Fun with Folktale

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why?

- Folktale models functional programming concepts in JS
- less runtime exceptions, or informative as to why
- avoid null / undefined (they are ambiguous)
- “correct” means like Algebra, equations are incorrect or correct

when?

- Using JUST JavaScript, especially Node, but ES6 Browser too
- You’re not using Elm, Dart, PureScript, or ClojureScript
- TypeScript in library coming

Folktale

fun / functional programming

FOLKTALE

- Maybe
- Predicates and Checkers vs Validators
- Union Types
- Tasks

WHEN DO YOU USE THEM

- Maybe: a value is there or it isn’t
- Validator: user or server or file data is legit or not, if not why not
- Union: another useful data type
- Task: enhancement on Promises

In Practice

- Use Maybe instead of null / undefined
- use Validators for user input, sanitizing server input, & nice error messages
- If null/undefined is a legit return value, use a Union type
- if a bunch of things can be returned, use a Union type

In Practice: Tasks

- Tasks are enhanced Promises
- you can cancel them and have cleanup code for them
- easily convert back to a Promise

MAYBE

MAYBE

A data structure that models the presence or absence of a value.

```
Maybe.Just('I matter');
Maybe.Nothing();
```

```javascript
const users = [
    {name: "Jesse", age: 38},
    {name: "Albus", age: 2},
    undefined,
    {name: "Cow"}
];

const getUserAtIndex = index => users[index];

getUserAtIndex(1); // { name: 'Albus', age: 2 }
getUserAtIndex(2); // undefined
```

