

**TIGP Bio 2021 Spring Syllabus**  
**Basic Molecular Biology II (B2)**

**Place:** Room 107, New Building of the Institute of Information Science, Academia Sinica.

**Time:** Tuesday 09:00-12:00

**Chair:** Dr. Chuan-Hsiung Chang (cchang@ym.edu.tw), Dr. Sen-Lin 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%.

**Note:** For **Non-BP student** to register/sit-in any BP course, it is required to gain course chair's permission and follow the steps:

(1) Submit the hard copy or PDF file of the completed [TIGP Bioinformatics Course Registration Consent Form](#) to the TIGP BP office

(2) Provide the information via the google form at [BP Class Enrollment Information](#).

The deadline for above requirement is **the 4<sup>th</sup> week** of each semester. Signature of corresponding BP Course Chair should be collected and 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.

For the most up-to-date syllabus, please visit <https://tigppb.iis.sinica.edu.tw/tigppbio/index.html>

Week	Date	Topics/Brief Description	Lecturers
1	2021/02/23	Genomics and Genome Analysis (I)	Dr. Chuan-Hsiung Chang Changed to Dr. Ueng-Cheng Yang
2	2021/03/02	NGS Analytics - <a href="#">Comparative and Evolutionary Genomics</a>	Dr. I-Sheng Tsai
3	2021/03/09	Microbiome and Metagenomics	Dr. Sen-Lin Tang
4	2021/03/16 ->Moved to 2021/04/06	--	--
5	2021/03/23	<a href="#">Genome Assemblies and Annotations</a>	Dr. I-Sheng Tsai
6	2021/03/30	Transcriptome Informatics	Dr. Ho-Ming Chen
7	2021/04/06 (Moved from 2021/03/16)	Proteomics Informatic	Dr. Victor Ng
8	2021/04/13	Midterm Exam	
9	2021/04/20 ->Moved to 2021/04/27	--	--
10	2021/04/27	Population Genomics	Dr. John Wang
10	2021/04/27 @14:00-17:00 (Moved from 2021/04/20)	Genomics and Genome Analysis (II)	Dr. Chuan-Hsiung Chang Changed to Dr. Ueng-Cheng Yang
11	2021/05/04	Medical Genomics	Dr. Ling-Hui Li
12	2021/05/11	Structural Bioinformatics in Pharmacogenomics	Dr. Jung-Hsin Lin
13	2021/05/18 (Moved to 2021/05/25)	--	--
14	2021/05/25 @Webex	Precision medicine and clinical informatics	Dr. Ueng-Cheng Yang
14	2021/05/25 @14:00-17:00 @Webex (Moved from 2021/05/18)	From Data-Driven Analysis to Knowledge	Dr. Yu-Chao Wang Changed to Dr. Ueng-Cheng Yang
15	2021/06/01	Review Week	



## TIGP Bio 2021 Spring Syllabus Advanced Algorithms (C2)

**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)

**Aim:**

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

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

1. Learning from Data- A Short Course (Abu-Mostafa, Magdon-Ismael, 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. Convex optimization (Boyd and Vandenberghe, 2004; book and lecture slides available at <http://www.stanford.edu/~boyd/cvxbook/> )

**TA:** Yueh-Hua Tu 杜岳華 **Email:** a504082002@gmail.com

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

**Office location:** Room 103, Old Building of the Institute of Information Science, Academia Sinica

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

**Note:** For **Non-BP student** to register/sit-in any BP course, it is required to gain course chair's permission and follow the steps:

- (1) Submit the hard copy or PDF file of the completed [TIGP Bioinformatics Course Registration Consent Form](#) to the TIGP BP office
- (2) Provide the information via the google form at [BP Class Enrollment Information](#).

The deadline for above requirement is **the 4<sup>th</sup> week** of each semester. Signature of corresponding BP Course Chair should be collected and 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.

