Exploring the Fitness Landscape using Spatial Analysis

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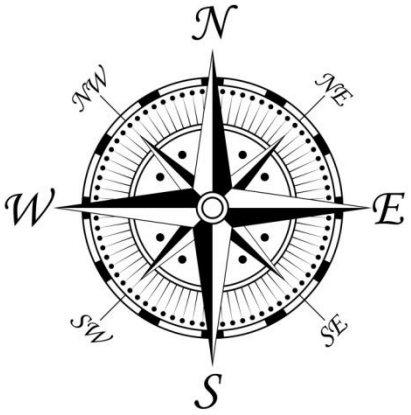
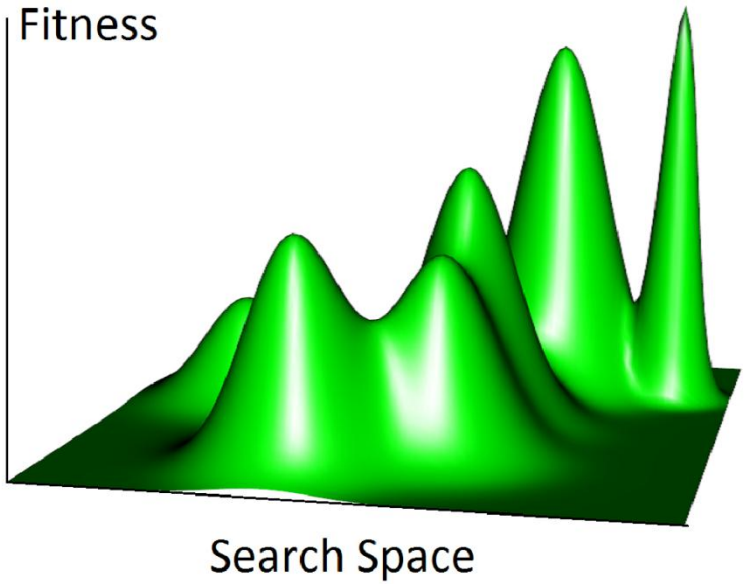
Outline

- Fitness landscape analysis
- Spatial metrics
- Case study
- Specific examples
- Conclusions





Fitness Landscape Analysis

Understanding the relationships between the **problem space**, the suitability of each potential **solution** and the performance of the optimisation **algorithm**

Why should we care?

1) How hard is the problem?

2) How good is my technique?

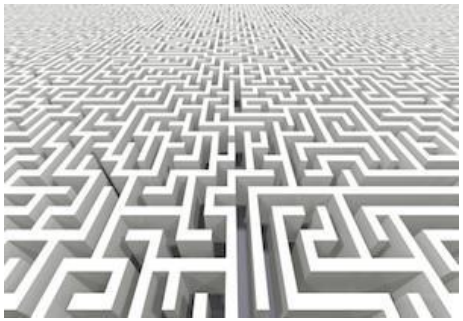
3) Which technique is best?

4) Can we tune it further?

Spatial Metrics

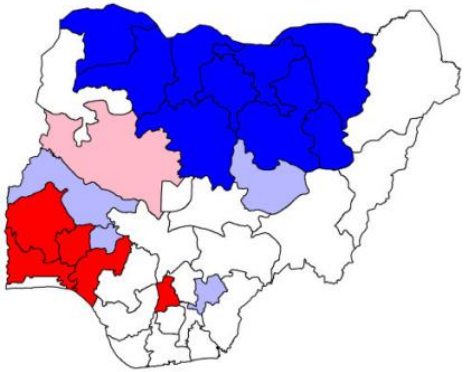
- Composition

- Complexity



- Connectivity

- Autocorrelation



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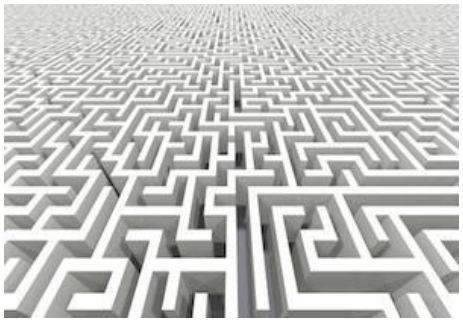

