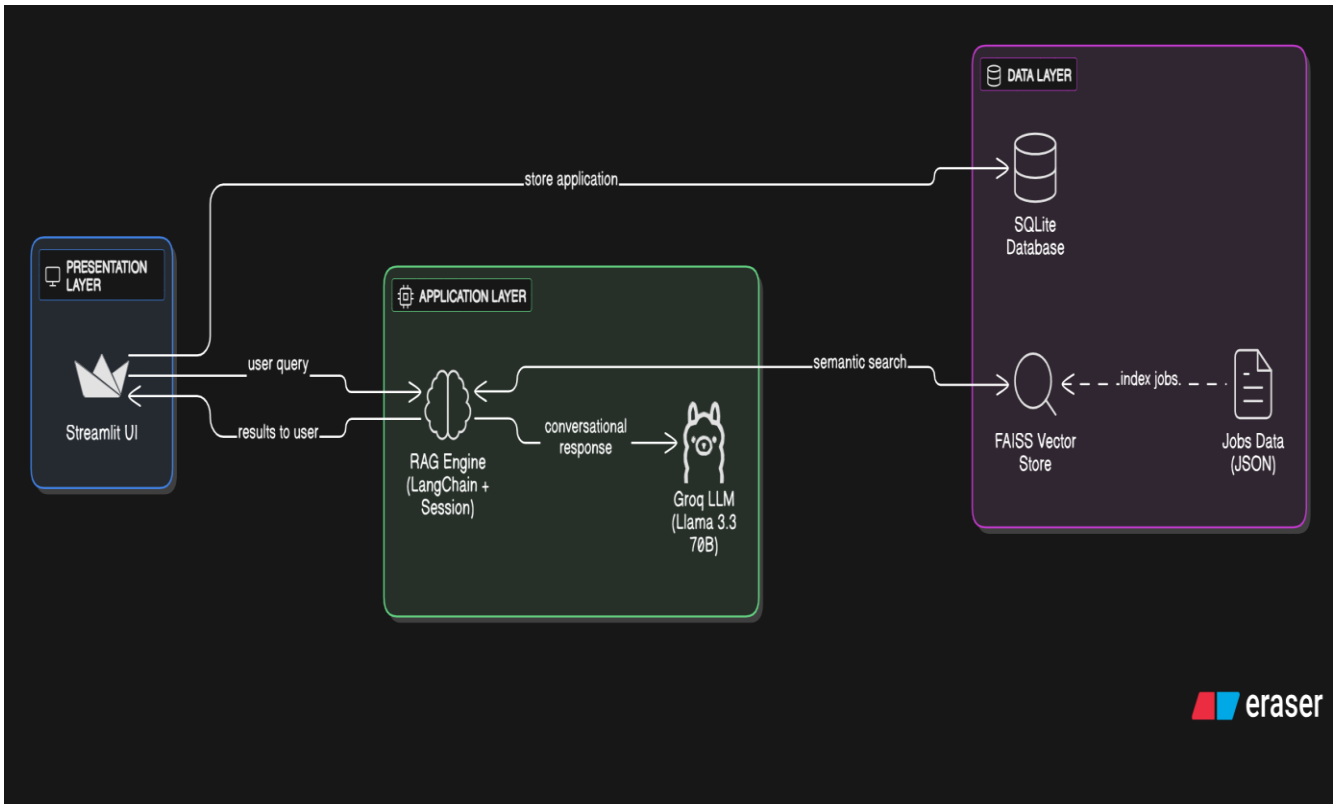
System Design Document – SmartApply RAG Agent

1. Executive Summary

SmartApply is an AI-powered job application system that leverages Retrieval-Augmented Generation (RAG) to provide intelligent job matching and streamlined application processing. The system uses semantic search to match candidates with relevant positions and guides them through a conversational application process.

