

# Testing in Duckietown

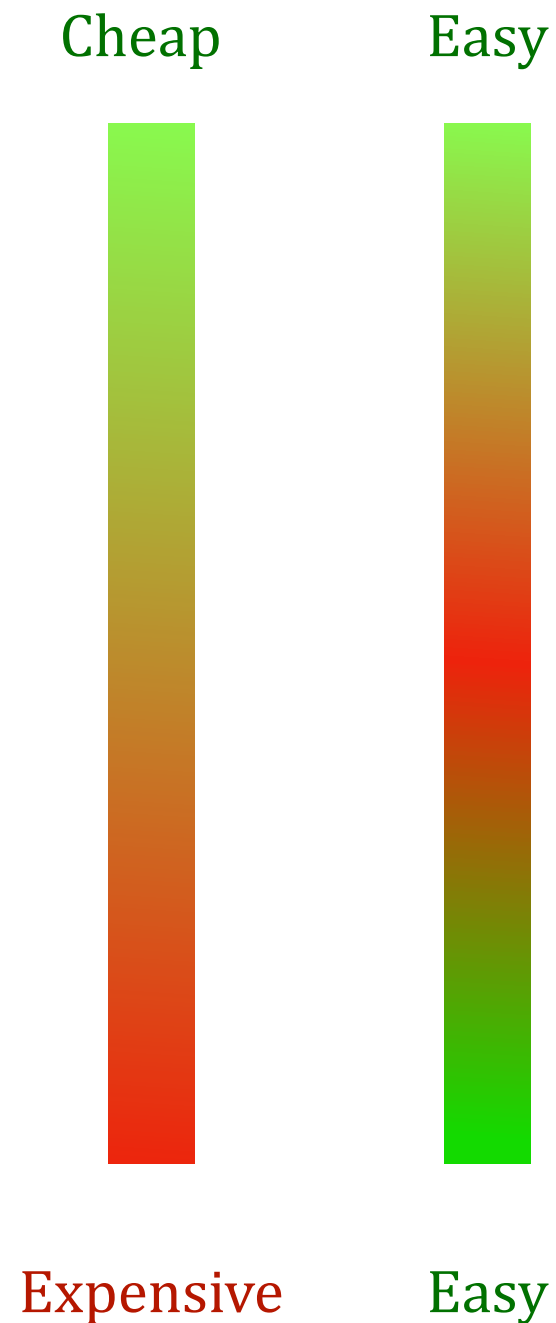


# Challenges for testing in robotics

- Robots live in an “**open world**” that you cannot fully model.
  - No nice “theorems” possible.
- Robots live in **multi-domains**: hardware, software, environment, users are hard to model, and very hard to model in a coherent framework.
- **Variability** is a big problem: of the *hardware*, of the *compute*, of the *environment*, etc.
- **Non-modularity**: hard to test a component in isolation.
- **Expensive experiments**

# Testing hierarchy

- **Unit tests:** single function, single module
- **Integration tests:** multiple modules, testing their communication/interaction
- **Functional tests:** multiple modules, testing the end-to-end functionality, often with synthetic data.
- **Regression tests:** multiple modules, testing on real data
- **Simulation tests:** testing in simulation; multiple fidelity levels.
- **Hardware in the loop (HWIL) tests:** tests performance (cpu, network, ...)
- **Flight tests:** closed course (controlled conditions), or actual roads



# Testing we do in Duckietown

- **Unit tests:** single function, single module

**nosetests / CI**

- **Integration tests:** multiple modules, testing their communication/interaction

**limited to special cases in DT**

- **Functional tests:** multiple modules, testing the end-to-end functionality, often with synthetic data.

- **Regression tests:** multiple modules, testing on real data

- **Simulation tests:** testing in simulation; multiple fidelity levels.

**AI-DO cloud simulation**

- **Hardware in the loop (HWIL) tests:** tests performance (cpu, network, ...)

- **Flight tests:** closed course (controlled conditions), or actual roads

**AI-DO autolab evaluation**

# Nosetests

- **nose** is the simplest way to create unit tests.
- Simply create functions by the name “test\*” in files by name “\*test\*.py”.
- Running “nose package” will run all tests in all files.

mytests.py

```
def test1():  
    assert 1 + 2 == 3  
  
def test2():  
    assert 0.1 + 0.2 == 0.3
```

\$ nosetests mytests.py

```
=====
FAIL: mytests.test2
-----

Traceback (most recent call last):
  File "lib/python3.7/site-packages/nose/case.py", line 198, in runTest
    self.test(*self.arg)
  File "mytests.py", line 5, in test2
    assert 0.1 + 0.2 == 0.3
AssertionError

-----

Ran 2 tests in 0.001s

FAILED (failures=1)
```

# Code coverage

- Suggested services: **codecov** or **coveralls**
- Code coverage shows which lines are executed or not.

