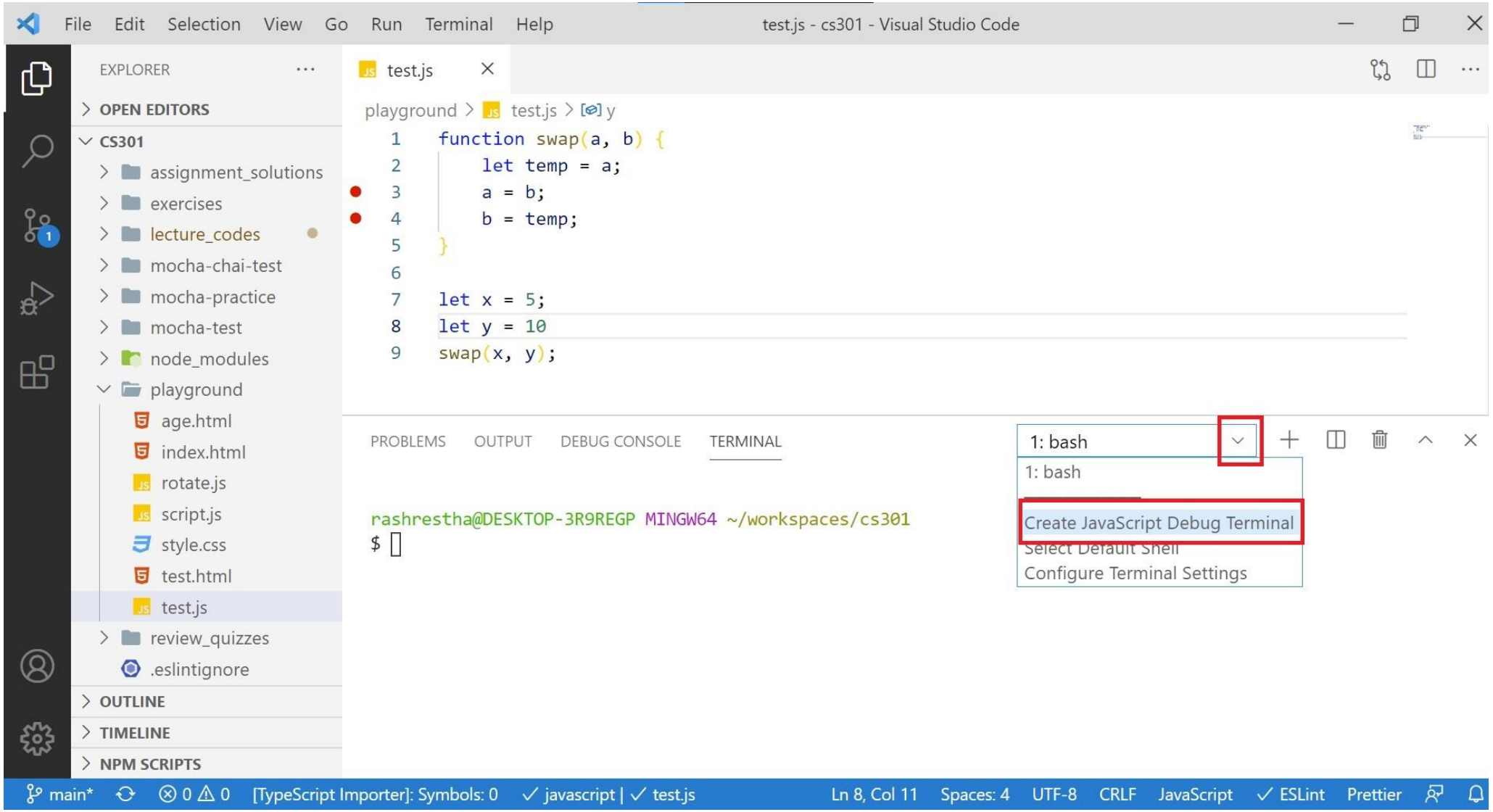
LESSON
CODE QUALITY

Source of Orderliness and Coherence

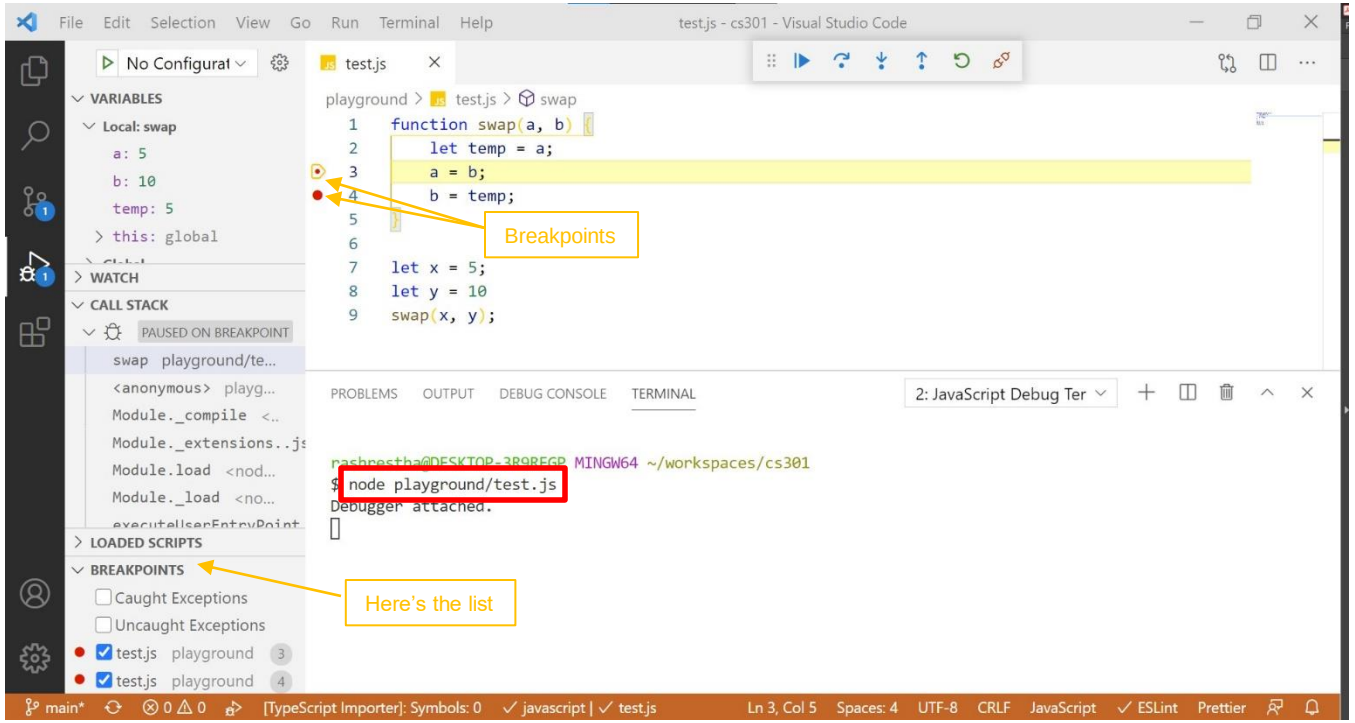
Wholeness: The best quality code is easy to understand and maintain. Science of Consciousness: Pure consciousness is a state of perfect orderliness and simplicity. Having this experience promotes the ability to find the simplest and most orderly solutions to problems.

Debugging in Node



Breakpoints

- list of breakpoints in the left panel. It allows us to:
  - Quickly jump to the breakpoint in the code by clicking in the breakpoints list.
  - Temporarily disable the breakpoint by unchecking it.
  - Remove the breakpoint by right-clicking and selecting Remove.



Debugger command

- pause the code by using the debugger command in it
  - Helpful in sandbox sites like jsfiddle or plunker
  - and when have infinite loop in code
    - in browser code runs automatically upon loading
  - like a breakpoint, but not dependent on the visual interface

