Solingen GEOINFORMATION

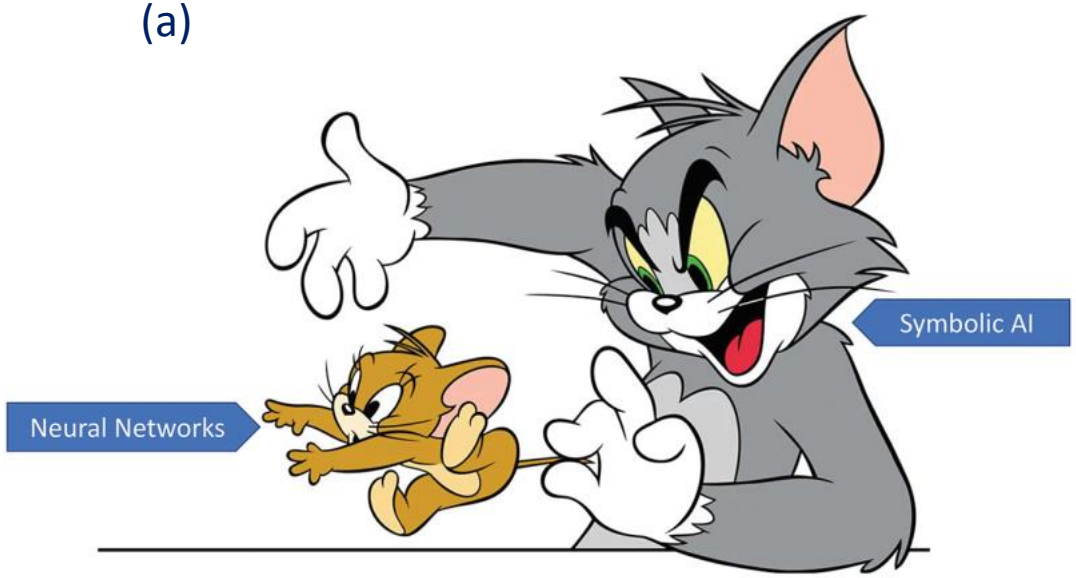
Perzeptron

SD62-1 Dr. Lingquan Zhao

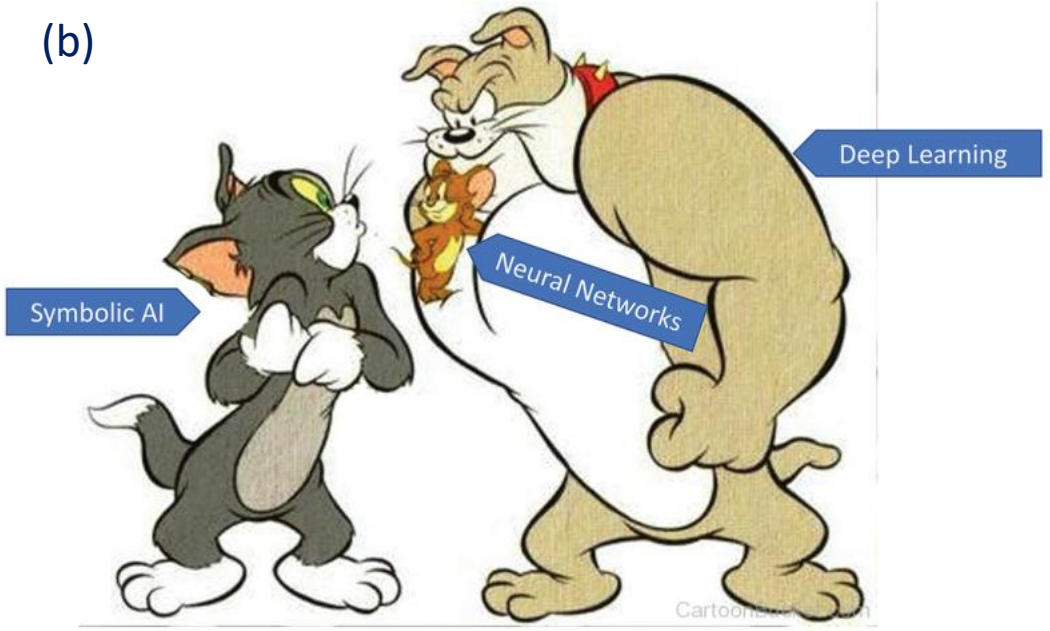
21.02.2024

Geschichte der KI

(a)



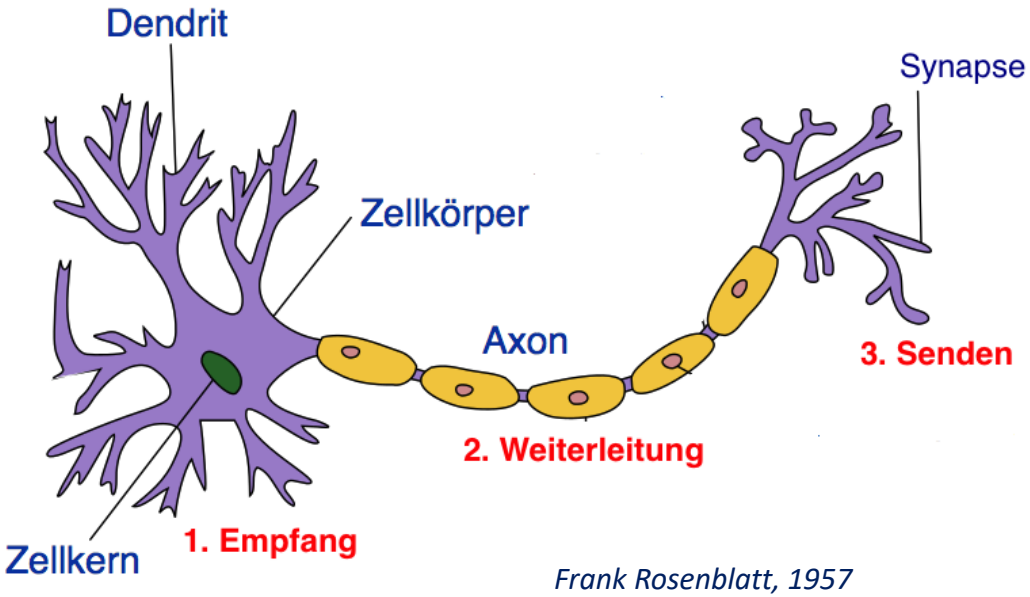
(b)



Cartoon-Geschichte der KI: (a) Tom (symbolische KI) besiegt Jerry (neuronale Netze). (b) Spike (Deep Learning) hält Jerry und schlägt Tom

Kautz, H., 2022

Neuron im Nervensystem



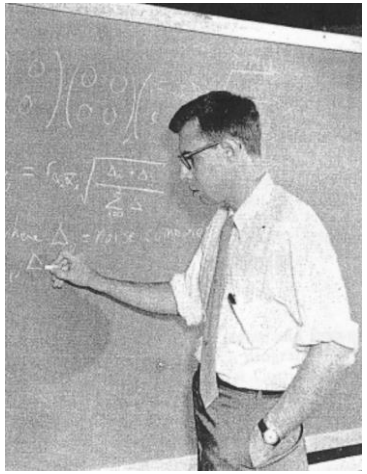
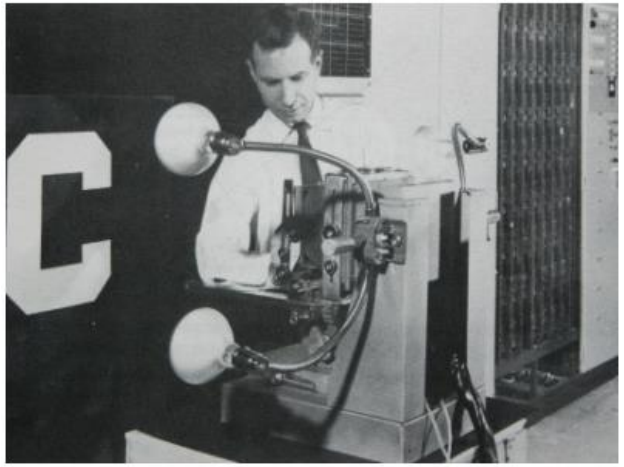
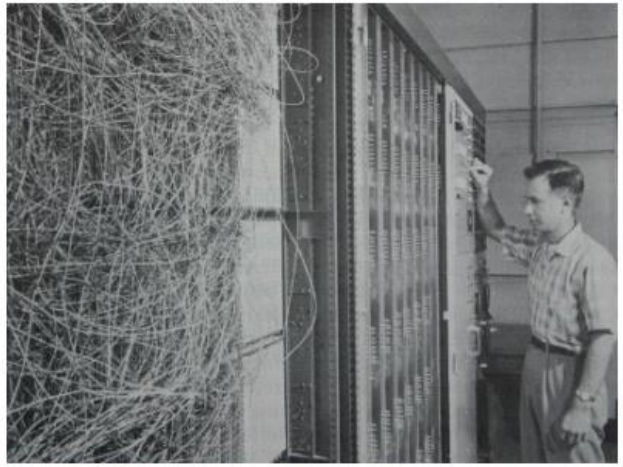
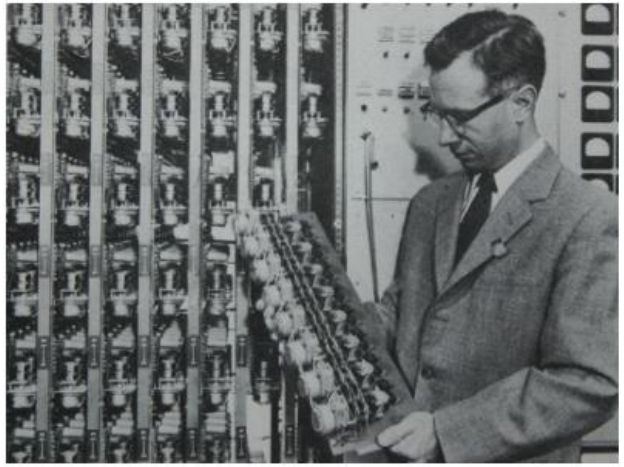
Frank Rosenblatt, 1957

Neuron im Nervensystem: viele Inputs, ein Output.

Threshold: Schwellenwert (m.)

