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Schülerpraktikum

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Einführung in FuzzyLogic



• Zustände im Rechner darstellen

Beispiel: Messwerte (1-9)

2 niedrig

4 mittel

9 hoch

Möglichkeit 1

durch Bereiche

niedrig = 1-3

mittel = 4-6

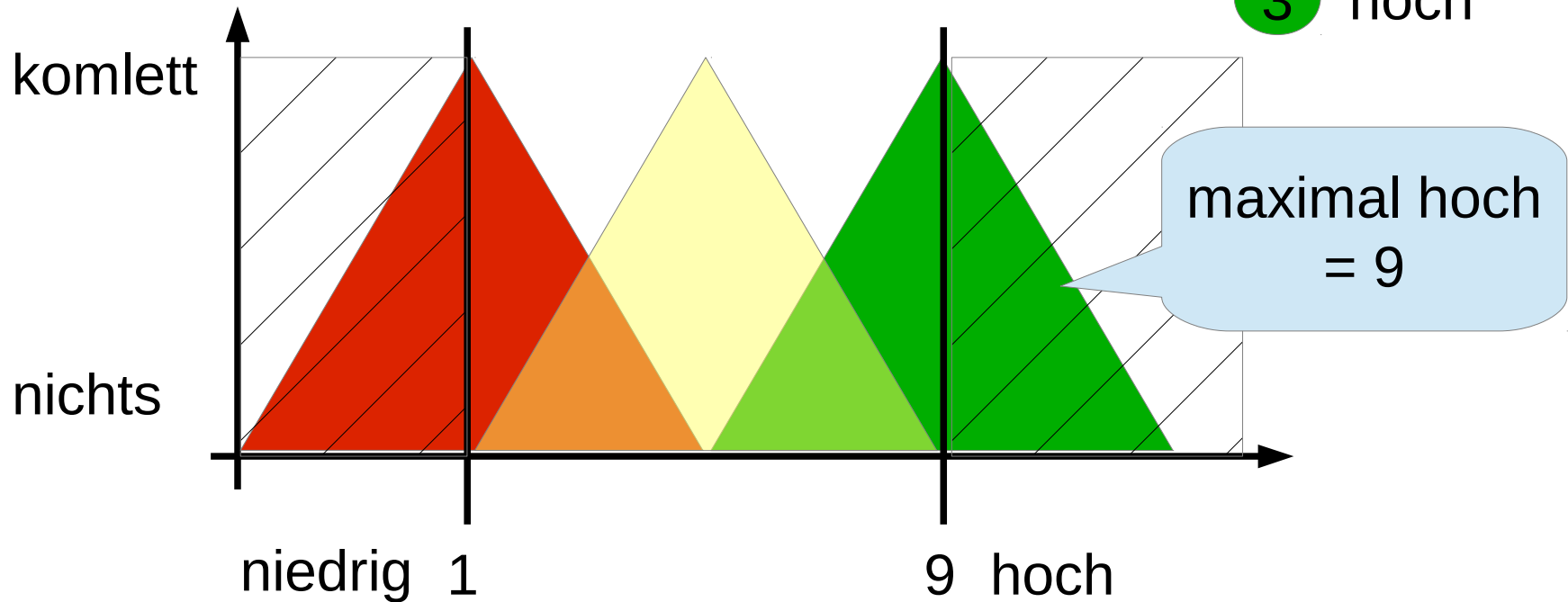
hoch = 7-9

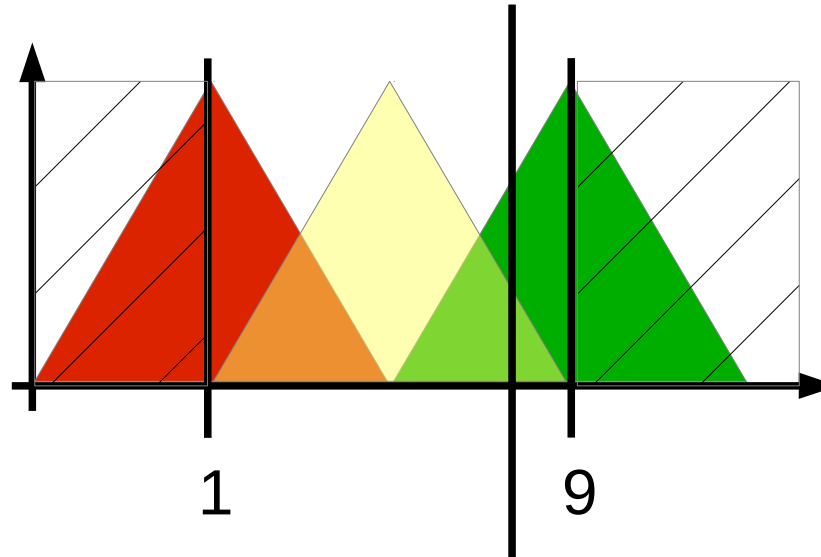
• Rechnen mit niedrig/mittel?

$$\begin{array}{ccccc} \text{2} & + & \text{9} & = & 11 = \text{sehr hoch?} \\ \text{niedrig} & & \text{hoch} & & = 11/2 = \text{mittel?} \end{array}$$

• Wertebereiche

- 1 niedrig
- 2 mittel
- 3 hoch





Zahl als (niedrig/mittel/hoch):

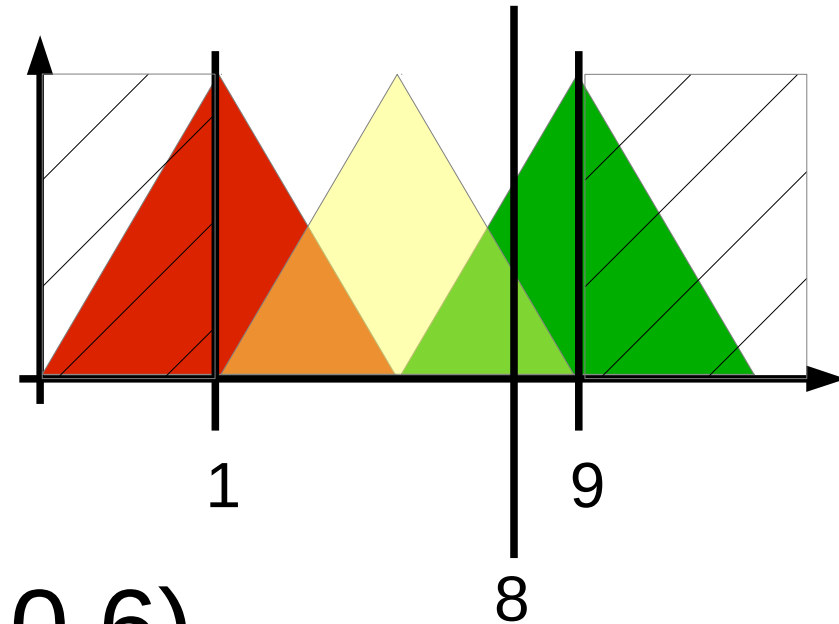
„nicht rot“	0 %
„kaum gelb“	20 %
„viel grün“	80 %

Zahl als (niedrig/mittel/hoch):

