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Intelligent Document Classifier and Router - Product Requirements Document

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Intelligent Document Classifier and Router - Product Requirements Document

1. Executive Summary

1.1 Product Vision

Eliminate the productivity drain of manual document management by intelligently classifying, routing, and

1.2 Business Objectives

Productivity: Save 1 full workday per week per knowledge worker
Speed: 70% reduction in document routing time (3 days → 8 hours)
Accuracy: 95% correct document classification rate
Searchability: 80% reduction in time spent searching for documents

1.3 Target Market

Knowledge-intensive businesses (legal, consulting, finance)
Companies with document-heavy workflows
Organizations with compliance requirements
Remote/hybrid teams needing document collaboration

2. Product Overview

2.1 Core Value Proposition

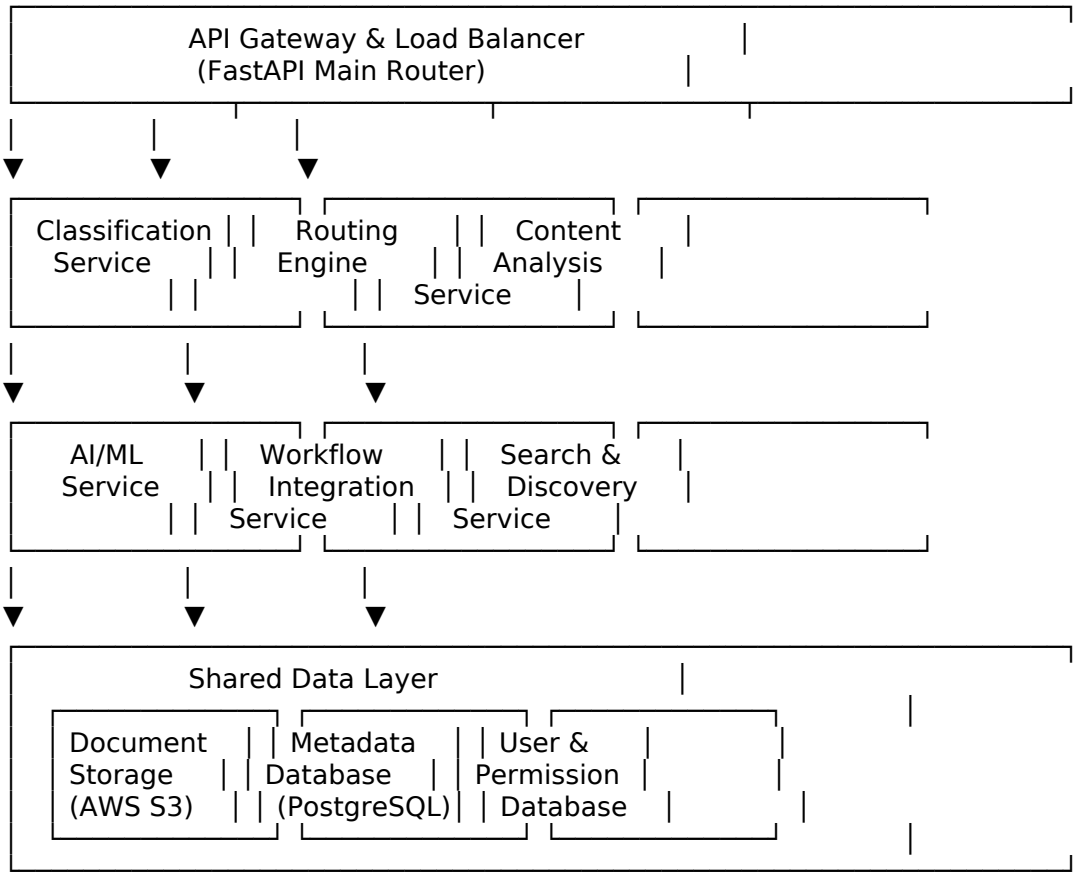
AI-powered document intelligence that automatically understands, categorizes, and routes business docum

