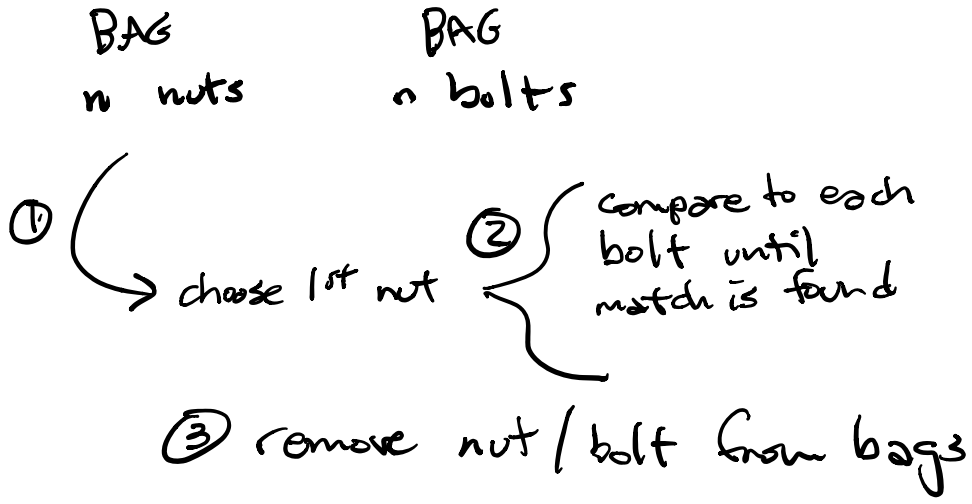


$O(n \log n)$??

---

row[0..m] col[0..n]

2d array

A_{11} A_{12} A_{13} A_{14} ... A_{1N}

A_{21}

A_{31}

A_{M1}

find X

i = 0 , j = n-1

```
while A[i,j] < X
    i++      //next row
while A[i,j] > X
    j--
```

Question: Why can't I do rectangle and cut search area in half (about) each time?

max subarray (Kadane's algorithm)

max_so_far = 0

array A (contains pos AND neg integers)

max_to_here array (same length as A)

keep summing elements into max_to_here

until it is ≤ 0

THEN

compare this value to max_so_far and keep Max()

For 2D array...

Next Higher Number

Find next higher number with same digits

(for 3-digit #)

permutations = $3! = 3 \cdot 2 \cdot 1 = 6$

123
132
213
231
312
321

4-digit = $4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24$

$$P(n,r) = \frac{n!}{(n-r)!}$$ n things taken r at a time

$$C(n,r) = \frac{n!}{(n-r)!\,r!}$$ Combination (order doesn't matter)

DUMB WAY: Find all permutations {P}

find min {P} that is also > X

SMARTER WAY:

1234 → 1243

1254 → 1245 → 1425

v = [i]

while A[i] <= A[i-1] :

swap [i], [i-1]

i--

THEN

swap [i], [i-1]

[0 1 2 3]

1 2 3 4

find non-increasing ending sequence : 4 at [3] so i = 2

(where A[j] is > A[i])

A[i] : 3

within sequence, smallest value > A[i] where immediate next value < A[i] : 4 at [3] so j = 3

1,095 digits added up (book page numbers)

1 2 3 4 5 6 7 8 9 — 9

10 11 12 13 14 15 16 17 18 19 — 10

20, 30, 40, 50, 60, 70, 80, 90

100 → 199

299

391 → 399

96 32

189
300
300
300
} 1,089 for 399 pgs

400 pgs = 1,092
401 pgs = 1,095

N (ones digit)

N-9 (tens digit)

N-99 (100s digit)

