

# **BS6220: Spatial and Multi-omics Data Analytics and Machine Learning**

Overview of week 8 & 13 schedule  
and assessment format

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# Self-introductions



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## Research Interest<sup>2</sup>

- Develop innovative causal process modeling & data-driven approach to elucidate actionable insights regarding biological & biotechnological systems
- Leverages multi-omics data analyses and systems biology & AI modelling

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2. [https://scholar.google.com.sg/citations?hl=en&user=cw4XSBQAAAAJ&view\\_op=list\\_works&sortby=pubdate](https://scholar.google.com.sg/citations?hl=en&user=cw4XSBQAAAAJ&view_op=list_works&sortby=pubdate)

# Schedule of topics to cover

## Week 8 (16<sup>th</sup> Jan)

- Application of ML for output optimization in synthetic biology
- Deep modeling & exploration of cell-wise metabolism using single-cell RNA-seq data

## Week 13 (20<sup>th</sup> Feb)

- Optimal experimental design for machine learning
- Reproducibility, pitfalls & leakage in ML-based sciences
- Presentation of self-directed group learning on given topic

# What we could learn from group learning (besides subject matter)

*Group work may be messy, but it teaches vital skills for the real world that you can't learn alone:*

Straits time, 6th Jan 2026

- Self-direct learning
  - Articulate ideas
  - How to work synergistically as a team
  - Think critically
  - Initiative/leadership
  - Realization that team work carry you further
  - Self awareness & empathy, ...
- Apply ourselves

*The power of learning through collaboration deserves more attention*

Group work may be messy, but it teaches vital skills for the real world that you can't learn alone.

Intan Azura Mokhtar

At the Singapore Institute of Technology (SIT), I teach management, entrepreneurship and Change Management. Both modules involve group work and role assignments, which culminates with the conclusion of one of the classes. I involved an insightful teacher who always motivates students.

"I am concluding that group work strategies help to facilitate ability as students to contribute meaningfully to societal shifts and changes. It may not be polarizing yet, but through discussion, debate, design and effective teamwork, we've shown that youths driven that is truly possible - it's achievable."

The student shared these comments after a module that required a reflection on how the group worked together. The group was encouraging, and it was also a reminder that learning and contributing to society is not just a private obligation of education. It is a dynamic and interconnected process that influences on collaboration.

As an example, a group project is simple. If a group of individuals thinking and working together to solve a complex real-life problem, identified and negotiate different principles. Or, if a group of individuals – virtual or physical – this method of learning can be a process of solving, analyzing, assessing, adapting, innovation and personal growth.

However, fully harnessing the potential of collaborative learning, we must consider how the group works and what kind of experiences. This means to ensure that there is no dominance by one person, nor teachers talking and students listening. It requires reflections to shift the focus from individual to be aware and adapt group-based projects to spark student's interest.

Institutionalized a need to do more than encourage collaboration – they must provide the space for the people who make it possible. That means investment and tangible support for students to develop and acquire the skills to guide students and facilitate teamwork. It also means providing the space to design learning opportunities that allow students to learn from each other, uncertainty and inclusiveness.

Such experiences help students learn in deeper and more meaningful ways, challenging them to new perspectives. When the conditions are right, collaboration does something remarkable.

**COLLABORATIVE BASIC**  
Research shows that collaborative learning enhances critical thinking, enhances



*School for Humans*

engagement with the problem and students' deeper understanding of concepts and a greater ability to apply them. Our local universities (NUS) are also committed to exploring the value of collaborative learning in preparing students for complex, real-world challenges. These are some examples. These are group settings and individualized learning, suggesting that the former focuses on the whole group, while the latter focuses on the individual.

For instance, a study in the United States found that students compared the effectiveness of individualized learning with individualized learning in science.

Another study found a notable difference in post-test scores between pupils engaged in group work and those who worked individually with their teacher.

With students work with their teacher, the process of learning goes beyond mere absorption of facts and figures. They figure things out together, test ideas, and use practical feedback to refine their practice. This can lead to greater

that include critical thinking and communication, digital citizenship, problem-solving, design innovation and a social entrepreneurship.

Opportunities for higher education are available from local government and industry partners. At one of our local MIs, final year students took on a real-life challenge and were co-ordinated and guided by industry partners. For example, a team of students from the School of Science, Business and Psychology students might develop a mental health app for the elderly, while another team might be conducting technical development with user experience design and user interface.

Collaboration has clearly become an integral part of education. This signals that it needs to become a key element of the curriculum in primary and secondary schools, so as to prepare our learners well.

An one educator stated, "team-based implementation and group projects can be a great way to engage students to project work in schools. Doing group work together is important in this larger mission relevance and engagement, and it can help us achieve our learning objectives. Our challenge is ensuring that assessment reflects the overall learning objective."

