City University of Hong Kong
Course Syllabus

offered by Department of Infectious Diseases and Public Health
with effect from Summer Term 2019/20

Part I Course Overview

Course Title:	Computational Biology, Experimental Design and Data Science
Course Code:	PH8001
Course Duration:	One semester
Credit Units:	3 credits
Level:	
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to make the postgraduate students a) equipped with the fundamental knowledge in computational biology and data science; b) prepared with practical skills and appropriate logic to analyze molecular or numerical data, including data processing, visualizing, interpreting and hypothesizing; and c) capable of designing biomedical/veterinary projects/experiments rationally. Python will be the main programming language used in the practical sessions.

2. Course Intended Learning Outcomes (CILOs)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Understand the concepts, logic and algorithms underlying the commonly used bioinformatics tools	10%	✓	✓	
2.	Attain the ability of performing data mining for the -omics data using proper tools/parameters under a Linux environment	40%		✓	✓
3.	Design an experiment regarding statistical and biological factors	15%	✓	✓	✓
4.	Perform explanatory data analysis with Python	15%	✓	✓	✓
5.	Apply supervised machine learning models to biological data for regression or classification	20%		✓	✓
		100%			

A1: *Attitude*
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: *Ability*
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

TLA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lectures	Learning through lectures to understand the fundamental philosophy/algorithms and apply appropriate tools for -omics data mining.	✓	✓	✓	✓	✓	
Hands-on practice	Learning through on problem-based practice to 1) strengthen the understanding of the principles/algorithms/philosophy underlying the models/tools; and 2) be skilled in applying bioinformatics or data mining tools/models on biomedical/veterinary problems and interpreting the results	✓	✓	✓	✓	✓	
Take-home assignments and reports	Learning through take-home assignments based on problem-based projects to consolidate students' understanding of bioinformatics or data mining tools/models and proficiency in performing the analyses.		✓	✓	✓	✓	Out of classroom
Q&A sessions	Teacher will 1) help students correct the misunderstanding of the principles, algorithms or philosophy underlying the models/tools; 2) widen the horizon of the students; 3) inspire the students to cooperate and apply the methods/tools learned to the real-world problems.	✓	✓	✓	✓	✓	

4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.					Weighting*	Remarks
	1	2	3	4	5		
Continuous Assessment: 100%							
Classroom assessment		✓	✓			30%	Formative assessment will be carried out to check the students' comprehension and improve the teaching and re-learning activities.
Assignments and reports	✓	✓	✓	✓	✓	70%	These tasks are designed to evaluate the understanding of different tools/models learned in this course and the ability of applying them to realistic biomedical or veterinary problems.
						100%	

5. Assessment Rubrics

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C)	Failure (F)
1. Classroom assessment	The comprehension of the contents in both the theoretical and practical parts.	High	Significant	Basic	Not even reaching marginal levels
2. Assignments	1) The comprehension of the key concepts and algorithms in the commonly used bioinformatics tools; ability to design a biological/ veterinary experiment based on the principles taught in this course; 2) the ability to solve some specific biological problems using the techniques/ tools learned/ recommended in this course.	High	Significant	Basic	Not even reaching marginal levels

Part III Other Information

1. Keyword Syllabus

Bioinformatics, computational biology, sequence analysis, -omics data mining, bioinformatics software, Linux operation, Python programming, experimental design, data visualization, multivariate analysis, supervised machine learning, unsupervised machine learning, exploratory data analysis, predictive modeling, causal inference.

2. Reading List

2.1 Compulsory Readings

1	Biological sequence analysis, R. Durbin, S.Eddy, A. Krogh, G.Mitchison, https://pdfs.semanticscholar.org/2ed5/d6b35f8971fb9d7434a2683922c3bfcc058e.pdf
2	Python Data Science Handbook, Jake VanderPlas, https://github.com/jakevdp/PythonDataScienceHandbook

2.2 Additional Readings

1	Deep Learning, Yoshua Bengio, MIT Press, ISBN10 0262035618
2	The Book of Why: The New Science of Cause and Effect, Judea Pearl and Dana Mackenzie, ISBN-10: 046509760X
3	How to Create a Mind: The Secret of Human Thought Revealed, Ray Kurzweil, Penguin Books; 7/28/13 edition, ISBN-10: 9780143124047