die großen Männer

Frank Rosenblatt (1928-1971): Psychologe

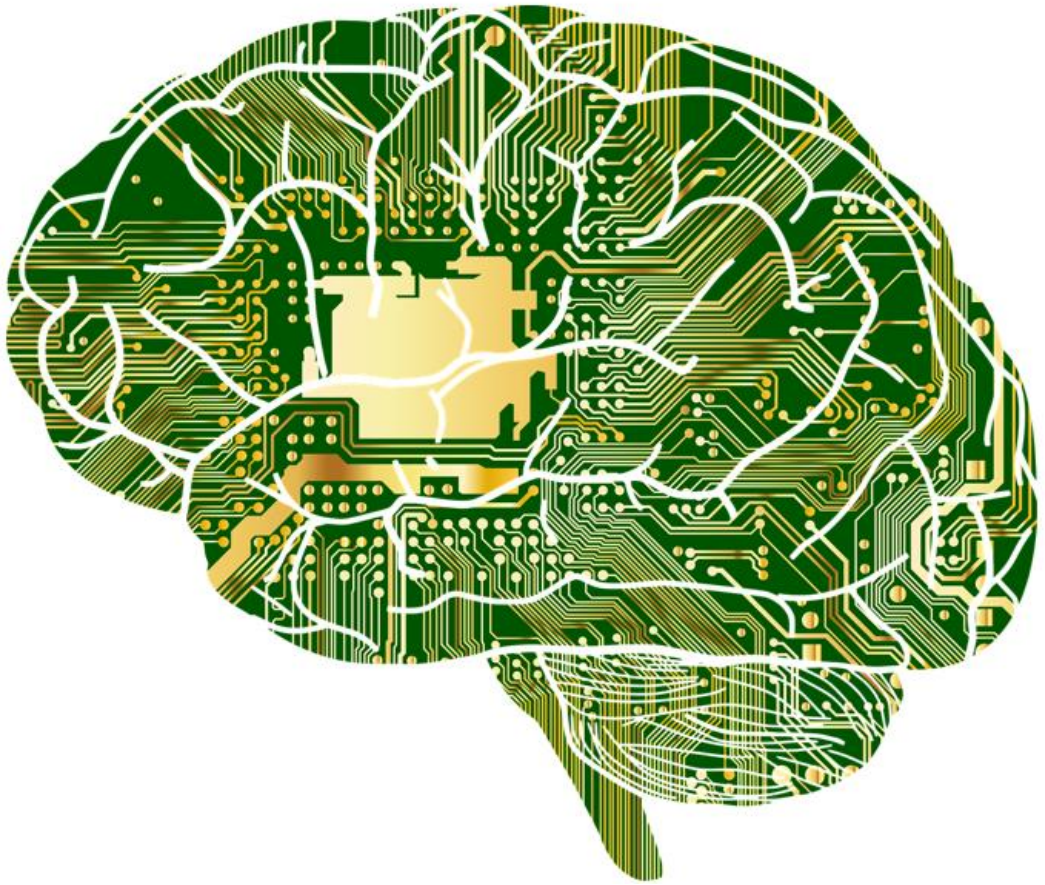





Bishop, 2006

Geoff Hinton (1947-): Psychologe

Nets: www

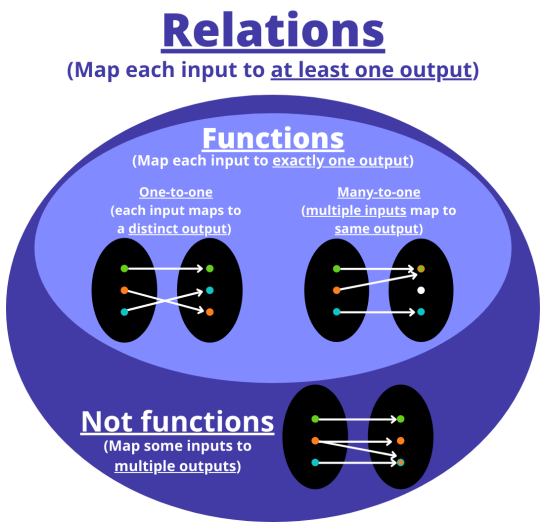
Perzeptron



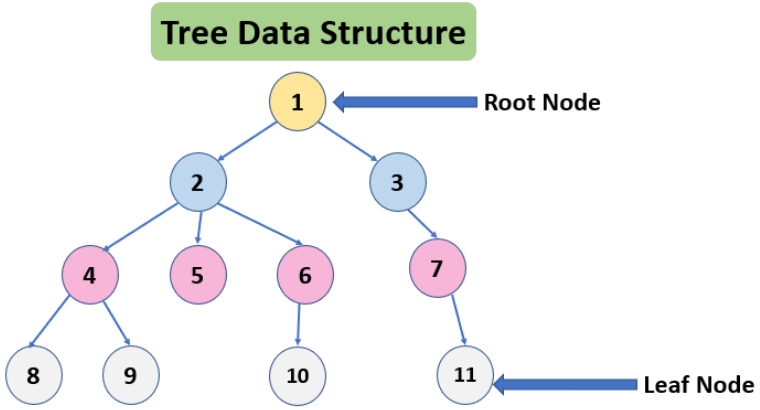
Logikgatter

Gatter-Typen	
	NOT
AND	NAND
OR	NOR
XOR	XNOR
AOI	OAI

Perzeptron



Funktion in der Mathematik: viele Inputs, ein Output.



Baum in Datenstruktur: viele Inputs, ein Output.

Perzeptron

1. How is information about the physical world sensed, or detected, by the biological system?
2. In what form is information stored, or remembered?
3. How does information contained in storage, or in memory, influence recognition and behavior?

Rosenblatt, F., 1958

1. Wie werden Informationen über die physikalische Welt durch das biologische System wahrgenommen oder erkannt?

2. In welcher Form werden Informationen gespeichert bzw. erinnert?

3. Wie beeinflussen die gespeicherten oder erinnerten Informationen das Erkennen und Verhalten?

Perzeptron

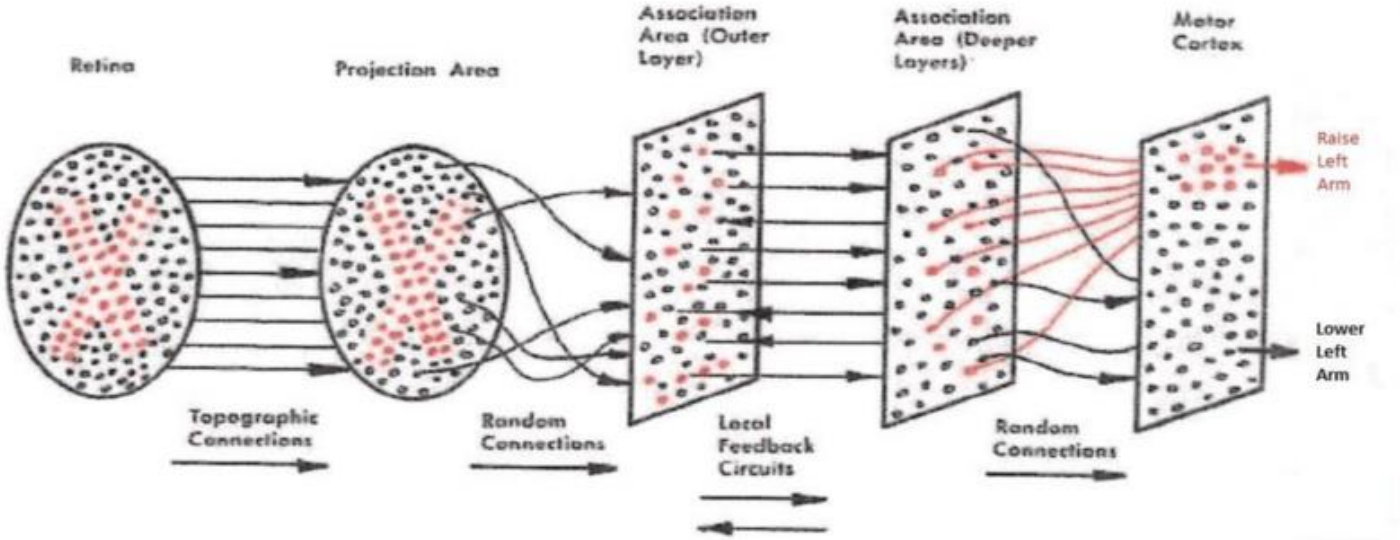


FIG. 1 — Organization of a biological brain. (Red areas indicate active cells, responding to the letter X.)

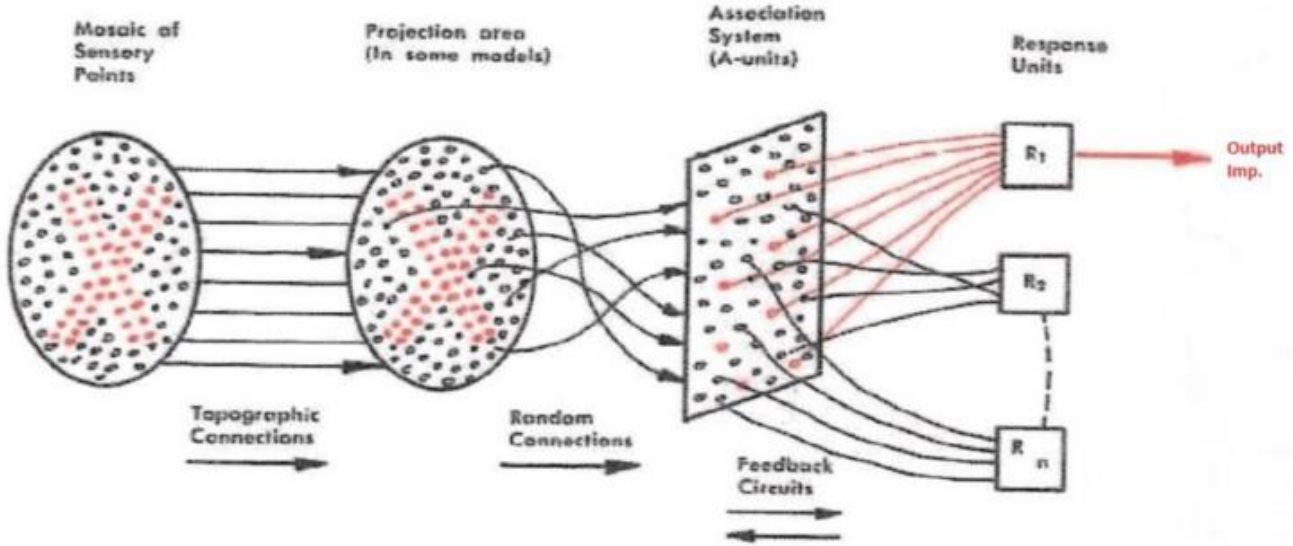


FIG. 2 — Organization of a perceptron.

Rosenblatt, 1958

Perzeptron

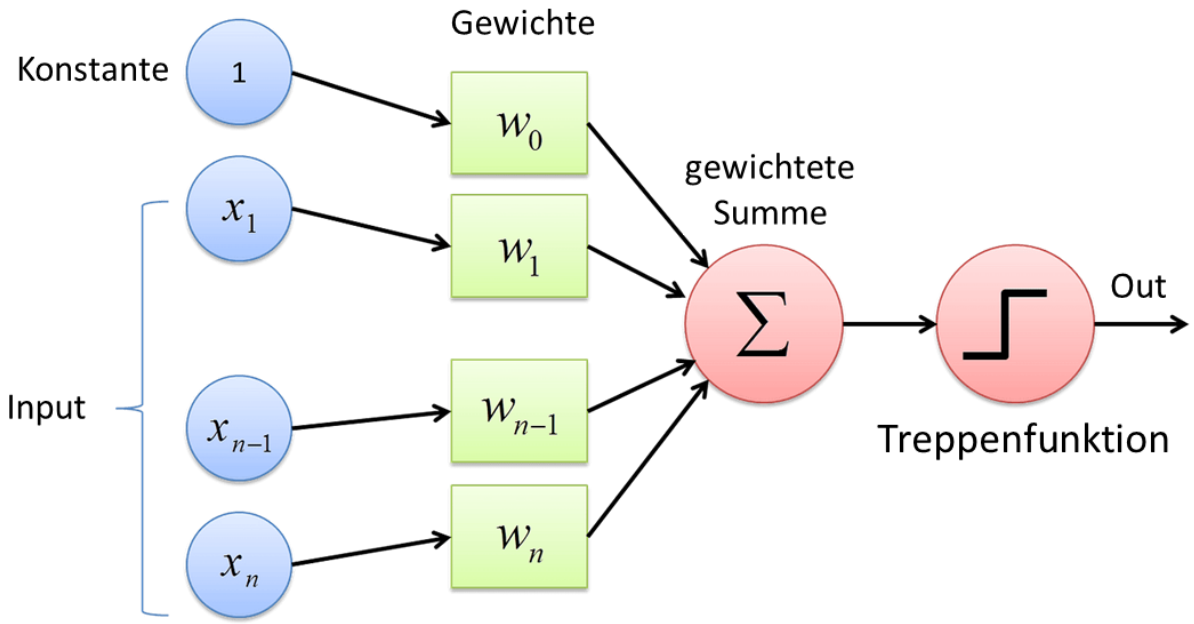
$$t = f\left(\sum_{i=1}^{n} w_i x_i + b\right) = f(\mathbf{w}^T\,\mathbf{x})$$

Dabei ist:

