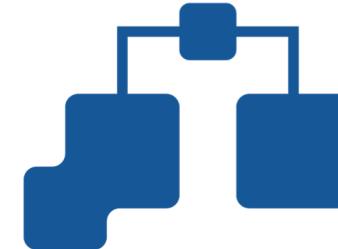


# Introduction BIASlab

“Bayesian Intelligent Autonomous Systems”

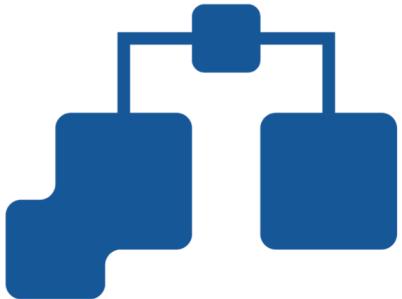


Bert de Vries  
TU Eindhoven



2019

<http://biaslab.org>



**TU/e SPS / BIASlab**

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# Developing autonomous agents that learn from their environment

Using these agents to develop novel signal processing systems

**BIASLAB**  
Bayesian Intelligent Autonomous Systems

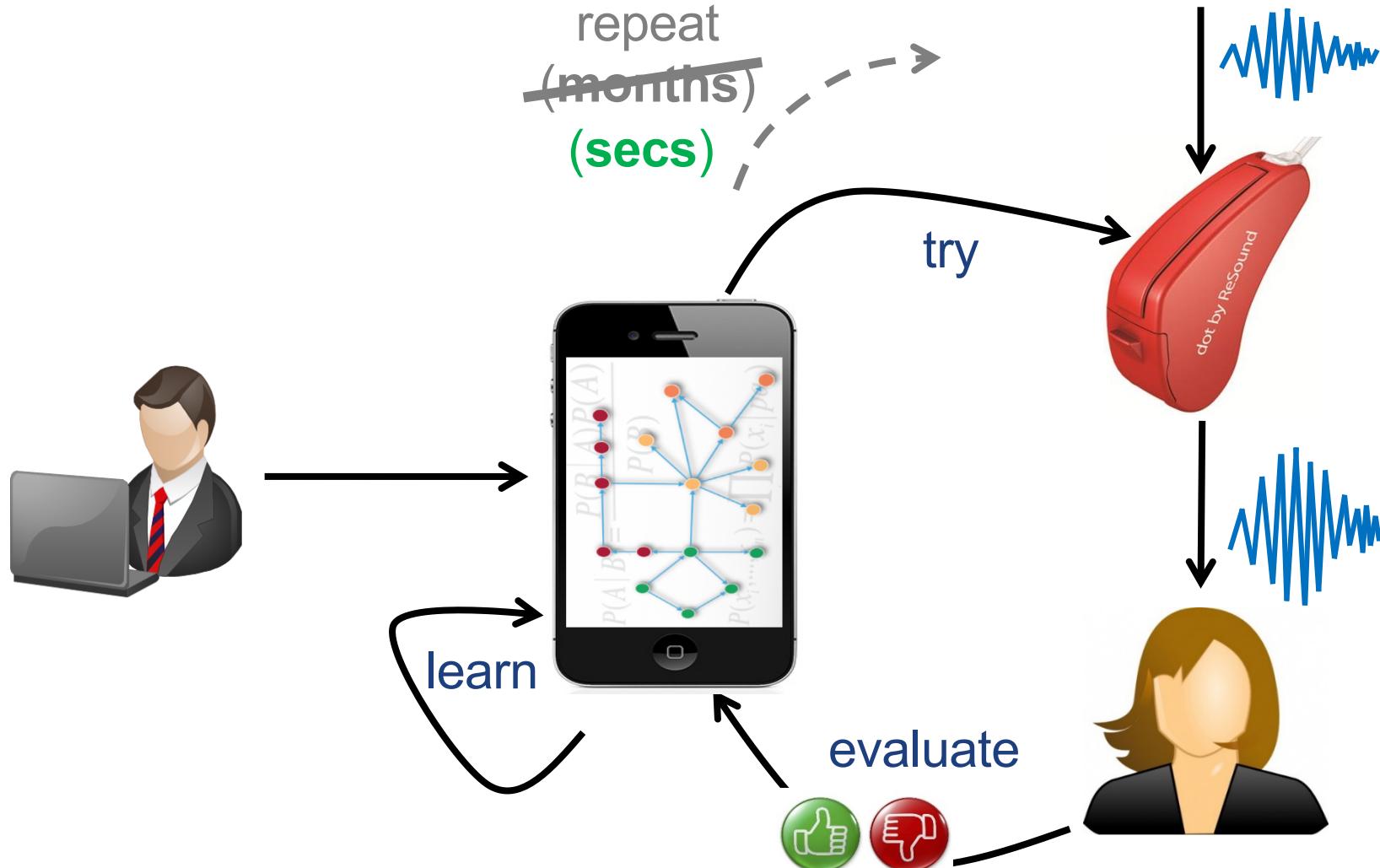
**About**

**Mission**

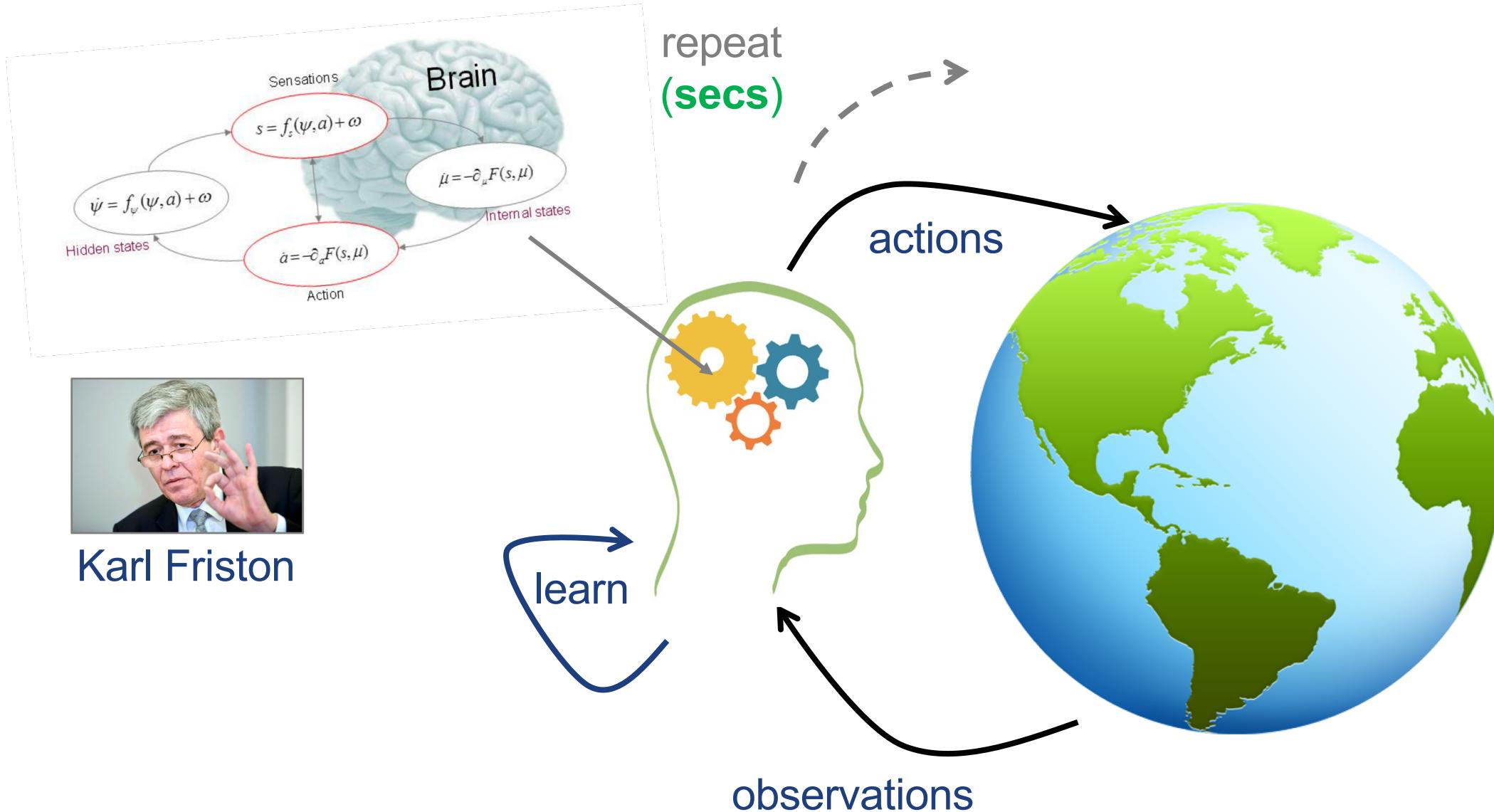
