

# Curriculum Vitae

## Wes J. Lloyd

Assistant Professor, University of Washington – Tacoma

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Home Page: <http://faculty.washington.edu/wlloyd>

### 1 Research Interests

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My research interests span cloud computing, distributed systems, and software engineering. I have extensive experience in performance analysis and characterization of Infrastructure-as-a-Service, container-based, and serverless cloud computing software systems. My research focuses on leveraging machine learning and statistical techniques to model application performance, address scaling, autonomy, and resource management. By harnessing software and system level metrics I develop data analytics to better quantify performance and autonomously manage complex systems. My research helps scientists and practitioners improve the performance and availability of applications leveraging cloud computing technologies to reduce hosting costs.

### 2 Education

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- 2014 Ph.D. Computer Science, Colorado State University, Fort Collins, Colorado  
*Advisor:* Professor Shrideep Pallickara
- 2001 M.S. Computer Science and Applications, Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, Virginia  
*Co-Advisors:* Professor Mary Beth Rosson, Professor Stephen Edwards
- 1997 B.S. Computer Science and Engineering, University of Toledo, Toledo, Ohio

### 3 Professional Experience

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Sept 23 -	Associate Professor	Computer Science and Systems, School of Engineering and Technology University of Washington - Tacoma
Jul 16 -	Affiliate Faculty	Department of Civil and Environmental Engineering Colorado State University
Sept 16 - Aug 22	Assistant Professor	Computer Science and Systems, School of Engineering and Technology University of Washington - Tacoma
Jan 15 - Jul 16	Research Scientist	Department of Civil and Environmental Engineering Colorado State University, in cooperation with the US Department of Agriculture, Agricultural Research Services and Natural Resources Conservation Service
Jul 07 – Dec 14	Research Associate	Department of Civil and Environmental Engineering Colorado State University, in cooperation with the US Department of Agriculture, Agricultural Research Services and Natural Resources Conservation Service
Nov 04 – Jul 07	Software Engineer	US Geological Survey and US Fish and Wildlife Service, Fort Collins Science Center, contractor

Jan 03 – Nov 04	Development Manager	Continuing Education Department, Colorado State University
Aug 01 – Dec 02	Software Engineer	Hewlett Packard Fort Collins, Colorado
Aug 00 – Aug 01	Research Assistant	Department of Computer Science, Virginia Tech
May 00 – Aug 00	Software Dev. Intern	IBM Research Triangle Park, North Carolina
Aug 99 – May 00	Teaching Assistant	Department of Computer Science, Virginia Tech
Jan 98 – Jan 00	Software Dev. Consultant	Netstar Corporation (Owens Illinois Consultant), Bloomfield Hills, MI
Nov 95 – Jan 98	Software Engineer	Matrix Technologies (Owens Illinois Consultant), Toledo, Ohio
Jun 94 – Nov 95	Instructor/Developer	National Center for Tooling and Precision Components, Toledo, Ohio
Jun 93 – Dec 96	Engineering Technician	The Mack Iron Works Company, Sandusky, Ohio

## 4 Publications

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Last author indicates project leadership in Computer Science publications.

### 4.1 Original Journal Publications

- [59] Hung, L.H., Nasam, N., **Lloyd, W.**, Yeung, K. Y., Single cell RNA sequencing data processing using cloud-based serverless computing. bioRxiv preprint:650787, April 2025.  
Role: Manuscript review and technical mentorship
- [58] Hung, L.H., Fukuda, B., Schmitz, R., Hoang, V., **Lloyd, W.**, Yeung, K. Y., Harmonizing and integrating the NCI Genomic Data Commons through accessible, interactive, and cloud-enabled workflows. PloS one. 20(3), March 2025, e0318676.  
Role: Manuscript review and technical mentorship
- [57] Hoang, V., Hung, L.H., Perez, D., Deng, H., Schooley, R., Arumilli, N., Yeung, K.Y., **Lloyd, W.**, Container Profiler: Profiling Resource Utilization of Containerized Big Data Pipelines, GigaScience, Volume 12, (August) 2023, giad069.  
Role: Project/technical leadership and manuscript co-authorship
- [56] Guan, X., Chen, C., Ren, I., Yeung, K. Y., Hung, L. H., **Lloyd, W.** (2022). Mobility Analysis Workflow (MAW): An accessible, interoperable, and reproducible container system for processing raw mobile data. arXiv preprint arXiv:2204.09125, April 2022.  
Submission planned to Springer Transportation  
Role: Manuscript review and technical mentorship
- [55] Hung, L.H., Niu, X., **Lloyd, W.**, Yeung, K.Y., Accessible and interactive RNA sequencing analysis using serverless computing, bioRxiv preprint:576199 v2, 17 p., October 2020.  
Under revision for submission to Nature Methods.  
Role: Manuscript review and technical mentorship

- [54] Hung, L.H., Hu, J., Meiss, T., Ingersoll, A., **Lloyd, W.**, Kristiyanto, D., Xiong, Y., Sobie, E., Yeung, K.Y., Building Containerized Workflows Using the BioDepot-workflow-builder (Bwb), Cell Systems, doi: 10.1016/j.cels.2019.08.007, pp. 508-514, September 2019. [Impact Factor 8.67]  
Role: Manuscript review
- [53] Hung L.H., **Lloyd W.**, Agumbe S.R., Devi A.R., Xiong Y., Sobie E., Yeung K.Y., Holistic optimization of an RNA-seq workflow for multi-threaded environments. Bioinformatics (Oxford, England), pp.4173-4175, March 2019. [Impact Factor 5.61]  
Role: Manuscript review and technical mentorship
- [52] Kumanov D., Hung L.H., **Lloyd W.**, Yeung K.Y., Serverless computing provides on-demand high performance computing for biomedical research. arXiv preprint arXiv:1807.11659, 11 p., July 2018.  
Role: Manuscript review and technical mentorship
- [51] Zhang, P., Hung, L.H., **Lloyd, W.**, Yeung, K.Y., Hot-starting software containers for STAR aligner. GigaScience, 31;7(8), 5p, 2018. [Impact Factor 5.99]  
Role: Manuscript review and technical mentorship
- [50] **Lloyd, W.**, Pallickara, S., David, O., Arabi, M., Rojas, K., Wible, T., Ditty, J., Demystifying the Clouds: Harnessing Resource Utilization Models for Cost Effective Infrastructure Alternatives. IEEE Transactions on Cloud Computing, 2017 5(4): pp. 667-680, Oct 2017. [Impact Factor 4.71]  
Role: Manuscript author and implemented project research
- [49] Dozier, A., David, O., Arabi, M., **Lloyd, W.**, Zhang, Y., A minimally invasive model data passing interface for integrating legacy environmental system models. Submitted to Environmental Modelling & Software. Vol. 80 (6): pp. 265-280, June 2016. Elsevier. [Impact Factor 4.81]  
Role: Manuscript review and technical mentorship
- [48] David, O., Ascough, J., **Lloyd, W.**, Green, T., Rojas, K., Leavesley, G., Ajuha, L., 2013, A software engineering perspective on environmental modeling framework design: The Object Modeling System. Environmental Modelling & Software, Special Issue. vol. 39 (1): pp. 201-213, Jan 2013. Elsevier. [Impact Factor 4.81]  
Role: Manuscript co-author and implemented project research
- [47] **Lloyd, W.**, Pallickara, S., David, O., Lyon, J., Arabi, M., Rojas, K., 2013, Performance Implications of Multi-Tier Application Deployments on Infrastructure-as-a-Service Clouds: Towards Performance Modeling, Future Generation Computer Systems Journal, Special Issue: Model driven Provisioning of Application Services in Hybrid Computing Environments. vol. 29 (5): pp. 1254-1264, May 2013. Elsevier. [Impact Factor 6.13]  
Role: Manuscript author and implemented project research

[46] **Lloyd, W.**, David, O., Ascough II, J.C., Rojas, K.W., Carlson, J.R., Leavesley, G.H., Krause, P., Green, T.R., Ahuja, L.R., Environmental modeling framework invasiveness: Analysis and implications. *Environmental Modelling & Software* 26(10): pp. 1240-1250, 2011. Elsevier. [Impact Factor 4.81]  
Role: Manuscript author and implemented project research

[45] **Lloyd, W.**, A Common Criteria Based Approach for COTS Component Selection. *Journal of Object Technology*, 4(3): pp.25-32, 2004. [Impact Factor 1.31]  
Role: Project/technical mentorship and manuscript co-authorship

#### 4.2 Conference Proceedings (peer reviewed)

[44] Chen, X., Cordingly, R., Hung, L.H., **Lloyd, W.**, Predicting ARM64 Serverless Function Runtime: Leveraging function profiling for generalized performance models, 2024 17th IEEE/ACM Int. Conf. on Utility and Cloud Computing (UCC 2024), Dec 16-19, 2024, 10p. [Acceptance Rate 35%]  
Role: Project/technical mentorship and manuscript co-authorship

