5th school on Belief Functions and Their Applications

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First Name:
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1 Graphical models for belief functions [Prakash Shenoy]

Please answer the following questions by selecting the appropriate answer, or providing detailed answer as requested.

1.1 There are several equivalent mathematical representations of belief functions. Which one of the below is semantically inappropriate for the Dempster-Shafer theory of belief functions:

☐ basic probability assignment (aka mass functions)

☐ plausibility functions

☐ commonality functions

☑ credal sets of probability mass functions

Credal set semantics are incompatible with Dempster's combination rule

1.2 Suppose m_1 is a mass function for A, and m_2 is a mass function for $\{A, B\}$, and m_3 is a mass function for $\{A, C\}$. Assume these are all distinct and we wish to find the marginal of the joint for C. Which of the following is the most efficient and correct method for finding such a marginal:

☐ $(m_1 \oplus m_2 \oplus m_3)^{\downarrow C}$

☐ $m_3^{\downarrow C}$

☑ $(m_1 \oplus m_2^{\downarrow A} \oplus m_2)^{\downarrow C}$

☐ $((m_1 \oplus m_2)^{\downarrow A} \oplus m_3)^{\downarrow C}$

As we are computing marginal for C, we should delete A and B is some sequence.
Deleting A first leads to global computation as A is in the domain of all three valuation.
So we should delete B first, which is only in the domain of m_2.

1.3 There are many combination rules for combining belief functions. Which of the following are central to the Dempster-Shafer theory of belief functions:

- ☐ Shafer's rule for discounting belief functions
- ☑ Dempster's rule for combining belief functions
- ☐ Disjunctive rule for combining belief functions
- ☐ Fagin-Halpern rule for updating belief functions

By definition, Dempster-Shafer belief functions theory uses Dempster's combination rule for combining belief functions, and is central to this theory.

1.4 The D-S theory of belief functions is an attractive uncertainty calculus for reasoning under uncertainty because:

- ☐ It is more efficient than using probability theory
- ☑ It is more flexible than using probability theory when we have missing information about priors and/or conditionals
- ☐ It is a newer theory that is more modern than probability theory
- ☐ It is more efficient than using possibility theory

First and last are false. Being new is not a justification for being attractive.

1.5 Graphical methods have become popular in practice because

- ☐ They allow us to represent knowledge in small chunks and reason from them
- ☐ They allow us to build very large models
- ☐ We can compute marginals of the joint very efficiently without explicitly computing the joint
- ☑ All of the above