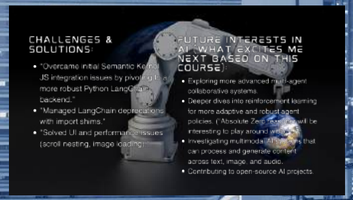

May 11, 2025
RAYYAAN HAAMID - AI & DEEP LEARNING PORTFOLIO: ITAI 2376
MASTERING CONCEPTS, BUILDING SOLUTIONS: FROM AZURE AI FUNDAMENTALS TO A CAPSTONE AI AGENT
GET STARTED
ITAI 2376 Deep Learning and AI Agent Development
Rayyaan Haamid


LAYING THE GROUNDWORK: CORE AI SKILLS & FOUNDATIONAL PROJECTS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Deeper dives into reinforcement learning for more adaptive and robust agent policies. (Absolute Zero would be interesting to play around with)
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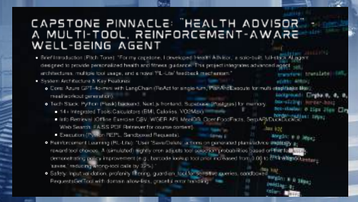
CAPSTONE PINNACLE: "HEALTH ADVISOR" - A MULTI-TOOL, REINFORCEMENT-AWARE WELL-BEING AGENT


REFLECTIONS, FUTURE DIRECTIONS & CONNECTING
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MIDTERM SHOWCASE: GENERATING IMAGES WITH DIFFUSION MODELS

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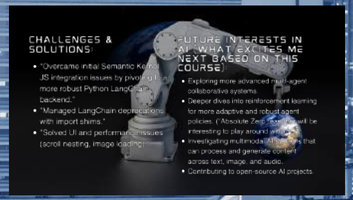
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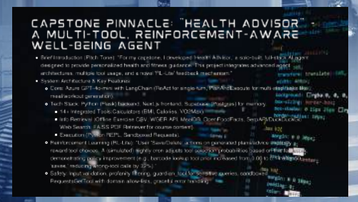
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- Cloud AI Services & Machine Learning Fundamentals
  - Brief Description: "My journey began with exploring Azure AI services, understanding content safety, image analysis (Azure Vision), and NLP (Azure Language). I gained hands-on experience with resource provisioning, model utilization, and the practical applications of pre-trained models."
- Key Learnings/Projects Highlighted:
  - L01-L05 (Azure Labs): Content Safety, Vision Studio (captioning, object detection), Language Studio (sentiment analysis), Document Intelligence, Generative AI with Azure AI Foundry.
  - Key Takeaway: "Mastered Azure AI service deployment and practical applications in content moderation, image analysis, and NLP, including prompt engineering for generative AI."

- Deep Learning Concepts & No-Code ExplorationBrief Description: "Ventured into Deep Learning fundamentals with a no-code approach (L02: TensorFlow/Keras with VGG16), understanding model architecture, data preprocessing, and prediction sensitivity. This provided a crucial bridge to more complex implementations."
- Key Learnings/Projects Highlighted:
  - L02 (VGG16): Image classification, understanding pre-trained models, sensitivity to input variations. (e.g., "Misclassification of a 'cat' as 'hamper' highlighted model limitations and the importance of training data diversity.")

- Practical Neural Network Implementation & Theory
  - Brief Description: "Progressed to hands-on neural network development using PyTorch (L03: AWS MLU Labs) and TensorFlow/Keras (L04: CNNs for MNIST). This involved understanding tensor operations, network learning, end-to-end text classification, and CNN architectures."
- Key Learnings/Projects Highlighted:
  - L03 (PyTorch): Tensor manipulation, dynamic computation graphs, autograd, MLP design, dropout, LSTM for text.
  - L04 (CNNs): MNIST classification (achieved 99.12% accuracy), understanding Conv2D/MaxPooling layers, one-hot encoding.
  - A03 (Neural Network Zoo): "Creatively explained complex architectures (CNNs as Falcons, RNNs as Dolphins, LSTMs as Elephants, GANs as Octopuses, Transformers as Owls) to solidify my understanding of their unique characteristics and applications."

