**MegaHack**

**Spring 2024 Challenges**

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## Smart Health:

| **Smart Health Challenge 1:** |
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Create a smart pill management system for an elderly patient living at home. How would you go about dispensing multiple medications in a way that ensures they are taken?

**Submitted By:** Central Virginia Node - CCI

| **Smart Health Challenge 2:** |
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Create and demonstrate an IFTTT (<https://ifttt.com/>) Applet to let families check in on a relative at home and help manage outpatient care.

**Submitted By:** Central Virginia Node - CCI

| **Smart Health Challenge 3:** |
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With telehealth on the rise, many patients are able to connect with doctors, specialists, and other care providers that they previously didn't have access to through email, phone, or video. However, collecting biometric data is still an essential tool in the diagnostic process that has become more difficult due to the physical distance between provider and patient. Create a solution to assist in the collection of patient data through the use of portable, cost-effective, at-home devices; these may include IoT devices, visual or infrared cameras, wearable sensors, and other devices.

**Submitted By:** Central Virginia Node - CCI

| **Smart Health Challenge 4:** |
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As smart home technologies become more prevalent (Nest, Alexa, Google Home, etc), at-home health monitoring also becomes more accessible. Create a plan to outfit an existing home with smart devices that can be used to help an elderly person live at home while managing their health. Consider how to utilize technology to collect data that a personal care provider can use to track the development of long-term conditions and adjust treatment plans

**Statement of Need:** When patients leave the physician’s office or from a hospital stay, they are generally provided instructions for self-care activities and an appointment for follow-up. The instructions are sometimes verbal or provided in a document printout. Could these materials and instructions be provided in a mobile app with appropriate time reminders for self-care actions?

**Submitted By:** Central Virginia Node - CCI

| **Smart Health Challenge 5:** |
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As more health-focused digital technologies become available to consumers (FitBit, online trackers, mobile apps), there is increased awareness of health & biometric data. How can this data be used to provide insights and prompt positive behavior change in one or more of the following areas?

1. Predict an individual’s biometrics and send automated alerts that prompt better dietary choices (possible fit for AI, data mining, predictive algorithms/analytics applications).
2. Track fitness activities that can help people come up with better exercise routines.
3. Track biometrics to predict when stress levels will interfere with everyday activity, send automated warnings when biometric data indicates increased stress & suggestions of behavior change.
4. Provide alerts from medical devices to relatives’/EMTs’ phones/smart watches when a patient’s health degrades.

**Submitted By:** MegaHack@VCU

## Smart Tech

| **Smart Tech Challenge 1:** |
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**Quick Code Fusion:** Develop a simple web application that performs a useful function. For example, it could be a task tracker, a note-taking app, a weather app, etc.

**Goals:**

* Combine the power of two distinct programming languages to create a unique and functional application. This challenge is designed to test your adaptability and problem-solving skills as you merge the strengths of different languages to build something innovative.

**Rules:**

* You must use at least one endpoint or function written in each of the chosen languages. The interaction between the two languages should be seamless and enhance the overall functionality of the application. External libraries and frameworks are allowed, but keep in mind the time constraint.
* Languages to Combine: Choose two programming languages from the following list: Python JavaScript (Node.js) Java Ruby C# Go Swift

**Submitted By:** MegaHack

| **Smart Tech Challenge 2:** |
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**Decrypt the Login Information:** Participants will be given an encrypted file containing login information. The encryption method may vary, such as hash functions, encryption algorithms, or other cryptographic techniques.

**Goals:**

* Participants are tasked with cracking encrypted login information contained within a provided file. Competitors will need to leverage their skills in cryptography, ethical hacking, and password cracking to decipher the login credentials. The challenge is designed to test participants' ability to choose and apply the appropriate tools and techniques to break the encryption and reveal the hidden login details.

**Rules:**

* Competitors must carefully analyze the encryption used in the file and choose the most suitable tools and techniques to crack the login information. This could involve the use of password-cracking tools, decryption algorithms, or custom scripts.
* Participants are expected to adhere to ethical hacking principles. Unauthorized access or any malicious activities are strictly prohibited. The focus should be on decrypting the login information within the provided scope and guidelines.

**Submitted By:** MegaHack

| **Smart Tech Challenge 3:** |
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**Blockchain-Enabled Supply Chain Transparency:** Develop a blockchain-based solution to enhance transparency in the supply chain. The goal is to create a simple yet effective application that utilizes blockchain technology to trace the journey of a product from its origin to the end-user, ensuring authenticity and transparency in the supply chain.

