

Bioinformatics CSM17

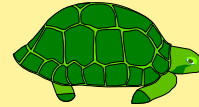
Week 4: Evolutionary systems

- Evolution and phylogeny
- Historical systems
- Modern methods
- Tools and software

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Evolution and phylogeny

- definition of terms
- what is phylogeny?
- what is evolution?



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Historical systems

- Charles Darwin
- Cronquist (plants)
- Mostly phenotypic characters



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Historical systems

- Charles Darwin
- The voyage of the Beagle
- The Galapagos Islands
- *The Origin of Species* (1859)



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Modern methods

- Cladistics
- Willi Hennig (1950, 1966)
- Phylogenetic systematics

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Cladistics principles

- clades
- convergence (homoplasy)
- parallelism
- apomorphy and synapomorphy
- plesiomorphy and symplesiomorphy

- has 4 main Axioms (assumptions, premises)

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Cladistics axiom #1

- Nature's hierarchy can be represented by a branching diagram
- Cladograms
- Monophyly

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Cladistics axiom #2

- Characters change status at different hierarchical levels. Those present in all members of the group, or have a wider distribution than the group cannot indicate relationships within the group
- Outgroup(s)

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Cladistics axiom #3

- Character congruence is the decisive criterion for distinguishing homology from non-homology

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Cladistics axiom #4

- The principle of parsimony maximises character congruence
- Occam's Razor - the simplest is best

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Cladistics terms

- apomorphy (advanced, derived)
- synapomorphy (shared and advanced)
- plesiomorphy (primitive, ancestral)
- symplesiomorphy (shared and ancestral)

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Tools and software

- HENNIG86 (Farris, 1988)
- PAUP (Swofford, 1983)
- PHYLIP (Felsenstein, 1985)
- MacClade (Maddison & Maddison, 1987)

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HENNIG86

- The first!
- Willi Hennig
- Characters polarised before cladogram construction



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PAUP

(Phylogenetic Analysis Using Parsimony)

- Swofford (1983)
- widely used on Mac
- also available for PC (Beta test version)
- costs money...

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PHYLIP

- by Joe Felsenstein (Univ. Washington)
- produced in 1985
- for a number of platforms (incl. PC)
- FREE! (by download)

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PARS

- A *Parsimony* method
- Wagner parsimony

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Useful Websites

- PHYLIP
<http://evolution.genetics.washington.edu/phylip.html>
- PAUP
<http://paup.csit.fsu.edu/>
- HENNIG Society:
<http://www.cladistics.org/education.html>
- TREE OF LIFE
<http://tolweb.org/tree/phylogeny.html>

References & Bibliography

- Krane, D.E. & Raymer, M.L. (2003) *Fundamental concepts of bioinformatics*. Benjamin Cummings Publishers, San Francisco, USA. ISBN 0-8053-4633-3 (paperback) [Chapter 5](#).
- Kitching, I. J. *et al.* (1998) *Cladistics - the theory and practice of parsimony analysis*. Systematics Association Publication No. 11. Oxford University Press, UK. ISBN 0-19-850138 (paperback)
- Skelton, P. & Smith, A (2002). *Cladistics – a practical primer on CD-ROM*. Cambridge University Press, UK. ISBN 0-521-52341 (hardback + CD-ROM)
- Pankhurst, R. J. (1991) *Practical Taxonomic Computing*. Cambridge University Press, UK. pp. 68-87. ISBN 0-521-41760-0 (hardback)
- Lewin, R. (1999). *Patterns in Evolution*. Scientific American Library, New York
- Gee, H. (2000) *Deep Time - cladistics, the revolution in evolution*. Fourth Estate Ltd., London, UK.
- Gibas, C. & Jambeck, P. (2001). *Developing bioinformatics computer skills*. O'Reilly, USA. pp. 199-205. ISBN 1-56592-664-1 (paperback)

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