

CSE 599: Computing for Conservation

Fall 2022

Time: MW 3:00-4:20pm

Instructor: Kurtis Heimerl <kheimerl@cs.washington.edu>

Instructor Office Hours: By Appointment

TA: Matt Ziegler <mattzig@cs.washington.edu>

TA Office Hours: TBD

Communications: Canvas

Location: CSE2 G04

Introduction:

Increasingly, wildlife conservancies and environmental institutions are experimenting with digital technologies for research, public outreach, tracking at-risk wildlife, designing mechanisms for sustainable systems, aggregating data to support management decisions, and encouraging the public to take political and personal actions. In this class, we will broadly explore the area of *Conservation Technology* by reading about national- and global-scale challenges and more specific subproblems with relevant technology projects. This class will build from foundational understandings of conservation to a set of active research agendas conducted throughout the world. We will encourage a critical lens; one of our aims will be to differentiate between nice-sounding-but-ineffective tech-for-good solutions, nice-sounding-but-actually-quite-harmful tech-for-good-solutions, and answers that have a chance for real impact.

All students will complete a project and end up with an artifact; potentially a tool (designed and/or built) for solving a real-world problem that they bring to the class or a fictional narrative elucidating the potentials and dangers of new ongoing advances. The class will also be strictly in person; the point is to discuss and build community. Some speakers will be remote though.

This is a graduate-level computer science class but particularly motivated and experienced students (including undergrads) from other disciplines can reach out if they'd like to participate.

Some potential areas we plan to cover include:

- History of environmental movements
- Processes for conservation and environmental governance
- Animal tracking
- Behavior change
- Computer vision / camera traps
- Biodiversity informatics
- Environmental communication
- Big data applications / mechanism design

Grading:

50% Final Project: Projects of 1-3 students that address some conservation or environmental agenda. All will eventually need to produce an artifact: a program, model, or design for a solution to a problem.

25% Class Presentations: Teams of 1-3 students will be asked to present some related research area and lead related discussion.

20% Reading Writeups: A couple-paragraph writeup of the readings with what you, as a reader, found interesting about this work. This means you'll post all writeups on our message board here under the thread corresponding to the class date, by 2am that morning:

https://canvas.uw.edu/courses/1579027/discussion_topics.

This will be used to give direction to presenters. Late policy: 50% deducted for all late submissions unless permission is granted beforehand.

5% In-class participation: The last bit is wiggle room for general participation. Everyone is asked to share their brilliant insights and keep the discussion going throughout the quarter.

Final Project:

Initial project ideas (0.5-1 pg) are due (via email to Matt and me) by October 10th. You are strongly encouraged to think about possible project ideas before the start of classes!

- 1) Who is on your team? (Include any relevant outside community partners or resources.)
- 2) What is the problem you are trying to solve?
- 3) What are some existing solutions (lightweight related work)?
- 4) What is your design/solution?

More detailed project proposals are due by October 24th.

The general format is a 2-4 page paper in academic format (2 column) detailing any updates on your initial proposal:

- 1) Who is on your team?
- 2) What is the problem you are trying to solve?
- 3) What are some existing solutions (related work)?
- 4) What is your design/solution?
- 5) What technologies are you leveraging to build your design/solution?
- 6) How do you plan (or hope) to evaluate your design/solution?
- 7) A general timeline for tasks over the next two months to the deadline of June 5th.

After the initial proposal stage, Matt and I will be scheduling meetings to discuss them.

Final Project Presentations:

Your projects are due Friday, December 1st at 11PM. Projects will be presented in class December 5th.

1. A 6-10 page writeup of the work in two-column CHI format (<http://www.sigchi.org/publications/chipubform/sigchi-paper-format-2016/view>). This should look very similar to the Computer Science papers you've read throughout the class: Abstract, Introduction, Related Work, Content, Discussion, Conclusion. Those of you from Computer Science will be graded *much* more hardly on formatting; part of the goal of this exercise is to practice paper writing as well. Alternative formatting can be discussed for different research communities.
2. A 12-minute presentation on your team's project and progress throughout the quarter. A robust 1-minute discussion of the project, inclusive of the perspectives shared in the class, will then follow.