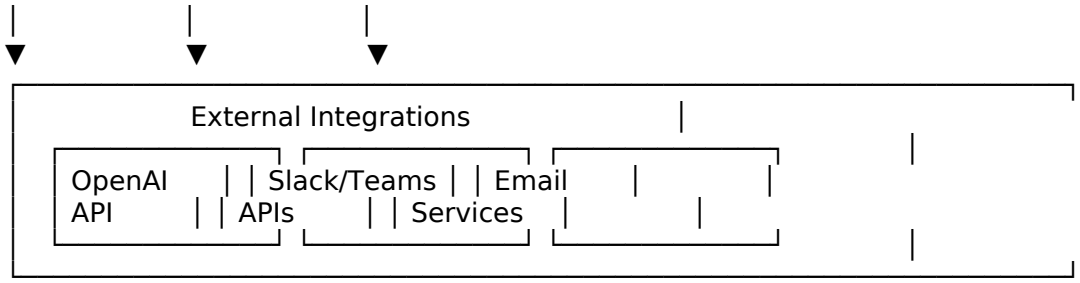
2.2 Key Features

Intelligent Classification: AI-powered document type and content analysis
Smart Routing: Context-aware assignment to teams and individuals
Content Extraction: Key information extraction and tagging
Workflow Integration: Seamless integration with existing business tools
Knowledge Discovery: AI-powered insights and document relationships

3. Microservice Architecture

3.1 High-Level Architecture Diagram



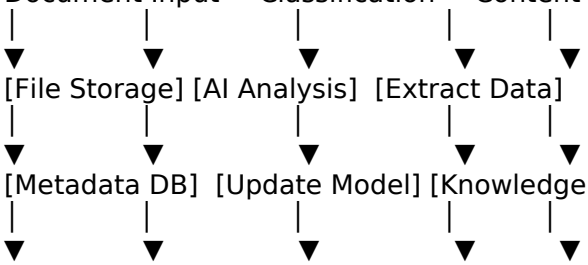


3.2 Detailed Service Architecture

Classification Service
- Document Ingestion
  - Multi-format support (PDF, DOC, TXT, images)
  - Batch processing
  - Real-time processing
- Content Analysis
  - Text extraction
  - OCR processing
  - Metadata extraction
- AI Classification Engine
  - Document type detection
  - Content categorization
  - Confidence scoring
- Learning Module
- User feedback integration
- Model fine-tuning
- Performance optimization

Routing Engine
- Rule Engine
  - Business rule evaluation
  - Priority assignment
  - Escalation logic
- Assignment Logic
  - Team/individual routing
  - Workload balancing
  - Expertise matching
- Context Analysis
  - Project association
  - Customer relationship
  - Historical patterns
- Decision Tracking
- Routing decisions log
- Performance metrics
- Optimization insights

Content Analysis Service
- Information Extraction
  - Entity recognition (names, dates, amounts)
  - Key phrase extraction
  - Summary generation
- Relationship Mapping
  - Document connections
  - Reference detection
  - Dependency analysis
- Compliance Scanning
  - Sensitive data detection
  - Regulatory compliance
  - Risk assessment
- Insight Generation
- Actionable insights

├── Trend analysis
└── Recommendation engine
3.3 Data Flow Diagram
Document Input → Classification → Content Analysis → Routing → Notification

[File Storage] [AI Analysis] [Extract Data] [Assign Task] [Notify Users]

[Metadata DB] [Update Model] [Knowledge Base] [Track Status] [Log Activity]

[Search Index] [Feedback Loop] [Relationships] [Analytics] [Audit Trail]
4. Feature Specifications
4.1 Document Classification Features
4.1.1 Multi-Format Support
Document Types: PDF, Word, Excel, PowerPoint, images, text files
Email Integration: Direct email attachment processing
Drag & Drop: Browser-based file upload interface
Batch Processing: Multiple file handling
API Upload: Programmatic document submission
4.1.2 AI-Powered Classification
Document Types: Contracts, invoices, reports, correspondence, legal docs
Content Categories: Financial, legal, technical, marketing, HR
Industry-Specific: Healthcare, finance, legal, manufacturing classifications
Custom Categories: User-defined classification schemes
Confidence Levels: AI certainty scores for classifications
4.1.3 Content Understanding
Entity Extraction: People, organizations, dates, amounts, locations
Key Information: Critical data points and summaries
Language Detection: Multi-language document support
Sentiment Analysis: Document tone and sentiment scoring
Topic Modeling: Automatic subject identification
4.2 Intelligent Routing Features
4.2.1 Smart Assignment
Role-Based Routing: Route based on user roles and responsibilities
Expertise Matching: Match documents to subject matter experts
Workload Balancing: Distribute work evenly across team members
Priority-Based: High-priority documents to appropriate resources
Time Zone Awareness: Route to available team members
4.2.2 Business Rule Engine
Conditional Routing: If-then-else routing logic
Multi-Criteria: Route based on multiple document attributes
Escalation Rules: Automatic escalation for unhandled documents
Exception Handling: Special handling for edge cases
Approval Workflows: Multi-step approval processes
4.2.3 Context-Aware Processing
Project Association: Link documents to relevant projects
Customer Context: Associate with customer relationships
Historical Patterns: Learn from past routing decisions
Deadline Awareness: Consider time-sensitive requirements
Compliance Requirements: Route for regulatory compliance
4.3 Workflow Integration
4.3.1 Communication Integration
Slack Integration: Channel notifications and bot interactions
Microsoft Teams: Team collaboration and notifications
Email Notifications: Customizable email alerts
Mobile Push: Real-time mobile notifications
In-App Messaging: Internal messaging system
4.3.2 Task Management
Jira Integration: Automatic ticket creation and updates

