LODES (Library of ODE Solvers)

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Overview

1. Module Hierarchy

2. Modules for Discussion
   - External Interface
   - Euler's Method
   - Heun's Method
   - Output Format

Module Hierarchy

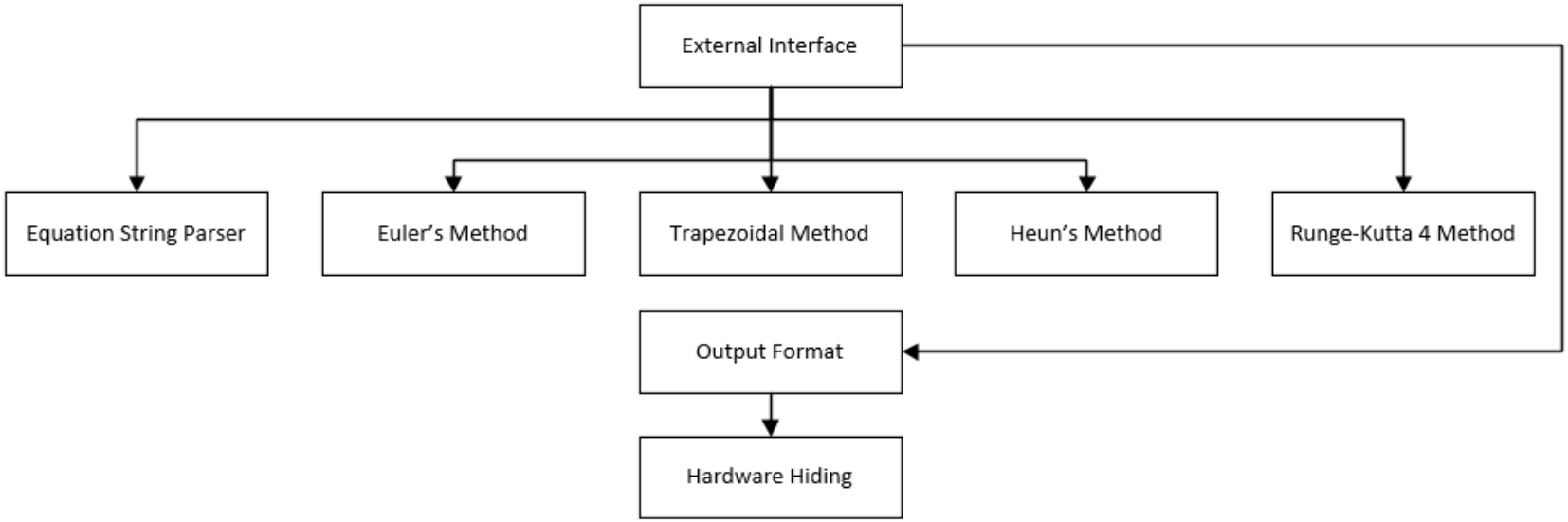

Figure: Use Hierarchy Among Modules

External Interface

- Uses:
  - Equation Parser, Euler's Method, Trapezoidal Method, Heun's Method, Runge-Kutta 4 Method, Output
- Syntax:
  - Access Routine Semantics:
    - parseEquation()
      Input: User-input ODE string
      Output: Machine-interpreted ODE
    - euler()
      Input: Machine-interpreted ODE, x_0, y_0, x_k, h Output: y_k, success
    - trap()
      Input: Machine-interpreted ODE, x_0, y_0, x_k, h Output: y_k, success
    - heun()
      Input: Machine-interpreted ODE, x_0, y_0, x_k, h Output: y_k, success
    - rk()
      Input: Machine-interpreted ODE, x_0, y_0, x_k, h Output: y_k, success
    - output()
      Input: y_k, success Output: Screen Display
  - Exceptions:
    - badEq, badX0, badY0, badXK, badH, error

Euler's Method

- Uses:
  - none
- Syntax:
  - Input: Machine-interpreted ODE (f), x_0, y_0, x_k, h
  - Output: y_k, success

Euler's Method

- Semantics:
  - output: y_k, success
    - Pseudo-code:
      success = false; x(1) = x_0;
      y(1) = y_0;
      N = (x_0 - x_k) / h
      for n = 1 to N
      x(n+1) = x(n) + h;
      y(n+1)=y(n) + h * f(x(n), y(n));
      end
      y_k = y(N)
      success = true
      return y_k, success

Heun's Method

- Uses:
  - none
- Syntax:
  - Input: Machine-interpreted ODE (f), x_0, y_0, x_k, h
  - Output: y_k, success

Heun's Method

- Semantics:
  - output: y_k, success
    - Pseudo-code:
      success = false; x(1) = x_0;
      y(1) = y_0;
      N = (x_0 - x_k) / h
      for n = 1 to N
      x(n+1) = x(n) + h;
      y(n+1)=y(n) + (h/2) * [f(x(n), y(n)) + f(x(n) + h, y(n) + h * f(x(n), y(n)))];
      end
      y_k = y(N)
      success = true
      return y_k, success

Output Format

- Uses:
  - Hardware Hiding
- Syntax:
  - Input: y_k, success
  - Output: y_k, success

The End