UPYUN · OPEN TALK

UPYUN OPEN TALK

耳目一新的在线答疑服务背后的核心技术

学霸君APP

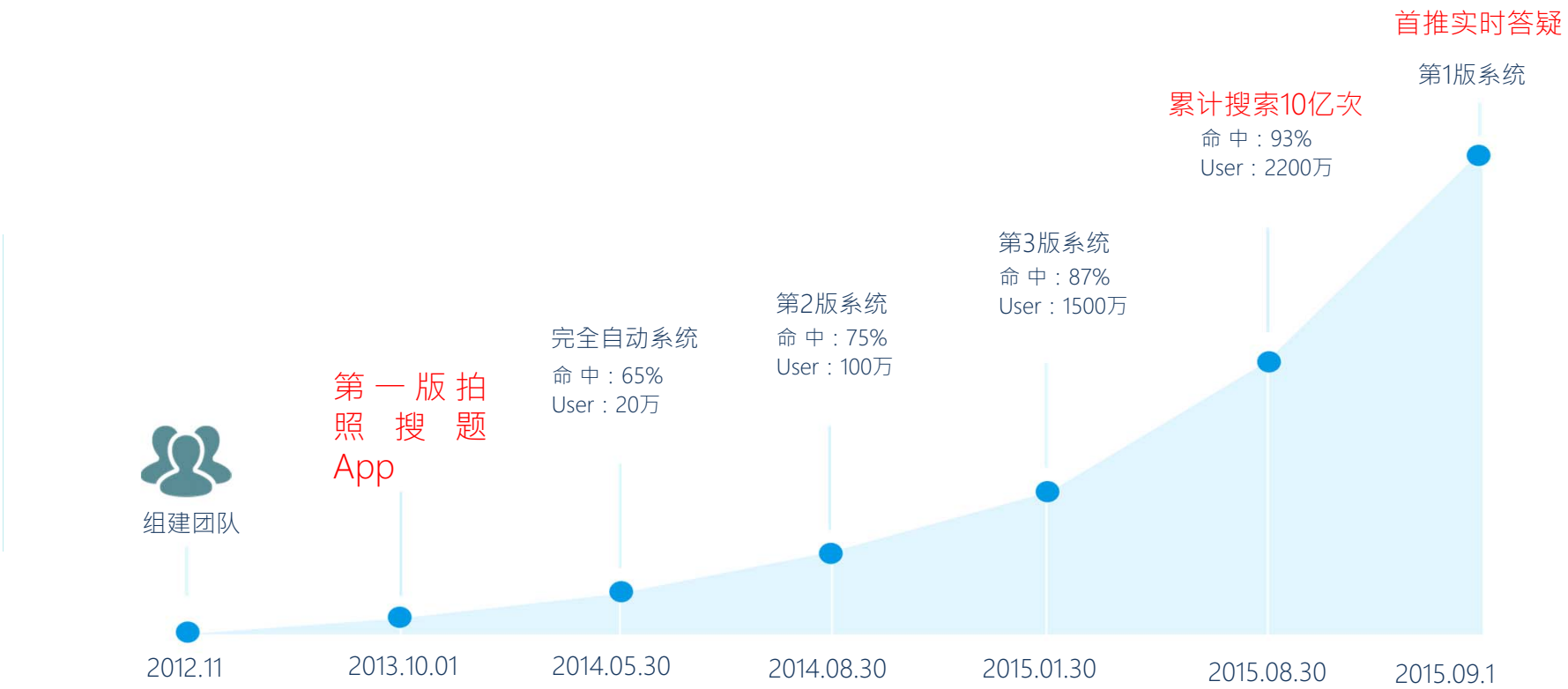
姜 波
资深研究员

学霸君

目录

学霸君

1.1.学霸君的简史



学霸君

1.2. 学霸君1V1实时答疑

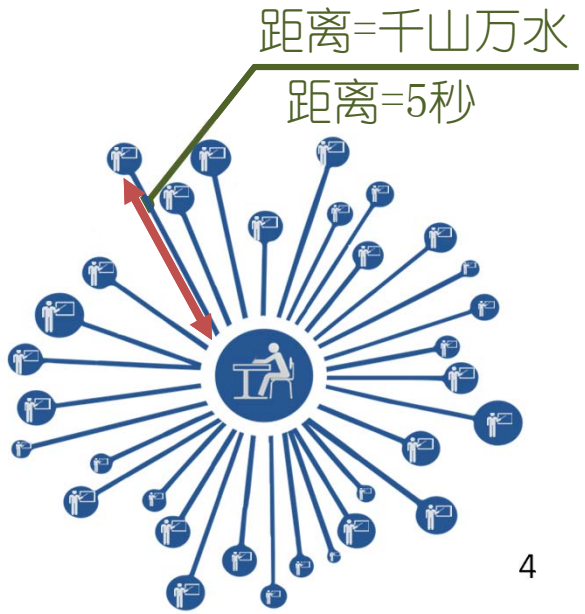
- 现状 -

[学生]
不敢问
不想问
不会问

[老师]
薪酬低
空余时间多

[家长]
望子成龙
不计成本
无力辅导

- 我们的解决方案 -



学霸君

学霸君老师答疑——难题即刻得到讲解

老师：拿题就讲

学生：不懂就问，问懂为止

真正做到今日难题今日毕

学霸君

目录

学霸君

2.1. 发动一场大规模的垂直领域数据采集

- 2012~2013年我们思考的核心问题，如何获得最学生个体学习信息？
  - 举个例子，随便给一个学生，如何知道他在学什么？

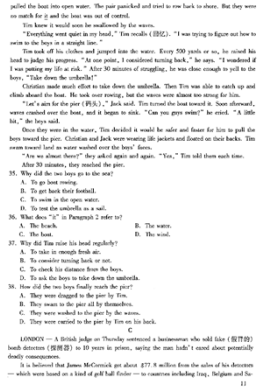
- 数十次头脑风暴后，学霸君决定把注意力落于他日常接触的书、试卷。

学霸君

- 技术孵化早期典型心理——在盲目乐观与盲目悲观中游荡

有Idea了！！！

文字提取是个坎



pulled the boat into open water. The pair panicked and tried to row back to shore. But they were no match for it and the boat was out of control.

Tim knew it would soon be swallowed by the waves.

"Everything went quiet in my head," Tim recalls (回忆). "I was trying to figure out how to swim to the boys in a straight line."

Tim took off his clothes and jumped into the water. Every 500 yards or so, he raised his head to judge his progress. "At one point, I considered turning back," he says. "I wondered if I was putting my life at risk." After 30 minutes of struggling, he was close enough to yell to the boys, "Take down the umbrella!"

Christian made much effort to take down the umbrella. Then Tim was able to catch up and climb aboard the boat. He took over rowing, but the waves were almost too strong for him.

"Let's aim for the pier (码头)," Jack said. Tim turned the boat toward it. Soon afterward, waves crashed over the boat, and it began to sink. "Can you guys swim?" he cried. "A little bit," the boys said.

Once they were in the water, Tim decided it would be safer and faster for him to pull the boys toward the pier. Christian and Jack were wearing life jackets and floated on their backs. Tim swam toward land as water washed over the boys' faces.

"Are we almost there?" they asked again and again. "Yes," Tim told them each time.

After 30 minutes, they reached the pier.

35. Why did the two boys go to the sea?
A. To go boat rowing.
B. To get back their football.
C. To swim in the open water.
D. To test the umbrella as a sail.

36. What does "it" in Paragraph 2 refer to?
A. The beach. B. The water.
C. The boat. D. The wind.

37. Why did Tim raise his head regularly?
A. To take in enough fresh air.
B. To consider turning back or not.
C. To check his distance from the boys.
D. To ask the boys to take down the umbrella.

38. How did the two boys finally reach the pier?
A. They were dragged to the pier by Tim.
B. They swam to the pier all by themselves.
C. They were washed to the pier by the waves.
D. They were carried to the pier by Tim on his back.

C

LONDON — A British judge on Thursday sentenced a businessman who sold fake (假冒的) bomb detectors (探测器) to 10 years in prison, saying the man hadn't cared about potentially deadly consequences.

It is believed that James McCormick got about £77.8 million from the sales of his detectors — which were based on a kind of golf ball finder — to countries including Iraq, Belgium and Su-

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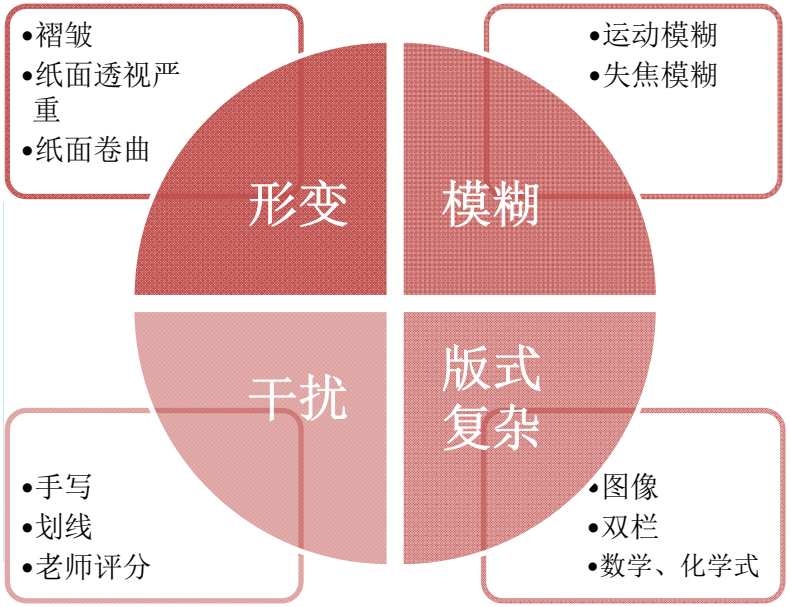
不就是OCR嘛买买买！！！

