1 Ising Model with Markov Chain Monte Carlo for a grid of side N

Hamiltonian:

$$H = -J \sum_i S_i S_j - \sum_i h S_i$$

1.1 Some Results

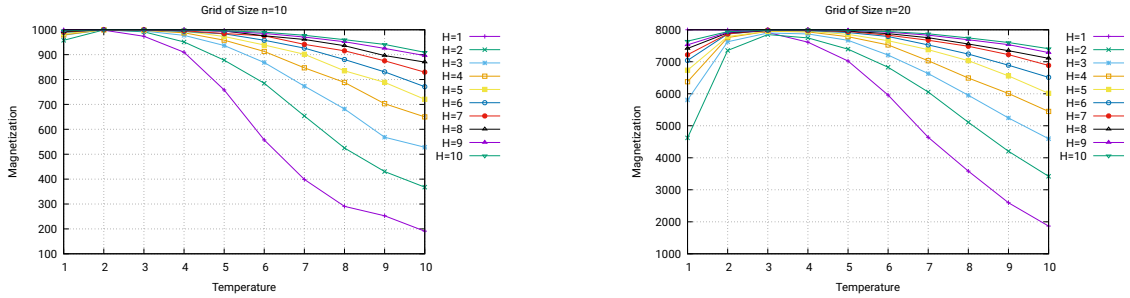

Figure 1: Magnetization v. Temperature for different grid sizes

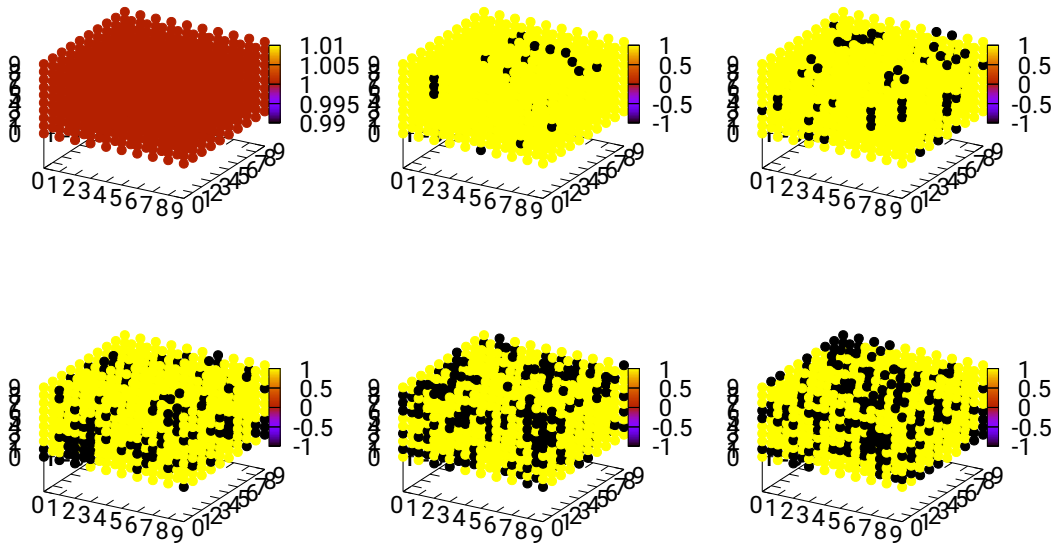

Figure 2: Configurations at different temperature values with h constant

2 Updated Ising Model

- Hamiltonian
$$\mathcal{H} = -\sum_{n}\left(J_n \sum_{i} S_i S_j(n)\right) - \sum_{i} BS_i$$
with $n = 2$, $J_n = 1.0, 0.5$ and $B = 1.0$

- Magnetic Susceptibility, $\mathcal{X}$
$$\mathcal{X} = \beta[< M^2 > - < M >^2]$$
with $\beta = 1.0/T$

- Heat Capacity, C_v
$$C_v = \beta^2[< E^2 > - < E >]$$

- The random number generator used is the Mersenne Twister as found in the C++ std libraries.

- The magnetization time autocorrelation function is computed using the FFT method, employing the FFTW library version 3.3.6.

