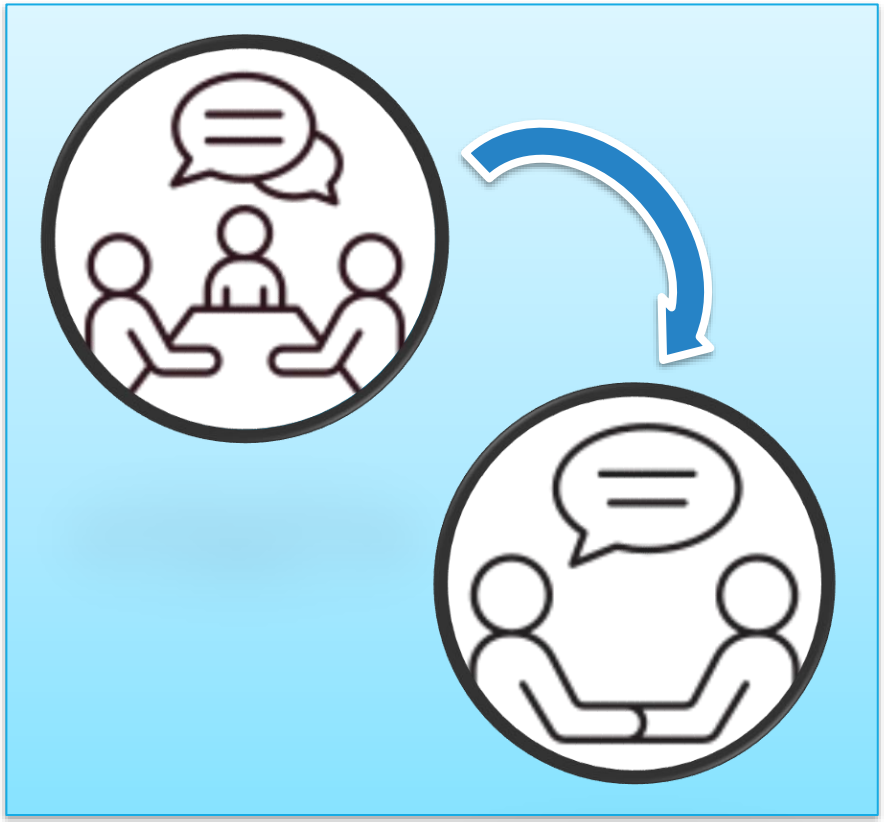
Fusion operators

DEALING WITH BELIEFS IN DOMAIN MODELS

How to reach an agreement - Fusion operators

- Once everyone states their opinion about a fact using Subjective Logic, they may merge their opinions to **reach an agreement** using the **fusion operators.**
- There are five different merge operators that are suitable for different situations.
- In some contexts, more than one operator may be suitable.



BELIEF CONSTRAINT FUSION

- Situations in which it is used:
  - Agents have **committed to their choices** and will not change their minds.
  - In case of totally conflicting opinions, there are no agreements and the result is *Undefined*.
- The **vacuous opinion** is the neutral element.
- Example: *Going to the cinema with stubborn friends*

ALEATORY CUMULATIVE BELIEF FUSION

- Situations in which it is used:
  - It is assumed that the amount of **independent evidence** increases by including more and more sources.
  - It applies to **statistical evidence**, i.e. aleatory opinions (variables governed by frequentist process).

- Examples: *Flipping a coin, locating a subscriber in a mobile network*

EPISTEMIC CUMULATIVE BELIEF FUSION

- Situations in which it is used:
  - It is assumed that the amount of **independent evidence** increases by including more and more sources.
  - It applies to variables assumed **non-frequentist**, i.e. epistemic opinions.
- The process to calculate the fused value:
  - Apply Aleatory Cumulative Belief Fusion
  - Apply Uncertainty maximization
- Example: *Who shot Kennedy?*

AVERAGING BELIEF FUSION

- Situations in which it is used:
  - It is assumed that that there is **dependency** between sources: the existence of more sources does not imply more evidence.
  - **Every opinion carries the same weight**, even a vacuous one

- Example: *Jury tries to reach a verdict after having observed the court proceedings*

WEIGHTED BELIEF FUSION

- Situations in which it is used:
  - It is assumed that that there is **dependency** between sources: the existence of more sources does not imply more evidence.
  - **Opinions are weighted as a function of their confidence**, i.e. the less uncertain, the more weight it carries.

- Example: *A group of doctors express opinions about a set of diagnoses for a patient.*

CONSENSUS AND COMPROMISE FUSION

- Situations in which it is used:
  - It is assumed that that there is **dependency** between sources: the existence of more sources does not imply more evidence.
  - It **preserves shared beliefs from each source**, transforming conflicting beliefs into vague belief.

- Example: *A group of doctors express opinions about a set of diagnoses for a patient. We intend that all opinions, even uncertain ones, carry the same weight.*

HOW TO SELECT THE MOST ADEQUATE FUSION OPERATOR

Property / Fusion operator	Willingness to compromise	Assumed dependency between opinions	Vacuous opinion as neutral element	Preserve shared beliefs, and conflicting opinions are turned into vague belief
Belief Constraint Fusion (BCF)	NO. If conflict, undefined result.	Only for fusion of agents' preferences	YES	NO
Cumulative Belief Fusion (CBF)	YES	NO	YES	NO
Averaging Belief Fusion (ABF)	YES	YES	NO	NO
Weighted Belief Fusion (WBF)	YES	YES	YES	NO
Consensus and Compromise Fusion (CCF)	YES	YES	YES	YES

[1] Not applicable for fusing evidence from different agents to determine the most likely hypothesis or actual event.

[2] There are two types of Cumulative Belief Fusion operators: Epistemic Cumulative Fusion (E-CBF) and Aleatory Cumulative Fusion (A-CBF). Their use depends on the nature of the fused opinions.