※ For the most up-to-date syllabus, please visit <https://tigppp.iis.sinica.edu.tw/tigppbio/index.html>

Week	Date	Topics/Brief Description	Lecturers
		Subtopics/Detail Descriptions/Examples	
1	2021/02/26	Data Classification	Dr. Li Su
2	2021/03/05	Standard Optimization Algorithms Basic idea of optimization, Convex optimization, Lagrangian method for optimization method, and Gradient descent methods.	Dr. Wen-Liang Hwang
3	2021/03/12 @N106	Support Vector Machines and Large Margin and Kernel Methods Hard and soft support vector machines (SVM) and kernel methods. SVM is a convex optimization method. So, I can use the results of week 1 in week 2.	Dr. Wen-Liang Hwang
4	2021/03/19	Neural Networks and Deep Learning (I) The shallow neural network, and universality theorem	Dr. Wen-Liang Hwang
5	2021/03/26	Neural Networks and Deep Learning (II) Mathematical formulation for deep neural network, learning techniques, architecture, and implications.	Dr. Wen-Liang Hwang
6	2021/04/02	Review Week- Make-up holiday for Children's Day	---
7	2021/04/09	Hidden Markov Models	Dr. Yu Tsao

8	2021/04/16	Midterm Exam	---
9	2021/04/23 (Moved to 2021/04/26)	--	--
10	2021/04/26 (Mon.) @14:00-17:00 (Moved from 2021/04/23)	Graphical Models	Dr. Hsing-Kuo Pao
10	2021/04/30 @15:00-18:00	Conditional Random Fields	Dr. Richard Tzong-Han Tsai
11	2021/05/07	MapReduce in Cloud Computing	Dr. Yu-Jung Chang
12	2021/05/14	Advanced algorithms for NGS	Dr. Hsin-Nan Lin
13	2021/05/21 <a href="#">@Webex</a>	Clustering for cancer subtyping	Dr. Ching-Tai Chen
14	2021/05/28 <a href="#">@Webex</a>	Network Analysis	Dr. Hsuan-Cheng Huang
15	2021/06/04	Review Week	---
16	2021/06/11	Final Exam	

**TIGP Bio 2021 Spring Syllabus**  
**Advanced Statistical Methods in Bioinformatics (S2)**

**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

**Reference book:** papers will be given by instructors

**TA:** N/A (Please refers to the lectures respectively shall you have any questions of each class)

**E-mail:** Contact the Lecturers Directly.

**Office hours:** N/A

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

**Note:** For **Non-BP student** to register/sit-in any BP course, it is required to gain course chair's permission and follow the steps:

(1) Submit the hard copy or PDF file of the completed [TIGP Bioinformatics Course Registration Consent Form](#) to the TIGP BP office

(2) Provide the information via the google form at [BP Class Enrollment Information](#).

The deadline for above requirement is **the 4<sup>th</sup> week** of each semester. Signature of corresponding BP Course Chair should be collected and 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.

For the most up-to-date syllabus, please visit <https://tigppb.iis.sinica.edu.tw/tigpbio/index.html>

Week	Date	Topics/Brief Description	sub-topics/Detail Descriptions	Lecturers
1	2021/02/25	Analysis of NGS data I	N/A	Dr. Hao Ho
2	2021/03/04	Analysis of NGS data II	N/A	Dr. Hao Ho
3	2021/03/11	Maximum likelihood estimates and the EM algorithm I	Maximum likelihood estimates	Dr. Yen-Tsung Huang
4	2021/03/18	Maximum likelihood estimates and the EM algorithm II	The EM algorithm	Dr. Yen-Tsung Huang
5	2021/03/25	Bayesian methods	Bayesian methods	Dr. Grace S. Shieh
6	2021/04/01	Monte Carlo Markov Chains	Monte Carlo Markov Chains	Dr. Shin-Sheng Yuan
7	2021/04/08	Resampling methods I	Bootstrap	Dr. Grace S. Shieh

8	2021/04/15	Midterm Exam		
9	2021/04/22	Resampling methods II	Permutation test, jackknife	Dr. Grace S. Shieh
10	2021/04/29	Clustering, classification and data visualization (I)	Clustering: K-Means, Hierarchical Clustering, Cluster Validation	Dr. Han-Ming Wu
11	2021/05/06	Clustering, classification and data visualization (II)	KNN, Decision Tree, Support Vector Machine, Data visualization in R	Dr. Han-Ming Wu
12	2021/05/13	Statistics in Human Genetics I	Concept of Statistical Genetics, International Genomic Projects, Linkage Analysis	Dr. Hsin-Chou Yang
13	2021/05/20 <a href="#">@Webex</a>	Statistics in Human Genetics II	Genetic Association, Gene-Gene interaction, Rare Variant Analysis	Dr. Hsin-Chou Yang
14	2021/05/27 <a href="#">@Webex</a>	Advanced regression and dimension reduction I	N/A	Dr. Shin-Sheng Yuan
15	2021/06/03 <a href="#">@Webex</a>	Advanced regression and dimension reduction II	N/A	Dr. Shin-Sheng Yuan
16	2021/06/10	Final Exam		