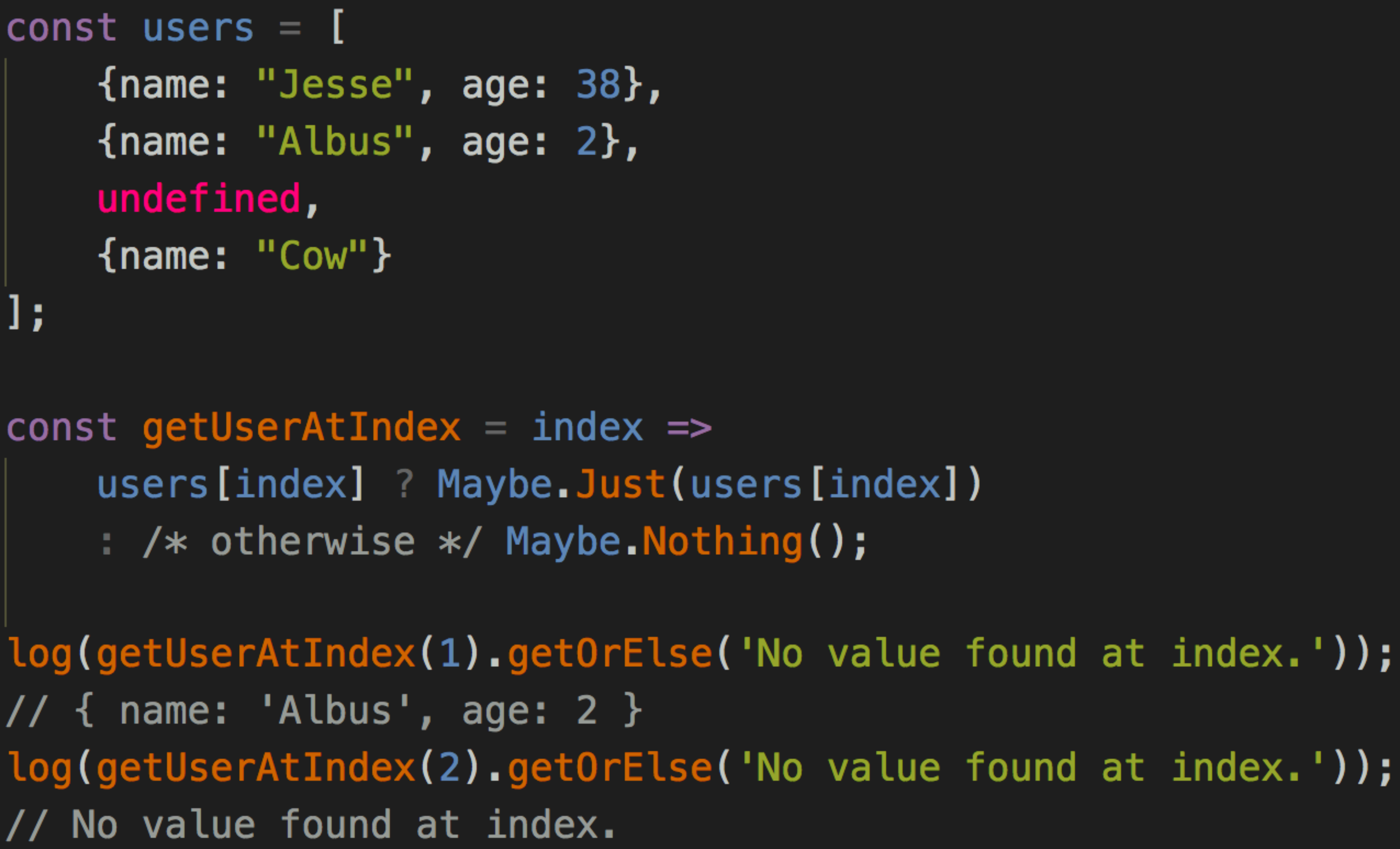
```
const getUserAtIndex = index =>
    users[index] ? Maybe.Just(users[index])
    : /* otherwise */ Maybe.Nothing();

getUserAtIndex(1);
// folktale:Maybe.Just({ value: { name: "Albus", age: 2 } })
getUserAtIndex(2);
// folktale:Maybe.Nothing({  })
```

```
const _= require('lodash');

const users = [
    {name: "Jesse", age: 38, id: 1},
    {name: "Albus", age: 2, id: 2},
    {name: "Cow", age: 1000, id: 4}
];

const findUserByName = name => _.find(users,
    user => user && user.name === name);

findUserByName('Jesse'); // { name: 'Jesse', age: 38, id: 1 }
findUserByName('Bruce'); // undefined
```

```
const findUserByName = name =>
{
    const result = _.find(users,
        user => user && user.name === name);
    if(_.isNil(result))
    {
        return Maybe.Nothing();
    }
    else
    {
        return Maybe.Just(result);
    }
};

findUserByName('Jesse');
// folktale:Maybe.Just({ value: { name: "Jesse", age: 38, id: 1 } })
findUserByName('Bruce');
// folktale:Maybe.Nothing({  })
```

MAYBE

extracting data



```javascript
const users = [
    {name: "Jesse", age: 38},
    {name: "Albus", age: 2},
    undefined,
    {name: "Cow"}
];

const getUserAtIndex = index =>
    users[index] ? Maybe.Just(users[index])
    : /* otherwise */ Maybe.Nothing();

log(getUserAtIndex(1).getOrElse('No value found at index.'));
// { name: 'Albus', age: 2 }
log(getUserAtIndex(2).getOrElse('No value found at index.'));
// No value found at index.
```

```
const users = {
    "Jesse": {age: 38, skillz: ['powerlifting', 'parkour']},
    "Albus": {age: 2, skillz: ['being cute', 'being fluffy']},
    "Cow": {age: 1000, skillz: ['looking cool']}
};

_.get(users, 'Albus', 'Unknown property Albus.');
// { age: 2, skillz: [ 'being cute', 'being fluffy' ] }
_.get(users, 'Brandy', 'Unknown property Brandy.');
// Unknown property Brandy.
```

```
users.Brandy;
// undefined
users.Brandy.age;
// TypeError: Cannot read property 'age' of undefined
_.get(users, 'Brandy.age', 'Unknown property Brandy.age.');
// Unknown property Brandy.age.
```

