TIGP Bio 2023 Spring Syllabus

Basic Molecular Biology II (B2)

For the latest syllabus, please visit the BP website: https://tigpbp.iis.sinica.edu.tw

Place: Room 308, Institute of Statistical Science, Academia Sinica

Time: Tuesday 09:00-12:00

Chair: Dr. Ho-Ming Chen (homing@gate.sinica.edu.tw), Dr. Sen-Ling Tang (sltang@gate.sinica.edu.tw)

Aim: Introduce key concepts and methods to manage, integrate and analyze bio big data in the era of post-genomics life sciences

Outline: Big Data in Bioinformatics - From Data-Driven Analysis to Knowledge

Textbook: (Reference books, not required)

1. Scalable Big Data Analytics for Protein Bioinformatics [Publisher: Springer; 1st ed. 2018 edition (September 26, 2018)]
2. Computational Intelligence and Big Data Analytics: Applications in Bioinformatics [Publisher: Springer; 1st ed. 2019 edition (September 9, 2018)]
3. Big Data in Omics and Imaging [Publisher: Chapman and Hall/CRC; 1 edition (June 19, 2018)]
4. Big Data Analytics in Genomics [Publisher: Springer; Softcover reprint of the original 1st ed. 2016 edition (April 25,

TA: N/A (Please refer to the lectures respectively shall you have any questions for each class)

Grades: Midterm exam 50%. Final exam 50%.

【For Non-BP student】

For Non-BP student to register/sit-in any BP course, it is required to gain course chair's permission:

(1) Basic Enrollment Information form (https://forms.gle/dbthaUe77GeNziNw5)

(2) TIGP-BP Course Registration Consent Form (http://bit.ly/3ubl2Bs)

※ Deadline: **the 4th week** of each semester.

※ Signature of the course chair should be collected before submission. Incomplete form will not be accepted.

※Course grade will NOT be given (even class enrollment is completed at school) if fail to follow the procedures.

Week	Date	Topics/Brief Description	Lecturers	Evaluation Method	Email
1	2023/2/14 @Webex Only	Genomics and Genome Analysis	Dr. Ueng-Cheng Yang	HW with a specified deadline: ▶ April 18th	uyang@nycu.edu.tw
2	2023/2/21	NGS Analytics - Comparative and Evolutionary Genomics	Dr. I-Sheng Tsai	In-class exam on midterm date	ijtsai@gate.sinica.edu.tw
3	2023/2/28	Holiday--228 Memorial Day (no class)	--	--	--
4	2023/3/7	Proteomics Informatic	Dr. Victor Ng	HW with a specified deadline: ▶ April 7th	wailap.ng@gmail.com
5	2023/3/14 @Auditorium, B1F	Genome Assemblies and Annotations	Dr. I-Sheng Tsai	In-class exam on midterm date	ijtsai@gate.sinica.edu.tw
6	2023/3/21	Microbiome	Dr. Sen-Lin Tang	HW with a specified deadline: ▶ April 25th	sltang@gate.sinica.edu.tw
7	2023/3/28	Metagenomics	Dr. Sen-Lin Tang		sltang@gate.sinica.edu.tw
8	2023/4/4	Holiday--Children's Day (no class)	--		
9	2023/4/11	Midterm Exam	--		
10	2023/4/18	Medical Genomics	Dr. Ling-Hui Li	HW with a specified deadline: ▶ May 30th	lli@ibms.sinica.edu.tw
11	2023/4/25	Population Genomics	Dr. John Wang	HW with a specified deadline: ▶ May 9th	johnwang@gate.sinica.edu.tw
11	2023/4/26(Wed) 14:00-17:00	Transcriptome Informatics	Dr. Ho-Ming Chen	HW with a specified deadline: ▶ 23:00 pm, May 15th	homing@gate.sinica.edu.tw
12	2023/5/2	Structural Bioinformatics in Pharmacogenomics	Dr. Jung-Hsin Lin	HW with a specified deadline: ▶ June 8th	jhlin@gate.sinica.edu.tw
13	2023/5/9 @Webex Only--Video	Systems biology and biological modeling	Dr. Yu-Chao Wang	HW with a specified deadline: ▶ May 30th	yuchao@nycu.edu.tw
14	2023/5/16 @Webex Only	Precision medicine and clinical informatics	Dr. Ueng-Cheng Yang	HW with a specified deadline: ▶ June 2nd	uyang@nycu.edu.tw
15	2023/5/23	Review Week (no class)	--		
16	2023/5/30	Final Exam	--		

