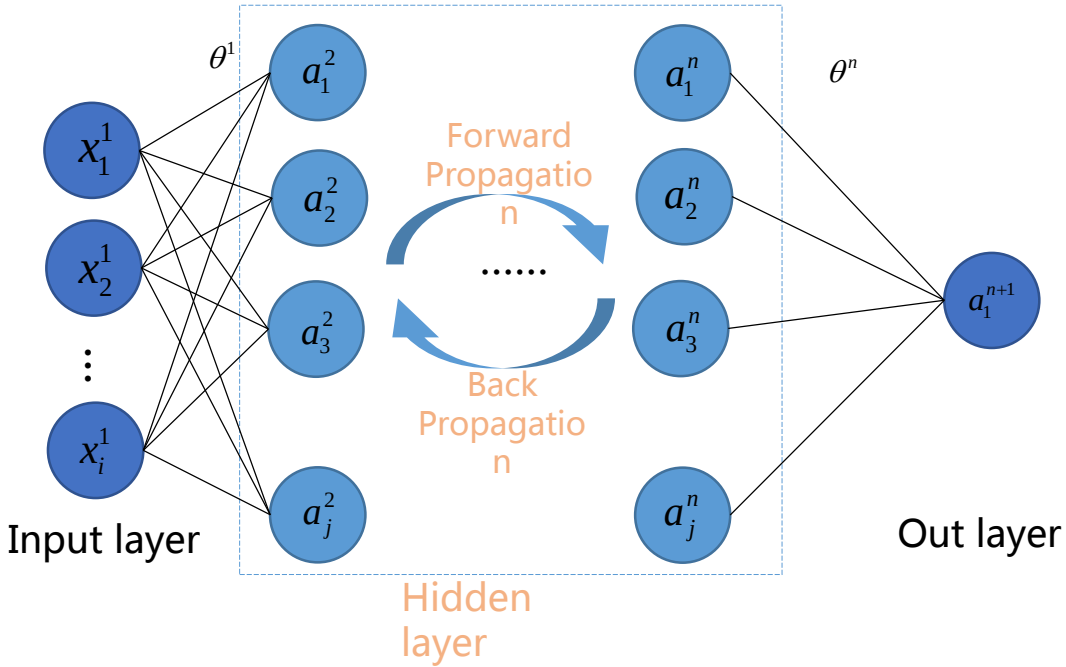
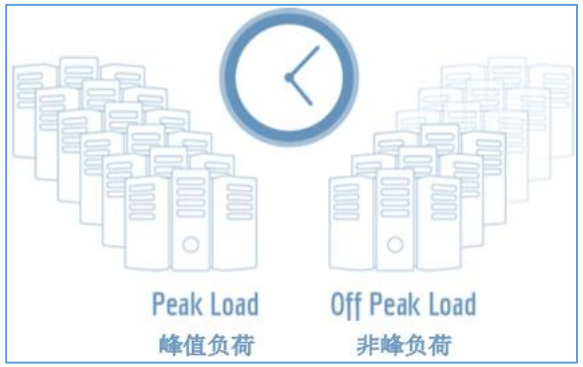


Fig. 3 Predicted vs actual PUE values at a major DC.

