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SQL2005 数据挖掘算法详解

Lesson 2

杨大川

CTO

北京迈思奇科技有限公司



MSDN Webcasts

讲师简介

- 杨大川 - 迈思奇科技有限公司CTO
 - 微软MVP.2004, 2005 (最有价值专家)
 - 曾任美国硅谷Annuncio公司首席工程师
 - 招商迪辰产品研发部总经理
 - 现兼任中科院客座教授
- Minesage :迈思奇科技有限公司
 - 微软数据分析/挖掘领域合作伙伴
 - 面向企业客户提供完整的数据分析与挖掘解决方案
 - 提供专业、高端的BI培训
 - www.minesage.com



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收听本次课程需具备的条件

- 本讲座难度属于中级
- 面向技术人员
- 建议收听过SQL2005 数据挖掘算法详解 Lesson 1
(2005年12月21日)

复习：上一讲的内容

- SQL2005数据挖掘概述
- 贝叶斯 (Naive Bayes)
- 决策树 (Decision Trees)
 - 线性回归 (Linear Regression)
- 神经网络 (Neural Networks)
 - 逻辑回归 (Logistic Regression)
- 比较挖掘的准确度

本次课程内容包括

- SQL2005数据挖掘概述
- 关联规则(Association Rules)
- 聚类分析(Clustering)
- 序列聚类分析 (Sequence Clustering)
- 时序(Time Series)

什么是数据挖掘?

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数据挖掘(**Data Mining**), 又称信息发掘 (**Knowledge Discovery**), 是用自动或半自动化的方法在数据中找到潜在的, 有价值的信息和规则.

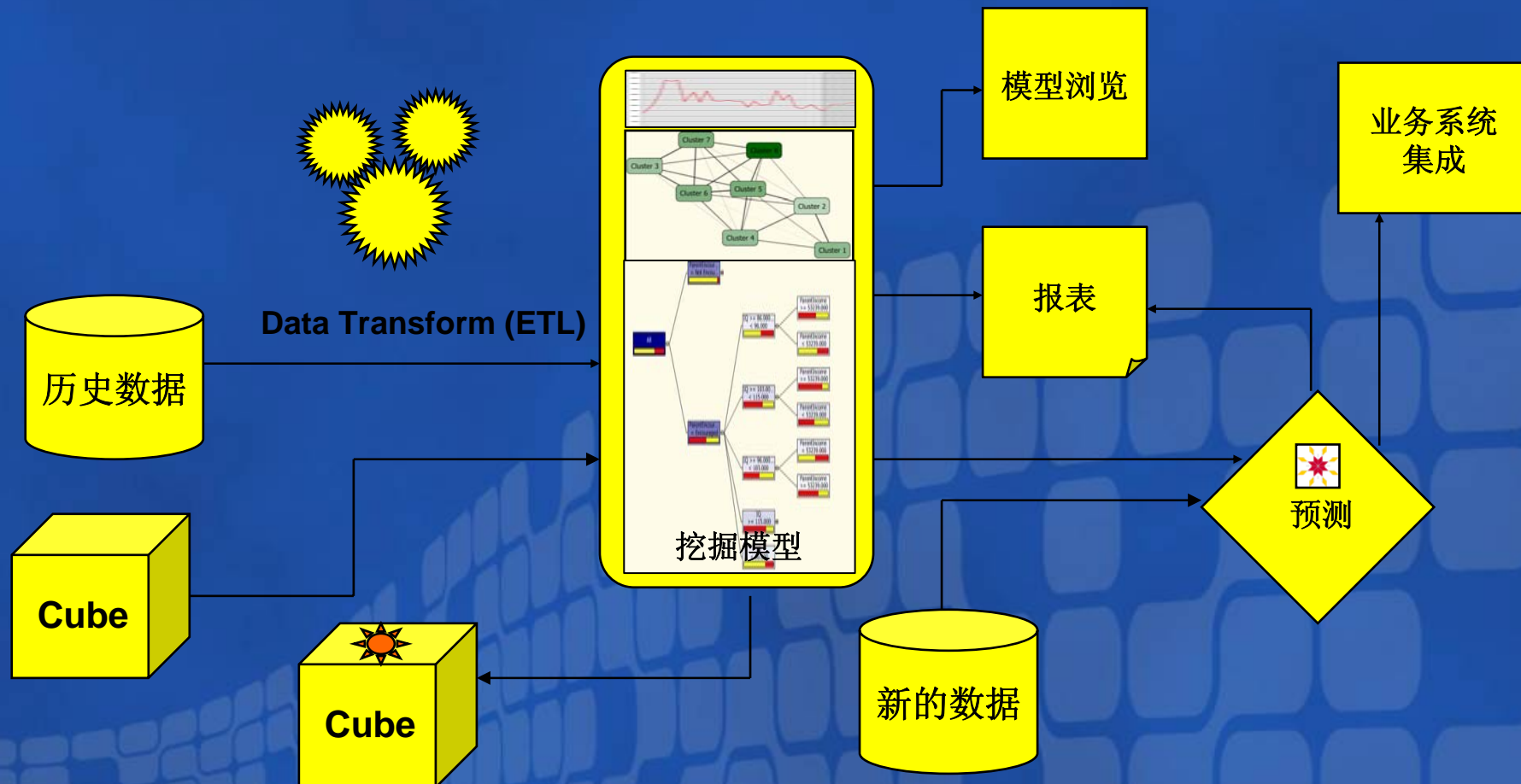
数据挖掘技术来源于数据库, 统计和人工智能.



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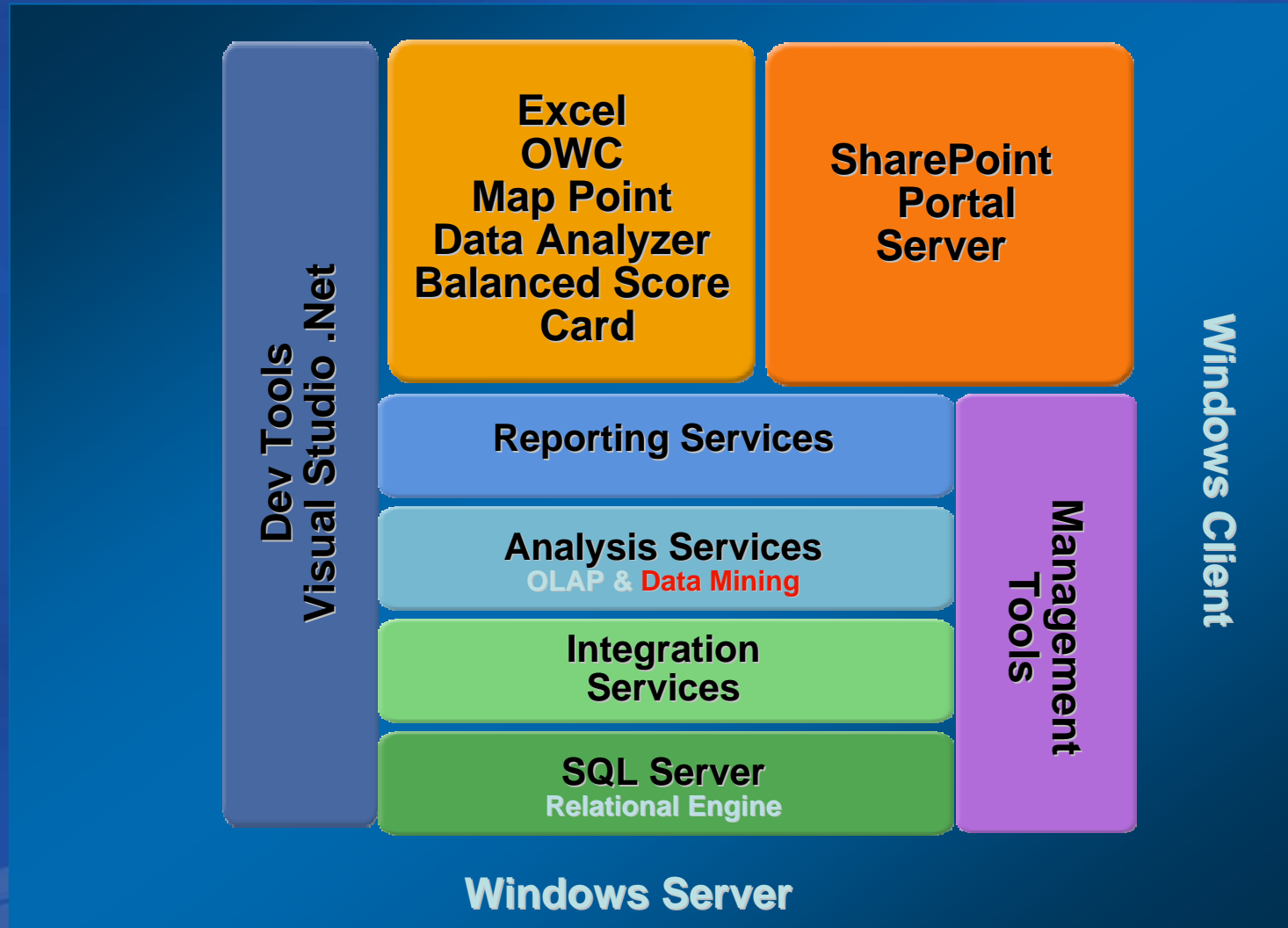
Data Mining Data Flow



数据挖掘 与 Microsoft 商务智能

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API: DMX

CREATE MINING MODEL CreditRisk

(CustID LONG KEY,
Gender TEXT DISCRETE,
Income LONG CONTINUOUS,
Profession TEXT DISCRETE,
Risk TEXT DISCRETE PREDICT)

USING Microsoft_Decision_Trees

INSERT INTO CreditRisk

(CustId, Gender, Income, Profession,
Risk)

Select

CustomerID, Gender, Income,
Profession, Risk

From Customers

Select NewCustomers.CustomerID, CreditRisk.Risk,
PredictProbability(CreditRisk)

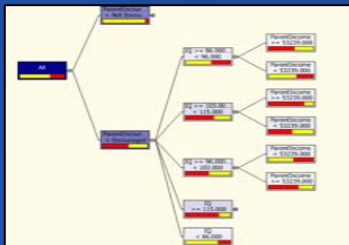
FROM CreditRisk **PREDICTION JOIN** NewCustomers

ON CreditRisk.Gender=NewCustomer.Gender

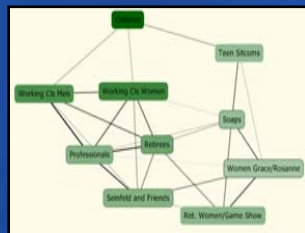
AND CreditRisk.Income=NewCustomer.Income

