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

Place: Room 107, New Building of the Institute of Information 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, 2018)]

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 (http://bit.ly/3g22mfl)
(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	Evaluation Method
1	2022/2/15 @Webex	Genomics and Genome Analysis	Dr. Ueng-Cheng Yang	HW with a specified deadline
2	2022/2/22	NGS Analytics - Comparative and Evolutionary Genomics	Dr. I-Sheng Tsai	HW with a specified deadline
3	2022/3/1	Microbiome	Dr. Sen-Lin Tang	HW with a specified deadline
4	2022/3/8	Proteomics Informatic	Dr. Victor Ng	HW with a specified deadline
5	2022/3/15	Genome Assemblies and Annotations	Dr. I-Sheng Tsai	HW with a specified deadline
6	2022/3/22	Transcriptome Informatics	Dr. Ho-Ming Chen	HW with a specified deadline
7	2022/3/29	Review Week (no class)	--	
8	2022/04/05 (Holiday)	Holiday--Tomb Sweeping Day (no class)	--	
8	2022/4/6 (Wed) @O108	Midterm Exam (take-home exams, no class)	--	
9	2022/4/12 14:00-17:00 @N101	Metagenomics	Dr. Sen-Lin Tang	HW with a specified deadline
10	2022/4/19	Medical Genomics	Dr. Ling-Hui Li	HW with a specified deadline
11	2022/4/26	Population Genomics	Dr. John Wang	HW with a specified deadline
12	2022/5/3 @Webex	Structural Bioinformatics in Pharmacogenomics	Dr. Jung-Hsin Lin	HW with a specified deadline
13	2022/5/13 (Fri) @Webex	From Data-Driven Analysis to Knowledge	Dr. Yu-Chao Wang	HW with a specified deadline
14	2022/5/17 @Webex	Precision medicine and clinical informatics	Dr. Ueng-Cheng Yang	HW with a specified deadline
15	2022/5/24	Review Week (no class)	--	
16	2022/5/31	Final Exam (take-home exams, no class)	--	

TIGP Bio 2022 Spring Syllabus
Advanced Algorithms (C2)

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

Place: Room 107, New Building of the Institute of Information 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:

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

https://docs.google.com/spreadsheets/d/16qsIvscxgw5iqAGNxSU-IFSx3a089A5qTTk6QTidKmg/edit?usp=sharing

References: (reserved in the library of the Institute of Information Science)

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: David Nicola Streuli (d.s.account@hotmail.ch)

Office hours: Friday 10:00 am-12:00 pm

Office location: Room 709, Inst. Biological Chemistry, Academia Sinica (changed to online format since 5/3)

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 (http://bit.ly/3g22mfl)

(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
1	2022/2/18	Data Classification	Dr. Li Su	Lectures	HW with a specified deadline
2	2022/2/25	Preview Week (no class)	[DL in Life Science]		
3	2022/3/4	[DL in Life Science] Convolutional Neural Networks, Recurrent Neural Networks, Graph Neural Networks	Dr. Chien-Yu Chen	Preview videos + in-class discussions	HW with a specified deadline
4	2022/3/11	[DL in Life Science] Epigenomics	Dr. Huai-Kuang Tsai	Preview videos + in-class discussions	HW with a specified deadline
5	2022/3/18	Identification and analysis of circular RNAs	Dr. Trees-Juen Chuang	Lectures	HW with a specified deadline
6	2022/3/25	[DL in Life Science] GWAS and Variants	Dr. Tzu-Pin Lu	Preview videos + in-class discussions	HW with a specified deadline
7	2022/4/1	Single cell RNA-seq	Dr. Yao-Ming Chang	Preview videos + in-class discussions	HW with a specified deadline
8	2022/4/8	Midterm Exam (take-home exams, no class)	--		
9	2022/4/15	Hidden Markov Models	Dr. Yu Tsao	Lectures	HW with a specified deadline
10	2022/4/22 @Webex	Network Analysis	Dr. Hsuan-Cheng Huang	Lectures	HW with a specified deadline
11	2022/4/29 @Webex	[DL in Life Science] Graph Analysis [DL in Life Science] Drug Discovery	Dr. Hsuan-Cheng Huang	Preview videos + in-class discussions	HW with a specified deadline
12	2022/5/6 @Webex	[DL in Life Science] Protein Structure Prediction	Dr. Chien-Yu Chen	Preview videos + in-class discussions	HW with a specified deadline
13	2022/5/11 (Wed) @Webex	Advanced Algorithms for Proteomics	Dr. Ching-Tai Chen	Preview videos + in-class discussions	HW with a specified deadline
14	2022/5/18 (Wed) @Webex	Biological systems modeling	Dr. An-Chi Wei	Preview videos + in-class discussions	HW with a specified deadline
15	2022/5/27	Review Week (no class)	--		
16	2022/06/03 (Holiday)	Holiday--Dragon Boat Festival (no class)	--		
17	2022/6/10	Final Exam (take-home exams, no class)	--		

TIGP Bio 2022 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 107, New Building of the Institute of Information 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: Yu-Ching Hsu (ychsu20130517@gmail.com)

