MoneySplit - Assignment 2 Implementation Report

Course: Software Engineering II **Assignment:** Assignment 2 - Code Quality, Testing, CI/CD, and Deployment
Date: November 30, 2025 **Live Deployment:** https://moneysplit-app-96aca02a2d13.herokuapp.com/
Repository: https://github.com/SnileMB/MoneySplit

Executive Summary

This report documents the transformation of MoneySplit from a functional prototype into a production-ready application with professional development practices, automated quality assurance, containerized deployment, and comprehensive monitoring.

Key Achievements:

- ✅ 570 automated tests achieving 71% code coverage (exceeds 70% requirement)
- ✅ GitHub Actions CI/CD pipeline with matrix testing (Python 3.9-3.12, Node 18-22)
- ✅ Live Heroku deployment with Docker containerization
- ✅ Prometheus metrics and Grafana dashboards
- ✅ SOLID principles implementation with comprehensive refactoring

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1. Code Quality and Refactoring (25%)

Code Smells Addressed

Identified and resolved critical issues:

- **Hardcoded Values**: Centralized 130+ configuration constants in `config.py`
- **Inconsistent Naming**: Standardized terminology across codebase
- **Poor Error Handling**: Implemented custom exception hierarchy with 8 specific exception types
- **No Logging**: Added structured JSON logging with file rotation (10MB, 5 backups)

SOLID Principles Implementation

Single Responsibility Principle: Separated concerns into focused modules:

- `api/health.py` - Health checks only
- `api/metrics.py` - Prometheus metrics
- `api/middleware.py` - Request/response handling
- `exceptions.py` - Custom exception hierarchy

Open/Closed Principle: Custom exceptions allow extension without modification. Middleware pattern enables adding request processing without changing core API.

Dependency Inversion Principle: API layer depends on abstractions (Pydantic models), not concrete implementations. Database operations isolated in `DB/setup.py`.

Code Quality Tools Implemented

Tool	Purpose	Impact
Black	Auto-formatting	27 files formatted, consistent style
Flake8	Linting	Max complexity: 10, 0 violations

Mypy	Type checking	85% type coverage
Bandit	Security scanning	Vulnerability detection in CI
EditorConfig	Editor consistency	Cross-platform standards

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2. Testing and Coverage (20%)

Test Infrastructure

- **Framework**: pytest with fixtures and parametrization
- **Coverage Tools**: pytest-cov, Coverage.py with HTML/XML reports
- **Test Organization**: 6 test files covering unit, integration, and edge cases

Coverage Results

71% Overall Coverage (570 tests passing) - EXCEEDS 70% REQUIREMENT

Module	Coverage	Key Tests
api/models.py	100%	Pydantic validation
api/health.py	100%	Health endpoints
api/middleware.py	100%	Error handling
Logic/tax_engine.py	100%	Tax calculations
Logic/tax_comparison.py	98%	Strategy comparison
Logic/pdf_generator.py	96%	Report generation
Logic/forecasting.py	79%	ML predictions
api/main.py	61%	API endpoints
DB/setup.py	55%	CRUD operations

Test Categories

- **Unit Tests (320+)**: Tax calculations, validation, business logic, DB operations
- **Integration Tests (180+)**: API endpoints, database with foreign keys, exports
- **Edge Cases (70+)**: Boundary values, invalid inputs, duplicates, concurrent operations

CI Coverage Enforcement

Pipeline fails if coverage drops below 70%, preventing quality regression.

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3. CI/CD Pipeline (20%)

GitHub Actions Workflow

File: `.github/workflows/ci.yml`

Triggers: Push to main/feature/assignment branches, pull requests to main

Multi-Job Pipeline:

```
Backend Quality (Python 3.9–3.12)     Frontend Quality (Node 18–22)
├─ Dependency caching                 ├─ npm install with caching
├─ Flake8 linting                     ├─ ESLint (0 warnings allowed)
├─ Black format check                 ├─ TypeScript compilation
├─ Mypy type checking                 ├─ React build
├─ Pytest execution                   └─ Jest tests with coverage
├─ Coverage ≥70% enforcement
└─ Codecov upload (optional)

Docker Build                          Security Scanning
├─ Backend image build                ├─ Bandit vulnerability scan
└─ Frontend image build               └─ JSON report generation
```

Performance: 8-12 minutes average (with cache), 15-20 minutes cold start

Key Features:

- Matrix testing ensures compatibility across Python 3.9-3.12 and Node 18-22
- Dependency caching reduces build time by ~60%
- Coverage threshold enforcement prevents regression
- Artifacts preserved for 30 days (coverage reports, builds)

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4. Deployment and Containerization (20%)

Docker Implementation

Multi-Stage Backend Dockerfile:

- Stage 1: Build dependencies
- Stage 2: Runtime with non-root user, health checks every 30s
- Benefits: 40% smaller image, security hardening, reproducible builds

Frontend Dockerfile:

- Stage 1: Build React app with npm
- Stage 2: Serve with Nginx (alpine), gzip compression, security headers

Docker Compose Stack

4 Services:

Service	Port	Purpose
api	8000	FastAPI REST API
frontend	3000	React web UI
prometheus	9090	Metrics collection
grafana	3001	Dashboard visualization

Features: Custom network, volume persistence, health checks, service dependencies

Heroku Production Deployment

Live: https://moneysplit-app-96aca02a2d13.herokuapp.com/

Architecture:

- **Buildpacks**: Node.js (frontend build) → Python (API runtime)
- **Procfile**: `uvicorn api.main:app --host 0.0.0.0 --port $PORT`
- **Database**: SQLite with automatic initialization on startup
- **Features**: Automatic deployments from `assignment-2` branch, HTTPS by default, zero-downtime restarts

FastAPI serves React: Backend mounts frontend build files and handles React Router with catch-all routes.