2.1 Results for N=20

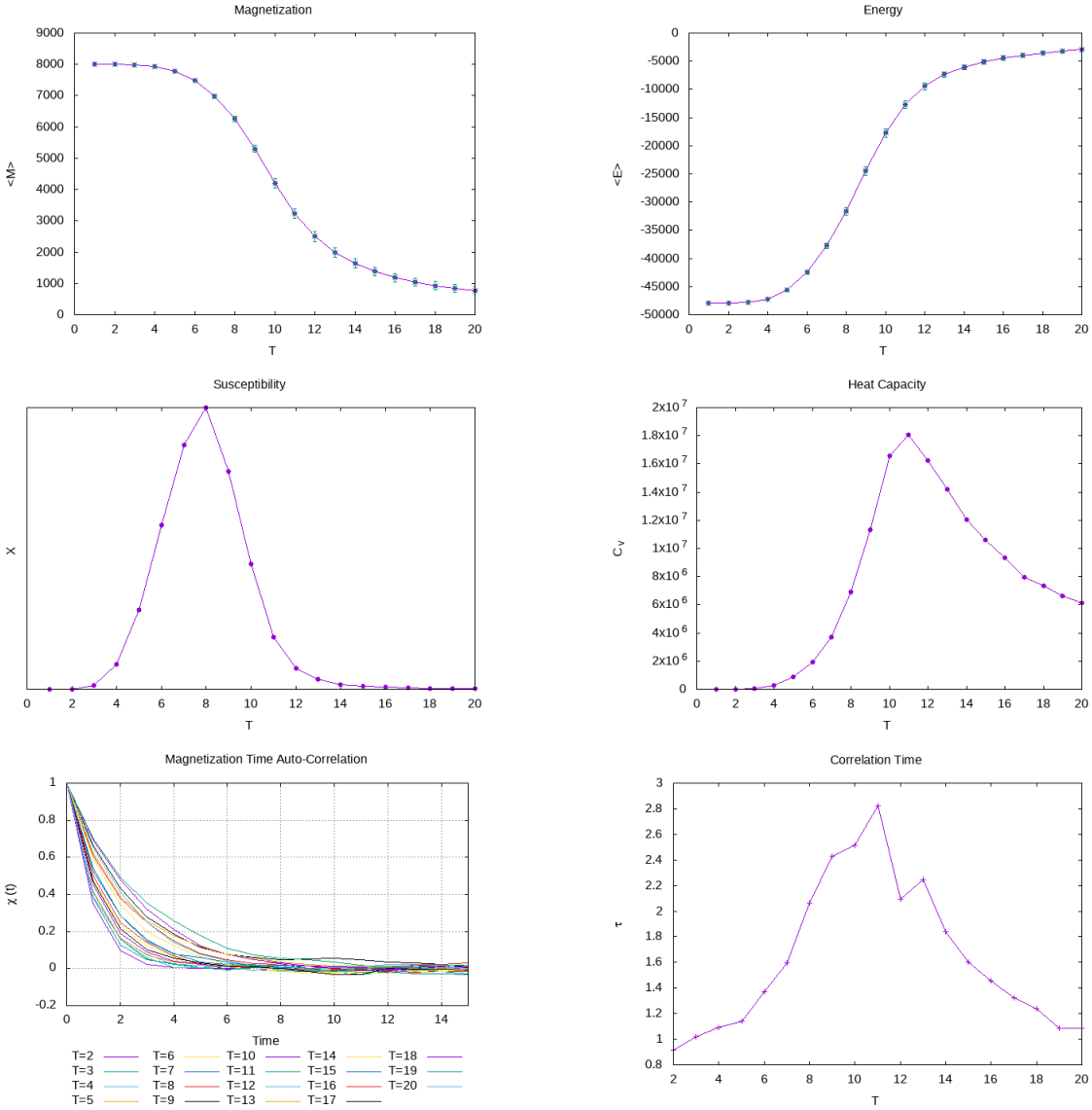

Figure 3: Calculated quantities for $N = 20$

2.2 Results for N=30

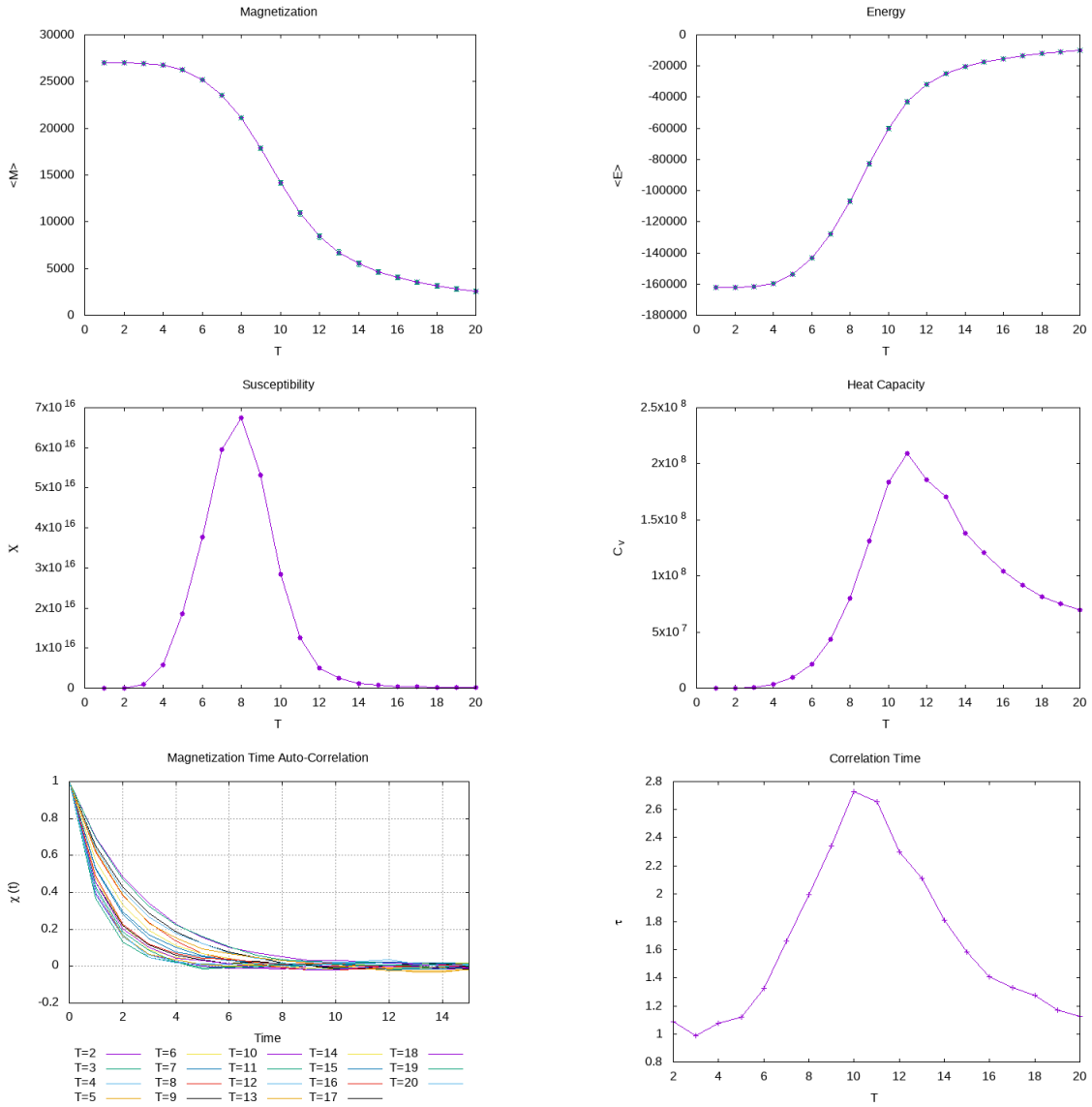

Figure 4: Calculated quantities for $N = 30$

