

### Section 5.3 The Multiplication Principle

#### Generalized Multiplication Principle

Suppose a task  $T_1$  can be performed in  $N_1$  ways, a task  $T_2$  can be performed in  $N_2$  ways, ..., and, finally a task  $T_n$  can be performed in  $N_n$  ways. Then the number of ways of performing the tasks  $T_1, T_2, \dots, T_n$  in succession is given by the product

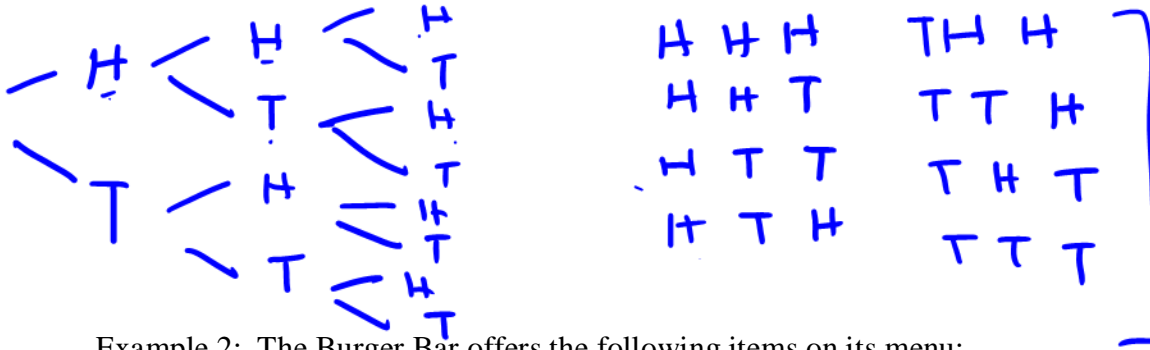
$$N_1 \cdot N_2 \cdot \dots \cdot N_n.$$

Example 1: A coin is tossed 3 times, and the sequence of heads and tails is recorded.

a. Determine the number of outcomes of this activity.

$$\underline{2} \cdot \underline{2} \cdot \underline{2} = 2^3 = 8$$

b. List the outcomes of this experiment by first drawing a tree diagram.



Example 2: The Burger Bar offers the following items on its menu:

<u>Burger</u>	<u>Sides</u>	<u>Beverages</u>	<u>Desserts</u>
Single Meat	Fries	Tea	Cheesecake
✓ Double Meat	Onion Rings	✓ Coffee	✓ Brownie
	✓ Fruit Bowl	Soda	Cookie
	Cheddar Peppers		Ice Cream Cone

If a customer chooses 1 item from each category, how many meals can be made? List 1 meal possible.

$$\underline{2} \cdot \underline{4} \cdot \underline{3} \cdot \underline{4} = 96$$

DM, FB, C, B

0-9

Example 3: An identification number for employees at a certain company contains six digits. How many ID numbers are possible if repetition is allowed?

Rep allowed:  $\underline{10} \cdot \underline{10} \cdot \underline{10} \cdot \underline{10} \cdot \underline{10} \cdot \underline{10} = 10^6$

Rep not allowed:  $\underline{10} \cdot \underline{9} \cdot \underline{8} \cdot \underline{7} \cdot \underline{6} \cdot \underline{5} = 151200$

Example 4: A license plate consists of 2 letters followed by 4 digits. How many license plates are possible if the 1st letter can't be Q, the 1st digit can't be 0 and no repetitions are allowed?

$\underline{25} \cdot \underline{25} \cdot \underline{9} \cdot \underline{9} \cdot \underline{8} \cdot \underline{7} = 2835000$   
cannot repeat  
A-Z: 26  
0-9: 10  
Not 0

Example 5: In the original plan for area codes in 1945, the first digit could be any number from 2 through 9, the second digit was either 0 or 1, and the third digit could be any number except 0. With this plan, how many different area codes were possible?

2-9 → 8 choices  
0-1 → 2 choices  
1-9 → 9 choices  
 $8 \cdot 2 \cdot 9 = 144$

Example 6: Six performers are to present their comedy acts on a weekend evening at a comedy club. One of the performers insists on being the last stand-up comic of the evening. If this performer's request is granted, how many different ways are there to schedule the appearances?

$\underline{5} \cdot \underline{4} \cdot \underline{3} \cdot \underline{2} \cdot \underline{1} \cdot \underline{1} = 120$

Example 7: The call letters for radio station begin with K or W, followed by 3 additional letters. How many sets of call letters having 4 letters are possible? Repetition is allowed.

K or W: 2 choices

letters: 26

$\underline{2} \cdot \underline{26} \cdot \underline{26} \cdot \underline{26} = 35152$