2. System Architecture

2.1 High-Level Architecture



2.2 Component Details

Presentation Layer (app.py)

- **Technology**: Streamlit
- **Responsibilities**:
    - User interface for job search
    - Application form handling

    - Resume upload management
    - Admin dashboard
    - Session state management

Application Layer (RAG Engine (rag_engine.py))

- **Core Components**:
    - **Embeddings**: HuggingFace sentence-transformers/all-MiniLM-L6-v2
    - **Vector Store**: FAISS with persistent indexing
    - **LLM**: Groq API (Llama 3.3 70B)
    - **Memory**: ConversationBufferMemory for context retention

Database Layer (database.py)

- **Technology**: SQLite with SQLAlchemy ORM
- **Tables**:
    - applications: Core application data
    - screening_responses: Q&A storage
    - resumes: Binary file storage

3. Data Flow

3.1 Job Search Flow

1. User Query → "ML engineer in Bangalore"
2. Query Embedding → Convert to vector representation
3. Semantic Search → FAISS similarity search
4. Retrieve Jobs → Top-k matching jobs
5. Display Results → Ranked by relevance score

3.2 Application Flow

1. Job Selection → User clicks "Apply"
2. Information Collection → Name, email, phone, location
3. Resume Upload → PDF/DOCX file processing
4. Screening Questions → Dynamic Q&A based on job
5. Data Persistence → Store in SQLite

6. Confirmation → Application ID generation

4. Key Features

4.1 Semantic Job Search

- Vector similarity matching using FAISS
- Relevance scoring (0-100% match)
- Filter support (location, salary, experience)

4.2 Intelligent Caching

- MD5 hash-based change detection for jobs.json
- Persistent FAISS index to avoid re-computation
- Automatic reindexing on data changes

4.3 Conversational Interface

- Natural language job queries
- Context-aware responses using conversation memory
- Multi-turn dialogue support

4.4 Application Management

- Complete application lifecycle tracking
- Status management (submitted/reviewed/accepted/rejected)
- Admin dashboard with statistics

5. Technical Specifications

5.1 Dependencies

- **LangChain**: Orchestration framework
- **FAISS**: Vector similarity search
- **Groq**: LLM inference
- **Streamlit**: Web interface
- **SQLAlchemy**: Database ORM
- **Sentence-Transformers**: Free embeddings

5.2 Data Models

Job Schema

```
{
  "job_id": "string",
  "title": "string",
  "company": "string",
  "location": "string",
  "experience_required": "string",
  "salary_range": "string",
  "skills_required": ["array"],
  "screening_questions": ["array"]
}
```

Application Schema

```
applications (
  id: INTEGER PRIMARY KEY,
  job_id: VARCHAR,
  candidate_name: VARCHAR,
  candidate_email: VARCHAR,
  status: VARCHAR,
  submitted_at: DATETIME
)
```

6. Performance Optimizations

6.1 Embedding Caching

- First run: ~30 seconds to create embeddings
- Subsequent runs: <2 seconds (cached loading)
- Hash-based invalidation for data updates

6.2 Resource Usage

- Memory: ~200MB for vector store (20 jobs)
- Storage: ~10MB for FAISS index
- API Calls: Minimal (only for LLM responses)

7. Security Considerations

- API keys stored in environment variables
- SQL injection prevention via ORM
- File upload validation (type and size checks)
- No PII exposed in logs

8. Scalability

Current Limitations

- Single-user session management
- Local file storage for resumes
- In-memory conversation history

Scaling Strategy

- Move to PostgreSQL for production
- Implement Redis for session management
- Use cloud storage (S3) for resumes
- Deploy on cloud platforms (AWS/GCP)

9. Testing Approach

Functional Testing

- End-to-end application flow
- Job search accuracy validation
- Database persistence verification

Performance Testing

- Embedding generation time
- Search response latency
- Concurrent user handling

10. Deployment

Local Development

pip install -r requirements.txt

streamlit run app.py

Production Deployment

- Containerize with Docker
- Environment variable management
- HTTPS enforcement
- Rate limiting implementation

11. Future Enhancements

- Multi-language support
- Resume parsing and skill extraction
- Email notifications
- Advanced analytics dashboard
- Integration with ATS systems
- Real-time job updates

12. Conclusion

The SmartApply RAG Agent successfully demonstrates an end-to-end AI-powered recruitment system with semantic search, conversational interaction, and complete application management. The architecture is modular, scalable, and optimized for performance while maintaining simplicity.