QP_A4_PartB

October 12, 2018

Dilraj Ghuman | 205654228

In [13]:
```
N = 2
B = 3
Ham = zeros(Float32, 2^N, 2^N)
for Ket = 0:(2^N - 1) # Loop over the kets
    Diagonal::Float32 = 0
    for SpinIndex = 0:N-2 # loop through the indices
        Spin1 = 2*((Ket>>SpinIndex) & 1)-1
        Spin2 = 2*((Ket>>(SpinIndex+1)) & 1) - 1
        Diagonal = Diagonal + Spin1*Spin2
    end
    Ham[Ket+1,Ket+1] = Diagonal # Fill the diagonal component
    # Adding in the Bra component
    for SpinIndex = 0:N-1
        bit = 2^SpinIndex
        Bra = Ket ⊻ bit # Define our Bra for each Ket
        Spin1 = 2*((Ket>>SpinIndex) & 1)-1 # Read in the Ket and Bra to compute the out
        Spin2 = 2*((Bra>>SpinIndex) & 1)-1
        Spinx = Spin1*Spin2
        Ham[Ket+1,Bra+1] = -3*Spinx*0.5 # Fill the off-diagonal components
        #println(Ket, " ", Bra)
    end
end
display(Ham)
```

```
4×4 Array{Float32,2}:
 1.0   1.5   1.5  0.0
 1.5  -1.0   0.0  1.5
 1.5   0.0  -1.0  1.5
 0.0   1.5   1.5  1.0
```

In [14]:
```
N = 3
B = 3
Ham = zeros(Float32, 2^N, 2^N)
for Ket = 0:(2^N - 1) # Loop over the kets
    Diagonal::Float32 = 0
```

```
            for SpinIndex = 0:N-2 # loop through the indices
                Spin1 = 2*((Ket>>SpinIndex) & 1)-1
                Spin2 = 2*((Ket>>(SpinIndex+1)) & 1) - 1
                Diagonal = Diagonal + Spin1*Spin2
            end
            Ham[Ket+1,Ket+1] = Diagonal # Fill the diagonal component
            # Adding in the Bra component
            for SpinIndex = 0:N-1
                bit = 2^SpinIndex
                Bra = Ket ⊻ bit # Define our Bra for each Ket
                Spin1 = 2*((Ket>>SpinIndex) & 1)-1 # Read in the Ket and Bra to compute the out
                Spin2 = 2*((Bra>>SpinIndex) & 1)-1
                Spinx = Spin1*Spin2
                Ham[Ket+1,Bra+1] = -3*Spinx*0.5 # Fill the off-diagonal components
                #println(Ket, " ", Bra)
            end
        end
        display(Ham)
```

```
8×8 Array{Float32,2}:
 2.0  1.5   1.5  0.0  1.5   0.0  0.0  0.0
 1.5  0.0   0.0  1.5  0.0   1.5  0.0  0.0
 1.5  0.0  -2.0  1.5  0.0   0.0  1.5  0.0
 0.0  1.5   1.5  0.0  0.0   0.0  0.0  1.5
 1.5  0.0   0.0  0.0  0.0   1.5  1.5  0.0
 0.0  1.5   0.0  0.0  1.5  -2.0  0.0  1.5
 0.0  0.0   1.5  0.0  1.5   0.0  0.0  1.5
 0.0  0.0   0.0  1.5  0.0   1.5  1.5  2.0
```