

# Project Definition

## Project Name:

Analyzing the Relationship Between Microglia Cell Morphology and Mitochondrial Membrane Potential for Evaluating the Effects of Light Therapy

## Team Members:

Noam Sela and Omri Peer

## Project Objective:

Post-trauma is a condition that combines psychological and physiological difficulties, including chronic brain inflammation that affects the functioning of microglia cells, the "maintenance team" of the brain. In such conditions, microglia cells remain in an over-activated state, leading to impaired mitochondrial function, the "power stations" of the cell. Dr. Lilach Gavish is researching how light therapy may improve microglia function and help restore mitochondrial activity. Our project focuses on developing a machine learning-based tool to analyze the relationship between the morphology of microglia cells and the mitochondrial membrane potential. This tool will provide precise insights into the effects of light therapy on cellular structure and function, enabling researchers to make data-driven decisions about therapy protocols.

## Innovation in the Project:

The project integrates cellular biology, image processing, and machine learning to analyze intracellular processes. The system will enable comprehensive and rapid analysis of light therapy effects, serving as a foundation for future research and improving diagnostic tools for inflammatory brain conditions.

## Data Source:

The project is based on data from Dr. Gavish's research, including images of microglia cells in various states:

- **Unstained images:** For analyzing microglia morphology.
- **Green fluorescent-stained images:** For visualizing mitochondrial distribution within the cell.
- **Red fluorescent-stained images:** For measuring mitochondrial membrane potential.

## Project Scope:

### 1. Initial Data Analysis:

- **Image processing:** Identifying cell morphology.
- **Mitochondrial localization:** Analyzing mitochondrial positioning.
- **Quantitative data extraction:** Measuring mitochondrial membrane potential levels.

### 2. Machine Learning Model Development:

- Utilizing advanced machine learning models to identify correlations between cell morphology, mitochondrial positioning, and membrane potential.

### 3. Model Evaluation:

- Testing the model's accuracy on unseen test data.

### 4. Implementation and Final Output:

- Developing a research tool capable of generating quantitative and graphical reports.

#### **5. Application Development:**

- Creating a web application allowing researchers to upload new image datasets, view previous results, and generate customized reports.

#### **Expected Outcome:**

The project will deliver a machine learning-based tool that provides fast, accurate, and user-friendly analyses to help researchers better understand the effects of light therapy on microglia cells.