A New Priority Rule Cloud Scheduling Technique That Utilizes Gaps to Increase The Efficiency of Jobs Distribution.

SAYDUL AKBAR MURAD

MASTER OF SCIENCE

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis, and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.

(Supervisor's Signature)
Name of Supervisor: Dr. Zafril Rizal Bin M Azmi
Position: Senior Lecturer
Date: 07/07/2023

STUDENTS'S DECLARATION

I declare that this thesis entitled "A New Priority Rule Cloud Scheduling Technique That Utilizes Gaps to Increase The Efficiency of Jobs Distribution" is the result of my own re-search except as cited in the reference. The thesis has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree

Murad

(Student's Signature)
Name: Saydul Akbar Murad
ID number: MCN21001
Date: 07/07/2023

A New Priority Rule Cloud Scheduling Technique That Utilizes Gaps to Increase The Efficiency of Jobs Distribution

Saydul Akbar Murad

Report submitted in fulfillment of the requirements for the Viva of
Master of Science

Faculty of Computing
UNIVERSITI MALAYSIA PAHANG

July 2023

ACKNOWLEDGEMENTS

First and foremost, I would like to express my deep thanks to ALLAH Almighty for the grace he blessed me throughout my life.

I am grateful and would like to express my sincere gratitude to my supervisor Dr. Zafril Rizal Bin M Azmi, for his ideas, invaluable guidance, and constant support in making this viva possible. He has always impressed me with his outstanding professional conduct and his belief in me to successfully make the report.

My sincere thanks go to all the staff of the Faculty of Computing, UMP, who helped me in many ways and made my stay at UMP pleasant and unforgettable.

ABSTRAK

Dalam beberapa tahun terakhir ini, konsep komputasi awan telah semakin mendapat perhatian untuk menyediakan akses yang meningkat secara dinamik kepada sumber daya komputasi bersama (perisian dan perkakasan) melalui internet. Tidak dirahsiakan lagi bahawa keupayaan komputasi awan untuk menyediakan perkhidmatan yang penting bagi sesuatu misi telah menjadikan penjadualan kerja sebagai topik panas dalam industri pada masa ini. Walau bagaimanapun, penggunaan sumber daya awan ini secara efisien telah menjadi cabaran, sering kali mengakibatkan pembaziran atau prestasi perkhidmatan yang terjejas disebabkan penjadualan yang lemah. Bagi menyelesaikan isu ini, penyelidikan sedia ada telah memberi tumpuan kepada teknik penjadualan kerja berdasarkan antrian, di mana kerja-kerja dijadualkan berdasarkan tarikh akhir atau panjang kerja yang tertentu. Bagi mengatasi cabaran ini, ramai penyelidik telah memberi tumpuan kepada peningkatan penjadual awan berdasarkan Peraturan Keutamaan (PR) sedia ada dengan membangunkan algoritma penjadualan dinamik, tetapi mereka belum dapat memenuhi kepuasan pengguna seperti masa aliran kerja, masa penyelesaian keseluruhan, dan masa kelewatan. Ini adalah batasan pelaksanaan semasa penjadualan berdasarkan Peraturan Keutamaan (PR) yang sedia ada, terutamanya disebabkan oleh halangan yang disebabkan oleh kerja-kerja di bahagian hadapan antrian. Batasan-batasan ini mengakibatkan prestasi yang lemah dalam aplikasi mudah alih berdasarkan awan dan perkhidmatan awan lain. Bagi menangani isu ini, objektif utama penyelidikan ini adalah untuk meningkatkan penjadual awan PR sedia ada dengan membangunkan algoritma penjadualan dinamik baru dengan memanipulasi kesenjangan dalam jadual kerja kerja-kerja awan. Dalam tesis ini, pertamanya diperkenalkan algoritma Penjadualan Adil Berdasarkan Keutamaan (PBFS) untuk menjadualkan kerja-kerja supaya kerja-kerja mendapat akses kepada sumber daya yang diperlukan pada waktu yang optimal. Kemudian, satu strategi pengisian semula yang dipanggil Penjadualan Adil Berdasarkan Keutamaan Kesenjangan Terpendek (SG-PBFS) dicadangkan yang cuba memanipulasi kesenjangan dalam jadual kerja kerja-kerja awan. Akhirnya, penilaian prestasi menunjukkan bahawa algoritma SG-PBFS yang dicadangkan mengungguli SG-SJF, SG-LJF, SG-FCFS, SG-EDF, dan SG-(MAX-MIN) dari segi masa aliran kerja, masa penyelesaian keseluruhan, dan masa kelewatan yang dengan tegas membuktikan keberkesanannya. Keputusan eksperimen menunjukkan bahawa bagi 500 kerja, SG-PBFS masa aliran kerja, masa penyelesaian keseluruhan, dan masa kelewatan adalah 9%, 4%, dan 7% lebih rendah.

ABSTRACT

In recent years, the concept of cloud computing has been gaining traction to provide dynamically increasing access to shared computing resources (software and hardware) via the internet. It's no secret that cloud computing's ability to supply mission-critical services has made job scheduling a hot subject in the industry right now. However, the efficient utilization of these cloud resources has been a challenge, often resulting in wastage or degraded service performance due to poor scheduling. To solve this issue, existing research has been focused on queue-based job scheduling techniques, where jobs are scheduled based on specific deadlines or job lengths. To overcome this challenge, numerous researchers have focused on improving existing Priority Rule (PR) cloud schedulers by developing dynamic scheduling algorithms, but they have fallen short of meeting user satisfaction, such as flowtime, makespan, and total tardiness. These are the limitations of the current implementation of existing Priority Rule (PR) schedulers, mainly caused by blocking made by jobs at the head of the queue. These limitations lead to the poor performance of cloud-based mobile applications and other cloud services. To address this issue, the main objective of this research is to improve the existing PR cloud schedulers by developing a new dynamic scheduling algorithm by manipulating the gaps in the cloud job schedule. In this thesis, first a Priority-Based Fair Scheduling (PBFS) algorithm has been introduced to schedule jobs so that jobs get access to the required resources at optimal times. Then, a backfilling strategy called Shortest Gap Priority-Based Fair Scheduling (SG-PBFS) is proposed that attempts to manipulate the gaps in the schedule of cloud jobs. Finally, the performance evaluation demonstrates that the proposed SG-PBFS algorithm outperforms SG-SJF, SG-LJF, SG-FCFS, SG-EDF, and SG-(MAX-MIN) in terms of flow time, makespan time, and total tardiness, which conclusively demonstrates its effectiveness. The experiment result shows that for 500 jobs, SG-PBFS flow time, makespan time, and tardiness time are 9%, 4%, and 7% less than PBFS gradually.

