



TypeScript

入門3

Getting Started

Hello, world!

Hello, world!

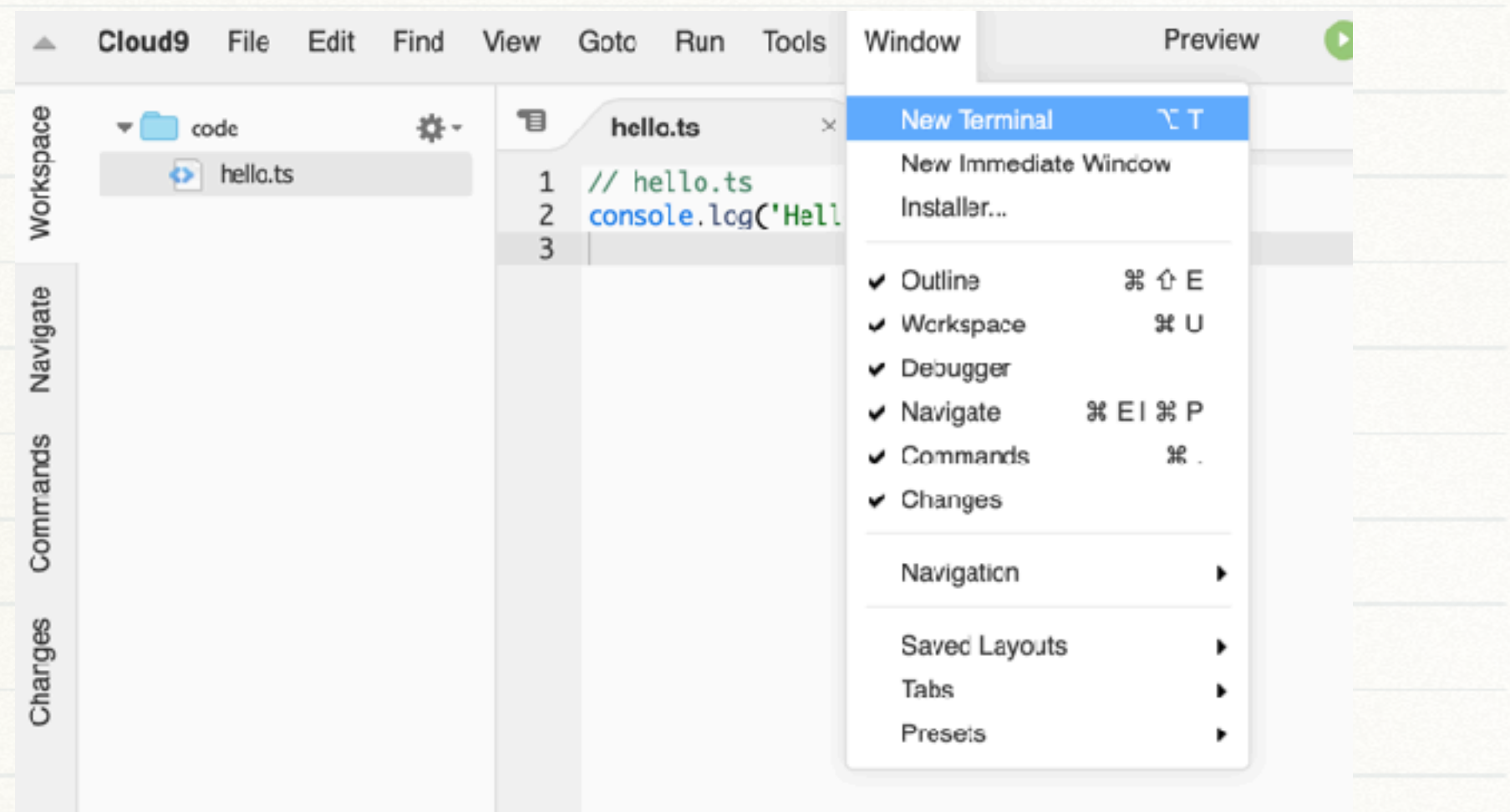
hello.ts

拡張子は **.ts**

```
// hello.ts
console.log('Hello, world!');
```

Window → New Terminal

実行してください



10 Things I Regret About Node.js - Ryan Dahl

```
deno run filename.ts
```

```
--help
```

```
--reload
```

```
$ deno run hello.ts  
Hello, world!
```

```
ls
```

```
pwd
```

```
cd
```

```
mkdir
```

```
rmdir
```

```
cp
```

```
rm
```

```
$ ls
```

```
$ pwd
```

```
$ cd
```

```
$ pwd
```

```
$ cd /code
```

```
zip -r file.zip dir
```