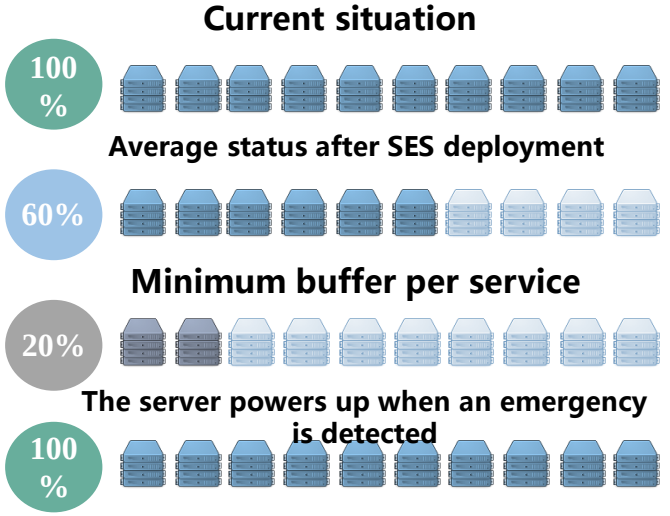


CTBRI’s Data Center Energy Saving Model Based on Artificial Intelligence



Modeling the load characteristics of different services in the data center based on the in-depth learning network, exploring the energy-saving potential, and triggering migration dormancy to realize green energy saving in the non-peak load period.

1. Smart Energy Solutions (SES) will only put servers that wake up for less than 2 minutes into sleep while the 'slower' servers are always powered up.
2. The SES has a prediction mechanism and can start the ‘wake up’ server at full capacity based on the time that occurred.

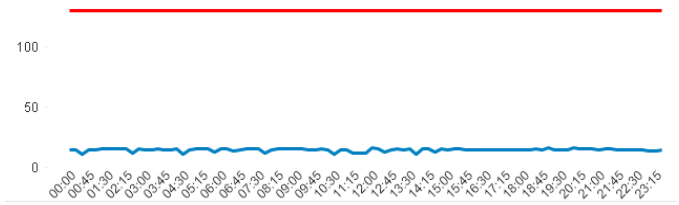


2、Energy-saving system based AI for data centers

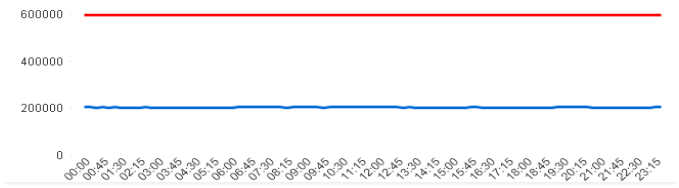
SES

Software	Autonomous operation	Cloud - based or site - based	Autonomous learning & forecasting	Conventional environments
No hardware failure; low maintenance; con-venient installation and remote support.	SES works in the background without affecting user data and business 。	SES can be run and controlled in one center ,as well as be deployed one by one, if required by the security mechanism	SES continuously learns the behavior of data centers and adjusts energy saving methods accordingly	SES is common to most software environments and hardware vendors and does not require a data center transformation 。

Pilot: CTBRI Cloud Computing Laboratory



CPU energy saving potential:
130 allocated vCPUs v.s. 14 actually used vCPUs



Memory Saving Potential:
597GB of allocated memory v.s. 204GB of actual used memory

Pilot: Tianyi Cloud Company Inner Mongolia Resource Pool

Cluster 1 to 5

Daily energy saving degree	93.6KWh
Annual energy savings	27331.2yuan

About 34 percent of electricity consumption and 121,518.72 yuan is saved each year, and each server saves nearly 357.4 yuan per year.