**Approach**



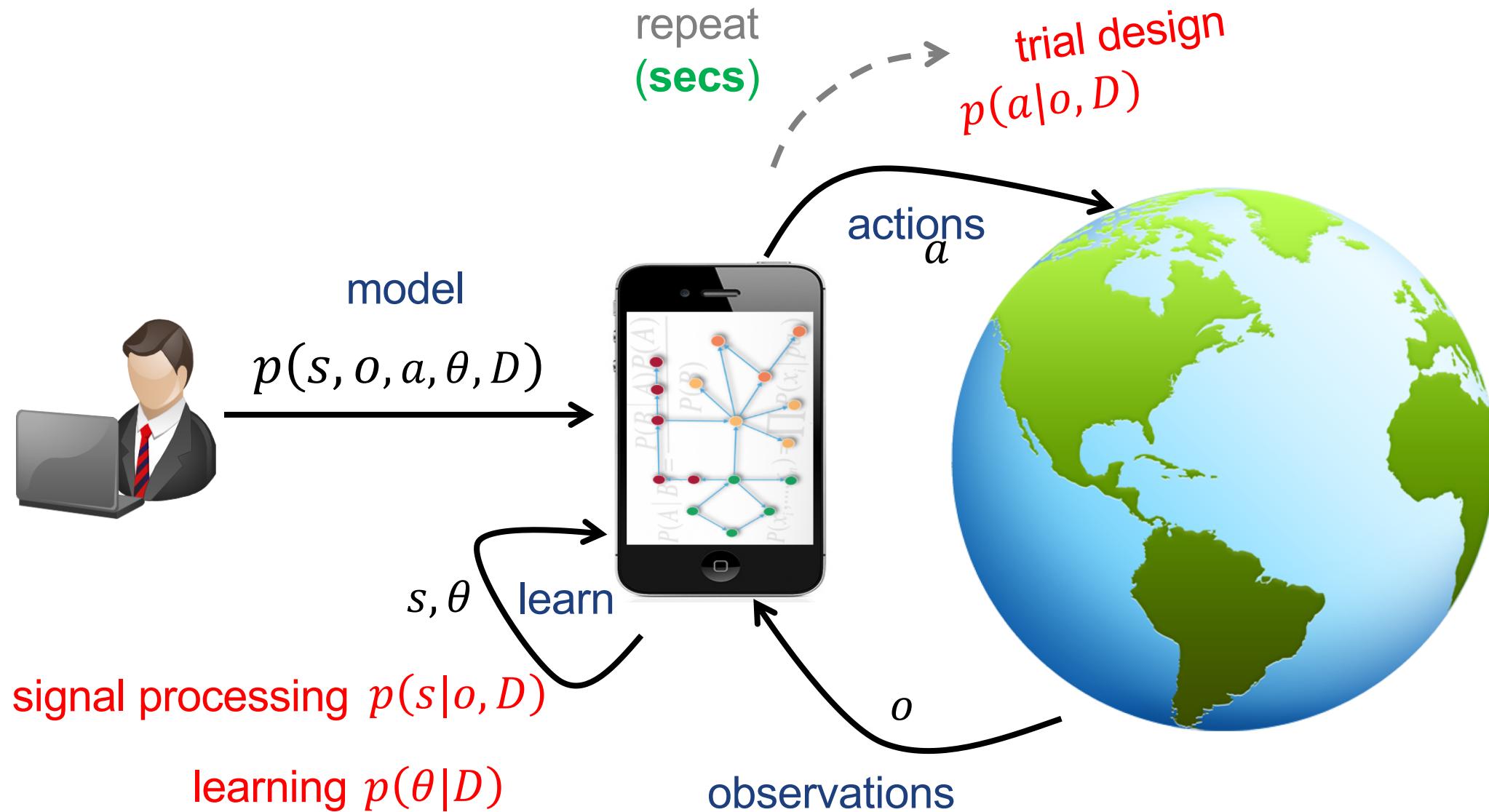
# Situated Agent-based Design



# The Free Energy Principle (Friston)

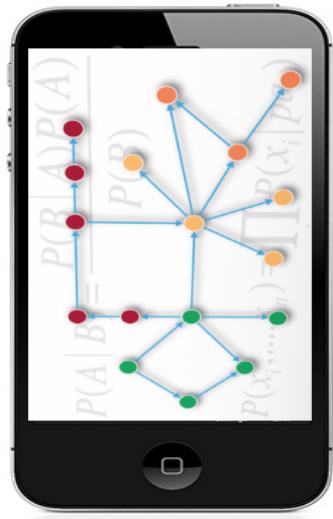


# Situated Agent-based Design based on FEP



# BIASlab mission

(1) Developing autonomous agents  
that learn from their environment ...



