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DAFTAR PUSTAKA

[1] S. Sinha, "State of IoT 2025: Number of Connected IoT Devices Growing 14% to 21.1 Billion Globally," IoT Analytics. Accessed: Apr. 03, 2026. [Online]. Available: https://iot-analytics.com/number-connected-iot-devices/

[2] F. Golpayegani *et al.*, "Adaptation in Edge Computing: A Review on Design Principles and Research Challenges," *ACM Trans. Auton. Adapt. Syst.*, vol. 19, no. 3, pp. 1–43, Sep. 2024, doi: 10.1145/3664200.

[3] M. Ergen *et al.*, "Edge Computing in Future Wireless Networks: A Comprehensive Evaluation and Vision For 6G and Beyondd," *ICT Express*, vol. 10, no. 5, pp. 1151–1173, Oct. 2024, doi: 10.1016/j.icte.2024.08.007.

[4] I. Rojek *et al.*, "The Impact of Data Analytics Based on Internet of Things, Edge Computing, and Artificial Intelligence on Energy Efficiency in Smart Environment," *Applied Sciences*, vol. 16, no. 1, p. 225, Dec. 2025, doi: 10.3390/app16010225.

[5] Manohar, "An Introduction to Edge Computing in the Era of Connected Devices," Cavli Wireless. [Online]. Available: https://www.cavliwireless.com/blog/nerdiest-of-things/edge-computing-for-iot-real-time-data-and-low-latency-processing

[6] N. Yamsani and C. R. P, "SLA Aware Deep Reinforcement Learning for Adaptive Edge Cloud Task Scheduling," *Sci Rep*, vol. 16, no. 1, p. 10037, Feb. 2026, doi: 10.1038/s41598-026-40237-8.

[7] Y. Liu *et al.*, "Energy Efficient Task Scheduling for Heterogeneous Multicore Processors in Edge Computing," *Sci Rep*, vol. 15, no. 1, p. 11819, Apr. 2025, doi: 10.1038/s41598-025-92604-6.

[8] J. Ye *et al.*, "Artificial Intelligence for Low-Carbon Energy and Information Networks," *Nat Rev Electr Eng*, doi: 10.1038/s44287-026-00271-0.

[9] K. Ma and L. Xu, "Energy-Conscious Scheduling in Edge Environments: Hybridization of Traditional Control and DE Algorithm," *Front. Robot. AI*, vol. 12, p. 1656516, Dec. 2025, doi: 10.3389/frobt.2025.1656516.

[10] D. Sahu *et al.*, "Optimizing Energy and Latency in Edge Computing through a Boltzmann-Driven Bayesian Framework for Adaptive Resource Scheduling," *Sci Rep*, vol. 15, no. 1, p. 30452, Aug. 2025, doi: 10.1038/s41598-025-16317-6.

[11] P. Arroba *et al.*, "Sustainable Edge Computing: Challenges and Future Directions," *Softw Pract Exp*, vol. 54, no. 11, pp. 2272–2296, Nov. 2024, doi: 10.1002/spe.3340.

[12] X. Zhang and S. Debroy, "Resource Management in Mobile Edge Computing: A Comprehensive Survey," *ACM Comput. Surv.*, vol. 55, no. 13s, pp. 1–37, Dec. 2023, doi: 10.1145/3589639.

[13] H. Asghar and E.-S. Jung, "A Survey on Scheduling Techniques in the Edge Cloud: Issues, Challenges and Future Directions," 2022, *arXiv*. doi: 10.48550/ARXIV.2202.07799.

[14] X. Kong *et al.*, "Edge Computing for Internet of Everything: A Survey," *IEEE Internet Things J.*, vol. 9, no. 23, pp. 23472–23485, Dec. 2022, doi: 10.1109/JIOT.2022.3200431.