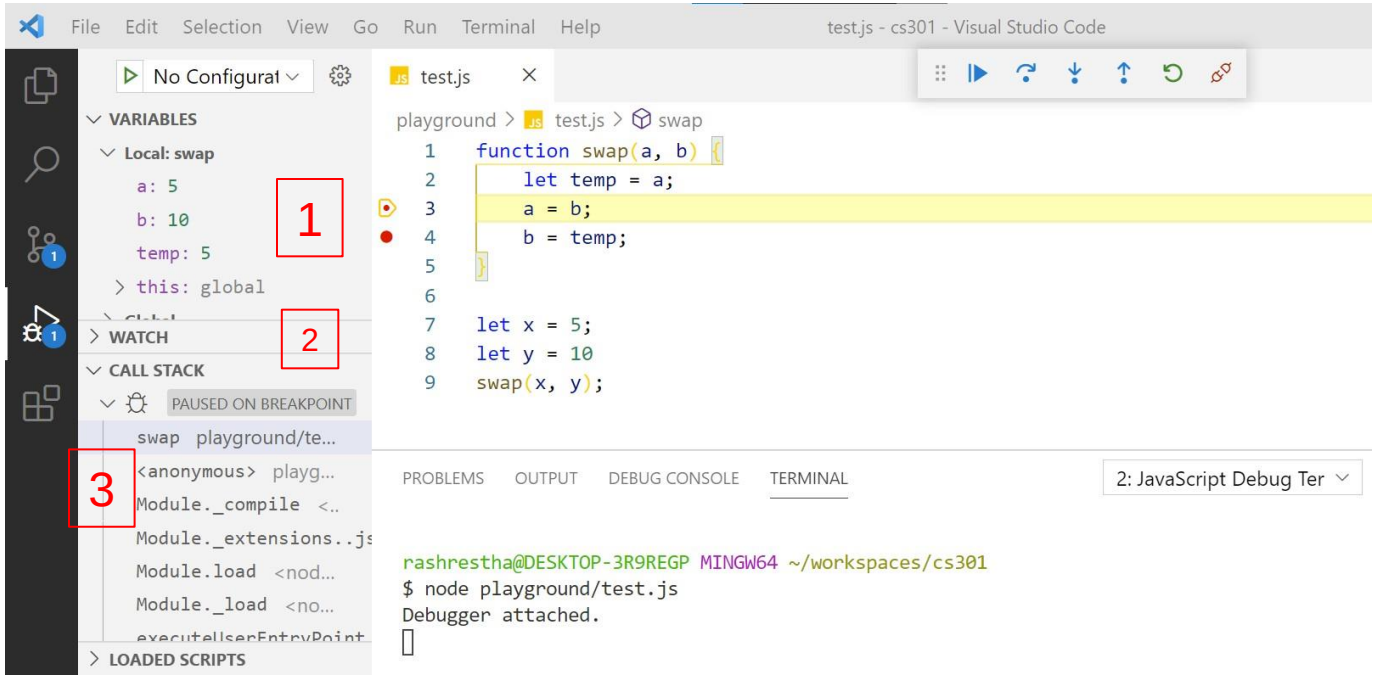
```
function hello(name) {
  let phrase = `Hello, ${name}!`;

  debugger;  // <-- the debugger stops here

  say(phrase);
}
```

Pause and look around

- In our example, as the breakpoints are set at line 3 and 4, the execution pauses at the fist breakpoint on 3rd line:
  - VARIABLES – current variables in different scopes.
  - WATCH – shows current values for any expressions (if any).
  - CALL STACK– shows the nested calls chain



Tracing the execution

- Continue the execution, F5.
- Step Over (run the next command), but don’t go into the function, F10.
- Step Into, F11.
- Step Out, Shift + F11
- Restart, Ctrl + shift + F5
- Disconnect