最后我们发现，2013年拍照搜题没有特别现成技术，识别效果是个未知数

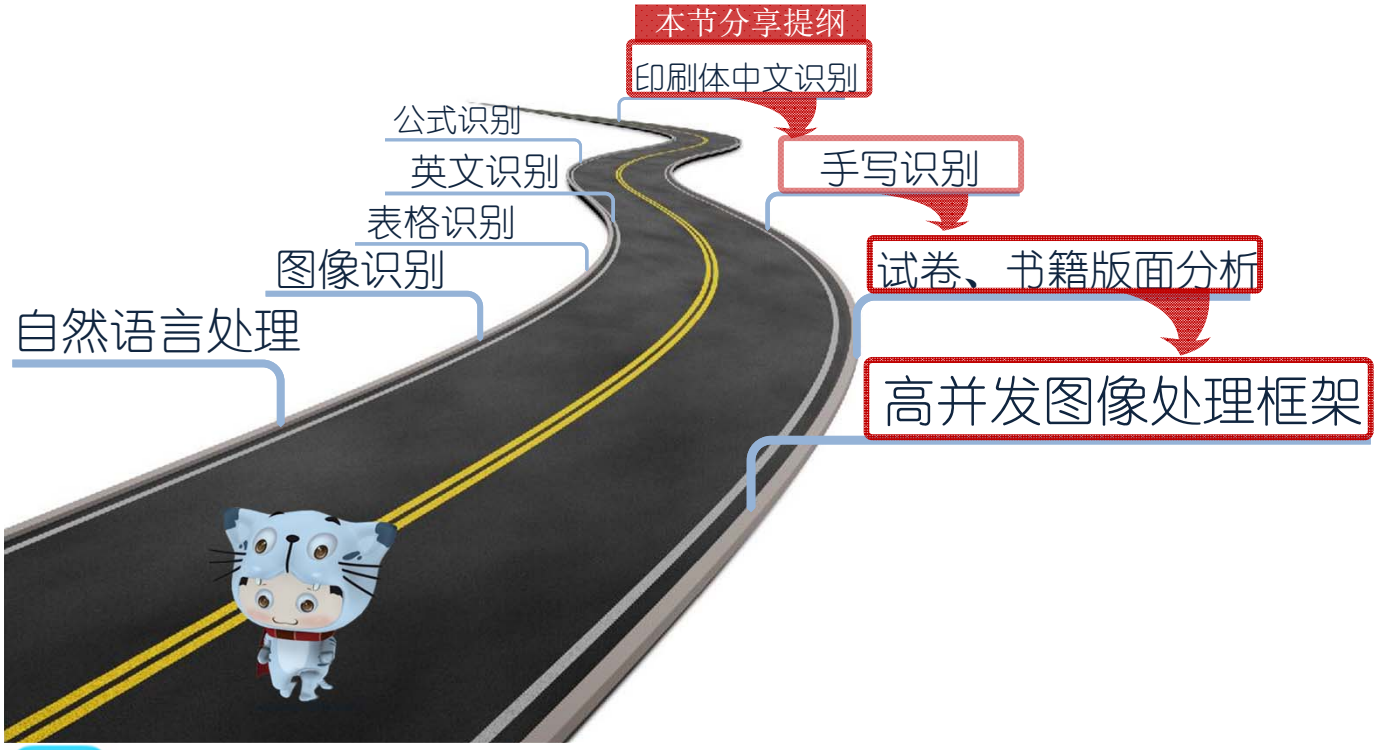
学霸君

- 为什么拍照搜题的识别技术充满挑战：



学霸君

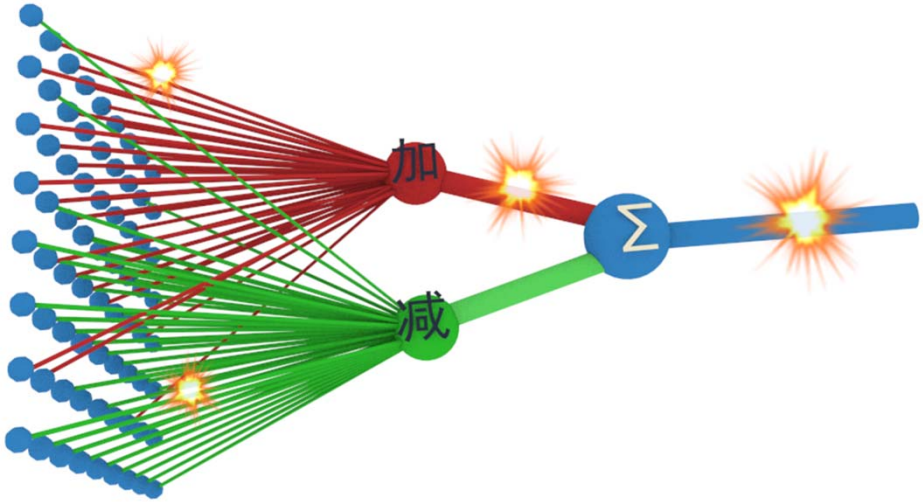
- 2013年初，学霸君开始开拓拍照搜题的核心识别技术道路



学霸君

2.2. 学霸君文字识别

- 利用深度神经网络进行中文字符识别（训练字符库：20亿，单字符识别率：99.5%）



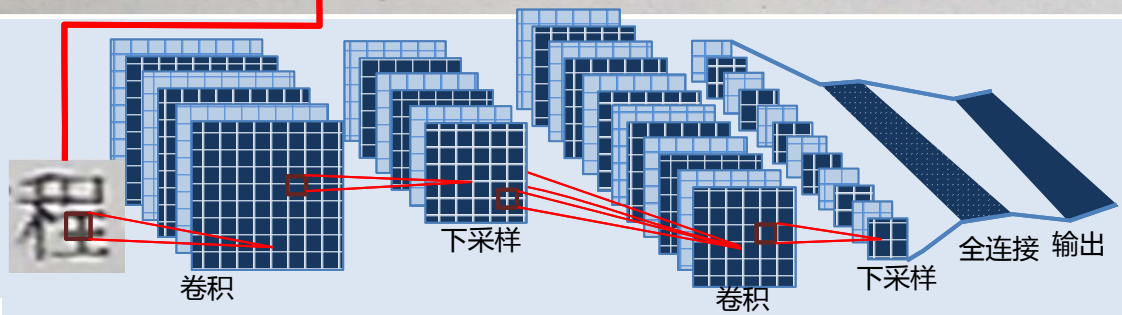
学霸君

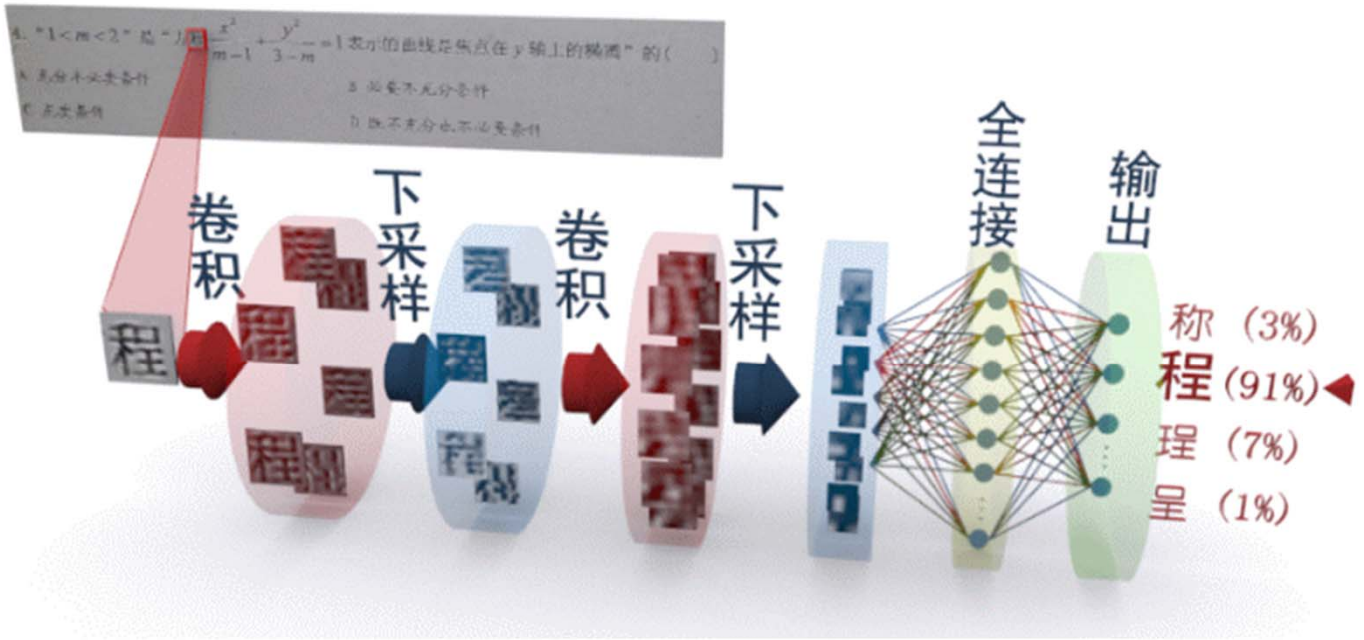
4. “$1<m<2$”是“方程$\frac{x^2}{m-1}+\frac{y^2}{3-m}=1$表示的曲线是焦点在$y$轴上的椭圆”的(　　)

