在網格環境中動態排程最佳化問題之研究

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摘 要

在網格環境中，未知數量的Job會被使用者不斷的提出，為了提高處理單元的使用程度，因此動態排程會比傳統靜態排程來的合適。此外，當Task需要進行工作分派時，排程器(Scheduler)必須在短時間內決定服務Task的處理單元(Processing Element, or PE)。而眾多學者所提出的啟發式演算法(Heuristic Algorithms)雖然能夠產生較佳的排程結果，但由於演算法的運算時間較長，因此較不適用於網格環境。 本文提出一個用以解決：在使用者不斷提出Job的工作要求下，排程器如何分派Task至適當處理單元，並儘可能的提高處理單元的使用率並增加網格環境的產能(Throughput)。若以傳統先到先服務(First Come First Serve, or FCFS)的排程法則，越早到達系統的Job因具有較高的執行優先權，而較早開始執行。然而，工作排程考慮的因素不單單只是Job的提出時間，另外還有Task的工作負載量或是等待時間。本文提出網格環境動態排程(Dynamic Scheduling for Grid Environment, or DSGE)，採用最高回應比優先技術(Highest Response Ratio Next, or HRRN)評估Job的等待時間與服務時間，並針對Task的聯外分支度設計了最多分支優先方法(Most Outgoing Branch First, or MOBF)以決定Job處理順序的影響。相較於其他的排程策略，在實驗結果中顯示DSGE能夠以更有效率的分派Task於處理單元上執行。

關鍵詞 : 網格環境 ; 動態排程 ; 工作分派問題

目錄

參考文獻

[1] 揚錦潭, 張宸彬, “談網路應用程式架構與實作技術, ” 資訊與教育雜誌, pp. 73-87, 2001年12月.

[2] A. Silberschatz, P. Galvin, and G. Gagne “ Operating System Concepts, ” 7th Edition, Wiley & Sons, 2004. (ISBN: 0-471-69466-5).

[3] ChungNan Lee, ChuanWen Chiang, and MinFong Horng, “ Collaborative Web Computing Environment: An Infrastructure for Scientific Computation, ” IEEE Internet Computing, pp. 27-35, March and April 2000.

[4] Domenico Talia, “ The Open Grid Services Architecture: Where the Grid Meets the Web, ” IEEE Internet Computing, pp. 67-71, November and December 2002.

[5] E. Aarts and J. Korst, Simulated Annealing and Boltzmann, “ Machines: A Stochastic Approach to Combinatorial Optimization and Neural Computing, ” John Wiley & Sons, 1989.

[6] E. S. H. Hou, N. Ansari, and H. Ren, “ A Genetic Algorithm for Multiprocessor Scheduling, ” IEEE Trans. Parallel and Distributed Systems,

