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Multi-Currency Wallet Simulator

Static Testing + White-Box Coverage

Static analysis is executed automatically in the CI pipeline on every push and pull request. We used Pylint for fast code-quality feedback and SonarCloud for maintainability/security reporting and for importing the unit-test coverage report (coverage.xml). This makes the static results reproducible and consistent with the submitted codebase (not dependent on local runs).

Coverage measurements: Coverage was calculated using pytest-cov and interpreted as statement coverage (executed lines) and decision/branch coverage (executed conditional paths). We report two views because they answer different questions:

- Unit-test coverage: how much of the internal Python logic (domain + services) is executed by unit tests (white-box focus).
- Unit + integration execution: how much of the full vertical slice is executed when integration tests are included (routes → services → repositories → SQLite).

Metric	Before	After
Unit coverage (pytest-cov)	41% (108 tests)	63% (127 tests)
Executed lines (statement) incl. integration	89% (116 tests)	93% (135 tests)
SonarCloud coverage (coverage.xml)	40.9%	63.4%
SonarCloud quality gate	Passed	Passed

Meaning (how to read the numbers)

- **Unit coverage (41% → 63%)** increased because we added targeted white-box unit tests for previously unexecuted branches/decisions in internal logic (services + rules).
- **Unit+integration (89% → 93%)** The combined coverage is already high because integration tests execute many lines through the API wiring. The smaller increase means the main gap was branch coverage inside logic, not missing route execution.
- **SonarCloud (40.9% → 63.4%)** matches the unit view because it imports unit-test coverage.xml, so it reflects improvement in white-box unit coverage.

Coverage gap → action → outcome

Coverage gap	White-box tests added	Value / outcome
Did not handle "non-numeric rate" safely	White-box tests for malformed FX payloads	**Bug fixed:** API now fails predictably (502) instead of crashing
Service-layer "happy path" never executed	White-box test for list_transactions	Confirms service works without needing DB/HTTP
Exchange decision branches were not executed	White-box tests targeting exchange rule branches	Higher confidence that key rule decisions are exercised by tests

Conclusion: Static analysis and coverage are integrated into CI and therefore reproducible. Coverage was used diagnostically to identify unexecuted internal branches; targeted white-box tests increased unit coverage (41% → 63%) and directly improved robustness at the external FX boundary and domain logic.

