Imagine Cup Junior

Team Hackminors

Microsoft

Microsoft

Imagine Cup Junior Submission :

School Name: *South Point High School*

Student team name: *Hackminors*

The idea in a sentence: *An AI-powered platform which empowers individuals worldwide to accurately track, analyze, mitigate and manage their Carbon Footprints through intuitive interfaces and get actionable insights from our LLM and discuss varied sustainable topics on its Community Forum, fostering a collective effort towards combating global warming and achieving sustainability.*

Number of team members: *3*

Class of team members: *IX*

AI for Good initiative: *AI For Earth*

Team video link (*required*): *https://www.youtube.com/watch?v=ENhW6AN1RK0*

The Problem

Problem Statement:

- The world is facing a pressing environmental crisis, with climate change posing significant threats to ecosystems, livelihoods, and human health, which is quite observant in recent times.

- Specifically, carbon emissions, stemming from various sources including transportation, industrial activities, and energy production, are major contributors to global warming and climate change (Greenhouse Gases).

- According to the Intergovernmental Panel on Climate Change (IPCC), carbon dioxide (CO_2) emissions reached a record high of 36.8 billion metric tons in 2020, exacerbating the effects of climate change.

- These emissions lead to rising temperatures, extreme weather events, sea level rise (may be due to melting of glaciers), and disruptions to ecosystems, posing a grave threat to biodiversity and human well-being.

- Thus it is of utmost importance to understand the harm we do to the environment, to our Mother Earth with the help of a data for its proper management, because we can never have a better management unless we know it well. Carbon Footprint, which is the total amount of greenhouse gases , including carbon dioxide and methane that are generated by our actions, obviously fills out the slot. It then helps take proper actions for its management to reduce it.

- Moreover, individuals and organizations often lack awareness of their own carbon footprints and struggle to take effective action to mitigate their environmental impact.

The Problem

Research and Impact:

🔍 Extensive research and analysis have identified carbon emissions as a critical environmental issue, with profound implications for the planet.

🔍 Data from the Global Carbon Project reveals that the transportation sector accounts for approximately 14% of global CO2 emissions, highlighting the urgent need for innovative solutions in this area.

🔍 Furthermore, studies have shown that reducing carbon emissions is essential to limit global warming to below 1.5 degrees Celsius and avoid catastrophic consequences for ecosystems and societies.

