JEFF CLUNE

SENIOR RESEARCH MANAGER & FOUNDING MEMBER, UBER AI LABS

LOY AND EDITH HARRIS ASSOCIATE PROFESSOR
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EDUCATION

Ph.D. in Computer Science, Michigan State University. 2010. 4.0 GPA.

M.A. in Philosophy, Michigan State University. 2005. 4.0 GPA.

Honors B.A. in Philosophy, University of Michigan. 1999. 3.9 GPA.

ACADEMIC POSITIONS

Harris Associate Professor, Computer Science, University of Wyoming, 2017 – Present

Senior Research Manager, Uber AI Labs, 2017 – Present

Assistant Professor, Computer Science, University of Wyoming, 2013 – 2017

Consultant, Geometric Intelligence, a deep learning startup (acquired by Uber), 2015 – 2016

Visiting Scientist, Cornell University, Department of Mechanical and Aerospace Engineering, 2012 – 2013. Advisor: Hod Lipson

Postdoctoral Fellow, Cornell University, Department of Mechanical and Aerospace Engineering, 2010 – 2012. Advisor: Hod Lipson

Postdoctoral Scientist, BEACON Center for the Study of Evolution in Action, Michigan State University, Summer 2010. Advisor: Charles Ofria

JOURNAL PUBLICATIONS

- Stanley K, Clune J, Lehman J, Miikkulainen R (2019) Designing Neural Networks through Neuroevolution. **Nature Machine Intelligence** (accepted, to appear).
- Norouzzadeh M, Nguyen A, Kosmala M, Swanson A, Palmer MS, Parker C, <u>Clune</u> J (2018) Automatically identifying, counting, and describing wild animals in camera-trap images with deep learning. **Proceedings of the National Academy of Sciences**. 115:25. (**cover article**)
- Stanley K, Clune J, Lehman J, Miikkulainen R (2018) Neuroevolution: Designing Neural Networks through Evolutionary Algorithms (2018) **Nature Machine Intelligence**, in revision.

- Tabak MA, Norouzzadeh MS, Wolfson DW, Sweeney SJ, VerCauteren KC, Snow NP, Halseth JM, Di Salvo PA, Lewis JS, White MD, Teton B, Beasley JC, Schlichting PE, Boughton RK, Wight B, Newkirk ES, Ivan JS, Odell EA, Brook RK, Lukacs PM, Moeller AK, Mandeville EG, Clune J, Miller RS (2018) Machine learning to classify animal species in camera trap images: Applications in ecology. Methods in Ecology and Evolution, to appear. Preprint on bioRxiv 10.1101/346809

- Huizinga J, Stanley K, Clune J (2018) The emergence of canalization and evolvability in an open-ended, interactive evolutionary system. *Artificial Life* (to appear).

- Velez R, Clune J (2017) Diffusion-based neuromodulation can eliminate catastrophic forgetting in simple neural networks. PLoS ONE.

- Helms L, Clune J (2017) Improving HybrID: How to best combine indirect and direct encoding in evolutionary algorithms. PLoS ONE 12(3): e0174635.

- How evolution learns to generalise: Using the principles of learning theory to understand the evolution of evolvable developmental organization. Kouvaris K, Clune J, Kounios L, Brede M, Watson R (2017) PLoS Computational Biology. 13(4): e1005358.

- Stanton C, Clune J (2016) Curiosity Search: Producing Generalists by Encouraging Individuals to Continually Explore and Acquire Skills Throughout Their Lifetime. PLoS One. 11(9): e0162235

- Mengistu H, Huizinga J, Mouret JB, Clune J (2016) The evolutionary origins of hierarchy. PLoS Computational Biology. 12(6): e1004829.

- Nguyen A, Yosinski J, Clune J (2016) Understanding Innovation Engines: Automated Creativity and Improved Stochastic Optimization via Deep Learning. Evolutionary Computation Journal.

- Taylor T, Auerbach JE, Bongard J, Clune J, Hickinbotham S, Ofria C, Mizuki O, Risi S, Stanley KO, Yosinski J (2016) WebAL comes of age: A review of the first 21 years of Artificial Life on the web. Artificial Life. 22: 364–407.

- Cully A, Clune J, Tarapore D, Mouret JB (2015) Robots that can adapt like natural animals. **Nature**. 521.7553: pp. 503-507. (**cover article**)

- Ellefsen K, Mouret JB, Clune J (2015) Neural modularity helps organisms evolve to learn new skills without forgetting old skills. PLoS Computational Biology. 11(4): e1004128. (**cover article**)

- Clune J, Baptiste-Mouret J-B, Lipson H (2013) The evolutionary origins of modularity. Proceedings of the Royal Society B. 280: 20122863. **Winner: Top 5 Most Cited Papers of 2013.**

- Clune J, Pennock RT, Ofria C, Lenski RE (2012) Ontogeny tends to recapitulate phylogeny in digital organisms. The American Naturalist. 180: E54–E63.

- Clune J, Stanley KO, Pennock RT, Ofria C (2011) On the performance of indirect encoding across the continuum of regularity. IEEE Transactions on Evolutionary Computation. 15(3): 346-367.

- Clune J, Goldsby H, Ofria C, Pennock RT (2011) Selective pressures for accurate altruism targeting: Evidence from digital evolution for difficult-to-test aspects of inclusive fitness theory. Proceedings of the Royal Society B. 278: 666-674.