- Advanced NLP & Transformer Models
  - Brief Description: "Explored advanced NLP techniques (L05: AWS MLU Module 2 - Text Processing, BoW, GloVe, RNNs) and culminated in fine-tuning transformer models (L06: BERT), understanding tokenization, attention, and transfer learning's power."
- Key Learnings/Projects Highlighted:L05 (NLP Pipeline): Stemming/Lemmatization, POS tagging, NER, TF-IDF, GloVe embeddings.
  - L06 (BERT Fine-tuning): Transfer learning, WordPiece tokenization, AdamW optimization, learning rate scheduling. Achieved ~92% accuracy on sentiment classification.
  - A02 (Tool Comparison): "Analyzed Hugging Face Transformers vs. OpenAI GPT-4 API, understanding their trade-offs in usability, performance, and customizability."
  - A05 (Analyzing "Arrival"): "Applied NLP concepts to analyze communication challenges in the film 'Arrival,' drawing parallels to real-world NLP issues like ambiguity and low-resource languages."


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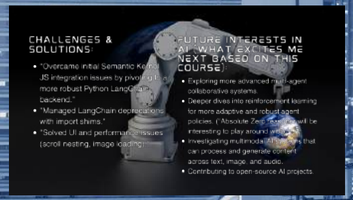
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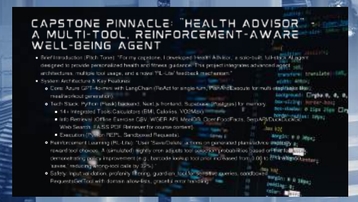
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MIDTERM SHOWCASE: GENERATING IMAGES WITH DIFFUSION MODELS

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- Brief Introduction: "The midterm project was a deep dive into generative AI, where I implemented and trained a diffusion model from scratch to generate realistic Fashion-MNIST images. This provided hands-on experience with the mathematics, U-Net architecture, and the iterative noise-adding and removal process."
- Key Implementation Aspects:
  - Dataset: Fashion-MNIST (28x28 grayscale images).
  - Architecture: U-Net with time and class conditioning (sinusoidal position embeddings for time, one-hot encoded class labels).
  - Process: Implemented both forward (noise addition) and reverse (model-led noise removal) diffusion processes over 100 timesteps.
  - Training: 30 epochs, Adam optimizer, MSE loss (decreased from ~0.17 to ~0.11).
- Key Learnings & Insights:
  - "Grasped why U-Net is ideal (encoder-decoder with skip connections for detail preservation) and the critical roles of time embedding (guiding denoising strength) and class conditioning (directing generation)."
  - "Visualized the step-by-step denoising, observing images becoming recognizable roughly 30-40% into the reverse process."
- CLIP Evaluation (Bonus):
  - "Implemented CLIP (ViT-B/32) to quantitatively evaluate generated images against text prompts (e.g., 'a clear, well-detailed Fashion-MNIST image of class 5')."
  - "Achieved CLIP scores around 0.26-0.28, providing a relative measure of alignment and sparking hypotheses on why certain classes might be easier to generate."


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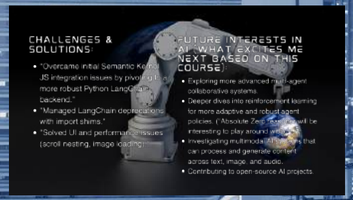
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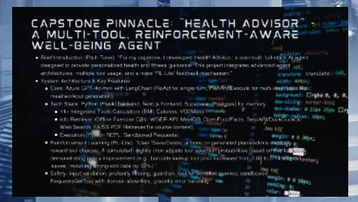
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CAPSTONE PINNACLE: "HEALTH ADVISOR" - A MULTI-TOOL, REINFORCEMENT-AWARE WELL-BEING AGENT

