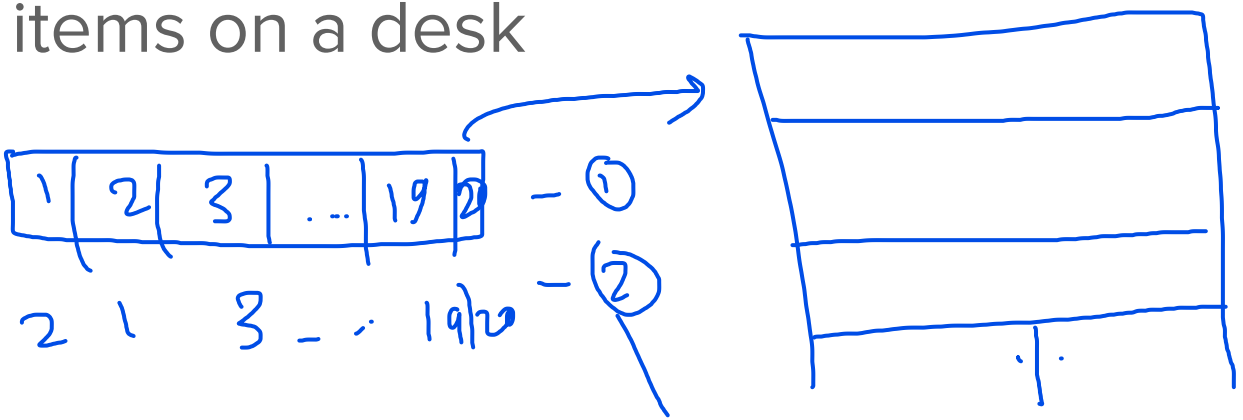
Topics for today

- Permutations
- Combinations

Permutation

- The arrangement of items in some order
- The order matters
- For e.g., arranging books in a shelf or arranging items on a desk