„nicht rot“ 0 %

„kaum gelb“ 40 %

„viel grün“ 60 %

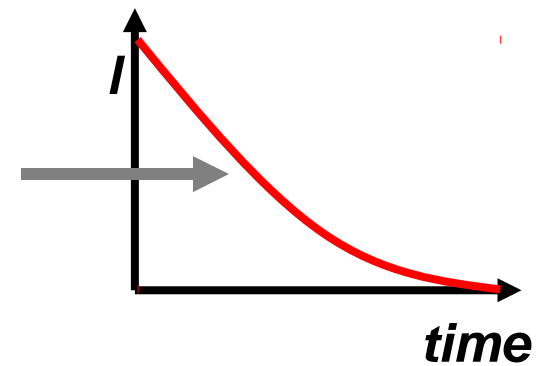
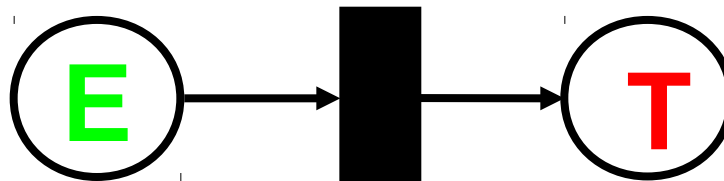
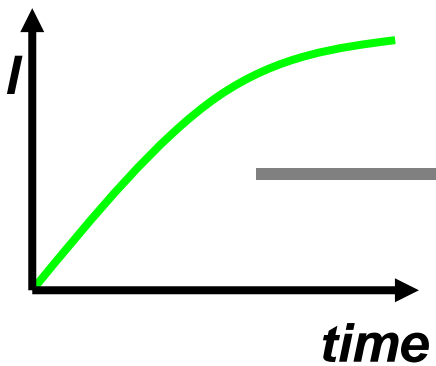


(0.0, 0.4, 0.6)

Fuzzy
Darstellung

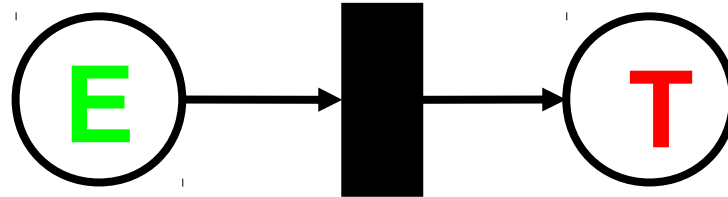
Simulation

PNFL: Petri Nets
with Fuzzy Logic

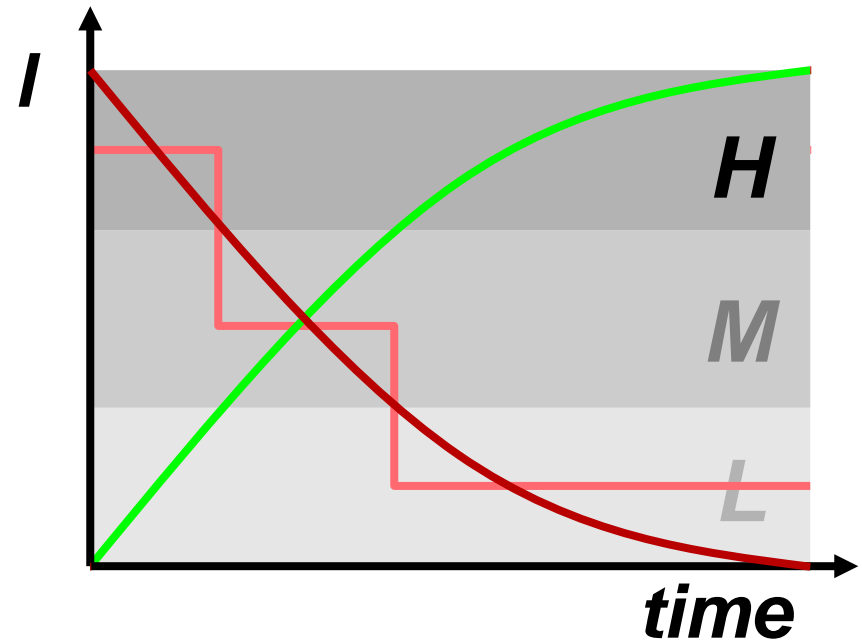


PNFL Modeling

Discrete vs. Fuzzy



E	T
$H=2$	$L=0$
$M=1$	$M=1$
$L=0$	$H=2$

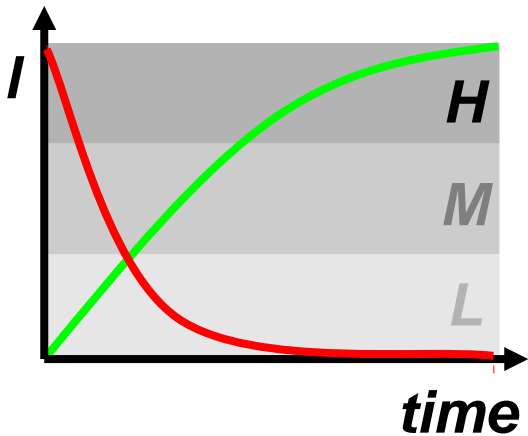


PNFL Modeling (2)