2.3 Results for N=35

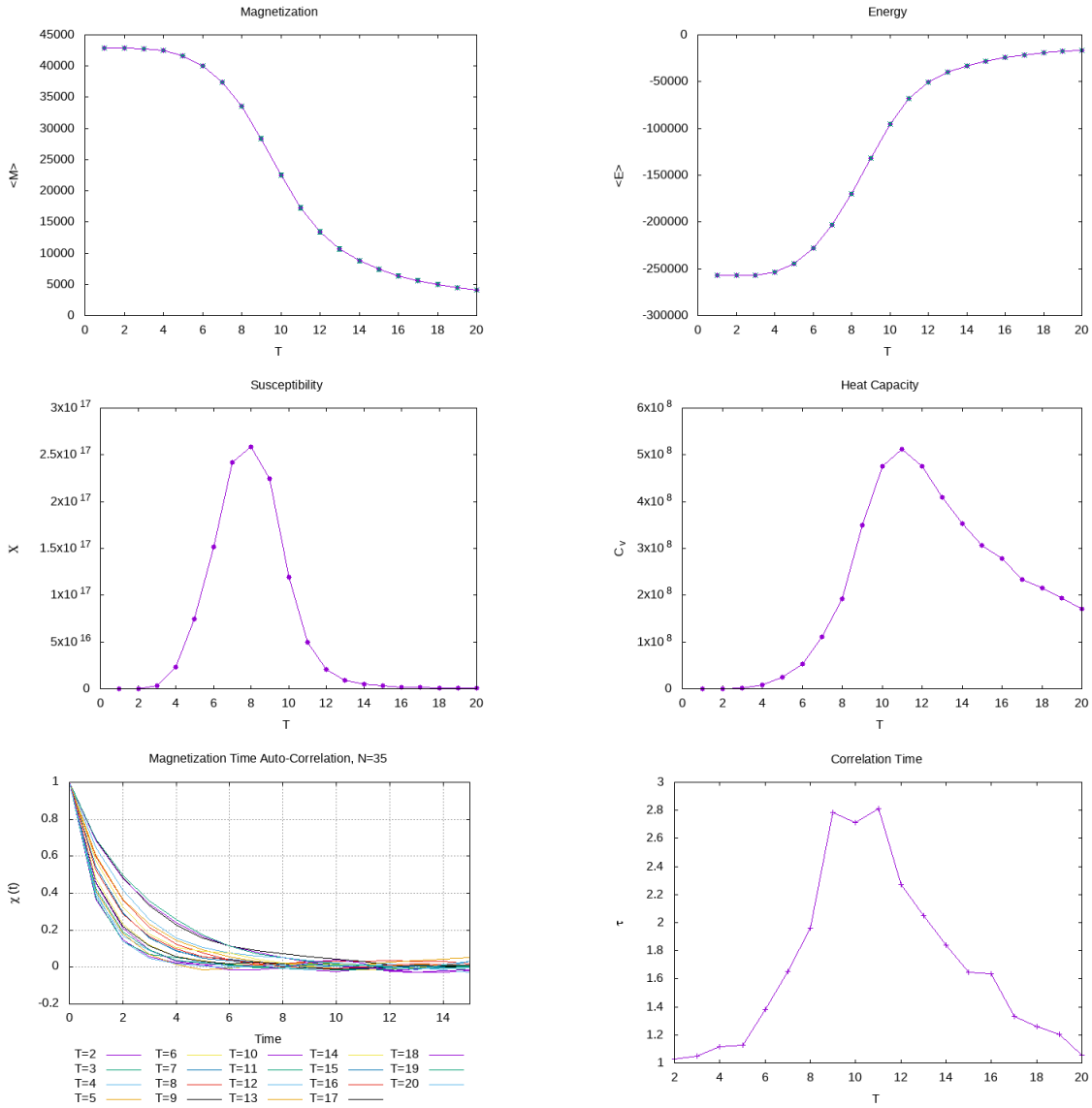

Figure 5: Calculated quantities for $N = 35$

3 Classical Heisenberg Model for a 3D grid of side N with $n = 2$ nearest neighbors

- Hamiltonian

