

# 10 minutes of Algorithms

and making them faster



If this isn't nerdy enough

Here's a picture of me wearing 2  
pairs of glasses at the same time



# Algorithms?

“Any well-defined computational procedure that takes some value, or set of values, as input and produces some value, or set of values as output. An algorithm is thus a sequence of computational steps that transform the input into the output.” [Cormen et al]

Translated from Math to English: a list of steps for performing a computation.

...are not very funny....

algorithm



+Rachel



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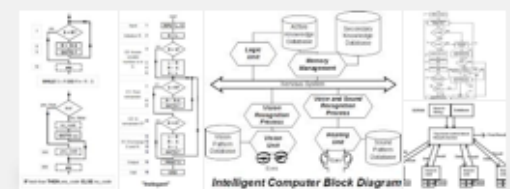
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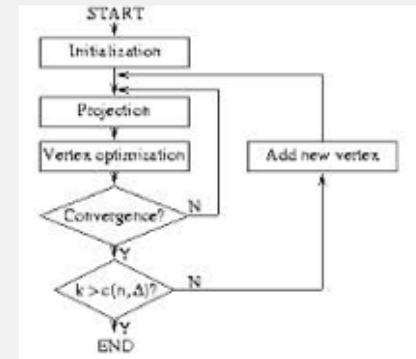
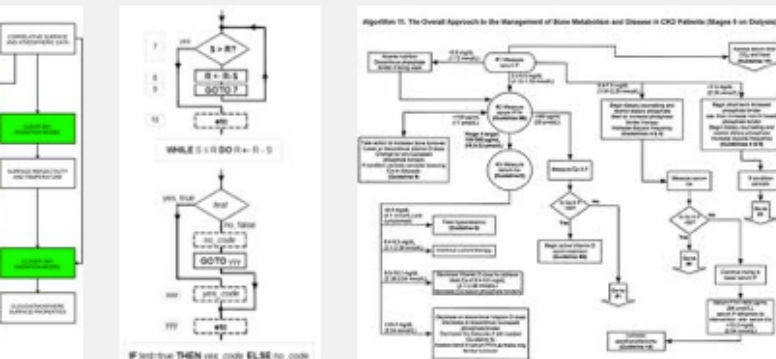
$$\begin{array}{r} 27 \\ 27 \\ +27 \\ \hline 71 \end{array} \quad \text{or} \quad \begin{array}{r} 63 \\ -37 \\ \hline 34 \end{array}$$



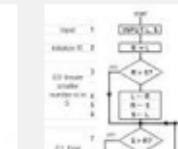
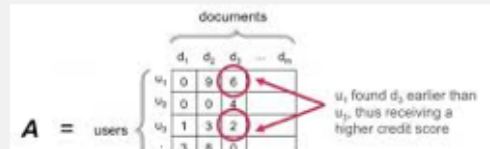
Simple



Computer



Johnson Method for  $\lambda_{max}(A)$  for HEP  
ting case  
1.  
e  $\lambda_{max}$



# ...but they are everywhere



What is the most relevant page?

Who is likely to be a friend?

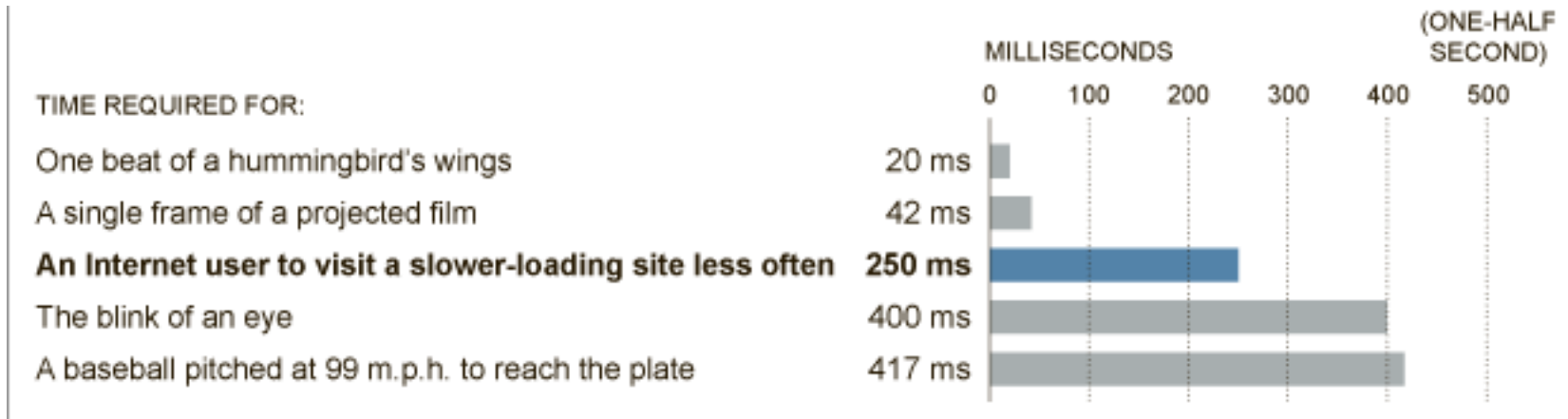


What product to advertise?

What movie to recommend?

**NETFLIX**

# It's not enough to be right. You also have to be fast.



New York Times, "The Blink of an Eye? Oh Please". Feb 29, 2012\*

# Sort a list from lowest to highest

1,4,3,2,7,9,5

Algorithm:

1. Reorder the list in every possible order
2. Check them until you find one that is correct



# Sort a list from lowest to highest

1,4,3,2,7,9,5

Algorithm:

1. Reorder the list in every possible order
2. Check them until you find one that is correct

There are 5040 ways to order the 7 numbers.

# Sort a list from lowest to highest

1,4,3,2,7,9,5

Algorithm:

1. Reorder the list in every possible order
2. Check them until you find one that is correct

There are 5040 ways to order the 7 numbers.

Computers are fast. This won't take long.



## If the list contains 1000 numbers:

[illegible]

different arrangements are possible

# A better way to sort?

1,4,3,2,7,9,5

Algorithm:

1. Starting with the second number, check whether it's smaller than the number in front of it
2. If it is, swap them
3. Keep swapping until you hit a smaller number
4. Move on to the next number you haven't checked

# Example

Start: 1,4,3,2,7,9,5

Compare 1 and 4: 1,4,3,2,7,9,5

Compare 4 and 3: 1,4,3,2,7,9,5

Switch: 1,3,4,2,7,9,5

Compare 1 and 3: 1,3,4,2,7,9,5

Compare 2 and 4: 1,3,4,2,7,9,5

Switch 2 and 4: 1,3,2,4,7,9,5

Compare 2 and 3: 1,3,2,4,7,9,5

Switch 2 and 3: 1,2,3,4,7,9,5

Compare 1 and 2: 1,2,3,4,7,9,5

etc



# Worst case?

- You have to compare and move every number
- For 7 items, this requires 49 moves
- For 1000 items, it requires 1,000,000 moves



# 1,000,000 is a lot less than

[illegible]

# Takeaway

- “Algorithm” refers to the method of solving, not the solution
- There are multiple algorithms for solving any problem
- Bad ones won’t scale. They’ll crash your website when you have enough data
- Or fail to run in your lifetime (really!)
- Clever algorithms return the same solution, they just do it faster