

Homework 2: Practice TDD by adding functions to Calc

313552024 網工所 楊宇盛

Steps

1. Make a fail test
2. Modify the code to pass the test
3. Refactor the code
4. Repeat the process

Test cases

ADD

1. Add tests

```
// Calc_test.js
test('測試加法功能', async (t) => {
  await t.test('兩個正數相加', () => {
    assert.strictEqual(Calc.add(2, 3), 5);
  });
  await t.test('兩個負數相加', () => {
    assert.strictEqual(Calc.add(-2, -3), -5);
  });
  await t.test('一個正數一個負數相加', () => {
    assert.strictEqual(Calc.add(2, -3), -1);
  });
});
```

```
node --test --experimental-test-coverage
```

```
└─
```

▶ 測試加法功能

- ✓ 兩個正數相加 (0.490833ms)
- ✓ 兩個負數相加 (0.120792ms)
- ✓ 一個正數一個負數相加 (0.039959ms)
- ✓ 測試加法功能 (1.042417ms)

i tests 4

i suites 0

i pass 4

i fail 0

i cancelled 0

i skipped 0

i todo 0

i duration_ms 60.323791

i start of coverage report

i -----

```

i file          | line % | branch % | funcs % | uncovered lines
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |
i Calc.js       | 100.00 |   100.00 |   100.00 |
i -----
i all files     | 100.00 |   100.00 |   100.00 |
i -----
i end of coverage report

```

SUBTRACT

1. Add fail tests

```

// Calc_test.js
test('測試減法功能', async (t) => {
  await t.test('兩個正數相減', () => {
    assert.strictEqual(Calc.subtract(5, 3), 2);
  });
  await t.test('兩個負數相減', () => {
    assert.strictEqual(Calc.subtract(-2, -3), 1);
  });
  await t.test('一個正數一個負數相減', () => {
    assert.strictEqual(Calc.subtract(2, -3), 5);
  });
  await t.test('一個負數一個正數相減', () => {
    assert.strictEqual(Calc.subtract(-2, 3), -5);
  });
});

```

```

node --test --experimental-test-coverage
└─

```

```

▶ 測試加法功能
  ✓ 兩個正數相加 (0.5545ms)
  ✓ 兩個負數相加 (0.119916ms)
  ✓ 一個正數一個負數相加 (0.042042ms)
✓ 測試加法功能 (1.090458ms)
▶ 測試減法功能
  ✗ 兩個正數相減 (0.08ms)
  ✗ 兩個負數相減 (0.414125ms)
  ✗ 一個正數一個負數相減 (0.03725ms)
  ✗ 一個負數一個正數相減 (0.030958ms)
✗ 測試減法功能 (0.7275ms)
i tests 9
i suites 0
i pass 4
i fail 5
i cancelled 0
i skipped 0
i todo 0

```

```

i duration_ms 64.004458
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |
i Calc.js       | 100.00 |   100.00 |   100.00 |
i -----
i all files     | 100.00 |   100.00 |   100.00 |
i -----
i end of coverage report

* failing tests:

test at Calc_test.js:18:13
* 兩個正數相減 (0.08ms)
  TypeError [Error]: Calc.subtract is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:19:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:18:13)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.processPendingSubtests
(node:internal/test_runner/test:677:18)
    at Test.postRun (node:internal/test_runner/test:1090:19)

test at Calc_test.js:21:13
* 兩個負數相減 (0.414125ms)
  TypeError [Error]: Calc.subtract is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:22:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:21:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

test at Calc_test.js:24:13
* 一個正數一個負數相減 (0.03725ms)
  TypeError [Error]: Calc.subtract is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:25:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)

```

```

    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:24:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

test at Calc_test.js:27:13
✖ 一個負數一個正數相減 (0.030958ms)
  TypeError [Error]: Calc.subtract is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:28:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:27:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