- Clune J, Misevic D, Ofria C, Lenski RE, Elena SF, and Sanjuán R (2008) Natural selection fails to optimize mutation rates for long-term adaptation on rugged fitness landscapes. PLoS Computational Biology. 4(9): e1000187. (**cover article**)

PEER REVIEWED CONFERENCE PUBLICATIONS

- Conti E, Madhavan V, Petroski Such F, Lehman J, Stanley KO, Clune J (2018) Improving exploration in evolution strategies for deep reinforcement learning via a population of novelty-seeking agents. Advances in Neural Information Processing Systems (NIPS). (20% acceptance rate).
- Miconi T, Clune J, Stanley KO (2018) Differentiable plasticity: Training plastic neural networks with backpropagation. ICML.
- Stanton C, Clune J (2018) Deep curiosity search: Intra-life exploration improves performance on challenging deep reinforcement problems. NIPS Deep Reinforcement Learning Workshop.
- Petroski Such F, Madhavan V, Conti E, Lehman J, Stanley KO, Jeff Clune (2018) Deep neuroevolution: Genetic algorithms are a competitive alternative for training deep neural networks for reinforcement learning. NIPS Deep Reinforcement Learning Workshop.
- Lehman J, Chen J, Clune J, Stanley KO (2017) ES is more than just a traditional finite-difference approximator. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO).
- Lehman J, Chen J, Clune J, Stanley KO (2017) Safe mutations for deep and recurrent neural networks through output gradients. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO).
- Nguyen A, Clune J, Bengio Y, Dosovitskiy A, Yosinski J (2016) Plug & Play Generative Networks: Conditional Iterative Generation of Images in Latent Space. Computer Vision and Pattern Recognition (CVPR). Awarded **spotlight oral presentation** (~10% spotlight acceptance rate).
- Nguyen A, Dosovitskiy A, Yosinski J, Brox T, Clune J (2016) Synthesizing the preferred inputs for neurons in neural networks via deep generator networks. Advances in Neural Information Processing Systems (NIPS). (23% acceptance rate).
- Nguyen A, Yosinski J, Clune J (2016) Multifaceted Feature Visualization: Uncovering the different types of features learned by each neuron in deep neural networks. ICML Workshop on Visualization for Deep Learning. Selected for oral presentation. **Winner: Best Workshop Paper** (14% award acceptance rate).
- Norouzzadeh M, Clune J (2016) Neuromodulation improves the evolution of forward models. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO).
- Velez R, Clune J (2016) Identifying core functional networks and functional modules within artificial neural networks via subsets regression. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO).
- Mengistu H, Lehman J, Clune J (2016) Evolvability Search: Directly selecting for evolvability in order to study and produce it. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO).
- Huizinga J, Mouret JB, Clune J (2016) Does aligning phenotypic and genotypic modularity improve the evolution of neural networks? Proceedings of the Genetic and Evolutionary Computation Conference (GECCO).
- Tarapore D, Clune J, Cully A, Mouret JB (2016) How do different encodings influence the performance of the MAP-Elites algorithm? Proceedings of the Genetic and Evolutionary Computation Conference (GECCO).
- Lehman J, Risi S, Clune J (2016) Creative Generation of 3D Objects with Deep Learning and Innovation Engines. Proceedings of the International Conference on Computational Creativity.
- Li Y, Yosinski J, Clune J, Lipson H, Hopcroft J (2015) Convergent Learning: Do different neural networks learn the same representations? International Conference on Learning Representations (ICLR). Selected for oral presentation (**5.7% oral acceptance rate**). Also selected for oral presentation at the Neural Information Processing Systems (NIPS) Feature Extraction Workshop (**6.7% oral acceptance rate**).

- Yosinski J, Clune J, Nguyen A, Fuchs T, Lipson H (2015) Understanding neural networks through Deep Visualization. International Conference on Machine Learning (ICML) Deep Learning Workshop.
- Nguyen A, Yosinski J, Clune J (2015) Innovation Engines: Innovation Engines: Automated Creativity and Improved Stochastic Optimization via Deep Learning. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO). **Winner: Best Paper Award (3% award acceptance rate).**
- Nguyen A, Yosinski J, Clune J (2015) Deep Neural Networks are Easily Fooled: High Confidence Predictions for Unrecognizable Images. Computer Vision and Pattern Recognition (CVPR). Awarded oral presentation (**3% oral acceptance rate**). Overall acceptance rate: 25%.
- Gurbhoo N, Kubichek RF, Muknahallipatna S, Clune J (2015) A Method to Improve Signal Quality in Wireless Ad-Hoc Networks with Limited Mobility. Proceedings of the International Conference on Computing, Networking, and Communications.
- Yosinski J, Clune J, Bengio Y, and Lipson H (2014) Quantifying the transferability of features in deep neural networks. Advances in Neural Information Processing Systems (NIPS). Selected for oral presentation (**1% oral acceptance rate**).
- Li J, Storie J, Clune J (2014) Encouraging Creative Thinking in Robots Improves Their Ability to Solve Challenging Problems. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO). 193-200.
- Velez R, Clune J (2014) Novelty Search Creates Robots with General Skills for Exploration. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO). 737-744.
- Huizinga J, Mouret JB, Clune J (2014) Evolving Neural Networks That Are Both Modular and Regular: HyperNeat Plus the Connection Cost Technique. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO). 697-704.
- Cheney N, Clune J, Lipson H (2014) Evolved Electrophysiological Soft Robots. Proceedings of the Artificial Life Conference (ALIFE).
- Coleman O, Blair A, Clune J (2014) Automated Generation of Environments to Test the General Learning Capabilities of AI Agents. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO). 161-168.
- Clune J, Chen A, Lipson H (2013) Upload Any Object and Evolve It: Injecting Complex Geometric Patterns into CPPNs for Further Evolution. Proceedings of the IEEE Congress on Evolutionary Computation (CEC). 3395-3402.
- Cheney N, MacCurdy R, Clune J, Lipson H (2013) Unshackling evolution: evolving soft robots with multiple materials and a powerful generative encoding. Proceedings of the Genetic and Evolutionary Computation Conference (GECCO). 167-174.
- Lee S, Yosinski J, Glette K, Lipson H, Clune J. 2013. Evolving gaits for physical robots with the HyperNEAT generative encoding: the benefits of simulation. Applications of Evolutionary Computing. 540-549. Springer.
- Lohmann S, Yosinski J, Gold E, Clune J, Blum J, Lipson H (2012) Aracna: An Open-Source Quadruped Platform for Evolutionary Robotics. Proceedings of the Artificial Life Conference. 387-392. **Best presentation award.**
- Clune J, Lipson H (2011) Evolving three-dimensional objects with a generative encoding inspired by developmental biology. Proceedings of the European Conference on Artificial Life. 144-148.
- Yosinski J, Clune J, Hidalgo D, Nguyen S, Cristobal Zagal J, Lipson H (2011) Evolving robot gaits in hardware: the HyperNEAT generative encoding vs. parameter optimization. Proceedings of the European Conference on Artificial Life. 890-897.
- Suchorzewski M, Clune J (2011) A novel generative encoding for evolving modular, regular and