$\mathbf{W} = [w_1\ w_2 \ldots wn\ b\ ]^T$

$\mathbf{X} = [x_1\ x_2 \ldots\ x_n\ 1\ ]^T$

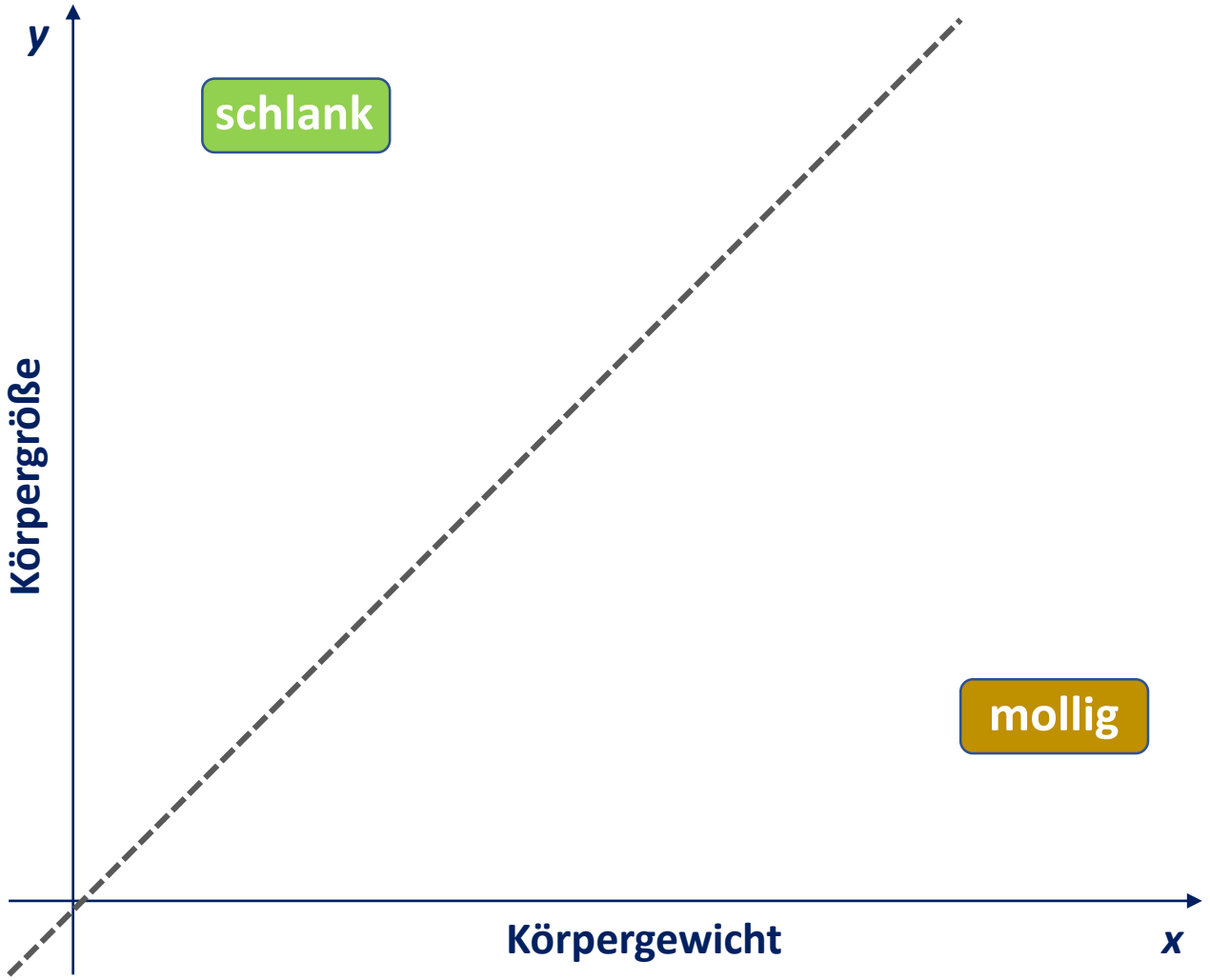
$$f(n) = \begin{cases} +1 & \text{n} \geq 0 \\ -1 & \text{ansonsten} \end{cases}$$



Perzeptron

ID	Körpergröße (m)	Körpergewicht (kg)
P1	1,1	20
P2	1,6	50
P3	1,3	39
P4	0,8	18
P5	1,6	55
P6	1,9	80
P7	1,7	75
P8	1,2	55
P9	1,5	60
P10	1,0	22
…	…	…

Perzeptron



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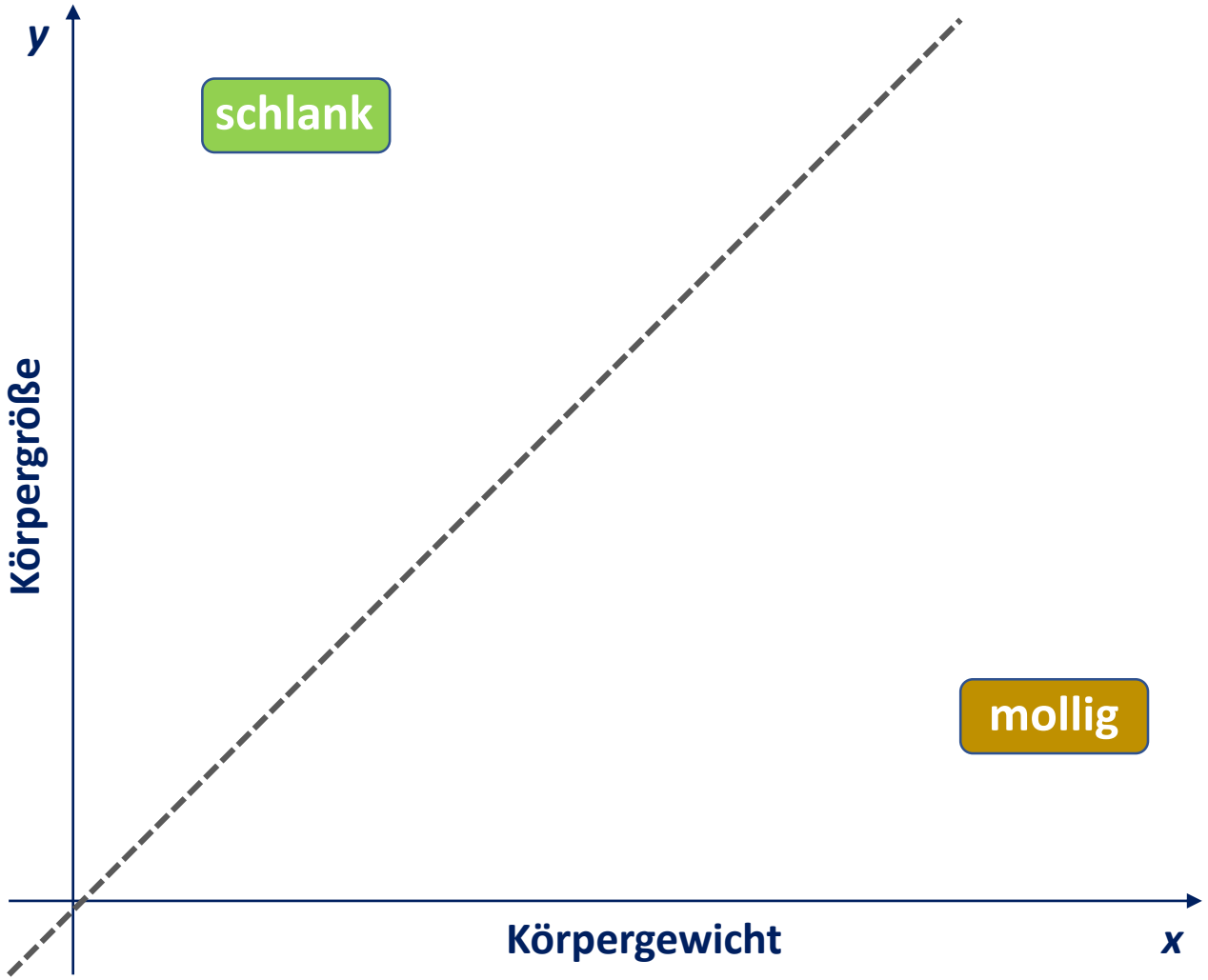
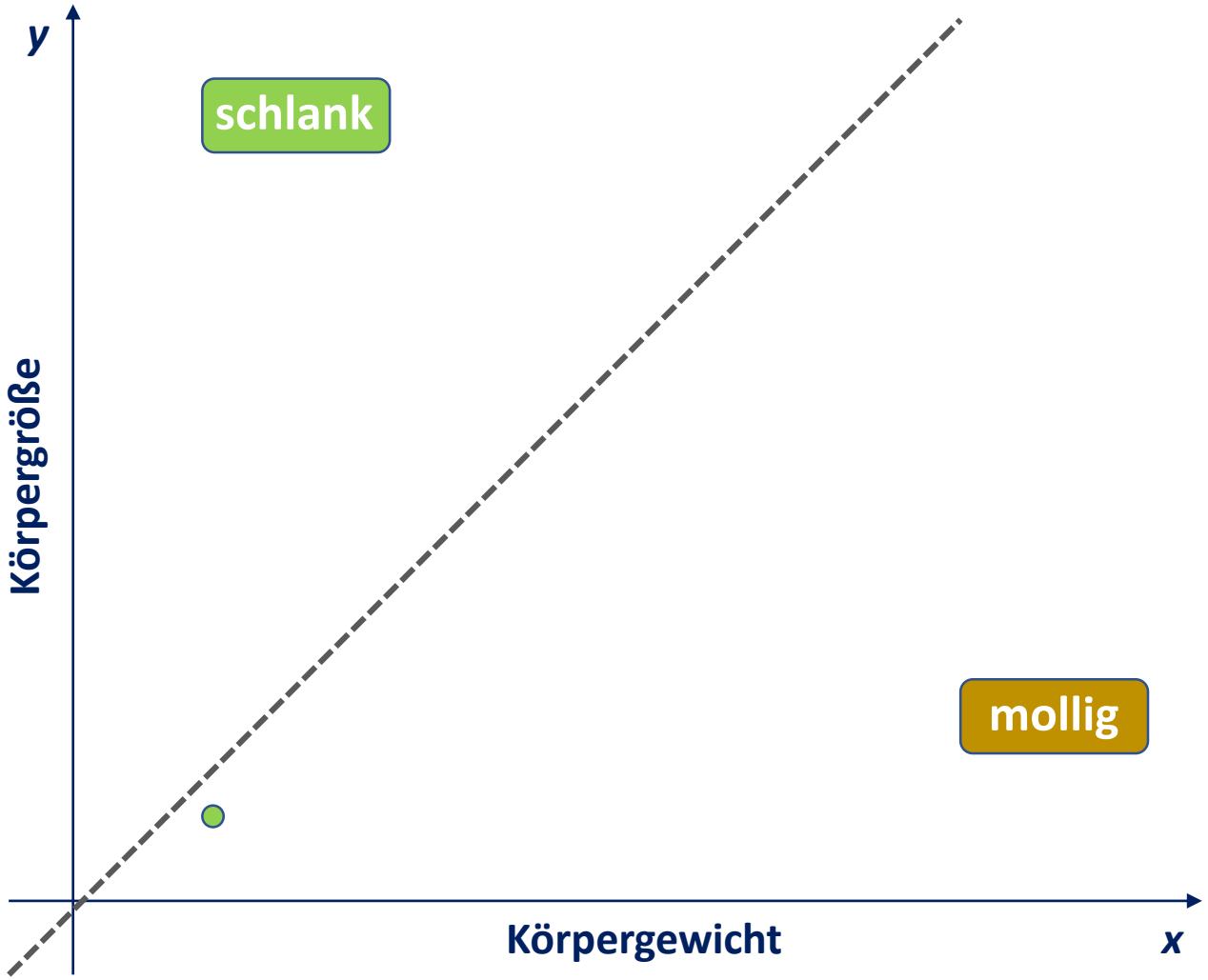


Perzeptron



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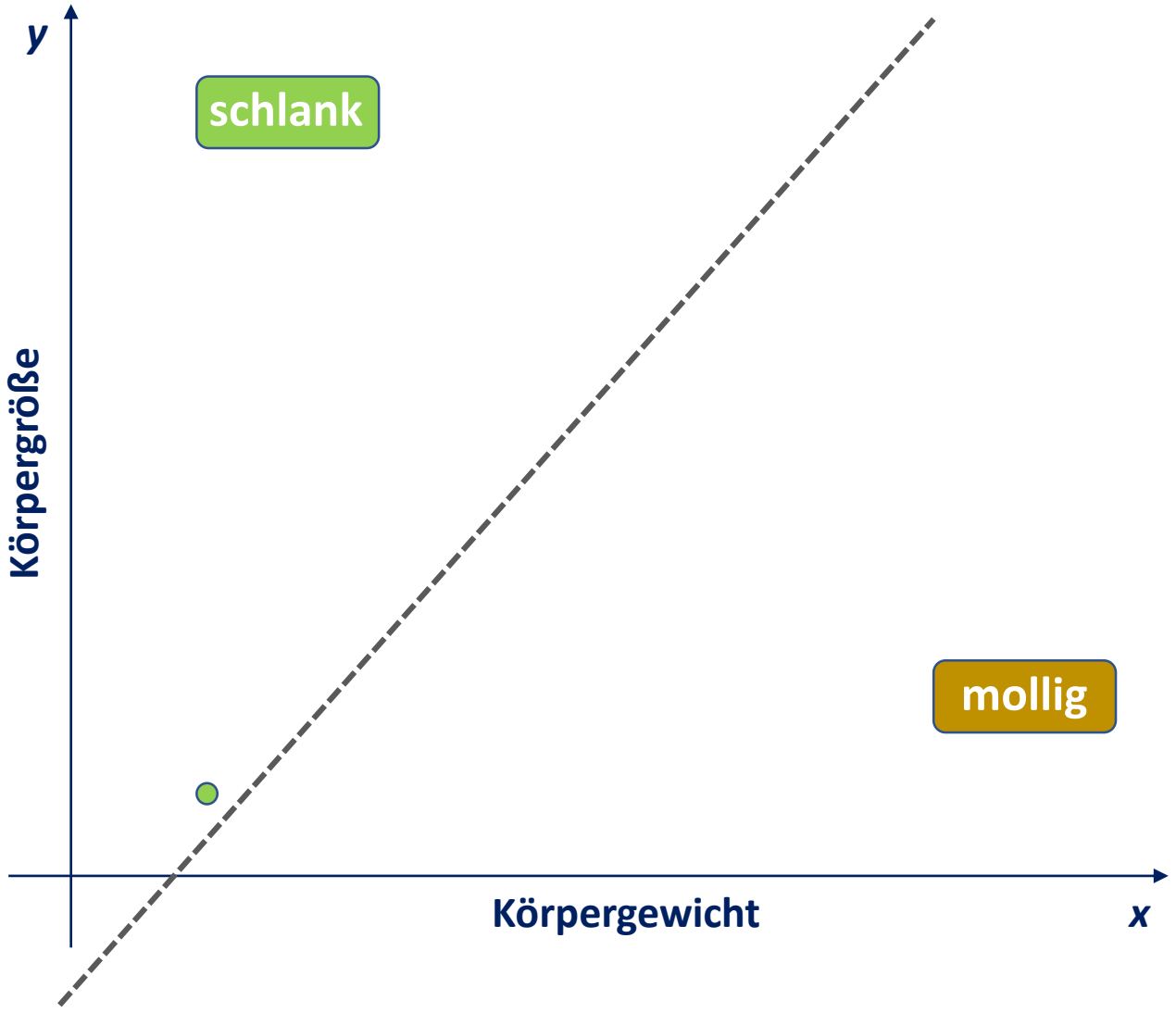

