Travel/Hotel Booking Website (Airbnb-like)

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        * Performance vs Features
        * Business vs User Experience
        * Scalability Considerations

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Clarify the Problem and Requirements

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Problem Understanding

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Design a comprehensive travel and accommodation booking platform that enables users to search, compare, and book properties/experiences while providing hosts with tools to manage their listings, similar to Airbnb, Booking.com, or VRBO. The system must handle complex search filters, real-time availability, dynamic pricing, and secure payment processing while delivering an intuitive user experience.

Functional Requirements

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- **Property Search**: Location-based search with maps, date/guest filters, advanced criteria
- **Listing Management**: Property creation, photo uploads, availability calendar, pricing rules
- **Booking Flow**: Multi-step booking process, payment handling, confirmation system
- **User Profiles**: Guest and host profiles, verification system, reviews and ratings
- **Communication**: In-app messaging, automated notifications, booking updates
- **Payment System**: Secure payments, multiple payment methods, refund processing
- **Review System**: Bidirectional reviews, photo uploads, response management
- **Map Integration**: Interactive maps, property locations, neighborhood information

Non-Functional Requirements

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- **Performance**: <3s page load, <500ms search results, optimized image loading
- **Scalability**: Handle millions of properties, concurrent bookings, peak traffic
- **Availability**: 99.9% uptime, graceful degradation during high traffic
- **Security**: PCI compliance, secure payment processing, data encryption
- **Mobile Optimization**: Responsive design, progressive web app features
- **SEO**: Server-side rendering, structured data, optimized meta tags
- **Accessibility**: WCAG 2.1 AA compliance, screen reader support
- **Global Support**: Multi-language, multi-currency, regional compliance

Key Assumptions

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- Property inventory: 1M+ active listings globally
- Peak concurrent users: 100K+ during booking surges
- Average booking value: $100-$500 per reservation
- Search-to-booking conversion: 2-5% industry standard
- Mobile traffic: 60-70% of total traffic
- Geographic distribution: Global with regional peaks
- Payment processing: Multiple currencies, international cards
- Image storage: 10-50 high-quality photos per property

High-Level Design (HLD)

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System Architecture Overview

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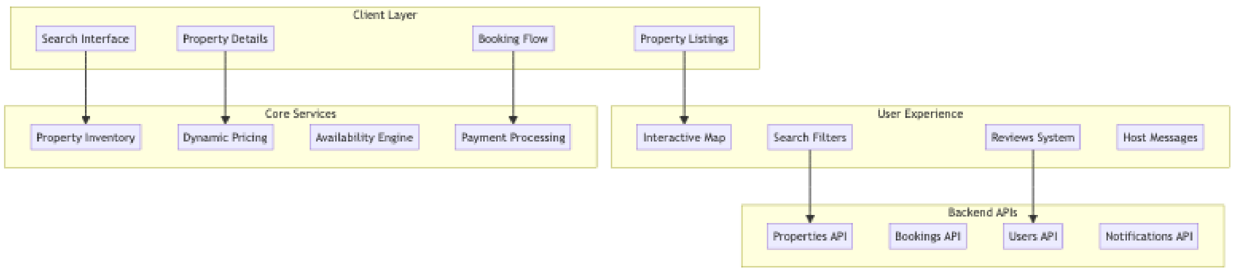

Booking Data Model

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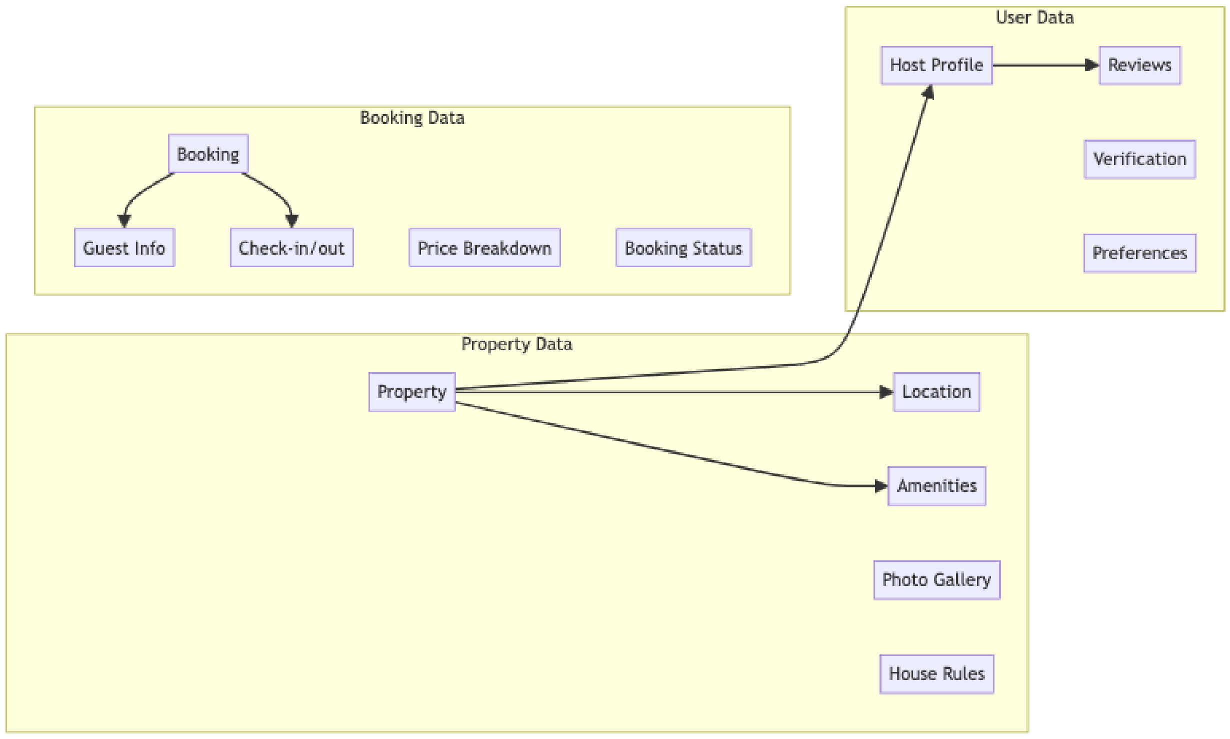

Low-Level Design (LLD)