[43] Jin, R., Cordingly, R., Zhao, D., **Lloyd, W.**, GraphQL vs. REST: A Performance and Cost Investigation for Serverless Applications, 2024 10th International Workshop on Serverless Computing (WOSC 2024), Dec 2-5, 2024.  
Role: Project/technical mentorship and manuscript co-authorship

[42] Kaur, J., Cordingly, R., Hung, L.H., **Lloyd, W.**, Towards Low-Cost Global Highly Available Large Container-Based Serverless Functions, 2024 8th IEEE Cloud Summit, June 27-28, 2024.  
**[Best Paper Award]**  
Role: Project/technical mentorship and manuscript co-authorship

[41] Chen, X., Cordingly, R., Hung, L.H., **Lloyd, W.**, X86 vs. ARM64: An Investigation of Factors Influencing Serverless Performance, 2023 9th International Workshop on Serverless Computing (WOSC 2023), Dec 11-15, 2023.  
Role: Project/technical mentorship and manuscript co-authorship

[40] Bhaia, N., Cordingly, R., Hung, L.H., **Lloyd, W.**, Understanding Container Isolation: An Investigation of Performance Implications of Container Runtimes, 2023 9th International Workshop on Container Technologies and Container Clouds (WoC 2023), Dec 11-15, 2023.  
Role: Project/technical mentorship and manuscript co-authorship

[39] Mo, D., Cordingly, R., Chinn, D., **Lloyd, W.**, Addressing Serverless Computing Vendor Lock-In through Cloud Service Abstraction, 2023 14th IEEE International Conference on Cloud Computing Technology and Science (CloudCom 2023), Dec 4-6, 2023.  
Role: Project/technical mentorship and manuscript co-authorship

- [38] Cordingly, R., **Lloyd, W.**, Enabling Serverless Sky Computing, 2023 11th IEEE International Conference on Cloud Engineering (IC2E 2023), Phd Symposium, Sept 25-28, 2023.  
Role: Project/technical mentorship and manuscript co-authorship
- [37] Cordingly, R., Kaur, J., Dwivedi, D., **Lloyd, W.**, Towards Federated Serverless Computing: An Investigation on Global Workload Distribution to Mitigate Carbon Intensity, Network Latency, and Cost, 2023 11<sup>th</sup> IEEE International Conference on Cloud Engineering (IC2E 2023), Sept 25-28 2023. [Acceptance Rate 33.3%]  
Role: Project/technical mentorship and manuscript co-authorship
- [36] Cordingly, R., Xu, S., **Lloyd, W.**, Function Memory Optimization for Heterogeneous Serverless Platforms with CPU Time Accounting, 2022 10th IEEE International Conference on Cloud Engineering (IC2E 2022), Sept 26-30, 2022.  
Role: Project/technical mentorship and manuscript co-authorship
- [35] Cordingly, R., **Lloyd, W.**, FaaSSET: A Jupyter notebook to streamline every facet of serverless development, 2022 13th ACM/SPEC International Conference on Performance Engineering: 5th Workshop on Hot Topics in Cloud Computing Performance (HotCloudPerf-2022), Apr 9, 2022.  
Role: Project/technical mentorship and manuscript co-authorship
- [34] Lambion, D., Schmitz, R., Cordingly, R., Heydari, N., **Lloyd, W.**, Characterizing X86 and ARM Serverless Performance Variation: A Natural Language Processing Case Study, 2022 13th ACM/SPEC International Conference on Performance Engineering: 5th Workshop on Hot Topics in Cloud Computing Performance (HotCloudPerf-2022), Apr 9, 2022.  
Role: Project/technical leadership and manuscript co-authorship
- [33] Quinn, S., Cordingly, R., **Lloyd, W.**, Implications of Alternative Serverless Application Control Flow Methods, 2021 22nd ACM/IFIP International Middleware Conference: 7th International Workshop on Serverless Computing (WoSC '21), Dec 6-10, 2021.  
Role: Project/technical leadership and manuscript co-authorship
- [32] Yu, H., Irissappane, A., Wang, H., **Lloyd, W.**, FaaSRank: Learning to Schedule Functions in Serverless Platforms, 2nd IEEE International Conference on Autonomic Computing and Self-Organizing Systems (ACSOS 2021), 10p., Sept 2021.  
Role: Project/technical leadership and manuscript co-authorship
- [31] Cordingly, R., Heydari, N., Yu, H., Hoang, V., Sadeghi, Z., **Lloyd, W.**, Enhancing Observability of Serverless Computing with the Serverless Application Analytics Framework, Tutorial Paper. 2021 12th ACM/SPEC International Conference on Performance Engineering (ICPE '21), pp. 161-164, Apr 2021.  
Role: Project/technical leadership and manuscript co-authorship

- [30] Cordingly, R., Yu, H., Hoang, V., Sadeghi, Z., Foster, D., Perez, D., Hatchett, R., **Lloyd, W.**, The Serverless Application Analytics Framework: Enabling Design Trade-off Evaluation for Serverless Software, 2020 21st ACM/IFIP International Middleware Conference: 6th International Workshop on Serverless Computing (WoSC '20), pp. 67-72, Dec 2020.  
Role: Project/technical leadership and manuscript co-authorship
- [29] Perez, D., Hung, L.H., Xu, S., Yeung, K.Y., **Lloyd, W.**, An Investigation on Public Cloud Performance Variation for an RNA Sequencing Workflow, In Proceedings of the 2020 ACM International Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB ParBio 2020), 7 p., September 2020.  
Role: Project/technical leadership and manuscript co-authorship
- [28] Cordingly, R., Shu, W., **Lloyd, W.**, Predicting Performance and Cost of Serverless Computing Functions with SAAF, 2020 6th IEEE International Conference on Cloud and Big Data Computing (CBDCOM 2020), pp. 640-649, Aug 2020. [Acceptance Rate 27%]  
Role: Project/technical leadership and manuscript co-authorship
- [27] Cordingly, R., Yu, H., Hoang, V., Perez, D., Foster, D., Sadeghi, Z., Hatchett, R., **Lloyd, W.**, Implications of Programming Language Selection for Serverless Data Processing Pipelines, 2020 6th IEEE International Conference on Cloud and Big Data Computing (CBDCOM 2020), pp. 704-711, Aug 2020. Short Paper. [Acceptance Rate 40%]  
Role: Project/technical leadership and manuscript co-authorship
- [26] Perez, D., Hung, L.H., Xu, S., Yeung, K.Y., **Lloyd, W.**, Characterizing Performance Variation of Genomic Data Analysis Workflows on the Public Cloud, 2020 6th IEEE International Conference on Cloud and Big Data Computing (CBDCOM 2020), pp. 680-683, Aug 2020.  
Role: Project/technical leadership and manuscript co-authorship
- [25] Han, X., Schooley, R., Mackenzie, D., David, O., **Lloyd, W.**, Characterizing Public Cloud Resource Contention to Support Virtual Machine Co-residency Prediction, 2020 8th IEEE International Conference on Cloud Engineering (IC2E 2020), pp. 162-172, Apr 2020. [Acceptance Rate 21.2%]  
Role: Project/technical leadership and manuscript co-authorship
- [24] Fotouhi, M., Chen, D., **Lloyd, W.**, Function-as-a-Service Application Service Composition: Implications for a Natural Language Processing Application, 2019 20th ACM/IFIP International Middleware Conference: 5th Workshop on Serverless Computing (WoSC '19), pp. 49-54, December 2019.  
Role: Project/technical leadership and manuscript co-authorship

