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A NEW KIND OF SCIENCE

(Chapter 1&2)

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Outline:

- The Foundations for a New Kind of Science
  - Emerging of a “New Kind of Science”
  - The Benefits of a “New Kind of Science”
  - Conclusion
- The Crucial Experiment
  - Cellular Automata
  - Conclusion

Emerging

- Started by curiosity of process of randomization (1972)
- Studied more in particle physic and cosmology and realized that everyday phenomena still couldn’t be answered.
- Developed a software system with symbolic language (Part of Mathematica) (1981)
- Changed the idea of relying on traditional mathematic to a “New Kind of Science”
- Rely on a computer (simple program : sophisticated behavior).

Benefits

- Purpose
  - to initiate another transformation
  - to introduce a new science, based on much more general types of rules, that can be embedded in computer programs
- Advantages
  - Concentrating on much more general abstract system.
  - Simple programs to simulate complex behaviors

Conclusion

- Simple rules can create complex behavior
- Instead of thinking based on specific detail, rethinking based on how process of natural works

Cellular Automata

- It consists of a line of cells
- Each cell can be ether black or white.
- a cell’s color of the next step depends on the previous step and rules
- Examples
  - Rule 254
  - Rule 250
  - Rule 90
  - Rule 30
  - Rule 110
  - Game of Life

Cellular Automata

- Rule 254 : The cell should be yellow in all cases where it or either of its neighbors were yellow on the step before
- Rule 250 : The cell is black whenever both of its neighbors were yellow on the step before
- Rule 90 : The cell is yellow when either its left neighbor or its right neighbor – but not both – were yellow on the step before

Cellular Automata

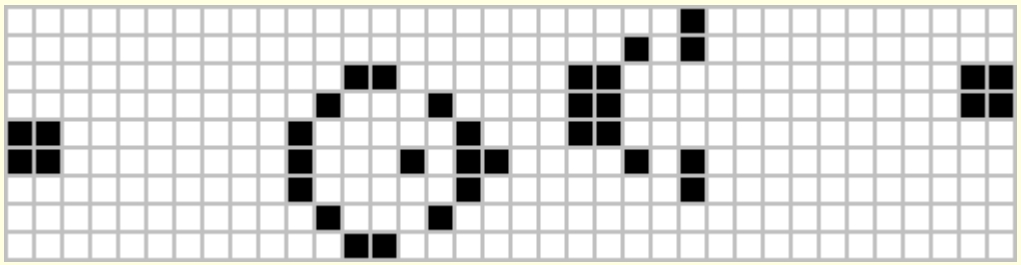
- Rule 30 : First look at each cell and its right-and neighbor. If both of these were black on the previous step, then take the new color of the cell the be whatever the previous color of its left-hand neighbor was. Otherwise, take the new color to be the opposite of that.
- Rule 110 : The cell should be yellow in every case except when the previous colors of the cell and its two neighbors were all the same or, when the left neighbor was yellow and the cell and its right neighbor were both black

Game of Life

- Play on grid cell board
- Each cell can be empty (dead) or occupied (alive)
- Rule of Death or Survive
  - Survive if there are two or three neighbors
  - Death if it has four or more neighbors or if it has only one neighbor or none.
  - A dead cell becomes alive cell in the next generation if it has exactly three neighbors.
- Q : no pattern can grow without a limit? ($ 50)

Game of Life

- The first pattern that won the cash prize offered by Conway.
- This pattern was invented by a group of students at MIT let by Bill Gosper



Gosper Glider Gun

http://en.wikipedia.org/wiki/Conway's_Game_of_Life

Conclusion

- Very basic programming can generate very complex behavior
- Slightly different behavior can generate very different behavior

Questions & Comments