Assignment Lecture 1 Encoding version 0.3

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Abstract

In this assignment you will be creating quantum circuits to convert classical to quantum data. Three encoding patterns, i.e. basis, angle and amplitude encoding, will be used in three different exercises.

Read the instructions for delivering your product in Lecture_0.

Introduction

Guidelines for this assignment:

- This exercise is done by a team of two students.
- The deadline for submitting the exercise is a week after the assignment is issued.
- You will create a Jupiter notebook for each exercise and hand in this notebook.
- In the notebook you will give ample comments on what you are doing and why.
- You will use Qiskit as a simulation tool.

1 Basis encoding

1.1 Excercise 1a

Encode the following numbers using the basis encoding pattern:

- 2,
- 3,
- 5,

- 7,
- 11,
- 13,
- 17,
- 19,
- 23,

1.2 Excercise 1b

How would you encode a negative number?

1.3 Excercise 1c

Is it possible to encode multiple numbers in one go?

1.4 Excercise 1d

All the encoding is from decimal to quantum. Make also an uncompute, i.e. from quantum to decimal.

2 Angle encoding

Encode the following numbers using the angle encoding pattern:

- 29,
- 31,
- 37,
- 41,
- 43,
- 47,
- 53,
- 59,

2.1 Excercise 1b

How would you encode a negative number?

2.2 Excercise 1c

Is it possible to encode multiple numbers in one go?

2.3 Excercise 1d

All the encoding is from decimal to quantum. Make also an uncompute, i.e. from quantum to decimal.

3 Amplitude encoding

Encode the following numbers using the amplitude encoding pattern:

- 61,
- 67,
- 71,
- 73,
- 79,
- 83,
- 89,
- 97

Use *'qc.prepare_state(state, qubits)'* as a method to create the gates needed for this encoding, where

- *qc* is the QuantumCircuit
- *state* is the list with the amplitudes
- *qubits* is the list of qubits

3.1 Excercise 1b

How would you encode a negative number?

3.2 Excercise 1c

Is it possible to encode multiple numbers in one go?

3.3 Excercise 1d

All the encoding is from decimal to quantum. Make also an uncompute, i.e. from quantum to decimal.

4 Uniform Superposition

Create a notebook which implements the Uniform Superposition pattern found at Quantum patterns.