MAYBE

PATTERN MATCHING

```
Maybe.Just('dat string tho').matchWith({
    Just: ({value}) => log("value:", value),
    Nothing: ({value}) => log("error:", value)
});
// value: dat string tho
```

```
Maybe.Nothing().matchWith({
    Just: ({value}) => log("value:", value),
    Nothing: _ => log("Nothing, brah.")
});
// Nothing, brah.
```

```javascript
const result = Maybe.Just('chicken').matchWith({
    Just: ({value}) => true,
    Nothing: _ => false
});
log("result:", result);
// result: true
```

MAYBE

- I/O
- reading files
- HTTP calls
- parsing data

```javascript
const fs = require('fs');

const readConfig = () => fs.readFileSync('config.json');

readConfig();
// throws ENOENT: no such file or directory, open 'config.json'
```

```javascript
const fs = require('fs');

const readConfig = () => fs.readFileSync('config.json');

readConfig();
// <Buffer 7b 22 70 61 74 ...
```

```javascript
const readConfig = () => {
    try
    {
        const result = JSON.parse(fs.readFileSync('config.json').toString('utf8'));
        return Maybe.Just(result);
    }
    catch(err)
    {
        return Maybe.Nothing();
    }
};

log(readConfig().getOrElse({path: 'default/path'}));
// { path: 'chicken/moo/cow' }
// { path: 'default/path' }
```

VALIDATOR

PREDICATES

- a function that returns true or false
- _.isString, _.some, validCreditCard, etc.
- easiest to make pure / no side effects

```javascript
const nonEmptyString = o => _.isString(o) && o.length > 0;
log(nonEmptyString('cow')); // true
log(nonEmptyString(``)); // false
log(nonEmptyString(123)); // false
log(nonEmptyString(new Date())); // false
```

```javascript
const legitNumber = o => _.isNumber(o) && _.isNaN(o) === false;
legitNumber(1); // true
legitNumber(2.34); // true
legitNumber(10/0); // true
legitNumber(Number.Infinity / 0); // false

const legitDate = o => _.isDate(o) && o.toString() !== 'Invalid Date';
legitDate(new Date()); // true
legitDate(Date.now()); // false
legitDate(new Date('cow')); // false
```

VALIDATORS

- predicates with an error message
- validateCreditCard.errorMessage = “Not a valid credit card.”