## TIGP Bio 2021 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)

**Remarks:** Attend any 2 none-BP Seminars (either on campus or off campus is fine) and submit a report for each seminar to advisor/lab professor (Format: 1 page A4, 12pts font, single space) and send the report to BP office after grading is completed by the professor by the end of the semester. Please download the report form from BP web-page

**Grades:** attendance 100%

For the most up-to-date syllabus, please visit [https://tigbbp.iis.sinica.edu.tw/tigbbio/syllabus/2021\\_Spring/2021\\_Spring\\_Syllabus\\_\(Seminar\).pdf](https://tigbbp.iis.sinica.edu.tw/tigbbio/syllabus/2021_Spring/2021_Spring_Syllabus_(Seminar).pdf)

Week	Date	Topics/Brief Description	Speaker's Affiliation	Speaker	Host
1	2021/02/25	Prediction of Drug Response in the Precision Medicine Era	Institute of Statistical Science, Academia Sinica	<a href="#">Dr. Grace S. Shieh</a>	Jia-Ying Su
2	2021/03/04	Identifying the Molecular Determinants for Functional Properties of Biomolecules by Integrating Molecular Simulation, Machine Learning, and Graph Theory	Institute of Bioinformatics and Systems Biology, National Yang Ming Chiao Tung University	<a href="#">Dr. Jih-Wei Chu</a>	Po-Yuan Chen
3	2021/03/11 (13:30-15:00)	Identifying Primate ACE2 Variants that Confer Resistance to SARS-Cov-2	Biodiversity Research Center, Academia Sinica	<a href="#">Dr. Wen-Hsiung Li</a>	Jen-Hung Wang
4	2021/03/18	The Microfluidic Device Integrating Surface-Enhanced Raman Scattering for Rapid Antibiotic Susceptibility Test <a href="#">(Abstract)</a>	Department of Electrical Engineering, National Taiwan University	<a href="#">Dr. Nien-Tsu Huang</a>	David Nicola Streuli
5	2021/03/25	Classification of Blood Loss from Prostate Surgery Videos Using Convolutional Neural Network <a href="#">(Abstract)</a>	Institute of BioMedical Informatics, National Yang Ming Chiao Tung University	<a href="#">Dr. Che-Lun Hung</a>	Erickson Erigio Fajiculary
6	2021/04/01	Forecasting Influenza Infection by Deep Learning	Department of Computer Science and Engineering, National Taiwan Ocean University	<a href="#">Dr. Kuan Y. Chang</a>	Yu-Ching Hsu
7	2021/04/08	Review Week	--	--	--
8	2021/04/15	Midterm Exam	--	--	--

9	2021/04/22	Identification of Cancer Prognostic Biomarkers from Multi-Omics Data	Institute of Bioinformatics and Systems Biology, National Yang Ming Chiao Tung University	<a href="#">Dr. Ting Wen Chen</a>	Yu-Chun Huang
10	2021/04/29	Crime Scene Investigation in the RNA World: RNA Degradome Data Analysis	Agricultural Biotechnology Research Center, Academia Sinica	<a href="#">Dr. Ho-Ming Chen</a>	Yueh-Hua Tu
11	2021/05/06	Exploration for Personalized Combinatorial Chemotherapies for Cancers <a href="#">(Abstract)</a>	Department of Electrical Engineering, National Taiwan University	<a href="#">Dr. Hsin-Yu Lee</a>	Hsin-Han Lee
12	2021/05/13	Multi-Site-Targetting Drug Repurposing - Theories and Applications <a href="#">(Abstract)</a>	Institute of Bioinformatics and Structural Biology, National Tsing Hua University	<a href="#">Dr. Lee-Wei Yang</a>	Yu-Hsin Chen
13	2021/05/20 <a href="#">@Webex</a>	Detecting genetic ancestry and adaptation in the Taiwanese Han people <a href="#">(Abstract)</a>	Department of Life Sciences and Institute of Genome Sciences, National Yang Ming Chiao Tung University	<a href="#">Dr. Wen-Ya Ko</a>	Chayanika Goswami
14	2021/05/27 <a href="#">@Webex</a>	Causative Biology and Cryptic Regulatory Mechanisms underlying Autism <a href="#">(Abstract)</a>	Genomics Research Center, Academia Sinica	<a href="#">Dr. Trees-Juen Chuang</a>	Yu-Hsiang Chen
15	2021/06/03	Review Week	--	--	--
16	2021/06/10	Final Exam	--	--	--



## TIGP Bio 2021 Spring Syllabus & Guidelines

### Student Presentation

**Place:** Room 101, New Building of the Institute of Information Science, Academia Sinica

**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.

\*Students are required to submit the topics by **Feb 25, 2021** (First Year Students: The paper will 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.