Lesson1

interface

JavaScript

```
// ex1.js
function print(p) {
    console.log(p);
}

let p2 = { x: 10, y: 20 };
let p3 = { x: 1, y: 2, z: 3 };

print(p2);
print(p3);

p2 = p3;
print(p2);

p2.z = 0;
```

代入できてしまう

```
$ deno run ex1.js
{ x: 10, y: 20 }
{ x: 1, y: 2, z: 3 }
{ x: 1, y: 2, z: 3 }
```

class extends(Object指向)

class
extends

```
// ex2.ts
class Point2 {
    constructor(public x: number, public y: number) { }
}

class Point3 extends Point2 {
    constructor(x: number, y: number, public z: number) {
        super(x, y);
    }
}

function print(p: Point2) {
    console.log(p);
}

let p2 = new Point2(10, 20);
let p3 = new Point3(1, 2, 3);

print(p2);
print(p3);

p2 = p3;
print(p2);

// p2.z = 0;
```


interface extends

interface

extends

newなしで使用

```
// ex3.ts
interface Point2 {
    x: number;
    y: number;
}

interface Point3 extends Point2 {
    z: number;
}

function print(p: Point2) {
    console.log(p);
}

let p2: Point2 = { x: 10, y: 20 };
let p3 = { x: 1, y: 2, z: 3 } as Point3;

print(p2);
print(p3);

p2 = p3;
print(p2);

// p2.z = 0;
```


Duck Typing

interface

継承しなくてもOK

```
// ex4.ts
interface Point2 {
  x: number;
  y: number;
}

interface Point3 {
  x: number;
  y: number;
  z: number;
}

function print(p: Point2) {
  console.log(p);
}

let p2: Point2 = { x: 10, y: 20 };
let p3 = { x: 1, y: 2, z: 3 } as Point3;

print(p2);
print(p3);

p2 = p3;
print(p2);

// p2.z = 0;
```

ERROR

```
$ deno check ex2.ts
Check file:///Users/shingo1551/Documents/github/course/ts3/lesson1/ex2.ts
error: TS2339 [ERROR]: Property 'z' does not exist on type 'Point2'.
p2.z = 0;
   ^
   at file:///Users/shingo1551/Documents/github/course/ts3/lesson1/ex2.ts:25:4

$ deno check ex3.ts
Check file:///Users/shingo1551/Documents/github/course/ts3/lesson1/ex3.ts
error: TS2339 [ERROR]: Property 'z' does not exist on type 'Point2'.
p2.z = 0;
   ^
   at file:///Users/shingo1551/Documents/github/course/ts3/lesson1/ex3.ts:24:4

$ deno check ex4.ts
Check file:///Users/shingo1551/Documents/github/course/ts3/lesson1/ex4.ts
error: TS2339 [ERROR]: Property 'z' does not exist on type 'Point2'.
p2.z = 0;
   ^
   at file:///Users/shingo1551/Documents/github/course/ts3/lesson1/ex4.ts:26:4
```


Lesson2

Type Guard

typeof

```
// ex1.js
function f(x) {
  console.log(x.slice(1));

  if (typeof x === 'string')
    console.log(x.slice(2));
}

f('123');
f(123);
```

```
$ deno run ex1.js
23
3
error: Uncaught TypeError: x.slice is not a function
      console.log(x.slice(1));
                    ^
    at f (file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex1.js:3:19)
    at file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex1.js:10:1
```


typeof 続き

```
// ex1.ts
function f(x: number | string) {
  console.log(x.slice(1));

  if (typeof x === 'string')
    console.log(x.slice(2));
}

f('123');
f(123);
```

```
$ deno check ex1.ts
Check file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex1.ts
error: TS2339 [ERROR]: Property 'slice' does not exist on type 'string | number'.
  Property 'slice' does not exist on type 'number'.
    console.log(x.slice(1));
                      ~~~~~
    at file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex1.ts:3:19
```

