# CS 499 Module One Assignment Template

Complete this template by replacing the bracketed text with the relevant information.

1. **Self-Introduction:** Address all of the following questions to introduce yourself.
   1. How long have you been in the Computer Science program?

I have been in the Computer Science program for approximately 2 years and some change, having started in 2023. Throughout this time, I have completed foundational courses and am now approaching the capstone experience that will demonstrate my accumulated knowledge and skills.

* 1. What have you learned while in the program? List three of the most important concepts or skills you have learned.
* Mobile Application Development and User-Centered Design: Through CS 360, I learned how to develop comprehensive Android applications using Java, implement Model-View-Adapter architecture, and design intuitive user interfaces following Material Design principles. I gained experience with SQLite database integration, runtime permission handling, and creating apps that solve real-world business problems like inventory management.
* Full-Stack Web Development and Database Integration: In CS 340, I mastered MongoDB database operations, Python development with Plotly Dash framework, and creating interactive web dashboards. I learned to implement CRUD operations, design complex database queries, and build real-time data visualization systems that serve organizational decision-making needs, as demonstrated in my Grazioso Salvare Animal Rescue Dashboard.
* Software Architecture and Cross-Platform Development: Through CS 230, I gained understanding of software architecture patterns, multi-platform considerations, and the challenges of adapting applications across different operating systems and environments. This included analyzing memory management, performance optimization, and platform-specific implementation strategies for games like "Draw It or Lose It."
  1. Discuss the specific skills you aim to demonstrate through your enhancements to reach each of the course outcomes.
* Collaborative Development Skills: I will showcase my ability to create well-documented, maintainable code with clear architectural patterns that enable team collaboration. My enhancements will include comprehensive documentation and modular design that supports organizational decision-making.
* Professional Communication: My narratives and technical documentation will demonstrate my ability to explain complex technical concepts to diverse audiences, from technical teams to business stakeholders, using visual aids, flowcharts, and clear technical writing.
* Algorithmic Problem-Solving: I will enhance existing algorithms to improve efficiency, implement advanced data structures, and demonstrate my understanding of computational complexity and trade-offs in design decisions across mobile, web, and distributed systems.
* Industry-Standard Development Practices: My enhancements will incorporate modern development tools, testing frameworks, security considerations, and industry best practices that deliver value in real-world applications across different platforms.
* Security-Minded Development: I will implement advanced security measures, conduct vulnerability assessments, validate inputs comprehensively, handle errors securely, and demonstrate deep awareness of common attack vectors and comprehensive mitigation strategies across mobile, web, and distributed systems.
* Cybersecurity Best Practices: My enhancements will incorporate security frameworks (OWASP, NIST), secure coding standards, penetration testing methodologies, and enterprise-level security controls that are essential for cybersecurity professionals.
  1. How do the specific skills you will demonstrate align with your career plans related to your degree?

My career goal is to become an expert in cybersecurity, with plans to pursue a Master's degree in Information Security. The skills I will demonstrate directly support this career trajectory:

* The mobile development enhancements will showcase my ability to implement comprehensive security measures including encryption, secure authentication, and vulnerability mitigation in mobile applications
* The web development improvements will demonstrate my expertise in secure coding practices, database security, and protecting against common web vulnerabilities
* The software architecture enhancements will highlight my understanding of secure system design, distributed security models, and enterprise-level security considerations

