Context

Google Summer of Code 2024 project on the **Python** open-source library **Sympy**, focused on performance improvements in the physics/mechanics and physics/vector modules.

Goal

Speed up linearization of systems of equations of motion for large multi-body mechanical systems. (Important for stability analysis and control of systems)

Key Results:

1- Developed **new implementation** of the jacobian() function, leveraging forward-mode automatic differentiation principles and Common Subexpression Elimination (CSE) **leading up to 2.7× faster system linearization on Sympy test benchmarks.**

2- Developed a **new implementation** of the partial_velocities() function, used by the Kane's method to compute the equations of motion, leading **up to a 24x speed-up.**