Course theme:
You often hear – “let’s not print that file and save a tree”. You also often hear about “smart” devices that can be used to reduce the environmental impact of, for example, heating and cooling your home. We deliver lecture slides and coordinate this course using ICT. The implicit assumption here is that using Internet and communication technologies (ICT), including “smart” devices, lower one’s environmental impact than not using ICT. Is this a “good” assumption? What are the environmental benefits of using ICT versus older technologies? We will probe this question and beyond to look at the ICT through the lens of environmental sustainability.

And why should we dedicate a course to examining the environmental sustainability of ICT? It is hard to imagine a world without ICT. About half of the world’s population is online. In only a few decades, the Internet and ICT in general, has come to pervade virtually all aspects of our lives from education, to how we build and maintain friendships, to how we shop, to the way we think, solve problems and retrieve information, etc. More app’s and uses continue to enter our lives. Although we are very familiar with and use the Internet extensively, few of us understand the inner workings of the ICT. Further, ICT Internet has many unintended consequences at personal, societal, and environmental levels, whether it is cloud computing or the materials from which your smart phone is made.

Our task is to think critically about the choices (and lack of choices) that ICT brings us, and to explore and act on the intended and unintended consequences and responsibilities that come with ICT. This course intends to help us make informed choices and be active participants rather than passive consumers of ICT.
Course objectives:
This course examines and debates the environmental sustainability of ICT, including intended and unintended consequences, using lectures, in-class activities and real-world examples that foster critical thinking and problem solving. The course will introduce you to disciplinary and interdisciplinary modes of inquiry and engagement. Most of this course builds on information from the physical, applied and health sciences.

What you will learn in the course:

- How to probe the breadth, depth and interconnectedness of a system as complex as ICT; how complex phenomena defy simple explanations, and why it’s important to think and solve problems with the help of multiple disciplines.
- How to think critically and use tools for creative and effective problem solving as individuals and in groups.
- To improve your scientific literacy and communication skills, through: 1) a deeper understanding of how ICT works; 2) how to assess environmental benefits and costs of ICT; and 3) how to clearly communicate your ideas using a variety of forms.

Course Evaluation:

<table>
<thead>
<tr>
<th>Assignment 1: Measure the carbon footprint of your ICT devices</th>
<th>Due October 15; final Oct 22</th>
<th>25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 2: Unintended consequences of ICT: the problem and solutions. Group project.</td>
<td>Due November 26; final Dec 3</td>
<td>30%</td>
</tr>
<tr>
<td>Tutorial participation (six over the term)</td>
<td>Throughout the term</td>
<td>5%</td>
</tr>
<tr>
<td>Reading summaries (five over the term)</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>Final exam period</td>
<td>30%</td>
</tr>
</tbody>
</table>

Coursework Assignments (55% overall): Each assignment will be discussed in class and then completed outside of class time. You will have the opportunity to improve each assignment through a peer review process conducted in tutorial.

- Assignment 1 is completed individually. It involves tallying ICT devices owned and used by yourself and your family. You will then calculate the embodied carbon emissions contained in those devices.
- Assignment 2 is conducted in groups of 2-4 students. You will explore unintended environmental consequences of one aspect of ICT and develop options and a plan for averting or minimizing those consequences. Examples include the environmental sustainability of the use of conflict minerals in ICT devices and the social sustainability of mass production of ICT devices.

Marking rubrics for each assignment will be available one week before the submission date. Some of the criteria included in the rubrics include depth of critical analysis, coverage of the literature, coherence and comprehensibility, and presentation.

The first version of your assignment is due by the beginning of class on the first due date by 2:10pm. Submit through Quercus and bring a hard copy to class. You will peer-review one other student’s assignment in tutorial. Your final assignment must be submitted on the final due date through Quercus by the beginning of class by 2:10pm.

Final, late assignments can be submitted to Quercus up to one week after the due date with a penalty levied.
All assignments should include the following information:

- Your name
- Title of assignment
- Course title and number
- Name of Professor and TA

- Double or 1.5 line spacing using 12 point type in black ink with 2.5 cm (1 inch) margins
- Include page numbers

Tutorials. Six tutorials over the term are aimed at helping you to improve your research and communication skills, and to help you complete and improve your assignments. You can obtain up to 5% for attending and participating in 5 out of 6 tutorials. Each assignment will be discussed in tutorial and your penultimate version will be peer reviewed. Attendance at each tutorial is worth 0.5% of your total mark and a further 0.5% if you participate. Thus, attending and participating in tutorials can give you 5% of your total mark. Each week a tutorial is held is indicated below by the underlining of the date.

Reading summaries. You will submit a summary of five required or recommended readings of your choice over the duration of the term. Summaries of websites or videos are not eligible. The summary should be 1 page in length or 500 words total. The summary should be written in prose and not point form. Each summary is worth a maximum of 2% for a total of 10%. A summary for a reading is due before it is discussed in class. Submit through Quercus. You are responsible for keeping track of the number of reading summaries you submit.

Final exam. A two hour final exam worth a maximum of 30% will be held during the exam period at the end of term. The exam will be a combination of short answer and a few long answer questions based on lectures, readings and assignments. You may bring a one page (double sided) summary of information to the exam.