UNIVERSITAS
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[15] M. Mahbub and R. M. Shubair, "Contemporary Advances in Multi-Access Edge Computing: A survey of fundamentals, architecture, technologies, deployment cases, security, challenges, and directions," *Journal of Network and Computer Applications*, vol. 219, p. 103726, Oct. 2023, doi: 10.1016/j.jnca.2023.103726.
[16] H. Nouhas, A. Belangour, and M. Nassar, "Heuristic-Based Workload Scheduling Approaches in Edge-Cloud Environments: A Review," *IJETT*, vol. 73, no. 11, pp. 39–50, Nov. 2025, doi: 10.14445/22315381/IJETT-V73I11P104.
[17] S. Dong *et al.*, "Task Offloading Strategies for Mobile Edge Computing: A survey," *Computer Networks*, vol. 254, p. 110791, Dec. 2024, doi: 10.1016/j.comnet.2024.110791.
[18] X. Deng *et al.*, "Task Allocation Algorithm and Optimization Model on Edge Collaboration," *Journal of Systems Architecture*, vol. 110, p. 101778, Nov. 2020, doi: 10.1016/j.sysarc.2020.101778.
[19] V. Patsias *et al.*, "Task Allocation Methods and Optimization Techniques in Edge Computing: A Systematic Review of the Literature," *Future Internet*, vol. 15, no. 8, p. 254, Jul. 2023, doi: 10.3390/fi15080254.
[20] D. Sahu *et al.*, "Beyond Boundaries: A Hybrid Cellular Potts and Particle Swarm Optimization Model for Energy and Latency Optimization in Edge Computing," *Sci Rep*, vol. 15, no. 1, p. 6266, Feb. 2025, doi: 10.1038/s41598-025-90348-x.
[21] J. Zhai *et al.*, "Energy-Efficient and Latency-Aware Task Offloading for Industrial Cloud-Edge Systems With Heterogeneous CPUs and GPUs," *IEEE Internet Things J.*, vol. 12, no. 13, pp. 25757–25772, Jul. 2025, doi: 10.1109/JIOT.2025.3559690.
[22] W. Liu *et al.*, "Resource Scheduling Algorithm for Edge Computing Networks Based on Multi-Objective Optimization," *Applied Sciences*, vol. 15, no. 19, p. 10837, Oct. 2025, doi: 10.3390/app151910837.
[23] N. M. Dankolo *et al.*, "Optimizing Resource Allocation for IoT Applications in the Edge Cloud Continuum Using Hybrid Metaheuristic Algorithms," *Sci Rep*, vol. 15, no. 1, p. 14409, Apr. 2025, doi: 10.1038/s41598-025-97648-2.
[24] W. Li *et al.*, "A Hybrid GA-PSO Strategy for Computing Task Offloading Towards MES Scenarios," *PeerJ Computer Science*, vol. 9, p. e1273, Apr. 2023, doi: 10.7717/peerj-cs.1273.
[25] G. Li and J. Li, "Optimizing Low-Power Task Scheduling for Multiple Users and Servers in Mobile Edge Computing by The MUMS Framework," *Heliyon*, vol. 10, no. 11, p. e31622, Jun. 2024, doi: 10.1016/j.heliyon.2024.e31622.
[26] X. Jin *et al.*, "Task Offloading for Multi-Server Edge Computing in Industrial Internet with Joint Load Balance and Fuzzy Security," *Sci Rep*, vol. 14, no. 1, p. 27813, Nov. 2024, doi: 10.1038/s41598-024-79464-2.
[27] J. Pérez *et al.*, "Edge Computing: A Grounded Theory Study," *Computing*, vol. 104, no. 12, pp. 2711–2747, Dec. 2022, doi: 10.1007/s00607-022-01104-2.
[28] W. Z. Khan *et al.*, "Edge Computing: A Survey," *Future Generation Computer Systems*, vol. 97, pp. 219–235, Aug. 2019, doi: 10.1016/j.future.2019.02.050.