$$P(x, y, r, a, \theta, D)$$

(1) Model specification by



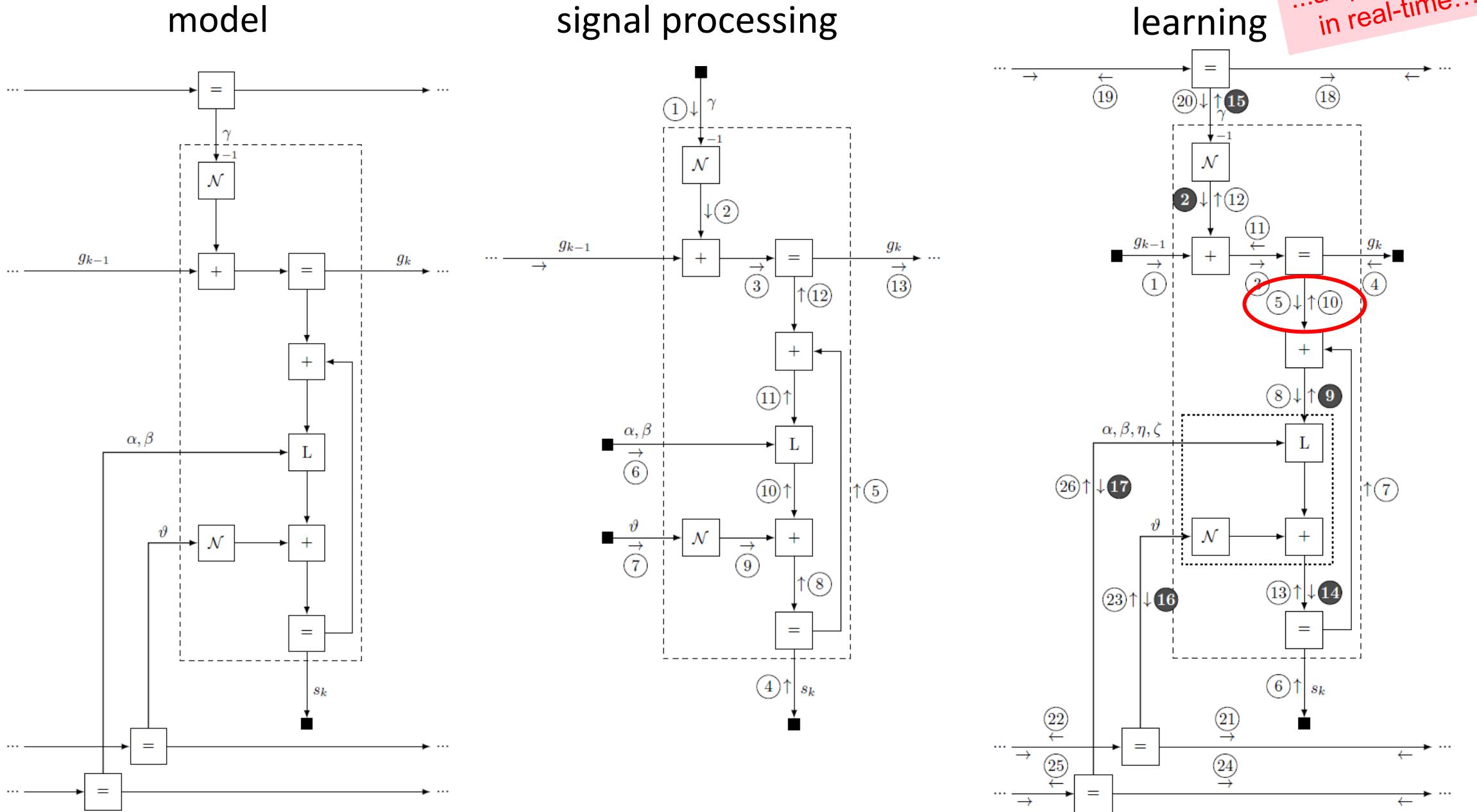
(2) Using these agents to develop  
novel signal processing systems