```

2. Modify the code to pass the test

```

// Calc.js
static subtract(a, b) {
  return a - b;
}

```

```
node --test --experimental-test-coverage
└─
```

```

▶ 測試加法功能
  ✓ 兩個正數相加 (0.563333ms)
  ✓ 兩個負數相加 (0.128583ms)
  ✓ 一個正數一個負數相加 (0.044709ms)
✓ 測試加法功能 (1.143541ms)
▶ 測試減法功能
  ✓ 兩個正數相減 (0.052542ms)
  ✓ 兩個負數相減 (0.411959ms)
  ✓ 一個正數一個負數相減 (0.043625ms)
  ✓ 一個負數一個正數相減 (0.037708ms)
✓ 測試減法功能 (0.675083ms)
i tests 9
i suites 0
i pass 9
i fail 0
i cancelled 0
i skipped 0
i todo 0

```

```

i duration_ms 66.933
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |
i Calc.js       | 100.00 |   100.00 |   100.00 |
i -----
i all files     | 100.00 |   100.00 |   100.00 |
i -----
i end of coverage report

```

MULTIPLY

1. Add fail tests

```

// Calc_test.js
test('測試乘法功能', async (t) => {
  await t.test('兩個正數相乘', () => {
    assert.strictEqual(Calc.multiply(2, 3), 6);
  });
  await t.test('兩個負數相乘', () => {
    assert.strictEqual(Calc.multiply(-2, -3), 6);
  });
  await t.test('一個正數一個負數相乘', () => {
    assert.strictEqual(Calc.multiply(2, -3), -6);
  });
  await t.test('一個負數一個正數相乘', () => {
    assert.strictEqual(Calc.multiply(-2, 3), -6);
  });
  await t.test('乘以0', () => {
    assert.strictEqual(Calc.multiply(2, 0), 0);
  });
  await t.test('乘以正無窮', () => {
    assert.strictEqual(Calc.multiply(2, Infinity), Infinity);
  });
  await t.test('乘以負無窮', () => {
    assert.strictEqual(Calc.multiply(2, -Infinity), -Infinity);
  });
  await t.test('乘以NaN', () => {
    assert.strictEqual(Calc.multiply(2, NaN), NaN);
  });
  await t.test('乘以字串', () => {
    assert.strictEqual(Calc.multiply(2, '3'), NaN);
  });
});

```

```

node --test --experimental-test-coverage
└─

```

```

▶ 測試加法功能
  ✓ 兩個正數相加 (0.312458ms)
  ✓ 兩個負數相加 (0.137375ms)
  ✓ 一個正數一個負數相加 (0.043417ms)
✓ 測試加法功能 (0.878792ms)
▶ 測試減法功能
  ✓ 兩個正數相減 (0.075458ms)
  ✓ 兩個負數相減 (0.062875ms)
  ✓ 一個正數一個負數相減 (0.044791ms)
  ✓ 一個負數一個正數相減 (0.038708ms)
✓ 測試減法功能 (0.690083ms)
▶ 測試乘法功能
  ✗ 兩個正數相乘 (0.0895ms)
  ✗ 兩個負數相乘 (0.035625ms)
  ✗ 一個正數一個負數相乘 (0.032167ms)
  ✗ 一個負數一個正數相乘 (0.028125ms)
  ✗ 乘以0 (0.030208ms)
  ✗ 乘以正無窮 (0.030166ms)
  ✗ 乘以負無窮 (0.032209ms)
  ✗ 乘以NaN (0.033ms)
  ✗ 乘以字串 (0.0275ms)
✗ 測試乘法功能 (0.577875ms)
i tests 19
i suites 0
i pass 9
i fail 10
i cancelled 0
i skipped 0
i todo 0
i duration_ms 54.35875
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |
i Calc.js       | 100.00 |   100.00 |   100.00 |
i -----
i all files     | 100.00 |   100.00 |   100.00 |
i -----
i end of coverage report

✗ failing tests:

test at Calc_test.js:33:13
✗ 兩個正數相乘 (0.0895ms)
  TypeError [Error]: Calc.multiply is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:34:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:33:13)