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5. Monitoring and Documentation (15%)

Health Check System

Three-Tier Monitoring:

1. **Liveness (`/health`)**: Basic uptime verification for load balancers
2. **Readiness (`/health/ready`)**: Database connectivity, system resources (CPU, memory)
3. **Detailed (`/health/detailed`)**: Full diagnostics with version, environment, feature flags

Prometheus Metrics

Endpoint: `/metrics`

Custom Metrics:

- `http_requests_total` - Total requests by method, endpoint, status
- `http_request_duration_seconds` - Latency histogram
- `http_requests_in_progress` - Active requests gauge
- `http_exceptions_total` - Exceptions by type
- Database operation duration and counts

Configuration: Scrape interval 10s for API, 15s globally

Grafana Dashboard

Access: http://localhost:3001 (Docker Compose), Credentials: admin/admin

8 Dashboard Panels:

1. Request rate over time
2. Error rate (4xx, 5xx)
3. Response time percentiles (P50, P95, P99)
4. Active requests gauge
5. Top endpoints by volume
6. Status code distribution
7. Database operation latency
8. System resources (CPU, memory)

Alerts: Error rate >5% for 5 minutes, P95 latency >2s for 10 minutes, service down >1 minute

Documentation

5 Comprehensive Files:

1. **README.md** - Features, quick start (4 run methods), testing, CI/CD, deployment, API docs
2. **REPORT.md** - This report covering all Assignment 2 improvements
3. **SOLID.md** - SOLID principles application and design patterns
4. **TESTING.md** - Test organization, coverage measurement, running tests
5. **MONITORING.md** - Prometheus/Grafana setup, alert rules, log aggregation

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6. Challenges and Solutions

Challenge 1: Test Coverage Below 70%

- **Issue**: Initial 32% coverage, target 70%
- **Solution**: Added 485 tests (85→570), focused on DB functions, achieved 71%

Challenge 2: Heroku Deployment Errors

- **Issues**: gunicorn (WSGI) vs uvicorn (ASGI), missing prometheus-client, no DB initialization
- **Solutions**: Updated Procfile to uvicorn, added dependency, implemented startup event

Challenge 3: Frontend Network Errors

- **Issue**: Hardcoded localhost URLs failed in production
- **Solution**: Environment-aware API_BASE_URL using `process.env.NODE_ENV`

Challenge 4: CI/CD pytest Version Conflict

- **Issue**: pytest 9.x incompatible with Python 3.9
- **Solution**: Pinned to `pytest>=8.0.0,<9.0.0`

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7. Results and Impact

Quantifiable Improvements

Metric	Before	After	Improvement
Test Count	85	570	+571%
Code Coverage	32%	71%	+122%
Linting Violations	Unknown	0	✅ Clean
Type Coverage	~30%	~85%	+183%
CI/CD Pipeline	None	Full automation	✅ Complete
Deployment	Local only	Heroku + Docker	✅ Production
Monitoring	None	Prometheus + Grafana	✅ Observable

Business Value

- **Faster Development**: CI/CD catches issues in 10 minutes vs hours of manual testing
- **Lower Risk**: 71% test coverage prevents regression bugs

- **Easier Debugging**: Metrics and structured logs pinpoint issues quickly
- **Scalability**: Docker containers enable horizontal scaling
- **Team Collaboration**: Consistent code standards reduce friction

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8. Conclusion

Assignment 2 successfully transformed MoneySplit from a functional prototype into a **production-ready application** with:

- **Professional Development Practices**: SOLID principles, code quality tools, comprehensive testing
- **Automated Quality Assurance**: CI/CD pipeline, coverage enforcement, security scanning
- **Production Deployment**: Live Heroku deployment with Docker containerization
- **Full Observability**: Health checks, Prometheus metrics, Grafana dashboards, structured logging
- **Comprehensive Documentation**: 5 detailed guides covering all aspects

All Assignment 2 requirements met or exceeded:

✅ **Code Quality and Refactoring (25%)**: SOLID principles, refactoring, professional standards ✅ **Testing and Coverage (20%)**: 570 tests, 71% coverage (exceeds 70%) ✅ **CI/CD Pipeline (20%)**: GitHub Actions, matrix testing, automated checks ✅ **Deployment and Containerization (20%)**: Docker, Compose, live Heroku deployment ✅ **Monitoring and Documentation (15%)**: Prometheus, Grafana, health checks, 5 docs

Live Demo: https://moneysplit-app-96aca02a2d13.herokuapp.com/ **Repository:** https://github.com/SnileMB/MoneySplit **CI/CD Pipeline:** https://github.com/SnileMB/MoneySplit/actions

The foundation is solid for continued development, team scaling, and production operations.

Report Date: November 30, 2025 **Total Pages:** 6 **Word Count:** ~2,400 words