Cognitive Trading

Trading with Deep Learning Forecasts of Chaos & Order in global currency markets

It might have seemed obvious but we now know all change is a mix of order and chaos[1]. It's just a matter of which types and how much of each are present in any particular kind of change.

So, wouldn't it be great for foreign exchange trading if we could actually work out those types and quantities and use them to generate both point forecasts *and* prediction interval forecasts based on each component? Then we would know when our forecasts *reliably* balance risk and profit and when profit or loss is just as likely to be determined by the roll of the dice – when the only way to win is not to play.

This is in fact the basis of our low-frequency, high-confidence approach: trade smart, not fast, using the right signal processing, statistical and deep-learning neural-network tools for just the right jobs.

Given enough data, resources and time, a deep-learning system should be able to develop a profitable strategy – the deep-learning "policy" – that takes everything into account. But there probably isn't enough for a complex network to converge on a stable policy because the noise of chaos dilutes the learning signal. The "vanishing gradient"problem of deep-learning has been solved, but if the gradients just keep changing...

We overcome this problem with a purely algorithmic front-end that delivers a more manageable (but still huge) state-space whose dimensions involve moving averaged baselines, frequency notch filtering and our proprietary chaos metric *Xi*,so that the neural networks can do what they do best: learn from valid information.

We have two deep-learning elements in the end-end architecture: hierarchical LSTM forecasting (with connectivity between the chaos/order discriminant and the forget-gate) and a zero-knowledge[2] trading player whose wins are quantified by profit.

But the trading player does not play with forecast prices and prediction intervals only, it also knows about forecasts of predictability and about correlations between currency pairs – because chaos *here* may imply order *there*, chaos now may imply order to come, and even when there are unforeseen shocks, the response here may guide the response there. Pair-wise correlations of numerous metrics, as measured by Granger Causality[3], are also learnable.

The Cognitive Trading approach is to apply our unique combination of statistics, signal processing, chaos theory and deep learning to multiple currency pairs and train on both knowledge and ignorance. Based on academic research, the enhanced *Xi* metric has been proven against the onset of chaos in in the Logistic Map[4], and with simple one-hot level encoding this measure of financial ignorance becomes the lever that lifts the LSTM forecasts to new levels of reliability and allows the deep-learning player to deliver superior alpha.

They said, *Garbage In, Garbage Out*. So we're taking the garbage out of the input – until it's been recycled.

There will always be surprises – but we have a better idea when to expect the unexpected.

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[1] See https://www.quantamagazine.org/math-proof-finds-all-change-is-mix-of-order-and-randomness-20190327/
[2] In the sense of the Deep Mind AlphaZero system, see e.g. https://deepmind.com/blog/alphazero-shedding-new-light-grand-games-chess-shogi-and-go/
[3] See https://en.wikipedia.org/wiki/Granger_causality
[4] See e.g. https://en.wikipedia.org/wiki/Logistic_map