Gauge Algorithm

Remedy for the “subset sum problem” complexity

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Imagine you have a set with four numbers `{-3, 2, 4, 7}` and wish to find subsets that have assigned sum equal to 4.

The most brutal method is to list all subsets and make the partial sums.

Subsets of cardinality `1` (there are `4`)
`{-3}, {2}, {4}, {7}`

Subsets of cardinality `2` (there are `6`)
`{-3, 2}, {-3, 4}, {-3, 7}, {2, 4}, {2, 7}, {4, 7}`

Subsets of cardinality `3` (there are `4`)
`{-3, 2, 4}, {-3, 2, 7}, {-3, 4, 7}, {2, 4, 7}`

Subset (no proper) of cardinality `4` (there is only one)
`{-3, 2, 4, 7}`

More generally, the number of subsets of cardinality *k* in a set with *n* elements is

$$\frac{n!}{k!(n-k)!}$$

n increases, the problem becomes very complex even for powerful computers.

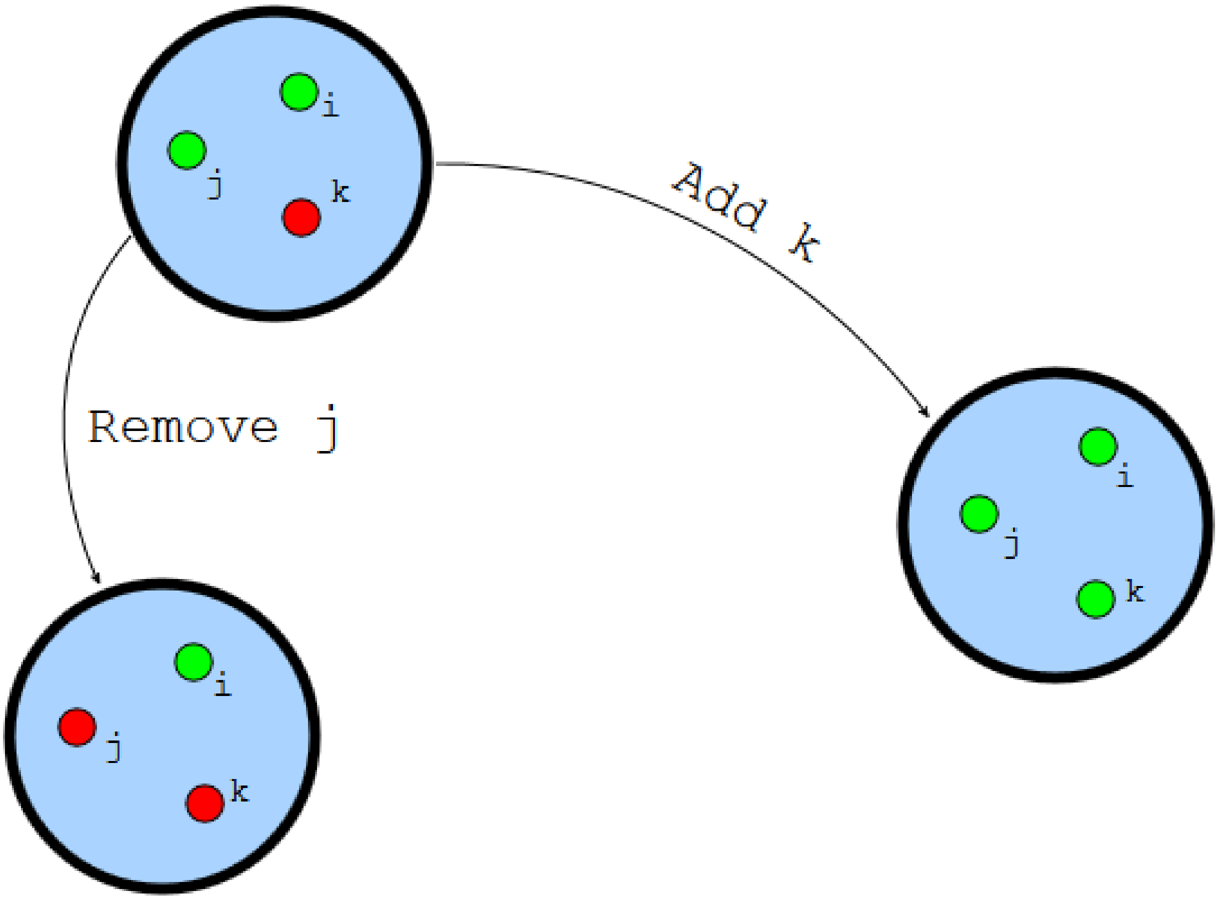
To give an idea, a set with `1000` elements, possesses
`1.368.173.298.991.500` subsets with `6` elements,
`194.280.608.456.793.000` subsets with `7` elements,
`24.115.080.524.699.431.125` subsets with `8` elements, ...

Computationally, the problem is classified as NP-complete.

The component of **Cambusa©**, which remedies statistically to the problem of complexity, uses a procedure based on *Markov processes* that I called **"Gauge algorithm"**. I'll describe in broad terms the basic idea.

From a set with *n* elements, we consider the non-empty 2^n-1 subsets be taken as process states. A state transition is accomplished by adding or removing an item. For each transition is assigned a probability according to a law that *more the transition leads to a partial sum closer to the reference value, the greater the probability that the transition happen.*

Starting from a pivot state, kick the process off: the **conjecture** is that you generate a kind of **"statistical attraction"** towards the sought solutions.



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