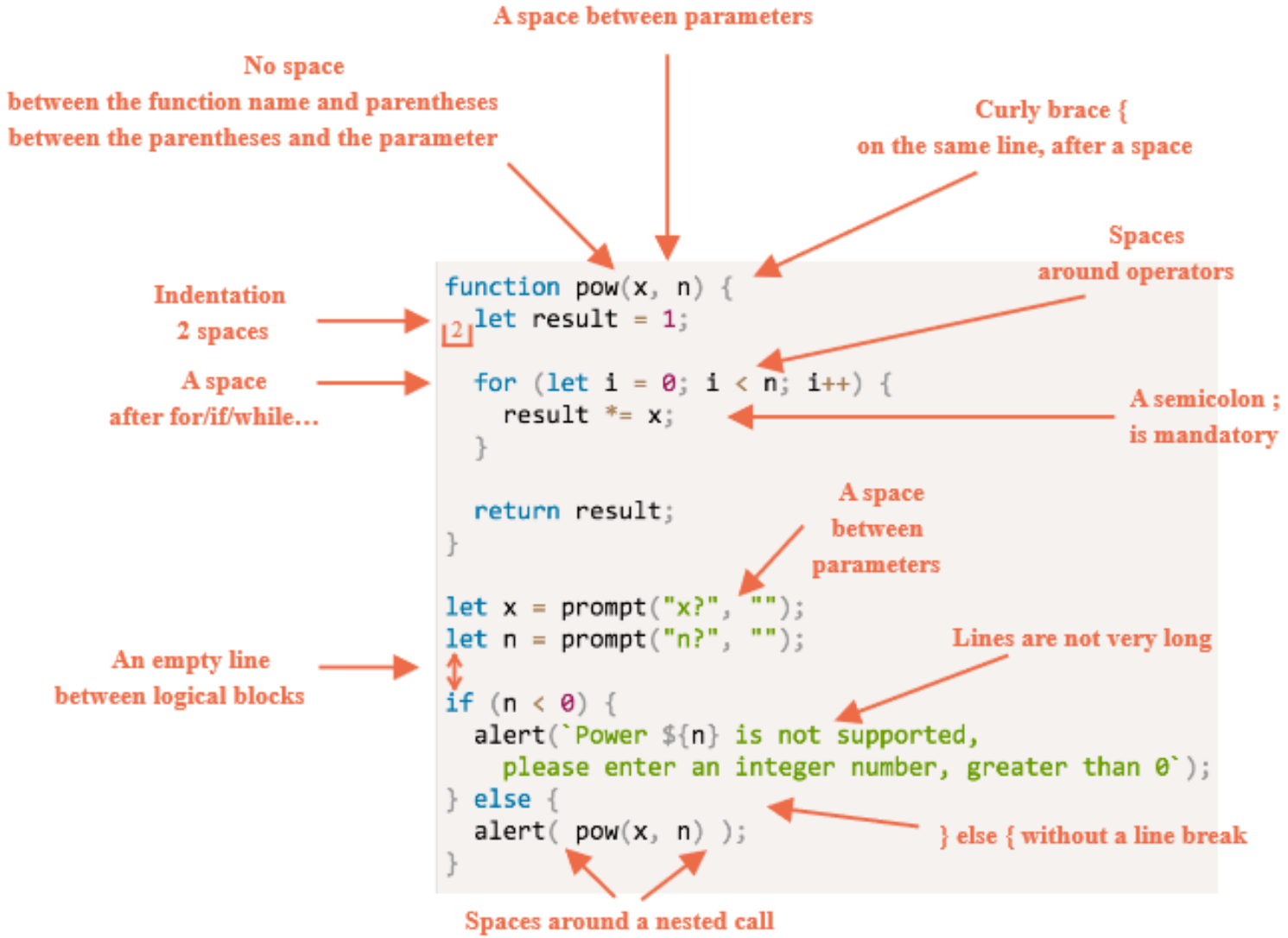
Main Point: Using the Node or Chrome debugger

One should carefully develop code to avoid bugs, but in the real world some mistakes are inevitable even for the best developers. Proper use of debugging tools greatly reduces the time required to remove errors. Science of Consciousness: Ideally one can avoid stress and strain in daily life, but in the real world some daily stress is inevitable. The TM Technique is an effective and efficient manner to remove stress.

Coding conventions

“Debugging is twice as hard as writing the code in the first place. Therefore, if you write the code as cleverly as possible you are, by definition, not smart enough to debug it.”
Kernighan and Plauger, *The Elements of Programming Style*

Good code looks good.



Coding conventions

- Curly Braces
  - In most JavaScript projects curly braces are written with the opening brace on the same line as the corresponding keyword – not on new line.

```
if (n < 0) {
    alert(`Power ${n} is not supported`);
}
```

  - Line Length
    - No one likes to read a long horizontal line of code. It's best practice to split them.
  - Horizontal indents: 2 or 4 spaces.
  - Vertical indents: empty lines for splitting code into logical blocks
  - A semicolon should be present after each statement, even if it could possibly be skipped
    - not needed at the end of a code block { … } //no semicolon needed here

Function Placement

- Code first, then functions
  - when reading code, we first want to know what it does.
  - If the code goes first, then it becomes clear from the start.
  - Then, maybe we won't need to read the functions, especially if their names are descriptive

```
// the code which uses the functions
let elem = createElement();
setHandler(elem);
walkAround();

// --- helper functions ---
function createElement() {
  ...
}

function setHandler(elem) {
  ...
}

function walkAround() {
  ...
}
```

