Easy and privacy-preserving modeling tools (Highlight A)

Developing AI is still difficult and time-consuming, especially for probabilistic approaches. Many of FCAI’s research contributions are about making it easier. FCAI Highlight Program A exists to make sure this research has quantifiable impact for people building AI in industry and academia.

Highlight objectives

AI has uniquely narrow gap between fundamental and applied research: the advances in AI methods are rapidly taken into use in industry and other research fields.

This requires AI methods that are

1. **Easy enough** to be used by **wide audience**
2. Easily **accessible** as (open-source) software
3. Computationally **reliable** and addressing the **real needs**

FCAI takes this seriously. This Highlight exists to make sure the fundamental research carried out in Research Programs is taken into use. Its main objective is to measure and maximize the impact of FCAI research on the process of probabilistic AI development.

We focus on

1. Principles for improving the (typically interactive) modeling workflow (R1, R5)
2. Tools for building probabilistic AI models (probabilistic programming, efficient inference) (R1)
3. Tools for building AI that links to existing domain simulators (R2)
4. Tools that make possible privacy-preserving inference for existing probabilistic models (R4)

Research results

Examples of ongoing research in R1–R5 on lowering the expertise requirements for the modeler.

**Modeling made easy**

R5: Kashyap Todi, Pedram Daee, Antti Oulasvirta

Interactive tool for domain experts without modelling expertise. AI assists by intelligent querying, feedback, and suggestions, to extract knowledge, facilitate model exploration and construction, and support learning and understandability.

**Bayesflow**

R1: Paul Bürkner, Aki Vehtari

Software-assisted Bayesian workflow for interpretable models. AI acts as statistical expert supporting a domain expert developing a reproducible model in an interactive R scripting environment.

**Prior predictive elicitation**

R1: Marcelo Hartmann, Tomasz Kušmierczyk, Arto Klami

Automatic selection of prior distributions for predictive Bayesian models and interactive elicitation of expert’s knowledge for interpretable models, based on prior predictive distribution.

Methodologies

Highlight A builds integrally on the Research Programs that develop solutions addressing the key problems in current modeling pipelines.

**Modeling principles**

R1: Formulation of Bayesian modeling workflow and development of specific algorithms and methods for different stages of that process, such as prior specification, inference, decision-making, and model checking. Development of probabilistic programming systems.

R2: Fundamental algorithms for simulator-based inference.

R4: Differential privacy guarantees for probabilistic inference

R5: Collaborative human-AI model design, human aspects in modeling workflows

**Practical tools**

FCAI contributes to a range of already established modeling tools, but additionally works on large number of smaller software projects, typically building on top of tools with existing userbase.

**Stan**

Leading probabilistic programming language

**brms**

R package for generalized multi-level models using Stan

**ELFI**

Leading tool for simulator-based inference

Impact

At the core of Highlight A are means for measuring and maximizing the impact of our research

1. Are the tools being used?
2. Do they help solving important problems? (in REAL WORLD)
3. How strong is the community involvement?
4. Are they actually easy to use? (for REAL PEOPLE)

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