```

```

    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.processPendingSubtests
(node:internal/test_runner/test:677:18)
    at Test.postRun (node:internal/test_runner/test:1090:19)

test at Calc_test.js:36:13
* 兩個負數相乘 (0.035625ms)
  TypeError [Error]: Calc.multiply is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:37:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:36:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

test at Calc_test.js:39:13
* 一個正數一個負數相乘 (0.032167ms)
  TypeError [Error]: Calc.multiply is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:40:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:39:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

test at Calc_test.js:42:13
* 一個負數一個正數相乘 (0.028125ms)
  TypeError [Error]: Calc.multiply is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:43:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:42:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

test at Calc_test.js:45:13
* 乘以0 (0.030208ms)
  TypeError [Error]: Calc.multiply is not a function

```

```

    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:46:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:45:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

```

test at Calc_test.js:48:13

✖ 乘以正無窮 (0.030166ms)

```

    TypeError [Error]: Calc.multiply is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:49:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:48:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

```

test at Calc_test.js:51:13

✖ 乘以負無窮 (0.032209ms)

```

    TypeError [Error]: Calc.multiply is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:52:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:51:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

```

test at Calc_test.js:54:13

✖ 乘以NaN (0.033ms)

```

    TypeError [Error]: Calc.multiply is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:55:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:54:13)
    at async Test.run (node:internal/test_runner/test:980:9)

```



```

    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

test at Calc_test.js:57:13
✖ 乘以字串 (0.0275ms)
  TypeError [Error]: Calc.multiply is not a function
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:58:33)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:57:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7)

```

2. Modify the code to pass the test

```

// Calc.js
static multiply(a, b) {
  return a * b;
}

```

```

node --test --experimental-test-coverage
└─

```

- ▶ 測試加法功能
 - ✓ 兩個正數相加 (0.553625ms)
 - ✓ 兩個負數相加 (0.131125ms)
 - ✓ 一個正數一個負數相加 (0.043417ms)
- ✓ 測試加法功能 (1.135167ms)
- ▶ 測試減法功能
 - ✓ 兩個正數相減 (0.050792ms)
 - ✓ 兩個負數相減 (0.041875ms)
 - ✓ 一個正數一個負數相減 (0.038083ms)
 - ✓ 一個負數一個正數相減 (0.035333ms)
- ✓ 測試減法功能 (0.688625ms)
- ▶ 測試乘法功能
 - ✓ 兩個正數相乘 (0.050417ms)
 - ✓ 兩個負數相乘 (0.035208ms)
 - ✓ 一個正數一個負數相乘 (0.03375ms)
 - ✓ 一個負數一個正數相乘 (0.032166ms)
 - ✓ 乘以0 (0.036708ms)
 - ✓ 乘以正無窮 (0.03525ms)
 - ✓ 乘以負無窮 (0.091416ms)
 - ✓ 乘以NaN (0.035375ms)
 - ✖ 乘以字串 (0.480958ms)
- ✖ 測試乘法功能 (1.073292ms)

```

i tests 19
i suites 0
i pass 17
i fail 2
i cancelled 0
i skipped 0
i todo 0
i duration_ms 62.230208
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |
i Calc.js       | 100.00 |   100.00 |   100.00 |
i -----
i all files     | 100.00 |   100.00 |   100.00 |
i -----
i end of coverage report

✖ failing tests:

test at Calc_test.js:57:13
✖ 乘以字串 (0.480958ms)
  AssertionError [ERR_ASSERTION]: Expected values to be strictly equal:

    6 !== NaN

      at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:58:16)
      at Test.runInAsyncScope (node:async_hooks:211:14)
      at Test.run (node:internal/test_runner/test:979:25)
      at Test.start (node:internal/test_runner/test:877:17)
      at TestContext.test (node:internal/test_runner/test:307:20)
      at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:57:13)
      at async Test.run (node:internal/test_runner/test:980:9)
      at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7) {
  generatedMessage: true,
  code: 'ERR_ASSERTION',
  actual: 6,
  expected: NaN,
  operator: 'strictEqual'
}