A 充分不必要条件　　B 必要不充分条件

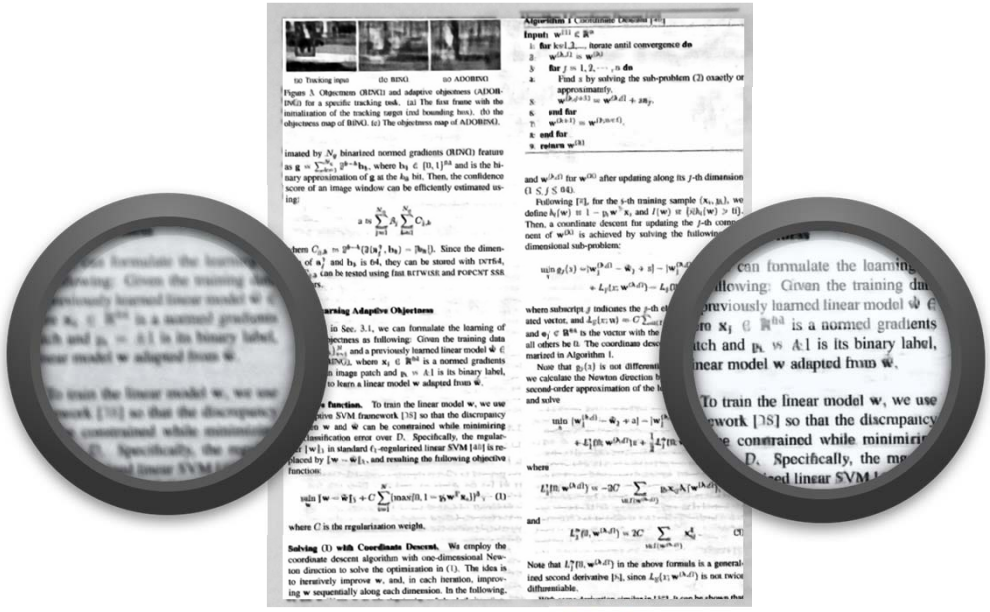
C 充要条件　　D 既不充分也不必要条件

深度神经网络





图像恢复技术，解决移动端采集图片质量低的问题



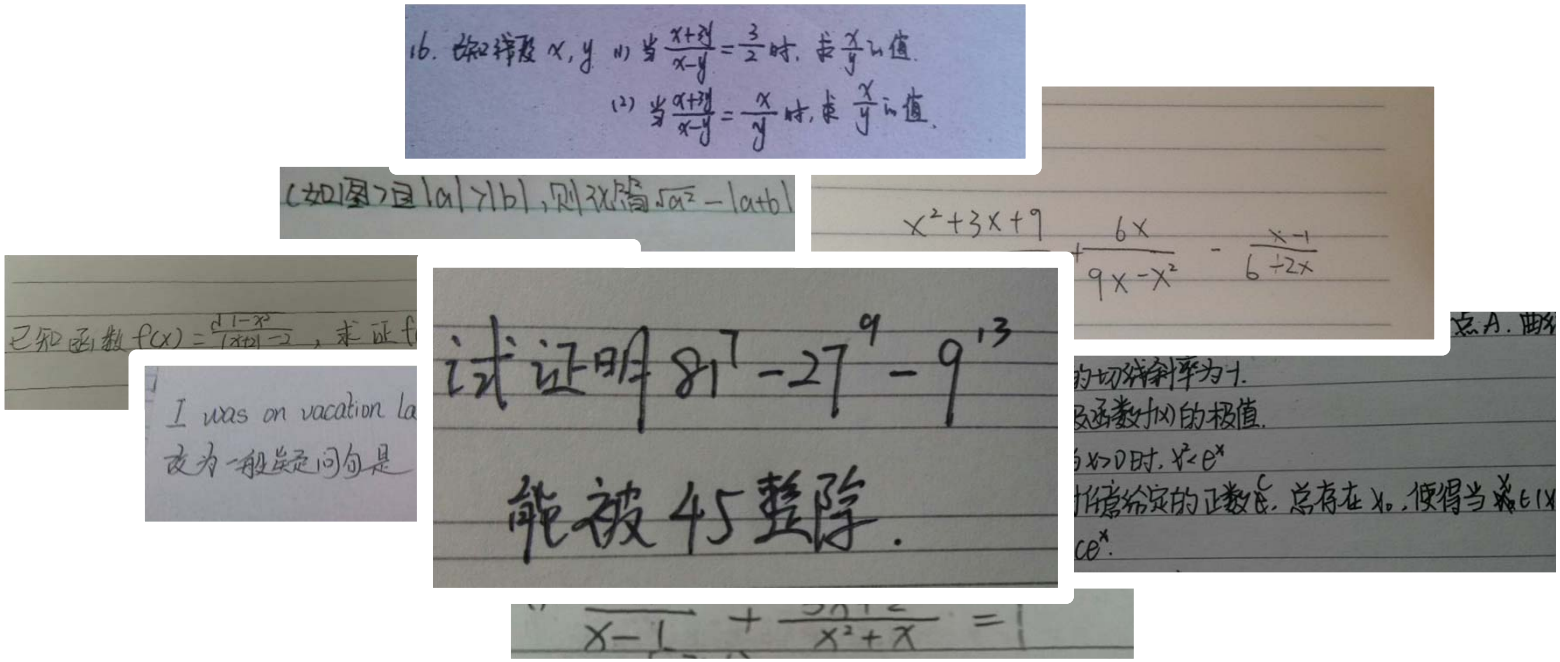
收集、标注
原始图片

训练深度
神经网络
（GPU集群）

生成模型
应用模型

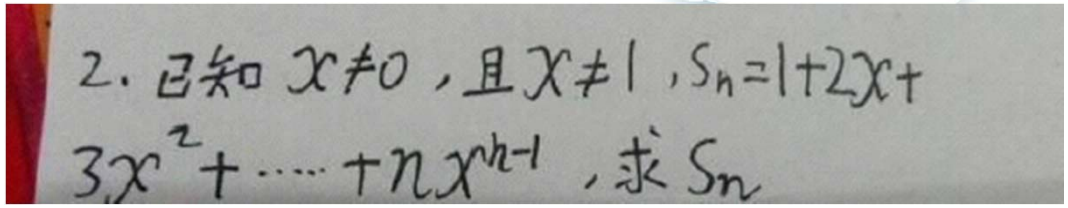
2.3. 手写识别

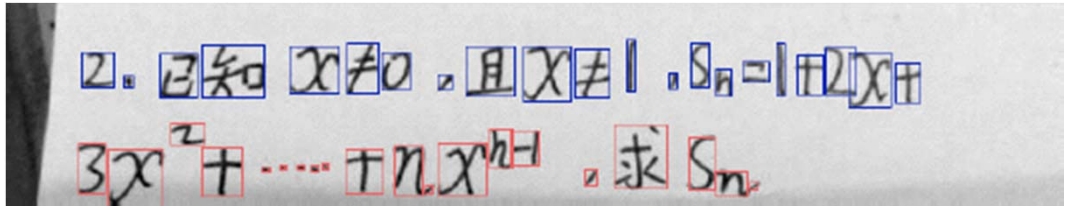
- 手写题目直接拍照答疑，拓宽了应用场景识别率将能进一步提升！



底纹滤除 → 版面分析 → 识别 → 自然语言处理

- 识别结果

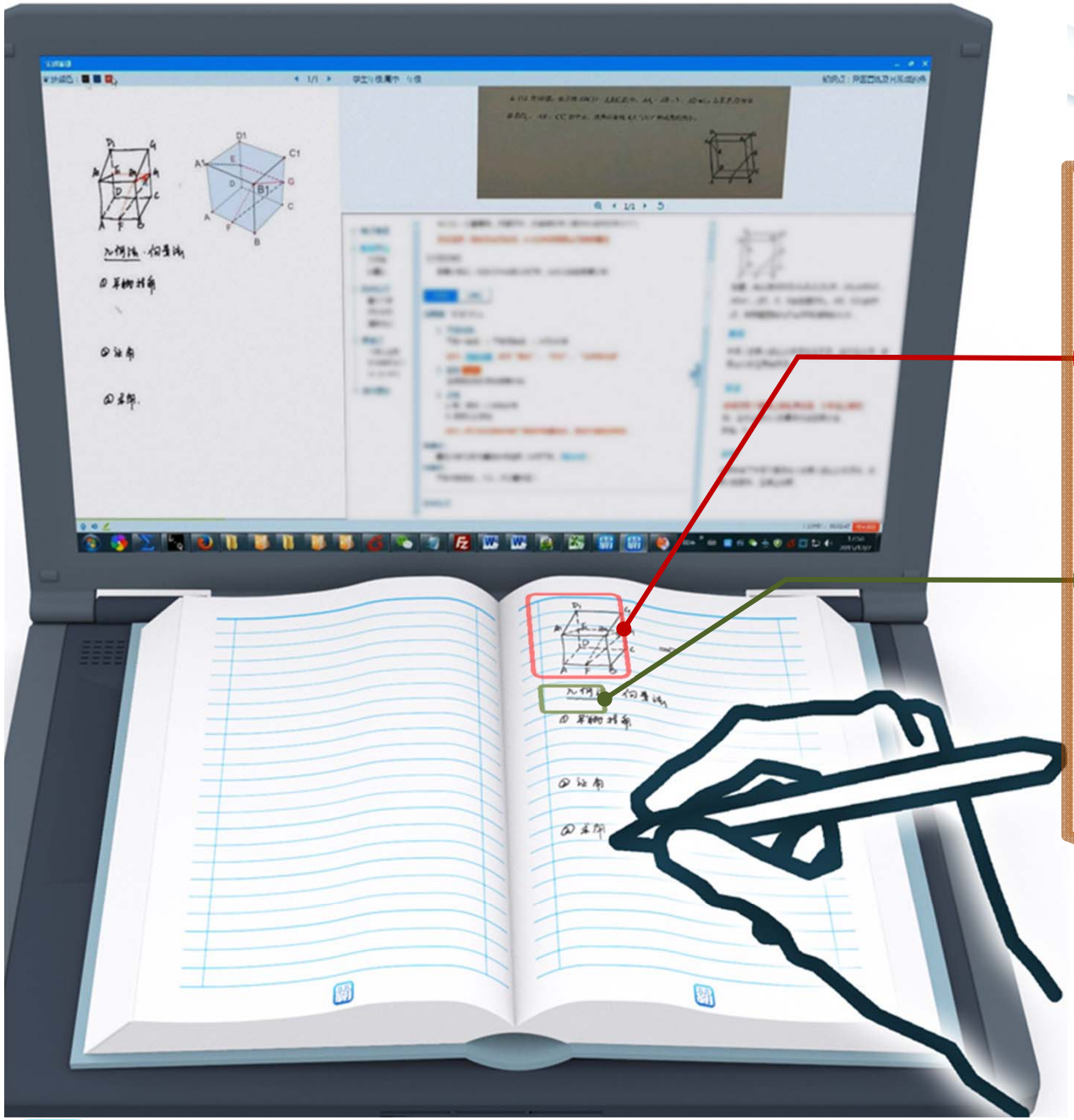




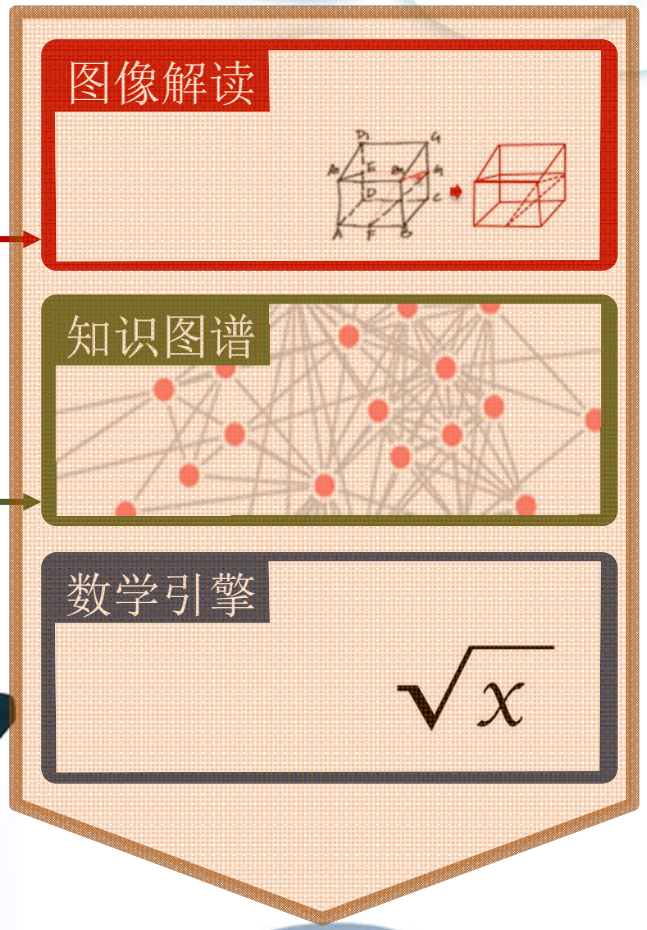
2	已	知	x	≠	0	且	x	≠	1	s	n	=	1	+	2	x	+
2	已	知	x	≠	0	且	x	≠	1	s	n	=	1	+	2	x	+

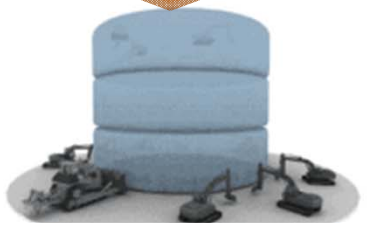
3	x	2	+	.	.	.	+	n	x	h	H	求	S	n
3	x	2	+	.	.	.	+	n	x	n	H	求	s	n

错误



- 实时分析+知识联动算法架构





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2.4. 智能化的版面分析和题目提取

2.5.学霸君的图像云

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目录

学霸君

3.1.最核心技术：分发策略——让最**合适**的老师给一个学生讲题

- 一个与Uber调度可类比却又很不同的问题，挑战如下：
  - 老师
    - 上线时间不确定
    - 老师擅长版块不一致
    - 各地教纲不同
    - 讲题方式不同
  - 学生
    - 随机发起提问
    - 对价格敏感程度不同
    - 对获取结果期待不同