scalable networks. Proceedings of the Genetic and Evolutionary Computation Conference. 1523-1530.

- <u>Clune</u> J, Beckmann BE, McKinley PK, Ofria C (2010) Investigating whether HyperNEAT produces modular neural networks. Proceedings of the Genetic and Evolutionary Computation Conference. 635-642.

- <u>Clune</u> J, Beckmann BE, Pennock RT, Ofria C (2009) HybrID: A hybridization of indirect and direct encodings for evolutionary computation. Proceedings of the European Conference on Artificial Life. Vol. 2: 134: 141.

- Goldsby HJ, Knoester DB, <u>Clune</u> J, McKinley PK, Ofria C (2009) The evolution of division of labor. Proceedings of the European Conference on Artificial Life. Vol. 2: 10-18.

- <u>Clune</u> J, Pennock RT, and Ofria C (2009) The sensitivity of HyperNEAT to different geometric representations of a problem. Proceedings of the Genetic and Evolutionary Computation Conference. 675-682. **Best paper award**.

- Goldsby HJ, Goings S, <u>Clune</u> J, and Ofria C (2009) Problem decomposition using indirect reciprocity in evolved populations. Proceedings of the Genetic and Evolutionary Computation Conference. 105-112.

- <u>Clune</u> J, Beckmann BE, Ofria C, and Pennock RT (2009) Evolving coordinated quadruped gaits with the HyperNEAT generative encoding. Proceedings of the IEEE Congress on Evolutionary Computing. 2762-2771.

- <u>Clune</u> J, Ofria C, and Pennock RT (2008) How a generative encoding fares as problem-regularity decreases. Proceedings of the 10th International Conference on Parallel Problem Solving From Nature. 358-367.

- <u>Clune</u> J, Ofria C, and Pennock RT (2007) Investigating the emergence of phenotypic plasticity in digital organisms. Proceedings of the European Conference on Artificial Life. 74-83.

- <u>Clune</u> J, Goings S, Goodman ED, and Punch W (2005) Investigations in meta-GAs: panaceas or pipe dreams? Proceedings of the Genetic and Evolutionary Computation Conference. 235-241.

- Goings S, <u>Clune</u> J, Ofria C, and Pennock RT (2004) Kin-Selection: The rise and fall of kin cheaters. Proceedings of the Ninth Conference on Artificial Life. 303-308.

PUBLICATIONS ON ARXIV

- Joost Huizinga, Jeff Clune (2018) Evolving Multimodal Robot Behavior via Many Stepping Stones with the Combinatorial Multi-Objective Evolutionary Algorithm. arXiv:1807.03392.

- Joel Lehman, Jeff Clune, Dusan Misevic et al. (2018) The surprising creativity of digital evolution: A collection of anecdotes from the evolutionary computation and artificial life research communities. arXiv 1803.03453 (In Review, *Artificial Life*)

- Xingwen Zhang, Jeff Clune, Kenneth O. Stanley (2017) On the relationship between the OpenAI evolution strategy and stochastic gradient descent. arXiv 1712.06564.

- Mouret JB, Clune J (2015) Illuminating search spaces by mapping elites. arXiv http://arxiv.org/abs/1504.04909

GRANTS & FELLOWSHIPS

- 2018: Overcoming Catastrophic Forgetting and Rapidly Adapting via Selective Plasticity Driven

by Diffusion-Based Neuromodulation. PI. DARPA Lifelong Learning Machines Program. With Nick Cheney. **$1,669,969**