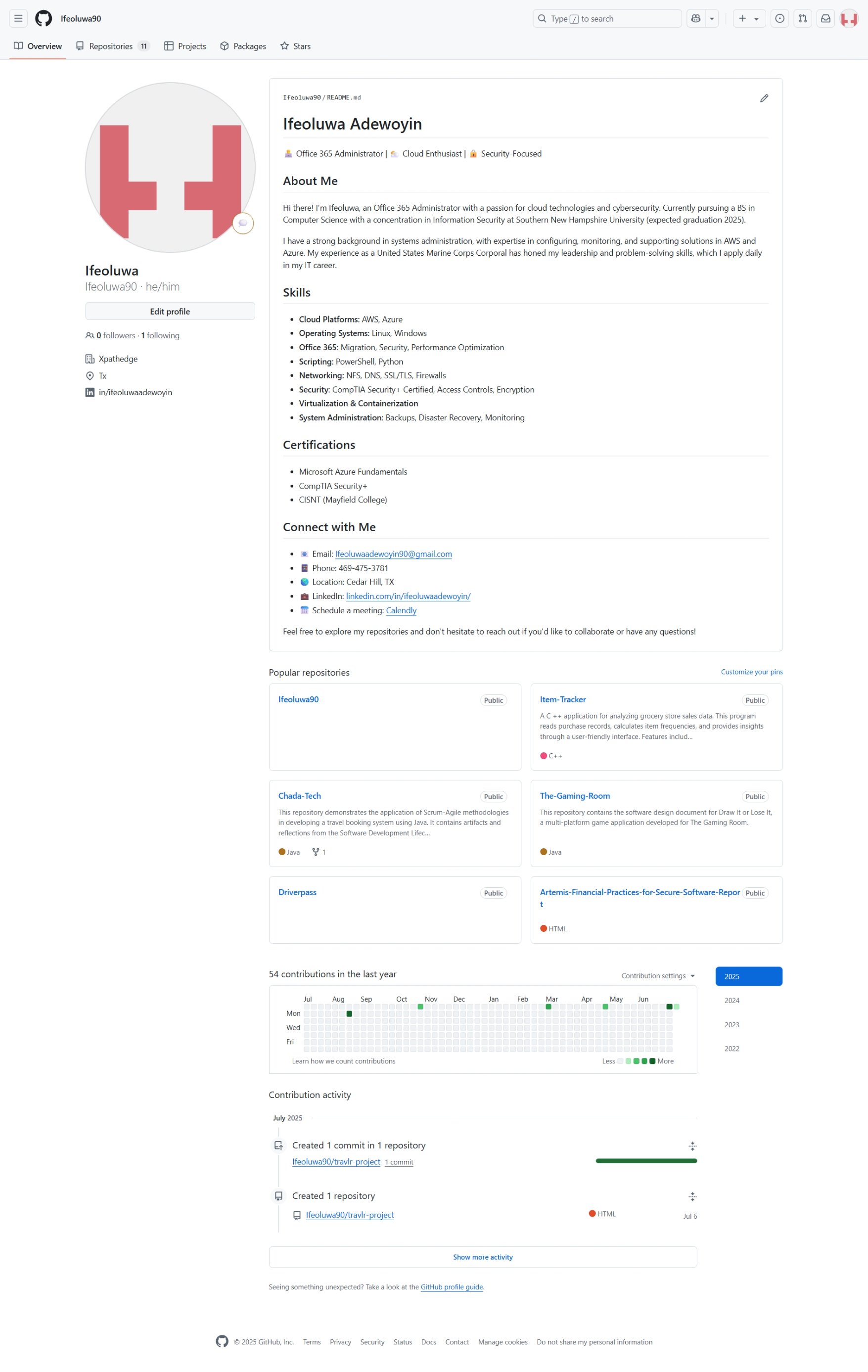
These skills are essential for cybersecurity roles where I will need to architect secure solutions, conduct security assessments, and implement robust defense mechanisms across various platforms and technologies.

* 1. How does this contribute to the specialization you are targeting for your career?

I am targeting a specialization in cybersecurity with particular focus on application security and secure software development. This ePortfolio contributes to this specialization by:

* Demonstrating security-first thinking across mobile (Android), web (Python/Dash), and distributed system architectures
* Showing my ability to identify and mitigate security vulnerabilities in different database technologies and platforms
* Highlighting my understanding of encryption, authentication, and access control implementation
* Proving my capability to enhance existing applications with enterprise-grade security measures that align with industry cybersecurity frameworks and standards

1. **ePortfolio Set Up:**
   1. Submit a **screen capture** of your ePortfolio GitHub Pages home page that clearly shows your URL.
      1. You already have a repository in GitHub where you uploaded projects in previous courses. Your ePortfolio will reside in GitHub but can link to work at other sites, such as Bitbucket.
   2. Use the GitHub Pages link in the Resource section for directions on:
      1. How to create your GitHub website and publish code to GitHub Pages
      2. Issues, such as adding links to other sites
   3. Paste a screenshot of your GitHub Pages home page with your URL clearly showing in the space below.

****

**Github link:** [**Ifeoluwa90 (Ifeoluwa)**](https://github.com/Ifeoluwa90)

1. **Enhancement Plan:** 
   1. **Category One:** Software Engineering and Design
      1. **Select an** **artifact** that is **aligned with** **the** software engineering and design **category** and explain its origin. Submit a file containing the code for the artifact you choose with your enhancement plan.

Artifact: Mobile Inventory Management Application Origin: CS 360 - Mobile Architecture and Programming

This artifact is a comprehensive Android inventory management application developed in Java using Android Studio. The application allows businesses to track inventory items, monitor stock levels, and receive SMS notifications for low stock alerts. The original version implements Material Design principles with a Model-View-Adapter architecture, SQLite database integration, and runtime permission handling for SMS functionality. The app features secure authentication, CRUD operations for inventory items, real-time stock monitoring, and an intuitive dashboard with color-coded stock level indicators.

