# Course Outline

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| **Course title: Biomedical Information Processing** | **Instructor name: Jun Albert Pardillo** |
| **Credit units: 3** | **Total hours: 54** |

## Course Description:

Biomedical Information Processing is a course designed for 4th Year Computer Science and Information Engineering students who are interested in exploring the intersection of computer science and biomedical engineering. This course will provide students with an in-depth understanding of the principles and techniques used in processing and analyzing biomedical data. The course will cover a range of topics, including the basics of biomedical signal processing, image processing, and machine learning techniques. Students will learn how to apply these techniques to various biomedical applications, such as medical imaging, electroencephalography (EEG), electrocardiography (ECG), and more. Throughout the course, students will also be introduced to various biomedical databases and tools used in the field. They will learn how to access and analyze data from these sources, and how to use this information to develop new biomedical applications. By the end of the course, students will have gained a comprehensive understanding of the principles and techniques used in biomedical information processing. They will be able to apply this knowledge to real-world problems in the field, and will be well-prepared for further study or work in the biomedical engineering industry.

## Course Learning Outcomes (CLOs)

* Understand the fundamental principles and techniques used in biomedical information processing.
* Apply various signal and image processing techniques to biomedical data.
* Utilize machine learning algorithms to analyze and interpret biomedical data.
* Access, analyze, and interpret data from biomedical databases and tools.
* Develop applications that incorporate biomedical information processing techniques to solve real-world problems.

## Topics / Modules and Intended Learning Outcomes

1. Introduction to Biomedical Information Processing

* Describe the role of AI in biomedical information processing, including diagnostics and research.
* Identify the challenges and opportunities in applying AI to biomedicine.

1. Biomedical Signal Processing

* Explain the various signal preprocessing techniques and their applications in health monitoring.
* Analyze biomedical signals using machine learning methods for disease detection, including COVID-19.

1. Biomedical Image Processing

* Understand the fundamentals of biomedical image processing and its challenges.
* Apply deep learning algorithms for the classification and analysis of medical images.

1. Machine Learning in Biomedical Applications

* Evaluate the use of machine learning algorithms in biomedical applications, including Alzheimer's disease diagnosis.
* Discuss the importance of privacy-preserving techniques in collaborative machine learning for biomedical applications.

1. Biomedical Databases and Tools

* Identify and access public biomedical databases for research and application development.
* Analyze biomedical data using tools and techniques for multimodal image processing.

## Weekly Activities

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| **Week No.** | **Topic** | **Activity Description** | **Expected Output** | **Assessment Tools** |
| Week 1 | **Introduction to Biomedical Information Processing** | Lecture on the importance of AI in biomedical information processing and its potential to transform healthcare diagnostics and research. | Students will write a reflection paper on the potential impacts of AI in biomedicine. | Reflection paper grading rubric |
| Week 2-3 | **Biomedical Signal Processing** | Introduction to signal preprocessing techniques followed by hands-on lab sessions using MATLAB or Python to preprocess and analyze ECG signals. | Preprocessing and analysis report of ECG signals. | Lab report grading rubric |
| Week 4-5 | **Biomedical Image Processing** | Lecture on the basics of biomedical image processing followed by a project to apply deep learning algorithms for medical image classification. | A project report detailing the methods used and the classification results. | Project report grading rubric |
| Week 6-7 | **Machine Learning in Biomedical Applications** | Discussion on the use of machine learning in biomedical applications, including case studies on Alzheimer's disease diagnosis. Students will then work on a mini-project using a public dataset. | Mini-project report on machine learning application for disease diagnosis. | Mini-project grading rubric |
| Week 8-9 | **Biomedical Databases and Tools** | Workshop on accessing and utilizing public biomedical databases and tools for research. Students will be tasked to find data relevant to a given biomedical problem and analyze it. | Report on the data found and analysis conducted. | Data analysis report grading rubric |
| Week 10-18 | **Capstone Project** | Students will work in groups to propose and develop a biomedical information processing application, incorporating techniques learned throughout the course. Regular progress presentations will be scheduled. | A fully documented project including code, datasets used, and a final presentation. | Project documentation, code review, and presentation grading rubrics |

## References

*Sigatapu, L., Sundar, S., & Padmalatha, K. (2023). Artificial intelligence in healthcare-An overview. Asian Journal of Pharmacy and Technology.*  
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*Sonawani, S., Patil, K., & Deshpande, N. (2023). Biomedical signal processing for health monitoring applications: a review. International Journal of Applied Systemic Studies.*  
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*Tallapragada, V. V. S. (2021). Deep Learning and Its Applications in Biomedical Image Processing. In Handbook of Deep Learning in Biomedical Engineering.*  
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*Ryzhikova, E., Ralbovsky, N. M., & Sikirzhytski, V. (2021). Raman spectroscopy and machine learning for biomedical applications: Alzheimer's disease diagnosis based on the analysis of cerebrospinal fluid. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy.*  
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*López-Úbeda, P., Díaz-Galiano, M. C., & Montejo-Ráez, A. (2020). An integrated approach to biomedical term identification systems. Applied Sciences.*  
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