$N + N-9 + N-99 = 1,095$

$3N - 108 = 1,095$

$3N = 1,203$

$N = 401$

30-minute period

95 %

60 mph
1 m/min

1 or 2 steps at a time

Nth step

4

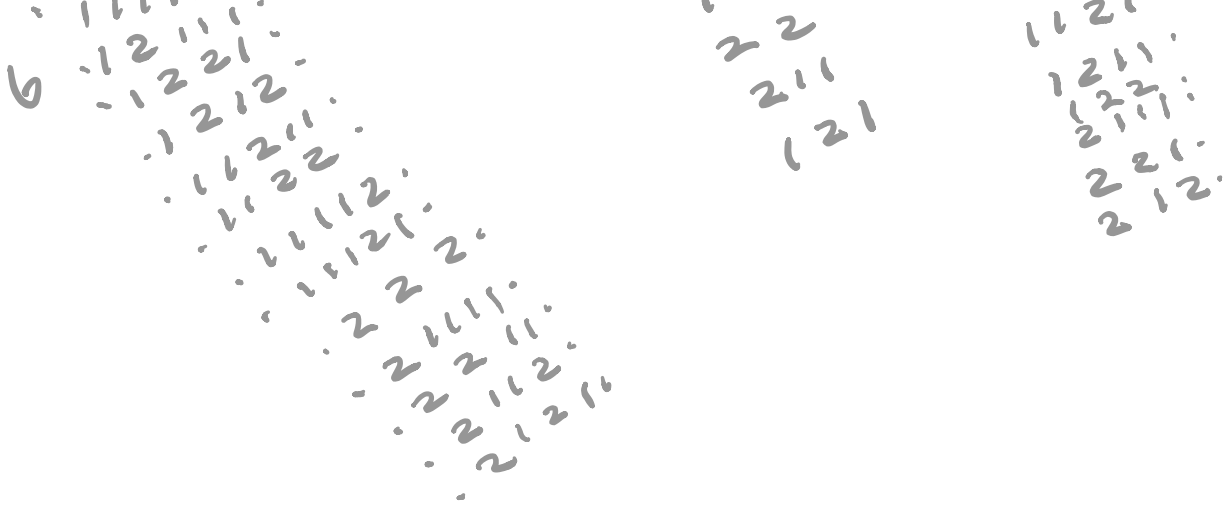
$N = 2x + 1y$

1 → 1
2 → 2
3 → 3
4 → 5
5 → 8

3

4

5



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1. DEPTH-FIRST SEARCH (trees, graphs)
   USE STACK

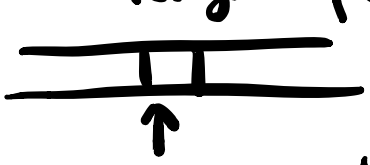
2. BREADTH-FIRST SEARCH
   USE QUEUE

3. MATCHING PARENTHESIS
   USE STACK

4. HASH TABLES
   - dynamic programming
   - caching values

5. MANIPULATE multiple variable pointers at once
   - traversing a linked list
   - pointer at start of string, end of string

   i.e. Find longest palindrome

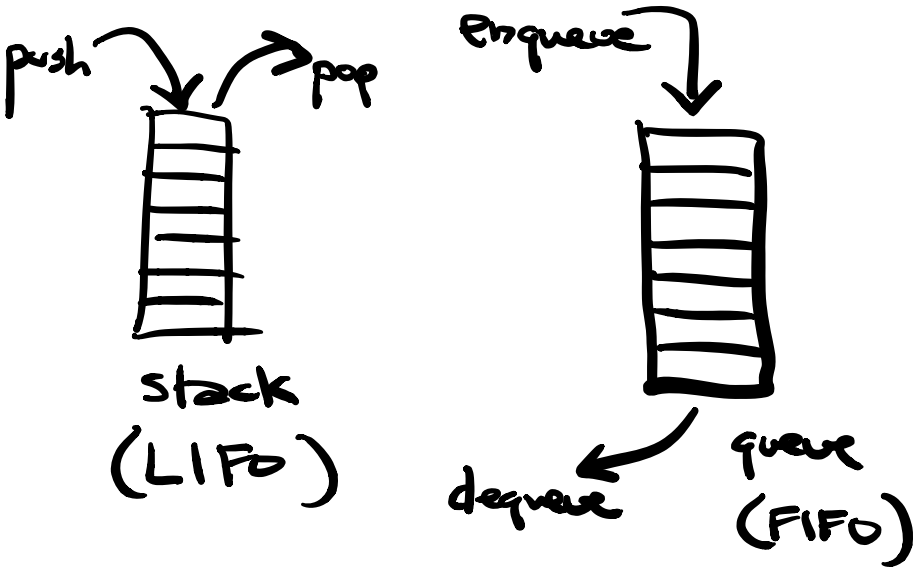


at every letter, 2 pointers that expand outward

⑥ REVERSING A LINKED LIST

---

implement a queue using one or more stacks



---

given rand5() function which returns random 1-5

write rand7() function (each int 1-7 should have equal probability)

1	001
2	010
3	011
4	100
5	101
6	110

"Cake Thief"

tuples of (kilograms, shillings)

(7,160) (3,90) (2,15)

capacity = 20

answer: 555 (6 of 3,90 and 1 of 2,15)

max_duffel_bag_values (cake_tuples, capacity)

```
int max[capacity]
max[0] = 0
for (int i=1 ; i<=capacity ; ++i)
{
        for (int j=0; j<count; j++)
            w = cake[j].weight
            p = cake[j].price
```

takes you X seconds to eat a unit of pizza
takes your friend Y seconds.
can't reach for new slice until current slice eaten
# of slices to give you most pizza?