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Property Search Algorithm

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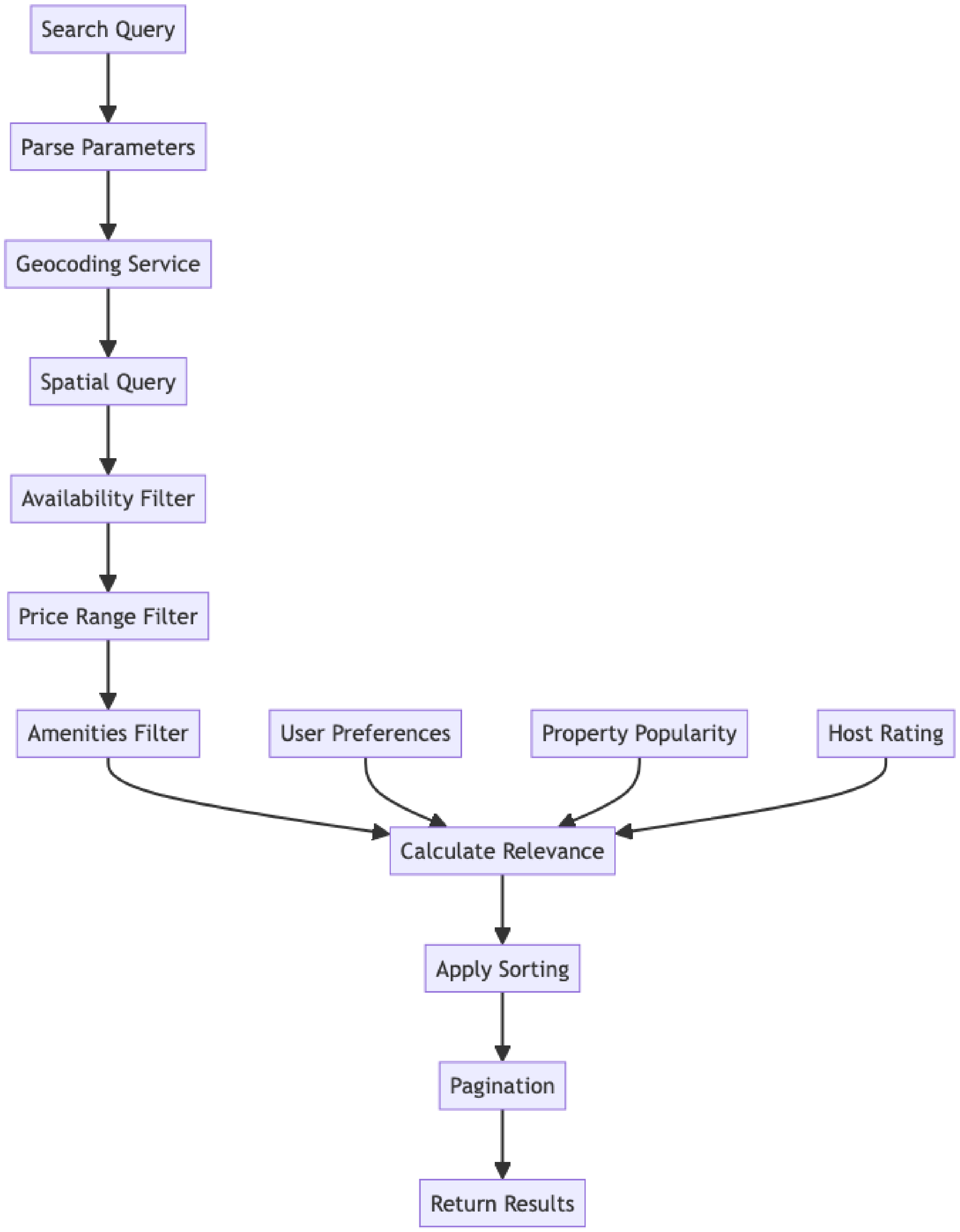
Search Query
Parse Parameters
Geocoding Service
Spatial Query
Availability Filter
Price Range Filter
Amenities Filter
User Preferences
Property Popularity
Host Rating
Calculate Relevance
Apply Sorting
Pagination
Return Results

Dynamic Pricing Engine

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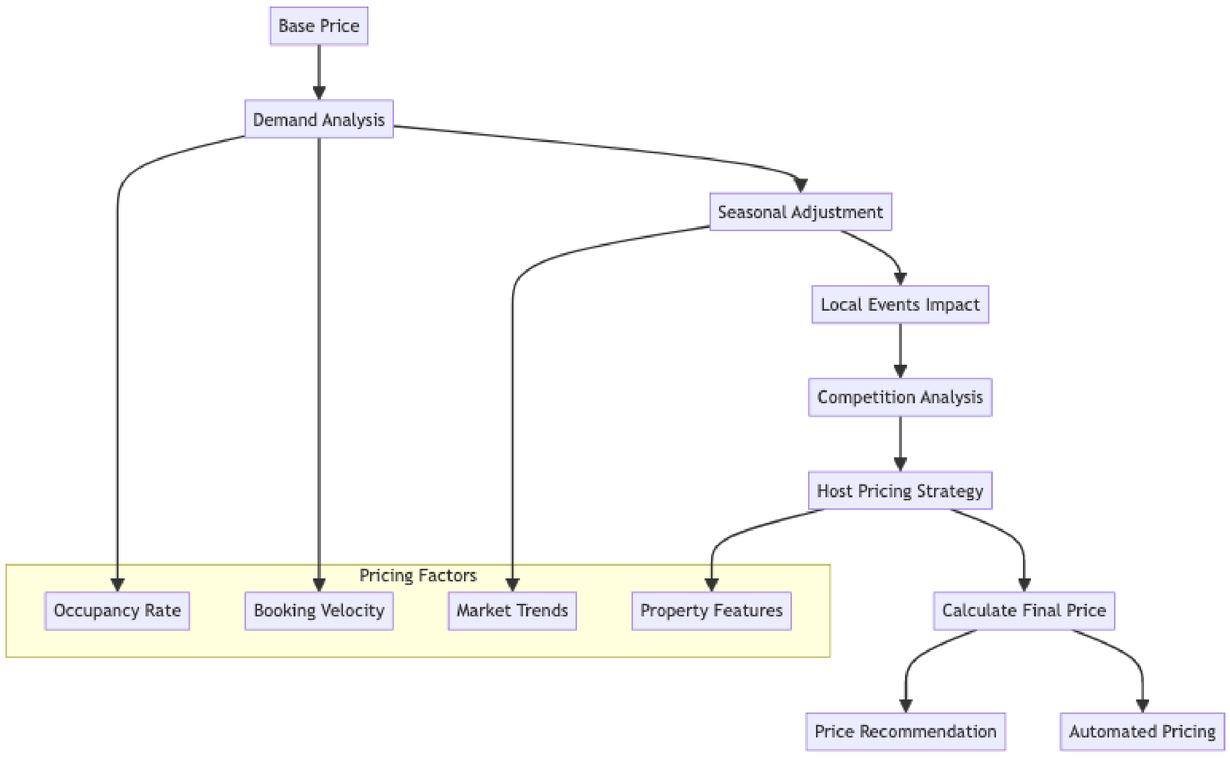

