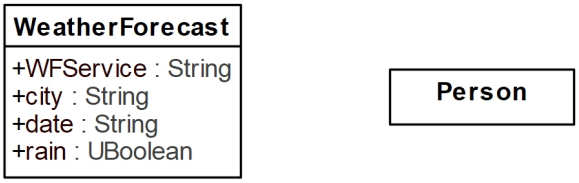
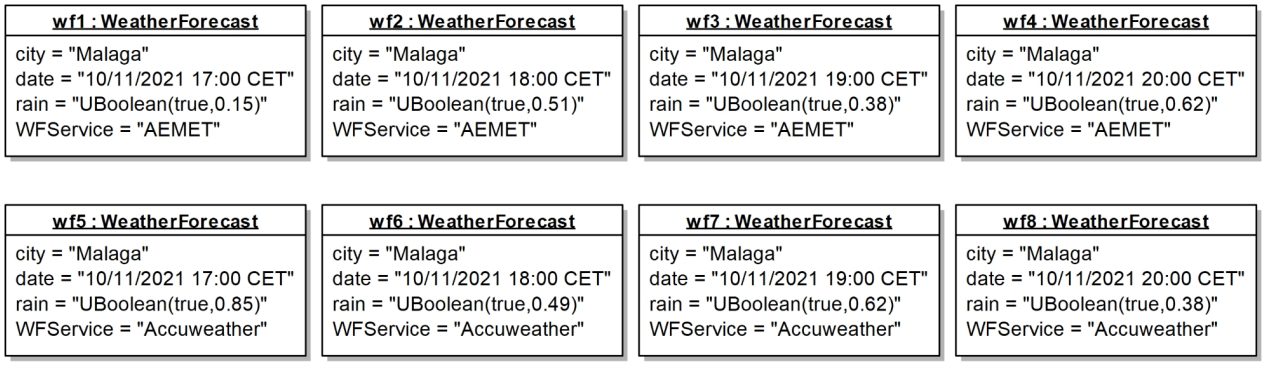
Exercise 3A: Weather forecast

Suppose that we would like to go out for a jog, and use two independent weather services to know about the expected chances of rain. The following model contains two classes, one to represent the information provided by each forecast, and another to represent the person willing to jog.



Note the use of datatype UBoolean to represent the chances of rain. This extended datatype represents Boolean values enriched with uncertainty [Bertoa et al, 2020]. For example, UBoolean(true, 0.9) means a probability of 90% of rain, and UBoolean(true, 0.1) means 10% chances of rain.

With this, the estimated weather in Málaga at four moments in time can be represented by the following object model:



Exercise 3A. Weather forecast - reaching a consensus (in groups of three people)

Please, if you grant us permission to record your voice as you work together with your colleagues, fill the form that you can find at: https://forms.gle/Nmurajs7QzpAQWiv5

First, try to collaboratively decorate one of the object models of the Rain system with the opinions of the 3 components of the group (5 minutes).

Then, try to reach a consensus on the time of the day when it is best to go jogging, using the arguments you consider appropriate (15 minutes).

Please, individually, describe the process you have followed to reach a solution, or what has prevented them from reaching it, using the questionnaire that you can find at: https://forms.gle/gJXebAqnsHUtVxGY6 (10 minutes)

Exercise 3B: Weather forecast - fusion operators

Reaching a consensus based on the opinions of groups of agents about the same model elements, if possible, is another goal of this work. To accomplish this task, Subjective Logic provides a set of operators that allow merging opinions by different agents about the same model elements. These are the so-called "fusion operators." This is of paramount importance for permitting collaborative modeling and enabling cooperative work between the agents, currently a strong requirement for many systems.

Each fusion operator was designed for a specific purpose. Depending on the situation, the modeler has to decide which fusion operator is the most suitable one. They can be classified according to two main categories:

Willingness to compromise. The **Belief Constraint Fusion** (BCF) operator can be used when the agents have already committed their choices and will not change their minds, at the potential cost of not being able to reach a consensus. In contrast, the **Consensus and Compromise Fusion** (CCF) transforms conflicting opinions into vague beliefs, being suitable in situations where we look for consensus if it exists, and for a vague opinion otherwise.

Cumulative information. The **Aleatory** and **Epistemic Cumulative Belief Fusion** (aCBF and eCBF, resp.) operators are more suitable in situations where the amount of independent evidence increases when more sources are included (i.e., when more agents give their opinion). Contrarily, the **Averaging Belief Fusion** (ABF) operator is better when some dependency is assumed between sources and more sources will not necessarily mean more evidence, i.e., more agents providing opinions does not imply being closer to the truth because each agent has their own perception about the observed fact. Finally, the **Weighted Belief Fusion** (WBF) operator also assumes dependency between sources but the opinions are weighted depending on their confidence, i.e., the stronger the confidence (or, equivalently, the smaller the uncertainty), the higher the weight.

The following table summarizes the properties of the different fusion operators in subjective logic.

	Belief Constraint Fusion (BCF)	Cumulative Belief Fusion ([A&E]CBF)	Averaging Belief Fusion (ABF)	Weighted Belief Fusion (WBF)	Consensus & Compromise Fusion (CCF)
Agents' willingness to compromise	–	✓	✓	✓	✓
Dependence between opinions	✓	–	✓	✓	✓
Vacuous opinion is neutral element	✓	✓	–	✓	✓
Preserve shared beliefs; conflicting opinions turned into vague beliefs	–	–	–	–	✓

Exercise 3B. Weather forecast - reaching a consensus using the fusion operators (in groups of three people)

Using the three models decorated with the opinions of your friends and you (10 min):

1. select the most appropriate fusion operator to merge your opinions and explain why it was chosen,
2. fuse your opinions and check the value obtained,
3. try to reach a consensus about when to go out for jogging, if possible.

Then, respond ***individually*** to questionnaire Q3B (https://forms.gle/RKDJuGApAm7rHYRKA) (10 min).