Methods to create sorting networks

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Abstract

A sorting network is a mathematical model of a network which contains wires and comporators. Wires are horizontal connections which carry values from left to right. There cannot be more the one value on one wire. Every comparator connect two wires. When a pair of two wires reach a comparator, they switch the values between them if the upper wire has a bigger value then the value from the lower wire.

The principal difference between a sorting network and a usual sorting algorithm is that on the sorting network the comparators are prepared in advance. Because of the independency between comparators, these can be used in parallel and that can result in a lower execution time. If we make a comparation between a sorting network and a sorting algorithm, sorting network are more complex to create and can take a more time to implement them.

Zero-One Principle is a principle that help me to know if a comparator network is a sorting network and what this principle says is:

- Has a number > 0 of wires and comparators.
- If with the help from the wires and comparators, it succeeded any array of a specific size then that network can be called sorting network.
- If a network can sort all sequences of bits from 1 to 2^n, then that network will succeeded to sort all array of n values.

The reason for which we will use a sorting network is when we want to sort a list of numbers in the least amount of time we can get. A sorting network is fast because we know from the beginning what comparators we will have but that need some preparation time before we start to sort some lists of numbers.

A sorting network is constructed with these steps:

- Construct some random networks with a specific number of comparators and wires.
- We use genetic algorithm to manipulate all the network in order to create new networks that can became sorting networks.
- A genetic algorithm will use:
  - Selection for choosing the best network that will go to the next generation.
  - Mutation that change some comparators of a specific network.
  - Crossover that make merges between two networks.
  - Evaluation step in which we will calculate how good a network is.

The sorting network are very good in practice if we know that what will be the size of the arrays that we will sort in the future, because in these way we can find what are the least amount of comparators in order to sort any kind of array of numbers on that size.

The references:

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[2] Conf. Dr. Mădălina Răschip, Conf. Dr. Cristian Gaţu, https://profs.info.uaic.ro/~sd/

[3] Prof.dr. Lucanu Dorel, https://profs.info.uaic.ro/~dlucanu/cursuri/poo/poo20082009.htm