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Exercise Session 1: Quality Scenarios

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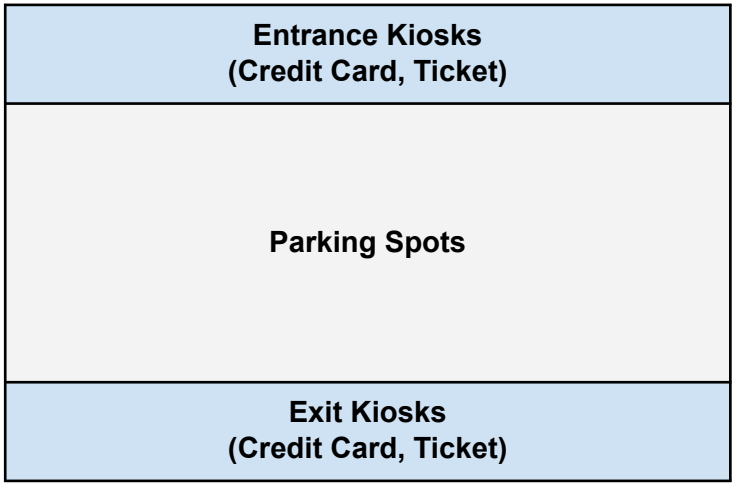
Exercise Sessions

- Builds on the lectures with interactive activities.
  - Work in groups. Feel free to come and go, split off into breakout rooms.
  - Not graded - intended to build skills that will be helpful on assignments and in the future.
- Professor + TAs will answer questions.
  - Also a good time to ask us homework questions!

Exercise - Airport Parking

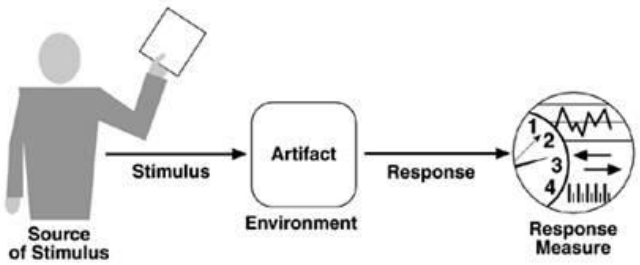
- Automated parking system.
  - User can insert credit card into a reader at parking ramp entrance or get a ticket. Records time of entry.
  - User presents same card or ticket on exit.
  - Once they pay, they can leave the garage



Exercise - Airport Parking

- Interacts with:
  - customers
  - police and emergency responders
  - external payment systems
  - accounting databases
  - physical gates and signs
  - security equipment (cameras, alarms)

Scenario Format



Overview:

Brief description of the scenario.

System State:

Aspects of internal state that affect quality (e,g., important information stored in the system, current load)

Environment State:

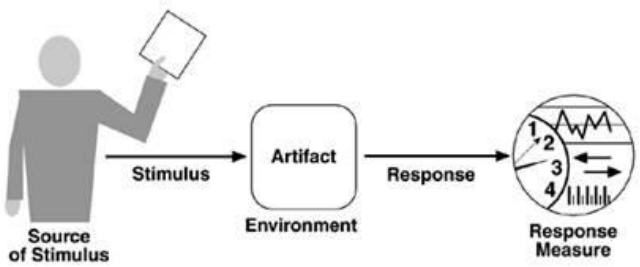
Observations about the environment (e.g., network connection, external system availability).

Scenario Format

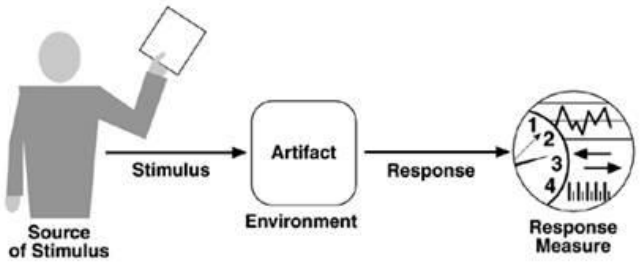
External Stimulus:

Event (input or environmental factor) that triggers a response from the system.