Effect Strength

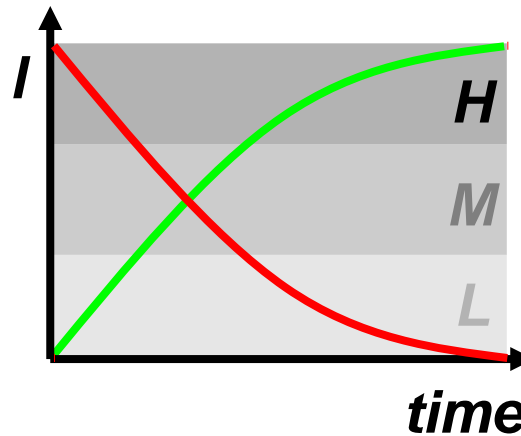


E	T
H	L
M	L
L	H



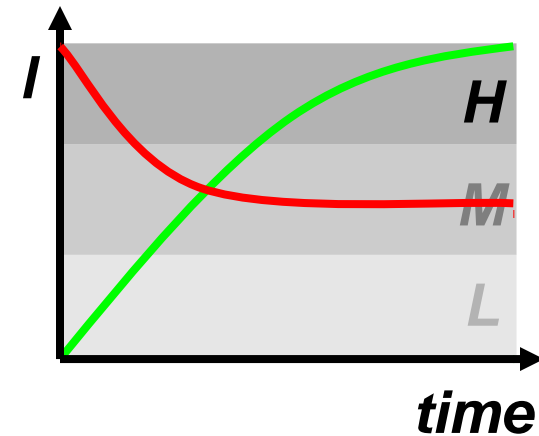
**Strong
Inhibitor**

E	T
H	L
M	M
L	H

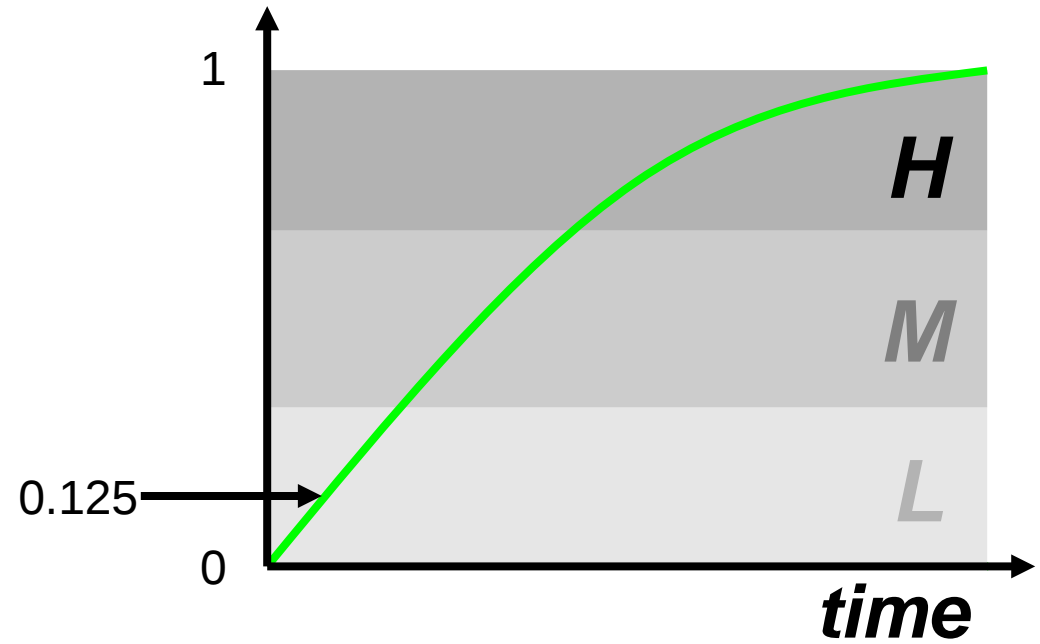


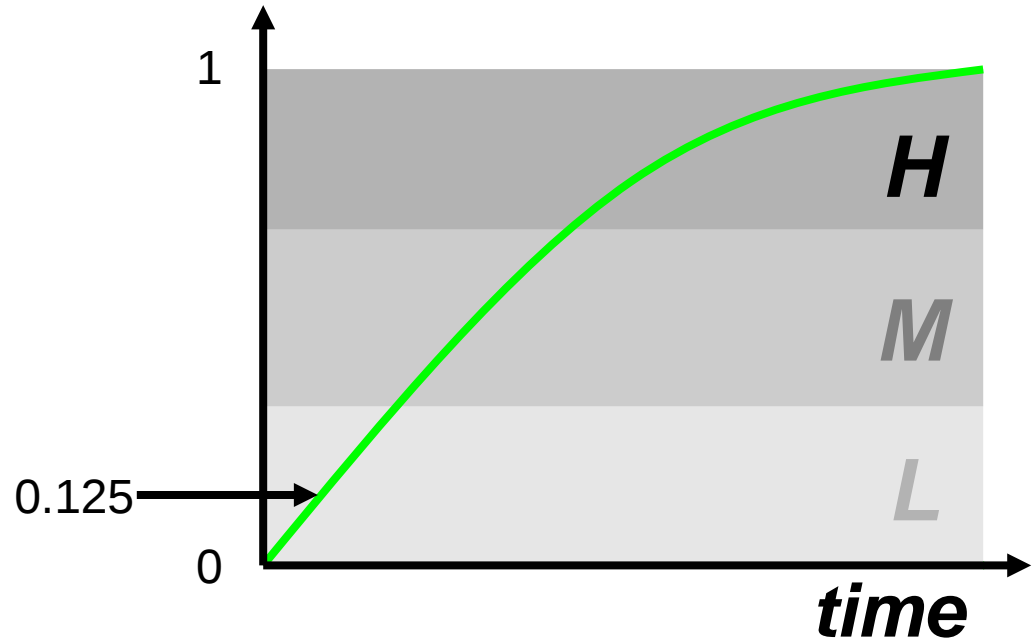
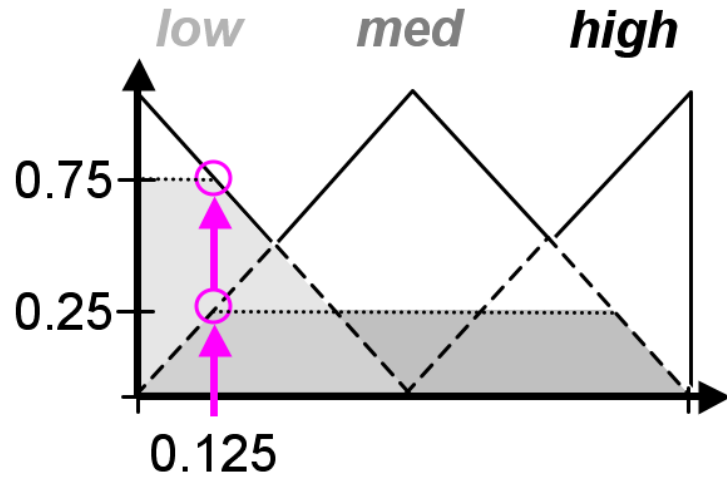
**Medium
Inhibitor**

