Supplementary text

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1 Brief explanation of Grover's Algorithm

In this regard, one can define a so-called response function ($R(x)$), which classically maps the database entries to `True` or `False`, usually represented by the binary digits (bits) `0` and `1`, respectively. The response function assumes the value $R(x) = 0$ if and only if the entry x satisfies the search criteria ($x = y$). For this, one can use the so-called Oracle subroutine [1]. The Oracle's function is to query the list until it finds the searched element. Thus, as further the desired element is in the list, the greater will be the number of queries needed to find the element. In this regard, the complexity of this problem is directly related to the number of elements in the list [2, 3, 4]. On average, the complexity of this problem requires $\frac{N}{2}$ queries to the list. Therefore, the complexity of the classical search problem is defined of order $\mathcal{O}(N)$.

Grover's famous quantum search algorithm works by performing searches on unstructured databases, and consists of an application that illustrates the superiority that quantum computing power can assume over its classical counterpart [5, 6, 4, 7]. By exploiting the superposition principle, Grover's complexity is quadratically speeding up, $\mathcal{O}\left(\sqrt{N}\right)$, in contrast to the $\mathcal{O}(N)$ complexity of the classical problem [2]. The quantum superposition principle allows the algorithm to map all the database items simultaneously [8], reducing the number of steps and consequently optimizing the search process [2, 1].

References

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