CS1800 Discrete Structures *Out: October 17, 2026*

Problem Set 5

Strange & Varma *Due: October 23, 2026*

- This assignment is **due on October 23, 2026 at 11:59 PM** via Gradescope. You may submit up to 48 hours late with no penalty.
- Your solutions must be handwritten, with your name on the first page. All your work must be shown even if the problem doesn't specifically ask for it.
- Discussing problems with classmates is allowed but all solutions must be written by yourself, in your own words.
- Copying solutions from a classmate, an online source, or AI tools, is a violation of our academic integrity policy. Do *not* submit anything you cannot explain. Please list all your collaborators and online reference sources in your solution for each problem.
- If you get stuck on a homework problem, come by office hours or post on Campuswire! We recommend you spend about 30 minutes trying to figure out a problem, and then ask for help. We'll be happy to clarify material from class and algorithm concepts, but we will not give out solutions or confirm your answers are correct.

Problem 1 (Product and Sum rule) 5+10+10+(5+5+5+5)

Indicate which rule is applicable in the following situations: product rule, sum rule, or both. Then calculate the number of combinations for the scenario. *You should leave the solution unsimplified, we care more about the process and approach than the arithmetic to find an exact number.*

1. Shallan owns 5 thick and 3 thin brushes. She also owns 10 different colors. How many different ways can Shallan pair the brushes with the colors? Provide the answers separately if only thick or only thin brushes are used and also if either brush can be used.
2. License plates in Elendel starts with four (atomic) symbols, each chosen from one of the eight "internal" metals.[1] This is followed by five digits (from 0–9), e.g. "Fe Cu Al Au 89342". Alternatively, it can also be made of six "internal" metal symbols followed by three digits (from 0–9), e.g. "Cu Cu Al Fe Au Al 275". How many different license plates are possible?
3. How many strings of length 5 can you write, using the letters A, B, and C so that no two consecutive letters are the same? For example, A C B A C is a valid string, but A B C B B is not.
4. In how many ways can you answer the TRUE/FALSE questions of a quiz that consists of a total of 20 questions. Give your answer for the following three scenarios.
   (a) If you decide to answer all 20 questions.
   (b) If you decide to leave some questions blank.
   (c) If you decide that you'll answer all questions using True/False except questions which are numbered multiples of three or five. These questions you might decide to leave blank instead of choosing an answer. But you also decide that question 15 must be left blank because you are feeling particularly chaotic.
   (d) If you decide to answer one-half of the questions True and one-half False, in how many ways can you answer the questions?

Problem 2 (Password Troubles) 30

You are generating random numeric 7-digit passwords in order to send them to the members of your website as part of their first time login credentials. Your website is very successful, and you know that you will have at least 5 million people interested in becoming a member.[2] You also require that each member should be given a unique password; no two members can have the same password.

1. Assuming that you do not want to use "0" in your passwords, will you be able to generate enough passwords for your members? Why or why not? *You can use a calculator to figure out the exact value, but we need to see the approach/process for full credit.*
2. A bug due to vibe coding this causes digits 3 and 8 cannot be distinguished anymore, so "1328" looks the same as "1823" which is the same as "1323" and "1828". Of course, 0 is still not used. How many different passwords would you be able to generate in this case?
3. Unfortunately, the programmer who was supposed to fix the previous bug has introduced a new one. For some reason, the new code generates all possible passwords which have a "3" or "8" on

[1] It doesn't matter which they are, just that there are 8 of them.
[2] They are surely, definitely, absolutely, not AI bots.

exactly 3 of the 7 places and nowhere else. 0 is still excluded, but all other digits can appear. How many passwords does their program generate?

Problem 3 (Words and Numbers) 39

1. A palindrome is a word (or a number) which does not change when read from left or right. How many 7-letter or 8-digit palindromes are there which consist of any letters of the alphabet (for the 7-letter) or any digit (for the 8-digit) palindromes? Note that the obtained 7-letter words do not have to have a meaning.
2. How many 9-digit numbers are there whose all digits are prime and which is not even?
3. How many distinct words (they do not need to mean anything) can be formed from the word MASSACHUSETTS that use all of the 13 letters?

Problem 4 (Permutations and Combinations) 5+10+15+15

1. How many strings can you write using 7 As and 4 Bs, so that no two Bs are consecutive? [***Hint**: Insert the Bs between the As*]
2. In how many ways can you arrange the symbols

   ♠, ■, ▲, ▼, ♦, ★

   in a row under the restriction that the symbol ♠ cannot appear at the beginning or at the end of the sequence.
3. Akshar likes 15 K-pop songs, 13 progressive instrumental post-rock songs, and 6 Mongolian throat singing metal fusion songs. How many playlists[3] can be formed that consist of 6 K-pop, 4 post-rock, and 2 fusion-metal songs if:
   (a) Repetitions are allowed (the same song may be played multiple times)
   (b) Repetitions arent allowed.

Problem 5 (Games) 15+20

1. The gaming group has four different board games, *Catan* which is a 4-player game, *Set* which is a 3-player game, *Monopoly* which is a 4-player game, and *Solitaire* which is a single player game. How many different game assignments can be made up of the 20 members? Note that since there is only one copy of each game, some of the members won't be assigned games and will not be able to play.
2. In the second round, the groups wants to change things and wish to reassign members. The person who was playing solitaire shouldn't continue to play that. One specific person from the *Catan* group, the *Set* group, and the *Monopoly* group should continue to play the same game. The others can be moved anywhere else. How many ways can the members be rearranged?

[3] A playlist is decided once you specify the order in which to play the selected songs.