Vol. 5, No. 2, pp. 113-120, February 1994.
[7] Eric Yen, “ Introduction to Grid Computing, ” Grid technology and Application workshop, 2005.
[8] Glenn Wasson and Marty Humphrey, “ Policy and Enforcement in Virtual Organization, ” Fourth International Workshop on Grid Computing, 2003.
[9] H.M. Wong, D. Yu, B. Veeravalli and T.G. Robertazzi, ” Data Intensive Grid Scheduling: Multiple Sources with Capacity Constraints, ” Proc. of the IASTED International Conference on Parallel and Distributed Computing and Systems, Los Angeles, Nov. 2003.
[10] I. Foster, Argonne & U.Chicago, H. Kishimoto, Fujitsu, A. Savva, Fujitsu, D. Berry, A. Djaoui, A. Grimshaw, B. Horn, F. Maciel, F. Siebenlist, R. Subramaniam, J. Treadwell, and J. Von Reich , “ The Open Grid Services Architecture, Version 1.0, ” http://forge.gridforum.org/projects/ogsa-wg, GFD-I.030, 29 January 2005.
[11] I. -T. Hsu, Z. -Y. Huang, and S. -D. Wang, “ Dynamic Scheduling Methods for Computational Grid Environments, ” International Conferences on Parallel and Distributed Systems, Japan, Jul. 2005.
[12] Li Chunlin, Li Layuan, “ Agent framework to support the computational grid, ” Journal of Systems and Software, Vol. 70, Issues 1-2, pp. 177-187, February 2004.
[13] Li Chunlin; Li Layuan, “ An agent-based approach for grid computing, ” IEEE Parallel and Distributed Computing, Fourth International Conference, pp. 608-611, 27-29 Aug. 2003.
[14] Li Chunlin, Li Layuan, “ Apply agent to build grid service management, ” Journal of Network and Computer Applications, Vol. 26, Issue 4, pp. 323-340, November 2003.
[15] Li Chunlin, Li Layuan, “ Integrate software agents and CORBA in computational grid, ” Computer Standards & Interfaces, Vol. 25, Issue 4, pp. 357-371, August 2003.
[16] Ligang He, Stephen A. Jarvis, Daniel P. Spooner, and Graham R. Nudd, “ Optimising Static Workload Allocation in Multiclusters, ” IPDPS 2004, 2004.
[17] M. Dalheimer, F.-J. Pfreundt, and P. Merz. Calana – A General-purpose Agent-based Grid Scheduler. In Proceedings of the 14th IEEE International Symposium on High Performance Distributed Computing (HPDC-14). To appear.
[18] M. Dorigo, V. Maniezzo, and A. Colorni, “ Ant System: Optimization by a Colony of Cooperating Agents, ” IEEE Trans. System, Man and Cybernetics-Part B: Vol. 26, No. 1, February 1996.
[19] Man Lin, Lars Karlsson, and Laurence Tianruo Yang, “ Heuristic Techniques: Scheduling Partially Ordered Tasks in a Multi-processor Environment with Tabu and Genetic Algorithm, ” Proc. of the 7th International Conference on Parallel and Distributed Systems, pp.515-523, July 2000.
[20] Marcus Alexander, “ Getting to Grips with the Virtual Organization, ” Long Range Planning Vol. 30, February 1997.
[21] Mario Cannataro and Domenico Talia, “ The knowledge grid, ” Communications of the ACM, Volume 46, Pages 89-93, Number 2003.
[22] Moges, M., Yu, D., and Robertazzi, T.G. “ Grid scheduling divisible loads from multiple sources via linear programming, ” Proc. IASTED International Conference on Parallel and Distributed Computing and Systems (PDCS 2004), Cambridge, MA, Nov. 2004.
[23] R. Sethi, “ Scheduling Graphs on Two Processors, ” SIAM J. Computing, Vol. 5, No. 1, pp. 73-82, March 1976.
[24] Ramin Yahyapour, Philipp Wieder, “ Grid Scheduling Use Cas, ” Grid Scheduling Architecture Research Group (GSA-RG), GWD-I (draft-ggf-gsa-usecase-1.7), February 2006.
[25] Sivakumar Viswanathan, Bharadwaj Veeravalli, Dantong Yu, Thomas G. Robertazzi, “ Design and Analysis of a Dynamic Scheduling Strategy with Resource Estimation for Large-Scale Grid Systems, ” GRID 2004, pp. 163-170, 2004.
[26] T. C. Hu, “ Parallel Sequencing and assembly Line Problems, ” Oper. Research, Vol. 19, No. 6, pp. 244-257, April 1989.
[27] T. D. Braun, H. J. Siegel, N. Beck, L. L. Boloni, M. Maheswaran, A. I. Reuther, J. P. Robertson, M. D. Theys, B. Yao, D. Hensgen, and R. F. Freund, “ A Comparison of Eleven Static Heuristics for Mapping a Class of Independent Tasks onto Heterogeneous Distributed Computing Systems, ” Journal of Parallel and Distributed Computing, vol. 61, no. 6, pp. 810-837, June 2001.
[28] T.G. Robertazzi, “ Ten Reasons to Use Divisible Load Theory, ” IEEE Computer Society, vol. 36, no. 5, pp. 63-68, May 2003.
[29] T. L. Adam, K. Chandy, and J. Dickson, “ A Comparison of List Scheduling for Parallel Processing Systems, ” Comm. ACM, Vol. 17, No. 12, pp. 685-690, December 1974.
[30] The GridWay Project, web site, 2006. Online: www.gridway.org.
[31] The Knowledge Grid Lab, web site, 2005. Online: http://dns2.icar.cnr.it/kgrid/.
[32] Thomas Sandholm, and Jarek Gawor, “ Globus Toolkit 3 Core – A Grid Service Container Framework, ” http://www.globus.org/toolkit/downloads/3.2.1/, 2 July 2003.
[33] Tracy D. Braun, Howard Jay Siegel, Noah Beck, Ladislau Boloni, Muthucumaru Maheswaran, Albert I. Reuther, James P. Robertson, Mitchell D. Theys, Bin Yao, Debra A. Hensgen, Richard F. Freund, “ A Comparison of Eleven Static Heuristics for Mapping a Class of Independent Tasks onto Heterogeneous Distributed Computing Systems, ” J. Parallel Distrib. Comput, Vol. 61(6): pp. 810-837, 2001.
[34] VIOLA – Vertically Integrated Optical Testbed for Large Application in DFN. Project web site, 2005. Online: http://www.viola-testbed.de/.

[35] W. H. Kohler and K. Steiglitz, “ Characterization and Theoretical Comparison of Branch-and-Bound Algorithms for Permutation Problems, ” J. ACM, Vol. 21, No. 1, pp 140-156, January 1974.
[36] Yuan Pu Shao, Matthew K. O. Lee and Shao Yi Liao, “ Virtual Organizations: The Key Dimensions, ” AIWoRC, pp. 3-8, 2000.