TABLE OF CONTENTS

DECLARATION

TITLE PAGE

ACKNOWLEDGEMENTS **i**

ABSTRAK **ii**

ABSTRACT **iii**

TABLE OF CONTENTS **iv**

LIST OF TABLES **vii**

LIST OF FIGURES **viii**

LIST OF ABBREVIATIONS **xi**

LIST OF APPENDICES **xiii**

CHAPTER 1 INTRODUCTION **1**

1.1 Overview 1

1.2 Problem Statement 3

1.2.1 Priority Rules Scheduler in Cloud Computing 4

1.2.2 Gap Filling Technique in Cloud Computing 6

1.3 Hypotheses 7

1.4 Research Question 7

1.5 Research Objectives 8

1.6 Research Scopes 8

1.7 Research Contributions 8

1.8 Thesis Organization 9

CHAPTER 2 LITERATURE REVIEW **10**

2.1 Overview of JST in Cloud Computing 10

2.1.1 User 11

2.1.2 Submitted Job 11
2.1.3 Resource Management 11
2.1.4 Cloud Information Service (CIS) 14
2.1.5 Datacenter 14
2.2 Taxonomy of JST in Cloud Computing 15
2.2.1 Allocation of Resources 15
2.2.2 Task Scheduling 25
2.2.3 Resource Mapping 40
2.3 Summary 42

CHAPTER 3 METHODOLOGY 43

3.1 Introduction 43
3.2 Operational Framework 43
3.3 Research Design and Procedure 43
3.3.1 Proposed Priority Rule Design in Cloud Computing 44
3.3.2 Proposed Backfilling Technique (SG- PBFS) Algorithm 48
3.3.3 Gap Searching 52
3.4 Performance Evaluation 57
3.5 Time Complexity 60
3.6 Experimental Setup 60
3.6.1 Prototype development 63
3.6.2 Environmental setup 64
3.7 Summary 69

CHAPTER 4 RESULT AND DISCUSSION 71

4.1 Introduction 71
4.1.1 Experimental result of proposed PBFS, EG-PBFS and SG-PBFS using low job load 71
4.1.2 Experimental result of proposed PBFS, EG-PBFS and SG-PBFS using median job load 78

4.1.3 Experimental result of proposed PBFS, EG-PBFS and SG-PBFS using higher number job load 84
4.1.4 Performance Comparison between PBFS, EG-PBFS and SG-PBFS 89

CHAPTER 5 CONCLUSION AND FUTURE WORK 94

5.1 Introduction 94

5.2 Research Summary 94

5.3 Future Directions and Research Opportunities 95

REFERENCES 97

APPENDICES 115

REFERENCES

Abd Elaziz, M., Xiong, S., Jayasena, K., & Li, L. (2019). Task scheduling in cloud computing based on hybrid moth search algorithm and differential evolution. *Knowledge-Based Systems*, *169*, 39–52.

Abdelmaboud, A., Jawawi, D. N., Ghani, I., Elsafi, A., & Kitchenham, B. (2015). Quality of service approaches in cloud computing: A systematic mapping study. *Journal of Systems and Software*, *101*, 159–179.

Abedi, M., & Pourkiani, M. (2020). Resource allocation in combined fog-cloud scenarios by using artificial intelligence. In *2020 fifth international conference on fog and mobile edge computing (fmec)* (pp. 218–222).

Abhishek, M. K., & Rajeswara Rao, D. (2022). A scalable framework for high-performance computing with cloud. In *Ict systems and sustainability* (pp. 225–236). Springer.

Adhikari, M., Nandy, S., & Amgoth, T. (2019). Meta heuristic-based task deployment mechanism for load balancing in iaas cloud. *Journal of Network and Computer Applications*, *128*, 64–77.

Agarwal, D., Jain, S., et al. (2014). Efficient optimal algorithm of task scheduling in cloud computing environment. *arXiv preprint arXiv:1404.2076*.

Ahmed, F., & Al Nejam, A. (2013). Cloud computing: Technical challenges and cloudsim functionalities. *International Journal of Science and Research*, *2*(2319-7064), 10.

Aladwani, T. (2020). *Types of task scheduling algorithms in cloud computing environment*. IntechOpen. https://doi.org/10.5772/intechopen.86873

Aldailamy, A. Y., Maipan-uku, J., & Muhammed, A. (2020). Heuristic task scheduling algorithms for optimal resource utilisation in grid computing. *Technology*, *11*(12), 1099–1107.

Alemnesh, G. (2020). *Time optimized hybrid scheduling algorithm for cloud computing environment* (Unpublished doctoral dissertation). ASTU.

Alhaidari, F., & Balharith, T. Z. (2021). Enhanced round-robin algorithm in the cloud computing environment for optimal task scheduling. *Computers*, *10*(5), 63.

Ali, H., Qureshi, M. S., Qureshi, M. B., Khan, A. A., Zakarya, M., & Fayaz, M. (2020). An energy and performance aware scheduler for real-time tasks in cloud datacentres. *IEEE Access*, *8*, 161288–161303.

Ali, J., Zafari, F., Khan, G. M., & Mahmud, S. A. (2013). Future clients' requests estimation for dynamic resource allocation in cloud data center using cgpann. In *2013 12th international conference on machine learning and applications* (Vol. 2, pp. 331–334).

Alkayal, E. S., Jennings, N. R., & Abulkhair, M. F. (2016). Efficient task scheduling multi-objective particle swarm optimization in cloud computing. In *2016 ieee 41st conference on local computer networks workshops (lcn workshops)* (pp. 17–24).

Alkhateeb, F., Abed-alguni, B. H., & Al-rousan, M. H. (2021). Discrete hybrid cuckoo search and simulated annealing algorithm for solving the job shop scheduling problem. *The Journal of Supercomputing*, 1–28.

Al-Maamari, A., & Omara, F. A. (2015). Task scheduling using pso algorithm in cloud computing environments. *International Journal of Grid and Distributed Computing*, *8*(5), 245–256.

Almezeini, N., & Hafez, A. (2017). Task scheduling in cloud computing using lion optimization algorithm. *International Journal of Advanced Computer Science and Applications*, *8*(11).

Alnumay, W. S. (2020). A brief study on software as a service in cloud computing paradigm. *Journal of Engineering and Applied Sciences*, *7*(1), 1–15.

Alsadie, D. (2021). Tsmgwo: optimizing task schedule using multi-objectives grey wolf optimizer for cloud data centers. *IEEE Access*, *9*, 37707–37725.

Alsaih, M. A., Latip, R., Abdullah, A., Subramaniam, S. K., & Ali Alezabi, K. (2020). Dynamic job scheduling strategy using jobs characteristics in cloud computing. *Symmetry*, *12*(10), 1638.

Alworafi, M. A., Dhari, A., El-Booz, S. A., Nasr, A. A., Arpitha, A., & Mallappa, S. (2019a). An enhanced task scheduling in cloud computing based on hybrid approach. In *Data analytics and learning* (pp. 11–25). Springer.

Alworafi, M. A., Dhari, A., El-Booz, S. A., Nasr, A. A., Arpitha, A., & Mallappa, S. (2019b). An enhanced task scheduling in cloud computing based on hybrid approach. In *Data analytics and learning* (pp. 11–25). Springer.

Alworafi, M. A., & Mallappa, S. (2020). A collaboration of deadline and budget constraints for task scheduling in cloud computing. *Cluster Computing*, *23*(2), 1073–1083.

Ananth, A., & Chandrasekaran, K. (2015). Cooperative game theoretic approach for job scheduling in cloud computing. In *2015 international conference on computing and network communications (coconet)* (pp. 147–156).

Ardagna, D., Casale, G., Ciavotta, M., Pérez, J. F., & Wang, W. (2014). Quality-of-service in cloud computing: modeling techniques and their applications. *Journal of Internet Services and Applications*, *5*(1), 1–17.

Aslam, S., & Shah, M. A. (2015). Load balancing algorithms in cloud computing: A survey of modern techniques. In *2015 national software engineering conference (nsec)* (pp. 30–35).

Astrachan, O. (2003). Bubble sort: an archaeological algorithmic analysis. *ACM Sigcse Bulletin*, *35*(1), 1–5.

