

## Utility

Monday, October 24, 2016 9:14 AM

Knowledge:

- Joint Full Distribution
- Conditional Distribution
- Bayes Net

Action

## Utility Theory

## Probability

$P(x | e_1, e_2, e_3, e_4, \dots) \rightarrow$  prob that  $x$  is true in a world in which  $x$  is true

$U(x) \rightarrow$  utility of  $x$  in a world in which  $x$  is true

## Actions

- Suppose action  $a$  has some probability of making  $x$  true

-  $P(x | do(a), e_1, e_2, e_3, e_4, \dots)$

$result_i(a)$  a possible result for performing  $a$   $i = 1$  to  $N$

$a = \text{play/battery}$

$result_1(a) = \text{win}$      $result_2(a) = \text{lose}$

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$$EU(a) = \sum_{i=1}^N [P(result_i(a)) \cdot U(result_i(a))]$$

$$EU(\text{play}) = \left( \frac{1}{125m} \cdot 1m \right) + \left( \left( 1 - \frac{1}{125m} \right) \cdot (-1) \right)$$

Utility Theory

Given an action  $a$  with results  $result_i(a)$   $i = 1$  to  $N$

$$EU(a) = \sum [P(result_i(a)) \cdot U(result_i(a))]$$

$$P(x | do(c), e_1, e_2, e_3, \dots, e_m)$$

$\uparrow$  what value I get

Action: Play Lottery

result<sub>1</sub> = win       $U_1 = 1m$        $P_1 = \frac{1}{125m}$

result<sub>2</sub> = loss       $U_2 = -5$        $P_2 = 1 - \frac{1}{125m}$

$$EU(\text{play}) = \left( \frac{1}{125m} \cdot 1m \right) + \left( \left( 1 - \frac{1}{125m} \right) \cdot (-5) \right)$$

$$EU(\text{buy candy})$$

$$EU(\text{give charity})$$

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X

AI picks the action with greatest expected utility

\* Non-sequential decision making

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