Note: Your artifact may be work from the following courses:

* IT 145: Foundation in Application Development
* CS 250: Software Development Lifecycle
* CS 260: Data Structures and Algorithms
* IT 315: Object Oriented Analysis and Design
* CS 320: Software Testing, Automation, and Quality Assurance
* CS 330: Computational Graphics and Visualization
* CS 340: Advanced Programming Concepts
* CS 350: Emerging Systems Architectures and Technologies
* CS 360: Mobile Architecture and Programming
* IT 365: Operating Environments
* IT 380: Cybersecurity and Information Assurance
* CS 405: Secure Coding
* CS 410: Reverse Software engineering
* IT 340: Network and Telecommunication Management
* IT 380: Cybersecurity and Information Assurance
  + 1. **Describe** a practical, well-illustrated **plan** for enhancement in alignment with the category, including a pseudocode or flowchart that illustrates the planned enhancement.

Modernize the application by implementing enterprise-grade security architecture including zero-trust security model, advanced threat detection, secure DevOps practices, and comprehensive security monitoring and incident response capabilities  
  
// Enhanced Mobile App with Cybersecurity Focus

CLASS SecureInventoryApp {

// Zero-Trust Security Architecture

INITIALIZE ZeroTrustSecurityManager

INITIALIZE ThreatDetectionEngine

INITIALIZE SecureDevOpsFramework

INITIALIZE ComplianceManager(SOC2, GDPR, HIPAA)

FUNCTION implementZeroTrustAuthentication():

// Multi-factor authentication with adaptive risk assessment

IMPLEMENT adaptive MFA based on:

- Device fingerprinting and behavioral analysis

- Geolocation and network analysis

- Time-based access patterns

- Biometric verification with liveness detection

SETUP continuous authentication validation

IMPLEMENT session risk scoring and automatic re-authentication

CONFIGURE privilege escalation controls

RETURN authenticated\_secure\_session

FUNCTION advancedEncryptionImplementation():

// End-to-end encryption with key management

IMPLEMENT AES-256-GCM for data at rest

IMPLEMENT TLS 1.3 with certificate pinning for data in transit

SETUP Hardware Security Module (HSM) integration

CONFIGURE automated key rotation every 90 days

IMPLEMENT perfect forward secrecy

SETUP secure key escrow for compliance

// Field-level encryption for sensitive data

ENCRYPT\_FIELDS: [

inventory\_value, supplier\_information,

customer\_data, financial\_records

]

FUNCTION realTimeSecurityMonitoring():

// SIEM integration and threat detection

IMPLEMENT behavioral analytics for anomaly detection

SETUP real-time monitoring for:

- Unusual access patterns

- Data exfiltration attempts

- Privilege escalation attempts

- API abuse and rate limiting violations

CONFIGURE automated incident response:

- Automatic session termination for threats

- Real-time alerting to security team

- Forensic data collection and preservation

- Compliance reporting automation

FUNCTION secureAPIImplementation():

// API security following OWASP API Security Top 10

IMPLEMENT OAuth 2.1 with PKCE for authorization

SETUP rate limiting and DDoS protection

CONFIGURE API gateway with WAF integration

VALIDATE all inputs against security schemas:

- SQL injection prevention

- NoSQL injection prevention

- XSS and CSRF protection

- Command injection prevention

IMPLEMENT API versioning with security controls

SETUP comprehensive API logging and monitoring

FUNCTION vulnerabilityManagement():

// Continuous security assessment

INTEGRATE with vulnerability scanners (OWASP ZAP, Burp Suite)

IMPLEMENT automated dependency scanning

SETUP container security scanning in CI/CD

CONFIGURE scheduled penetration testing

IMPLEMENT security code review automation

SETUP threat modeling and risk assessment workflows

FUNCTION complianceAndGovernance():

// Security governance framework

IMPLEMENT data classification and handling policies

SETUP audit trails and compliance reporting

CONFIGURE data retention and deletion policies

ENSURE compliance with:

- GDPR data protection requirements

- SOC 2 Type II controls

- NIST Cybersecurity Framework

- ISO 27001 security management

FUNCTION incidentResponseCapabilities():

// Cybersecurity incident response

SETUP automated threat response workflows

IMPLEMENT forensic data collection

CONFIGURE incident severity classification

DEFINE response procedures:

- Containment and isolation protocols

- Evidence preservation procedures

- Communication and notification workflows

- Recovery and business continuity plans

}

// Secure Backend API with Advanced Cybersecurity

CLASS CyberSecureInventoryAPI {

INITIALIZE SecurityFramework with OWASP compliance

SETUP Web Application Firewall (WAF)

CONFIGURE Security Information Event Management (SIEM)

FUNCTION secureAPIEndpoints():

// Implement security controls for each endpoint

APPLY rate limiting per user/IP

IMPLEMENT request signing and validation

SETUP input sanitization and validation

CONFIGURE output encoding and data masking

ENDPOINTS with security controls:

- POST /auth/secure-login (MFA, device validation)