学霸君1V1调度算法架构

分发算法

随机建模

最优化

智能调度

预测算法

需求预测

供给预测

用户画像

学生画像

老师画像

知识模型

知识导航

知识图谱

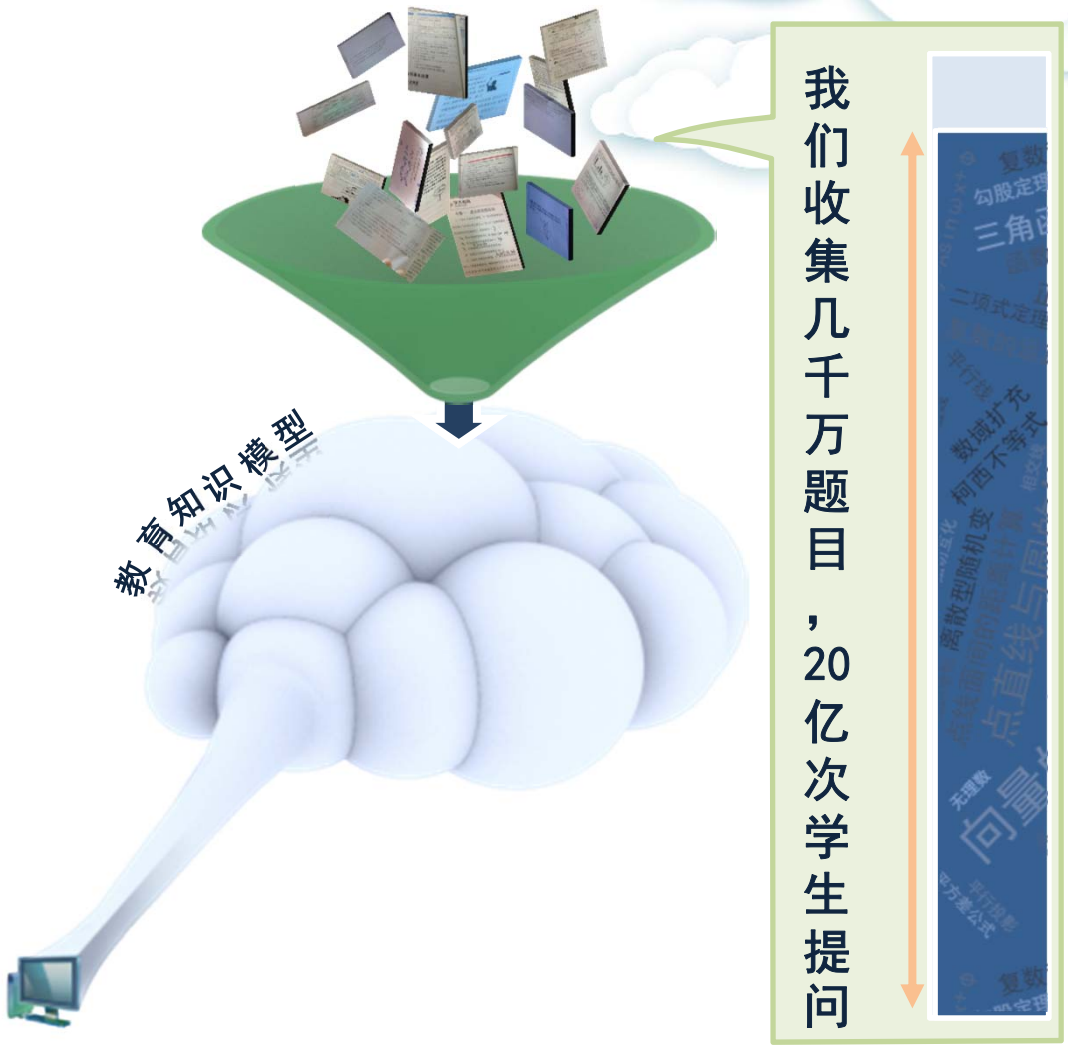
本节分享提纲

学霸君

3.3. 知识导航体系

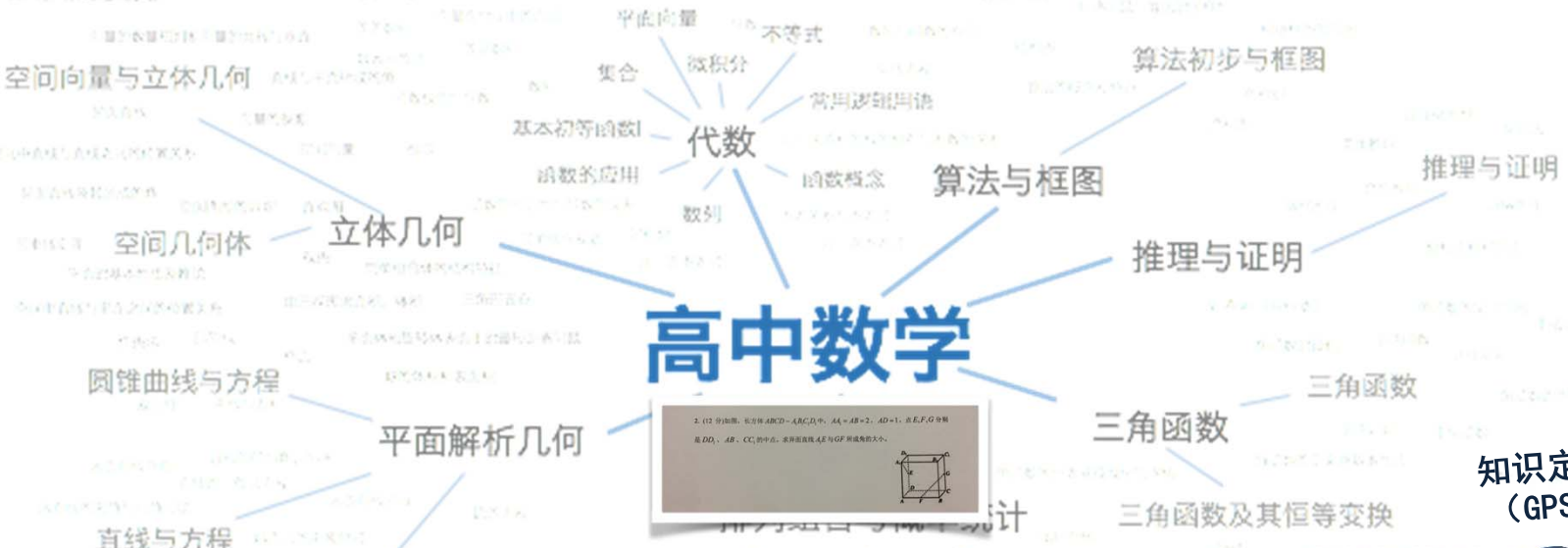
基于自然语言理解和深度学习的数据挖掘

- 通过高性能机器学习技术，我们对数据进行多种维度的挖掘和分析
- 在教育领域，我们搭建了基于海量数据的知识导航系统

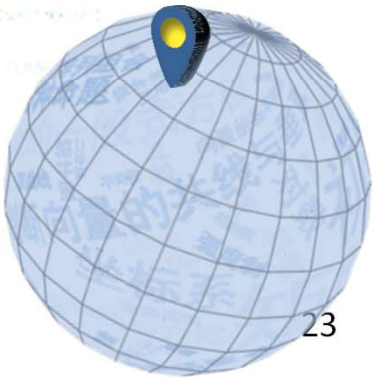


- 对于任意一道K12题目，可以通过数据挖掘的结果自动分析出其知识点，并推荐学习内容。基于大数据的分析对学生精准学习非常有益

7个板块　　22个章节　　550个知识点　　3529个题型



知识定位（GPS）



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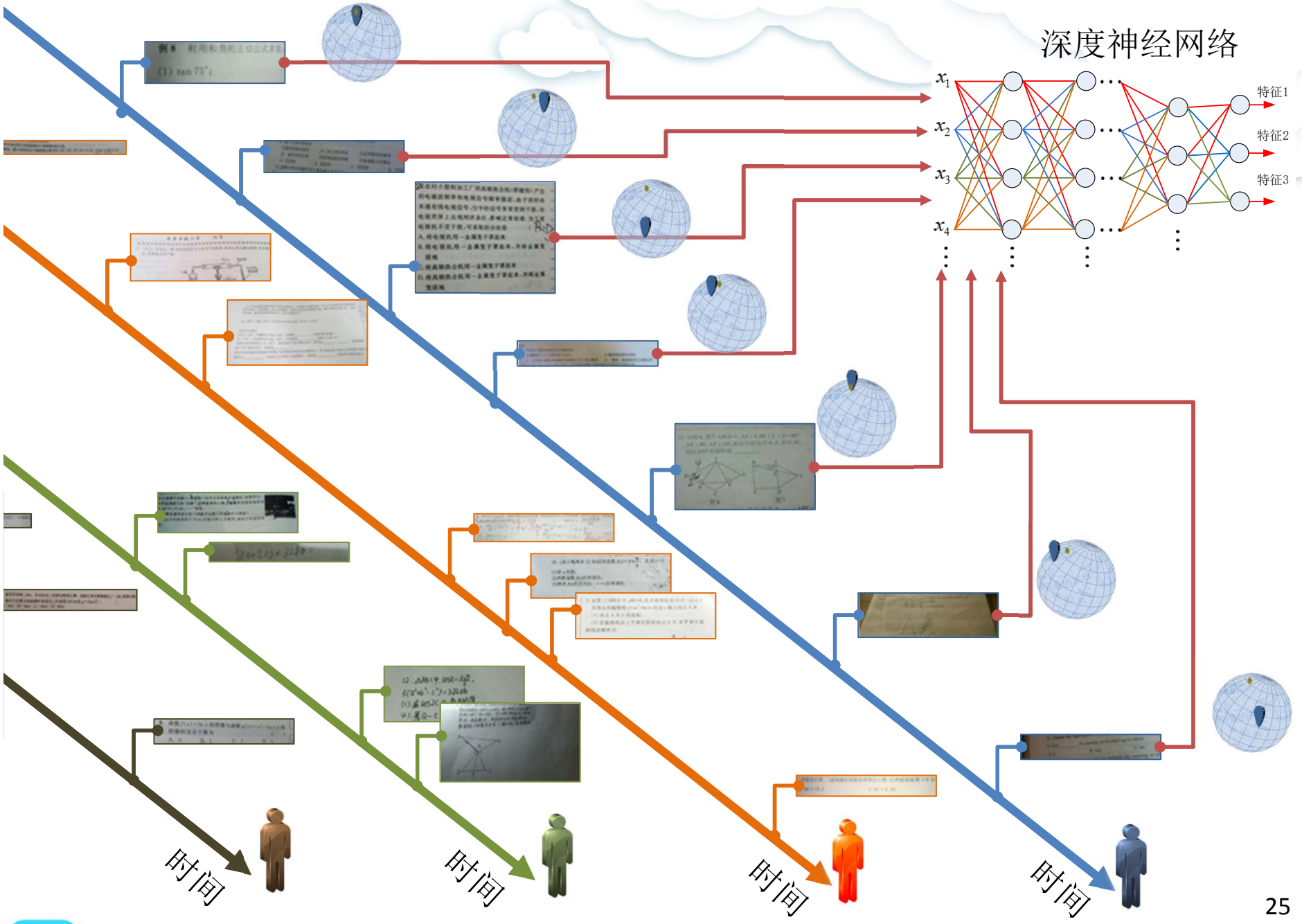
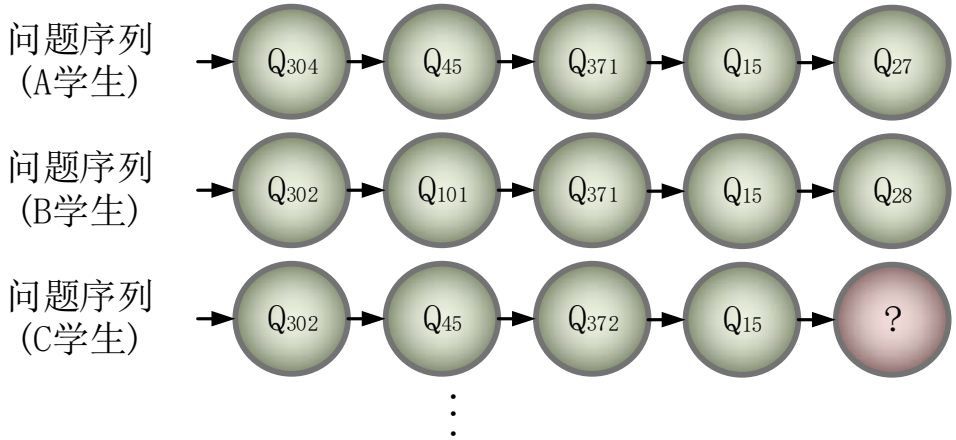
3.4. 学生画像：一花一世界，一叶一菩提