Azmi, Z. R. M., Bakar, K. A., Shamsir, M. S., Manan, W. N. W., & Abdullah, A. H. (2011). Scheduling grid jobs using priority rule algorithms and gap filling techniques. *International Journal of Advanced Science and Technology*, *37*, 61–76.

Bagheri, M. H., Bagherizadeh, M., Moradi, M., & Moaiyeri, M. H. (2021). Design of cntfet-based current-mode multi-input m: 3 (4≤ m≤ 7) counters. *IETE Journal of Research*, *67*(3), 322–332.

Bansal, N., Maurya, A., Kumar, T., Singh, M., & Bansal, S. (2015). Cost performance of qos driven task scheduling in cloud computing. *Procedia Computer Science*, *57*, 126–130.

Belgacem, A., & Beghdad-Bey, K. (2021). Multi-objective workflow scheduling in cloud computing: trade-off between makespan and cost. *Cluster Computing*, 1–17.

Benny, R., & Wirawan, I. (2022). Comparison analysis of round robin algorithm with highest response ratio next algorithm for job scheduling problems. *International Journal of Open Information Technologies*, *10*(2), 21–26.

Bezdan, T., Zivkovic, M., Bacanin, N., Strumberger, I., Tuba, E., & Tuba, M. (2022). Multi-objective task scheduling in cloud computing environment by hybridized bat algorithm. *Journal of Intelligent & Fuzzy Systems*, *42*(1), 411–423.

Buyya, R., & Venugopal, S. (2004). The gridbus toolkit for service oriented grid and utility computing: An overview and status report. In *1st ieee international workshop on grid economics and business models, 2004. gecon 2004.* (pp. 19–66).

Calheiros, R. N., Ranjan, R., Beloglazov, A., De Rose, C. A., & Buyya, R. (2011). Cloudsim: a toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms. *Software: Practice and experience*, *41*(1), 23–50.

Carastan-Santos, D., De Camargo, R. Y., Trystram, D., & Zrigui, S. (2019). One can only gain by replacing easy backfilling: A simple scheduling policies case study. In *2019 19th ieee/acm international symposium on cluster, cloud and grid computing (ccgrid)* (pp. 1–10).

Chen, R., Chen, X., & Yang, C. (2022). Using a task dependency job-scheduling method to make energy savings in a cloud computing environment. *The Journal of Supercomputing*, *78*(3), 4550–4573.

Chen, X., & Long, D. (2019). Task scheduling of cloud computing using integrated particle swarm algorithm and ant colony algorithm. *Cluster Computing*, *22*(2), 2761–2769.

Cheng, F., Huang, Y., Tanpure, B., Sawalani, P., Cheng, L., & Liu, C. (2022). Cost-aware job scheduling for cloud instances using deep reinforcement learning. *Cluster Computing*, *25*(1), 619–631.

Cheng, T. C. E., & Kahlbacher, H. G. (1991). A proof for the longest-job-first policy in one-machine scheduling. *Naval Research Logistics (NRL)*, *38*(5), 715–720.

Chien, W.-C., Lai, C.-F., & Chao, H.-C. (2019). Dynamic resource prediction and allocation in c-ran with edge artificial intelligence. *IEEE Transactions on Industrial Informatics*, *15*(7), 4306–4314.

Cui, D., Peng, Z., Lin, W., et al. (2017). A reinforcement learning-based mixed job scheduler scheme for grid or iaas cloud. *IEEE Transactions on Cloud Computing*.

Dabbagh, M., Hamdaoui, B., Guizani, M., & Rayes, A. (2015). Energy-efficient resource allocation and provisioning framework for cloud data centers. *IEEE Transactions on Network and Service Management*, *12*(3), 377–391.

Dakkak, O., Awang Nor, S., & Che Mohamed Arif, A. S. (2016). Proposed algorithm for scheduling in computational grid using backfilling and optimization techniques. *Journal of Telecommunication, Electronic and Computer Engineering*, *8*(10), 133–138.

Dakkak, O., Fazea, Y., Nor, S. A., & Arif, S. (2021). Towards accommodating deadline driven jobs on high performance computing platforms in grid computing environment. *Journal of Computational Science*, *54*, 101439.

Dakkak, O., Nor, S. A., & Arif, S. (2016a). Scheduling through backfilling technique for hpc applications in grid computing environment. In *2016 ieee conference on open systems (icos)* (pp. 30–35).

Dakkak, O., Nor, S. A., & Arif, S. (2016b). Scheduling through backfilling technique for hpc applications in grid computing environment. In *2016 ieee conference on open systems (icos)* (pp. 30–35).

Danelutto, M., Fragopoulou, P., Getov, V., Baraglia, R., Capannini, G., Pasquali, M., … Techiouba, A. (2008). Backfilling strategies for scheduling streams of jobs on computational farms. In *Making grids work: Proceedings of the coregrid workshop on programming models grid and p2p system architecture grid systems, tools and environments 12-13 june 2007, heraklion, crete, greece* (pp. 103–115).

Dashti, S. E., & Rahmani, A. M. (2016). Dynamic vms placement for energy efficiency by pso in cloud computing. *Journal of Experimental & Theoretical Artificial Intelligence*, *28*(1-2), 97–112.

Deol, G. J. S., et al. (2021). Hadoop job scheduling using improvised ant colony optimization. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(2), 3417–3424.

de Weerdt, M., Baart, R., & He, L. (2021). Single-machine scheduling with release times, deadlines, setup times, and rejection. *European Journal of Operational Research*, *291*(2), 629–639.

Dubey, K., Kumar, M., & Chandra, M. A. (2015). A priority based job scheduling algorithm using iba and easy algorithm for cloud metaschedular. In *2015 international conference on advances in computer engineering and applications* (pp. 66–70).

Dubey, K., Kumar, M., & Sharma, S. (2018). Modified heft algorithm for task scheduling in cloud environment. *Procedia Computer Science*, *125*, 725–732.

Dubey, K., & Sharma, S. (2021). A novel multi-objective cr-pso task scheduling algorithm with deadline constraint in cloud computing. *Sustainable Computing: Informatics and Systems*, *32*, 100605.

Dutta, D., & Rath, S. (2022). Job scheduling on computational grids using multi-objective fuzzy particle swarm optimization. In *Soft computing: Theories and applications* (pp. 333–347). Springer.

Ebadifard, F., & Babamir, S. M. (2018). A pso-based task scheduling algorithm improved using a load-balancing technique for the cloud computing environment. *Concurrency and Computation: Practice and Experience*, *30*(12), e4368.

Eldesokey, H. M., Abd El-atty, S. M., El-Shafai, W., Amoon, M., & Abd El-Samie, F. E. (2021). Hybrid swarm optimization algorithm based on task scheduling in a cloud environment. *International Journal of Communication Systems*, *34*(13), e4694.

Endo, P. T., de Almeida Palhares, A. V., Pereira, N. N., Goncalves, G. E., Sadok, D., Kelner, J., … Mangs, J.-E. (2011). Resource allocation for distributed cloud: concepts and research challenges. *IEEE network*, *25*(4), 42–46.

Eto, Y., Tsuji, T., Takezawa, M., Takano, S., Yokogawa, Y., & Shibai, H. (1987). Purification and characterization of erythroid differentiation factor (edf) isolated from human leukemia cell line thp-1. *Biochemical and biophysical research communications*, *142*(3), 1095–1103.

