

# NCKU Programming Contest Training Course

## Backtracking

### 2018/03/21

---

**Yu-Cheng Chang (Vic)**  
*vic85821@gmail.com*

Department of Computer Science and Information Engineering  
National Cheng Kung University  
Tainan, Taiwan



# Backtracking

---

- What is backtracking?
  - A **searching** technique
- Goal
  - Find **solutions** under some constraints
  - Try to list out all kinds of possible ways
- Concept
  - Enumerate (枚舉)
  - Pruning (剪枝)



# Example

- Goal
  - give 5 numbers ( 1~5 )
  - choose 3 numbers and list out by its order
- possible solution
  - 1 2 3 、 2 3 4 、 3 4 5 ...

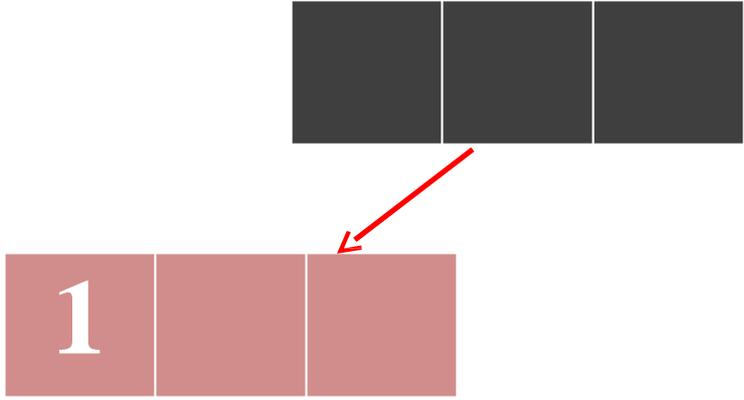
