

# JUDGMENT AGGREGATION JUNE PROJECT: TRUTH TRACKING

Zoi Terzopoulou

Institute for Logic, Language, and Computation  
University of Amsterdam

7/6/2018

(based on the slides of Ulle Endriss)

# GOALS

- ▶ *Truth tracking* in Judgment Aggregation.
- ▶ A *review* of what we have seen this week.

# TRUTH TRACKING

Two views of Judgment Aggregation:

- ▶ *Normative perspective*: Agents give us their opinions, and we need to treat them “fairly”, finding a collective judgment that accurately reflects the views of the group.
- ▶ *Epistemic perspective*: There is an objectively true judgment set (the ground truth) out there. Our agents perceive noisy signals and report them. We need to try and recover this ground truth.

## THE CONDORCET JURY THEOREM

This classical theorem applies to the case of JA with just a single pair of formulas in the agenda (i.e., a single binary issue).

### THEOREM (CONDORCET, 1785)

*Suppose a jury of  $n$  voters need to select the better of two alternatives and each voter independently makes the correct decision with the same probability  $p > \frac{1}{2}$ . Then the probability that the majority rule returns the correct decision increases monotonically in  $n$  and approaches 1 as  $n$  goes to infinity.*

Indeed, by the law of large numbers, the number of voters making the correct choice then approaches  $p \cdot n > \frac{1}{2} \cdot n$ .

Writings of the Marquis de Condorcet. In I. McLean and A. Urken (eds.), *Classics of Social Choice*, University of Michigan Press, 1995.

## TRUTH TRACKING IN JA

Due to complicated logical interconnections between the formulas, very little research has been done on the epistemic approach in JA (all assuming only two independent formulas, or studying “easy” rules, like the premise-based rule).

I. Bozbay, F. Dietrich, and H. Peters. Judgment Aggregation in Search for the Truth. *Games and Economic Behavior*, 87:571–590, 2014.

S. Hartmann and J. Springer. Judgment Aggregation and the Problem of Tracking the Truth. *Synthese*, 187(1): 209–221, 2012.

## PREMISE-BASED AND CONCLUSION-BASED RULES

- ▶ We have a set of *premises* and a *conclusion*.
- ▶ The *premise-based* rule accepts the conclusion iff it follows from the judgment of the majority on the premises.
- ▶ The *conclusion-based* rule accepts the conclusion iff a majority accepts the conclusion itself.

	<i>s</i>	<i>r</i>	<i>c</i>	<i>s</i>	<i>r</i>	<i>c</i>
Judge 1:	<b>Yes</b>	<b>Yes</b>	Yes	Yes	Yes	Yes
Judge 2:	<b>Yes</b>	No	No	No	No	<b>No</b>
Judge 3:	No	<b>Yes</b>	No	No	Yes	<b>No</b>
Committee:	<hr/>			<hr/>		
			<b>Yes!</b>			<b>No!</b>

Premise-based.

Conclusion-based.

## A COMPARISON

Consider the *premises*: two propositional variables  $s, r$ , and a *conclusion*  $c$ , which is equivalent to their conjunction  $c \equiv (s \wedge r)$ .

What is the best way to find out the *ground truth* about the conclusion?

We can compare the truth-tracking abilities of the *premise-based* rule and the *conclusion-based* rule.

L. Bovens and W. Rabinowicz. Democratic Answers to Complex Questions: An Epistemic Perspective. *Synthese*, 150(1):131–153, 2006.

## A TASTE OF TRUTH TRACKING FOR THE PREMISE-BASED RULE

The probability that an agent makes the correct evaluation on a single premise is  $p$ .

Then, the probability that *the majority* makes the correct evaluation on a *single premise* is

$$P(M) = \sum_{k=(n+1)/2}^n \binom{n}{k} p^k (1-p)^{n-k}$$

However, the probability that *the majority* makes the correct evaluation on the *conclusion*, depends on whether the conclusion is actually *true* or *false*.

If it is true, then,  $P(M_c) = P(M)^2$ . If it is false...? (★).



## A RESULT

A rule may also “*reach the truth by mistake*”.

For example, if the *conclusion* is *false* because *only one* of the premises is actually false, the rule can still evaluate the conclusion as false by evaluating *both* premises as false.

**THEOREM (BOVENS AND RABINOWICZ, 2006)**

*The conclusion-based rule does better than the premise-based rule when it comes to reaching the truth by mistake.*

## SUMMARY OF PART B

- ▶ We saw the *Condorcet Jury Theorem*.
- ▶ We briefly discussed *truth tracking in JA*.

Feel free to explore this topic in the presentations/papers!

# REVIEW OF THIS WEEK

## LECTURE 1

- ▶ Introduction to the field of COMSOC.
- ▶ Formal framework of Judgment Aggregation, and impossibility by List & Pettit.

## LECTURE 2

- ▶ Ways to avoid List & Pettit's impossibility.
- ▶ Axiomatic characterisations of (classes of) rules.

## LECTURE 3

- ▶ How agendas' structures relate to rules' consistency. Universal and Existential agenda characterisations.

## LECTURE 4

- ▶ Strategic behaviour in Judgment Aggregation.
- ▶ A bit of truth tracking.

## WHY CARE ABOUT JUDGMENT AGGREGATION?

- ▶ A very *general framework*, tailored to the fans of models that use Logic!
- ▶ It is a *young research area*. Still possible to get a good global view of the field. Also, several opportunities to make original contributions yourselves!
- ▶ Methods used in JA reflect more widely methods in computational social choice. So, easy to switch!