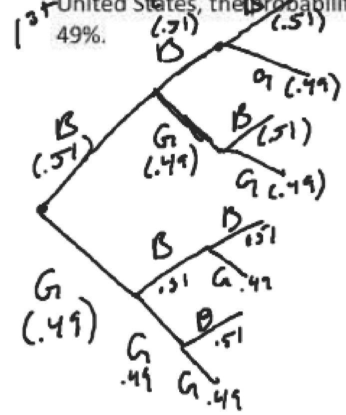
7. *Tree Graphs* are a way of organizing all possible sequences of outcomes. For example, tree graph below shows all possible families of exactly three children (with no twins or triplets). Each G means a girl was born, and each B means a boy was born. In the United States, the probabilities that a girl is born approximately 49%.



a. Use the graph to find the probability that a family of three children will consist of two girls and a boy (not necessarily born in that order).

GGB GBG BGG

$(.49)(.49)(.51) + (.49)(.51)(.49) + (.51)(.49)(.49)$

$.122 + .122 + .122$

$.366$

What you will learn about:
Finding Probabilities in Situations with Conditions

$\frac{14}{\ }$

$\frac{m}{9}$ $\frac{F}{5}$

1. Count the number of students in your classroom who are wearing sneakers. Count the number of girls. Count the number of students who are wearing sneakers and are girls. Record the number of students who fall into each category.

P (Boy or Sneakers)

	Wearing Sneakers	Not Wearing Sneakers	Total
Boy	8	1	9
Girl	3	2	5
Total	11	3	14

$\frac{9}{14} + \frac{11}{14} = \frac{20}{14} - \frac{8}{14}$

$\frac{12}{14}$

a. Suppose you select a student at random from your class. What is the probability that the student is wearing sneakers?

$\frac{11}{14}$

b. Suppose you select a student at random from your class. What is the probability that the student is a girl?

$\frac{5}{14}$

$\frac{3}{5} = \frac{55}{196}$

$.6 \neq .28$

c. Does the Multiplication Rule correctly compute the probability that the student is wearing sneakers and is a girl? $\left(\frac{11}{14}\right)\left(\frac{5}{14}\right) = \frac{55}{196}$

No! Not Independent

d. How is this situation different from previous situations in which the Multiplication Rule gave the correct probability?

P(A) → Probability of event a happening

P(A|B) Probability of event A happening Given B happens first

2. The phrase "the probability event a occurs given event B occurs" is written symbolically as P $(A|B)$. This **conditional probability** sometimes is read as "the probability of A given B". The table below categorizes the preferences of 300 students in a junior class about plans for their prom.

P (Sneakers | Girl) = $\frac{3}{5}$

P (Boy | Sneakers) = $\frac{8}{11}$

		Preference for Location		
		Hotel	Rec Center	Total
Preference for Band	Hip-Hop	$\boxed{73}$	80	153
	Classic Rock	55	92	147
Total		128	172	300

Suppose you pick a student at random from this class. Find each of the following probabilities.

a. P(*prefers hotel*) $\frac{128}{300}$

b. P(*prefers hip-hop band*) $\frac{153}{300}$

c. P(*prefers hotel and prefers hip-hop band*) $\frac{73}{300}$

$P(A)+P(B)-P(A \text{ and } B)$

d. P(*prefers hotel or prefers hip-hop*) $\frac{281}{300} - \frac{73}{300} = \frac{208}{300}$

e. $P(prefers\ hotel|prefers\ hip-hop\ band)$ $\frac{73}{153}$

f. $P(prefers\ hip-hop\ band|\underline{prefers\ hotel})$ $\frac{73}{128}$

3. Recall that events A and B are independent if knowing whether one of the events occurs does not change the probability that the other event occurs.

a. Using the data from problem 1, suppose you pick a student at random. Find $P(wearing\ sneakers|is\ a\ girl)$. How does this compare to *P(wearing sneakers)*?

$\frac{3}{5} = .6$ $\frac{11}{14} = .78$

b. Are the events *wearing sneakers and is a girl independent*? Why or why not?

No. When add the condition of being a girl the probability changed.

$P(A) = P(A|B)$

	c. Consider this table from a different class.

	Wearing Sneakers	Not Wearing Sneakers	
Boy	5	9	14
Girl	10	18	28
	15	27	$\boxed{42}$

Suppose you pick a student at random from this class.

i. Find P(wearing sneakers). $\frac{15}{42} = .35$

ii. Find $P(wearing\ sneakers|is\ a\ girl)$. $\frac{10}{28} = .35$

iii. Are the events *wearing sneakers and is a girl* independent?

P(Sneakers) = P(Sneakers | Girl) Yes,

d. If events A and B are independent, how are P(A) and $P(A|B)$ related? $P(A) = P(A|B)$

4. Suppose that you roll a pair of dice.
   a. Which is greater? P(doubles) or $P(doubles|\underline{sum\ is\ 2})$?

   $\frac{1}{6}$ $\frac{1}{1}$

   b. Are the events getting doubles and getting a sum of 2 independent? How would you describe the relationship?

5. Refer to the table in Problem 2.

P(Hotel) $\stackrel{?}{=}$ P(Hotel | Hip)

a. If you select a junior at random, are the events *prefer hotel and prefers hip-hop band* independent? Explain.

$\frac{128}{300} \stackrel{?}{=} \frac{73}{153}$ $.42 \neq .47$

b. Recall from Math 1 that two events are **mutually exclusive** if they cannot both occur on the same outcome. If you select a junior at random, are the events prefer hotel and prefers hip-hop band mutually exclusive? Explain.