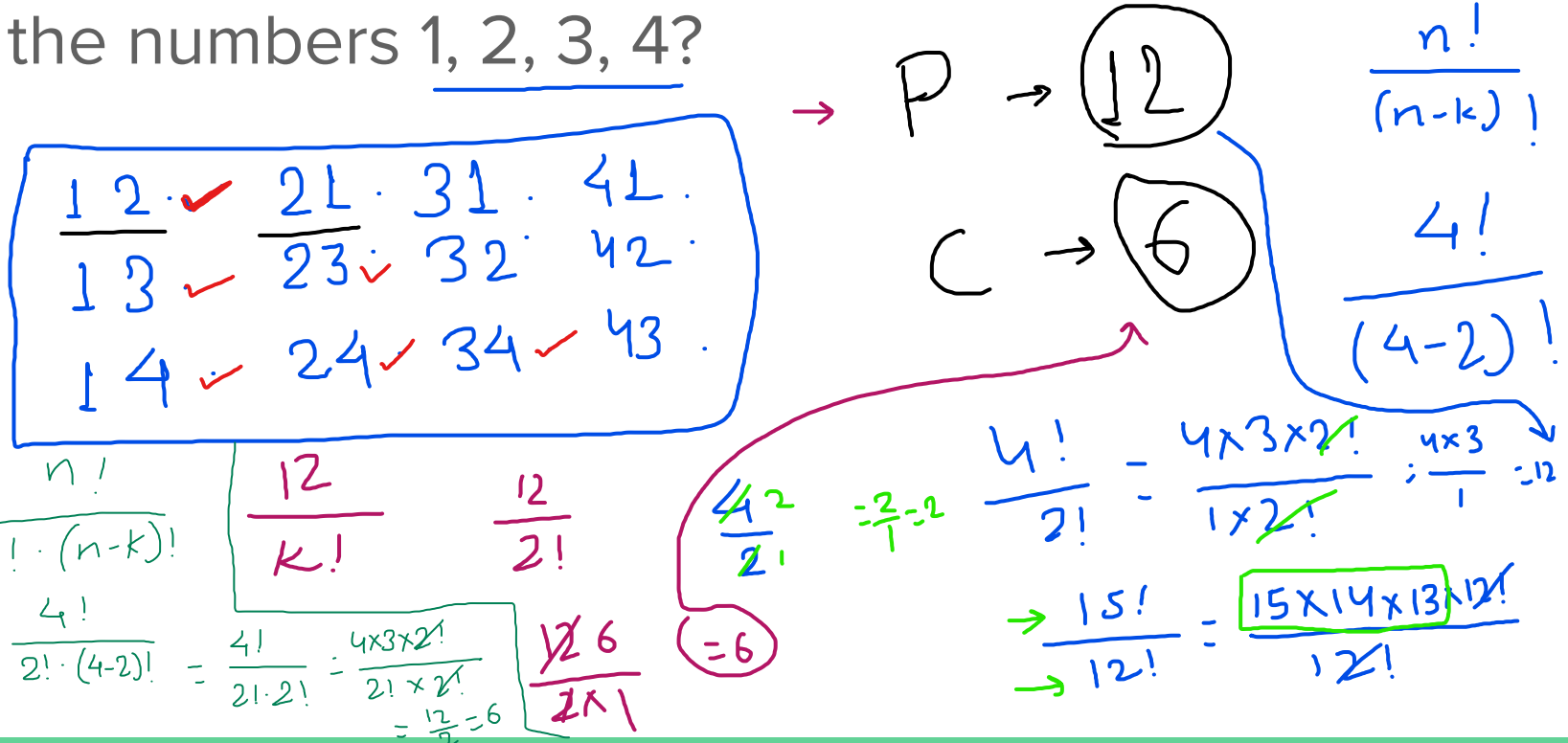


Combination

- Selection of items from a set of elements
- The order does not matter
- For e.g., selecting 2 fruits out of 4 fruits that are on the table (apple, orange, banana and mango)

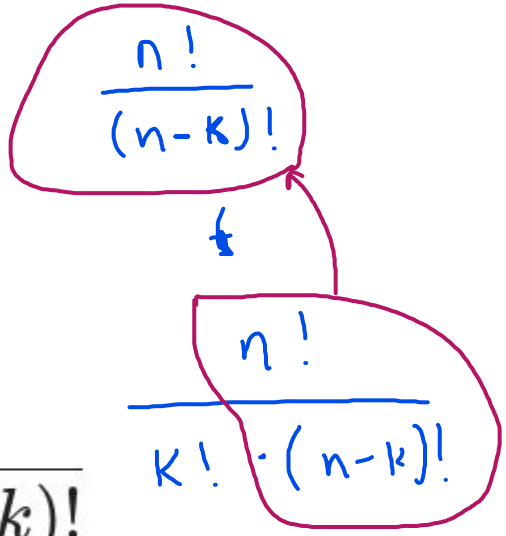
Permutation

How many ways can we ~~arrange~~ 2 numbers out of the numbers 1, 2, 3, 4?



Formulas

- Permutation $$P(n,k) = \frac{n!}{(n-k)!}$$
- Combination $$C(n,k) = \frac{n!}{k! \cdot (n-k)!}$$



where, n = total number of items, and

k = number of items to arrange or select

Exercise

How many ways can we arrange 4 fruits out of 9 fruits on a table?

$$P_{(n,k)} = \frac{n!}{(n-k)!}$$

$$P_{(9,4)} = \frac{9!}{(9-4)!} = \frac{9!}{5!} = \frac{9 \times 8 \times 7 \times 6 \times 5!}{5!} = 3024$$

$$C_{(n,k)} = \frac{n!}{k!\,(n-k)!} = \frac{9!}{4! \times (9-4)!} = \frac{9 \times 8 \times 7 \times 6 \times 5!}{4! \times 5!}$$

$$= \frac{3 \times 2 \times 7 \times 6}{4 \times 3 \times 2 \times 1} = \frac{3 \times 7 \times 6}{1} = 126$$

Exercise

Let's say, a company needs to hire 3 people for a position. There were 10 applicants. How many combination of those applicants can the company select?

1

1, 2, 3, 4, 5, . . . , 9, 10

$n = 10$

$K = 3$

$$C_{(n,k)} = C_{(10,3)} = \frac{n!}{k! \cdot (n-k)!} = \frac{10!}{3! \cdot (10-3)!} = \frac{10 \times 9 \times 8 \times 7!}{3! \times 7!}$$

$$= \frac{10 \times 9^{3} \times 8^{4}}{3 \times 2 \times 1} = 120$$

When all items are taken

- Permutation

$$P(n,k) = \frac{n!}{(n-k)!}$$

but k = n so P(n, n) = n!/(n-n)! = n!/0! = n!/1 = n!

