

Quiero Grace T.

11/ENG021045

COMPUTER ENGINEERING

$$\frac{dT(x,t)}{dt} = \frac{d^2T(x,t)}{dx^2}$$

$$C = 2.2 \text{ cm}^2/\text{hr}$$

$$T(x,0) = 3x^2$$

$$T(0,t) = 0$$

$$T(L,t) = 108$$

$$r = \frac{C \Delta t}{(\Delta x)^2} = \frac{2.2 \times 0.02}{0.8^2}$$

$$= 0.489$$

Using $\Delta t = 0.02 \text{ hr}$ and $\Delta x = 0.8 \text{ cm}$

		x									
		1	2	3	4	5	6	7	8	9	10
t	0	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
0	0	0.27	1.08	2.43	4.32	6.75	9.72	13.20	17.23	21.87	27.00
0.02	0	0.345	1.345	2.615	4.585	7.105	9.785	13.495	17.545	22.135	27.265

$$\text{at } t = 0, \quad x = 3x^2 \quad \text{at } x=0, x=0.$$

$$\text{at } x = 0.3$$

$$x = 3(0.3)^2 = 0.27$$

$$\text{at } x = 0.6$$

$$x = 3(0.6)^2 = 1.08$$

$$\text{at } x = 0.9$$

$$x = 3(0.9)^2 = 2.43$$

$$\text{at } x = 1.2$$

$$x = 3(1.2)^2 = 4.32$$

$$\text{at } x = 1.5$$

$$x = 3(1.5)^2 = 6.75$$

$$\text{at } x = 1.8$$

$$x = 3(1.8)^2 = 9.72$$

$$\text{at } x = 2.1$$

$$x = 3(2.1)^2 = 13.20$$

$$\text{at } x = 2.4$$

$$x = 3(2.4)^2 = 17.28$$

at $x = 2.7$

$$x = 3(2.7)^2 = 21.87$$

at $xc = 3.0$

$$x = 3(3.0)^2 = 27.00$$

~~for $x = 3.0$~~

at $xc = 3.3$

$$x = 3(3.3)^2 = 32.67$$

at $x = 3.6$

$$x = 3(3.6)^2 = 38.88$$

at $xc = 3.9$

$$xc = 3(3.9)^2 = 45.63$$

at $xc = 4.2$

$$xc = 3(4.2)^2 = 52.92$$

at $xc = 4.5$

$$xc = 3(4.5)^2 = 60.75$$

at $xc = 4.8$

$$xc = 3(4.8)^2 = 69.12$$

at $xc = 5.1$

$$x = 3(5.1)^2 = 78.03$$

at $xc = 5.4$

$$xc = 3(5.4)^2 = 87.48$$

at $xc = 5.7$

$$xc = 3(5.7)^2 = 97.47$$

at $xc = 6.0$

$$xc = 3(6.0)^2 = 108.00$$

at $x = 6.3$

$$x = 3(6.3)^2 = 119.07$$

t	11	12	13	14	15	16	17	18	19	20
32.64	38.88	45.63	52.92	60.75	69.12	78.03	87.48	97.47	108.00	

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$$u_{i,j+1} = \phi u_{i+1,j} + \phi u_{i-1,j} + \Delta t u_{i,j}$$

at $T_{1,1}$

$$T_{1,1} = 0.489 T_{2,0} + 0.489 T_{0,0} + 0.02 T_{1,0}$$

$$T_{1,1} = 0.489(1.08) + 0.489(0) + 0.02(0.27) \\ = 0.52812 + 5.4 \times 10^{-3} = 0.5436$$

at $T_{2,1}$

$$T_{2,1} = 0$$

$$T_{2,1} = 0.489 T_{3,0} + 0.489 T_{1,0} + 0.02 T_{2,0} \\ = 0.489(2.43) + 0.489(0.27) + 0.02(1.08) \\ = 1.3203 + 0.0216 = 1.3446$$

at $T_{3,1}$

$$T_{3,1} = 0.489 T_{4,0} + 0.489 T_{2,0} + 0.02 T_{3,0} \\ = 0.489(4.32) + 0.489(1.08) + 0.02(2.43) \\ = 2.6406 + 0.0486 = 2.6946$$

at $T_{4,1}$

$$T_{4,1} = 0.489 T_{5,0} + 0.489 T_{3,0} + 0.02 T_{4,0} \\ = 0.489(6.75) + 0.489(2.43) + 0.02(4.32) \\ = 4.48902 + 0.08 = 4.5846$$