$$\mathcal{H} = -\sum_{n}\left(J_n \sum_{i} S_i S_j(n)\right) - \sum_{i} BS_i$$

with $n = 2$, $J_n = 1.0, 0.5$ and $B = 1.0$ and

$$S_i = [sin\theta_i cos\phi_i, sin\theta_i sin\phi_i, cos\theta_i]$$

- Magnetization

$$M_i = \sqrt{M_{i,x}^2 + M_{i,y}^2 + M_{i,z}^2}$$

$$< M >= \frac{1}{N * N * N} \sum_{i}^{N*N*N} M_i$$

- Magnetic Susceptibility, $\mathcal{X}$

$$\mathcal{X} = \beta[< M^2 > - < M >^2]$$

with $\beta = 1.0/T$

- Heat Capacity, C_v

$$C_v = \beta^2[< E^2 > - < E >]$$

3.1 Results for N = 12

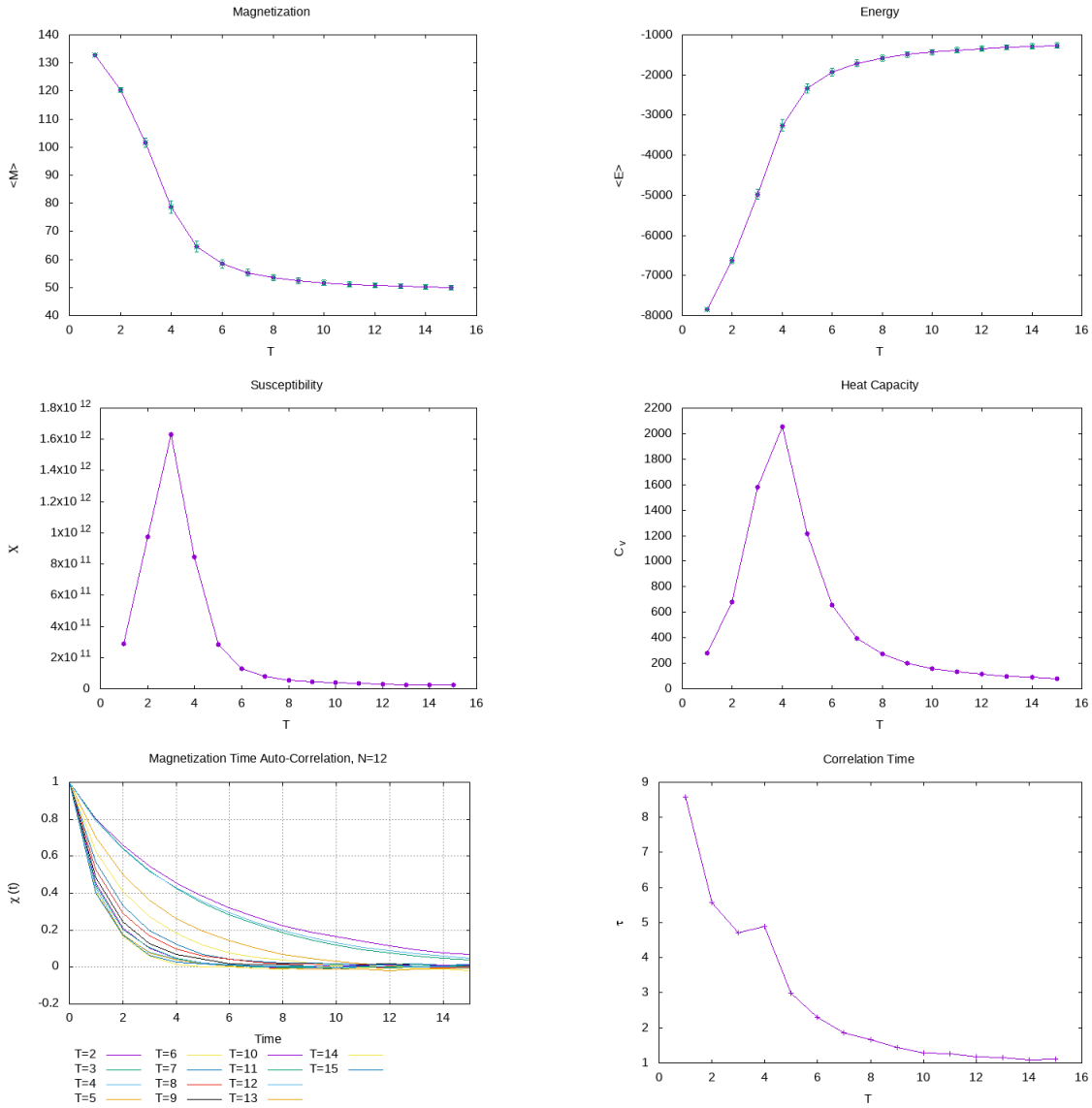

Figure 6: Heisenberg model Calculated quantities for $N = 12$

3.2 Results for N = 20