想想怎麼用recursive實作，想通你就會一半了



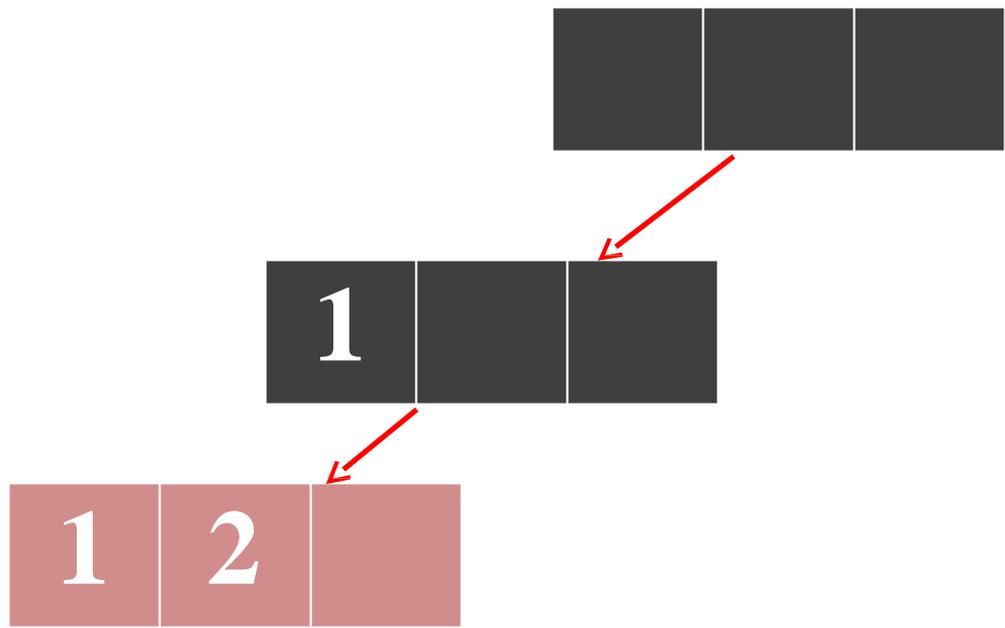
# Example



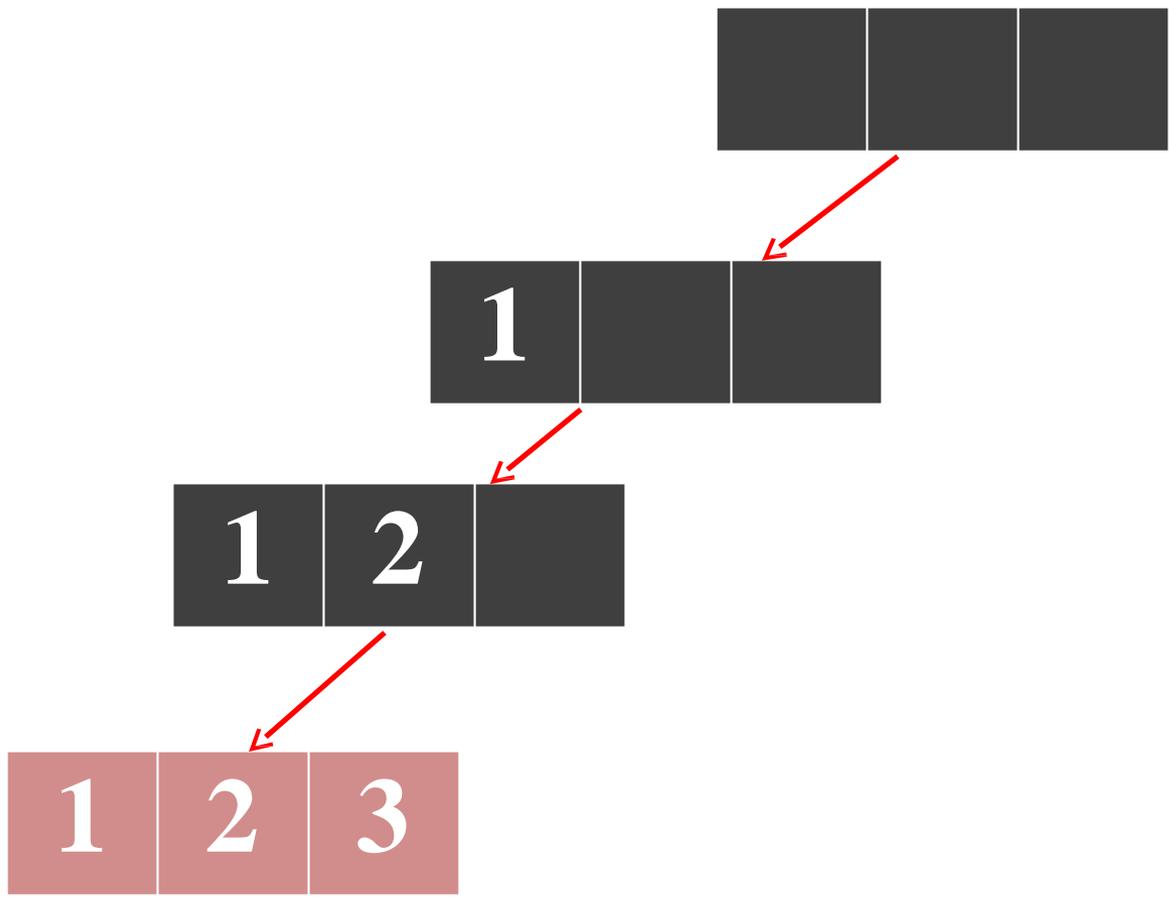
# Example



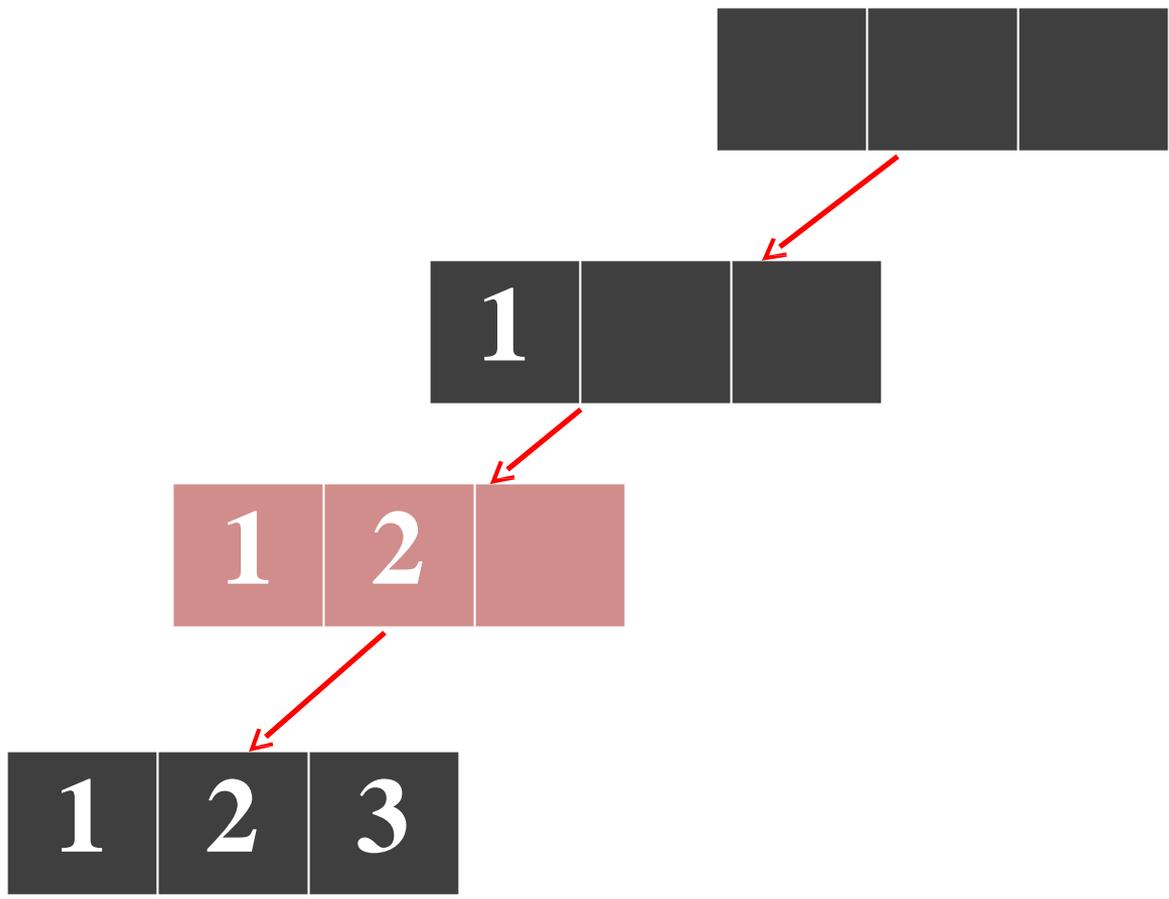
# Example



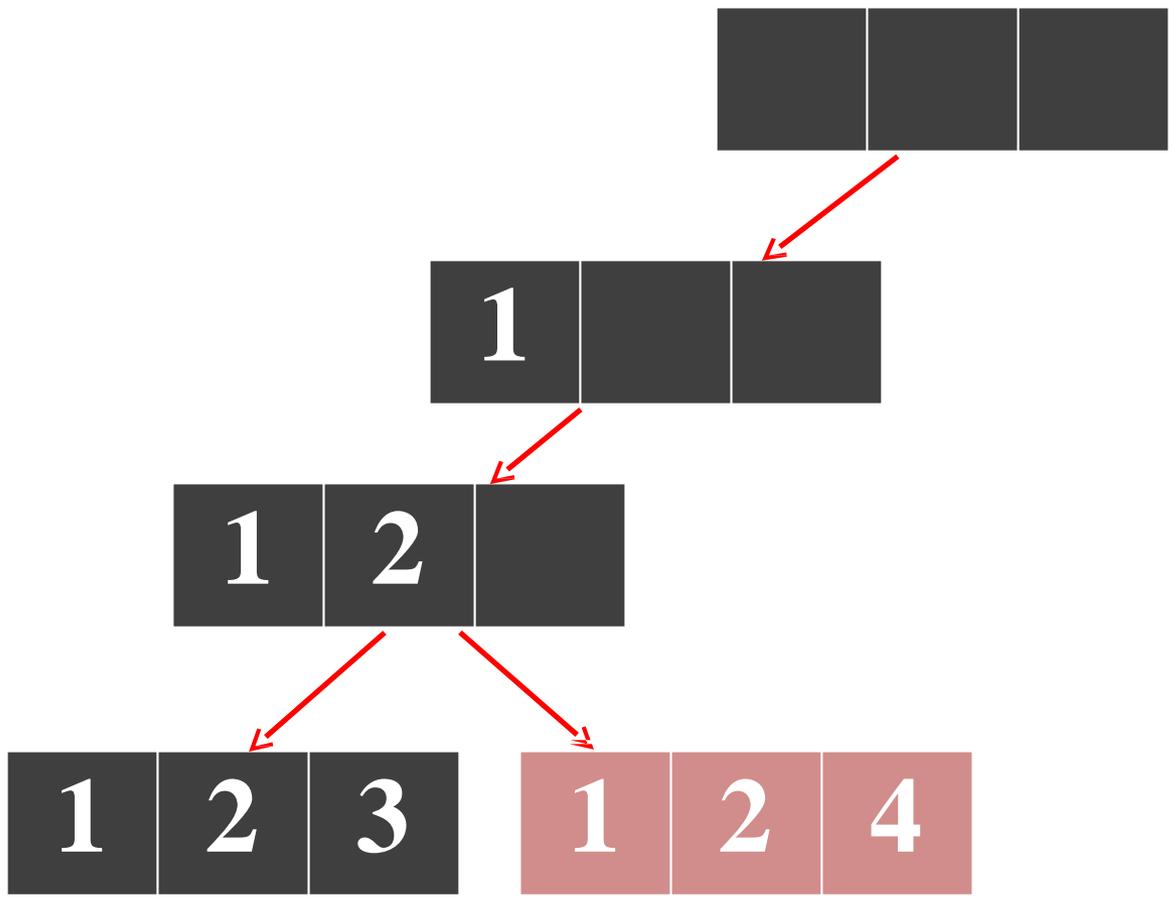
# Example



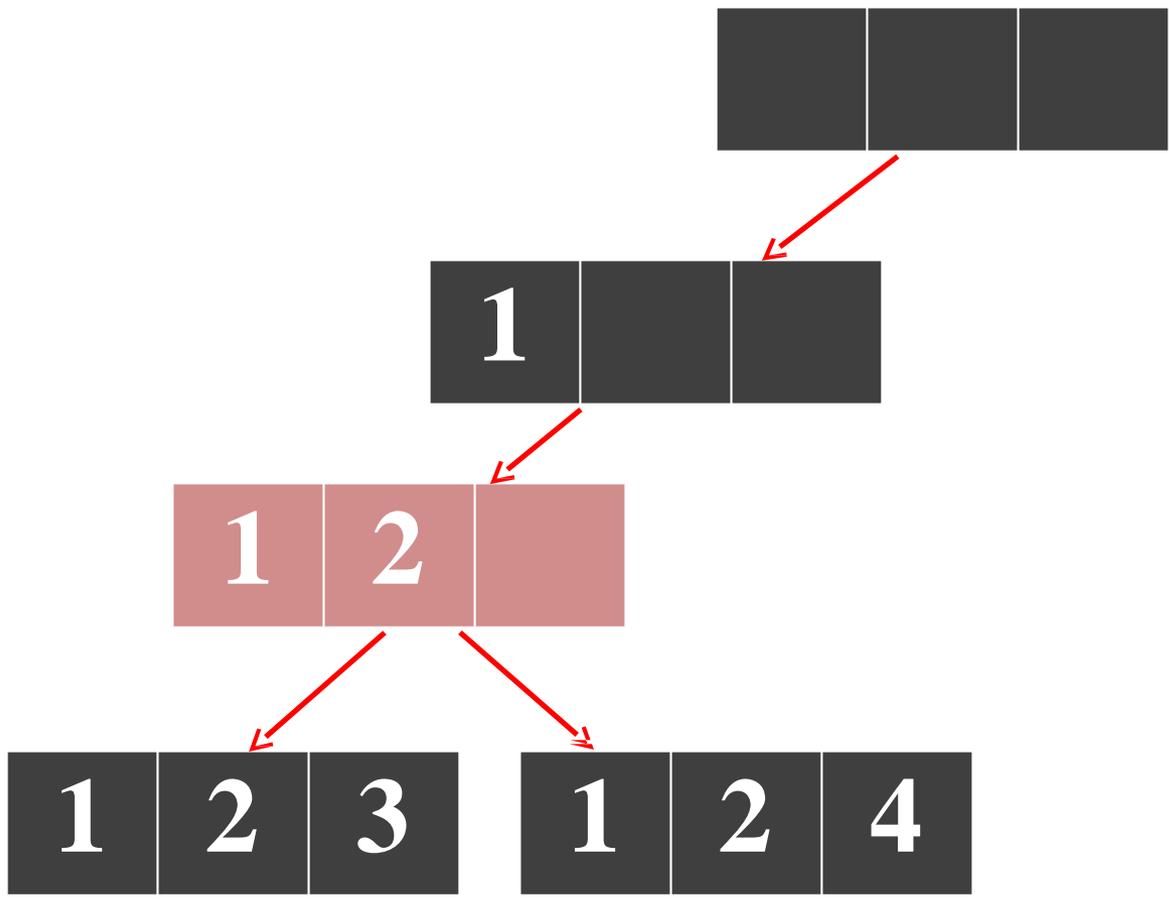