Booking State Machine

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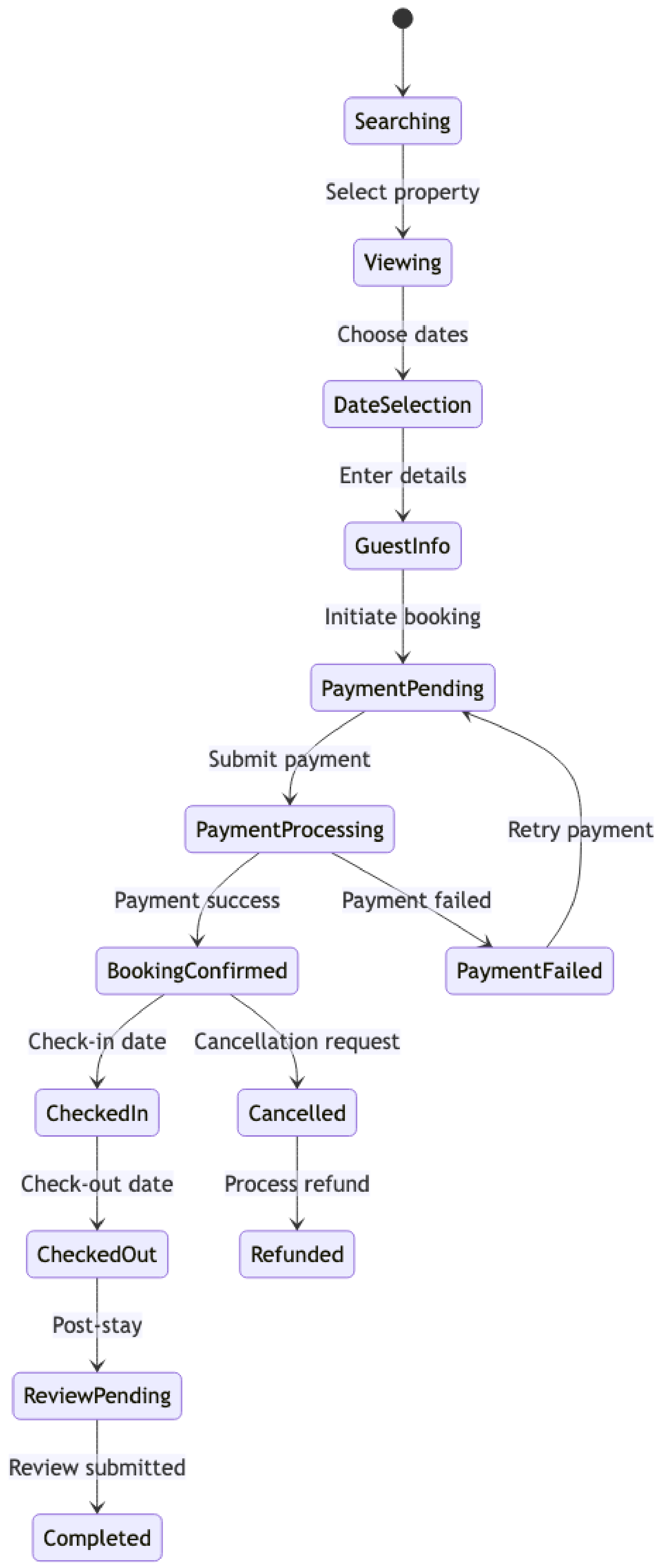
Searching
Select property
Viewing
Choose dates
DateSelection
Enter details
GuestInfo
Initiate booking
PaymentPending
Submit payment
PaymentProcessing
Retry payment
Payment success
Payment failed
BookingConfirmed
PaymentFailed
Check-in date
Cancellation request
CheckedIn
Cancelled
Check-out date
Process refund
CheckedOut
Refunded
Post-stay
ReviewPending
Review submitted
Completed

Core Algorithms

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1. Property Search and Ranking Algorithm

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Purpose: Find and rank properties based on user preferences and relevance.

Search Parameters:

```
SearchQuery = {
  location: string,
  checkIn: Date,
  checkOut: Date,
  guests: number,
  priceRange: { min: number, max: number },
  amenities: string[],
  propertyType: string[],
  instantBook: boolean
}
```

Ranking Algorithm:

```
function calculatePropertyScore(property, query, userHistory):
  baseScore = 0

  // Location relevance (40%)
  locationScore = calculateLocationRelevance(property.location, query.location)
  baseScore += locationScore * 0.4

  // Price competitiveness (25%)
  priceScore = calculatePriceScore(property.price, query.priceRange, marketAverage)
  baseScore += priceScore * 0.25

  // Property quality (20%)
  qualityScore = (property.rating * 0.6) + (property.reviewCount * 0.4)
  baseScore += normalizeScore(qualityScore) * 0.2

  // Amenities match (10%)
  amenitiesScore = calculateAmenitiesMatch(property.amenities, query.amenities)
  baseScore += amenitiesScore * 0.1
  // Personalization (5%)
  personalScore = calculatePersonalization(property, userHistory)
  baseScore += personalScore * 0.05

  return baseScore
```

Location Relevance Calculation: - Use geographic distance with decay function - Consider transportation accessibility - Weight popular neighborhoods higher - Factor in local attractions proximity

2. Availability Management Algorithm

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Purpose: Track and manage property availability across multiple platforms.

Availability State:

```
AvailabilityCalendar = {
  propertyId: string,
  dates: Map<Date, AvailabilityStatus>,
  blockedPeriods: DateRange[],
  minimumStay: number,
  maximumStay: number
}

AvailabilityStatus = 'available' | 'booked' | 'blocked' | 'maintenance'
```

Conflict Resolution:

```
function checkAvailability(propertyId, checkIn, checkOut):
  calendar = getPropertyCalendar(propertyId)
  requestedDates = generateDateRange(checkIn, checkOut)

  for date in requestedDates:
    status = calendar.dates.get(date)

    if status !== 'available':
      return { available: false, conflictDate: date, reason: status }

  // Check minimum/maximum stay requirements
  stayDuration = calculateDuration(checkIn, checkOut)

  if stayDuration < calendar.minimumStay:
    return { available: false, reason: 'minimum_stay_not_met' }
  if stayDuration > calendar.maximumStay:
    return { available: false, reason: 'maximum_stay_exceeded' }

  return { available: true }
```

Calendar Synchronization: - Real-time updates across all platforms - Handle double-booking prevention - Implement optimistic locking for concurrent bookings - Support bulk availability updates

3. Dynamic Pricing Algorithm

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Purpose: Automatically adjust property prices based on market conditions.

Pricing Factors:

```
PricingFactors = {
  baseDemand: number,        // Historical booking patterns
  seasonalDemand: number,    // Seasonal variations
  localEvents: Event[],      // Conferences, festivals, etc.
  competitorPricing: number, // Market rates
  propertyFeatures: number,  // Unique selling points
  bookingVelocity: number,   // Recent booking speed
  occupancyRate: number      // Current occupancy
}
```

Price Calculation:

```
function calculateOptimalPrice(property, targetDate, factors):
  basePrice = property.basePrice

  // Demand multiplier calculation
  demandMultiplier = 1.0

  // Seasonal adjustment (±30%)
  seasonalFactor = calculateSeasonalFactor(targetDate, property.location)
  demandMultiplier *= (1 + seasonalFactor * 0.3)

  // Local events impact (±50%)
  eventsFactor = calculateEventsImpact(property.location, targetDate)
  demandMultiplier *= (1 + eventsFactor * 0.5)

  // Market competition (±20%)
  competitionFactor = calculateCompetitionFactor(property, targetDate)
  demandMultiplier *= (1 + competitionFactor * 0.2)
  // Booking velocity adjustment (±15%)
  velocityFactor = calculateVelocityFactor(property, targetDate)
  demandMultiplier *= (1 + velocityFactor * 0.15)

  finalPrice = basePrice * demandMultiplier

  // Apply pricing constraints
  return applyPriceConstraints(finalPrice, property.priceRules)
```

Price Optimization Strategy: - A/B testing for price sensitivity - Machine learning for demand prediction - Host preferences and constraints - Revenue maximization algorithms

4. Review and Rating System

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Purpose: Manage and display authentic guest reviews with spam detection.

