Introduction to Phylogenetic Analysis

Tuesday 24 – Wednesday 25 July, 2012

School of Biological Sciences

Overview

This free workshop provides an introduction to phylogenetic analysis, with a focus on the Bayesian methods and models implemented in the software *BEAST*. The workshop is run by the *Molecular Ecology, Evolution, and Phylogenetics* (MEEP) lab and is hosted by the School of Biological Sciences, University of Sydney.

Lectures

The workshop will include 6 lectures given over 2 days. The first day will include introductory lectures on phylogenetic analysis, sequence alignment, maximum likelihood, and Bayesian methods. The second day will include advanced lectures on Bayesian phylogenetic analysis, including estimating timescales, demographic reconstruction, and species trees.

Practical

Practical sessions will be held on both days of the workshop. They will involve basic analyses of a prepared data sets using desktop PCs, but participants are encouraged to bring their own laptops. We will be using free software that can be installed on PC, Mac, and UNIX platforms.

Location

The workshop will be held in the School of Biological Sciences at the University of Sydney. Lectures will be held in the DT Anderson Lecture in the Heydon-Laurence Building (A08). Practical classes will be held in the Robert Brown Laboratory in the Macleay Building (A12). Both of these buildings are adjacent to Parramatta Rd and are within reasonable walking distance (20-25 minutes) or a short bus ride from Central Station. Please refer to the campus map at the end of this programme.

Tuesday 24 July: Introductory topics

9.30 – 9.35 **Welcome**
Simon Ho

9.35 – 10.00 **Introduction to Phylogenetic Analysis**
Nathan Lo

- Introduction to phylogenetic analysis
- DNA sequence alignment

10.15 – 11.00 **Phylogenetic Methods**
Nathan Lo

- Maximum parsimony
- Distance-based methods
- Maximum likelihood
- Evolutionary models

11.15 – 12.00 **Bayesian Phylogenetic Analysis**
Simon Ho

- The Bayesian paradigm
- Markov chain Monte Carlo sampling
- Advantages and disadvantages

13.00 – 17.00 **Practical: The evolution of ratite birds**
Simon Ho, Martyna Molak, & Sebastián Duchêne

Wednesday 25 July: Advanced topics

9.30 – 10.15 **Bayesian Phylogenetics: Rates and Timescales**
Simon Ho

- The molecular clock
- Relaxed molecular clocks
- Calibrating the molecular clock

10.30 – 11.15 **Bayesian Phylogenetics: Analysing Populations**
Simon Ho

- Interspecific *vs* intraspecific data
- Coalescent theory
- Skyline-plot methods
- Bayesian phylogeography

11.30 – 12.00 **Bayesian Phylogenetics: Gene Trees and Species Trees**
Simon Ho

- Inferring species trees from gene trees
- Bayesian inference of species trees

13.00 – 17.00 **Practical: A mysterious hominin from Siberia**
Simon Ho, Martyna Molak, & Sebastián Duchêne

Optional post-workshop practical

Practical: The extinction of the cave bear

Useful references

Introductory books

- *The Phylogenetic Handbook*
  Lemey, Salemi, & Vandamme (2009) Cambridge University Press.
- *Reading the Story in DNA*
  Bromham (2008) Oxford University Press.
- *Inferring Phylogenies*
  Felsenstein (2003) Sinauer Associates.
- *Molecular Evolution: A Phylogenetic Approach*
  Page & Holmes (1998) Wiley-Blackwell.

Bayesian phylogenetic analysis

- *Bayesian inference of phylogeny: a non-technical primer*
  Archibald, Mort, & Crawford (2003) Taxon 52: 187-191.
- *BEAST: Bayesian evolutionary analysis by sampling trees*
  Drummond & Rambaut (2007) *BMC Evol Biol* 7: 214.

Molecular clocks and calibrations

- *The modern molecular clock*
  Bromham & Penny (2003) *Nature Rev Genet* 4: 216-224.
- *Relaxed phylogenetics and dating with confidence*
  Drummond, Ho, Phillips, & Rambaut (2006) *PLoS Biol* 4: e88.
- *Accounting for calibration uncertainty in phylogenetic estimation of evolutionary divergence times*
  Ho & Phillips (2009) *Syst Biol* 58: 367-380.

Demographic reconstruction

- *Skyline-plot methods for estimating demographic history from nucleotide sequences*
  Ho & Shapiro (2011) *Mol Ecol Res* 11: 423-434.
- *Bayesian inference of population size from multiple loci*
  Heled & Drummond (2008) *BMC Evol Biol* 8: 289.
- *Bayesian coalescent inference of past population dynamics from molecular sequences*
  Drummond, Rambaut, Shapiro, & Pybus (2005) *Mol Biol Evol* 22: 1185-1192.

Gene trees and species trees

- *Gene tree discordance, phylogenetic inference and the multispecies coalescent*
  Degnan & Rosenberg (2009) *Trends Ecol Evol* 24: 332-340.

