COMP 019 - Applications Development and Emerging Technologies

Emerging Technologies: MCP, A2A, Pgvector

SESSION 12: BUILDING AI-POWERED APPLICATIONS (EMERGING TECHNOLOGY)

ACTIVITY 12.1: COMBINING MCP + A2A + PGVECTOR

Topic: Integrating all emerging technologies

Description: Build a complete AI-powered application using all learned technologies

INSTRUCTIONS:

Design integrated architecture:
- Django backend with PostgreSQL + Pgvector
- MCP server exposing database tools
- A2A server providing analysis capabilities
- RAG for intelligent search

Create 'Intelligent Student System':
- Traditional features (CRUD via Django)
- MCP tools for AI agents to query data
- A2A service for cross-agent collaboration
- Vector search for semantic queries

User scenarios:
- 'Find students similar to Juan in performance'
- 'Analyze why grades dropped in Semester 2'
- 'Recommend courses based on student profile'

Document system architecture:
- Component diagram
- Data flow diagram
- API documentation

Deliverables: Submit integrated system code and architecture documentation	**40 Points**

ACTIVITY 12.2: TESTING AND OPTIMIZATION

Topic: Testing AI-powered features and optimizing performance

Description: Comprehensive testing of integrated AI features

INSTRUCTIONS:

Test MCP integration:
- All tools callable and returning correct data
- Error handling for invalid inputs
- Performance under load

Test A2A integration:
• Agent discovery working
• Task execution reliable
• Streaming responses functioning
Test Pgvector/RAG:
• Semantic search accuracy
• Response relevance
• Query performance (indexing)
Optimization:
• Add caching where appropriate
• Optimize database queries
• Connection pooling
• Async operations for long tasks
Create test documentation:
• Test cases and results
• Performance benchmarks

Deliverables: Submit test results and optimization report	**30 Points**

ACTIVITY 12.3: DEPLOYMENT AND DOCUMENTATION

Topic: Deploying AI-enhanced application to production

Description: Deploy the complete system and create comprehensive documentation

INSTRUCTIONS:

Deploy to cloud:
• Django + Pgvector on Railway/Render
• Verify all features working in production
• Test MCP and A2A endpoints
• Monitor for errors
Create documentation:
Technical documentation:
• System architecture overview
• API documentation (REST + MCP + A2A)
• Database schema with vectors
• Deployment guide
User documentation:
• Feature overview
• How to use AI features
• Example queries and use cases
Prepare for project phase:
• Review all technologies learned
• Brainstorm project ideas

- Consider how to combine technologies

Deliverables: Submit deployed URL and complete documentation package	**35 Points**

TOTAL POINTS: 105