Fang, K., Uhan, N., Zhao, F., & Sutherland, J. W. (2011). A new approach to scheduling in manufacturing for power consumption and carbon footprint reduction. *Journal of Manufacturing Systems*, *30*(4), 234–240.

Farooq, M. U., Shakoor, A., & Siddique, A. B. (2017). An efficient dynamic round robin algorithm for cpu scheduling. In *2017 international conference on communication, computing and digital systems (c-code)* (pp. 244–248).

Feitelson, D. G., & Weil, A. M. (1998). Utilization and predictability in scheduling the ibm sp2 with backfilling. In *Proceedings of the first merged international parallel processing symposium and symposium on parallel and distributed processing* (pp. 542–546).

Gao, X.-Z., Gurumurthy, S., & Venkatesan, S. (2015). Improved cpu utilization using advanced fuzzy based cpu scheduling algorithm (afcs). *International Journal of Electrical Sciences & Engineering (IJESE)*, *1*(1), 1–5.

Gao, Y., & Huang, C. (2021). Energy-efficient scheduling of mapreduce tasks based on load balancing and deadline constraint in heterogeneous hadoop yarn cluster. In *2021 ieee 24th international conference on computer supported cooperative work in design (cscwd)* (pp. 220–225).

Garcia, L. G., Montoya, E., Isaza, S., & Velasquez, R. A. (2021). An open edx extension for parallel programming assignments with automatic configurable grading. *International Journal of Engineering Pedagogy*, *11*(4).

Gąsior, J., & Seredyński, F. (2019). Security-aware distributed job scheduling in cloud computing systems: a game-theoretic cellular automata-based approach. In *International conference on computational science* (pp. 449–462).

Geetha, P., & Robin, C. (2021a). Power conserving resource allocation scheme with improved qos to promote green cloud computing. *Journal of Ambient Intelligence and Humanized Computing*, *12*(7), 7153–7164.

Geetha, P., & Robin, C. (2021b). Power conserving resource allocation scheme with improved qos to promote green cloud computing. *Journal of Ambient Intelligence and Humanized Computing*, *12*(7), 7153–7164.

Geetha, R., & Parthasarathy, V. (2021). An advanced artificial intelligence technique for resource allocation by investigating and scheduling parallel-distributed request/response handling. *Journal of Ambient Intelligence and Humanized Computing*, *12*(7), 6899–6909.

Ghanbari, S., & Othman, M. (2012). A priority based job scheduling algorithm in cloud computing. *Procedia Engineering*, *50*(0), 778–785.

Gharbia, R., El Baz, A. H., Hassanien, A. E., & Tolba, M. F. (2014). Remote sensing image fusion approach based on brovey and wavelets transforms. In *Proceedings of the fifth international conference on innovations in bio-inspired computing and applications ibica 2014* (pp. 311–321).

Gomathi, B., Krishnasamy, K., & Balaji, B. S. (2018). Epsilon-fuzzy dominance sort-based composite discrete artificial bee colony optimisation for multi-objective cloud task scheduling problem. *International Journal of Business Intelligence and Data Mining*, *13*(1-3), 247–266.

Gond, S., & Singh, S. (2018). Load balancing in cloud computing: A survey on comparison of two algorithms pso and sjf-mmbf. In *2018 8th international conference on communication systems and network technologies (csnt)* (pp. 62–66).

Goswami, S., & De Sarkar, A. (2013). A comparative study of load balancing algorithms in computational grid environment. In *2013 fifth international conference on computational intelligence, modelling and simulation* (pp. 99–104).

Goutam, S., & Yadav, A. K. (2015). Preemptable priority based dynamic resource allocation in cloud computing with fault tolerance. In *2015 international conference on communication networks (iccn)* (pp. 278–285).

Govindaraj, P., & Natarajan, J. (2020). Trust-based fruit fly optimisation algorithm for task scheduling in a cloud environment. *International Journal of Internet Manufacturing and Services*, *7*(1-2), 97–114.

Goyal, K., Jain, V., & Chauhan, S. (2020). Relating job scheduling algorithms on job lengths and number of cloudlets in cloud computing.

Goyal, T., Singh, A., & Agrawal, A. (2012). Cloudsim: simulator for cloud computing infrastructure and modeling. *Procedia Engineering*, *38*, 3566–3572.

Gu, K., Wu, N., Yin, B., & Jia, W. (2019). Secure data sequence query framework based on multiple fogs. *IEEE Transactions on Emerging Topics in Computing*, *9*(4), 1883–1900.

Gu, Y., Tao, J., Wu, X., & Ma, X. (2017). Online mechanism with latest-reservation for dynamic vms allocation in private cloud. *International Journal of System Assurance Engineering and Management*, *8*(3), 2009–2016.

Gupta, I., Kumar, M. S., & Jana, P. K. (2018). Efficient workflow scheduling algorithm for cloud computing system: a dynamic priority-based approach. *Arabian Journal for Science and Engineering*, *43*(12), 7945–7960.

Gupta, S., Iyer, S., Agarwal, G., Manoharan, P., Algarni, A. D., Aldehim, G., & Raahemifar, K. (2022). Efficient prioritization and processor selection schemes for heft algorithm: A makespan optimizer for task scheduling in cloud environment. *Electronics*, *11*(16), 2557.

Hamayun, M., & Khurshid, H. (2015). An optimized shortest job first scheduling algorithm for cpu scheduling. *J. Appl. Environ. Biol. Sci*, *5*(12), 42–46.

Hameed, A., Khoshkbarforoushha, A., Ranjan, R., Jayaraman, P. P., Kolodziej, J., Balaji, P., … others (2016). A survey and taxonomy on energy efficient resource allocation techniques for cloud computing systems. *Computing*, *98*(7), 751–774.

Hansen, K. (1985). [hutch housing of calves [seem, dan, em, funen, sjf]]. *Orientering. Statens Jordbrugstekniske Forsoeg (Denmark)*.

Hassan, M.-A., Kacem, I., Martin, S., & Osman, I. M. (2015a). Genetic algorithms for job scheduling in cloud computing. *Studies in Informatics and Control*, *24*(4), 387–400.

Hassan, M.-A., Kacem, I., Martin, S., & Osman, I. M. (2015b). Genetic algorithms for job scheduling in cloud computing. *Studies in Informatics and Control*, *24*(4), 387–400.

Holladay, K., Pickens, K., & Miller, G. (2017). The effect of evaluation time variance on asynchronous particle swarm optimization. In *2017 ieee congress on evolutionary computation (cec)* (pp. 161–168).

Hu, W. X., Zheng, J., Hua, X. Y., & Yang, Y. Q. (2013). A computing capability allocation algorithm for cloud computing environment. In *Applied mechanics and materials* (Vol. 347, pp. 2400–2406).

Humane, P., & Varshapriya, J. (2015). Simulation of cloud infrastructure using cloudsim simulator: A practical approach for researchers. In *2015 international conference on smart technologies and management for computing, communication, controls, energy and materials (icstm)* (pp. 207–211).

Hussain, A., & Aleem, M. (2018a). Gocj: Google cloud jobs dataset for distributed and cloud computing infrastructures. *Data*, *3*(4), 38.

Hussain, A., & Aleem, M. (2018b). Gocj: Google cloud jobs dataset for distributed and cloud computing infrastructures. *Data*, *3*(4), 38.

Hussain, A., Aleem, M., Iqbal, M. A., & Islam, M. A. (2019). Sla-ralba: cost-efficient and resource-aware load balancing algorithm for cloud computing. *The Journal of Supercomputing*, *75*(10), 6777–6803.