```

這時候發現，如果a或b不是數字，就要回傳NaN，所以需要修改

```

// Calc.js
static multiply(a, b) {
  if (typeof a !== 'number' || typeof b !== 'number') {
    return NaN;
  }
}

```

```
    return a * b;
}
```

```
node --test --experimental-test-coverage
```

```
└─
```

```
▶ 測試加法功能
  ✓ 兩個正數相加 (0.312333ms)
  ✓ 兩個負數相加 (0.126083ms)
  ✓ 一個正數一個負數相加 (0.043291ms)
✓ 測試加法功能 (0.86325ms)
▶ 測試減法功能
  ✓ 兩個正數相減 (0.048042ms)
  ✓ 兩個負數相減 (0.040583ms)
  ✓ 一個正數一個負數相減 (0.036333ms)
  ✓ 一個負數一個正數相減 (0.033875ms)
✓ 測試減法功能 (0.58325ms)
▶ 測試乘法功能
  ✓ 兩個正數相乘 (0.052833ms)
  ✓ 兩個負數相乘 (0.033042ms)
  ✓ 一個正數一個負數相乘 (0.032917ms)
  ✓ 一個負數一個正數相乘 (0.034ms)
  ✓ 乘以0 (0.036916ms)
  ✓ 乘以正無窮 (0.037917ms)
  ✓ 乘以負無窮 (0.095875ms)
  ✓ 乘以NaN (0.035042ms)
  ✓ 乘以字串 (0.037625ms)
✓ 測試乘法功能 (0.608375ms)
i tests 19
i suites 0
i pass 19
i fail 0
i cancelled 0
i skipped 0
i todo 0
i duration_ms 50.879375
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines |
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |                  |
i Calc.js       | 100.00 |   100.00 |   100.00 |                  |
i -----
i all files     | 100.00 |   100.00 |   100.00 |                  |
i -----
i end of coverage report
```

DIVIDE

1. Add fail tests

```
// Calc_test.js
test('測試除法功能', async (t) => {
  // Encode decision: 除法應該返回浮點數結果
  await t.test('一般除法應返回浮點數', () => {
    assert.strictEqual(Calc.divide(10, 3), 3.333333333333333);
  });
  // Encode decision: 除以零應該拋出錯誤
  await t.test('除以零應拋出錯誤', () => {
    assert.throws(() => {
      Calc.divide(5, 0);
    }, Error);
  });
  await t.test('除以NaN', () => {
    assert.strictEqual(Calc.divide(2, NaN), NaN);
  });
  await t.test('除以字串', () => {
    assert.strictEqual(Calc.divide(2, '3'), NaN);
  });
});
```

```
node --test --experimental-test-coverage
```

```
└─
```