UNIVERSITAS
GADJAH MADA
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[29] L. Cao *et al.*, "Cost Optimization in Edge Computing: a Survey," *Artif Intell Rev*, vol. 57, no. 11, p. 312, Oct. 2024, doi: 10.1007/s10462-024-10947-4.
[30] G. Carvalho *et al.*, "Edge Computing: Current Trends, Research Challenges and Future Directions," *Computing*, vol. 103, no. 5, pp. 993–1023, May 2021, doi: 10.1007/s00607-020-00896-5.
[31] H. Topcuoglu, S. Hariri, and Min-You Wu, "Performance-Effective and Low-Complexity Task Scheduling for Heterogeneous Computing," *IEEE Trans. Parallel Distrib. Syst.*, vol. 13, no. 3, pp. 260–274, Mar. 2002, doi: 10.1109/71.993206.
[32] Y. Mao *et al.*, "A Survey on Mobile Edge Computing: The Communication Perspective," 2017, *arXiv*. doi: 10.48550/ARXIV.1701.01090.
[33] W. Shi *et al.*, "Edge Computing: Vision and Challenges," *IEEE Internet Things J.*, vol. 3, no. 5, pp. 637–646, Oct. 2016, doi: 10.1109/JIOT.2016.2579198.
[34] E. M. Ali *et al.*, "Analysis of Deep Reinforcement Learning Algorithms for Task Offloading and Resource Allocation in Fog Computing Environments," *Sensors*, vol. 25, no. 17, p. 5286, Aug. 2025, doi: 10.3390/s25175286.
[35] M. O. Okello, "Time Governed Multi-Objective Optimization," *EPSTEM*, vol. 16, pp. 167–181, Dec. 2021, doi: 10.55549/epstem.1068585.
[36] L. Yang *et al.*, "Task Offloading Strategy of Multi-Objective Optimization Algorithm Based on Particle Swarm Optimization in Edge Computing," *Applied Sciences*, vol. 15, no. 17, p. 9784, Sep. 2025, doi: 10.3390/app15179784.
[37] K. Deb, *Multi-Objective Optimization using Evolutionary Algorithms*. in Wiley Interscience Series in Systems and Optimization. Wiley, 2001. [Online]. Available: https://books.google.co.id/books?id=OSTn4GSy2uQC
[38] S. S. Rao, *Engineering Optimization: Theory and Practice*, 1st ed. Wiley, 2009. doi: 10.1002/9780470549124.
[39] J. Crank, *The Mathematics of Diffusion*, 2d ed. Oxford, [Eng]: Clarendon Press, 1975.
[40] G. Cybenko, "Dynamic Load Balancing for Distributed Memory Multiprocessors," *Journal of Parallel and Distributed Computing*, vol. 7, no. 2, pp. 279–301, Oct. 1989, doi: 10.1016/0743-7315(89)90021-X.
[41] F. Graner and J. A. Glazier, "Simulation of Biological Cell Sorting Using a Two-Dimensional Extended Potts Model," *Phys. Rev. Lett.*, vol. 69, no. 13, pp. 2013–2016, Sep. 1992, doi: 10.1103/PhysRevLett.69.2013.
[42] F. Glover, "Tabu Search—Part I," *ORSA Journal on Computing*, vol. 1, no. 3, pp. 190–206, Aug. 1989, doi: 10.1287/ijoc.1.3.190.
[43] H. Rhim and M. Simic, "Tabu Search." [Online]. Available: https://www.baeldung.com/cs/tabu-search
[44] F. Glover and M. Laguna, *Tabu Search*. Boston, MA: Springer US, 1997. doi: 10.1007/978-1-4615-6089-0.
[45] M. Kaleia, "Tabu Search — gentle introduction." [Online]. Available: https://medium.com/%40m.kaleia/tabu-search-gentle-introduction-46c479eb6525

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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[46] J. Kennedy and R. Eberhart, "Particle Swarm Optimization," in *Proceedings of ICNN'95 - International Conference on Neural Networks*, Perth, WA, Australia: IEEE, 1995, pp. 1942–1948. doi: 10.1109/ICNN.1995.488968.

[47] Y. Shi and R. Eberhart, "A Modified Particle Swarm Optimizer," in *1998 IEEE International Conference on Evolutionary Computation Proceedings. IEEE World Congress on Computational Intelligence (Cat. No.98TH8360)*, Anchorage, AK, USA: IEEE, 1998, pp. 69–73. doi: 10.1109/ICEC.1998.699146.

[48] M. Clerc and J. Kennedy, "The Particle Swarm - Explosion, Stability, and Convergence in a Multidimensional Complex Space," *IEEE Trans. Evol. Computat.*, vol. 6, no. 1, pp. 58–73, Feb. 2002, doi: 10.1109/4235.985692.