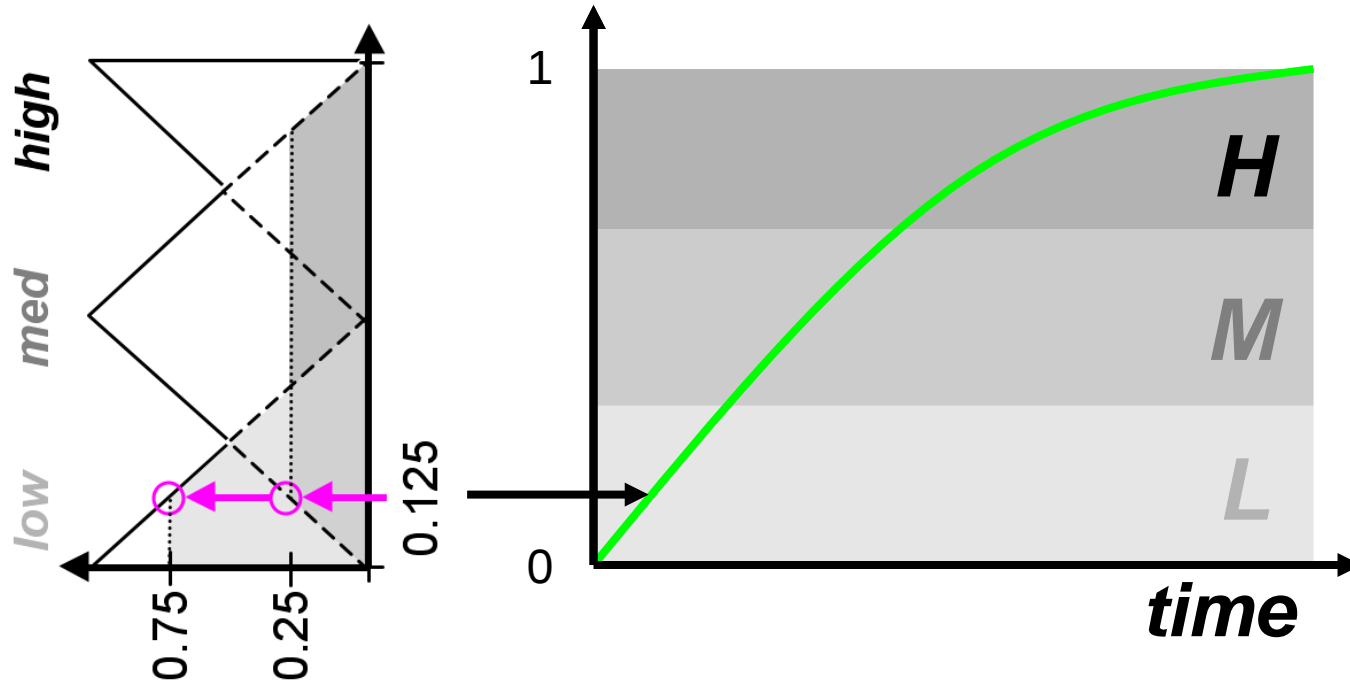
E	T
H	M
M	M
L	H



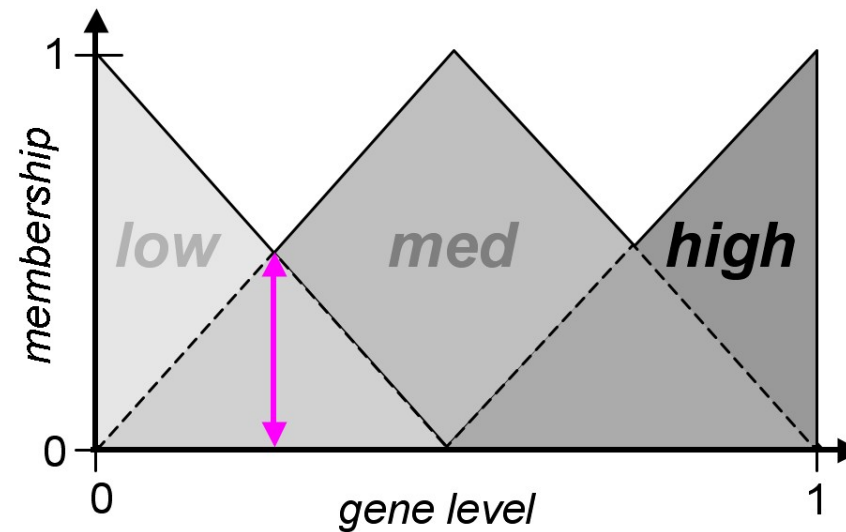
**Weak
Inhibitor**







Bedingung	Low	Medium	High
$v < 0.5$			0
$v \geq 0.5$	0		



Bedingung**Low****Medium****High**

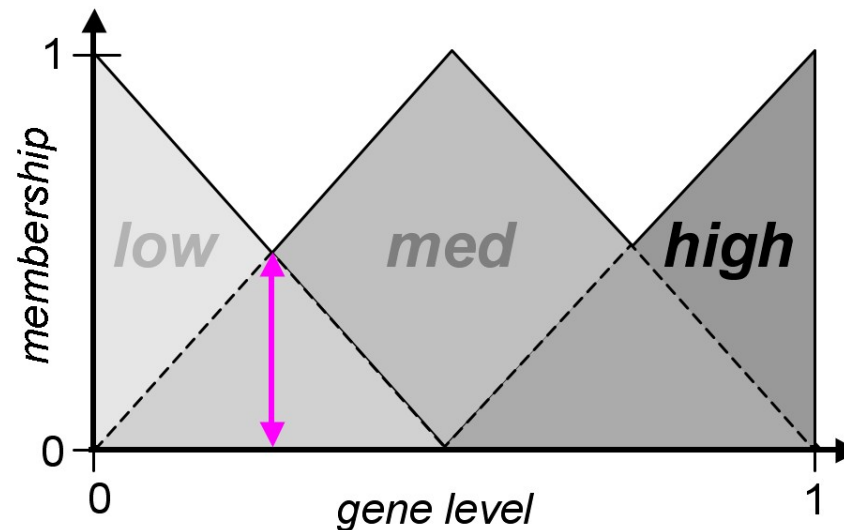
$$v < 0.5$$

$$2v$$

$$0$$

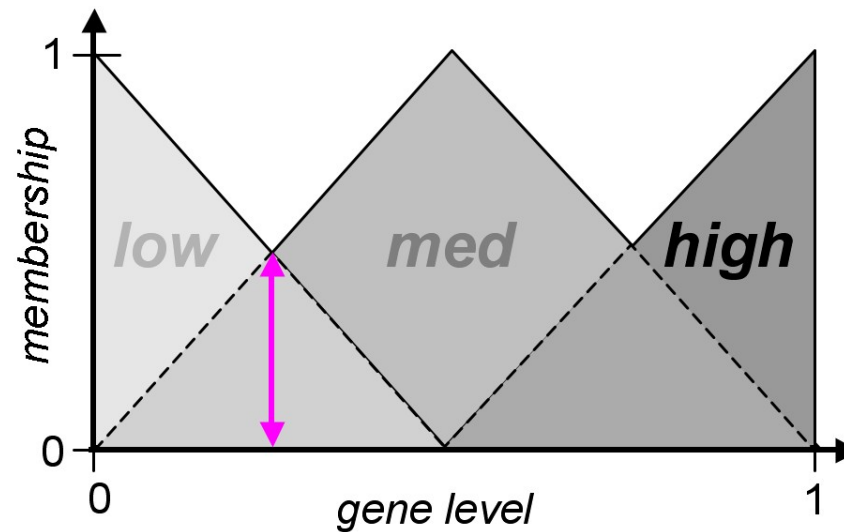
$$v \geq 0.5$$

$$0$$

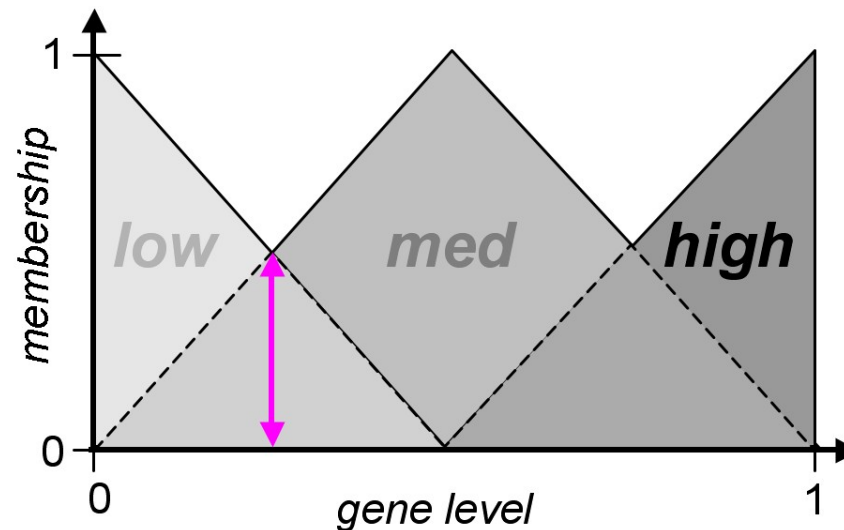


Bedingung
Low
Medium
High
 $v < 0.5$
 $-2v+1$
 $2v$
 0
 $v \geq 0.5$
 0

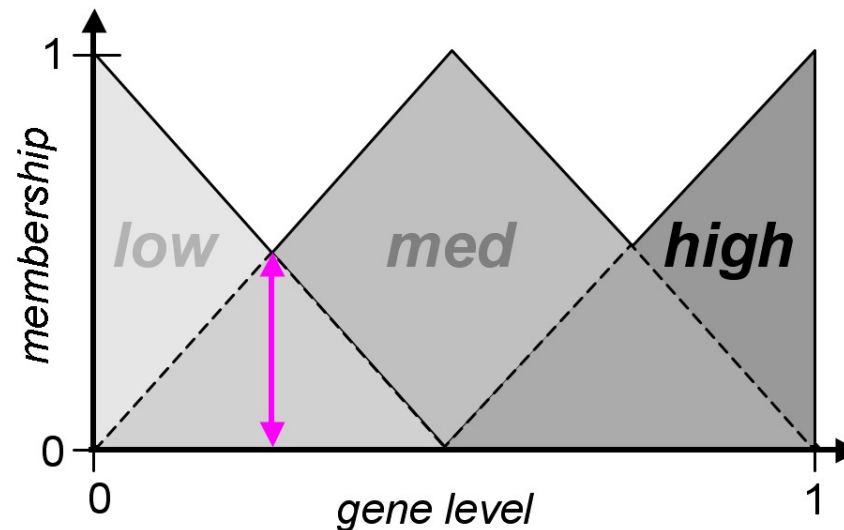
