
Pinterest

WRITING DOMAIN SPECIFIC LANGUAGES

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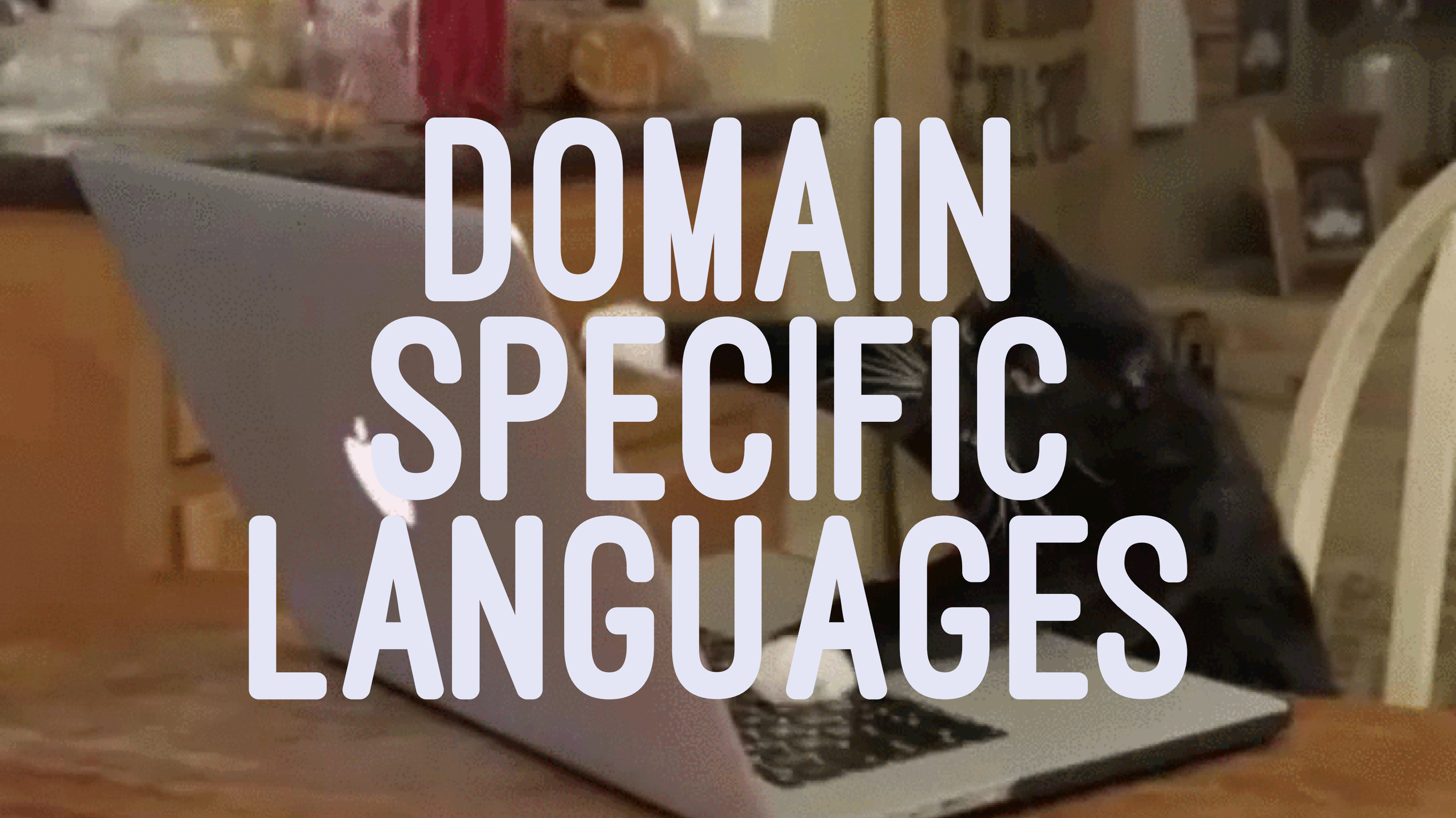
PROBLEM

MOVE FAST WITH QUALITY


DOMAIN
SPECIFIC
LANGUAGES

A COMPUTER PROGRAMMING LANGUAGE OF
LIMITED EXPRESSIVENESS
FOCUSED ON A
PARTICULAR DOMAIN
> MARTIN FOWLER

EXAMPLES

- MAKEFILE
- PODFILE
- QUICKCHECK

WHY SHOULD WE WRITE THEM?