- 2018: NSF Collaborative Research: Framework: Software: HDR: Building the Twenty-First Century Citizen Science Framework to Enable Scientific Discovery Across Disciplines. Co-PI with Sarah Benson-Amram at UW. **$85,284** to UW.
- 2017: Collaboration on Intelligent Machines. Grant from the Norwegian government to Jim Torresen to collaborate with scientists in other countries including myself. Co-PI. **$400,000** total, but none directly to UW.
- 2016: Oak Ridge Directors Discretion Award **$26,848** value.
- 2016: Ellbogen Next Generation Program **$1,500**
- 2015: **NSF CAREER Award**. **$507,465**
- 2015: NASA WSG Faculty Research Initiation Grant. **$20,000**
- 2015: UW CEAS Active Learning Initiative. **$30,180**
- 2015: XSEDE Supercomputing Research Allocation. Value: **$26,848**
- 2015: Berry Center Art in Conservation Grant. **$5,000**
- 2015: NVIDIA donation of two Titan GPU cards **$2,000**
- 2015: Co-PI on grant establishing UW as an NVIDIA GPU Research and Education Center. Includes hardware donation valued at $**4,150**
- 2015: UWEFE funds to buy robots. **$1,317**
- 2015: Three private donations to Laramie Robotics Club. **$1,600**
- 2015: External collaborator donation. **$1,600**
- 2014: Ellbogen K-12 engineering initiative. **$3,000**
- 2014: UW summer graduate research enhancement award. **$5,000**
- 2014: Nvidia hardware donation for research. **~$11,500** (value of donated Nvidia Tesla K40 graphics card and the matching hardware donated by the advanced research computing center)
- 2014: XSEDE computing allocation. **~$4000**
- 2014: Private donation from UW Alumni to my lab + Google match. **$16,000**
- 2014: iRobot donated 3 Roomba robots to Laramie Robotics Club. **~$2,000**
- 2014: Modular Robotics donated a robot kit. **$149**.
- 2014: Associated Students of U. Wyoming funded the Laramie Robotics Club. **$965**.
- 2013-2015: Co-author of successful Graduate Mentoring Initiative proposal at U. Wyoming. The award consisted of one funded Ph.D. graduate assistantship for two years, or **$21,060**.
- 2014-2016: Co-author of successful Graduate Mentoring Initiative proposal at U. Wyoming. The award consisted of one funded Ph.D. graduate assistantship for two years, or **$21,060**.
- 2013: UW Engineering Fund for Enrichment. **$2,541**
- 2013: Private donation from UW alumni to my lab. **$10,000**
- 2012: Co-author of funded DARPA grant titled "Matter Compiler: Visual Interaction for Rapid Exploratory Design for Manufacturing." **$824,000**
- 2010-2011: **NSF Postdoctoral Research Fellowship in Biology**. **$123,000**.
- 2010: Co-author of a successful funding request to the BEACON Center for the Study of Evolution in Action titled "Open-Ended Evolution of Ecologies of Digital Organisms in 3-Dimensions." The grant covered the cost of **one graduate student salary for one year**.
- 2010: Research Travel Fellowship, Michigan State University

- 2010: Genetic and Evolutionary Computation Conference Travel Award
- 2009: European Conference on Artificial Life Student Fellowship
- 2009: Council of Graduate Students Conference Grant
- 2006: NSF Graduate Research Fellowship, Honorable Mention
- 2005: Quantitative Biology and Modeling Initiative Research Fellowship, Michigan State University
- 2003-2005: Dean's Recruitment Fellowship, Michigan State University
- Won by Students I Advise
    - 2016: Wyoming Space Grant. Richard Yang. **$5,000**
    - 2015: EPSCoR Grant. Richard Yang. **$1,800**
    - 2015: Wyoming Research Scholars Program. Richard Yang. **$7,300**
    - 2015-2020: CEAS Excellence Fellowship. Christopher Stanton. **$225,000**
    - 2015-2020: CEAS Excellence Fellowship. Anh Nguyen. **$225,000**
    - 2014: ACM Women in Computing. Jingyu Li. **$600**
    - 2014: Wyoming Space Grant. Roby Velez. **$20,000**
    - 2014: Wyoming Space Grant. Tyler Hughes. **$5,000**
    - 2014: EPSCoR Grant. Tyler Hughes. (declined) **$3,500**
    - 2014: McNair Scholars Program. Tyler Hughes. **$3,600**
    - 2014: ACM Women in Computing Scholarship. Jingyu Li. **$600**
    - 2013:Minority and Women's Assistantship. **$31,590** (1.5 years of Ph.D. support)

AWARDS

- 2018: Invited to White House AI Summit
- 2017: Early Tenure
- 2016: **Distinguished Young Investigator Award**, International Society for Artificial Life. All students, postdocs, and pre-tenure faculty in the field worldwide were eligible.
- 2016: **Outstanding Paper of 2015**, International Society for Artificial Life. For our paper 'Robots that can adapt like animals', which was featured on the cover of Nature.
- 2016: Winner: Best Workshop paper (14% award acceptance rate) for the paper: Nguyen A, Yosinski J, Clune J (2016) Multifaceted Feature Visualization: Uncovering the different types of features learned by each neuron in deep neural networks. ICML Workshop on Visualization for Deep Learning. Also selected for oral presentation.
- 2016: Top 50 most downloaded papers of 2016, PLoS Computational Biology
- 2016: La Recherche Award for research advance in information technology.
- 2016: Best Student Video, AAAI Video Awards. For "Deep Neural Networks are Easily Fooled" (won by my Ph.D. student Anh Nguyen)
- 2015: CVPR Community Top Paper. **$3,000** cash prize.
- 2015: Altmetrics' analyses reveal our paper "Deep Neural Networks are Easily Fooled" to be the **63rd most impactful scientific paper worldwide** from any discipline in 2015
- 2015: Popular Science "Best of What's New" Award Winner
    - "The award is Popular Science's top prize, and the 100 winners—chosen from among

thousands of nominees—are each a revolution in their respective fields."- Cliff Ransom, Editor-in-Chief, Popular Science