Asana Integration: Task assignment and tracking
Trello Integration: Card creation and board management
Custom Webhooks: Integration with any REST API
Calendar Integration: Schedule document review sessions
4.4 Search & Discovery
4.4.1 Intelligent Search
Full-Text Search: Content-based document search
Semantic Search: Meaning-based search capabilities
Filter Options: Date, type, assignee, status filters
Faceted Search: Multiple filter combinations
Auto-Complete: Search suggestion and completion
4.4.2 Knowledge Discovery
Related Documents: Find similar or related content
Trend Analysis: Identify patterns in document types
Usage Analytics: Track document access and usage
Recommendation Engine: Suggest relevant documents
Knowledge Graphs: Visual relationship mapping
5. Technical Requirements
5.1 Performance Requirements
Processing Speed: <10 seconds per document classification
Throughput: 500+ documents per hour
Search Response: <1 second for search queries
Uptime: 99.5% service availability
Concurrent Users: Support 200+ simultaneous users
5.2 AI/ML Requirements
Classification Accuracy: >95% for standard document types
Model Training: Continuous learning from user feedback
Multi-Language: Support for 10+ major languages
Custom Models: Industry-specific model training
Confidence Thresholds: Configurable confidence levels
5.3 Integration Requirements
API Standards: RESTful APIs with comprehensive documentation
Real-time Events: WebSocket support for live updates
Webhook Support: Outbound event notifications
SSO Integration: SAML, OAuth 2.0 authentication
Data Export: Multiple format export capabilities
6. User Experience Design
6.1 Web Dashboard
Document Pipeline: Visual workflow status
Quick Actions: Common tasks and shortcuts
Analytics Dashboard: Usage and performance metrics
Configuration Panel: Rule and workflow management
6.2 Mobile Interface
Document Capture: Camera-based document upload
Quick Classification: Mobile document processing
Notification Center: All alerts and updates
Offline Capability: Basic functionality without internet
6.3 Admin Console
User Management: Role and permission administration
Rule Configuration: Business rule setup and management
Model Training: AI model management and tuning
Analytics & Reporting: Comprehensive usage analytics
7. Security & Compliance
7.1 Data Security
Encryption: End-to-end encryption for all documents
Access Control: Granular permission management
Audit Logging: Complete activity tracking
Data Residency: Configurable data storage locations
Backup & Recovery: Automated backup systems
7.2 Compliance Features
GDPR Compliance: Data protection and privacy controls

HIPAA Ready: Healthcare data handling capabilities
SOX Compliance: Financial document audit trails
Industry Standards: ISO 27001, SOC 2 compliance
Data Retention: Configurable retention policies
8. Success Metrics
8.1 Operational Metrics
Classification Accuracy: Percentage of correct classifications
Processing Time: Average time per document
User Adoption: Active users and feature usage
Search Success Rate: Successful search completion
8.2 Business Impact Metrics
Time Savings: Reduction in document handling time
Productivity Gains: Documents processed per user
Error Reduction: Decrease in misrouted documents
User Satisfaction: Net Promoter Score (NPS)
9. Implementation Roadmap
9.1 Phase 1 - Core Classification (2 Days POC)
Basic document upload and classification
Simple routing rules
OpenAI integration for content analysis
Basic notification system
9.2 Phase 2 - Enhanced Intelligence (Week 1-2)
Advanced classification models
Complex routing engine
Integration with Slack/Teams
Search capabilities
9.3 Phase 3 - Enterprise Features (Week 3-4)
Multi-tenant architecture
Advanced analytics
Custom model training
Compliance features
9.4 Phase 4 - AI Enhancement (Month 2)
Machine learning optimization
Predictive routing
Advanced insights
Knowledge graph features
10. Risk Assessment
10.1 Technical Risks
AI Accuracy: Variable classification performance
Scalability: High volume processing challenges
Integration Complexity: Multiple system integrations
Data Privacy: Sensitive document handling
10.2 Mitigation Strategies
Human-in-the-Loop: Manual review for low confidence
Microservice Architecture: Independent scaling
API-First Design: Standardized integrations
Privacy by Design: Built-in data protection
11. Competitive Advantages
11.1 Technical Differentiators
AI-First Approach: Native AI capabilities vs. bolt-on features
Real-time Processing: Immediate classification and routing
Context Awareness: Understanding document relationships
Learning System: Continuous improvement from usage
11.2 Business Differentiators
Rapid Deployment: 2-day POC to production in weeks
Cost Effective: 80% lower than enterprise solutions
User-Friendly: Intuitive interface requiring minimal training
Flexible Integration: Works with existing tool ecosystem
12. Conclusion
The Intelligent Document Classifier and Router addresses a critical productivity challenge in modern busine

