REASONING ABOUT PROBABILITY

P(“Rain”) = 0 absolutely **certain** that it won’t rain

P(“Rain”) = 1 absolutely **certain** that it rains

$P(Rain) = 0.3$ $P(\neg Rain) = 0.8$

I observe evidence:

P(Rain) = 0.3

P(¬Rain) = 0.8

P(Clouds | Rain) = 0.8

P(Clouds | ¬Rain) = 0.2


DO I CHANGE MY GUESS?

I observe evidence:

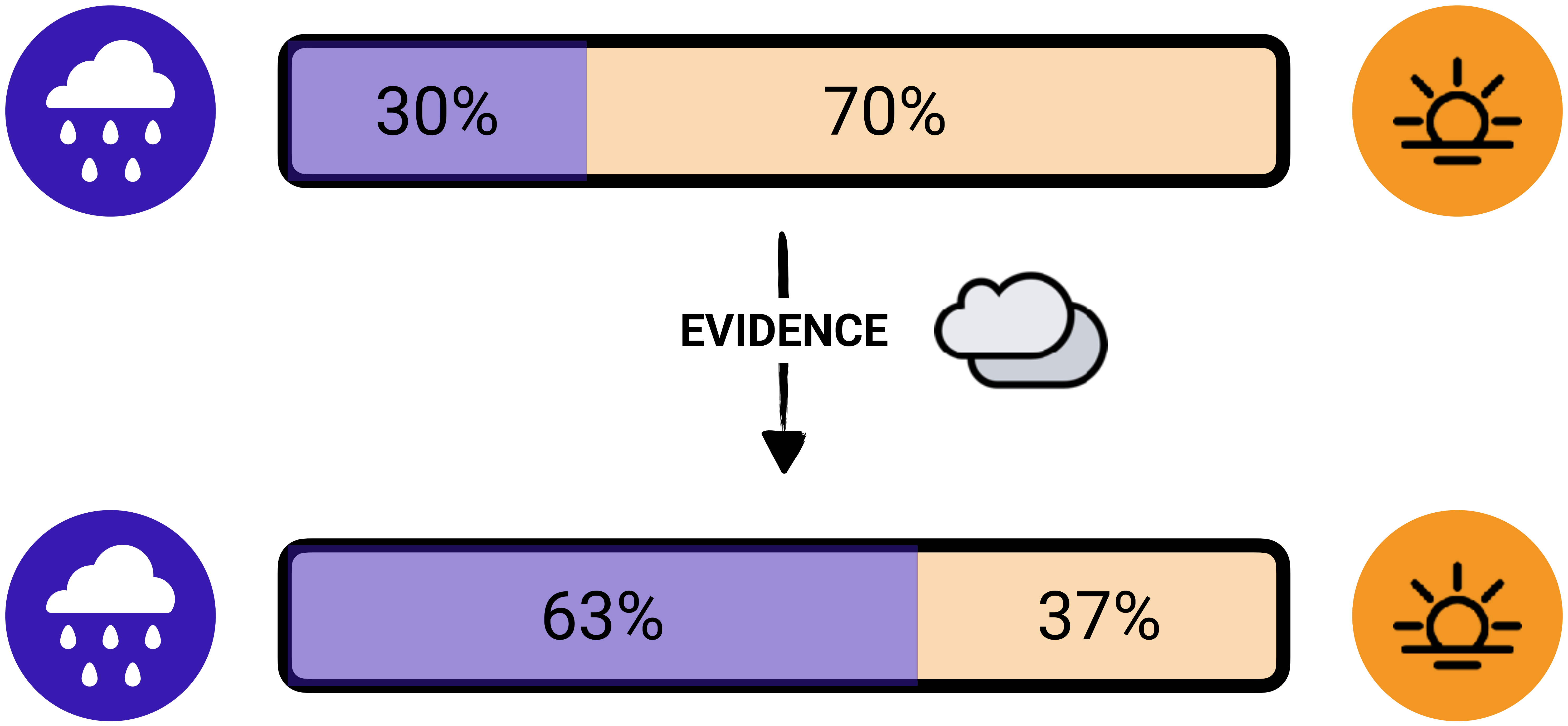
$$P(\text{Rain} \mid \text{Clouds}) = \frac{24}{24 + 14} \approx 0.63$$