- 2015: "Top Prof" award from the University of Wyoming Mortar Board (senior honors society)
- 2015: Best paper award. Genetic and evolutionary computation conference. For the paper "Innovation Engines: Automated Creativity and Improved Stochastic Optimization via Deep Learning."
- 2015: Winner: Virtual Creatures Competition, Genetic and Evolutionary Computation Conference
- 2015: Winner: Best Long Video & Most Educational Video. Deep Neural Networks are Easily Fooled. IJCAI 2015 Video competition.
- 2015: Winner: Most Entertaining Video. Unshackling evolution: evolving soft robots with multiple materials. IJCAI 2015 Video competition.
- 2014: Winner, Best Video, AAAI Video Competition, "Evolving Modular, Regular ANNs"
- 2014: Winner, GECCO Virtual Creatures Competition (Judged by Karl Sims, Peter Bentley, Auke Jan Ijspeert, Mark Bedau, & Sebastian Risi)
- 2014: Author of Top 5 Most Cited Publications in 2013 for the journal Proc. Royal Society B.
- 2013: Winner, Most Entertaining Video, AAAI Video Competition
- 2012: Winner, Visualizing Evolution Contest, Genetic & Evolutionary Computation Conference
- 2012: Student Paper of the Year award from The American Naturalist, runner-up (For Ontogeny Tends to Recapitulate Phylogeny in Digital Organisms).
- 2012: AAAI Video Award Finalist
- 2011: EndlessForms.com voted one of the top 35 websites in the 3D printing industry
- 2011: Finalist in the Evolutionary Art Competition (one of four), Genetic and Evolutionary Computation Conference
- 2009: Best Paper Award, Genetic and Evolutionary Computation Conference
- 1999: Angell Scholar, University of Michigan
- 1995: Branstrom Award, University of Michigan

CHAIRING, TUTORIALS, & SERVICE WITHIN MY FIELD

- 2018- Founder & Co-Director, Labeled Image Library of Alexandria. http://lila.science
- Reviewer:
  - *Funding agencies:* National Science Foundation
  - *Journals*: PLoS Biology, PLoS One, IEEE Transactions on Neural Networks, Journal of Machine Learning Research, IEEE Transactions on Evolutionary Computation, Evolutionary Computation, Neural Computation, Adaptive Behavior, Artificial Life Journal, Astrobiology, Soft Computing, Leonardo
  - *Conferences*: SIGGRAPH Conference, Genetic and Evolutionary Computation Conference, International Conference on Intelligent Robots and Systems, Artificial Life Conference, EvoStar Conference, AAAI AI Video Competition, Virtual Creatures Competition
- 2015-2018: Vice chair, IEEE Technical Committee on Cognitive and Developmental Systems EvoDevo TaskForce
- 2013-2017: Elected to the Board of Directors of the International Society of Artificial Life

- 2016: NIPS committee to accept/reject workshop proposals
- 2016: Program committee: ICML Workshop on Visualization for Deep Learning
- 2014. Co-organizer. Workshop On Artificial Life And The Web. Artificial Life Conference.
- 2013: Co-organizer, AAAI Symposium, How Should Intelligence be Abstracted in AI Research: MDPs, Symbolic Representations, Artificial Neural Networks, or _____? Featured 38 participants and five keynotes, each of which is a major leader of their respective fields (Andrew Ng, Stanford; Georg Striedter, UC Irvine; Randall O'reilly, University of Colorado Boulder; Risto Miikkulainen, UT Austin; Gary Marcus, NYU; Pierre-Yves Oudeyer, Inria France).
- 2010 & 2011: Co-chair, Generative and Developmental Systems Track, Genetic and Evolutionary Computation Conference
- 2010: The Avida Digital Evolution Platform, Tutorial, Genetic and Evolutionary Computation Conference
- 2009: Leveraging the Avida Digital Evolution Platform for Research in Evolving Cooperation, Tutorial, European Conference on Artificial Life

INVITED ARTICLES

- Lehman J, Clune J, Risi S. An Anarchy of Methods: Current Trends in How Intelligence Is Abstracted in AI. IEEE Intelligent Systems. 2015. 29 (6), 56-62.
- Burns G, Gil Y, Liu Y, Villanueva-Rosales N, Risi S, Lehman J, Clune J, Lebiere C, Rosenbloom P S, van Harmelen F, Hendler J A, Hitzler P, Janowic K, Swarup S. Reports on the 2013 AAAI Fall Symposium Series. AI Magazine. 2014. 35 (2), 69-74.

EDITED PUBLICATIONS

- Krasnogor N, Auger A, Meyer-Nieberg S, Bernadó-Mansilla E, Ochoa G, Browne WN, Ong Y-S, Clune J, Pelta D, Coello Coello CA, Poulding S, Collet P, Preuss M, Eiben AE, Raidl GR, Engelbrecht AP, Ritchie M, Freitas AA, Schoenauer M, Gagné C, Sipper M, Gallagher MR, Smith J, Gershenson C, Spector L, Gustafson S, Squillero G, Hansen N, Watson J-P, Hornby GS, Witt C, Landa-Silva D, Wong ML, Lozano JA and Yu T (2011) editors, Proceedings of the Genetic and Evolutionary Computation Conference. ACM Press, New York, New York.
- Branke J, Alba E, Arnold D, Bongard J, Brabazon A, Butz MV, Clune J, Cohen M, Deb K, Engelbrecht A, Krasnogor N, Miller JF, O'Neill M, Sastry K, Thierens D, Vanneschi L, van Hemert J and Witt C (2010) editors, Proceedings of the Genetic and Evolutionary Computation Conference. ACM Press, New York, New York, 2010.

PEER REVIEWED VIDEO PUBLICATIONS

Note: To date, videos of our research have been viewed over 850,000 times.