Technical Design Document: Intelligent Document Classifier & Router
1. System Architecture Overview
API Gateway

Classification Service

Routing Engine

Content Analysis

AI/ML Service

Workflow Integration

Search & Discovery

Shared Data Layer

Document Storage

Metadata DB

Permissions DB

2. Microservice Specifications
Service□Technology□Core Responsibilities□Key Interfaces
API Gateway□FastAPI, JWT□Request routing, authentication, rate limiting□REST endpoints, WebSocket
Classification□Python, spaCy□Document type detection, content categorization□File upload API, confidence
Routing Engine□Python, Rule Engine□Context-aware assignment, workload balancing□JSON rule definitions,
Content Analysis□Pandas, NumPy□Entity extraction, relationship mapping□Dataframe processing, metadata
AI/ML Service□scikit-learn□Model training/inference, feedback integration□Model versioning endpoint
Workflow Integration□Python, Webhooks□Jira/Slack connectivity, notification delivery□Custom adapter patte
Search & Discovery□SQLAlchemy, Full-Text□Semantic search, knowledge graphs□Query parser, ranking alg
3. Data Flow Sequence

4. Database Schema Design
Documents Table

Column□Type□Description
doc_id□UUID□Unique document identifier
original_name□VARCHAR(255)□Original filename
storage_path□TEXT□S3 path/object reference
doc_type□VARCHAR(50)□Contract/Invoice/Report etc.
confidence□FLOAT□Classification confidence score
Metadata Table

Column□Type□Description
meta_id□SERIAL□Auto-increment ID
doc_id□UUID□Foreign key to documents
key_entities□JSONB□Extracted names/dates/amounts
related_docs□UUID[]□Linked document references
risk_score□FLOAT□Compliance risk assessment
Routing Rules Table

Column□Type□Description
rule_id□SERIAL□Auto-increment ID
condition□JSONB□IF-THEN logic definition
assignee□VARCHAR(100)□User/team assignment target
priority□INT□1-5 urgency scale
5. CI/CD Pipeline Design

6. Non-Functional Requirements
Category□Requirement□Implementation Strategy
Performance□<10s/doc processing□Async processing, message queues
Scalability□500 docs/hour throughput□Kubernetes auto-scaling
Security□End-to-end encryption□TLS 1.3, AES-256 at rest
Reliability□99.5% uptime□Health checks, circuit breakers
Maintainability□85% test coverage□Pytest, mutation testing
Compliance□GDPR/HIPAA readiness□Audit logs, data anonymization hooks

8. Failure Mode Analysis
Failure Point□Mitigation Strategy□Recovery Process
OCR failure□Fallback to metadata-based routing□Human review queue
Classification low confidence□Secondary model verification□User feedback loop
Routing rule conflict□Priority-based arbitration□Dead-letter queue monitoring
Service downtime□Kubernetes liveness probes□Auto-container restart
Data corruption□Cryptographic hash verification□S3 version rollback
9. Monitoring & Observability
Key Metrics Dashboard

Metric□Source□Alert Threshold
Docs processed/min□Prometheus□<10
Classification accuracy□Model feedback□<90%
Avg. routing time□Application logs□>30s
Error rate□ELK stack□>5%
Container memory□cAdvisor□>80% utilization
10. Security Controls
Layer□Controls
Network□VPC isolation, Security Groups
Application□JWT authentication, Input validation
Data□AES-256 encryption, RBAC permissions
Infrastructure□Immutable containers, Signed images
Compliance□Audit trails, Data retention policies
This design enables implementation of core classification/routing functionality within 2 days using specified

Initial Folder Structure & Docker Setup Guide
Tech Stack: Python, FastAPI, Docker Compose, PostgreSQL, SQLAlchemy, RabbitMQ, GitHub Actions