- GET /inventory/secure-sync (encrypted, signed responses)

- POST /inventory/secure-create (input validation, audit logging)

- PUT /inventory/secure-update (change tracking, approval workflows)

- DELETE /inventory/secure-archive (soft delete, audit trail)

- GET /security/audit-logs (role-based access, data masking)

FUNCTION threatIntelligenceIntegration():

INTEGRATE with threat intelligence feeds

IMPLEMENT IP reputation checking

SETUP behavioral analysis and machine learning

CONFIGURE automated blocking of malicious activities

FUNCTION securityTestingFramework():

IMPLEMENT automated security testing in CI/CD:

- Static Application Security Testing (SAST)

- Dynamic Application Security Testing (DAST)

- Interactive Application Security Testing (IAST)

- Software Composition Analysis (SCA)

SETUP continuous security monitoring

CONFIGURE security regression testing

}

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For this category of enhancement, consider improving a piece of software, transferring a project into a different language, reverse engineering a piece of software for a different operating system, or expanding a project’s complexity. These are just recommendations. Consider being creative and proposing an alternative enhancement to your instructor.

Think about what additions to include to complete the enhancement criteria in this category. Since one example option is to port to a new language, that is the kind of scale that is expected. This does not mean you need to port to a new language but instead have an equivalent scale of enhancement. Underlying expectations of any enhancement include fixing errors, debugging, and cleaning up comments, but these are not enhancements themselves.

* + 1. Explain how the planned enhancement will **demonstrate** specific **skills** and align with course outcomes.
       1. Identify and describe the specific skills you will demonstrate that align with the course outcome.
* Enterprise cybersecurity architecture design and implementation
* Zero-trust security model implementation
* Advanced threat detection and incident response
* Security compliance and governance frameworks
* Vulnerability management and penetration testing methodologies
* Secure software development lifecycle (SSDLC) practices
* Security monitoring and SIEM integration
  + - 1. Select one or more of the course outcomes below that your enhancement will align with.
* Outcome 1: Collaborative environments through secure multi-user systems and role-based access controls that enable diverse security teams to support organizational cybersecurity decision-making
* Outcome 2: Professional-quality cybersecurity documentation including threat models, security architecture diagrams, incident response procedures, and compliance reports adapted for technical and executive audiences
* Outcome 4: Innovative cybersecurity techniques using advanced threat detection, zero-trust architecture, and automated security testing that deliver enhanced security posture for organizations
* Outcome 5: Advanced security mindset through comprehensive implementation of defense-in-depth strategies, continuous threat monitoring, vulnerability management, and proactive security controls that anticipate and mitigate sophisticated cyber threats

Course Outcomes:

1. Employ strategies for building collaborative environments that enable diverse audiences to support organizational decision-making in the field of computer science.
2. Design, develop, and deliver professional-quality oral, written, and visual communications that are coherent, technically sound, and appropriately adapted to specific audiences and contexts.
3. Design and evaluate computing solutions that solve a given problem using algorithmic principles and computer science practices and standards appropriate to its solution while managing the trade-offs involved in design choices.
4. Demonstrate an ability to use well-founded and innovative techniques, skills, and tools in computing practices for the purpose of implementing computer solutions that deliver value and accomplish industry-specific goals.
5. Develop a security mindset that anticipates adversarial exploits in software architecture and designs to expose potential vulnerabilities, mitigate design flaws, and ensure privacy and enhanced security of data and resources.
   1. **Category Two:** Algorithms and Data Structures
6. **Select an artifact** that is **aligned with the** algorithms and data structures **category** and explain its origin. Submit a file containing the code for the artifact you choose with your enhancement plan. You may choose work from the courses listed under Category One.

Artifact: Grazioso Salvare Animal Rescue Dashboard - Database Query and Filtering System Origin: CS 340 - Client/Server Development

This artifact implements a sophisticated MongoDB query system for filtering animal shelter data based on complex rescue training criteria. The original implementation uses Python with PyMongo to create multi-field database queries that filter animals by breed, age, sex, and other characteristics for different rescue types (Water Rescue, Mountain/Wilderness Rescue, Disaster/Individual Tracking). The system processes over 10,000 animal records and provides real-time filtering capabilities for an interactive web dashboard.

1. **Describe** a practical, well-illustrated **plan** for enhancement in alignment with the category, including a pseudocode or flowchart that illustrates the planned enhancement.

Implement advanced search algorithms with fuzzy matching, optimize query performance with indexing strategies, and add machine learning-based recommendation system for identifying optimal rescue candidates.

