

Information Transformation

An underpinning theory for software testing

In this talk

What is Information Theory and what can we do with it?

Example problems in software testing

The Theory of Information

Some examples in detail

What is Information Theory?

And what can we do with it?

Measure information

(but in a negative way)

ignorance

variation

uncertainty

randomness

entropy

Two flavours

randomness of random variables (sets)

- variable values

- program inputs and outputs

- software corpora

- test sets

randomness of strings (objects)

- programs

- program inputs and outputs

- test sets

What can we do with it?

model flows of information

e.g. communication channels, software

measure similarity between objects

e.g. programs, data, specifications

optimise search

e.g. program inputs, program gadgets

Problems in software testing

- Test set selection
- Test input generation
- Test set prioritisation
- Test oracle placement

Test set selection

Diversity

- Diversity = variation = randomness = maximum information

Effectiveness

- Effectiveness = no false negatives = no loss of information

Test set generation

Efficiency

paths generate tests

- infeasible path = no information at end
- measure degree of infeasibility

compare efficiency of generation methods

- rate of reduction of information about failing tests

Test set prioritisation

Prioritisation

- rate of reduction of information about location of errors

Oracle placement

Measure how difficult programs are to test

- loss of information through program execution

Difficult programs need internal oracles

- internal oracles = reduce loss of information

Optimise oracle placement = minimise loss of information