Ibnyaich, S., Wakrim, L., & Hassani, M. M. (2021). Nonuniform semi-patches for designing an ultra wideband pifa antenna by using genetic algorithm optimization. *Wireless Personal Communications*, *117*(2), 957–969.

Ilyushkin, A., & Epema, D. (2018). The impact of task runtime estimate accuracy on scheduling workloads of workflows. In *2018 18th ieee/acm international symposium on cluster, cloud and grid computing (ccgrid)* (pp. 331–341).

Jain, A., & Gupta, R. (2015). Gaussian filter threshold modulation for filtering flat and texture area of an image. In *2015 international conference on advances in computer engineering and applications* (pp. 760–763).

Jain, R., & Sharma, N. (2022). A deadline-constrained time-cost-effective salp swarm algorithm for resource optimization in cloud computing. *International Journal of Applied Metaheuristic Computing (IJAMC)*, *13*(1), 1–21.

Jayanthi, S. (2014). Literature review: Dynamic resource allocation mechanism in cloud computing environment. In *2014 international conference on electronics, communication and computational engineering (icecce)* (pp. 279–281).

Jena, R. (2015). Multi objective task scheduling in cloud environment using nested pso framework. *Procedia Computer Science*, *57*, 1219–1227.

Jena, R. (2017). Task scheduling in cloud environment: A multi-objective abc framework. *Journal of Information and Optimization Sciences*, *38*(1), 1–19.

Karthick, A., Ramaraj, E., & Subramanian, R. G. (2014). An efficient multi queue job scheduling for cloud computing. In *2014 world congress on computing and communication technologies* (pp. 164–166).

Kathiravelu, P., & Veiga, L. (2014). Concurrent and distributed cloudsim simulations. In *2014 ieee 22nd international symposium on modelling, analysis & simulation of computer and telecommunication systems* (pp. 490–493).

Katyal, M., & Mishra, A. (2014). Application of selective algorithm for effective resource provisioning in cloud computing environment. *arXiv preprint arXiv:1403.2914*.

Khalili, A., & Babamir, S. M. (2015). Makespan improvement of pso-based dynamic scheduling in cloud environment. In *2015 23rd iranian conference on electrical engineering* (pp. 613–618).

Kiruthiga, R., & Akila, D. (2021). Prediction-based cost-efficient resource allocation scheme for big data streams in cloud systems. In *Proceedings of first international conference on mathematical modeling and computational science* (pp. 233–242).

Klusacek, D., & Rudova, H. (2008). Improving qos in computational grids through schedule-based approach. In *Scheduling and planning applications workshop at the eighteenth international conference on automated planning and scheduling (icaps*

2008), sydney, australia.

Kodli, S., & Terdal, S. (2021). Hybrid max-min genetic algorithm for load balancing and task scheduling in cloud environment. *Int J Intell Eng Syst.*, *14*(1), 63–71.

Kopanski, J. (2021). Optimisation of job scheduling for supercomputers with burst buffers. *arXiv preprint arXiv:2111.10200*.

Kopanski, J., & Rzadca, K. (2021). Plan-based job scheduling for supercomputers with shared burst buffers. In *European conference on parallel processing* (pp. 120–135).

Kreutzer, W., Hopkins, J., & Van Mierlo, M. (1997). Simjava—a framework for modeling queueing networks in java. In *Proceedings of the 29th conference on winter simulation* (pp. 483–488).

Kumar, A. S., & Venkatesan, M. (2019). Multi-objective task scheduling using hybrid genetic-ant colony optimization algorithm in cloud environment. *Wireless Personal Communications*, *107*(4), 1835–1848.

Kumar, E. M. (2018). Cloud computing in resource management. *International Journal of Engineering and Management Research (IJEMR)*, *8*(6), 93–98.

Kumar, J., Singh, A. K., & Buyya, R. (2021). Self directed learning based workload forecasting model for cloud resource management. *Information Sciences*, *543*, 345–366.

Kumar, M., & Sharma, S. C. (2016). Priority aware longest job first (pa-ljf) algorithm for utilization of the resource in cloud environment. In *2016 3rd international conference on computing for sustainable global development (indiacom)* (pp. 415–420).

Kumar, M., & Sharma, S. C. (2018). Pso-cogent: Cost and energy efficient scheduling in cloud environment with deadline constraint. *Sustainable Computing: Informatics and Systems*, *19*, 147–164.

Kumar, M., Sharma, S. C., Goel, A., & Singh, S. P. (2019a). A comprehensive survey for scheduling techniques in cloud computing. *Journal of Network and Computer Applications*, *143*, 1–33.

Kumar, M., Sharma, S. C., Goel, A., & Singh, S. P. (2019b). A comprehensive survey for scheduling techniques in cloud computing. *Journal of Network and Computer Applications*, *143*, 1–33.

Kumar, N., & Saxena, S. (2015). A preference-based resource allocation in cloud computing systems. *Procedia computer science*, *57*, 104–111.

Kumar, R., & Sahoo, G. (2014). Cloud computing simulation using cloudsim. *arXiv preprint arXiv:1403.3253*.

Lamar, K., Goponenko, A., Peterson, C., Allan, B. A., Brandt, J. M., & Dechev, D. (2021). Backfilling hpc jobs with a multimodal-aware predictor. In *2021 ieee international conference on cluster computing (cluster)* (pp. 618–622).

Lavanya, M., Shanthi, B., & Saravanan, S. (2020). Multi objective task scheduling algorithm based on sla and processing time suitable for cloud environment. *Computer Communications*, *151*, 183–195.

Lee, H. M., Jeong, Y.-S., & Jang, H. J. (2014). Performance analysis based resource allocation for green cloud computing. *The Journal of Supercomputing*, *69*(3), 1013–1026.

Lehoczky, J. P. (1990). Fixed priority scheduling of periodic task sets with arbitrary deadlines. In *[1990] proceedings 11th real-time systems symposium* (pp. 201–209).

Lelong, J., Reis, V., & Trystram, D. (2018). Tuning easy-backfilling queues. In *Job scheduling strategies for parallel processing: 21st international workshop, jsspp 2017, orlando, fl, usa, june 2, 2017, revised selected papers 21* (pp. 43–61).

Li, C., & Li, L. (2013). Efficient resource allocation for optimizing objectives of cloud users, iaas provider and saas provider in cloud environment. *The Journal of Supercomputing*, *65*(2), 866–885.

Li, D., & Wu, J. (2014). Minimizing energy consumption for frame-based tasks on heterogeneous multiprocessor platforms. *IEEE Transactions on Parallel and Distributed Systems*, *26*(3), 810–823.

Li, F., & Hu, B. (2019). Deepjs: Job scheduling based on deep reinforcement learning in cloud data center. In *Proceedings of the 2019 4th international conference on big data and computing* (pp. 48–53).

Lifka, D. A. (1995). The anl/ibm sp scheduling system. In *Job scheduling strategies for parallel processing: Ipps'95 workshop santa barbara, ca, usa, april 25, 1995 proceedings 1* (pp. 295–303).

Lin, W., Liang, C., Wang, J. Z., & Buyya, R. (2014). Bandwidth-aware divisible task scheduling for cloud computing. *Software: Practice and Experience*, *44*(2), 163–174.

