# Requirements

## Top-Level Requirement

- **R1: Dynamic Parking Pricing Solution**
  The system shall provide a scalable and adaptive pricing solution for parking lots that maximizes revenue while maintaining high occupancy. It will ensuring customer satisfaction through high availability and fair pricing. The solution shall be able to embed artificial intelligence for optimization and integrate diverse data streams.

## Functional Requirements (FR)

- **FR1: Data Acquisition**
  - FR1.1: The system shall measure occupancy in real time (via sensors, could also be cameras).
  - FR1.2: The system shall support integration of external data sources (e.g., weather, events, public transport availability).
  - FR1.3: The system shall support historical data storage for model training and evaluation.
- **FR2: Pricing Engine**
  - FR2.1: The system shall provide dynamic price calculation based on demand factors.
  - FR2.2: The system shall initially implement a rule-based pricing function (e.g., demand thresholds).
  - FR2.3: The system shall support AI/ML-based pricing optimization, more specifically, reinforcement learning.
- **FR3: Customer Interaction**
  - FR3.1: The system shall provide real-time price information to customers via a client application.
  - FR3.2: The system shall allow customers to request availability and book parking.
- **FR4: Modularity & Scalability**
  - FR4.1: The system shall support modular addition of new data sources (e.g., new sensors, event feeds).
  - FR4.2: The system shall allow extension with alternative optimization algorithms.
  - FR4.3: The system shall operate in a distributed manner, enabling interaction between independent subsystems (e.g., sensors, pricing, payment).

- **FR5: Service-Oriented Interaction**
  - FR5.1: The system shall allow components to discover available services (e.g., occupancy, pricing, payment).
  - FR5.2: The system shall enable dynamic binding to services, supporting replacement or extension of components (e.g., swapping pricing engine).

## Non-Functional Requirements (NFR)

- **NFR1: Security**
  - NFR1.1: The system shall protect customer data (e.g., bookings, payments) from unauthorized access.
  - NFR1.2: The system shall prevent unauthorized manipulation of pricing or occupancy data.
- **NFR2: Resilience**
  - NFR2.1: The system shall tolerate sensor or subsystem failures without complete system failure.
  - NFR2.2: The system shall degrade gracefully (e.g., fall back to rule-based pricing if AI module is unavailable).
- **NFR3: Efficiency**
  - NFR3.1: The system shall maximize revenue while avoiding underutilization or overfull occupancy.
  - NFR3.2: The system shall minimize computational and communication overhead while operating in real time.
- **NFR4: Scalability (Non-Functional Aspect)**
  - NFR4.1: The system shall scale in size (number of sensors, number of parking spaces, multiple lots).
  - NFR4.2: The system shall scale in technology (from rule-based pricing to AI-driven optimization).