Quantum Mechanics Enabled Genetic Programming

***Abstract*—Quantum Computing (QC) has often been touted as an esoteric and terrifying field of computing research. However, the possible advantages offered by the inherent quantum fundamentals beseeches extensive additional ventures into this field. Just as QP offers exciting ideas in the field of computing, Genetic Programming (GP) offers an application oriented optimization route. GP uses Darwinian theories to maintain a set of candidate solutions, apply multiple operations on the candidates and eventually declare a global winner. In this paper, we combine QC and a flavour of GP to create a new interdisciplinary front of computational intelligence.**

***Index Terms*—component, formatting, style, styling, insert**

I. Introduction

Majority of the problems faced in any aspect of computer science, in one way or another, involves a catch-22 of multi-functional optimization. Entire fields have been dedicated to solving a generic version of this issue. The most common method of dealing with optimization problems is to be in collaboration with another interdisciplinary frontier acting in the capacity of a helper function.

A. Computing Methodologies

Most form of computational algorithms in the present day, are executed on a conventional computer. The fundamental notation used for differentiating classicial computing (CC) and QC is the basic unit of information. While classical computers use bits 0 and 1, quantum computers use "one of" two computational basis states. The label awarded to these states is "bra-ket" notation i.e, state $|0\rangle$ or $|1\rangle$. Bits are assigned states 0 or 1 deterministically and independently. However, qbits can exist in a superposition state of $\alpha_0|0\rangle + \alpha_1|1\rangle$, where $\alpha 0$ and $\alpha 1$ are complex numbers, such that $|\alpha_0|^2 + |\alpha_1|^2 = 1$.

B. Why go Quantum?

The field of applied quantum mechanics is still unexplored for the best part. However, there are certain applications in which QC outperforms CC. Consider Shor's algorithm and RSA, both of which are used for encryption. The encryption of any form of data transmitted over the Internet relies immensley on factorization of a huge number. This process is extremley ardous for a non-quantum computer, with the best known factoring technique requiring an amount of time proportional to $2^{\mathrm{n}^{\frac{1}{3}}\,\mathrm{log(n)}^{\frac{2}{3}}}$, where *n* is the number of digits in the number to be factored.