TIGP Bio 2023 Spring Syllabus

Advanced Algorithms (C2)

For the latest syllabus, please visit the BP website: https://tigpbp.iis.sinica.edu.tw

Place: Room 308, Institute of Statistical Science, Academia Sinica

Time: Friday 14:00-17:00

Chair: Dr. Chien-Yu Chen (chienyuchen@ntu.edu.tw)

Outline: This course is basically about data mining, machine learning and statistical modeling from data, and some other algorithms and applications.

Resources: https://bit.ly/41vGP3G

There are 8 topics given in the way of **Videos Preview** (about 2~3 hours) + **In-class discussions** (about 1~1.5 hours).

Below please find the link that WILL provide the links of the following:

(1) the videos to be watched BEFORE the class

(2) the questions to be discussed IN the class

(3) the homework to be completed AFTER the class

References:

1. Learning from Data- A Short Course (Abu-Mostafa, Magdon-Ismail, Lin, 2012)
2. Learning Pattern Classification (Duda, Harg, and Stork, 2001)
3. An Introduction to Support Vector Machines and Other Kernel-based Learning Methods (Cristianini and Shawe-Taylor, 2000)
4. [DL in Life Science] https://mit6874.github.io/
5. [ML for Genomics] https://www.classcentral.com/course/youtube-6-047-6-878-machine-learning-for-genomics-fall-2020-48203

TA: Yu-Chun Huang (r01628119@gmail.com)

Office hours: Friday 10:00-12:00

Office location: R316, Institute of Plant and Microbial Biology, Academia Sinica.

Grades: Midterm exam 50%. Final exam 50%.

【For Non-BP student】

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(1) Basic Enrollment Information form (https://forms.gle/dbthaUe77GeNziNw5)

(2) TIGP-BP Course Registration Consent Form (http://bit.ly/3ubl2Bs)

※ Deadline: **the 4th week** of each semester.

※ Signature of the course chair should be collected before submission. Incomplete form will not be accepted.

※ Course grade will NOT be given (even class enrollment is completed at school) if fail to follow the above procedures.