AND CreditRisk.Profession=NewCustomer.Profession

丰富的算法集合



决策树



聚类



时间序列

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| Recommendation scores for Professionals/Technical and Service Workers | | | |
|---|----------|----------------------------|-----------------------|
| Attributes | Values | Favor Professionals/Techn. | Favor Service Workers |
| Education/Year | 15-20 | | |
| Education/Year | 12-13 | | |
| Education/Year | 7-12 | | |
| relation hof(YOUNG AND THE RES. | Missing | | |
| relation hof(YOUNG AND THE RES. | Existing | | |
| relation hofAG THE WORLD TURN. | Existing | | |
| relation hofAG THE WORLD TURN. | Missing | | |

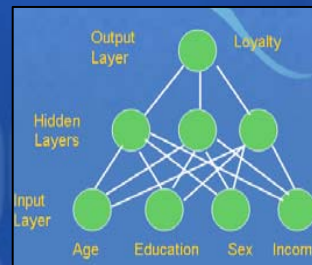
Naïve 贝叶斯



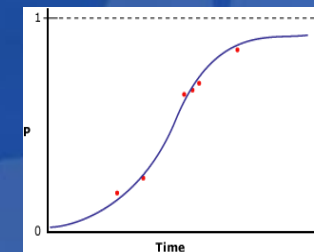
序列聚类



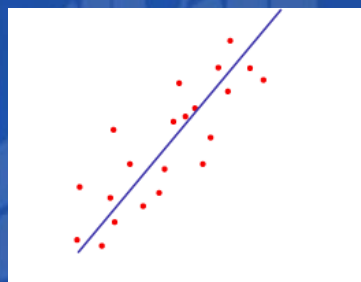
关联



神经网络



逻辑回归



线性回归

When upgrading to Microsoft® SQL Server™ 2000, you can upgrade servers in your org at a time; however, when servers are used for **Microsoft**, you must upgrade the Distrib. Publisher second, and then Subscribers. Upgrading servers one at a time following this is recommended when a large number of Publishers and Subscribers exist because you can **Microsoft** data even though servers are running different versions of SQL Server. You can publications and subscriptions with servers running instances of SQL Server 2000, and in subscriptions created in SQL Server 6.5 or SQL Server 7.0.

When using transactional **Microsoft**, you can upgrade Subscribers before the Publisher, using immediate updating with snapshot **Microsoft** or transactional **Microsoft**. There are upgrade recommendations in this topic under Upgrading and Immediate Updating.

You can upgrade **Microsoft** servers running SQL Server 6.5 or SQL Server 7.0 to SQL S the server is running SQL Server 6.5, you do not need to upgrade it to SQL Server 7.0 b upgrading to SQL Server 2000.

IMPORTANT When upgrading servers configured for **Microsoft** to SQL Server 2000, the compatibility level must be set to 70 (version 7.0 compatibility) or later. If you have a running in 65 (version 6.5) or an earlier compatibility level, temporarily change them during the upgrade process.

When the Publisher or Subscriber is running in 65 or an earlier compatibility level due to SQL Server 2000, error 15046 will be raised stating that the operation is supported Server version 7.0 or SQL Server 2000.

For more information about setting the backward compatibility level, see **SQL Server 2000: Books and Topics**.

If you are upgrading **Microsoft** on a failover cluster, you must uncluster the previous in before upgrading. Unclustering the previous installation means that you must delete all p remove **Microsoft**, and reconfigure it after upgrading to SQL Server 2000. This will not requirement when upgrading SQL Server 2000 to future releases.

文本挖掘

◆关联规则(Association Rules)

- 概念篇
- 参数篇
- 结果展现
- 与决策树之间的关系
- 适用场景

概念篇

- 在历史数据中, 快速找出产品之间的关联规则
- 可以处理海量数据
- 规则包括
 - 一对一 ($A \rightarrow B$ 的概率)
 - 多对一 ($A, B \rightarrow C$ 的概率)
- 找出经常同时出现的项集
- 画出关联网络

数学基础

- Support
 - 个体或者项集出现的次数
 - $\text{Support}(A)$, $\text{Support}(\{A, B\})$
- Probability
 - 概率
 - $\text{Probability}(A \rightarrow B) = \text{Support}(\{A, B\}) / \text{Support}(A)$
- Importance
 - $\text{Importance}(A \rightarrow B) = \text{Probability}(A \rightarrow B) / \text{Probability}(B)$
 - 1: 无关联 <1: 负关联 >1: 正关联

参数篇

- **Maximum_Itemset_Count**
 - 指定要生成的最大项集数。如果不加以指定，算法将生成所有可能的项集。
- **Maximum_Itemset_Size**
 - 指定一个项集中允许的最大项数。如果将该值设置为 0，则不限制此项集的大小。
- **Minimum_Itemset_Size**
 - 指定一个项集中允许的最小项数。[Enterprise Edition]
- **Maximum_Support**
 - 指定可包含某项集的最大事例数。如果此值小于 1，则表示该值在总事例中所占的百分比。如果大于 1，则表示可包含该项集的事例的绝对数。[Enterprise Edition]
- **Minimum_Support**
 - 指定包含该项集的最小事例数，只有达到该数目，才能生成规则。如果将该值设置为小于 1 的数，则最小事例数将通过其在总事例数中所占的百分比来加以指定。如果将该值设置为大于 1 的整数，则指定最小事例数为必须包含该项集的事例绝对数。如果内存有限，算法可能会增大此参数的值。
- **Minimum_Importance**
 - 指定关联规则的重要性阈值。重要性低于此值的规则将被筛选出去。[Enterprise Edition]
- **Minimum_Probability**
 - 指定规则为 True 的最小概率。例如，如果将该值设置为 0.5，则指定不生成概率低于 50% 的规则。

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- 影碟商店案例
 - 会员制影碟商店
 - 会员调查
 - “谁”买了“什么电影”

历史数据

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| CustID | Gender | Marital Status | Education | Home Ownership |
|--------|--------|----------------|--------------|----------------|
| 980001 | Male | Married | Bachelors | Rent |
| 980002 | Male | Married | Bachelors | Own |
| 980003 | Female | Single | Masters | Own |
| 980004 | Male | Single | Some College | Own |
| 980005 | Female | Married | Bachelors | Rent |
| 980006 | Female | Married | Masters | Rent |

| CustID | Movie |
|--------|-------------------|
| 980001 | Lord of the Rings |
| 980001 | Matrix |
| 980002 | Star Trek |
| 980002 | Terminator |
| 980002 | Star Wars |
| 980003 | E.T |
| 980004 | Star Wars |
| 980004 | Sixth Sense |
| 980004 | A Beautiful Mind |
| 980005 | Hours |
| 980005 | Signs |
| 980006 | Moulin Rouge |
| 980006 | Die Hard |
| 980006 | Apocalypse Now |

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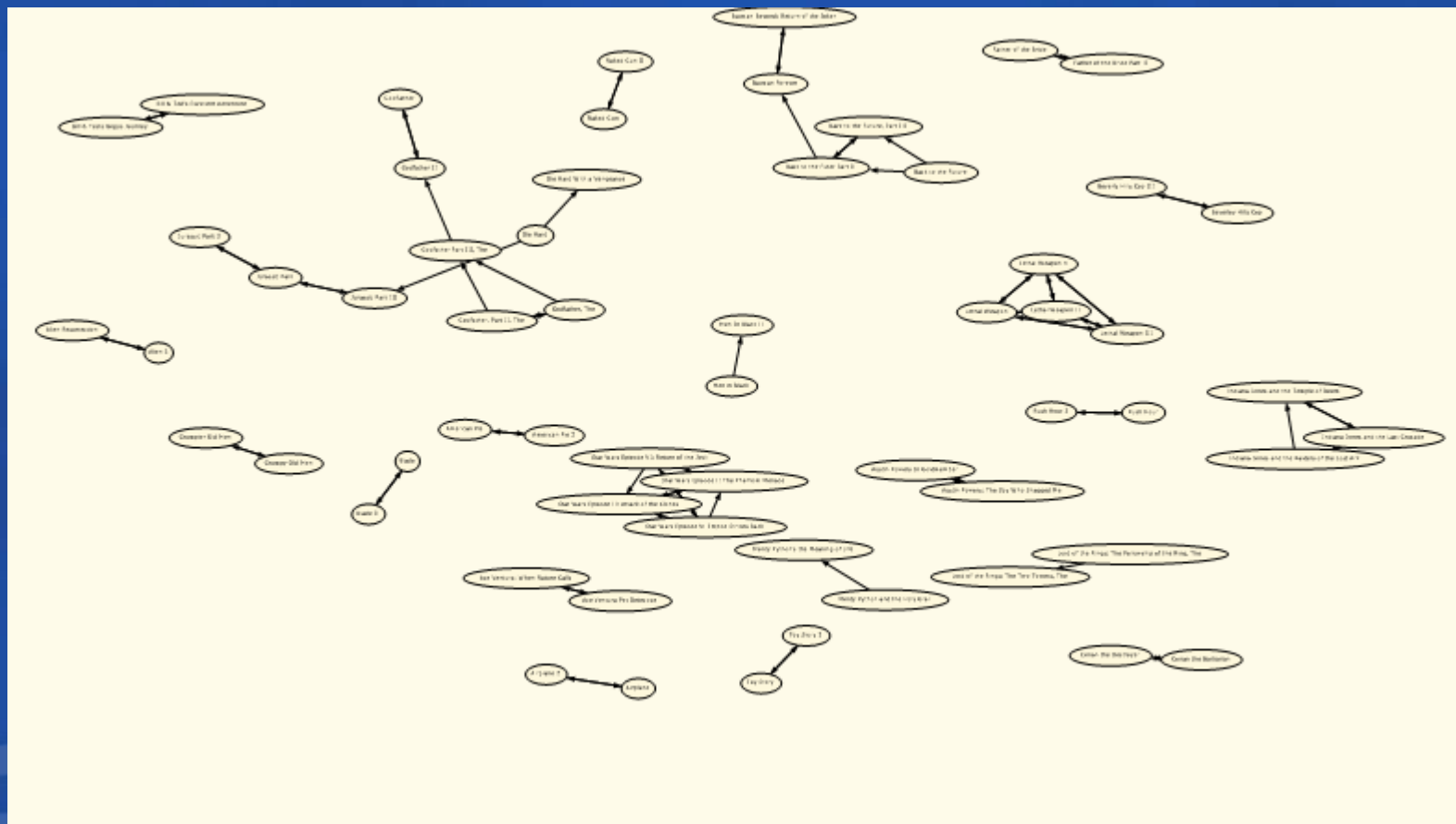
历史数据 (Nested)

| CustID | Gender | Marital Status | Education | Home Ownership | Movies |
|--------|--------|----------------|--------------|----------------|-------------------|
| 980001 | Male | Married | Bachelors | Rent | Lord of the Rings |
| | | | | | Matrix |
| 980002 | Male | Married | Bachelors | Own | Star Trek |
| | | | | | Terminator |
| | | | | | Star Wars |
| 980003 | Female | Single | Masters | Own | E.T |
| 980004 | Male | Single | Some College | Own | Star Wars |
| | | | | | Sixth Sense |
| | | | | | A Beautiful Mind |
| 980005 | Female | Married | Bachelors | Rent | Hours |
| | | | | | Signs |
| 980006 | Female | Married | Masters | Rent | Moulin Rouge |
| | | | | | Die Hard |
| | | | | | Apocalypse Now |

