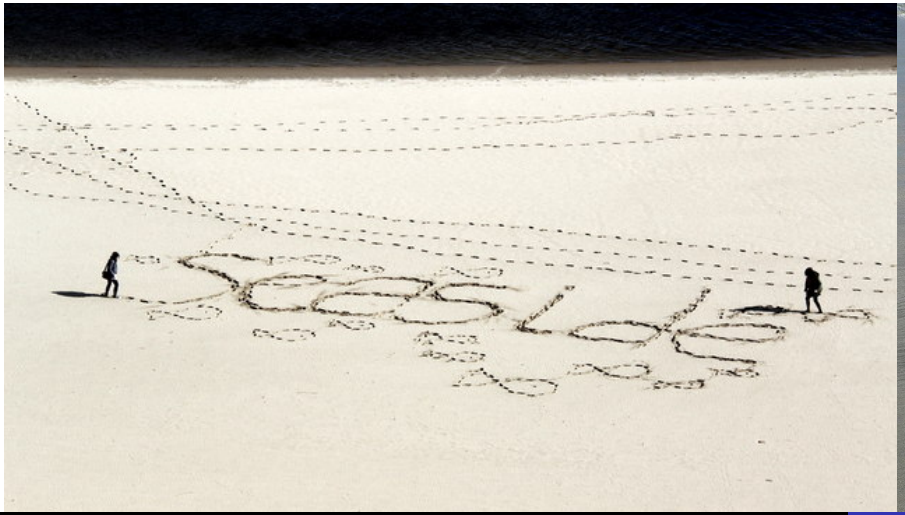
Something Designed. Something Not.






Contents

Inferring Design

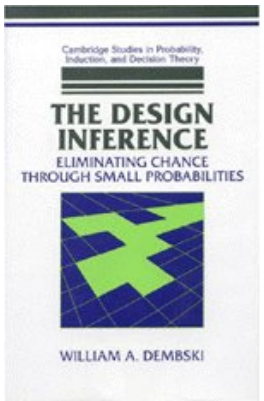
How do we infer design?

Inferring Design

How do we infer design?

- Complexity
- Specification

Specified Complexity



Complexity

Is it improbable?

- Most of the EIL work has been in this area
- Can we shuffle things around to make them probable?

Specification

Specification is conforming to an independently given pattern

- No precise definition
- Not quantifiable
- Difficult to maintain independance

Independence

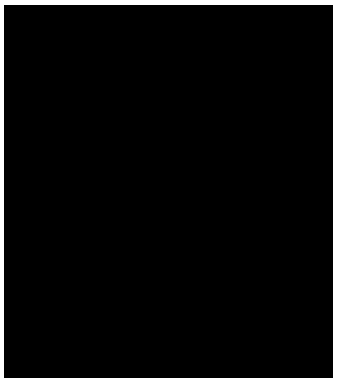
Our specification is usually derived from object of interest

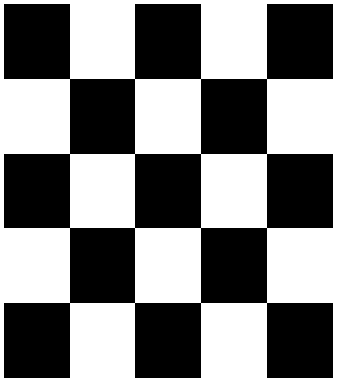
- Life
- Flight

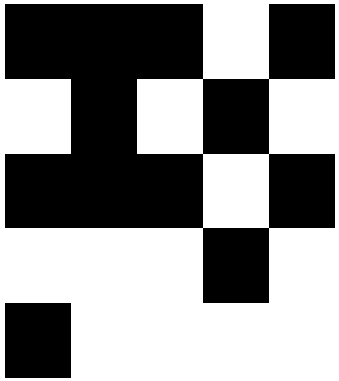
Kolmogorov

- Kolmogorov is based on the idea of describing patterns
- The complexity of an object is the length of the computer program required to describe that object
- In more lax terms, how many words does it take to describe that object