Presentations:

As you make materials for class, please make them accessible: Please see [this video on making presentations accessible](#).

Course Schedule:

September 28:

Introductions to the field and to each other. Before the class please come prepared with an example of a conservation technology or technical intervention from any sector that's particularly exciting for you.

Prior Reading: None

October 3: [Matt Gone]

Project proposals: What do you want to work on this quarter and why should people join you?

Small breakout groups for project brainstorming

Prior Reading: None

October 5: History of environmental movements

Readings:

- Karin Otsuka. The Evolution of Environmental Movements: Responding to Impending Threats. (short article)
<https://smea.uw.edu/currents/the-evolution-of-environmental-movements-responding-to-impending-threats/>

- Dave Berndtson. The long and winding road: charting the course of American conservation. (short article)
<https://smea.uw.edu/currents/the-long-and-winding-road-charting-the-course-of-american-conservation/>
- *Environmental Justice* by Vanderheiden, Introduction, Pages xi to xxii (available on Canvas under “file” or through UW libraries)
- Read one of these articles on US environmental movements:
 - (Longer) From Conservation to Environment: Environmental Politics in the United States Since World War Two. Samul P Hayes
<https://www.journals.uchicago.edu/doi/pdf/10.2307/3984153>
 - (Shorter) History of the Environmental Movement by Jeremiah Hall. (This is from an advocacy group pushing for restriction/reform of the Endangered Species Act, a controversial but fairly widespread position. It has a good concise (and cynical) summary of the movements.)
<https://web.archive.org/web/20060829033005/http://www.mtmultipleuse.org/endaangered/esahistory.htm>
- Look through this conservation history timeline by the US Fish and Wildlife Service:
<https://conservationhistory.org/history-timeline/>

October 10: [Kurtis Gone]: Leverage points for environmental impact

Readings:

- Jane Lubchenco. Entering the Century of the Environment: A New Social Contract for Science. 1998. <https://www.science.org/doi/10.1126/science.279.5350.491>
- Look through Aseem Prakash’s environmental governance syllabus, noting the different aspects of environmental governance: <http://faculty.washington.edu/aseem/epg2017.pdf>
- Skim through these topic-area reports to familiarize yourself with some of the different tech applications. (No need to read the papers/chapters, just look through the tables of contents or section headers to get an idea of what’s in there.)
 - Skim: “Digitising the landscape: Technology to improve integrity in natural resource management”
<https://www.u4.no/publications/digitizing-the-landscape-technology-to-improve-integrity-in-natural-resource-management>
 - Skim: Tilley, A. and Roscher, M. 2020. Information and communication technologies for small-scale fisheries (ICT4SSF) - A handbook for fisheries stakeholders. FAO.
<http://www.fao.org/documents/card/en/c/cb2030en>
 - Skim: “Tackling Climate Change with Machine Learning” accepted papers
<https://www.climatechange.ai/events/neurips2021>
 - Skim: Urban Computing workshop accepted papers
<http://urban-computing.com/urbcomp2021/accept.html>
- Optionally skim to get an idea of “HCI for Sustainability”: Christina Bremer, Bran Knowles, and Adrian Friday. 2022. Have We Taken On Too Much?: A Critical Review of

the Sustainable HCI Landscape. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22). <https://doi.org/10.1145/3491102.3517609> (

- Take a moment to browse through the *Wildlabs* forum to familiarize yourself with the conversation topics. <https://wildlabs.net/>
 - Note the Wildlabs “State of Conservation Technology 2021” report, outlining the current challenges for each technology application:
<https://wildlabs.net/state-of-conservation-technology>

October 12: [Kurtis Gone] Barath Raghavan

Co-founder of computing within limits <https://computingwithinlimits.org/2022/>

Readings:

- Three part post on shades of green:
 - <https://www.resilience.org/stories/2014-10-09/what-shade-of-green-are-you/>
 - <https://www.resilience.org/stories/2014-10-13/shades-of-green-part-2-reconciling-differences-and-building-solidarity/>
 - <https://www.resilience.org/stories/2014-10-21/a-movement-in-search-of-a-narrative/>
- Ada Palmer's post on hopepunk:
<https://beforewegoblog.com/purity-and-futures-of-hard-work-by-ada-palmer/>
- Hemenway's piece on native plants:
<https://tobyhemenway.com/116-native-plants-restoring-to-an-idea/>

October 17: Lidia & Lo

Readings:

- Watch this video: <https://vimeo.com/354276956>
- Two articles:
 - <https://space10.com/beyond-human-centered-design/>
 - <https://www.mdpi.com/2071-1050/14/3/1211>

October 19: Catherine Breen [Kurtis Gone]

UW SEFS; environment and wildlife monitoring, camera trap analysis, computer vision

Reading:

- Sakas, M.E. "How Warming Winters Are Affecting Everything".
<https://www.npr.org/2020/02/18/803125282/how-warming-winters-are-affecting-everything>
- Penczykowski, R.M., Connolly, B.M., Barton, B.T., 2017. Winter is changing: Trophic interactions under altered snow regimes. *Food Webs* 13, 80–91.
<https://doi.org/10.1016/j.fooweb.2017.02.006> (skim)
- Steenweg, R., Hebblewhite, M., Kays, R., Ahumada, J., Fisher, J.T., Burton, C., Townsend, S.E., Carbone, C., Rowcliffe, J.M., Whittington, J., Brodie, J., Royle, J.A.,

Switalski, A., Clevenger, A.P., Heim, N., Rich, L.N., 2017. Scaling-up camera traps: monitoring the planet's biodiversity with networks of remote sensors. *Frontiers in Ecol & Environ* 15, 26–34. <https://doi.org/10.1002/fee.1448> (skim)

October 24: Jen Mankoff

UW CSE; Human-computer interaction, accessibility

Readings:

- Choose one or more reading on disability & climate change:
 - Julia Watts Belser. 2020. *Disability, Climate Change, and Environmental Violence: The Politics of Invisibility and the Horizon of Hope* <https://dsq-sds.org/index.php/dsq/article/view/6959/5805>
 - Less academic option: Julia Watts Belser. 2019. *Disabled People Cannot Be “Expected Losses” in the Climate Crisis* <https://www.teenvogue.com/story/disabled-people-vulnerable-climate-crisis>
 - Video option (specific to disaster response): https://www.youtube.com/watch?v=vSGxW1uh8Pw&list=PLaYgKAZMUNMwd64FcT6EAoqXXRW1u_ErS&index=5
- Choose one or more reading on behavior change:
 - Jennifer Mankoff, Dimeji Onafuwa, Kirstin Early, Nidhi Vyas, and Vikram Kamath. 2018. Understanding the Needs of Prospective Tenants. (COMPASS'18). <https://dl.acm.org/doi/10.1145/3209811.3212708>
 - Tawanna Dillahunt, Jennifer Mankoff, Eric Paulos, and Susan Fussell. 2009. *It's not all about "Green": energy use in low-income communities*. (UbiComp '09). Association for Computing Machinery, New York, NY, USA, 255–264. <https://doi.org/10.1145/1620545.1620583>
 - Mankoff, Fussell, Dillahunt, Graves, Grevet, Johnson, Matthews, Matthews, McGuire, Thompson, Shick, Setlock. 2010. StepGreen.org: Increasing Energy Saving Behaviors via Social Networks <https://www.aaai.org/ocs/index.php/ICWSM/ICWSM10/paper/view/1474/1843>

October 26: Tom Anderson

UW CSE; Energy-efficient computing

Readings:

- Chasing Carbon, HPCA, 2021 https://ugupta.com/files/ChasingCarbon_HPCA2021.pdf
- Treehouse, HotCarbon 2022 <https://hotcarbon.org/pdf/hotcarbon22-anderson.pdf>
- Beyond PUE, HotCarbon 2022 <https://hotcarbon.org/pdf/hotcarbon22-chien.pdf>
- Carbon Emissions and Large Neural Network Training, 2021 <https://arxiv.org/pdf/2104.10350.pdf> (optional)

