13a) $F_1 = k_1(x_2 - x_1 - L) + k_2(x_3 - x_1 - L)$

$F_2 = -k_1(x_2 - x_1 - L) + k_1(x_3 - x_2 - L) + k_2(x_4 - x_2 - L)$

$F_3 = -k_1(x_3 - x_2 - L) - k_2(x_3 - x_1 - L) + k_1(x_4 - x_3 - L)$

$F_4 = -k_1(x_4 - x_3 - L) - k_2(x_4 - x_2 - L)$

If we plug these straight in as in K_old in the code comments, we get a singular matrix, instead we fix x_1 at pos 0, we get:

$$K = \begin{bmatrix} 1 & 0 & 0 & 0 \\ k_1 & -2k_1 - k_2 & k_1 & k_2 \\ k_2 & k_1 & -2k_1 - k_2 & k_1 \\ 0 & k_2 & k_1 & -k_1 - k_2 \end{bmatrix}$$

with $b = [0, -k_2L, k_2L, k_1L + k_2L]^T$

And solving $Kx = b$

19) $$\frac{du}{d\lambda} = \frac{8\pi c^2 h^2 A}{kT\lambda^7(A-1)^2} - \frac{40\pi ch}{\lambda^6(A-1)} = 0 \quad \text{where } A = e^{\frac{hc}{\lambda kT}}$$

$$\Rightarrow \frac{chA}{kT\lambda(A-1)} = 5 \Rightarrow \lambda_{max} = \left(\frac{A}{5(A-1)}\right)\frac{ch}{kT} \quad \text{Let } ch/_{kT} = 1$$

$$\Rightarrow \text{Solve } g(x) = x - \frac{A}{5(A-1)} = 0 \quad \text{where } A = e^{1/x}$$

$\Rightarrow$ Since $\frac{ch}{kT} = 1$, $\lambda_{max} = x = .2014$ (See hw4_ex19.py)