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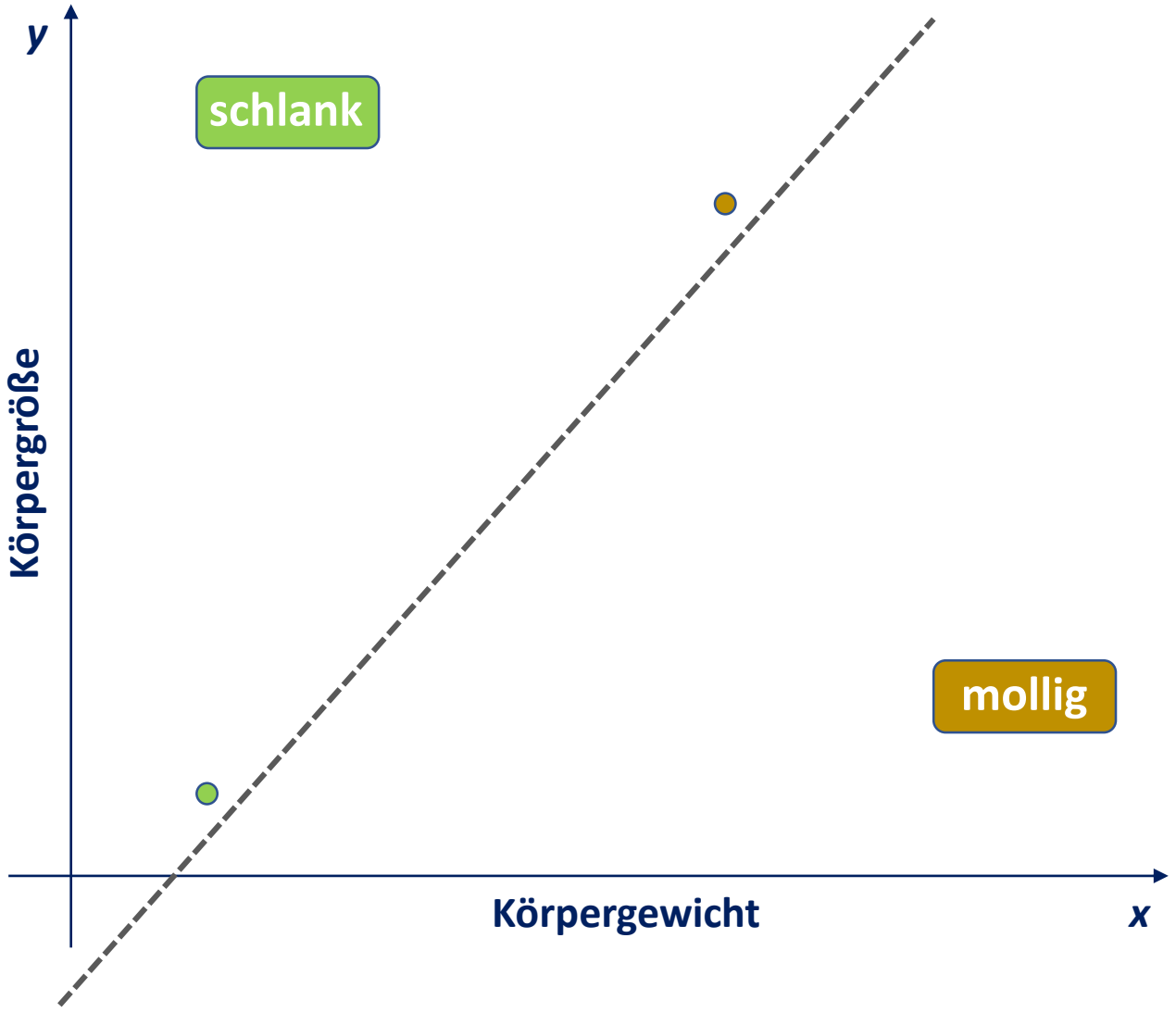

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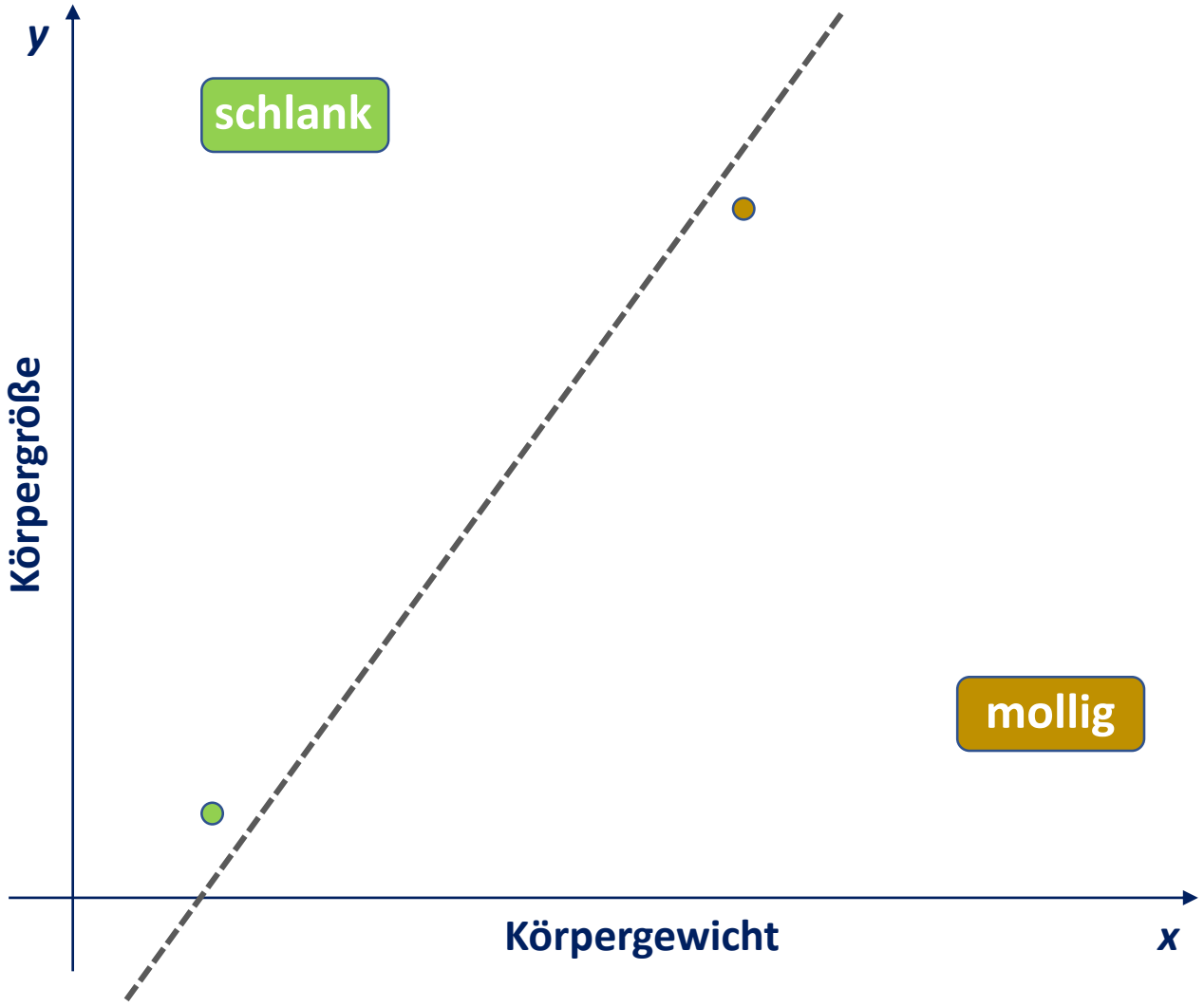

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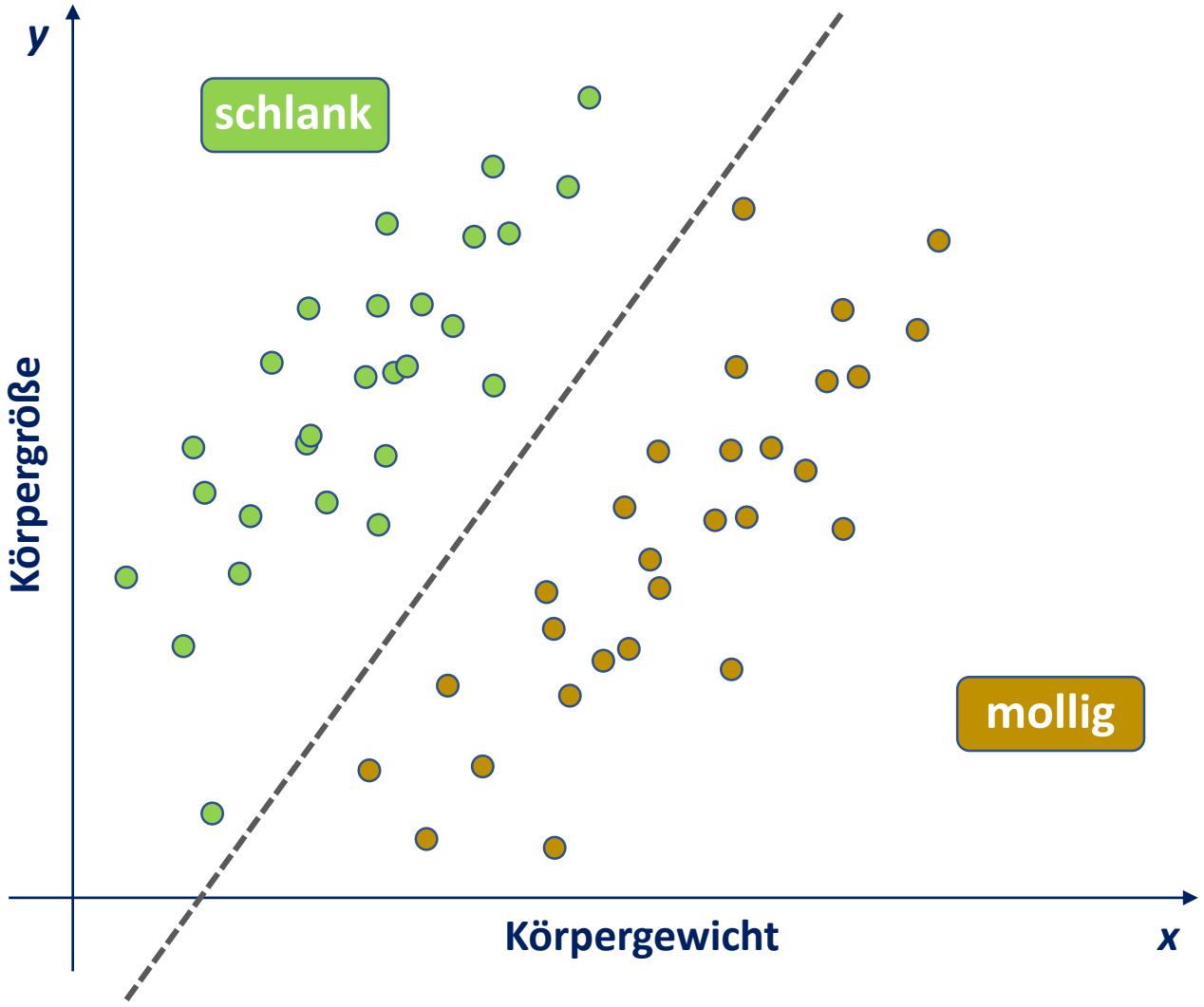