Liu, L., Mei, H., & Xie, B. (2016). Towards a multi-qos human-centric cloud computing load balance resource allocation method. *The Journal of Supercomputing*, *72*(7), 2488–2501.

Lu, Y., & Arkun, Y. (2000). Quasi-min-max mpc algorithms for lpv systems. *Automatica*, *36*(4), 527–540.

Ma, X., Gao, H., Xu, H., & Bian, M. (2019). An iot-based task scheduling optimization scheme considering the deadline and cost-aware scientific workflow for cloud computing. *EURASIP Journal on Wireless Communications and Networking*, *2019*(1), 1–19.

Mambretti, J., Chen, J., & Yeh, F. (2015). Next generation clouds, the chameleon cloud testbed, and software defined networking (sdn). In *2015 international conference on cloud computing research and innovation (icccri)* (pp. 73–79).

Manasrah, A. M., & Ba Ali, H. (2018). Workflow scheduling using hybrid ga-pso algorithm in cloud computing. *Wireless Communications and Mobile Computing*, *2018*.

Mansouri, N., & Javidi, M. M. (2020a). Cost-based job scheduling strategy in cloud computing environments. *Distributed and Parallel Databases*, *38*(2), 365–400.

Mansouri, N., & Javidi, M. M. (2020b). Cost-based job scheduling strategy in cloud computing environments. *Distributed and Parallel Databases*, *38*(2), 365–400.

Mansouri, N., Zade, B. M. H., & Javidi, M. M. (2019). Hybrid task scheduling strategy for cloud computing by modified particle swarm optimization and fuzzy theory. *Computers & Industrial Engineering*, *130*, 597–633.

Manzoor, M. F., Abid, A., Farooq, M. S., Nawaz, N. A., & Farooq, U. (2020). Resource allocation techniques in cloud computing: A review and future directions. *Elektronika ir Elektrotechnika*, *26*(6), 40–51.

Mao, Y., Chen, X., & Li, X. (2014). Max–min task scheduling algorithm for load balance in cloud computing. In *Proceedings of international conference on computer science and information technology: Csait 2013, september 21–23, 2013, kunming, china* (pp. 457–465).

Maray, M., & Shuja, J. (2022). Computation offloading in mobile cloud computing and mobile edge computing: survey, taxonomy, and open issues. *Mobile Information Systems*, *2022*.

Marphatia, A., Muhnot, A., Sachdeva, T., Shukla, E., & Kurup, L. (2013). Optimization of fcfs based resource provisioning algorithm for cloud computing. *IOSR Journal of Computer Engineering (IOSR-JCE)*, *10*(5), 1–5.

Meena, J., Kumar, M., & Vardhan, M. (2016). Cost effective genetic algorithm for workflow scheduling in cloud under deadline constraint. *IEEE Access*, *4*, 5065–5082.

Mehta, H., Prasad, V. K., & Bhavsar, M. (2017a). Efficient resource scheduling in cloud computing. *International Journal of Advanced Research in Computer Science*, *8*(3), 809–815.

Mehta, H., Prasad, V. K., & Bhavsar, M. (2017b). Efficient resource scheduling in cloud computing. *International Journal of Advanced Research in Computer Science*, *8*(3), 809–815.

Mishra, A. D., & Garg, D. (2008). Selection of best sorting algorithm. *International Journal of intelligent information Processing*, *2*(2), 363–368.

Mohamaddiah, M. H., Abdullah, A., Subramaniam, S., & Hussin, M. (2014). A survey on resource allocation and monitoring in cloud computing. *International Journal of Machine Learning and Computing*, *4*(1), 31–38.

Mohana, R. (2015). A position balanced parallel particle swarm optimization method for resource allocation in cloud. *Indian Journal of Science and Technology*, *8*(S3), 182–188.

Mondal, R. K., Nandi, E., & Sarddar, D. (2015). Load balancing scheduling with shortest load first. *International Journal of Grid and Distributed Computing*, *8*(4), 171–178.

Mousavi, S., Mosavi, A., Varkonyi-Koczy, A. R., & Fazekas, G. (2017). Dynamic resource allocation in cloud computing. *Acta Polytechnica Hungarica*, *14*(4), 83–104.

Mousavinasab, Z., Entezari-Maleki, R., & Movaghar, A. (2011). A bee colony task scheduling algorithm in computational grids. In *International conference on digital information processing and communications* (pp. 200–210).

Mu'alem, A. W., & Feitelson, D. G. (2001). Utilization, predictability, workloads, and user runtime estimates in scheduling the ibm sp2 with backfilling. *IEEE transactions on parallel and distributed systems*, *12*(6), 529–543.

Murad, S. A., Azmi, Z. R. M., Muzahid, A. J. M., & Al-Imran, M. (2021a). Comparative study on job scheduling using priority rule and machine learning. In *2021 emerging technology in computing, communication and electronics (etcce)* (pp. 1–8).

Murad, S. A., Azmi, Z. R. M., Muzahid, A. J. M., & Al-Imran, M. (2021b). Comparative study on job scheduling using priority rule and machine learning. In *2021 emerging technology in computing, communication and electronics (etcce)* (pp. 1–8).

Navimipour, N. J. (2015). Task scheduling in the cloud environments based on an artificial bee colony algorithm. In *International conference on image processing* (pp. 38–44).

Nayak, S. C., Parida, S., Tripathy, C., Pati, B., & Panigrahi, C. R. (2020). Multicriteria decision-making techniques for avoiding similar task scheduling conflict in cloud computing. *International Journal of Communication Systems*, *33*(13), e4126.

Nayak, S. C., Parida, S., Tripathy, C., & Pattnaik, P. K. (2019). Dynamic backfilling algorithm to increase resource utilization in cloud computing. *International Journal of Information Technology and Web Engineering (IJITWE)*, *14*(1), 1–26.

Nazir, S., Shafiq, S., Iqbal, Z., Zeeshan, M., Tariq, S., & Javaid, N. (2018). Cuckoo optimization algorithm based job scheduling using cloud and fog computing in smart grid. In *International conference on intelligent networking and collaborative systems* (pp. 34–46).

Nguyen, T., Nguyen, T., Vu, Q.-H., Huynh, T. T. B., & Nguyen, B. M. (2021). Multi-objective sparrow search optimization for task scheduling in fog-cloud-blockchain systems. In *2021 ieee international conference on services computing (scc)* (pp. 450–455).

Ozlen, M., & Azizoğlu, M. (2011). Rescheduling unrelated parallel machines with total flow time and total disruption cost criteria. *Journal of the Operational Research Society*, *62*(1), 152–164.

Pandi, K. M., & Somasundaram, K. (2016). Energy efficient in virtual infrastructure and green cloud computing: A review. *Indian journal of science and technology*, *9*(11), 1–8.

Panetta, C., Menk, J., Jonk, Y., Brown, A., Powers, M., & Shapiro, A. (2010). Prospective randomized clinical trial evaluating the impact of vinegar on high density lipoprotein. *Journal of the American Dietetic Association*, *110*(9), A87.

Pang, S., Li, W., He, H., Shan, Z., & Wang, X. (2019). An eda-ga hybrid algorithm for multi-objective task scheduling in cloud computing. *IEEE Access*, *7*, 146379–146389.

Parikh, S. M., Patel, N. M., & Prajapati, H. B. (2017). Resource management in cloud computing: classification and taxonomy. *arXiv preprint arXiv:1703.00374*.