Automated Linters

- Linters are tools that automatically check the style of your code and make improving suggestions.
- can also find some bugs, like typos in variable or function names.
- using a linter is recommended
- some well-known linting tools:

JSLint – one of the first linters.
JSHint – more settings than JSLint.
ESLint – newest and most widely used (see instructions for installing eslint in Sakai Resources)

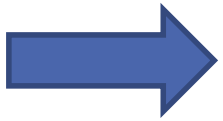
- Code style exercise: **Bad style**

Comments

```
function showPrimes(n) {
  nextPrime:
  for (let i = 2; i < n; i++) {

    // check if i is a prime number
    for (let j = 2; j < i; j++) {
      if (i % j == 0) continue nextPrime;
    }

    alert(i);
  }
}
```



refactor

```
function showPrimes(n) {

        for (let i = 2; i < n; i++) {
          if (isPrime(i)) {
              alert(i);
          }
        }
}

function isPrime(n) {
  for (let i = 2; i < n; i++) {
    if (n % i == 0) return false;
  }

  return true;
}
```

Good comments

- An important sign of a good developer is comments:
- Good comments help maintain code,
  - come back after a delay and use effectively

- Comment this:
  - Overall architecture, high-level view.

  - Function usage.
    - Parameters, return values, exceptions, side effects
    - process (if nontrivial, then defining table)

  - Important solutions, especially when not immediately obvious
    - If you worked out some complex problem and implemented solution
    - Highlight the solution with a succinct comment so others quickly understand

JS doc

- common development problem:
  - you have written JavaScript code that is to be used by others and need a nice-looking HTML documentation of its API.
  - standard tool in the JavaScript world is JSDoc.
  - It is modeled after its Java analog, JavaDoc.

- JSDoc takes JavaScript code with /** */ comments (normal block comments that start with an asterisk) and produces HTML documentation for it

- For functions and methods, you should document parameters and return values,
  - and exceptions they may throw:

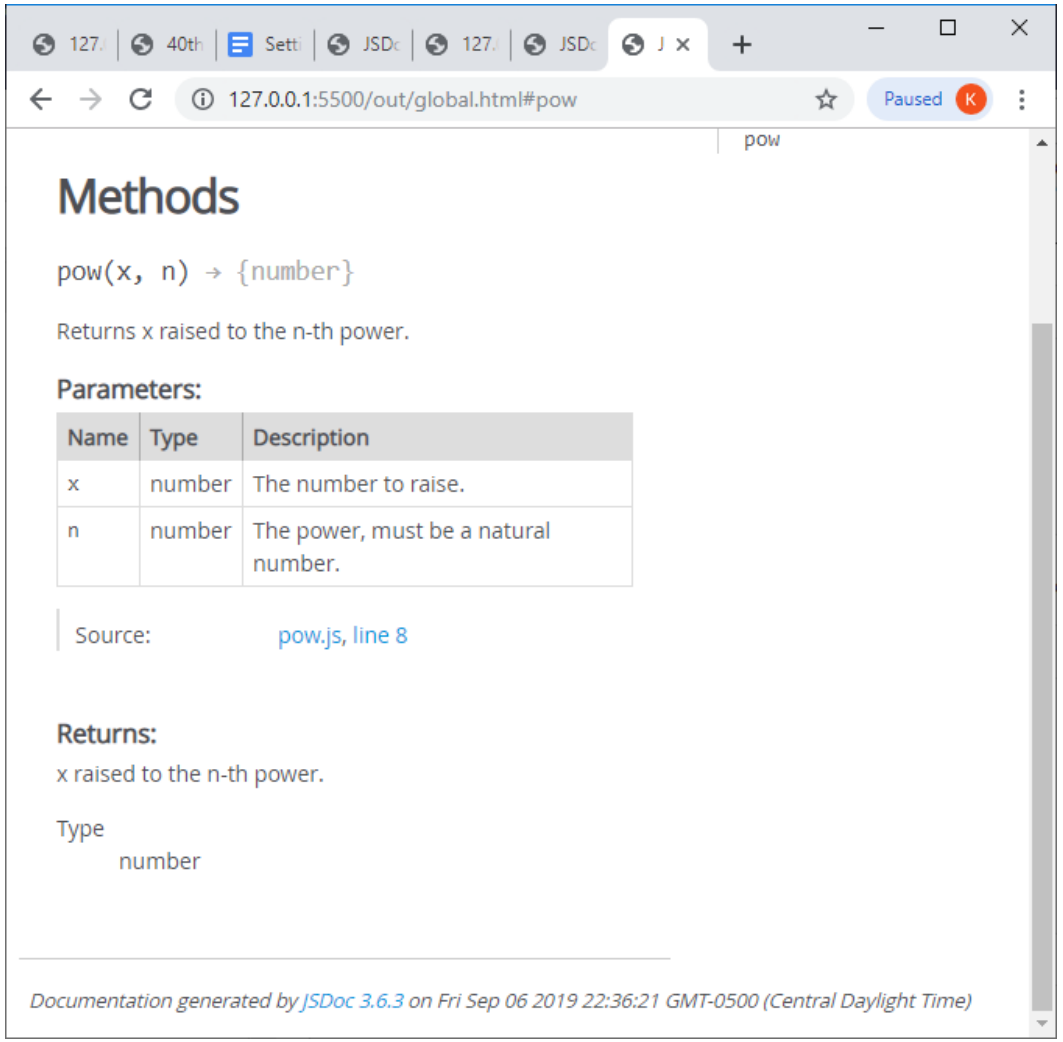
```
/**
*
 * @param {number} x The number to raise.
 * @param {number} n The power, must be a natural number.
 * @return {number} x raised to the n-th power.
 */
function pow(x, n) {
  ...
}
```