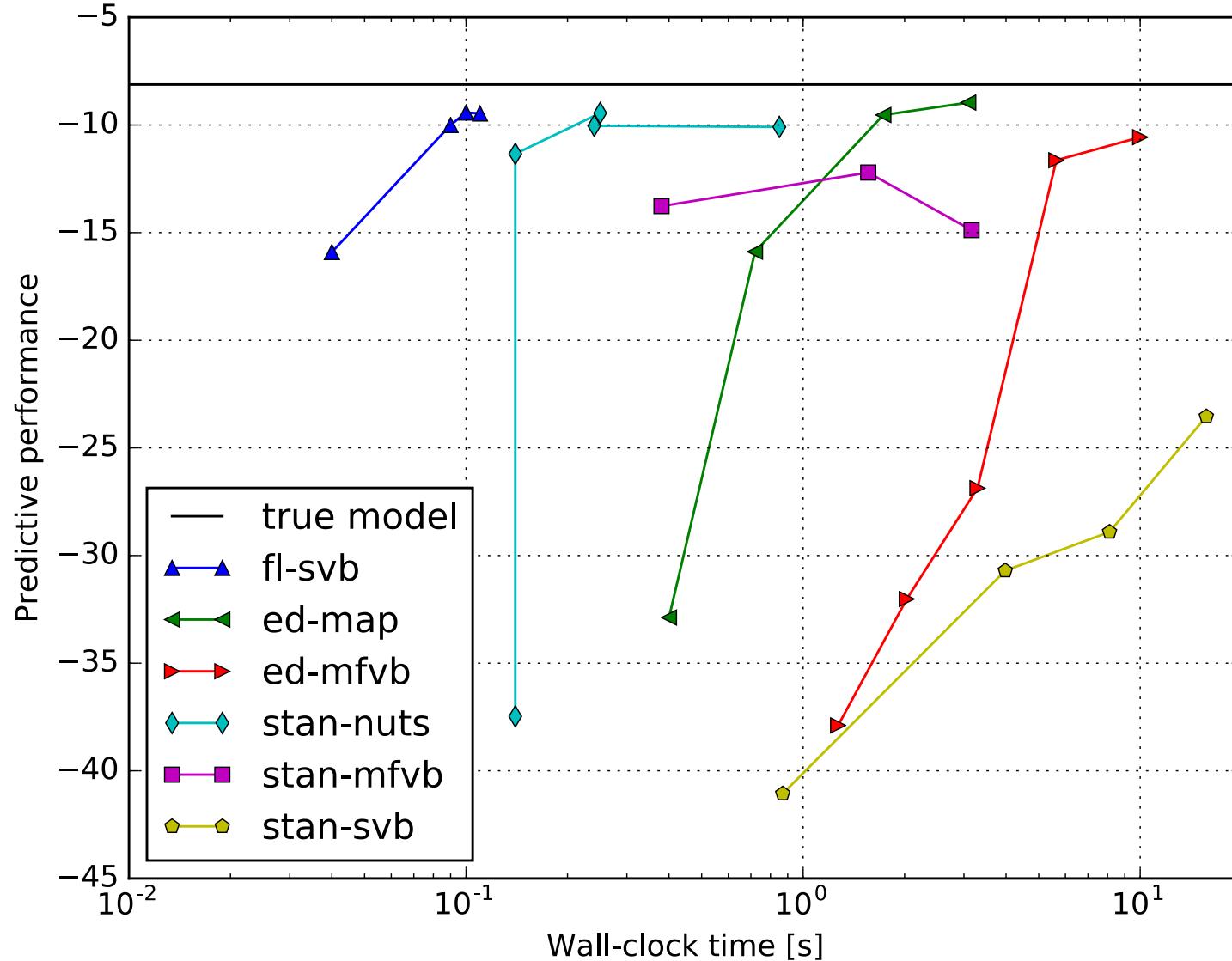
$$\begin{matrix} P(\theta|D) \\ P(y|x, D) \end{matrix} \quad P(a|x, y, r, D)$$

(2) **Automated** inference

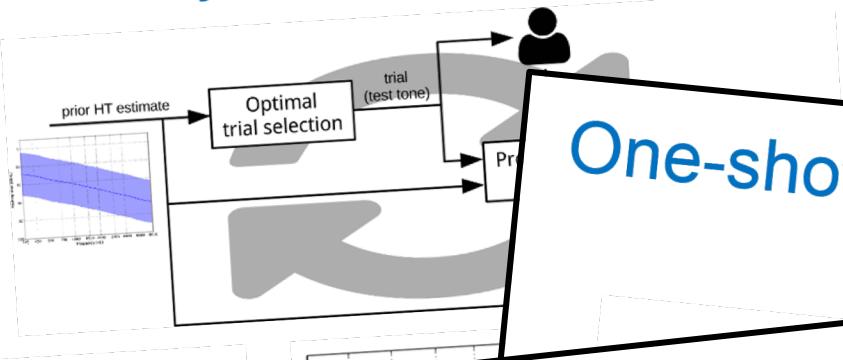
# Free Energy Minimization by Variational Message Passing