- [23] Niu, X., Kumanov, D., Hung, L.H., **Lloyd, W.**, Yeung, K.Y., Leveraging Serverless Computing to Improve Performance for Sequence Comparison, In Proceedings of the 2019 ACM International Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB ParBio 2019), pp. 683-687, September 2019.  
Role: Project/technical leadership and manuscript co-authorship
- [22] Vu M., Zhang B., David O., Leavesley G., **Lloyd, W.**, Improving Application Migration to Serverless Computing Platforms: Latency Mitigation with Keep-Alive Workloads. In Proc. IEEE/ACM International Conference on Utility and Cloud Computing Companion (UCC 2018 Companion), pp. 195-200, Dec 2018.  
Role: Project/technical leadership and manuscript author
- [21] Lahmann, G., McCann, T., **Lloyd, W.**, Container Memory Allocation Discrepancies: An Investigation on Memory Utilization Gaps for Container-Based Application Deployments, IEEE 4th Int. Workshop on Container Technologies and Container Clouds (WoC 2018), in conjunction with IC2E 2018, pp. 404-405, April 2018.  
Role: Project/technical leadership and manuscript co-authorship
- [20] **Lloyd, W.**, Ramesh, S., Chinthapati, S., Ly, L., Pallickara, S., Serverless Computing: An Investigation of Factors Influencing Microservice Performance, IEEE Int. Conf. on Cloud Engineering (IC2E 2018), pp. 159-169, Apr 2018. [19% Acceptance Rate]  
Role: Project/technical leadership and manuscript author
- [19] **Lloyd, W.**, Pallickara, S., David, O., Lyon, J., Arabi, M., Rojas, K., Mitigating Resource Contention and Heterogeneity in Public Clouds for Scientific Modeling Service, Proc. IEEE Conf. On Cloud Engineering (IC2E 2017), pp. 159-166, Apr 2017. [33% acceptance rate]  
Role: Manuscript author and implemented project research  
*This paper was submitted to the 2017 IC2E industry track because the research track paper submission date was before my September 16<sup>th</sup> start date at UW Tacoma and I was involved in relocating to Tacoma, Washington. The industry track CFP was October 31 which provided time for the submission. The industry affiliation is supported by the US Department of Agriculture's Natural Resource Conservation Service's support of the research (USDA-NRCS).*
- [18] **Lloyd, W.**, David, O., Arabi, M., Ascough, J.C., Green, T.R., Carlson, J., Rojas, K., The Virtual Machine (VM) Scaler: An Infrastructure Manager Supporting Environmental Modeling on Infrastructure-as-a-Service Clouds, iEMSs 2014 International Congress on Environmental Modeling and Software: Bold Visions for Environmental Modelling, 7th Biennial Meeting (iEMSs 2014), San Diego, CA, USA, 8 p., June 2014.  
Role: Manuscript author and implemented project research

- [17] David, O., **Lloyd, W.**, Rojas, K., Arabi, M., Geter, F., Carlson, J., Leavesley, G., Ascough II, J.C., Green, T.R., Model as a Service (MaaS) using the Cloud Service Innovation Platform (CSIP), iEMSs 2014 International Congress on Environmental Modeling and Software: Bold Visions for Environmental Modelling, 7th Biennial Meeting (iEMSs 2014), San Diego, CA, USA, June 2014, 8p.  
Role: Manuscript co-author and implemented project research
- [16] Carlson, J., David, O., **Lloyd, W.**, Leavesley, G., Rojas, R., Green, T., Arabi, M., Yaege, L., Kipka, H., Data Provisioning for the Object Modeling System (OMS), iEMSs 2014 International Congress on Environmental Modeling and Software: Bold Visions for Environmental Modelling, 7th Biennial Meeting (iEMSs 2014), San Diego, CA, USA, 8p., June 2014.  
Role: Manuscript co-author and implemented project research
- [15] Wible, T., **Lloyd, W.**, David, O., Arabi, M., Cyberinfrastructure for Scalable Access to Stream Flow Analysis, iEMSs 2014 International Congress on Environmental Modeling and Software: Bold Visions for Environmental Modelling, 7th Biennial Meeting (iEMSs 2014), San Diego, CA, USA, 6 p., June 2014.  
Role: Manuscript review and technical mentorship
- [14] **Lloyd, W.**, Pallickara, S., David, O., Lyon, j., Arabi, M., Rojas, K., Dynamic Scaling for Service Oriented Applications: Implications of Virtual Machine Placement on IaaS Clouds, Proc. IEEE Conf. On Cloud Engineering (IC2E 2014), pp. 271-276, Mar 2014. [20.9% acceptance rate]  
Role: Manuscript author and implemented project research
- [13] **Lloyd, W.**, Pallickara, S., David, O., Lyon, j., Arabi, M., Rojas, K., Service Isolation vs. Consolidation: Implications for IaaS Cloud Application Deployment, Proc. IEEE Conf. On Cloud Engineering (IC2E 2013), pp. 21-30, Mar 2013. [20.5% acceptance rate]  
Role: Manuscript author and implemented project research
- [12] **Lloyd, W.**, David, O., Lyon, J., Rojas, K., Ascough II, J., Green, T., Carlson, R., The Cloud Services Innovation Platform – Enabling Service-Based Environmental Modelling Using Infrastructure-as-a-Service Cloud Computing, International Congress on Environmental Modeling and Software – Managing Resources of a Limited Planet, 6th Biennial Meeting (iEMSs 2012), Leipzig, Germany, 8p., July 2012.  
Role: Manuscript author and implemented project research
- [11] **Lloyd, W.**, Pallickara, S., David, O., Lyon, j., Arabi, M., Rojas, K., Performance Modeling to Support Multi-Tier Application Deployment to Infrastructure-as-a-Service Clouds, Proc. 5th IEEE/ACM Int. Conf. on Utility and Cloud Computing (UCC 2012), pp. 73-80, Nov 2012. [27% acceptance rate]  
Role: Manuscript author and implemented project research

- [10] **Lloyd, W.**, Pallickara, S., David, O., Lyon, J., Arabi, M., Rojas, K., Migration of Multi-tier Applications to Infrastructure-as-a-Service Clouds: An Investigation Using Kernel-Based Virtual Machines, Proc. 12th IEEE/ACM Intl. Conf. On Grid Computing (GRID 2011), Lyon, France, pp. 137-144, Sept 2011. [29% acceptance rate]  
Role: Manuscript author and implemented project research
- [9] **Lloyd, W.**, David, O., Ascough II, J., et al., Environmental Modeling Framework Invasiveness: Analysis and Implications, In: Swayne, Yang, Voinov, Rizzoli, and Filatova (Eds.), iEMSs 2010 International Congress on Environmental Modeling and Software – Modeling for Environment’s Sake, 5th Biennial Meeting, Ottawa, Canada, 8 p., July 2010.  
Role: Manuscript author and implemented project research
- [8] **Lloyd, W.**, David, O., Ascough, J.C., et. al., An Exploratory Investigation on the Invasiveness of Environmental Modeling Frameworks, International Congress on Modeling and Simulation (MODSIM 09), Cairns, Australia, 7 p., July 2009.  
Role: Manuscript author and implemented project research
- [7] **Lloyd, W.**, M. Rosson, and Arthur, J., Effectiveness of Distributed Requirements Engineering, Proceedings of the IEEE Joint International Requirements Engineering Conference (RE 2002), Essen, Germany September 2002. [17% acceptance rate]  
Role: Manuscript author and implemented project research
- [6] Schoenhoff, P., Henry, S., and **Lloyd, W.**, Software Development Teams Evaluation, Proceedings of the International Conference on Advances in Infrastructure for Electronic Business, Science, and Education on the Internet (SSGRR), L’Aquila, Italy, August 2001.  
Role: Implemented project research

#### 4.3 Peer-reviewed Meeting Abstracts

- [5] Scott S., Hung L.H., **Lloyd W.**, and Yeung K.Y. Using BioDepot-workflow-builder to access public databases in a containerized environment. Poster abstract at the IEEE International Conference on Bioinformatics and Biomedicine (BIBM) 2019, page 1243, San Diego, November 2019.  
Role: Manuscript review and technical mentorship
- [4] Zhang, B., **Lloyd, W.**, David, O., Leavesley, G., Going Serverless: Evaluating the Potential of Serverless Computing Platforms for Environmental Modeling Application Hosting, 9th International Congress on Environmental Modelling and Software, (iEMSs 2018), June 2018.  
Role: Project/technical leadership and abstract author. George Leavesley is the lead scientist of the scientific application of study, the Precipitation-Runoff Modeling System (PRMS).

- [3] David, O., **Lloyd, W.**, Carlson, J., Arabi, M., and Wible, T., Cloud Services Integration Platform (CSIP) model and data services, International Congress on Environmental Modeling and Software: Supporting a Sustainable Future, 8<sup>th</sup> Biennial Meeting (iEMSs 2016), Toulouse, France, July 10-14, 2016.  
Role: Implemented project research

#### 4.4 PhD Dissertation and Masters Thesis

- [2] Autonomous Management of Cost, Performance, and Resource Uncertainty for Migration of Applications to Infrastructure-as-a-Service (IaaS) Clouds. Ph.D. Dissertation, December 2014 Colorado State University.
- [1] Tools and Techniques for Effective Distributed Requirements Engineering: An Empirical Study. Masters Thesis, August 2001 Virginia Tech.

#### 4.5 Impact

From Google Scholar as of 5/3/2025:

Citation Indices	All	Since 2020
Citations	1775	1086
h-index	20	16
i10-index	31	23

## 5 Projects

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### 5.1 The Serverless Application Analytics Framework

The Serverless Application Analytics Framework (SAAF) enables profiling performance, resource utilization, and infrastructure to enable accurate characterizations of serverless software deployments enabling new insights into the operation of serverless applications. SAAF supports the evaluation of alternate architectures and service compositions enabling practitioners to better evaluate design tradeoffs of serverless software designs. SAAF enables case studies on legacy application migration, microservice composition, and application flow control to identify implications for hosting RESTful APIs. These innovations enable software deployments to serverless computing platforms to realize performance improvements and cost savings enabling the next generation of cloud software.