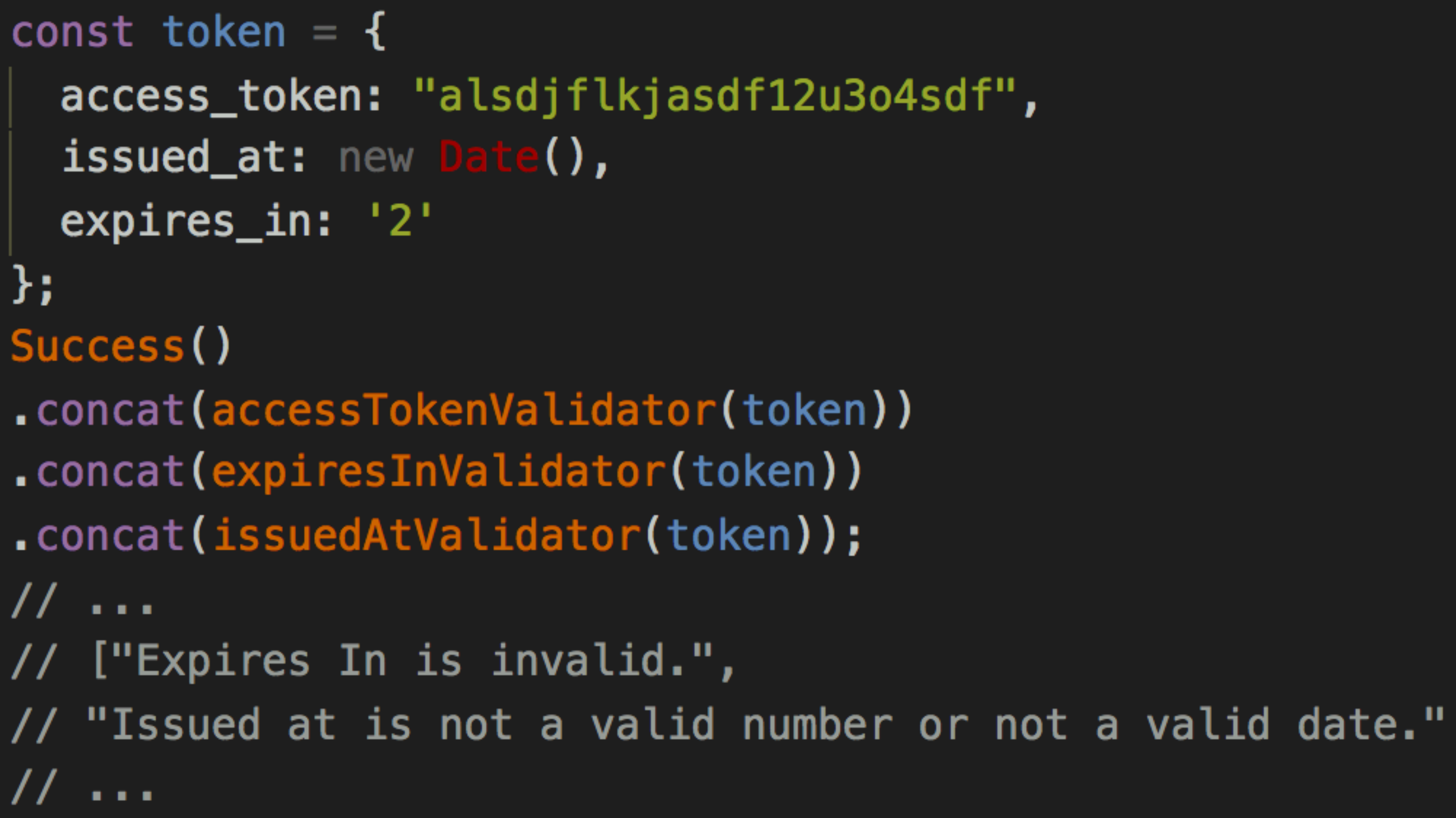
```
const nonEmptyString = o => _.isString(o) && o.length > 0;
const validString = o =>
  nonEmptyString(o) ? Success(o)
  : /* otherwise */ Failure(["Not a valid, must be a non-empty String."]);

validString('cow');
// folktale:Validation.Success({ value: "cow" })

validString('');
// folktale:Validation.Failure({ value: ["Not a valid, must be a non-empty String."] })

validString(123);
// folktale:Validation.Failure({ value: ["Not a valid, must be a non-empty String."] })
```

```
const validator = (errorString, predicate) => o =>
  predicate(o) ? Success(o)
  : /* otherwise */ Failure([errorString]);
```