**Goal:**

* Enable product manufacturers or suppliers to register their products on the blockchain. Include relevant details such as product name, manufacturing date, origin, and any certifications.
* Implement a blockchain ledger to record and track transactions as the product moves through the supply chain. Each participant in the supply chain (manufacturer, distributor, retailer) should have a unique identifier on the blockchain.
* Use smart contracts to automate verification processes at each stage of the supply chain. For example, when a distributor receives a batch of products, the smart contract should verify the authenticity and update the blockchain.
* Develop a user-friendly interface for stakeholders to interact with the blockchain. Include a feature for end-users to scan a product's QR code or use an identifier to view its entire journey through the supply chain.
* Implement real-time updates to the blockchain to ensure that all participants have access to the latest information about the product's status.
* Utilize the blockchain to provide a mechanism for consumers, retailers, or any other stakeholders to verify the authenticity of a product easily.

**Tips:**

* Consider using a public blockchain network (e.g., Ethereum) or a suitable permissioned blockchain to demonstrate the transparency and immutability of the supply chain data. Ensure that the solution is scalable and can handle a growing number of participants and transactions. Emphasize the importance of the solution in reducing fraud, ensuring product quality, and building trust among stakeholders in the supply chain.

**Submitted By:** MegaHack

| **Smart Tech Challenge 4:** |
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**Malware Hunt:** Participants will be tasked with enhancing the capabilities of a system that detects malware using an external tool, for example: (McAfee Security Scan). The challenge involves identifying the location of the malware, uncovering the potential program disguises, and determining the type of malware present. Participants will engage in a cybersecurity investigation to strengthen the system's malware detection and analysis capabilities.

**Goals:**

* Develop improvements to the malware detection mechanism within the system. Consider refining algorithms, integrating additional detection tools, or enhancing existing signatures for more accurate identification.
* Implement a solution to precisely pinpoint the location of the detected malware within the system. Provide insights into where the malware has infiltrated and establish a detailed report.
* Develop algorithms or heuristics to identify potential program disguises employed by the malware. Uncover the names or appearances the malware may adopt to evade detection.
* Implement a classification system to determine the type of malware present. Differentiate between viruses, worms, trojans, ransomware, or other malicious entities based on their characteristics and behavior.
* Create an automated reporting system that generates detailed reports on malware detections. The reports should include information on malware location, potential disguises, and the identified type.
* Strengthen the integration with McAfee Security Scan or a similar external malware checker tool. Optimize the communication and data exchange to enhance the overall malware detection process.
* Design the solution to be scalable, and capable of handling increased malware detection demands as the system grows. Consider potential increases in data volume and the diversity of malware types.

**Submitted By:** MegaHack

| **Smart Tech Challenge 5:** |
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**Cipher Unraveling Adventure**: Embark on a Cipher Unraveling Adventure! In this challenge, participants are tasked with deciphering encoded messages using various cryptographic techniques. The provided example uses ROT-13, but the challenge goes beyond. Decode the hidden message: "**Lbh unir fhpprffshyyl penpxrq gur cnffjbeq.**" and unravel the mystery that lies within.

**Goals:**

* Decode the given message using different ROT variants. Explore ROT-1 to ROT-25, and identify the version that reveals the intended message. Provide explanations for the decoding process.
* Apply Caesar Cipher decoding techniques to unveil the hidden message. Demonstrate how you determine the key and decipher the encrypted text effectively.
* Implement Substitution Cipher decryption methods to crack the encoded message. Uncover the substitutions made and present the steps taken for decryption.
* Tackle the challenge of Vigenère Cipher decryption. Identify the key and decipher the message, showcasing your understanding of this more complex cryptographic method.
* Utilize frequency analysis to decipher the encoded message. Analyze the occurrence of letters or symbols to deduce the original text.
* Explore advanced cryptographic methods such as transposition ciphers, homophonic ciphers, or Playfair ciphers to decode the message. Provide a brief explanation of your chosen method and its application.

**Submitted By:** MegaHack

| **Smart Tech Challenge 6:** |
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**CodeCrafters Showdown:** Harness the power of Visual Studio Code to craft a groundbreaking tool that pushes the boundaries of innovation and efficiency. Participants in the CodeCrafters Showdown are challenged to develop a tool using Visual Studio Code that solves a real-world problem, streamlines a workflow, or introduces a unique functionality.

**Goals:**

* Create a tool that demonstrates innovation and addresses a specific problem or need. Consider originality and the potential impact of the tool.
* Showcase effective integration with Visual Studio Code, utilizing its features and extensions to enhance the development experience.
* Prioritize user experience by designing an intuitive and user-friendly tool interface. Consider accessibility and ease of navigation.
* Implement a robust set of features that align with the tool's purpose. Strive for functionality that is both comprehensive and efficient.
* Emphasize clean, well-documented, and efficient code. Adhere to best coding practices and consider the maintainability of the tool.
* Explore opportunities for integrating the developed tool with other development tools or workflows. Demonstrate its versatility and compatibility.
* Encourage collaboration by incorporating features that facilitate teamwork or code-sharing. Consider version control and collaborative coding environments.

