**Definition of a Genetic Algorithm**

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**Initial Overview of a Genetic Algorithm:**

A genetic algorithm is a searching strategy based on the Darwinist evolution theory to solve optimization problems. To utilize a genetic algorithm, an initial population must be created. Each member of the population will have a certain set of traits to be optimized over each generation. Each member of the initial population will be evaluated using a mathematical fitness function, and the fittest members of the population will be selected to produce offspring for the next generation. New generations will be created using their fittest members until the desired values in the fitness function are achieved.

**The Initial Population:**

The initial population consists of a set of solution candidates, each representing a unique configuration of the design to be optimized. Each candidate of the initial population is generated randomly to ensure diversity in the design space and to avoid early convergence on suboptimal solutions.

**Chromosomes:**

Chromosomes are how certain traits are represented in each member of a population. The chromosomes which will be used as variables for this project are chip area, delay and power consumption.

**The Fitness Function:**

To determine the success of the genetic algorithm over multiple generations, a mathematical representation of the fitness for each member of the population must be applied. From the three traits outlined in the project (chip area, delay and power consumption), a ranking of these by order of importance must be determined. Within the functions, the ranking of the traits will determine the weight of that trait’s term in the equation. For example, if the device must fit within a small container, then chip area will be the most important trait.

A fitness function where chip area is the most important trait could look like this:

Fitness = w1\*(1/areanorm) + w2\*(1/delaynorm) + w3\*(1/powernorm)

Where w1 = 0.6, w2 = 0.25 and w3 = 0.15.

Since it is desired that the chip area, delay, and power consumption are small, the variables representing them are inverted when multiplied by the weights. This ensures that the fitness score for each member of the population will increase if any of these variables should decrease.

**Generations and Selecting an Optimized Solution:**

The genetic algorithm produces an optimal result by iterating through generations, following a set of steps which create new, optimized candidates derived from the previous ones. For each generation, the members of the population are evaluated and selected to produce offspring for the next generation. This evaluation is done via the fitness function defined earlier. The selection of the fittest candidates are crossed over with each other in pairs, producing offspring which inherit traits from each parent. To maintain diversity and explore the solution space, random mutations are introduced into the offspring’s chromosome. The new offspring will replace their parents as the current generation, and this set of steps will repeat until the criterion for optimization are met.