

# Quick Review of Introduction Mitchell chapters 1 -7

## Chapter 1: What is Complexity

- Examples of CAS
- Characteristics of CAS (p 12)
  - Complex collective behaviors
  - Signaling & information processing
  - Adaptation

## Chapter 2: Dynamics, chaos, prediction

Logistic map:  $x_{t+1} = Rx_t(1-x_t)$

Sensitive Dependence on Initial Conditions

Deterministic but unpredictable

Bifurcation diagram and the meaning of Feigenbaum's constant

## Chapter 3: Information

Shannon Entropy:  $H = -\sum p_i \log_2 p_i$

Calculate Amount of information in a series of events

Amount of surprise observing an event

# Quick Review of Introduction

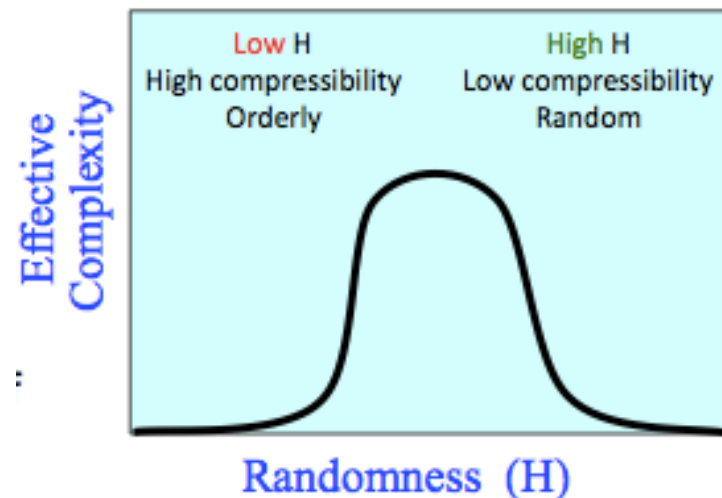
## Mitchell chapters 1 -7

- Chapter 4: Computation
  - Godel Incompleteness
  - Turing Uncomputability
  - Relevance to DNA
- Chapter 5: Evolution
  - Exponential growth of populations
  - Struggle for existence: Limited Capacity for any population
  - Variable, heritable survival and reproduction
- Chapter 6: Genetics, simplified
  - DNA, RNA
  - Transcription, Translation, Codon
  - Crossing over
  - Relate information to evolution, information & computation
    - How much information (in bits) in 1 codon?

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- Ch 7: Defining and Measuring Complexity
  - AIC (Algorithmic Information Content): The length of the shortest program that completely describes an object
  - Logical Depth: The number of steps required to construct an object
  - Effective Complexity: The AIC of the regularities of an object
  - Fractal Dimension...

“Most of the effective complexity of the universe lies in the AIC of a description of those frozen accidents and their consequences...”



## Ch 8: Self Reproducing Programs

```
1  program selfcopy
2      L = ip - 1
3      loop until line[L] = "end"
4      {
5          print(line[L])
6          L = L + 1
7      }
8      print("end")
9  end
```

## Ch 8: Self Reproducing Programs

- $S = \text{“This statement is not provable”}$
- $M$  is the interpreted meaning of  $S$
- $D = \text{“ACTGCGGTT”}$ 
  - Information content of the string?
  - Fitness value of this string?