**Lab Assignment #5 – Emerging Technologies, sustainability and responsibility as global citizens**

**Due Date**: Wednesday 12:30pm, Week 14.

**Purpose:** This assignment aims to:

* Examine the initiatives and responses of leading software companies concerning sustainability and their roles as global citizens.
* Utilize Generative AI APIs from platforms such as Gemini , OpenAI, or Llama to generate summaries of pertinent content.

**References:**

* [Microsoft's Environmental Sustainability](https://www.microsoft.com/en-us/corporate-responsibility/sustainability)
* [Microsoft's AI for Earth](https://www.microsoft.com/en-us/ai/ai-for-earth)
* [Amazon's Sustainability Initiatives](https://aws.amazon.com/about-aws/sustainability/)
* [Google's Sustainability Efforts](https://sustainability.google/)
* [OpenAI Platform Introduction](https://platform.openai.com/docs/introduction)
* [OpenAI API Reference](https://platform.openai.com/docs/api-reference/chat/object)
* <https://ai.google.dev/gemini-api/docs/api-key>
* <https://ollama.com/>
* <https://docs.llama-api.com/quickstart>
* <https://ai.google.dev/gemini-api/docs>

Be sure to read the following general instructions carefully:

* This assignment **may be completed in groups of 4-5 students**. You may use the same group as in the group project.
* Submit your findings using the assignment link on the eCentennial shell. Your file should be named “YourFullNameLab5”.
* Demonstrate the solution in class on the assigned date.
* List the names of all team members in your submission.

**Exercise 1**

In this assignment, you will study and discuss the impact of emerging software technologies on the environment and explore various sustainable solutions provided by top software makers/providers (Microsoft, Amazon, Google, Meta, etc.). You may use more references than those listed here. Submit a short report (2-3 pages). Use the GEMINI API (as demonstrated in Week 12 Part 1 lecture) or the OpenAI API to generate your answers/summary for at least one of the articles. Provide the JavaScript code.

(10 marks)

Group Members:

1 – Hung Nguyen

2 - Darshmeen Dhillon

3 - Juan Jose Marquez Gamboa

4 – Noveen Mirza

5 – John | Jiu Qiang Xu

Use the spaces below for both summaries:

**I. Impact of Emerging Technologies to the environment**

Provide one page summary of the most recent articles here.

This article explores the significant environmental impact of technology, particularly focusing on the rapidly growing concerns surrounding artificial intelligence (AI) and the broader digital landscape. The core argument centers on the substantial energy consumption and resulting greenhouse gas emissions associated with the production, use, and disposal of technological devices and infrastructure.

The article highlights that the tech industry, including AI development and deployment, already accounts for a considerable portion (2-7%) of global greenhouse gas emissions, a figure projected to double by 2025. This impact stems from several key sources:

\* \*\*Energy-intensive data centers and cloud computing:\*\* These facilities consume vast amounts of electricity, contributing significantly to the industry's carbon footprint. The article cites data centers as responsible for 1% of global electricity use and 45% of the ICT sector's carbon emissions.

\* \*\*Manufacturing processes:\*\* The production of electronic devices is extremely energy-intensive and resource-heavy, demanding significant amounts of water and rare earth minerals. The manufacturing process alone accounts for 47% of the tech sector's emissions. The article points out that 80% of a smartphone's carbon footprint is generated during its manufacturing.

\* \*\*E-waste:\*\* The rapidly growing volume of discarded electronic devices (e-waste) poses a major environmental challenge. Globally, over 57.4 million metric tons of e-waste were generated in 2022, with only a small fraction (around 17.4%) being properly recycled. This improper disposal leads to soil and water contamination from toxic materials like lead, mercury, and cadmium.

The article emphasizes the global nature of this problem, presenting data on e-waste generation and recycling rates across different regions. Asia leads in e-waste production, while Europe shows higher recycling rates. However, even in regions with higher recycling rates, significant challenges remain in managing the sheer volume of e-waste.

The article also discusses the economic implications of the tech industry's environmental impact, highlighting the increasing costs associated with carbon emissions and e-waste management. The transition to a circular economy model, prioritizing resource efficiency and waste reduction, is presented as a crucial step towards mitigating these impacts.

Beyond the direct environmental damage, the article touches upon the "digital toxicity" associated with technology, encompassing issues like digital addiction, cyberbullying, and the spread of misinformation. This broader societal impact underscores the need for responsible technology development and usage.

**2. Sustainable solutions provided by top Software makers**

Provide a one-page summary (generated by GEMINI, GPT-4, Llama 3) of the most recent articles here:

This article, "Accelerating Climate Action with AI," discusses the dual role of artificial intelligence (AI) in both mitigating and contributing to climate change. The core argument is that AI possesses the potential to significantly reduce greenhouse gas emissions while simultaneously requiring careful management of its own environmental footprint.

The article highlights AI's potential to mitigate 5-10% of global greenhouse gas emissions by 2030 – a substantial impact equivalent to the European Union's total annual emissions. This potential is realized through three key applications:

1. \*\*Providing Helpful Information:\*\* AI-powered tools, such as Google Maps' fuel-efficient routing, offer users more sustainable choices. The article cites that this feature alone has prevented an estimated 2.4 million metric tons of CO2e emissions since its launch. This demonstrates how AI can directly influence individual behavior towards more environmentally conscious actions.

2. \*\*Predicting Climate-Related Events:\*\* AI's predictive capabilities are crucial for adapting to climate change. Google's flood forecasting initiative, using AI and geospatial analysis, provides real-time flood information to over 460 million people in 80 countries, enabling better preparedness and response to this increasingly frequent natural disaster. This showcases AI's role in enhancing resilience to climate impacts.

3. \*\*Optimizing Climate Action:\*\* AI can optimize existing processes to minimize environmental harm. The example given is the collaboration between Google Research, American Airlines, and Breakthrough Energy to reduce contrails (condensation trails from airplanes) through AI-powered flight path optimization. Test flights demonstrated a 54% reduction in contrails, highlighting AI's ability to target specific, high-impact contributors to climate change.

However, the article acknowledges the environmental impact of AI itself. The energy consumption of AI computing in data centers is a significant concern. While historically data center energy consumption has grown slower than computing demand, the rapid advancement of AI necessitates careful consideration. The article emphasizes that Google employs various strategies to minimize the carbon footprint of AI workloads, including techniques to reduce the energy required to train AI models by up to 100 times and associated emissions by up to 1,000 times. They highlight their Tensor Processing Units v4 as a highly efficient and sustainable ML infrastructure and emphasize the superior energy efficiency of their data centers compared to industry averages. Their data centers are designed for maximum efficiency, employing various cooling methods while prioritizing responsible water use.

**Evaluation:**

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| --- | --- |
| **Summary of articles on sustainability and environmental impact** |  |
| **Quality of summary** | 45% |
| **Relevance of articles** | 25% |
| **Use of summarizer (GEMINI, OpenAI, or Llama)** | 15% |
| **UI for running the summarizer and displaying results** | 15% |
|  |  |
| **Total** | **100%** |

**Additional Guidance:**

* + Include any recent links and articles related to the environmental initiatives of software makers to ensure your findings are up-to-date.
  + Provide process documentation (in the README file) explaining how you implemented the summarizer, selected articles, and tested the solution.
  + Collaborate effectively within your group to divide tasks and ensure a cohesive submission.
  + Ensure the README file includes clear instructions for running your summarizer code and UI.