EASE OF USE

TYPE-SAFETY

DECLARATIVE

(INTENT) -> ACTION

Typical Ambiguity
@CodaFi_

Follow

"C is a basically domain-specific language for writing unsafe code"

Yes, yes it is.

RETWEETS 15 LIKES 39

10:58 PM - 12 Apr 2017

FUNCTIONAL LANGUAGES

- STRONG TYPE SYSTEM
- HIGHER-ORDER FUNCTIONS / LAZY EVALUATION
- ELEGANT SYNTAX

RECIPE FOR CREATING A NEW DSL

- MODEL THE PROBLEM (REIFY)
- BUILD MODULAR / COMPOSABLE ABSTRACTIONS
- WORK ITERATIVELY

PINCORE

SWIFT PACKAGE INIT

FILES & FOLDERS

```
➜ mkdir MyLibrary
➜ swift package init
Creating library package: MyLibrary
Creating Package.swift
Creating .gitignore
Creating Sources/
Creating Sources/MyLibrary.swift
Creating Tests/
Creating Tests/LinuxMain.swift
Creating Tests/MyLibraryTests/
Creating Tests/MyLibraryTests/MyLibraryTests.swift
```

CREATING FOLDERS...

```
let frameworkName = "MyLibrary"
// make the directory structure
c.mkdir(frameworkName)
c.currentDirectory += "/\(frameworkName)"
let coreDirectories = ["Sources", "Tests"]
// add placeholder .gitkeep files to directories
coreDirectories.forEach(c.mkdir)
coreDirectories.forEach(c.gitkeep)
```

CREATING FOLDERS...

```
let frameworkName = "MyLibrary"
// make the directory structure
c.mkdir(frameworkName)
c.currentDirectory += "/\(frameworkName)"
let coreDirectories = ["Sources", "Tests"]
// add placeholder .gitkeep files to directories
coreDirectories.forEach(c.mkdir)
coreDirectories.forEach(c.gitkeep)
c.currentDirectory += "/Tests"
c.mkdir("\(frameworkName)Tests")
```

CREATING FILES...