Example Patterns



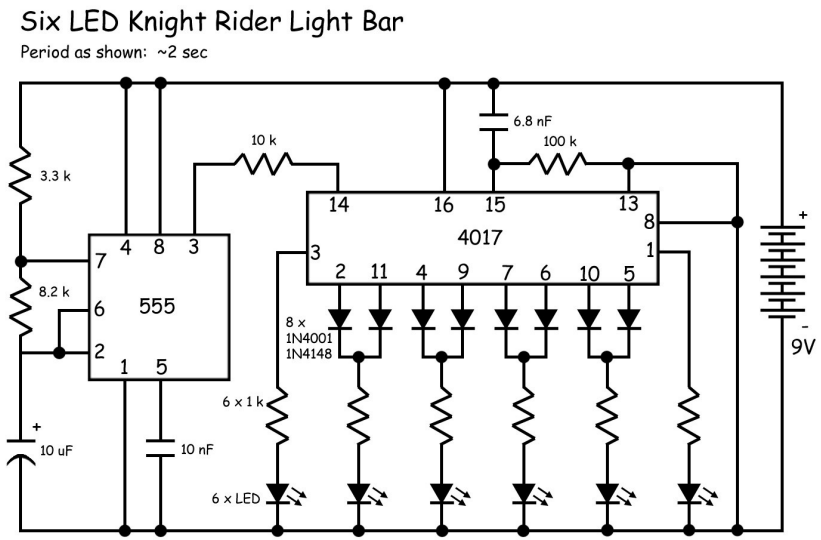




Not everything fits

Many specified things cannot be reduced to simple patterns

- The quick brown fox jumps over the lazy dog
- Building designs

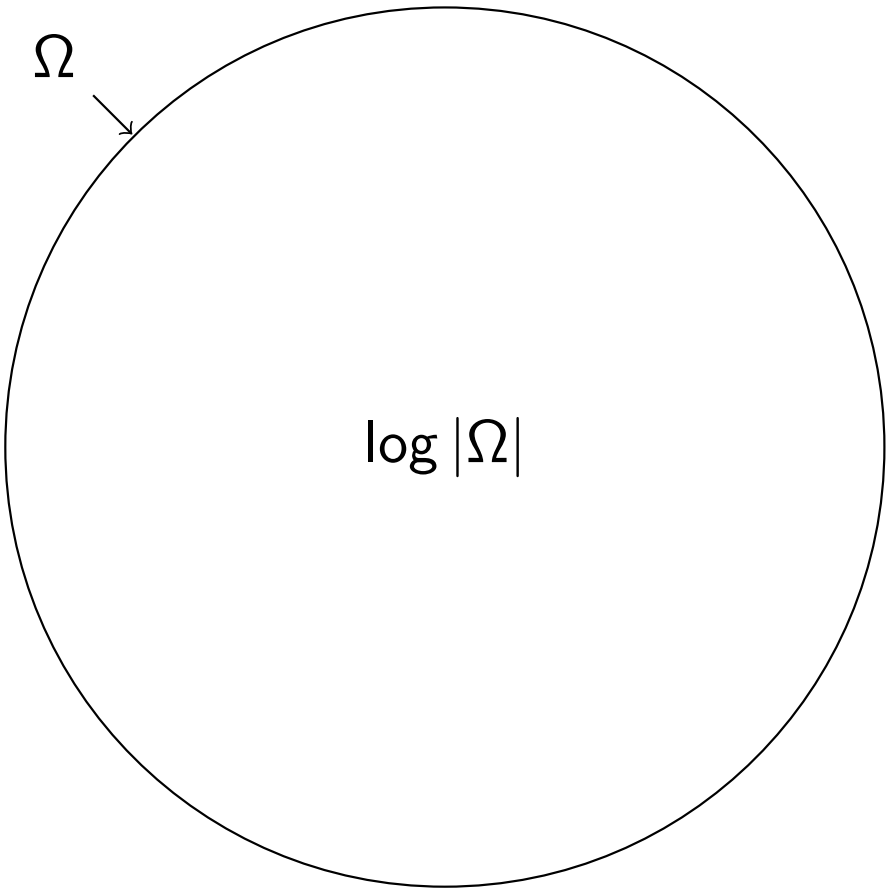