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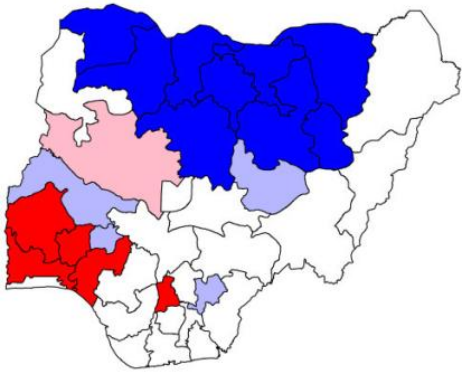
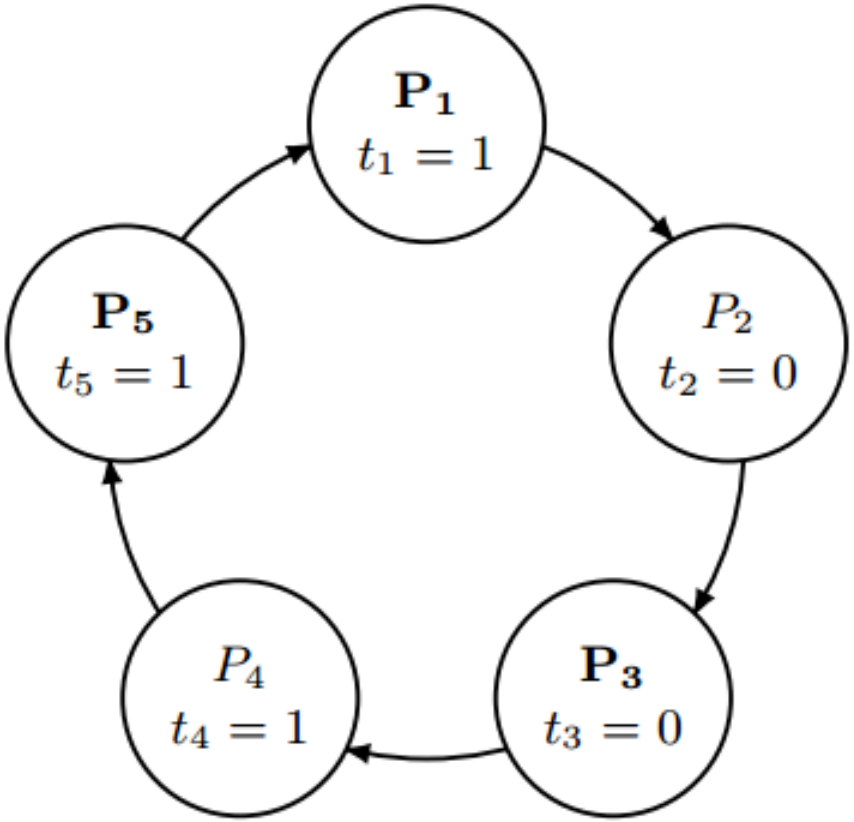


Cases Study: Token Passing



Millard et al. “Searching for Pareto-optimal Randomised Algorithms”