Coverage for **util** : 80%

5 statements   4 run   1 missing   0 excluded


```
1 | from math import ceil, pi
2 |
3 | def borkify(i):
4 |     return int(ceil(i/pi) + 1)
5 |
6 | def fnord(j):
7 |     return j/2 - 3
```

“dead code”


# Example for duckietown-world


<https://codecov.io/gh/duckietown/duckietown-world/>


fix

 AndreaCensi

3 minutes ago

 a9d3dec

 daffy

 Not found

85.02%

Diff


Files

Build


Graphs


/ src / duckietown_world						
Files					Coverage	
geo	433	387	0	46	89.38%	
rules	320	294	0	26	91.88%	
seqs	170	140	0	30	82.35%	
svg_drawing	401	332	0	69	82.79%	
utils	407	226	0	181	55.53%	
world_duckietown	1,359	1,246	0	113	91.69%	
_init_.py	14	14	0	0	100.00%	
Folder Totals (7 files)	3,104	2,639	0	465	85.02%	
Project Totals (45 files)	3,104	2,639	0	465	85.02%	

# Example for duckietown-world

 / [src](#) / [duckietown\\_world](#) / [world\\_duckietown](#) / [duckietown\\_map.py](#)

72.22%






```
1  # coding=utf-8
2  from duckietown_world.geo import PlacedObject, SE2Transform
3
4  __all__ = [
5      'DuckietownMap',
6  ]
7
8
9  class DuckietownMap(PlacedObject):
10     def __init__(self, tile_size, *args, **kwargs):
11         self.tile_size = tile_size
12         PlacedObject.__init__(self, *args, **kwargs)
13
14     def params_to_json_dict(self):
15         return dict(tile_size=self.tile_size)
16
17     def se2_from_curpos(self, cur_pos, cur_angle):
18         """ Conversion from Duckietown Gym Simulator coordinates z """
19         H = self.children['tilemap'].H
20         gx, gy, gz = cur_pos
21         p = [gx, (H - 1) * self.tile_size - gz]
22         transform = SE2Transform(p, cur_angle)
23         return transform
24
25     def get_drawing_children(self):
26         children = sorted(self.children)
27         children.remove('tilemap')
28         return ['tilemap'] + children
```




