RIKEN AIP-NEC Collaboration Center (RANCC)

Our Goals and Research Themes

Goals: Beyond human AI technologies

Beyond human Cognition (for safety & security)
Crime & accident prevention

Beyond human Thinking (to tackle hard problems)
Hit products development

Beyond human Optimization (overwhelming efficiency)
Optimization of transportation

Safe, secure, and efficient social system

Problems

Conventional AI requires huge amount of data

- **Hard to detect rare events** such as crimes and accidents
- **Hard to reason new events** such as hit product prediction
- **Hard to optimize total system** automated by multiple AIs

Research themes

We develop novel AI technologies to solve the problems

Beyond human Cognition
1. Machine learning that achieves high accuracy with small data

Beyond human Thinking
2. AI that supports decision making under unknown situation

Beyond human Optimization
3. Automated negotiation and mechanism design among AIs

Theme 1: Machine Learning that Achieves High Accuracy with Small Data

Background / Problem

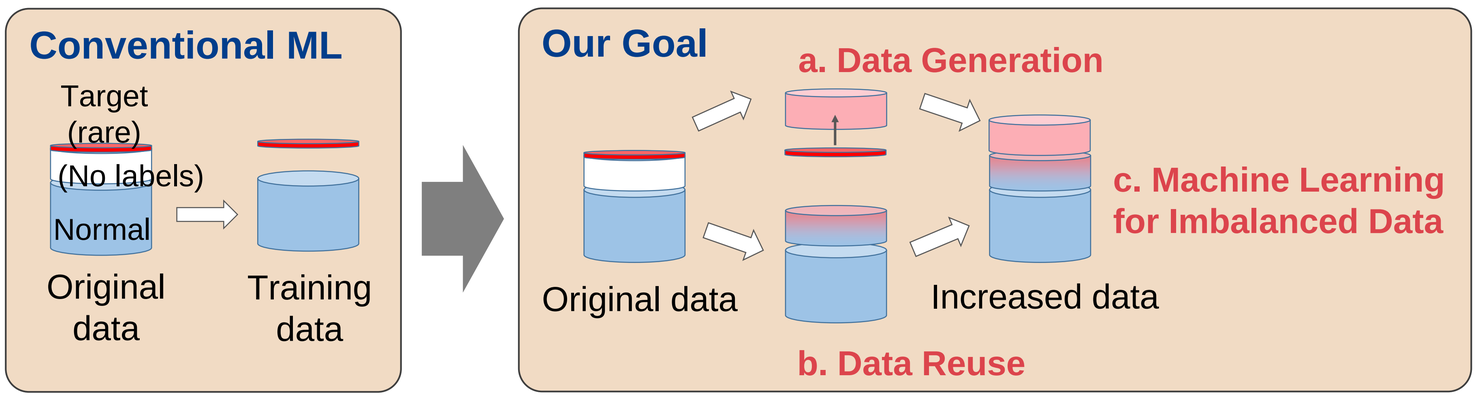
Finding signs of crimes and accidents is necessary for realizing safe and secure society. Recognizing various human behavior and objects in the real world is a key technology.

Straightforward application of deep learning is not effective since it is hard to collect huge amount of data from the real world.

- Data available from the Internet are hard to use for real-world modeling.
- Labeling operation is required, which involves significant cost.
- Crimes and accidents do not happen frequently.

Technology to Develop

Achieves high accuracy in recognizing rare events such as suspicious behavior by data generation, data reuse, and advanced machine learning for Imbalanced data.

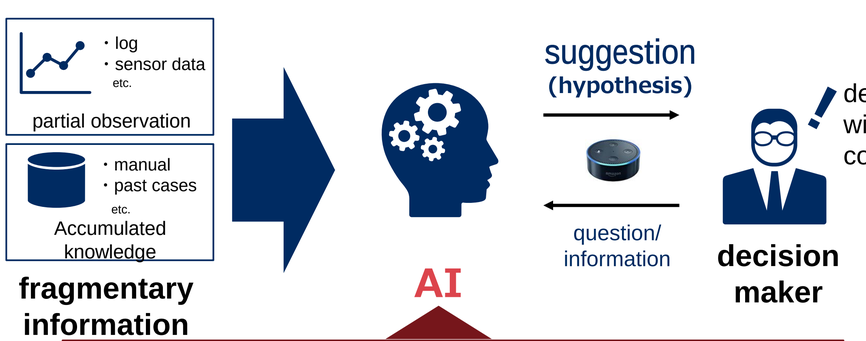


a. Data Generation : utilize domain knowledge to generate effective data
b. Data Reuse : utilize uncertain data and different domain data
c. ML for Imbalanced data: develop advanced ML algorithms effective for rare event recognition