关联网络

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项集

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MovieSample (DIANGNOTEBOOK_SQL2005) - Microsoft Visual Studio

File Edit View Project Debug Database Mining Model Tools Window Community Help

AssoRule [Online] Movie Survey [Online] Start Page

Mining Structure Mining Models Mining Model Viewer Mining Accuracy Chart Mining Model Prediction

Mining Model: AssoRule Viewer: Microsoft Association Rules Viewer

Itemsets Rules Dependency Network

Minimum support: 10 Filter Itemset: Show: Show attribute name only

Minimum itemset size: 0 Show long name: ☐ Maximum rows: 2000

| Support | Size | Itemset |
|---------|------|--|
| 27 | 5 | Indiana Jones and the Temple of Doom, Indiana Jones and the Last Crusade, Star Wars Episode I: The Phantom Menace, Star Wars Episode VI: Return of t... |
| 27 | 5 | Indiana Jones and the Temple of Doom, Star Wars Episode I: The Phantom Menace, Indiana Jones and the Raiders of the Lost Ark, Star Wars Episode VI: R... |
| 27 | 5 | Indiana Jones and the Last Crusade, Star Wars Episode I: The Phantom Menace, Indiana Jones and the Raiders of the Lost Ark, Star Wars Episode V: Empir... |
| 27 | 5 | Indiana Jones and the Last Crusade, Star Wars Episode I: The Phantom Menace, Indiana Jones and the Raiders of the Lost Ark, Star Wars Episode VI: Retu... |
| 27 | 5 | Star Trek: The Wrath of Khan, Star Wars Episode I: The Phantom Menace, Star Wars Episode VI: Return of the Jedi, Star Wars Episode V: Empire Strikes Ba... |
| 27 | 5 | Star Trek: The Wrath of Khan, Star Wars Episode I: The Phantom Menace, Star Wars Episode II: Attack of the Clones, Star Wars Episode V: Empire Strikes ... |
| 27 | 5 | Indiana Jones and the Last Crusade, Star Wars Episode I: The Phantom Menace, Star Wars Episode II: Attack of the Clones, Star Wars Episode V: Empire S... |
| 27 | 5 | Star Wars Episode I: The Phantom Menace, Star Wars Episode II: Attack of the Clones, Star Wars Episode VI: Return of the Jedi, Lord of the Rings: The Fel... |
| 27 | 5 | Star Wars Episode I: The Phantom Menace, Star Wars Episode II: Attack of the Clones, Gladiator, Star Wars Episode VI: Return of the Jedi, Star Wars Epis... |
| 26 | 5 | Star Trek: Insurrection, Star Wars Episode I: The Phantom Menace, Star Wars Episode II: Attack of the Clones, Star Wars Episode VI: Return of the Jedi, S... |
| 26 | 5 | Indiana Jones and the Temple of Doom, Star Wars Episode I: The Phantom Menace, Star Wars Episode II: Attack of the Clones, Indiana Jones and the Raid... |
| 26 | 5 | Indiana Jones and the Temple of Doom, Star Wars Episode I: The Phantom Menace, Star Wars Episode II: Attack of the Clones, Indiana Jones and the Raid... |
| 26 | 5 | Indiana Jones and the Temple of Doom, Indiana Jones and the Last Crusade, Star Wars Episode I: The Phantom Menace, Star Wars Episode II: Attack of th... |
| 26 | 5 | Indiana Jones and the Temple of Doom, Indiana Jones and the Last Crusade, Star Wars Episode I: The Phantom Menace, Star Wars Episode II: Attack of th... |
| 26 | 5 | Indiana Jones and the Temple of Doom, Star Wars Episode I: The Phantom Menace, Star Wars Episode VI: Return of the Jedi, Star Wars Episode V: Empire ... |
| 26 | 5 | Indiana Jones and the Temple of Doom, Indiana Jones and the Last Crusade, Star Wars Episode I: The Phantom Menace, Indiana Jones and the Raiders of ... |
| 26 | 5 | Indiana Jones and the Temple of Doom, Star Wars Episode II: Attack of the Clones, Indiana Jones and the Raiders of the Lost Ark, Star Wars Episode VI: R... |
| 26 | 5 | Indiana Jones and the Temple of Doom, Star Wars Episode II: Attack of the Clones, Indiana Jones and the Raiders of the Lost Ark, Star Wars Episode V: Em... |
| 26 | 5 | Indiana Jones and the Temple of Doom, Indiana Jones and the Last Crusade, Star Wars Episode I: The Phantom Menace, Indiana Jones and the Raiders of ... |

Error List

Item(s) Saved

概率

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MovieSample (DIANGHOTEBOOK_SQL2005) - Microsoft Visual Studio

File Edit View Project Debug Database Mining Model Tools Window Community Help

AssoRule [Online] Movie Survey [Online] Start Page

Mining Structure Mining Models Mining Model Viewer Mining Accuracy Chart Mining Model Prediction

Mining Model: AssoRule Viewer: Microsoft Association Rules Viewer

Itemssets Rules Dependency Network

Minimum probability: 0.05 Filter Rule: Show: Show attribute name only

Minimum importance: -0.25 Show long name: ☐ Maximum rows: 2000

| Probability | Importance | Rule |
|-------------|------------|--|
| 1.000 | 0.757 | Star Trek VI: The Undiscovered Country, Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: First Contact, Star Tr... |
| 1.000 | 2.237 | Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: First Contact, Star Trek: The Wrath of Khan, Star Wars Episod... |
| 1.000 | 1.110 | Indiana Jones and the Temple of Doom, Braveheart, Star Wars -> Indiana Jones and the Raiders of the Lost Ark |
| 1.000 | 1.786 | Star Trek VI: The Undiscovered Country, Star Trek Generations, Star Trek: First Contact, Star Trek: The Wrath of Khan, Star War... |
| 1.000 | 1.513 | Star Trek VI: The Undiscovered Country, Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: The Wrath of Khan, S... |
| 1.000 | 1.374 | Highlander, Terminator 2: Judgement Day -> Terminator, The |
| 1.000 | 1.101 | Indiana Jones and the Temple of Doom, Braveheart, Matrix, The -> Indiana Jones and the Raiders of the Lost Ark |
| 1.000 | 1.064 | Star Trek VI: The Undiscovered Country, Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: First Contact, Star Tr... |
| 1.000 | 1.013 | Star Trek VI: The Undiscovered Country, Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: First Contact, Star Tr... |
| 1.000 | 0.757 | Star Trek VI: The Undiscovered Country, Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: First Contact, Star Tr... |
| 1.000 | 2.237 | Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: First Contact, Star Trek: The Wrath of Khan, Star Wars Episod... |
| 1.000 | 1.128 | Indiana Jones and the Temple of Doom, Braveheart, Lord of the Rings: The Fellowship of the Ring, The -> Indiana Jones and the ... |
| 1.000 | 1.786 | Star Trek VI: The Undiscovered Country, Star Trek Generations, Star Trek: First Contact, Star Trek: The Wrath of Khan, Star War... |
| 1.000 | 1.101 | Indiana Jones and the Temple of Doom, Braveheart, Lord of the Rings: The Fellowship of the Ring, The -> Indiana Jones and the Raiders of the |
| 1.000 | 1.101 | Indiana Jones and the Temple of Doom, Braveheart, Star Wars Episode V: Empire Strikes Back -> Indiana Jones and the Raiders o... |
| 1.000 | 1.106 | Terminator, The, Men in Black, Indiana Jones and the Last Crusade -> Indiana Jones and the Raiders of the Lost Ark |
| 1.000 | 1.013 | Star Trek VI: The Undiscovered Country, Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: First Contact, Star Tr... |
| 1.000 | 0.757 | Star Trek VI: The Undiscovered Country, Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: First Contact, Star Tr... |
| 1.000 | 2.209 | Star Trek Generations, Star Trek IV: The Voyage Home, Star Trek: First Contact, Star Trek: The Wrath of Khan, Star Wars Episod... |
| 1.000 | 1.101 | Indiana Jones and the Temple of Doom, Braveheart, Star Wars Episode VI: Return of the Jedi -> Indiana Jones and the Raiders o... |

Error List

Item(s) Saved

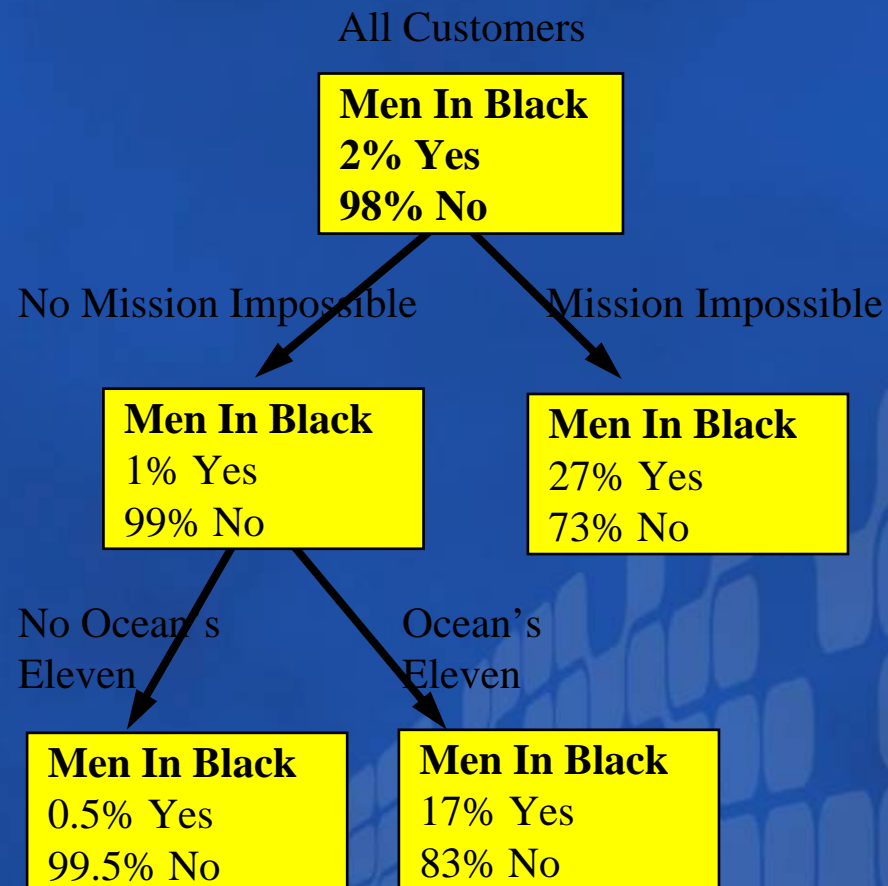
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对比试验

