

Taylor Galerkin Method (2 steps)

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Considering

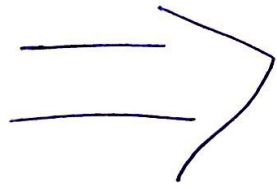
$$u_t^\epsilon + f_x(u^\epsilon) = \epsilon u_{xx}^\epsilon$$

And the second order expansion:

$$u^{\epsilon n+1} \approx u^\epsilon + \Delta t \left(u^\epsilon + \frac{\Delta t}{2} u_t^\epsilon \right)_t$$

We have:

$$\begin{cases} u^{\epsilon n+1/2} = u^\epsilon + \frac{\Delta t}{2} u_t^\epsilon \\ u^{\epsilon n+1} = u^\epsilon + \Delta t u_t^{\epsilon n+1/2} \end{cases}$$



$$\begin{cases} u^{\epsilon n+1/2} = u^\epsilon + \frac{\Delta t}{2} \left(\epsilon u_{xx}^\epsilon - f_x(u^\epsilon) \right)_t \\ u^{\epsilon n+1} = u^\epsilon + \Delta t \left(\epsilon u_{xx}^{\epsilon n+1/2} - f_x(u^{\epsilon n+1/2}) \right) \end{cases}$$

$$\frac{\Delta u^\epsilon}{\Delta t} = \epsilon u_{xx}^{\epsilon n+1/2} - f_x(u^{\epsilon n+1/2})$$

$$\left(w, \frac{\Delta u^\epsilon}{\Delta t} \right) = \left(w, \epsilon u_{xx}^{\epsilon n+1/2} \right) - \left(w, f_x(u^{\epsilon n+1/2}) \right)$$

$$= \left(n w, \epsilon u_x^{\epsilon n+1/2} \right)_\Gamma - \left(w_x, \epsilon u_x^{\epsilon n+1/2} \right) + \left(w_x, f_x(u^{\epsilon n+1/2}) \right) - \left(w n, f(u^{\epsilon n+1/2}) \right)_\Gamma$$