Root Directory Structure
```
intelligent_document_router/
├── .github/
│   └── workflows/
│       ├── ci-cd.yml          # GitHub Actions pipeline
├── docker-compose.yml         # Main compose file
├── .env                       # Environment variables
├── docs/                      # Architecture diagrams
├── libs/                      # Shared Python libraries
│   ├── database/              # SQLAlchemy base models
│   ├── utils/                 # Common utilities
├── microservices/
│   ├── api_gateway/           # Entry point
│   │   ├── Dockerfile
│   │   ├── app/
│   │   │   ├── main.py        # FastAPI routes
│   │   │   └── dependencies.py
│   │   └── requirements.txt
│   │
│   ├── classification/        # Doc classification
│   │   ├── Dockerfile
│   │   ├── app/
```

```
│   │   │   ├── classifier.py  # spaCy model
│   │   │   └── schemas.py
│   │   └── requirements.txt
│   │
│   ├── routing_engine/        # Assignment logic
│   │   ├── Dockerfile
│   │   ├── rules/             # Business rules
│   │   ├── app/
│   │   └── requirements.txt
│   │
│   ├── content_analysis/      # Entity extraction
│   │   ├── Dockerfile
│   │   ├── app/
│   │   └── requirements.txt
│   │
│   └── workflow_integration/  # Jira/Slack
│       ├── Dockerfile
│       ├── adapters/          # Jira/Slack clients
│       └── requirements.txt
│
├── infrastructure/
│   ├── db/                    # PostgreSQL setup
│   │   ├── Dockerfile
│   │   └── init.sql           # DB schema
│   ├── rabbitmq/              # Message broker
│   └── storage/               # MinIO (S3-compatible)
│
└── tests/                     # Pytest suites
    ├── unit/
    └── integration/
```

Key Files Implementation

1. docker-compose.yml

```
version: '3.8'

services:
api_gateway:
build: ./microservices/api_gateway
ports:
- "8000:8000"
env_file: .env
depends_on:
- rabbitmq
- db

classification:
build: ./microservices/classification
env_file: .env

routing_engine:
build: ./microservices/routing_engine
env_file: .env

content_analysis:
build: ./microservices/content_analysis
env_file: .env

workflow_integration:
build: ./microservices/workflow_integration
env_file: .env

db:
```

```
build: ./infrastructure/db
env_file: .env
volumes:
- pgdata:/var/lib/postgresql/data

rabbitmq:
image: rabbitmq:3-management
ports:
- "5672:5672"
- "15672:15672"

minio:
image: minio/minio
command: server /data
volumes:
- storage:/data
ports:
- "9000:9000"

volumes:
pgdata:
storage:
```

2. Sample Dockerfile (for classification service)

```
FROM python:3.9-slim

WORKDIR /app

COPY ./requirements.txt .
RUN pip install --no-cache-dir -r requirements.txt

# Download spaCy model during build
RUN python -m spacy download en_core_web_sm

COPY ./app ./app

CMD ["uvicorn", "app.classifier:app", "--host", "0.0.0.0", "--port", "8001"]
```

3. .env File

```
# PostgreSQL
POSTGRES_HOST=db
POSTGRES_USER=admin
POSTGRES_PASSWORD=secret
POSTGRES_DB=document_db

# RabbitMQ
RABBITMQ_HOST=rabbitmq
RABBITMQ_QUEUE=document_queue

# MinIO Storage
MINIO_ENDPOINT=minio:9000
MINIO_ACCESS_KEY=minioadmin
MINIO_SECRET_KEY=minioadmin
```

4. Database Initialization (infrastructure/db/init.sql)

```
CREATE TABLE documents (
id UUID PRIMARY KEY,
filename VARCHAR(255) NOT NULL,
filepath VARCHAR(255) NOT NULL,
doc_type VARCHAR(50),
confidence FLOAT
);

CREATE TABLE routing_rules (
```

id SERIAL PRIMARY KEY,
condition JSONB NOT NULL,
assignee VARCHAR(100) NOT NULL
);
Development Workflow
Initialize Services:
docker-compose up --build -d
Access Services:
API Gateway: http://localhost:8000/docs
RabbitMQ Console: http://localhost:15672 (guest/guest)
MinIO Console: http://localhost:9000 (minioadmin/minioadmin)
CI/CD Pipeline (.github/workflows/ci-cd.yml):
name: CI/CD Pipeline
on: [push]

jobs:
build-test:
runs-on: ubuntu-latest
steps:
- uses: actions/checkout@v3

- name: Build and test
run: |
docker-compose -f docker-compose.test.yml up --build --abort-on-container-exit
Microservice Communication Pattern:
# api_gateway/app/main.py
from fastapi import FastAPI, UploadFile
import httpx

app = FastAPI()