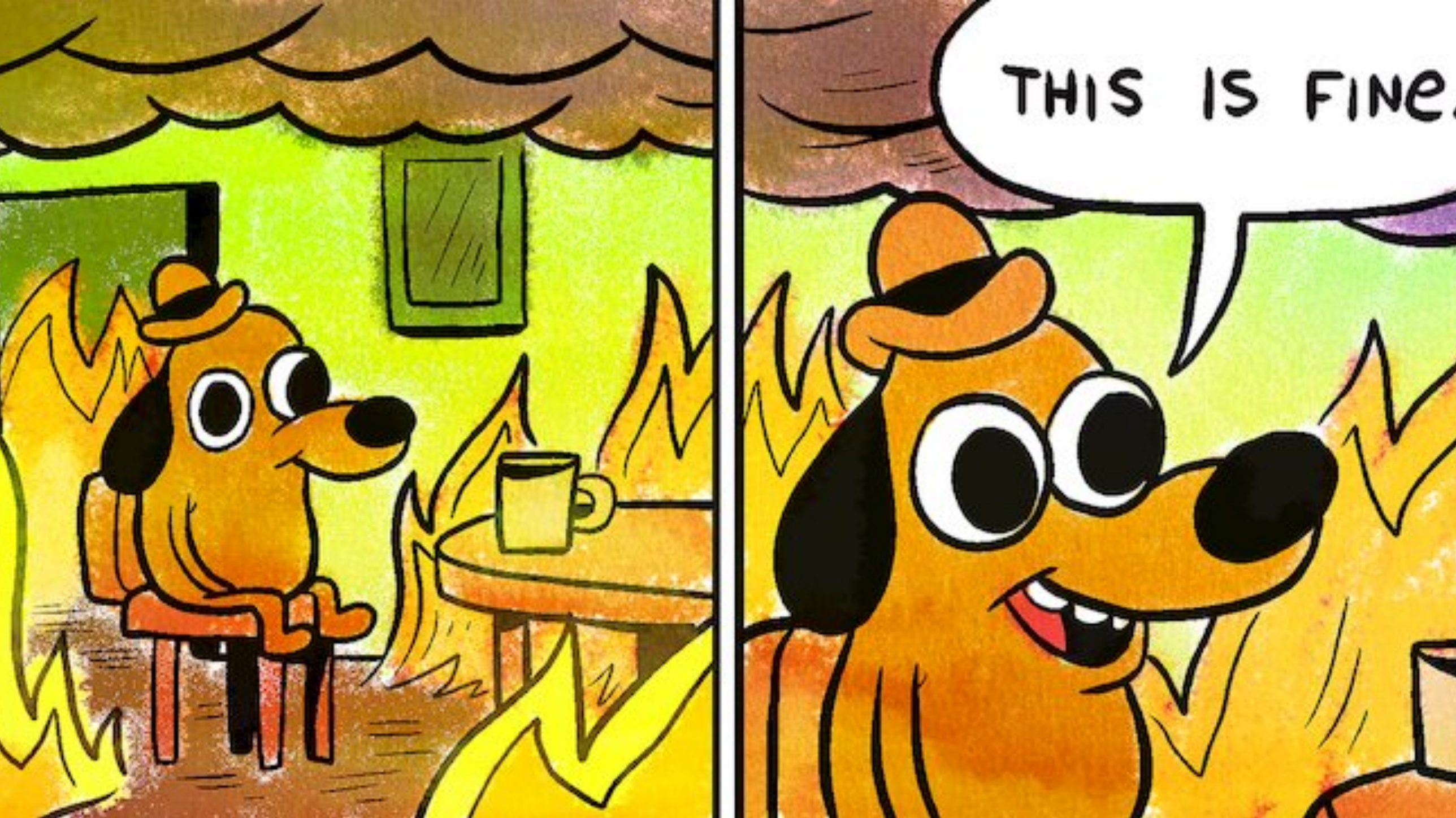
```
// ctx - Context variables for all templates

// Create files from templates
evalTemplate(resource: ".gitignore", context: ctx, to: Path(""))

evalTemplate(resource: "Package.swift", context: ctx, to: Path(""))

evalTemplate(resource: "Tests.swift", context: ctx,
                to: Path("Tests/\(frameworkName)Tests/\(frameworkName)Tests.swift"))

// Repeat for every file ...
```


THIS IS FINE

WHATS WRONG WITH THIS?

- ERROR PRONE
- HARD TO FOLLOW
- IMPERATIVE

MODEL THE PROBLEM

RECURSIVE ENUMS

```
enum Tree<A> {
    case Empty
    indirect case Node(left: Tree<A>, value: A, right: Tree<A>)
}
```

ALGEBRAIC DATA TYPES (ADT) 

TYPE FORMED BY COMBINING OTHER TYPES.

REIFY WITH RECURSIVE ENUMS

```
enum DirectoryItem {
  case File(name: String, content: String)
  indirect case Folder(name: String, contents: [DirectoryItem])
}
```

FILES / FOLDERS WITH ADT

```
let package = DirectoryItem.Folder(
    name: "MyLibrary",
    contents: [
        .File(name: ".gitignore", content: ""),
        .Folder(
            name: "Sources",
            contents: [.File(name: "MyLibrary.swift", content: "...")]),
        .Folder(
            name: "Tests",
            contents: [
                .File(name: "LinuxMain.swift", content: "..."),
                .Folder(name: "MyLibraryTests",
                        contents: [.File(name: "MyLibraryTests.swift", content: "...")])
            ]
        )
    ]
)
```

```
func createFiles(atPath path: String, rootDirectory item: DirectoryItem) {
    switch item {
    case .File(name: let name, contents: let contents):
        writeFile(contents: contents, atPath: Path(name))
    }
}
```

```
func createFiles(atPath path: String, rootDirectory item: DirectoryItem) {
    switch item {
    case .File(name: let name, contents: let contents):
        writeFile(contents: contents, atPath: Path(path + name))
    case .Folder(name: let name, items: let subdirs):
        c.mkdir(name)
        let newPath = path + "/\(name)"
        c.currentDirectory = newPath
        _ = subdirs.map { createFiles(atPath: newPath, rootDirectory: d) }
        c.currentDirectory = path
    }
}
```