- Brief Introduction (Pitch Tone): "For my capstone, I developed 'Health Advisor,' a solo-built, full-stack AI agent designed to provide personalized health and fitness guidance. This project integrates advanced agent architectures, multiple tool usage, and a novel 'RL-Lite' feedback mechanism."
- System Architecture & Key Features:
  - Core: Azure GPT-4o-mini with LangChain (ReAct for single-turn, PlanAndExecute for multi-step tasks like meal/workout generation).
  - Tech Stack: Python (Flask) backend, Next.js frontend, Supabase (Postgres) for memory.
    - 14+ Integrated Tools:Calculators (BMI, Calories, VO2Max).
    - Info Retrieval (Offline Exercise CSV, WGER API, MealDB, OpenFoodFacts, SerpAPI/DuckDuckGo Web Search, FAISS PDF Retriever for course content).
    - Execution (Python REPL, Sandboxed Requests).
  - Reinforcement Learning (RL-Lite): "User 'Save/Delete' actions on generated plans/advice implicitly reward tool choices. A (simulated) nightly cron adjusts tool selection probabilities based on this feedback, demonstrating policy improvement (e.g., barcode lookup tool prior increased from 0.06 to 0.14 after 50 'saves,' reducing wrong-tool calls by 32%)."
  - Safety: Input validation, profanity filtering, guardian_tool for sensitive queries, sandboxed RequestsGetTool with domain allow-lists, graceful error handling.


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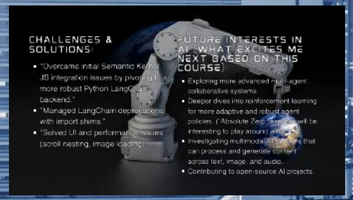
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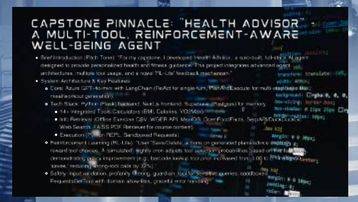
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- Practical Application is Key: "Hands-on labs (Azure, AWS, local implementations) were crucial for cementing theoretical concepts, from basic ML to advanced transformers and generative models."
- The Power of Iteration & Debugging: "Encountered and resolved numerous challenges (API issues, version conflicts, model limitations, UI bugs), reinforcing the iterative nature of AI development and the importance of systematic debugging." (Reference Capstone's "Stumbling Blocks").
- Tooling & Frameworks: "Gained proficiency in diverse tools like LangChain, Hugging Face, PyTorch, TensorFlow, and cloud platforms (Azure AI Studio), understanding their strengths for different AI tasks."
- Agent Design Principles: "Learned to design and implement agentic systems with clear architectures (Input, Memory, Reasoning, Output), leveraging patterns like ReAct and Plan-and-Execute."
- Importance of Safety & Ethics: "Integrated safety measures in projects, understanding the need for input validation, boundary enforcement, and transparency in AI systems." (Reference "Arrival" analysis & Capstone safety).
- Effective Communication of Complex AI: "Developed skills in explaining complex AI/DL topics to varied audiences, from technical reports to simplified explanations for an 11-year-old (Gradient Descent presentation)."