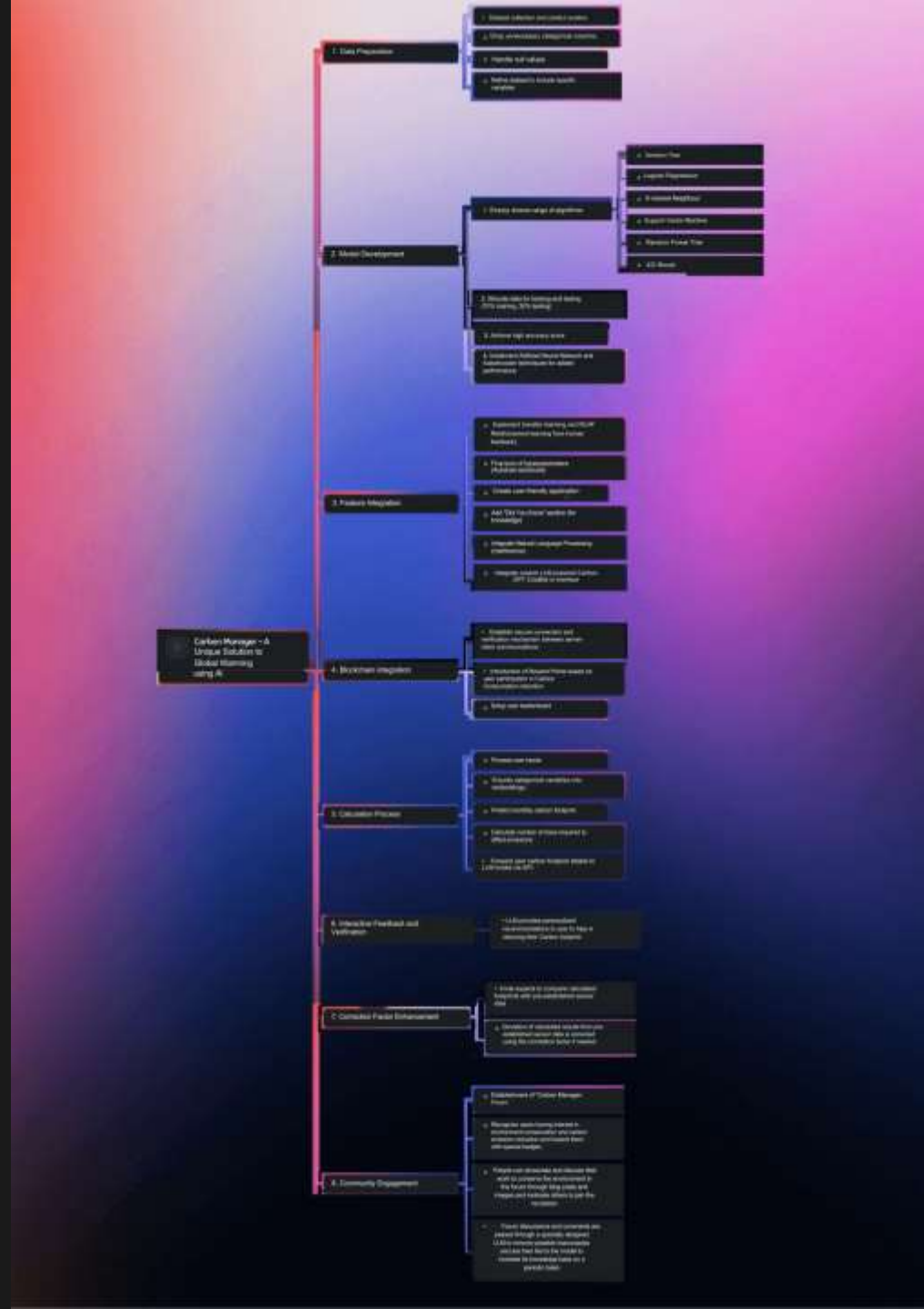
🔍 Our project, Carbon Manager, addresses this pressing challenge by leveraging AI technology to empower individuals to accurately measure, reduce, and offset their carbon footprints on our user-friendly application by planting adequate number of trees (reforestation), which is also quite a pressing challenge nowadays, or get best unique, creative and innovative suggestions, choices and ideas or generate creative writing pieces from our LLM in any desired language or ask, discuss, suggest, learn, share, market, showcase, news & updates, research, chat, inform and many more for a sustainable Carbon-friendly, clean green and safer Earth on our social-media-like Community Forum.

🔍 By doing so, our project, Carbon Manager aims to contribute to global efforts to combat climate change and create a more sustainable future for all.

Your AI Concept

AI Carbon Footprint Manager:

- **Data Preparation:** Curated dataset from Kaggle, and open-source providers. Refined dataset to 10,000 entries with 5 numerical and 11 categorical variables.
- **Model Development:** Employed Decision Tree, Logistic Regression, K-nearest Neighbour, Support Vector Machine, Random Forest Tree, and XG Boost algorithms and Gradient Boosting. - Achieved 97% accuracy. Used 80% data for training and 20% for testing. Enhanced models with Artificial Neural Network and Autoencoder techniques.
- **Data Processing and Prediction:** System processes user inputs, encoding categorical variables for prediction of monthly carbon footprint. Calculates number of trees needed to offset emissions, providing options to plant by self under expert supervision, or by donating Carbon Credits to NGOs .
- **Interactive Suggestions:** Chat2Eco Plugin provides personalized recommendations and others for reducing carbon footprint based on user's inputted data.
- **Feature Integration:** Implemented transfer learning and fine-tuned hyperparameters for optimal performance. Dynamic "Did You Know" section educates users on carbon emissions.
- **Correction Factor Enhancement:** "Correction Factor" feature improves accuracy through expert feedback after verifying the authenticity of the research. Through natural user feedback while Report and Proof Submission.
- **Community Engagement:** "Carbon Manager-Forum" fosters discussions and collaborations. Special badges encourage active participation. Forum data enriches AI Carbon-Friendly Chatbot.