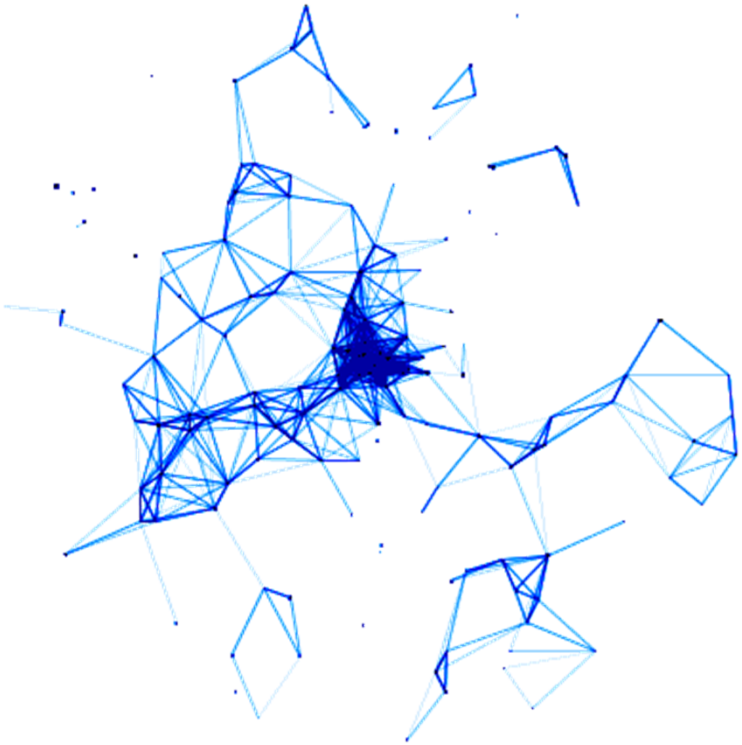
- 聚拢了约3000万学生用户，每个学生都有不一样的属性：
  - 年级
  - 地区教材
  - 对不同知识点的掌握水平
  - 学习能力
  - 等等

学霸君



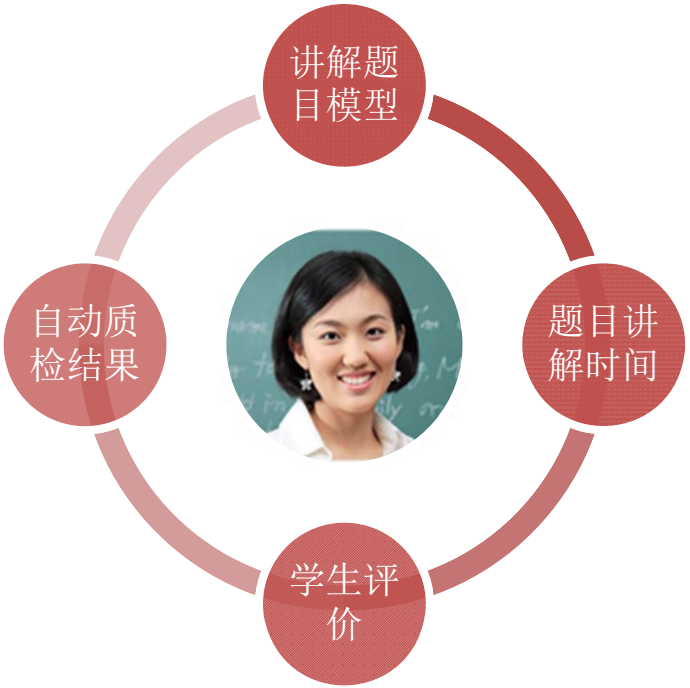
- 实际应用中，需要考虑时间轴和相关性，分析中会产生动态学习轨迹
- 对于顺序发生的事件的行为模式进行挖掘和分析





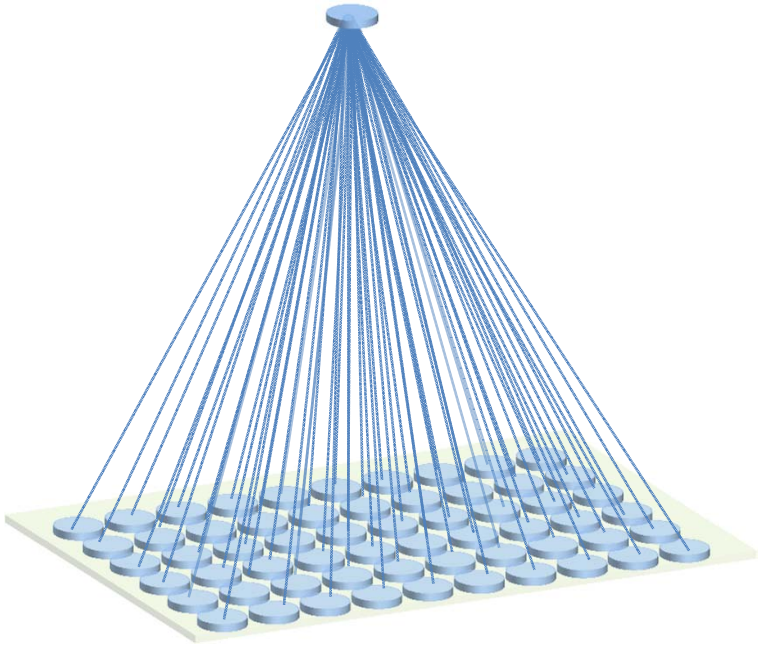
3.5.老师画像

- 每次老师主动讲题，都是一次对老师能力空间的评估
- 积累了一段时间后，每个老师的擅长领域及答疑习惯都能从数据中体现出来

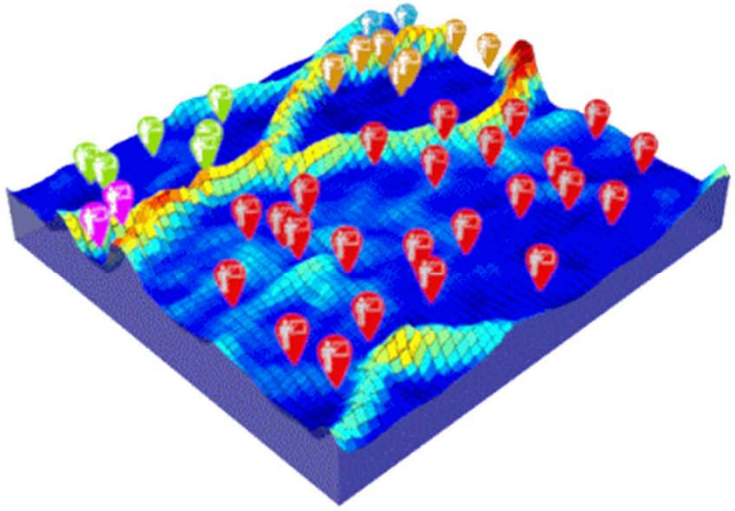


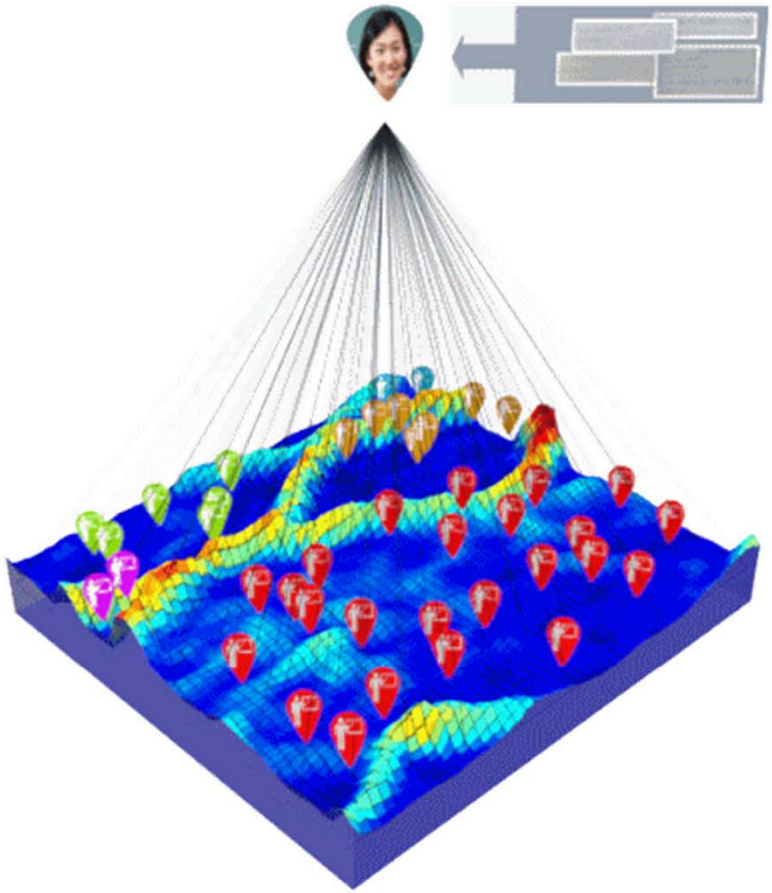
- 分类策略
  自组织地图（竞争神经网络）

老师各个维度的数据输入



- 按照区域化的划分，每个老师都可以归于不同的组群里
- 当学生提出答疑需求时，学霸君后台会优先选择最为匹配的老师进行答疑服务

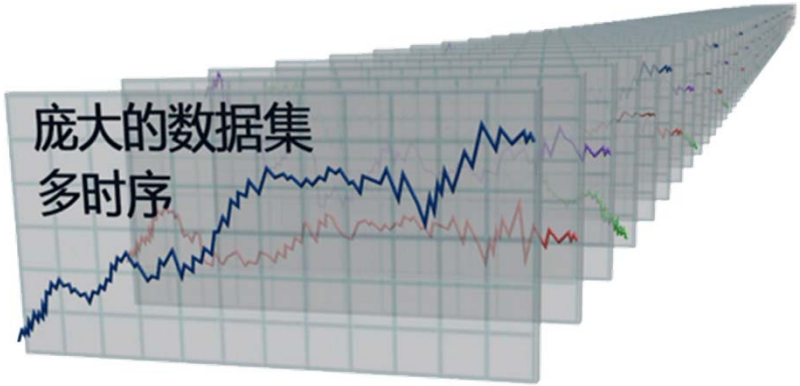




学霸君

3.6.调度的基石——供应预测

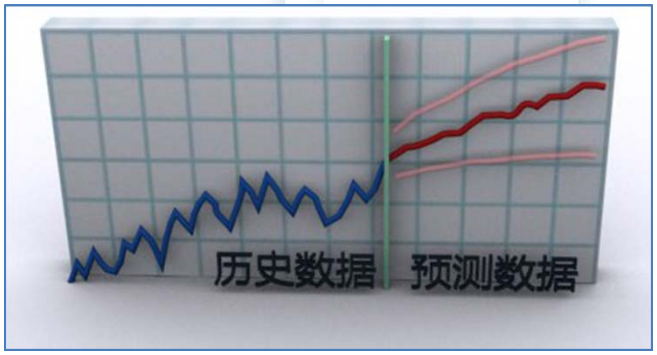
- 每个省份，每个知识点对应的老师的上线时间都具有强烈的随机形态。
- 从不同尺度对老师答疑服务量进行评估，可以得到：
  - 以省份为颗粒度的供应时序
  - 以知识点为颗粒度的供应时序
  - 以个人为颗粒度的供应时序

