

Brute Force

- ① Loops Straight forward ✓
- ② Combo/Perm using Recursion

→ If search space is ~ a few million, usually we can just try them all.

How do I enumerate (go through) all the possible choices?

00000 = 0
00001 = 1
00010 = 2

11111 = 31

0 = F
1 = T

4 3 2 1 0
0 1 0 1 1 = 11

$0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

Candy 0 - kit kat
1 - m&m
2 - twix
3 - snickers
4 - skittles

Candy 0 } kit kat
Candy 1 } m&m
Candy 3 } snickers

Bitwise Operators

$a \ll k$, shift a to the left by k bits → mult by 2^k

$a = 101$

5

$k = 3$

$a = 101$

$101 \ll 3 \rightarrow$

2 2 2 0

101000 → multiplied by

5 4 3 2 1 0
2 2 2 2 2 2

2^3

$1 \leq n$ is also 2^n .

$a \& b$ is the bitwise and of a and b
and

$$\begin{array}{r} a = 11010 \\ b = 10011 \\ \hline 10010 = 18 \end{array}$$

$a \wedge b$ = exclusive or
(exactly 1 thing
is true)

$$\begin{array}{r} a \vee b = 11010 \text{ (26)} \\ \text{or} \quad 10011 \text{ (19)} \\ \hline 11011 = 27 \end{array}$$

$$\begin{array}{r} a \wedge b \quad 11010 \\ \wedge 10011 \\ \hline 01001 = 9 \end{array}$$

$a \gg k$: Chops off the last k bits
int Division by 2^k

$$\begin{array}{r} \text{mask} = 01011 \\ \& \text{flashlight} = 00100 \\ \hline 00100 \end{array} \left. \begin{array}{l} \text{ans is either} \\ 0 \text{ or } 2^x \end{array} \right\}$$

$$(\text{mask} \& (1 \ll k)) \neq 0$$

tests if bit k is on or not.

Recursive Subsets

k represents the # items I've already made a decision on

0 - Kit Kat Y
 1 - m+m N
 2 - Twix Y
 3 - Snickers
 4 - Skittles

$k \boxed{3}$ Print all subset w/ Kit Kat, not m+m and Twix

Permutation

0, 1, 2, $n=3$
 0, 2, 1
 1, 0, 2
 1, 2, 0
 2, 0, 1
 2, 1, 0

$perm \begin{pmatrix} 0 & 1 & 2 \\ 1 & 0 & 2 \end{pmatrix}$ $(k=1) \rightarrow 102$
 $used \begin{pmatrix} 0 & 1 & 2 \\ F & T & F \end{pmatrix}$
 $used \begin{matrix} T & F \\ F & T \\ T & \end{matrix}$

$p(1, -, -)$
 $\swarrow \searrow$
 $p(1, 0, -)$ $p(1, 2, -)$
 $\swarrow \searrow \downarrow$
 $p(1, 0, 2)$ $p(1, 2, 0)$
 $\checkmark \quad \uparrow$

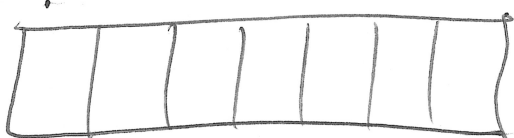
Ant Typing

try all perm of 1-9 keyboard

$$9! \sim 360,000$$

then simulating typing a message that is
100,000 char long

$$\text{run time} = 3.6 \times 10^5 \times 10^5 = 3.6 \times 10^{10} \text{ (too slow)!}$$



Read string once
count how many of
each transition it have

$$\begin{array}{l} \# \ 1-2 \quad 16 \\ \quad 2-9 \quad 200 \end{array}$$

new runtime

$$9! \times \underbrace{81}_{\text{Size of table}}$$

$$S = 352112627$$

all transitions of the
form a to b

$$\begin{array}{l} 1 \leq a \leq 9 \\ 1 \leq b \leq 9 \end{array}$$

make a 9×9 vector

$$\text{change}[a][b] =$$

times ant goes
from a to b