



Domain-oriented services and resources
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A Novel Environment for Simulation of Quantum Computing

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Objective: Design a simulator which will help to understand and learn quantum computing in an efficient way

The screenshot shows the QuIDE interface with the following components and callouts:

- 1:** Run-Time Preview of the internal quantum state (Output window)
- 2:** Run In Console button
- 3:** Source Code Editor (Teleportation.cs file)
- 4:** Interactive Circuit Designer (Circuit Designer window)
- 5:** Console Output Tab
- 6:** Properties window (Blaschke circle)
- 7:** A large set of predefined composite gates (Circuit Designer toolbar)

```
11 public static void Main() {
12     QuantumComputer comp = QuantumComputer.GetInstance();
13
14     // nontrivial state to be teleported
15     var x_initStates = new Dictionary<ulong, Complex>() {
16         {0, new Complex(-0.6, 0)},
17         {1, new Complex(0, 0.8)}
18     };
19     Register x = comp.NewRegister(x_initStates, 1);
```

Value	Qubits	Probability	Amplitude
0>	000>	P = 0.18	-0.42 + 0.00i
3>	011>	P = 0.18	-0.42 + 0.00i
5>	101>	P = 0.32	0.00 + 0.57i
6>	110>	P = 0.32	0.00 + 0.57i

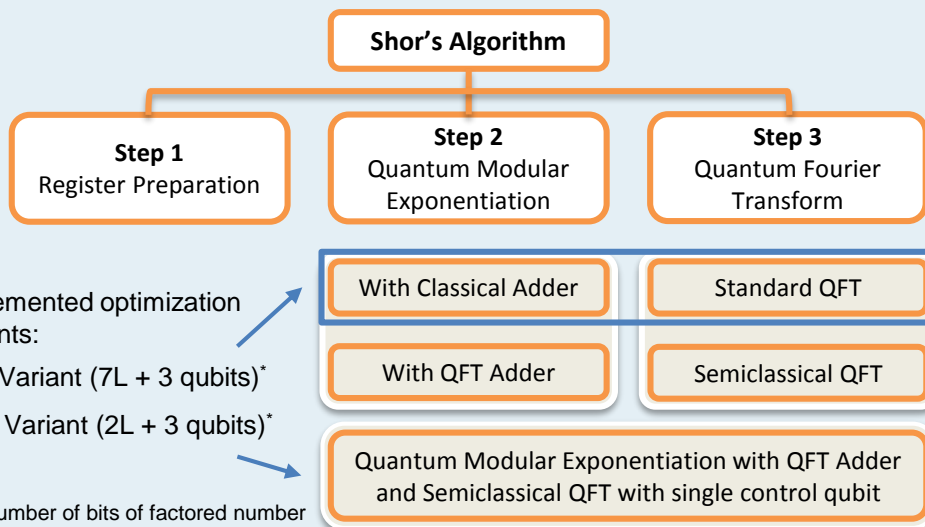
- generate the quantum circuit from the source code (1)
- generate the source code from the circuit (4)
- execute the quantum circuit in the console (2)
- evaluate the circuit step-by-step in the Run-Time Preview (3)
- group the quantum gates into composite gates (6),
- ungroup composite gate (5)
- a large set of predefined composite gates (7)

Usability Evaluation:

- QuIDE was used at the Quantum Computation classes at DCS AGH
- Usability measured by System Usability Scale surveys

Shor's Algorithm Simulation:

- Two implementation variants simulated and compared

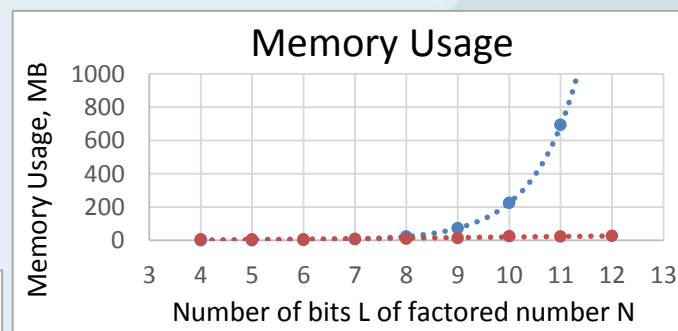
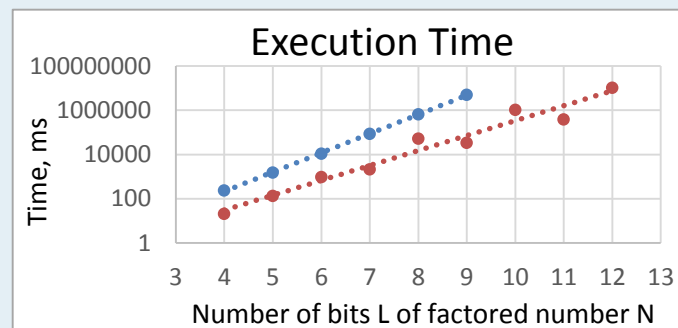
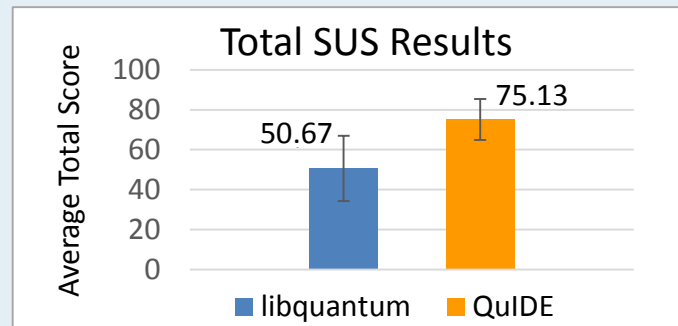


Implemented optimization variants:

- 1st Variant (7L + 3 qubits)*
- 2nd Variant (2L + 3 qubits)*

*L – number of bits of factored number

- 7L+3
- 2L+3



- *Review, analysis and simulation of quantum algorithms in cryptography*, Bartłomiej Patrzyk; **Master of Science Thesis** supervised by Katarzyna Rycerz; AGH University of Science and Technology, Kraków, Poland (September 2014)
- *Graphical and programming support for simulations of quantum computations*, Joanna Patrzyk; **Master of Science Thesis** supervised by Katarzyna Rycerz; AGH University of Science and Technology, Kraków, Poland (September 2014)

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