

UNDERGRAD SEMINAR

Individual Studies on Quantum Programming

Seminar Lecture – Autumn 2019

by

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“Learning the basics of quantum computing by writing computer programs.”

Each participant studies an introductory material on the basics of quantum computing and quantum programming:

ej.uz/qintro

This material was used in European project *Quantum Drive*. ej.uz/q-drv

It is composed by Jupyter notebooks. The main programming language is Python.

The quantum programs will be coded by using qiskit library, founded by IBM Research.

No prerequisite except curiosity is needed.

- The seminar will start in September and finish before Christmas.
- Please send an e-mail to abuzer@lu.lv if you are interested in or if you have any question.

CONTENT

Test your system

- Cells in Notebook
- Hello from Quantum World

References

- Python Reference
- Python: Drawing
- Qiskit Reference

Connecting to real quantum computers

- Access IBM Q Systems *[external link]*

Python review

- Variables
- Loops
- Conditionals
- Lists

Some linear algebra

- Vectors
- Dot Product
- Matrices
- Tensor Product

Probabilistic systems

1. One Bit
2. First Quantum Program
3. Coin Flipping
4. Coin Flipping Game
5. Probabilistic States
6. Probabilistic Operators
7. Two Probabilistic Bits
8. Freivalds [optional]
9. Correlation

Basics of quantum systems

10. Quantum Coin Flipping
11. Hadamard Operator
12. One Qubit
13. Quantum State
14. Visualization of a (Real-Valued) Qubit
15. Superposition and Measurement
16. Quantum Tomography

Quantum correlation (entanglement)

17. Two Qubits
18. Phase Kickback
19. Entanglement and Superdense Coding
20. Quantum Teleportation

Operations on (real-valued) qubits

21. Reflections
22. Rotations

23. Rotation Automata [optional]
24. Multiple Control Constructions
25. Multiple Rotations [optional]

Grover's search algorithm

26. Inversion About the Mean
27. Grover's Search: One Qubit Representation
28. Grover's Search: Implementation