SAAF is available on GitHub at:

<https://github.com/wlloydw/SAAF>

### 5.2 The Container Profiler

The Container Profiler provides an easy-to-use tool to characterize the resource requirements of any containerized computational tasks. Any task deployed to a Docker container can be profiled to quantify

the total resource utilization (e.g. CPU, memory, disk I/O, and network I/O). Profiling can be configured to collect resource utilization statistics at varying sampling intervals to support time series analysis of resource utilization of containerized computational workloads. Data is represented in JSON-format. In addition to standard CPU, disk I/O, and network I/O resource utilization metrics, a variety of VM-level, container-level, and process-level metrics are collected.

The Container Profiler is available on GitHub at:

<https://github.com/wlloyduw/ContainerProfiler>

### **5.3 BioDepot Workflow Builder**

The BioDepot-workflow-builder (Bwb) is a software tool enabling users to create and execute reproducible bioinformatics workflows using a drag-and-drop interface where graphical widgets represent Docker containers executing a modular task. Widgets are linked graphically to build bioinformatics workflows that can be reproducibly deployed across different local and cloud platforms. Creation of the Bwb has been supported through an NIH NGIMS R01 research grant.

The BioDepot Workflow Builder is available on GitHub at:

<https://github.com/BioDepot/BioDepot-workflow-builder>

### **5.4 IaaS Cloud Resource Contention Test Framework**

In this project, we developed Python-based client/server testing framework to automate parallel execution of performance benchmarks across cloud-based VMs. When deployed on isolated cloud hosts (physical servers) these automated benchmarks can help characterize performance degradation from VM multitenancy. Benchmarks are then leveraged as features to train machine learning models to infer the number of co-resident VM instances on IaaS clouds. When cloud users inadvertently execute similar embarrassingly parallel tasks across co-resident VMs in parallel, job performance can suffer from CPU, memory, disk, and/or network resource contention. Our tool quantifies the expected degree of contention across exhaustive VM tenancies using well-known benchmarks to characterize outcomes from resource contention. Benchmarks include: sysbench, y-cruncher, pgbench, and iPerf.

Project source code is available at:

<https://github.com/wlloyduw/IaaSCloudResourceContention>

### **5.5 Cloud Constructor - Educational Game**

The Cloud Constructor game provides an interactive educational experience that introduces cloud computing, client/server, and distributed systems concepts for grade levels 2-12+. The game features 10 levels where each level introduces additional concepts while gradually training the user on how to play the game. In the game the player serves as the computer “systems administrator” and they must adapt their cloud computing infrastructure in each level to provide resources sufficient to meet user (client) demand. The primary tasks involve: storing messages, movies, and pictures, backing up and replicating data elements across multiple servers, and routing client (user) requests to the appropriate server with

the requested data. Once completing all levels, students can play the game in “ENDLESS” mode where each level features increasing difficulty and randomly generated challenges. The game also features a multiple-choice quiz to test comprehension of computing concepts taught in the game. Development of our game has been supported through an NSF CISE CRII research grant, and our game has been published by Code.org on the Hour of Code website that features educational games and tutorials in support of the annual computer science education week in December.

The Cloud Constructor game is online at:

<https://hourofcode.com/uwcloud>

## **5.6 The Cloud Services Innovation Platform**

The Cloud Services Innovation Platform (CSIP) is a REST/JSON-based Java application framework used to support development of distributed and scalable scientific modeling services. CSIP aims to provide modeling-as-a-service to support both interactive (synchronous) and batch (asynchronous) model runs. CSIP enables cloud-based computing resources to be harnessed for both new and existing environmental models supporting the disaggregation of work into subtasks which execute in parallel using a scalable number of virtual machines. CSIP has been harnessed to deploy both research and operational environmental scientific models for the US Department of Agriculture. Example models include: the Wind Erosion Prediction System (WEPS), the RUSLE2 soil erosion model, the Comprehensive Flow Analysis toolkit, and SWAT-Deg, a stream channel degradation prediction system. CSIP services have been tested and deployed to both public and private Infrastructure-as-a-Service clouds.

Project source code is available at:

<https://alm.engr.colostate.edu/cb/project/csip>

## **5.7 The Virtual Machine Scaler**

The VM-Scaler is a REST/JSON-based web services application that supports cloud infrastructure provisioning and management. VM-Scaler harnesses the IaaS cloud application programming interfaces (APIs) to support model-service scalability, cloud management, and infrastructure configuration for supporting service-oriented application hosting. VM-Scaler provides "cloud control" while abstracting the underlying IaaS cloud from the end user. VM-Scaler is extensible to support any cloud and currently supports the Amazon and Azure public clouds, and Eucalyptus private clouds. VM-Scaler provides a platform to improve scientific model deployment by supporting experimentation with: hot spot detection schemes, VM management and placement approaches, workload profiling techniques, and model job scheduling/proxy services. VM-Scaler has been exercised to scale model services and execute large workloads in the cloud for research and operational environmental science models used by the US Department of Agriculture.

## **6 Teaching**

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I have taught and developed a variety of credit and continuing education courses at The University of Washington in Tacoma, Colorado State University, Front Range Community College, and Virginia Tech.

Courses where I developed original lecture content are indicated using the § symbol. Double sections are indicated with the † symbol.

### 6.1 Courses Taught at University of Washington, Tacoma, Washington

Term	Course	Enrollment	Audience
Winter 2017	§ TCSS 360: Software Development and Quality Assurance Techniques	26	Undergraduate Core Course
Spring 2025 Spring 2024 Spring 2023 Fall 2021 † Spring 2021 † Spring 2020 Winter 2019 Fall 2018 Spring 2018 † Winter 2018 Spring 2017 Winter 2017 Fall 2016	§ TCSS 422: Operating Systems	63 43 58 33 67 68 40 46 51 70 46 41 31	Undergraduate Core Course
Fall 2024 Fall 2023 Fall 2022	§ TCSS 462: Cloud Computing	41 43 32	Undergraduate Elective Course
Winter 2024 Winter 2023 Winter 2021 Winter 2020 Winter 2019 Fall 2017	§ TCSS 558: Applied Distributed Computing	30 32 28 22 29 34	Graduate Core Course
Fall 2024 Fall 2023 Fall 2022 Fall 2021 Fall 2020 Fall 2019 Fall 2018 Spring 2018 Spring 2017	§ TCSS 562: Software Engineering for Cloud Computing	20 26 26 32 27 29 21 32 28	Graduate Elective Course
Spring 2022 Winter 2022 Fall 2021	§ TCSS 591: Research Seminar in Distributed Systems	6 4 2	Graduate Elective Course
	Undergraduates: 2016-2024	696	
	Graduates: 2016-2024	402	
	Total: 2016-2023	<b>1,098</b>	

## 6.2 Courses Taught at Colorado State University, Fort Collins, Colorado

Term	Course	Enrollment	Audience
Fall 2012	§ CS 555: Distributed Systems, Guest Lecturer	13	Graduate Course
Summer 2004	CS 150: Interactive Java Programming	15	Undergraduate Course
Spring 2004	§ NCT 0793: Intermediate Visual Basic .NET	5	Professional Development
Fall 2003	§ NCT 0792: Introduction to Visual Basic .NET	5	Professional Development
Summer 2003	§ NCT 0792: Introduction to Visual Basic .NET	8	Professional Development
Fall 2002	§ CS 253: Problem Solving in C++	50	Undergraduate course

## 6.3 Courses Taught at Front Range Community College, Fort Collins, Colorado

Term	Course	Enrollment	Audience
Spring 2003	§ CSC 230: C Programming	20	Undergraduate Course

## 6.4 Courses Taught at Virginia Tech, Blacksburg, Virginia

Term	Course	Enrollment	Audience
Summer 2001	§ CS 2984: Java Programming	30	Undergraduate Course
Fall 2000	§ CS 4704: Software Engineering Lab	30	Undergraduate Course
Spring 2000	§ CS 4704: Software Engineering Lab	30	Undergraduate Course
Fall 1999	CS 1004: Computer Literacy, Teaching Asst.	50	Undergraduate Course

## 6.5 Courses Taught at the National Center for Tooling and Precision Components, Toledo, Ohio

Term	Course	Enrollment	Audience
Summer 1995	§ Microsoft Office, 8 sections, 10 students ea	80	Professional Development

## 7 Mentorship

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### 7.1 Graduate Advisor

*† - Student graduated from MS program w/ capstone before creation of PhD program. Now completing MS thesis which is required for PhD*