P(Rain) = 0.3

P(¬Rain) = 0.8

P(Clouds | Rain) = 0.8

P(Clouds | ¬Rain) = 0.2


30%
70%
EVIDENCE
63%
37%

When to use Bayes' theorem

You have a hypothesis:

It's gonna rain

You have observed evidence:

There are dark clouds

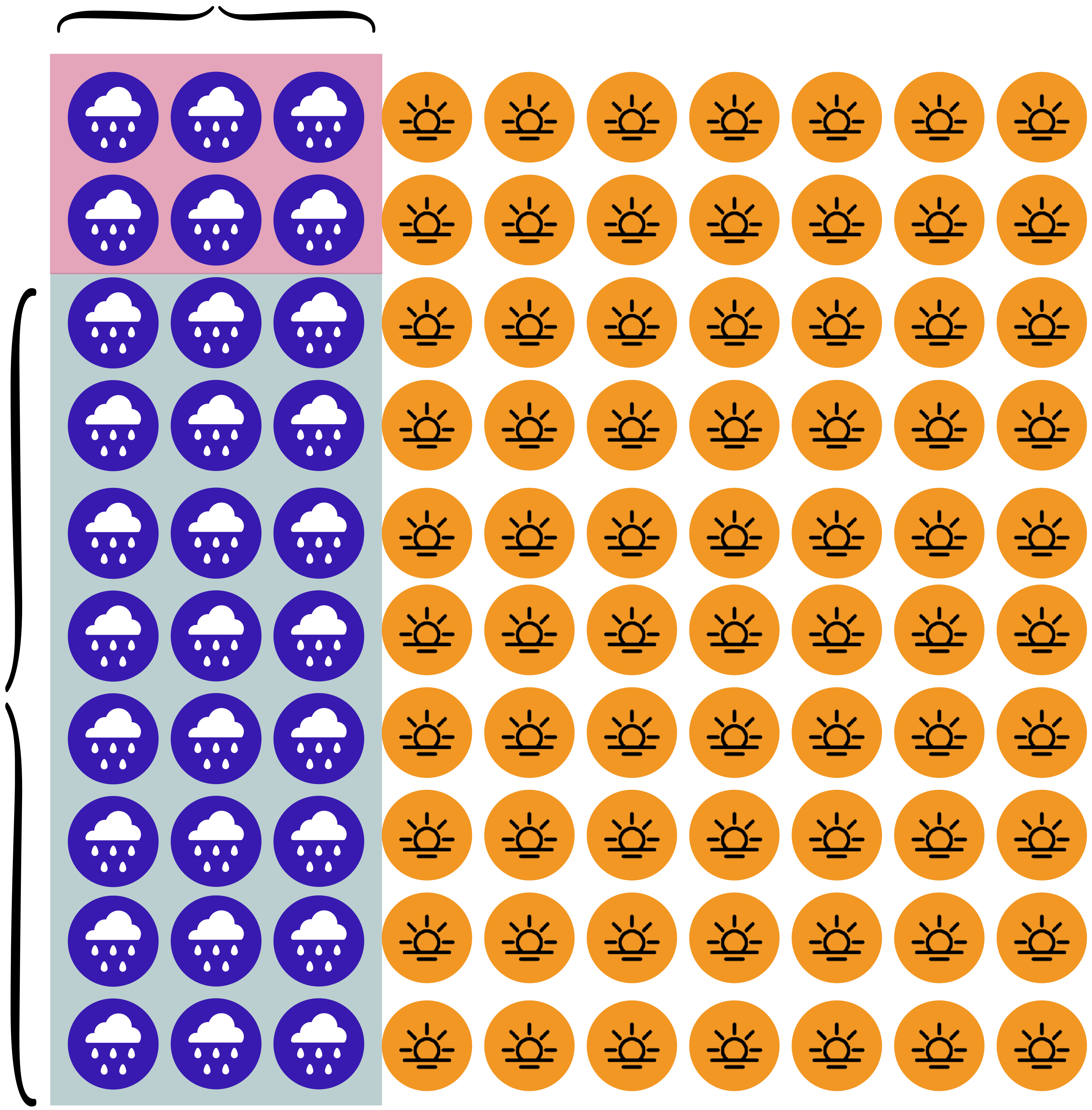
You want to know:

$$P(H \mid E)$$

$$P\left(\begin{array}{c}\text{hypothesis}\\ \text{given}\\ \text{evidence}\end{array}\right)$$

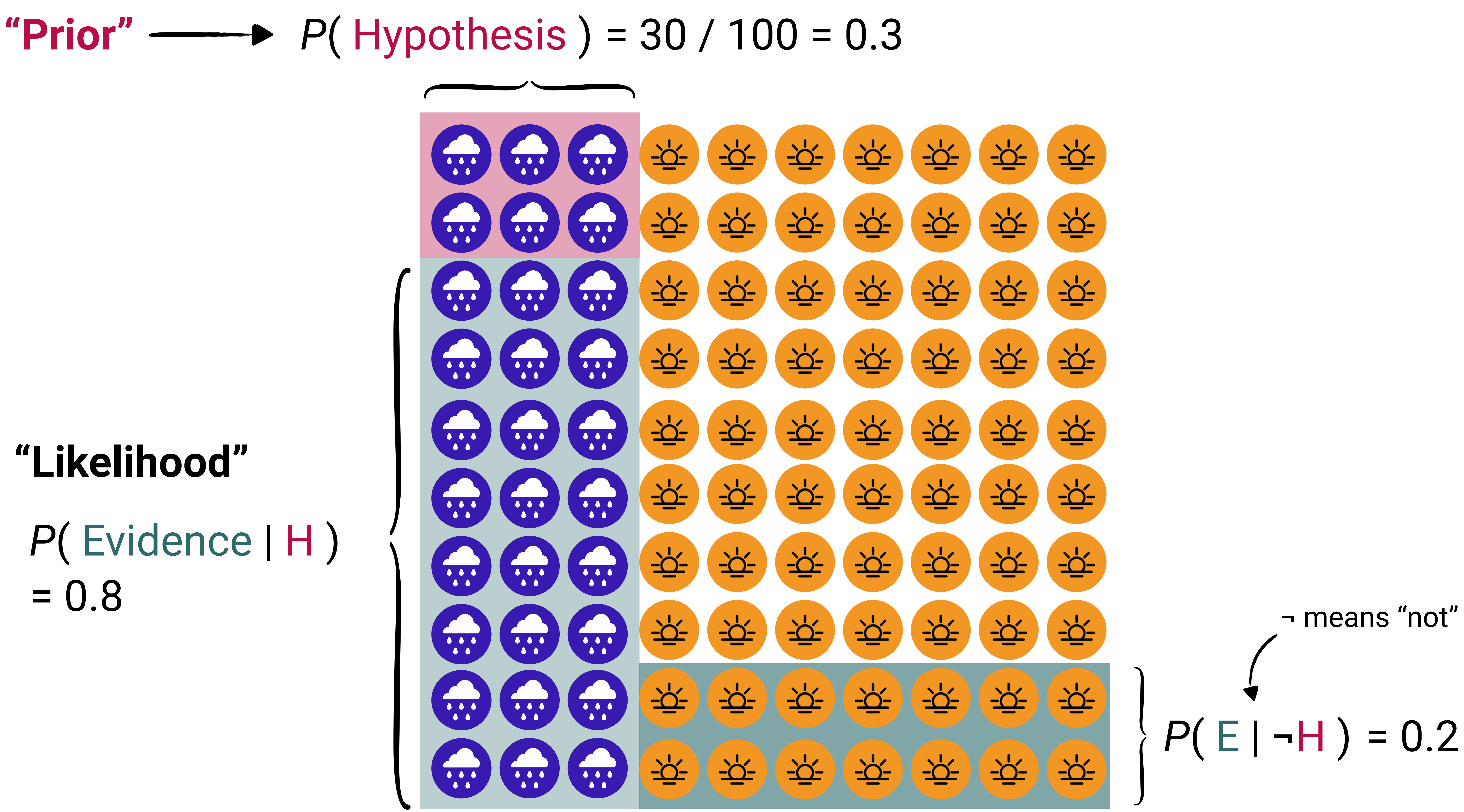
"Prior" → $P(\text{Hypothesis}) = 30 / 100 = 0.3$

