AGENTIC AI TO MEASURE AI'S CARBON FOOTPRINT IN BUSINESS ENVIRONMENTS

Name: Durva Dhanraj Patil

Institute: K.B.Joshi Institute of Information Technology, Pune

E-mail: patildurva2003@gmail.com

Problem Statement:

Businesses run multiple AI/ML models but do not know how much energy or CO_2 each model consumes, leading to:

- *higher cloud costs*
- *unnecessary GPU usage*
- *increased carbon emissions*
- *no visibility or optimization*

Proposed Solution (High-Level)

Build an Agentic AI system that automatically tracks, analyses, and optimizes the carbon footprint of all AI workloads.

The solution has 3 major layers:

A) Data Collection Layer (Measurement & Monitoring)

B) Agentic Intelligence Layer (Analysis & Recommendations)

C) Visualization & Reporting Layer (Dashboard + Alerts)

A) DATA COLLECTION LAYER (MEASUREMENT & MONITORING)

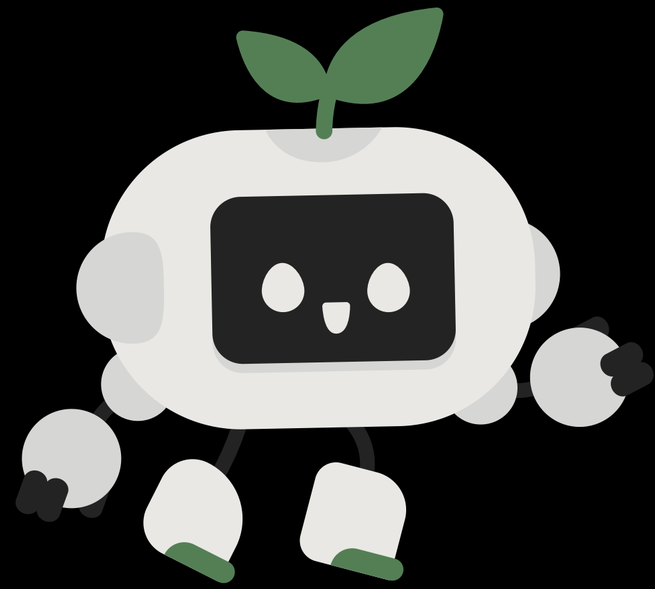
Goal: Measure real-time energy and CO_2 emissions per AI model/job.

How it works (Technical):

- ***Wrap ML training/inference jobs using Python energy trackers***
  - *CodeCarbon, psutil, nvidia-smi, CPU/GPU utilization APIs*
- ***Track:***
  - *runtime*
  - *GPU/CPU usage*
  - *power consumption*
  - *kWh used*
  - *CO_2 emitted (kg CO_2e)*
- ***Export metrics using:***
  - *Prometheus exporters*
  - *Docker containers for isolation*
- ***Store emissions in a lightweight database (SQLite or PostgreSQL)***

Outcome (Functional):

- ***Every ML model automatically logs its carbon footprint.***
- ***CO_2 per model, per job, per hour becomes visible.***



B) AGENTIC INTELLIGENCE LAYER (ANALYSIS & RECOMMENDATIONS)

Goal: Use an AI agent to analyze emissions and suggest optimization strategies.

How it works (Technical):

- ***Use LangChain to build an agent that can query emission metrics.***
- ***Agent reasons over:***
  - *high-consumption jobs*
  - *idle GPU time*
  - *peak vs off-peak grid carbon intensity*
- ***Suggests optimizations such as:***
  - *switch to mixed precision*
  - *reduce batch size*
  - *use efficient model architectures*
  - *schedule jobs to low-carbon hours*
  - *move workloads to greener cloud regions*

- ***Optional automation:***
  - *scale down unused GPU nodes*
  - *schedule training at night*
  - *auto-stop long-running jobs*
- ***Outcome (Functional):***
- *Business gets actionable insights or auto-executed steps for greener AI usage.*

C) VISUALIZATION & REPORTING LAYER (DASHBOARD + ALERTS)

Goal: Give business teams a simple UI to track and improve emissions.

How it works (Technical):

- *Build dashboard using Streamlit or Dash.*
- *Display:*
  - *total CO_2 emissions*
  - *emissions per model/job*
  - *energy usage charts*
  - *cost vs carbon metrics*
- *Alerts using:*
  - *Prometheus Alert Manager*
  - *Email/SMS/Slack notifications*

- *Deploy entire system using Docker containers.*

Outcome (Functional):

- *Business teams can see:*
  - *which models are expensive*
  - *which jobs waste energy*
  - *how to optimize deployments*
- *Alerts warn if a job is consuming too much power.*

END-TO-END FLOW SUMMARY

Step-by-step flow :

1. *ML job starts*
2. *Energy tracker measures power, runtime, CPU/GPU usage*
3. *CO_2 emission calculation (kWh × Carbon Intensity)*
4. *Prometheus collects & stores metrics*
5. *Dashboard visualizes emissions per model/job*
6. *Agentic AI analyses patterns & recommends or auto-takes actions*
7. *Alerts notify high-emission events*
8. *Business achieves lower cost & lower carbon footprint*