# Example



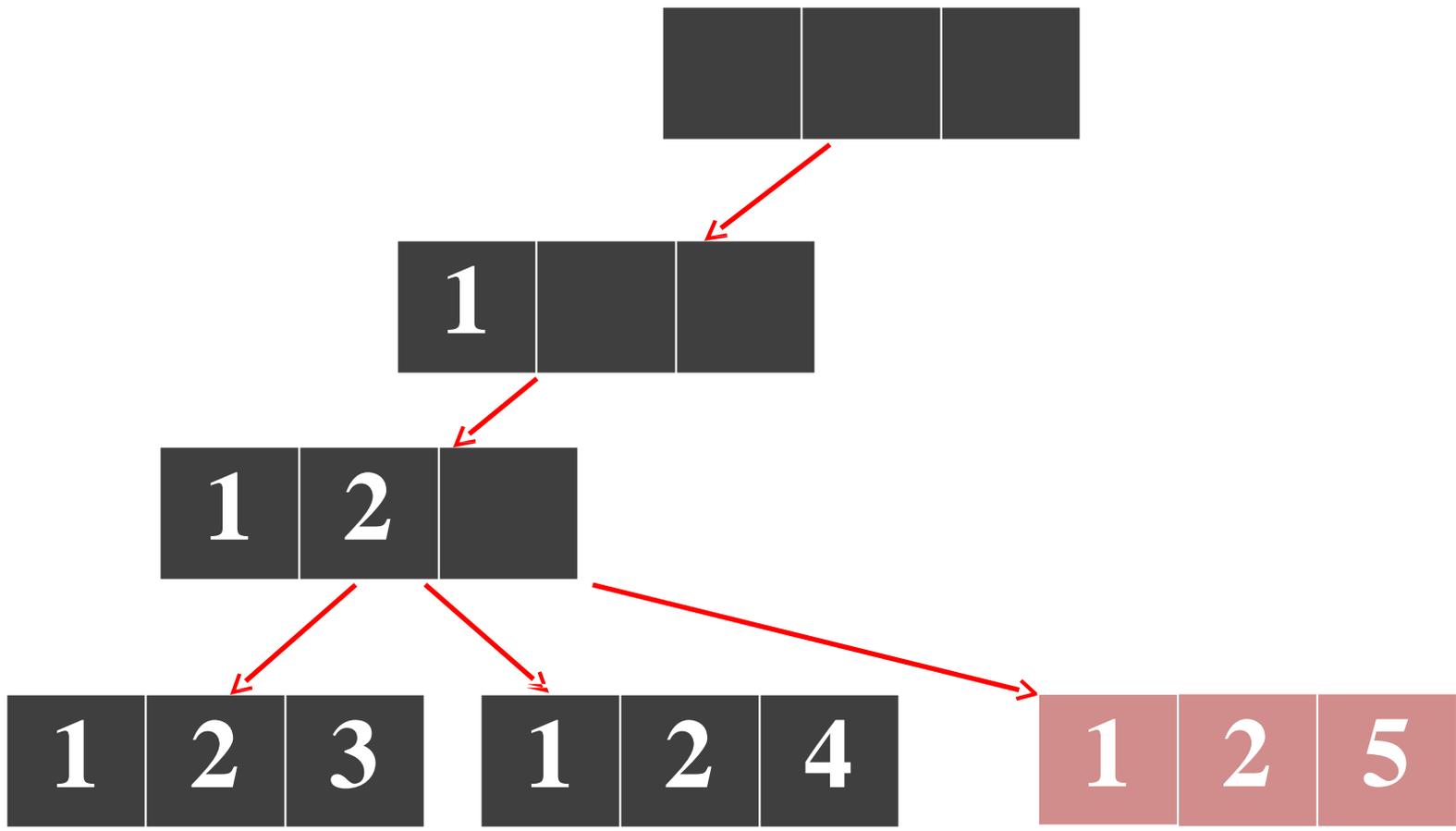
# Example



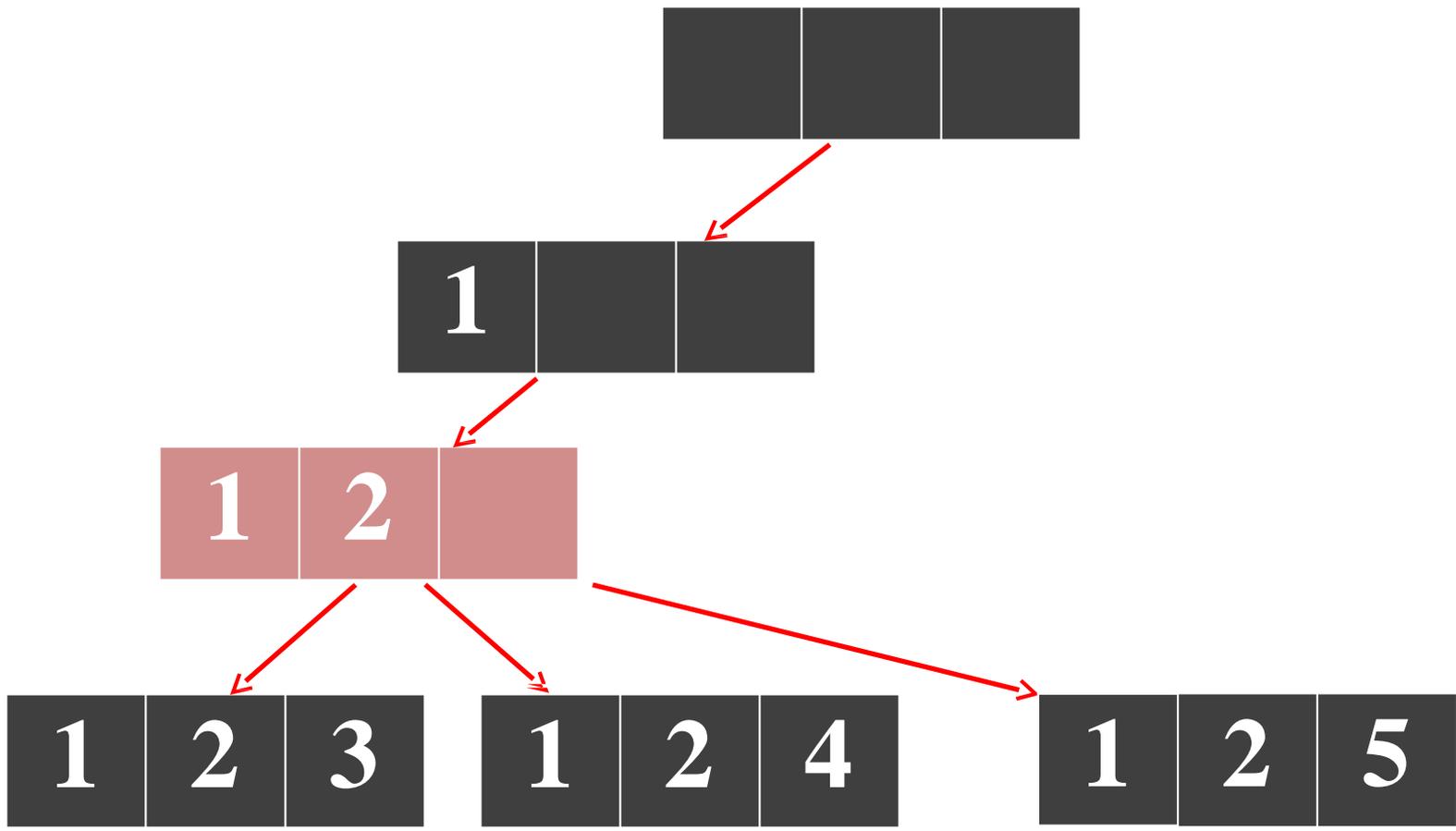
# Example



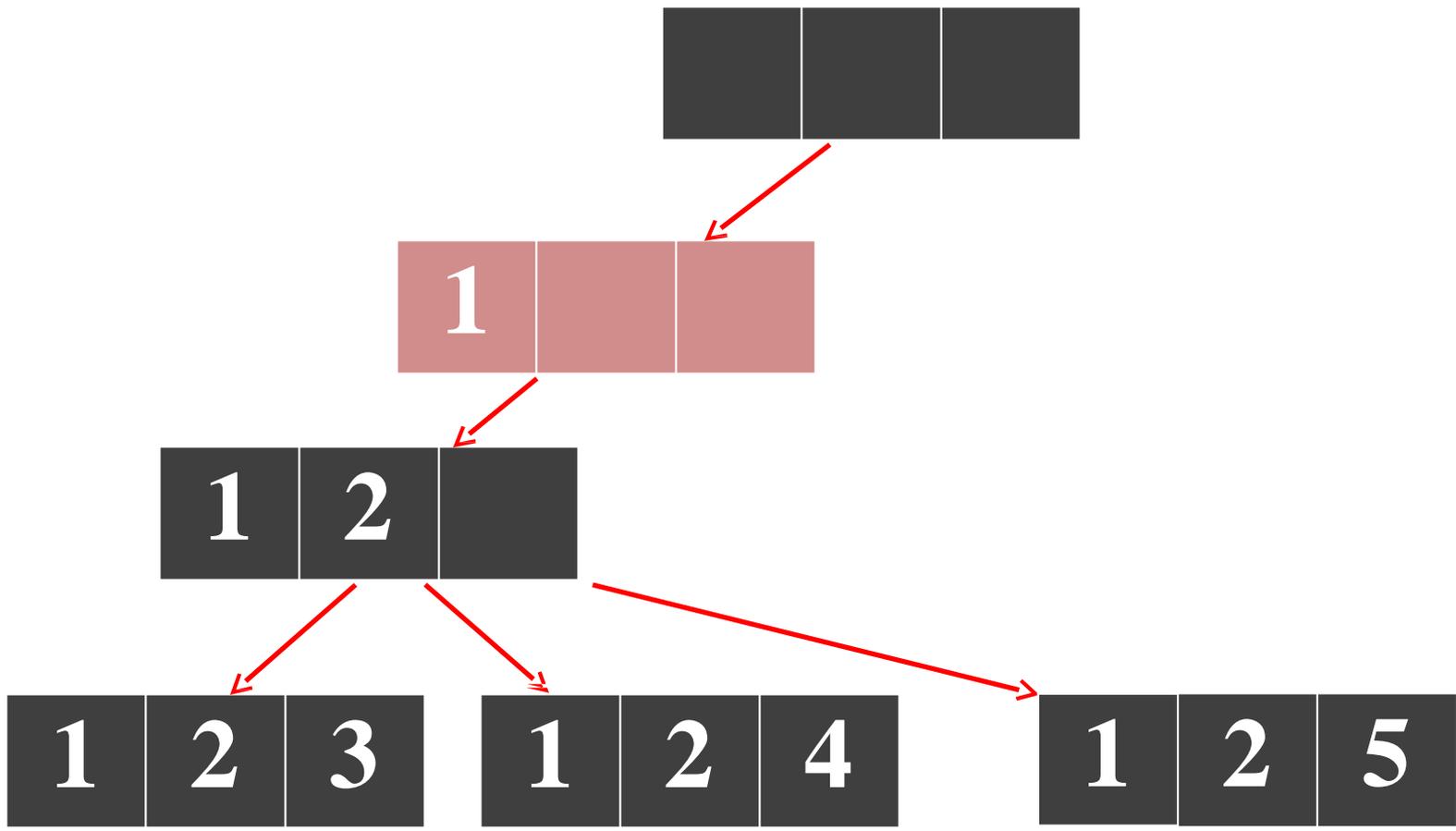
# Example



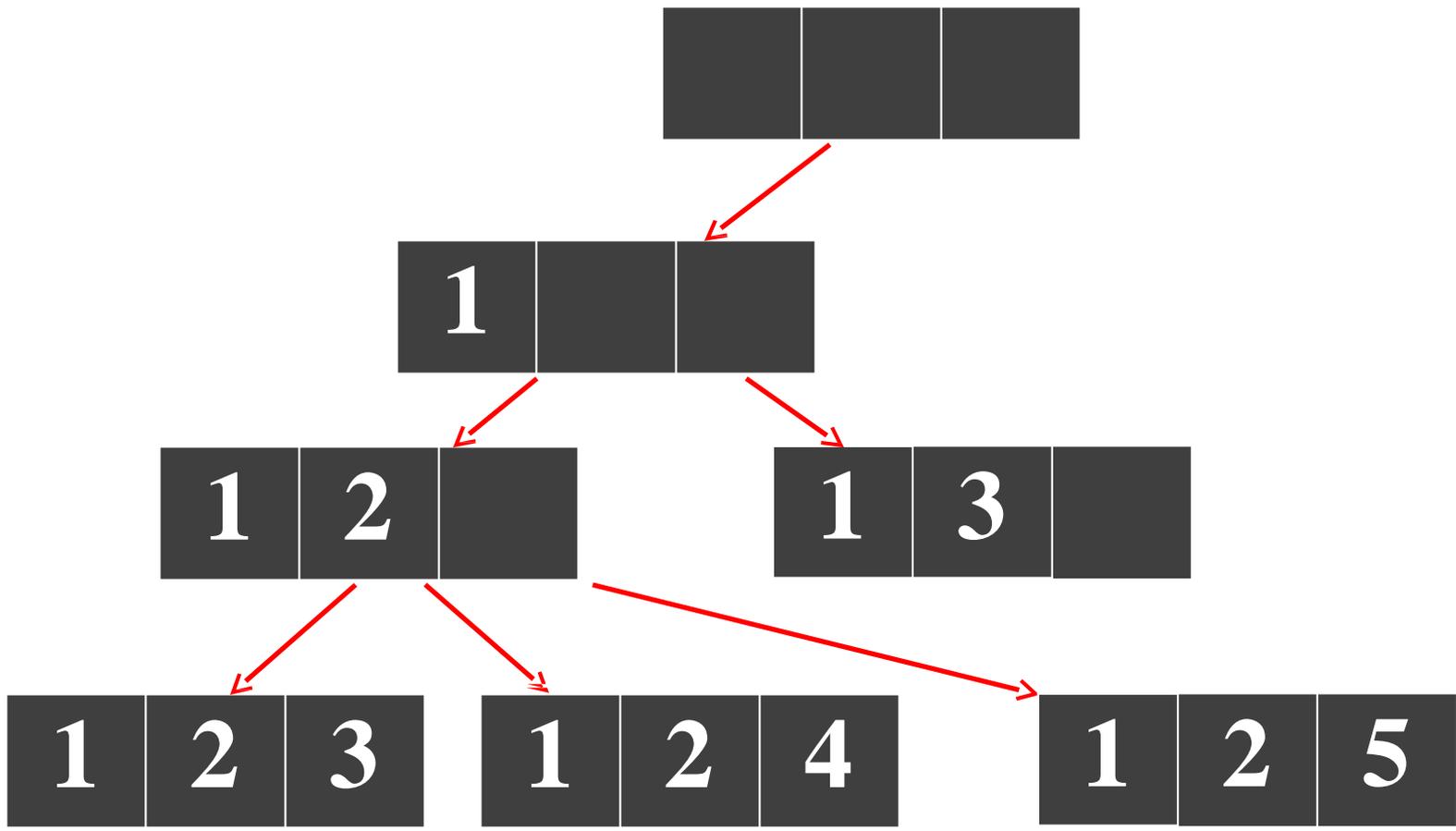
# Example



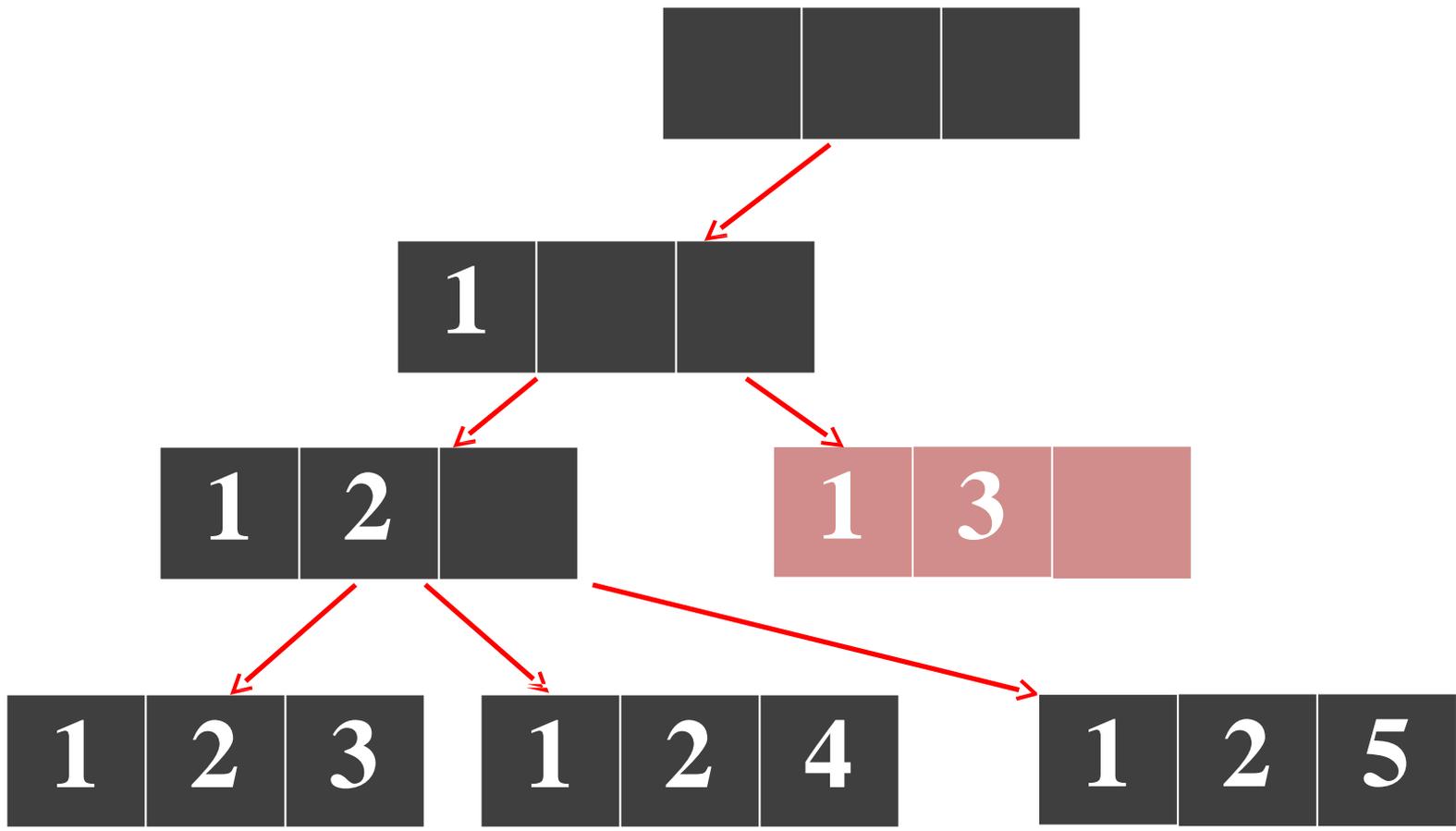
# Example



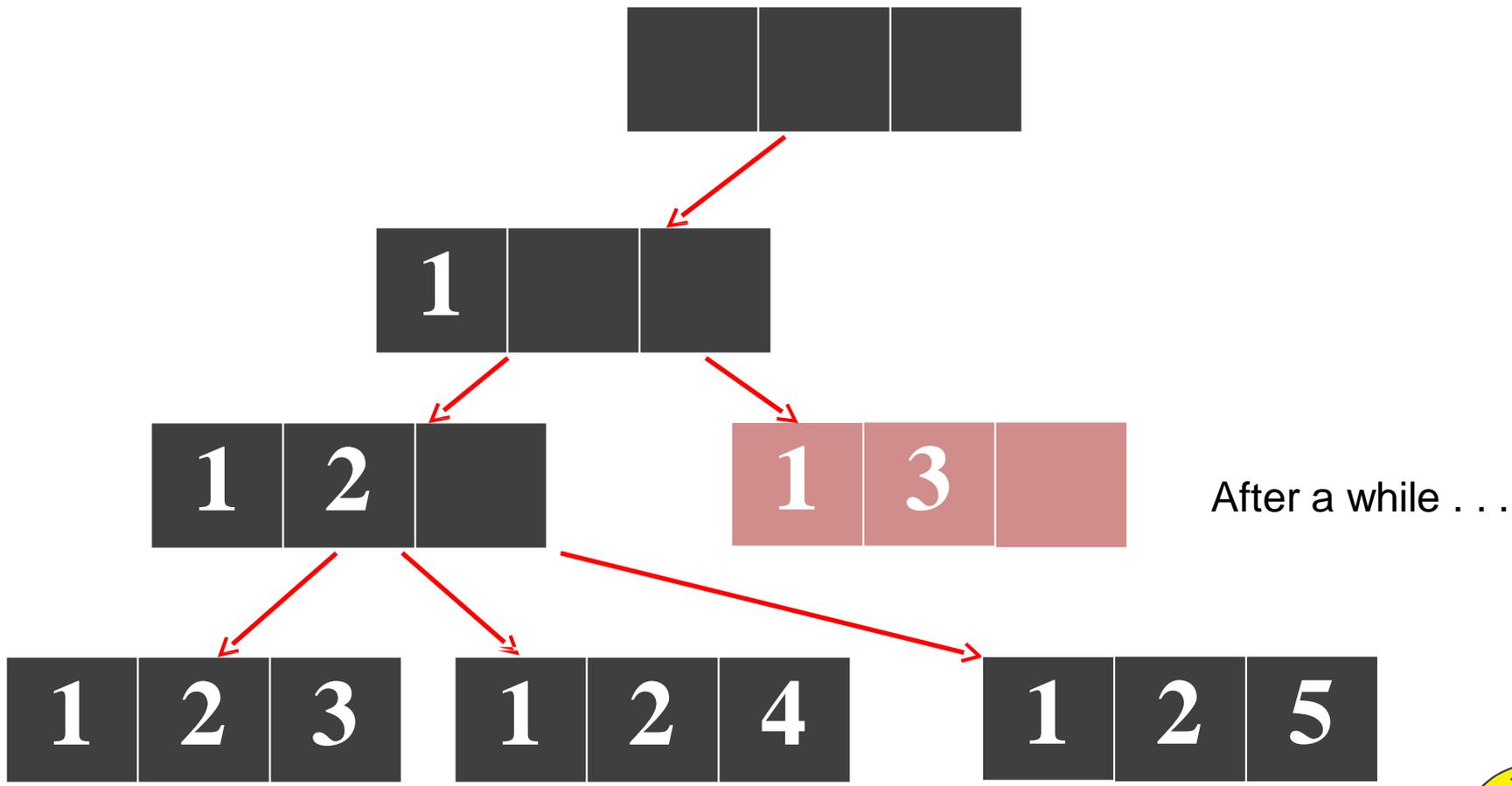
# Example



# Example



# Example



# Example

---

You find all the solution

123      234      345

124      235

125      245

134

135

145



# Strategy

---

- Enumerate possible solution
  - by DFS order
- Set the end point (or stack overflow)
  - return when find out a solution
- Answer Array
  - maintain **possible solution** during searching
- Prune
  - **Skip unnecessary search**



# Pseudo Code

```
int solution[MAX_DIMENSION];
void backtracking(int dimension)
{
    if( solution is well-generated )
    {
        process solution
        return;
    }
    for( x = each value of current dimention )
    {
        if( condition )
        {
            solution[dimension] = x;
            backtrack( dimension + 1 );
        }
    }
}
call backtracking( 0 );
```



# Practice

---

Uva 441

Uva 167





```
void backtrack(int digit, int index)
{
    visit[index] = true;
    ans[digit] = num[index];

    for(int i = index+1; i < size; ++i) {
        if(visit[i] == false) {
            backtrack(digit+1, i);
        }
    }

    if(digit == N) {
        printf("%d", ans[0]);
        for(int i = 1; i < N+1; ++i)
            printf(" %d", ans[i]);
        puts("");
    }

    visit[index] = false;
    return;
}
```

---

# Thank for Your Attention