# ForneyLab Performance

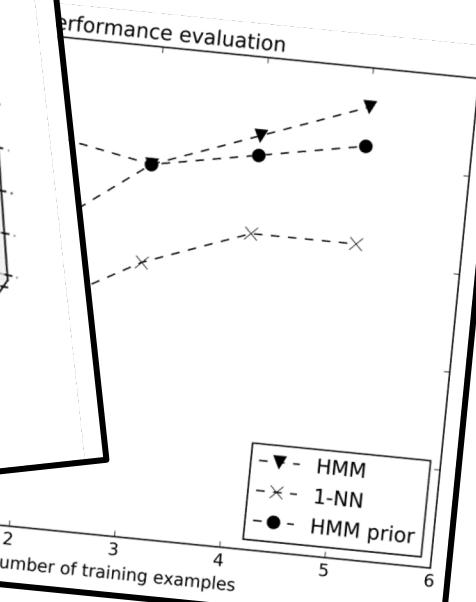
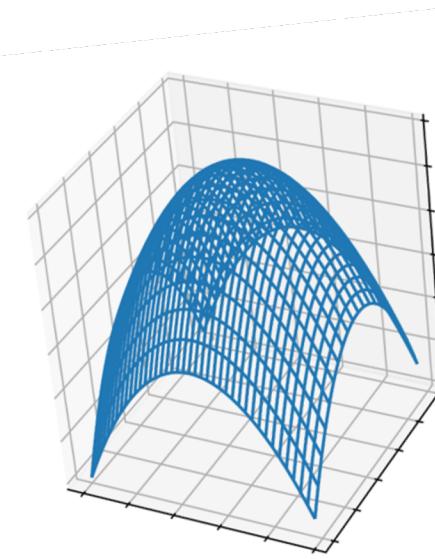
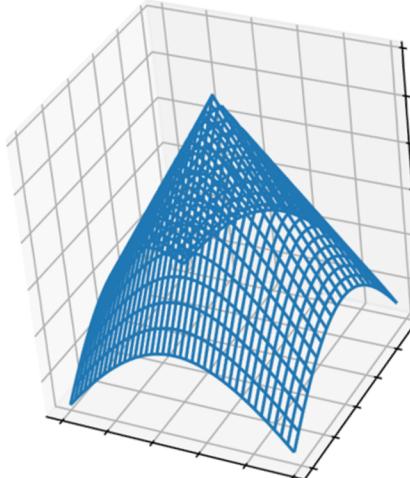
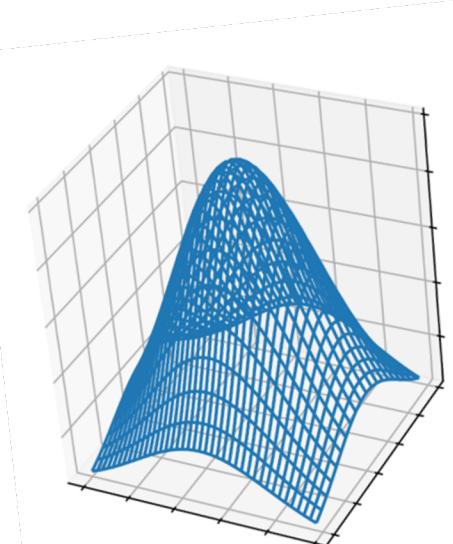
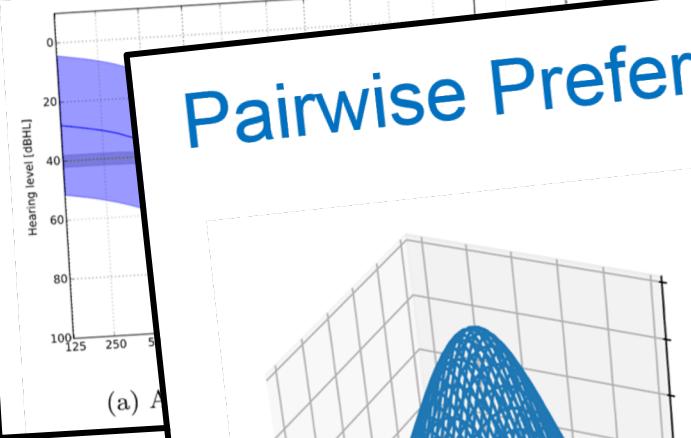