- 决策树
- 相同点
 - 都可以生成关联网络
- 不同点
 - 关联规则：项集、概率、规则
 - 决策树：针对每一个对象的详细分析

Decision Tree



- Popular technique for classification
 - Churn analysis
 - Credit risk analysis
 - ...
- Easy to understand
 - any path from node to leaf forms a rule
- Fast to build
- Prediction based on leaf node stats

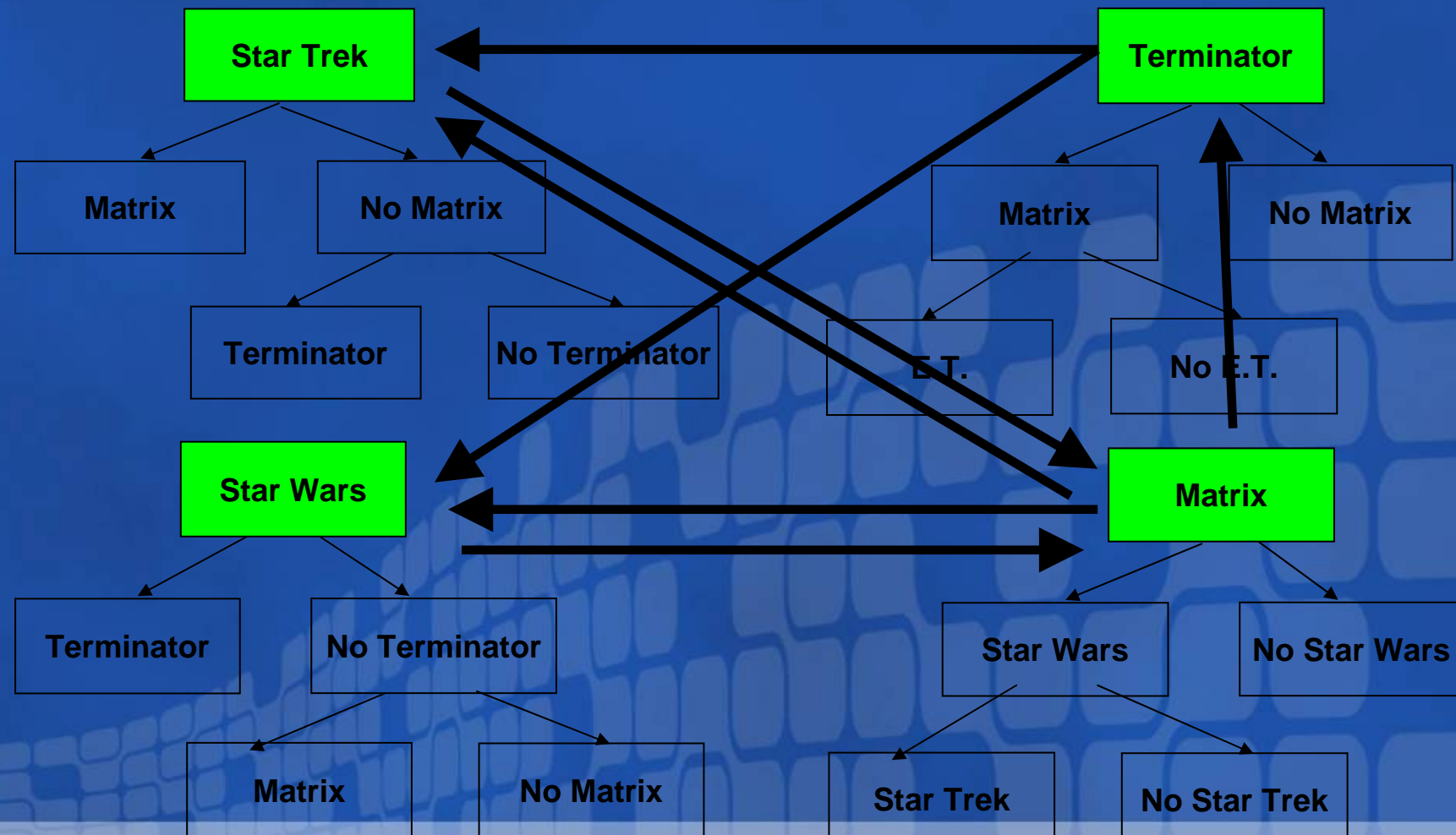
Association analysis using Microsoft Decision Trees



Association analysis using Microsoft Decision Trees

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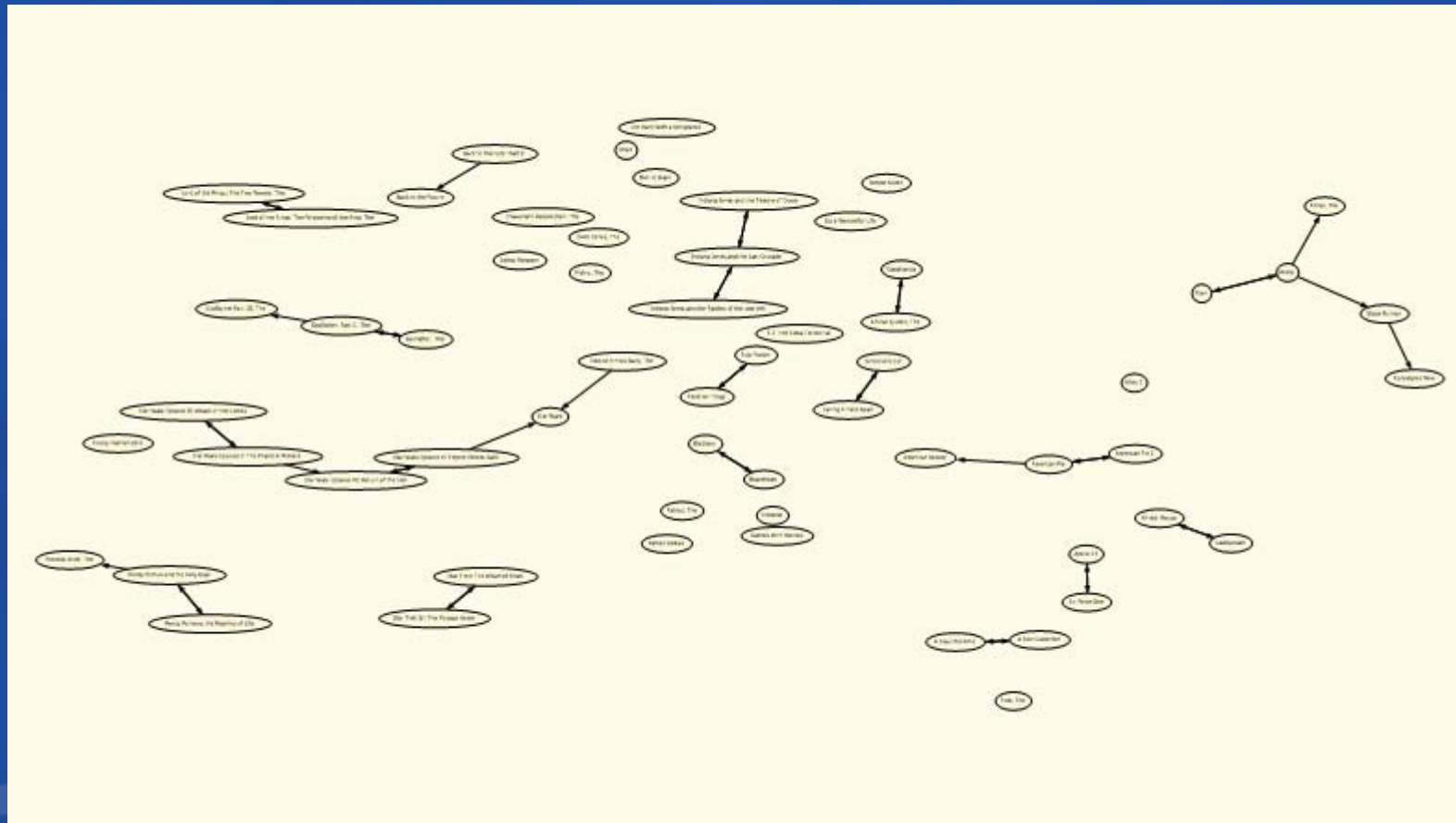
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决策树的关联网络



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适用场景

- 寻找相关规律
 - 特别是海量数据
- 典型问题:
 - 交叉销售
 - 网站内容关联
 - 个性化促销

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◆ 聚类 Clustering

- 概念篇
- 新的特点
- 结果展现
- 适用场景

概念篇

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与SQL2000相比新的特点

- SQL2000
 - 聚类的数目必须定好
 - 挑战：我怎么知道该分几类？
- SQL2005
 - 聚类的数目可以自动找出来

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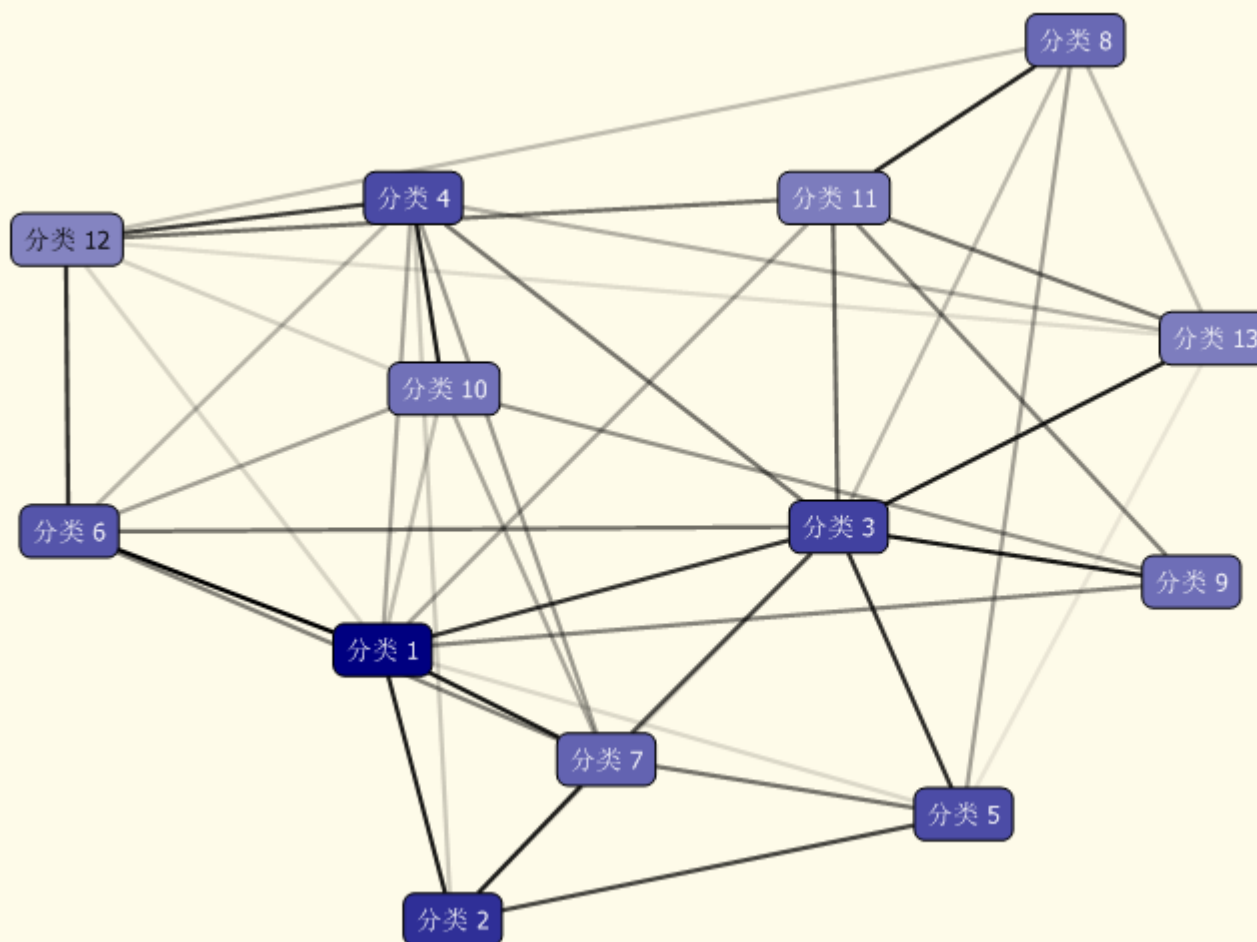
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- 客户分类