In Singapore's primary and secondary schools, collaborative learning approaches are also common. Interestingly, some groups may have members that are quite silent and others do not speak up. In order to be successful, these

may be team members who tend to dominate discussions, others just following and being less involved.

Autonomy and freedom can be mitigated through clear roles, responsibilities, and accountability, and a culture of inclusion, including structured individual accountability and a focus on inclusive learning experiences. This can be done in safe spaces where diverse voices are valued, and constructive feedback is provided.

Collaboration is an excellent tool in collaborative learning, such as the case of SIT. Other students know their group members well, and their contributions in the group they tend to participate more actively.

This is why schools and institutions must look to achieve a balance between individual exercises to design and manage collaborative projects effectively. Through this, students can turn the challenges into opportunities, helping students to put their learning experiences into ways that prepare them for the real world.

**REAL-WORLD RELEVANCE**  
The benefits of collaboration extend far beyond the classroom, however. It is also a valuable framework in the field of innovation. Cross-functional teams with diverse backgrounds with varied expertise to tackle complex challenges.

For example, interdisciplinary collaboration often leads to discoveries and learning that transcend the boundaries of a single discipline. It applies to business domains, for example. The development of mobile technologies – from mobile wallets to digital healthcare – has been driven by innovative initiatives of higher learning and tech companies, as well as governments.

On a global scale, we have seen collaboration at the heart of many major breakthroughs. Take Google, for example. By bringing together the Chinese search engine Baidu and the Indian search engine IIT Bombay, Google created a unique experience that is now used by millions of people around the world. This is often taken for granted.

As we prepare students for an increasingly interconnected world, we must be prepared by rapid technological change, global volatility and complex challenges. Collaboration will be more important than ever. It is not just about learning a skill set, it is a way of living a more empathetic and interconnected life.

Learning with and through others means that they can also contribute to the process. New and bold ideas often emerge and form the basis for innovation. But, for collective effort to succeed,

It is crucial that educators are actively involved, assist and support for successfully designed and implemented projects. Community Leadership and Social Innovation Centre at the Singapore Institute of Technology

A School for Humans is a core competency of the Singapore Institute of Technology. It aims to develop the conversations around education and highlight the human aspects of the focus of teaching and learning.

# Mode of learning: experientially

- Learning by doing rather than being spoon-fed
- Real-world connection: emphasis on skilful application & innovation
- Active engagement: take initiative & make decisions
- Multiple capabilities: self-learning, technical, communication, etc.
- Reflection: what was learned that is applicable to your area of interest?

# Assessment format & grading criteria

# Assessment format

## Team-based self-learning & presentation

- 20% of overall assessment
- ~6 person per team: member list & *algorithm* to present
  - to be submitted by team leader
  - via NTUlearn by 23<sup>rd</sup> Jan 2026
- Assessment:
  - (i) max 7 min in class presentation
  - (ii) pre-recorded presentation
  - (iii) PowerPoint slides (ppt format)
- To be submitted by team leader
  - via NTUlearn by 22<sup>nd</sup> Feb 2026 2359 hrs
- Usage of generative AI allowed **as per university guidelines**

# Grading criteria

## Key sections of slides (40%)

- Purpose of ML algorithm chosen by team
- One real-world application (Keep it Simple)
- Explain how algorithm works, using a numeric example<sup>1</sup> (Keep it Simple)

## Format (10%)

- Non-verbose (key words/phrases)  
(Notes may be made in Powerpoint's Note section)
- References
- Aptos font suggested: header font size 36-40, content font size 16-28

1. e.g., <https://www.frontiersin.org/journals/ecology-and-evolution/articles/10.3389/fevo.2022.1010278/full><sup>9</sup>

# Grading criteria

## Outperformance (50%)

- Intuitive, self-explanatory slides
- Good flow
- Instructive for peers
- Effective sharing via class presentation & recording

**Explicitly** acknowledge what resources have been used & the specific ways they are used (e.g., gen AI)

# Grading criteria

Last slide to state *significant* contribution  
of individual team members, e.g.,

- *Class presentation: Peter, ... (1 to 2 pax expected)*
- *Recorded presentation: Lee (1 pax expected)*
- *Research & slides preparation: Sue, ... (2 to 3 pax expected)*
- *Numeric example of algorithm computation: ... (1 to 2 pax expected)*
- *Coordination: ... (1 pax expected)*
  
- Individuals may contribute in more than one area

# List of ML algorithms for group-learning & presentation

Deep learning is heavily used in many domain applications.

Select one of following related algorithms for your learning:

- Forward propagation (Neural network)
- Back propagation (Neural network)
- Forward propagation (Mathematical expression)
- Back propagation (Mathematical expression)
- Bayesian belief propagation

# Question?