Molecular Evolution	
Course Code	DIC 8007
Credits	Three (lectures: 3 hr per week)
Organizers	Shih-Ying Hwang
Lecturers	Daryi Wang, Arthur Chun-Chieh Shih, Chih-Horng Kuo, Ryuji Machida, Shu-Miaw Chaw, Trees-Juen Chuang, Kinya Ota, Tzi-Yuan Wang
Time	Friday 09:10-12:00
Place	B208, 2F, Biodiversity Research Center, AS
Prerequisites	Population Genetics and Evolution
Remark	Under 20 students
Description	Evolutionary analyses are increasingly important in many different fields of biological research, particularly as advances in molecular genetic techniques have made large DNA sequence data sets readily available. This course covers the basic concepts of evolutionary analysis and their application in fields such as systematics, comparative biology, and molecular evolution. Lectures will emphasize the logical basis and computational details of various algorithms and associated methods of hypothesis testing, as well as novel applications of phylogenetic analysis in various fields of biology.
Purpose	1. Students will learn the dynamics of evolutionary change at the molecular level, the driving forces govern the evolutionary process, the effects of the various molecular mechanisms on the structure of genes, proteins, and genomes, the methodology involved in dealing with molecular data from an evolutionary perspective, and the logic of molecular hypothesis testing. 2. Students will identify an area of interest and propose research to answer an outstanding question in that area.
Reference	Textbook ♦ Fundamentals of Molecular Evolution, Second Edition by Dan Graur and Wen-Hsiung Li (Sinauer, 1999) Other reference book ♦ Bioinformatics and Molecular Evolution by Paul Higgs and Teresa Attwood (Wiley-Blackwell, 2005) ♦ Computational Molecular Evolution by Ziheng Yang (Oxford University Press, 2006) ♦ Inferring Phylogenies (Paperback) by Joseph Felsenstein (Sinauer, 2003) Molecular Evolution and Phylogenetics by Masatoshi Nei and Sudhir Kumar (Oxford University Press, 2000) ♦ Molecular Evolution by Wen-Hsiung Li (Sinauer Associates, 1997) Molecular Evolution: A Phylogenetic Approach by Roderick D.M. Page and, Edward C. Holmes (1991, Wiley-Blackwell) ♦ Phylogenetic Trees Made Easy: A How-to Manual, Third Edition by Barry G. Hall (Sinauer, 2007) ♦ Statistical Methods in Molecular Evolution by Rasmus Nielsen (Springer, 2005) ♦ The Phylogenetic Handbook: A Practical Approach to DNA and Protein Phylogeny Ed. by Marco Salemi and Anne-Mieke Vandamme (Cambridge University Press, 2003) Page & Holmes (Molecular Evolution: A Phylogenetic Approach).
Grade	Mid-term 40% Final 40% Attendance & Discussion 20%

Week	Date	Topic
1	2/27	**Adjusting to Holiday**
2	3/6	**Genes, genetic codes, and mutation (R. Machida)** This chapter provides some basic background in molecular biology that is required for evolutionary process at the DNA level.
3	3/13	**Dynamics of genes in population (D. Wang)** Understand the genetics changes and its evolution patter in population. Introduce the neo-Darwinian theory and the neutral mutation hypotheses. Examples and papers associated with population genetics for discussion.
4	3/20	**Evolutionary change in nucleotide sequences (Arthur Shih)** Introduce nucleotide substitution in a DNA sequence. In this lecture, we will study the Jukes and Cantor's on parameter model and Kimura's Two parameter model.
5	3/27	**Estimating the number of nucleotide substitutions between sequences (Arthur Shih)** In this lecture, we will study different models in calculating substitution rate.
6	4/3	**Adjusting to Holiday**
7	4/10	**Comparative and evolutionary genomics I (T. Chuang)** After understanding the first section, we will discuss some evolutionary arguments associated with alternative splicing and gene duplication.
8	4/17	**Comparative and evolutionary genomics II (T. Chuang)** This lecture will introduce post-transcriptional events such as cis-splicing, trans-splicing, and RNA editing.
9	4/22	**Mid-term exam (D. Wang)**
	4/24	**Molecular clocks (Arthur Shih)** We will introduce the definition of molecular clock and relative rate test.
10	5/1	**Gene duplication, exon shuffling I (S. M. Chaw)** Gene duplication has been recognized to be the main role in evolution. In the lecture we will introduce 5 different types of gene duplication. Also, we will study the definition of Exon and types of domain, and discuss the mutation meaning in evolution.
11	5/8	**BRC 10th Anniversary Conference**
12	5/15	**DNA polymorphism in populations (R. Machida)** Introduce the methods to measure DNA polymorphism and how to detect natural selection.
13	5/22	**Gene duplication, exon shuffling II (S. M. Chaw)** Introducing recent papers associated with gene duplication.
14	5/29	**Concerted evolution (K. Ota)** Introducing evo. devo.
15	6/5	**Evolution by transposition (C.H. Kuo)** In this lecture, we will describe the myriad of transposable genetic elements that facilitate the movement of genetic material from on genomic location to another. We will study the impacts that may have had on the evolutionary process.
16	6/12	**Genome evolution (C.H. Kuo)**
17	6/19	**Final Presentation (TY Wang)**
18	6/26	**Adjusting to Holiday**