



Computing and the Environment

INFO I400/I590 • Spring 2021

One of the more persistent and popular explanations of why the modern “Information Age” is so radically different from other eras in the history of technology has to do with the perceived immateriality of information technology. Whereas other technological revolutions were so clearly associated with the production of physical artifacts and the consumption of material resources, the increasing computerization of society seems to be moving us towards a less resource-intensive and environmentally impactful form of living.

More recently, humankind has started to realize the environmental impacts of information technology, including not only the toxic byproducts associated with their production, but also the polluting effects of the massive amounts of energy and water required by data centers at Google and Facebook (whose physicality is conveniently and deliberately camouflaged behind the disembodied, ethereal “Cloud”).

In this course we will explore the intersection between the digital and the material worlds, and will attempt to answer the following questions:

- how has the human desire to understand and manipulate the environment shaped the development of computer and information technologies?
- how do the computer and information technologies that we have developed shape the way we perceive, study, and understand the natural world?
- what are the effects of the digital economy on the global environment, and how can we measure these effects and compare them to earlier or alternative modes of human social and economic activity?
- how can we build sustainable technological infrastructures that better reflect our environmental values, goals, and economic and political agendas?

Although we will deal with technical topics in this course, we will do so in a way that will be accessible to all of you, no matter what your chosen major or level of experience. There are no pre-requisites, other than curiosity and attentiveness.

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Course Schedule

I A series of tubes? Information as Infrastructure

How do we think about the material dimensions of immaterial information? What exactly is the Internet? How does thinking about the Internet as a form of infrastructure (or not) shape the way we think about its implications for the environment?

II The Cloud is a Factory

If the Cloud were a country it would be the sixth largest consumer of electricity on the planet. Despite its seeming ethereality, the Cloud is actually a vast web of physical objects, built and operated by human labor, occupying space and consuming resources.

III Water, water, everywhere ...

A typical data center requires hundreds of thousands of gallons of fresh water a day to operate; a single semiconductor fabrication facility requires millions.

IV The Global Lifecycle of Digital Goods

A recent United Nations study estimated that the production of just one desktop computer required 240 kilograms of fossil fuels, 22 kilograms of chemicals and 1,500 kilograms of water — and that does not include the human labor involved. Each one of these resources and resource-chains represents a set of stories to be told about global politics, international trade, worker safety, and environmental consequences.

V Containers

One of the ironies of the Information Age is that, despite the apparent shift in economic activity “from atoms to bits,” human beings are now more dependent on ever on the physical transportation of materials. The rise of a massively integrated global shipping network is as much a story of computerization as it is of containerization.

VI Digital Residues

Information technologies often do not eliminate but only conceal the materiality of the so-called “new” economy. It externalizes the costs, and centralizes the benefits. This is particularly true in the case of the environmental pollution associated with both the production and disposal of electronic goods. Both problems have been shifted to parts of the world — India, China, Africa — where environmental and worker-safety regulations are relatively lax. But even in the heart of Silicon Valley,

the environmental consequences of computing can be long-lasting and deadly.

VII Maintain, Reuse, Recycle

In the United States, digital devices are assumed to be ephemeral, useful only until the next upgrade cycle. But in other parts of the world, users are much more resourceful about reusing and recycling these devices. The short lifespan of most consumer electronics in the Western world is not only a product of their design, but also a product of legal, economic, and political developments.

VIII Simulation & Surveillance

The use of computing devices to “see,” measure, and represent the physical world has a long history. Indeed, most of what we know about climate change is the result of complex (and energy-intensive) computer simulation. Many of the sciences most essential to understanding the environment — from ecology to meteorology to genomics — are essentially computational.

IX The World is(in) a Computer

How have the new ways in which information and computing technologies allowed us to “experience” the world changed the way we think about our relationship to our environment? From virtual zoos to GPS-enabled adventure travel, digital devices are part of the complex ways in which humans have always used technology to mediate their relationship with the “natural” world.

X Hey! That Elephant Has a Cell Phone...

Computers and other ICTs have greatly enhanced the ability of environmentalists and activists to interact with the natural world. Many of these developments have been positive and productive, and indicative of new modes of interaction between humans and non-humans.

XI Back to the Future

There is a close but complicated relationship between the counter-cultures that produced both the Internet and the modern environmental movement. But the vision of techno-utopian culture that came to dominant Silicon Valley was/is not the only model of a post- or non-industrial society. In this week, we will explore alternative “social imaginaries” that define new relationships between technology and environment, with a particular focus on the Afro-futurist movement of the mid-to-late 20th century.

XII Sustainable Digital Design

Like all technologies, “the Cloud” as it is currently configured is the product of human imagination, guided and constrained by history and society. There is a growing movement with ICT design to take seriously questions of environmental sustainability, labor equity, and global justice, and we will close by contemplating the possibilities of such designs.

XIII The Big Finish

Student projects and concluding remarks.

Online Course Meetings

This course is online-only, and so we will always be meeting via Zoom. The permanent zoom link for the course is <https://iu.zoom.us/j/3721147179>.

The class is scheduled to meet on Monday and Wednesday afternoons from 2:30-3:50. Because I will be providing as much of the lecture material as possible asynchronously, I expect that for many of our sessions we will not require the full hour and twenty minutes. In fact, over the course of the semester, as you start to get familiar with the material (and each other), I will move the course increasingly away from the scheduled meeting sessions.

Grading

Your grade for this course will be based on three main components:

- each week you are expected to do the readings and to attend each course meeting. As the course moves increasingly to an asynchronous model, I will make very clear what sessions you need to attend, and when.
- each week you will have a short assignment. These will be based on the readings and/or the lecture material, and will generally focus on applying concepts to real-world case studies. Collectively, these assignments will comprise 40
- in addition to the weekly assignments, there will be three larger assignments (due at the ends of week 5, week 9, and week 13). Each of these assignments will represent 20
- finally, throughout the semester there will several occasions for you to earn extra credit points. The exact nature and points awarded will be determined as opportunities arise.

It is my goal to have all of your assignments graded within one week of them being due. It is also my goal to respond to all student emails within 24 hours.

Office Hours

I will be holding regular office hours on Wednesdays from 1-2pm, and on Thursdays from 3-4pm. The zoom link for office hours is the same as that for the regular course meetings: <https://iu.zoom.us/j/3721147179>.