Context

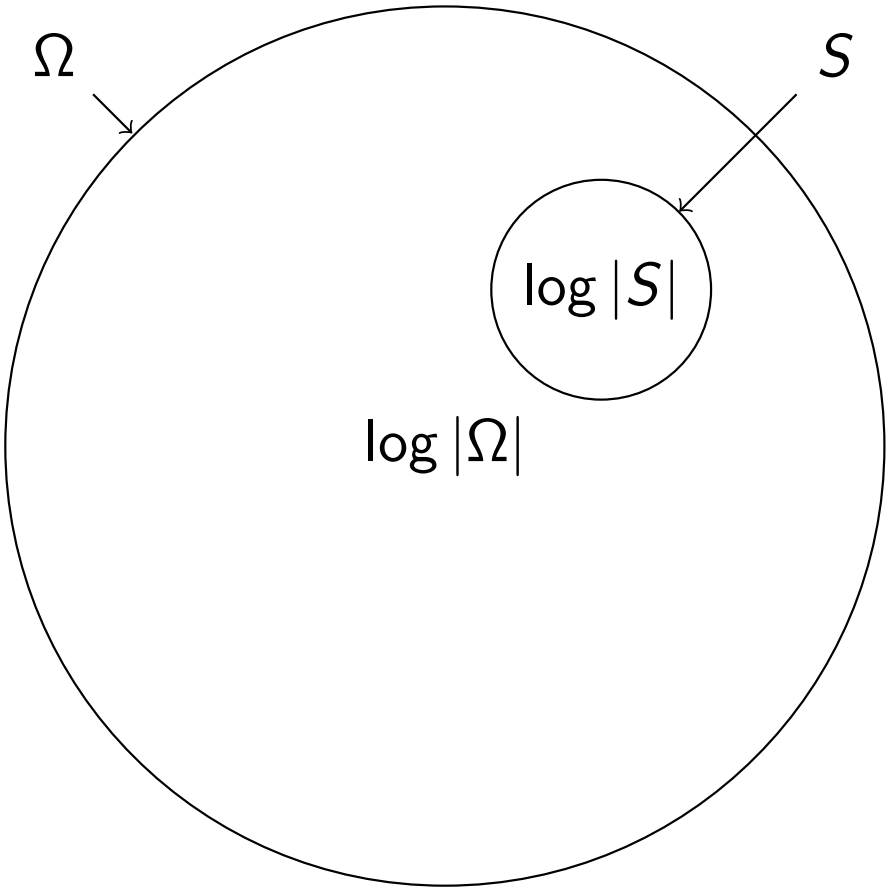
Conditional Kolmogorov Complexity has an input context, it can use it to derive the answers

- We are not restricted to simple patterns
- Anything you can describe using the context is fair game