- Nguyen A, Yosinski J, Clune J (2016) 2016: **Best Student Video**, AAAI Video Awards. For "Deep Neural Networks are Easily Fooled"

- Cully A, <u>Clune</u> J, Tarapore D, Mouret JB (2016) Robots that can adapt like natural animals. AAAI video competition. Nominated for best video, best student video, and best robot video.
- Ellefsen K, Mouret JB, Clune J (2016) Neural modularity helps organisms evolve to learn new skills without forgetting old skills. AAAI video competition. Nominated for best student video. Decision to be announced.
- Nguyen A, Yosinski J, Clune J (2015) Deep Neural Networks are Easily Fooled. IJCAI 2015 Video competition. **Winner: Best Long Video** & **Most Educational Video**.
- Huizinga J, Mouret JB, Clune J (2014) Evolving neural networks that are both modular and regular. AAAI Video Competition. **Winner: Best Video**.
- Li J, Storie J, Clune J (2014) Encouraging creative thinking in robots improves their ability to solve challenging problems.
- Cheney N, MacCurdy R, Clune J, Lipson H (2013) Unshackling evolution: evolving soft robots with multiple materials. **Winner: Most Entertaining Video** at both the 2013 AAAI Video Competition and the 2015 IJCAI Video competition.
- Clune J (2013) Evolving gaits for legged robots. AAAI Video Competition.
- Clune J, Mouret JB, Lipson H (2013) The evolutionary origins of modularity: video summary. AAAI Video Competition.
- Clune J, Yosinski J, Doan E, Lipson H (2012) Automating user creation of 3D printable objects using evolutionary algorithms based on developmental biology. AAAI Video Competition. **Finalist: Best Video Award.**

NON-PEER REVIEWED PUBLICATIONS

- Ellefsen K, <u>Clune</u> J (2015) The surprising creativity of digital evolution. Laboratory News.
- Stanley K, <u>Clune</u> J (2017) Welcoming the Era of Deep Neuroevolution. Uber Engineering Blog.
- Miconi T, <u>Clune</u> J, Stanley K (2018) Differentiable Plasticity: A New Method for Learning to Learn. Uber Engineering Blog.
- Petroski Such F, Stanley K, <u>Clune</u> J (2018) Accelerating Deep Neuroevolution: Train Atari in Hours on a Single Personal Computer. Uber Engineering Blog.
- Ecoffet A, Huizinga J, Lehman J, Stanley KO, <u>Clune</u> J (2018) Montezuma's Revenge Solved by Go-Explore, a New Algorithm for Hard-Exploration Problems (Sets Records on Pitfall, Too)

PRESS COVERAGE (SELECTED ARTICLES)

See http://www.evolvingai.org/press for links to the articles and additional articles

- **MIT Technology Review**. 2018. Uber has cracked two classic '80s video games by giving an AI algorithm a new type of memory
- **Wired**. 2018. When Bots Teach Themselves to Cheat
- **BBC**. 2018. The AI developed to identify and count wild animals
- **MIT Technology Review**. 2018. AI is helping wildlife biologists identify rare beasts on the Serengeti

- **New York Times**. 2018. Google Researchers Are Learning How Machines Learn
- **New Scientist**. 2018. 8 hilarious ways AI has outsmarted us to get the job done
- **Science**. 2018. Artificial intelligence can 'evolve' to solve problems
- **Nature**. 2017. Astronomers explore uses for AI-generated images
- **Wired**. 2017. AI Will Make Forging Anything Entirely Too Easy
- **Slate**. 2017. The Fake-Image Arms Race
- **BBC**. 2017. Tiny changes can cause AI to fail.
- **Science**. 2017. AI detectives are cracking open the black box of deep learning. (Video)
- **New Scientist**. 2017. Deep learning tells giraffes from gazelles in the Serengeti.
- **MIT Technology Review**. 2017. The Dark Secret at the Heart of AI
- The Verge. 2017. Magic AI: These Are the Optical Illusions That Trick, Fool, and Flummox Computers
- The Verge. 2016. Artificial Intelligence Is Going to Make It Easier Than Ever to Fake Images and Video
- Coverage of our startup Geometric Intelligence being acquired by Uber occurred in **Wired**, **Fortune**, the **New York Times**, **MIT Tech Review**, **BBC**, **Bloomberg**, **Wall Street Journal**, **Tech Crunch**, and many more.
- **Nature News**, **Nature News Podcast**. 2016. Can we open the black box of AI?
- KurzweilAI.net. 2016. Hierarchies exist in the brain because of lower connection costs.
- Press coverage of 2015 Nature cover paper "Robots that can adapt like natural animals."
  - Two commentaries in **Nature** and one in **Science**
  - Coverage in **BBC**, **Washington Post**, **The Guardian**, **Nature News, NBC News, NPR's Science Friday, The Atlantic, Fast Company, MIT Technology Review, BBC Inside Science, BBC World Service, The Economist, CNBC, Popular Science, Christian Science, Discover, Wired, Daily Mail, Voice of America, Le Monde**, Liberation, Gizmodo, IFL Science, IEEE Spectrum, The Times, The Verge, Live Science, The Register, BFM Business, Wyoming Public Media, Vice, and many more.
- **Popular Science**. 2016. See the difference one year makes in artificial intelligence research an improved way of learning about neural networks.
- **Popular Science**. 2016. This sculpture was designed and 3d printed by an AI artist.
- Motherboard. 2016. When AI goes wrong, we won't be able to ask it why
- HowStuffWorks. 2016. Are you actually an android?
- **The Economist**. 2015. Rise of the machines.
- Scientific American Mind. 2015. Do androids dream?
- Reddit Ask Me Anything (AMA) hosted by PLoS. **Over 1,000 comments/questions and 42,000+ unique participants**.
- Communications of the ACM. 2015. Teaching computers with illusions.
- Laramie Boomerang. 2016. UW professor's research lights up scientific, media interest.
- Nautilus Magazine. 2015. Artificial intelligence is already weirdly inhuman.
- Wyoming Public Media. 2016. Programming Through Trial And Error, With An Emphasis On Error.
- Motherboard magazine. 2015. How automating evolution could give machines imaginations.
- **BBC World Service**. 2015. Why computers forget. Also on interviewed for BBC Four.