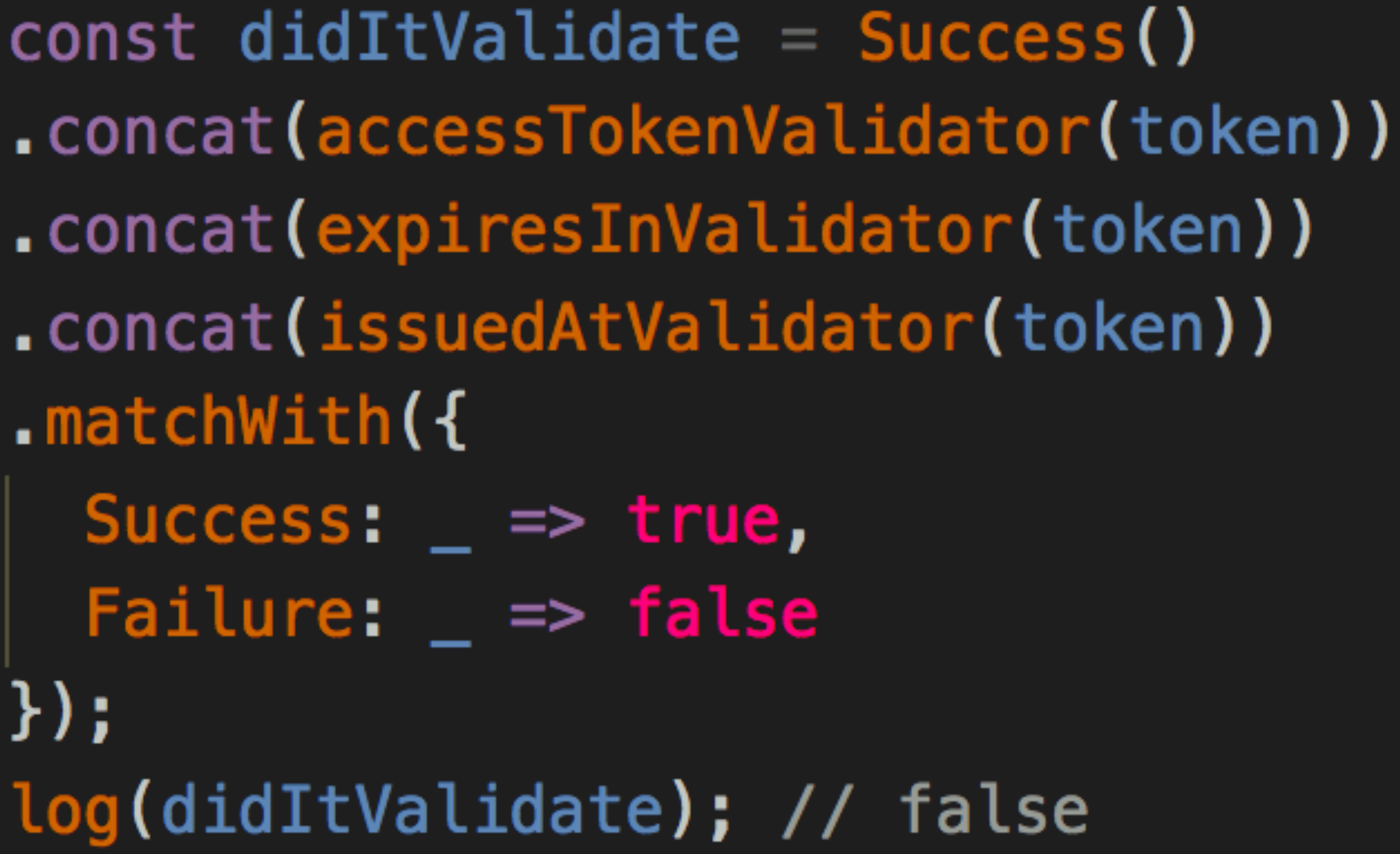
```javascript
const legitString           = token        => _.isString(token) && token.length > 0;
const legitNumber           = number       => _.isNumber(number) && _.isNaN(number) === false;
const legitDate             = date         => _.isDate(date) && date.toString() !== 'Invalid Date';
const legitAccessToken      = token        => legitString(_.get(token, 'access_token'));
const legitIssuedAt         = token        => legitNumber(_.get(token, 'issued_at')) && legitDate(new Date(_.get(token, 'issued_at')));
const legitExpiresIn        = token        => legitNumber(_.get(token, 'expires_in'));
const legitClientID         = clientID     => _.isString(clientID) && clientID.length > 0;
const legitClientSecret     = clientSecret => _.isString(clientSecret) && clientSecret.length > 0;
const legitURL              = url          => _.isString(url) && url.length > 0 && url.indexOf('http') !== -1;

const stringValidator       = validator('Not a string, or an empty string.', legitString);
const accessTokenValidator  = validator('Access Token is invalid.', legitAccessToken);
const expiresInValidator    = validator('Expires In is invalid.', legitExpiresIn);
const issuedAtValidator     = validator('Issued at is not a valid number or not a valid date.', legitIssuedAt);
const clientIDValidator     = validator('Invalid clientID, must be a string and length longer than 0.', legitClientID);
const clientSecretValidator = validator('Invalid clientSecret, must be a string and length longer than 0.', legitClientSecret);
const urlValidator          = validator('Invalid URL; must be a string, not empty, and contain http.', legitURL);
const token = {
  access_token: "alsdjflkjasdf12u3o4sdf",
  issued_at: new Date().valueOf(),
  expires_in: 2
};

Success()
.concat(accessTokenValidator(token))
.concat(expiresInValidator(token))
.concat(issuedAtValidator(token));
// folktale:Validation.Success({ ...
```