Week	Date	Topics/Brief Description	Lecturers	Lecture Style	Evaluation Method	Email
1	2023/2/17	Data Classification	Dr. Li Su	Lectures	HW with a specified deadline: ▶ April 7th	lisu@iis.sinica.edu.tw
2	2023/2/22 (Wed) 14-17:00	Convolutional Neural Networks, Recurrent Neural Networks (optional: Graph Neural Networks)	Dr. Che Lin	Preview videos + in-class discussions	HW with a specified deadline: ▶ March 15th	che.lin@gmail.com
3	2023/3/3	Preview Week (no class)		--	--	--
4	2023/3/8 (Wed) 14-17:00	[DL in Life Science] Epigenomics	Dr. Huai-Kuang Tsai	Preview videos + in-class discussions	HW with a specified deadline: ▶ April 7th	hktsai@iis.sinica.edu.tw
5	2023/3/15 (Wed) 14-17:00	Identification and analysis of circular RNAs	Dr. Trees-Juen Chuang	Lectures	HW with a specified deadline: ▶ April 14th	trees@gate.sinica.edu.tw
6	2023/3/24	[DL in Life Science] GWAS and Variants	Dr. Tzu-Pin Lu	Preview videos + in-class discussions	HW with a specified deadline: ▶ April 17th	tplu@ntu.edu.tw
7	2023/3/31	Single cell RNA-seq	Dr. Yao-Ming Chang	Preview videos + in-class discussions	HW with a specified deadline: ▶ April 18th	petitming@ibms.sinica.edu.tw
8	2023/4/7	Midterm Exam (take-home exams, no class)	--			--
9	2023/4/14	Hidden Markov Models	Dr. Yu Tsao	Lectures	HW with a specified deadline: ▶ June 2nd	yu.tsao@citi.sinica.edu.tw
10	2023/4/21	Network Analysis	Dr. Hsuan-Cheng Huang	Lectures	HW with a specified deadline: ▶ June 2nd	hsuancheng@nycu.edu.tw
11	2023/4/28	[DL in Life Science] Graph Analysis [DL in Life Science] Drug Discovery	Dr. Yueh-Hua Tu	Preview videos + in-class discussions	HW with a specified deadline: ▶ May 29th	a504082002@gmail.com
12	2023/5/5	[DL in Life Science] Protein Structure Prediction	Dr. Chien-Yu Chen	Preview videos + in-class discussions	HW with a specified deadline: ▶ June 2nd	chienyuchen@ntu.edu.tw
13	2023/5/12	Advanced Algorithms for Proteomics	Dr. Ching-Tai Chen	Preview videos + in-class discussions	HW with a specified deadline: ▶ June 2nd	ctchen@asia.edu.tw
14	2023/5/17 (Wed) 14-17:00	Biological systems modeling	Dr. An-Chi Wei	Preview videos + in-class discussions	HW with a specified deadline: ▶ June 2nd	acwei86@ntu.edu.tw
15	2023/5/26	Review Week (no class)	--			--
16	2023/6/2	Final Exam (take-home exams, no class)	--			--

TIGP Bio 2023 Spring Syllabus

Advanced Statistical Methods in Bioinformatics (S2)

For the latest syllabus, please visit the BP website: https://tigpbp.iis.sinica.edu.tw

Place: Room 308, Institute of Statistical Science, Academia Sinica

Time: Thursday 9:00-12:00

Chair: Dr. Grace S. Shieh (gshieh@stat.sinica.edu.tw)

Outline: Introduction to useful and advanced statistical methods in computational biology. The topics include: Analysis of next generation sequencing (NGS) Data (e.g., RNA-Seq and ChIP-Seq), maximum likelihood estimation, the EM algorithm, Bayesian inference, Monte Carlo methods, Resampling (Bootstrap & permutation test), Human Genetics, clustering and classification, dimension-reduction and missing data.

Textbook: N/A

TA: N/A (Please refer to the lectures respectively shall you have any questions for each class)

Grades: Midterm exam 50%. Final exam 50%.

【For Non-BP student】

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(1) Basic Enrollment Information form (https://forms.gle/dbthaUe77GeNziNw5)
(2) TIGP-BP Course Registration Consent Form (http://bit.ly/3ubl2Bs)

※ Deadline: **the 4th week** of each semester.

※ Signature of the course chair should be collected before submission. Incomplete form will not be accepted.

※Course grade will NOT be given (even class enrollment is completed at school) if fail to follow the above procedures.