- ▶ 測試加法功能
 - ✓ 兩個正數相加 (0.675583ms)
 - ✓ 兩個負數相加 (0.051208ms)
 - ✓ 一個正數一個負數相加 (0.040417ms)
- ✓ 測試加法功能 (1.386959ms)
- ▶ 測試減法功能
 - ✓ 兩個正數相減 (0.388959ms)
 - ✓ 兩個負數相減 (0.039541ms)
 - ✓ 一個正數一個負數相減 (0.038958ms)
 - ✓ 一個負數一個正數相減 (0.035083ms)
- ✓ 測試減法功能 (0.624208ms)
- ▶ 測試乘法功能
 - ✓ 兩個正數相乘 (0.110375ms)
 - ✓ 兩個負數相乘 (0.037708ms)
 - ✓ 一個正數一個負數相乘 (0.037125ms)
 - ✓ 一個負數一個正數相乘 (0.034208ms)
 - ✓ 乘以0 (0.036375ms)
 - ✓ 乘以正無窮 (0.043125ms)
 - ✓ 乘以負無窮 (0.035ms)
 - ✓ 乘以NaN (0.032625ms)
 - ✓ 乘以字串 (0.032417ms)
- ✓ 測試乘法功能 (0.635458ms)
- ▶ 測試除法功能
 - ✗ 一般除法應返回浮點數 (0.663833ms)
 - ✗ 除以零應拋出錯誤 (0.310708ms)
 - ✗ 除以NaN (0.0585ms)
 - ✗ 除以字串 (0.048333ms)
- ✗ 測試除法功能 (1.229334ms)

```

i tests 24
i suites 0
i pass 19
i fail 5
i cancelled 0
i skipped 0
i todo 0
i duration_ms 79.413458
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |
i Calc.js       | 100.00 |   100.00 |   100.00 |
i -----
i all files     | 100.00 |   100.00 |   100.00 |
i -----
i end of coverage report

* failing tests:

test at Calc_test.js:64:13
* 一般除法應返回浮點數 (0.663833ms)
  AssertionError [ERR_ASSERTION]: Expected values to be strictly equal:
    + actual - expected

    + undefined
    - 3.3333333333333335

      at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:65:16)
      at Test.runInAsyncScope (node:async_hooks:211:14)
      at Test.run (node:internal/test_runner/test:979:25)
      at Test.start (node:internal/test_runner/test:877:17)
      at TestContext.test (node:internal/test_runner/test:307:20)
      at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:64:13)
      at Test.runInAsyncScope (node:async_hooks:211:14)
      at Test.run (node:internal/test_runner/test:979:25)
      at Test.processPendingSubtests
(node:internal/test_runner/test:677:18)
      at Test.postRun (node:internal/test_runner/test:1090:19) {
    generatedMessage: true,
    code: 'ERR_ASSERTION',
    actual: undefined,
    expected: 3.3333333333333335,
    operator: 'strictEqual'
  }

test at Calc_test.js:68:13
* 除以零應拋出錯誤 (0.310708ms)
  AssertionError [ERR_ASSERTION]: Missing expected exception (Error).
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:69:16)

```

```

    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:68:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7) {
  generatedMessage: false,
  code: 'ERR_ASSERTION',
  actual: undefined,
  operator: 'throws'
}

```

test at Calc_test.js:73:13

✖ 除以NaN (0.0585ms)

AssertionError [ERR_ASSERTION]: Expected values to be strictly equal:

undefined !== NaN

```

    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:74:16)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:73:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7) {
  generatedMessage: true,
  code: 'ERR_ASSERTION',
  actual: undefined,
  expected: NaN,
  operator: 'strictEqual'
}

```

test at Calc_test.js:76:13

✖ 除以字串 (0.048333ms)

AssertionError [ERR_ASSERTION]: Expected values to be strictly equal:

undefined !== NaN

```

    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:77:16)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-
2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:76:13)
    at async Test.run (node:internal/test_runner/test:980:9)

```

```

    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7) {
  generatedMessage: true,
  code: 'ERR_ASSERTION',
  actual: undefined,
  expected: NaN,
  operator: 'strictEqual'
}