- Combination

$$C(n,k) = \frac{n!}{k! \cdot (n-k)!}$$

but k = n so, C(n, n) = n! /(n! . (n-n)!) = 1 / 0! = 1 / 1 = 1

Example

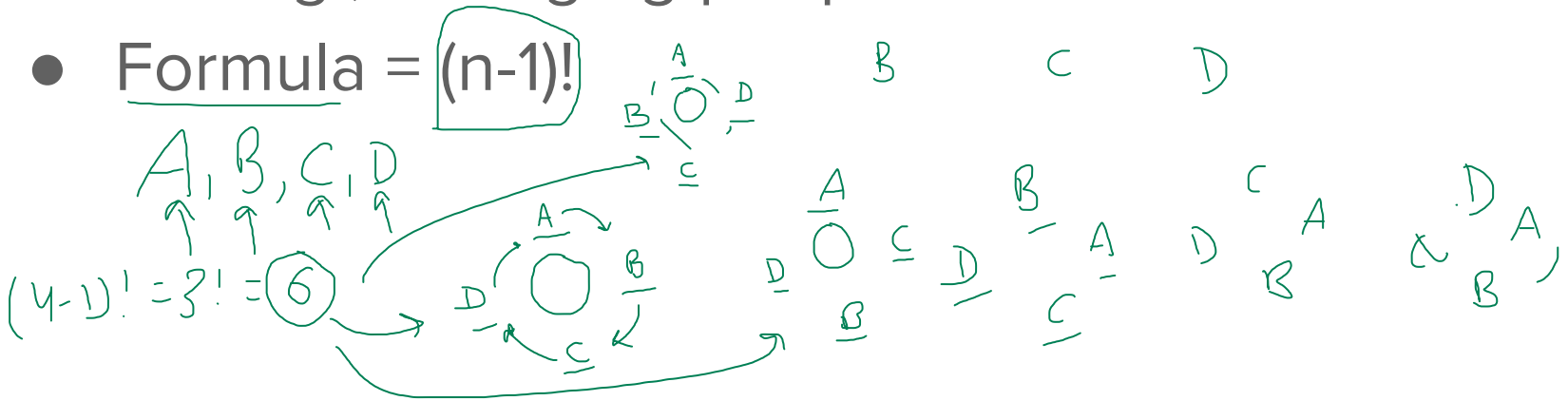
What if we take all items from a set of 4 books?

$$P(4,4) = \frac{n!}{(n-k)!}$$

$$= n! = 4! = 4 \times 3 \times 2 \times 1 = 24$$

Circular Permutation

- Arrangement of items in a circular order
- the items after arranging will form a closed loop
- For e.g., arranging people around a dinner table
- Formula = (n-1)!



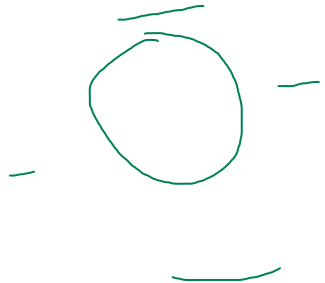
Example

How many ways can we arrange 4 people around a circular dinner table?

6

$n = 4$

$P(n) = (n-1)!$ $= (4-1)! = 3! = 3 \times 2 \times 1 = 6$



Permutation with repetition

- If we can select the items that we have already selected, then, our formula becomes:

$$P(n, r) = n^r =$$

1222

0 - 9 0011

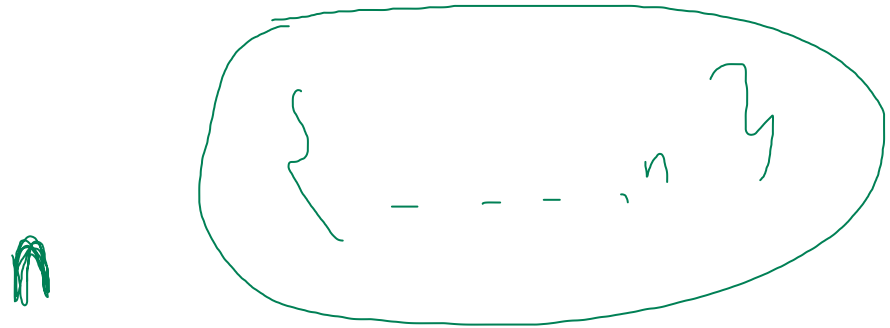
0123, 1234, . . . , 0000,

- For e.g, selecting a 4 digit password on a phone

$$P_{(10,4)} = 10^4 = 10{,}000$$

Example

How many ways to select a 4-digit password on a phone?



