For my 6.231 project, I am looking at implementing a vehicle routing problem. The problem will involve numerically finding the lowest cost (shortest) path in a 2D plane. The cost of covering a piece of ground will be determined by a contour plot covering the landscape. The plan is to discretize the state and control space into squares with any of the 9 directions allowed. I will compare VI and PI over the space of the problem in terms of time to convergence for various landscapes. Additionally, I’ll attempt to determine if a hybrid strategy can find a solution faster (in terms of computing time). Additionally, I will compare the quality and runtime of the rollout algorithm, using Euclidean distance as its heuristic, instead of the exact solution.

There are some possible extensions of the problem that may be investigated if time permits. One extension involves solving the traveling salesman problem over this open 2D routing. Another extension involves searching for the optimal hybrid strategy of VI and PI iterations for each landscape (using dynamic programming over the space of DP algorithms applications on the original problem). Finally, I may also look at the complications of introducing stochastic control. For example, I could consider the possibility that some surfaces are covered in black ice that may cause the vehicle to slide downhill (with probability proportional to the steepness) or skid in some other direction (with probability proportional to the speed).

Proposal B:

For my 6.231 project, I am looking at implementing a linear system solver using dynamic programming. The current goal will be to compare the performance of the solver based upon DP principles with the memory and computational time required for the direct solution of the linear system. Information on the general method is covered in Vol II Chapter 7 of “Dynamic Programming and Optimal Control” by D. Bertsekas. In addition, various papers will be used to motivate the computation of examples. Those may include, but are not limited to:

Bertsekas, D. P., and Yu, H., 2009. “Projected Equation Methods for Approximate Solution of Large Linear Systems," Journal of Computational and Applied Mathematics, Vol. 227, pp. 27-50.

Xin Xu, Han-gen He, and Dewen Hu, 2002 “Efficient Reinforcement Learning Using Recursive Least-Squares Methods” Journal Of Artificial Intelligence Research, Volume 16, pages 259-292 (arXiv:1106.0707)

Any of the other papers listed under “Simulation-Based Scientic Computation and Least Squares Inference Problems” in the project guidelines handout

Proposal C:

For my 6.231 project, I am looking at implementing a selection of dynamic vehicle routing problems. The goal of this project is to compare the various approaches and derive some insights into the effectiveness and generality of various approaches that have been suggested in the literature. This will be based upon the paper “A review of dynamic vehicle routing problems” and/or the online summary table “Benchmark data sets for dynamic vehicle routing problems”

Victor Pillac, Michel Gendreau, Christelle Guéret, Andrés L. Medaglia, A review of dynamic vehicle routing problems, European Journal of Operational Research, Volume 225, Issue 1, 16 February 2013, Pages 1-11, ISSN 0377-2217, 10.1016/j.ejor.2012.08.015.

Dr. Giselher Pankratz, Veikko Krypczyk, 2009 “Benchmark data sets for dynamic vehicle routing problems” (http://web.archive.org/web/20100415210552/http://www.fernuni-hagen.de/WINF/inhalte/benchmark\_data.htm)

Proposal D:

For my 6.231 final project, I am looking at implementing an extension of a linear solver for solving finite-differencing in parallel using dynamic programming. This combines several advanced topics in dynamic programming. There seems to be several papers written on this topic. I have included references to two of them below that may form the basis of my implementation work. If the implementation proves too difficult to achieve, I may instead present an evaluation of these papers.

S.L. Chung, F.B. Hanson, H.H. Xu, Parallel stochastic dynamic programming: finite element methods, Linear Algebra and its Applications, Volume 172, 15 July 1992, Pages 197-218, ISSN 0024-3795, 10.1016/0024-3795(92)90026-7.

Floyd B. Hanson, Techniques in computational stochastic dynamic programming, In: Cornelius T. Leondes, Editor(s), Control and Dynamic Systems, Academic Press, 1996, Volume 76, Pages 103-162, ISSN 0090-5267, ISBN 9780120127764, 10.1016/S0090-5267(96)80017-X.

(http://www.sciencedirect.com/science/article/pii/S009052679680017X)

Code for Graham V. Candler “Finite-Difference Methods for Continuous-Time Dynamic Programming”, in Ramon Marimon and Andrew Scott (eds), Computational Methods for the Study of Dynamic Economies, Chapter 8, Oxford University Press (http://ideas.repec.org/c/dge/qmrbcd/129.html)