(tie reach goes to friend)

pizza
(call it 1 unit)

slice count = N

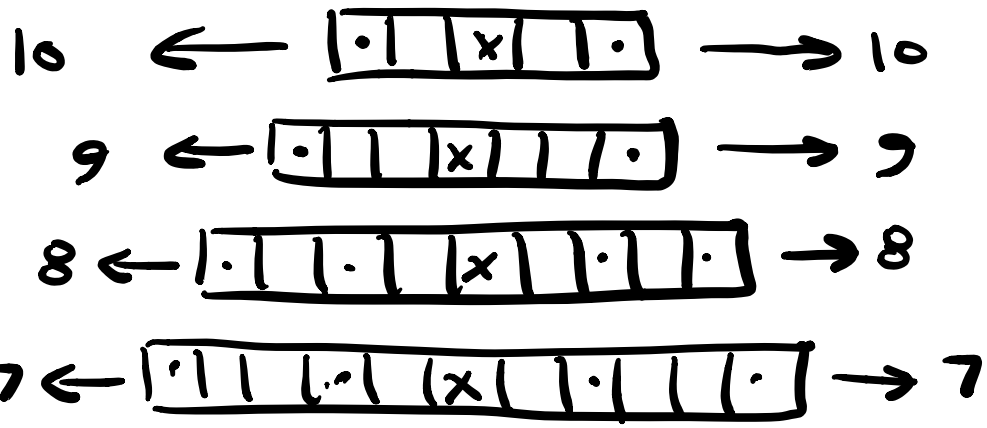
- never have less than 50% pizza (2 slices)
  (if you are slower eater — $X > Y$)
- if you are faster eater, how much faster?

$Y = 2X$? → 3 slices (you get 2/3)?
$Y = 3X$? → 4 slices (you get 3/4)
$Y = 4X$? → 5 slices (you get 4/5)

so...
$\text{floor}\left(\frac{Y}{X}\right)+1$
slices?

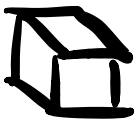
"anti-social bar"

25 seats in a line
each customer sits as far away as possible
No customer will sit right next to another customer
Where should bartender seat first customer?



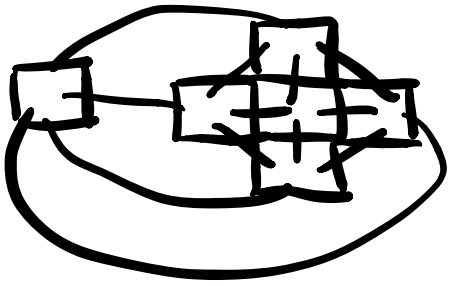
* I think bartender can seat first customer at 1st, last, or middle seat (maybe at any odd seat?)

How many different ways can you paint a cube with 3 colors of paint?

 = 6 sides

$3^6 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 729$

BUT if resulting cube can be rotated to equivalent coloring, don't count it



answer:
3 ways to paint w/1 color chosen from 3

24 ways to paint w/2 out of 3 colors

30 ways to paint w/3 out of 3 colors

3+24+30 = 57

C	1	{2, 3, 4, 5}
A	2	{5, 3, 1, 6}
B	3	{2, 4, 1, 6}
A	4	{3, 5, 1, 6}
B	5	{4, 2, 1, 6}
C	6	{2, 3, 4, 5}

So... I think we only have 3 sides to paint (A, B, C) which would be $3 \cdot 3 \cdot 3 = 27$ (?)

---

draw lines in a plane equidistant from 3 non-collinear points. how many lines?

answer: 3 lines

3 1 3 6 = 8

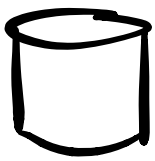
(add standard arithmetic signs)

$(3-1)^{(-3+6)} = 8$

$(3+1) \div (3 \div 6) = 8$

$((3+1) \div 3) \times 6 = 8$

$3 - 1 + \sqrt{36} = 8$



N = # of marbles at current time

"jar of marbles"

- you can know N at any time
- draw 1 or 2 marbles each turn (you + friend)
- person who draws last marble wins

3 left: whether drawing 1 or 2, other player will win

So...
get it so that OTHER player has 3 marbles left

which means I want my turn with 4 or 5 marbles left

So...
after my turn, I always want multiple of 3 marbles left

something like if N % 3 == 0, I want other player to go first OTHERWISE, I want to go first.

---

fleet of 50 trucks, each with full tank of gas and 100 mile range
How far can you deliver payload w/ 50 trucks?
w/ N trucks

50 → 49 w/49 and 1 w/99 → 50mi (transfer gas)

50 → 98 mi → 50 w/2 49 w/0 and 1 w/100 → 100 mi → 198 mi

50 → 2 mi → 98 (49) → 2 mi → 98 (98) → 2mi (still 198 mi?)

Simulate 7-sided die with 5-sided die

roll 1 rand5() → 1-5 → 0-4 → X

roll 2 rand5() → 1-5 → 0-4 → Y

roll 5-sided twice ⇒ base 5 # XY → 0-24

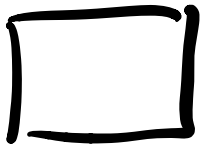
we only want 0-20, so redo if > 20

we now have 0-20

divide by 3 (integer) and add 1

this gives us $1 - \frac{1}{n}$

Group of people outside room (n)

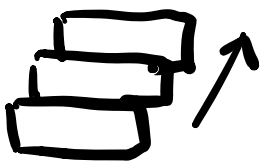


empty room (capacity N)

a "move" is
(1) admit one person
(2) let one person out

---

unlimited supply of bricks
each on stacked to overhang one beneath
what is maximum overhang you can create?



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how do you find closest pairs of stars in the sky?