

Fuzziness and artificial intelligence applied in spatial data processing

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The lecture will start with a general introduction of basic concepts from fuzzy logic, in particular, attention will go to different interpretations of fuzzy sets. The emphasis will be put on the difference between a possibilistic interpretation and a veristic interpretation, which is important as both interpretations are used further on. This introduction to fuzzy sets will serve as a basis to present fuzzy inference systems. Specifically, the Mamdani rulebase system will be explained. A rulebase system is one of the approaches in AI, where the training data is used to generate a set of fuzzy if-then rules, where both antecedent and consequent contain fuzzy sets. We will explain how a rulebase is constructed from training data and how subsequently is applied on datasets. Important aspects here are the various definitions of the parameters used in the system and both the interpretation and final processing of the output. The final processing is important as the rulebase outputs a fuzzy set, which needs to be interpreted as a crisp result is usually desired.

The next part is again a general introduction, but this time of spatial data, ranging from representation models to operations, with an emphasis on the issues that occur when combining datasets. Both feature-based and grid-based models are explained, along with some basics of the map algebra. The need for combining data from multiple datasets is detailed, as well as the issues that arise due to incompatible representations. Dealing with this requires regriding of one data set onto another; some current methods to deal with this are illustrated.

The final part of the lecture concerns an application of fuzzy rulebase systems in the context of spatial data processing. This is a novel approach where a fuzzy rulebase system is constructed in order to perform the regriding, making use of additional data that provides insight in the underlying spatial distribution in order to yield better results. Different aspects are considered, as the spatial problem has specific difficulties and imposes specific constraints that prevent a straightforward application of the rulebase system.