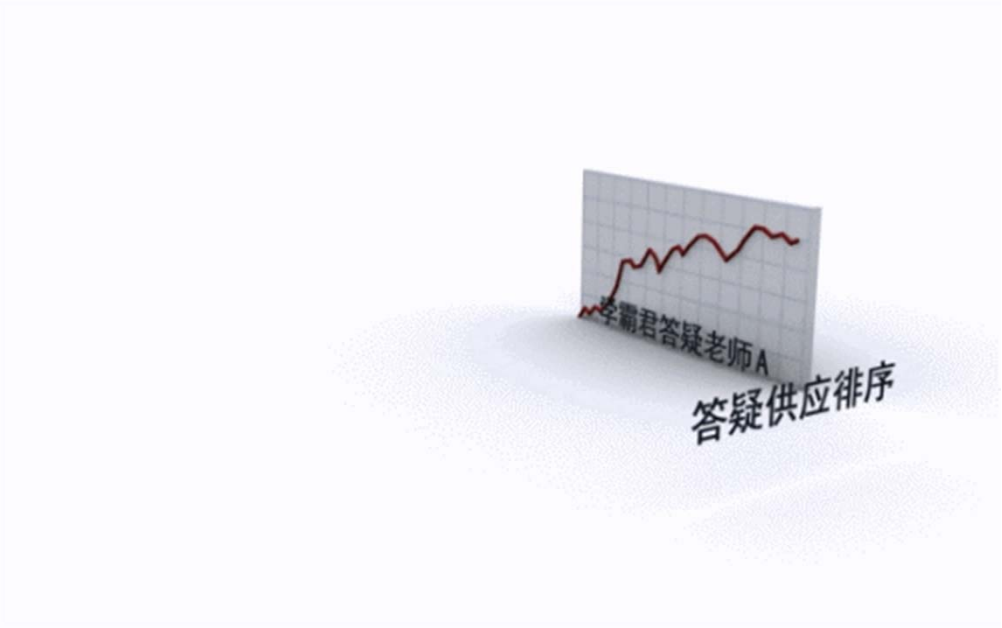


预测每个老师个体的上线时间

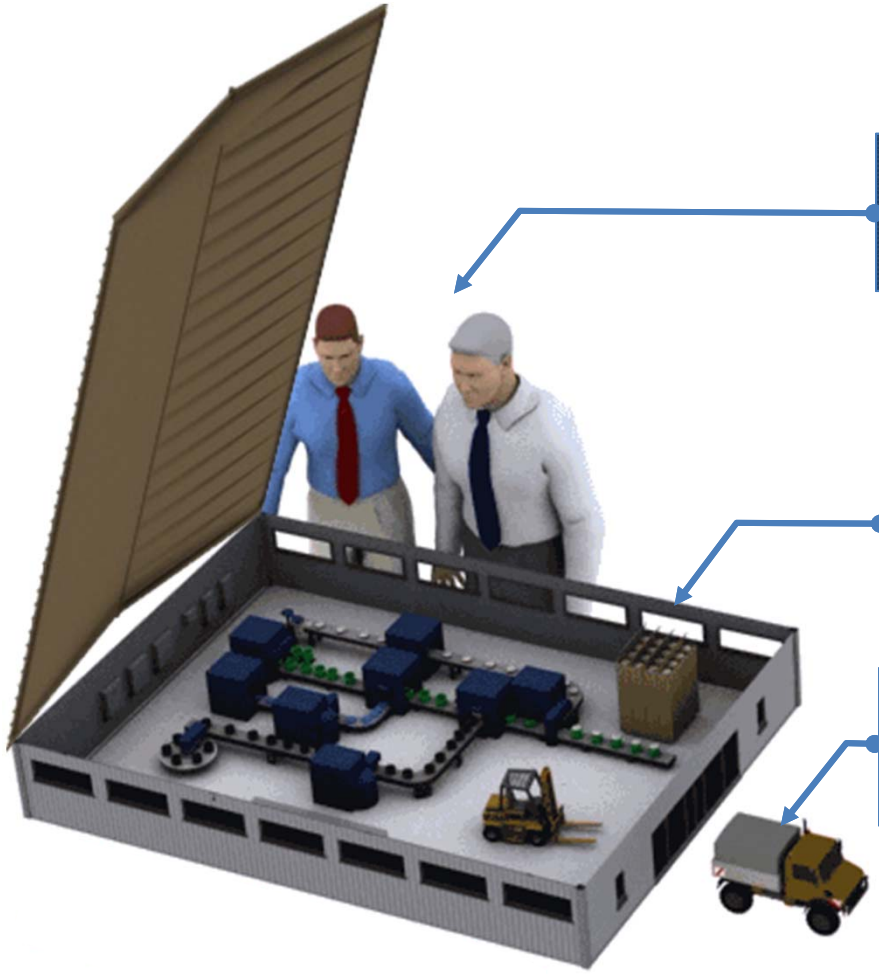
统计每个知识点的答疑供应能力

根据历史信息评估老师未来的服务能力





3.7.基于精益工程的老师答疑供给库存模型MTO（Make-To-Order）



简化的数学模型：

- $S=(x, \gamma_1, \gamma_2)$

x：老师服务库存队列

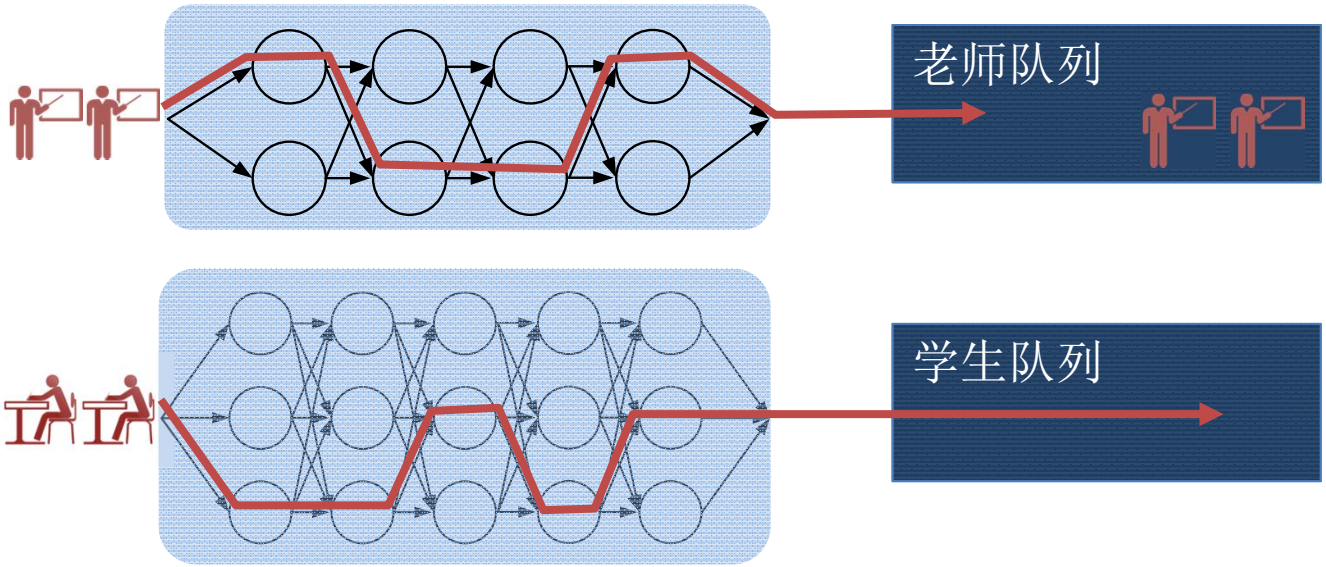
γ_1：老师上线事件

γ_2：学生提问事件

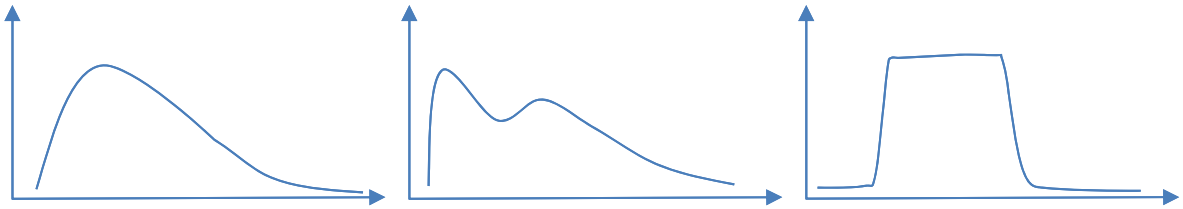
值得一提的是：

γ_1，γ_2服从复杂的Hyper-hypo-exponential随机分布

- 学霸君1V1答疑系统的Markov过程

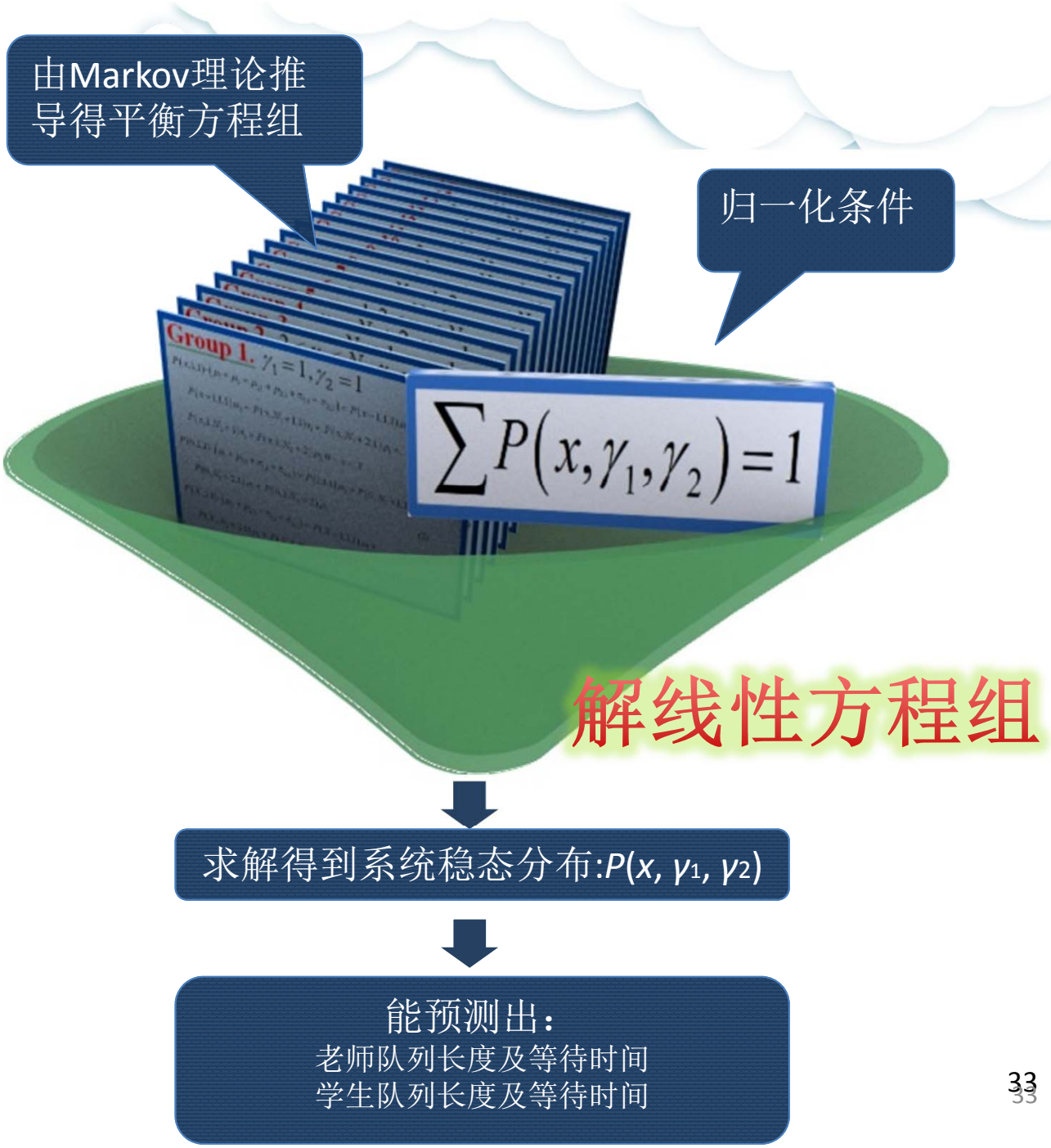


Hyper-hypo-exponential随机分布，可以拟合各类随机分布



学霸君