@app.post("/upload")
async def upload(file: UploadFile):
1. Save to MinIO
2. Send message to RabbitMQ
async with httpx.AsyncClient() as client:
await client.post("http://classification:8001/process", json=file_metadata)
Key Design Decisions
Decoupled Communication:

RabbitMQ for async inter-service messaging
HTTP for synchronous requests (service discovery via Docker DNS)
Shared Libraries:

Central libs/database with SQLAlchemy base models
Common validation schemas in libs/schemas.py
Stateless Services:

Each microservice connects directly to DB/MinIO
No inter-service dependencies during initialization
DevOps Integration:

Pre-configured Jenkinsfile in each service directory
GitHub Actions for automated testing
Docker Hub auto-builds on Git tags
POC-Scalable Architecture:

Local MinIO instead of AWS S3
SQLite option for lightweight testing
Mock AI models (spaCy) instead of cloud APIs
Next Steps for Implementation

Generate boilerplate code:
For each microservice
mkdir -p microservice/{service}/app
touch microservice/{service}/Dockerfile
touch microservice/{service}/requirements.txt
Start core services:
docker-compose up db rabbitmq minio -d
Implement classification service first:
Document upload endpoint
spaCy text processing
DB storage logic
This structure allows parallel development by new hires, with each team owning one microservice while lea

Intelligent Document Classifier and Router - Implementation Todo
Project Overview
AI-powered document intelligence that automatically understands, categorizes, and routes business docum

Phase 1: Core Classification (2 Days POC) - PRIORITY
Day 1: Core Services Setup
1.1 Project Structure Creation

Create root directory structure
Set up microservices folders (api_gateway, classification, routing_engine, content_analysis, workflow_integr
Create shared libraries folder (libs)
Set up infrastructure folder (db, rabbitmq, storage)
Create tests folder structure
1.2 Docker & Infrastructure Setup

Create docker-compose.yml with all services
Set up PostgreSQL database with init.sql
Configure RabbitMQ message broker
Set up MinIO (S3-compatible storage)
Create .env file with all environment variables
Test infrastructure startup
1.3 Database Schema Implementation

Create documents table (UUID, filename, filepath, doc_type, confidence)
Create metadata table (meta_id, doc_id, key_entities, related_docs, risk_score)
Create routing_rules table (rule_id, condition, assignee, priority)
Set up SQLAlchemy models in libs/database
Test database connectivity
1.4 API Gateway Service

Create FastAPI main application
Implement JWT authentication
Set up request routing and rate limiting
Create document upload endpoint
Implement health check endpoints
Add API documentation (Swagger/OpenAPI)
1.5 Classification Service MVP

Set up spaCy for text processing
Implement document type detection (PDF, DOC, TXT, images)
Create basic classification logic (contracts, invoices, reports)
Add confidence scoring
Implement file storage to MinIO
Create classification API endpoints
Day 2: Integration & Deployment
2.1 Content Analysis Service

Implement text extraction from various formats

Add OCR processing for images
Create entity extraction (names, dates, amounts)
Implement key phrase extraction
Add summary generation
Test with sample documents
2.2 Routing Engine

Create rule engine for business logic
Implement basic routing rules (role-based, expertise matching)
Add workload balancing logic
Create priority assignment system
Implement routing decision tracking
Test routing with sample scenarios
2.3 Workflow Integration

Set up Slack integration (notifications)
Implement Jira integration (ticket creation)
Create email notification system
Add webhook support for external systems
Test notification delivery
2.4 Message Queue Integration

Implement RabbitMQ producers/consumers
Set up async document processing pipeline
Create error handling and retry logic
Add dead letter queue for failed messages
Test message flow between services
2.5 Basic Search & Discovery

Implement full-text search
Add basic filtering (date, type, assignee)
Create document relationship mapping
Add simple analytics dashboard
Test search functionality
2.6 POC Testing & Validation

End-to-end testing with sample documents
Performance testing (<10 seconds per document)
Load testing (500+ documents per hour)
User acceptance testing
Document POC results and findings
Phase 2: Enhanced Intelligence (Week 1-2)
Week 1: Advanced Features
3.1 Advanced Classification Models

Implement multi-language support
Add industry-specific classifications
Create custom category training
Implement model fine-tuning
Add confidence threshold configuration
3.2 Complex Routing Engine

Implement conditional routing (if-then-else)
Add multi-criteria routing logic
Create escalation rules
Implement approval workflows
Add exception handling
3.3 Enhanced Content Analysis

Add sentiment analysis
Implement topic modeling

Create compliance scanning
Add risk assessment scoring
Implement relationship mapping
Week 2: Integration & Optimization
3.4 Advanced Integrations