Your AI Concept

Chat2Eco – Our LLM

- The Chat2Eco-180B base model serves as a cutting-edge amalgamation of advanced techniques within the realm of large language model (LLM) architecture.
- Employing a sophisticated Mixture of Experts (MoE) approach, it seamlessly integrates components from renowned models such as gemini 7b, llama 70b-chat, and mixtral 8x7b, culminating in a highly versatile and efficient architecture.
- At its core, the model employs a sparse decoder-only network, intricately orchestrated through a sophisticated merge mechanism utilizing the "slerp" interpolation method, allowing for dynamic parameter selection for each token.
- This dynamic selection process, akin to Mixtral's architecture, enables the model to effectively expand its parameter space while maintaining computational efficiency by selectively activating only a fraction of the total parameters per token.
- The Chat2Eco model further refines its architecture with a fine-grained MoE approach, boasting a total of 132B parameters, with 36B active per input.
- Unlike previous MoE models, which often featured fewer experts and limited combinations, Chat2Eco adopts a finer granularity with 16 experts and a selection of 4 per token, resulting in superior model quality and performance.
- To optimize performance and efficiency, the model leverages advanced techniques such as rotary position encodings (RoPE), gated linear units (GLU), and grouped query attention (GQA), complemented by the integration of the GPT-4 tokenizer from the tiktoken repository.

Use of Artificial Intelligence

- Our project, Carbon Manager, leverages advanced Artificial Intelligence (AI) techniques to address environmental challenges and promote sustainability, using AI for Good, the one for Earth.

- Primarily, we employ machine learning algorithms such as **Decision Tree, Logistic Regression, K-nearest Neighbour, Support Vector Machine, Random Forest Tree, and XG Boost and Gradient Boosting** to accurately predict carbon footprints and provide the number of trees one needs to offset emission either by self or by providing Carbon Credits to NGOs.

- Additionally, we utilize **Artificial Neural Network and Autoencoder** techniques to enhance the predictive capabilities of our models, ensuring precise calculations and recommendations.

- **Advanced Neural Network Architectures:** The creation of the LLM begins with the design of advanced neural network architectures, leveraging state-of-the-art techniques such as transformers and recurrent neural networks (RNNs). These architectures form the backbone of the model, enabling it to process and generate human-like text.

- **Mixture of Experts (MoE) Approach:** A fundamental aspect of the LLM's design is the utilization of a Mixture of Experts (MoE) approach. This technique involves integrating multiple expert models, each specializing in different aspects of language understanding and generation. By dynamically combining the predictions of these experts, the model can achieve superior performance across a wide range of linguistic tasks.

- **Fine-tuning and Transfer Learning:** To further enhance the performance of the LLM, fine-tuning and transfer learning techniques are employed. This involves initializing the model with pre-trained weights from a larger language model and fine-tuning it on domain-specific data related to environmental conservation and sustainability. By leveraging the knowledge encoded in the pre-trained model, the LLM can quickly adapt to the nuances of the target domain and achieve better performance with less data.

- **Hyperparameter Optimization:** Additionally, hyperparameter optimization techniques are utilized to fine-tune the model's hyperparameters, such as learning rate, batch size, and regularization strength. This optimization process helps to maximize the model's performance and generalization ability on unseen data.

Impact

🌐 Our innovative AI-powered platform, Carbon Manager, stands at the forefront of combating climate change by empowering individuals to actively understand and reduce their carbon footprints.

