

HW 9

Problem 1b) The  $w$  vs  $n$  plot is only relevant between  $w = .01$  &  $w = .33$  because below  $.01$ , the solutions for  $x$  move out of tolerance range & become inaccurate. Beyond  $.33$  solutions become so large they appear infinite.

There seems to be a basin of sorts limited by max & min.

Over the course of the  $w$  range, the plot of iterations almost form strati in downward direction. You can see this if you change the  $x$  range to  $.0001$  and plot out the pixels.

Is this result expected? Yes! Although, the downward strati I did not expect and I still don't know why that is. We expect the basin shape though because the less the relaxation, the more the result is undershot and the longer it takes. The more larger it is, the more it is overshoot and the longer it takes.

Problem 2

a) 
$$\iint \frac{d^2 \phi(x)}{dx^2} = -4\pi \sin(x)$$

$$\int \frac{d\phi(x)}{dx} = \int 4\pi \cos(x) + C$$

$$\phi(x) = 4\pi \sin(x) + Cx + A$$

$C = 0$  because  $\phi(x)$  is periodic

$$\phi(x) = 4\pi \sin(x) + B$$

b)

$$\frac{1}{h^2} \begin{bmatrix} -2 & 1 & 0 & \dots & 0 & 1 \\ 1 & -2 & 1 & & & 0 \\ 0 & 1 & -2 & 1 & & \vdots \\ \vdots & & \ddots & \ddots & \ddots & 0 \\ 0 & & & 1 & -2 & 1 \\ 1 & 0 & \dots & 0 & 1 & -2 \end{bmatrix} \begin{bmatrix} \phi(x_1) \\ \phi(x_2) \\ \phi(x_3) \\ \vdots \\ \phi(x_{n-1}) \\ \phi(x_n) \end{bmatrix} = -4\pi \begin{bmatrix} \sin(x_1) \\ \sin(x_2) \\ \sin(x_3) \\ \vdots \\ \sin(x_{n-1}) \\ \sin(x_n) \end{bmatrix}$$

3c) The temperatures do not make sense because the boundaries are  $0^\circ$ ,  $0^\circ$ ,  $100^\circ$ , and  $200^\circ$  and my resultant vector contains negative temperatures.

The modification I proposed in part b was to multiply the  $b$  vector by  $-1$  such that the distribution we did w/ the given's equation (where we moved temperatures to the right hand side) is correctly represented.