NODE VS. ELIXIR

```javascript
const token = {
  access_token: "alsdjflkjasdf12u3o4sdf",
  issued_at: new Date().valueOf(),
  expires_in: '2'
};
log(Success()
.concat(accessTokenValidator(token))
.concat(expiresInValidator(token))
.concat(issuedAtValidator(token)));
// folktale:Validation.Failure({ value: ["Expires In is invalid."] })
```



```
const token = {
  access_token: "alsdjflkjasdf12u3o4sdf",
  issued_at: new Date(),
  expires_in: '2'
};
Success()
.concat(accessTokenValidator(token))
.concat(expiresInValidator(token))
.concat(issuedAtValidator(token));
// ...
// ["Expires In is invalid.",
// "Issued at is not a valid number or not a valid date."
// ...
```



```
const didItValidate = Success()
.concat(accessTokenValidator(token))
.concat(expiresInValidator(token))
.concat(issuedAtValidator(token))
.matchWith({
  Success: _ => true,
  Failure: _ => false
});
log(didItValidate); // false
```

uniontype

Scalar

- 1 atomic value
- “cow”, 1, true

PRODUCT

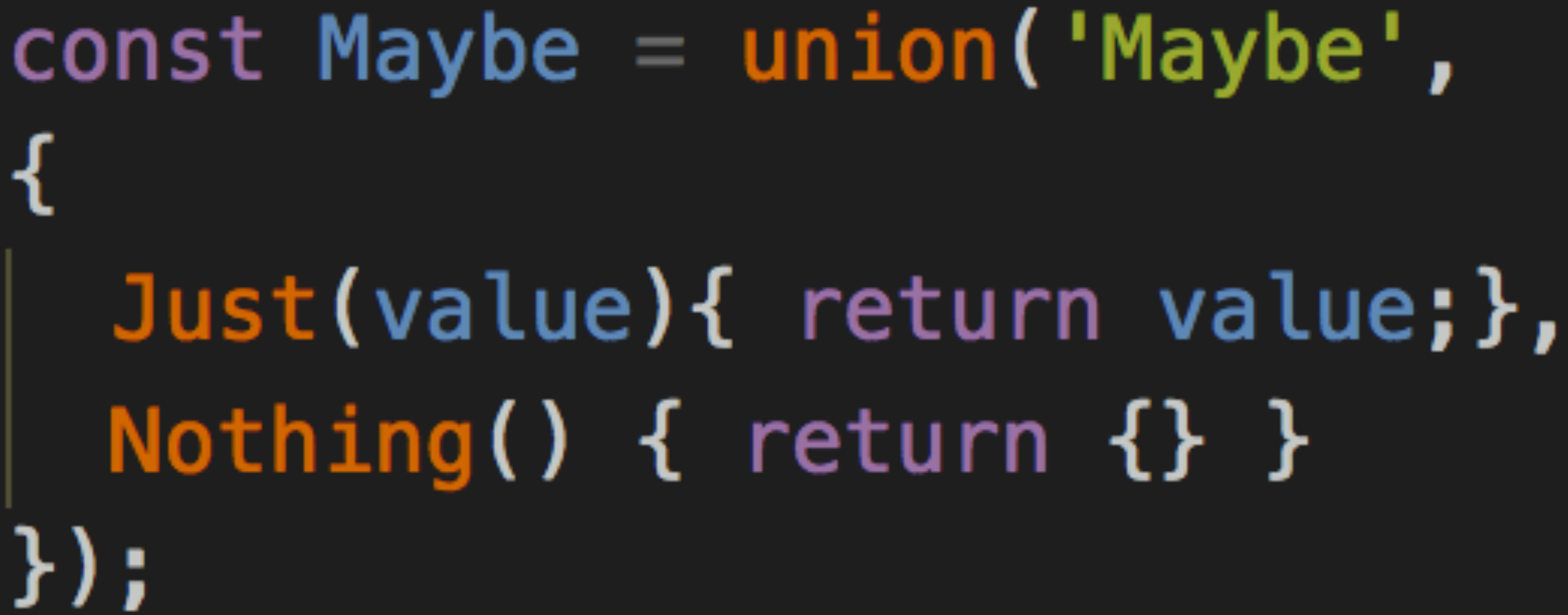
- multiple, independent values
- {name: “Jesse”, age: 38}
- class Person