```

2. Modify the code to pass the test

```

// Calc.js
static divide(a, b) {
  return a / b;
}

```

```

node --test --experimental-test-coverage
└─

```

```

▶ 測試加法功能
  ✓ 兩個正數相加 (0.689167ms)
  ✓ 兩個負數相加 (0.078375ms)
  ✓ 一個正數一個負數相加 (0.052667ms)
✓ 測試加法功能 (2.023667ms)
▶ 測試減法功能
  ✓ 兩個正數相減 (0.744709ms)
  ✓ 兩個負數相減 (0.04175ms)
  ✓ 一個正數一個負數相減 (0.040958ms)
  ✓ 一個負數一個正數相減 (0.038083ms)
✓ 測試減法功能 (1.006916ms)
▶ 測試乘法功能
  ✓ 兩個正數相乘 (0.120708ms)
  ✓ 兩個負數相乘 (0.037458ms)
  ✓ 一個正數一個負數相乘 (0.035125ms)
  ✓ 一個負數一個正數相乘 (0.036958ms)
  ✓ 乘以0 (0.039167ms)
  ✓ 乘以正無窮 (0.035625ms)
  ✓ 乘以負無窮 (0.036208ms)
  ✓ 乘以NaN (0.035833ms)
  ✓ 乘以字串 (0.034958ms)
✓ 測試乘法功能 (0.632084ms)
▶ 測試除法功能
  ✓ 一般除法應返回浮點數 (0.05075ms)
  ✗ 除以零應拋出錯誤 (0.939209ms)
  ✓ 除以NaN (0.060041ms)
  ✗ 除以字串 (0.264792ms)
✗ 測試除法功能 (1.460791ms)
i tests 24
i suites 0
i pass 21

```

```

i fail 3
i cancelled 0
i skipped 0
i todo 0
i duration_ms 79.4615
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines
i -----
i Calc_test.js   | 100.00 |   100.00 |   100.00 |
i Calc.js        | 100.00 |   100.00 |   100.00 |
i -----
i all files      | 100.00 |   100.00 |   100.00 |
i -----
i end of coverage report

× failing tests:

test at Calc_test.js:68:13
× 除以零應拋出錯誤 (0.939209ms)
  AssertionError [ERR_ASSERTION]: Missing expected exception (Error).
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:69:16)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:68:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7) {
  generatedMessage: false,
  code: 'ERR_ASSERTION',
  actual: undefined,
  operator: 'throws'
}

test at Calc_test.js:76:13
× 除以字串 (0.264792ms)
  AssertionError [ERR_ASSERTION]: Expected values to be strictly equal:
    + actual - expected

    + 0.6666666666666666
    - NaN

    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:77:16)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:76:13)

```



```

    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7) {
  generatedMessage: true,
  code: 'ERR_ASSERTION',
  actual: 0.6666666666666666,
  expected: NaN,
  operator: 'strictEqual'
}

```

接著加上一些錯誤處理

```

// Calc.js
static divide(a, b) {
  if (typeof a !== 'number' || typeof b !== 'number') {
    return NaN;
  }
  if (b === 0) {
    throw new Error('除以零');
  }
  return a / b;
}

```

```
node --test --experimental-test-coverage
```

- └─
- ▶ 測試加法功能
 - ✓ 兩個正數相加 (0.577875ms)
 - ✓ 兩個負數相加 (0.051583ms)
 - ✓ 一個正數一個負數相加 (0.040833ms)
- ✓ 測試加法功能 (1.15875ms)
- ▶ 測試減法功能
 - ✓ 兩個正數相減 (0.466041ms)
 - ✓ 兩個負數相減 (0.040291ms)
 - ✓ 一個正數一個負數相減 (0.105542ms)
 - ✓ 一個負數一個正數相減 (0.036375ms)
- ✓ 測試減法功能 (0.771084ms)
- ▶ 測試乘法功能
 - ✓ 兩個正數相乘 (0.128875ms)
 - ✓ 兩個負數相乘 (0.039916ms)
 - ✓ 一個正數一個負數相乘 (0.034041ms)
 - ✓ 一個負數一個正數相乘 (0.0345ms)
 - ✓ 乘以0 (0.038417ms)
 - ✓ 乘以正無窮 (0.038875ms)
 - ✓ 乘以負無窮 (0.03575ms)
 - ✓ 乘以NaN (0.036375ms)
 - ✓ 乘以字串 (0.034625ms)
- ✓ 測試乘法功能 (0.648791ms)
- ▶ 測試除法功能
 - ✓ 一般除法應返回浮點數 (0.058458ms)

```

✓ 除以零應拋出錯誤 (0.367042ms)
✓ 除以NaN (0.037459ms)
✓ 除以字串 (0.038209ms)
✓ 測試除法功能 (0.631459ms)
i tests 24
i suites 0
i pass 24
i fail 0
i cancelled 0
i skipped 0
i todo 0
i duration_ms 78.898958
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |
i Calc.js       | 100.00 |   100.00 |   100.00 |
i -----
i all files     | 100.00 |   100.00 |   100.00 |
i -----
i end of coverage report