October 31: Ameya and Emmanuel

Personal carbon footprint management

Readings:

- <https://www.pnas.org/doi/10.1073/pnas.1922205117> - current situation in the US
- <https://www.tandfonline.com/doi/full/10.1080/17583004.2017.1409045> - how individuals can contribute (technology perspective)
- <https://www.ipitaka.com/blogs/news/9-easy-ways-to-reduce-your-carbon-footprint-with-technology> - how individuals can contribute (technology perspective)
- <https://www.nature.org/en-us/get-involved/how-to-help/carbon-footprint-calculator/> - check your own footprint

November 2: Amrita Gupta

Conservation Science Partners; AI/ML

Reading:

- Amrita Gupta, Tony Chang, Jeffrey Walker, and Benjamin Letcher. 2022. Towards Continuous Streamflow Monitoring with Time-Lapse Cameras and Deep Learning. COMPASS'22 <https://doi.org/10.1145/3530190.3534805>

November 7: Danli and Kunsang

Readings:

1. Forster, E. M. (1909). [*The machine stops. The Oxford and Cambridge Review*, 8, 83-122.](#)
2. Skim: [Ellis, E. C. \(2021\). Land use and ecological change: A 12,000-year history. *Annual Review of Environment and Resources*, 46\(1\), 1-33.](#)
3. [https://urldefense.com/v3/_https://dl.acm.org/doi/10.1145/3290605.3300547_!!!K-Hz7m0Vt54!m8ZU8k2pCtvePiieQutKDbC-t2pCznawJ800SaKr2kQzREr-ILLHp87Lvtsx_Hj1gmjns-fWNhc\\$](https://urldefense.com/v3/_https://dl.acm.org/doi/10.1145/3290605.3300547_!!!K-Hz7m0Vt54!m8ZU8k2pCtvePiieQutKDbC-t2pCznawJ800SaKr2kQzREr-ILLHp87Lvtsx_Hj1gmjns-fWNhc$)
4. [https://urldefense.com/v3/_https://dl.acm.org/doi/10.1145/3173574.3173614_!!!K-Hz7m0Vt54!m8ZU8k2pCtvePiieQutKDbC-t2pCznawJ800SaKr2kQzREr-ILLHp87Lvtsx_Hj1gmjn9p-5GRc\\$](https://urldefense.com/v3/_https://dl.acm.org/doi/10.1145/3173574.3173614_!!!K-Hz7m0Vt54!m8ZU8k2pCtvePiieQutKDbC-t2pCznawJ800SaKr2kQzREr-ILLHp87Lvtsx_Hj1gmjn9p-5GRc$)

November 9: Jason Young

UW Information School / Geography; participatory mapping / GIS

Reading:

- Jason C Young. 2019. The new knowledge politics of digital colonialism <https://journals.sagepub.com/doi/10.1177/0308518X19858998>
- Jason Young and Michael Gilmore. 2017. Participatory Uses of Geospatial Technologies to Leverage Multiple Knowledge Systems within Development Contexts: A Case Study from the Peruvian Amazon <http://dx.doi.org/10.1016/j.worlddev.2017.01.007>

November 14: Michael Quinlan

Environmental communication & media

Readings:

- David Geselbracht, 2021. [For some evangelical Christians, climate action is a God-given mandate](https://grist.org/politics/evangelical-christians-climate-action-god-mandate-bible/). (It's a great example of individuals seeking to meet a suspicious audience where they are to connect on climate change.)
<https://grist.org/politics/evangelical-christians-climate-action-god-mandate-bible/>
- Holly Parker, 2021. [Tell me a story – why climate change communication needs to embrace our childlike curiosity](https://council.science/current/blog/tell-me-a-story-why-climate-change-communication-needs-to-embrace-our-childlike-curiosity/).
<https://council.science/current/blog/tell-me-a-story-why-climate-change-communication-needs-to-embrace-our-childlike-curiosity/>
- Short video as an example of human-centered climate change storytelling:
 Shellfish Farms: Building Community
<https://www.youtube.com/watch?v=Qql6DcCxsZE>