union

- 1 out of many concepts at any time
- read a file: Error, Permission Error, file contents
- access Restify header: it’s there, it’s there but bad value, no value, here’s a default

```
const Maybe = union('Maybe',
{
  Just(value){ return {value} },
  Nothing() { return {} }
});
```

```
const Maybe = union('Maybe',
{
  Just(value){ return {value} },
  Nothing() { return {} }
});

log(Maybe.Just('cow'))
// { value: 'cow' }
```



```
const Maybe = union('Maybe',
{
    Just(value){ return value;},
    Nothing() { return {} }
});
```

```
const Maybe = union('Maybe',
{
  Just(value){ return value },
  Nothing() { return {} }
});

log(Maybe.Just('cow'))
// { '0': 'c', '1': 'o', '2': 'w' }
```

```javascript
const maybeCow = Maybe.Just('cow');
const result = maybeCow.matchWith({
    Just: ({value}) => value,
    Nothing: _ => false
});
log("result:", result);
// result: cow
```

```
const maybeCow = Maybe.Nothing();
const result = maybeCow.matchWith({
    Just: ({value}) => value,
    Nothing: _ => false
});
log("result:", result);
// result: false
```

```
const HTTPMethod = union('HTTPMethod', {
    GET() { return {value: 'GET'} },
    POST() { return {value: 'POST'} },
    PUT() { return {value: 'PUT'} },
    DELETE() { return {value: 'DELETE'} },
    PATCH() { return {value: 'PATCH'} },
    OPTIONS() { return {value: 'OPTIONS'} }
});

HTTPMethod.GET(); // { value: 'GET' }
HTTPMethod.hasInstance(HTTPMethod.GET()); // true

HTTPMethod.GET.hasInstance(HTTPMethod.GET()); // true

HTTPMethod.POST.hasInstance(HTTPMethod.GET()); // false
```

```
const HTTPMethod = union('HTTPMethod', {
    GET() { return {value: 'GET'} },
    POST() { return {value: 'POST'} },
    PUT() { return {value: 'PUT'} },
    DELETE() { return {value: 'DELETE'} },
    PATCH() { return {value: 'PATCH'} },
    OPTIONS() { return {value: 'OPTIONS'} }
}).derive(Equality);

log(HTTPMethod.GET().equals(HTTPMethod.GET())); // true

const a = HTTPMethod.GET();
const b = HTTPMethod.GET();
log(a.equals(b)); // true
```

```javascript
const Attack = union('Attack', {
    Hit(amount, critical=false) { return {amount, critical}},
    Miss() { return {value: 'Miss'}}
}).derive(Equality);
const { Hit, Miss } = Attack;

Hit(1, false).hasInstance(Hit(1, false)); // true
Hit(1, false).hasInstance(Hit(2, true)); // true
Hit(1, false).equals(Hit(1, false)); // true
Hit(1, false).equals(Hit(2, true)); // false
```

