Introduction to Scientific and Engineering Computing HW 2

Due Date: May 7, 2010

1. The upward velocity of the rocket is measured with respect to time and the data is given in the following table

Velocity vs time data for a rocket

Time, t (s)	Velocity, v (m/s)
5	106.8
8	177.2
12	279.2

We wanted to approximate the velocity profile by

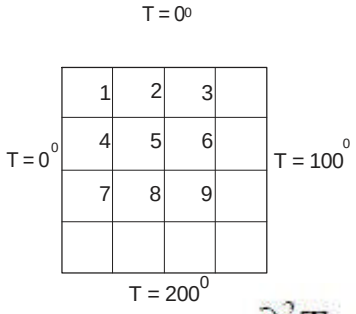
$$v(t) = at^2 + bt + c, \quad 5 \le t \le 12$$

Construct the set of linear equation and solve the equation for the coefficients $a, b,$ and c in $v(t)$

2. By taking u6= u4 solve the following system of equations

$$\begin{aligned} 0 + 4u1 - u2 &= 0 + 0.4 \\ -u1 + 4u2 - u3 &= 0.2 + 0.6 \\ -u2 + 4u3 - u4 &= 0.4 + 0.8 \\ -u3 + 4u4 - u5 &= 0.6 + 1.0 \\ -u4 + 4u5 - u6 &= 0.8 + 0.8. \end{aligned}$$

3. The edges of the square plate are kept at the temperatures shown in the following figure. Assuming steady-state heat conduction, the differential equation governing the temperature T in the interior is



$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$$

If this equation is approximated by finite differences using the mesh shown, we obtain the following algebraic equations for temperatures at the mesh point. Solve these equations

$$\begin{bmatrix} -4 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & -4 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & -4 & 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & -4 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & -4 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & -4 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & -4 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 1 & -4 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & -4 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \\ T_7 \\ T_8 \\ T_9 \end{bmatrix} = - \begin{bmatrix} 0 \\ 0 \\ 100 \\ 0 \\ 0 \\ 100 \\ 200 \\ 200 \\ 300 \end{bmatrix}$$