“Prior” → $P($ Hypothesis $) = 30 / 100 = 0.3$



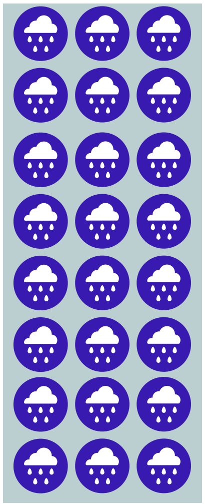
“Likelihood”

$P($ Evidence | H $)$
$= 0.8$

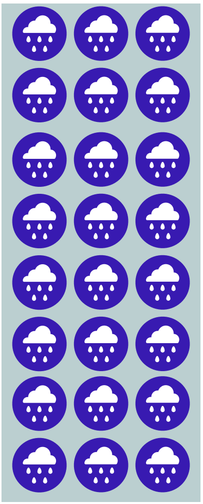


"Prior"
P(Hypothesis) = 30 / 100 = 0.3
"Likelihood"
P(Evidence | H)
= 0.8
¬ means "not"
P(E | ¬H) = 0.2

$P(H \mid E) =$



divided by



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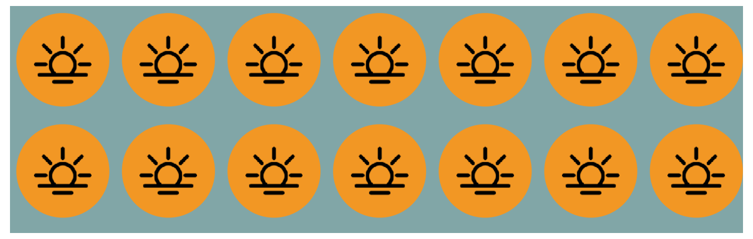
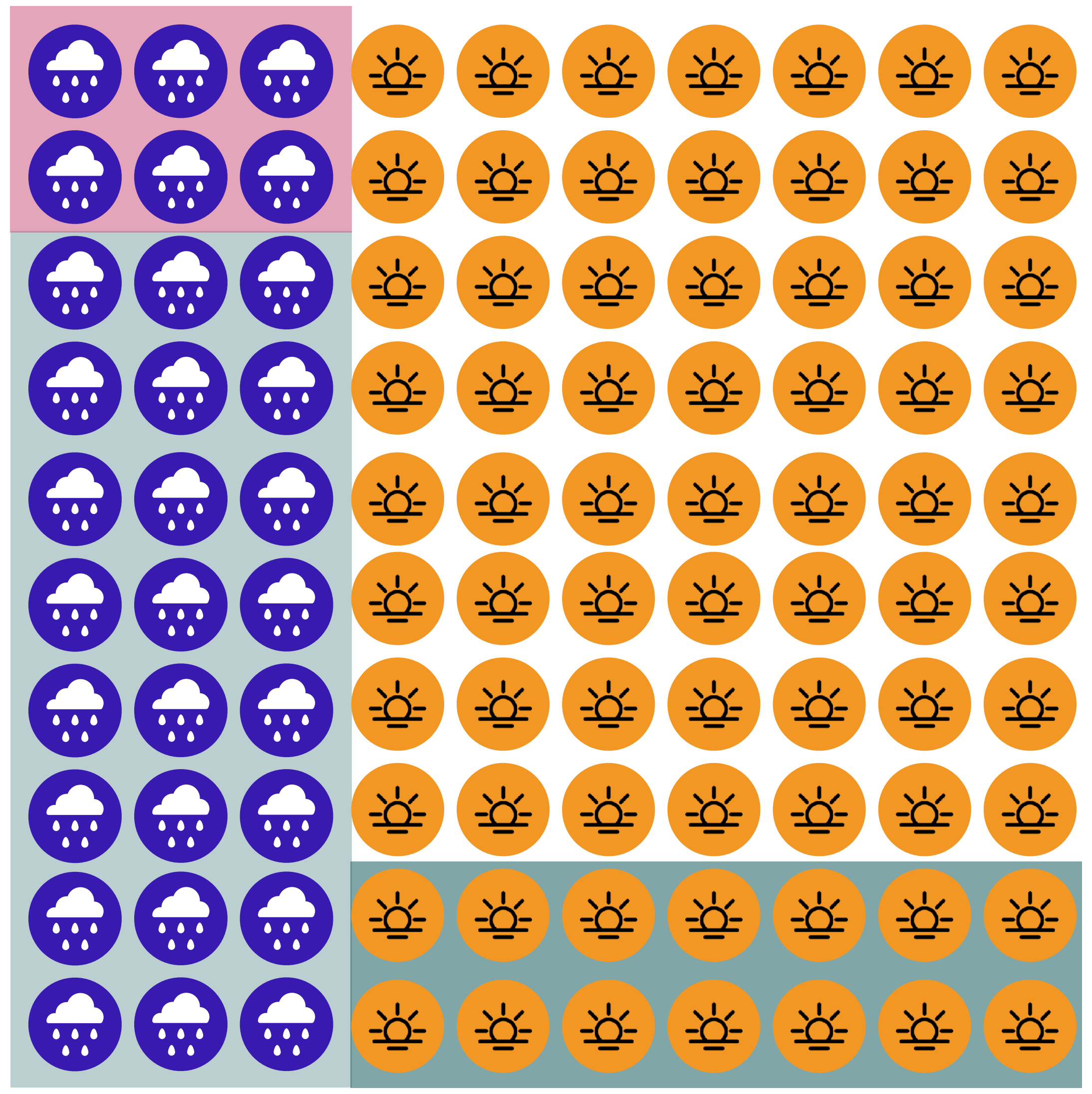


