

Guess a number puzzle

Think of a number between 1 and 20

I **guarantee** to guess it within five guesses if you tell me if I need to go “higher” or “lower”

This works every time - guaranteed

Guess a number puzzle

Behind this is a really important computing **algorithm** that helps computers and the internet work quicker

It's called a **binary search algorithm**

Guess a number puzzle

How does this work?

Here's the set of numbers:

{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16,
17, 18, 19, 20}

Guess a number puzzle

Let's assume the number I'm thinking of is 9

{1, 2, 3, 4, 5, 6, 7, 8, **9**, 10, 11, 12, 13, 14, 15, 16,
17, 18, 19, 20}

Guess a number puzzle

You always guess the middle number. So...

Guess 1: 10

{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16,
17, 18, 19, 20}

You tell me that I need to go lower

Guess a number puzzle

I can get rid of 10 and above - it can't be these

This halves the set of numbers left

{1, 2, 3, 4, 5, 6, 7, 8, 9}

By halving the set of numbers, it straightaway makes this a really efficient algorithm

Guess a number puzzle

Always guess the middle point of what's left

Guess 2: 5

{1, 2, 3, 4, 5, 6, 7, 8, 9}

You tell me higher...

Guess a number puzzle

That only leaves four numbers

Guess 3: 7 (or 8 - up to you when it's like this)

{6, 7, 8, 9}

You tell me higher again

Guess a number puzzle

Leaves two numbers

Guess 4: 8

{8, 9}

You tell me higher

Guess a number puzzle

Which only leaves one number left

Guess 5: 9

{9}

Done it in five guesses

Guess a number puzzle

If there are 20 numbers, I guarantee to guess it in five goes or fewer

Every time

This works because I can use a **binary search**

Guess a number puzzle

A **binary search** only works if the numbers are **in order**

Each time you guess you have to be able to say if the number is higher or lower. This lets you **remove half** of the remaining numbers each time

This means you **very quickly** get down to just a few numbers. So it's a really **efficient** way to search

Guess a number puzzle

The other way to search is to start at the beginning and work your way through one number at a time

This is called a **linear search** - it works in a line

It's easier to do a linear search, but not as efficient if there are lots of numbers. You might have to do a linear search if the values **aren't in order**

Guess a number puzzle

You can use a binary search on anything which can be put in a **logical order**:

{Mon, Tue, Wed, Thu, Fri, Sat, Sun}

{J, F, Ma, Ap, My, Jn, Jy, Au, S, O, N, D}

{H, He, Li, Ba, B, C, N, O, F, Ne}

{Adele, Bingo, Clarise, Dave, Egg, Fiona, George, Georgina, Hambel, Jemima, Ted}

Guess a number puzzle

What month were you born in?

Guess 1: July

{J, F, Ma, Ap, My, Jn, Jy, Au, S, O, N, D}

Earlier or later?

Guess a number puzzle

Binary search is efficient

If there are 20 numbers, I guarantee to guess it in five goes or fewer

Every time

How many guesses will I need for 1 to 100?

What about 1 to 1,000? Or 1 to 1,000,000?

Guess a number puzzle

1-20: five guesses

1-100: seven guesses

1-1,000: ten guesses

1-1,000,000: twenty guesses

1-10,000,000: twenty-four guesses

1-1,000,000,000: thirty guesses