```

最後幫ADD跟SUBTRACT加上NaN跟無窮大的test

```

// Calc.js
// static add(a, b) {
await t.test('與NaN相加', () => {
  assert.strictEqual(Calc.add(2, NaN), NaN);
});
await t.test('與字串相加', () => {
  assert.strictEqual(Calc.add(2, '3'), NaN);
});
await t.test('與無窮大相加', () => {
  assert.strictEqual(Calc.add(2, Infinity), Infinity);
  assert.strictEqual(Calc.add(2, -Infinity), -Infinity);
});

```

node --test --experimental-test-coverage

```

▶ 測試加法功能
✓ 兩個正數相加 (0.789542ms)
✓ 兩個負數相加 (0.054708ms)
✓ 一個正數一個負數相加 (0.046375ms)
✓ 與0相加 (0.044375ms)
✓ 與NaN相加 (0.361167ms)
✗ 與字串相加 (0.580708ms)
✓ 與無窮大相加 (0.041459ms)

```

```

× 測試加法功能 (2.682041ms)
▶ 測試減法功能
  ✓ 兩個正數相減 (0.101959ms)
  ✓ 兩個負數相減 (0.036542ms)
  ✓ 一個正數一個負數相減 (0.031625ms)
  ✓ 一個負數一個正數相減 (0.030666ms)
  ✓ 與0相減 (0.032375ms)
  ✓ 與NaN相減 (0.032041ms)
  × 與字串相減 (0.056292ms)
  ✓ 與無窮大相減 (0.037083ms)
× 測試減法功能 (0.5505ms)
▶ 測試乘法功能
  ✓ 兩個正數相乘 (0.052958ms)
  ✓ 兩個負數相乘 (0.031708ms)
  ✓ 一個正數一個負數相乘 (0.032959ms)
  ✓ 一個負數一個正數相乘 (0.031458ms)
  ✓ 乘以0 (0.031125ms)
  ✓ 乘以正無窮 (0.030833ms)
  ✓ 乘以負無窮 (0.360458ms)
  ✓ 乘以NaN (0.03425ms)
  ✓ 乘以字串 (0.032584ms)
✓ 測試乘法功能 (0.844083ms)
▶ 測試除法功能
  ✓ 一般除法應返回浮點數 (0.053417ms)
  ✓ 負數除法 (0.036958ms)
  ✓ 除以零應拋出錯誤 (0.190583ms)
  ✓ 0除以任何數 (0.036292ms)
  ✓ 除以NaN (0.03375ms)
  ✓ 除以字串 (0.034083ms)
  ✓ 除以無窮大 (0.0855ms)
✓ 測試除法功能 (0.651417ms)
i tests 35
i suites 0
i pass 31
i fail 4
i cancelled 0
i skipped 0
i todo 0
i duration_ms 159.164459
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |
i Calc.js       | 100.00 |   100.00 |   100.00 |
i -----
i all files     | 100.00 |   100.00 |   100.00 |
i -----
i end of coverage report

× failing tests:

test at Calc_test.js:22:13
× 與字串相加 (0.580708ms)

