Computer Assignment 2

Evolution using basis sets

Next, consider a tight binding Hamiltonian,

$$H = -\hbar\Omega \sum_{i=1}^{N-1} \left(|\phi_i\rangle\langle\phi_{i+1}| + |\phi_{i+1}\rangle\langle\phi_i| \right)$$

with $\hbar\Omega = 1$. Use Mathematica or other symbolic algebra software to perform the following calculations

(a) For $N = 10$, calculate the eigenstates and eigenvalues of the Hamiltonian. Express the left-most site $|\phi_1\rangle$ in terms of the eigenstates and calculate its time evolution. Calculate the probability of finding the system on site i as a function of time.

(b) Repeat for $N = 20$. Discuss your results.