[49] R. W. Putri, "BAB III Particle Swarm Optimization," Perpustkaan Digital ITB. [Online]. Available: https://digilib.itb.ac.id/assets/files/2019/2015_TS_PP_RINI_WIDIA_PUTRI_Z_1-BAB_3.pdf

[50] K. M. Passino, "Biomimicry of Bacterial Foraging for Distributed Optimization and Control," *IEEE Control Syst.*, vol. 22, no. 3, pp. 52–67, Jun. 2002, doi: 10.1109/MCS.2002.1004010.

[51] S. Das *et al.*, "Bacterial Foraging Optimization Algorithm: Theoretical Foundations, Analysis, and Applications," in *Foundations of Computational Intelligence Volume 3*, vol. 203, A. Abraham, A.-E. Hassanien, P. Siarry, and A. Engelbrecht, Eds., in Studies in Computational Intelligence, vol. 203. , Berlin, Heidelberg: Springer Berlin Heidelberg, 2009, pp. 23–55. doi: 10.1007/978-3-642-01085-9_2.

[52] Q. Luo *et al.*, "Resource Scheduling in Edge Computing: A Survey," *IEEE Commun. Surv. Tutorials*, vol. 23, no. 4, pp. 2131–2165, 2021, doi: 10.1109/COMST.2021.3106401.

[53] A. Abouaomar *et al.*, "Resource Provisioning in Edge Computing for Latency-Sensitive Applications," *IEEE Internet Things J.*, vol. 8, no. 14, pp. 11088–11099, Jul. 2021, doi: 10.1109/JIOT.2021.3052082.

[54] Z.-Y. Tong and J. Wang, "Research on Computing Task Offloading Mechanism Based on Cloud-Edge Collaboration," *JOC*, pp. 173–190, Jun. 2025, doi: 10.63367/19911599202506360 3012.

[55] O. J. Boxma and M. Vlasiou, "On Queues with Service and Interarrival Times Depending on Waiting Times," *Queueing Syst*, vol. 56, no. 3–4, pp. 121–132, Aug. 2007, doi: 10.1007/s11134-007-9011-3.

[56] R. L. Graham, "Bounds on Multiprocessing Timing Anomalies," *SIAM J. Appl. Math.*, vol. 17, no. 2, pp. 416–429, Mar. 1969, doi: 10.1137/0117039.

[57] S. Hartmann and D. Briskorn, "A Survey of Variants and Extensions of The Resource-Constrained Project Scheduling Problem," *European Journal of Operational Research*, vol. 207, no. 1, pp. 1–14, Nov. 2010, doi: 10.1016/j.ejor.2009.11.005.

[58] X. Fan, W.-D. Weber, and L. A. Barroso, "Power Provisioning for a Warehouse-Sized Computer," *SIGARCH Comput. Archit. News*, vol. 35, no. 2, pp. 13–23, Jun. 2007, doi: 10.1145/1273440.1250665.

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GADJAH MADA
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[59] S. Deng *et al.*, "Edge Intelligence: The Confluence of Edge Computing and Artificial Intelligence," *IEEE Internet Things J.*, vol. 7, no. 8, pp. 7457–7469, Aug. 2020, doi: 10.1109/JIOT.2020.2984887.
[60] C. Gea, K. J. D. Lase, and M. Syamsudin, "Implementasi Virtual Private Server untuk Mini Hosting," *JURNAL INFACT*, vol. 7, no. 01, pp. 5–9, Jan. 2023, doi: 10.61179/jurnalinfact.v7i01.402.
[61] R. Kaur and S. Chopra, "Virtualization In Cloud Computing : A Review," *IJSRCSEIT*, pp. 01–05, Jul. 2020, doi: 10.32628/CSEIT20641.
[62] J. Wilkes and C. Reiss, "ClusterData 2011 traces." Github repository, Google Storage for Developers. [Online]. Available: https://github.com/google/cluster-data/blob/master/ClusterData2011_2.md
[63] C. Reiss *et al.*, "Heterogeneity and Dynamicity of Clouds at Scale: Google trace analysis," in *Proceedings of the Third ACM Symposium on Cloud Computing*, San Jose California: ACM, Oct. 2012, pp. 1–13. doi: 10.1145/2391229.2391236.
[64] G. Amvrosiadis *et al.*, "On The Diversity of Cluster Workloads and Its Impact on Research Resu," 2018.