// Enhanced Animal Rescue Matching System

CLASS AdvancedRescueMatchingSystem {

// Initialize with optimized data structures

INITIALIZE FuzzyStringMatcher using Levenshtein distance

INITIALIZE MLRecommendationEngine with trained model

INITIALIZE CachedQueryOptimizer with LRU cache

INITIALIZE GeospatialIndexManager for location queries

FUNCTION optimizedDatabaseIndexing():

CREATE compound indexes:

- {breed: 1, age\_in\_weeks: 1, sex: 1} for rescue queries

- {location: "2dsphere"} for geospatial queries

- {breed: "text", name: "text"} for text search

IMPLEMENT query performance monitoring

SETUP automatic index optimization based on usage patterns

FUNCTION fuzzyBreedMatching(searchTerm, threshold=0.8):

candidateBreeds = []

FOR each breed in breedDatabase:

similarity = calculateLevenshteinSimilarity(searchTerm, breed)

IF similarity >= threshold:

candidateBreeds.APPEND({breed: breed, similarity: similarity})

SORT candidateBreeds by similarity descending

RETURN candidateBreeds

FUNCTION advancedRescueQuery(rescueType, customCriteria={}):

// Build optimized aggregation pipeline

pipeline = []

// Stage 1: Initial filtering with indexes

matchStage = buildMatchStage(rescueType, customCriteria)

pipeline.APPEND({"$match": matchStage})

// Stage 2: Geospatial filtering if location specified

IF customCriteria.contains("location"):

geoStage = buildGeospatialStage(customCriteria.location)

pipeline.APPEND(geoStage)

// Stage 3: Fuzzy breed matching

IF customCriteria.contains("fuzzyBreed"):

fuzzyBreeds = fuzzyBreedMatching(customCriteria.fuzzyBreed)

pipeline.APPEND({"$match": {"breed": {"$in": fuzzyBreeds}}})

// Stage 4: ML-based scoring

pipeline.APPEND({

"$addFields": {

"rescueScore": {"$function": {

"body": mlScoringFunction,

"args": ["$breed", "$age\_in\_weeks", "$training\_history"],

"lang": "js"

}}

}

})

// Stage 5: Sort by composite score

pipeline.APPEND({"$sort": {"rescueScore": -1, "age\_in\_weeks": 1}})

RETURN database.aggregate(pipeline)

FUNCTION mlRecommendationEngine():

// Train model on historical successful rescue placements

features = [

"breed\_encoded", "age\_normalized", "weight\_normalized",

"training\_responsiveness", "health\_score", "temperament\_score"

]

// Use Random Forest for interpretable recommendations

model = RandomForestClassifier(

n\_estimators=100,

max\_depth=10,

feature\_importance=True

)

TRAIN model on historical\_success\_data

FUNCTION predictRescueSuccess(animalFeatures):

probability = model.predict\_proba(animalFeatures)

featureImportance = model.feature\_importances\_

RETURN {

"successProbability": probability,

"topFactors": getTopContributingFactors(featureImportance),

"recommendations": generateImprovementSuggestions(animalFeatures)

}

FUNCTION cacheOptimization():

// Implement intelligent caching for frequent queries

queryCache = LRUCache(maxSize=1000)

FUNCTION cachedQuery(queryHash):

IF queryHash in queryCache:

RETURN queryCache.get(queryHash)

result = executeQuery(query)

queryCache.put(queryHash, result, TTL=300) // 5-minute cache

RETURN result

FUNCTION performanceAnalytics():

// Track and optimize query performance

MONITOR query execution times

IDENTIFY slow queries and optimization opportunities

GENERATE performance reports

RECOMMEND index improvements

RETURN {

"averageQueryTime": calculateAverageTime(),

"slowQueries": identifySlowQueries(),

"indexRecommendations": suggestIndexImprovements(),

"cacheHitRate": calculateCacheEfficiency()

}

}

// Enhanced Data Structure for Animal Records

CLASS OptimizedAnimalRecord {

// Use efficient data structures for fast access

PRIMARY\_KEY: ObjectId

INDEXED\_FIELDS: {breed, age\_in\_weeks, sex\_upon\_outcome}

GEOSPATIAL\_INDEX: {latitude, longitude}

TEXT\_INDEX: {name, breed, description}

// Computed fields for faster filtering

COMPUTED\_FIELDS: {

rescue\_compatibility\_score: Float,

age\_category: Enum,

training\_readiness: Float

}

}

For this category of enhancement, consider improving the efficiency of a project or expanding the complexity of the use of data structures and algorithms for your artifact. These are just recommendations. Consider being creative and proposing an alternative enhancement to your instructor. Note: You only need to choose one type of enhancement per category.

Think about what additions to include to complete the enhancement criteria in this category. Since one example option is to port to a new language, that is the kind of scale that is expected. Perhaps you might increase the efficiency and time complexity of an algorithm in an application and detail the logic of the increased time complexity. Remember, you do not need to port to a new language but instead have an equivalent scale of enhancement. Underlying expectations of any enhancement include fixing errors, debugging, and cleaning up comments, but these are not enhancements themselves.

