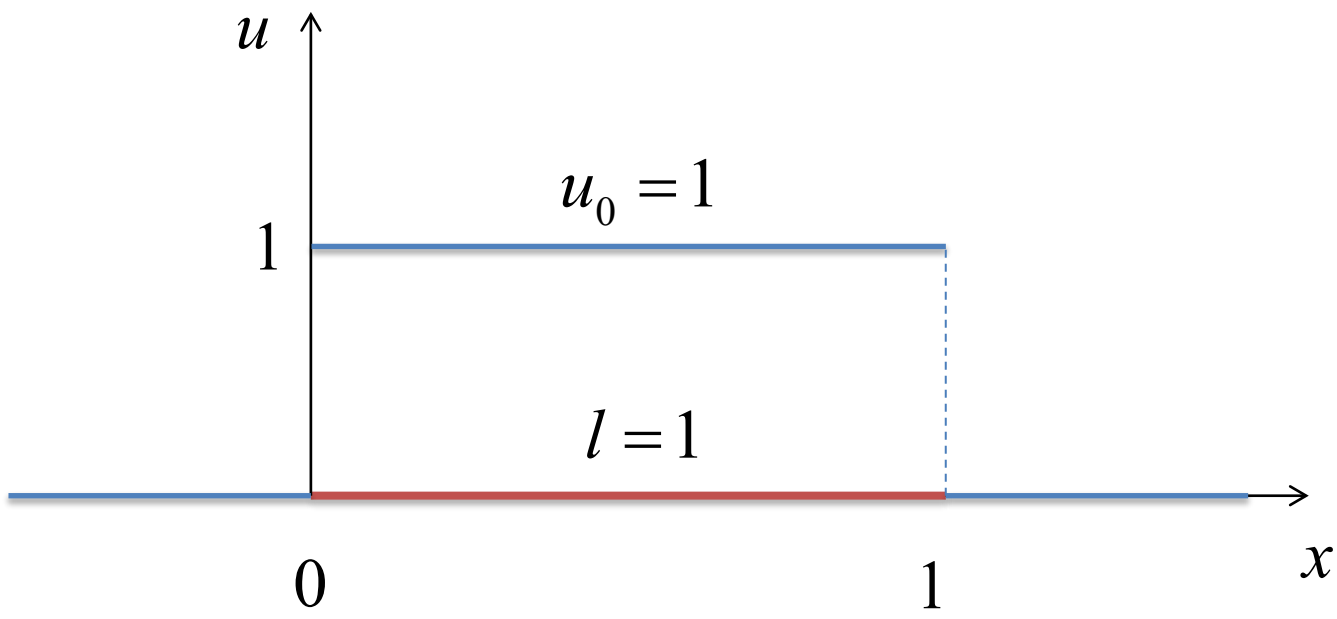
Heat equation

One-dimensional homogeneous heat equation

Statement of the problem:



One-dimensional homogeneous heat equation

The main equation:

$$\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2}$$

The finite difference approximation:

$$\frac{\partial u}{\partial t} \sim \frac{u_i^{n+1} - u_i^n}{\tau} \qquad \frac{\partial^2 u}{\partial x^2} \sim \frac{u_{i+1}^n - 2u_i^n + u_{i-1}^n}{h^2}$$

$$\frac{u_i^{n+1} - u_i^n}{\tau} = k\frac{u_{i+1}^n - 2u_i^n + u_{i-1}^n}{h^2}$$

One-dimensional homogeneous heat equation

Finally:

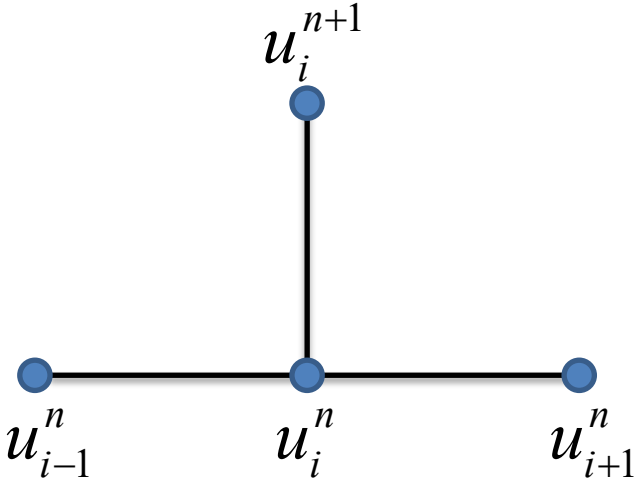
$$u_i^{n+1} = u_i^n + \frac{k\tau}{h^2}\left(u_{i+1}^n - 2u_i^n + u_{i-1}^n\right)$$

