

# CMPSCI 240: Reasoning Under Uncertainty

## Discussion 7

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**The data:** Assume we have a dataset that consists of 1000 movies. For each movie, we have information about its genre  $G$  (comedy, drama, or action), the movie's length  $L$  (long or short), the movie's user-rating  $R$  (good or bad). Specifically, we know that 200 movies are comedies, 300 are dramas and 500 are action movies. We also know that 10% of the comedies are long, 80% of the dramas are long, and 40% of the action movies are short. Regarding the rating, 20% of the comedies are rated as good, 80% of dramas are rated as good, and only 30% of the action movies are rated as good.

What are the probabilities you can infer from the above description?

**Bayes Theorem:** Use Bayes theorem to write an expression for  $P(G = \textit{Comedy} | L = \textit{long}, R = \textit{good})$ .

**Naive Bayes Assumption** What is the assumption we have to make in order to use Naive Bayes Classification? Write an expression for  $P(G = \textit{Comedy} | L = \textit{long}, R = \textit{good})$  using that assumption.

**Finding the MAP hypothesis:** What is the most likely genre of a long movie that is rated as good?

**Finding the MAP hypothesis:** What is the most likely genre of a long movie that is rated as bad?

**Alien invasion:** Assume that the probability aliens invade Amherst is  $P(A) = 0.001$ . Let  $D_i$  be the event that your  $i$ -th friend tells you that aliens have invaded. If aliens have actually invaded, then each of your friends will tell you so with probability 1. If aliens have not invaded, each of your friends will tell you that they have invaded with probability 0.1.

What are the probabilities you can infer from this description?

**How many of your friends will you ask before you start panicking?** Assume that each of your friends is independent conditioned on whether aliens have invaded. You start asking your friends, and everyone you ask tells you that aliens have invaded. How many friends would you ask, until you started to believe that aliens have invaded?

**Evidence:** Does  $D_1$  happening increase the probability of  $D_2$  happening? (Still under the assumption that your friends are independent conditioned on whether aliens invaded.)

**The Naive Bayes assumption:** Give a possible reason when the conditional independence assumption would not hold.