"Prior" **"Likelihood"**

$$= \frac{P(H)\; P(E \mid H)}{P(H)\,P(E \mid H) + P(\neg H)\,P(E \mid \neg H)}$$

$P(H) = 0.3$

$P(E \mid H) = 0.8$



$P(\neg H) = 0.7$

$P(E \mid \neg H) = 0.2$

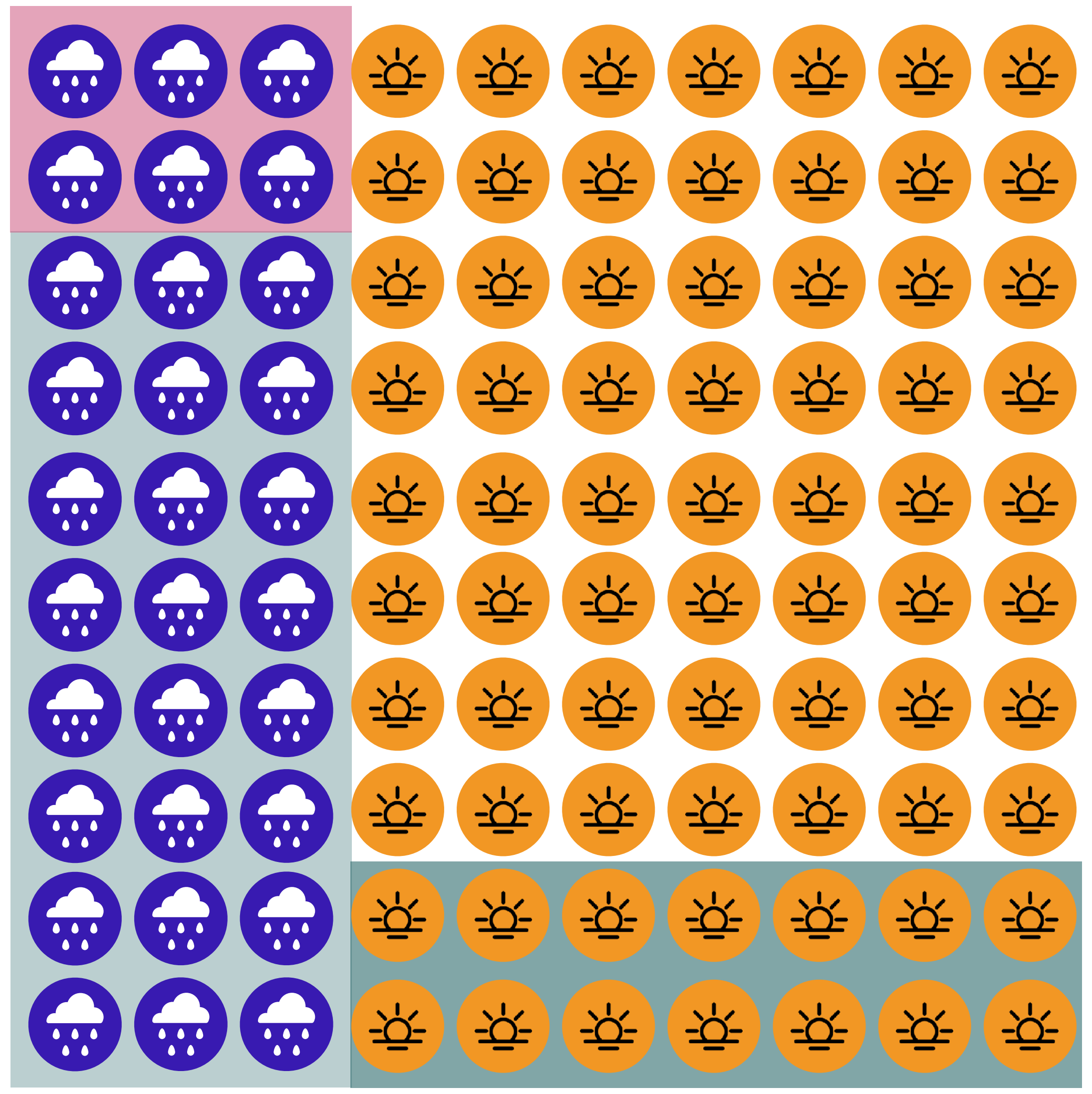
"Prior" **"Likelihood"**

$$P(H \mid E) = \frac{P(H)\;P(E \mid H)}{P(E)} = \frac{P(H)\;P(E \mid H)}{P(H)\,P(E \mid H) + P(\neg H)\,P(E \mid \neg H)}$$

"Posterior"

