# SED 500

## Assignment 1

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Answers

1. Euler’s method is a straightforward numerical technique, but it may not be the most efficient method for all cases, especially when working with non-linear circuits. Some other methods that are more efficient in simulation can be:

* Improved Numerical Integration Methods: Like the Runge-Kutta family provide improved accuracy and can be more efficient. They require additional function evaluations per time step but can yield better results.
* Optimized Data Structures: Using optimized data structures for circuit components and state variables can improve simulation efficiency. Hash tables or sparse matrix representations can be applied to reduce the complexity of circuit equations.

1. By adding intelligence to the cost function through machine learning, the circuit simulation can adapt and optimize itself more efficiently, reducing the need for manual adjustments and iterations. Some of the methods can be:

* Parallel Processing: By using parallel processing, we can accelerate the learning process, especially for large circuits with complex behaviors. Distributed training of machine learning models can significantly reduce simulation time.
* Parameter Learning: We can treat the circuit component parameters (e.g., resistance, inductance, capacitance) as learnable parameters. Initialize them with some values and let the optimization algorithm adjust these parameters during the simulation to fit the circuit's actual behavior.

1. Using a predictive model or machine learning technique to directly estimate the circuit's current based on historical voltage and current values is an alternate way to implement the cost function. This method eliminates the need for manual parameter tuning and repeated iterations by providing a more straightforward and effective way to estimate the current.
2. The one thing we might change would be the selection of the language. We are using C++ in this assignment, but we would prefer Python because of its simplicity, provides a wide range of libraries and tools for scientific computing and simulation.