Best Paper Prize SSBSE 2012

Autocorrelation

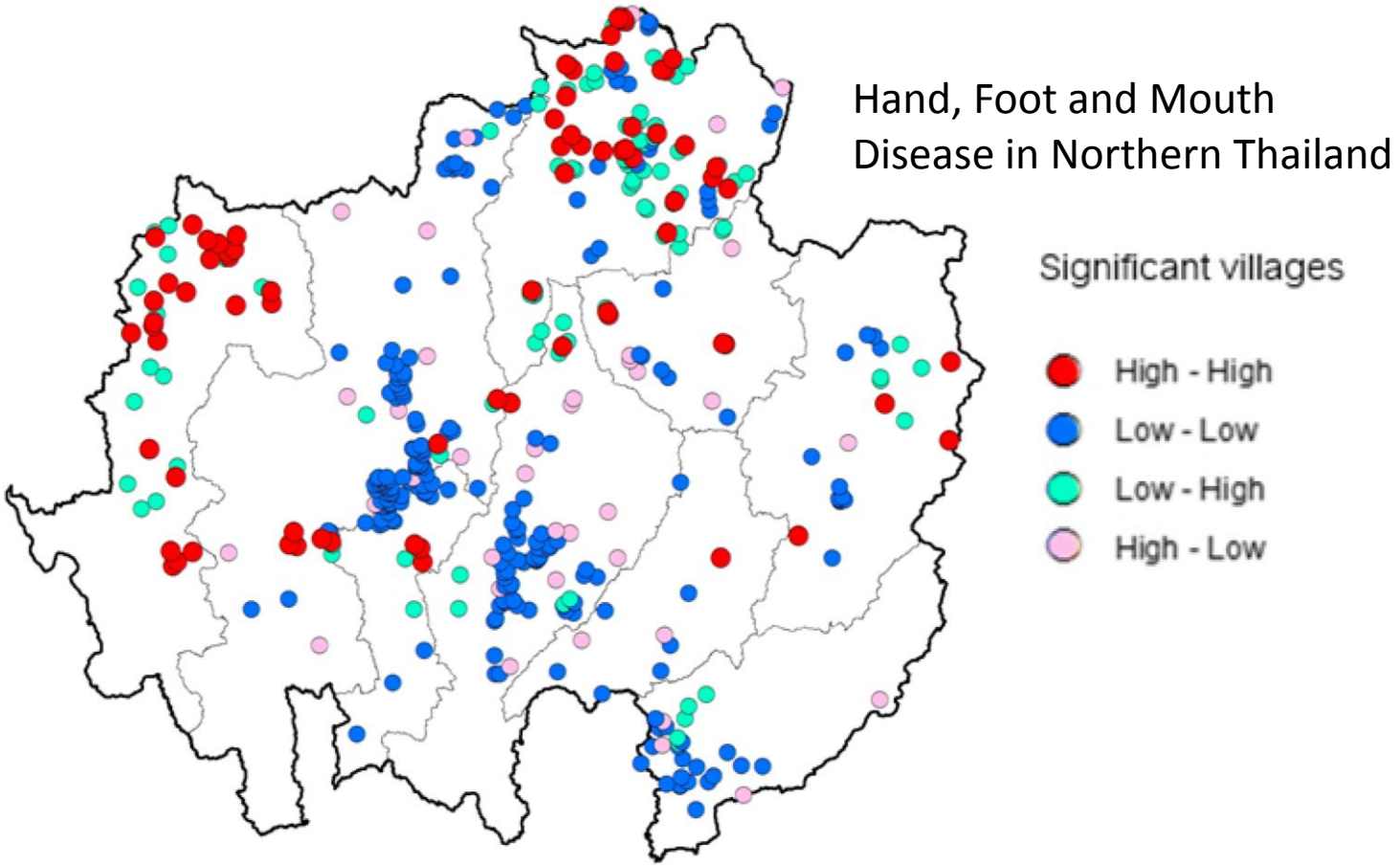
Getis & Ord

$$G_i^* = \frac{\sum_j w_{ij} z_j}{\sum_j z_j}$$

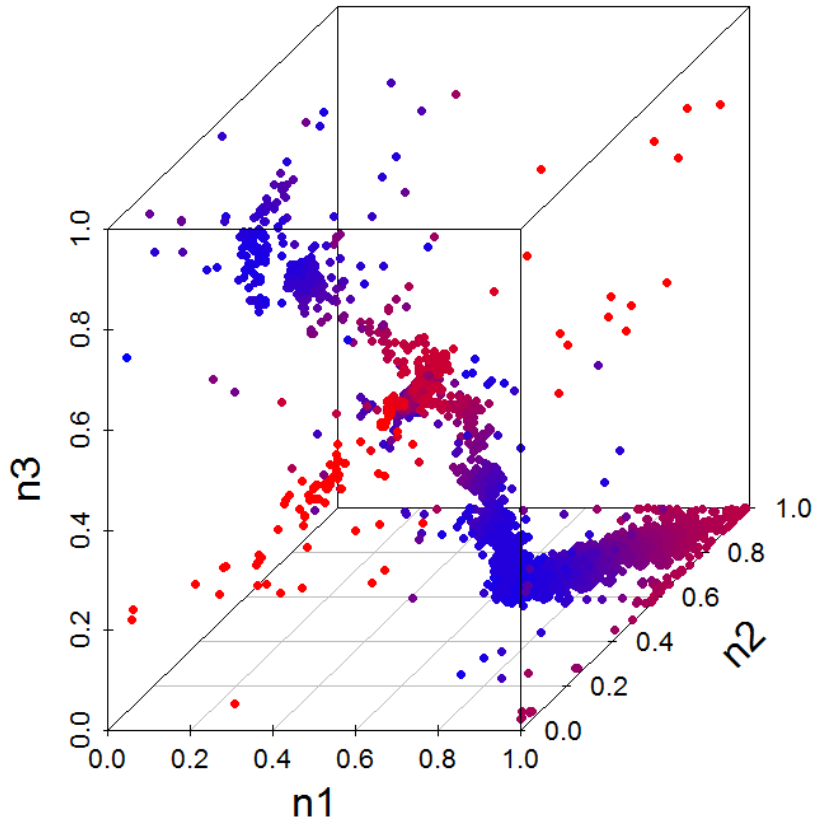
Moran

$$I_i = \frac{n z_i \sum_j w_{ij} z_j}{z_i^2}$$