**Submitted By:** MegaHack

| **Smart Tech Challenge 7:** |
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**Network Map Integration:**Larry has started a photography business. He has contracted with ABC Consulting Company to set up his network. He wants to ensure that the setup is optimized for the work he needs to do. As the consultant assigned to the job, you are to create a basic network diagram that will work for Larry and his photography business.

**Goals:**

* Your network diagram should include all the following: Internet Router/Modem Firewall 2 desktop computers IP Phone Printer Laptop (wireless) Digital camera (wireless) Make sure that each object pictured in the diagram is labeled correctly. <https://www.diagrams.net/> (click start to create free diagrams; no login required)

**Submitted By:** MegaHack

| **Smart Tech Challenge 8:** |
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**DSBSD Chatbot:**Create a chat bot that can be accessed from specific pages within a website as well as from within a web-based application by clicking a link or button. The chatbot should have the ability to answer questions typed into a provided field, based on a list of questions and corresponding answers maintained with the chat bot system. The chatbot should also have the ability to route the user to their choice of additional support through phone and email.

**Goals:**

* The chatbot should be embedded on specific pages within a website.
* Users should be able to access the chat bot by clicking on a designated link or button on the website.
* The chat bot should also be accessible within a web-based application.
* The chatbot should analyze user-inputted questions and provide relevant answers based on the predefined list.
* Enable users to type questions into a provided field.
* Integrate the chat bot with a routing system that allows users to choose additional support options.
* Design the chat bot system to be scalable, allowing for easy integration with new questions and support options.
* Provide comprehensive documentation on how to integrate, customize, and extend the chat bot system.
* Autoresponses for the [bot can be found here](https://docs.google.com/document/d/1lpq-Twc2ipEATPBavV_DNyXIGygqca_n/edit?usp=sharing&ouid=102871629002695577976&rtpof=true&sd=true). These are provided by the sponsor.

**Submitted By:** MegaHack & Virginia Department of Small Business & Supplier Diversity

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## Smart Cities:

| **Smart Cities Challenge 1:** |
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**MegaHacks Smart Urban Mobility:** Develop an innovative smart urban mobility solution to optimize transportation within the simulated smart city testbed.

**Goals:**

* Create a tool that demonstrates innovation and addresses a specific problem or need. Consider originality and the potential impact of the tool.
* Showcase effective integration with Visual Studio Code, utilizing its features and extensions to enhance the development experience.
* Prioritize user experience by designing an intuitive and user-friendly tool interface. Consider accessibility and ease of navigation.
* Implement a robust set of features that align with the tool's purpose. Strive for functionality that is both comprehensive and efficient.
* Emphasize clean, well-documented, and efficient code. Adhere to best coding practices and consider the maintainability of the tool.
* Explore opportunities for integrating the developed tool with other development tools or workflows. Demonstrate its versatility and compatibility.
* Encourage collaboration by incorporating features that facilitate teamwork or code-sharing. Consider version control and collaborative coding environments.

**Submitted By:** Central Virginia Node - CCI

| **Smart Cities Challenge 2:** |
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**Sustainable Smart Buildings:**Design and implement an eco-friendly and energy-efficient smart building system within the testbed to reduce environmental impact and improve occupant comfort.

**Goals:**

* Integrate IoT devices and smart sensors to monitor building energy usage, occupancy patterns, and indoor air quality.
* Develop predictive analytics algorithms to optimize energy consumption based on occupancy and weather forecasts.
* Create a central energy management platform to control lighting, heating, and cooling systems for maximum efficiency.
* Evaluate the sustainability and energy savings achieved by the smart building system, showcasing its benefits to the environment.

**Submitted By:** Central Virginia Node - CCI

| **Smart Cities Challenge 3:** |
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**Resilient Urban Infrastructure:**Develop a resilient urban infrastructure solution within the smart city testbed that can withstand and adapt to various disruptions and emergency situations.

**Goals:**

* Implement IoT sensors and data analytics algorithms to monitor and predict potential disruptions, such as traffic accidents, natural disasters, or power outages.
* Design an adaptive routing and resource allocation system to respond quickly to emergency situations while maintaining critical services.
* Create a real-time data visualization platform to inform city officials and citizens about the status of urban infrastructure during emergencies.
* Evaluate the system's performance in simulating different scenarios and demonstrating its ability to ensure safety and continuity during crises.

**Submitted By:** Central Virginia Node - CCI

| **Smart Cities Challenge 4:** |
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**Resilient Response - Adaptive Emergency Routing System:** Embark on the Resilient Response challenge! Participants are tasked with designing an adaptive routing and resource allocation system to respond swiftly to emergency situations while ensuring the continuity of critical services. In this challenge, harness your creativity and technical expertise to develop a robust system that dynamically adapts to emergencies, optimizing routing and resource allocation for effective and rapid response.