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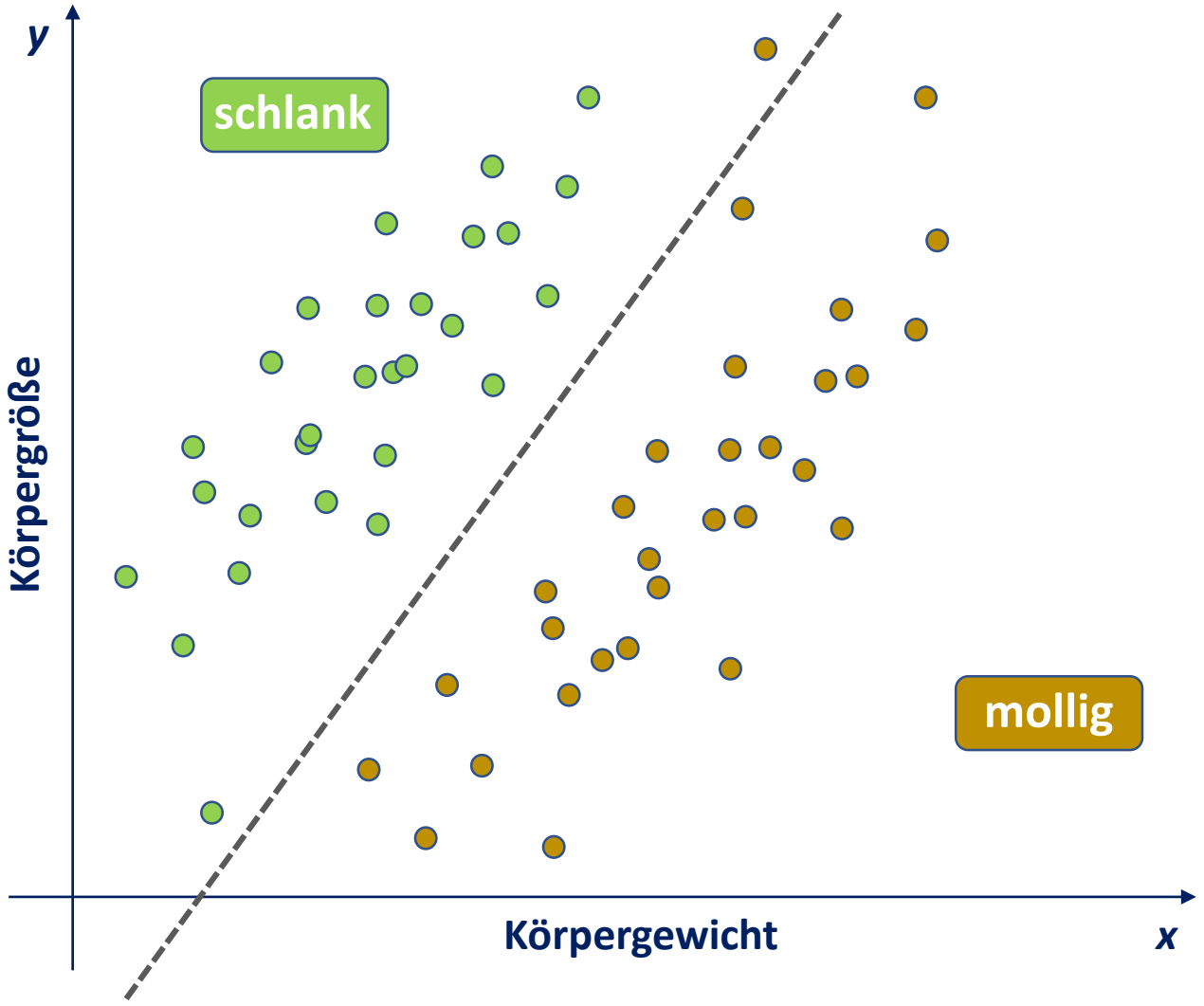

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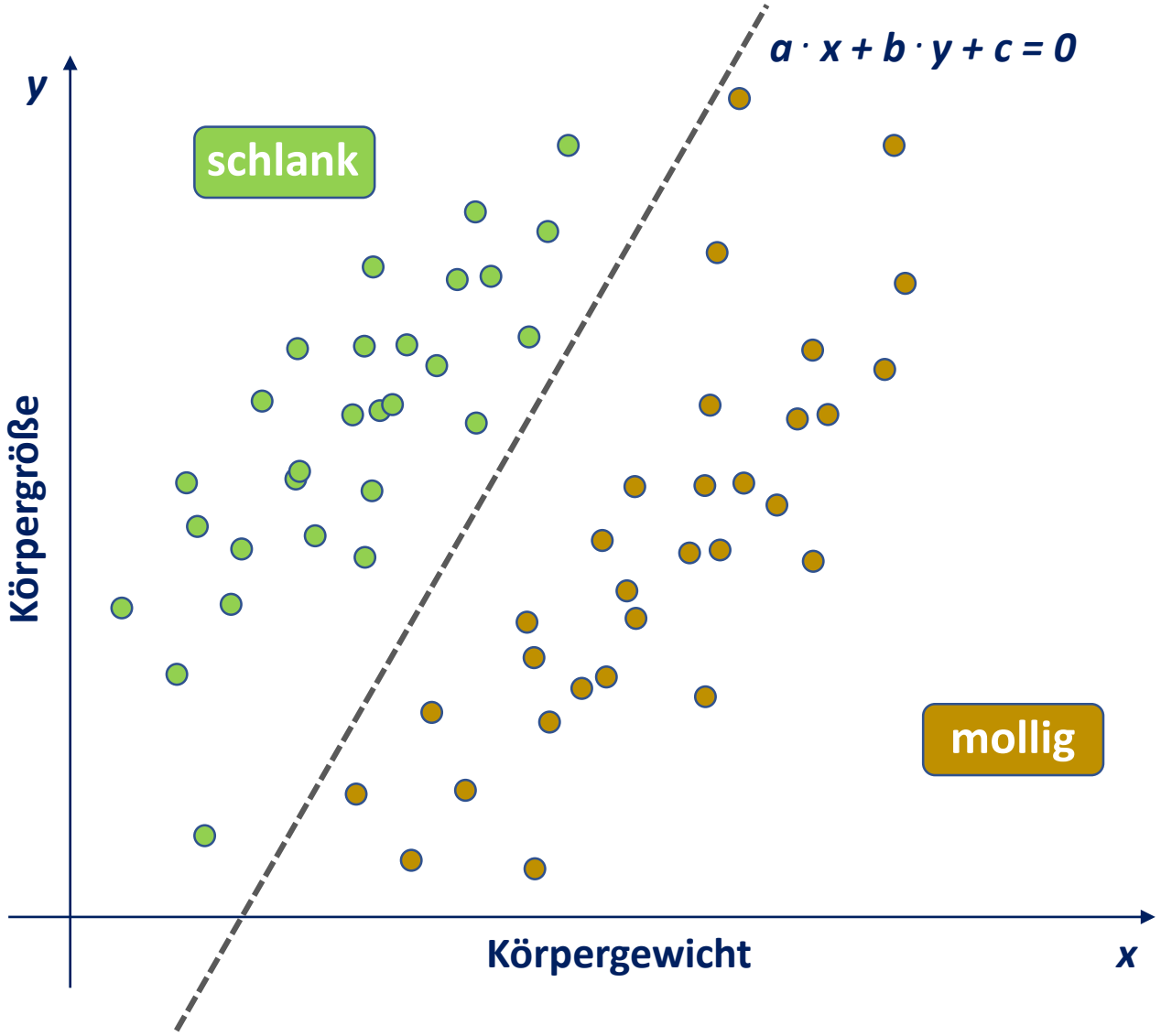

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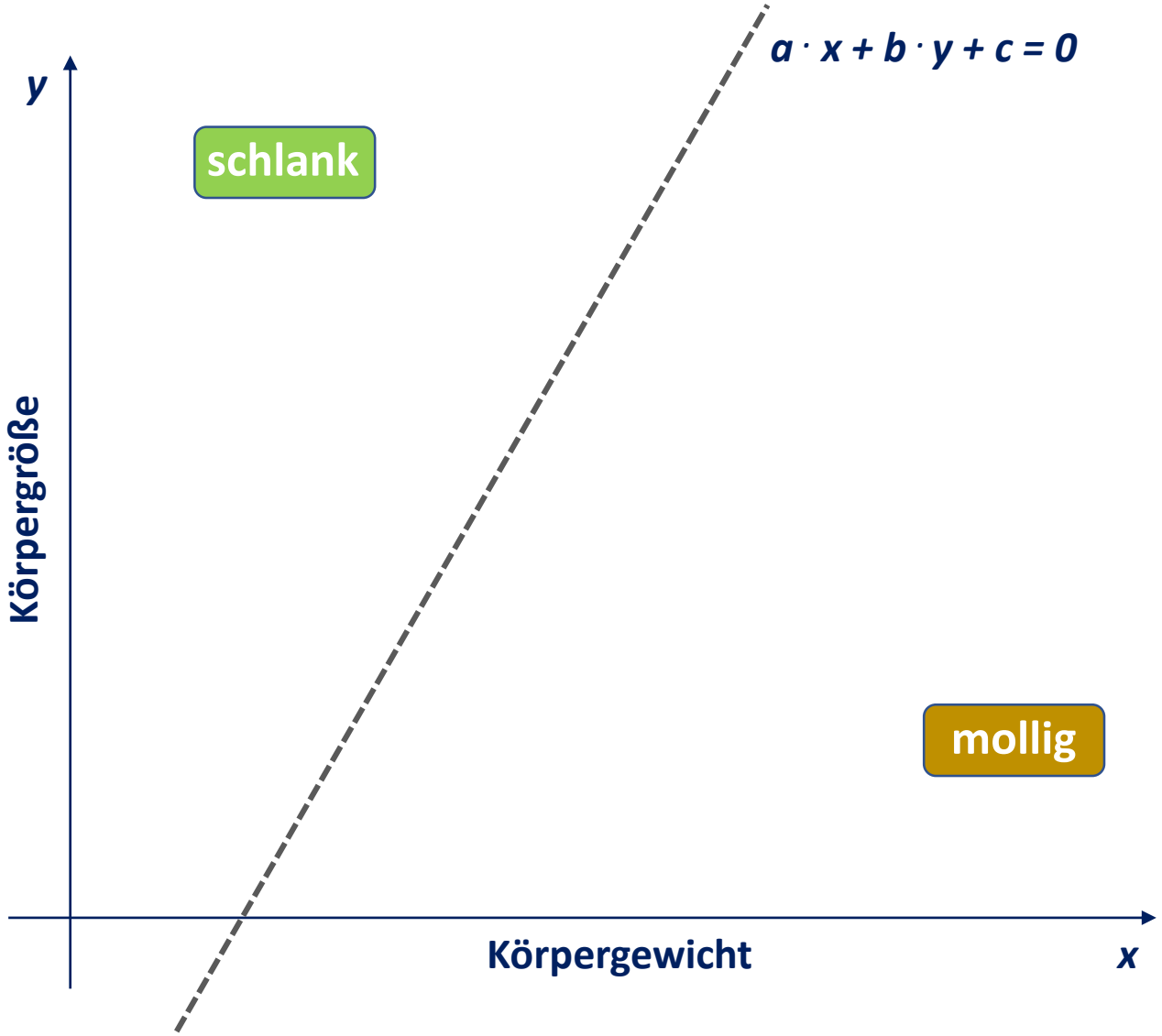

