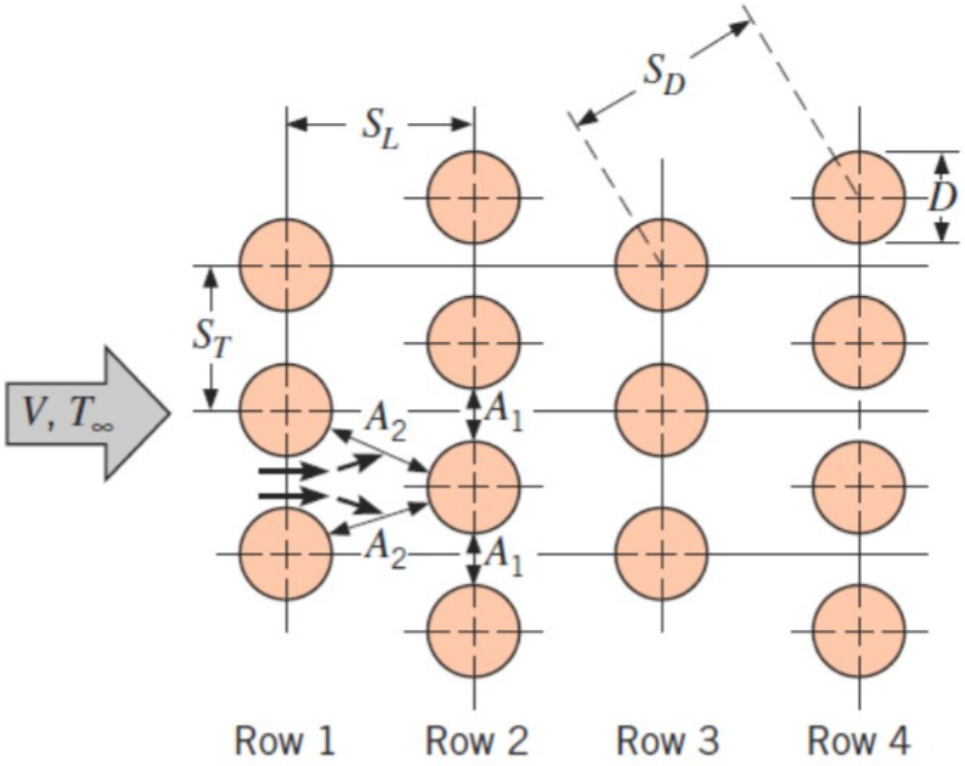
HW4, PP2



The energy balance for this system is

$$q = m c_p (T_o - T_i) = h A_s dT_{lm}$$

The area to calculate the mass flow rate and the surface area of the tubes depend on the choosing of the control volume.

The Reynolds number is now calculated based on the maximum velocity, which is the magnitude of the velocity in the narrowest space between the tubes (conservation of mass). The length scale that describes the nature of the flow is the diameter of a tube, and hence, the characteristic length for Reynolds number and Nusselt number is the diameter of a tube.

The Nusselt number correlation for this case is (given in the assignment sheet):

$$\overline{Nu}_D = C_1 Re_{D,max}^m Pr^{0.36} \left(\frac{Pr}{Pr_s}\right)^{1/4}$$

The values for C1 and m are obtained from the table given in the assignment sheet.

The "tricky" part of this problem is how to define the control volume and what areas to use for the mass flow rate and the surface area of the tubes. To define the control volume, think about the symmetry of the system.

Hint: the number of columns or the length of the tubes do not affect the number of rows.

The correct answer is of the order of $N = 30\, rows$