Patel, K., Thakkar, A., Shah, C., & Makvana, K. (2016). A state of art survey on shilling attack in collaborative filtering based recommendation system. In *Proceedings of first international conference on information and communication technology for intelligent systems: Volume 1* (pp. 377–385).

Patel, R., & Dahiya, D. (2015). Aggregation of cloud providers: a review of opportunities and challenges. In *International conference on computing, communication & automation* (pp. 620–626).

Patel, S., & Bhoi, U. (2013). Priority based job scheduling techniques in cloud computing: a systematic review. *International journal of scientific & technology research*, *2*(11), 147–152.

Patel, S. J., & Bhoi, U. R. (2014a). Improved priority based job scheduling algorithm in cloud computing using iterative method. In *2014 fourth international conference on advances in computing and communications* (pp. 199–202).

Patel, S. J., & Bhoi, U. R. (2014b). Improved priority based job scheduling algorithm in cloud computing using iterative method. In *2014 fourth international conference on advances in computing and communications* (pp. 199–202).

Pillai, P. S., & Rao, S. (2014). Resource allocation in cloud computing using the uncertainty principle of game theory. *IEEE Systems Journal*, *10*(2), 637–648.

Pradhan, P., Behera, P. K., & Ray, B. (2016). Modified round robin algorithm for resource allocation in cloud computing. *Procedia Computer Science*, *85*, 878–890.

Pratap, R., & Zaidi, T. (2018a). Comparative study of task scheduling algorithms through cloudsim. In *2018 7th international conference on reliability, infocom technologies and optimization (trends and future directions)(icrito)* (pp. 397–400).

Pratap, R., & Zaidi, T. (2018b). Comparative study of task scheduling algorithms through cloudsim. In *2018 7th international conference on reliability, infocom technologies and optimization (trends and future directions)(icrito)* (pp. 397–400).

Praveenchandar, J., & Tamilarasi, A. (2021a). Dynamic resource allocation with optimized task scheduling and improved power management in cloud computing. *Journal of Ambient Intelligence and Humanized Computing*, *12*(3), 4147–4159.

Praveenchandar, J., & Tamilarasi, A. (2021b). Dynamic resource allocation with optimized task scheduling and improved power management in cloud computing. *Jour-*

nal of Ambient Intelligence and Humanized Computing, *12*(3), 4147–4159.

Pu, S., Escudero-Garzás, J. J., Garcia, A., & Shahrampour, S. (2020). An online mechanism for resource allocation in networks. *IEEE Transactions on Control of Network Systems*, *7*(3), 1140–1150.

Qin, H., Zawad, S., Zhou, Y., Yang, L., Zhao, D., & Yan, F. (2019). Swift machine learning model serving scheduling: a region based reinforcement learning approach. In *Proceedings of the international conference for high performance computing, networking, storage and analysis* (pp. 1–23).

Raju, R., Babukarthik, R., Chandramohan, D., Dhavachelvan, P., & Vengattaraman, T. (2013). Minimizing the makespan using hybrid algorithm for cloud computing. In *2013 3rd ieee international advance computing conference (iacc)* (pp. 957–962).

Ramezani, F., Lu, J., & Hussain, F. K. (2014). Task-based system load balancing in cloud computing using particle swarm optimization. *International journal of parallel programming*, *42*(5), 739–754.

Ramkumar, K., & Gunasekaran, G. (2019). Preserving security using crisscross aes and fcfs scheduling in cloud computing. *International Journal of Advanced Intelligence Paradigms*, *12*(1-2), 77–85.

Ravichandran, P., Krishnamurthy, K., & Parameshwaran, R. (2016). A hybrid pso-cs algorithm for parallel line job shop scheduling to minimize makespan. *World Applied Sciences Journal*, *34*(7), 878–883.

Rekha, S., & Kalaiselvi, C. (2021). Load balancing using sjf-mmbf and sjf-elm approach.

Ren, Y. M., Ding, Y., Zhang, Y., & Christofides, P. D. (2021). A three-level hierachical framework for additive manufacturing. *Digital Chemical Engineering*, *1*, 100001.

Rezvani, M., Akbari, M. K., & Javadi, B. (2015). Resource allocation in cloud computing environments based on integer linear programming. *The Computer Journal*, *58*(2), 300–314.

Rimal, B. P., & Maier, M. (2016). Workflow scheduling in multi-tenant cloud computing environments. *IEEE Transactions on parallel and distributed systems*, *28*(1), 290–304.

Rjoub, G., & Bentahar, J. (2017). Cloud task scheduling based on swarm intelligence and machine learning. In *2017 ieee 5th international conference on future internet of things and cloud (ficloud)* (pp. 272–279).

Rjoub, G., Bentahar, J., Abdel Wahab, O., & Saleh Bataineh, A. (2020). Deep and reinforcement learning for automated task scheduling in large-scale cloud computing systems. *Concurrency and Computation: Practice and Experience*, e5919.

Ruan, L., Yan, Y., Guo, S., Wen, F., & Qiu, X. (2019). Priority-based residential energy management with collaborative edge and cloud computing. *IEEE Transactions on Industrial Informatics*, *16*(3), 1848–1857.

Sahkhar, L., & Balabantaray, B. K. (2021). Scheduling cloudlets to improve response time using cloudsim simulator. In *Proceedings of the international conference on computing and communication systems: I3cs 2020, nehu, shillong, india* (pp. 483–493).

Sahraei, S. H., Kashani, M. M. R., Rezazadeh, J., & Farahbakhsh, R. (2019). Efficient job scheduling in cloud computing based on genetic algorithm. *International Journal of Communication Networks and Distributed Systems*, *22*(4), 447–467.

Sajjad, A. (2020). *Performance analysis of scheduling schemes for cloud computing resources* (Unpublished doctoral dissertation). CAPITAL UNIVERSITY.

Samriya, J. K., & Kumar, N. (2022). Spider monkey optimization based energy-efficient resource allocation in cloud environment. *Trends in Sciences*, *19*(1), 1710–1710.

Saraswathi, A., Kalaashri, Y. R., & Padmavathi, S. (2015). Dynamic resource allocation scheme in cloud computing. *Procedia Computer Science*, *47*, 30–36.

Sels, V., Gheysen, N., & Vanhoucke, M. (2012). A comparison of priority rules for the job shop scheduling problem under different flow time-and tardiness-related objective functions. *International Journal of Production Research*, *50*(15), 4255–4270.

Servranckx, T., & Vanhoucke, M. (2019). A tabu search procedure for the resource-constrained project scheduling problem with alternative subgraphs. *European Journal of Operational Research*, *273*(3), 841–860.

Shang, Q. (2021). A dynamic resource allocation algorithm in cloud computing based on workflow and resource clustering. *Journal of Internet Technology*, *22*(2), 403–411.

Shao, Z., Shao, W., & Pi, D. (2020). Effective constructive heuristic and metaheuristic for the distributed assembly blocking flow-shop scheduling problem. *Applied Intelligence*, *50*, 4647–4669.

Sheikhani, L., Lu, H., & Gu, C. (2021). Priority-based scheduling approach to minimize the sla violations in cloud environment. In *2021 7th international conference on computer and communications (iccc)* (pp. 1449–1457).

Shin, S., Kim, Y., & Lee, S. (2015). Deadline-guaranteed scheduling algorithm with improved resource utilization for cloud computing. In *2015 12th annual ieee consumer communications and networking conference (ccnc)* (pp. 814–819).

