Comment on Ising Models applicability in Large Language Models

by Charles H. Martin, 7/1/2025

This is exactly what we see in the layers of well-trained AI models as well. When the layer is performing optimally, the weight matrices take on the form shown below at . When the layer is less than optimal, it can look almost like a random matrix, or, as shown below, a high-T spin model (). And if the layer is overfit to the data (i.e over-compressed, over-correcting, etc), then it looks a lot like the spin-glass phase of the Ising model, with.

*David Vaizelli wrote*:

Financial markets sometimes behave like they are perfectly synchronized, all buying or selling at once, causing crashes or rallies.

Recently I have read about an application of statistical physics to explain this behavior using the Ising model, originally designed to describe how tiny magnetic spins in materials align and flip collectively.

Basically the idea is to consider each stock like a tiny spin, which can be "up" when price goes up or "down" obviously when price goes down. Stocks influence each other, some tend to move together (positive coupling or high positive correlation), others might move oppositely (negative coupling/highly negative correlation).

By learning these interactions directly from market data, is found that markets behave near a critical point, a phase transition where small shocks can cause massive market moves.

In the figure below is shown three different phases of the Ising model: paramagnetic, critical, and ferromagnetic. This pictures represents how individual spins can move from a disordered state to a more synchronized one, illustrating the collective behavior that can emerge in markets.

A red and blue squares

Description automatically generated

# References

[1] [Original Linkedin post by Charles H. Martin, 71/2025](https://www.linkedin.com/posts/charlesmartin14_finance-physics-quantitativefinance-activity-7345690024199262209-lIta?utm_source=share&utm_medium=member_desktop&rcm=ACoAAAFZfUoBgPoGUucdnvtwuzPv79P8VHj6uvk)

[2] [Ising Model – Physics of Risk, Aleksejus Kononovicius, 2010](https://rf.mokslasplius.lt/ising-model/)