Cluster 5 to 8

Daily energy saving degree	50.4KWh
Annual energy savings	14716.8yuan

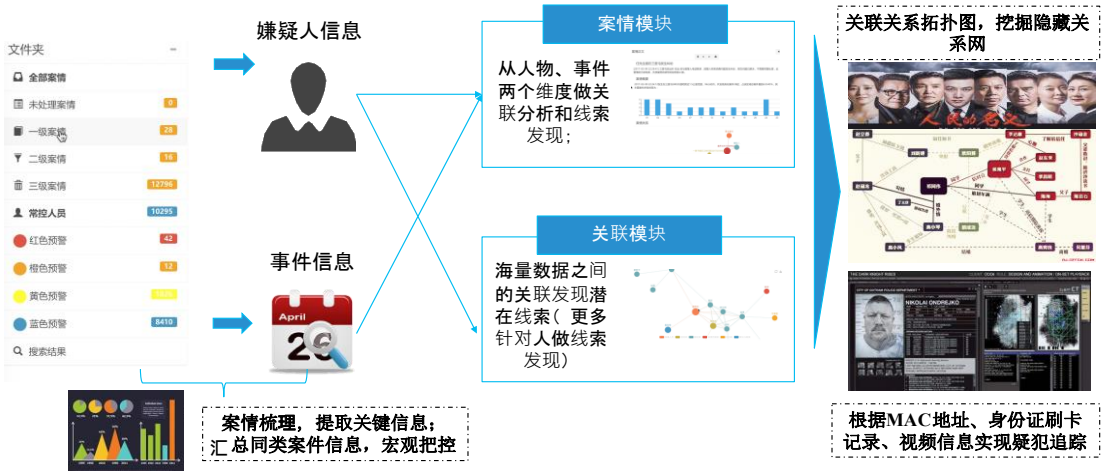
Cluster 8 to 24

Daily energy saving degree	273.6KWh
Annual energy savings	79891.2yuan

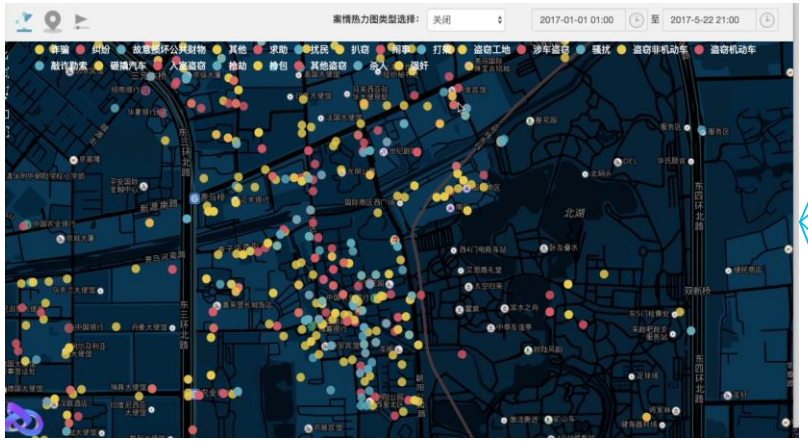
2、 “Smart police” system has been applied in police work

1、Clues intelligence mining

Combing key clues to find out the deep links between cases and suspicious persons; drawing topological maps of the cue relationships to assist the police in enhancing the efficiency of decision-making.