Where:

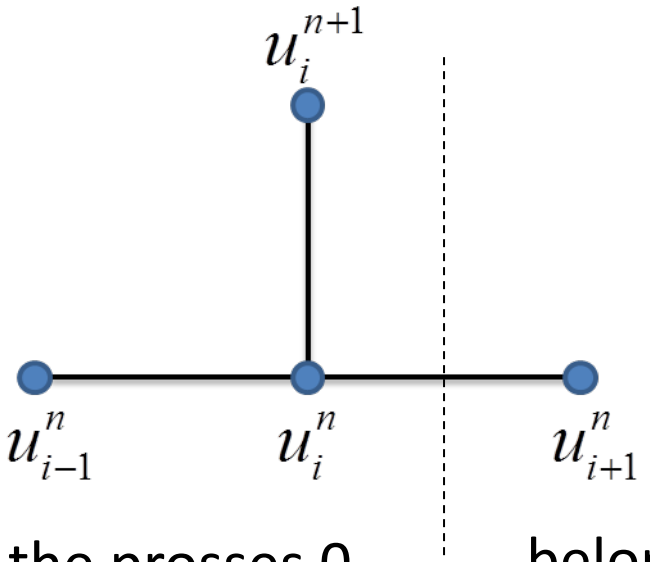
k - thermal diffusivity coefficient,

τ - time step,

h - step on the x-coordinate



How to make it parallel

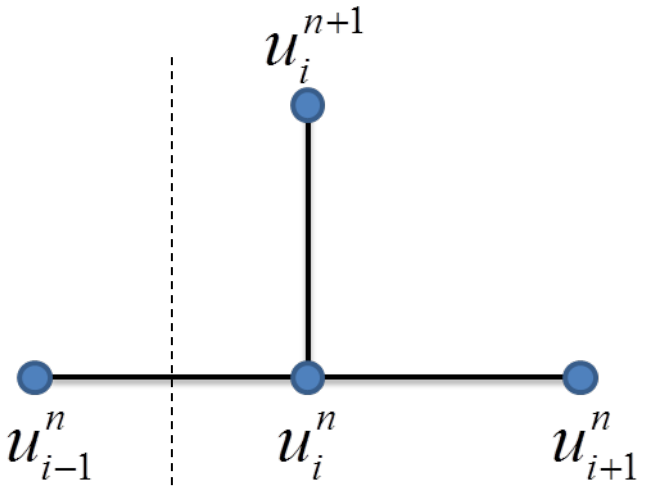


belongs to the prosses 0 belongs to the prosses 1

How does the process 0 get the value of the point u_{i+1}^n ?

The process 1 have to send the message, i.e. the value of u_{i+1}^n !

How to make it parallel



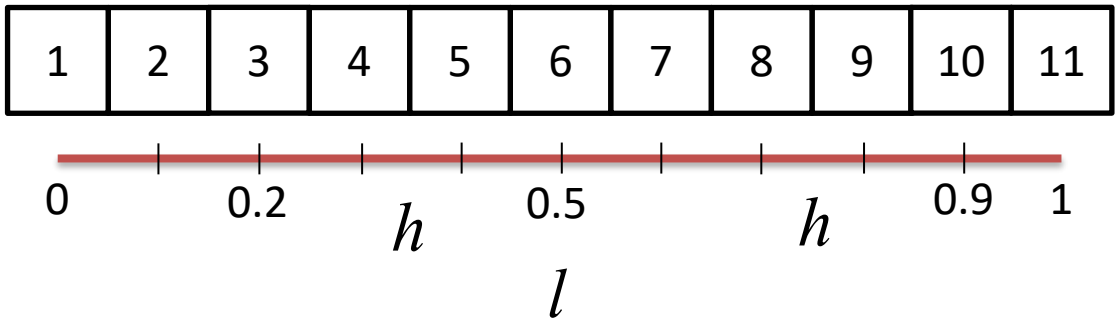
belongs to the prosses 0

belongs to the prosses 1

How does the process 1 get the value of the point u_{i-1}^n ?

The process 0 have to send the message, i.e. the value of u_{i-1}^n !

How to make it parallel



belongs to the prosses 0

1	2	3	4	5	6

belongs to the prosses 1

7	8	9	10	11

How to make it parallel