Theme 2: AI that Supports Decision Making under Unknown Situation

Background / Problem

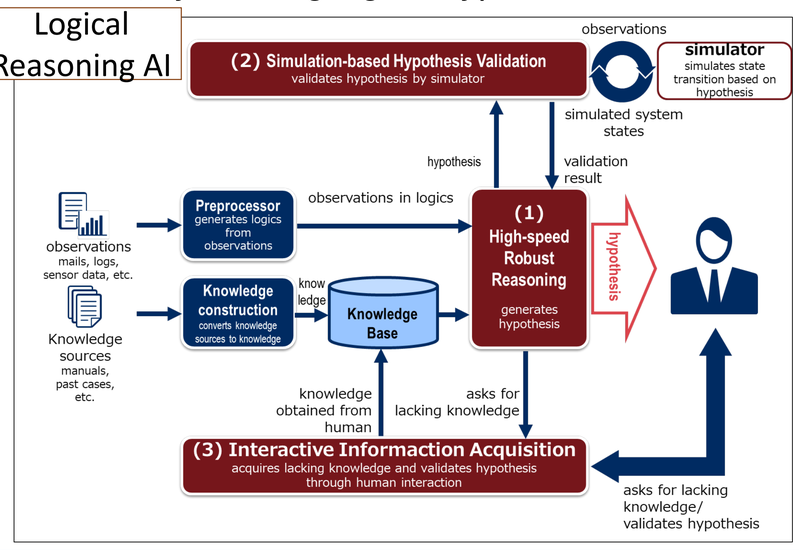
It is "humans' responsibility" to make high-impact decisions.
AI should support decision makers by providing "suggestions".



Problem of Current AI
- **low interpretability to accept suggestion**
- **Inaccurate suggestion based on fragmentary information (low robustness)**

Technology to Develop

Realizes **Logical Reasoning AI** that collaboratively supports decision makers, by creating logical hypotheses even from fragmentary information



RANCC focuses on improving scalability for human collaboration

(1) High-speed Robust Reasoning
Provides hypothesis and its reason based on observation and knowledge

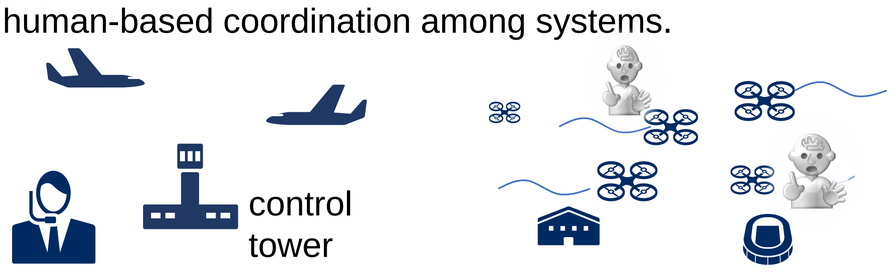
(2) Simulation-based Hypothesis Validation
Validates / refines hypothesis through simulation

(3) Interactive Information Acquisition
Acquires lacking information and validates hypothesis through human interaction

Theme 3: Automated Negotiation and Mechanism Design among AIs

Background / Problem

Because of the enhancement of social systems by AI and population decline, it becomes difficult to maintain current human-based coordination among systems.



Landing of airplanes
Limited number of flights and congestion points can be managed by human

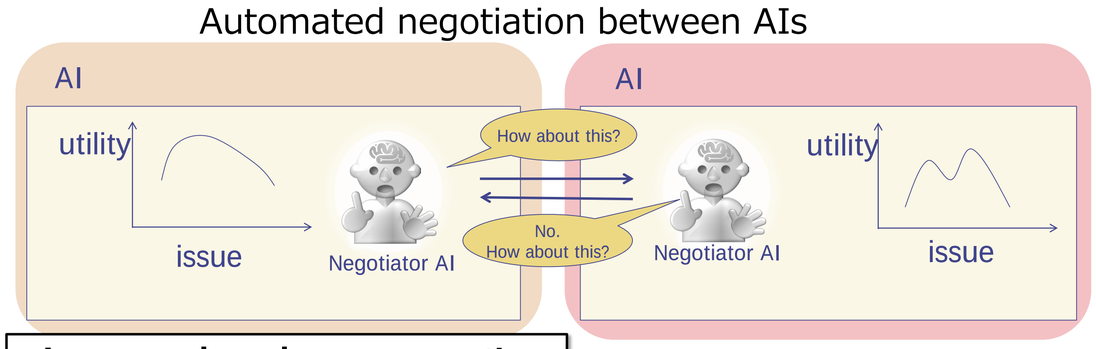
Conflict avoidance among drones
Too many flights and places to be managed by human

- **Required coordination among AIs and Coordinator AI**
- **Coordination considering each AI's convenience**

Technology to Develop

Realizes **Negotiator AI** that communicating with another AI to find WIN-WIN relationship without fully disclosing its utility functions, which represent its business preference.
For example, a company using drones collaboratively use airspace with other companies.

Automated negotiation between AIs



Challenge
- **Incomprehensive opponent's behavior**
- **Unsettled negotiation because of various individual utilities**

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- **Infers opponent's utility function**
- **Finds a valid solution for several AIs**