Parallel and Distributed Algorithms and Programs
TP n°2 - Sorting networks

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All documents are available on my website : `http://hadriencroubois.com/#Teaching`

Part 1

Distributed merge-sort

Consider we have an array A of size n and $p = 2^k$ nodes available to sort it. A is distributed among the different nodes so each ones has $m = n/p$ elements. We call A_i the subset of A owned by each node i. At this stage you have no limitations on the amount of memory used or on the comunications.

Question

a) Initiate a random array that would be different on each node.

b) Implement a C function that locally sorts an array of double :

```
void local_sort(double *A_i, size_t m);
```

c) Think of an implementation of the merge sort algorithm that could work in our context. What is it's complexity ?

d) Implement this algorithm usign MPI. All program should call the `sort` function providing the same size.

```
void sort(double *A_i, size_t m, MPI_Comm comm);
```

Part 2

With some constraints

Here we add some constraint.

First of all, we are affraid our machines won't have a lot of memory space. Given the potentially large size of A we are not able to store all of it on a single machine. Therefore, our algorithme should not use more then twice the size needed to store A_i.

Also, we are working on a ring topology, so a node is only alowed to communicate with it's neighbours $i-1 \mod n$ and $i+1 \mod n$.

Question

a) Think of an new sorting algorithm that could work with our new restrictions. What is it's complexity ?

b) Implement this algorithm usign MPI. Try to optimize it as much as you can.

```
void sort_ring(double *A_i, size_t m, MPI_Comm comm);
```

Part 3

Evaluating performances

Question

a) Think of a protocol for evaluating the performances of both algorithms. What are the parameters you would like to investigate ?

b) Run this protocol and compare the performances of your algorithms with other students.