Appendix / Evidence

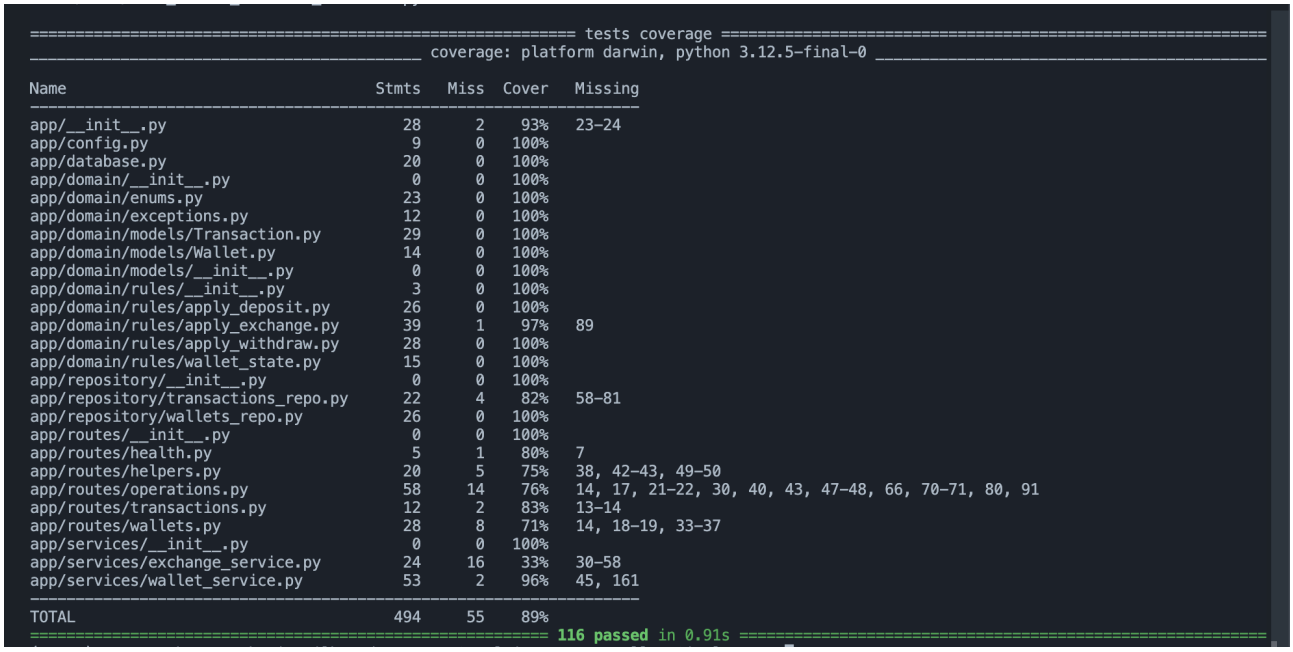
```
========================================================== tests coverage ==========================================================
_____________________________________________ coverage: platform darwin, python 3.12.5-final-0 _____________________________________________

Name                                    Stmts   Miss  Cover   Missing
-----------------------------------------------------------------------
app/__init__.py                            28     20    29%   16-46
app/config.py                               9      0   100%
app/database.py                            20     11    45%   40-46, 50-52, 56-58, 62
app/domain/__init__.py                      0      0   100%
app/domain/enums.py                        23      0   100%
app/domain/exceptions.py                   12     12     0%   1-23
app/domain/models/Transaction.py           29      0   100%
app/domain/models/Wallet.py                14      0   100%
app/domain/models/__init__.py               0      0   100%
app/domain/rules/__init__.py                3      0   100%
app/domain/rules/apply_deposit.py          26      0   100%
app/domain/rules/apply_exchange.py         39      1    97%   89
app/domain/rules/apply_withdraw.py         28      0   100%
app/domain/rules/wallet_state.py           15      0   100%
app/repository/__init__.py                  0      0   100%
app/repository/transactions_repo.py        22     22     0%   1-119
app/repository/wallets_repo.py             26     26     0%   1-80
app/routes/__init__.py                      0      0   100%
app/routes/health.py                        5      5     0%   1-7
app/routes/helpers.py                      20     20     0%   1-52
app/routes/operations.py                   58     58     0%   1-93
app/routes/transactions.py                 12     12     0%   1-14
app/routes/wallets.py                      28     28     0%   1-37
app/services/__init__.py                    0      0   100%
app/services/exchange_service.py           24     24     0%   3-58
app/services/wallet_service.py             53     53     0%   1-162
-----------------------------------------------------------------------
TOTAL                                     494    292    41%
========================================================== 108 passed in 0.34s ==========================================================
```

Figure A 1: Unit coverage (pytest-cov), before white-box additions

```
(.venv) marcus_rk@MacBook-Air-tilhrende-Marcus-2 Multi-Currency-Wallet-Simulator %
python -m pytest --cov=app --cov-report=term-missing tests/unit
app/config.py                              9      0   100%
app/database.py                           20     11    45%   40-46, 50-52, 56-58, 62
app/domain/__init__.py                     0      0   100%
app/domain/enums.py                       23      0   100%
app/domain/exceptions.py                  12      0   100%
app/domain/models/Transaction.py          29      0   100%
app/domain/models/Wallet.py               14      0   100%
app/domain/models/__init__.py              0      0   100%
app/domain/rules/__init__.py               3      0   100%
app/domain/rules/apply_deposit.py         26      0   100%
app/domain/rules/apply_exchange.py        39      0   100%
app/domain/rules/apply_withdraw.py        28      0   100%
app/domain/rules/wallet_state.py          15      0   100%
app/repository/__init__.py                 0      0   100%
app/repository/transactions_repo.py       22     12    45%   17-53, 58-81, 89-114, 119
app/repository/wallets_repo.py            26     15    42%   12-27, 32-42, 47-55, 60-75, 80
app/routes/__init__.py                     0      0   100%
app/routes/health.py                       5      5     0%   1-7
app/routes/helpers.py                     20     20     0%   1-52
app/routes/operations.py                  58     58     0%   1-93
app/routes/transactions.py                12     12     0%   1-14
app/routes/wallets.py                     28     28     0%   1-37
app/services/__init__.py                   0      0   100%
app/services/exchange_service.py          24      0   100%
app/services/wallet_service.py            53      0   100%
-----------------------------------------------------------------------
TOTAL                                    494    181    63%
============================== 127 passed in 0.90s ==============================
```

