

Reasoning

- Reasoning means going from premises (existing beliefs) to conclusions (new beliefs)

How should reasoning work?

(Prescriptivist question)

How does reasoning work?

(Descriptivist question)

The object of reasoning is to find out, from the consideration of what we already know, something else which we do not know. - C. S. Peirce

Induction vs. deduction (again)

Deduction: logically certain reasoning

- If an animal has a liver, it must have a stomach;
- squirrels have livers; therefore squirrels have stomachs

Induction: probable reasoning

- Squirrels like nuts; badgers are similar to squirrels; therefore badgers probably like nuts
- My friend likes baseball, and she likes football, so she probably likes basketball

- plausible, but not deductively valid

Modes of deduction

- Modus Ponens

Antecedent $\rightarrow$ $A \rightarrow B$ (if A then B) $\leftarrow$ Consequent
A (A is true)

B (B is true)

- Modus Tollens

$A \rightarrow B$ (if A then B)
 $\sim B$ (B is false)

 $\sim A$ (A is false)

Question: How good are people at deduction?

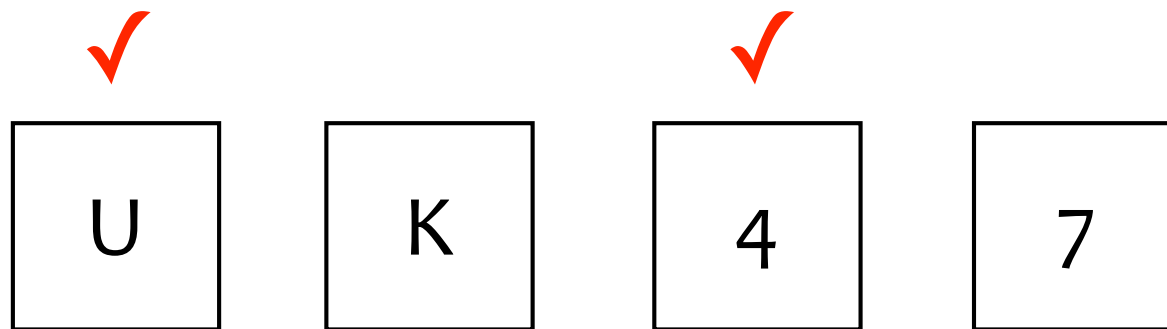
The Wason selection task

Each of these 4 cards has a letter on one side and a number on the other.

Your task is to evaluate the rule: If there is a VOWEL on one side, there is an EVEN NUMBER on the other side

VOWEL $\rightarrow$ EVEN. Note: $V \rightarrow E = \sim V \vee E = \sim(V \wedge \sim E)$
antecedent consequent

Data:

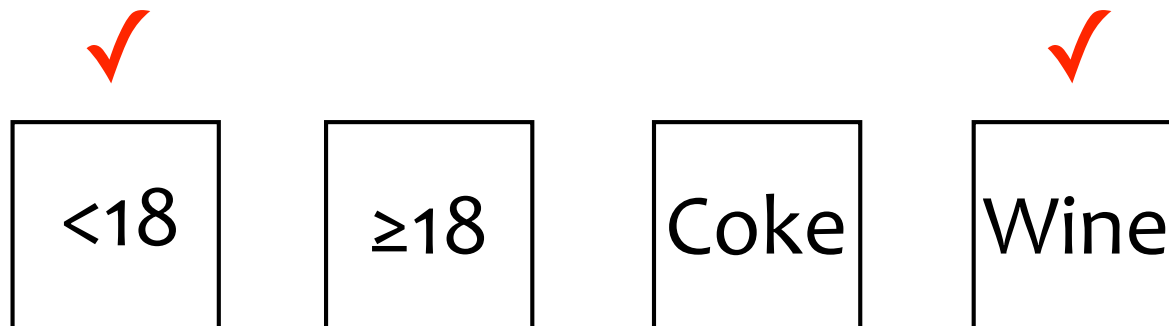


Logic:

You are the chaperone at a party. Your job is to make sure nobody under 18 is drinking wine.

Rule: If under 18, must be drinking coke. ($<18 \rightarrow \text{coke}$)

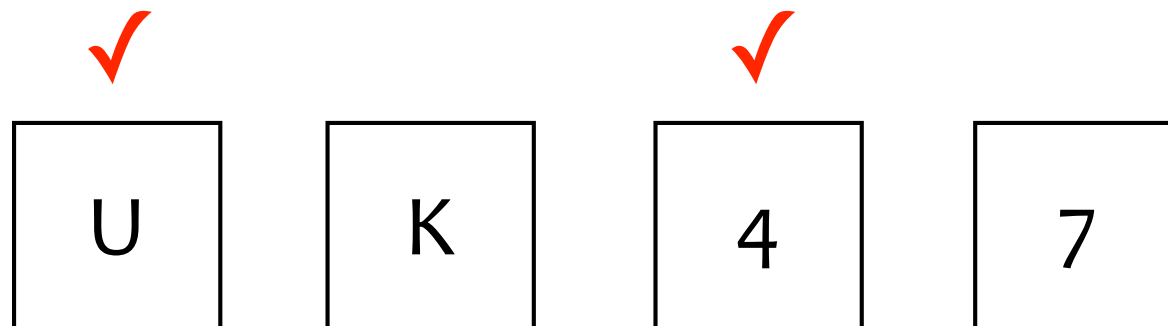
Data:



Logic:



Data:



Logic:



Conclusions

- Human reasoners apparently can't reason deductively very well, except in certain circumstances
- Deduction isn't all that useful in real circumstances anyway
- And many inferences we do make are not deductive
- So if not deduction, what about induction?

Reasoning with propositions that are neither certainly true nor certainly false, but are somewhere in between



Induction

Hume: Inductive beliefs are never absolutely certain

Thomas Bayes (1763): But we can quantify the **degree of belief**—the degree to which we **ought** to believe a proposition.

If so, induction is just **probabilistic reasoning**, and to understand it we need a “calculus of probabilities”

Laplace (1812): “Probability theory is nothing but common sense reduced to calculation”

Probability

- A, B are propositions
- $p(A)$ means “the probability that A is true” or “degree of belief in A ”.
- $p(A)$ is between 0 and 1.
- $p(\sim A) = 1 - p(A)$