$P(H) = 0.3$

$P(E \mid H) = 0.8$



$P(\neg H) = 0.7$

$P(E \mid \neg H) = 0.2$

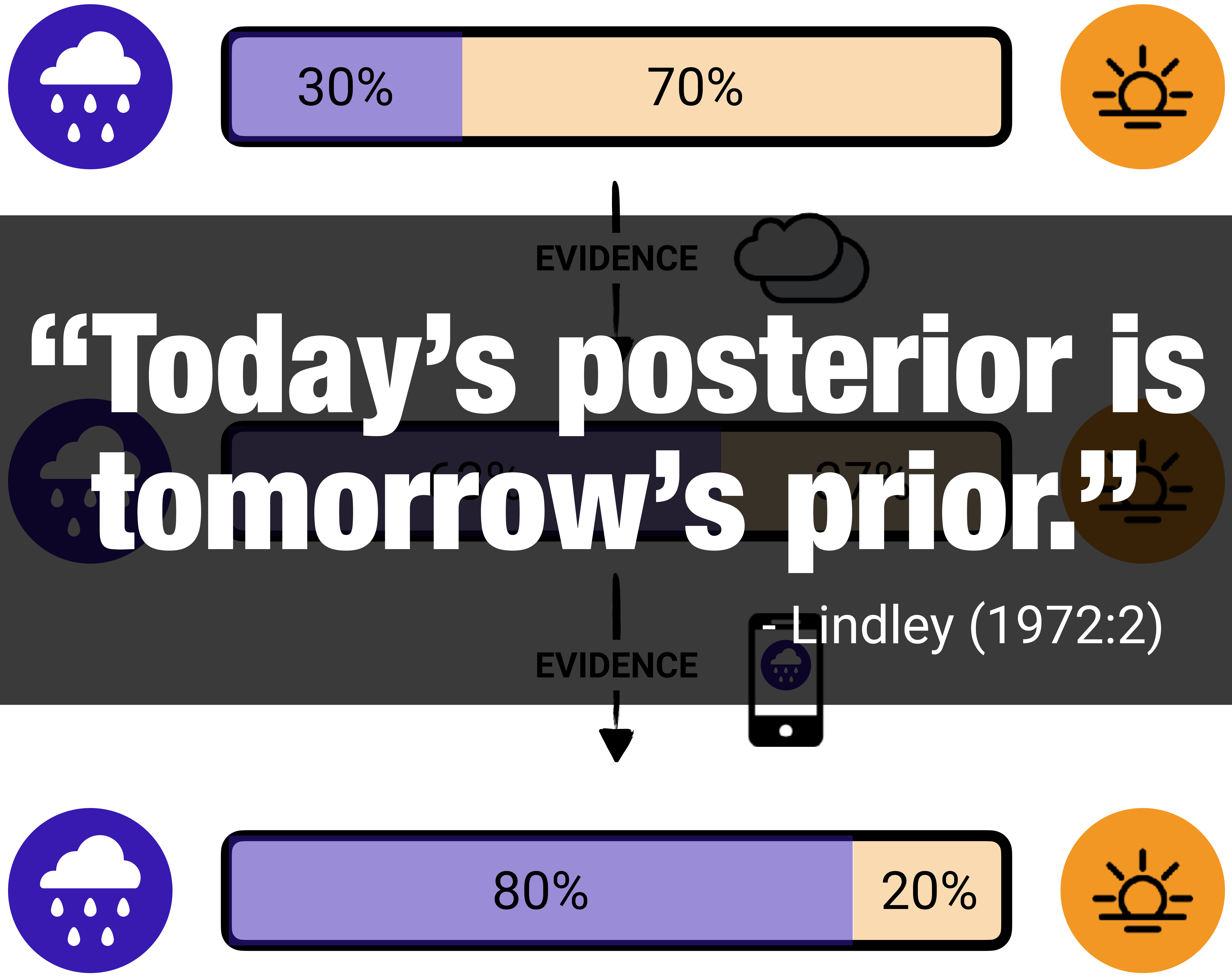
This is Bayes Theorem

prior: initial degree of belief in hypothesis

likelihood: the probability of the evidence given the hypothesis

$$P(\mathbf{H} \mid \mathbf{E}) = \frac{P(\mathbf{H}) \; P(\mathbf{E} \mid \mathbf{H})}{P(\mathbf{E})}$$

posterior: degree of belief in hypothesis, after seeing evidence



"Today's posterior is tomorrow's prior."

- Lindley (1972:2)


DO I BRING MY UMBRELLA?

What is more likely?

Steve is very **shy and withdrawn**, invariably helpful but with very little interest in people or in the world of reality. A **meek and tidy soul**, he has a need for order and structure, and a passion for detail.

librarian

farmer