Class Policies:

Late Penalty for assignments: A lowering of the grade by one increment per day, unless accompanied by documentation (see http://www.illnessverification.utoronto.ca), e.g., from B+ to B for 1 day late, B+ to B- for 2 days late including weekends (one day of the weekend is counted). The note must include the dates of absence. Late assignments will not be accepted one week past the due date even if accompanied by a certificate unless you have obtained prior agreement from the instructor. Requests to re-mark your assignment must be submitted in writing to Prof. Diamond and clearly state the reason for your request. Prof. Diamond will respond within a week as to whether your assignment will be remarked. Your assignment will be remarked by our TA.
You can expect a response to a post on Quercus within 24 hours on weekdays and 48 hours on weekends. Do not expect responses to questions about assignments within 24 hours of the due date.

Academic Integrity:

Very few have of us have truly original ideas but rather we almost always build on the ideas and information provided by others. We need to re-emphasize that plagiarism — representing someone else’s words as your own or submitting work that you have previously submitted for marks in another class or program — is a serious offence. Assignments, reading summaries and exams are reviewed for evidence of these infractions. Penalties for these offences can be severe and can be recorded on your transcript.
Trust your own ability to think and write and make use of the resources available at U of T that can help you do so (e.g. professors, TAs, writing centres). See the U of T writing website, especially the “How Not

The following is a list of examples (not complete) of what constitutes an academic offence:

- Using someone else’s ideas or words without appropriate acknowledgement.
- Copying material word-for-word from a source (including lecture and study group notes) and not placing the words within quotation marks and not citing the author/source.
- Submitting your own work in more than one course without the permission of the instructor.
- Making up sources or facts, including references to sources that you did not use.
- Obtaining or providing unauthorized assistance on any assignment including:
  - Working in groups on assignments that are supposed to be individual work
  - Having someone rewrite or add material to your work while “editing”.
  - Lending your work to a classmate who submits it as his/her own without your permission.

On tests and exams:

- Using or possessing any unauthorized aid, including a cell phone
- Looking at someone else’s answers
- Letting someone else look at your answers
- Copying material word-for-word from a source (including lecture and study group notes) and not placing the words within quotation marks and not citing the author/source.
- Misrepresenting your identity
- Submitting an altered test for re-grading
- AND FOR THIS COURSE, submitting for credit a definition taken verbatim from another source without attribution

Misrepresentation:

- Falsifying or altering any documentation required by the University, including doctor’s notes
- Falsifying institutional documents or grades

Participation:

Students are expected to attend every class and tutorial having read required readings or videos, etc., and to participate fully in the discussion through both attentive listening and speaking. Research shows that you improve your concentration and recall when you take notes longhand and when you “unplug” from the Internet during class. So, during class please hide your cell phone and minimize your use of computers unless it’s necessary.

Accommodation:

The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible: accessibility.services@utoronto.ca or http://studentlife.utoronto.ca/accessibility
Reading/Viewing/Listening hints:
As you read, listen, and/or watch, take notes on the following:

1) **Identify the key terms in the reading.** Think about how the author(s) defines these terms and uses them in the broader argument.

2) **Note key concepts that relate to other readings/lectures** in the course and that help you to understand the main themes in the course and their interrelationships, i.e., build bridges between the readings and lectures.

3) **Note methods used** to investigate the topic or solve the problem. How could you use this method?

4) **Write down any questions** that arise when in lecture and reading (no question is stupid!).

5) **Look up words/concepts** in the reading that you do not understand. Reading with a dictionary at your side is the best way to expand your vocabulary!

6) **Explore the context for the reading.** As you know, the Internet is moving fast! How recently was it published? At what stage in the development of the Internet was it written? What type of publication did it appear in? How does it relate to other readings you have met?

Remember, when writing down a quote, **always put quotation marks around the author’s words** and note the page number from which you are quoting. This will provide you with a good basis of quotes for later writing assignments, and will help you to develop responsible practices of note-taking in line with the requirements of academic integrity.

**LECTURE SCHEDULE AND READINGS**

1) Sept. 10: **Why is this course about the Internet and why the question “is it green”?**
We will introduce the professor, the TA, the course themes, and the students to each other, through a combination of in-class activities and a short lecture.

**Required Reading:**

**Recommended Sources:**
- Watch: Manuel Lima on the Power of Networks: [https://www.youtube.com/watch?v=nJmGrNdJ5Gw](https://www.youtube.com/watch?v=nJmGrNdJ5Gw) [https://www.youtube.com/watch?v=nJmGrNdJ5Gw](https://www.youtube.com/watch?v=nJmGrNdJ5Gw)
2) Sept 17: Environmental problem solving, systems thinking and ICT

Systems thinking is a method of understanding and thus problem solving for complex systems and processes of change within them. We need to adopt a systems thinking approach to explore the question “is the Internet green” because of the complexity of system (the Internet and society). Life cycle assessment is one tool that takes a systems thinking approach. We delve deeper into systems thinking approaches and explore some properties of systems that cannot be understood by studying parts of a system in isolation (e.g. exponential growth, feedback loops, etc).

