

Please find below a few example projects under each topic for inspiration!

Mechanism

Single-cell transcriptomes to identify gene expressions associated with facioscapulohumeral muscular dystrophy (FSHD)

Project Goals:

1. Utilize online databases and computational/biostatistical methods, including PCA or t-SNE, to analyze single-cell RNA sequencing datasets and identify significantly overexpressed and underexpressed genes in FSHD patients.
2. Explore the individual functions of these genes or their interactions in causing FSHD
3. Outline experimental designs, such as gene knockdowns, to demonstrate the validity and effectiveness of their findings if possible.

Deliverables:

1. A research paper exploring the functions of overexpressed and underexpressed genes in FSHD, including code demos.
2. Expected experimental results demonstrating the validity and effectiveness of the team's findings, if available.

Timeline:

Morning: Conduct literature review on gene expressions associated with FSHD and find online databases

Afternoon: Identification of significantly overexpressed and underexpressed genes, and research on their individual functions or interactions.

Night: Completion of the research paper, including code demos, and potential experimental designs and results if applicable.

Investigating the Effects of Modulating the Serotonin Pathway on Behavior: A Computational Modeling Approach

Project Goals:

1. Develop a simplified computational model of the serotonin pathway
2. Simulate the effects of different levels of serotonin on behavior
3. Analyze the behavior of the simulated system to understand how modulating the serotonin pathway affects behavior

Deliverables:

1. Computational model of the serotonin pathway with simulated behavior

2. Analysis of the behavior of the simulated system under different levels of serotonin

Timeline:

Morning: Learn about the serotonin pathway and computational modeling techniques

Afternoon: Develop a simplified computational model of the serotonin pathway

Night: Simulate the effects of different levels of serotonin on behavior, analyze the behavior of the simulated system under different levels of serotonin, interpret the results of the analysis and prepare preliminary presentation

Therapy

Targeted Drug Delivery System for Cancer Therapy

Project Goals:

1. Develop a targeted drug delivery system for cancer therapy
2. Optimize the drug-loading capacity of the delivery system

Deliverables:

1. Research proposal outlining the design and synthesis of the delivery system
2. Discussion of potential clinical implications of the proposed delivery system

Timeline:

Morning: Literature review on drug delivery systems and cancer treatment

Afternoon: Start to design targeted drug delivery system

Night: Analyze data and prepare final research proposal and presentation

Investigating the Potential of Mesenchymal Stem Cells (MSCs) for Cell Therapy: A Research Proposal

Project Goals:

1. Conduct a literature review on the properties, differentiation potential, and immunomodulatory effects of Mesenchymal stem cells (MSCs), a type of adult stem cell that have shown potential for use in cell therapy.
2. Analyze the current state of knowledge about MSCs and their potential for use in cell therapy

Deliverables:

1. Research proposal outlining the analysis of the current state of knowledge about MSCs and their potential for use in cell therapy
2. Proposed research plan to further investigate the potential of MSCs for use in cell therapy

Timeline:

Morning: Conduct a literature review on the properties, differentiation potential, and immunomodulatory effects of MSCs

Afternoon: Analyze the current state of knowledge about MSCs and their potential for use in cell therapy

Night: Propose a research plan to further investigate the potential of MSCs for use in cell therapy, prepare preliminary research proposal and presentation

BME

Designing a Wearable Device to Monitor Blood Glucose Levels

Project Goals:

1. Identify the key features necessary for a wearable device that can accurately monitor blood glucose levels
2. Design a prototype device that incorporates these features
3. Test the prototype device and evaluate its accuracy in monitoring blood glucose levels

Deliverables:

1. A prototype device that can monitor blood glucose levels
2. A detailed report on the design process, including the features incorporated into the device and the testing process used to evaluate accuracy

Timeline:

Morning: Learn about the key features necessary for a wearable device that can accurately monitor blood glucose levels

Afternoon: Brainstorm, design, and build a prototype device

Evening: Continue building the prototype device, test the accuracy of the device and refine the design as necessary; Evaluate the device's accuracy and prepare a preliminary report

Building an Algorithm to Classify EEG-Based Motor Movement Neural Signals

Project goals:

1. Develop an algorithm that can classify EEG-based neural signals related to motor movement
2. Investigate various machine learning techniques and determine the most effective method for signal classification
3. Create a user-friendly interface to display the results of the classification algorithm

Deliverables:

1. A functional algorithm that can classify EEG-based neural signals related to motor movement
2. A report documenting the development process and analysis of different machine learning techniques
3. A user-friendly interface that displays the results of the classification algorithm

Timeline:

Morning: Research different machine learning techniques and choose the most promising method for classification, and gather and preprocess EEG data for training and testing the algorithm

Afternoon: Develop and train the classification algorithm, evaluate the performance of the algorithm and refine as needed

Night: Continue training and evaluating algorithm, create a user-friendly interface to display the results of the classification algorithm, and finalize the report

Public Health

Project Title: Online Mindfulness-Based Stress Reduction (MBSR) Program

Project Goals:

1. Design and develop an interactive website that provides guided mindfulness meditations and stress reduction techniques and is based on Mindfulness-Based Stress Reduction (MBSR)
2. Evaluate the effectiveness of the online program in reducing stress levels and improving mental health
3. Identify potential barriers to the adoption and implementation of online MBSR programs for college students

Deliverables:

1. Research proposal outlining the development and evaluation of the online MBSR program

2. Preliminary data demonstrating the effectiveness of the online program in reducing stress levels and improving mental health
3. Discussion of potential barriers to the adoption and implementation of online MBSR programs for college students

Timeline:

Morning: Literature review on MBSR and stress reduction

Afternoon: Design and develop the online MBSR program

Night: Continue designing the website, collect and analyze data, prepare preliminary research proposal and presentation

Analyzing COVID-19 Data to Identify Correlations and Trends

Project Goals:

1. Review relevant literature on public health policies and discuss potential implications of the findings on policy decisions
2. Utilize publicly available data on COVID-19 cases, deaths, and vaccinations
3. Develop analysis methods using programming to identify correlations and trends
4. Develop visualizations to effectively communicate the identified correlations and trends to the general public

Deliverables:

1. A report outlining the findings and potential implications for public health policy
2. Visualizations that effectively communicate the identified correlations and trends to the general public
3. Code demos demonstrating the analysis and visualization techniques used

Timeline:

Morning: Conduct literature review of current datasets and methods of analysis

Afternoon: Data collection and analysis

Night: Continue data collection and analysis, develop visualizations and write reports, finalize report and visualizations, code demos
