

KHypER: An Explainable Risk Reasoning Model System for Financial Knowledge Hypergraph

Zhao Li¹, Zirui Chen¹, Xin Wang¹, Chenxu Wang¹, Jianxin Li²

¹College of Intelligence and Computing, Tianjin University, Tianjin, China

²School of Information Technology, Deakin University, Geelong, Victoria, Australia



Outline

- 1. Background**
- 2. System Design**
- 3. Demonstration**
- 4. Conclusion**

Outline

1. Background

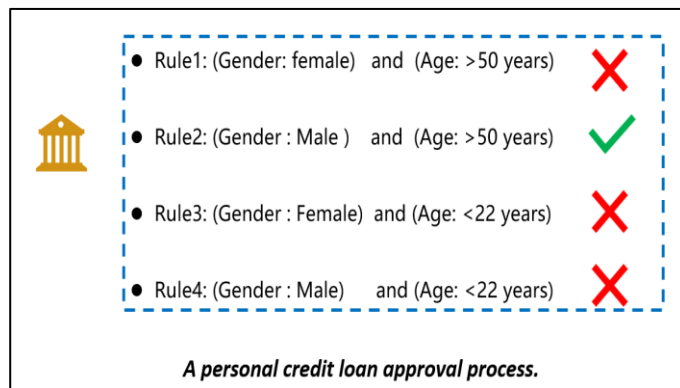
2. System Design

3. Demonstration

4. Conclusion

Background

1. Our social and economic development cannot be achieved without **finance**.
2. **Financial risk control** is the constant theme and the most important element of finance.



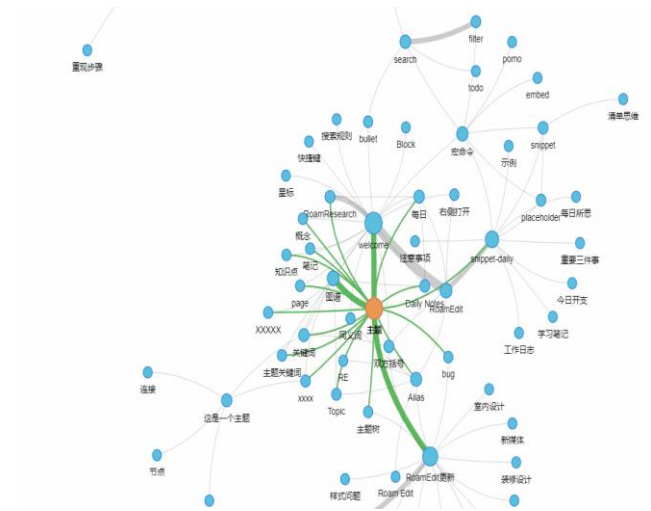
Risk Rules



Credit Score Card

Background

- Traditional risk models cannot mine **complex correlation information**
- **Knowledge hypergraph** has more powerful expression ability
- The **explainability** of knowledge hypergraphs is a major challenge

