1. The Rwanda Agricultural Board has been working with AI experts at University of Kigali to develop a smart farming system that predicts how much maize farmers will harvest. This system uses special satellite pictures that show how healthy crops are, small devices in the soil that measure water and nutrients, and weather information from the past five years.

At first, the system worked perfectly for farmers in flat areas like Nyagatare, giving predictions that were only 5% different from actual harvests. But farmers in hilly places like Karongi complained that the system always predicted much smaller harvests than what they actually got. This became a serious problem because banks use these predictions to decide how much money to lend farmers for seeds and fertilizer. Some hill farmers couldn't get enough loans because of these wrong predictions.

After investigating, the engineers found the system wasn't properly accounting for how hills create different growing conditions. The way sunlight hits slopes and how water drains in hilly areas makes crops grow differently than in flat lands.

**Questions:**  
a) The system's "hidden layers" process all the farm data. Name two important things these layers do to turn soil moisture and weather information into harvest predictions.

b) Breadth-First Search helps organize the soil data before the system uses it. Give two ways this helps make better predictions for farmers.

c) The satellite pictures are part of which PAGE component? Choose from: Percepts/Actions/Goals/Environment. Give one reason for your answer.

d) The system needs to work better in hilly areas. Suggest one way to use reinforcement learning to fix this problem.

1. The City of Kigali has started using flying cameras (drones) to take pictures of neighborhoods and analyze them with AI. The system looks for three important things: how close together houses are, which roads are wide enough for emergency vehicles, and which areas might flood during heavy rains.

Last rainy season, there was a big problem. The shiny metal roofs on many houses looked like water to the AI system when the sun reflected off them. This caused 38 false flood alerts, sending emergency teams to places that weren't actually flooded. Meanwhile, some real flood areas in Nyabugogo were missed because the system was busy checking the wrong places. The city wasted about 8 million RWF sending teams to these false alarms.

Engineers discovered the system was trained mostly with flood pictures taken on cloudy days. It didn't have enough examples of what metal roofs look like when the sun shines on them after rain.

**Questions:**  
a) The AI uses "convolutional layers" to understand drone pictures. Describe two things these layers do to identify roads in the images.

b) The system makes most mistakes with metal roofs between 10am and 2pm. What is the main reason for these errors?

c) The system's flood predictions have an MSE score of 0.25. What does this tell us about how accurate it is?   
d) Should the city let the AI make all decisions about flood risks without human checking? Give one good reason for and one against this idea.

1. A tech company in Kigali made a new app that can listen to Kinyarwanda speech and type out what people say. The app works very well for the standard Kinyarwanda used in capital city, but struggles with the way people speak in other areas of the country.

For example, in some rural areas people say "kwenderanya" when they mean "provoking," but the app only understands the city word "gushotorana." This caused problems at different legal courts of laws, where clarks tried to use the app with customers speaking local dialects. In Gatsibo district, 12 customers got wrong legal advice because the app misunderstood their words.

The app was originally trained using recordings from radio stations, which mostly use the formal city dialect. It didn't have enough examples of how people actually speak in different parts of Rwanda.

**Questions:**a) The app uses "recurrent neural networks" to understand speech. How is this different from how regular computer programs process words?

b) The company needs to collect better voice samples. Suggest a smart way to gather recordings from all parts of Rwanda.

c) What should be the main goal for this app to work well for all Rwandans?

d) The app needs to understand different dialects better. Suggest one way to improve it

1. University of Kigali researchers created a special AI that can make fake pictures of sick crops to help train other AI systems. These fake pictures look very real and show different plant diseases. But when farmers in Muhanga tried using the system, they noticed it didn't show the early signs of cassava disease that they see in their fields.

The problem was the AI had learned mostly from pictures of maize diseases (85% of its training) and only a few cassava examples (15%). Because of this, it missed the small yellow spots that appear first on cassava leaves. Some farmers lost crops because they didn't see the disease early enough.

Many farmers don't trust these fake pictures. They say, "How can pretend pictures help with real problems in our fields?" The researchers need to convince farmers the system can really help them.

**Questions:**  
a) The AI has two parts that work together to make fake pictures. What does each part do?

b) Why does the system work well for maize but not cassava?

c) The researchers want farmers to trust the system. Suggest one way to help farmers feel more comfortable with these fake pictures.

1. The Ministry of Health launched "Indakemwa AI", a chatbot that answers questions about M-POX in Kinyarwanda, English and French. During normal hours, it responds quickly (about 45 seconds) with 92% accuracy. But every evening between 6-9 PM when many people use it, the wait time jumps to 8 minutes.

This happens because the system uses Depth-First Search to handle questions. It completely finishes difficult medical questions before answering simple ones. In Nyarugenge District, 14 people gave up waiting when asking about urgent symptoms. The system also struggles when people mix languages, like using both Kinyarwanda and English words in one question. About 18% of vaccination questions get wrong answers because of this.

The technical team at University of Kigali in partnership with RBC (Rwanda Biomedical Center) discovered the chatbot was trained mostly on formal medical language. It doesn't understand how regular people, especially youth, actually ask health questions in daily conversation.

**Questions:**

a) The chatbot uses "self-attention" to understand different languages. How does this help it better than old systems when people mix Kinyarwanda and English?

b) Changing to Breadth-First Search could improve evening performance. Name two ways response times would get better during busy hours.

c) The response time MSE is 4.0. What does this mean for rural clinics where internet is slow?

d) Which is more important for this chatbot: learning new medical terms automatically or giving clear answers? Choose one and say why.

1. Kigali's new smart traffic light system has been operating at twelve major intersections across the city for the past three months, including busy locations like Giporoso-Kanombe and Kimironko-Town. The system uses cameras and road sensors to monitor traffic flow in real-time, with an AI controller that automatically adjusts green light durations to keep vehicles moving smoothly. While the technology has successfully reduced average waiting times by **27%** at the intersections where it's installed, unexpected problems have emerged in other parts of the traffic network. Nearby junctions without the smart system have seen congestion increase by **14%** as drivers change their routes. Public service vehicles including buses and ambulances are experiencing nine percent longer delays because the current system prioritizes private car flow. Pedestrian crossing times have only improved by three percent, far below the **18%** target set by city planners.

A particularly concerning situation developed at Remera junction during morning rush hours, where the AI's optimization for vehicle flow has created dangerous conditions for pedestrians. Crossing times now regularly exceed four minutes, violating the city's urban safety standards. The system's limitations become especially apparent during special events or when schools close early, as it was primarily trained on standard weekday traffic patterns without accounting for these variations. Traffic engineers have noted that the AI's reward function focuses too narrowly on reducing overall vehicle delay without properly considering other important factors like public transit efficiency, pedestrian safety, and emergency vehicle priority.

**Questions:**a) The AI system earns rewards based on its success at reducing traffic delays. Connect this reward mechanism to the PAGE framework's Goal component, showing how the current implementation aligns or conflicts with broader urban planning objectives.

b) When encountering unusual traffic patterns like school dismissal times or event traffic, describe how the Deep Q-Network technology attempts to calculate appropriate light timings for these unforeseen situations.

c) Breadth-First Search could potentially improve coordination between multiple smart intersections. Explain the advantage this approach would have over Depth-First Search for managing citywide traffic flow.

d) Identify one potentially dangerous consequence that could occur if the system used Depth-First Search logic to prioritize emergency vehicle routes through the network.