Review Processing:

```
ReviewData = {
  bookingId: string,
  guestRating: number,
  hostRating: number,
  categories: {
    cleanliness: number,
    accuracy: number,
    communication: number,
    location: number,
    checkIn: number,
    value: number
  },
  comments: string,
  photos: string[]
}
```

Review Validation Algorithm:

```
function validateReview(review, booking):
  validationScore = 0

  // Verify legitimate booking
  if not verifyBookingCompleted(review.bookingId):
    return { valid: false, reason: 'invalid_booking' }
  // Content authenticity check
  authenticityScore = checkContentAuthenticity(review.comments)
  if authenticityScore < 0.7:
    return { valid: false, reason: 'suspicious_content' }

  // Rating consistency check
  categoryAverage = calculateCategoryAverage(review.categories)
  overallRating = review.guestRating

  if Math.abs(categoryAverage - overallRating) > 1.5:
    return { valid: false, reason: 'inconsistent_ratings' }

  // Temporal validation
  timeToReview = Date.now() - booking.checkOutDate
  if timeToReview > 14 * 24 * 60 * 60 * 1000: // 14 days
    return { valid: false, reason: 'review_too_late' }

  return { valid: true }
```

Spam Detection Features: - Natural language processing for fake reviews - User behavior pattern analysis - Cross-reference with other platforms - Machine learning-based authenticity scoring

5. Map-based Property Discovery

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Purpose: Enable geographic property search with interactive map interface.

Spatial Query Optimization:

```
function findPropertiesInBounds(bounds, filters):
  // Use spatial indexing (R-tree or geohashing)
  candidateProperties = spatialIndex.query(bounds)

  // Apply filters
  filteredProperties = candidateProperties.filter(property => {
    return matchesFilters(property, filters) &&
           isAvailable(property, filters.dates) &&
           meetsGuestRequirements(property, filters.guests)
  })

  // Cluster nearby properties for map display
  clusters = clusterPropertiesByProximity(filteredProperties, bounds.zoom)
  return {
    properties: filteredProperties,
    clusters: clusters,
    bounds: calculateResultBounds(filteredProperties)
  }
```

Map Clustering Algorithm:

```
function clusterProperties(properties, zoomLevel):
  clusterRadius = calculateClusterRadius(zoomLevel)
  clusters = []
  processedProperties = new Set()

  for property in properties:
    if processedProperties.has(property.id):
      continue

    cluster = {
      center: property.location,
      properties: [property],
      averagePrice: property.price
    }

    // Find nearby properties
    nearbyProperties = findPropertiesWithinRadius(
      property.location,
      clusterRadius,
      properties
    )

    for nearbyProperty in nearbyProperties:
      if not processedProperties.has(nearbyProperty.id):
        cluster.properties.push(nearbyProperty)
        processedProperties.add(nearbyProperty.id)

    // Calculate cluster statistics
    cluster.averagePrice = calculateAveragePrice(cluster.properties)
    cluster.center = calculateClusterCenter(cluster.properties)

    clusters.push(cluster)

  return clusters
```

Component Architecture

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Booking Platform Component Hierarchy

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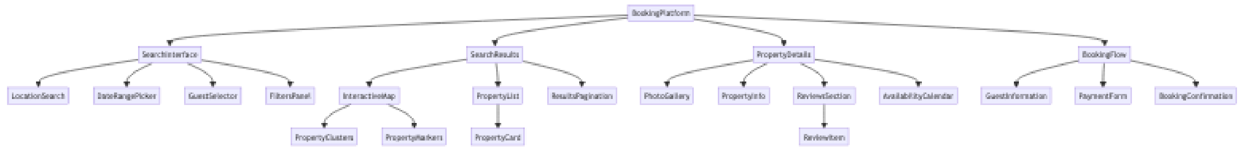

State Management Architecture

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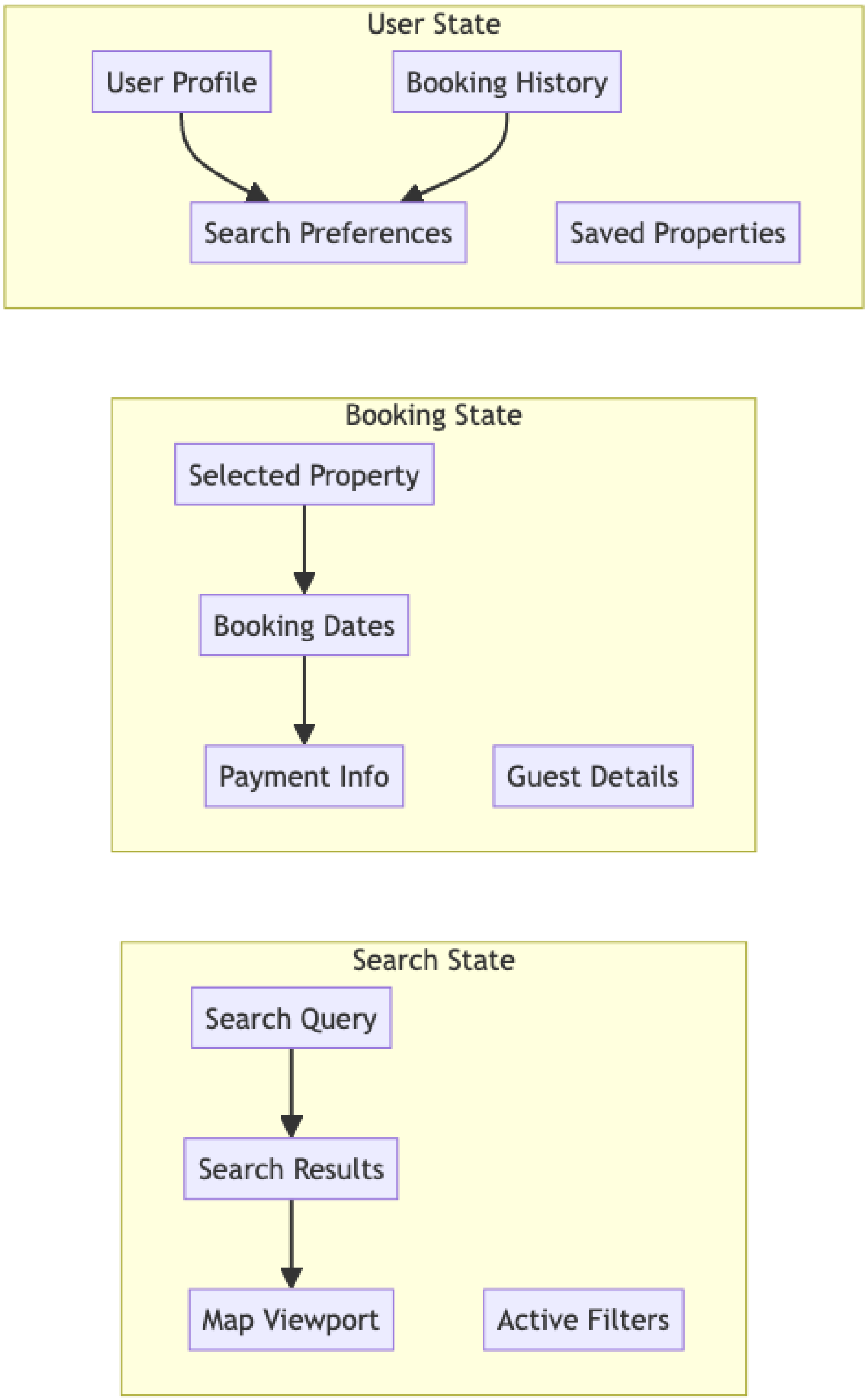
User State
User Profile
Booking History
Search Preferences
Saved Properties
Booking State
Selected Property
Booking Dates
Payment Info
Guest Details
Search State
Search Query
Search Results
Map Viewport
Active Filters