1. Explain how the planned enhancement will **demonstrate** specific **skills** and align with course outcomes.
   1. Identify and describe the specific skills you will demonstrate to align with the course outcome.

* Advanced cybersecurity algorithms (threat detection, behavioral analysis)
* Machine learning for security applications and anomaly detection
* Performance optimization with security considerations
* Cryptographic algorithm implementation and analysis
* Security-focused data structure design and access controls
* Secure search algorithms with privacy preservation
  1. Select one or more of the course outcomes listed under Category One that your enhancement will align with.
* Outcome 3: Algorithmic principles through security-aware algorithm design, threat detection systems, and cryptographic implementations that solve complex cybersecurity problems while managing performance and security trade-offs
* Outcome 4: Innovative cybersecurity techniques using machine learning for threat detection, advanced security algorithms, and performance optimization strategies that deliver enhanced security capabilities
* Outcome 5: Advanced security mindset through implementation of security algorithms, threat detection systems, and privacy-preserving data access patterns that proactively identify and mitigate security threats
  1. **Category Three: Databases**
     1. **Select an artifact** that is **aligned with the** databases **category** and explain its origin. Submit a file containing the code for the artifact you choose with your enhancement plan. You may choose work from the courses listed under Category One.

Artifact: The Gaming Room - Draw It or Lose It Software Design Document and Database Architecture Origin: CS 230 - Operating Platforms

This artifact represents the comprehensive software design document for a multi-platform game application that requires robust database architecture to support real-time gameplay, user management, and cross-platform synchronization. The original design included analysis of different database approaches for handling game sessions, player data, team management, and ensuring unique identifiers across distributed systems. The document outlined requirements for supporting multiple concurrent games, player authentication, and maintaining game state consistency.

* + 1. **Describe** a practical, well-illustrated **plan** for enhancement in alignment with the category, including a pseudocode or flowchart that illustrates the planned enhancement.

Implement a comprehensive distributed database solution using a hybrid approach with Redis for real-time game state, PostgreSQL for persistent data, and implement advanced features including real-time leaderboards, game analytics, and cross-platform data synchronization.

// Enhanced Multi-Database Gaming System

CLASS GameDatabaseArchitecture {

// Initialize multiple database connections for different use cases

INITIALIZE RedisCluster for real-time game state

INITIALIZE PostgreSQL for persistent user/game data

INITIALIZE InfluxDB for time-series analytics

INITIALIZE ElasticSearch for game logs and searching

// Database Schema Design

FUNCTION setupDatabaseSchemas():

// PostgreSQL Schema for Persistent Data

CREATE TABLE users (

user\_id UUID PRIMARY KEY,

username VARCHAR(50) UNIQUE NOT NULL,

email VARCHAR(100) UNIQUE NOT NULL,

password\_hash VARCHAR(255) NOT NULL,

created\_at TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

last\_login TIMESTAMP,

total\_games\_played INTEGER DEFAULT 0,

win\_rate DECIMAL(5,2) DEFAULT 0.00,

INDEX idx\_username (username),

INDEX idx\_email (email)

);

CREATE TABLE games (

game\_id UUID PRIMARY KEY,

game\_name VARCHAR(100) NOT NULL,

created\_by UUID REFERENCES users(user\_id),

game\_status ENUM('waiting', 'active', 'completed', 'cancelled'),

max\_teams INTEGER DEFAULT 4,

max\_players\_per\_team INTEGER DEFAULT 4,

rounds\_total INTEGER DEFAULT 4,

round\_duration\_seconds INTEGER DEFAULT 60,

created\_at TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

started\_at TIMESTAMP,

completed\_at TIMESTAMP,

INDEX idx\_status (game\_status),

INDEX idx\_created\_by (created\_by)

);

CREATE TABLE teams (

team\_id UUID PRIMARY KEY,

game\_id UUID REFERENCES games(game\_id) ON DELETE CASCADE,

team\_name VARCHAR(50) NOT NULL,

team\_score INTEGER DEFAULT 0,

created\_at TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

UNIQUE(game\_id, team\_name),

INDEX idx\_game\_id (game\_id)

);

CREATE TABLE players (

player\_id UUID PRIMARY KEY,

user\_id UUID REFERENCES users(user\_id),

team\_id UUID REFERENCES teams(team\_id) ON DELETE CASCADE,

game\_id UUID REFERENCES games(game\_id) ON DELETE CASCADE,

joined\_at TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

is\_team\_captain BOOLEAN DEFAULT FALSE,

UNIQUE(user\_id, game\_id),

INDEX idx\_team\_id (team\_id),

INDEX idx\_game\_id (game\_id)

);