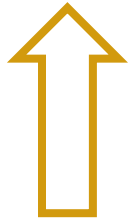


Outline

1. Background
- 2. System Design**
3. Demonstration
4. Conclusion

System Design

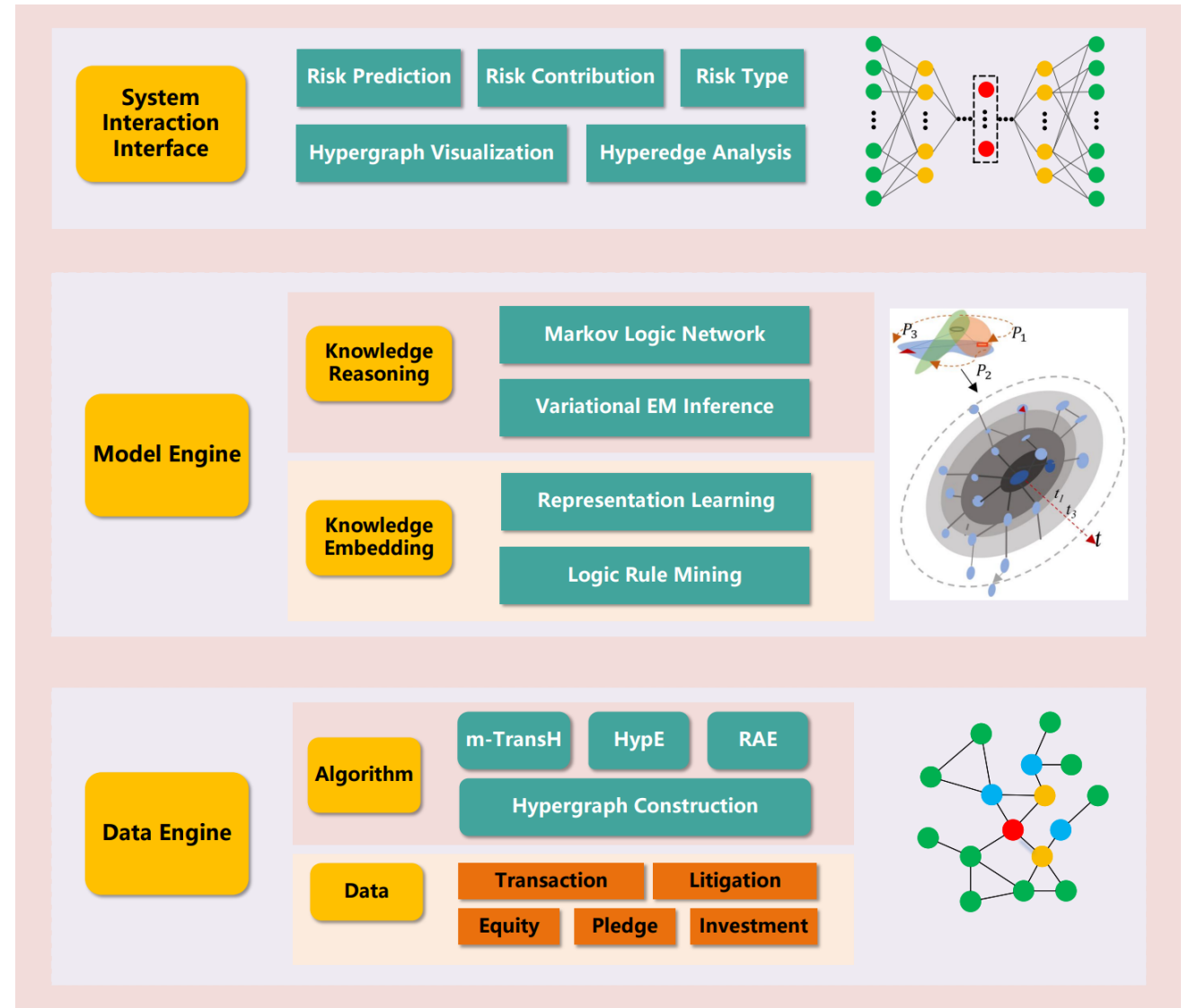
System Interaction Interface



Model Engine



Data Engine



System Design — Data Engine

- The construction of the financial knowledge hypergraph is the basis for explainable risk reasoning and is the architectural underpinning of the entire system.

The image shows a web interface for a data engine with three rows of input fields. Each row has a blue 'Dataset' label and a dropdown menu. The top row's 'Algorithm' dropdown is open, showing a list of algorithms: JF17K, M-FB15K, FB-AUTO, and CB67. The middle row's 'Dataset' and 'Algorithm' labels are highlighted with red boxes. A red line connects the 'Algorithm' label of the middle row to the 'Algorithm' dropdown of the bottom row. The bottom row's 'Algorithm' dropdown is open, showing a list of algorithms: m-TransH, RAE, and HypE. A red box highlights the 'Load' and 'Run' buttons on the right side of the interface.

System Design — Model Engine

- The model engine is the most **central part** of KHypER, and its working principle is mainly divided into two parts: **knowledge embedding** and **knowledge reasoning**.
- We propose a knowledge hypergraph explainable reasoning framework, **HyperMLN**, which combines **logic rule-based MLNs** and **knowledge hypergraph reasoning** models via the **variational EM algorithm**, with the training process alternating between variational E-steps and M-steps until convergence.

System Design — System Interaction Interface

- Target Financial Entity
- Risk Type
- Risk Probability Prediction
- Risk Contribution Calculation
- Logical Rule Mining
- Hypergraph Visualization
- Hyperedge Analysis

Target Entity: LeEco Risk Type: Low Risk / Equity Pl... Company: LeEco Internet Informa Government: Beijing Internet Court Predict

Contribution to Risk

Person_a	4.081633
Person_b	3.915302
Company_B	1.886902
Company_C	1.855844
Company_D	1.826828
Company_E	3.59929
Company_F	3.498595
Company_G	5.113834
Company_H	3.290652
Person_c	1.611113
Person_d	1.595405
Company_I	4.741179
Company_J	4.614208
Company_K	1.500808
Person_e	1.489612
Person_f	1.478826
Company_L	1.468428
Person_g	1.458396
Company_M	1.448712
Company_N	1.439355
Company_O	1.43031
Company_P	1.42156
Company_Q	1.413092
Company_R	1.404891
Company_S	1.396945
Company_T	1.389242
Company_U	1.38177
Company_V	1.374519
Company_W	1.367479
Company_X	1.360642
Person_h	1.353998
Person_i	1.347539
Company_Y	1.341257
Company_Z	1.335146
Company_LeEcoA	1.329198
Company_LeEcoB	2.646815
Company_LeEcoC	1.312175

Target Entity: LeEco Internet Information & Technology Corp., Beijing
Risk Type: Equity Pledge
Risk Probability: 50.71%

Rule Display

$Litigation(x1,x2) \wedge Litigation(-,x1) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Filing\ a\ lawsuit(x1,-) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Litigation(x1,-) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Qualification\ certificate(x1,-,-) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Customer(-,x1) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Litigation(-,x1) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Filing\ a\ lawsuit(x1,-) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Litigation(-,x1) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Shareholder(-,-,x1,-) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Litigation(x1,-) \Rightarrow Equity\ Pledge(x2,x1)$
 $Litigation(x1,x2) \wedge Litigation(x1,-) \Rightarrow Equity\ Pledge(x2,x1)$

Low Risk > Equity Pledge
Medium Risk >
High Risk >

Low Risk > Lawsuit >
Medium Risk > Abnormal Business Operation
High Risk > Administrative Penalty

Low Risk > Register a Case >
Medium Risk > Enforcement
High Risk > Dishonest
Illegal

Outline

1. Background
2. System Design
- 3. Demonstration**
4. Conclusion

Demonstration

Target Entity

LeEco

Risk Type

Risk Level of the Rule

Company

Name of the Company,

Government

Name of the Governme

Predict

Contribution to Risk

Target Entity:

Risk Type:

Risk Probability: %

Rule Display

Outline

1. Background
2. System Design
3. Demonstration
- 4. Conclusion**

Conclusion

- The KHypER is **an explainable risk reasoning model system** for financial knowledge hypergraphs.
- We demonstrate that financial explainable risk reasoning based on **knowledge hypergraphs** is a very promising approach to improve the explainability and predictive power of financial risk models.
- The KHypER provides a superior solution for this field.

THANK YOU!