## amil

# CMPUT 397 Reinforcement Learning: 

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## Admin review

$\checkmark$ Getting good grades is difficult in this course
$\checkmark \quad$ There is no late submission allowed
$\checkmark$ Our office hours \& email addresses are given in the course page
$\checkmark$ Graded notebook (programming assignment) due this Friday
$\checkmark$ Practice quiz for mini-course 1, module 2 (Markov Decision Processes) due this Sunday
$\checkmark$ Reading book chapters is a must (otherwise low marks in mid-term/final exam)
$\checkmark$ Bring paper or tablet each day

## Probabilities review

$\checkmark \quad$ A probability is a non-negative number mapped from an event denoting likelihood of an event: $P(A)$
$\checkmark \quad$ What kind of object is $P$ ?
$\checkmark$ What kind of object is $A$ ?
$\checkmark$ Is the sample space an event?
$\checkmark \quad$ Definition of conditional probability: $P(A \mid B)=P(A \cap B) / P(B) \neq P(A)$
$\checkmark \quad$ What kind of object is $B$ ?
$\checkmark$ Law of total probabilities: $P(B)=\sum_{k} P\left(B \cap A_{k}\right)=\sum_{k} P\left(B \mid A_{k}\right) P\left(A_{k}\right)$
$\checkmark$ What are the conditions on $A_{k}$ ?

## Expectations \& conditional expectations

$\checkmark$ An expected value of a random variable is a weighted average of possible outcomes, where the weights are the probabilities of those outcomes

$$
E[X]=\sum_{x \in x} x P(X=x)
$$

$\checkmark$ An expected value of a random variable conditional on another event is a weighted average of possible outcomes, where the weights are the conditional probabilities of those outcomes given the event

$$
E[X \mid Y=y]=\sum_{x \in x} x P(X=x \mid Y=y)
$$

$\checkmark \quad$ Expectation conditional on a random variable $E[X \mid Y]$ itself is a random variable, which is a function $g(Y)$ of another random variable $Y$

## Properties of expectations

$\checkmark$ Linearity: $E[X+Y]=E[X]+E[Y]$
$\checkmark$ Linearity: $E[\mathrm{a} X]=a E[X]$
$\checkmark$ Non-multiplicativity: $E[X Y] \neq E[X] E[Y]$
$\checkmark$ Law of the unconscious statistician: $E[g(X)]=\sum_{x \in X} g(x) P(X=x)$

## Expectations: example

$\checkmark$ In the double dice-rolling experiment, What is the expected value of the sum of the two dice?

## Expectations: example

$\checkmark \quad$ Show that $E[X]=E[E[X \mid Y]]$