React Component Implementation ☐ Back to Top

BookingPlatform.jsx

```
import React, { useState, useEffect, useCallback } from 'react';
import { BookingProvider } from './BookingContext';
import SearchInterface from './SearchInterface';
import SearchResults from './SearchResults';
import PropertyDetails from './PropertyDetails';
import BookingFlow from './BookingFlow';
import { useLocationSearch } from './hooks/useLocationSearch';

const BookingPlatform = () => {
  const [currentView, setCurrentView] = useState('search'); // 'search', 'results', 'pr
  const [searchQuery, setSearchQuery] = useState({
    location: '',
    coordinates: null,
    checkIn: null,
    checkOut: null,
    guests: { adults: 2, children: 0, infants: 0 }
  });
  const [filters, setFilters] = useState({
    priceRange: [0, 1000],
    propertyTypes: [],
    amenities: [],
    rating: 0,
    instantBook: false
  });
  const [searchResults, setSearchResults] = useState([]);
  const [selectedProperty, setSelectedProperty] = useState(null);
  const [mapViewport, setMapViewport] = useState({
    latitude: 37.7749,
    longitude: -122.4194,
    zoom: 10
  });
  const [loading, setLoading] = useState(false);
  const [bookingData, setBookingData] = useState({
    property: null,
    dates: null,
    guests: null,
    totalPrice: 0
  });

  const { searchLocations } = useLocationSearch();
  const handleSearch = useCallback(async (query = searchQuery) => {
    if (!query.location || !query.checkIn || !query.checkOut) return;

    setLoading(true);
    try {
      const response = await fetch('/api/properties/search', {
        method: 'POST',
        headers: { 'Content-Type': 'application/json' },
        body: JSON.stringify({
          ...query,
          filters,
          limit: 20
        })
      });

      const data = await response.json();
      setSearchResults(data.properties);

      if (data.properties.length > 0) {
        setCurrentView('results');

        // Update map viewport to show results
        const bounds = calculateBounds(data.properties);
        setMapViewport(bounds);
      }
    } catch (error) {
      console.error('Search failed:', error);
    } finally {
      setLoading(false);
    }
  }, [searchQuery, filters]);

  const calculateBounds = (properties) => {
    if (properties.length === 0) return mapViewport;

    const lats = properties.map(p => p.latitude);
    const lngs = properties.map(p => p.longitude);

    return {
      latitude: (Math.min(...lats) + Math.max(...lats)) / 2,
      longitude: (Math.min(...lngs) + Math.max(...lngs)) / 2,
      zoom: 12
    };
  };
```

```
const handlePropertySelect = useCallback(async (propertyId) => {
  try {
    const response = await fetch(`/api/properties/${propertyId}`);
    const property = await response.json();
    setSelectedProperty(property);
    setCurrentView('property');
  } catch (error) {
    console.error('Failed to load property:', error);
  }
}, []);

const handleBookingStart = useCallback((property) => {
  setBookingData({
    property,
    dates: {
      checkIn: searchQuery.checkIn,
      checkOut: searchQuery.checkOut
    },
    guests: searchQuery.guests,
    totalPrice: calculateTotalPrice(property, searchQuery)
  });
  setCurrentView('booking');
}, [searchQuery]);

const calculateTotalPrice = (property, query) => {
  const nights = Math.ceil(
    (new Date(query.checkOut) - new Date(query.checkIn)) / (1000 * 60 * 60 * 24)
  );
  const basePrice = property.pricePerNight * nights;
  const taxes = basePrice * 0.12;
  const serviceFee = basePrice * 0.03;

  return basePrice + taxes + serviceFee;
};

const handleFilterChange = useCallback((newFilters) => {
  setFilters(prev => ({ ...prev, ...newFilters }));
}, []);

const handleBookingComplete = useCallback(async (bookingDetails) => {
  try {
    const response = await fetch('/api/bookings', {
      method: 'POST',
      headers: { 'Content-Type': 'application/json' },
        body: JSON.stringify(bookingDetails)
      });

      if (response.ok) {
        const booking = await response.json();
        // Redirect to confirmation page or show success message
        console.log('Booking confirmed:', booking);
      }
    } catch (error) {
      console.error('Booking failed:', error);
    }
  }, []);

  const value = {
    currentView,
    searchQuery,
    filters,
    searchResults,
    selectedProperty,
    mapViewport,
    bookingData,
    loading,
    setCurrentView,
    setSearchQuery,
    setFilters: handleFilterChange,
    setMapViewport,
    onSearch: handleSearch,
    onPropertySelect: handlePropertySelect,
    onBookingStart: handleBookingStart,
    onBookingComplete: handleBookingComplete
  };

  return (
    <BookingProvider value={value}>
      <div className="booking-platform">
        {currentView === 'search' && <SearchInterface />}
        {currentView === 'results' && <SearchResults />}
        {currentView === 'property' && <PropertyDetails />}
        {currentView === 'booking' && <BookingFlow />}
      </div>
    </BookingProvider>
  );
};

export default BookingPlatform;
```

SearchInterface.jsx

```
import React, { useContext, useState } from 'react';
import { BookingContext } from './BookingContext';
import LocationSearch from './LocationSearch';
import DateRangePicker from './DateRangePicker';
import GuestSelector from './GuestSelector';

const SearchInterface = () => {
  const { searchQuery, setSearchQuery, onSearch, loading } = useContext(BookingContext);
  const [errors, setErrors] = useState({});

  const handleLocationChange = (location) => {
    setSearchQuery(prev => ({
      ...prev,
      location: location.name,
      coordinates: location.coordinates
    }));
  };

  const handleDateChange = (dates) => {
    setSearchQuery(prev => ({
      ...prev,
      checkIn: dates.startDate,
      checkOut: dates.endDate
    }));
  };

  const handleGuestChange = (guests) => {
    setSearchQuery(prev => ({ ...prev, guests }));
  };

  const validateSearch = () => {
    const newErrors = {};

    if (!searchQuery.location) {
      newErrors.location = 'Please select a destination';
    }

    if (!searchQuery.checkIn || !searchQuery.checkOut) {
      newErrors.dates = 'Please select check-in and check-out dates';
    }

    if (new Date(searchQuery.checkIn) >= new Date(searchQuery.checkOut)) {
      newErrors.dates = 'Check-out date must be after check-in date';
    }

    setErrors(newErrors);
    return Object.keys(newErrors).length === 0;
  };

  const handleSubmit = (e) => {
    e.preventDefault();

    if (validateSearch()) {
      onSearch();
    }
  };

  return (
    <div className="search-interface">
      <div className="search-hero">
        <h1>Find your perfect stay</h1>
        <p>Discover amazing places to stay around the world</p>
      </div>

      <form className="search-form" onSubmit={handleSubmit}>
        <div className="search-fields">
          <div className="field-group">
            <label htmlFor="location">Where</label>
            <LocationSearch
              value={searchQuery.location}
              onChange={handleLocationChange}
              placeholder="Search destinations"
              error={errors.location}
            />
          </div>

          <div className="field-group">
            <label htmlFor="dates">When</label>
            <DateRangePicker
              startDate={searchQuery.checkIn}
              endDate={searchQuery.checkOut}
              onChange={handleDateChange}
              error={errors.dates}
            />
          </div>

          <div className="field-group">
            <label htmlFor="guests">Who</label>
```

```
            <GuestSelector
              guests={searchQuery.guests}
              onChange={handleGuestChange}
            />
          </div>
        </div>

        <button
          type="submit"
          className="search-button"
          disabled={loading}
        >
          {loading ? 'Searching...' : 'Search'}
        </button>
      </form>
    </div>
  );
};

export default SearchInterface;
```