at $T_{5,1}$

$$T_{5,1} = 0.489 T_{6,0} + 0.489 T_{4,0} + 0.02 T_{5,0} \\ = 0.489(9.72) + 0.489(4.32) + 0.02(6.75) \\ = 6.86556 + 1.35 = 7.0146$$

at $T_{6,1}$

$$T_{6,1} = 0.489 T_{7,0} + 0.489 T_{5,0} + 0.02 T_{6,0} \\ = 0.489(13.20) + 0.489(6.75) + 0.02(9.72) \\ = 9.7556 + 0.1944 = 9.9846$$

at $T_{7,1}$

$$T_{7,1} = 0.489 T_{8,0} + 0.489 T_{6,0} + 0.02 T_{7,0} \\ = 0.489(17.23) + 0.489(9.72) + 0.02(13.20) \\ = 13.1786 + 0.264 = 13.4946$$

at $T_{8,1}$

$$T_{8,1} = 0.489 T_{9,0} + 0.489 T_{7,0} + 0.02 T_{8,0}$$

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$$T_{8,0} = 0.489(21.87) + 0.489(13.20) + 0.02(17.23)$$

$$T_{8,1} = 17.149 + 0.3446 = 17.5446$$

at $T_{9,1}$

$$T_{9,1} = 0.489T_{10,0} + 0.489T_{8,0} + T_{9,0}$$

$$T_{9,1} = 0.489(27) + 0.489(17.23) + 0.02(21.87)$$

$$= 21.628 + 8.4344 = 22.1346$$

at $T_{10,1}$

$$= 0.489T_{11,0} + 0.489T_{9,0} + T_{10,0} \cdot 0.02$$

$$= 0.489(32.67) + 0.489(21.87) + 0.02(27.0)$$

$$= 26.67006 + 0.54 = 27.2646$$

at $T_{11,1}$

$$0.489T_{12,0} + 0.02T_{11,0} + 0.489T_{10,0}$$

$$= 0.489(38.88) + 0.02(32.67) + 0.489(27)$$

$$= 32.9346$$

at $T_{12,1}$

$$= 0.489T_{13,0} + 0.02T_{12,0} + 0.489T_{11,0}$$

$$= 0.489(45.63) + 0.02(38.88) + 0.49(32.67)$$

$$= 39.1446$$

at $T_{13,1}$

$$T_{13,1} = 0.489T_{14,0} + 0.02T_{13,0} + 0.489T_{12,0}$$

$$= 0.489(52.92) + 0.02(45.63) + 0.49(38.88)$$

$$= 45.8946$$

at $T_{14,1}$

$$T_{14,1} = 0.489T_{15,0} + 0.02T_{14,0} + 0.489T_{13,0}$$

$$= 0.489(60.75) + 0.02(52.92) + 0.489(45.63)$$

$$= 53.1846$$

at $T_{15,1}$

$$T_{15,1} = 0.489T_{16,0} + 0.02T_{15,0} + 0.489T_{14,0}$$

$$= 0.489(69.12) + 0.02(60.75) + 0.489(52.92)$$

$$= 61.0146$$

at $T_{16,1}$

$$T_{16,1} = 0.489T_{17,0} + 0.02T_{16,0} + 0.489T_{15,0}$$

$$= 0.489(78.03) + 0.02(69.12) + 0.489(60.75)$$

$$= 69.3846$$

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at $T_{17,1}$

$$\begin{aligned} T_{17,1} &= 0.49T_{18,0} + 0.02T_{17,0} + 0.49T_{16,0} \\ &= 0.489(87.48) + 0.02(78.03) + 0.489(69.12) \\ &= 78.2946 \end{aligned}$$

at $T_{18,1}$

$$\begin{aligned} T_{18,1} &= 0.489T_{19,0} + 0.02T_{18,0} + 0.489(78.03) \\ &= 87.446 \end{aligned}$$

at $T_{19,1}$

$$\begin{aligned} T_{19,1} &= 0.489T_{20,0} + 0.02T_{19,0} + 0.489T_{18,0} \\ &= 0.489(108) + 0.02(97.47) + 0.489(87.44) \\ &= 97.7346 \end{aligned}$$

at $T_{20,1}$

$$\begin{aligned} T_{20,1} &= 0.489T_{21,0} + 0.02T_{20,0} + 0.489T_{19,0} \\ &= 0.489(119.07) + 0.02(108) + 0.489(97.47) \\ &= 108.04 \end{aligned}$$