5.1 Exercise: In-class exercises are meant to introduce you to a new topic and provide some practice with the new topic. Work in a team of up to 4 people to complete this exercise. You can work simultaneously on the problems, or work separate and then check your answers with each other. You can take the exercise home, score will be based on the in-class quiz the following class period. **Work out problems on your own paper** - this document just has examples and questions.

5.1 Intro to Combinatorics

Combinatorics are counting problems, asking how many different combinations or outcomes there can be given some input(s), and when selecting a certain amount of items. These problems differ in how you solve them based on the type of structure.

Types of structures

	Repeats allowed?	**Order matters?**
Ordered list	yes	yes
Unordered list	yes	no
Permutations	no	yes
Sets	no	no

Question 1
Identify the structure type for each of the following problems. You DON'T need to solve the problems.

a. You want to throw a birthday party at your favorite restaurant, but you can only book 8 seats. You have 11 friends to choose from. How many different groups of friends could attend your birthday party?

Repetitions allowed? Order matter? What structure?

b. There are only 4 bags of chips left at the sandwich shop: Nacho, ranch, garden, and potato. You and your friend both want chips. If you're selecting first for your friend and then for yourself, how many ways are there to get chips?

Repetitions allowed? Order matter? What structure?

Question 1 (continued)
Identify the structure type for each of the following problems. You DON'T need to solve the problems.

c. A student is purchasing colored pens to use for each of their four classes. First they choose a pen for Discrete Math, then for English, then for Physics, and then for Programming. They can choose from the colors red, orange, yellow, green, blue, or purple.

Repetitions allowed? [1] Order matter? What structure?

d. You're filling your plate with food at a buffet. As you go down the buffet line, you might get more than one dessert... just because. If there are 5 main meal items and 1 dessert item, how many dinner combinations can you make if you have space for 3 items?

Repetitions allowed? Order matter? What structure?

Question 2

We have a pool of four people, Andrew, Bob, Carly, Diane, and two prizes will be distributed between two of these people. [2]

a. Assuming that prize #1 and prize #2 are different, list out all the ways the prizes can be distributed (i.e., permutations).

Example: (A, A), (A, B), (B, A), ...

b. Assuming that prize #1 and price #2 are both the same, list out all the ways the prizes can be distributed (i.e., sets).

Note: {A, B} and {B, A} would be considered the same.

[1] Nothing in the problem specifies that it isn't, and choosing pens in and of itself isn't generally a "is this unique?" type of problem.

[2] Based on Practice Problem 2 from Discrete Mathematics, Ensley & Crawley

Question 3

All possible outcomes of rolling a red 6-sided die and a green 6-sided die, in an organized way is given in the table. For the given set of data, answer the questions. [3]

	Green 1	Green 2	Green 3	Green 4	Green 5	Green 6
Red 1	(1,1)	(1,2)	(1,3)	(1,4)	(1,5)	(1,6)
Red 2	(2,1)	(2,2)	(2,3)	(2,4)	(2,5)	(2,6)
Red 3	(3,1)	(3,2)	(3,3)	(3,4)	(3,5)	(3,6)
Red 4	(4,1)	(4,2)	(4,3)	(4,4)	(4,5)	(4,6)
Red 5	(5,1)	(5,2)	(5,3)	(5,4)	(5,5)	(5,6)
Red 6	(6,1)	(6,2)	(6,3)	(6,4)	(6,5)	(6,6)

a. Of the listed outcomes, how many are "doubles" (both dice have the same value)? What percentage of total outcomes does this represent? (You can write it as a fraction)

b. How many are doubles *and* have the sum of two dice values less than 4? (You can write it as a fraction)

c. How many have a 5 on exactly one of the dice?

d. How many have a 5 on at least one of the dice?

Question 4

Identify all possible outcomes for the following:

a. All possible outcomes if you flip one coin.

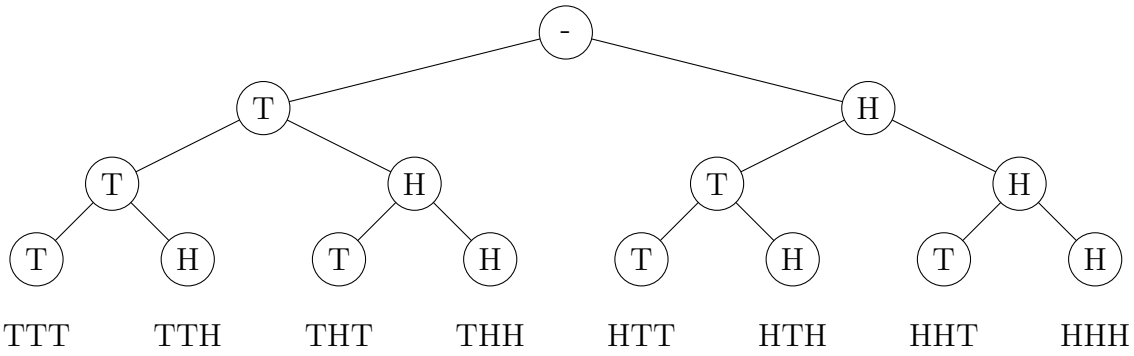
b. All possible outcomes if you flip two coins together.

c. All possible outcomes if you flip three coins together.

[3] Based on Exercise 5.1 #6 from Discrete Mathematics, Ensley & Crawley

Question 5

The following tree diagrams all possible outcomes when tossing a penny, a nickel, and a dime together. Given this tree, answer the following questions [4]



a. Of the outcomes shown, for how many does the result on the penny match the result on the dime?

b. Which is more likely, that the result on the penny matches the result on the dime, or that they do not match?

c. For how many of the outcomes do all three coins match?

d. For how many of the outcomes do exactly two of the coins match?

e. For how many outcomes is the number of tails less than the number of heads?

[4] Based on Exercise 5.1 #8 from Discrete Mathematics, Ensley & Crawley