ENHANCED PROMISE

TASK

TASKS

- enhanced Promise
- can cancel it
- resource clean up option

```
const delay = ms => task(
  (resolver) => {
    const timerId = setTimeout(() => resolver.resolve(ms), ms);
    resolver.cleanup(() => {
      clearTimeout(timerId);
    });
    resolver.onCancelled(() => {
      /* does nothing */
    });
  }
);

// waits 100ms
const result = await delay(100).or(delay(2000)).run().promise();
$ASSERT(result == 100);
```

```
const tokenOk = ({res, obj}) => new Promise((resolve, reject)=>
    checkToken(obj)
    .matchWith({
        Success: _ => resolve({res, obj}),
        Failure: err => reject(new Error(err.value))
    })
);

const tokenOk = ({res, obj}) => task( resolver =>
    checkToken(obj)
    .matchWith({
        Success: _ => resolver.resolve({res, obj}),
        Failure: err => resolver.reject(new Error(err.value))
    })
);
```

```javascript
const sendLoginResponse = () =>
{
    let connection;
    return oracle.getConnection(oracleDefaultConnection(), oracleDefaultConfig())
    .then( conn =>
    {
        connection = conn;
        return user.login(connection, req.body.EID);
    })
    .then( userObject =>
    {
        oracle.release(connection)
        .then(()=>
        {
            res.send(200, {result: true, data: userObject});
        });
    })
    .catch((err)=>
    {
        oracle.release(connection)
        .then(()=>
        {
            res.send(401, {result: false, error: err.toString()});
        });
    });
};
```

```
const sendLoginResponse = task(
    resolver =>
    {
        let connection;
        resolver.cleanup(connection => oracle.release(connection));
        oracle.getConnection(oracleDefaultConnection(), oracleDefaultConfig())
        .then( conn =>
        {
            connection = conn;
            return user.login(connection, req.body.EID);
        })
        .then( userObject => resolver.resolve(res.send(200, {result: true, data: userObject}))
        .catch( err => resolver.reject(res.send(401, {result: false, error: err.toString()}))))
    }
);
```

CONCLUSIONS

MAYBE

MAYBE: WHEN DO YOU USE THEM

- Maybe: a value is there or it isn't
- instead of returning null or undefined, use Maybe
- Side effect? I/O? Maybe it'll work… so use a Maybe

VALIDATOR

VALIDATOR: WHEN DO YOU USE THEM

- Validator: validating user, or server, inputs
- data is legit or not, if not why not
- nice error messages

uniontype

Union: when do you use them?

- Union: another useful data type
- If null/undefined is a legit return value, use a Union type
- if a bunch of things can be returned, use a Union type
- modeling your data (like Objects, Classes)

ENHANCED PROMISE

TASK

TASK: WHEN DO YOU USE THEM

- Task: enhancement on Promises
- you can cancel them and have cleanup code for them
- easily convert back to a Promise

FOLKTALE

fun / functional programming

the end

- Folktale API Docs http://folktale.origamitower.com/api/v2.0.0/en/folktale.html (click on API's to get good documentation)
- Folktale Github https://github.com/origamitower/folktale
- (me) Jesse Warden | @jesterxl | youtube.com/user/jesterxl | jesse@jessewarden.com
- Functional Programming people to follow on Twitter
    - @bodil (lots of pizza posts)
    - @doppioslash
    - @robotlolita (works on Folktale, lots of Japanese idol posts)
    - @drboolean (I understand 1% of his tweets)
    - @swannodette (Clojure luva)
- Great beginner video on Elm, helps with basic functional concepts https://www.youtube.com/watch?v=D740qUZVcr4
- wonderful weekend exercise, get this working in your project https://github.com/bodil/eslint-config-cleanjs