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ASSIGNMENT II

Rwanda Agricultural Board – Smart Farming System

a) Two important things hidden layers do:

1. **Feature extraction:** Hidden layers analyze patterns in soil moisture and weather data to determine which factors most affect maize growth.
2. **Nonlinear transformation:** They convert raw data into abstract representations that help predict harvest yield even with complex environmental variations.

b) Two ways Breadth-First Search helps with soil data:

1. **Layered prioritization:** It processes all sensor data from the same depth before moving deeper, ensuring complete input coverage.
2. **Efficient structure comparison:** It enables comparison across many soil sensors in similar zones, leading to more generalized predictions.

c) Satellite pictures are part of the Percepts component of PAGE.

Reason: They are inputs from the environment that the AI system observes and interprets to make decisions.

d) Use of reinforcement learning to improve in hilly areas:

Train the system with rewards based on how closely predictions match real harvests in hilly zones, allowing the model to adapt to slope, water drainage, and light exposure patterns over time.

City of Kigali – Drone AI for Flood Detection

a) Two functions of convolutional layers:

1. **Edge detection:** They identify visual boundaries of roads in drone images.
2. **Pattern recognition:** They highlight road texture and shape differences to distinguish between drivable areas and surroundings.

b) Reason for errors with metal roofs:

The AI mistakes reflected sunlight on metal roofs as water because it was not trained on sunny-condition images; reflection patterns confuse the system.

c) MSE of 0.25 means:

There is a **moderate error** in prediction. The lower the MSE, the better. A score of 0.25 suggests some predictions are close, but many still deviate.

d) Should AI make flood decisions without human checking?

- **For:** AI reacts faster and can cover wide areas quickly.
- **Against:** False positives and missed detections (like in Nyabugogo) show human oversight is crucial.

Kinyarwanda Speech-to-Text App

a) RNN vs. traditional programs:

Recurrent Neural Networks remember **previous words** in a sentence, allowing them to understand context. Traditional programs process words independently, ignoring sentence flow.

b) Smart way to collect diverse voice samples:

Deploy a mobile app that rewards users for submitting voice samples in their local dialect. Partner with schools and community radios across districts.

c) Main goal of the app:

To **accurately transcribe speech across all dialects** of Kinyarwanda so all Rwandans receive fair, understandable service.

d) One way to improve dialect understanding:

Use **transfer learning** by fine-tuning the model with labeled recordings from rural speakers and expanding the vocabulary.

Fake Crop Images for AI Training

a) Two parts of the AI system:

1. **Generator:** Creates fake images that mimic crop diseases.
2. **Discriminator:** Evaluates images and improves realism by comparing fakes to real disease photos.

b) Why it works for maize but not cassava:

The model was trained mostly on maize images (85%) and has too few cassava examples, so it cannot detect early cassava symptoms reliably.

c) How to build trust in fake images:

Show side-by-side comparisons of fake vs. real disease symptoms during farmer training sessions, and validate predictions with expert feedback.

Indakemwa AI Chatbot (Health)

a) Self-attention helps with mixed languages:

It allows the model to focus on key words in a sentence regardless of position or language, so it can understand "hybrid" questions better than old models.

b) Two benefits of using Breadth-First Search during peak hours:

1. **Faster responses to simpler questions:** Handles all requests layer by layer.
2. **Improved fairness:** Ensures that easy or urgent cases aren't delayed behind complex ones.

c) Response MSE of 4.0 means:

Responses vary widely from expected times. In rural areas with slow internet, delays could be even worse, making the system unreliable without optimization.

d) More important: Giving clear answers

Why: Clarity builds public trust and ensures people understand health advice, even if the system doesn't know every term.

Kigali Smart Traffic Light System

a) AI reward function and PAGE Goal:

Currently, the AI optimizes for low vehicle delay (its "goal") but **conflicts** with broader urban planning goals like pedestrian safety, public transit, and emergency vehicle priority.

b) How DQN handles unpredictable traffic:

The Deep Q-Network uses previous states and reward feedback to **simulate future actions**, testing various light sequences in real-time to choose the best response for sudden traffic changes.

c) Breadth-First Search advantage over DFS:

BFS evaluates traffic flow **level-by-level across all intersections**, allowing the system to coordinate lights citywide and avoid tunnel-vision effects of DFS (which may over-prioritize one path).

d) Risk of DFS for emergency vehicle routing:

DFS could overly prioritize one route, leaving other paths unadjusted. This might delay other emergency responders or trap vehicles in unintended bottlenecks.