instanceof

```
// ex2.ts
class Foo {
  foo = 123;
}

class Bar {
  bar = 'abc';
}

function f(arg: Foo | Bar) {
  console.log(arg.foo);

  if (arg instanceof Foo)
    console.log(arg.foo);
}

f(new Foo());
f(new Bar());
```

```
$ deno check ex2.ts
Check file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex2.ts
error: TS2339 [ERROR]: Property 'foo' does not exist on type 'Foo | Bar'.
  Property 'foo' does not exist on type 'Bar'.
    console.log(arg.foo);
                      ~~~
    at file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex2.ts:11:21
```



```
// ex3.ts
interface Foo {
  foo: number;
}

interface Bar {
  bar: string;
}

function f(arg: Foo | Bar) {
  console.log(arg.foo);

  if ('foo' in arg)
    console.log(arg.foo);
}

f({ foo: 123 });
f({ bar: 'abc' });
```

```
$ deno check ex3.ts
Check file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex3.ts
error: TS2339 [ERROR]: Property 'foo' does not exist on type 'Foo | Bar'.
  Property 'foo' does not exist on type 'Bar'.
    console.log(arg.foo);
                      ~~~
at file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex3.ts:11:21
```

literal

```
// ex4.ts
interface Foo {
  t: 'foo';
  foo: number;
}

interface Bar {
  t: 'bar';
  bar: string;
}

function f(arg: Foo | Bar) {
  console.log(arg.foo);

  if (arg.t === 'foo')
    console.log(arg.foo);
}

f({ t: 'foo', foo: 123 });
f({ t: 'bar', bar: 'abc' });
f({ t: 'boo', bar: 'abc' });
```



```
$ deno check ex4.ts
Check file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex4.ts
error: TS2339 [ERROR]: Property 'foo' does not exist on type 'Foo | Bar'.
  Property 'foo' does not exist on type 'Bar'.
    console.log(arg.foo);
                      ~~~
    at file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex4.ts:13:21

TS2322 [ERROR]: Type '"boo"' is not assignable to type '"foo" | "bar"'.
f({ t: 'boo', bar: 'abc' });
  ^
  at file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex4.ts:21:5

The expected type comes from property 't' which is declared here on type 'Foo | Bar'
  t: 'foo';
  ^
  at file:///Users/shingo1551/Documents/github/course/ts3/lesson2/ex4.ts:3:5

Found 2 errors.
```

switch

```
// ex5.ts
interface Foo {
  t: 'foo';
  foo: number;
}

interface Bar {
  t: 'bar';
  bar: string;
}

function f(arg: Foo | Bar) {
  switch (arg.t) {
    case 'foo':
      console.log(arg.foo);
      break;

    case 'bar':
      console.log(arg.bar);
      break;
  }
}

f({ t: 'foo', foo: 123 });
f({ t: 'bar', bar: 'abc' });
```

```
$ deno run ex5.ts
123
abc
```


Lesson3

例外处理

try ... catch ... finally

```
// ex1.ts
let s: any;

console.log(s.length);
```

```
try {
  ...
} catch (e) {
  ...
} finally {
  ...
}
```

```
// ex2.ts
let s: any;

try {
  console.log('pass 1');
  console.log(s.length)
  console.log('pass 2');
} catch (e) {
  console.log('pass catch');
} finally {
  console.log('pass finally');
}
```

```
$ deno run ex2.ts
pass 1
pass catch
pass finally
```


throw

throw *string*

throw Error(*string*)

```
// ex3.ts
function f1() {
  try {
    throw 'Exception';
  } catch (e) {
    console.log(e);
  }
}
f1();

function f2() {
  try {
    throw Error('Exception!!!');
  } catch (e) {
    console.log(e);
  }
}
f2();
```

```
$ deno run ex3.ts
Exception
Error: Exception!!!
    at f2 (file:///Users/shingo1551/Documents/github/course/ts3/lesson3/ex3.ts:13:15)
    at file:///Users/shingo1551/Documents/github/course/ts3/lesson3/ex3.ts:18:1
```

