CS - 435 - ESG Assignment: Theoretical Sustainability Evaluation in AI Deployments

Objective

To explore the environmental impact of AI deployments through an ESG lens without requiring direct access to major hyperscale cloud platforms. Students will rely on publicly available sustainability reports, white papers, or academic research to approximate or compare the energy consumption and carbon emissions of AI workloads. This revised approach ensures that all students can participate, regardless of platform access.

What is ESG in the Context of AI Deployments?

- **Environmental**: Examines the ecological footprint of AI, such as energy use, emissions, and resource depletion. Students will identify key indicators (e.g., estimated carbon emissions) from publicly available data.
- **Social**: Relates to the broader societal impact, including equity, fairness, and transparency. Although this assignment focuses primarily on environmental metrics, students should remain aware of social dimensions when evaluating published reports.
- **Governance**: Covers policy, compliance, and ethical management of AI. Students will note any governance mechanisms mentioned in sustainability reports (e.g., renewable energy commitments, adherence to recognized frameworks).

Assignment Description

Given that most students do not have direct access to AWS, Azure, or Google Cloud to run experiments, this assignment will focus on collecting, comparing, and analyzing **publicly available** data regarding the environmental impact of AI models on these platforms. Students will synthesize their findings into a concise executive summary.

1. Literature and Data Review

- **Public Sources**: Explore official reports, case studies, or news articles from:
  - **AWS Sustainability**: Public pages discussing energy usage, carbon footprint, renewable energy goals.
  - **Azure Sustainability**: Documentation or blog posts on Microsoft's carbon-negative pledge and data center efficiency.

  - **Google Cloud Sustainability**: Reports on carbon-neutral or carbon-free operations, including relevant metrics.
  - **Academic/Industry Papers**: Research on model energy consumption (e.g., from the Allen Institute for AI, Stanford's DAWNBench, or peer-reviewed journals).

- **Key Metrics to Identify**:
  - Estimated energy consumption (kWh) of AI training or inference.
  - Approximate carbon emissions or carbon intensity (kg CO_2e per kWh).
  - Sustainability goals or commitments (e.g., carbon neutrality, renewable energy usage).

2. Theoretical Comparison of AI Workloads

- **Hypothetical Model:**
  - Select a common vision or language model (e.g., ResNet-50 or BERT) from the literature.
  - Use published benchmarks or estimates of training/inference costs (e.g., energy required to train ResNet-50 on ImageNet).

- **Platform Comparison**:
  - Using collected data, discuss how the same or similar workloads might differ in carbon footprint across AWS, Azure, and Google Cloud, *if* such comparisons are available in the literature.
  - Consider regional differences (e.g., data center locations and their energy grids), noting that not all data will be uniformly available.

3. Proposed Strategies for Minimizing Environmental Impact

- **Best Practices**:
  - Selecting more efficient models or using techniques like pruning and quantization.
  - Choosing data center regions with higher renewable energy penetration (based on published reports).
  - Scheduling training or inference when cleaner energy is more abundant (if such data is publicly discussed).

- **Policy or Governance Notes**:
  - Refer to any governance frameworks (e.g., NIST AI RMF, ISO/IEC 42001) explicitly mentioned in public sources.
  - Highlight where cloud providers claim compliance or provide sustainability guarantees.

Deliverable: Executive Summary Only

- **Length**: 2 pages (maximum).
- **Content and Structure**:
  - **Introduction (2–3 sentences)**: Explain what ESG means in the context of AI and why it matters.
  - **Key Findings (Short Bullets)**:
    - Summarize approximate energy or carbon metrics found for each platform or from relevant studies.
    - Highlight any notable sustainability commitments or achievements (e.g., renewable energy usage).
  - **Comparison (1–2 sentences)**: Briefly contrast how different platforms or scenarios rank in terms of environmental impact.
  - **Recommendations (2–3 bullet points)**: Suggest practical measures based on the reviewed data (e.g., model efficiency, region selection).
  - **Conclusion (1–2 sentences)**: Emphasize the importance of continuous monitoring and the role of ESG in shaping responsible AI.
- **Formatting**:
  - Single-spaced or 1.15 spacing.
  - Use clear headings or bullet points to ensure brevity and readability.

Evaluation Criteria

- **Relevance (30%)**: Quality of chosen sources and relevance to ESG impacts in AI.
- **Insightfulness (30%)**: Depth of analysis and clarity in connecting data points to ESG principles.
- **Actionability (20%)**: Usefulness and clarity of recommended strategies.
- **Conciseness and Clarity (20%)**: Ability to present a cohesive summary in a single page.

Additional Notes

- **Resource Access**: No direct deployment required; all data should come from free, publicly accessible sources.
- **Ethical Considerations**:
  - Critically evaluate claims of carbon neutrality or sustainability from the providers to avoid unverified greenwashing.
  - Acknowledge any gaps or assumptions made due to incomplete public data.