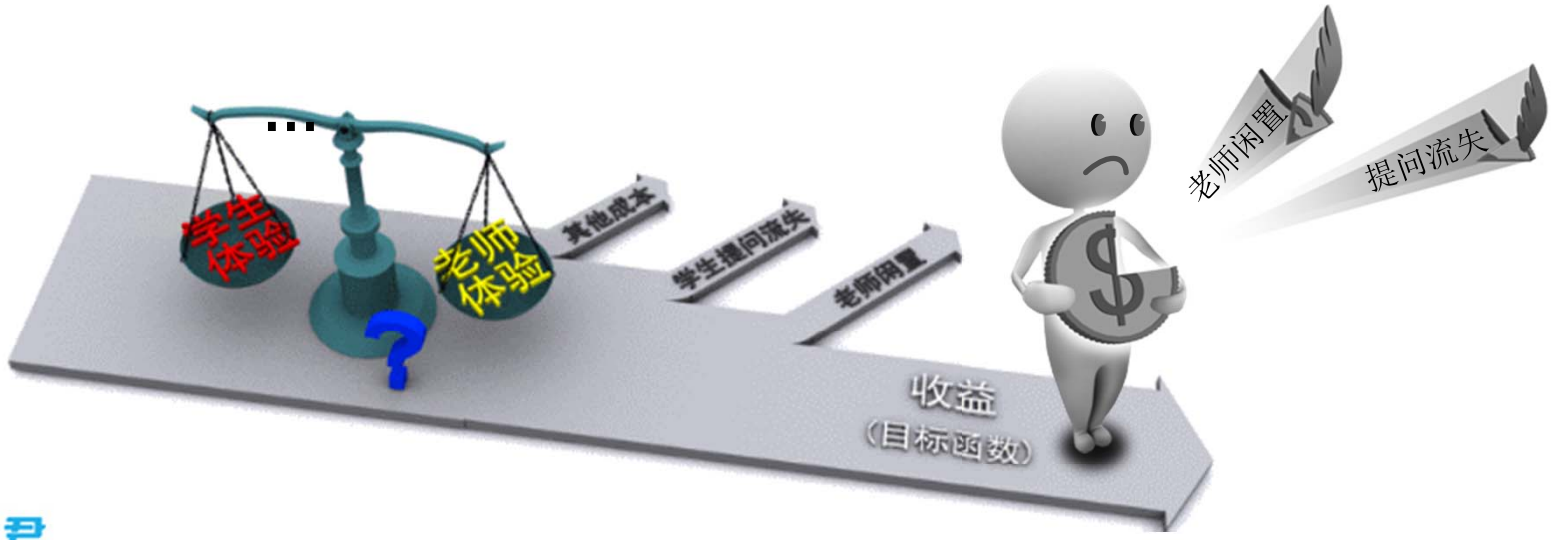
- 数学计算过程


由Markov理论推导得平衡方程组
归一化条件
$\sum P(x,\gamma_1,\gamma_2)=1$
解线性方程组
求解得到系统稳态分布:$P(x, \gamma_1, \gamma_2)$
能预测出:
老师队列长度及等待时间
学生队列长度及等待时间

运筹学模型(极度简化版):

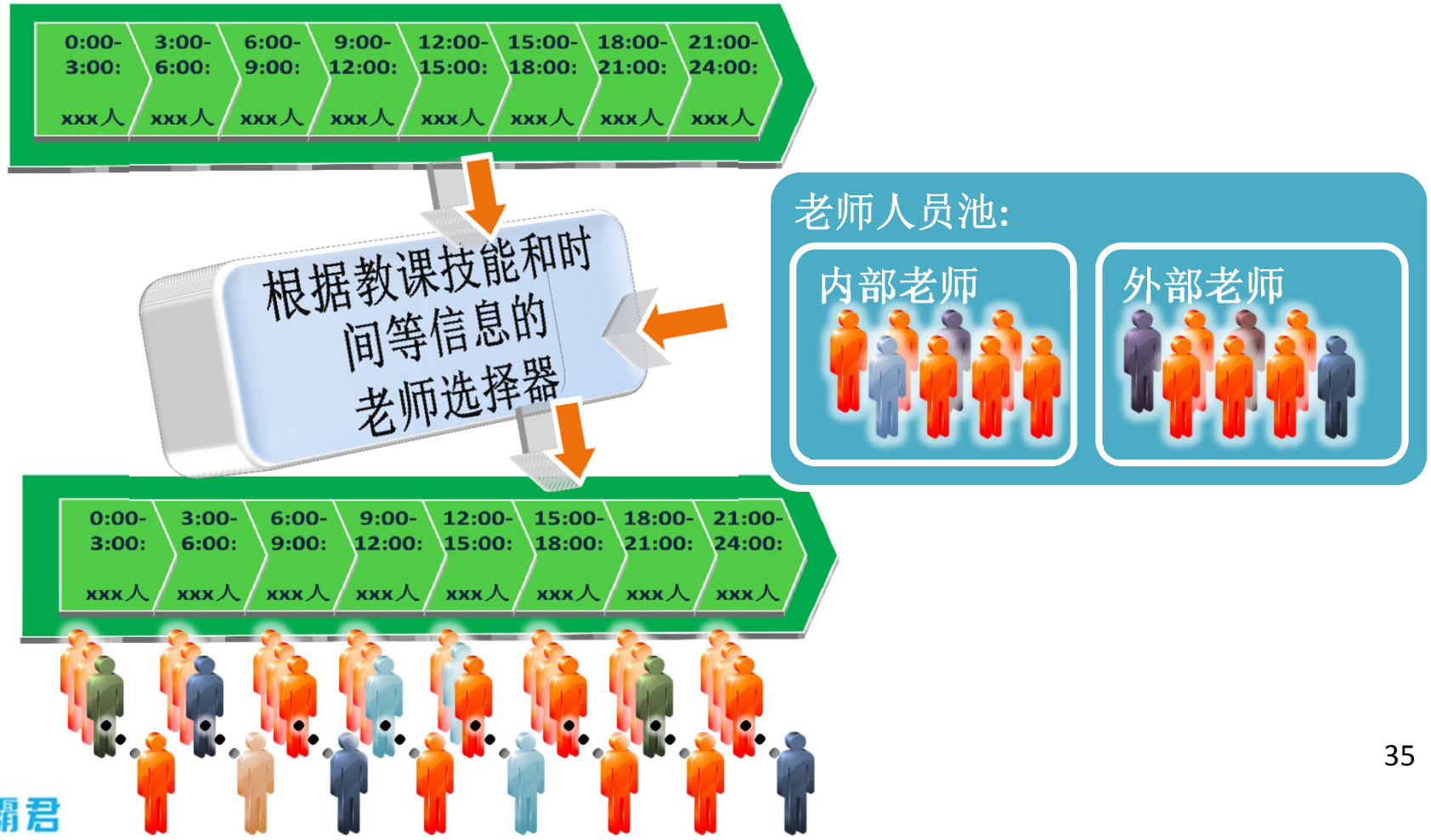
Maxmize: $\alpha \cdot$ 答疑总量 $+ \beta \cdot$ 答疑评分 $- \gamma \cdot$ 提问流失率 $- \delta \cdot$ 老师闲置率 $-$ 其他成本

Subject to: 老师实际调配量x(t) $<$ 最大老师量MaxSupply(t)



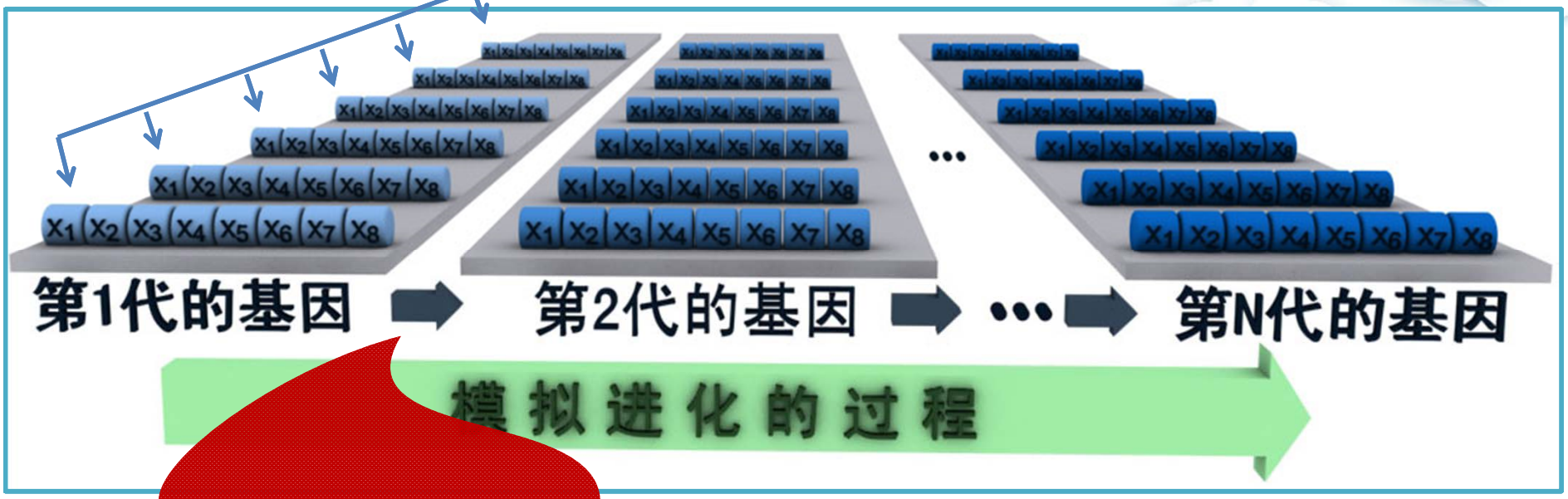
- 调度决策

  高效地自动排班，保障答疑时效的同时又节约了老师人力成本。

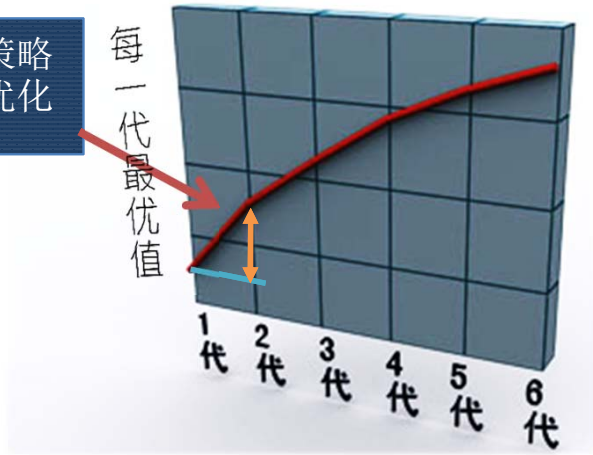


排班优化实战：遗传算法 (GA)

