QIC710/CS667/CO681/PH767/AM871 Additional Project Topics

<u>More on quantum Shannon theory and information theory:</u> See also surveys (2) and (3) at then end of this document for a broad overview. The third reference makes an interesting connection with the so-called "black hole information" paradox.

C. H. Bennett, I. Devetak, A. W. Harrow, P. W. Shor, A. Winter, "Quantum Reverse Shannon Theorem". http://arxiv.org/abs/0912.5537

T. S. Cubitt, D. Leung, W. Matthews, A. Winter, "Improving zero-error classical communication with entanglement". http://arxiv.org/abs/0911.5300

P. Hayden and J. Preskill "Black holes as mirrors: quantum information in random subsystems". http://arxiv.org/abs/0708.4025

M. Horodecki, J. Oppenheim, A. Winter "Quantum information can be negative". http://arxiv.org/abs/quant-ph/0505062

G. Smith, J. Yard, "Quantum Communication With Zero-Capacity Channels". http://arxiv.org/abs/0807.4935

<u>More on the hidden subgroup problem, as well as the *hidden shift problem*:</u> See also survey (1) for a broad overview.

O. Regev, "A Subexponential Time Algorithm for the Dihedral Hidden Subgroup Problem with Polynomial Space". http://arxiv.org/abs/quant-ph/0406151

G. Ivanyos, L. Sanselme, M. Santha, "An efficient quantum algorithm for the hidden subgroup problem in nil-2 groups". http://arxiv.org/abs/0707.1260

G. Ivanyos, L. Sanselme, M. Santha, "An efficient quantum algorithm for the hidden subgroup problem in extraspecial groups". http://arxiv.org/abs/quant-ph/0701235

Van Dam, S. Hallgren, and L. Ip, "Quantum Algorithms for some Hidden Shift Problems". http://arxiv.org/abs/quant-ph/0211140

A. Childs and W. van Dam, "Quantum algorithm for a generalized hidden shift problem". http://arxiv.org/abs/quant-ph/0507190

Quantum walks: Here are a few more papers in this area. Part of the second reference and the third reference concern a *continuous-time* quantum walk.

H. Krovi, F. Magniez, M. Ozols, and J. Roland, "Finding is as easy as detecting for quantum walks". http://arxiv.org/abs/1002.2419

C. Moore and A. Russell, "Quantum Walks on the Hypercube". http://arxiv.org/abs/quant-ph/0104137

A. M. Childs, "Universal computation by quantum walk". http://arxiv.org/abs/0806.1972

Linear optics: Proposes problems that are "hard" in a complexity theoretic sense but nevertheless solvable by easily implementable quantum computers. (Warning: the definitions of the problems and their hardness are somewhat subtle.)

S. Aaronson, A. Arkhipov, "The Computational Complexity of Linear Optics". http://arxiv.org/abs/1011.3245

Approximating any unitary gate from a simple set of generating operations:

Y. Shi, "Both Toffoli and Controlled-NOT need little help to do universal quantum computation". http://arxiv.org/abs/quant-ph/0205115

Quantum computation using only measurement gates:

R. Jozsa, "An introduction to measurement based quantum computation". http://arxiv.org/abs/quant-ph/0508124

Using the mathematics of quantum information to prove theorems: There are a few mathematical theorems whose statements seem to have nothing to do with quantum information, but which have been reduced to questions about quantum information and then proved by techniques of quantum information. These are applications of quantum computing that stand whether or not one ever builds a quantum computer! (Note: this is quite different from the topic "Quantum `proof systems'," in the original list, which is also interesting but for different reasons.)

A. Drucker, R. de Wolf, "Quantum Proofs for Classical Theorems". http://arxiv.org/abs/0910.3376

Complexity of finding the minimum eigenvalue of certain Hamiltonians: Related to the "minimum energy levels" of a certain quantum mechanical systems

J. Kempe, A. Kitaev, O. Regev, "The Complexity of the Local Hamiltonian Problem". http://arxiv.org/abs/quant-ph/0406180

Surveys:

These are included for you to peruse for a broad perspective about an "area of research". You might select a topic based on a specific part of one of these surveys (the entire survey would be long). In some cases, this list (above) or the originally posted list already has an item pertaining to a section of the survey.

(1) A. Childs and W. van Dam, "Quantum algorithms for algebraic problems". http://arxiv.org/abs/0812.0380

(2) I. Devetak, A.W. Harrow, and A. Winter, "A resource framework for quantum algorithms".http://arxiv.org/abs/quant-ph/0512015

(3) G. Smith, "Quantum Channel Capacities". http://arxiv.org/abs/1007.2855

(4) J. Watrous, "Quantum Computational Complexity". http://arxiv.org/abs/0804.3401