🌐 With a staggering accuracy rate of 98%, our platform enables users to accurately measure, understand, and mitigate their carbon emissions through answering simple daily life questions on an intuitive interface which anyone above the age of 5 can use.

🌐 By facilitating reforestation efforts and providing personalized action suggestions, we empower users to take meaningful steps towards resource conservation, health, and sustainable practices.

🌐 The specially designed AI Carbon-Friendly Chatbot, Chat2Eco serves as a constant companion, offering sustainability tips, ideas, suggestions, choices, and writings to users at any time either through plugin or through its UI.

🌐 Through tree-planting facilitation or donating Carbon Credits and carbon offsetting mechanisms, users not only offset their emissions but also contribute to creating a cleaner, greener environment.

🌐 Monthly reports and proof submissions go under a strict verification process by both blockchain and manual, which later enable administrators to make informed decisions for more efficient country administration.

🌐 By incentivizing participation through redeemable carbon reward points for eco-friendly purchases, and a competitive leaderboard, our platform inspires and motivates users to actively engage in environmental stewardship.

🌐Additionally, our social media-like discussion forum fosters knowledge sharing, collaboration, and community building, further enhancing the impact of our concept.

🌐 Ultimately, Carbon Manager empowers individuals to become proactive agents of change, leading to a significant reduction in carbon emissions and a brighter, more sustainable future for generations to come.

Ethics

- We believe that our AI Concept is **Fair** because we believe our AI-powered platform fosters fairness by providing equal access to carbon management tools, ensuring unbiased data collection, and opportunities for all individuals, regardless of background or socioeconomic status.

- We believe that our AI Concept is **Reliable and Safe** because our project prioritizes reliability and safety by rigorously testing and validating our algorithms, models and interfaces to ensure accurate carbon footprint calculations and LLM response, secure code handling practices to avoid SQL injection, X-site-scripting, etc. and secure data handling practices, by reducing data storing on cloud, performing all the verification and database work on local device of our team, and using secure and highly protected platforms for deployment and forms (Microsoft Forms).

- Privacy & Security: We uphold the highest standards of privacy and security, implementing robust encryption measures and data anonymisation techniques to protect user information and maintain confidentiality.

- We believe that our AI Concept is **Inclusive** because our project embraces inclusiveness by designing intuitive interfaces and features accessible to users of diverse backgrounds and abilities and ages, ensuring everyone can actively participate in environmental conservation efforts.

- We believe that our AI Concept is **Transparent** because we are committed to transparency in our project, providing clear explanations of our methodologies, data sources, and algorithms to users, fostering trust and understanding.

- We believe that our AI Concept is **Accountable** because our project operates with accountability, establishing mechanisms for user feedback, oversight, and accountability to ensure continuous improvement and adherence to ethical standards.

Cybersecurity

🔒 Cybersecurity is a top priority in the development of our AI platform, Carbon Manager, to safeguard both our system and its users.

🔒 We have implemented robust encryption measures and data protection protocols to secure user information and prevent unauthorized access, by using verified and highly protected platforms and services.

🔒 Multi-factor authentication and role-based access controls ensure that only authorized personnel can access sensitive data and functionalities within the platform.

🔒 Regular security audits and penetration testing are conducted to identify and mitigate potential vulnerabilities and threats.

🔒 Our platform adheres to industry-standard security frameworks and compliance regulations to ensure the highest level of protection for user data and privacy.

🔒 Continuous monitoring and real-time threat detection mechanisms are in place to promptly respond to and mitigate any security incidents or breaches.

🔒 User education and awareness initiatives are conducted to promote cybersecurity best practices and empower users to protect their personal information.

🔒 Our team is dedicated to staying abreast of the latest cybersecurity trends and technologies to continuously enhance the security posture of our AI platform.

🔒 By prioritizing cybersecurity, we aim to instill confidence in our users and ensure a safe and secure environment for their interactions with our AI platform.