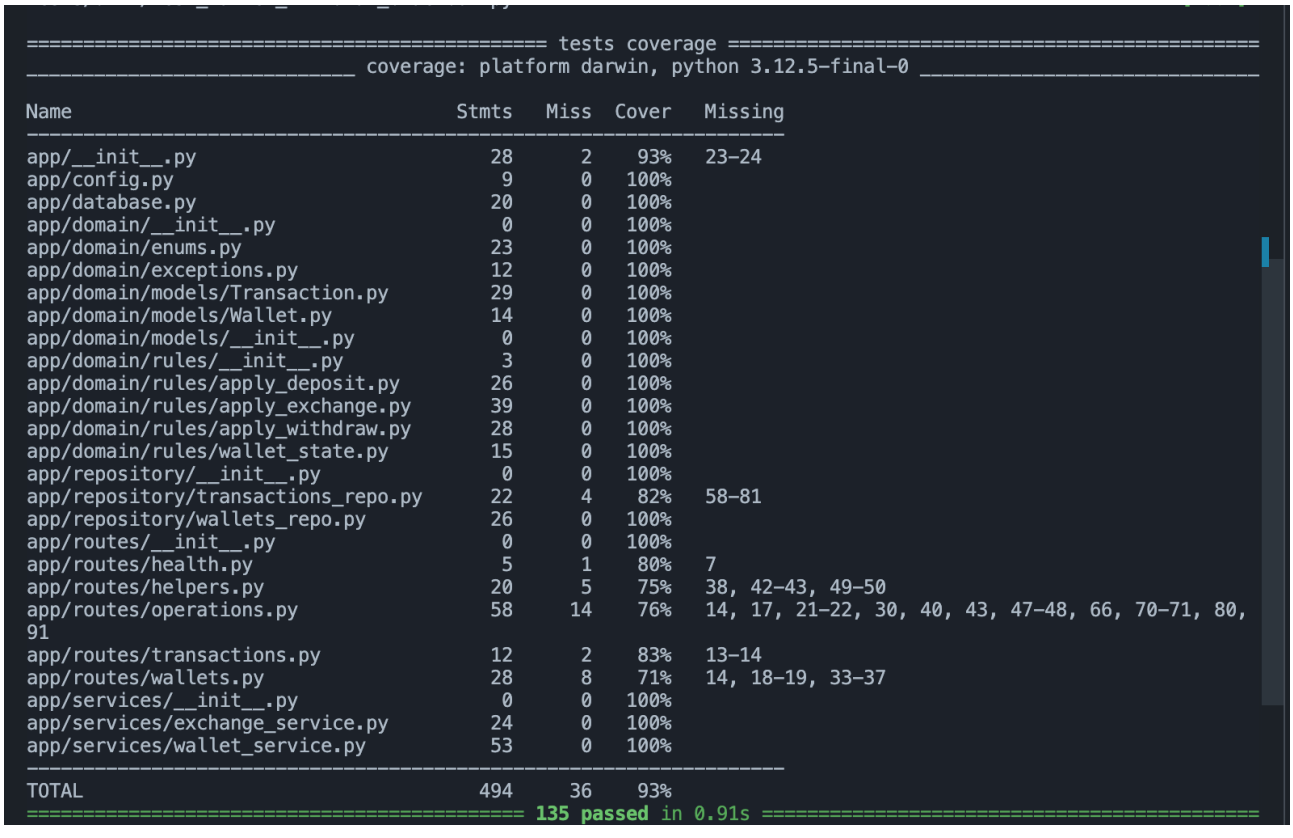
Figure A 2:Unit coverage (pytest-cov), after white-box additions



```
========================================================== tests coverage ==========================================================
_____________________________________ coverage: platform darwin, python 3.12.5-final-0 _____________________________________

Name                                  Stmts   Miss  Cover   Missing
-----------------------------------------------------------------
app/__init__.py                          28      2    93%   23-24
app/config.py                             9      0   100%
app/database.py                          20      0   100%
app/domain/__init__.py                    0      0   100%
app/domain/enums.py                      23      0   100%
app/domain/exceptions.py                 12      0   100%
app/domain/models/Transaction.py         29      0   100%
app/domain/models/Wallet.py              14      0   100%
app/domain/models/__init__.py             0      0   100%
app/domain/rules/__init__.py              3      0   100%
app/domain/rules/apply_deposit.py        26      0   100%
app/domain/rules/apply_exchange.py       39      1    97%   89
app/domain/rules/apply_withdraw.py       28      0   100%
app/domain/rules/wallet_state.py         15      0   100%
app/repository/__init__.py                0      0   100%
app/repository/transactions_repo.py      22      4    82%   58-81
app/repository/wallets_repo.py           26      0   100%
app/routes/__init__.py                    0      0   100%
app/routes/health.py                      5      1    80%   7
app/routes/helpers.py                    20      5    75%   38, 42-43, 49-50
app/routes/operations.py                 58     14    76%   14, 17, 21-22, 30, 40, 43, 47-48, 66, 70-71, 80, 91
app/routes/transactions.py               12      2    83%   13-14
app/routes/wallets.py                    28      8    71%   14, 18-19, 33-37
app/services/__init__.py                  0      0   100%
app/services/exchange_service.py         24     16    33%   30-58
app/services/wallet_service.py           53      2    96%   45, 161
-----------------------------------------------------------------
TOTAL                                   494     55    89%
========================================================== 116 passed in 0.91s ==========================================================
```