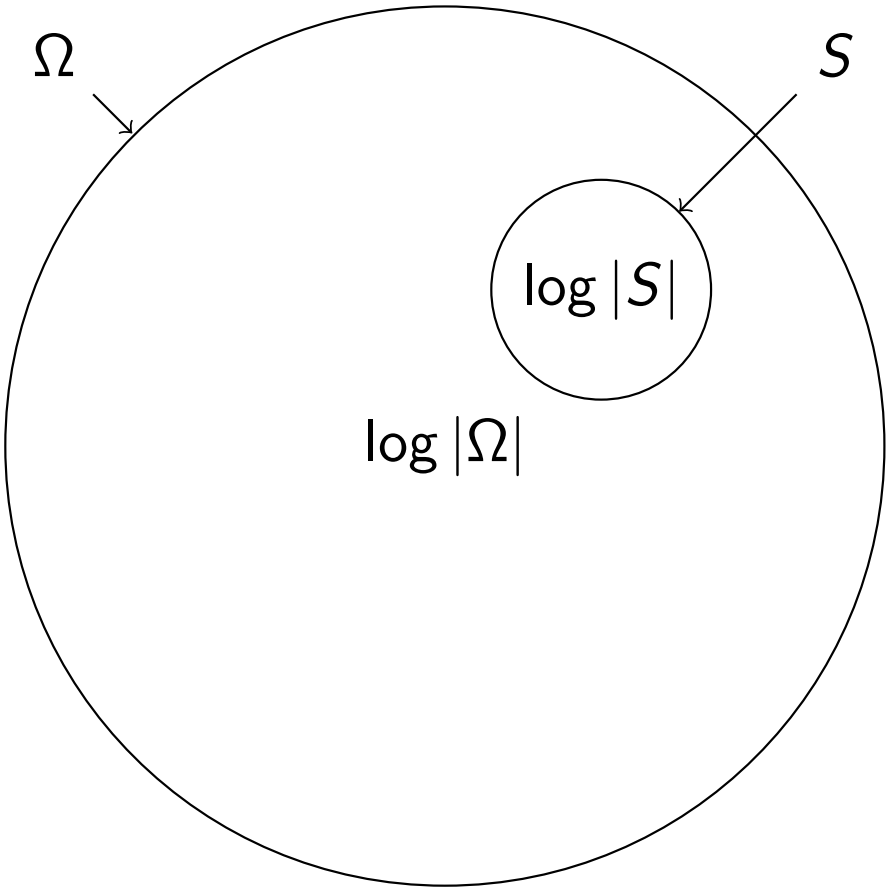
How It Works



How It Works

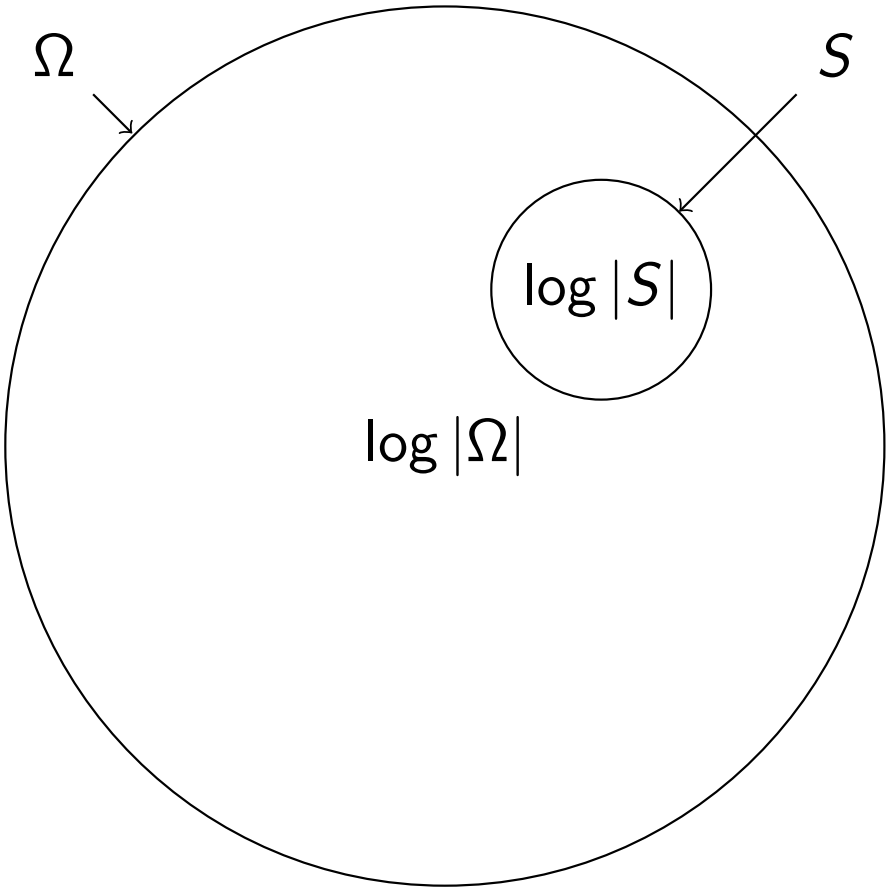


How It Works



- Valid English
- Royal Flush
- Folding Protien
- Functional Motor

How It Works



- Valid English
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$$K(S) + \log |S| \qquad (1)$$

Putting them together

$$ASC = -\log p(X) - K(X|C) \tag{2}$$

- X is the item we are investigating
- p is the probability distribution
- C is the context
- K is the kolmogorov complexity
- Algorithmic Specified Complexity

