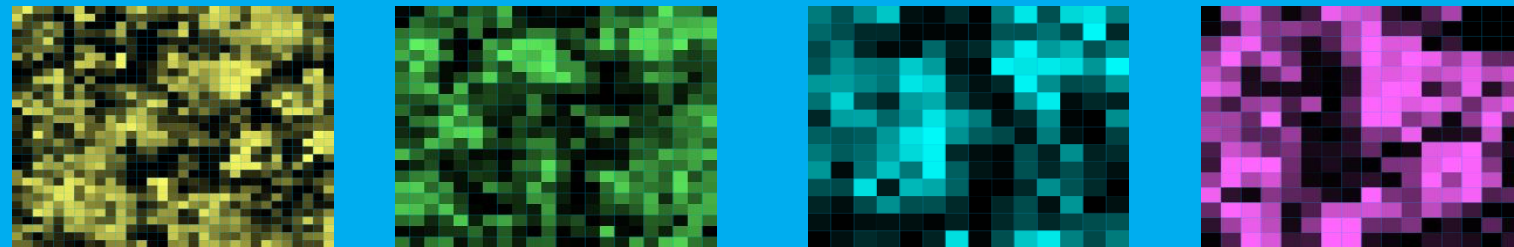# The Characteristic Direction: A Geometrical Approach to Differential Expression – Part One

Network Analysis in Systems Biology

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Overview

▸ The challenges of differential expression analysis
  – These are more than just technicalities
  – These are **very important** – solving them is crucial for inferring **biology** from genome-wide profiling
▸ Our new approach
▸ Validation using independent ChIP-Seq data
  – Compare to other approaches
▸ An new formulation of GSEA
  – Biological processes in breast cancer

Some of the Challenges of Differential Expression Analysis

▸ Genes do not function in isolation but as part of a complex network

– Univariate differentially expressed genes

– Multivariate differential expression

▸ There are always more genes than microarrays

– The curse of dimensionality
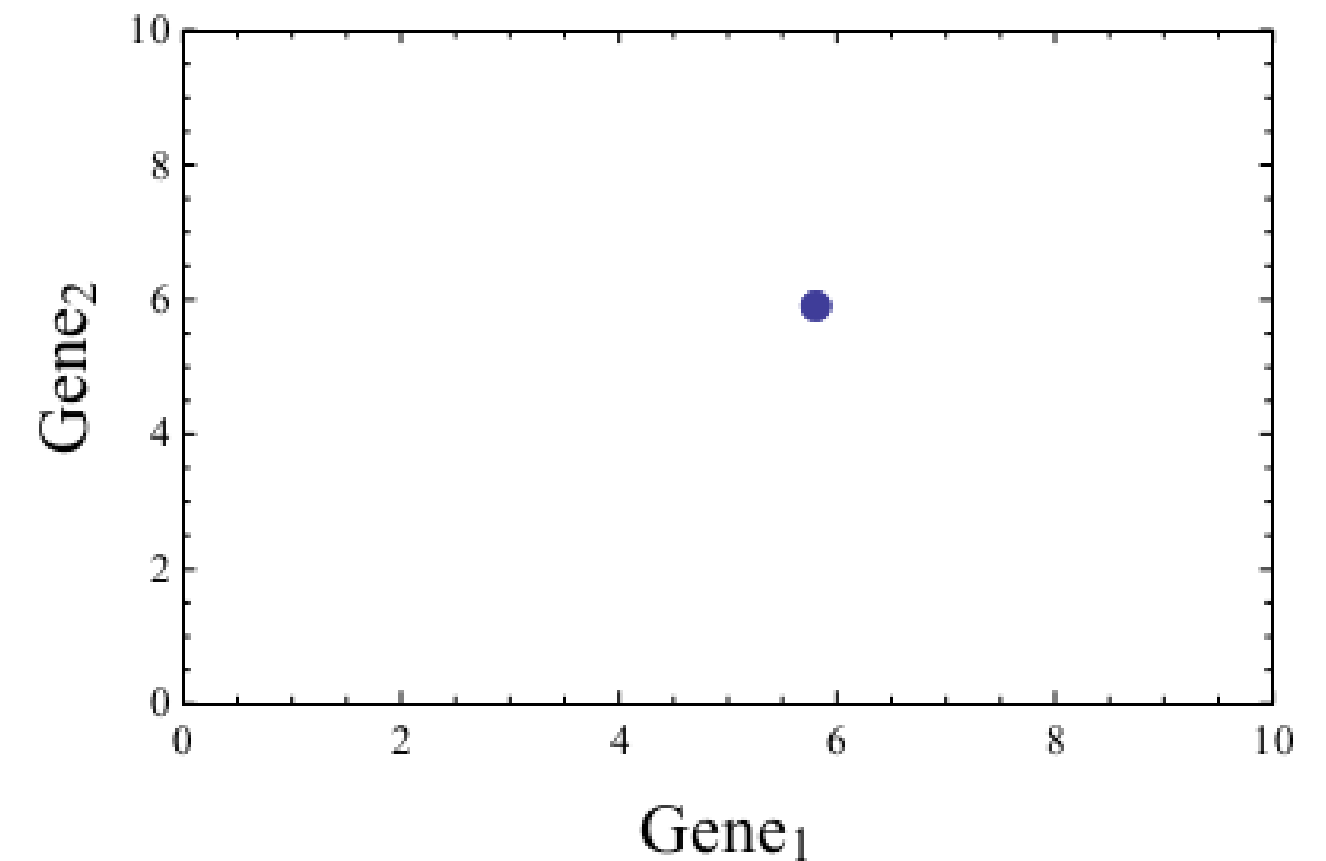
Multivariate vs. Univariate Approaches

