1. Level Set Curve:

$$u_t = \frac{u_x^2 u_{yy} - 2u_x u_y u_{xy} + u_y^2 u_{xx}}{u_x^2 + u_y^2 + \epsilon} \tag{1}$$

$$u_x = \frac{u^n_{j+1,k} - u^n_{j-1,k}}{2} = \frac{\text{Right} - \text{Left}}{2} \tag{2}$$

$$u_y = \frac{u^n_{j,k+1} - u^n_{j,k-1}}{2} = \frac{\text{Up} - \text{Down}}{2} \tag{3}$$

$$u_{xx} = \frac{u^n_{j+1,k} - 2u^n_{j,k} + u^n_{j-1,k}}{(\Delta x)^2} = \text{Right} - 2 * \text{Center} + \text{Left} \tag{4}$$

$$u_{xy} = \frac{u^n_{j+1,k+1} - u^n_{j-1,k+1} - u^n_{j+1,k-1} + u^n_{j-1,k-1}}{4} = \frac{\text{UR} - \text{UL} - \text{DR} + \text{DL}}{4} \tag{5}$$

$$u_{yy} = \frac{u^n_{j,k+1} - 2u^n_{j,k} + u^n_{j,k-1}}{(\Delta y)^2} = \text{Up} - 2 * \text{Center} + \text{Down} \tag{6}$$

4	4	4
4	4	4
4	4	4

$$u_x = \frac{4-4}{2} = 0 \tag{7}$$

$$u_y = \frac{4-4}{2} = 0 \tag{8}$$

$$u_{xx} = 4 - 2 * 4 + 4 = 0 \tag{9}$$

$$u_{xy} = \frac{4-4-4+4}{4} = 0 \tag{10}$$

$$u_{yy} = 4 - 2 * 4 + 4 = 0 \tag{11}$$

$$u_t = \frac{0^2 * 0 + 2 * 0 * 0 * 0 + 0^2 * 0}{0^2 + 0^2 + \epsilon} = 0 \tag{12}$$

2	6	4
0	5	7
1	0	3

$$u_x = \frac{\text{Right} - \text{Left}}{2} \tag{13}$$

$$= \frac{7-0}{2} = 3.5 \tag{14}$$

$$u_y = \frac{\text{Up} - \text{Down}}{2} \tag{15}$$

$$= \frac{6-0}{2} = 3 \tag{16}$$

$$u_{xx} = \text{Right} - 2 * \text{Center} + \text{Left} \tag{17}$$

$$= 7 - 2 * 5 + 0 = -3 \tag{18}$$

$$u_{xy} = \frac{\text{UR} - \text{UL} - \text{DR} + \text{DL}}{4} \tag{19}$$

$$= \frac{4-2-3+1}{4} = 0 \tag{20}$$

$$u_{yy} = \text{Right} - 2 * \text{Center} + \text{Left} \tag{21}$$

$$= 6 - 2 * 5 + 0 = -4 \tag{22}$$

$$u_t = \frac{(3.5)^2(-4) - 2 * (3.5)(3)(0) + (3)^2(-3)}{(3.5)^2 + (3)^2 + \epsilon} = \frac{-76}{21.25 + \epsilon} = -3.576 \tag{23}$$

$$\frac{u_{j,k}^{n+1} - u_{j,k}^{n}}{\Delta t} = -3.576 \tag{24}$$

$$u_{j,k}^{n+1} = -3.576 \cdot \Delta t + u_{j,k}^{n} \tag{25}$$

$$u_{j,k}^{n+1} = -3.576 \cdot 0.25 + 5 = 4.106 \Rightarrow 4 \tag{26}$$