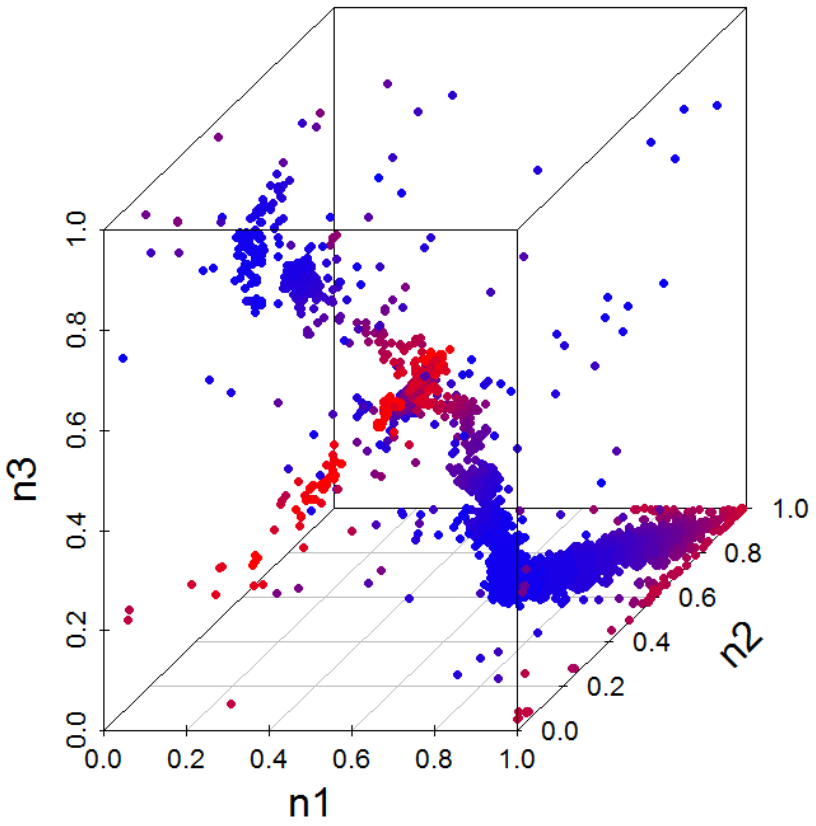
Autocorrelation for Spatial Landscapes



Moran's I for Fitness Landscapes



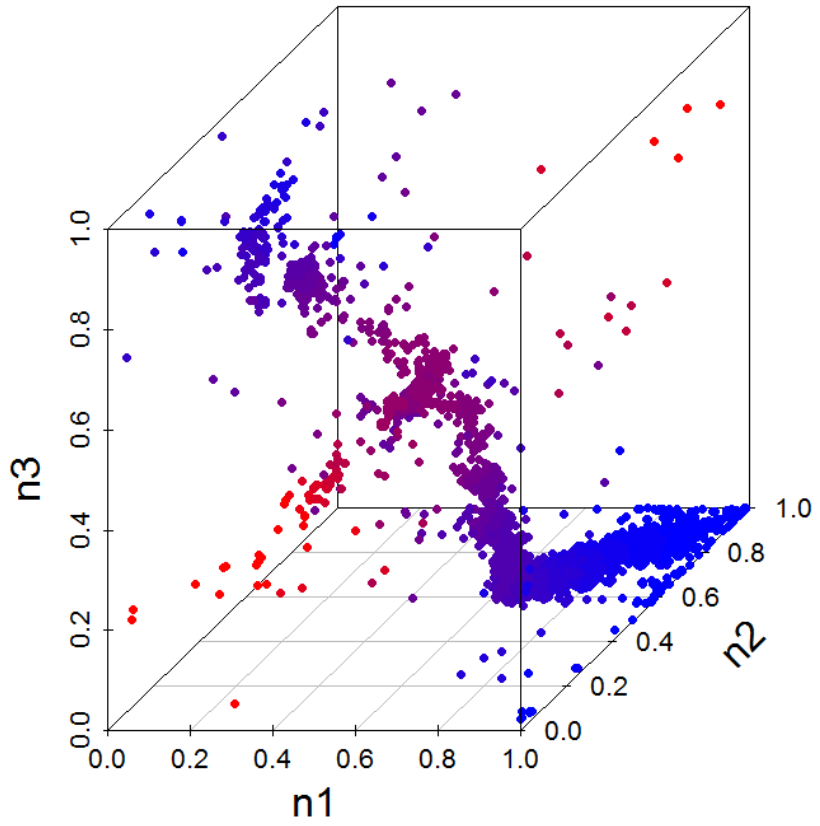
Stabilisation Time



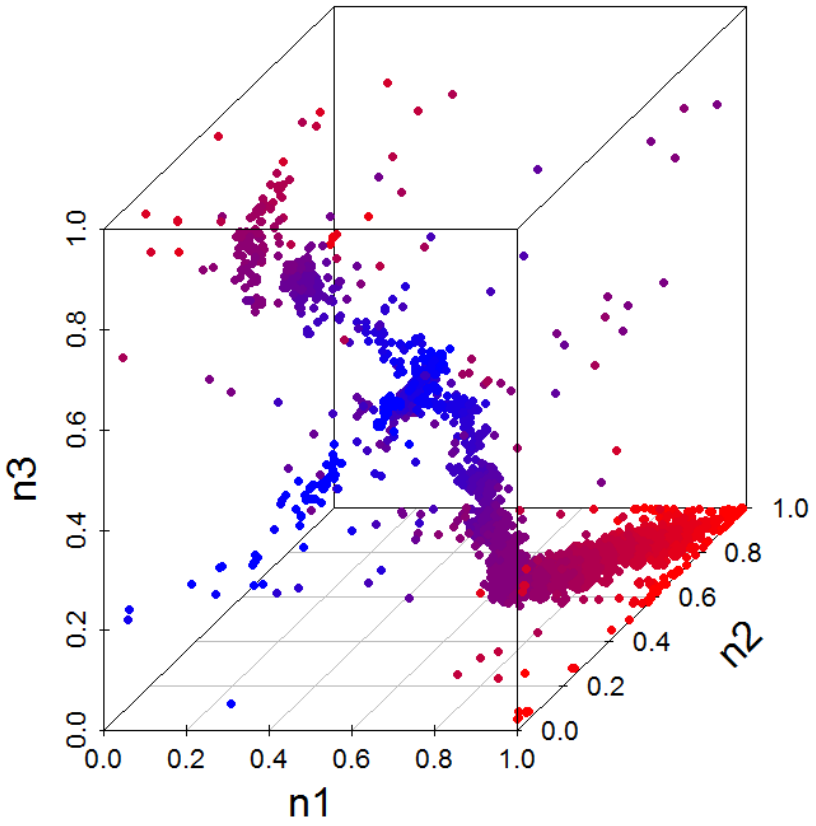
Fairness

Red indicates strong autocorrelation, **blue** indicates weak autocorrelation