$$y = av + b$$



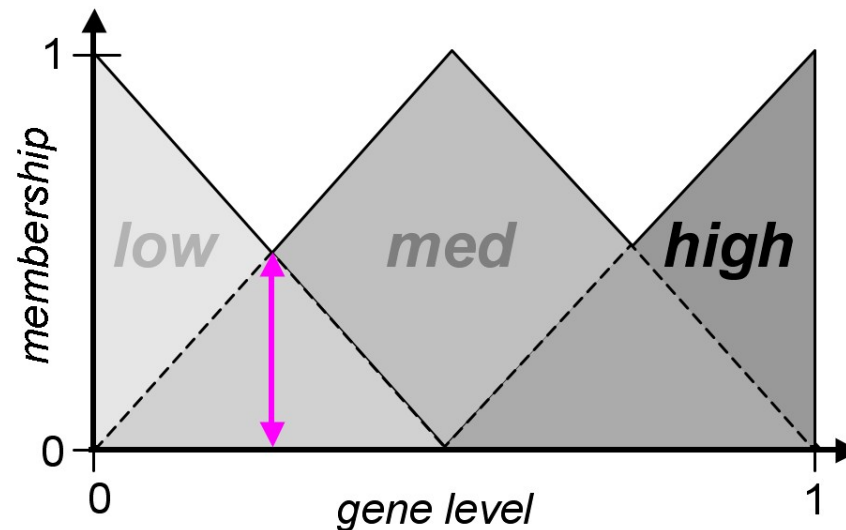
Bedingung	Low	Medium	High
$v < 0.5$	$-2v+1$	$2v$	0
$v \geq 0.5$	0	$-2v+2$	



Bedingung	Low	Medium	High
$v < 0.5$	$-2v+1$	$2v$	0
$v \geq 0.5$	0	$-2v+2$	$2v-1$



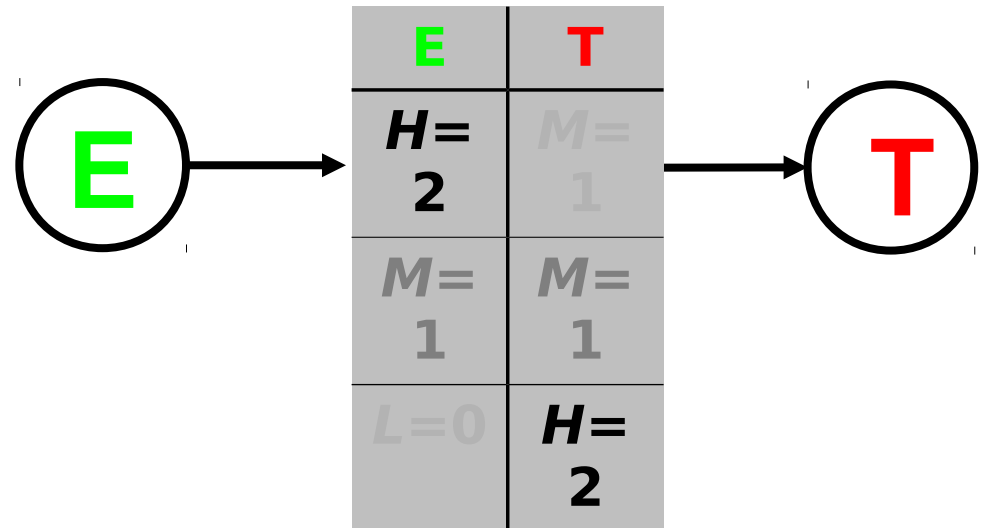
$$v = 0 * \text{Low} + 0.5 * \text{Medium} + 1.0 * \text{High}$$



- Jedes Gen hat eine Aktivität zwischen
 - “aus” = 0, and
 - “ein” = 1

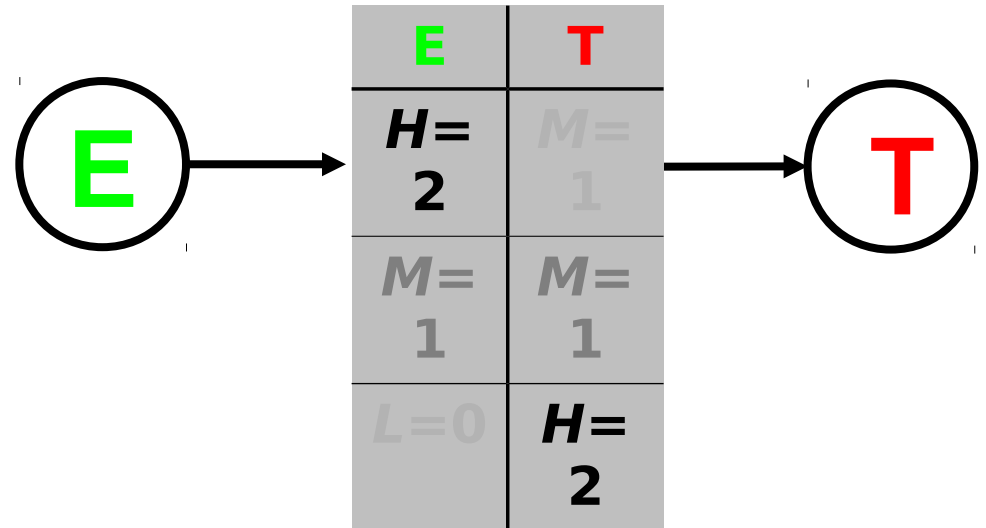
• Jedes Gen hat eine Aktivität irgendwo zwischen

