

# CS 188 SECTION 6

# ABOUT ME

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- Sections MW 4-5pm in 310 Soda
- Office Hours Thursdays 4-6pm in 411 Soda

**MIDTERM 1 IS  
OVER!!!**

# UPCOMING DEADLINES

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- HW 3 due **Wednesday** 7/13 @ 11:59
- Project 3 due **Friday** 7/15 @ 5pm
- Contest 2 due **Sunday** 7/17 @ 11:59

**PROBABILITY**

# RANDOM VARIABLES

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- A random variable is some aspect of the world about which we (may) have uncertainty
  - R = Is it raining?
  - T = Is it hot or cold?
  - D = How long will it take to drive to work?
  - L = Where is the ghost?
- We denote random variables with capital letters
- Like variables in a CSP, random variables have domains
  - R in {true, false} (often write as {+r, -r})
  - T in {hot, cold}
  - D in  $[0, \infty)$
  - L in possible locations, maybe  $\{(0,0), (0,1), \dots\}$

# PROBABILITY TABLES

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$P(T)$

T	P
hot	0.5
cold	0.5

$P(W)$

W	P
sun	0.6
rain	0.1
fog	0.3
meteor	0.0

# JOINT DISTRIBUTIONS

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$$P(T, W)$$

T	W	P
hot	sun	0.4
hot	rain	0.1
cold	sun	0.2
cold	rain	0.3



# MARGINAL DISTRIBUTIONS

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- Marginal distributions are sub-tables which eliminate variables
- Marginalization (summing out): Combine collapsed rows by adding

$P(T, W)$

T	W	P
hot	sun	0.4
hot	rain	0.1
cold	sun	0.2
cold	rain	0.3



$$P(t) = \sum_s P(t, s)$$



$$P(s) = \sum_t P(t, s)$$

$P(T)$

T	P
hot	0.5
cold	0.5

$P(W)$

W	P
sun	0.6
rain	0.4

# CONDITIONAL PROBABILITIES

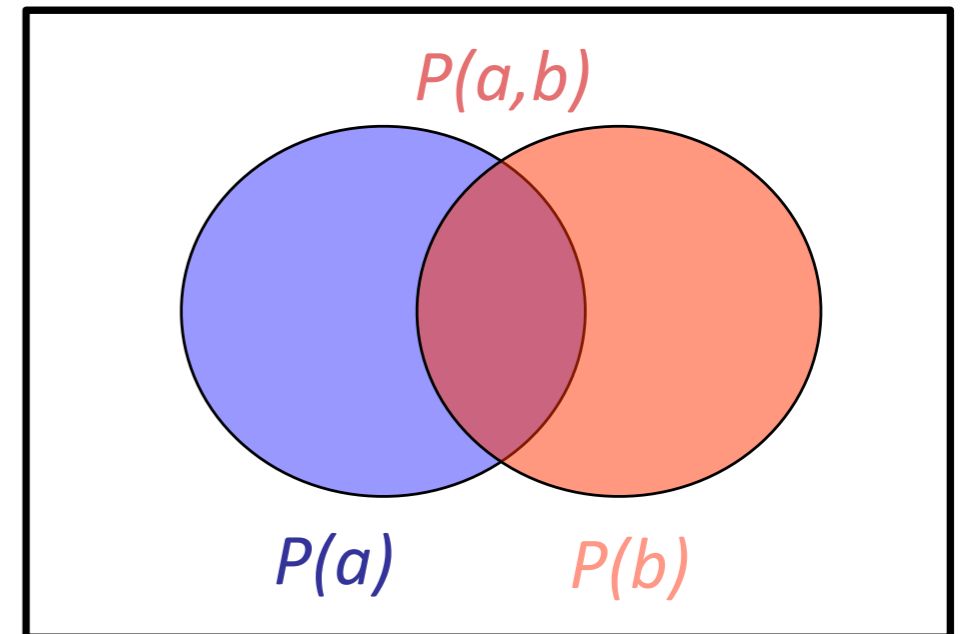
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*Definition of conditional probability*

$$P(a|b) = \frac{P(a, b)}{P(b)}$$

*Product Rule*

$$P(y)P(x|y) = P(x, y)$$



# CHAIN RULE AND BAYES' RULE

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$$P(x_1, x_2, x_3) = P(x_1)P(x_2|x_1)P(x_3|x_1, x_2)$$

$$P(x, y) = P(x|y)P(y) = P(y|x)P(x)$$

- Given:

$P(W)$

R	P
sun	0.8
rain	0.2

$P(D|W)$

D	W	P
wet	sun	0.1
dry	sun	0.9
wet	rain	0.7
dry	rain	0.3

- What is  $P(W | \text{dry})$  ?