- **The Atlantic**. 2015. Teaching a computer not to forget.
- **Popular Science**. 2015. To build multi-tasking robots, mimic the human brain.
- **MIT Technology Review**. 2014. Smart" Software can be tricked into seeing what isn't there.
- **Wired**. 2014. Simple pictures that state-of-the-art AI still can't recognize. Rebroadcast on **Slate**.
- **Slashdot (homepage)**. 2014. Research highlights how AI sees and how it knows what it's looking at. Also #1 article on HackerNews.
- **The Atlantic**. 2014. How to fool a computer with optical illusions
- **New Scientist**. 2014. Optical illusions fool computers into seeing things
- **BBC (featured on homepage)**. 2014. Robot learns to keep going with broken leg.
- **IEEE Spectrum**. 2014. Hexapod robot gets even better at being indestructible.
- **Slashdot (homepage)**. 2014. Robot with broken leg learns to walk again in under 2 minutes.
- **CNET Video**. 2014. Tomorrow daily. (Show featured segment on robot damage recovery).
- **Discover News**. 2013. Evolution helps build better robots.
- **NBC News**. 2013. Squishy virtual creatures 'evolve' walking behaviors. The story was also featured on YouTube's Most Popular Videos page, MSNBC.com, and the front pages of Digg.com, Hacker News, BuzzFeed, and Reddit Science.
- **Discover**. 2013. Watch This: Squishy Robots Evolve for Speed.
- **National Geographic**. 2013. The parts of life, by Carl Zimmer.
- **BBC**. 2013. 3D printing your thoughts.
- **Through the Wormhole with Morgan Freeman**. 2013. Are Robots the Future of Human Evolution?
- **Popular Science**. 2013. 175,000 ways to walk.
- **Fast Company**: 2013. With evolved brains, robots creep closer to animal-like learning.
- **NPR** (National Public Radio). 2012. Academic Minute − Evolution and Embryology.
- **Houston Chronicle.** Laramie club teaches students to control robots. 2013.
- **Cornell Chronicle**. 2013. Scientists find 'holy grail' of evolving modular networks.
- **MIT Technology Review**. 2012. Computer scientists reproduce the evolution of evolvability.
- ScienceDaily. 2013. Engineers solve a biological mystery and boost artificial intelligence.
- **The New Scientist (featured on cover)**. 2011. Darwin's robots: A holistic, evolutionary approach means that robots could learn to design themselves.
- **MSNBC.com**. 2011. Intelligent design: Users power evolution in 3-D Web printing.
- **Slashdot**. 2011. Crowdsourcing speeds evolution of 3D printable objects.
- **IEEE Spectrum**. 2013. Bizarre Soft Robots Evolve to Run.
- **The New Scientist (featured on cover)**. 2010.
    - Main article: Artificial life forms evolve basic intelligence
    - Editorial: Digital evolution and the meaning of life
- **US News & World Report**. 2010. New MSU research sheds light on how we become altruistic.
- **The Daily Telegraph**. 2010. Computer-simulated life forms evolve intelligence.
- **Slashdot**. 2010. Artificial life forms evolve basic memory, strategy.
- **MIT Technology Review**. 2011. 3-D design simplified: a new website could accelerate the adoption of 3-D printing.
- **Science**. 2006 (vol. 311). Darwin's Place on Campus Is Secure—But Not Supreme.

- **NSF Highlight**. 2013. Modular Biological Networks Avoid Costly Connections.
- Servo Magazine. 2013. Aracna: 3D printed, open-source robot.
- **Communications of the ACM**. 2010. 'EndlessForms' uses the Web to breed 3D printable objects.
- **KurzweilAI.net**. 2010. Artificial life forms evolve basic intelligence.
- Miami Herald/Houston Chronicle/Laramie Boomerang 2013. Laramie club teaches area students to control robots.
- Gizmodo. 2014. Watch this bot with a broken leg learn to walk straight again.
- UW News. 2013. Visiting doctoral student from Norway works to evolve robots to learn better.
- Discover. 2005 (cover article). Testing Darwin.
- Mechanical Engineering. 2012. Design in the age of 3-D printing.
- ZDNet.com. 2013. Fabricated: The New World of 3D Printing.
- SigEvolution, ACM's newsletter on Genetic and Evolutionary Computation. Cover article.
- ScienceDaily.com. 2012. Why do organisms build tissues they seemingly never use?
- ScienceDaily.com. 2011. No technical know-how needed: Endless Forms Web site helps users 'breed' 3-D printable objects.
- ScienceDaily.com. 2010. Research sheds light on altruism.
- Hacker News (front page). 2011. Breed 3D printable objects, no technical know-how needed.
- Research also covered in the following: Lansing State Journal, Jerusalem Post, Cornell Daily Sun, Innovation News Daily, LiveScience.com, PhysOrg.com, eCampusNews, NewsWise.com, BigThink.com, Business News Daily, Cornell Chronicle, State News, Shapeways blog, Thingiverse blog, Carl Zimmer's blog, 3Dprinter.net, PlasticsToday.com, Biota Live Podcast, Impact Radio, City Pulse, OneIndia.com, Computerra.com, TodayOnline.com, Creativity Online, Heise.de, ZeitNews.org, MyScience.cc, TheHighLow.com, and 50+ other media outlets.

INVITED TALKS

- NIPS Deep RL Workshop, Mexican Conference on AI (keynote), Stanford, Cambridge, NYU, DeepMind, OpenAI, Cornell, Santa Fe Institute, BEACON Congress (keynote), Genetic Programming in Theory & Practice (keynote), Toyota Research Institute, University of California Irvine, Michigan State University, Queen Mary London (via Skype), IST Austria, Pierre & Marie Curie University, American University, Colorado State University, Center for a New American Security, Wyoming Global Technology Summit, Canterbury University, University of Puerto Rico, Paris Descartes Medicine Faculty: Center for Interdisciplinary Research, University of Lausanne, Swiss AI Lab (IDSIA), ReWork Deep Learning Summit, ReWork Deep Learning for Robotics Summit, NIPS Workshop on Emergent Communication, Origins Project at Arizona State University, UC Merced.

