



EMYCIN

CPSC 433
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Calculate This:

- Group the rules that lead to the conclusion h you want into set e .
- If $|e| = 1$ only one rule ($P_1 \wedge \dots P_n \Rightarrow_i h$).
 - $MB(h, e) = I(P_1 \wedge \dots P_n \Rightarrow_i h) * \max(0, \min(I(P_1), \dots I(P_n)))$
- If $|e| \geq 2$ ($e = \{e1, e2\}$)
 - $MB(h, \{e1, e2\}) = MB(h, \{e1\}) + MB(h, \{e2\}) * (1 - MB(h, \{e1\}))$
 - $MB(h, \{e1, e2\}) = 0$, if $MD(h, \{e1, e2\}) = 1$
- MD is calculated the same way, but now we want the rules $P_1 \wedge \dots P_n \Rightarrow_i \neg h$
- $I(h) = MB(h) - MD(h)$



A Problem (with numbers)

- If a student has good funding and a good GPA then there is a good chance (0.8) that the student will be accepted to grad school.
- If a student has a high community involvement and a low amount of outside obligations then there is a good chance (0.7) that they will be accepted to grad school.
- If a student has bad funding and a high amount of outside obligations then there is a chance (0.6) that the student will not be accepted to grad school.
- If a student has a low GPA, but has good research potential there is a chance (0.5) that they will be accepted to grad school.



Rules

- (e1): $\text{Funding}(X, \text{good}) \wedge \text{GPA}(X, \text{good}) \Rightarrow_1 \text{Accepted}(X)$; $I(e1) = 0.8$
- (e2): $\text{Involvement}(X, \text{high}) \wedge \text{Obligations}(X, \text{low}) \Rightarrow_2 \text{Accepted}(X)$;
 $I(e2) = 0.7$
- (e3): $\text{Funding}(X, \text{bad}) \wedge \text{Obligations}(X, \text{high}) \Rightarrow_3 \neg \text{Accepted}(X)$;
 $I(e3) = 0.6$
- (e4): $\text{GPA}(X, \text{low}) \wedge \text{Potential}(X, \text{high}) \Rightarrow_4 \text{Accepted}(X)$; $I(e4) = 0.5$



Other Inferences

- $I(\text{Funding}(\text{Bob}, \text{good})) = 0.7$
- $I(\text{GPA}(\text{Bob}, \text{high})) = 0.8$
- $I(\text{Involvement}(\text{Bob}, \text{high})) = 0.6$
- $I(\text{Obligations}(\text{Bob}, \text{low})) = 0.7$
- $I(\text{Funding}(\text{Bob}, \text{bad})) = 0.2$
- $I(\text{Obligations}(\text{Bob}, \text{high})) = 0.4$
- $I(\text{GPA}(\text{Bob}, \text{low})) = 0.2$
- $I(\text{Potential}(\text{Bob}, \text{high})) = 0.9$



So?

- Will Bob be accepted to grad school?
- Accepted(Bob)
- We need to know the measure of belief (MB) and the measure of disbelief (MD) of Accepted(Bob)
- MB and MD are not probabilities,
 - so $MB = 1 - MD$ is no necessarily true.



No Grad School for Bob

- $MD(\neg h, e) = I(P_1 \wedge \dots P_n \Rightarrow_i \neg h) * \max(0, \min(I(P_1), \dots I(P_n)))$
- $MD(\text{Accepted}(\text{Bob}), e3) = I(\text{Funding}(X, \text{bad}) \wedge \text{Obligations}(X, \text{high}) \Rightarrow_3 \neg \text{Accepted}(X)) * \max(0, \min(I(\text{Funding}(\text{Bob}, \text{bad})), I(\text{Obligations}(\text{Bob}, \text{high}))))$
- $MD(\text{Accepted}(\text{Bob}), e3) = 0.6 * \max(0, \min(0.2, 0.4))$
- $MD(\text{Accepted}(\text{Bob}), e3) = 0.6 * 0.2$
- $MD(\text{Accepted}(\text{Bob}), e3) = 0.12$



Grad School for Bob

- $MB(\text{Accepted}(\text{Bob}, \{e1\})) = I(\{e1\}) * \max(0, \min(I(\text{Funding}(\text{Bob}, \text{good})), I(\text{GPA}(\text{Bob}, \text{high}))))$
 - $= 0.8 * \max(0, \min(0.7, 0.8))$
 - $= 0.8 * 0.7 = 0.56$
- $MB(\text{Accepted}(\text{Bob}, \{e2\})) = I(\{e2\}) * \max(0, \min(I(\text{Involvement}(\text{Bob}, \text{high})), I(\text{Obligations}(\text{Bob}, \text{low}))))$
 - $= 0.7 * \max(0, \min(0.6, 0.7))$
 - $= 0.7 * 0.6 = 0.42$
- $MB(\text{Accepted}(\text{Bob}, \{e4\})) = I(\{e4\}) * \max(0, \min(I(\text{GPA}(\text{Bob}, \text{low})) \wedge I(\text{Potential}(\text{Bob}, \text{high}))))$
 - $= 0.5 * \max(0, \min(0.2, 0.9))$
 - $= 0.5 * 0.2 = 0.1$



Grad School for Bob

- $MB(\text{Accepted}(\text{Bob}), \{e2, e4\}) = MB(\text{Accepted}(\text{Bob}), \{e2\}) + MB(\text{Accepted}(\text{Bob}), \{e4\}) * (1 - MB(\text{Accepted}(\text{Bob}), \{e2\}))$
 - $= 0.42 + 0.1 * 0.58$
 - $= 0.48$
- $MB(\text{Accepted}(\text{Bob}, e) = MB(\text{Accepted}(\text{Bob}), \{e1, \{e2, e4\}\}) = MB(\text{Accepted}(\text{Bob}), \{e1\}) + MB(\text{Accepted}(\text{Bob}), \{e2, e4\}) * (1 - MB(\text{Accepted}(\text{Bob}), \{e1\}))$
 - $= 0.56 + 0.48 * 0.44$
 - $= 0.77$



Solution

- $I(h) = MB(h) - MD(h)$
- $I(\text{Accepted}(\text{Bob})) = MB(\text{Accepted}(\text{Bob})) - MD(\text{Accepted}(\text{Bob}))$
- $I(\text{Accepted}(\text{Bob})) = 0.77 - 0.12$
- $I(\text{Accepted}(\text{Bob})) = 0.65$