分类结果

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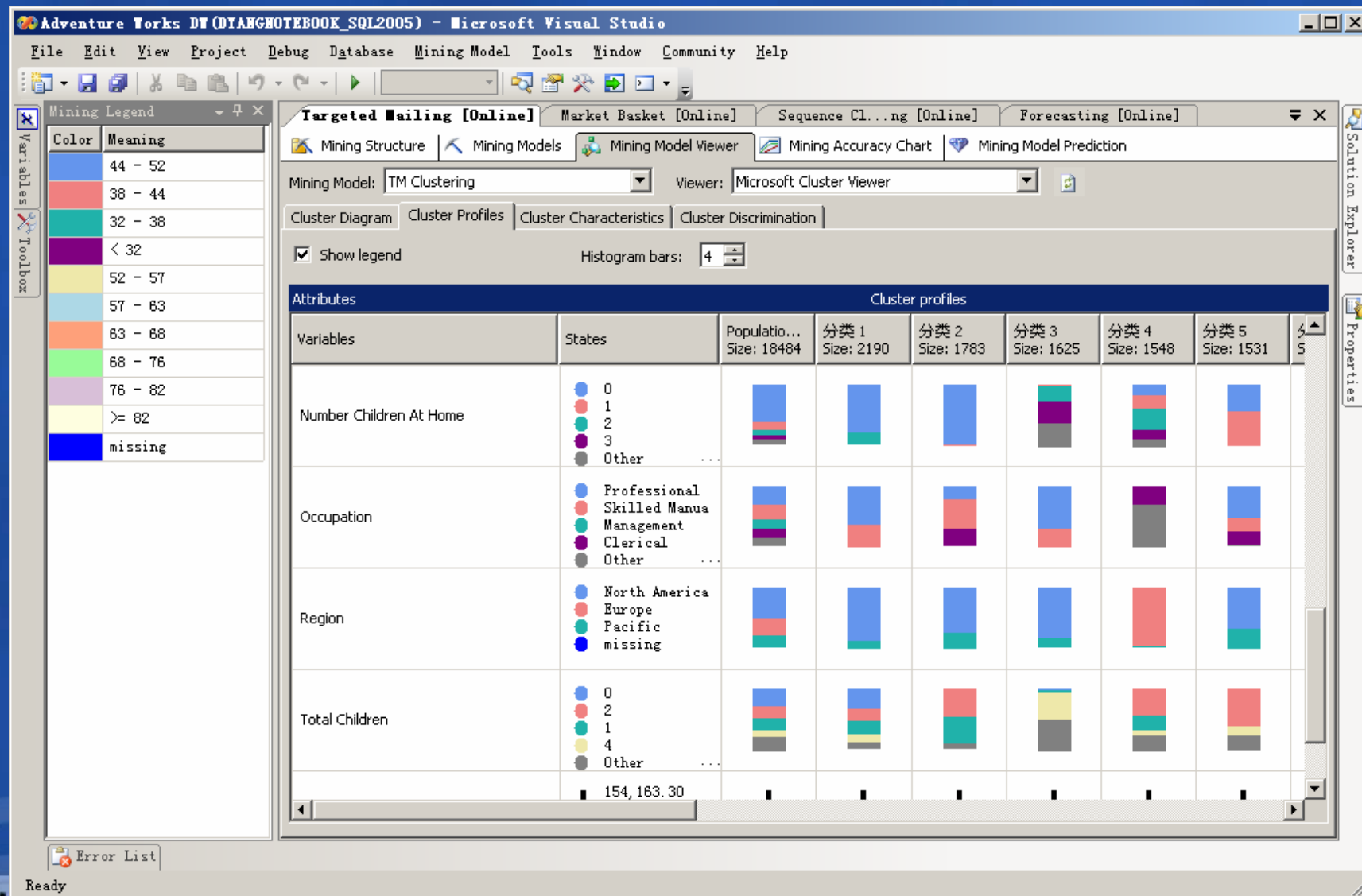
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Profiles

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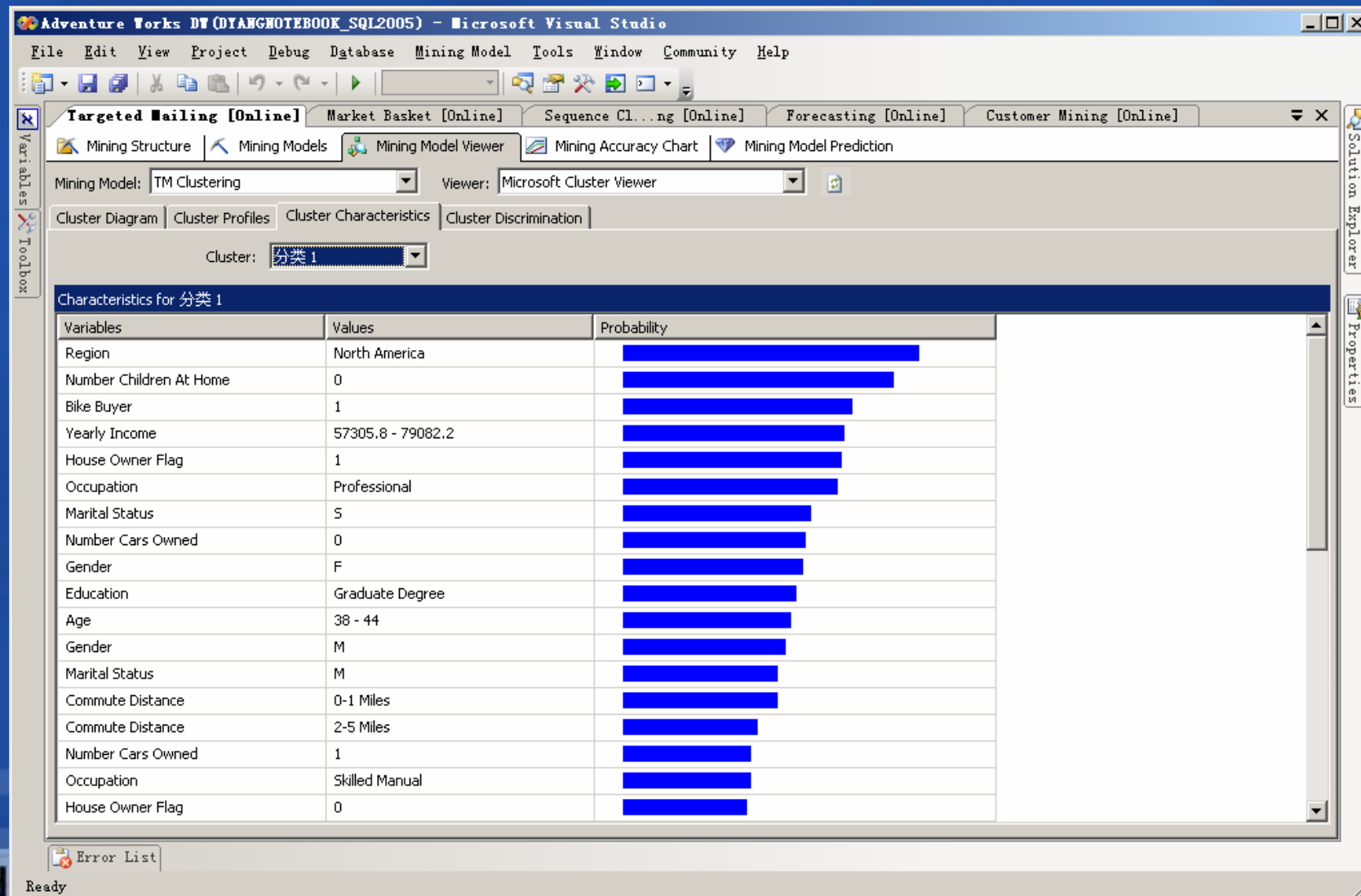
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个性特征