- [A1] Jugal Gandhi, MS Capstone Project: Identification and Mitigation of Public Cloud Resource Contention using Machine Learning Techniques, Spring 2017-Fall 2017
- [A2] Paranjit Singh, MS Capstone Project: The Virtual Machine (VM) Scaler Application Implementation for Microsoft Azure, Spring 2017-Fall 2017
- [A3] Minh Vu, MS Capstone Project: Spreading Data and Persisting Infrastructure, Spring 2018-Summer 2018
- [A4] Xinlei Han, MS Capstone Project: Multi-dimensional Public Cloud Resource Contention

- Detection, Spring 2018-Fall 2018
- [A5] Baojia Zhang, MS Capstone Project: Characterizing Performance and Cost Tradeoffs of Service Compositions for Application Migration to Serverless Computing Environments, Spring 2018-Fall 2018
  - [A6] Lan Ly, MS Capstone Project: Performance Simulation and Modeling for Microservices Deployments to Serverless Computing Platforms, Spring 2018-Fall 2018
  - [A7] Harrison Ross, MS Capstone Project: A Comparison of Edge and Cloud Computing Performance for Mobile Clients: A Trade-off Analysis to Support Hybrid Solutions, Spring 2018-Winter 2019
  - [A8] Ailian Li, MS Capstone Project: CPU Heterogeneity in Function-as-a-Service platforms: Characterization and Avoidance to Improve Microservice Performance, Spring 2019–Fall 2019.
  - [A9] Delvin Mackenzie, MS Capstone Project: Exploring Performance and Cost Implications of Container Deployments on Container-as-a-Service Platforms, Spring 2019–Fall 2019 .
  - [A10] Raymond Schooley, MS Capstone Project: Visualizing a Container’s Resource Utilization Profile, Spring 2019-Fall 2019 , Funded Summer Stipend 2019
  - [A11] Zohreh Sadgehi, MS Capstone: A Performance and Resource Isolation Evaluation of the Firecracker MicroVM, Spring 2020-Summer 2020.
  - [A12] Sonia Xu, MS Capstone Project: Bioinformatics Workflow Runtime Prediction with Linux Time Accounting to Determine the Best Virtual Machine Type, Spring 2020-Fall 2020.
  - [A13] Hanfei Yu, **MS Thesis**: Improving Schedulers for Open Source Function-as-a-Service Frameworks, Spring 2020-Winter 2021.
  - [A14] Robert Cordingly, **MS Thesis**: Enabling Analytics and Experiments for Serverless Applications with SAAF, Winter 2020-Spring 2021, **PhD Student**.
  - [A15] Zohreh Sadgehi, **MS Thesis**: BenchPress: Enabling Investigations of Serverless Computing Infrastructure Abstraction, Winter 2021-present, **PhD Student**<sup>†</sup>.
  - [A16] Varik Hoang, **MS Thesis**: Performance Modeling of Containerized Genomic Alignment using Linux CPU Time Accounting, Spring 2021-present, **PhD Student**<sup>†</sup>.
  - [A17] Madhuri Sharma, **MS Thesis**: Public Cloud Virtual Machine Co-residency: Prediction and Implications, Spring 2021-August 2022.
  - [A18] Navid Heydari, MS Capstone: Automatic Classification of Serverless Computing Performance Variability, Spring 2021-December 2021.
  - [A19] Siddharth Sheth, MS Capstone: Serverless Containers: An Evaluation of Factors Influencing Performance for Scientific Applications, Spring 2021-December 2021.
  - [A20] Nischal Khadka, MS Capstone: Scaling up with Firecracker microVMs: An Investigation on Performance and Resource Isolation, Spring 2022-December 2022.
  - [A21] Di Mo, MS Capstone: Addressing Serverless Computing Vendor Lock-In through Cloud Service Abstraction, Spring 2022-December 2022.
  - [A22] Robert Schmitz, MS Capstone Project: Investigating Open-Source Cloud-Native Application Solutions, Spring 2022-March 2023.

- [A23] Ruochen Wang, MS Capstone Project: Try-Before-You-Buy: Leveraging Memory Benchmarks to Classify Serverless Instance Performance, Spring 2022-August 2022.
- [A24] Zening Zhao, MS Capstone Project: Public Cloud Application Performance and Virtual Machine Co-Residency Prediction, Spring 2022-December 2022.
- [A25] Xinghan Chen, MS Thesis Project: Serverless Function Performance Models on ARM: Leveraging x86 resource profiling to predict runtime performance, Spring 2023-.
- [A26] Naman Bhaia, MS Capstone Project, Observability and Isolation in Container Technologies, Spring 2023-Summer 2023.
- [A27] Divyansh Dwivedi, MS Capstone Project, Performance Analysis of Self-Hosted and Cloud-Hosted API Gateways: A Comparative Study, Spring 2023-Fall 2023.
- [A28] Jasleen Kaur, MS Capstone Project, Towards Low-Cost Global Highly Available Container-Based Serverless Functions, Spring 2023-Fall 2023.
- [A29] Sunita Gajurel, MS Capstone Project, Messaging Services for Serverless Computing: An Investigation of Performance and Vendor Lock-in, Spring 2023-Fall 2023.
- [A30] Tomoki Kusunoki, MS Thesis Project: Distributed FaaSRunner: Enabling Reproducible Multi-node, Multi-threaded Function-as-a-Service Endpoint Testing, Spring 2024-.
- [A31] Runjie Jin, MS Thesis Project: GraphQL vs REST: An Investigation of Tradeoffs for Serverless Applications, Spring 2024-.
- [A32] Heyuan Wang, MS Capstone Project: Snapshotting Techniques for Multi-Epoch Serverless Functions and Migration, Spring 2024-.
- [A33] Agamjot Singh Panesar, MS Capstone Project: Investigating Serverless Application Portability using Vendor Agnostic CloudEvents, Spring 2024-.
- [A34] Andrew Nguyen, MS Capstone Project: Towards Enhancing Observability of Power Utilization as a Sustainability Metric in the Cloud

## **7.2 Graduate Committee Member**

- [C 35] Kim Stuart, MS Thesis: Scalable Real-Time Streaming Sensor Fusion for Smart Buildings, Winter 2017-Spring 2017.
- [C 36] Saranya Devi Athmalingam Ravishankar, MS Capstone Project: Predictive models to optimize cloud computing using genomics data, Spring 2017-Fall 2017.
- [C 37] Jiaming Hu, MS Capstone Project: Development and benchmarking of a scheduler for deploying containerized bioinformatics workflows on heterogeneous clouds, Spring 2017-Fall 2017.
- [C 38] Kuangdi Yu, MS Capstone Project: Optimization and Development of High Performance Tools for Biomedical Big Data, Spring 2017-Fall 2017.
- [C 39] Pai Zhang, MS Capstone Project: Empirical Studies of Docker Orchestration Tools for The Analyses of Big Biomedical Data, Spring 2017-Fall 2017.
- [C 40] Radhika Agumbe Sridhar, MS Capstone Project: Optimizing bioinformatics workflows on the cloud, Spring 2018-Fall 2018.

- [C 41] Xingzhi Niu, MS Capstone Project: Serverless computing workflows for sequence alignment, Spring 2019 – Fall 2019
- [C 42] Tong Wu, MS Capstone Project: Practical Evaluations of Cancer RNA Sequencing Workflows on the Cloud, Spring 2020-Fall 2020.
- [C 43] Yuazhi (Ian) Ren, MS Capstone Project: Reproducible and modular workflows in BioDepot-workflow-Builder with applications in transportation and cancer genomics data, Spring 2020 -Fall 2020.
- [C 44] Yuazhi (Ian) Ren, MS Thesis: Building Reproducible and Modular Workflows using Transportation Data and COVID-19 Data, Winter 2021.
- [C 45] Fei Fei Zhang, MS Capstone Project: Visualization of bioinformatics workflows using the BioDepot-workflow-builder, Spring 2020 – Fall 2020.
- [C 46] Anubha Agrawal, MS Capstone Project: Using Neural Networks for Detecting Yelp Review Spam, Spring 2020 – Fall 2020.
- [C 47] Bowei Huang , MS Capstone Project: Weak Supervised Learning for Image Segmentation with Image-level Labels, Spring 2020 – Fall 2020.
- [C 48] Yankun Shen, MS Capstone Project: GANs for Spam Review Detection, Spring 2020 – Fall 2020.
- [C 49] Sreenavya Nrusimhadevara, MS Capstone Project: CSRF: A Ranking Approach for Microservices in Service Composition, Spring 2020 – Fall 2020.
- [C 50] Jing Tian, MS Capstone Project: Meta Gradient RL for Partially Observable Environments, Spring 2021, advisor left university, student did not complete.
- [C 51] Ken Gil M. Romero, MS Capstone Project: A Web Application for Training Reinforcement Learning Agents, Spring 2021 – August 2021.
- [C 52] Manoj Chinniah, MS Capstone Project: Cloud-enabled workflows to analyze prostate cancer 3D images, Spring 2022 – December 2022.
- [C 53] Bryce Fukuda, MS Capstone Project: Benchmarking and uniform processing of cancer data on the cloud, Spring 2022 – March 2023.
- [C 54] Karen Setiawan, MS Capstone Project: Single-Cell RNA Sequencing Workflows in the Biodepot-workflow-builder, Spring 2023-Fall 2023.
- [C 55] Shubing Yang, MS Capstone Project: Enhancing Database Security through Parallel Caching in Multi-key Homomorphic Encryption, Fall 2023-Winter 2024.
- [C 56] Niharika Nasam, MS Capstone Project: Cloud-based Serverless Workflows for Genomics Data, Winter 2024-Winter 2025.