Permutation of n objects with some items not distinct

- The n objects are not all distinct →
- Arrangement of the n objects in some order
- For e.g., arranging 10 balls where 4 are red, 3 are blue and the remaining 3 are all different colours.

→ $$Pconstrained(n, k1, k2, ..., kr) = \frac{n!}{k1! \times k2! \times \cdots \times kr!}$$

Where *k*1,*k*2,...,*kr* represent the number of repetitions for each distinct object.

Example

How many ways can we arrange the letters in the word “BANANA”? What about “SLEEPLESSNESS”?

S → 5 = k_1
L → 2 = k_2
E → 4 = k_3
P → 1
N → 2

$n = 13$

$$P(n, k_1!, \dots) = \frac{n!}{k_1! \times \dots k_3!}$$

$$= \frac{13!}{5! \times 2! \times 4! \times 1! \times 1!}$$

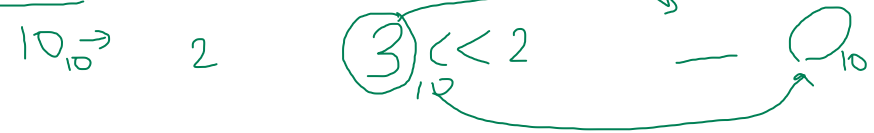
$$= 1081,080$$

CS Fundamentals
Final exam guidance

CS fundamentals final exam guidelines

General

- Ensure you answer **all** questions to the best of your ability within the time limit.
- This exam is **open** book (i.e. you can access your notes).
  - Digital notes made by you and stored online in your Google Drive and/or your GitHub account.
  - Paper notes: Hand-written by you or typed then printed out.
  - CA materials: accessed on Canvas and Ed.
  - Notes of any kind MUST be authored by you and NOT contain any 3rd party content. That is, your notes may ONLY contain your own original content and/or Canvas/Ed content.
- This exam is **not** open Internet.
  - Googling or using websites other than those mentioned above is not allowed during the exam.
- You are expected to be on camera for the duration of the exam. Your face must be seen on camera.
- No headphones for the duration of the exam, please. You can use headphones when the session starts to hear your educator's instructions. Once the exam starts, please remove the headphones. Make sure you are still able to hear your instructor if required.
- You don't need to have your mic on.
- If you need to go to the bathroom, let the educator know.
- You can use a simple calculator; there's one included in Canvas at the top of the page. Scientific calculators are not allowed.
- The initial mark is not final. All answers will be reviewed by a marker.
- Being caught cheating during the exam will result in a 0 for this exam.
- If not specified, provide answer in the same base as the question (i.e. question asks for a calculation of two decimal numbers and it's not asking to convert it to another base, then provide the answer in decimal)
- Time limit: **2 hours**



Marks

- Marks and/or results for this Assessment (as released in Canvas) are only raw marks and may not necessarily reflect final grades on transcripts. Grades are only finalised after review by the Academic Board and applicable processing (moderation, etc).

CS fundamentals final exam guidelines

33 questions (not equally weighted)
No multiple choice questions
Questions on any CS Fundamentals topic covered in the course.
Ed challenges are a great way to practice for the exam.

CS fundamentals. Final exam day

Exam starts at 7:05pm NSW/VIC/QLD and finishes 2 hours later.

The class will split in 2 Zoom conferences. You will be notified which one is your conference.

Access to the Zoom conference no later than 7:00pm NSW/VIC/QLD.

Connect your webcam or mobile camera the way your face is visible.

The notes you write during the exam for calculations must be submitted after the Exam.

CS fundamentals. After the exam.

Once you finish the exam, notify on Zoom to your educator your submission and leave the conference.

The notes you write during the exam for calculation purposes must be submitted after the exam is finished.

There are a few hours to do that, but **don’t edit those notes after the exam**.

CS fundamentals. Questions?

Good luck!!