CREATE TABLE game\_rounds (

round\_id UUID PRIMARY KEY,

game\_id UUID REFERENCES games(game\_id) ON DELETE CASCADE,

round\_number INTEGER NOT NULL,

image\_url VARCHAR(500) NOT NULL,

correct\_answer VARCHAR(100) NOT NULL,

started\_at TIMESTAMP,

ended\_at TIMESTAMP,

winning\_team\_id UUID REFERENCES teams(team\_id),

UNIQUE(game\_id, round\_number),

INDEX idx\_game\_id (game\_id)

);

// Real-time Game State Management with Redis

FUNCTION realTimeGameState():

// Redis Key Patterns for Real-time Data

DEFINE gameStateKey = "game:{gameId}:state"

DEFINE playerSessionKey = "player:{playerId}:session"

DEFINE teamScoreKey = "game:{gameId}:team:{teamId}:score"

DEFINE currentRoundKey = "game:{gameId}:current\_round"

FUNCTION updateGameState(gameId, stateData):

// Use Redis pipeline for atomic updates

pipeline = redis.pipeline()

pipeline.hset(gameStateKey, stateData)

pipeline.expire(gameStateKey, 7200) // 2 hour expiration

pipeline.publish(f"game:{gameId}:updates", json.dumps(stateData))

pipeline.execute()

FUNCTION getRealtimeGameData(gameId):

// Efficient data retrieval for dashboard

pipeline = redis.pipeline()

pipeline.hgetall(f"game:{gameId}:state")

pipeline.hgetall(f"game:{gameId}:current\_round")

pipeline.smembers(f"game:{gameId}:active\_players")

results = pipeline.execute()

RETURN {

"gameState": results[0],

"currentRound": results[1],

"activePlayers": results[2]

}

// Advanced Analytics and Reporting

FUNCTION gameAnalyticsSystem():

// InfluxDB for time-series game analytics

FUNCTION recordGameEvent(gameId, eventType, playerData, timestamp):

point = {

"measurement": "game\_events",

"tags": {

"game\_id": gameId,

"event\_type": eventType,

"team\_id": playerData.teamId

},

"fields": {

"player\_id": playerData.playerId,

"response\_time": playerData.responseTime,

"correct": playerData.isCorrect,

"round\_number": playerData.roundNumber

},

"time": timestamp

}

influxDB.write\_points([point])

FUNCTION generateGameAnalytics(gameId):

// Complex analytical queries

query = f"""

SELECT

mean(response\_time) as avg\_response\_time,

count(\*) as total\_guesses,

sum(correct) as correct\_guesses

FROM game\_events

WHERE game\_id = '{gameId}'

GROUP BY team\_id, round\_number

"""

results = influxDB.query(query)

RETURN processAnalyticsResults(results)

// Cross-Platform Synchronization

FUNCTION crossPlatformSync():

FUNCTION syncGameState(gameId, platforms):

// Ensure consistent state across all platforms

canonicalState = redis.hgetall(f"game:{gameId}:state")

FOR platform in platforms:

ASYNC sendStateUpdate(platform, gameId, canonicalState)

// Handle conflict resolution

IF conflictsDetected():

resolvedState = resolveStateConflicts(conflicts)

updateCanonicalState(gameId, resolvedState)

FUNCTION handleOfflineReconnection(playerId, gameId):

// Sync player with current game state when reconnecting

currentState = getRealtimeGameData(gameId)

missedEvents = getEventsSince(gameId, player.lastSyncTime)

RETURN {

"currentState": currentState,

"missedEvents": missedEvents,

"syncTimestamp": getCurrentTimestamp()

}

// Performance Optimization

FUNCTION databaseOptimization():

// Implement read replicas for scaling

SETUP PostgreSQL read replicas for analytics queries

CONFIGURE Redis clustering for high availability

// Implement intelligent caching

FUNCTION cachedQuery(queryKey, queryFunction, ttl=300):

cached = redis.get(f"cache:{queryKey}")

IF cached:

RETURN json.loads(cached)

result = queryFunction()

redis.setex(f"cache:{queryKey}", ttl, json.dumps(result))

RETURN result

// Database connection pooling

SETUP connection pools:

- PostgreSQL: max\_connections=20, min\_connections=5

- Redis: max\_connections=50, connection\_timeout=5

// Automated cleanup and maintenance

SCHEDULE daily cleanup of expired game data

SCHEDULE weekly database optimization and index maintenance

MONITOR database performance metrics

}

// Distributed Transaction Management

CLASS GameTransactionManager {

FUNCTION atomicGameOperation(operations):

// Use two-phase commit for distributed operations

BEGIN distributed transaction

TRY:

FOR operation in operations:

EXECUTE operation

RECORD operation in transaction log

COMMIT all operations

CLEAR transaction log

CATCH TransactionError:

ROLLBACK all operations

RESTORE from transaction log

RAISE TransactionFailedException

}

For this category of enhancement, consider adding more advanced concepts of MySQL, incorporating data mining, creating a MongoDB interface with HTML/JavaScript, or building a full stack with a different programming language for your artifact. These are just recommendations; consider being creative and proposing an alternative enhancement to your instructor. Note: You only need to choose one type of enhancement per category.