```

```
AssertionError [ERR_ASSERTION]: Expected values to be strictly equal:
```

```
'23' !== NaN
```

```
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:23:16)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:22:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async startSubtestAfterBootstrap
(node:internal/test_runner/harness:296:3) {
  generatedMessage: true,
  code: 'ERR_ASSERTION',
  actual: '23',
  expected: NaN,
  operator: 'strictEqual'
}
```

```
test at Calc_test.js:51:13
```

```
✖ 與字串相減 (0.056292ms)
```

```
AssertionError [ERR_ASSERTION]: Expected values to be strictly equal:
```

```
-1 !== NaN
```

```
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:52:16)
    at Test.runInAsyncScope (node:async_hooks:211:14)
    at Test.run (node:internal/test_runner/test:979:25)
    at Test.start (node:internal/test_runner/test:877:17)
    at TestContext.test (node:internal/test_runner/test:307:20)
    at TestContext.<anonymous> (/Users/ysyang/Documents/NYCU/113-2/Software_Testing/113-spring-software-testing/HW2/Calc_test.js:51:13)
    at async Test.run (node:internal/test_runner/test:980:9)
    at async Test.processPendingSubtests
(node:internal/test_runner/test:677:7) {
  generatedMessage: true,
  code: 'ERR_ASSERTION',
  actual: -1,
  expected: NaN,
  operator: 'strictEqual'
}
```

最後完成所有test

```
node --test --experimental-test-coverage
```

```
└─
```

```
► 測試加法功能
```

```
✓ 兩個正數相加 (0.312458ms)
```

```

✓ 兩個負數相加 (0.049333ms)
✓ 一個正數一個負數相加 (0.039875ms)
✓ 與0相加 (0.040458ms)
✓ 與NaN相加 (0.394917ms)
✓ 與字串相加 (0.109875ms)
✓ 與無窮大相加 (0.047042ms)
✓ 測試加法功能 (1.554708ms)
▶ 測試減法功能
✓ 兩個正數相減 (0.125291ms)
✓ 兩個負數相減 (0.044292ms)
✓ 一個正數一個負數相減 (0.036833ms)
✓ 一個負數一個正數相減 (0.034208ms)
✓ 與0相減 (0.041542ms)
✓ 與NaN相減 (0.03525ms)
✓ 與字串相減 (0.03575ms)
✓ 與無窮大相減 (0.036417ms)
✓ 測試減法功能 (0.609292ms)
▶ 測試乘法功能
✓ 兩個正數相乘 (0.056166ms)
✓ 兩個負數相乘 (0.036166ms)
✓ 一個正數一個負數相乘 (0.037875ms)
✓ 一個負數一個正數相乘 (0.03875ms)
✓ 乘以0 (0.037542ms)
✓ 乘以正無窮 (0.040417ms)
✓ 乘以負無窮 (0.037125ms)
✓ 乘以NaN (0.04075ms)
✓ 乘以字串 (0.087792ms)
✓ 測試乘法功能 (1.064708ms)
▶ 測試除法功能
✓ 一般除法應返回浮點數 (0.052375ms)
✓ 負數除法 (0.032208ms)
✓ 除以零應拋出錯誤 (0.2125ms)
✓ 0除以任何數 (0.032833ms)
✓ 除以NaN (0.032958ms)
✓ 除以字串 (0.03125ms)
✓ 除以無窮大 (0.030584ms)
✓ 測試除法功能 (0.604583ms)
i tests 35
i suites 0
i pass 35
i fail 0
i cancelled 0
i skipped 0
i todo 0
i duration_ms 57.36075
i start of coverage report
i -----
i file          | line % | branch % | funcs % | uncovered lines |
i -----
i Calc_test.js  | 100.00 |   100.00 |   100.00 |                  |
i Calc.js       | 100.00 |   100.00 |   100.00 |                  |
i -----
i all files     | 100.00 |   100.00 |   100.00 |                  |

```

```
i -----  
i end of coverage report
```

Thanks for reading!