JS doc

- At terminal prompt:
  - npm install -g jsdoc
  - jsdoc pow.js

- Will then find pow.js.html under an out directory

```
/**
 * Returns x raised to the n-th power.
 *
 * @param {number} x The number to raise.
 * @param {number} n The power, must be a natural number.
 * @return {number} x raised to the n-th power.
 */
function pow(x, n) {
  ...
}
```



Exercise: Ninja code

- Read this section on your own
- Write the real rules implied by the irony examples
- Submit this as part of today's homework

For example:

- Ninja irony: Make the code as short as possible. Show how smart you are
  - Meaning: do not sacrifice code clarity for brevity.

- use single-letter variable names everywhere.
  - Meaning: *your answer here*

- If the team rules forbid the use of one-letter and vague names – shorten them, make abbreviations
  - Meaning: *your answer here*

- While choosing a name try to use the most abstract word
  - Meaning: *your answer here*

- Etc etc

Main Point: Coding conventions

Coding conventions are standardized best practices that ensure that code is easy to read and maintain. Science of Consciousness: The TM Technique is taught in a standard manner to ensure that the knowledge is understood and maintained over time and across individuals.

Main Point Preview: Behavior Driven Development (BDD)

In Behavior Driven Development we write tests that define what a function is supposed to do before we implement the function. Science of Consciousness: This provides a goal to guide development and a means to test success. This is like the SCI principle of Capture the Fort or Seek the Highest First. Once you have defined the required outcome the rest of the implementation flows from that.

Automated testing and Behavior Driven Development (BDD)

- Automated testing means tests are written separately, in addition to the code.
  - run functions and compare actual results with expected.
  - BDD is automated testing where tests are written before the code is implemented
- BDD is three things in one:
  - tests
  - documentation
  - examples

BDD Specification

- imagine what the function should do and describe it.

- **describe**("title", function() { ... })
  - functionality we're describing.
  - Used to group "workers" – the it blocks.

- **it**("use case description", function() { ... })
  - In the title of it describe the particular use case
  - second argument is a function that tests it.

- **assert**.equal(actual, expected)
  - first argument is call to function under test
  - second argument the result you expect

```
describe("pow", function() {
  it("returns 2 raised to power 3", function() {
    assert.equal(pow(2, 3), 8);
  });
});
```

Development flow

1. An initial spec is written, with tests for the most basic functionality.
2. An initial implementation (stub) is created.
3. To check whether it works, we run the testing framework Mocha (more details soon) that runs the spec. While the functionality is not complete, errors are displayed. We make corrections until everything works.
4. Now we have a working initial implementation with tests.
5. We add more use cases to the spec, probably not yet supported by the implementations. Tests start to fail.
6. Go to 3, update the implementation till tests give no errors.
7. Repeat steps 3-6 till the functionality is ready.

JavaScript libraries for tests

- Mocha – the core framework: it provides common testing functions including describe and it and the main function that runs tests.