2、Intelligent police deployment



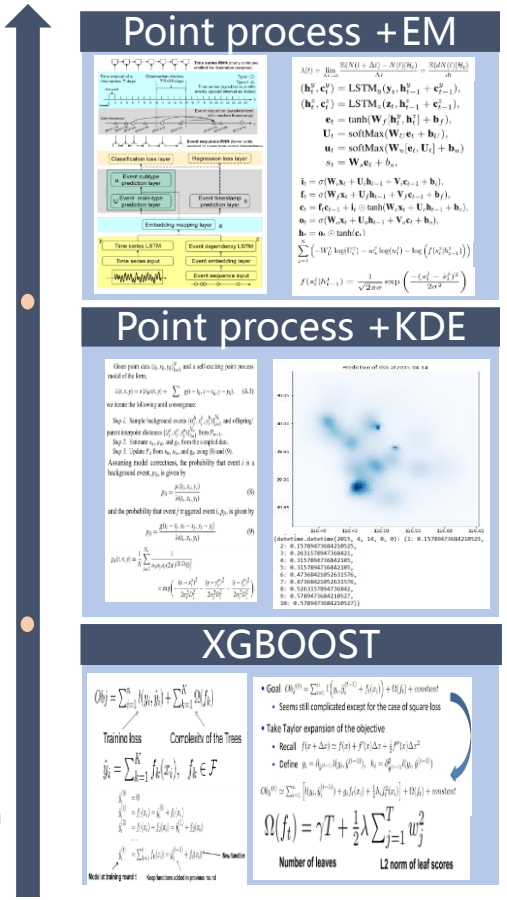
警车巡逻地图，智能调配警力

根据案件密集度部署调控警力

匹配案情高发地带指导进行核录工作

案情热力图分类查看，开展专项案件整治

3、Alert forecast



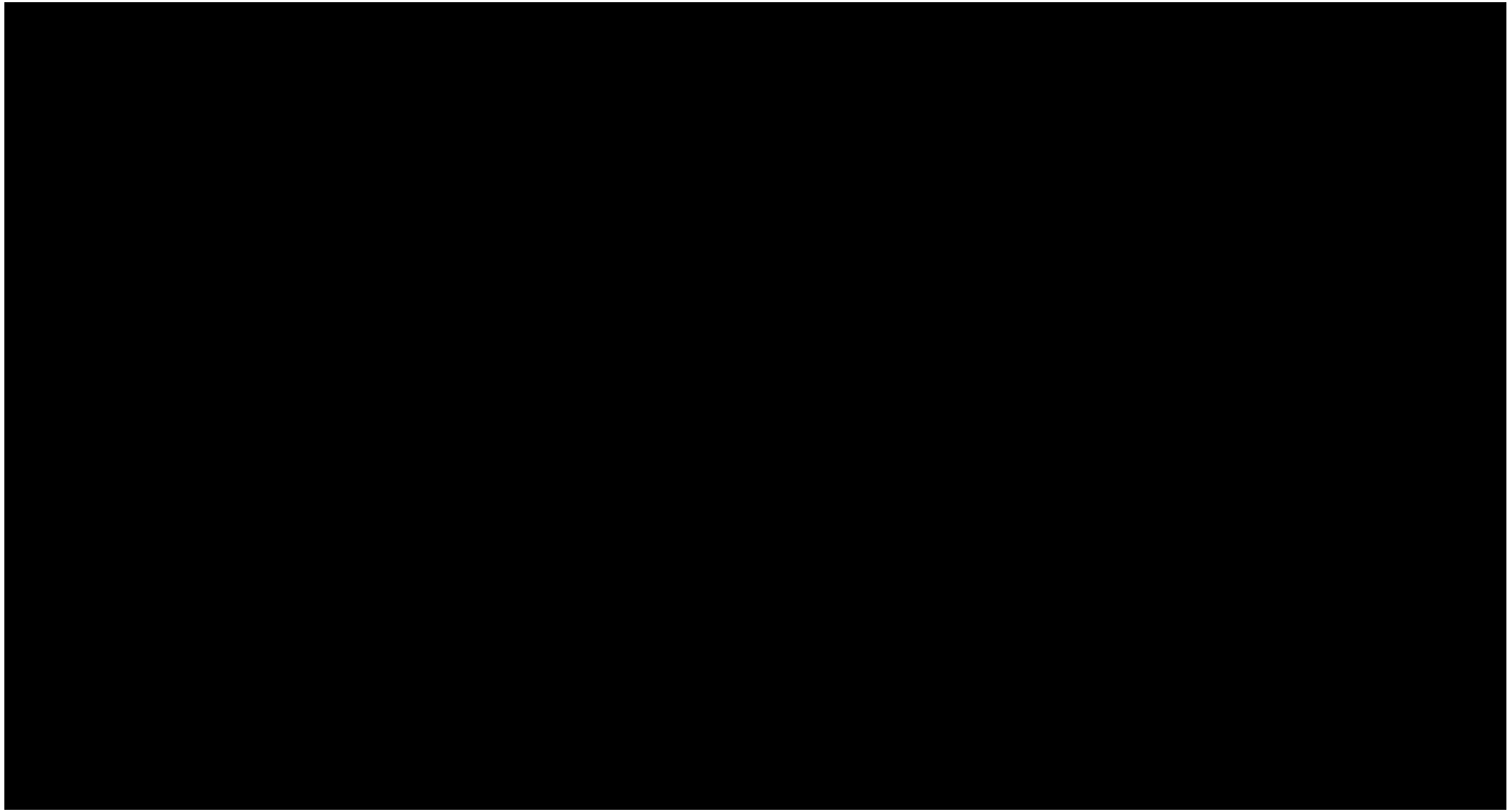
Phase iii
Self – exciting point process + em algorithm
Accuracy: 90 %