SearchResults.jsx

```
import React, { useContext, useState } from 'react';
import { BookingContext } from './BookingContext';
import InteractiveMap from './InteractiveMap';
import PropertyList from './PropertyList';
import FiltersPanel from './FiltersPanel';

const SearchResults = () => {
  const {
    searchResults,
    filters,
    setFilters,
    mapViewport,
    setMapViewport,
    onPropertySelect
  } = useContext(BookingContext);

  const [viewMode, setViewMode] = useState('list'); // 'list' or 'map'
  const [showFilters, setShowFilters] = useState(false);

  const filteredResults = searchResults.filter(property => {
    // Apply filters
    if (property.pricePerNight < filters.priceRange[0] ||
        property.pricePerNight > filters.priceRange[1]) {
```

```
      return false;
    }

    if (filters.propertyTypes.length > 0 &&
        !filters.propertyTypes.includes(property.type)) {
      return false;
    }

    if (filters.rating > 0 && property.rating < filters.rating) {
      return false;
    }

    if (filters.instantBook && !property.instantBook) {
      return false;
    }

    return true;
  });

  return (
    <div className="search-results">
      <div className="results-header">
        <div className="results-info">
          <h2>{filteredResults.length} stays found</h2>
          <button
            className="filters-toggle"
            onClick={() => setShowFilters(!showFilters)}
          >
            Filters
          </button>
        </div>

        <div className="view-toggle">
          <button
            className={viewMode === 'list' ? 'active' : ''}
            onClick={() => setViewMode('list')}
          >
            List
          </button>
          <button
            className={viewMode === 'map' ? 'active' : ''}
            onClick={() => setViewMode('map')}
          >
            Map
          </button>
        </div>
      </div>

      {showFilters && (
        <FiltersPanel
          filters={filters}
          onFiltersChange={setFilters}
          onClose={() => setShowFilters(false)}
        />
      )}

      <div className="results-content">
        {viewMode === 'list' ? (
          <PropertyList
            properties={filteredResults}
            onPropertySelect={onPropertySelect}
          />
        ) : (
          <div className="results-layout">
            <div className="map-section">
              <InteractiveMap
                properties={filteredResults}
                viewport={mapViewport}
                onViewportChange={setMapViewport}
                onPropertySelect={onPropertySelect}
              />
            </div>
            <div className="list-section">
              <PropertyList
                properties={filteredResults}
                onPropertySelect={onPropertySelect}
                compact={true}
              />
            </div>
          </div>
        )}
      </div>
    </div>
  );
};

export default SearchResults;
```

Advanced Features

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Personalization Engine

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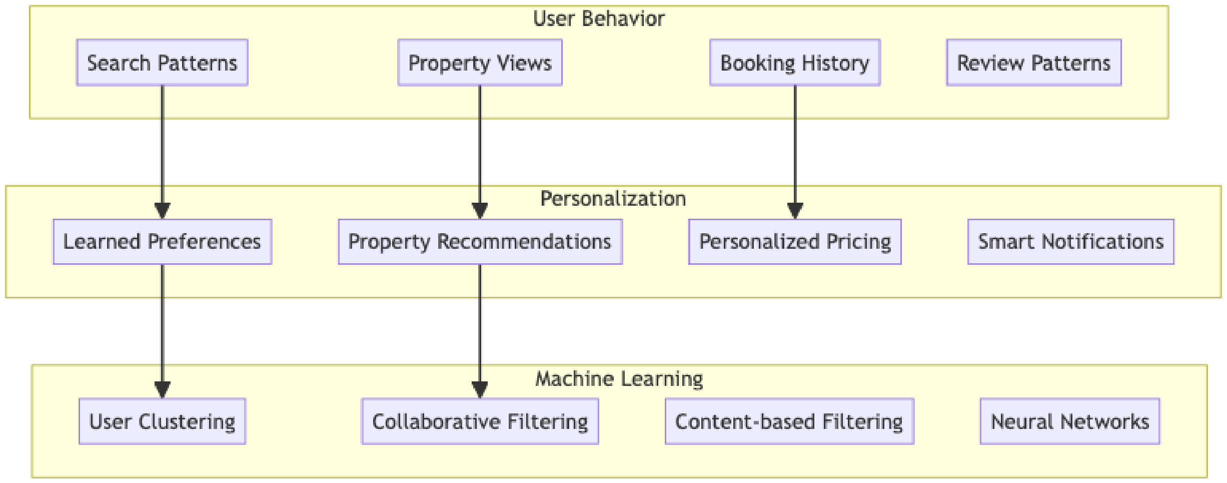

Smart Notifications System

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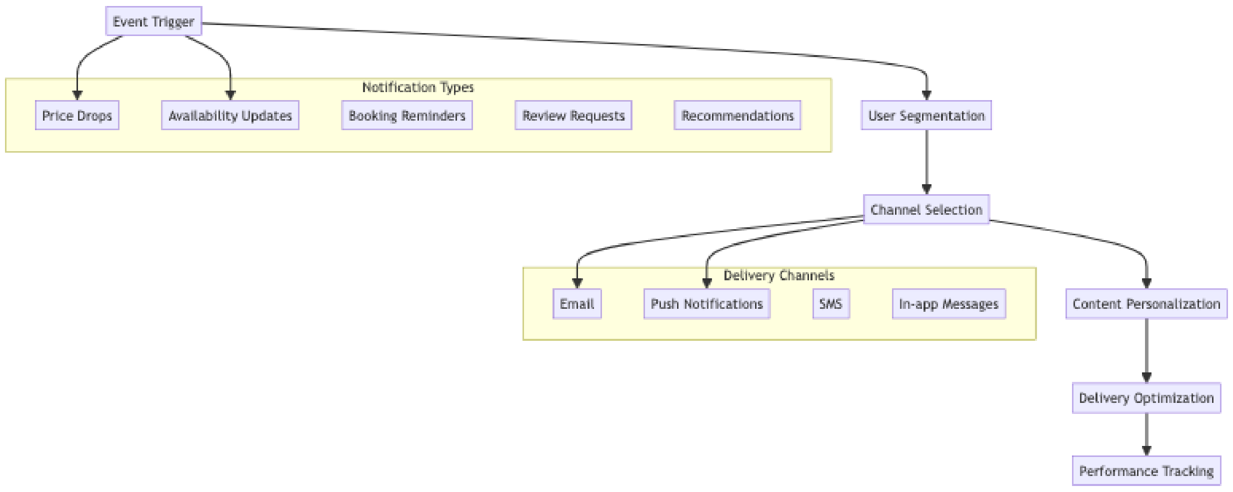

