Distributing the Heat Equation

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1 Question 1

Lemma 1. N^2 applications of function δ are necessary to compute X^t from X^{t-1}.

Proof. Each cell $X^t_{i,j}$ needs one application of δ to be computed from $X^{t-1}_{i,j}$. There are N^2 cells, so N^2 applications of δ are needed. □

Property 2. tN^2 applications of function δ are necessary to compute X^t on $[\![0, N-1]\!]^2$.

Proof. X^t is obtained after t applications of $\delta^\dagger$ on X^0. Each application needs N^2 calls to δ according to lemma 1. The whole computation needs tN^2 applications of δ. □

2 Question 2

We associate one processor per cell (N^2 processors are needed). Each processor $p_{i,j}$ stores at time t the value of cell $X^t_{i,j}$.

At time t, each processor sends its value to its 8 neighbours and receives their values in parallel. Then each processor updates $X^t_{i,j}$ to $X^{t+1}_{i,j}$.

$\longrightarrow$ à changer :(, le nombre de processeurs est un paramètre donné en entrée ($< N^2$ à priori)