- “aus” = 0, and
- “ein” = 1



- Jedes Gen hat eine Aktivität irgendwo zwischen

- “aus” = 0, und
- “ein” = 1



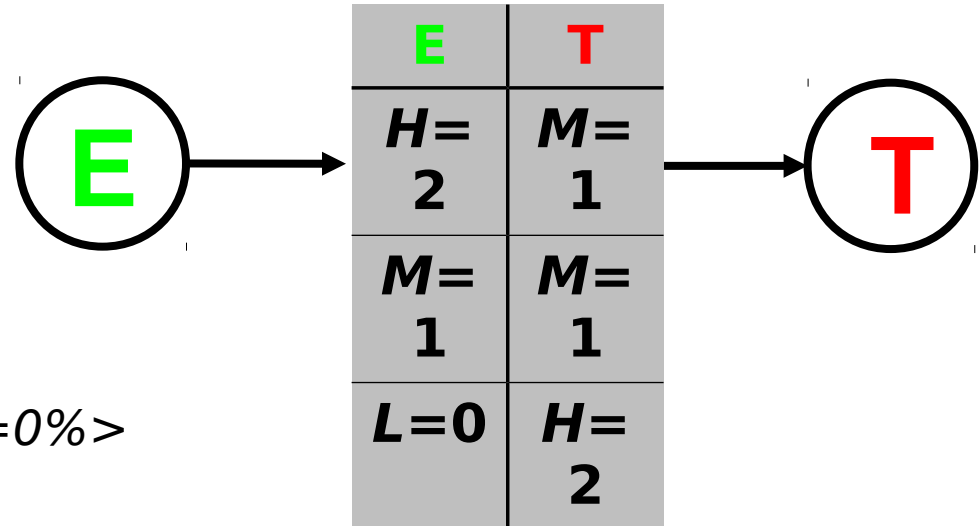
- Fuzzifikation:

- z.B. **0.125** =

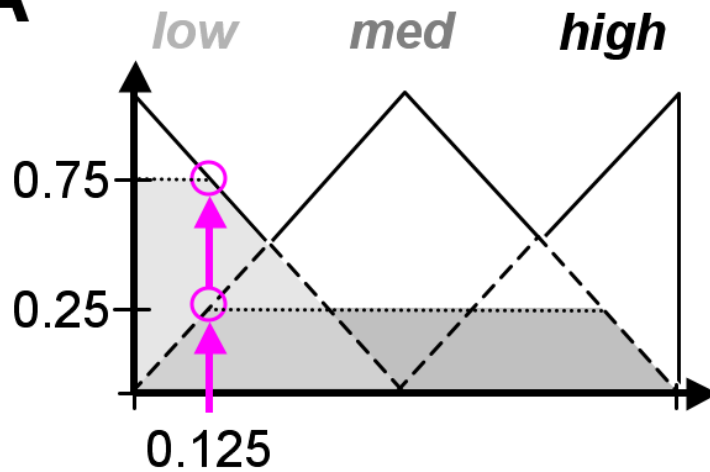
<low:75%, med:25%, high=0%>

- Jedes Gen hat eine Aktivität irgendwo zwischen

- “aus” = 0, and
- “ein” = 1



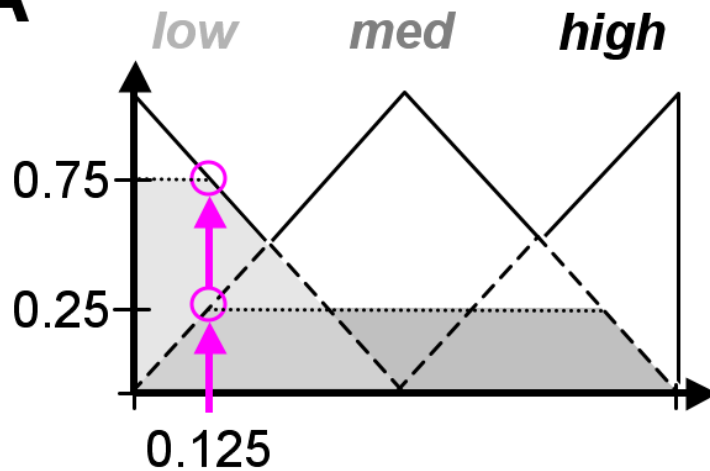
- Fuzzifikation:
 - z.B. **0.125** =
 $\langle low:75\%, med:25\%, high=0\% \rangle$
- Anwendung einer Regeltabelle:
 - z.B. $\langle low:0\%, med:25\%, high=75\% \rangle$
- Defuzzifikation:
 - $\langle 0\%, 25\%, 75\% \rangle = \mathbf{0.875}$

A

$$I_e = 0.125 \quad \left\{ \begin{array}{l} L(\text{high}, I_e) = 0.0 \\ L(\text{med}, I_e) = 0.25 \\ L(\text{low}, I_e) = 0.75 \end{array} \right.$$

Fuzzification

A



$$I_e = 0.125 \quad \begin{cases} L(\text{high}, I_e) = 0.0 \\ L(\text{med}, I_e) = 0.25 \\ L(\text{low}, I_e) = 0.75 \end{cases}$$

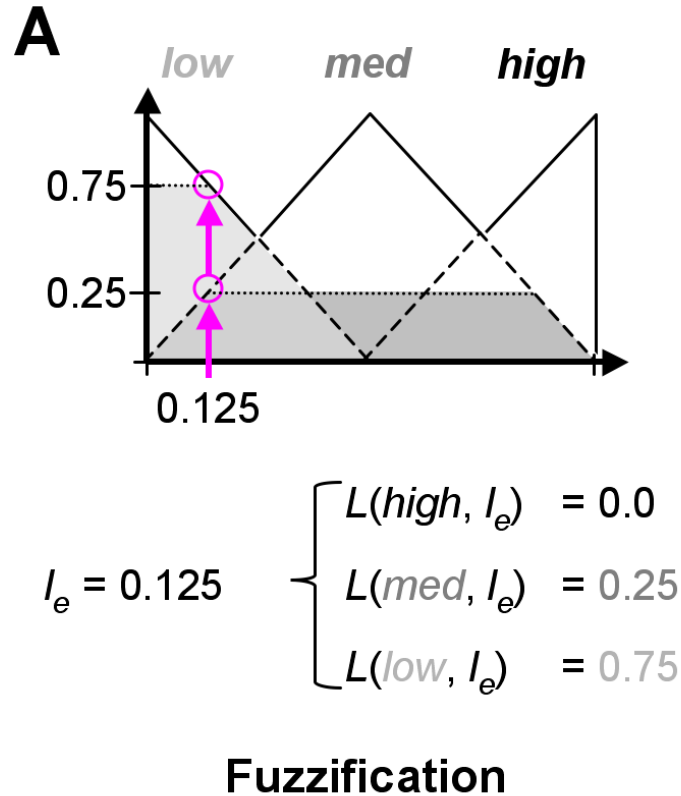
Fuzzification

B

e	t	
high	med	$r_{e,t}(\text{high}) = \text{med}$
med	med	$r_{e,t}(\text{med}) = \text{med}$
low	high	$r_{e,t}(\text{low}) = \text{high}$

$$\left. \begin{array}{l} \text{high} \\ \text{med} \\ \text{low} \end{array} \right\} \Sigma \rightarrow \begin{array}{l} C(\text{low}, I_e, r_{e,t}) = 0.0 \\ C(\text{med}, I_e, r_{e,t}) = 0.25 \\ C(\text{high}, I_e, r_{e,t}) = 0.75 \end{array}$$

