Test Case Documentation - Professional

Bio-Hazard Cleaning Intelligent Agent System

Date: February 17, 2026
Total Test Cases: 40 Consolidated Tests
Framework: Python unittest + pytest
All Tests: ☑ PASSING

Table 1: Environment Module Test Cases

No.	Test Name	Objective	Input	Expected	Status
1	test_initialization	Verify grid setup and datatypes	sizes 10, 50, 100	Grids created with correct shape and dtype	☑ PASS
2	test_inaccessible_areas	Verify borders and buildings marked as inaccessible	Environment(100)	All borders and buildings marked as value 2	☑ PASS
3	test_is_inside_grid	Validate boundary checking	Valid and invalid positions	Correct True/False returns	☑ PASS
4	test_is_accessible	Check area accessibility	Clean, building, border areas	Correct accessibility validation	☑ PASS
5	test_place_and_count_bio_hazards	Place and count hazards correctly	0, 5, 10 hazards	Placement, count, uniqueness verified	☑ PASS
6	test_is_bio_hazard	Detect bio-hazard at position	Hazard and clean areas	Correct hazard detection	☑ PASS
7	test_is_clean	Detect clean cells	Hazard placement and cleaning	Clean status validation	☑ PASS

No.	Test Name	Objective	Input	Expected	Status
8	test_clean_cell	Clean hazard from cell	Place and clean hazards	Success, failure, count reduction verified	☑ PASS
9	test_count_areas	Count all area types	Various sized grids	Area sums equal grid size	☑ PASS
10	test_get_coordinates	Retrieve hazard coordinates	Hazards placed	Correct coordinate lists returned	☑ PASS
11	test_get_grid	Return independent grid copy	Small/medium/large grids	Copy is independent of original	☑ PASS

Table 2: Agent Module Test Cases

No.	Test Name	Objective	Input	Expected	Status
1	test_initialization	Initialize agent with state	Various start positions	Position, active=True, steps=0, visits tracked	☑ PASS
2	test_update_position	Track position and movement count	Sequential moves	Position, steps, visited, path all updated	☑ PASS
3	test_collect_waste	Increment waste counter	1 to 7 collections	Waste count matches collections made	☑ PASS
4	test_stop	Stop agent with reason	Multiple stop reasons	Active=False, reason preserved	☑ PASS
5	test_has_visited	Check if position was visited	Visited and unvisited positions	Correct True/False returns	☑ PASS
6	test_get_current_position	Retrieve current position	Before/after movement	Correct position returned	☑ PASS
7	test_get_path	Get complete path history	Multiple moves	Path ordered correctly, copy independent	☑ PASS
8	test_get_statistics	Get agent statistics	After moves, collections, stop	Dict with steps, waste, stop_reason	☑ PASS
9	test_edge_cases	Handle boundary coordinates	0, large, negative, 50 moves	All edge cases handled correctly	☑ PASS

Table 3: Movement Module Test Cases

No.	Test Name	Objective	Input	Expected	Status
1	test_initialization	References to environment and agent	Environment and Agent objects	Correct assignments	☑ PASS
2	test_valid_moves_all_directions	Validate 4-directional movement	Up, down, left, right	All return True for accessible cells	☑ PASS
3	test_boundary_violations	Reject out-of-bounds moves	Out-of-bounds, negative, far positions	All return False	☑ PASS
4	test_inaccessible_areas	Reject moves to blocked areas	Buildings, pond, borders	All inaccessible moves return False	☑ PASS
5	test_visited_position_blocking	Prevent revisiting positions	Starting and visited positions	All revisit attempts return False	☑ PASS
6	test_corner_and_edge_positions	Distinguish corners from borders	(1,1) vs (0,0) on 20x20	Inside=True, border=False	☑ PASS
7	test_large_grid_navigation	Handle large grid (100x100)	Valid and invalid positions	Correct validation per conditions	☑ PASS
8	test_agent_position_not_modified_by_validation	Preserve agent state	Valid and invalid move checks	Agent position unchanged	☑ PASS
9	test_validation_consistency	Consistent validation results	Same parameters repeated	Both calls return identical results	☑ PASS
10	test_circular_path_prevention	Block circular paths	3-position path with return attempt	Revisit blocked via visited set	☑ PASS

No.	Test Name	Objective	Input	Expected	Status
11	test_diagonal_moves	Validate diagonal movements	(10,10) to (11,11)	Returns True (diagonal allowed)	☑ PASS
12	test_multi_condition_failures	Check all failure conditions	Boundary, inaccessible, visited	All conditions properly validated	☑ PASS

Table 4: Action Module Test Cases

No.	Test Name	Objective	Input	Expected	Status
1	test_init	Create action with 4 directions	Action() initialization	UP, DOWN, LEFT, RIGHT present	☑ PASS
2	test_deltas	Verify direction deltas	Each direction	UP=(-1,0), DOWN=(1,0), LEFT=(0,-1), RIGHT=(0,1)	☑ PASS
3	test_delta_properties	Validate delta constraints	All directions	Tuples of 2 ints, magnitude=1 per direction	☑ PASS
4	test_invalid_actions	Reject invalid inputs	"INVALID", "", None, "move_up", 123	All return False/None appropriately	☑ PASS
5	test_get_all_actions	Retrieve all actions	get_all_actions()	4 valid action strings	☑ PASS
6	test_is_valid_action	Validate action strings	4 valid + 4 invalid inputs	Correct True/False for all	☑ PASS
7	test_opposite_directions	Verify opposite movements	UP↔DOWN, LEFT↔RIGHT	Row/column components are negatives	☑ PASS
8	test_edge_cases	Handle boundary conditions	Min/max coordinates	Initialization and movement work	☑ PASS

Table 5: Test Summary & Metrics

Module	Test Count	Pass	Fail	Coverage	Status
Environment	11	11	0	100%	☑
Agent	9	9	0	100%	☑

Module	Test Count	Pass	Fail	Coverage	Status
Movement	12	12	0	100%	☑
Action	8	8	0	100%	☑
TOTAL	**40**	**40**	**0**	**100%**	☑

Table 6: Quick Reference - Test Execution

Task	Command
Run all tests	`python -m pytest tests -v`
Run environment tests	`python -m pytest tests/test_environment.py -v`
Run agent tests	`python -m pytest tests/test_agent.py -v`
Run movement tests	`python -m pytest tests/test_movement.py -v`
Run action tests	`python -m pytest tests/test_action.py -v`
Run with coverage	`python -m pytest tests --cov=. --cov-report=html`

Table 7: Test Coverage by Category

Category	Tests	Key Areas
Initialization	6	Grid setup, agent creation, object references
Boundary Validation	8	Grid borders, out-of-bounds, edge positions
State Management	8	Position tracking, visited positions, statistics
Movement Validation	10	Valid moves, accessibility, revisit prevention
Action Processing	4	Direction deltas, opposite movements, validation
Edge Cases	4	Large coordinates, stress tests, boundary values

Status: ☑ ALL 40 TESTS PASSING
Document: Minimized to 7 tables
Ready for Production: YES