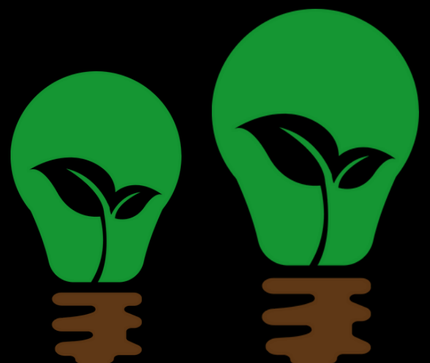
WHAT THIS SYSTEM DELIVERS

Functional Benefits :

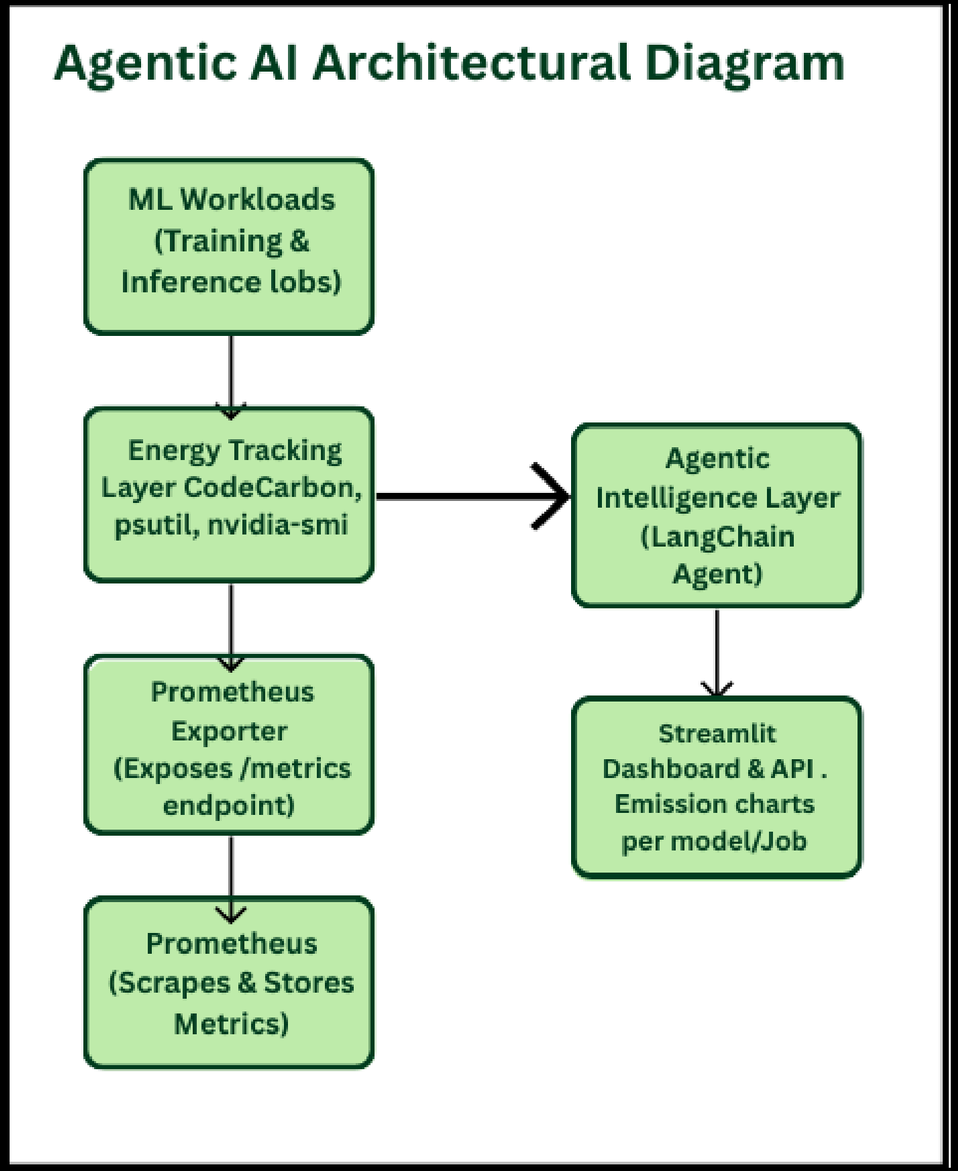
- *Real-time carbon tracking for all AI workloads*
- *Automatic insights to reduce cost and emissions*
- *Transparent reporting for sustainability teams*
- *Data-driven decision making for deployment and scaling*

Technical Strengths :

- *Python-based lightweight monitoring*
- *Prometheus metrics pipeline*
- *Docker for reproducibility*
- *Agentic AI powered by LangChain*
- *Fast dashboards with Streamlit*
- *Modular & expandable architecture*



A complete agentic AI system that monitors AI model emissions, analyzes energy usage, and offers intelligent optimization strategies — helping businesses run greener, cost-efficient AI.



Thank You