**Goals:**

* Develop an adaptive routing algorithm that dynamically adjusts based on the nature and severity of emergency situations. Consider factors such as traffic conditions, geographical constraints, and the urgency of response.
* Implement a system to integrate real-time emergency data from diverse sources, including emergency services, weather updates, and incident reports. Enable the system to continuously analyze incoming data for swift decision-making.
* Design algorithms for optimal resource allocation during emergency response. Consider variables such as the type of emergency, resource availability, and the criticality of maintaining essential services.
* Develop a mechanism to prioritize critical services during emergencies. Ensure that essential services such as healthcare, utilities, and communication are maintained while responding effectively to the emergency at hand.
* Design the system infrastructure to be scalable, accommodating various emergency scales and types. Ensure resilience against potential disruptions to maintain functionality during high-stress situations.
* Create an intuitive user interface tailored for emergency responders. The interface should provide real-time information, route suggestions, and resource allocation insights to aid decision-making under pressure.
* Develop features that engage and communicate with the community during emergencies. Provide real-time updates, evacuation routes, and safety instructions to enhance public awareness and safety.
* Establish seamless integration with existing emergency services and communication channels. Ensure compatibility with emergency response protocols and standards for effective collaboration.

**Submitted By:** MegaHack

| **Smart Cities Challenge 5:** |
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**Urban Insight - Real-Time Emergency Infrastructure Visualization**: Participants are tasked with creating a real-time data visualization platform to provide city officials and citizens with crucial information about the status of urban infrastructure during emergencies. In this challenge, unleash your creativity to develop an intuitive and impactful platform that facilitates informed decision-making and enhances public awareness during critical situations.

**Goals:**

* Develop mechanisms to aggregate and integrate real-time data from various urban infrastructure sources during emergencies. This may include data from traffic systems, utility networks, public services, and more.
* Create a robust framework for real-time data visualization that dynamically updates during emergencies. Implement visualizations such as maps, charts, and graphs to convey the status of key urban infrastructure elements.
* Identify and prioritize critical urban infrastructure components that need to be visualized during emergencies. Ensure that the platform highlights information crucial for decision-making and public safety.
* Design an intuitive user interface tailored for city officials. Provide features that allow officials to analyze and interpret data effectively, facilitating quick and informed decision-making in emergency scenarios.
* Develop a user-friendly public-facing dashboard to keep citizens informed about the status of urban infrastructure during emergencies. Prioritize clarity, accessibility, and real-time updates for enhanced public awareness.
* Ensure mobile accessibility for both city officials and citizens. Create a responsive design that allows users to access the platform on various devices, facilitating on-the-go information retrieval.
* Integrate the platform with existing emergency response protocols and systems. Ensure compatibility and seamless collaboration with emergency services for coordinated response efforts.
* Implement features that encourage community engagement during emergencies. Provide channels for public feedback, reporting, and communication to foster a sense of collaboration and shared responsibility.

**Submitted By:** MegaHack

| **Smart Cities Challenge 6:** |
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**CrisisSim Performance Evaluation:** Welcome to the CrisisSim Performance Evaluation challenge! Participants are called upon to evaluate a simulation system's performance in handling various scenarios, showcasing its prowess in ensuring safety and continuity during crises. In this challenge, dive into the simulation environment and assess the system's capability to navigate and respond effectively to diverse crisis situations.

**Goals:**

* Assess the simulation system's ability to handle a diverse range of crisis scenarios. Evaluate its adaptability to simulate natural disasters, public health emergencies, security threats, and other critical situations.
* Evaluate the realism and accuracy of the simulated scenarios. Analyze how well the system mirrors real-world conditions and events, ensuring a high-fidelity representation for effective crisis response.
* Review the incorporation of safety measures within the simulation system. Assess how well it replicates safety protocols, evacuation procedures, and other critical elements to ensure the well-being of individuals during crises.
* Evaluate the system's capacity to simulate and support continuity planning. Assess its ability to model business continuity, essential services provision, and infrastructure resilience during and after crises.
* Examine the user interface designed for decision-makers during simulated crises. Evaluate its intuitiveness, data representation, and overall usability for effective decision-making under pressure.
* Assess the simulation system's dynamic adaptability to changing conditions during crises. Evaluate its ability to respond to unforeseen developments and adjust the simulation accordingly.
* Review the integration of the simulation system with real-world emergency services and response mechanisms. Ensure seamless coordination and communication for effective crisis management.
* Analyze the system's performance metrics and analytics capabilities. Evaluate how well it measures and provides insights into the effectiveness of crisis response strategies and decision-making.

**Submitted By:** MegaHack