### **7.3 Graduate Independent Study Advisor (TCSS 600)**

- [IS57] Swetha Chinthalapati, Summer 2017
- [IS58] Agumbe Sridhar, Radhika, Winter 2018
- [IS59] Balasubrahmanya, Spoorthy, Winter 2018
- [IS60] Dange, Rituja, Winter 2018

- [IS61] Gorrepati, Tejaswi, Winter 2018
- [IS62] Momin, Misba, Winter 2018, Spring 2018
- [IS63] Zoe Sadeghi, Winter 2020
- [IS64] Sonia Xu, Winter 2020
- [IS65] Asmita Singla, Spring 2020
- [IS66] Tong Wu, Winter 2021, Spring 2021
- [IS67] Pragatil Patil, Winter 2022, Spring 2022
- [IS68] Shuo Peng, Winter 2022, Spring 2022
- [IS69] Yanliu Wang, Winter 2023
- [IS70] Sunita Garurel, Spring 2023
- [IS71] Chhavi Gupta, Spring 2023
- [IS72] Angela Mu, Spring 2023, Fall 2023, Spring 2024
- [IS73] Vishnu Priya Rajendran, Spring 2024, Winter 2025
- [IS74] Xinru Wu, Spring 2025

#### **7.4 Undergraduate Advisor**

- [U 75] Lan Ly, TCSS 499 Undergraduate Research in CSS: Benchmarking Platform-as-a-Service (PaaS) Clouds: Investigating How Service Utilization Influences Infrastructure for Microservice Performance Improvement, Autumn 2016
- [U 76] Devin Durham, TCSS 499 Undergraduate Research in CSS: Benchmarking Performance and Scalability of Unikernel Virtual Machines for Cloud Application Hosting, Summer 2017
- [U 77] Garrett Lahmann, TCSS 499 Undergraduate Research in CSS: Investigating Discrepancies Between Memory Allocation and Usage in Container-Based Cloud Applications, Winter 2018-Spring 2018
- [U 78] Ben Yuen, TCSS 499 Undergraduate Research in CSS, AWS Lambda CPU Heterogeneity, Winter 2019
- [U 79] Wen Shu, TCSS 499 Undergraduate Research in CSS, The Function-as-a-Service (FaaS) Inspector framework development and research, Winter 2019
- [U 80] Steven Golob, TCSS 499 Undergraduate Research in CSS, The Function-as-a-Service (FaaS) Inspector framework development and research, Winter 2019 (2 credits)
- [U 81] Jake Yang, TCSS 499 Undergraduate Research in CSS, Jupyter Notebook FaaS Client for Interactive Testing and Visualization, Spring 2019
- [U 82] Andrea Moncada, TCSS 499 Undergraduate Research in CSS, NLP Application integration with FaaS Inspector Framework, Spring 2019
- [U 83] David Perez, TCSS 498/499: Cloud Computing for Bioinformatics, Funded Undergraduate Research Assistant, Spring 2019 – Summer 2020
- [U 84] Christin Scott, TCSS 499: Undergraduate Research in CSS, Cloud Computing for Bioinformatics: Apply SAAF to characterize hybrid RNA-sequencing workflows leveraging IaaS and FaaS cloud resources, Fall 2019

- [U 85] Thaddaeus Hug, TCSS 499: Undergraduate Research in CSS, Implications of application flow control for serverless data processing pipelines on Function-as-a-Service serverless platforms, sub-topic: Analysis of Client side flow control, and microservice as a controller architecture, Winter 2020 – Spring 2020
- [U 86] Sterling Quinn, TCSS 499: Undergraduate Research in CSS, Implications of application flow control for serverless data processing pipelines on Function-as-a-Service serverless platforms, sub-topic: Analysis of AWS Step Functions and Asynchronous Flow Control Architecture. Project for fulfillment of **Undergraduate Honors Thesis**, Spring 2020 – Fall 2020.
- [U 87] Bao Nguyen, TCSS 498: Directed Reading in CSS: Cloud Computing, Winter 2022
- [U 88] Emanuel Stupart, TCSS 499 - Directed Research in CSS: Cloud Computing, Winter 2022
- [U 89] Austin Bomhold, TCSS 499 – Directed Research in CSS, Distributed Function-as-a-Service (FaaS) Test Trace Generation Tool. Winter 2025 – Spring 2025.

## 7.5 Undergraduate Committee Member

- [UC90] Dimitar Kumanov, TCSS 499 Undergraduate Research in CSS (advisory support), Serverless Computing for Bioinformatics Workflows, Winter 2018-Fall 2018

## 8 Honors and Awards

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2020 UW Tacoma School of Engineering and Technology Outstanding Faculty Research Award.  
 2019 NSF CISE Research Initiation Initiative Grant Award, \$175,000.  
 2018 NSF Career Workshop Travel Grant Award, \$1300.  
 2016 NSF Cloud Workshop Travel Grant Award, \$1000.  
 2013 IEEE International Conference on Cloud Engineering (IC2E) Travel Grant Award, \$400.  
 2012 Computerworld Honors Laureate project - Winner Economic Development category: “Cloud Services Innovation Platform” (5% award rate, selected from 200 laureate projects)  
 2007 Special Service Award for Software Development, US Fish and Wildlife Service  
 Upsilon Pi Epsilon, Computer Science Honor Society, Virginia Tech  
 Eta Kappa Nu Electrical Engineering and Computer Science Honorary, University of Toledo  
 Golden Key National Honor Society, University of Toledo  
 National Dean’s List 1997-1998  
 Top 10% of senior class in engineering, University of Toledo 1997

## 9 Research Funding

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- [F29] AWS Cloud Credits for Education, Wes J. Lloyd (PI), \$6,800, 09/2024-09/2025.

- [F28] USDA-ARS NACA: Graphical User Interface for Multi-Group Particle Swarm Optimization, Wes J. Lloyd (PI), \$10,000, 01/2024-03/2025.
- [F27] AWS Cloud Credits for Education, Wes J. Lloyd (PI), \$12,500, 09/2023-12/2024.
- [F26] USDA-ARS NACA: A Tool to Facilitate Model Calibration Using Cloud Enabled Multi-group Particle Swarm Optimization, Wes J. Lloyd (PI), \$25,000, 09/2022-12/2023.
- [F25] AWS Cloud Credits for Education, Wes J. Lloyd (PI), \$8,250, 09/2022-12/2023.
- [F24] AWS Cloud Credits for Research: Surrogate Model Development and Application using AWS, Francesco Serafin (PI), Wes Lloyd (Collaborator), \$20,000, 12/2022-12/2023.
- [F23] NSF DCL NSF 21-013: Non-Academic Research Internships for Graduate Students (INTERN) Supplemental Funding Opportunity for OAC-1849970, Wes J. Lloyd (PI), \$54,739, 07/2021-12/2021.
- [F22] NIH NCI SBIR UW subcontract: Accessible Cloud-Based Multi-Omic and Imaging Analysis for the Cancer Research Data Commons, Wes J. Lloyd (PI), \$57,964, 09/2021-09/2022.
- [F21] AWS Educate: Education Cloud credits to support teaching and student projects, \$5,000, 01/2021-12/2022.
- [F20] NIH NCI SBIR A150181 UW subcontract: Optimized and accessible cloud-based multi-omics workflows for the Cancer Research Data Commons, Wes J. Lloyd (PI), \$52,979, 09/16/2020-09/15/2021.
- [F19] AWS Educate: Education Cloud credits to support Winter 2020 TCSS 558: Applied Distributed Computing Graduate Course, Wes J. Lloyd (PI), \$5,000, 01/2020-12/2020.
- [F18] UW CoMotion Innovation Gap Fund: BioDepot: A suite of tools to reduce costs, improve performance, and enhance accessibility of biomedical data analyses, Ka Yee Yeung (PI), Wes J. Lloyd (co-I), \$50,000, 1/15/2020 – 9/1/2021.
- [F17] UW CoMotion Step Fund, Ka Yee Yeung (PI), Wes J. Lloyd (co-I), \$17,000, 06/2019-06/2020.
- [F16] NIH Diversity Supplement for undergraduate student David Perez, NIH R01 GM126019 - 02S2, Ka Yee Yeung (PI), Wes J. Lloyd (co-I and advisor), \$39,828, 04/2019 - 01/2021.
- [F15] CRII: OAC: RUI: Improving Software Deployments to Serverless Computing Environments, Wes J. Lloyd (PI). NSF CISE Research Initiation Initiative (CRII), \$175,000, 3/2019 - 02/2022.
- [F14] NIH Diversity Supplement for undergraduate student Christin Scott, NIH R01 GM126019 - 02S1, Ka Yee Yeung (PI), Wes J. Lloyd (co-I), \$36,510, 02/2019 – 01/2020.