OUTREACH

- Founded the Laramie Robotics Club, a weekly meeting where local middle and high school students have fun playing with robots and learn to love programing and STEM (science, technology, engineering, & math). Around 20 6th-12th grade students and 20 volunteer mentors regularly attend. See http://LaramieRoboticsClub.org for more information. We also regularly

do outreach activities teaching STEM and robotics to local middle and high schools, scout groups, and other youth organizations visiting campus.

- Led team that built EndlessForms.com, a website where non-technical users can design 3-D, printable objects with evolutionary algorithms based on concepts from developmental biology. The site also enables the public to learn about evolution and see its ability to create complexity. To date, over 2 million objects have been evaluated by nearly 40 thousand visitors from over 140 countries and all 50 US states. Video tours of the site have been viewed nearly 10,000 times.

- One of three designers and developers of Avida-ED, a software package used in university biology classes to teach evolution. Avida-ED enables students to conduct research in experimental evolution by testing evolutionary hypotheses and getting immediate feedback. Avida-ED was discussed in Science magazine (2006: 311) and has been used in many universities worldwide. The NSF grant overseer for Avida-ED described it as "one of the most successful science education materials projects with which I am acquainted. The product is excellent, dissemination is already successful, and the assessment plan is outstanding."

- Featured in a University of Wyoming advertising campaign called "Can one university make an impact?" The year-long campaign included billboards at the Denver International Airport. The ads showed me working with graduate students in my lab and were used to encourage students to attend UW and participate in scientific research.

- Presenter to Upward Bound at Laramie High School, a program to inspire low-income students to pursue science.

ADVISING

- Current Ph.D. Students:
  - Joost Huizinga
  - Roby Velez
  - Mohammad (Arash) Norouzzadeh
  - Christopher Stanton
- Current Master's Students:
  - Cameron Wunder
- Current Undergraduate Students (doing research in my lab):
  - Richard Yang
- Former students I advised:
  - Anh Nguyen, received PhD. Now an Assistant Professor at Auburn University
  - Henok Mengistu, received PhD. Now with Accenture
  - Lucas Helms, graduated with master's degree
  - Jingu Li, now on a full-ride undergraduate scholarship to MIT
  - Kai Olav Ellefsen (visited from Norway), now a postdoc in Norway
  - Tyler Hughes, now with Google
- External committee member for:
  - Jason Yosinski, Cornell University
- Former students I served as a committee member for:
  - Md. Arif Khan (Electrical & Computer Engineering). Master's.

- Nicholas Gurbhoo (Electrical & Computer Engineering). Master's.
- Anh Nguyen (Computer Science). Master's.

SERVICE

- Co-leader of a Dialog and Listening Topic for the University Strategic Planning Effort, 2016
- U. Wyoming Computer Science Department: Faculty Search Committee (two openings), 2016
- U. Wyoming Computer Science Department: Graduate Program Improvement Committee, 2013-present
- U. Wyoming: Faculty Advisory Committee on high-performance computing cluster for campus-wide research computing, 2013-present
- U. Wyoming Computer Science Department: Graduate Assistantship Award Committee, 2013-present
- Robotics/AI and Diplomacy Board Member, The Lifeboat Foundation, 2013-present
- Computer Science and Engineering Graduate Student Association, Liaison to Computer Science Department Faculty Meetings, MSU, 2009-2010
- Computer Science and Engineering Advisory Committee, MSU, 2009-2010
- College Hearing Board, MSU, 2009-2010
- Panelist & Speaker, Graduate Student Orientation and Recruitment
- Founder, Meteorite, University of Michigan Undergraduate Journal of Philosophy
- Associate Editor, Michigan Journal of Political Science, 1996-1998

INDUSTRY EXPERIENCE

- Co-founder and owner, RoomSimple, a house rental company in Lansing, MI. 2003-Present.
- Analyst Relations Manager, SoftAd, an Internet Software Company. San Francisco, California. 2000-2001.
- Business Development Strategist, SoftAd, an Internet Software Company. Dearborn, MI and San Francisco, CA. 1999-2000.
- Marketing Intern, Ford Motor Company. Dearborn, MI. Summer, 1998 & 1999.
- Co-founder and owner, Full Immersion, a website development company. Ann Arbor, MI. 1997-1998.

PATENTS
- Robot that routinely explores home to locate objects to help find them, provide warnings, and order more supplies. Patent pending.
- Eye tracking system and methods for developing content. Patent pending.

REFERENCES

- Hod Lipson, Professor, Departments of Mechanical Engineering, Columbia University. Postdoctoral advisor. hod.lipson@columbia.edu. (607) 254-8940
- Charles Ofria, Associate Professor, Department of Computer Science and Engineering, Michigan State University. Ph.D. and postdoctoral advisor. ofria@msu.edu. (517) 355-8389
- Josh Bongard, Associate Professor, Department of Computer Science, University of Vermont. josh.bongard@uvm.edu, (802) 656-4665
- Kenneth O. Stanley, Associate Professor, School of Electrical Engineering and Computer Science, University of Central Florida. kstanley@cs.ucf.edu. (407) 473-0072
- More available upon request

INTERESTS

- Travel (over 55 countries on 6 continents)
- Sports (surfing, kitesurfing, rock climbing, hockey, whitewater kayaking, ultimate frisbee, hiking, mountain climbing, rock climbing, mountain biking, running)
- Literature (Borges, Kundera, Calvino, Penn Warren, Dostoyevsky, DeLillo, Marquez, Card, Tolkien, Tolstoy, Carroll, Pirsing, Stephenson)
- Spanish language (fluent at one time)