Introduction
The forest fire model has been used as an analogy to test the theory of Self-Organized Criticality as a model of complexity. The goal is to search for scale invariance in randomly generated forest fires using a computer simulation. In a previous model by B. Drossel and F. Schwabl, power-law behavior was seen when the nearest neighbors to a tree on fire catch on fire, and it has been assumed that if further neighboring trees also catch on fire, then it will still exhibit self-organized criticality, showing scale invariance. Testing this assumption aids to the exploration of the applicability of self-organized criticality because the model is the most useful when it applies to a large range of systems, as closely related to nature as possible.

Self-Organized Criticality (SOC)

**Self Organization:** Larger system shows order due to small scale interactions, this order being *scale invariance* in the *power law behavior*.

**Critical State:** The point in which a system is no longer in equilibrium.

Sand Pile Model:
- First model used to explore SOC
- Grains of sand are added to the pile one by one
- Eventually avalanches randomly occur
- Avalanche size and avalanche frequency shows “power-law” behavior

Power Law Behavior:
- Relative change in one quantity shows a proportional relative change in another
- Smaller avalanches are more frequent than larger ones
- Power-law equation: \( s = \frac{1}{f^\alpha} \)
  - \( \alpha \) is the slope on a log-log scale

Scale Invariance:
- When changing the lattice size, the slope does not change
- 200 grains of sand and 1000 grains of sand show the same slope in their power-law relationship

Methods
- Each circle represents a “cluster”
- Cluster Size (\( s \)) is the number of trees in a cluster
- Number of clusters \( N(s) \)
- Radius of the average number of trees \( R(s) \)

Analysis
- Power-law still present with the expanded parameters
- Scale Invariance was shown for \( R(s) \) because of the same slope, but not for \( N(s) \).
- In order to fully prove or disprove self organized criticality, both fires must be tested at different lattice sizes.

Future Work
- Test different lattice sizes
- Expand different parameters such as lightning frequency and forest density
- Refine counting algorithm in code

References

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