CSCI262 – Computer Security

Distinguishable Permutation Objects

Distinguishable Permutation Object

Suppose we have a number of letters:

- 1 W,
- 3 Os,
- 2 Ls,
- 2 Ns, and
- 2 Gs.

How many ordered (different ways of) arrangements are there to arrange the letters?

W									

$$\binom{10}{1}$$

- All together we have 10 letters.
- To start with, we have 10 different possible position to place the letter 'W'.

Distinguishable Permutation Objects

W	O	O	O						

$$\binom{10}{1} \times \binom{9}{3}$$

- We have 9 different possible position left to place the remaining 9 letters.
- Let’s say we place the 3 letters ‘O’.

Distinguishable Permutation Objects

W	O	O	O						

$$\binom{10}{1} \times \binom{9}{3} \times \binom{6}{2}$$

- We have 6 different possible position left to place the remaining 6 letters.
- Let’s say we place the 2 letters ‘L’ next.

Distinguishable Permutation Objects

W	O	O	O	L	L				

$$\binom{10}{1} \times \binom{9}{3} \times \binom{6}{2}$$

- We have 6 different possible position left to place the remaining 6 letters.
- Let’s say we place the 2 letters ‘L’ next.

Distinguishable Permutation Objects

W	O	O	O	L	L	N	N		

$$\binom{10}{1} \times \binom{9}{3} \times \binom{6}{2} \times \binom{4}{2}$$

- We have 4 different possible position left to place the remaining 4 letters.
- Let’s say we place the 2 letters ‘N’ next.

Distinguishable Permutation Objects

W	O	O	O	L	L	N	N	G	G

$$\binom{10}{1} \times \binom{9}{3} \times \binom{6}{2} \times \binom{4}{2} \times \binom{2}{2}$$

- We have 2 different possible position left to place the remaining last 2 letters.
- Let's say we place the remaining 2 letters 'G'.

Distinguishable Permutation Objects

W	O	O	O	L	L	N	N	G	G

$$\binom{10}{1} \times \binom{9}{3} \times \binom{6}{2} \times \binom{4}{2} \times \binom{2}{2}$$

$$\frac{10!}{1! \times 9!} \times \frac{9!}{3! \times 6!} \times \frac{6!}{2! \times 4!} \times \frac{4!}{2! \times 2!} \times \frac{2!}{2! \times 0!}$$

- The total number of distinguishable permutation (arrangement) of the letters can be computed as

$$\frac{10!}{1! \times 9!} \times \frac{9!}{3! \times 6!} \times \frac{6!}{2! \times 4!} \times \frac{4!}{2! \times 2!} \times \frac{2!}{2! \times 0!}$$

Distinguishable Permutation Objects

W	O	O	O	L	L	N	N	G	G

$$\binom{10}{1} \times \binom{9}{3} \times \binom{6}{2} \times \binom{4}{2} \times \binom{2}{2}$$

$$\frac{10!}{1! \times \cancel{9!}} \times \frac{\cancel{9!}}{3! \times \cancel{6!}} \times \frac{\cancel{6!}}{2! \times \cancel{4!}} \times \frac{\cancel{4!}}{2! \times \cancel{2!}} \times \frac{\cancel{2!}}{2! \times 0!}$$

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Distinguishable Permutation Objects

W	O	O	O	L	L	N	N	G	G

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Distinguishable Permutation Objects

W	O	O	O	L	L	N	N	G	G

$$\binom{10}{1} \times \binom{9}{3} \times \binom{6}{2} \times \binom{4}{2} \times \binom{2}{2}$$

$$\frac{10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{(1) \times (3 \times 2) \times (2 \times 1) \times (2 \times 1) \times (2 \times 1) \times (1)}$$

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$$\frac{10 \times 9 \times 8 \times 7 \times \cancel{6} \times 5 \times 4 \times 3 \times \cancel{2} \times 1}{(1) \times (\cancel{6}) \times (\cancel{2}) \times (\cancel{2}) \times (\cancel{2}) \times (1)}$$

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$75{,}600$

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$75{,}600$

Distinguishable Permutation Objects

W	O	L	L	O	N	G	O	N	G

- One of the possible arrangement (permutation) is WOLLONGONG.

Distinguishable Permutation Objects