Shukri, S. E., Al-Sayyed, R., Hudaib, A., & Mirjalili, S. (2021). Enhanced multi-verse optimizer for task scheduling in cloud computing environments. *Expert Systems with Applications*, *168*, 114230.

Singh, P. (2021). Scheduling tasks based on branch and bound algorithm in cloud computing environment. In *2021 8th international conference on signal processing and integrated networks (spin)* (pp. 41–46).

Singh, S. (2015). Green computing strategies & challenges. In *2015 international conference on green computing and internet of things (icgciot)* (pp. 758–760).

Singh, S., & Chana, I. (2016). Resource provisioning and scheduling in clouds: Qos perspective. *The Journal of Supercomputing*, *72*(3), 926–960.

Sluijter, F., & van Wijngaarden, L. (1981). A brief summary of ljf broer's work up till his retirement. *Applied scientific research*, *37*(1), 4–19.

Srinivasan, S., Kettimuthu, R., Subramani, V., & Sadayappan, P. (2002). Characterization of backfilling strategies for parallel job scheduling. In *Proceedings. international conference on parallel processing workshop* (pp. 514–519).

Stavrinides, G. L., & Karatza, H. D. (2019). An energy-efficient, qos-aware and cost-effective scheduling approach for real-time workflow applications in cloud computing systems utilizing dvfs and approximate computations. *Future Generation Computer Systems*, *96*, 216–226.

Surendran, R., & Tamilvizhi, T. (2018). How to improve the resource utilization in cloud data center? In *2018 international conference on innovation and intelligence for informatics, computing, and technologies (3ict)* (pp. 1–6).

Suresh, A., & Vijayakarthick, P. (2011). Improving scheduling of backfill algorithms using balanced spiral method for cloud metascheduler. In *2011 international conference on recent trends in information technology (icrtit)* (pp. 624–627).

Tang, S., Voronov, S., & Anderson, J. H. (2021). Extending edf for soft real-time scheduling on unrelated multiprocessors. In *2021 ieee real-time systems symposium (rtss)* (pp. 253–265).

Tarahomi, M., Izadi, M., & Ghobaei-Arani, M. (2021). An efficient power-aware vm allocation mechanism in cloud data centers: a micro genetic-based approach. *Cluster Computing*, *24*(2), 919–934.

Tchendji, V. K., Myoupo, J. F., & Dequen, G. (2016). Deriving cgm based-parallel algorithms for the optimal binary search-tree problem. In *Information technology: New generations* (pp. 655–664). Springer.

Tighazoui, A., Sauvey, C., & Sauer, N. (2020). New efficiency-stability criterion in a rescheduling problem with dynamic jobs weights. In *2020 7th international conference on control, decision and information technologies (codit)* (Vol. 1, pp. 475–480).

Tiwari, S. P., & Bansal, K. K. (2021). Hybrid cs+ aco algorithm for job scheduling. , *11*(1).

Tripathy, B., Dash, S., & Padhy, S. K. (2015). Dynamic task scheduling using a directed neural network. *Journal of Parallel and Distributed Computing*, *75*, 101–106.

Vakilinia, S. (2018). Energy efficient temporal load aware resource allocation in cloud computing datacenters. *Journal of Cloud Computing*, *7*(1), 1–24.

Vinothiyalakshmi, P., & Anitha, R. (2021). Efficient dynamic resource provisioning based on credibility in cloud computing. *Wireless Networks*, *27*(3), 2217–2229.

Wang, C.-F., Hung, W.-Y., & Yang, C.-S. (2014). A prediction based energy conserving resources allocation scheme for cloud computing. In *2014 ieee international conference on granular computing (grc)* (pp. 320–324).

Wang, L., von Laszewski, G., Huang, F., Dayal, J., Frulani, T., & Fox, G. (2011). Task scheduling with ann-based temperature prediction in a data center: a simulation-based study. *Engineering with Computers*, *27*(4), 381–391.

Wang, Z., & Su, X. (2015). Dynamically hierarchical resource-allocation algorithm in cloud computing environment. *The Journal of Supercomputing*, *71*(7), 2748–2766.

Wang, Z., Zhang, J., & Si, J. (2020). Dynamic job shop scheduling problem with new job arrivals: A survey. In *Proceedings of 2019 chinese intelligent automation conference* (pp. 664–671).

Weckman, G. R., Ganduri, C. V., & Koonce, D. A. (2008). A neural network job-shop scheduler. *Journal of Intelligent Manufacturing*, *19*(2), 191–201.

Williams, L. (2021, March). *Priority scheduling algorithm: preemptive, non-preemptive example.* Retrieved 2022-03-24, from https://www.guru99.com/priority-scheduling-program.html

Wood, L., & Alsawy, S. (2018). Recovery in psychosis from a service user perspective: a systematic review and thematic synthesis of current qualitative evidence. *Community Mental Health Journal*, *54*(6), 793–804.

Xiong, A.-p., & Xu, C.-x. (2014). Energy efficient multiresource allocation of virtual machine based on pso in cloud data center. *Mathematical Problems in Engineering*, *2014*.

Xu, X., & Yu, H. (2014). A game theory approach to fair and efficient resource allocation in cloud computing. *Mathematical Problems in Engineering*, *2014*.

Yao, Y., Cao, J., & Li, M. (2013). A network-aware virtual machine allocation in cloud datacenter. In *Ifip international conference on network and parallel computing* (pp. 71–82).

Yu, M., Yang, B., & Chen, Y. (2018). Dynamic integration of process planning and scheduling using a discrete particle swarm optimization algorithm. *Advances in Production Engineering & Management*, *13*(3), 279–296.

Yuvaraj, N., Karthikeyan, T., & Praghash, K. (2021). An improved task allocation scheme in serverless computing using gray wolf optimization (gwo) based reinforcement learning (ril) approach. *Wireless Personal Communications*, *117*(3), 2403–2421.

Zhang, J., Xie, N., Zhang, X., Yue, K., Li, W., & Kumar, D. (2018). Machine learning based resource allocation of cloud computing in auction. *Comput. Mater. Continua*, *56*(1), 123–135.

Zhang, Q., Cheng, L., & Boutaba, R. (2010). Cloud computing: state-of-the-art and research challenges. *Journal of internet services and applications*, *1*(1), 7–18.

Zhang, Q., Zhu, Q., & Boutaba, R. (2011). Dynamic resource allocation for spot markets in cloud computing environments. In *2011 fourth ieee international conference on utility and cloud computing* (pp. 178–185).

Zhang, Z., Wang, H., Xiao, L., & Ruan, L. (2011). A statistical based resource allocation scheme in cloud. In *2011 international conference on cloud and service computing* (pp. 266–273).

Zhao, W., & Stankovic, J. A. (1989). Performance analysis of fcfs and improved fcfs scheduling algorithms for dynamic real-time computer systems. In *1989 real-time systems symposium* (pp. 156–157).

Zheng, J., & Wang, Y. (2021). A hybrid multi-objective bat algorithm for solving cloud computing resource scheduling problems. *Sustainability*, *13*(14), 7933.

Zhou, S., Zhang, X., Chen, B., & Van De Velde, S. (2014). Tactical fixed job scheduling with spread-time constraints. *Computers & operations research*, *47*, 53–60.

Zhu, Y., Jiang, Y., Wu, W., Ding, L., Teredesai, A., Li, D., & Lee, W. (2014). Minimizing makespan and total completion time in mapreduce-like systems. In *Ieee infocom 2014-ieee conference on computer communications* (pp. 2166–2174).