During the workshop

Places to eat

On campus

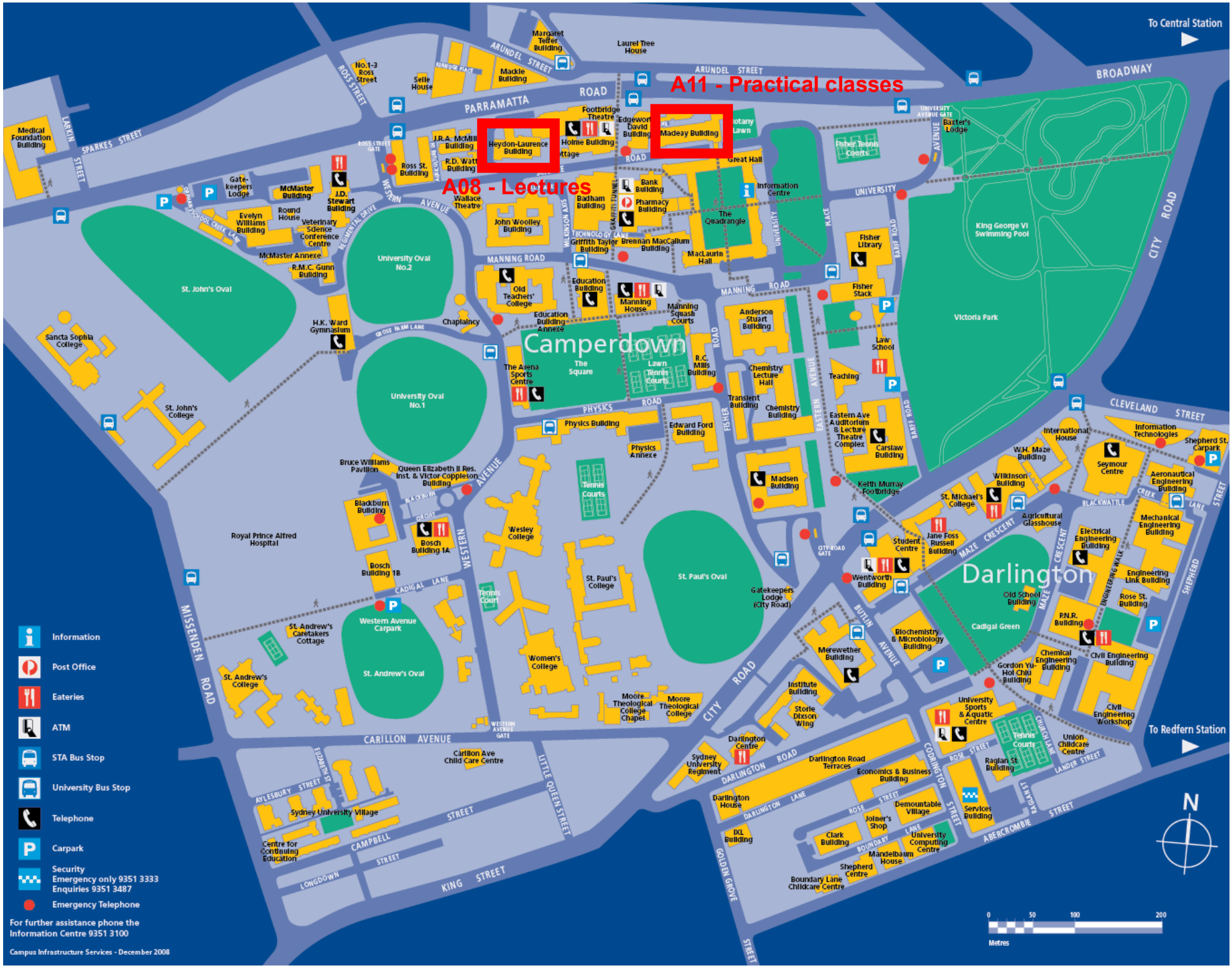
- Courtyard Café (Holme Building)
- Taste (New Law Building)
- Various food outlets (Manning Building)

Near campus

- Uni Thai (Broadway)
- Clipper Café (Glebe Point Rd)
- La Banette Patisserie (Glebe Point Rd)
- Various Japanese, Chinese, SE Asian (Broadway, Glebe Point Rd)
- Little Devil Bakery (Broadway)
- Food court (Broadway Shopping Centre)

Things to do on campus

- **Macleay Museum**
  The Macleay Museum had its origins in the collection of insects begun by Alexander Macleay in the late eighteenth century. It has developed into an extraordinary collection of natural history specimens, ethnographic artifacts, scientific instruments and historic photographs. Admission is free. Open 10-4.30 Monday-Friday.
- **Nicholson Museum**
  The Nicholson Museum contains the largest and most prestigious collection of antiquities in Australia. It is also the country's oldest university museum, and features masterpieces of ancient art and objects of daily life from Egypt, the Middle East, Greece, Rome, Cyprus and Mesopotamia. Admission is free. Open 10-4.30 Monday-Friday.
- **University Art Gallery**
  Founded in the 1860s, the University of Sydney Art Collection now holds more than 3,000 paintings, sculptures and works on paper by Australian, Asian and European artists. The University Art Gallery showcases changing exhibitions of works from the collection as well as high quality exhibitions of both contemporary and historical works. Admission is free. Open 10-4.30 Monday-Friday.


A11 - Practical classes
A08 - Lectures
Heydon-Laurence Building
Madeay Building
Camperdown
Darlington
To Central Station
To Redfern Station
Information
Post Office
Eateries
ATM
STA Bus Stop
University Bus Stop
Telephone
Carpark
Security
Emergency only 9351 3333
Enquiries 9351 3487
Emergency Telephone
For further assistance phone the Information Centre 9351 3100
Campus Infrastructure Services - December 2008
Metres