For the most up-to-date syllabus, please visit <https://tigbbp.iis.sinica.edu.tw/tigbbio/index.html>

Week	Date	Topics	Student
1	2021/02/25	N/A	N/A
2	2021/03/04	<a href="#">Major Impacts of Widespread Structural Variation on Gene Expression and Crop Improvement in Tomato</a>	Hsin-Han Lee 李昕翰
3	2021/03/11	<a href="#">Diversity of Cytosine Methylation Across the Fungal Tree of Life</a>	Yu-Chun Huang 黃郁琿
4	2021/03/18	<a href="#">Quantifying the effect of experimental perturbations at single-cell resolution. Nat Biotechnol (2021)</a>	Yueh-Hua Tu 杜岳華
5	2021/03/25	<a href="#">Learning the Language of Viral Evolution and Escape</a>	David Nicola Streuli 施大衛
6	2021/04/01	<a href="#">Mendelian Randomization Accounting for Correlated and Uncorrelated Pleiotropic Effects Using Genome-Wide Summary Statistics</a>	Jia-Ying Su 蘇家瑩
7	2021/04/08	Review Week	--
8	2021/04/15	Midterm Exam	--
9	2021/04/22	(Cancelled)	Po-Yuan Chen 陳柏元
10	2021/04/29	<a href="#">A Cancer Drug Atlas Enables Synergistic Targeting of Independent Drug Vulnerabilities</a>	Yu-Ching Hsu 徐于晴
11	2021/05/06	<a href="#">DNABERT: pre-trained Bidirectional Encoder Representations from Transformers model for DNA-language in genome</a>	Chung-En Ni 倪崇恩 (NYCU)
12	2021/05/13	<a href="#">Systematic Assessment of Secondary Bile Acid Metabolism in Gut Microbes Reveals Distinct Metabolic Capabilities in Inflammatory Bowel Disease</a>	Shu-Chuan Chen 陳淑娟 (NYCU)
13	2021/05/20	<a href="#">A Universal Gut-Microbiome-Derived Signature Predicts Cirrhosis</a>	Chien Jung Huang 黃千容 (NYCU)
14	2021/05/27	<a href="#">Discovery of rare variants associated with blood pressure regulation through meta-analysis of 1.3 million individuals</a>	Tsai-Yang Sun 孫在陽 (NYCU)

15	2021/06/03	Review Week	--
16	2021/06/10	Final Exam	--

[< Seminar presentation guidelines on the following pages >](#)

## Seminar presentation guidelines for PhD program students:

2021-3-17

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@ym.edu.tw](mailto:cchang@ym.edu.tw) (Dr. Chuan-Hsiung Chang), [chaoslin@ym.edu.tw](mailto:chaoslin@ym.edu.tw) (Dr. Chen-Ching Lin), [tigp.bio@gmail.com](mailto:tigp.bio@gmail.com), [tckuo@ym.edu.tw](mailto:tckuo@ym.edu.tw), 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 February 2019. (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 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.

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 2021 Spring Semester  
Lab Rotation**

All 1st year students:

1. Please inform BP office for the laboratory you are rotating by **5<sup>th</sup> March, 2021**
2. Submit the hard copy of [Lab Rotation Form](#) with lab advisor's signatures and score to the BP office by **11th June, 2021**.

Student	Mentor
Yu-Ching Hsu 徐于晴 (2020)	Dr. Hsin-Chou Yang 楊欣洲
Hsin-Han Lee 李昕翰 (2020)	Dr. Pao-Yang Chen 陳柏仰
Jia-Ying Su 蘇家瑩 (2020)	Dr. Yen-Tsung Huang 黃彥棕
Yu-Chun Huang 黃郁琿 (2020)	Dr. Trees-Juen Chuang 莊樹諄
Po-Yuan Chen 陳柏元 (2020)	Dr. Hsin-Chou Yang 楊欣洲
David Nicola Streuli 施大衛 (2020)	Dr. Hsin-Chou Yang 楊欣洲