Fast & Loose: Resource-bounded Reasoning in Wason's Selection Task

Genot, Emmanuel; Jacot, Justine; Pärnamets, Philip

2014

Citation for published version (APA):
Introduction

- In Wason’s Selection Task (ST) [Was68] subjects do not perform as classical-logical reasoners.
- If ST is treated as a “loose probabilistic task” [OC94], observed inferential behavior is optimal for Bayesian reasoners.
- [OC94] acknowledge that Bayesian computations are too complex for bounded-rational reasoners, but no model so far.
- We obtain convergence to the Bayesian solution under assumptions generalizing Bayesian Rationality w/ severely bounded cognitive resources.

Instructions for the Selection Task

“Here are four cards, all of which have a number on one side and a letter on the other, followed by a rule that applies only to them:

(Rule) If there is a vowel on the one side (P), then there is an even number on the other side (Q)

Which card (if any) must be turned in order to decide if the rule is true—without turning unnecessary cards?”

Components of the Model (Overview)

1. Interrogative Model of Learning : generalizes Bayesian (probabilistic) learning, captures interrogative strategies. [Hin07, GG14].
2. Non-classical semantics: subsumes truth-functional semantics [Was68] and probabilistic semantics proved equivalent to the Bayesian model [Duc09].
3. Cooperative Principle [Gri89]: constraints the expectations based on the instructions (generalize constraints on Bayesian priors).

Model (1): Interrogative Learning

- Sequential two-player game w/asymmetric info.: Inquirer (I) vs Nature (N).
- Problem=(T, ?, T): T = theory, ? = partition of models T Mod(T).
- N chooses a state s ∈ Mod(T) and a set of available answers Ans.
- I must identify s ‘up to’ inclusion in some cell of Q:
  - I uses ‘instrumental’ questions, N answers only if in Ans.
  - I stops asking questions at information fixpoints.

Model (2): Generalized Adams Hypothesis

- Adams’ Hypothesis captures the Bayesian model of ST [Duc09] in Wason’s Selection Task. Prob(I | P then Q) = Prob(Q | P) if P > 0, 1 otherwise (AH).
- Generalized Adams Hypothesis (GAH): X expects P, then Q to hold to the same extent that X expects Q to hold, knowing P.

Model (3): Cooperative Principle

Quality Rule: true
Quantity + Relation P and Q are mentioned, not-Q is not:
(Rule∗) If there is a vowel on the one side, then there is an even number on the other side more likely than a non-even one.

Rule = true in state s if P/Q-occurrences in s (denoted m_s) outnumber P/not-Q occurrences in s (denoted n_s).

Model (4): Putting it Together

- Modeler’s representation:
  Mod(T) = {(A, y_i), (K, y_z), (x_j), (x_4), (x_7)}: x_i ∈ {A, ..., , Z}, y_j ∈ FR
  \[ ? = \{Yes, No\} \text{ where } \begin{cases} s ∈ Yes \text{ if } m_s > n_s \\ s ∈ No \text{ otherwise} \end{cases} \] (1)
  \[ ∀s ∈ Mod(T), \text{Ans}(s) = \{a_1, a_2, a_3, a_4\} \text{ and } a_1 = y_1, a_2 = y_2, a_3 = x_3, a_4 = x_4 \] (2)
- Inquirer’s representation: linguistic competence & categorizing letters as vow/cons & numbers as even or not (even?/odd).

References