Phase ii
Self - exciting point process + kde algorithm
Accuracy: 64 %

Phase i
Choose the best from a variety of deep machines Learning algorithm
Accuracy: 48 %

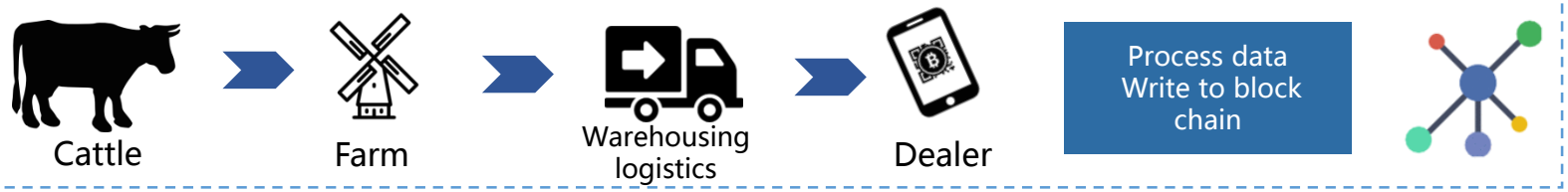
2、 “Smart police” system has been applied in police work

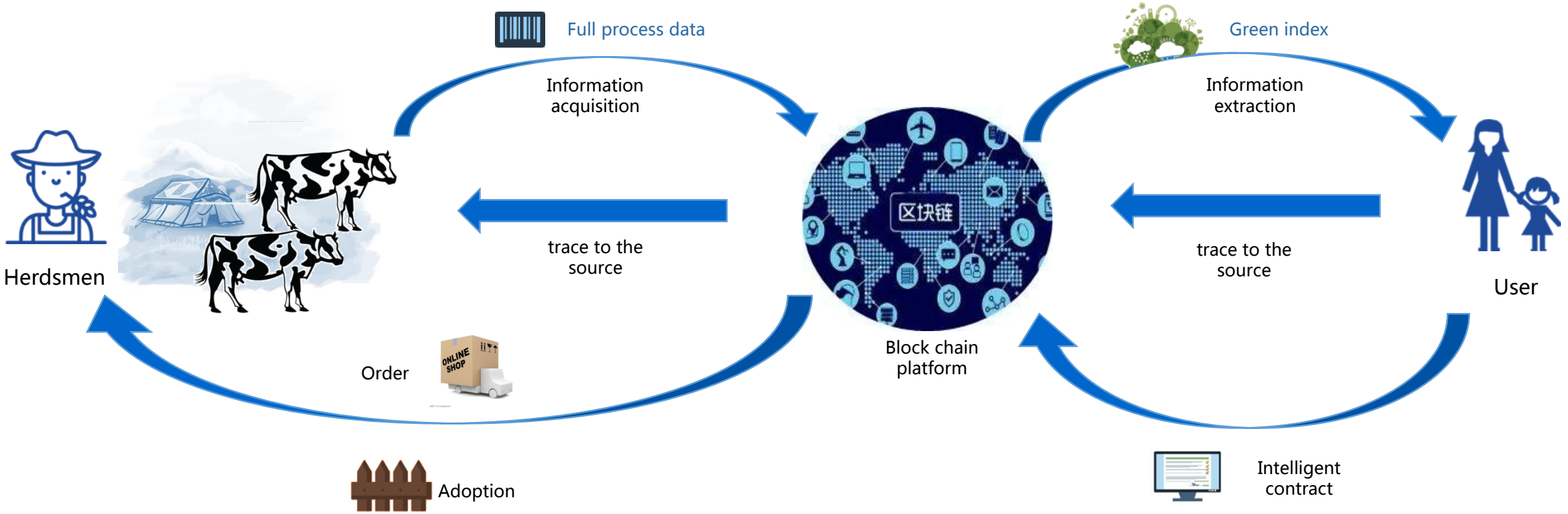
PC side



3、 AI+BlockChain: Agricultural Products Tracing

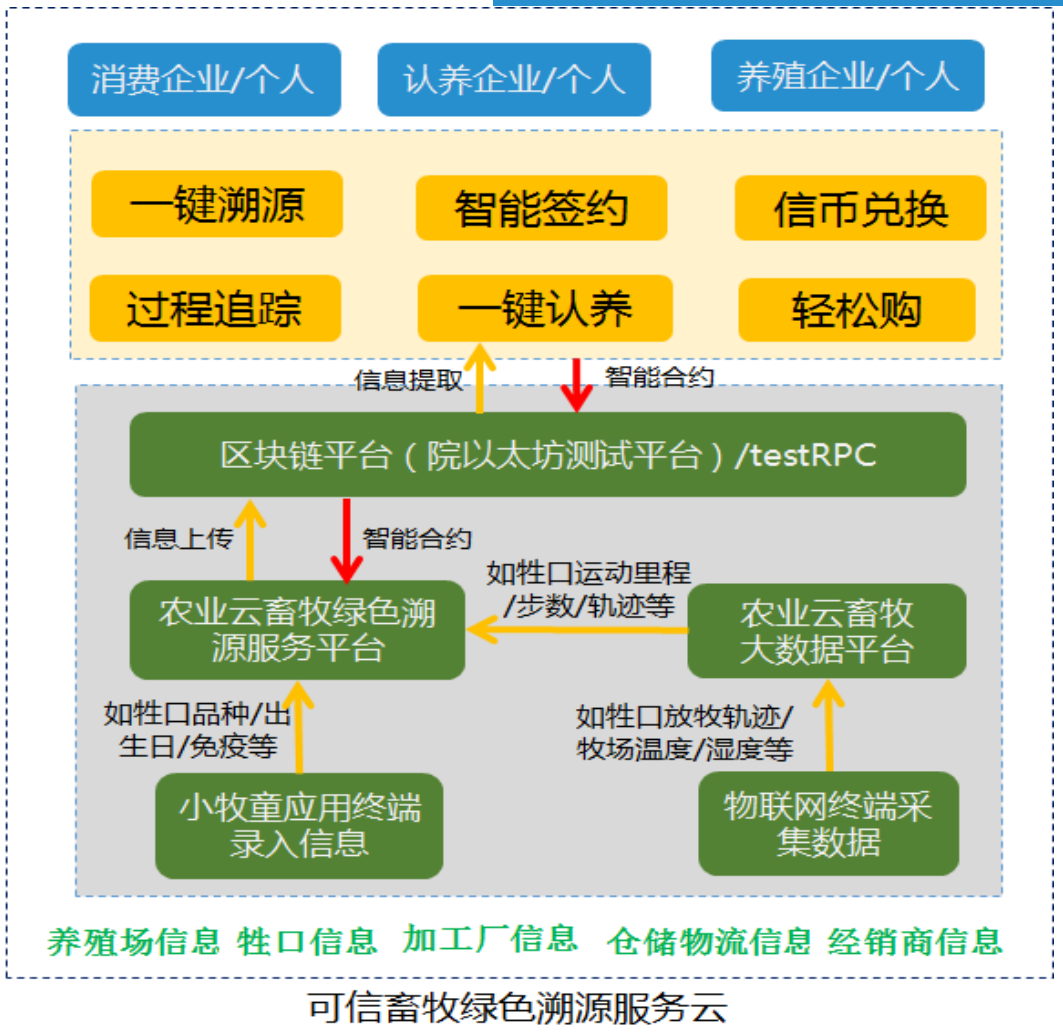
Main functions:
livestock growth monitoring + meat quality management





3、AI+BlockChain: Agricultural Products Tracing

Traceability of Agricultural Products Based on Block Chain



可信畜牧绿色溯源服务云

The grazing cattle and sheep's birth identity information, grassland information, grazing trajectory information, cattle and sheep livestock growth information, quarantine and epidemic prevention information are uploaded to the blockchain platform in real time to ensure that the information is not tampered with, and the object code uses the handle code;

OPPORTUNITY

For growth
The outside adopts the block chain traceability service for the logistics link.

