EXPLICIT FINITE DIFFERENCE APPROXIMATION

Take the simplified pressure equation:

$$\left(\frac{\partial P}{\partial t}\right) = \frac{k}{c\phi\mu}\left(\frac{\partial^2 P}{\partial x^2}\right)$$

where the constant $\frac{k}{c\phi\mu}$ is the hydraulic diffusivity. We can denote this by D_h.
If we assume $D_h = 1$ we get the equation:

$$\left(\frac{\partial P}{\partial t}\right) = \left(\frac{\partial^2 P}{\partial x^2}\right)$$

→ This is the pressure equation for a 1D system.

To continue with the finite difference approximation we must:

1. Discretise the x-direction by dividing it into a numerical gridblock of size Δx
2. Choose a time step, Δt
3. Use the following notation:

P_i^n → time level $n = 0, 1, 2$
→ x-grid block label, $i = 1, 2, 3$ NX (at $x = L$)

P_i^n current (known) P at time level
P_i^{n+1} is the new (unknown) P at time level.

4. Fix the boundary conditions (for this case are):

$P_1 = P_{in}$ and $P_{NX} = P_{out} = P_0$ which are fixed for all of t.

5. Apply finite differences to obtain:

$$\left(\frac{\partial P}{\partial t}\right)_i \simeq \frac{P_i^{n+1} - P_i^n}{\Delta t}$$