1. BAI-OPTIMA project

It is still difficult for present stage AI to match human domain expert intelligence in critical areas like healthcare/self-driving/financial-sectors due to several reasons [2] which Profound AI (PAI) [2] aims to remedy. To this end, abstractions (like rules) and inverse-abstractions (applying rules) are necessary to reason beyond limited data, which enable small dataset training and generalisation within domain. BAI-OPTIMA (BenAI common OPTimal Individualised decision MAking foundational architecture and algorithms for critical areas) provides decision making foundational framework for critical areas like healthcare domain. The GID (German equipped Infantry Division of China during World War II) model is a sophisticated ensemble model consisted of an untrainable abstraction module (like medical rules), a trainable abstraction module (representing Domain Expert Experiences), a prediction module (like neural network, xgboost), an abstraction-enforcement module (enforcing rules), a utility function. By introducing Domain Knowledge into the model, it supplements insufficiency of small dataset. For deterministic decision making, it could find the triggering thresholds. For non-deterministic decision making, optimal (individualised) decision is based on the matching rate of the decision and corresponding predicted outcome. At the moment, it could process structured data like numerical, categorical, time-series. and will be extended in the near future.

2. Major Innovations of BAI-OPTIMA project

- The GID model is consisted of the following modules:

The untrainable abstraction module (like rules or concept of image) helps improve prediction accuracy out of small dataset. The trainable abstraction module represents specific Domain Expert Experiences as logical rules or image concept. The prediction module could be any AI models. The utility function filters out or degrade the importance of irrelevant information or enhance importance of eligible actions. The abstraction-enforcement-module executes rules or concept.

- D-logic (Decision logic, False/Uncertain/True/Exceptionally-High) extends traditional logic and probability, like 200% is absolutely yes, 100% is yes, -50% is absolutely no, exceptionally-high values (optional) could make decision uncertain or completely negate the decision.
- The logic-MCUR (logic plus Multiple Criteria decision making within Uncertain Range) is an implementation of D-logic, which integrates propositional-logic with neural network and has trainable logical boundaries. It could incorporate domain knowledge, like monotonicity.

- The DONDE (Discovery Of New rules based on DEcision logic) algorithm is model-agnostic AI explainability (see DONDE paper for details).
- The Similarity Reasoning (SIR) algorithm finds similar cases. Similarity is defined according to several folds: similar/common features; feature-value similarity; matching rate towards a decision and its outcome; total similarity.
- The DEENA (Domain Expert knowledge Extraction from NAtural language) algorithms extracts Domain Knowledge from corpus or data described in natural language: domain data (electric healthcare record); domain rules (medical rules), like logical-not-and-or, logical-if-then-else
- TISU (Time-Series data with Uncertainties) algorithm: convert time-series data into Gaussian distribution for decision making
- HEGS (Heuristic Grid Search) algorithm: GPU paralleled heuristic grid search to find optimal configurations/results of AI models
- PRIDE (PredIcting effects of Decisions) algorithm: predicting effect of decisions based on similar cases. Firstly, find out similar cases towards a decision; use these cases to train different models according to different outcomes; use these models to predict probabilities of outcomes of a decision of a new case; the highest probability is the most likely result of a decision.

References:

[1]

[2] Future intelligence by BenAI http://benai.com.cn/en/latest-research/