► Genes do not function in isolation but as part of a complex network of interactions

  – This leads to significant correlations

► Univariate approaches can miss some structure in the data

► Multivariate approaches are sensitive to the curse of dimensionality
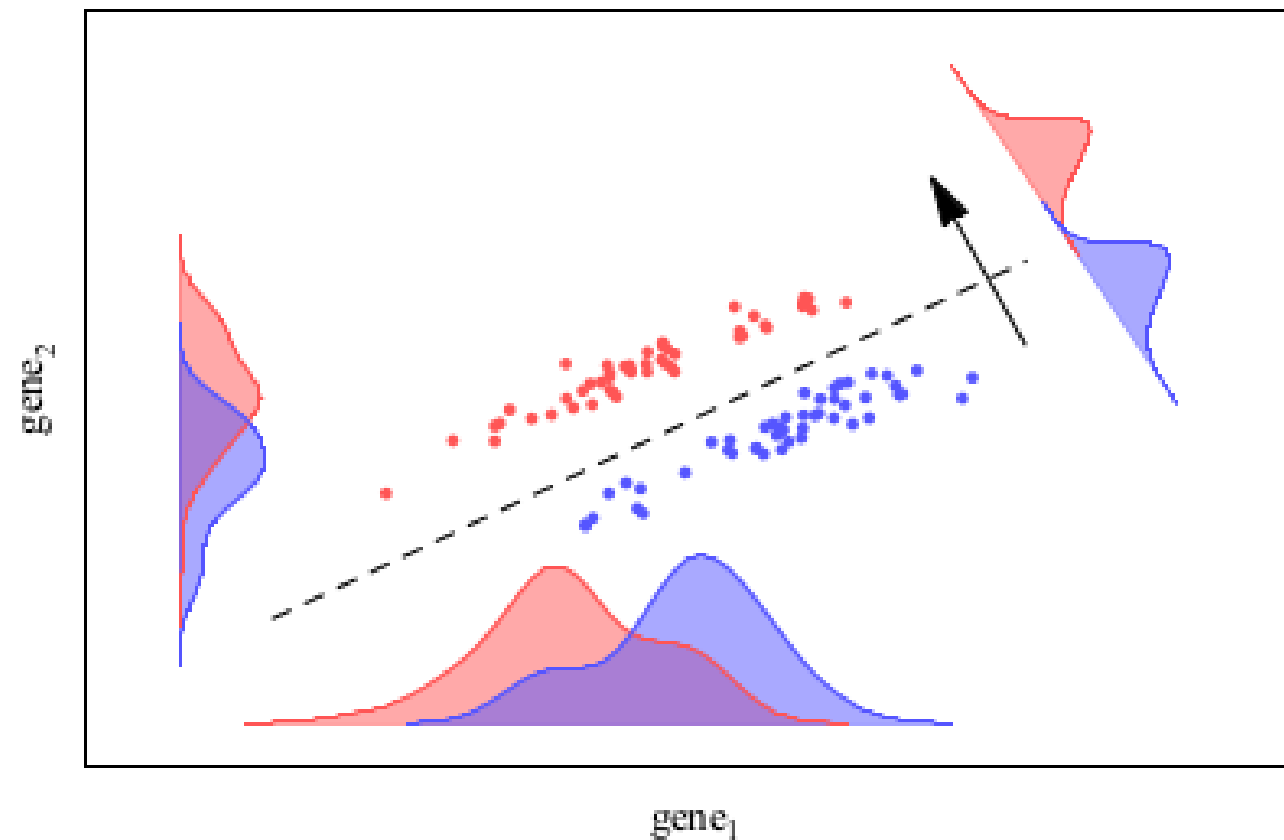
References

- Clark *et al.*: The characteristic direction: a geometrical approach to identify differentially expressed genes. BMC Bioinformatics 2014 15:79.
  - http://www.biomedcentral.com/1471-2105/15/79/abstract

- http://www.maayanlab.net/CD/

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