- [F13] Super Computing (SC 18) Early Career Program Travel Support, Wes J. Lloyd (PI), \$438, 11/2018.
- [F12] Fast and Robust AgES Watershed Model Calibration Leveraging Amazon Web Services, Wes J. Lloyd (PI). Amazon Cloud Credits for Research Grant, \$15,000, 10/2018-09/2019.
- [F11] Education Cloud credits to support Spring 2018 TCSS 562: Software Engineering for Cloud Computing Graduate Course, Wes J. Lloyd (PI), 03/2018-03/2019.
- [F10] NSF Career Workshop Travel Grant Award, Wes J. Lloyd (PI), \$1,300, 04/2018.
- [F9] Intelligent Deployment of Containerized Bioinformatics Workflows on the Cloud, Ka Yee Yeung (PI), Wes J. Lloyd (co-I), NIH R01 Grant. \$1,032,263, 02/2018 - 02/2022.
- [F8] AWS Educate: Education Cloud credits to support Fall 2017 TCSS 558: Applied Distributed Computing Graduate Course, Wes J. Lloyd (PI), 03/2017-03/2018.
- [F7] Improving Public Cloud Infrastructure Management to Accelerate Science, Wes J. Lloyd (PI). Azure Cloud Credits for Research Wes J. Lloyd (PI), \$20,000. 05/2017-05/2018.
- [F6] Mitigating Public Cloud Resource Contention to Accelerate Science, Wes J. Lloyd (PI). Amazon Cloud Credits for Research Grant Wes J. Lloyd (PI), \$5,000. 07/2017-07/2018.
- [F5] AWS Educate: Education Cloud credits to support Spring 2017 TCSS 562: Software Engineering for Cloud Computing Graduate Course, Wes J. Lloyd (PI), 03/2017-03/2018.
- [F4] NSF Cloud Workshop Travel Grant Award, Wes J. Lloyd (PI), \$1,000, 11/2016.
- [F3] Machine Learning to Improve the Runtime and Availability of the Wind Erosion Prediction System, Wes J. Lloyd (PI), with Olaf David. Amazon Web Services Research Grant. \$5,000. 04/2016-04/2017.
- [F2] Towards the Next Generation Water Supply Forecasting (EWSF) System harnessing IaaS Clouds, Wes J. Lloyd (PI), with Olaf David. Amazon Web Services Research Grant, \$5,000. 04/2016-04/2017.
- [F1] Autonomous Scaling of Multitier Soil Erosion Models in IaaS Clouds, Wes J. Lloyd (co-I), with Shrideep Pallickara (PI). Amazon Web Services Research Grant. \$5,000. 3/2014-3/2015

## 10 Campus, Professional, and Academic Service Activity

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### 10.1 Departmental Service

### New Academic Programs

Graduate Certificate in Software Development Engineering, certificate program proposal co-author and Program Co-coordinator, 2019-2023, **Program Chair**, 2023-

Program launched Fall 2020, <https://www.tacoma.uw.edu/set/gc-sde>

PhD in Computer Science & Systems, degree program, proposal contributor, 2018-2020

Program launched Fall 2020, <https://www.tacoma.uw.edu/set/phd>

MS in Computer Science & Systems, Distributed Systems Track, proposal contributor, 2018-2019

Track launched Fall 2019

### Faculty Search Committees

2017-18 Computer Science & Systems Assistant Professor Search Committee (3 positions)

2019-2020 Computer Science & Systems Lecturer Search Committee

2020-2021 Computer Science & Systems Research Assistant Professor Search Committee Chair

2022-2023 Computer Science & Systems Tenure Track Assistant Professor Search Committee Chair

2023-2024 Computer Science & Systems Tenure Track Multiple Positions (3) Assistant Professor Search Committee Co-Chair w/ Raghavi Sakpal

2024-2025 Information Technology & Systems Tenure Track Multiple Position (2) Assistant Professor Search

### Committees

School of Engineering and Technology Curriculum Day Planning Committee, 2017-2020

Computer Science & Systems Program Committee, 2016-present

Course Steward, TCSS 422 Operating Systems, 2016-present

Graduate Program Committee, 2016-present

**Graduate Program Coordinator**, Summer 2024 -

MSCSS Research Proposal Review Coordinator – coordinate review of student thesis and capstone proposals

MSCSS Student Application Reviewer – Annual review of student applications

### Courses Developed

TCSS 504 Software Engineering and Development Techniques

TCSS 505 Systems Programming

TCSS 462 Cloud Computing

TCSS 562 Software Engineering for Cloud Computing

TCSS 591 Research Seminar in Distributed Systems

TCSS 800 Doctoral Dissertation

### Other Activity

Classroom Peer Observation, Abraham, Barreto, Capaul, Hu, Hung, Irissappane, Nascimento, Sobolewska, Sakpal, Tolentino, and Zhao, 2016-2025

Part Time Faculty Recruitment, TCSS 551 Big Data Analytics, W17, F17, W19

Student Grader Supervision, 14 students, 2016-2025

## 10.2 Service to the Campus

### Committees

UWT Campus Technology Committee (UWT-CTC), 2019-

University Faculty Council: Tri Campus Policy (UW FCTPC), Voting Representative, 2018-2021

### Other Activity

ACCESS in STEM mentor for Jace Shirreff, 1<sup>st</sup> Generation Mechanical Engineering student @ UWT, 2018-2021, Lwazi Mabota, Computer Science and Systems Student @ UWT 2021-, Scholarship Program supported by NSF-1741595

UWT Computer Literacy Seminar Series, lead/organized 8 sessions related to cloud computing, 2018-

## 10.3 Community Engagement

Led development of Hour of Code - Computer Science Education module on Cloud Computing supported by NSF-1849970. Module distributed on Code.org platform for international use in conjunction with annual computer science week. Collaborated with Lincoln High School in Tacoma to review/test module. To date: 7,310 users, 10,059 sessions (as of March 2022) hosted at: <https://hourofcode.com/uwcloud>

## 10.4 Service on International Conference and Workshop Committees

[C40] Technical Program Co-Chair: 13<sup>th</sup> IEEE International Conference on Cloud Engineering (IC2E 2025), Rennes, France, September 2025

[C39] Technical Program Committee: 16<sup>th</sup> ACM/SPEC International Conference on Performance Engineering (ICPE 2025), Toronto, Canada, May 2025

[C38] Technical Program Committee, Track 5: Applications and Workflows: 24<sup>th</sup> ACM/SPEC International Conference on Performance Engineering (ICPE 2024), South Kensington, London, UK, May 2024

[C37] Tenth International Workshop on Serverless Computing (WoSC10), with ACM/IFIP Middleware 2024, Hong Kong, China, 2024

[C36] 13th International Workshop on Parallel and Cloud-based Bioinformatics and Biomedicine (ParBio), Workshop Organizer with Giuseppe Agapito, Workshop in conjunction with ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB 2024), Shenzhen, China, November 2024

- [C35] Technical Program Committee Member: 15<sup>th</sup> IEEE International Conference on Cloud Computing Technology and Services (CloudCom 2024), Cloud Services and Applications Track, Abu Dhabi, UAE 2024.
- [C34] Technical Program Committee: 12<sup>th</sup> IEEE International Conference on Cloud Engineering (IC2E 2024), Paphos, Cyprus, September 2024
- [C33] Technical Program Committee, Track 1: Algorithm and Software: 8<sup>th</sup> IEEE Cloud Summit, Washington D.C., USA, June 2024
- [C32] Technical Program Committee: 15<sup>th</sup> ACM/SPEC International Conference on Performance Engineering (ICPE 2024), South Kensington, London, UK, May 2024
- [C31] Technical Program Committee, Track 5: Applications and Workflows: 24<sup>th</sup> IEEE/ACM International Symposium on Cluster, Cloud and Internet Computing (CCGRID 2024), Philadelphia, PA, May 2024
- [C30] Ninth International Workshop on Serverless Computing (WoSC9), with ACM/IFIP Middleware 2023, Bologna, Italy, 2024
- [C29] Technical Program Committee Member: 14<sup>th</sup> IEEE International Conference on Cloud Computing Technology and Services (CloudCom 2023), Cloud Services and Applications Track, Napoli, Italy 2023.
- [C28] Technical Program Committee, Workshop/Tutorials co-Chair: 11<sup>th</sup> IEEE International Conference on Cloud Engineering (IC2E 2022), Boston, MA, September 2023
- [C27] 12th International Workshop on Parallel and Cloud-based Bioinformatics and Biomedicine (ParBio), Workshop Organizer with Giuseppe Agapito, Workshop in conjunction with ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB 2023), Houston, TX, September 2023
- [C26] Technical Program Committee: 13<sup>th</sup> IEEE International Conference on Cloud Computing Technology and Services (CloudCom 2022), Cloud Services and Applications Track, Bangkok, Thailand 2022.
- [C25] Eighth International Workshop on Serverless Computing (WoSC8), with ACM/IFIP Middleware 2022