Rule application



B

<i>e</i>	<i>t</i>
high	med
med	med
low	high

<i>e</i>	<i>t</i>
high	$r_{e,t}(\text{high}) = \text{med}$
med	$r_{e,t}(\text{med}) = \text{med}$
low	$r_{e,t}(\text{low}) = \text{high}$

\Leftrightarrow

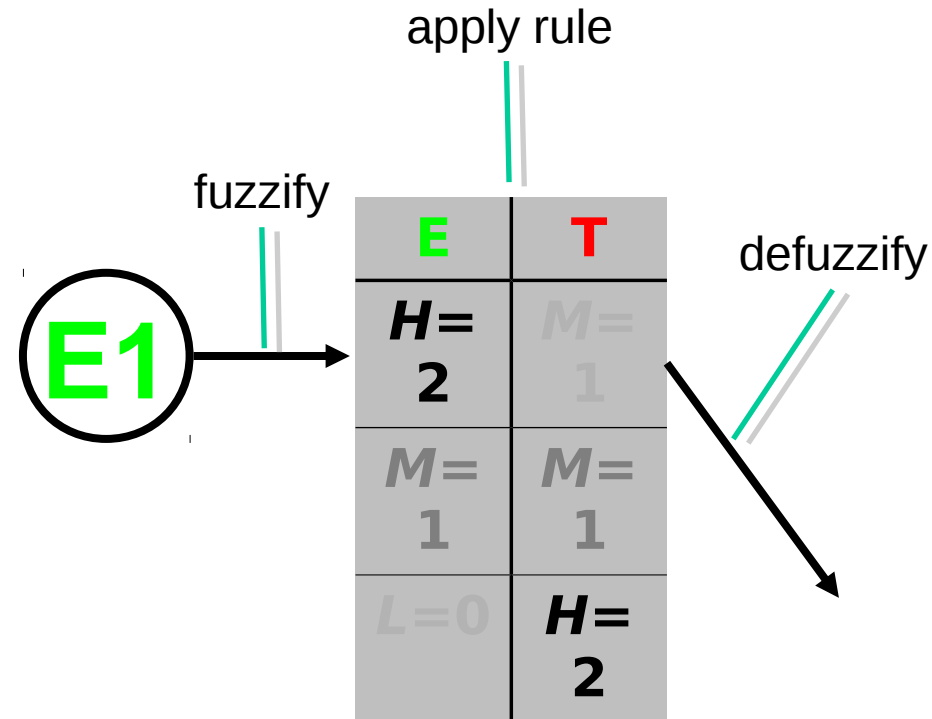
$\sum \rightarrow$

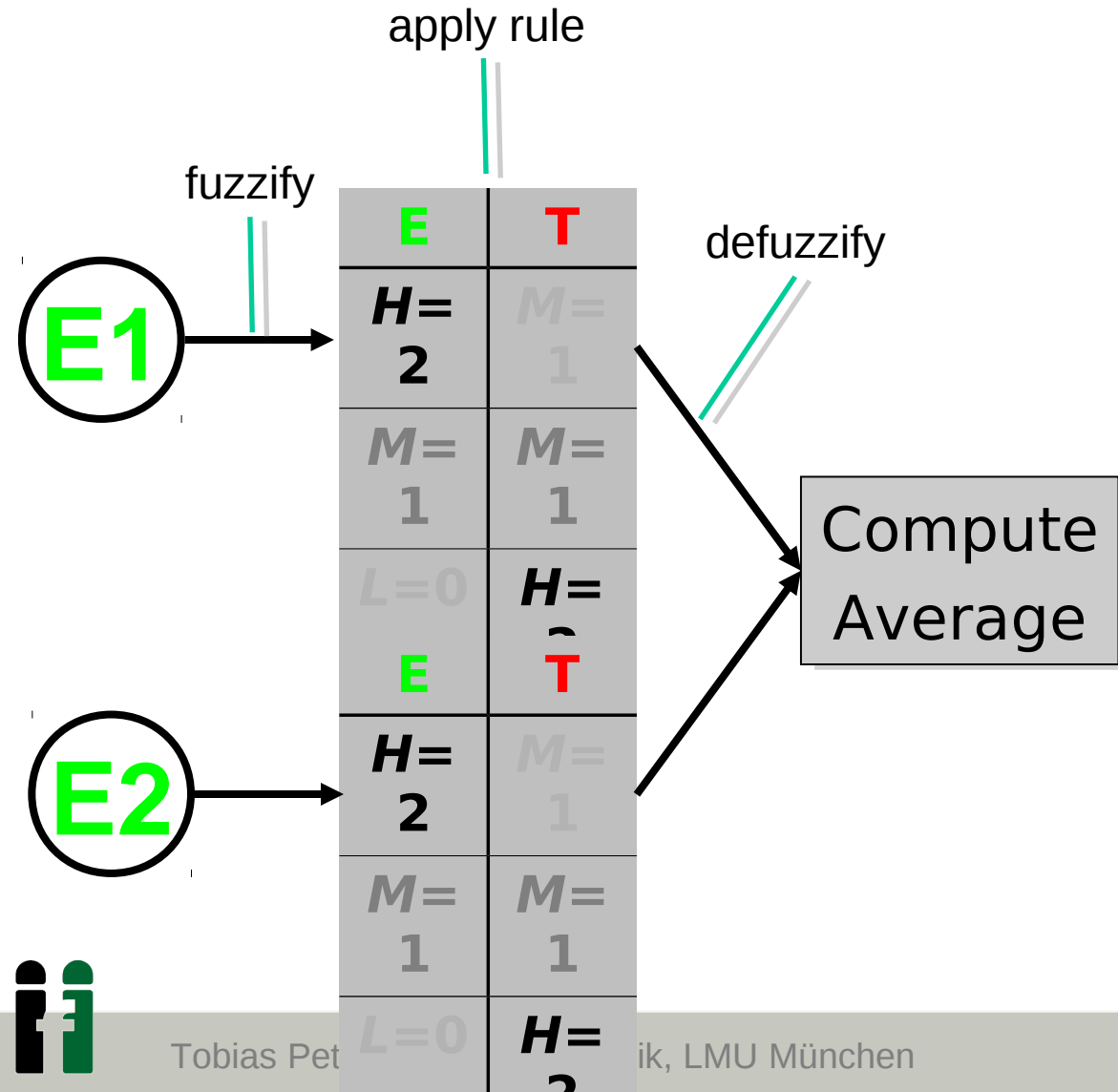
$C(\text{low}, I_e, r_{e,t}) = 0.0$
 $C(\text{med}, I_e, r_{e,t}) = 0.25$
 $C(\text{high}, I_e, r_{e,t}) = 0.75$