November 16: Rick Lorenz

US State Department; data, science, and diplomacy

Readings:

- Frederick Lorenz and Edward J. Erickson. Forthcoming. Strategic Water: Iraq and Security Planning in the Euphrates-Tigris Basin, 2nd edition. Read Chapter 7: Data, Science, and Diplomacy. (Available on Canvas under “Files”)

November 21: Sneha and Aditya

Water management at a local and grassroots level

Readings:

- About the water accounting challenges:
<https://www.science.org/doi/10.1126/science.aat9314>
- What can a city government do? -- Las Vegas:
 - <https://www.watereducation.org/western-water/climate-change-turns-heat-las-vegas-water-managers-try-wring-new-savings-stretch>
 - https://www.youtube.com/watch?v=3gE6gYC_I08
- Jaltil and the grassroots level water monitoring
<https://eos.org/articles/satellite-and-on-the-ground-data-help-monitor-groundwater-in-india>

November 23:

NO CLASS THANKSGIVING

November 28: Liz and Amanda

Readings:

- The environmental cost of animal source foods

- http://sirfonline.org/wp-content/uploads/2018/06/Hilborn_et_al-2018-Frontiers_in_Ecology_and_the_Environment.pdf
- Meal Kits Have A Smaller Carbon Footprint Than Grocery Shopping, Study Says
 - <https://www.npr.org/sections/thesalt/2019/04/22/716010599/meal-kits-have-smaller-carbon-footprint-than-grocery-shopping-study-says>
- Hello Fresh LCA (skim)
 - https://cdn.hellofresh.com/de/cms/HelloFresh_Meal_Kit_Life_Cycle_Assessment_Study.pdf
- Recent developments, future challenges and new research directions in LCA of buildings: A critical review (skim, focus on Table 3)
 - <https://www.sciencedirect.com/science/article/pii/S1364032116305524>

November 30: Sara Beery

Caltech/MIT, computer vision, camera trap analysis

Readings:

- S. Beery *et al.*, "The Auto Arborist Dataset: A Large-Scale Benchmark for Multiview Urban Forest Monitoring Under Domain Shift," 2022
<https://ieeexplore.ieee.org/document/9878589>

December 5: Kelci Zile

Madrona Venture Labs

Readings:

- <https://medium.com/radiant-earth-insights/democratizing-open-machine-learning-technologies-for-earth-observation-cf3fd9f0a432>
- <https://firststreet.org/research-lab/published-research/published-research-wildfire-model/>
- <https://medium.com/@EarthshotLabs/landos-automating-the-origination-of-carbon-credits-cce6be98fe05>

December 7: NO CLASS (project prep day)

December 15: Final Exam (2:30-4:20)

Class presentations

Project ideas:

- Rhino tracker device
- Beth Gardner's Images
- EarthRanger
- Karang
 - <https://drive.google.com/file/d/1M9W7jawyt519jPtS8F7LitrJqQo2yQk/view?usp=sharing>
- List of databases:
 - https://en.wikipedia.org/wiki/Category:Environmental_science_databases
 - National Ecological Observatory Network <https://www.neonscience.org/data>
 - MoveBank - animal tracking data <https://www.movebank.org/>

- DarwinCore / Global Biodiversity Information Facility <https://www.gbif.org/>
 - Ocean Biodiversity Information System <https://www.obis.org/>
- iNaturalist citizen science <https://api.inaturalist.org/v1/docs/>
- eBird citizen science <https://science.ebird.org/en/use-ebird-data>
- <https://environmentaldatainitiative.org/edis-featured-data-contributions/cuso4-toxicity-aquatic-microcosm/>
 - <https://portal.edirepository.org/nis/mapbrowse?packageid=edi.1083.3>