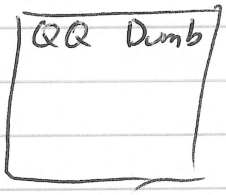
COP 3502 2/8/2024

- Backtracking
- Brute Force → Permutation
  - → "smart brute force"

8 Queens

Place 8 Queens on a chessboard so no 2 can attack each other!

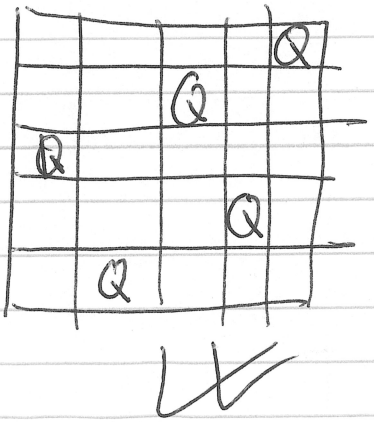
Dumb Brute Force = $\binom{64}{8}$ placements of 8 queens on 64 spots.

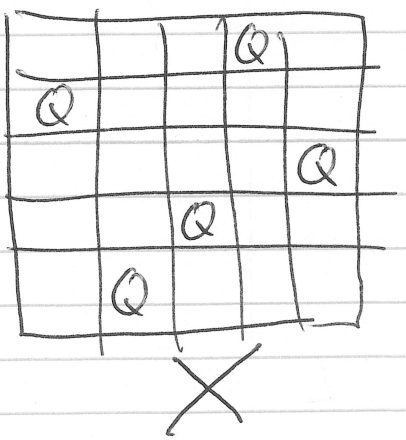


Simple Observation: each column can have at most one Queen. AND each row has to be unique. Map each permutation to a potential solution

n=5 [3,5,2,4,1] [2,5,4,1,3]

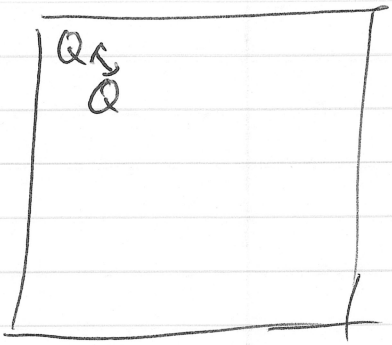
Smarter Brute Force Try each permutation





All of these doomed to fail

1, 2, 3, 4, 5, 6, 7, 8
1, 2, 3, 4, 5, 6, 8, 7
⋮
1, 2, 8, 7, 6, 5, 4, 3
1, 3, 2, 4, 5, 6, 7, 8



Backtracking:

As you are creating your partial solution, skip over any choices that are "doomed to fail" (for this problem: placing a queen here will attack a previously placed queen)

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

Digit Divisibility // Prefix Prime

each prefix of a # is divisible by the # of digits

32485

3 div 1
32 div 2
324 div 3
3248 div 4
32485 div 5

2333

2 is prime
23 is prime
233 prime?

Right-Truncatable Primes

City Spies
James Pontin

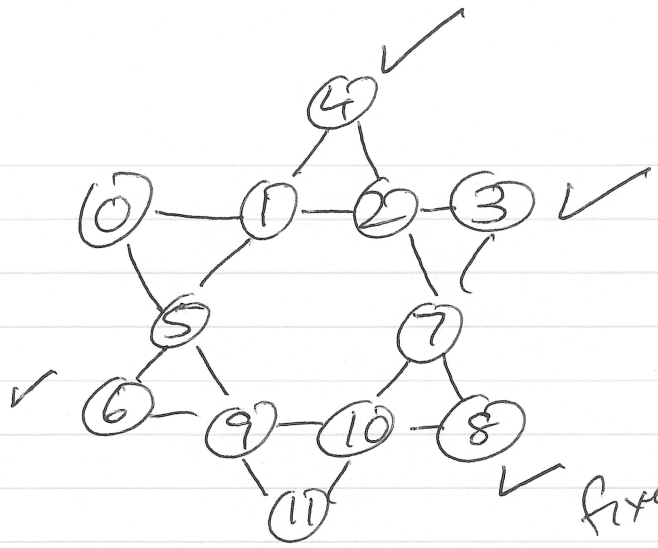
Hexagram

all 12 #s appear in exactly 2 rows

$$\sum 6 \text{ rows} = 2\sum \#$$

$$\sum \text{row} = \frac{2\sum \#}{6} = \frac{\sum \#}{3}$$

$$6X = 2a_1 + 2a_2 + 2a_3 + \cdots 2a_{12}$$
$$6X = 2(a_1 + a_2 + a_3 \cdots a_{12}) \rightarrow X = \frac{2(a_1 + a_2 + \cdots)}{6}$$



Rows = [0, 1, 2, 3]
[1, 4, 5, 6]
[2, 4, 7, 8]
[6, 8, 9, 10]
[0, 5, 9, 11]
[3, 7, 10, 11]

perm [0, 1, ... 11]

nums {3, 17, -- , 13}

B.C.

if (conflict) return 0;