English Text

The quick brown fox jumps over the lazy dog

Encoding Length	$43 * 32 = 1376$ bits in UTF-32
Context	English Alphabet
Compressed Length	$43 * \log_2(27) = 204.45 + c$
Probability Distribution	Uniform over sequences of 1376 bits
Complexity	1376 bits
ASC	$1171.55 - c$

English Text

The quick brown fox jumps over the lazy dog

Encoding Length	$43 * 32 = 1376$ bits in UTF-32
Context	English Alphabet
Compressed Length	$43 * \log_2(27) = 204.45 + c$
Probability Distribution	Uniform over english letters
Complexity	$-\log_2(27^{-43}) = 204.45$ bits
ASC	$-c$

English Text

The quick brown fox jumps over the lazy dog

Encoding Length	$43 * 32 = 1376$ bits in UTF-32
Context	Oxford English Dictionary: 414,800 words
Compressed Length	$9 * \log_2(414800) = 167.96 + c$
Probability Distribution	Uniform over english letters
Complexity	$-\log_2(27^{-43}) = 204.45$ bits
ASC	$36.49 - c$

Uniform Random Noise

Random data, generated by a fair coin flipped 1000 times

Encoding Length	1000 bits
Context	None
Compressed Length	$1000 + c$ bits
Probability Distribution	Uniform over all bits
Complexity	1000 bits
ASC	$-c$

Biased Coin

Random data, generated by a biased coin flipped 1000 times. The coin lands heads 2/3 of the time

Encoding Length	1000 bits
Context	None
Compressed Length	$918.3 + c$ bits
Probability Distribution	Uniform over all bits
Complexity	1000 bits
ASC	$81.7 - c$

Biased Coin

Random data, generated by a biased coin flipped 1000 times. The coin lands heads 2/3 of the time

Encoding Length	1000 bits
Context	None
Compressed Length	$918.3 + c$ bits
Probability Distribution	Biased coin distribution
Complexity	918.3 bits
ASC	$-c$

Poker Hands

Name	Count	Complexity	Compressed	ASC
Royal Flush	4	21.310	5.322	15.988
Straight Flush	36	21.310	8.492	12.818
Four of a Kind	624	21.310	12.607	8.702
Full House	3744	21.310	15.192	6.117
Flush	5108	21.310	15.640	5.669
Straight	10200	21.310	16.638	4.671
Three of Kind	54912	21.310	19.067	2.243
Two pair	123552	21.310	20.237	1.073
One pair	1098240	21.310	21.310	0.000
None	1302540	21.310	21.310	0.000

Repeating Poker Hands

Number	Complexity	Compressed	ASC
1	21.310	5.322	15.988
2	42.619	7.322	35.297
3	63.929	9.322	54.607
4	85.238	11.322	73.916
5	106.548	13.322	93.226
6	127.857	15.322	112.535
7	149.167	17.322	131.845
8	170.476	19.322	151.154
9	191.786	21.322	170.464

Folding Proteins

1 in 10^{64} protiens succesfully fold

Encoding Length	$2 * 500 = 1000$ bits
Context	Laws of Physics
Compressed Length	$787.4 + c$ bits
Probability Distribution	Uniform random bases
Complexity	1000 bits
ASC	$212.6 - c$

Functional Sequence Complexity

Functional Sequence Complexity by Durston et al is a special case.

- Complexity = Null State (Bits)
- Specification = log Number of sequences
- ASC = FSC

Usher	1,296
Paramyx RNA Pol	1,886
ACR Tran	1,650

Law Like Processes

Processes that are law-like have low Kolmogrov complexity

- Sometimes we know the distribution
- Real world is not very algorithmic
- Context may differ
- Time matters in the real world

Context is arbitrary

The context is arbitrary, you can make anything specified by providing the context

- That is how information works
- Only use contexts independent of object being investigated

It cannot be computed

Its impossible to actually compute any values

- Corresponds to the inability to detect design mechanically
- Theoretical underpinning

Conclusion

- Design is inferred by complexity and specification
- Specification can be measured by Conditional Kolmogorov Complexity