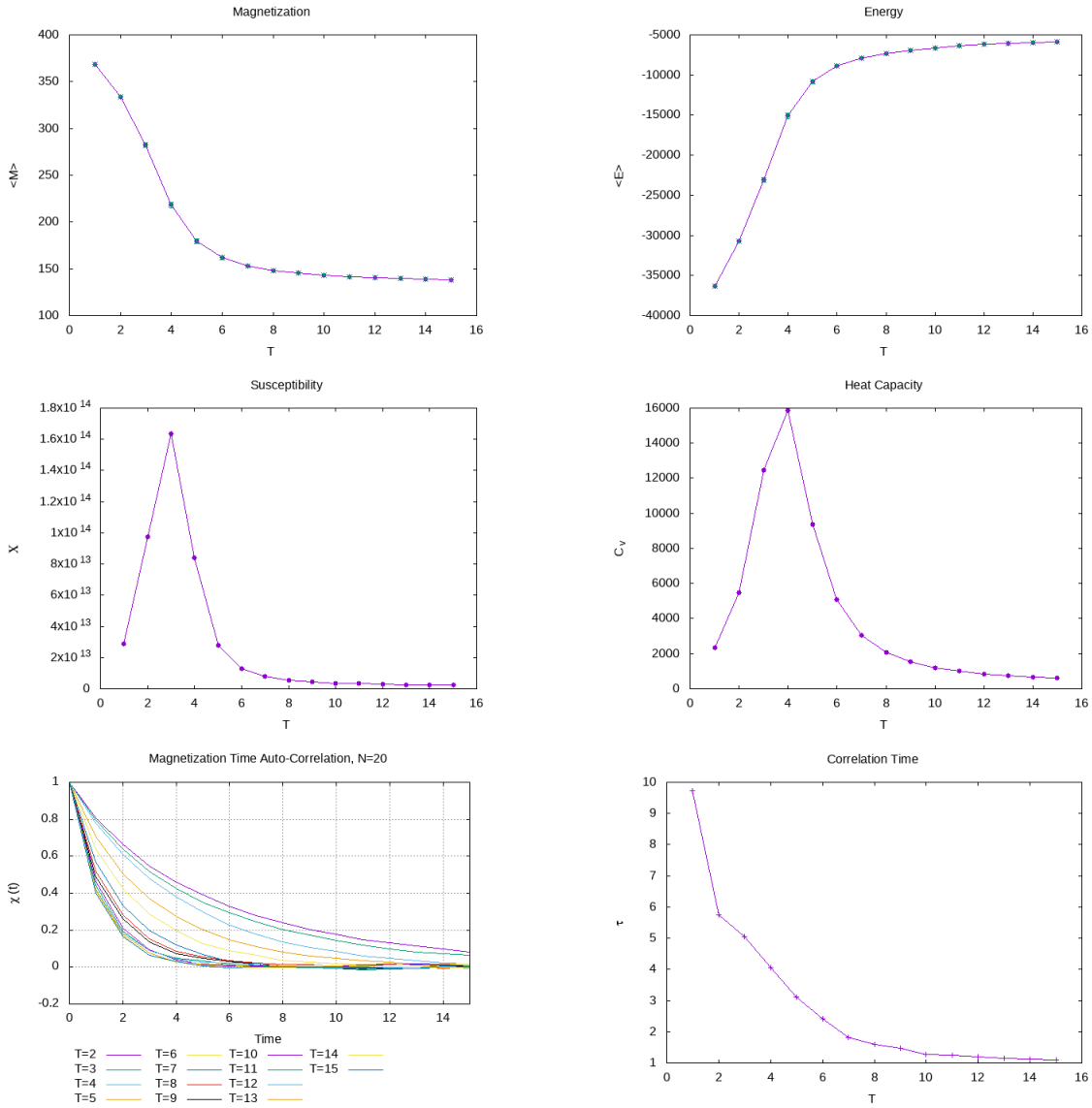

Figure 7: Heisenberg model Calculated quantities for $N = 20$

3.3 Results for N = 30

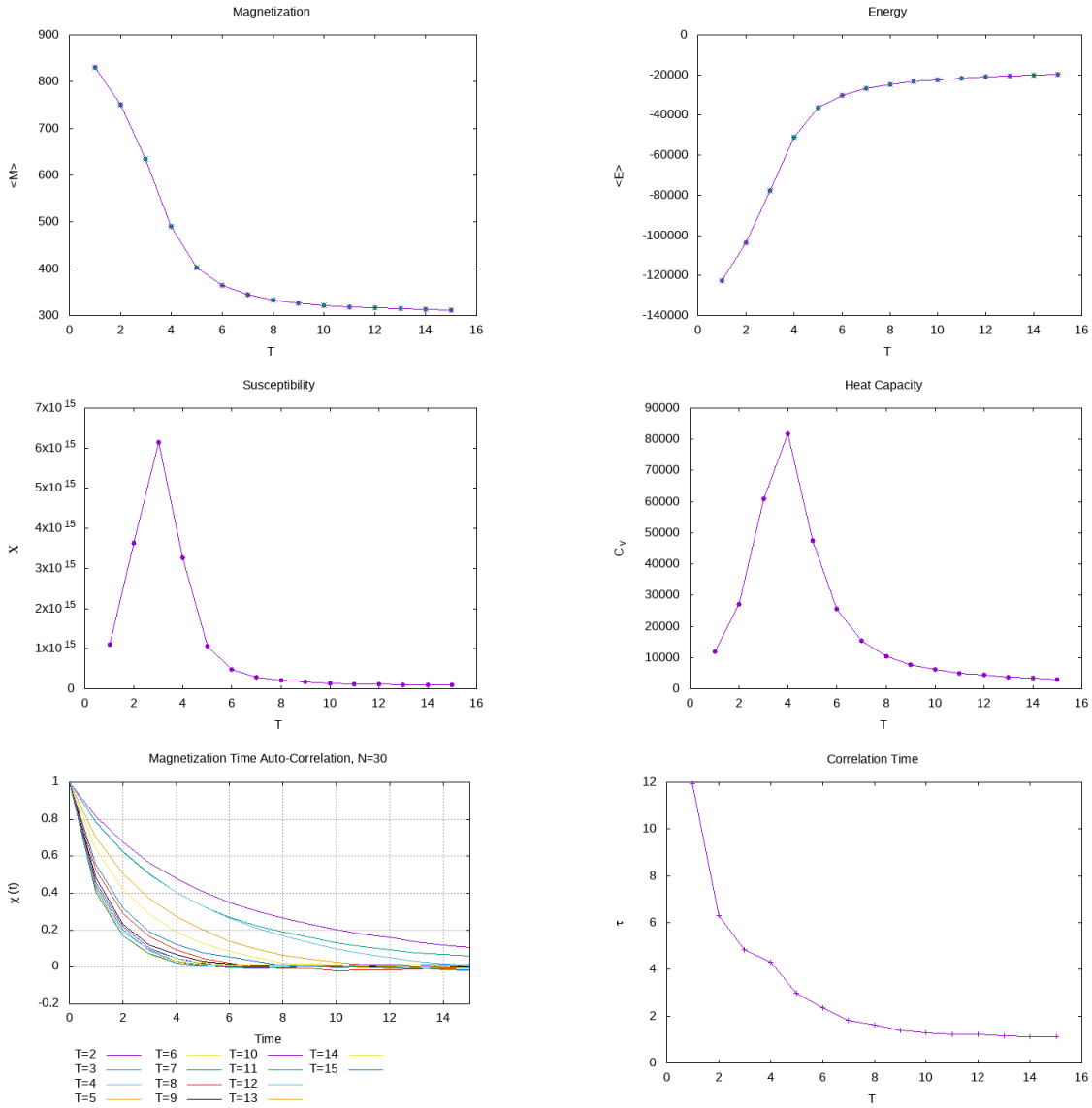

Figure 8: Heisenberg model Calculated quantities for $N = 30$