Getis' G_i^* for Fitness Landscapes



Stabilisation Time

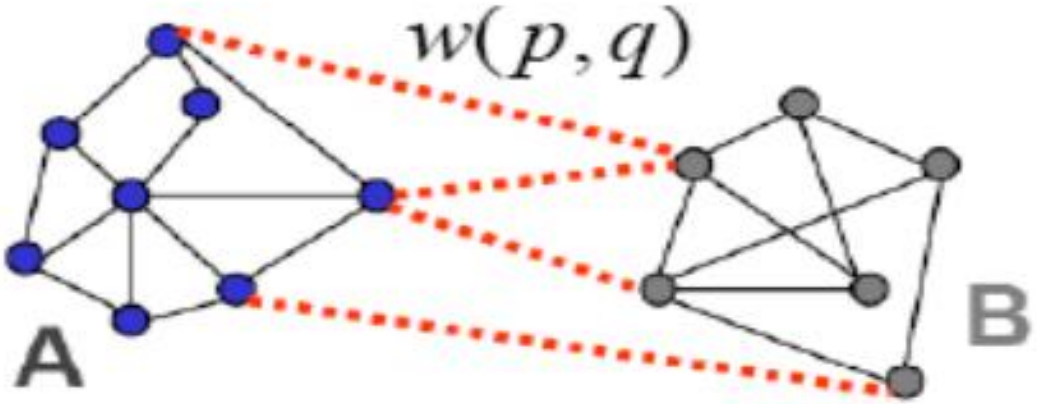


Fairness

Red indicates less fit solutions, **blue** indicates more fit solutions

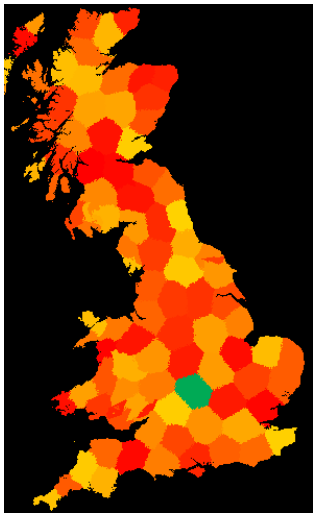
Connectivity