Week	Date	Topics/Brief Description	Sub-topics/Detail Descriptions	Lecturers	Evaluation Method	Email
1	2023/2/16	Analysis of NGS data I	N/A	Dr. Hao Ho	HW with a specified deadline: ▶April 6th	hho@stat.sinica.edu.tw
2	2023/2/23	Analysis of NGS data II	N/A	Dr. Hao Ho		hho@stat.sinica.edu.tw
3	2023/3/2	Maximum likelihood estimates and the EM algorithm I	Maximum likelihood estimates	Dr. Yen-Tsung Huang	HW with a specified deadline: ▶April 13th	ythuang@stat.sinica.edu.tw
4	2023/3/9	Maximum likelihood estimates and the EM algorithm II	The EM algorithm	Dr. Yen-Tsung Huang		ythuang@stat.sinica.edu.tw
5	2023/3/16	Bayesian Statistics (was Prediction of Drug Response I)	prior dist., conjugate families & applications to genetics (was Applications of Penalized regression: lasso, ridge & logistic ridge regression)	Dr. Grace S. Shieh	In-class exam on midterm exam date	gshieh@stat.sinica.edu.tw
7	2023/3/30	Resampling methods (was Prediction of Drug Response II)	Bootstrap and Permutation method (was Applications of K-Nearest Neighbor and transfer learning)	Dr. Grace S. Shieh	HW with a specified deadline: ▶April 20th	gshieh@stat.sinica.edu.tw
7	2023/3/30 14:00-17:00	Monte Carlo Markov Chains	Monte Carlo Markov Chains	Dr. Shin-Sheng Yuan	HW with a specified deadline: ▶April 13th	shinshengyuan@gmail.com
8	2023/4/6	Midterm Exam	--	--	--	--
9	2023/4/13	Prediction of Drug Response (was Resampling methods)	Feature selction, Penalized regression, KNN and transfer learning (was Bootstrap and Permutation method)	Dr. Grace S. Shieh	No exam. (was HW with a specified deadline)	gshieh@stat.sinica.edu.tw
10	2023/4/19 (Wed) 9:00-12:00	Cluster Analysis	K-Means, Hierarchical Clustering, Heatmap, Cluster Validation	Dr. Han-Ming Wu	HW with a specified deadline: ▶June 1st	wuhm@g.nccu.edu.tw
11	2023/4/26 (Wed) 9:00-12:00	Classification and Its Assessment	ROC Curve, Decision Tree, Ensemble Methods	Dr. Han-Ming Wu		wuhm@g.nccu.edu.tw
12	2023/5/4	Statistics in Human Genetics/Genomics I	Concept of Statistical Genetics, International Genomic Projects, Linkage Analysis, Genetic Association Analysis	Dr. Hsin-Chou Yang	HW with a specified deadline: ▶June 11th	hsinchou@stat.sinica.edu.tw
13	2023/5/11	Statistics in Human Genetics/Genomics II	Genome-Wide Association Study, Gene-Gene Interaction, Rare Variant Analysis, Polygenic Risk Score	Dr. Hsin-Chou Yang		hsinchou@stat.sinica.edu.tw
14	2023/5/18	Advanced regression and dimension reduction I	Sliced Inverse Regression and PHD	Dr. Shin-Sheng Yuan	HW with a specified deadline: ▶June 1st	shinshengyuan@gmail.com
15	2023/5/25	Advanced regression and dimension reduction II	Liquid Association and related developments	Dr. Hao Ho	HW with a specified deadline: ▶June 9th	hho@stat.sinica.edu.tw
16	2023/6/1	Final Exam	--	--	--	--

TIGP Bio 2023 Spring Syllabus
Seminar

For the latest syllabus, please visit the BP website: https://idv.sinica.edu.tw/tigpbio/

Announcement: https://www.stat.sinica.edu.tw/cht/index.php?
Place: Auditorium, B1F, Institute of Statistical Science, Academia Sinica.
Time: Thursday 14:00-15:20
Chair: Academia Sinica: Dr. Chung-Yen Lin (Informatics), Dr. Chien-Ling Lin (Biology), Dr. Wei-Chung Liu (Statistics)
Remark: Attend any 2 non-BP Seminars—either on campus or off campus is fine, and submit a seminar report: TIGP-BP Seminar Student Report (click to download) (Format: 1 page A4, 12pts font, single spaced) for each seminar to the advisor/lab professor. After collecting the grading and signature from the professor, send the report to the TIGP-BIO office (tigpbio@gate.sinica.edu.tw) by June 9th, 2023.
Grades: Attendance 100% (2 non-BP seminar reports included)

