UNIVERSITY OF GOTHENBURG

FACULTY OF SCIENCE

# BIO404, Advanced phylogenetics, 10,0 higher education credits

Avancerad fylogeni, 10.0 högskolepoäng

*Second Cycle*

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## 1. Confirmation

The course syllabus was confirmed by Faculty of Science on 2011-11-05 to be valid from 2012-07-01.

*Field of education:* Science 100 %
*Department:* Dep of Plant and Environmental Sciences

## 2. Position in the educational system

The course is given within NABiS - Masters in Biodiversity and Systematics but is also available as a standalone course.
Advanced

| *Main field of studies* | *Specialization* |
|---|---|
| Biology | A1F, Second cycle, has second-cycle course/s as entry requirements |

## 3. Entry requirements

1BG393 *Fundamental and molecularsystematics* (Uppsala university) within the programme NABiS - Masters in Biodiversity and Systematics or equivalent.

## 4. Course content

This course serves as an important foundation for careers that use and analyse biodiversity information, especially in research. The general topic of the course is the inference of gene and species phylogenies using DNA sequences.

This course consists of two parts: the first is a series of lectures and computer exercises, most or all of which will be delivered online. Part 1 of the course covers the following topics: (the exact topics may vary slightly from year to year as the field changes)

**(a) Model-based phylogenetic inference**, including:

- distance, maximum likelihood and Bayesian analysis
- model choice issues
- strengths and weaknesses of various methods
- troubleshooting Bayesian analyses

**(b) Incongruence and gene tree / species tree issues**, including:
- handling multiple alleles and gene copies in phylogeny
- coalescent theory and its application to lineage sorting
- the multi-species coalescent in practice
- handling hybridisation and paralogy in phylogeny
- recombination testing
- phylogenetic network analysis
- concatenation versus alternative approaches

**(c) Other topics**, that may include:
- DNA taxonomy (species discovery and delimitation)
- advanced alignment methods (event-based manual alignment, structural-based alignment)
- introduction to genomic tools for systematics
- confidence and support of phylogenetic hypotheses

The second part is a small research project using data supplied by the course leader, where each student will apply some of the methods learnt in the first part of the course to address biological questions that the student has a part in formulating.
*Subcourses*
Lectures and exercises in advanced phylogeny *(Lectures and exercises in advanced phylogeny)*, 6,0 hp grading scale: Fail (U), Pass (G), Pass with Distinction (VG)
Research project *(Research project)*, 4,0 hp grading scale: Fail (U), Pass (G), Pass with Distinction (VG)

## 5. Learning outcomes

After completing this course the student is expected to be able to plan and carry out a small research project in systematic biology. Specific knowledge and skills that the student is expected to acquire are:

*Knowledge and understanding*
- understand the different strengths and weaknesses of specific phylogenetic analysis methods
- understand the distinction between gene and species phylogenies and how they are connected
- understand the influence of specific processes in creating incongruence among gene trees and between gene and species trees

*Skills and abilities*
- perform complex phylogenetic analyses on DNA sequence data previously generated or supplied
- be able to troubleshoot common problems that arise with phylogenetic analysis
- generate separate gene and species phylogenies
- be able to implement analysis strategies to handle phylogenetic incongruence

*Judgement and approach*

- be able to assess the confidence in, and robustness of, the results of various phylogenetic analyses
- be able to judge which aspects of model selection, phylogenetic incongruence and analysis uncertainty are trivial and which are serious enough to affect conclusions drawn from typical analyses

## 6. Literature

Se separat litteraturlista

## 7. Assessment

The teaching components of the course include:

- lectures delivered online (either live or recorded)
- computer sessions guided by step-by-step instructions
- guidelines and online discussion with a teacher during the research project
- moderated online discussion forum with students and teachers
- literature to supplement the lectures and computer sessions

The assessable parts of the course include:

- regular short assignments (approx. 4) that review the information presented in each topic as well as addressing questions raised in the computer sessions
- a short independent research project carried out on data supplied by the course leader (approx. 2 weeks duration) and presented as a research journal paper

Compulsory Assessment:

(1) A minimum of 75% of the short assignments, each at a pass standard
(2) The independent research project paper, at a pass standard
(3) An overall pass standard when all assessable items are considered

Short assignments: approx. 15% each
Research paper: approx. 40%

## 8. Grading scale

The grading scale comprises Fail (U), Pass (G), Pass with Distinction (VG).

## 9. Course evaluation

## 10. Additional information

Language of instruction: English.