Lesson4

Http Server

Http Server ([Standard Library](#))

```
import { serve } from ...  
Response
```

```
// ex1.ts  
import { serve } from 'https://deno.land/std@0.148.0/http/server.ts';  
serve(() => new Response('Hello World!'), { port: 8080 });
```

```
--allow-net  
--watch
```

```
$ deno run --allow-net --watch ex1.ts
```

実行して、ブラウザで表示してみましょう

`http://localhost:8080/`

Http Server (続き)

Headers

URL

```
// ex2.ts
import { serve } from 'https://deno.land/std@0.148.0/http/server.ts';

const headers = new Headers([['content-type', 'text/html; charset=UTF-8']]);

const body = `
<html>
  <body>
    <h1>Hello World!</h1>
  </body>
</html>
`;

const handler = (req: Request) => {
  const url = new URL(req.url);
  if (req.method === 'GET' && url.pathname === '/')
    return new Response(body, { headers: headers });
  else
    return new Response('Not Found', { status: 404 });
}

serve(handler, { port: 8080 });
```

実行して、ブラウザで表示してみましょう

<http://localhost:8080/>

```
$ deno run --allow-net ex2.ts
```


API Server

```
// ex3.ts
import { serve } from 'https://deno.land/std@0.148.0/http/server.ts';
import { api as member } from './ex4.ts';

const handler = (req: Request) => {
  const pathname = new URL(req.url).pathname;
  if (pathname.startsWith('/member'))
    return member(req, pathname);
  else
    return new Response('Not Found', { status: 404 });
}

serve(handler, { port: 8080 });
```

```
$ deno run --allow-net ex3.ts
```

実行して、ブラウザで表示してみましょう

<http://localhost:8080/member/id-001>

API Server (続き)

```
// ex4.ts
import * as db from './ex5.ts';

export function api(req: Request, pathname: string) {
  try {
    if (req.method === 'GET')
      return get(pathname);
    else
      return new Response('Not Found', { status: 404 });
  } catch (e) {
    return new Response(e, { status: 400 });
  }
}

const headers = new Headers(['content-type', 'application/json']);

function get(pathname: string) {
  const body = { status: 0, member: db.get(parseUrl(pathname)) };
  return new Response(JSON.stringify(body), { headers });
}

function parseUrl(pathname: string) {
  const params = pathname.split('/');
  if (params.length !== 3 || !params[2])
    throw 'Bad Request';
  else
    return params[2];
}
```


[index: string]: Member;

```
// ex5.ts
export interface Member {
  name: string;
  age: number;
}

interface MemberDB {
  [index: string]: Member;
}

const memberdb: MemberDB = {
  'id-001': { name: 'suzuki', age: 30 },
  'id-002': { name: 'tanaka', age: 40 },
};

export function get(id: string) {
  return memberdb[id];
}
```

Lesson5

Http Client

fetch

fetch ... then

res.json()

```
// ex1.ts
fetch('http://localhost:8080/member/id-001')
  .then((res) => {
    return res.json();
  }).then((obj) => {
    console.log(obj);
  });

fetch('http://localhost:8080/member/id-002')
  .then(res => res.json()).then(obj => console.log(obj));

try {
  const res = await fetch('http://localhost:8080/member/id-002');
  console.log(await res.json());
} catch (e) {
  console.log(e);
}
```

```
$ deno run --allow-net ex1.ts
{ status: 0, member: { name: "tanaka", age: 40 } }
{ status: 0, member: { name: "tanaka", age: 40 } }
{ status: 0, member: { name: "suzuki", age: 30 } }
```

post

```
// ex2.ts
import { Member } from './ex5.ts';

const member: Member = {
  name: 'yamada',
  age: 45
}

const headers = new Headers(['content-type', 'application/json']);

const opt = {
  method: 'POST',
  headers: headers,
  body: JSON.stringify(member)
};

try {
  const res = await fetch('http://localhost:8080/member/id-003', opt);
  console.log(await res.json());
} catch (e) {
  console.log(e);
}
```

```
$ deno run --allow-net ex2.ts
{ status: 0 }
```