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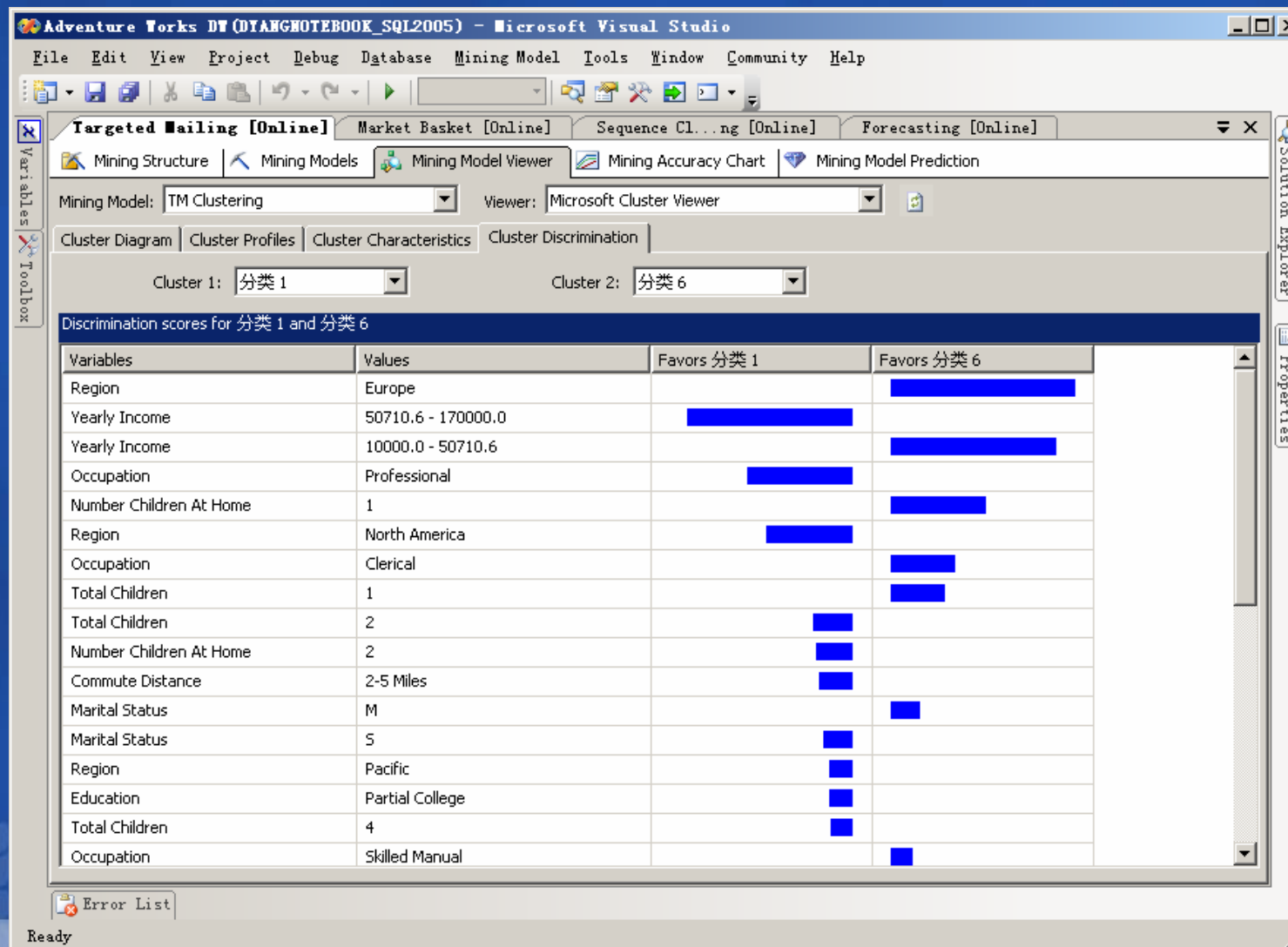
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类间差异

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适用场景

- 分类和预测
- 典型问题
 - 了解客户群体, 以及异同
 - 预测

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◆序列聚类

- 概念篇
- 结果展现
- 适用场景

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概念篇

- 聚类: 静态特征
- 思考:
 - 网站行为
 - WAP行为
 - 因果关系

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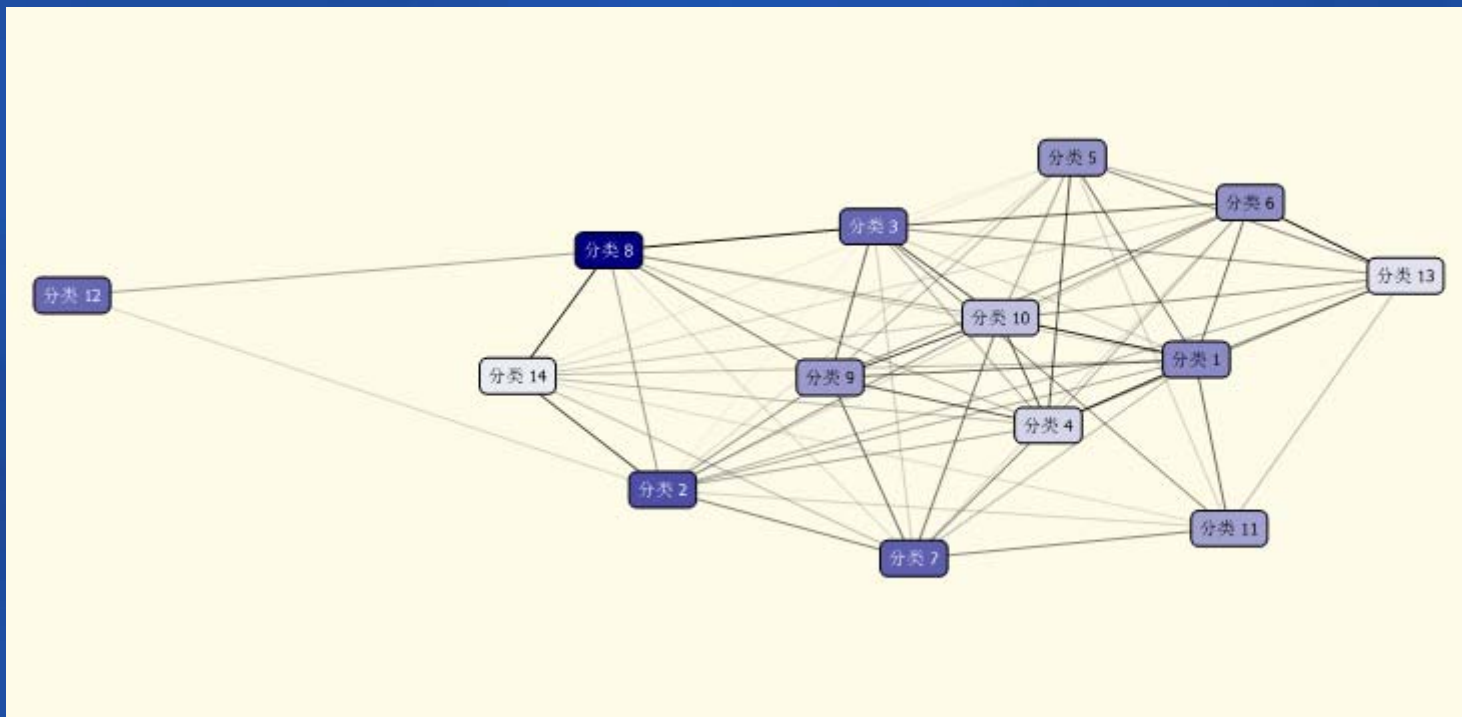
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分类结果

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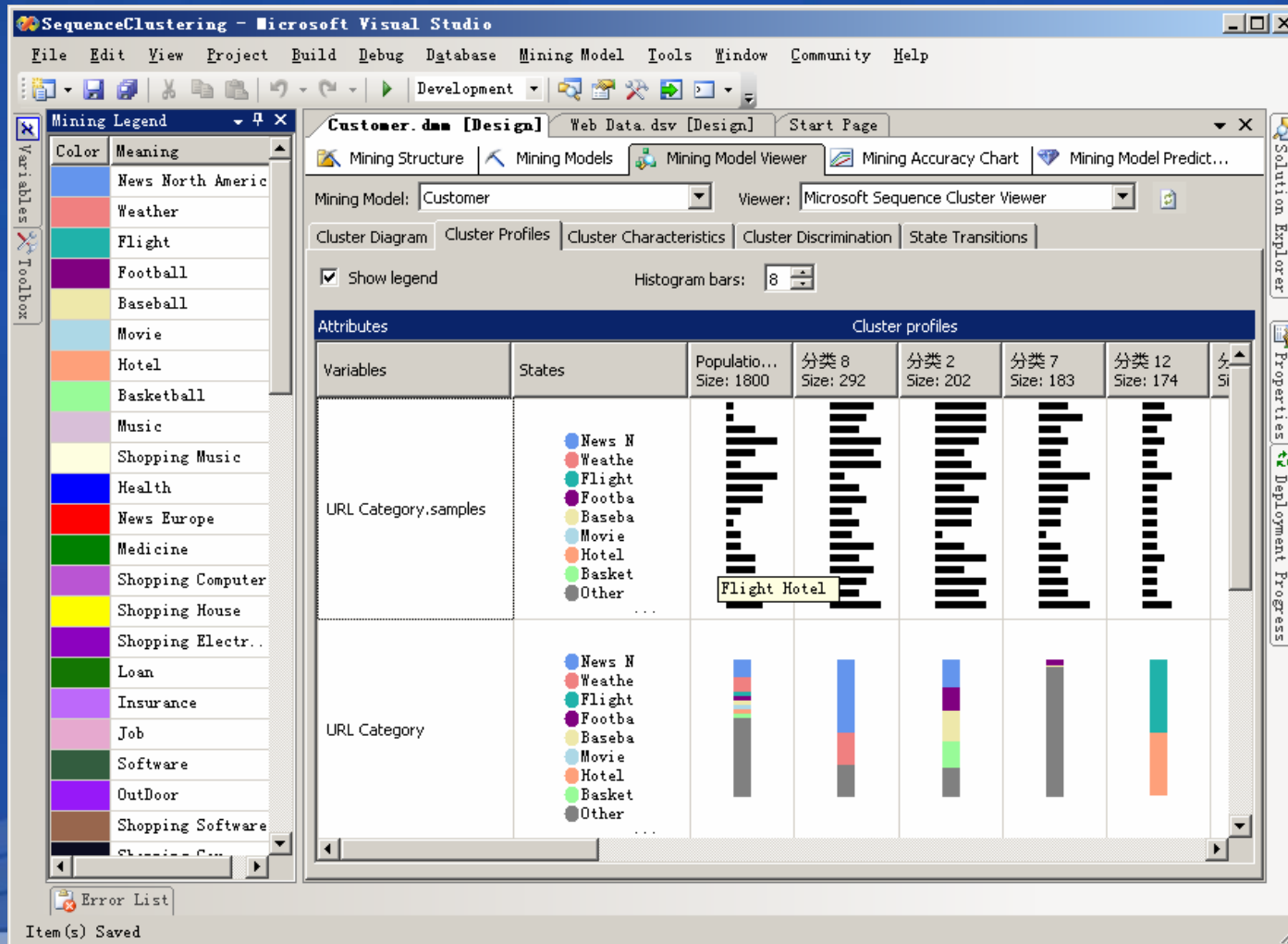
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Profile

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类别的特征

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SequenceClustering - Microsoft Visual Studio

File Edit View Project Build Debug Database Mining Model Tools Window Community Help

Customer.dnn [Design] Web Data.dsv [Design] Start Page

Mining Structure Mining Models Mining Model Viewer Mining Accuracy Chart Mining Model Prediction

Mining Model: Customer Viewer: Microsoft Sequence Cluster Viewer

Cluster Diagram Cluster Profiles Cluster Characteristics Cluster Discrimination State Transitions

Cluster: 分类 13

Characteristics for 分类 13

| Variables | Values | Probability |
|--------------------------|-------------------|-------------|
| URL Category.Transitions | [Start] -> Health | |
| URL Category | Health | |
| URL Category.Transitions | Health,Health | |
| URL Category | Medicine | |
| URL Category.Transitions | Health,Medicine | |