Week	Date	Topics/Brief Description	Speaker's Affiliation	Speaker	Website	Student Host
1	2023/2/16 @Webex Only	The Application of Mathematical Modeling and Pathogen Genomics to Infectious Diseases	Institute of Bioinformatics and Structural Biology, National Tsing Hua University	Prof. Hsiao-Han Chang		Yu-Chun Huang
2	2023/2/23	Please refer to the remark (no class)	--	--	--	--
3	2023/3/2	Context-Dependent Gene Regulatory Network Reveals Regulation Dynamics and Cell Trajectories Using Unspliced Transcripts	Taiwan AI Labs	Dr. Yueh-Hua Tu		Rodrigo Espinoza Silva
4	2023/3/9	Extracting Potential Antimicrobial Resistance Biomarker Genes Using Bacterial Pan-Genome-Based Feature Selection Methods	Graduate Institute of Biomedical Informatics, Taipei Medical University	Prof. Yu-Wei Wu		Shang-Kok Ng
5	2023/3/16	Please refer to the remark (no class)	--	--	--	--
6	2023/3/23	Social Network Neuroscience	Institute of Sociology, Academia Sinica	Dr. Yen-Sheng Chiang		Jia-Ying Su
7	2023/3/30	Review Week (no class)	--	--	--	--
8	2023/4/6	Midterm Week (no class)	--	--	--	--

9	2023/4/13	The Domestication and Expansion History of Mungbean and Adzuki Bean: Evidence From Population Genomics	Institute of Ecology and Evolutionary Biology, National Taiwan University	Prof. Cheng-Ruei Lee		David Nicola Streuli
10	2023/4/20	Sweet Poison: How Sugar Initiates Tumorigenesis in Pancreatic Cells	The Genomics Research Center, Academia Sinica	Dr. Chun-Mei Hu		Daniel Garcia-Ruiz
11	2023/4/27	In the “Loop”: Examining the Role of Circular RNAs in Human Diseases	Department of Life Science, National Taiwan University	Prof. Te-Lun Mai		Po-Yuan Chen
12	2023/5/4 Webex Only	Novel Schizophrenia Drug Discovery to Development – an AI-aided Story	Department of Computer Science and Information Engineering, National Taiwan University	Prof. Yu-Feng Jane Tseng		Yu-Chun Huang
13	2023/5/11	mRNA Signatures in Gene Expression Control: Lessons Learned from Biased Codon Usage and SARS-CoV-2 Nsp1-Mediated Translational Repression	Department of Biochemistry and Molecular Biology, National Cheng Kung University	Prof. Chien-Hung Yu		Tzu-Hsiang Lin
14	2023/5/18	Utilize Comparative Genomics to Unravel the Evolution of Bioluminescence in Fungi	Department of Microbiology, Soochow University	Prof. Huei-Mien Ke		Ping-Yun Ou
15	2023/5/25	Review Week (no class)	--	--	--	--
16	2023/6/1	Final Exam Week (no class)	--	--	--	--

TIGP-BIO 2023 Spring Syllabus & Guidelines
Student Presentation

For the latest syllabus, please visit the BP website: https://tigpbp.iis.sinica.edu.tw

Place: Online (Skype): https://join.skype.com/ycvKdxnlMeku
Time: Thursday, 15:30-17:00
Chair: Dr. Chuan-Hsiung Chang (cchang@nycu.edu.tw), Dr. Chen-Ching Lin (chenching.lin@nycu.edu.tw)
*Effective from the 2014 Fall semester, all TIGP-BP students are required to present once a semester in student presentation.
*First Year Students: the paper should be assigned by your lab professor.
*The following schedule is confirmed and will not be changed. Please contact Dr. Chuan-Hsiung Chang and Dr. Chen-Ching Lin if you do have difficulty with the assigned date.
*The presenter shall introduce the host and attended professors at the beginning of each seminar.