API Server

```
// ex3.ts
import { serve } from 'https://deno.land/std@0.148.0/http/server.ts';
import { api as member } from './ex4.ts';

const handler = (req: Request) => {
  const pathname = new URL(req.url).pathname;
  if (pathname.startsWith('/member'))
    return member(req, pathname);
  else
    return new Response('Not Found', { status: 404 });
}

serve(handler, { port: 8080 });
```


API Server (続き)

```
// ex4.ts
import * as db from './ex5.ts';

export function api(req: Request, pathname: string) {
  try {
    if (req.method === 'GET')
      return get(pathname);
    else if (req.method === 'POST')
      return post(req, pathname);
    else
      return new Response('Not Found', { status: 404 });
  } catch (e) {
    return new Response(e, { status: 400 });
  }
}

...

async function post(req: Request, pathname: string) {
  db.set(parseUrl(pathname), await req.json());
  return new Response(JSON.stringify({ status: 0 }), { headers });
}
```


API Server (続き2)

```
// ex5.ts
export interface Member {
  name: string;
  age: number;
}

interface MemberDB {
  [index: string]: Member;
}

const memberdb: MemberDB = {
  'id-001': { name: 'suzuki', age: 30 },
  'id-002': { name: 'tanaka', age: 40 },
};

export function get(id: string) {
  return memberdb[id];
}

export function set(id: string, member: Member) {
  memberdb[id] = member;
}

export function del(id: string) {
  delete memberdb[id];
}
```

delete

Question

ex4.tsに**DEL**を追加してください

DELを使用するclientを作成してください

Answer

```
// ext4.ts
```

省略

```
export function api(req: Request, pathname: string) {  
  try {  
    if (req.method === 'GET')  
      return get(pathname);  
    else if (req.method === 'POST')  
      return post(req, pathname);  
    else if (req.method === 'DEL')  
      return del(pathname);  
    else  
      return new Response('Not Found', { status: 404 });  
  } catch (e) {  
    return new Response(e, { status: 400 });  
  }  
}
```

省略

```
function del(pathname: string) {  
  db.del(parseUrl(pathname));  
  return new Response(JSON.stringify({ status: 0 }), { headers });  
}
```

```
// ans2.ts
const opt = {
  method: 'DEL'
};

try {
  const res = await fetch('http://localhost:8080/member/id-001', opt);
  console.log(await res.json());
} catch (e) {
  console.log(e);
}
```

```
$ deno run --allow-net ans2.ts
{ status: 0 }
```


Lesson6

API Test

assert

[Standard Library](#)

[assert](#)

`await res.body?.cancel()`

```
// api_test.ts
import { assertEquals } from "https://deno.land/std@0.149.0/testing/asserts.ts";
import { scenarios } from './scenario.ts';

const headers = new Headers([['content-type', 'application/json']]);

for (const scenario of scenarios) {
  Deno.test(scenario.message, async () => {
    const opt = {
      method: scenario.method,
      headers: headers,
      body: scenario.member ? JSON.stringify(scenario.member) : undefined
    };

    const res = await fetch(`http://localhost:8080/member/${scenario.id}`, opt);
    const expected = scenario.expected;

    assertEquals(res.status, expected.status);
    if (expected.member)
      assertEquals((await res.json()).member, expected.member);
    else
      await res.body?.cancel();
  });
}
```



```
// interface.ts
export interface Member {
  name: string;
  age: number;
}

export interface Scenario {
  message: string;
  method: 'GET' | 'POST' | 'PUT' | 'DEL';
  id: string;
  member?: Member;
  expected: Expected;
}

export interface Expected {
  status: number;
  member?: Member;
}
```

scenario.ts

```
// scenario.ts
import { Scenario } from './interface.ts';

export const scenarios : Scenario[] = [
  {
    message: 'get member',
    method: 'GET',
    id: 'id-001',
    expected: {
      status: 200,
      member: {
        name: 'suzuki',
        age: 30
      }
    }
  },
  {
    message: 'post member',
    method: 'POST',
    id: 'id-002',
    member: {
      name: 'nakamura',
      age: 19
    },
    expected: {
      status: 200
    }
  },
  {
    message: 'put member',
    method: 'PUT',
    id: 'id-003',
    member: {
      name: 'nakamura',
      age: 19
    },
    expected: {
      status: 200
    }
  },
  {
    message: 'del member',
    method: 'DEL',
    id: 'id-002',
    expected: {
      status: 200
    }
  }
];
```