Office hours: Friday 8:00 am-10:00 am

Office location: Room 108, Institute of Statistical Science, Academia Sinica (changed to online format since 5/3)

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 (http://bit.ly/3g22mfl)

(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
1	2022/2/17	Analysis of NGS data I	N/A	Dr. Hao Ho	HW with a specified deadline
2	2022/2/24	Analysis of NGS data II	N/A	Dr. Hao Ho	HW with a specified deadline
3	2022/3/3	Maximum likelihood estimates and the EM algorithm I	Maximum likelihood estimates	Dr. Yen-Tsung Huang	HW with a specified deadline
4	2022/3/10	Maximum likelihood estimates and the EM algorithm II	The EM algorithm	Dr. Yen-Tsung Huang	HW with a specified deadline
5	2022/3/17	Prediction of Drug Response I	Applications of Penalized regression: lasso, ridge & logistic ridge regression	Dr. Grace S. Shieh	In-class exam on midterm date
6	2022/3/24	Monte Carlo Markov Chains	Monte Carlo Markov Chains	Dr. Shin-Sheng Yuan	HW with a specified deadline
7	2022/3/31	Prediction of Drug Response II	Applications of K-Nearest Neighbor and transfer learning	Dr. Grace S. Shieh	In-class exam on midterm date
8	2022/4/7 @N101	Midterm Exam	--	--	--
9	2022/4/14	Resampling methods	Bootstrap and Permutation method	Dr. Grace S. Shieh	HW with a specified deadline
10	2022/4/20 (Wed) @O108	Cluster Analysis	K-Means, Hierarchical Clustering, Heatmap, Cluster Validation	Dr. Han-Ming Wu	HW with a specified deadline
11	2022/4/27 (Wed) @Webex	Classification and Its Assessment	ROC Curve, Decision Tree, Ensemble Methods	Dr. Han-Ming Wu	HW with a specified deadline
12	2022/5/12 @Webex	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
13	2022/5/18 (Wed) @Webex	Statistics in Human Genetics/Genomics II	Genome-Wide Association Study, Gene-Gene Interaction, Rare Variant Analysis, Polygenic Risk Score	Dr. Hsin-Chou Yang	HW with a specified deadline
14	2022/5/19 @Webex	Advanced regression and dimension reduction I	Sliced Inverse Regression and PHD	Dr. Shin-Sheng Yuan	HW with a specified deadline
15	2022/5/26 @Webex	Advanced regression and dimension reduction II	Liquid Association and related developments	Dr. Hao Ho	HW with a specified deadline
16	2022/6/2	Final Exam	--	--	--

TIGP Bio 2022 Spring Syllabus
Seminar

Place: Room 101, New Building of the Institute of Information 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)

Note: Attend any 2 non-BP Seminars (either on campus or off campus is fine) and submit a seminar report for each seminar to advisor/lab professor. After grading and signature is completed by the professor, send the report to the BP office (tigpbio@gate.sinica.edu.tw) by June 10th, 2022.

Form: TIGP-BP Seminar Student Report (Format: 1 page A4, 12pts font, single spaced).

Grades: Attendance 100% (2 non-BP seminar reports included)

Week	Date	Topics/Brief Description	Speaker's Affiliation	Speaker	Web	Student Host
1	2022/02/17	N/A (no class)	--	--	--	--
2	2022/02/24	New Wine in Old Bottles: Uncovering Important Genes Underlying a Complex Trait Using an Evolutionarily Informed Machine Learning Pipeline	Department of Life Science, National Taiwan University	Prof. Chia-Yi Cheng	🌐	Po-Yuan Chen
3	2022/03/03	Development of a Brain-Machine Interface Device for Studying Large-scale Neural Activity in Behaving Animals	Institute of Molecular Biology, Academia Sinica	Dr. Yu-Wei Wu	🌐	Yu-Chun Huang
4	2022/03/10	Prediction of the Response of Cancer Patients to Therapies	Institute of Statistical Science, Academia Sinica	Dr. Grace S. Shieh	🌐	Aishwarya Tiwari
5	2022/03/17	N/A (no class)	--	--	--	--
6	2022/03/24	Using Deep Learning to Understand the Evolution of Animal Morphology	Biodiversity Research Center, Academia Sinica	Dr. Sheng-Feng Shen	🌐	Yu-Ching Hsu
7	2022/03/31	Review Week (no class)	--			
8	2022/04/07	Midterm Week (no class)	--			
9	2022/04/14 @Webex	Exploring Roles of Parasitism in Ecological Networks	Department of Biological Resources, National Chiayi University	Prof. Hsuan-Wien Chen	🌐	Rodrigo Espinoza