(e.g., user request, infrastructure changes or failures, attacks, expiration of time limit)



Scenario Format



Required System Response:

How does the system respond and meet the quality goal?

(e.g., how should it handle a defined increase in requests?)

Response Measure:

How we judge whether the system meets the quality goal.

Measurement + Threshold

(e.g., throughput, PODOF, latency)

Activity

- Scenarios centered around the following:
  - Reliability
  - Availability
  - Performance
  - Scalability
- Remember to include both a response and a response measure (with acceptable threshold)!

Reliability Example

- **Overview**: A user attempts to enter the ramp, using the credit card option. Shows reliability of entry functionality under normal conditions.
- **System State**: System has been operating normally for over 12 hours, with an average of 10 users entering and exiting per hour.
- **Environment State**: The garage is not empty or full ($0 < N < 100$). All physical devices are functioning properly.
- **External Stimulus**: The user inserts a valid credit card at an entrance kiosk.
- **Required Response**: The system authenticates the card. Once accepted, the system sends the command to raise the physical gate. If the garage is now full, the ramp sign is updated to FULL.
- **Response Measure**: The ROCOF must be less than two failures per day, with MTBF of at least 16 hours.

Availability Example

- **Overview**: Shows that the system can recovery when connection to the entry gate is disrupted.
- **System State**: Operating normally for 14 hours, with an average of 10 users entering and exiting per hour.
- **Environment State**: Connectivity is normal. Garage is not empty or full ($0 < N < 100$). All physical equipment is functioning.
- **External Stimulus**: The system fails to connect to an entry gate for a sustained length of time (either two minutes, or 100 missed heartbeat messages, have elapsed).

Availability Example

- **Required Response**:
  - The system will update the sign to CLOSED for that kiosk. The screen will display an error message, and no credit cards will be accepted or tickets dispensed. The system will notify managers and personnel.
  - The system will continue to send messages until a sustained connection is established. When a connection is established, the entrance will be reopened and resume normal operations.
- **Response Measure**: The entrance must be closed within 30 seconds of detecting the loss of connection (95% of the time), within 45 seconds 99% of the time. On establishing a connection again, it must be reopened within 30/45 seconds (95/99% of the time).

Performance Example

- **Overview**: Ensure that system can handle cars exiting garage at rush hour (high throughput).
- **System State**: System is operating under heavy load (> 1000 exit requests per hour).
- **Environment State**: All 10 exit kiosks are occupied, with additional cars waiting to exit at each.
- **External Stimulus**: A large number of card processing/exit requests come within a short window of time (10 within a one minute window).

Performance Example

- **Required Response**: All valid card payments posted successfully. All cars are released (system lifts gate and recloses it once car leaves).
- **Response Measure**: 95% of the time, all 10 kiosks release the waiting car within 30 seconds of the request. 99% of the time, all kiosks release within 45 seconds of the request.

Scalability Example

- **Overview**: Impact on performance when we upgrade CPUs in each entry kiosk.
- **System State**: System has been operating normally for over 12 hours, with an average of 10 users entering and exiting per hour. Before the update, in 95% of executions, credit card authentication was completed within 25 seconds, with 99% of executions completing within 35 seconds.
- **Environment State**: The garage is not empty or full (0 < N < 100). All physical devices are functioning properly. The CPU in each entry kiosk has been upgraded.
- **External Stimulus**: The user inserts a valid credit card at an entrance kiosk.

Scalability Example

- **Required Response**: The system authenticates the card. Once accepted, the system sends the command to raise the physical gate. If the garage is now full, the ramp sign is updated to FULL.
  - The system takes advantage of the CPU by refactoring the design to execute on multiple, concurrent threads. Credit card authentication is handled in a dedicated thread, while other functionality is executed in additional threads.
- **Response Measure**: In 95% of executions, credit card authentication should be completed within 15 seconds, with 99% of executions completing within 20 seconds.

Some Starting Ideas

- Performance
  - Time to exit ramp
- Availability
  - Exit Kiosk Malfunction
  - Loss of Connection to Credit Card Processing
- Scalability
  - Removal of resources

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