Optimization Theory and Applications

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One-dimensional Line Search

- Golden section search (uses f)
- Fibonacci method (uses f)
- Bisection method (uses f')
- Newton's method (uses f' and f'')
- Secant method (uses f')
- Bracketing

Algorithms for Multi-dimensional Problems

- Gradient methods (steepest descent)
- Newton's method
- Conjugate direction methods
- Quasi-Newton method

Analysis of the Algorithms

- Descent property
- Convergence
- Order of convergence
- Further reading: Numerical optimization
- See a separated file for a detailed comparison

Algorithms for Multi-dimensional Problems

Initial points	Algorithm	Number of iterations	Objective value
(0,0)	Steepest descent	1159	1.163 x 10^{-10}
	Newton's method with optimal step-size	13	0.628 x 10^{-15}
	Levenberg-Marquardt modified Newton's method	16	4.7808 x 10^{-12}
(0.5,0.5)	Steepest descent	1397	1.0280 x 10^{-10}
	Newton's method with optimal step-size	11	3.5183 x 10^{-19}
	Levenberg-Marquardt modified Newton's method	10	2.4524 x 10^{-15}

Algorithms for Multi-dimensional Problems

Initial points	Algorithm	Number of iterations	Objective value
	Rank 1 formula	9	5.0071 x 10^{-15}
	DFP method	36	1.4693 x 10^{-14}
(1,1)	BFGS method	11	3.5612 x 10^{-14}
	Rank 1 formula	6	3.1693 x 10^{-13}
	DFP method	55	9.3942 x 10^{-15}
(2,2)	BFGS method	6	2.8084 x 10^{-15}

Assignment 2

- Use Matlab to implement the rank 1, DFP, and BFGS methods
- Use these algorithms to solve two problems
  - One quadratic problem (e.g., Example 11.3 or 11.4)
  - One general nonlinear problem (nonquadratic)
- Submit your codes
- Write a report showing the results for the two problems (show comparison among these algorithms and show intermediate results for the quadratic problem)
- Deadline: the end of this course

Important Dates

- In-class Quiz
  - Quiz Date: December 18
  - Time: 30 mins
  - Coverage: Lesson 1 - Lesson 9
- Final Examination
  - Date: January 15
  - Time: 10:00-12:00 am
  - Close-book test