Additional libraries commonly used with Mocha but beyond scope of 301 and 303

- Chai – the library with many assertions.
  - for now, we need only assert from Mocha

- Sinon – library for stubs, mocks, spies

```
sinon.stub(window, "prompt"); //insert Sinons static version of prompt function
prompt.onCall(0).returns("2");//first call to prompt will return “2”
prompt.onCall(1).returns("3");
```

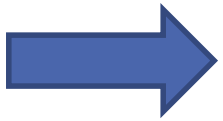
Principle: one test tests one thing

The first variant – add one more assert into the same it:

```
describe("pow", function() {

  it("raises to n-th power", function() {
    assert.equal(pow(2, 3), 8);
    assert.equal(pow(3, 4), 81);
  });

});
```



refactor

The second – make two tests:

```
describe("pow", function() {

  it("2 raised to power 3 is 8", function() {
    assert.equal(pow(2, 3), 8);
  });

  it("3 raised to power 3 is 27", function() {
    assert.equal(pow(3, 3), 27);
  });

});
```

In BDD, the spec comes first

The spec can be used in three ways:

1. As Tests – they guarantee that the code works correctly.
2. As Docs – the titles of describe and it tell what the function does.
3. As Examples – the tests are working examples showing how a function can be used.

- With the spec, we can safely improve, change, even rewrite the function from scratch and make sure it still works right.

- Without tests, developers have two options:
  - perform the change, no matter what.
    - then users meet bugs, as we probably fail to check something manually.
  - developers become afraid to modify such functions,
    - code becomes outdated, no one wants to get into it
- What's wrong in the test? (javascript.info)

how to run Mocha in VSCode

- Install Mocha Globally
  - `$npm install -g mocha`

- Create a project
  - Create a project directory `mocha-test` `(can be any name)`
  - Write your first test in file `myCodeTests.js` `(can be any name)`
  - Write your code in separate JavaScript file `myCode.js`.
  - Connect your test.js file to the functions you write in app.js using Node's CommonJS modules
    - See demo

- Now run `mocha myCodeTests.js`
- E.g., see functionTests.js and functions.js in Sakai > Resources > Mocha tests
  - also in 301Demo repo

```
//functionTests.js
"use strict";
const assert = require("assert");

/* import all exports from functions.js as methods on an object named fun */
const fun = require("./functions.js");

/*  returns true if argument is prime number */
describe("checkPrime", function () {

    it("37 is prime", function () {
        assert.strictEqual(fun.checkPrime(37), true);
    });
    it(" 77 is not prime", function () {
        assert.strictEqual(fun.checkPrime(77), false);
    });
});

describe("ssReverse", function () {
    it("[1, 2, 3, 4]", function () {//test array equality
        assert.deepStrictEqual(fun.ssReverse([1, 2, 3, 4 ]), [4,3,2,1] );
    });
});
```

```
//functions.js
"use strict";
exports.checkPrime = checkPrime;  //export the checkPrime function
exports.anotherFun =  anotherFun;  //export the anotherFun function

/**
 * @param {number} num is an integer
 * @returns {boolean} true if number is prime, else false
 * Prime numbers have only 2 factors: 1 and themselves.
*/
function checkPrime(num) {
    for (let i = 2; i < num; i++)
        if (num % i === 0) return false;
    return num > 1;
}

function anotherFun(){ .. . }
```

Main Point: Behavior Driven Development (BDD)

In Behavior Driven Development we write tests that define what a function is supposed to do before we implement the function. Science of Consciousness: This provides a goal to guide development and a means to test success. This is like the SCI principle of Capture the Fort or Seek the Highest First. Once you have defined the required outcome the rest of the implementation flows from that.

References

- Debugging in Chrome (javascript.info)
- Coding Style (javascript.info)
- Comments (javascript.info)
- Ninja code (javascript.info)
- Automated testing with Mocha (javascript.info)

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

Source of Orderliness and Coherence

1. Coding conventions provide guidelines to write code without bugs. Debuggers are critical for efficiently finding bugs that do occur.

2. Automated testing and Behavior Driven Development help guide development to prevent bugs during development and provide a means to ensure everything continues to work when there are extensions and modifications.

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3. **Transcendental consciousness**. State of perfect order and coherence
4. **Impulses within the transcendental field:** Thoughts arising from this level will naturally be orderly and coherent.
5. **Wholeness moving within itself:** In unity consciousness everything is appreciated in terms of this experience of order and coherence.