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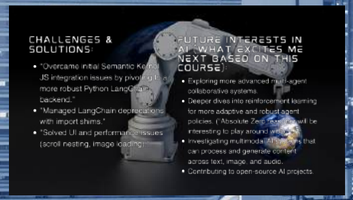
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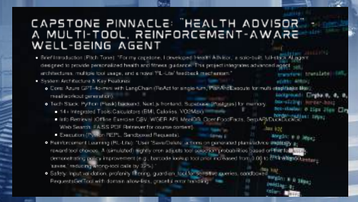
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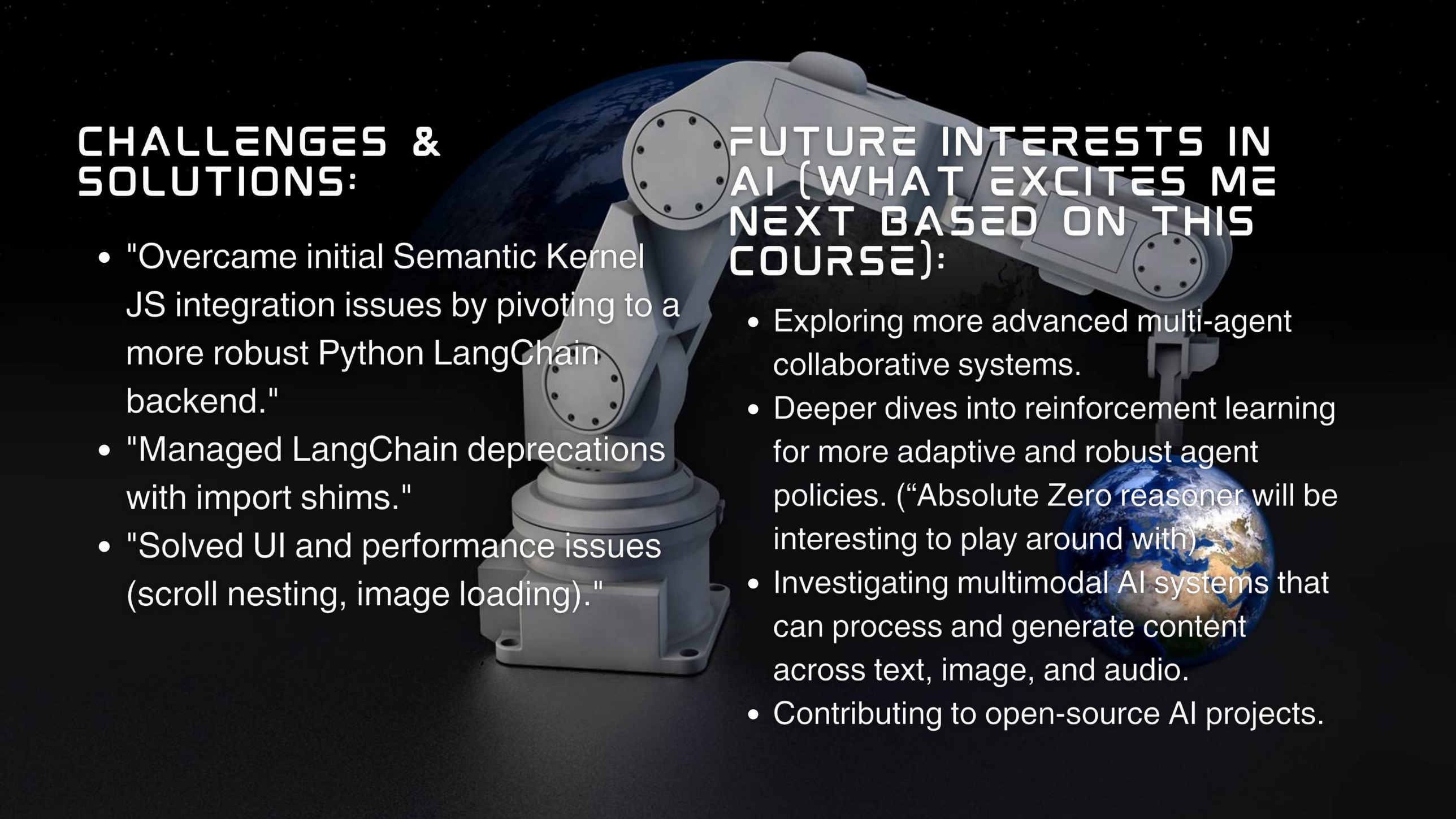

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Future Interests in AI (What excites me next based on this course):

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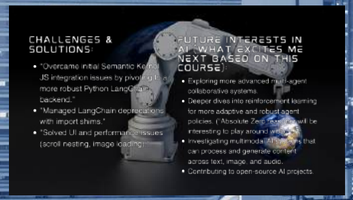
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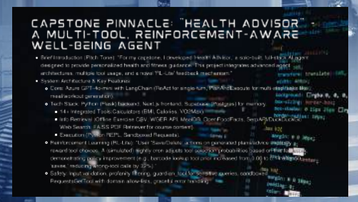
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GITHUB PORTFOLIO: GLUMLING
"THANK YOU FOR YOUR TIME. I'M READY TO DISCUSS HOW MY SKILLS AND EXPERIENCES CAN BENEFIT YOUR TEAM/ORGANIZATION."