TypeScript Interfaces & Component Props

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Core Data Interfaces

```
interface Property {
  id: string;
  title: string;
  description: string;
  type: 'hotel' | 'apartment' | 'house' | 'villa' | 'hostel';
  location: PropertyLocation;
  amenities: Amenity[];
  images: PropertyImage[];
  pricing: PricingInfo;
  availability: AvailabilityCalendar;
  host: HostInfo;
  rating: PropertyRating;
  policies: PropertyPolicies;
}

interface PropertyLocation {
  address: string;
  city: string;
  country: string;
  coordinates: {
    latitude: number;
    longitude: number;
  };
  neighborhood?: string;
  landmarks?: Landmark[];
  transportation?: TransportInfo[];
}

interface Booking {
  id: string;
  propertyId: string;
  guestId: string;
  checkIn: Date;
  checkOut: Date;
  guests: GuestInfo;
  totalPrice: number;
  status: 'pending' | 'confirmed' | 'cancelled' | 'completed';
  paymentInfo: PaymentInfo;
  specialRequests?: string;
  cancellationPolicy: CancellationPolicy;
}

interface SearchCriteria {
  destination: string;
  checkIn: Date;
  checkOut: Date;
  guests: {
    adults: number;
    children: number;
    infants: number;
  };
  filters: SearchFilters;
  sortBy: SortOption;
  priceRange: [number, number];
}

interface SearchFilters {
  propertyTypes: string[];
  amenities: string[];
  priceRange: [number, number];
  rating: number;
  instantBook: boolean;
  superhost: boolean;
  cancellation: 'flexible' | 'moderate' | 'strict';
}
```

Component Props Interfaces

```
interface PropertySearchProps {
  onSearch: (criteria: SearchCriteria) => void;
  onFiltersChange: (filters: SearchFilters) => void;
  popularDestinations?: Destination[];
  recentSearches?: SearchCriteria[];
  enableMapView?: boolean;
  showAdvancedFilters?: boolean;
  defaultLocation?: string;
}

interface PropertyCardProps {
  property: Property;
  onPropertyClick: (propertyId: string) => void;
  onFavoriteToggle: (propertyId: string) => void;
  onShareProperty: (property: Property) => void;
  showPricing?: boolean;
  showHost?: boolean;
  layout: 'grid' | 'list' | 'map';
  isWishlisted?: boolean;
}

interface BookingFormProps {
  property: Property;
  selectedDates: {
    checkIn: Date;
    checkOut: Date;
  };
  onBookingSubmit: (booking: BookingData) => void;
  onDateChange: (dates: DateRange) => void;
  onGuestChange: (guests: GuestInfo) => void;
  showPriceBreakdown?: boolean;
  allowInstantBook?: boolean;
}

interface PropertyGalleryProps {
  images: PropertyImage[];
  onImageClick: (index: number) => void;
  showThumbnails?: boolean;
  enableZoom?: boolean;
  enableFullscreen?: boolean;
  layout: 'carousel' | 'grid' | 'masonry';
  maxVisible?: number;
}

interface MapViewProps {
  properties: Property[];
  center: [number, number];
  zoom?: number;
  onPropertySelect: (property: Property) => void;
  onMapMove: (bounds: MapBounds) => void;
  showClusters?: boolean;
  showFilters?: boolean;
  customMarkers?: boolean;
}
```

API Reference

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Property Search & Discovery

- `GET /api/properties/search` - Search properties with filters, dates, and location
- `GET /api/properties/:id` - Get detailed property information and availability
- `GET /api/properties/featured` - Get featured properties and promotional listings
- `GET /api/properties/recommendations` - Get personalized property recommendations
- `POST /api/properties/save` - Save property to user's wishlist or favorites

Availability & Pricing

- `GET /api/properties/:id/availability` - Check property availability for date range
- `GET /api/properties/:id/pricing` - Get dynamic pricing for specific dates
- `POST /api/properties/:id/price-quote` - Get detailed price quote with taxes and fees
- `GET /api/properties/:id/calendar` - Get property's availability calendar
- `POST /api/properties/:id/block-dates` - Block dates for property (host only)

Booking Management

- `POST /api/bookings` - Create new booking with payment processing
- `GET /api/bookings/:id` - Get booking details and current status
- `PUT /api/bookings/:id` - Modify booking dates or guest information
- `POST /api/bookings/:id/cancel` - Cancel booking and process refund
- `GET /api/bookings/user/:userId` - Get user's booking history and upcoming trips

Payment & Transactions

- `POST /api/payments/intent` - Create payment intent for booking
- `POST /api/payments/confirm` - Confirm payment and complete booking
- `GET /api/payments/:id/status` - Get payment status and transaction details
- `POST /api/payments/refund` - Process refund for cancelled booking
- `GET /api/payments/methods` - Get available payment methods for region

Reviews & Ratings

- `GET /api/properties/:id/reviews` - Get property reviews with pagination
- `POST /api/reviews` - Submit review and rating for completed booking
- `PUT /api/reviews/:id` - Update or edit existing review
- `GET /api/reviews/user/:userId` - Get reviews written by specific user
- `POST /api/reviews/:id/helpful` - Mark review as helpful or report spam

Host Management

- `POST /api/properties` - Create new property listing (host only)

- `PUT /api/properties/:id` - Update property details and amenities
- `GET /api/properties/:id/bookings` - Get bookings for property (host only)
- `POST /api/properties/:id/photos` - Upload property photos with optimization
- `GET /api/host/dashboard` - Get host dashboard with analytics and earnings

Location & Geography

- `GET /api/locations/search` - Search locations with autocomplete
- `GET /api/locations/:id/properties` - Get properties in specific location
- `GET /api/locations/popular` - Get popular destinations and trending locations
- `GET /api/locations/:id/attractions` - Get nearby attractions and landmarks
- `POST /api/locations/geocode` - Convert address to coordinates

User Profile & Preferences

- `GET /api/users/:id/profile` - Get user profile and travel preferences
- `PUT /api/users/:id/preferences` - Update travel preferences and settings
- `GET /api/users/:id/wishlist` - Get user's saved properties and wishlist
- `POST /api/users/:id/verify` - Verify user identity for trusted bookings
- `GET /api/users/:id/trips` - Get user's trip history and upcoming bookings

Performance Optimizations

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Search Performance

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Caching Strategy:

```
SearchCache = {
  popularQueries: LRU<string, SearchResult[]>,
  locationData: Map<string, LocationInfo>,
  propertyPreviews: Map<string, PropertyPreview>,
  priceRanges: Map<string, PriceRange>
}
```

Optimization Techniques: - Implement search result caching with TTL - Use CDN for property images and static data - Lazy load property details and reviews - Implement virtual scrolling for large result sets - Pre-fetch popular locations and properties

Image and Media Optimization

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Progressive Loading: - Load low-quality image placeholders first - Progressive JPEG enhancement - WebP format with fallbacks - Responsive image sizing - Lazy loading with intersection observer

CDN Strategy: - Global content distribution - Automatic image optimization - Device-specific image variants - Smart caching policies - Bandwidth-aware loading

Database Optimization

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Search Index Strategy: - Geospatial indexing for location queries - Full-text search optimization - Composite indexes for filtered searches - Materialized views for aggregations - Read replicas for search queries

