BIRZEIT UNIVERSITY

## DEPARTMENT OF COMPUTER SCIENCE

COMP338 - Artificial Intelligence

Course Project
Due date: May 14, 2025

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## Project Title:

**Optimizing the 15-Dimensional Rastrigin Function Using Simulated Annealing**

## Objective:

The objective of this project is to apply the Simulated Annealing (SA) algorithm to find an approximate global minimum of the Rastrigin test function with 15 input values (15 dimensions). The function is known for its large number of local minima, making it an ideal benchmark for evaluating the effectiveness of optimization techniques.

## Problem Definition:

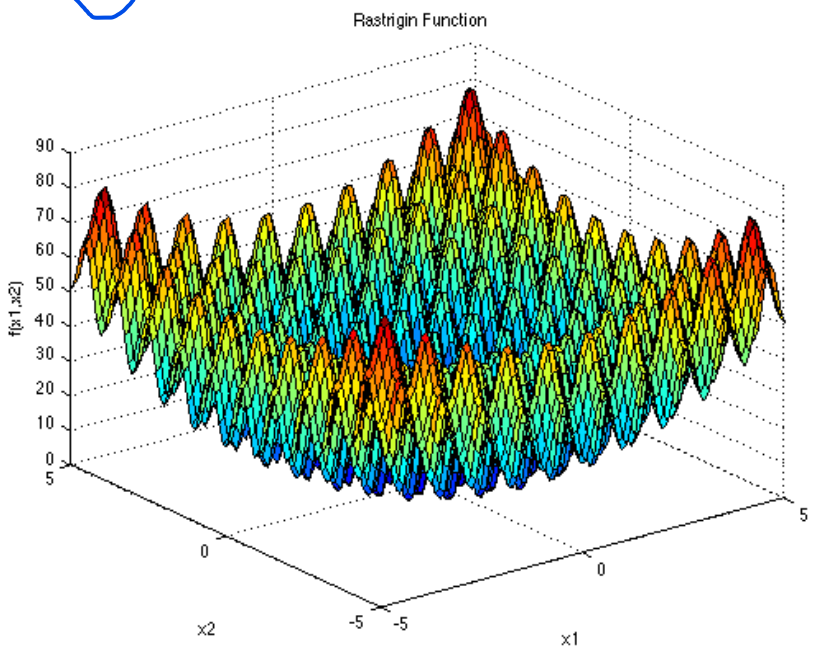
The Rastrigin function is defined as:

$$f(\mathbf{x}) = 10d + \sum_{i=1}^{d} \left[x_i^2 - 10\cos(2\pi x_i)\right]$$

Where:

- $x_i$ is value of input number $i$
- d=15 (dimensionality)
- $x_i \in [-2, 2]$ for all $i \in \{1,\ldots, 15\}$

The diagram below shows the output of two dimensional (2 inputs) Rastrigin function with many local minima and the global minimum at location (0,0):




## Evaluation Metrics:

- Final solution value f(x)
- Distance from the global minimum
- Convergence curve (value vs. iterations)
- Runtime performance

## What to Submit:

Eech team is expected to submit a working implementation of the Simulated Annealing algorithm and a Report including:

- Detailed problem formulation as explained in course material
- Visualization of the optimization process and convergence behavior: using a diagram, show how the algorithm improves its results over time (convergence rate).
- Insights and analysis on the influence of tuning parameters (temperature schedules and perturbation strategy) on the convergence rate.

## Grading Criteria:

- Grades are distributed as follows:
  Implementation: 33%
  Report: 33%
  Discussion: 33%

- For the project:
  - the quality of the final solution
  - the convergence rate
  - the choice for setting parameters

- For the report:
  - problem formulation
  - implementation explanation
  - convergence analysis
  - the process of parameter setting selection

- Discussion:
  You will be asked several questions some to verify your contribution to the project implementation and some to grade your understanding of the material itself
  Each student will be graded separately, so team members may have different scores.

## Tools and Technologies:

- Programming Language: Java or Python
- Libraries: Weka or NumPy, Matplotlib (for plotting)

## Important Rules:

- Late submissions will not be graded reply before midnight of 14th of May
- The project is a teamwork, each team consists of two students
- Team members can be from different sections
- There will be a project discussion and it will have 33% of the project scores
- Plagiarism is not tolerated and can lead to failing the whole course