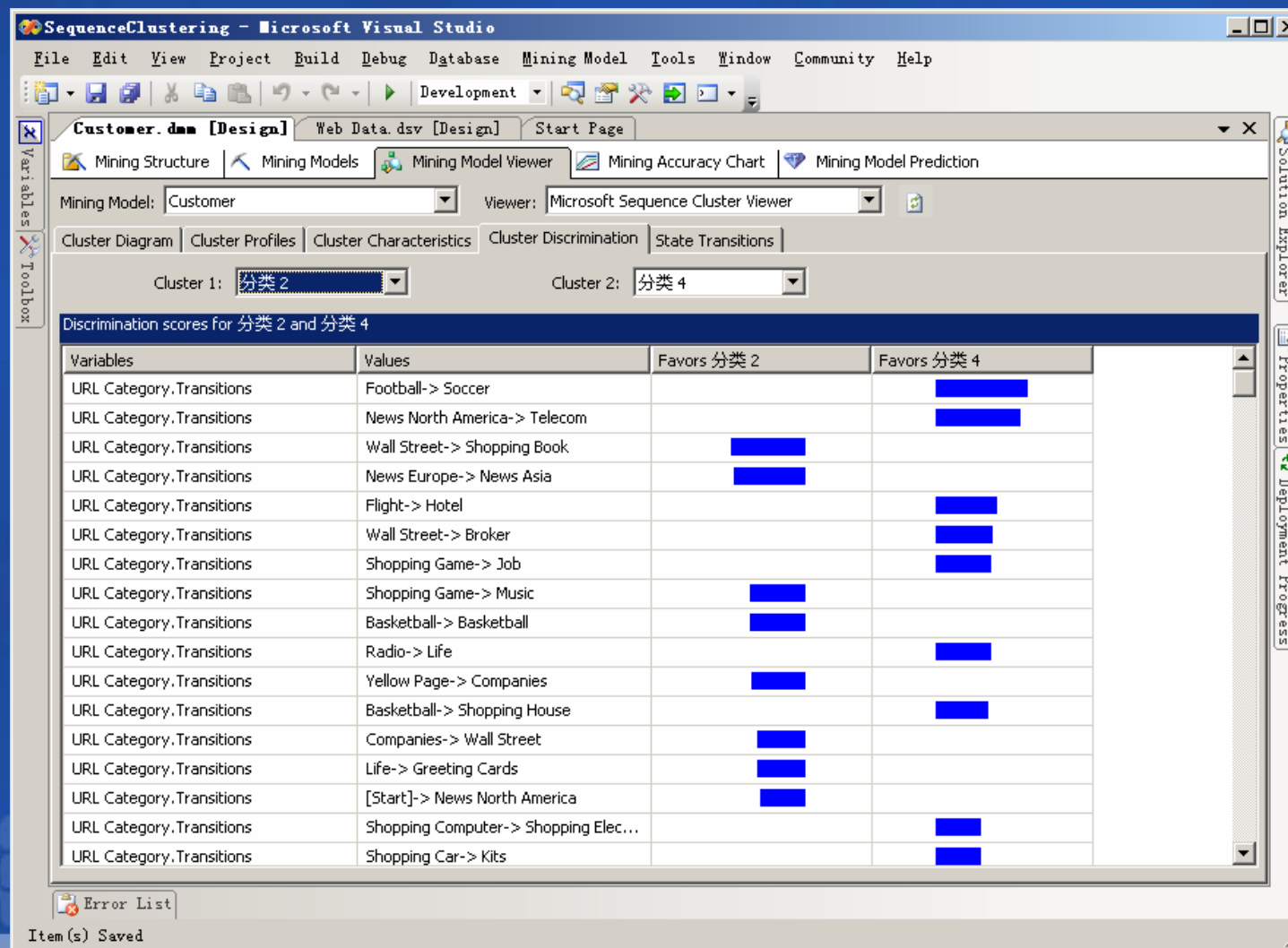
Error List

Item(s) Saved

类别的差异

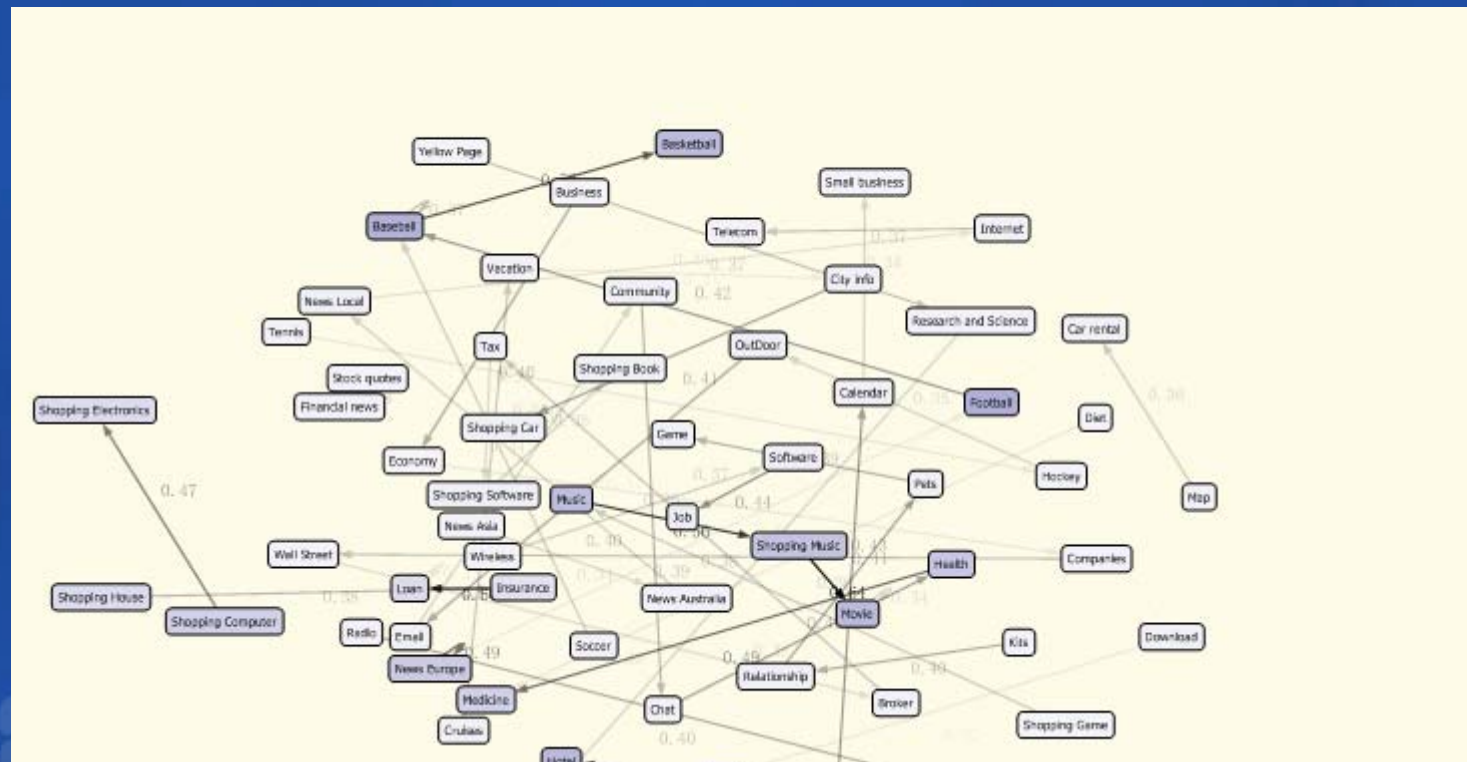
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状态转换



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适用场景

- 有顺序的行为的聚类

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◆时序

- 概念篇
- 结果展现
- 适用场景

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概念篇

- 基于过去的曲线，预测未来
- 基本思想：决策树技术的延伸

DEMO

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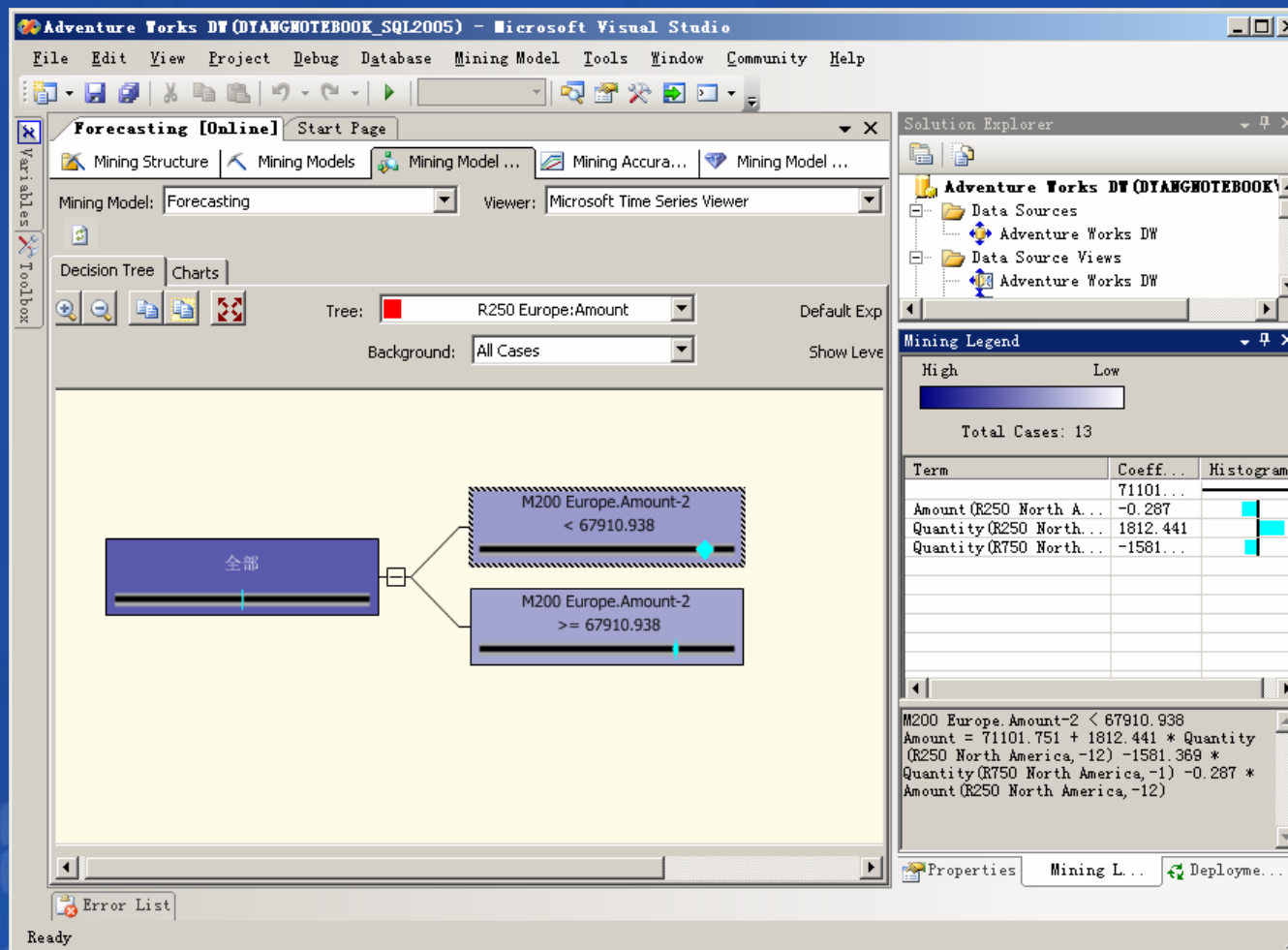
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决策树