Figure A 3:Combined execution (unit + integration), before white-box additions



```
============================================== tests coverage ==============================================
_____________________________ coverage: platform darwin, python 3.12.5-final-0 _____________________________

Name                                  Stmts   Miss  Cover   Missing
-----------------------------------------------------------------
app/__init__.py                          28      2    93%   23-24
app/config.py                             9      0   100%
app/database.py                          20      0   100%
app/domain/__init__.py                    0      0   100%
app/domain/enums.py                      23      0   100%
app/domain/exceptions.py                 12      0   100%
app/domain/models/Transaction.py         29      0   100%
app/domain/models/Wallet.py              14      0   100%
app/domain/models/__init__.py             0      0   100%
app/domain/rules/__init__.py              3      0   100%
app/domain/rules/apply_deposit.py        26      0   100%
app/domain/rules/apply_exchange.py       39      0   100%
app/domain/rules/apply_withdraw.py       28      0   100%
app/domain/rules/wallet_state.py         15      0   100%
app/repository/__init__.py                0      0   100%
app/repository/transactions_repo.py      22      4    82%   58-81
app/repository/wallets_repo.py           26      0   100%
app/routes/__init__.py                    0      0   100%
app/routes/health.py                      5      1    80%   7
app/routes/helpers.py                    20      5    75%   38, 42-43, 49-50
app/routes/operations.py                 58     14    76%   14, 17, 21-22, 30, 40, 43, 47-48, 66, 70-71, 80,
91
app/routes/transactions.py               12      2    83%   13-14
app/routes/wallets.py                    28      8    71%   14, 18-19, 33-37
app/services/__init__.py                  0      0   100%
app/services/exchange_service.py         24      0   100%
app/services/wallet_service.py           53      0   100%
-----------------------------------------------------------------
TOTAL                                   494     36    93%
============================================ 135 passed in 0.91s ============================================
```

