A problem of great interest in the data storage industry is the sliding of a reader over the surface of a disk drive. In the sketch below the head flies from right to left.

The flight elevation \( h(x) \) decreases from the front of the slider to the back. At the front the elevation is \( 0.38 \times 10^{-6} \) meters; at the back, it is \( 0.127 \times 10^{-6} \) meters. In steady state, the pressure distribution under the slider is given by the Reynolds’s equation:

\[
\frac{\partial}{\partial x} \left( h^3 P \frac{\partial P}{\partial x} \right) + \frac{\partial}{\partial y} \left( h^3 P \frac{\partial P}{\partial y} \right) = 6\mu U \frac{\partial(Ph)}{\partial x}
\]

The value of \( \mu \) is \( 1.81 \times 10^{-6} \) Pa-sec; the value of \( U \) is 50.80 m/sec.; the head is \( 2.54 \times 10^{-6} \) meters in the X direction, and \( 2.54 \times 10^{-6} \) meters in the Y direction. The pressure around the edge of the head is 101,325 Pa.

To begin solving for the pressure distribution under the slider, consider how finite difference the first term of the left hand side of the equation. Derive the following discretization

\[
\frac{\partial}{\partial x} \left( h^3 P \frac{\partial P}{\partial x} \right) \approx \frac{1}{\Delta x} \left[ \frac{(h_{i+1,j} + h_{i,j})}{2} \left( \frac{P_{i+1,j} + P_{i,j}}{2} \right) \left( \frac{P_{i+1,j} - P_{i,j}}{\Delta x} \right) \right]
\]

for a uniform \( \Delta x \) and uniform \( \Delta y \) grid. Doing the same for the other terms of the equation, solve for the pressure under the head using Gauss/Seidel or SOR.

Turn in:

1. The finite difference scheme and its derivation
2. A computer program
3. A legible plot of the steady-state pressure distribution