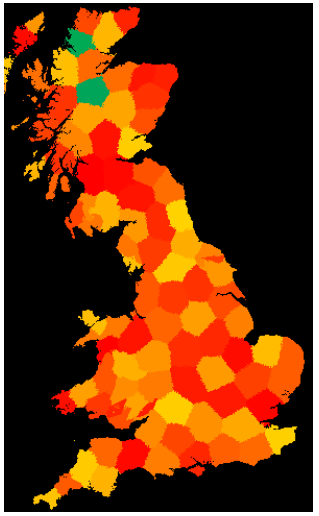
- The cost of a graph cut can be calculated from the sum of weights between segments

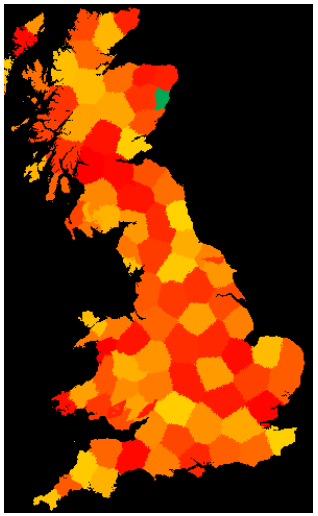


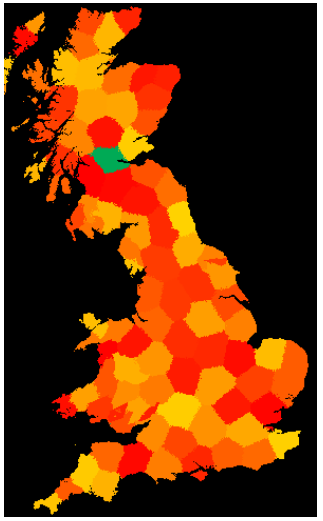
$$cut\,(A,B) = \sum_{p \in A, q \in B} w(p,q)$$