Figure A 4: Combined execution (unit + integration), after white-box additions

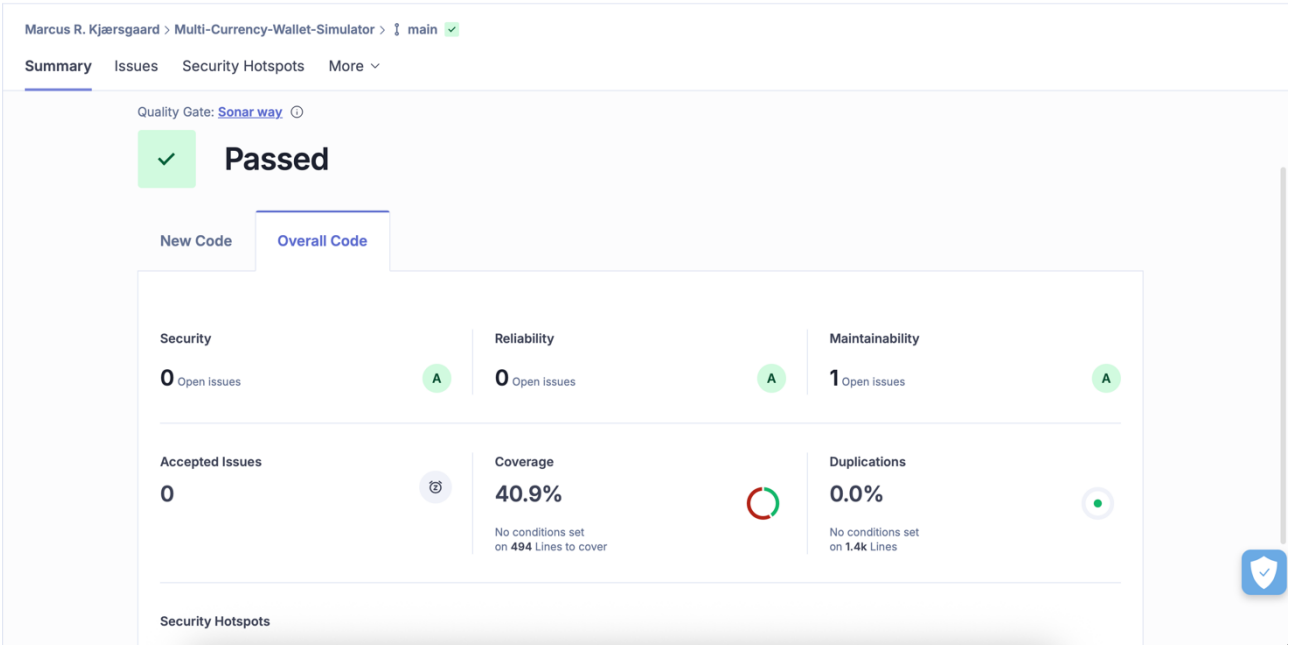


Figure A 5: SonarCloud overview (imports unit coverage.xml), before white-box additions

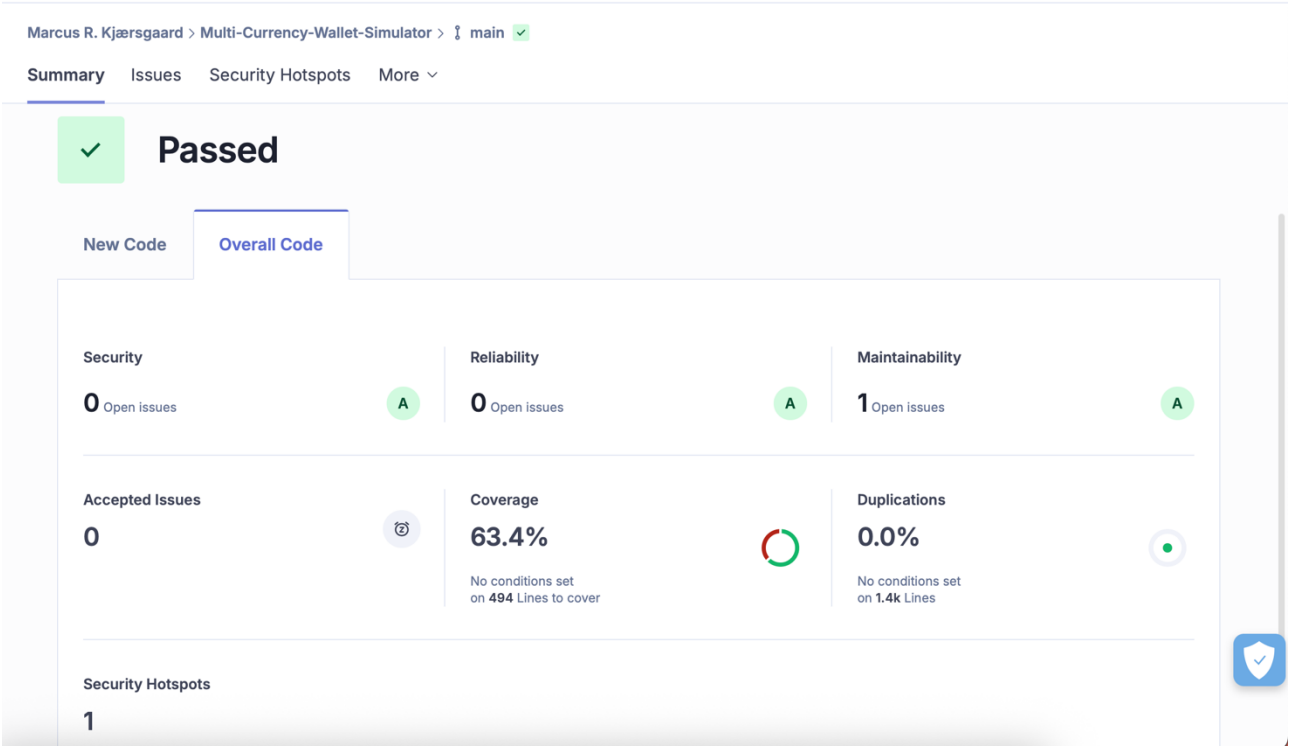


Figure A 6: SonarCloud overview (imports unit coverage.xml), after white-box additions