

```

In [1]: import Pkg
Pkg.add("DataStructures")
Pkg.add("Shuffle")
Pkg.add("Plots")
Pkg.add("Distributions")
Pkg.add("Random")
using DataStructures
using Shuffle
using Plots
using Random
using Distributions

#takes in an integer n
#returns array of length n of integers +/- 1 (randomly chosen) that represent s
function initial_config(n::Int)
    config = zeros(n)
    if n%2 != 0
        println("Size n must be even.")
        return
    else
        for i=1:n
            config[i] = rand([-1, 1])
        end
    end
    #print(config)
    return config
    #essentially from N, we get a randomized array of spin ups and downs
    #e.g., N=2 may equal [1,-1]; N=4 may equal [1,-1,-1,1] as our initial configu
end

function gaussian_rf(N)
    nd = Normal(0, 1)
    return rand(nd, N)
end

function unit_rf(N)
    field = zeros(N)
    for i=1:N
        field[i] = rand([-0.5, 0.5])
    end
    return field
end

#standard function for getting the hamiltonian of 1/r^2
#Ising Model
function get_energy(s::AbstractArray, h::AbstractArray, J)
    E0 = 0.0
    E1 = 0.0
    E2 = 0.0
    for i=1:length(s)
        #if i != length(s)
            #E0 += J*s[i]*s[i+1]
        #else
            #E0 += J*s[i]*s[1]
        #end
        for j=i:length(s)
            if j != i
                E1 += J*(s[i]-s[j])^2/(i-j)^2
            end
        end
        E2 += h[i]*s[i]
    end
    E = -E1/2 - E2
    return E
end

```

```

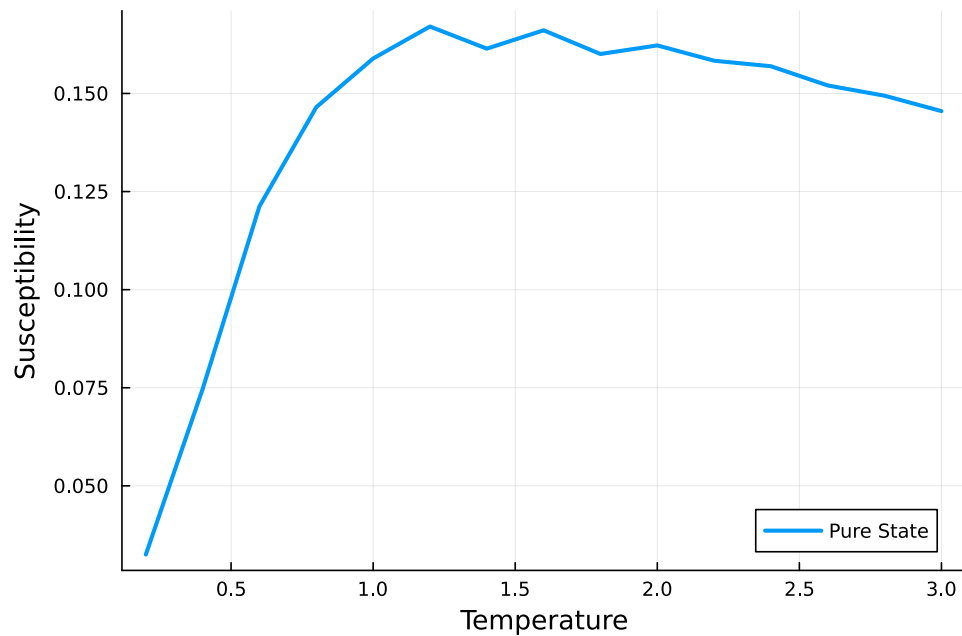
In [2]: #Pure State:
@time begin X_list1 = Vector{Float64}{}
for kT = initkT:iter:finalkT
    println("At ", kT, " kT.")
    data = metropolis(config0, kT, J, h3, mcsteps)
    X = get_susceptibility(data[1], data[2], kT, length(config0))
    push!(X_list1, X)
end
plot(initkT:iter:finalkT, X_list1, xlabel = "Temperature", ylabel = "Susceptibi
end

```

At 0.2 kT.
 At 0.4 kT.
 At 0.6 kT.
 At 0.8 kT.
 At 1.0 kT.
 At 1.2 kT.
 At 1.4 kT.
 At 1.6 kT.
 At 1.8 kT.
 At 2.0 kT.
 At 2.2 kT.
 At 2.4 kT.
 At 2.6 kT.
 At 2.8 kT.
 At 3.0 kT.

51242.544917 seconds (4.41 M allocations: 244.320 MiB, 0.00% gc time, 0.01% compilation time: 19% of which was recompilation)

Out[2]:



```
At 0.2 kT.
At 0.4 kT.
At 0.6 kT.
At 0.8 kT.
At 1.0 kT.
At 1.2 kT.
At 1.4 kT.
At 1.6 kT.
At 1.8 kT.
At 2.0 kT.
At 2.2 kT.
At 2.4 kT.
At 2.6 kT.
At 2.8 kT.
At 3.0 kT.
41466.535724 seconds (335.45 k allocations: 22.430 MiB, 0.00% compilation time)
```

Figure 1 is a line graph showing the Susceptibility (Y-axis, ranging from 0.1 to 0.7) versus Temperature (X-axis, ranging from 0.0 to 3.0). Two curves are plotted: a blue line for 'Pure State' and an orange line for 'Gaussian Random Field'. The 'Gaussian Random Field' curve starts at a high susceptibility of approximately 0.72 at Temperature 0.0 and decreases sharply to about 0.15 at Temperature 0.6, then remains relatively flat around 0.15-0.16 until Temperature 3.0. The 'Pure State' curve starts at a low susceptibility of approximately 0.03 at Temperature 0.0, increases to about 0.12 at Temperature 0.6, and then fluctuates slightly between 0.15 and 0.17 until Temperature 3.0.

Temperature	Pure State Susceptibility	Gaussian Random Field Susceptibility
0.0	0.03	0.72
0.5	0.10	0.22
1.0	0.16	0.15
1.5	0.16	0.16
2.0	0.16	0.16
2.5	0.15	0.15
3.0	0.15	0.15

```
[0.25007999999999997, 0.28896, 0.24372000000000005, 0.23897, 0.223208, 0.21837333333333334, 0.2132457142857143, 0.201125, 0.19762666666666667, 0.19142399999999998, 0.17792727272727274, 0.18039666666666668, 0.1668, 0.16540285714285716, 0.15995199999999998]
```