Graph Cuts for Spatial Landscapes

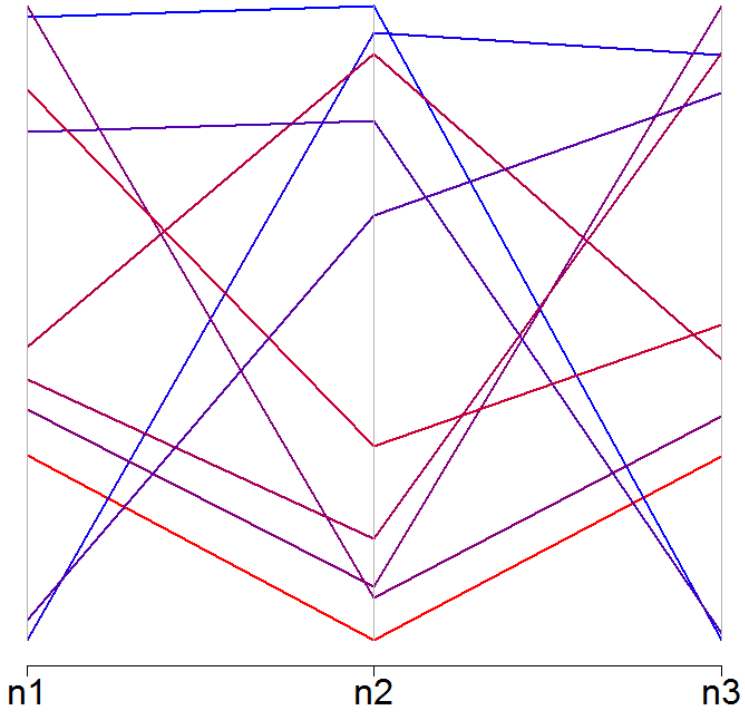




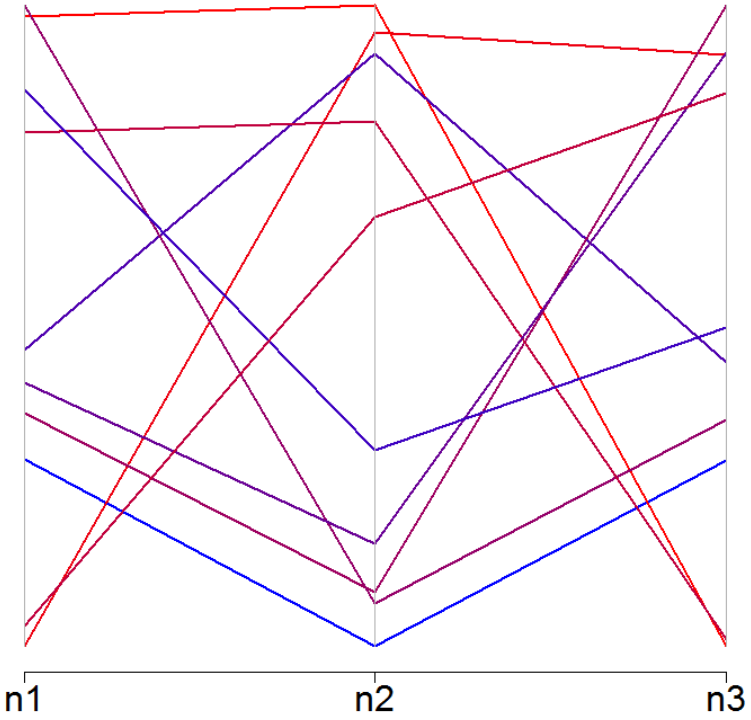




Graph Cuts for Fitness Landscapes



Stabilisation Time



Fairness

Conclusions

- Fitness landscape analysis helps us understand the problem and optimisation technique
- Spatial analysis techniques can be used to analyse fitness as well as spatial landscapes
- There are many more techniques to explore!

ANY QUESTIONS?