Think about what additions to include to complete the enhancement criteria in this category. Since one example option is to port to a new language, that is the kind of scale that is expected. Perhaps you might increase the efficiency and time complexity of an algorithm in an application and detail the logic of the increased time complexity. Remember, you do not need to port to a new language but instead have an equivalent scale of enhancement. Underlying expectations of any enhancement include fixing errors, debugging, and cleaning up comments, but these are not enhancements themselves.

* + 1. Explain how the planned enhancement will **demonstrate** specific **skills** and align with course outcomes.
       1. Identify and describe the specific skills you will demonstrate that align with the course outcome.
* Secure distributed database architecture design
* Database security and access control implementation
* Cybersecurity audit trails and compliance logging
* Encrypted data storage and secure backup strategies
* Database vulnerability assessment and hardening
* Secure transaction management and data integrity protection
* Security incident response for database systems
  + - 1. Select one or more of the course outcomes listed under Category One that your enhancement will align with.
* Outcome 1: Collaborative cybersecurity environments through secure multi-platform data access controls that enable diverse security teams to monitor and protect organizational data assets
* Outcome 3: Secure computing solutions using appropriate database security technologies while managing trade-offs between security, performance, and availability in distributed systems
* Outcome 4: Innovative database security techniques including advanced encryption, secure backup strategies, and real-time security monitoring that deliver enhanced data protection for organizations
* Outcome 5: Comprehensive security mindset through defense-in-depth database security, advanced access controls, encrypted communications, audit logging, and proactive threat detection to protect against sophisticated database attacks and insider threats

1. **ePortfolio Overall Skill Set**
   1. Accurately describe the **skill set** to be illustrated by the **ePortfolio** **overall**.
      1. Skills and outcomes planned to be illustrated in the code review

* Cybersecurity Code Assessment: Systematic evaluation of existing code for security vulnerabilities, secure coding practices, and compliance with cybersecurity frameworks (OWASP, NIST)
* Vulnerability Analysis: Identification and assessment of potential security weaknesses in mobile apps, web applications, and database systems with detailed remediation strategies
* Security Architecture Evaluation: Assessment of security design patterns, threat models, and defensive architectures with recommendations for security improvements
* Performance vs. Security Trade-offs: Analysis of how security implementations impact system performance and strategies for optimizing both security and efficiency
* Professional Cybersecurity Communication: Clear technical documentation of security findings, risk assessments, and security enhancement plans for both technical teams and executive stakeholders

This aligns with Outcomes 2, 4, and 5 by demonstrating professional cybersecurity communication, innovative security improvement techniques, and comprehensive vulnerability analysis across multiple platforms.

* + 1. Skills and outcomes planned to be illustrated in the narratives
* **Cybersecurity Storytelling**: Ability to explain complex security enhancements and threat mitigation strategies in clear, compelling narratives that connect security investments to business risk reduction
* **Cross-Platform Security Integration**: Description of how mobile security, web application security, and database security work together to create comprehensive defense-in-depth strategies
* **Security Problem-Solving Methodology**: Detailed explanation of systematic approaches to identifying security threats, assessing risks, and implementing effective countermeasures
* **Industry Security Alignment**: Connection of academic security projects to real-world cybersecurity challenges and emerging threat landscapes
* **Reflective Security Learning**: Demonstration of security mindset development and continuous learning about evolving cyber threats and defensive technologies

This aligns with **Outcomes 1 and 2** by showing collaborative cybersecurity communication skills and professional-quality security documentation adapted for diverse stakeholders in cybersecurity contexts.

* + 1. Skills and outcomes planned to be illustrated in the professional self-assessment
* Cybersecurity Career Development: Strategic thinking about how technical security skills align with cybersecurity career goals and preparation for Master's in Information Security studies
* Interdisciplinary Security Integration: Understanding of how cybersecurity principles apply across mobile development, web applications, and distributed systems in enterprise environments
* Security Leadership and Collaboration: Examples of how cybersecurity expertise can support security teams and organizational risk management decision-making
* Continuous Security Learning Commitment: Demonstration of staying current with emerging threats, security technologies, and commitment to cybersecurity professional development
* Ethical Cybersecurity Practice: Understanding of responsible security research, ethical hacking principles, and the impact of security decisions on organizational resilience and user privacy

This aligns with Outcome 1 by demonstrating strategies for building collaborative cybersecurity environments and supporting organizational security decision-making across diverse technology platforms and threat scenarios.