# CS 70 SPRING 2007 — DISCUSSION #9

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## 1. Administrivia

(1) Course Information
- You can pick up your midterm at the end of the discussion section if you haven't done it so.
- Homework 7 is posted, and it's due on *Tuesday*, March 20, at 2:30pm.

## 2. Probability

**Not Rule.** $\Pr\left(\overline{E}\right) = 1 - \Pr(E)$

**Exercise 1.** Which is more likely: rolling a total of 9 when two dice are rolled or rolling a total of 9 when three dice are rolled?

**Addition Rule.** $\Pr(E \cup F) = \Pr(E) + \Pr(F) - \Pr(E \cap F)$

**Exercise 2.** A card is drawn randomly from a deck of ordinary playing cards. You win \$ 10 if the card is a spade or an ace. What is the probability that you will win the game?

**Conditional Probability.** $\Pr(E \mid F) = \frac{\Pr(E \cap F)}{\Pr(F)}$

**Multiplication Rule.** $\Pr(E \cap F) = \Pr(E \mid F) \times \Pr(F)$

**Exercise 3.** Shuffle a deck of 52 cards. What is the probability that the first two cards are aces?

**Independence.** $\Pr(F \mid E) = \Pr(F)$

**Exercise 4.** In a binary communication channel the receiver sends *zero* or *one*, but at the receiver there are three possibilities: a *zero* is received, a *one* is received, and an *undecided bit* is received (which means that the receiver will ask the transmitter to repeat the bit). Define the event $T_1$={ 1 is sent } and $T_0$={ 0 is sent } and assume that they are equally probable. At the receiver we have three events: $R_1$={ 1 is received }, $R_0$ = {0 is received }, $R_u$={ cannot decide the bit }. We assume that we have the following conditional probabilities: $\Pr(R_0 \mid T_0) = \Pr(R_1 \mid T_1) = 0.9, \Pr(R_u \mid T_0) = \Pr(R_u \mid T_1) = 0.09$.

(1) Find the probability that a transmitted bit is received as *undecided*.
(2) Find the probability that a bit is received in error.
(3) Given that we received a *zero*, what is the conditional probability that a *zero* was sent? What is the conditional probability that a *one* sent?
$(E \cup F)(E \cup G)$

*Date*: March 16, 2007.