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Spaghetti Sort

An algorithm every Italian, Italy lover and algorithms lover should know.
My implementation using bitwise operations... yep no arithmetic or comparisons.

GitHub inside

Non-trivial bitwise implementation inside

Running this on your machine causes the following:
1) Full stomach: Memory eager
2) Demanding digestion: CPU intense

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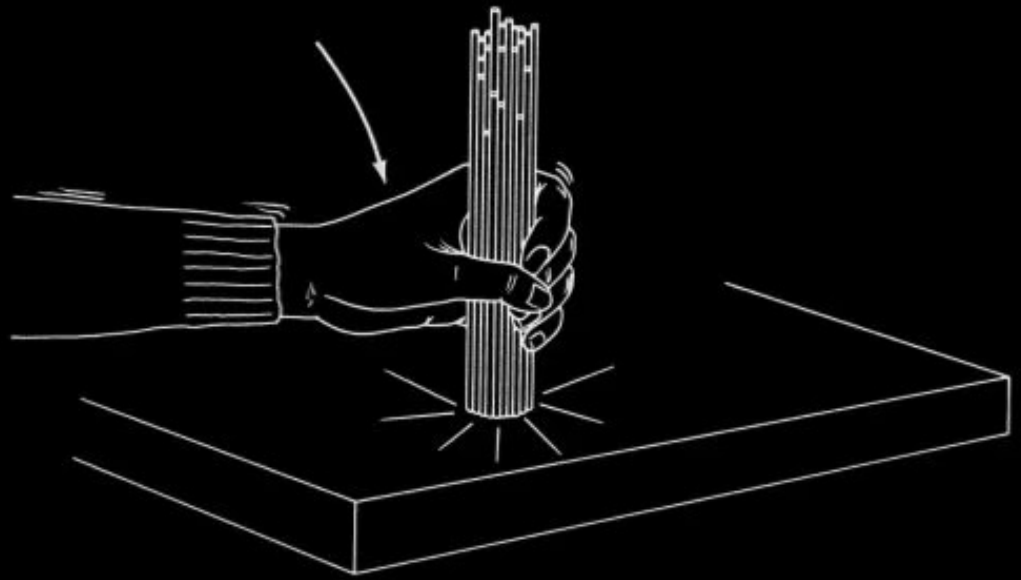
From Wikipedia:
Spaghetti sort is a linear-time, analog algorithm for sorting a sequence of items, introduced by A. K. Dewdney in his Scientific American column. **This is possible because the hand, the spaghetti rods and the table work as a fully parallel computing device**.

The sorting method is illustrated using uncooked rods of spaghetti:

1) For each number x in the list, obtain a rod of length x.
2) Once you have all your spaghetti rods, take them loosely in your fist and lower them to the table, so that they all stand upright, resting on the table surface.
3) Now, for each rod, lower your other hand from above until it meets with a rod—this one is clearly the longest, take it. Repeat until all rods have been removed.



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My Misson

Freaky Implementation of Spaghetti Sort: Binary Spaghetti Sort

```
# Spaghetti sort implementation using binary operations. Because of its
# nature, it sorts N+ numbers {1, 2, 3, ...}
#
# Key points:
# 1) Mimic the spaghetti sort main steps
#   1 - Spaghetti creation
#   2 - Spaghetti alignments according to length
#   3 - Hand moving down to collect spaghetti by length
# 2) Don't use imports
# 3) Use as many bitwise operations as possible
# Note: Instead of one hand we will be using a mask of bits
```

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Functions we need

```
def bitwiseRoundedLog2(x):
  # Calculates rounded log2
  k = -1
  while x > 0:
    x = x >> 1
    k += 1
  return k
```

Example

```
 x = 6
 log2(x) = 2.585
 x >> 1 = 3  ┐
 3 >> 1 = 1  ├ 3
 1 >> 1 = 0  ┘
```

```
def bitwiseBooleanToInteger(bitlist):
  # Turns a list of bit into an integer
  v = 0
  for bit in bitlist:
    v = (v << 1) | bit # sets the right most bit
  return v
```

Example

```
 bitlist = [1, 0, 1]
 v = 0 << 1 | 1 = 1
 v = 1 << 1 | 0 = 10 = 2
 v = 10 << 1 | 1 = 101 = 5
```

Step 1
Take array column = [0, 0, 1, 0, 0] make it a number.
S = bitwiseBooleanToInteger(Column) = 4 = 100
S = S ^ mask = 100
mask = S | mask = 100

 Processing bits in S 100
 K = bitwiseRoundedLog2(S) = 2
 Take value at index length+(-k-1) 2 => 5
 Updating S, setting processed bit to zero
 S = S ^ 1 << K = 0

Step 2
Take array column = [1, 0, 1, 1, 0] make it a number.
S = bitwiseBooleanToInteger(Column) = 22 = 10110
S = S ^ mask = 10010
mask = S | mask = 10110

 Processing bits in S 10010
 K = bitwiseRoundedLog2(S) = 4
 Take value at index length+(-k-1) 0 => 4
 Updating S, setting processed bit to zero
 S = S ^ 1 << K = 10

 Processing bits in S 10
 K = bitwiseRoundedLog2(S) = 1
 Take value at index length+(-k-1) 3 => 4
 Updating S, setting processed bit to zero
 S = S ^ 1 << K = 0

Step 3
Take array column = [1, 1, 1, 1, 0] make it a number.
S = bitwiseBooleanToInteger(Column) = 30 = 11110
S = S ^ mask = 1000
mask = S | mask = 11110

 Processing bits in S 1000
 K = bitwiseRoundedLog2(S) = 3
 Take value at index length+(-k-1) 1 => 3
 Updating S, setting processed bit to zero
 S = S ^ 1 << K = 0

Step 4
Take array column = [1, 1, 1, 1, 1] make it a number.
S = bitwiseBooleanToInteger(Column) = 31 = 11111
S = S ^ mask = 1
mask = S | mask = 11111

 Processing bits in S 1
 K = bitwiseRoundedLog2(S) = 0
 Take value at index length+(-k-1) 4 => 2
 Updating S, setting processed bit to zero
 S = S ^ 1 << K = 0

END
sorted array [5, 4, 4, 3, 2]

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```
def freakyBinarySpaghettiSort(values):

  length, maximum, minimum, mask = len(values), max(values), min(values), 0
  range_limit = maximum-minimum+1
  sorted, spaghetti = [0]*length, [0]*length
  spaghetti = [(1<<(n-minimum+1))-1<<(maximum-n) for n in values]

  index = 0
  for x in range(0, range_limit):
    xor = bitwiseBooleanToInteger([(s >> x) & 1 for s in spaghetti])
    xor = xor ^ mask
    mask = xor | mask
    while xor > 0:
      k = bitwiseRoundedLog2(xor)
      sorted[index] = values[-k-1]
      bin_pos = 1 << k
      xor = xor ^ bin_pos
      index += 1
  return sorted
```

Full implementation available at:

https://github.com/Sinnefa/binary-spaghetti-sort-using-bitwise-operations

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