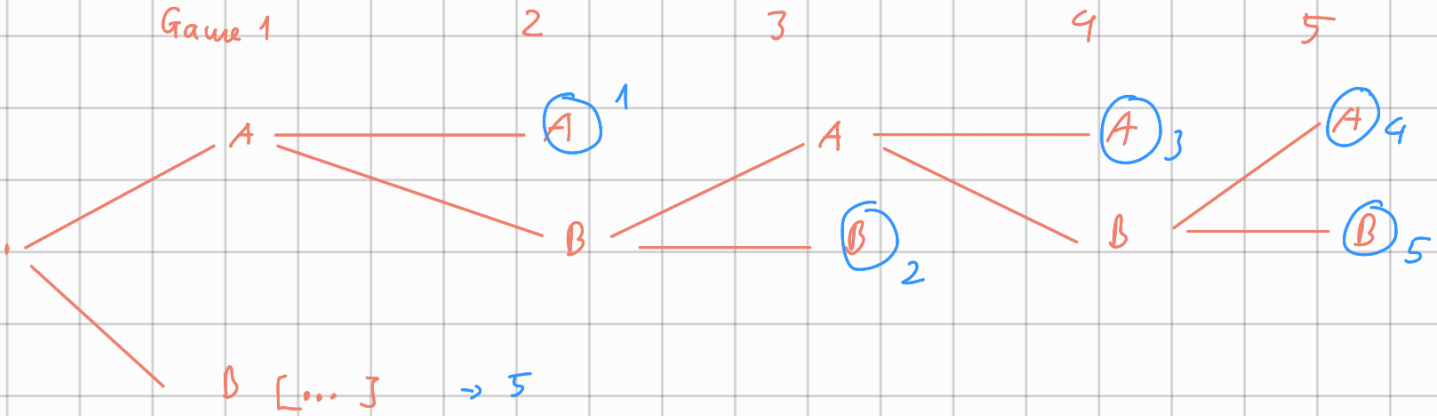
Ex: If in a game between A, B, a team wins if they either win 2 games in a row or 3 games total, how many ways can that tournament goes?



Theorem: Multiplication rule

If an event happens in k steps

1. n_1 ways for step 1
2. n_2 ways for step 2 regardless of step 1
3. ...
k. n_k ways for step k

→ The event can happen in $n_1 \cdot n_2 \cdot \dots \cdot n_k$ ways.

Ex: Number of 3-digits divisible by 5.

Step 1: 1 - 9
Step 2: 0 - 9
Step 3: {0, 5}

$9 \times 10 \times 2 = 180$

Note: Each steps must be independent of previous steps i.e. you can rearrange so they're independent.

⊛ Permutation: Suppose we want to arrange r elements of set A, $|A| = n$.

This is r-permutation of n-element sets:

$$P(n,r) = n \cdot (n-1) \cdot \dots \cdot (n-r+1) = \frac{n!}{(n-r)!}$$

⊛ Example: Arrangement of $\{a, b, c, d\}$ where 3 letters are used:

$$P(4,3) = \frac{4!}{1!} = 4! = \boxed{24}$$

⊛ Note: $0! = 1$, $P(n,n) = n!$