Security Considerations

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Payment Security

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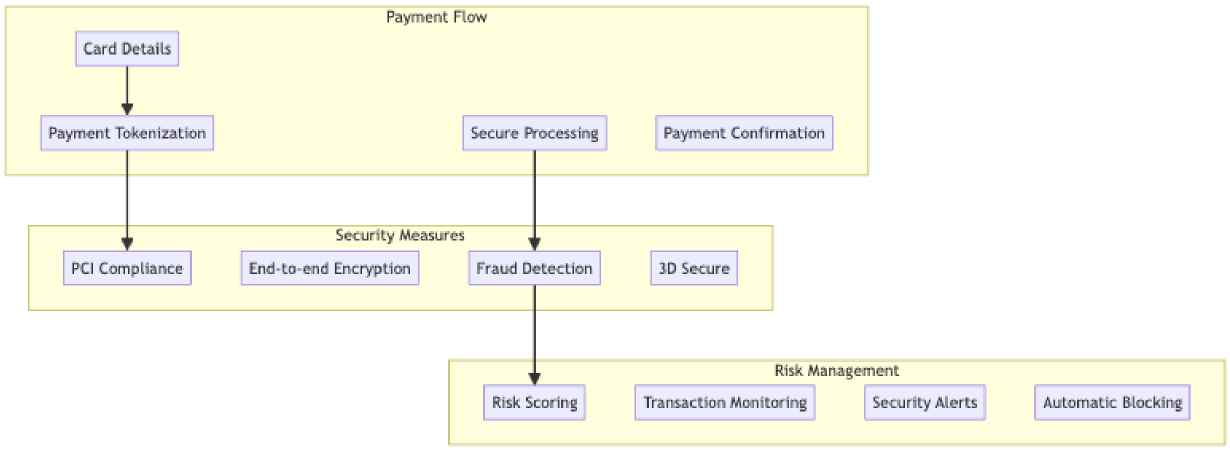

Data Protection

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Privacy Framework: - GDPR compliance for EU users - Data minimization principles - User consent management - Right to data deletion - Cross-border data transfer protections

Security Measures: - Input validation and sanitization - SQL injection prevention - XSS protection with CSP - Rate limiting for API endpoints - Authentication and authorization

Accessibility Implementation

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Keyboard Navigation

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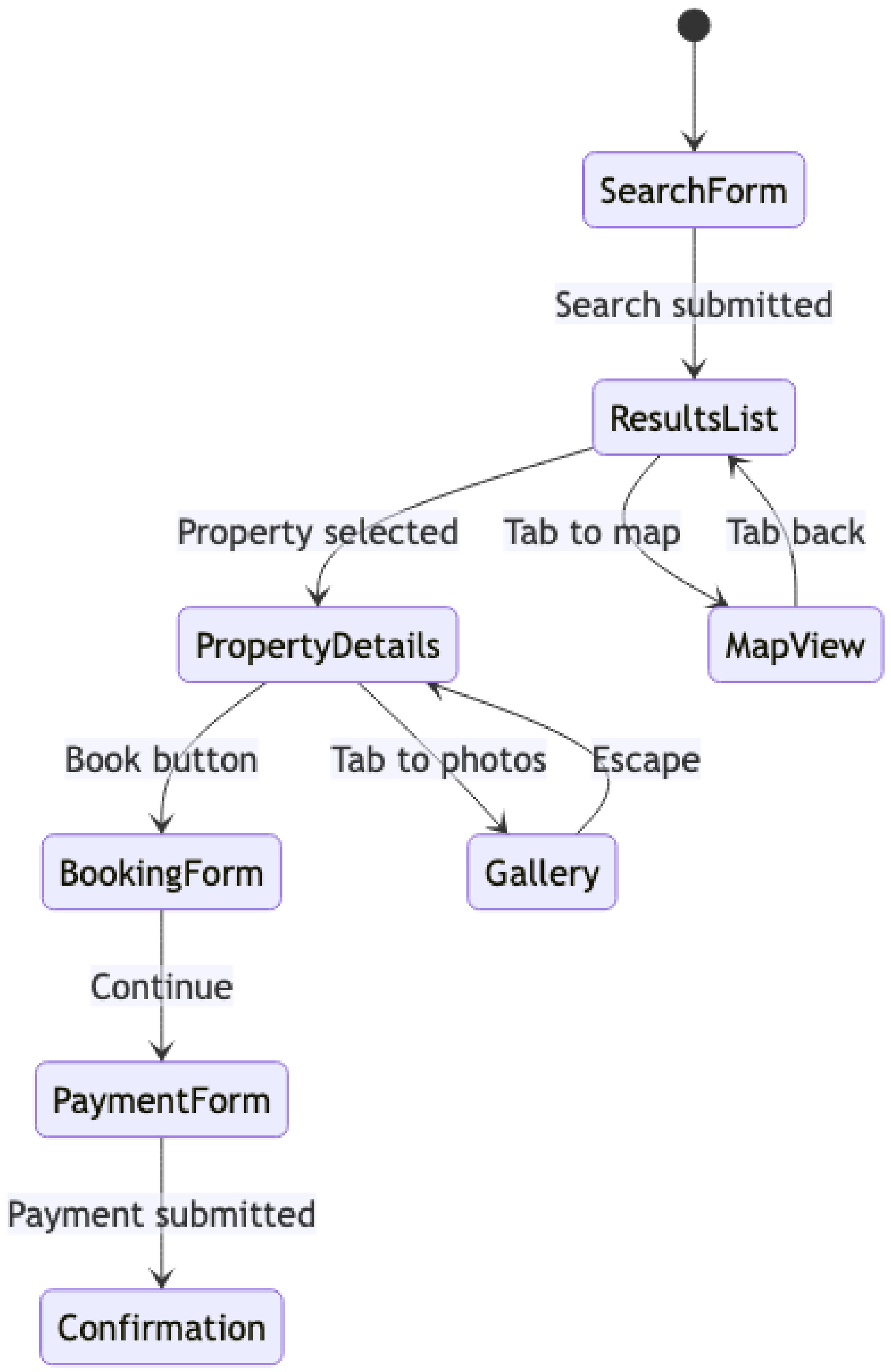

Accessibility Features: - Comprehensive ARIA labels and landmarks - Screen reader compatibility for all components - High contrast mode support - Keyboard navigation for all interactive elements - Focus management during page transitions

Inclusive Design

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Multi-language Support: - Right-to-left language support - Currency and date localization - Cultural adaptation of UI patterns - Accessibility in all supported languages

Testing Strategy

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Unit Testing Focus Areas

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Core Algorithm Testing: - Property search and ranking accuracy - Pricing calculation correctness - Availability conflict detection - Review validation logic

Component Testing: - Search interface interactions - Booking flow completeness - Map functionality - Payment form validation

Integration Testing

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End-to-End Booking Flow: - Complete user journey testing - Cross-browser compatibility - Mobile responsiveness - Payment processing integration

Performance Testing: - Search response times - Large dataset handling - Concurrent user scenarios - Geographic distribution performance

User Experience Testing

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Usability Testing: - User journey optimization - Conversion funnel analysis - A/B testing for UI improvements - Accessibility compliance verification

Trade-offs and Considerations

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Performance vs Features

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- **Real-time availability**: Accuracy vs response time
- **Search filters**: Comprehensiveness vs performance
- **Image quality**: Visual appeal vs loading speed
- **Personalization**: Relevance vs privacy concerns

Business vs User Experience

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- **Dynamic pricing**: Revenue optimization vs user trust
- **Search ranking**: Business priorities vs user preference
- **Booking policies**: Flexibility vs protection
- **Reviews system**: Authenticity vs user satisfaction

Scalability Considerations

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- **Global deployment**: Regional compliance vs unified experience
- **Peak demand**: Surge capacity vs cost optimization
- **Data growth**: Storage efficiency vs query performance
- **Feature complexity**: Functionality vs maintainability

This travel booking platform provides a comprehensive foundation for modern accommodation booking with advanced features like intelligent search, dynamic pricing, and personalized recommendations while maintaining high performance, security, and accessibility standards.