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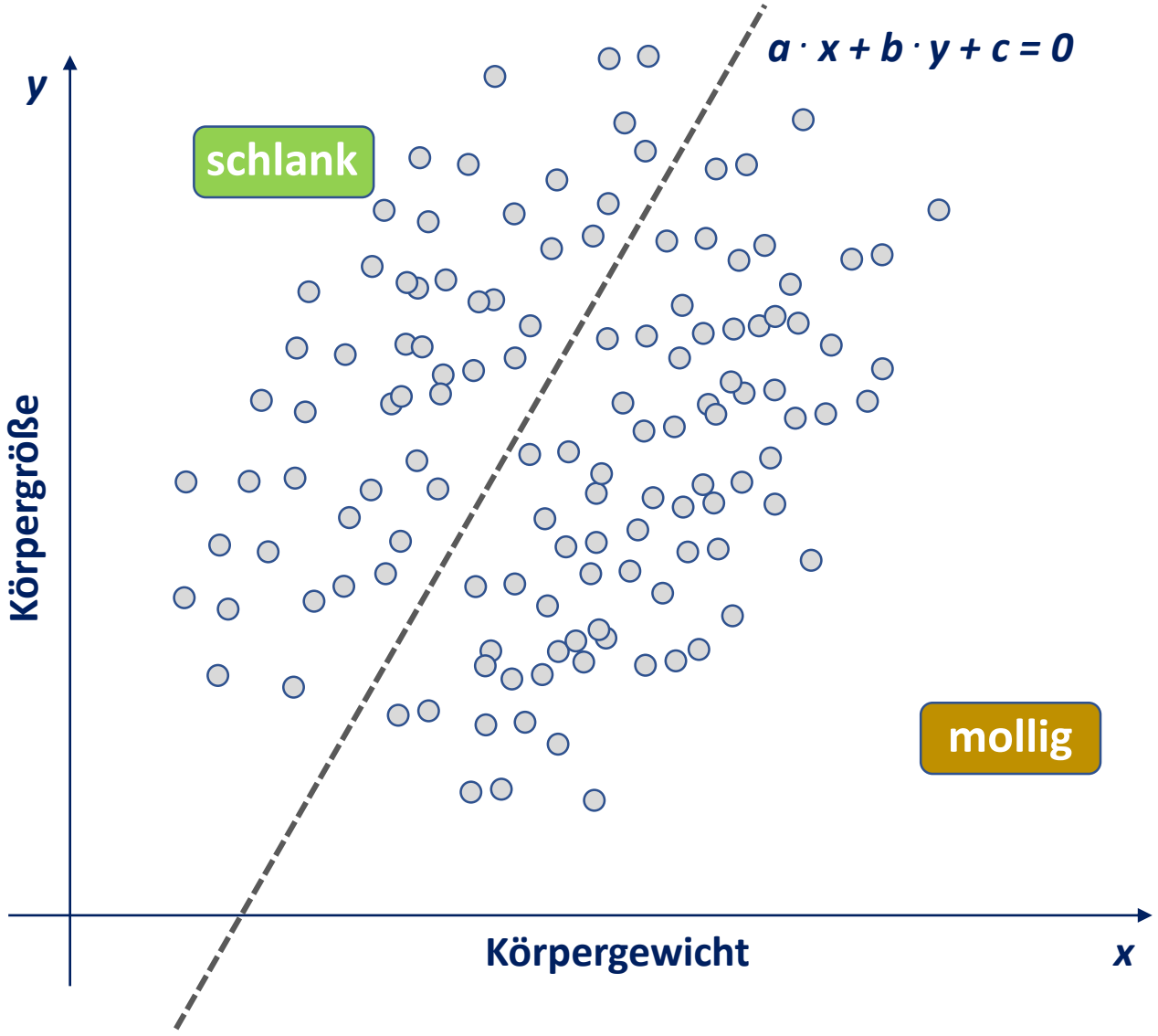


2D:

1. Begrenzungslinie;

2. Fähigkeit, den oberen und unteren Bereich zu unterscheiden

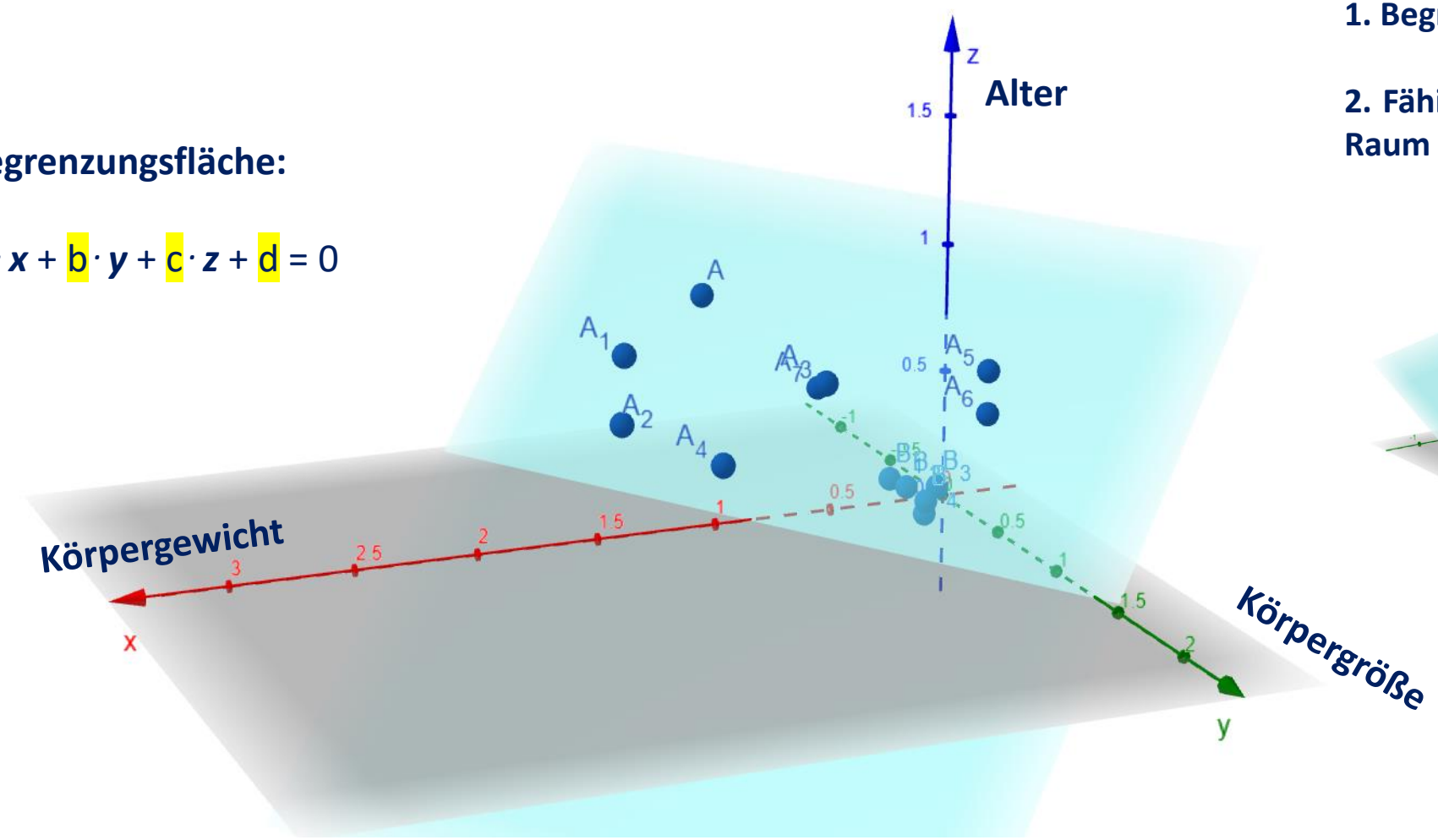
Perzeptron

ID	Körpergröße (m)	Körpergewicht (kg)	Alter (J)
P1	1,1	20	6
P2	1,6	50	13
P3	1,3	39	12
P4	0,8	18	5
P5	1,6	55	20
P6	1,9	80	55
P7	1,7	75	65
P8	1,2	55	15
P9	1,5	60	12
P10	1,0	22	9
…	…	…	…

Perzeptron

Begrenzungsfläche:

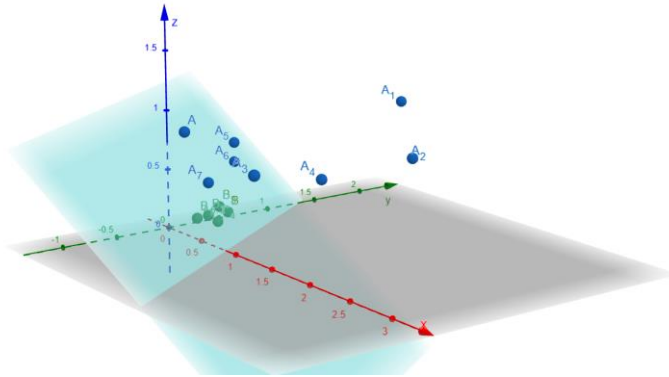
$a \cdot x + b \cdot y + c \cdot z + d = 0$



3D:

1. Begrenzungsfläche;

2. Fähigkeit, den oberen und unteren Raum zu unterscheiden



Perzeptron

ID	Körpergröße (m)	Körpergewicht (kg)	Alter (J)	…
P1	1,1	20	6	…
P2	1,6	50	13	…
P3	1,3	39	12	…
P4	0,8	18	5	…
P5	1,6	55	20	…
P6	1,9	80	55	…
P7	1,7	75	65	…
P8	1,2	55	15	…
P9	1,5	60	12	…
P10	1,0	22	9	…
…	…	…	…	…

nD:

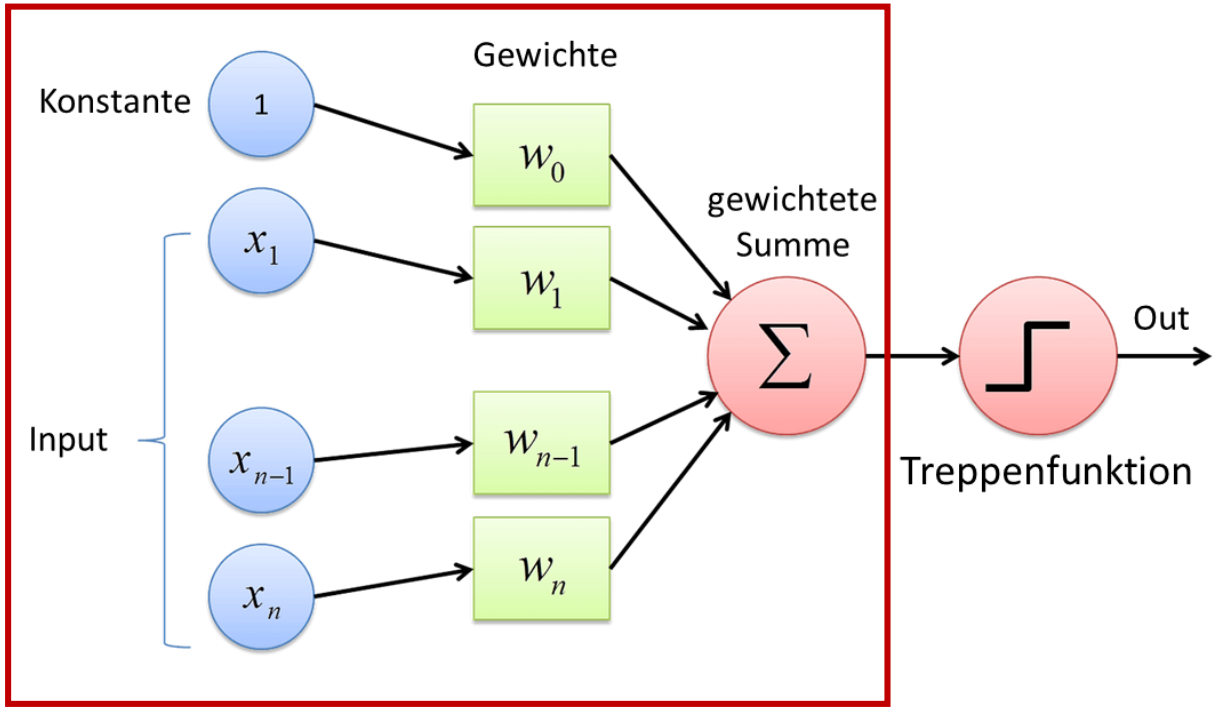
1. Begrenzungshyperfläche (n-1 D);