Microsoft Teams integration
Asana/Trello integration
Calendar integration
Mobile push notifications
Custom webhook framework
3.5 Search & Discovery Enhancement

Implement semantic search
Add faceted search capabilities
Create knowledge graphs
Implement recommendation engine
Add trend analysis
Phase 3: Enterprise Features (Week 3-4)
Week 3: Multi-tenancy & Security
4.1 Multi-tenant Architecture

Implement tenant isolation
Add tenant-specific configurations
Create tenant management UI
Implement resource quotas
Add tenant analytics
4.2 Advanced Security

Implement end-to-end encryption
Add granular access control
Create audit logging system
Implement data residency controls
Add backup and recovery
Week 4: Compliance & Analytics
4.3 Compliance Features

GDPR compliance implementation
HIPAA readiness features
SOX compliance audit trails
Data retention policies
Compliance reporting
4.4 Advanced Analytics

Comprehensive usage analytics
Performance monitoring dashboard
Predictive analytics
Business intelligence reports
Custom reporting engine
Phase 4: AI Enhancement (Month 2)
Month 2: Machine Learning & Optimization
5.1 Machine Learning Optimization

Implement continuous learning
Add model versioning
Create A/B testing framework
Implement model performance monitoring
Add automated model retraining
5.2 Predictive Features

Predictive routing

Document priority prediction
Workload forecasting
Risk prediction
Trend forecasting
5.3 Advanced Insights

Document relationship discovery
Knowledge graph expansion
Intelligent recommendations
Process optimization suggestions
Business intelligence insights
Technical Implementation Details
Current Status: READY TO START
Product Requirements Document (plan1.md)
Technical Architecture Design
Implementation Roadmap
Project Structure Creation
Docker Setup
Database Schema
First Microservice
Next Immediate Actions:
Create the complete project folder structure
Set up docker-compose.yml with all services
Implement database schema and models
Create API Gateway service
Build Classification Service MVP
Success Criteria:
Document classification accuracy >95%
Processing time <10 seconds per document
Throughput 500+ documents per hour
99.5% service availability
Support 200+ concurrent users
Risk Mitigation:
Human-in-the-loop for low confidence classifications
Fallback mechanisms for service failures
Comprehensive error handling and logging
Performance monitoring and alerting
Security and compliance by design
Last Updated: [Current Date]
Current Phase: Phase 1 - Core Classification
Next Milestone: Day 1 - Core Services Setup

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Intelligent Document Classifier and Router - Architecture & Folder Structure Guide
This guide explains the folder structure, code organization, and extension points for the Intelligent Docume

 Root Directory Structure

```
intelligent_document_router/
├── .github/workflows/     # CI/CD pipeline definitions (GitHub Actions)
├── docs/                  # Architecture diagrams, technical docs, PRDs
├── libs/                  # Shared Python libraries (models, utils)
│   ├── database/          # SQLAlchemy models, DB connection logic
│   └── utils/             # Common utilities (logging, helpers)
├── microservices/         # All microservices (each in its own folder)
│   ├── api_gateway/       # FastAPI entry point, auth, routing
│   ├── classification/    # AI-powered document classification
│   ├── routing_engine/    # Smart document routing logic
│   ├── content_analysis/  # Entity extraction, content analysis
│   └── workflow_integration/ # Slack/Jira/email integrations
├── infrastructure/        # Infrastructure as code (DB, MQ, storage)
```

```
│   ├── db/              # PostgreSQL Dockerfile, init.sql
│   ├── rabbitmq/        # RabbitMQ config (if needed)
│   └── storage/         # MinIO/S3 config (if needed)
├── tests/               # Unit and integration tests
│   ├── unit/            # Unit tests for each service
│   └── integration/     # Integration/E2E tests
├── docker-compose.yml   # Main compose file for all services
├── .env                 # Environment variables for all services
├── README.md            # Project overview and quickstart
├── todo.md              # Implementation progress tracker
└── SETUP_COMPLETE.md    # Setup summary and next steps
```