Week	Date	Topic	Student
1	2023/2/16	Exon architecture controls mRNA m^6A suppression and gene expression	Tzu-Hsiang Lin 林子翔
2	2023/2/23	Deep generative model embedding of single-cell RNA-Seq profiles on hyperspheres and hyperbolic spaces	Yin-Cheng Chen 陳胤丞
3	2023/3/2	Discovery of Ongoing Selective Sweeps within Anopheles Mosquito Populations Using Deep Learning	Daniel Garcia-Ruiz 丹尼爾加西亞
4	2023/3/9	Screening cell–cell communication in spatial transcriptomics via collective optimal transport	Ping-Yun Ou 歐秉昀
5	2023/3/16	Discovery of driver non-coding splice site creating mutations in cancer	Rodrigo Espinoza Silva 羅德
6	2023/3/23	Linear and nonlinear correlation estimators unveil undescribed taxa interactions in microbiome data	Shu-Chuan Chen 陳淑娟
7	2023/3/30	Review Week (no class)	--
8	2023/4/6	Midterm Exam (no class)	--
9	2023/4/13	DRPreter: Interpretable Anticancer Drug Response Prediction Using Knowledge-Guided Graph Neural Networks and Transformer	Chi-Tang Wang 王啓唐
10	2023/4/20	tappAS: a comprehensive computational framework for the analysis of the functional impact of differential splicing	Shang-Kok Ng 黃襄國
11	2023/4/27	--	--
12	2023/5/4	--	--
13	2023/5/11	--	--
14	2023/5/18	--	--
15	2023/5/25	Review Week (no class)	--
16	2023/6/1	Final Exam (no class)	--

< Seminar presentation guidelines on the following pages >

Seminar presentation guidelines for Ph.D. program students:

2023-01-18

This research seminar course is intended to provide students planning a research career in Bioinformatics with the opportunity to develop the skill of critically reading and evaluating research papers. The course consists of a weekly timetabled session in which students will read, present and discuss research papers published on high impact journals. A fixed threshold of impact factors is not imposed. Use your common sense instead.

Guidelines:

1. **Research article**: Each week, students will choose RESEARCH papers to be presented. The paper (+ supplements) pdf file should be emailed to cchang@nycu.edu.tw (Dr. Chuan-Hsiung Chang), chenching.lin@nycu.edu.tw (Dr. Chen- Ching Lin), tigpbio@gate.sinica.edu.tw (TIGP_Bio), all students in student presentation class, and also other participating professors at least one week before your in-class seminar presentation takes place. Any delay will result in 10 points deducted from your final grade. Please also send the slides to everyone 2 days before the report. Because some modifications may be made right before the report, it is okay if the slides are not the final version.

1. **Article selection:** You are required to select a recent RESEARCH article that was published after September 2020. (Review articles are NOT acceptable.)

2. **Presentations**: Everyone in the class will present one paper. You should plan to talk for around 40 minutes. Starting from this you should initiate a discussion of the paper (so it is a good idea to conclude your slide presentation with a selection of points to consider and discuss). We should plan to have time for a lively discussion of each paper; your job in giving a presentation is to initiate this discussion. Make sure to
    a. Draw **valid** conclusions from results of your presented paper.
    b. Summarize evidence for each conclusion. (How does the paper support its conclusions?)
    c. Compare the results with other similar experiments published previously, if appropriate.

    - Please refrain from presenting an article written by your supervisor or your friends/classmates. You need to increase the exposure to the breadth and depth of bioinformatics research.
    - Students are encouraged to prepare a few questions for group discussion at the end of the presentation. Students are not expected to simply sit in the class.
    - Please make a rehearsed presentation if you don't know how long your presentation is

going to last. An over-length presentation doesn't translate to a good one.

3. **Language of presentation**: You are required to present your research article in English.

Evaluation Criteria:

You will be evaluated by the following criteria:

1. Your seminar presentation (70%).
2. Your participation of discussion (30%).
   Note: you must participate the discussion, e.g., at least asking one question in each presentation, to obtain this 30% of your final grade. If you don't ask question in any class, this grade will be zero.

TIGP Bio 2023 Spring

Lab Rotation

All 1st year students:
1. Your lab advisor must be one of the BP core faculty.
2. Inform the BP office for the laboratory you are rotating by March 1st, 2023.
3. Submit the Lab Rotation Form with lab advisor's signatures and score to the BP office by June 9th, 2023.

Student (2022 enrolled)	Lab advisor
Ping-Yun Ou 歐秉昀	Dr. Hsueh-Fen Juan 阮雪芬老師
Shang-Kok Ng 黃襄國	Dr. Chien-Ling Lin 陳倩伶老師
Daniel Garcia-Ruiz 丹尼爾加西亞	Dr. Chien-Yu Chen 陳倩瑜老師