## Incremental Bayesian Pure-tone Audiometry

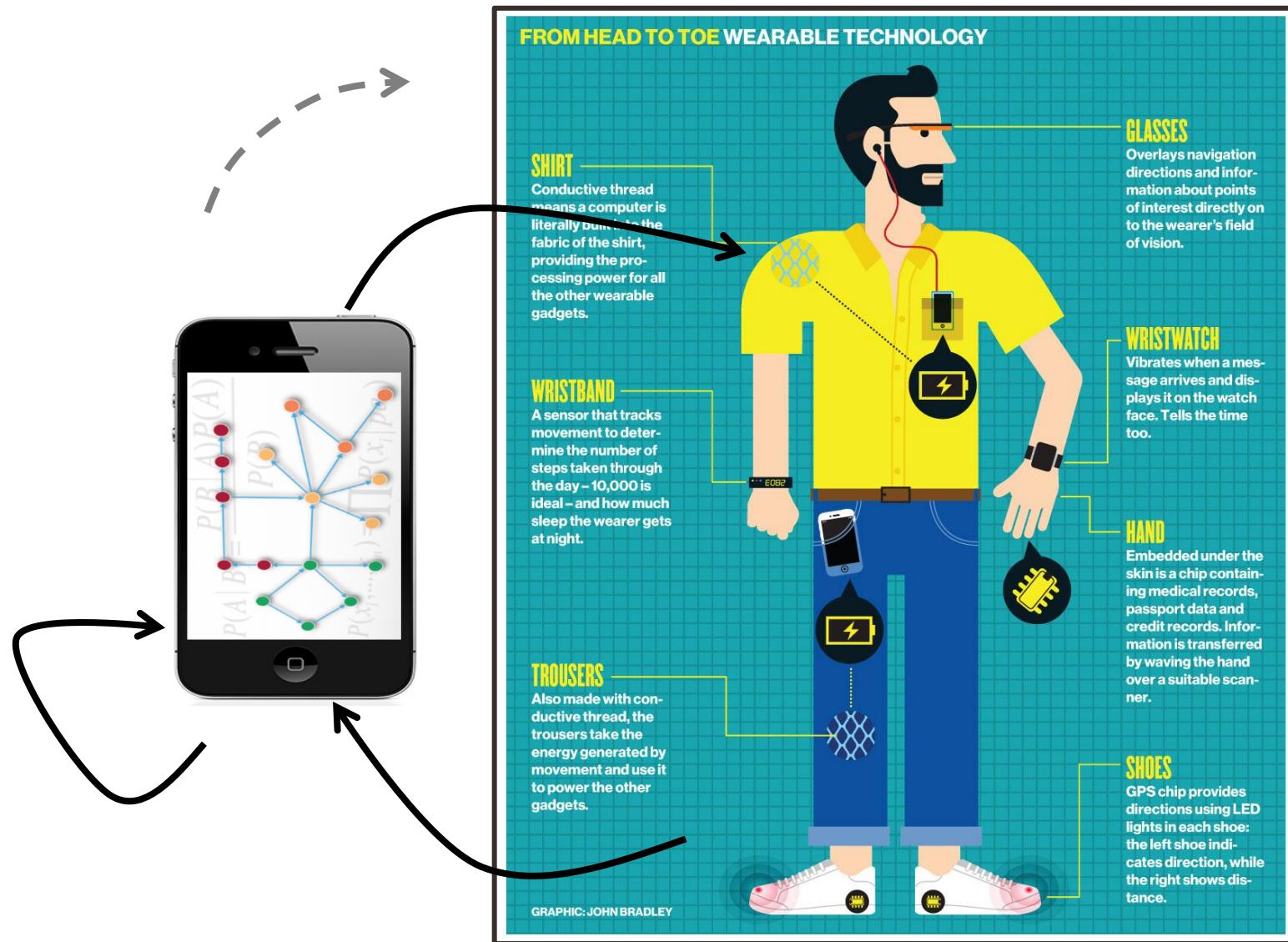


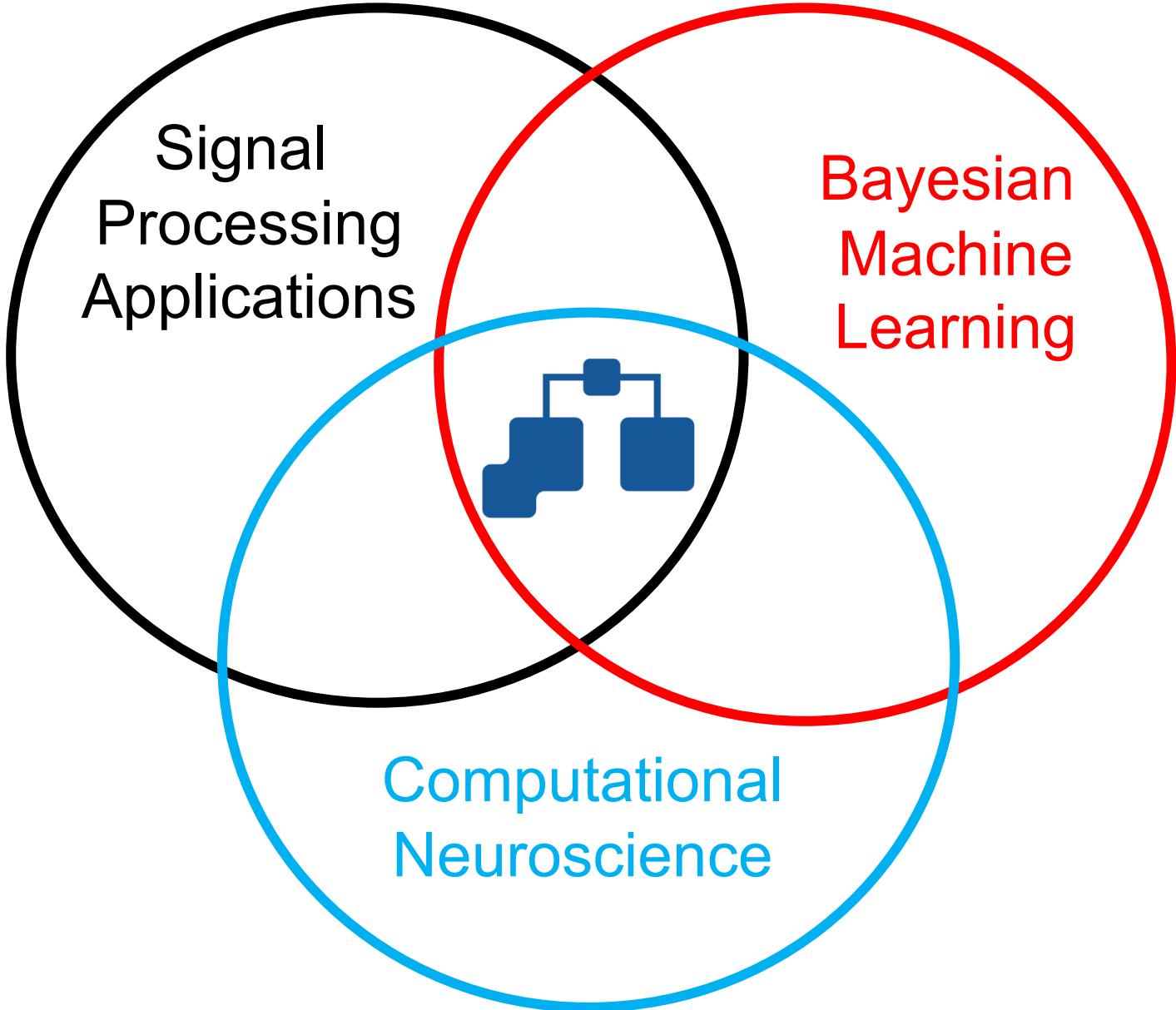
## One-shot Gesture Recognition

## Pairwise Preference-based Bayesian Optimization



# Applications





**Thank you**

# Probability Theory

Assume a joint probability distribution

$$P(x, y, r, a, \theta, D, m)$$

It is always possible to compute the probability for any subset of variables, given another subset of variables. For example,

$$P(y|x) = \frac{P(x, y)}{P(x)} = \frac{\sum_{r,a,\dots,m} P(x, y, r, a, \theta, D, m)}{\sum_{y,r,a,\dots,m} P(x, y, r, a, \theta, D, m)}$$

This “inference” computation can be **automated**.