deno test -A

```
$ deno test -A
Check file:///Users/shingo1551/Documents/github/course/ts3/lesson6/api_test.ts
running 4 tests from ./lesson6/api_test.ts
get member ... ok (8ms)
post member ... ok (4ms)
put member ... FAILED (4ms)
del member ... ok (3ms)

ERRORS

put member => ./lesson6/api_test.ts:8:8
error: AssertionError: Values are not equal:

    [Diff] Actual / Expected

-   404
+   200

    throw new AssertionError(message);
          ^
    at assertEquals (https://deno.land/std@0.149.0/testing/asserts.ts:177:9)
    at file:///Users/shingo1551/Documents/github/course/ts3/lesson6/api_test.ts:18:5

FAILURES

put member => ./lesson6/api_test.ts:8:8

FAILED | 3 passed | 1 failed (26ms)

error: Test failed
```

Appendix

async, await

非同期IO

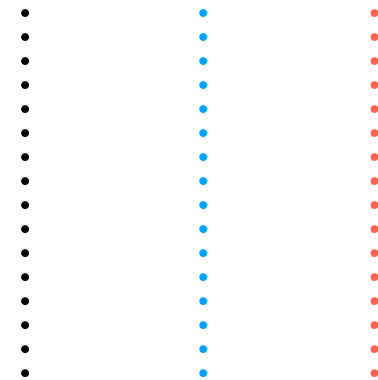
InternetはIOが多い

Multi Threadで同時処理を行なうと、
IO待ちによるsleepが長時間発生する

C10K問題

Threadごとに多くのメモリーが割り当てられるため、メモリーが枯渇し処理不能に陥った

Multi Thread

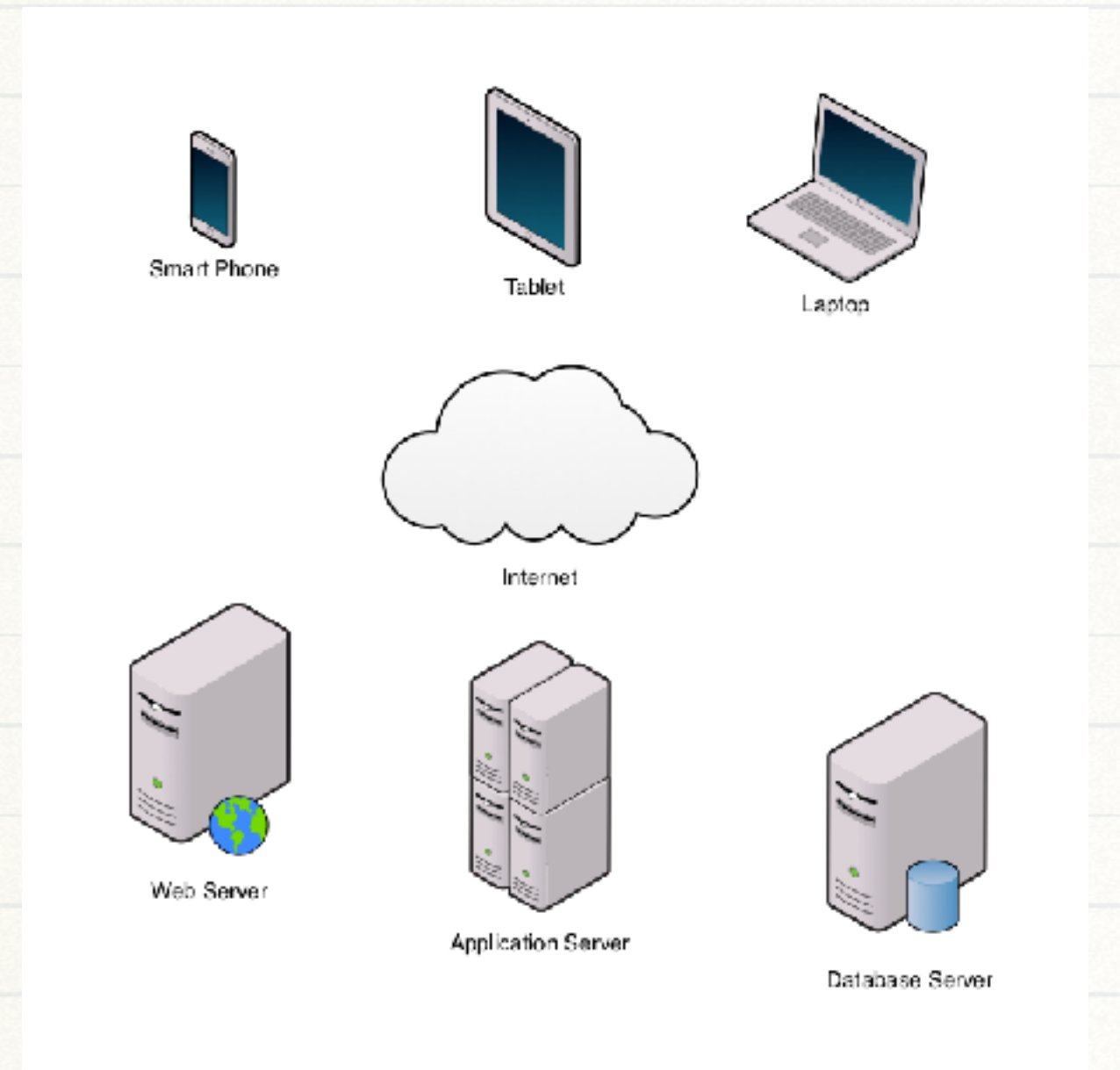


IO待ちが発生すると、別の処理を行う

C10K問題

1つのThreadで処理するため、メモリーが枯渇しない

非同期IO



async, await

Promise

resolve

reject

```
// ex1.ts
export function resolveAfter(sec: number, b: boolean) {
  return new Promise((resolve, reject) => {
    setTimeout(() => {
      if (b)
        resolve('resolved');
      else
        reject('rejected');
    }, sec * 1000);
  });
}
```

async

try {

...

await

...

} catch (e) {

...

}

```
// ex2.ts
import { resolveAfter } from './ex1.ts';

export async function asyncCall(sec: number, b: boolean) {