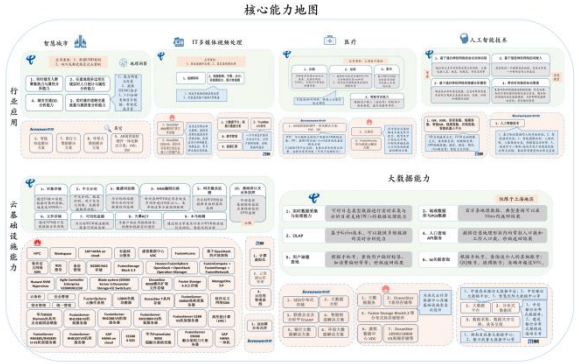
Smart contract
The third party can directly place orders on herdsmen, reduce the intermediate link and avoid the possible cost of the intermediate link

4 About AI， we still have a lot to do

Innovation is the driving force of development

Four links of innovative driving model

Technology Exploration



Application innovation

Solution build

零售业

- 武汉商超零售行业大数据平台建设

其它

- 教育、畜牧业等领域解决方案

智慧城市综合治理

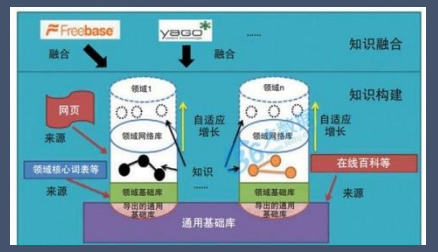
- 面向新型智慧城市的城市综合治理解决方案
- 南昌市政公用集团大数据公共事业管理平台初步建设
- 唐山曹妃甸区政府大数据平台
- 广西防城港口岸人口洞察平台
- 雄安公共治安智慧洞察系统解决方案
- 郑州国家产品质量大数据中心初步建设

Scale promotion

Algorithm Innovation Case - Knowledge Map

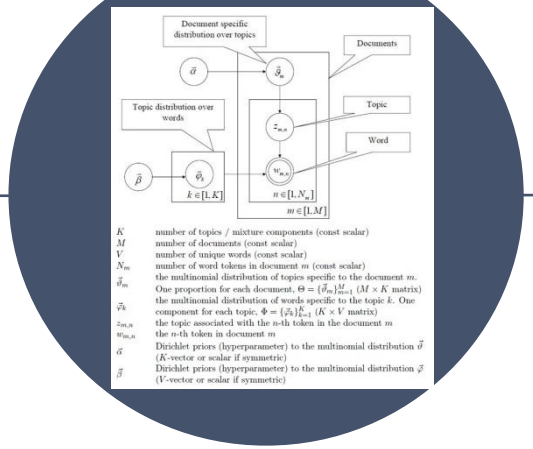
- **Rule extraction**

Extract knowledge from structured data such as encyclopedias



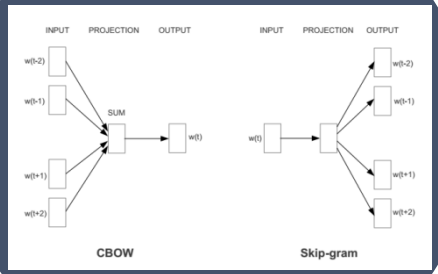
- **Probability model**

Using LDA and other technologies to extract knowledge topics

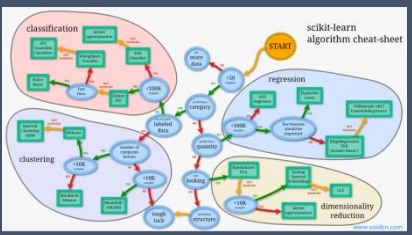


- **Deep neural network model**

Utilize technologies such as word2vec to form knowledge vectors



- **Multiple model fusion**



An integrated solution

Take the smart city solution as an example to form a "cloud+big data+artificial intelligence" solution and effectively stimulate the development of integration of optical bandwidth, Internet of Things, and cloud network.