# Automatic testing/coverage in the cloud


<https://circleci.com/gh/duckietown>




duckietown



Updates



Support



JOBS

WORKFLOWS

INSIGHTS

ADD PROJECTS

TEAM

SETTINGS

Jobs » duckietown

By project

My branches

All branches

My jobs

All jobs

Software

duckietown-world

docs-opmanual\_sky

docs-opmanual\_duckiebot

gym-duckietown

duckietown-shell-commands

duckietown-challenges

duckietown-intnav

docs-AIDO

duckietown-challenges-server

duckietown-cslam

course-RH

duckietown-shell

docs-brown

duckietown-objdet

duckietown-fplan

docs-opmanual\_autolab

SUCCESS

duckietown / course-CRA / daffy-devel #23

WIP AR exercise

workflow

build

36 min ago

01:58

82f92d1

FAILED

duckietown / aido-protocols / daffy #153

Bump version: 5.0.12 → 5.0.13

test

test-3.7

13 hr ago

14:09

9dda152

FAILED

duckietown / aido-protocols / daffy #152

Bump version: 5.0.12 → 5.0.13

test

test-3.6

13 hr ago

13:58

9dda152

FAILED

duckietown / duckietown-challenges-server / daffy #308

Bump version: 5.0.1 → 5.0.2

Build Error

Build Error

14 hr ago

00:05

316c24e

SUCCESS

duckietown / gym-duckietown / daffy #518

Bump version: 5.0.2 → 5.0.3

build\_and\_test

test

14 hr ago

01:27

0266fb4

SUCCESS

duckietown / duckietown-world / daffy #769

Bump version: 5.0.3 → 5.0.4

test

test-3.6

14 hr ago

02:45

6fb4044

SUCCESS

duckietown / duckietown-world / daffy #770

Bump version: 5.0.3 → 5.0.4

test

test-3.7

14 hr ago

03:00

6fb4044

FAILED

duckietown / aido-protocols / daffy #150

Bump version: 5.0.11 → 5.0.12

test

test-3.7

14 hr ago

13:41

c5da750

FAILED

duckietown / aido-protocols / daffy #151

Bump version: 5.0.11 → 5.0.12

test

test-3.6

14 hr ago

14:03

c5da750

SUCCESS

duckietown / duckietown-challenges-runner / daffy #305

Bump version: 5.0.7 → 5.0.8

test

test-3.6

15 hr ago

00:37

6aaf081

# Job history shows when the problem was introduced


<https://circleci.com/gh/duckietown/aido-protocols>

The screenshot displays the CircleCI interface for the `duckietown/aido-protocols` repository. The left sidebar contains navigation links for JOBS, WORKFLOWS, INSIGHTS, ADD PROJECTS, TEAM, and SETTINGS. The main content area shows a list of jobs under the heading "Jobs » duckietown » aido-protocols". The jobs are filtered by "My branches" and "All branches". The table below shows the job history:

Job ID	Status	Commit Message	Test Results	Time Ago	Duration	Link
daffy #153	FAILED	Bump version: 5.0.12 → 5.0.13	test-3.7	13 hr ago	14:09	9dda152
daffy #152	FAILED	Bump version: 5.0.12 → 5.0.13	test-3.6	13 hr ago	13:58	9dda152
daffy #151	FAILED	Bump version: 5.0.11 → 5.0.12	test-3.6	14 hr ago	14:03	c5da750
daffy #150	FAILED	Bump version: 5.0.11 → 5.0.12	test-3.7	14 hr ago	13:41	c5da750
daffy #149	FAILED	Bump version: 5.0.10 → 5.0.11	test-3.7	18 hr ago	13:18	fdb8f7d
daffy #148	FAILED	Bump version: 5.0.10 → 5.0.11	test-3.6	18 hr ago	13:42	fdb8f7d
daffy #147	SUCCESS	Bump version: 5.0.9 → 5.0.10	test-3.6	1 day ago	02:01	dc77525
daffy #146	SUCCESS	Bump version: 5.0.9 → 5.0.10	test-3.7	1 day ago	01:55	dc77525
daffy #145	SUCCESS	Bump version: 5.0.8 → 5.0.9	test-3.7	2 days ago	01:50	7062d83
daffy #144	SUCCESS	Bump version: 5.0.8 → 5.0.9	test-3.6	2 days ago	01:53	7062d83

# The change that broke the test

<https://github.com/duckietown/aido-protocols/commit/fdb8f7dfeaed74dabfb15d1044035b5f11cda000>


 Search or jump to... / Pull requests Issues Marketplace Explore

duckietown / aido-protocols Unwatch 3 Star 1 Fork 0



<> Code Issues 0 Pull requests 0 Security Insights Settings

### Bump version: 5.0.10 → 5.0.11

Browse files  
daffy

 AndreaCensi committed 18 hours ago 1 parent 21467bc commit fdb8f7dfeaed74dabfb15d1044035b5f11cda000

Showing 2 changed files with 2 additions and 2 deletions. Unified Split

2  .bumpversion.cfg 

... @@ -1,5 +1,5 @@

1 [bumpversion]

2 - current\_version = 5.0.10

3 files = src/aido\_schemas/\_\_init\_\_.py

4 commit = True

5 tag = True



1 [bumpversion]

2 + current\_version = 5.0.11

3 files = src/aido\_schemas/\_\_init\_\_.py

4 commit = True

5 tag = True

2  src/aido\_schemas/\_\_init\_\_.py 

... @@ -1,4 +1,4 @@

1 - \_\_version\_\_ = "5.0.10"

2

3

4 import logging

1 + \_\_version\_\_ = "5.0.11"

2

3

4 import logging

Duckietown

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# Writing testing code

ain't nobody got time for that



Kids only learn that the stove is hot when they put their finger on and they burn it. This, unfortunately, is the limitation of our precious brain.

— Hasso Plattner —



Sometimes if you want to know for sure whether the stove is hot, the only way to find out is to touch it.

— Lee Child —

# Bohr's definition of what is "an expert"

**An expert is a person who has made all the mistakes  
that can be made in a very narrow field**

Niels Bohr

**Corollary:** School is about making  
as many mistakes as possible  
as quickly as possible

...and remembering them with infinite regret.