HPC - Assignment 2
CUDA

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Outline

Problem Description

1D heat diffusion is the diffusion of heat along an infinitely narrow pipe. Initially, the whole pipe is at a stable and fixed temperature; for clarity purposes, we set our pipes initial temperature to be zero. At the start (time 0), we set both ends to a specified temperature, which remains fixed through the computation. We then calculate how the temperatures change in the rest of the pipe over time. Mathematically, the problem is to solve a 1D differential equation representing heat diffusion:

$$\frac{\delta u}{\delta t} = \frac{\delta^2 u}{\delta x^2}$$

Problem Description (cont.)

Our approach is to discretize the problem space by representing U by a one-dimensional array and computing values for a sequence of discrete time steps. Assume we have the values for U at time step k in an array Uk, then for the next time step $k+1$ update the second array $Ukp1$ as

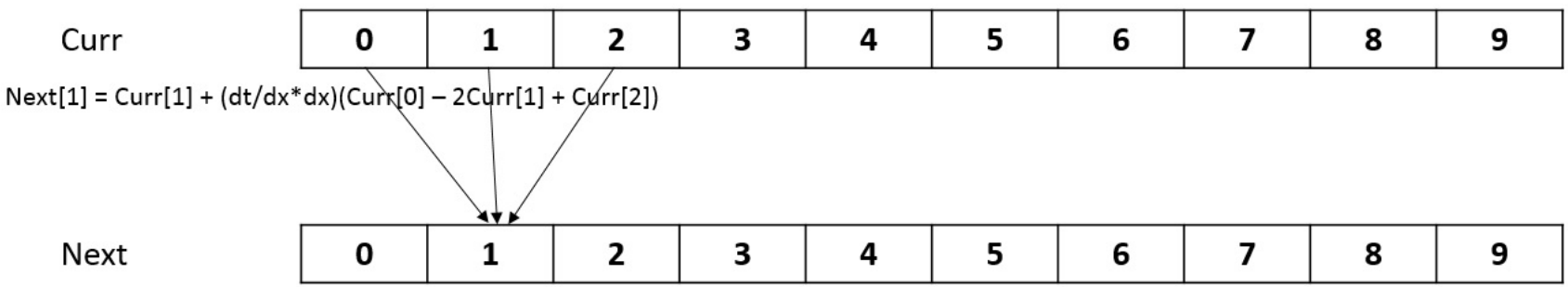
$$Ukp1[i] = Uk[i] + \frac{dt}{dx \times dx}(Uk[i+1] - 2Uk[i] + Uk[i-1])$$

where dt and dx represents the intervals between discrete time steps and between discrete points respectively.

A Visual Representation

The following is a visual representation of the update function

$$Ukp1[i] = Uk[i] + \frac{dt}{dx \times dx}(Uk[i+1] - 2Uk[i] + Uk[i-1])$$



A Visual Representation (cont.)