Required Reading:

Recommended Reading:

Tutorial 1: Research skills: detecting BS on the internet. Exercise on feedback loops.

3) Sept 24: A very short history of communication technologies leading to “what is the Internet”? Prof. Steve Easterbrook

To know the future we need to look at the past. We very briefly review communication technologies that bring us to the Internet. What is the Internet? What is it made of and how does it work?

Required Readings:
- Read: How Does the Internet Work? https://developer.mozilla.org/en-US/docs/Learn/Common_questions/How_does_the_Internet_work

Recommended Sources:

4) Oct 1: Is the Internet green? An energy analysis.

To answer the question “Is the Internet green?” we examine the energy used in ICT. We are interested in energy use because of related releases of greenhouse gases and thus contributions to increasing the rate and severity of climate change (we are in the midst of a climate crisis!). We introduce the environmental analysis tools of mass balance analysis and Life Cycle Assessment (LCA).

Required Readings:
Recommended Sources:


Tutorial 2: Workshop Assignment 1.

5) Oct 8: Beyond the carbon footprint: ICT’s resource use.

The ICT sector is a major user of industrial energy, and high purity, strategic minerals and critical metals. Our rapacious use of these minerals, their “criticality” and difficulties with recycling them may cause shortages which could curb our ability to produce new ICT products. Moreover, some of these strategic minerals are conflict commodities or have ethical geo-political implications. How do we combine the exponential growth in ICT gadgetry with resource limitations? Who pays the price for resource extraction and who benefits from these resources?

Required Readings:


Recommended Sources:

- [https://www.facebook.com/mineraljustice](https://www.facebook.com/mineraljustice)
One of the unintended consequences of using so many ICT gadgets and frequently upgrading them is the mountain of e-waste that must be dealt with. How big is the mountain of e-waste? What are the environmental, social and economic consequences of the mass of e-waste being produced and how do those consequences vary depending on where you live? What are the implications of handling e-waste in terms of human and ecological health? What solutions are best deal with it? We also look at technologies for recycling, but those technologies can only be implemented if they are “economic”. Thus, we look into the actual feasibility of implementing e-waste recycling solutions in terms of economics and the regulatory system.

Required Readings:

Recommended Sources:

Tutorial 3: Peer review of assignment 1.

7) Oct 22: Unintended environmental burden of the sharing economy
The sharing economy has quickly pervaded our lives, from sharing accommodations (e.g., AirBnb) to transportation (e.g., Uber, Lyft). The idea sounded great – share what you have so that all can benefit. The reality has been different with far-reaching implications. We discuss the sharing economy with respect to transportation, with the environmental implications of the dramatic rise in ride-sharing.

Required Readings:
Recommended Sources:

- https://www.cbc.ca/radio/spark/the-spark-guide-to-life-episode-one-transportation-ride-sharing-was-supposed-to-make-traffic-better-it-s-making-it-worse-1.4811762

8) Oct 29: The Internet and Mental Health.

With a half of the global population using the Internet and with Internet usage continuing to rise, what are the consequences to individual health? Do we have agency in controlling health impacts? What are the consequences to individual mental health? Are the health consequences experienced equitably amongst all users?

Required Readings:


Recommended Sources:


Tutorial 4: Workshop Assignment 2.

Nov 5: Reading Week


We have discussed the energy and resource implications of the internet. However, the internet offers many opportunities and benefits for environmental sustainability. What are some of those benefits? This lecture will provide a window into a selection of benefits, focusing on low and middle income countries.

Required Readings:

- Toyama, K. 2011. Technology as amplifier in international development. iConference 2011, Feb 8-11, Seattle, WA. ACM ACM 978-1-4503-0121-3/11/02

Recommended Sources:

Tutorial 5: Another discussion of Assignment 2.

10) Nov 19: Why do we embrace ICT and other new technologies? The idea of progress.
The notion of progress has been a dominant idea in western thinking since the enlightenment. The idea that life for each generation should get steadily better shapes our expectations from technology, and pushes us to value innovation and economic growth. We will explore ideas about progress and innovation from diverse perspectives, including those of other cultures who do not share a myth of progress, from the historical perspective from an environmental perspective where concerns about sustainability come into direct conflict with the growth imperative, and from an economics perspective, where the opportunity cost of ICT innovation must be weighed against other ways of investing our time and effort, such as such as clean energy, transport, food production, and social innovation.

Required Readings:

Recommended Sources:

11) Nov 26: Are we in the midst of a technological revolution?
Some commentators say that IT is the third technological revolution and that we are now in the midst of it. Evidence for the revolution comes from rapid innovation and change in numerous sectors. As with past technological revolutions, no one knows what the future holds but that there are and will be “winners and losers”. This is particularly salient for youth employment. We will explore these themes and tie them in with those introduced over the term.

Required Readings:

Recommended Sources:

Tutorial 6: Peer review of Assignment 2.

12) Dec 3: Integration and review.
Good grief. The lectures have finished! What did we learn? What are some of the major questions that have been raised but not answered? What should I know for the exam?