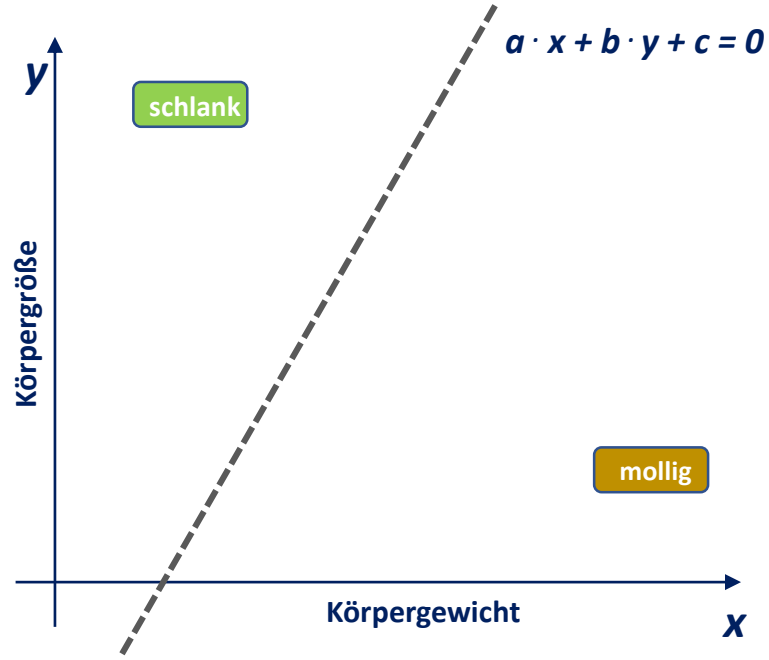
2. Fähigkeit, den oberen und unteren Raum zu unterscheiden

Perzeptron

$$w_0 = b$$

$$t = f\left(\sum_{i=1}^{n} w_i x_i + b\right) = f(\mathbf{w}^T\,\mathbf{x})$$





Begrenzungsline:

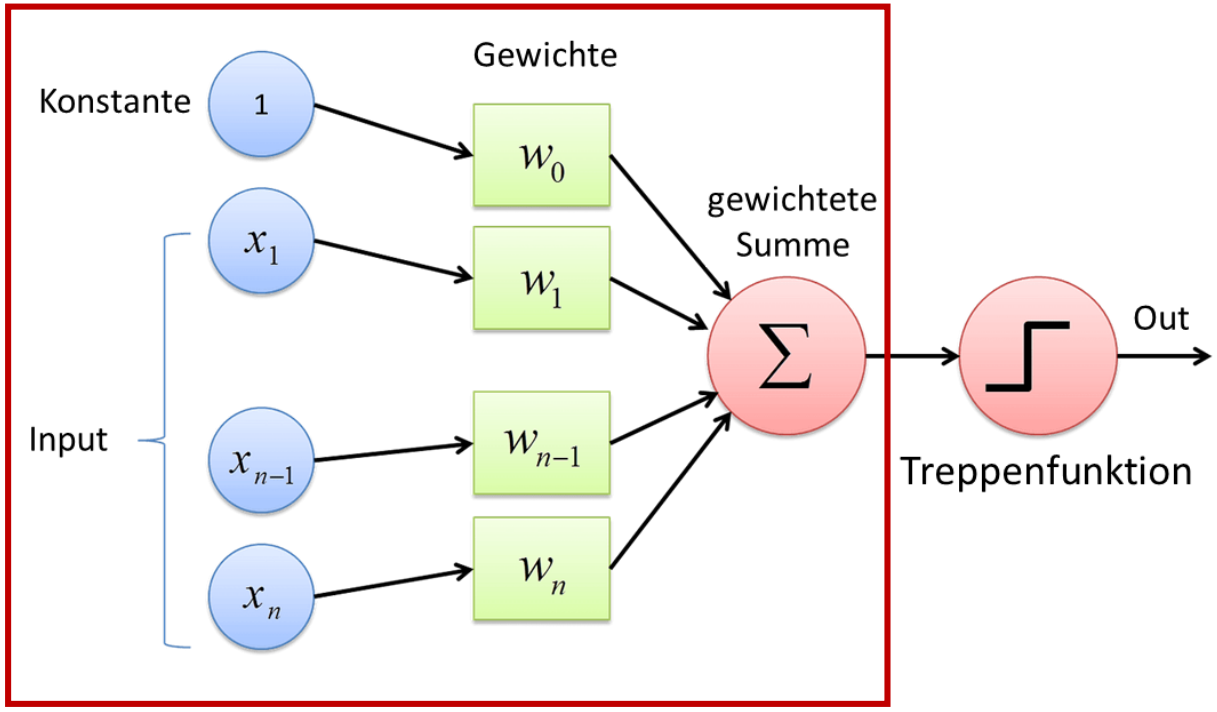
$a \cdot x + b \cdot y + c = 0 \rightarrow w_1 \cdot x_1 + w_2 \cdot x_2 + b = 0$

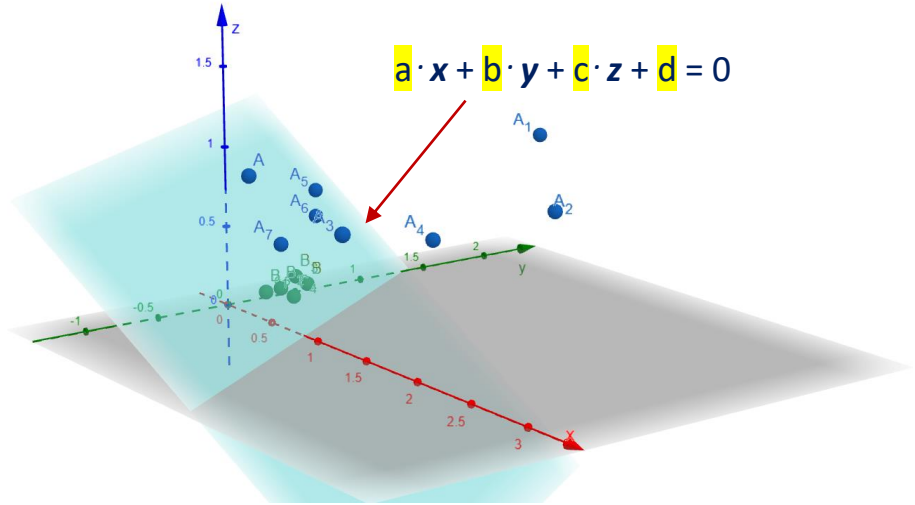
$$\sum_{i=1}^{n} w_i x_i + b = 0$$

Perzeptron

$$w_0 = b$$

$$t = f\left(\sum_{i=1}^{n} w_i x_i + b\right) = f(\mathbf{w}^T\,\mathbf{x})$$





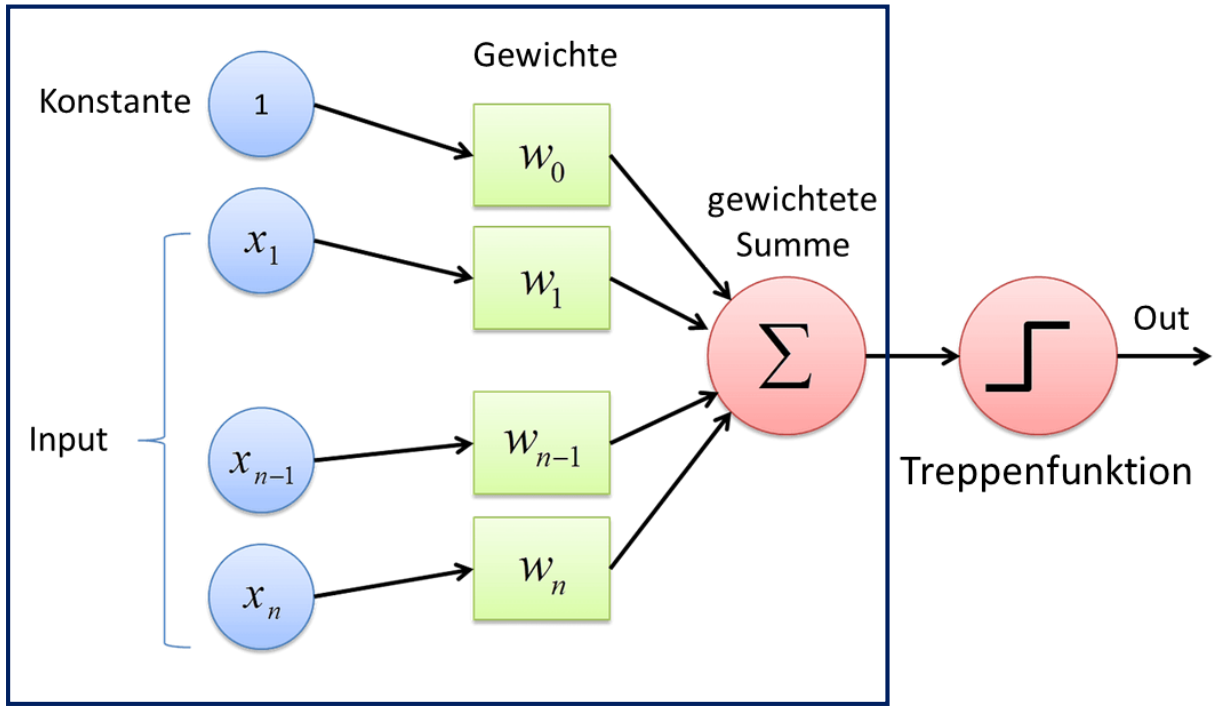
Begrenzungsfläche:

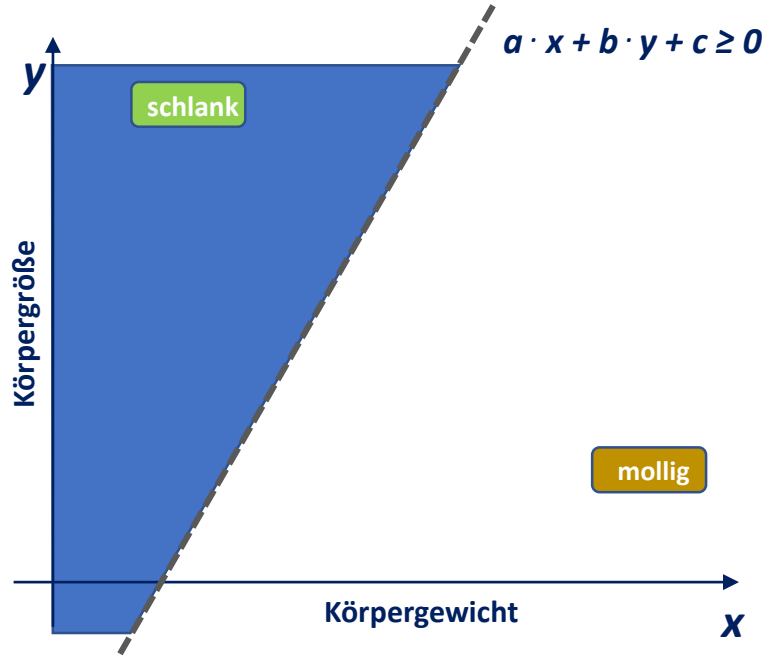
a · x + b · y + c · z + d = 0 → $w_1 \cdot x_1 + w_2 \cdot x_2 + w_3 \cdot x_3 + b = 0$

