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Written Assignment #1

1. **Describe the task environment**
    a. **Environment:** customer credit card account, email/text server or service
    b. **Actuators:** SMS (text message), IMAP/POP3 (email), credit card permissions if fraud prevention is a goal of the agent
    c. **Sensors:** credit cards purchase details (amount, vendor, time, location)

2. **Performance Measure**

    The fraud detection agent needs to be accurate and relatively quick (i.e. we don't want a detection flagged several days after the actual incident). Correct identification increases the measure and false flags decrease the measure, however we would like to err on the side of caution flag a purchase as fraud if we're unsure versus potentially letting a fraud go undetected. In information theory we would say we prioritize *recall* over *precision*. A good metric might be performance = 2*(correct fraud flags / all frauds) + (correct fraud flags / fraud flags). In other words performance = 2*recall + precision.

3. **Environment Properties**
    a. Partially-observable since the agent can't read the customer's mind or perfectly observe the context of every purchase.
    b. Stochastic since there's always a possibility that customers act irrationally and make uncharacteristic purchases that would otherwise look exactly like fraud.
    c. Episodic because each decision is independent, although the decision may depend on sudden changes in purchase location or amounts.
    d. I would describe the environment as dynamic because future purchases may be made while an agent is deliberating and these purchases may provide more information useful to predicting a fraudulent purchase.
    e. Discrete because this is a classification problem
    f. Single-agent, it's not necessary to model customers as agents for "good" performance

4. **Agent Design**

    A model-based reflex agent would work well since our idea of what to look for in detecting fraud can be programmed beforehand as a model for our agent, otherwise it may act essentially out of reflex because the decision tree is very small.

5. **Vacuum Cleaner**
    a. A simple reflex agent cannot be perfectly rational in this environment because the dirt distribution is unknown, therefore it will either move between squares

unnecessarily when it's current location is clean or stay put (by repeatedly sucking).

b. A reflex agent with a state that increments for each clean square it detects can act perfectly rationally by staying in place once the number of clean squares detected equals to total number of squares*2 + 1 (since squares stay clean and to account for the worst-case scenario). A more sophisticated state model that keeps track of locations could by default assign each location as "dirty" until it verifies that the corresponding location has no dirt, then does nothing once all table entries are "clean." The maximum penalty of the agent is the number of squares* 2 + 1 where in the worst case, the agent starts in the exact center and ends up having to backtrack across half of the squares.
c. A simple reflex agent can then act perfectly rational because it will stop moving (or stay sucking one square) once there are no dirty squares remaining. Similarly, a model-based reflex agent could be optimized from the previous answer to only move to locations known to have dirt, which means it can stay put in cases where only some of the squares are dirty and it doesn't have to backtrack or verify each square's cleanliness with movement that will penalize its performance measure.