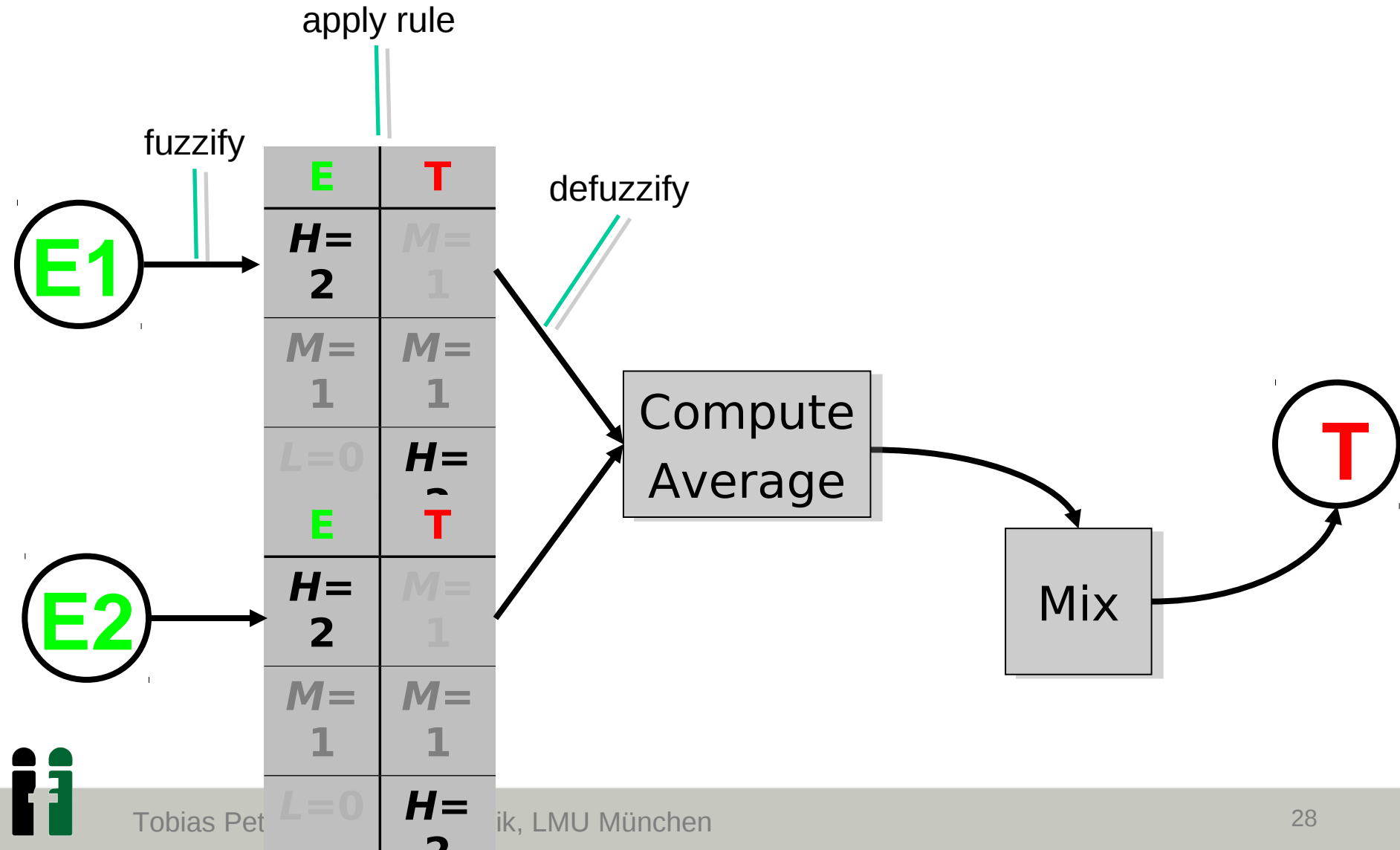
Rule application

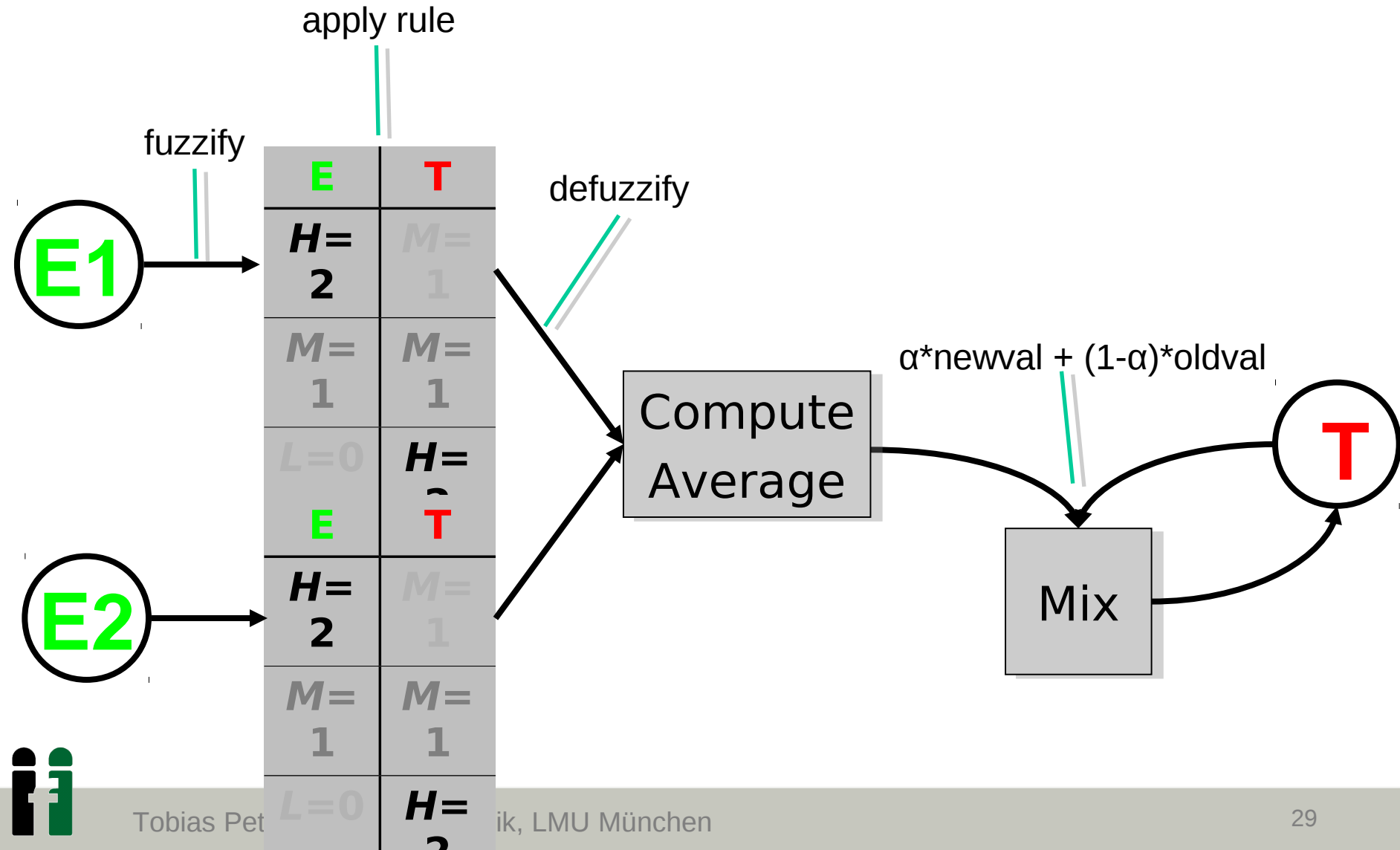
C **Defuzzification**

$$c(I_e, r_{e,t}) = \frac{0 \cdot 0.0 + 0.5 \cdot 0.25 + 1 \cdot 0.75}{0 + 0.25 + 0.75} = \underline{\underline{0.875}}$$









Insilico Experiment: Knockout/down

