**Game of Life:**

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1. **Analysis of Live Site Maintaining/Generating Configs**
2. 2 live sites in 8-neighborhood

Up to reflection and rotation symmetries the following 6 configurations are involved,

4 of them symmetric, 2 asymmetric.

XX0 X0X X00 X00 0X0 000

000 000 00X 000 X00 X0X

000 000 000 00X 000 000

1. 3 live sites in 8-neighborhood

Up to reflection and rotation symmetries the following 9 configurations are involved

XXX XX0 XX0 XX0 XX0 XX0 X0X X0X X00

000 00X 000 000 000 X00 000 000 00X

000 000 00X 0X0 X00 000 00X 0X0 0X0

1. **Deterministic gene replication rule**

Non-random inheritance possibility:

If there are two symmetric sites (in 2 cases, 8 and 9) take instead the third.

Otherwise, take the genome of the neighbour closest to middle of three live neighbors.

X**X**X X**X**0 X**X**0 **X**X0 **X**X0 **X**X0 X0**X** X0X **X**00

0**X**0 0**X**X 0**X**0 0**X**0 0**X**0 X**X**0 0**X**0 0**X**0 0**X**X

000 000 00X 0X0 X00 000 00X 0**X**0 0X0

So it is possible to create a deterministic gene replication rule for the GoL.

I would recommend that we work with this, since it avoids introducing additional stochasticity through the choice of ancestor in replication.

1. **Influence of genes on Game of Life**

An initial objective was to avoid the reduction of GoL random configs statistically with high probability to absorbing local states: e.g. 0 or blinkers. A second objective is to allow the genes to influence the dynamics. The idea was to allow rare departures of change of state rules, which by and large preserve symmetry of number of creation and destruction events. If the departures only take place when the genes are identical or close to one another, then since this is much more likely if local patterns stagnate than if globally communicating patterns are occurring, this effectively provides a local rule counteracting stagnation of the game of life patterns.

Note that some rules creating live cells from 2-live neighbourhoods are required, rather than just additional destruction rules, otherwise the tendency will be towards even more absorbing zero state configurations. We could introduce creation rules from 1-live neighbour states, but this seems like a very strong departure from spirit of GoL and a major perturbation. Rules creating live cells from 0-nb states would lead to ubiquitous spontaneous generation of random information: this is not of interest.

The rare birth from 2.live neighbour configs cannot be made deterministic in gene parentage if all configurations are permitted, since 4 configs are symmetric in two neighbours. We could:

1. Relax totalitarian (dependence on number of ones only) nature of rules, and only consider asymmetric configs as candidates for replication. Then chose the closest gene to central site (i.e. non-diagnonal neighbour)
2. Consider replication as sexual (but this introduces additional random component)
3. Abandon correcting the two-neighbour rule and instead work with an intrinsically asymmetric rule, such as 1,(3 already used),5 or 7. The choice of appropriate neighbour for gene is in all cases deterministic and simply defined. I guess I would be tempted to try 7. It would be useful to collect some statistics on the number of occurrences of cases 7 and 5. Note that High Life has been defined and studied which adds an additional birth rule for 6 live neighbours: interestingly it supports a replicator and has much in common with normal life.