  try {
    console.log('pass 1');
    console.log(await resolveAfter(sec, b));
  } catch (e) {
    console.log('catch:', e);
  }
}
```


await

```
// ex3.ts
import { asyncCall } from './ex2.ts';

asyncCall(2, true);
console.log('pass 2');

asyncCall(2, false);
console.log('pass 3');
```

```
$ deno run ex3.ts
pass 1
pass 2
pass 1
pass 3
resolved
catch: rejected
```


await

```
// ex4.ts
import { asyncCall } from './ex2.ts';

await asyncCall(2, true);
console.log('pass 2');

await asyncCall(2, false);
console.log('pass 3');
```

```
deno run ex4.ts
pass 1
resolved
pass 2
pass 1
catch: rejected
pass 3
```


then

ex2.tsと同等

.then((ok)=>{}, (ng)=>{})

```
// ex5.ts
import { resolveAfter } from './ex1.ts';

export function asyncCall(sec: number, b: boolean) {
  console.log('pass 1');

  return resolveAfter(sec, b).then(
    (ok) => {
      console.log('OK:', ok);
    },
    (ng) => {
      console.log('NG:', ng);
    }
  )
}
```


Callback Hell

ex4.tsと同等

Callback地獄

```
// ex6.ts
import { asyncCall } from './ex5.ts';

asyncCall(2, true).then(() => {
  console.log('pass 2');

  asyncCall(2, false).then(() => {
    console.log('pass 3');
  });
});
```

```
$ deno run ex6.ts
pass 1
OK: resolved
pass 2
pass 1
NG: rejected
pass 3
```


Link

TypeScript <https://www.typescriptlang.org>

deno <https://deno.land>

10 Things I Regret About Node.js <https://youtu.be/M3BM9TB-8yA>

Visual Studio Code (VScode) <https://code.visualstudio.com>