$$\sum_{i=1}^{n} w_i x_i + b = 0$$

Perzeptron

$$t = f\left(\sum_{i=1}^{n} w_i x_i + b\right) = f(\mathbf{w}^T \mathbf{x})$$



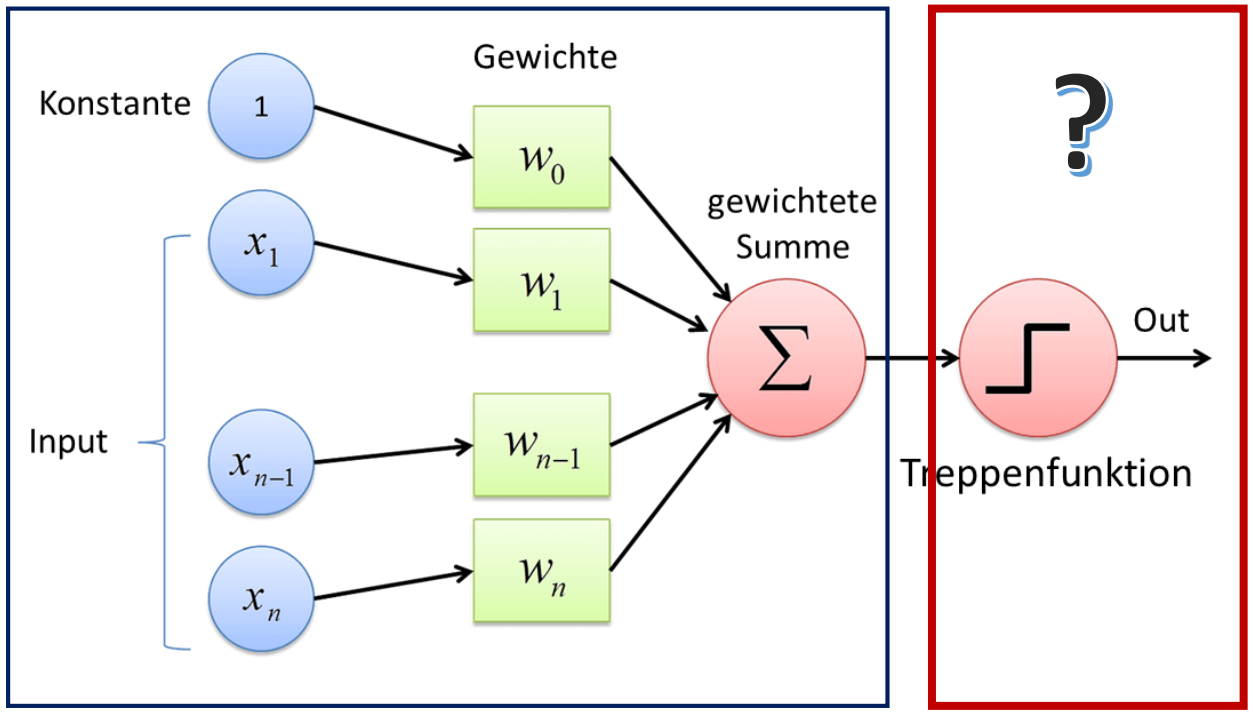


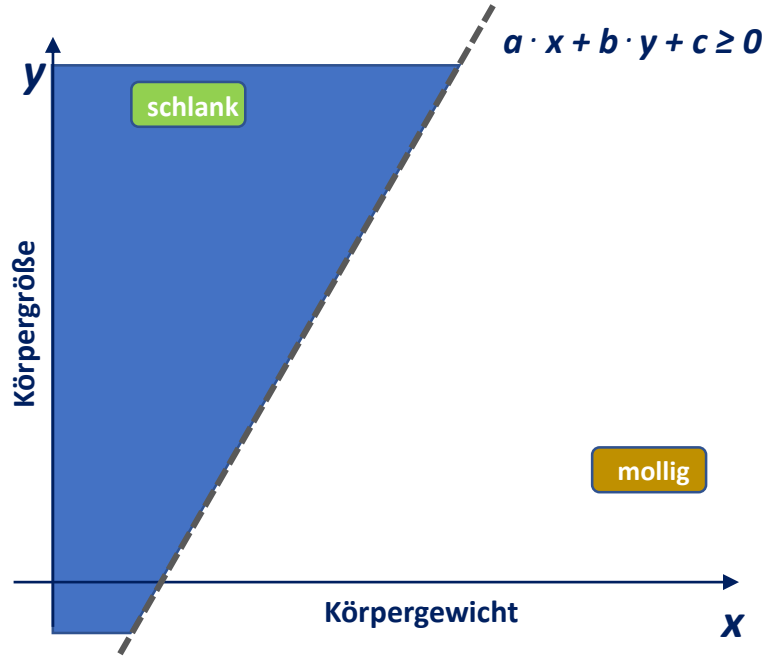
$$f(n) = \begin{cases} +1 & \text{if } n \geq 0 \\ -1 & \text{ansonsten} \end{cases}$$

$$\sum_{i=1}^{n} w_i x_i + b \geq 0$$

Perzeptron

$$t = f\left(\sum_{i=1}^{n} w_i x_i + b\right) = f(\mathbf{w}^T \mathbf{x})$$





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Perzeptron

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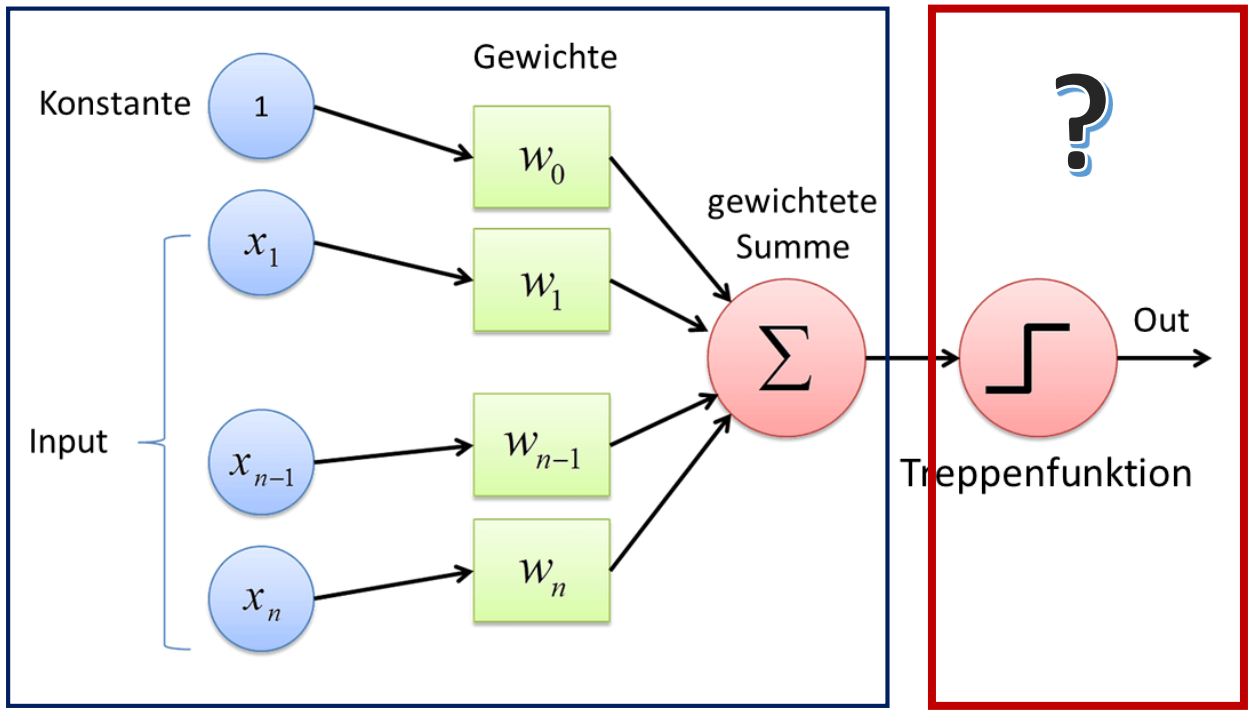
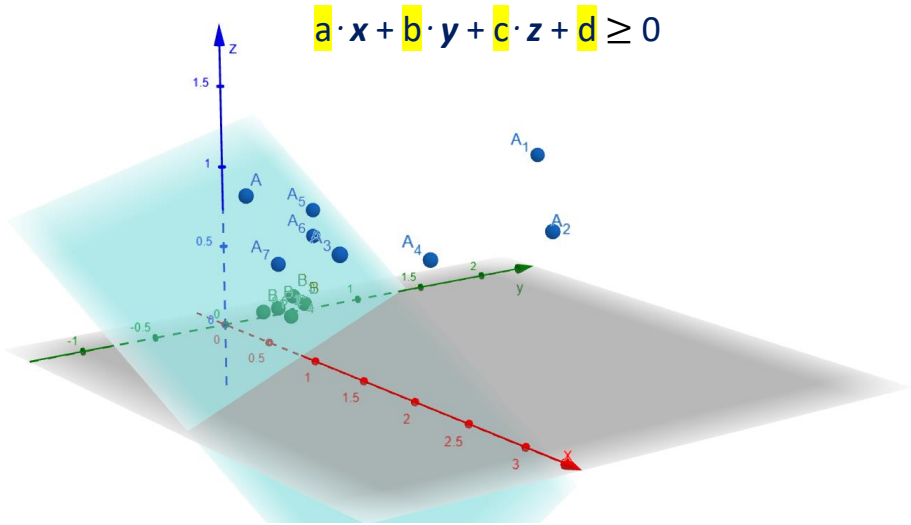




$$f(n) = \begin{cases} +1 & \text{if n } \geq 0 \\ -1 & \text{ansonsten} \end{cases}$$

$$\sum_{i=1}^{n} w_i x_i + b \geq 0$$

Perzeptron

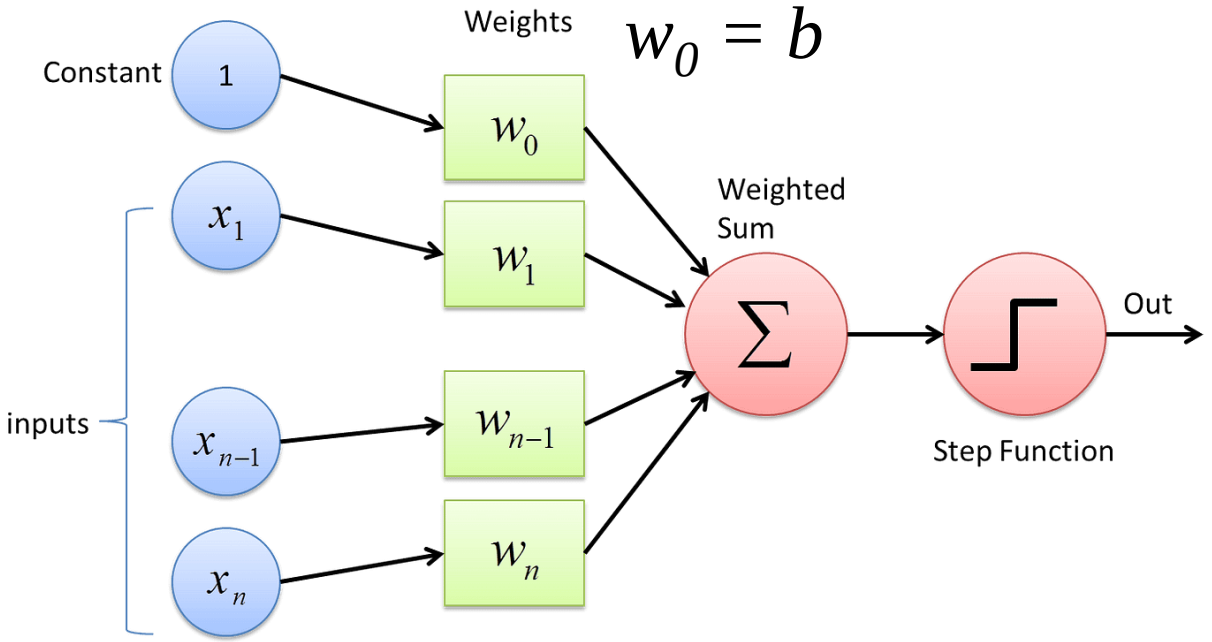
$$t = f\left(\sum_{i=1}^{n} w_i x_i + b\right) = f(\mathbf{w}^T\,\mathbf{x})$$

Dabei ist:

W = $[w_1\ w_2\ \ldots wn\ b\ ]^T$

X = $[x_1\ x_2\ \ldots xn\ 1\ ]^T$

$$f(n) = \begin{cases} +1 & \text{if n } \geq 0 \\ -1 & \text{ansonsten} \end{cases}$$



Begrenzungsline:

***a* · *x* + *b* · *y* + *c* =0 → $w_1 \cdot x_1 + w_2 \cdot x_2 + b = 0$**

Begrenzungsfläche:

a · *x* + b · *y* + c · *z* + d = 0 → $w_1 \cdot x_1 + w_2 \cdot x_2 + w_3 \cdot x_3 + b = 0$

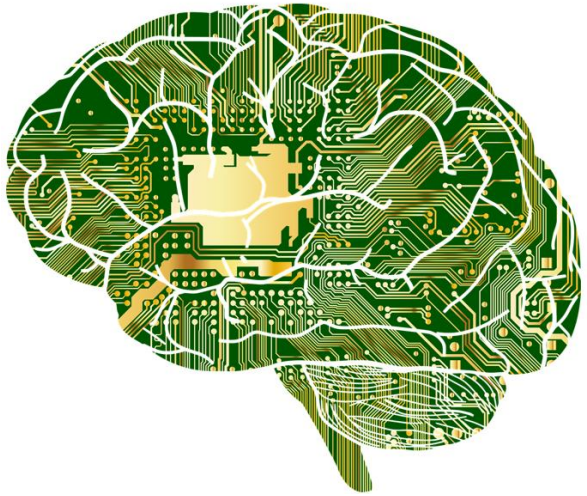
Hyperfläche (*n-1*):

$w_1 \cdot x_1 + w_2 \cdot x_2 + \cdots + w_n \cdot x_n + b = 0$

Take Home Messages

- **Das Perceptron (Feed-Forward-Netz) ist ein einfaches neuronales Netz, das mit solchen künstlichen Neuronen (?) aufgebaut werden kann.**
- **Perzeptron: Lineare Funktion + Aktivierungsfunktion**
- **Binäre-Klassifizierung**

Nächste Schritte:
Perzeptron & KI Winter



Gatter-Typen	
	NOT
AND	NAND
OR	NOR
XOR	XNOR
AOI	OAI