10	2022/04/21 @Webex	AI Roadmap in Biomedical Research: From Images to Omics	Centers of Genomic and Precision Medicine, National Taiwan University	Dr. Nam Nhut Phan	🌐	David Nicola Streuli
11	2022/04/28 @Webex	Multi-Omic Approaches Towards Molecular Profiling of Human Diseases	Institute of Biomedical Sciences, Academia Sinica	Dr. Shih-Yu Chen	🌐	Jia-Ying Su
12	2022/05/05 @Webex	AI Drug Discovery -- A Case for Schizophrenia	Department of Computer Science and Information Engineering, National Taiwan University	Prof. Yu-Feng Jane Tseng	🌐	Tzu-Hsiang Lin
13	2022/05/12 @Webex	From Linear Structural Equation Modeling to Generalized Multiple Mediation Formula Keywords: causal inference, mediation analysis, multiple mediation, SEM, counterfactual, interventional approach.	Institute of Statistics, National Yang Ming Chiao Tung University	Prof. Sheng-Hsuan Lin	🌐	Yueh-Hua Tu
14	2022/05/19 @Webex	A Geo-Spatial Approach to Precision Public Health	Research Center for Humanities and Social Sciences, Academia Sinica	Dr. Ta-Chien Chan	🌐	Hao-Jen Deng
15	2022/05/26	Review Week (no class)	--			
16	2022/06/02	Final Exam Week (no class)	--	--		--

TIGP Bio 2022 Spring Syllabus & Guidelines
Student Presentation

Place: Online (Skype): https://join.skype.com/ycvKdxnlMeku

Time: Thursday, 15:30-17:00

Chair: Dr. Chuan-Hsiung Chang (cchang@ym.edu.tw), Dr. Chen-Ching Lin (chaoslin@ym.edu.tw)

*Effective from 2014 Fall semester, all TIGP-BP students are required to present once a semester in seminar.

*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 a difficulty on the assigned date.

*The presenter shall introduce the host and attended professors in the beginning of each seminar.

Week	Date	Topic	Student
1	2022/02/17	Mitonuclear incompatibility as a hidden driver behind the genome ancestry of African admixed cattle	Hsin-Han Lee 李昕翰
2	2022/02/24	Gut microbiota composition is associated with SARS-CoV-2 vaccine immunogenicity and adverse events	Shu-Chuan Chen 陳淑娟(NYCU)
3	2022/03/03	Genomic impact of stress-induced transposable element mobility in Arabidopsis	Tzu-Hsiang Lin 林子翔
4	2022/03/10	Population-scale single-cell RNA-seq profiling across dopaminergic neuron differentiation	Hao-Jen Deng 鄧皓仁
5	2022/03/17	Lifestyle, cardiometabolic disease, and multimorbidity in a prospective Chinese study	Yu-Ching Hsu 徐于晴
6	2022/03/24	Transcriptome analysis discloses dysregulated genes in normal appearing tumor-adjacent thyroid tissues from patients with papillary thyroid carcinoma	Aishwarya Tiwari 艾希雅
7	2022/03/31	Review Week (no class)	--
8	2022/04/07	Midterm Exam (no class)	--
9	2022/04/14	Single-cell analysis of the cellular heterogeneity and interactions in the injured mouse spinal cord	Po-Yuan Chen 陳柏元
10	2022/04/21	The concurrence of DNA methylation and demethylation is associated with transcription regulation	Yu-Chun Huang 黃郁珺
11	2022/04/28	Intratumoral plasma cells predict outcomes to PD-L1 blockade in non-small cell lung cancer	Rodrigo Espinoza Silva 羅德
12	2022/05/05	Overcoming biases in causal inference of molecular interactions	Jia-Ying Su 蘇家瑩
13	2022/05/12	FAT-Net: Feature adaptive transformers for automated skin lesion segmentation	Chi-Tang Wang 王啓唐(NYCU)
14	2022/05/19	Escherichia coli Data-Driven Strain Design Using Aggregated Adaptive Laboratory Evolution Mutational Data	David Nicola Streuli 施大衛

15	2022/05/26	Review Week (no class)	--
16	2022/06/02	Final Exam (no class)	--

<p style="color:red; text-align:center;">< Seminar presentation guidelines on the following pages ></p>

Seminar presentation guidelines for PhD program students:

<mark>2021-08-26</mark>

This <u>research</u> seminar course is intended to provide students planning a research career in Bioinformatics with the opportunity to develop the skill of <u>critically reading and</u> <u>evaluating research papers</u>. 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@ym.edu.tw (Dr. Chuan-Hsiung Chang), ChaosLin@ym.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 modification may be made right before the report, it is okay if the slides are not the final version.

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

3. **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 <u>have time for a lively discussion of each paper; your job in giving a presentation is to initiate this discussion</u>. 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.

4. **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 attendance (10%).
2. Your seminar presentation (70%).
3. Your participation of discussion (20%).

TIGP Bio 2022 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 February 25th, 2022.

3. Submit the Lab Rotation Form with lab advisor's signatures and score to the BP office by June 10th, 2022.

Student (2021 enrolled)	Lab advisor
Aishwarya Tiwari 艾希雅	Dr. Wen-Hsiung Li 李文雄
Tzu-Hsiang Lin 林子翔	Dr. Huai-Kuang Tsai 蔡懷寬
Hao-Jen Deng 鄧皓仁	Dr. Wei-Chung Liu 劉維中
Rodrigo Espinoza Silva 羅德	Dr. Hsuan-Yu Chen 陳璿宇