$$i\hbar\frac{\partial\Psi(x,t)}{\partial t} = H\Psi(x,t)$$

$$H = -\frac{\hbar^2}{2m}\nabla^2 + V(r)$$

$$i\frac{\partial\Psi(x,t)}{\partial t} = \left(-\nabla^2 + V(x)\right)\Psi(x,t)$$

$$\Psi(x,t) = e^{-i\left(-\nabla^2+v(x)\right)t}\Psi(x,t) = e^{i\nabla^2 t}e^{-iVt}\Psi(x,0)$$

$$e^{i\Delta t\nabla^2} \simeq \frac{1+i\frac{\Delta t}{2}\nabla^2}{1-i\frac{\Delta t}{2}\nabla^2}$$

$$\Psi(x,t+\Delta t) = \frac{1+i\frac{\Delta t}{2}\nabla^2}{1-i\frac{\Delta t}{2}\nabla^2}e^{-iV\Delta t}\Psi(x,t)$$

$$\Psi(x,t+\Delta t) = \left(\frac{2}{1 - i\frac{\Delta t}{2}\nabla^2} - 1\right) e^{-iV\Delta t}\Psi(x,t)$$

$$\Psi(x,t+\Delta t) = \Psi^* - e^{-iV\Delta t}\Psi(x,t)$$

$$\Psi^* = \frac{2e^{-iV\Delta t}\Psi(x,t)}{1 - i\frac{\Delta t}{2}\nabla^2}$$

$$\left(1 - i\frac{\Delta t}{2}\nabla^2\right)\Psi^* = 2e^{-iV\Delta t}\Psi(x,t)$$

$$\Psi_i^{*n+1} = \frac{i + \Delta t/\Delta^2}{1 - \Delta t^2/\Delta^4}\left(\Psi_{i-1}^{*n} + \Psi_{i+1}^{*n}\right)\frac{\Delta t}{2\Delta^2} + 2e^{-iV_i\Delta t}\frac{1 - i\Delta t/\Delta^2}{1 - \Delta t^2/\Delta^4}\Psi_i$$

$$\Psi(x,0) = Ae^{-\frac{(x-x_0)^2}{2\sigma^2} - ikx}$$