Medical treatment	Agricultural	Urban governance
AI + Medical solution	Blockchain-based Smart Livestock Solutions	Smart Insight System Solution for Public Security

Our goal is to create the soul of the industry cloud with AI.

中国电信 CHINA TELECOM 世界触手可及

1、AI + Public Security

Basic advantage resources

Optical width

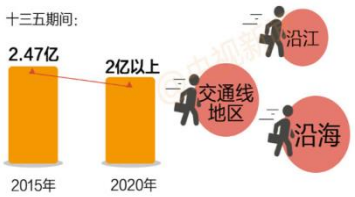
Forward Feedback

4G network

Wifi equipment

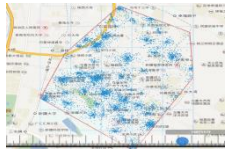
Cloud storage

Urban population mobility management

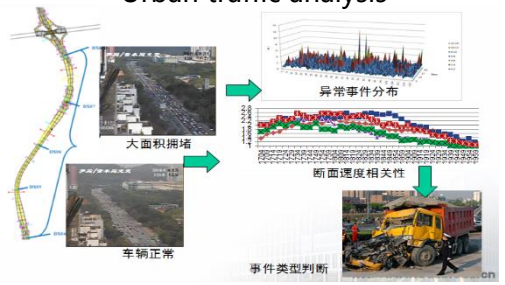


Intensive population monitoring

Danger alert

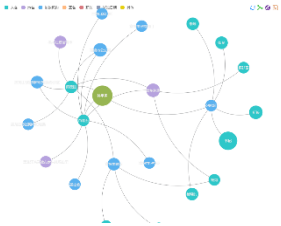


Urban traffic analysis



Intelligent prevention and control

Sensation monitoring



Public Security Case Management

Cloud + Big Data +AI

Large-scale real-time data analysis	Knowledge map	Text data intelligence analysis	Hidden Markov Road analysis model	Video, probe alignment
Large-scale data visualization	Cross-platform account mapping model	Graph data association mining	Geo Hash Area Crowd Quick Search	Video facial feature recognition

Computing and cluster management components

MapReduce | Spark | Storm | Hadoop YARN

Storage component

Hive | HBase | MySQL | Redis | Neo4j

2、AI + Medical

In the medical field, a big data solution of "cloud+big data+artificial intelligence" has been formed, and effectively stimulated the development of optical bandwidth, cloud computing, and cloud network convergence.

Basic advantage resources

Optical width

4G network

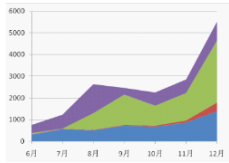
Wifi equipment

Cloud storage

Chronic Disease Management

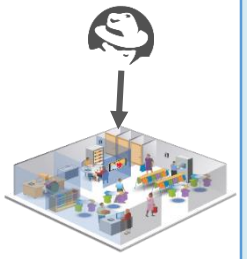
AI Diagnosis

Critical condition !

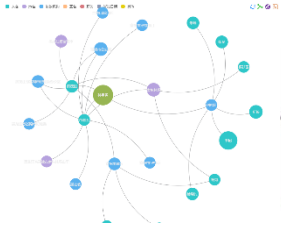


Meteorological medicine

Infectious disease prevention and control



Analysis of medication decision - making



Big data prediction of histology

Cloud + Big Data +AI

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谢谢您的聆听