- [C24] 11th International Workshop on Parallel and Cloud-based Bioinformatics and Biomedicine (ParBio), Workshop Organizer with Giuseppe Agapito, Workshop in conjunction with ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB 2022), Chicago, IL, August 2022
- [C23] Technical Program Committee: 10<sup>th</sup> IEEE International Conference on Cloud Engineering (IC2E 2022), Pacific Grove, CA, September 2022
- [C22] Technical Program Committee: 13<sup>th</sup> ACM/SPEC International Conference on Performance Engineering (ICPE 2022), Beijing, China or online, April 2022.
- [C21] Seventh International Workshop on Serverless Computing (WoSC7), with ACM/IFIP Middleware 2021
- [C20] Technical Program Committee: 9<sup>th</sup> IEEE International Conference on Cloud Engineering (IC2E 2021), San Francisco, CA or online, October 2021.
- [C19] 10th International Workshop on Parallel and Cloud-based Bioinformatics and Biomedicine (ParBio), Workshop Organizer with Giuseppe Agapito, Workshop in conjunction with ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB 2021), August 2021
- [C18] Sixth International Workshop on Serverless Computing (WoSC6), with ACM/IFIP Middleware 2020, Online 2020.
- [C17] Technical Program Committee: 12<sup>th</sup> IEEE International Conference on Cloud Computing Technology and Services (CloudCom 2020), Cloud Services and Applications Track, Bangkok, Thailand 2020.
- [C16] 9th International Workshop on Parallel and Cloud-based Bioinformatics and Biomedicine (ParBio), Workshop Organizer with Giuseppe Agapito, Workshop in conjunction with ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB 2020), August 2020
- [C15] Technical Program Committee: 8<sup>th</sup> IEEE International Conference on Cloud Engineering (IC2E 2020), Sydney, Australia, April 2020 (virtual conference due to covid-19).
- [C14] Technical Program Committee: 5<sup>th</sup> IEEE International Workshop on Serverless Computing (WoSC 2019), UC Davis, California, December 2019.

- [C13] Technical Program Committee: 11<sup>th</sup> IEEE International Conference on Cloud Computing Technology and Services (CloudCom 2019), Cloud Services and Applications Track, Sydney Australia, 2019.
- [C12] 8th International Workshop on Parallel and Cloud-based Bioinformatics and Biomedicine (ParBio), Workshop Organizer with Giuseppe Agapito, Workshop in conjunction with ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB 2019), August 2019
- [C11] 7th International Workshop on Parallel and Cloud-based Bioinformatics and Biomedicine (ParBio), Workshop Organizer with Giuseppe Agapito, Workshop, Workshop in conjunction with ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB 2018), August 2018
- [C10] Technical Program Committee: 10<sup>th</sup> IEEE International Conference on Cloud Computing Technology and Services (CloudCom 2018), Cloud Services and Applications Track, Cyprus, 2018.
- [C9] 9<sup>th</sup> International Congress on Environmental Modeling and Software (iEMSs 2018). Fort Collins, CO. 2018. Session Chair: Leveraging Cloud computing, Containerization, and Microservices for Environmental Modelling Software Deployment.
- [C8] Technical Program Committee, Best Paper Committee, Track Chair: 6<sup>th</sup> IEEE International Conference on Cloud Engineering (IC2E 2018), Tampa, Florida, USA, 2018.
- [C7] Technical Program Committee: 9<sup>th</sup> IEEE International Conference on Cloud Computing Technology and Services (CloudCom 2017), Cloud Services and Applications Track, Hong Kong, 2017.
- [C6] Technical Program Committee: 17<sup>th</sup> ACM/IEEE International Symposium on Cluster, Cloud and Grid Computing (CC Grid 2017), Performance Modeling and Evaluation Track, Madrid, Spain, 2017.
- [C5] Technical Program Committee: 2<sup>nd</sup> ACM International Workshop of Software-Defined Ecosystems (Big System 2015), Portland, OR. 2015.
- [C4] Reviewer: IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2014). London, UK. 2014.
- [C3] Track Chair, Reviewer: Stream A: Cyberinfrastructure and Cloud Computing for Environmental Modeling, Track A3: Session A3: Innovative Architectures and Approaches of Cloud and Mobile Technology for Environmental Modeling, 7<sup>th</sup> International Congress on Environmental Modeling and Software (iEMSs 2014). San Diego, CA. 2014.

[C2] Student Volunteer: ACM Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA '04). Vancouver, British Columbia, Canada. 2004.

[C1] Student Volunteer: ACM Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA '00). Minneapolis, Minnesota. 2000.

### 10.5 Research Presentations

[P8] University of California, Santa Barbara Computer Science, Research Seminar, Autonomic Management of Cost, Performance, and Resource Uncertainty for Migration of Applications to Infrastructure-as-a-Service (IaaS) Clouds, Pasadena, CA, November 2014.

[P7] NASA Visit, Jet Propulsion Lab (NASA/JPL) Site Visit, Autonomic Management of Cost, Performance, and Resource Uncertainty for Migration of Applications to Infrastructure-as-a-Service (IaaS) Clouds, Pasadena, CA, November 2014.

[P6] The Federation for Earth Science Information Partners (ESIP) Summer Meeting, The Virtual Machine Scaler: Supporting Environmental Modeling for the Cloud Services Innovation Platform, Frisco, CO, July 2014.

[P5] Department of Homeland Security Grant Site Visit, Autonomic Resource Management for Service Oriented Application Migration to Infrastructure-as-a-Service (IaaS) Clouds, Fort Collins, CO, March 2014.

[P4] IEEE International Conference on Cloud Engineer (IC2E 2014), PhD Symposium, Autonomic Resource Management for Service Oriented Application Migration to Infrastructure-as-a-Service (IaaS) Clouds, Boston, MA, March 2014.

[P3] EucaDay NYC 2012, Cloud Services Innovation Platform: Enabling Scalable Delivery of Scientific Modeling, New York, NY, Apr 2012.

[P2] Gov/Cloud 2012, Federal Government Case Studies, Cloud Services Innovation Platform, Washington DC, Feb 2012.

[P1] Euca Social 2011, held in conjunction with Cloud Expo 2011, Cloud Services Innovation Platform, Santa Clara, CA, Nov 2011.

### 10.6 Patents

[PA1] Ling-Hong Hung, **Wesley J. Lloyd**, Ka Yee Yeung-Rhee, "Techniques for improving processing of bioinformatics information to decrease processing time," US Patent #20210089358, Filed March 25, 2021.

### 10.7 Journal Review Activity

Editorial Board, Journal for Systems Research, Serverless Systems Track, <https://escholarship.org/uc/jsys>

Associate Editor, IEEE Transactions on Cloud Computing, <https://www.computer.org/csdl/journal/cc>

Reviewer for: ACM Communications, IEEE Transactions on System, Man, and Cybernetics, ACM Transactions on Autonomous and Adaptive Systems, IEEE Transactions on Services Computing Journal, IEEE Transactions on Big Data, IEEE Access, Elsevier Environmental Modeling and Software Journal, Elsevier Future Generation Computer Systems (FCGS), Elsevier Simulation Modeling Practice and Theory, Riley Software Practice and Experience Journal, IEEE Transactions on Cloud Computing, IEEE Software, Springer Journal of Cloud Computing, Elsevier Journal of Systems Research, IEEE Computer Communication, Computers In Industry

### **10.8 Grant Review Activity**

NSF Panel, June 2018

NSF Panel, February 2021

NSF Panel, February 2022

Louisiana Board of Regents, February 2023

NSF Panel, April 2024

### **10.9 Professional Society Membership**

Association for Computing Machinery (ACM), 1998-  
Institute of Electrical and Electronics Engineers (IEEE), 2012-  
Denver Eucalyptus Meetup

### **10.10 External Service**

Faculty advisor, Colorado State University Outdoor Club, 2007-2016.

Licensed Amateur Radio Operator, since 1988

Last updated May 3, 2025.