Key Equations:

Fourier's law:

$$\overline{q''} = (-k\frac{\partial T}{\partial x}\widehat{i} - k\frac{\partial T}{\partial y}\widehat{j} - \ -k\frac{\partial T}{\partial z}\widehat{k})$$

Where q" (W/m^2) is the vector containing heat flux and k is thermal conductivity

Basic heat transfer equation:

$$\rho c\frac{\partial T}{\partial t} = k(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2}) + Q$$

Where ρ is material density, c is specific heat, and Q is the rate of thermal energy generation

Newton's law of Cooling(1D):

$$q'' = h(Ts - T_\infty)$$

h is Convection heat transfer coefficient, Ts is surface temp and T_∞ is free stream temp.

Assumptions:

No heat is generated only transferred, Q = 0

Steady state $\frac{\partial T}{\partial t}$ =0

1D transfer only.

I will do a finite element discretisation of the geometry. If the geometry is represented by some f(x) this means finding the solution to the curve at some interval dx and storing the values in a list.

To find the heat flux per unit length, find the hypotenuse of the triangle between 2 points and multiply with q". This can be done by:

$$L = \sqrt{{y_i}^2 + {y_{i-1}}^2}$$

With our assumptions, the Fourier's law can be simplified to:

$$q_y'' = -k(\frac{T_1 - T_2}{y_i})$$

Set this equal to Newton's law of cooling on each side to find surface temperature on either side.

The geometry can be represented by a list of heights and a dx in between the heights.

If smoother geometries are needed, curve fitting algorithms can be used.