 Folder-by-Folder Explanation

.github/workflows/
Purpose: CI/CD pipeline definitions (e.g., build, test, deploy)
Add: YAML files for GitHub Actions, e.g., ci-cd.yml
docs/
Purpose: Architecture diagrams, PRDs, technical documentation
Add: Markdown docs, Mermaid diagrams, onboarding guides
libs/
Purpose: Shared code used by multiple microservices
database/`: SQLAlchemy models, DB session/connection logic
utils/`: Logging, error handling, helper functions
Add: New shared models, utility functions, or adapters
microservices/
Purpose: All business logic, each service in its own folder
api_gateway/`: FastAPI app, authentication, main API endpoints
app/: Main FastAPI app, routers, middleware, dependencies
routers/: Add new API endpoints (e.g., /documents, /auth)
middleware/: Custom middleware (logging, rate limiting)
dependencies.py: Dependency injection (auth, DB session)
main.py: FastAPI app entry point
adapters/: (Optional) HTTP clients for other services
rules/: (Optional) Business rule definitions
requirements.txt, Dockerfile: Service dependencies and build
classification/`: Document type detection, spaCy/NLP logic
routing_engine/`: Rule engine, workload balancing, assignment
content_analysis/`: Entity extraction, key phrase, summary
workflow_integration/`: Slack, Jira, email, webhooks
Add: New microservices for additional features
infrastructure/
Purpose: Infrastructure as code for DB, MQ, storage
db/`: PostgreSQL Dockerfile, schema init.sql
rabbitmq/`: RabbitMQ config (if custom setup needed)
storage/`: MinIO/S3 config (if custom setup needed)
Add: Custom Dockerfiles, config scripts
tests/
Purpose: All automated tests
unit/`: Unit tests for each microservice
integration/`: Integration/E2E tests across services
Add: New test modules as you add features

 Where to Add What Code

New API endpoint?
Add a new file in microservices/api_gateway/app/routers/ and register it in main.py.
New database model?
Add to libs/database/models.py and run migrations/init.
New microservice?
Create a new folder in microservices/, add app/, Dockerfile, requirements.txt.
Shared logic?
Add to libs/ (e.g., libs/utils/ for helpers, libs/database/ for DB logic).
Infrastructure change?
Update infrastructure/ and docker-compose.yml.

New test?
Add to tests/unit/ or tests/integration/ as appropriate.
 Onboarding Guide for New Developers
Read README.md and ARCHITECTURE_GUIDE.md for project overview.
Clone the repo and copy .env.example to .env.
Start infrastructure:
docker-compose up db rabbitmq minio redis -d
Run the API Gateway locally:
cd microservices/api_gateway
pip install -r requirements.txt
uvicorn app.main:app --reload
Explore the codebase:
API endpoints: microservices/api_gateway/app/routers/
DB models: libs/database/models.py
Shared logic: libs/
Add new features/tests as described above
Run tests:
pytest
Check progress in todo.md and update as you complete tasks.
 Extending the System
Add new document types: Update classification logic in classification/ and models in libs/database/models.p
Add new routing rules: Update routing_engine/ and libs/database/models.py.
Integrate new tools (Slack, Jira, etc): Add adapters in workflow_integration/.
Improve search/analytics: Extend content_analysis/ and add endpoints to API Gateway.
 Reference: plan1.md
All folder and service responsibilities are mapped directly from the PRD and technical design in plan1.md.
For detailed feature specs, see plan1.md and README.md.
For any questions, see the docs/ folder or contact the project maintainers.

 Example: Creating an API Endpoint in Each Microservice
Below are minimal examples for adding a simple /ping endpoint to each microservice. This helps new devel

1. API Gateway (microservices/api_gateway)
File: microservices/api_gateway/app/routers/ping.py

```
from fastapi import APIRouter
router = APIRouter()

@router.get("/ping")
def ping():
return {"message": "pong from API Gateway"}
```

Register in app/main.py:

```
from app.routers import ping
app.include_router(ping.router, prefix="/ping", tags=["ping"])
```

2. Classification Service (microservices/classification)
File: microservices/classification/app/main.py

```
from fastapi import FastAPI
app = FastAPI()

@app.get("/ping")
def ping():
return {"message": "pong from Classification Service"}
```

3. Routing Engine (microservices/routing_engine)
File: microservices/routing_engine/app/main.py

```
from fastapi import FastAPI
app = FastAPI()

@app.get("/ping")
```

def ping():
return {"message": "pong from Routing Engine"}
4. Content Analysis (microservices/content_analysis)
File: microservices/content_analysis/app/main.py

from fastapi import FastAPI
app = FastAPI()

@app.get("/ping")
def ping():
return {"message": "pong from Content Analysis Service"}
5. Workflow Integration (microservices/workflow_integration)
File: microservices/workflow_integration/app/main.py

from fastapi import FastAPI
app = FastAPI()

@app.get("/ping")
def ping():
return {"message": "pong from Workflow Integration Service"}
How to test:

Start the relevant service (e.g., with uvicorn app.main:app --reload or via Docker Compose)
Visit http://localhost:<service-port>/ping in your browser or use curl
Tip:

For more complex APIs, create a routers/ directory in each service and organize endpoints as in the API Gat
Always register new routers in your FastAPI main.py using app.include_router(...).
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