

COP3502 9/25/23

# Last Full Day - Recursion

## \* Brute Force

- Odometer (1 made up)
- Combinations
- Permutations
- Derangements
- Upwards (1 made up)

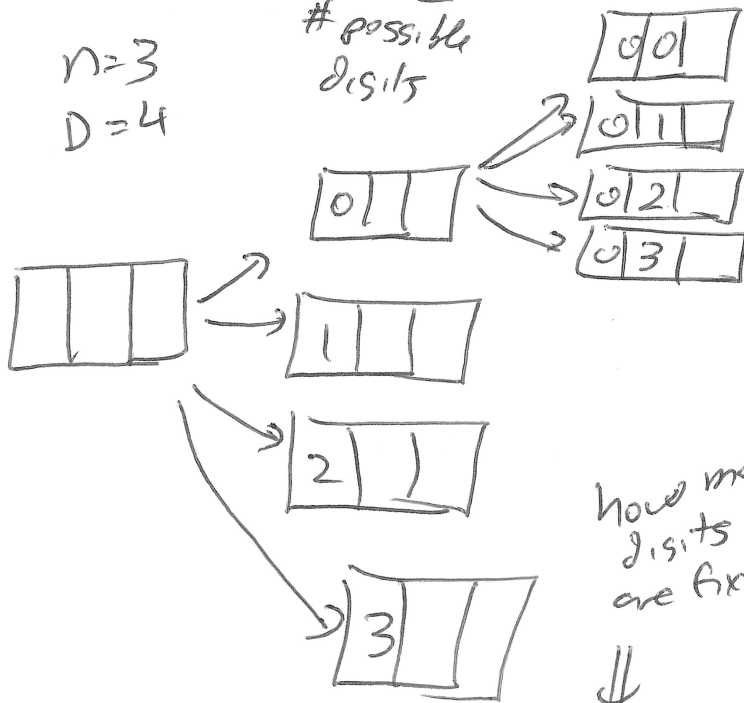
0000  
0001  
0002  
⋮  
0009  
0010  
0011  
⋮  
0099  
0100  
⋮  
0999  
1000  
⋮  
9999

# settings

$$= |D|^n$$

$n=3$   
 $D=4$

# possible  
digits



void odometer(int\* odom, int k, int n)

odometer( [0][ ][ ] , k=2, n=3 )

010, 011, 012, 013

```

void odometer(int* odom, int k, int n) {
    if (k == n) {
        print(odom, n);
        return;
    }
    for (int i = 0; i < NUMDIGITS; i++) {
        odom[k] = i;
        odometer(odom, k+1, n);
    }
}

```

## Combinations

$\{a, b, c\}$	a	b	c
<del><math>\{a, b, c\}</math></del>	0	0	0
$\{c\}$	0	0	1
$\{b\}$	0	1	0
$\{b, c\}$	0	1	1
$\{a\}$	1	0	0
$\{a, c\}$	1	0	1
$\{a, b\}$	1	1	0
$\{a, b, c\}$	1	1	1

1 0 1  $\Rightarrow$  a, c

# Permutations

0, 1, 2, 3, ... n-1

like odometer

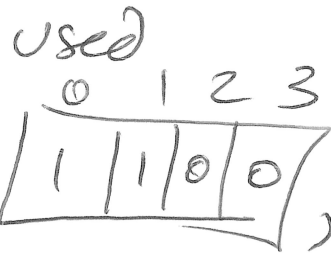
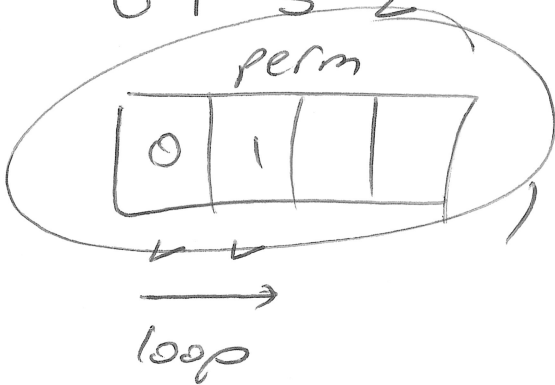


Difference

1. Can't repeat a value

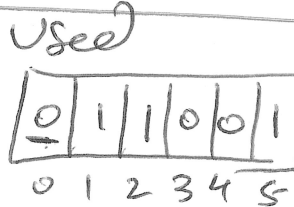
0 1 2 3

0 1 3 2



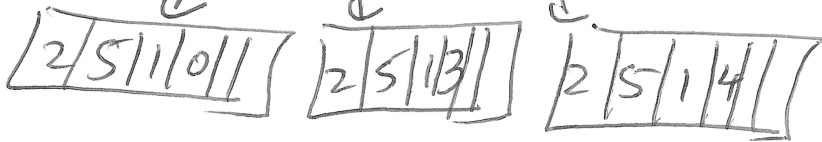
$k=2$

$n=4$



$k=3$

$n=6$



```
void perm (int* perm, int* used, int k, int n) {
```

```
    if (k == n) {
        print (perm, n);
        return;
    }
```

```
    for (int i=0; i<n; i++) {
        if (used[i]) continue;
        used[i] = 1; perm[k] = i;
        perm (perm, used, k+1, n);
    }
    used[i] = 0; // IMPORTANT
```