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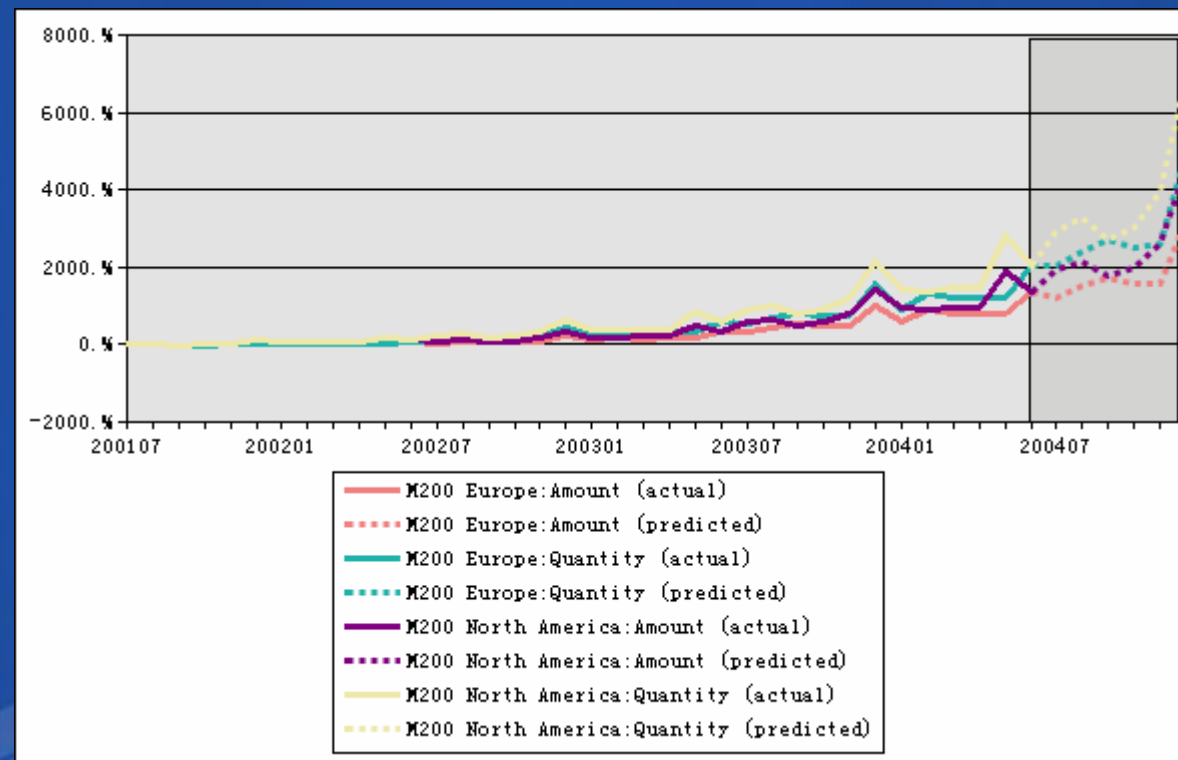
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时序预测



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适用场景

- 未来的曲线预测
- 峰值、波谷
- 目的不是精确的预测

◆Review

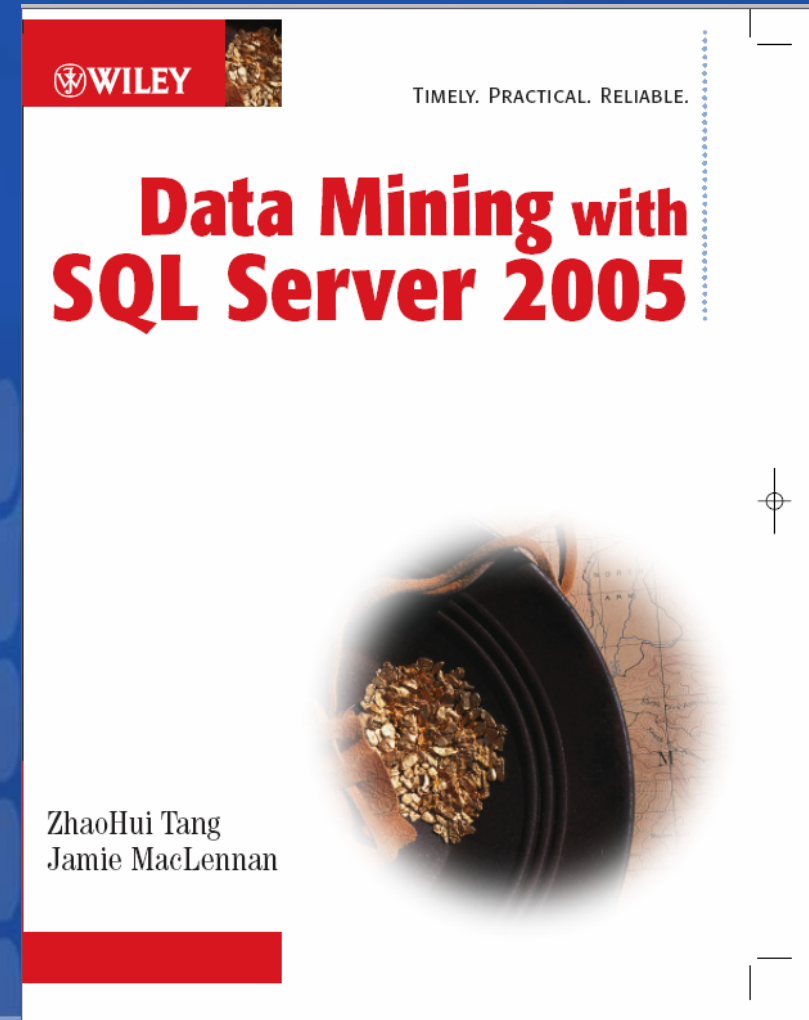
- SQL2005数据挖掘概述
- 关联规则(Association Rules)
- 聚类分析(Clustering)
- 序列聚类分析 (Sequence Clustering)
- 时序(Time Series)

更多信息...

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- DM URL
 - www.SqlServerDataMining.com
- 新闻组:
 - Microsoft.Public.SQLServer.DataMining

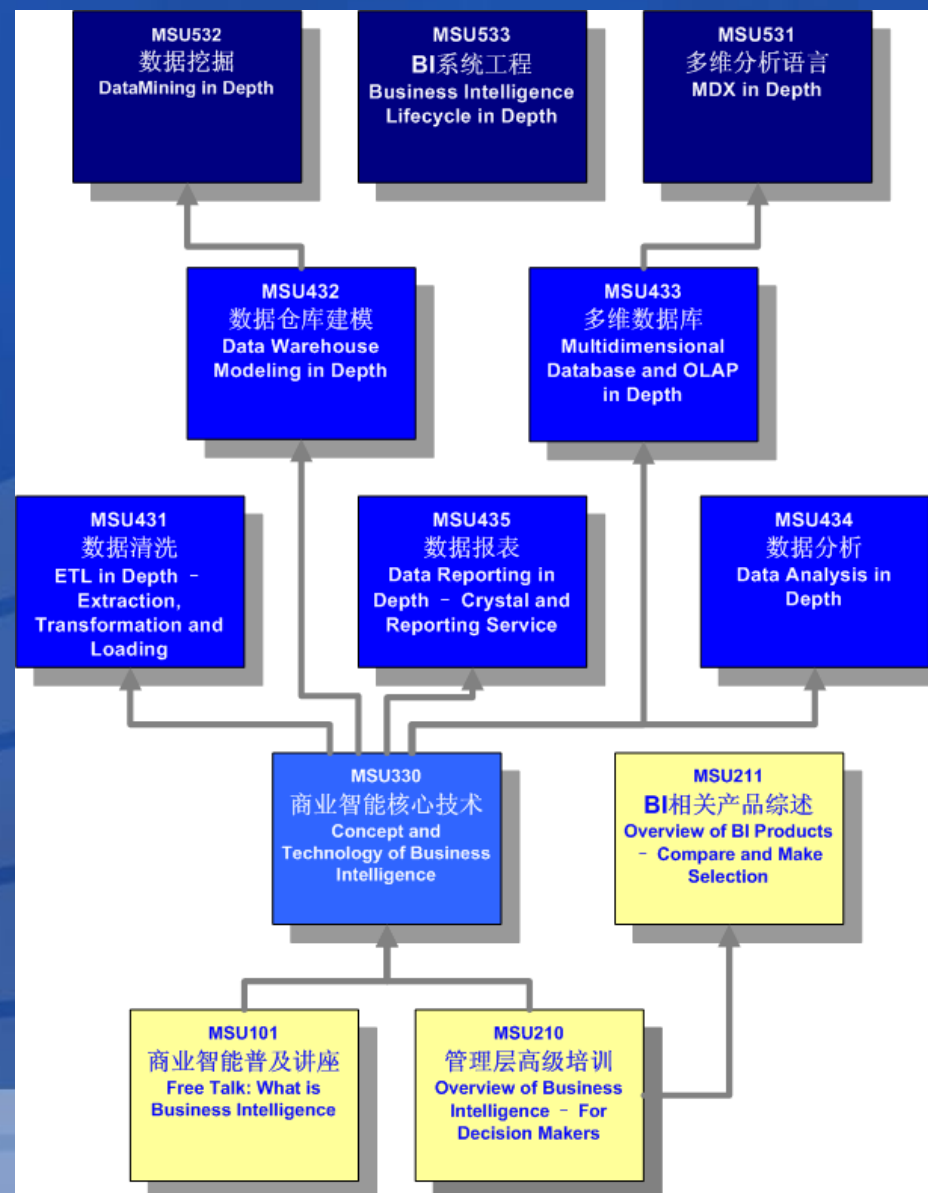


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Question & Answer

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 **问题和解答 (无问题)** ▲ ×

在此会议中尚未解答任何问题。

要向演示者提问，请在此处键入问

提问(A)

删除(D)

问题管理器(Q)

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