一个基因序列代表一种排班策略

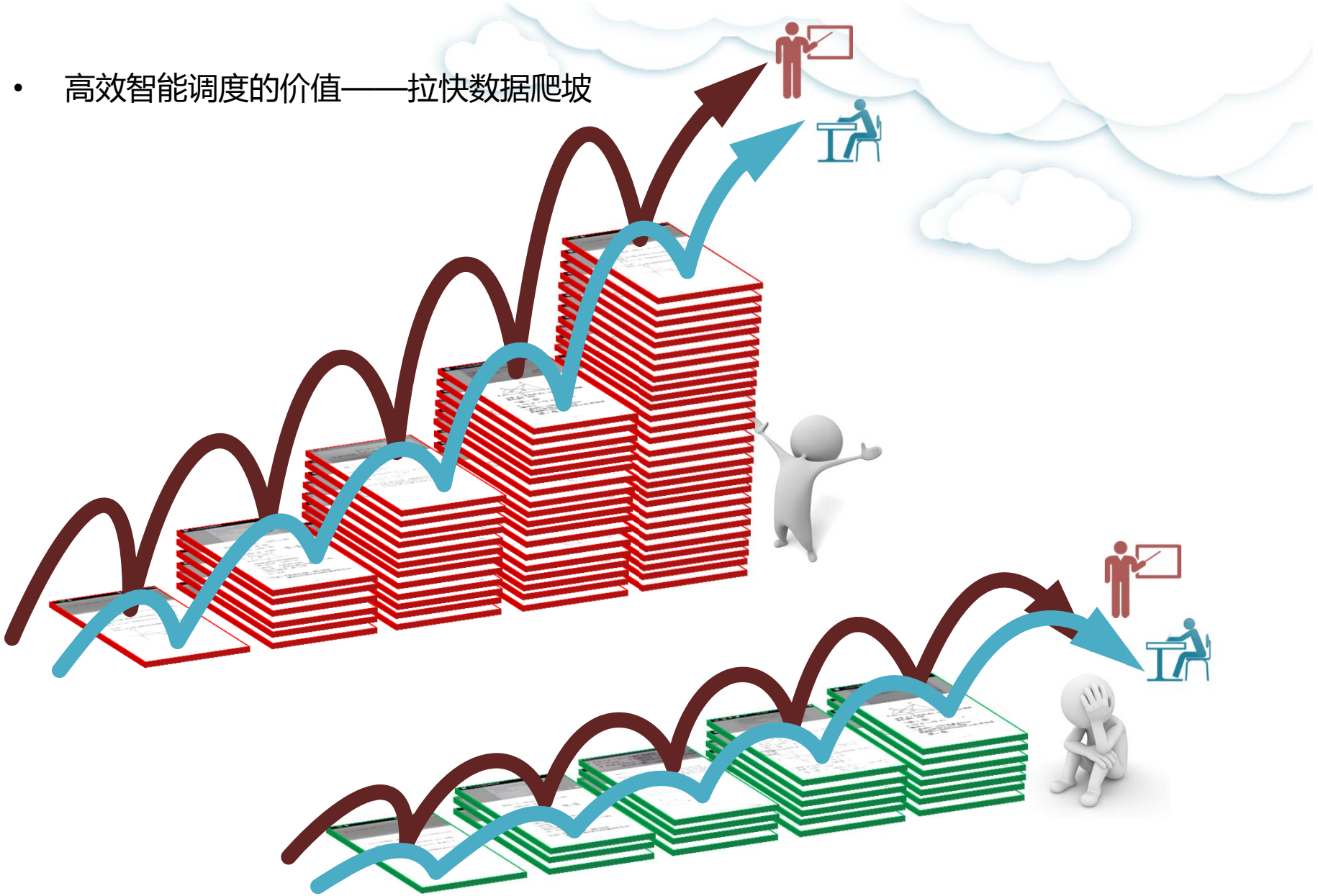


每一代对应的最优排班策略
预估收益比上一代有所优化



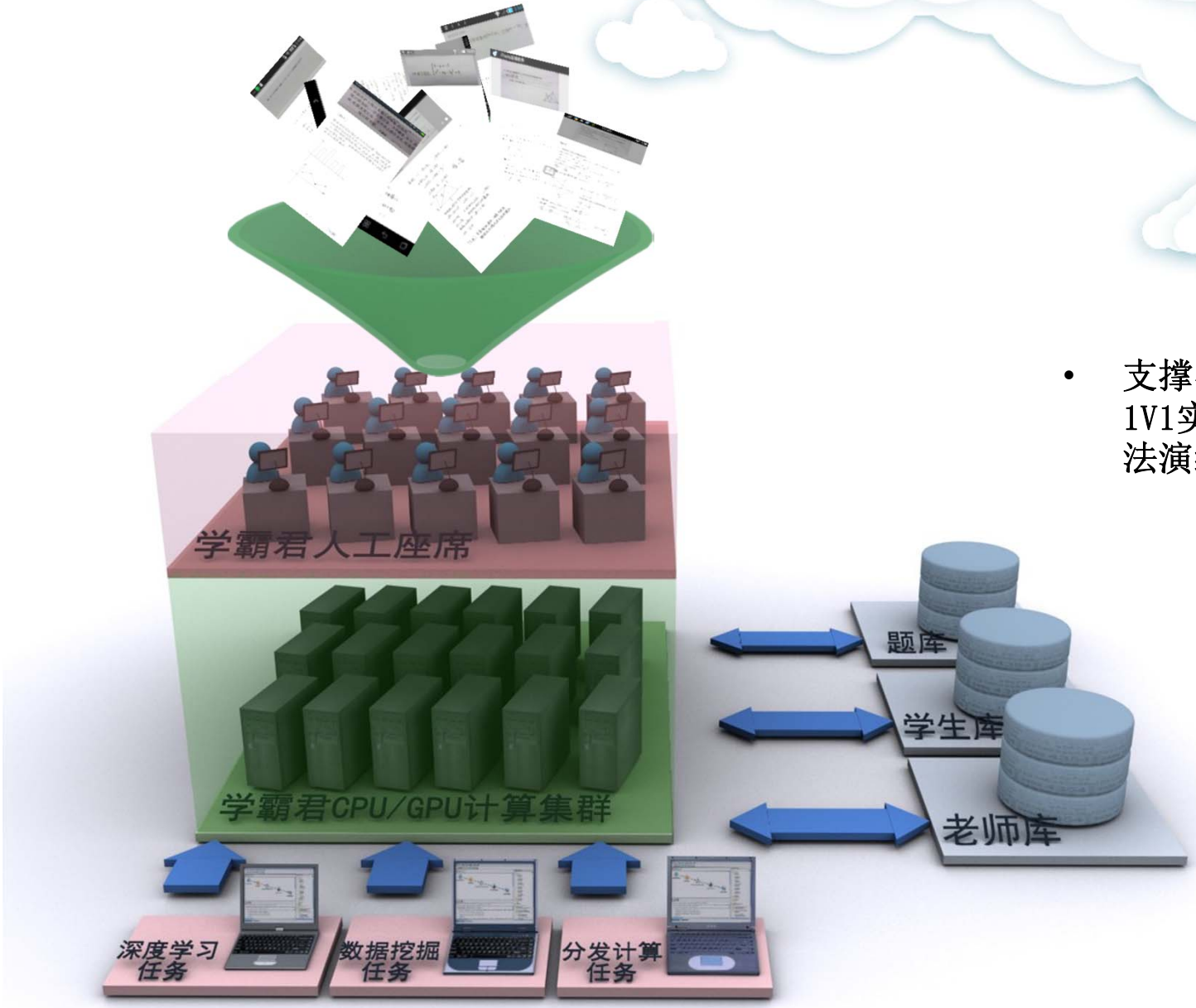
学霸君

- 高效智能调度的价值——拉快数据爬坡



学霸君下一个数据采集目标：1000万高质量1V1视频样本

学霸君



- 支撑学霸君拍照搜题、1V1实时答疑等业务的算法演练场

学霸君

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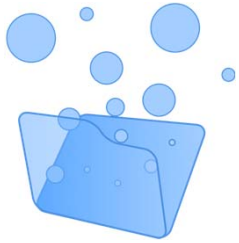
学霸君

- 学霸君的教育业务是以数据及分析为支撑的



收集

图像识别

手写识别

公式识别

文档布局分析

视频数据收集和识别

分析

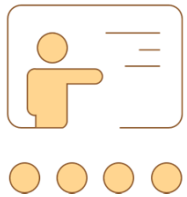
机器学习/深度学习

自然语言处理

数据挖掘

多维标签题库

知识图谱



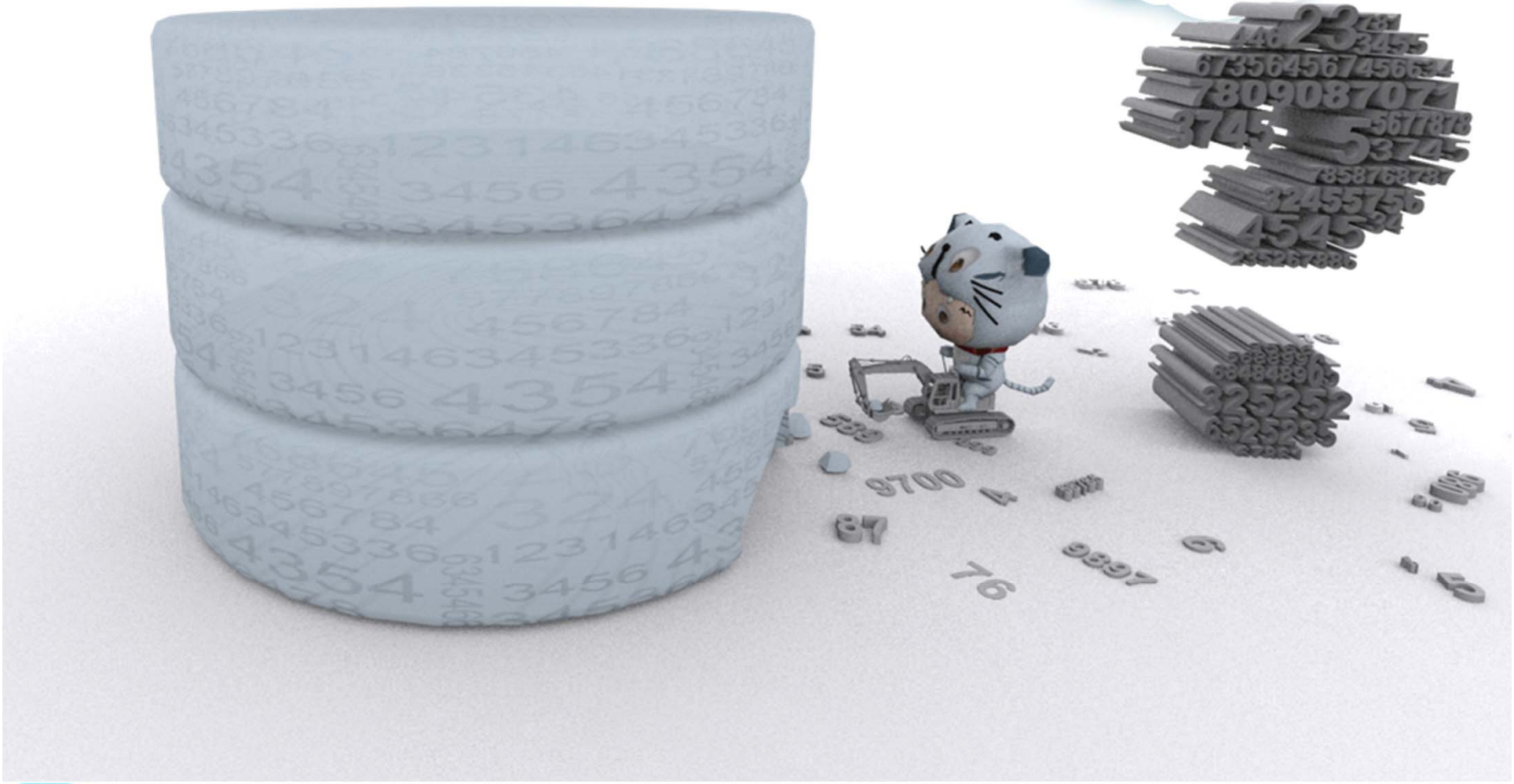
培训

实时答疑

学习内容推荐

自适应练习

Thank You!



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