LS

```
func ls(_ item: DirectoryItem, _ path: String) {
    switch item {
    case .File(name: let name, content:_):
        print([path, name].joined(separator: "/"))
    case .Folder(name: let name, contents: let contents):
        contents.map { ls($0, [path, name].joined(separator: "/"))}
    }
}
```

DEEP DSL

```
1 + 2 = Expr(+, 1, 2)
```

PLANK

plank

CODE GENERATION

```
typealias CodeGenerator = () -> [String]
```

FIBONACCI

```
func fibonacci(_ i: Int) -> Int {
    if i <= 2 {
        return 1
    } else {
        return fibonacci(i - 1) + fibonacci(i - 2)
    }
}
```

FIRST ATTEMPT

```
func generatefib () {
    return [
        "if i <= 2 {",
        "    return 1",
        "} else {",
        "    return fibonacci(i - 1) + fibonacci(i - 2)",
        "}",
    ]
}
```

IF / ELSE STRUCTURE

```
if (/* some condition */ ) {
   /* line 1 */
   /* line 2 */
   /* ...    */
} else {
   /* line 1 */
   /* line 2 */
   /* ...    */
}
```

IF

```
func ifStmt(_ condition: String,
            _ body: CodeGenerator) -> [String] {
    return [
        "if \(condition) {",
            -->body,
        "}"
    ]
}
```

ELSE

```
func elseStmt(_ body: CodeGenerator) -> [String] {
    return [
        " else {",
            -->body,
        "}"
    ]
}
```

IF + ELSE

```
func ifElseStmt(_ condition: String,
                body: @escaping CodeGenerator) -> (CodeGenerator) -> [String] {
    return { elseBody in [
        ifStmt(condition, body),
        elseStmt(elseBody)
      ].flatMap { $0 }
    }
}
```

FIBONACCI WITH DSL

```
ifElseStmt("i <= 2") {[
    // If
    "return 1"
]} ({
    // Else
    "return fibonacci(i - 1) + fibonacci(i - 2)"
})
```

HIGHER ORDER FUNCTIONS

SHALLOW DSL

1 + 2 = 3

SHALLOW

```
1 + 2 = 3
```

DEEP

```
1 + 2 = Expr(+, 1, 2)
```

LETS BUILD SOMETHING NEW!

GRAPHQL

WHAT IS GRAPHQL?

GRAPHQL IS A QUERY LANGUAGE FOR APIS.
IT'S AN ALTERNATIVE TO THE TRADITIONAL RESTFUL ENDPOINTS.

GITHUB

ISSUES IN REPOSITORY

```
{
  repository(owner:"pinterest", name:"plank") { // Repo
    name,
    description,
    homepageURL
  }
}
```

ISSUES IN REPOSITORY

```
{
  repository(owner:"pinterest", name:"plank") { // Repo
    name,
    description,
    homepageURL,
    owner { // User
      avatarURL
    }
}
```

ISSUES IN REPOSITORY

```
{
  repository(owner:"pinterest", name:"plank") { // Repo
    name,
    description,
    homepageURL,
    owner { // User
      avatarURL
    },
    issues(first:10) { // Issues
      nodes {
        title,
        state
      }
    }
  }
}
```

JSON RESPONSE


```
{
  "data": {
    "repository": {
      "name": "plank",
      "description": "A tool for generating immutable model objects",
      "homepageURL": "https://pinterest.github.io/plank/",
      "owner": {
        "avatarURL": "https://avatars1.githubusercontent.com/u/541152?v=3"
      },
      "issues": {
        "nodes": [
          {
            "title": "Model value type in Schema.Map / Schema.Array as a separate enum",
            "state": "OPEN"
          },
        ]
      }
    }
  }
}
```

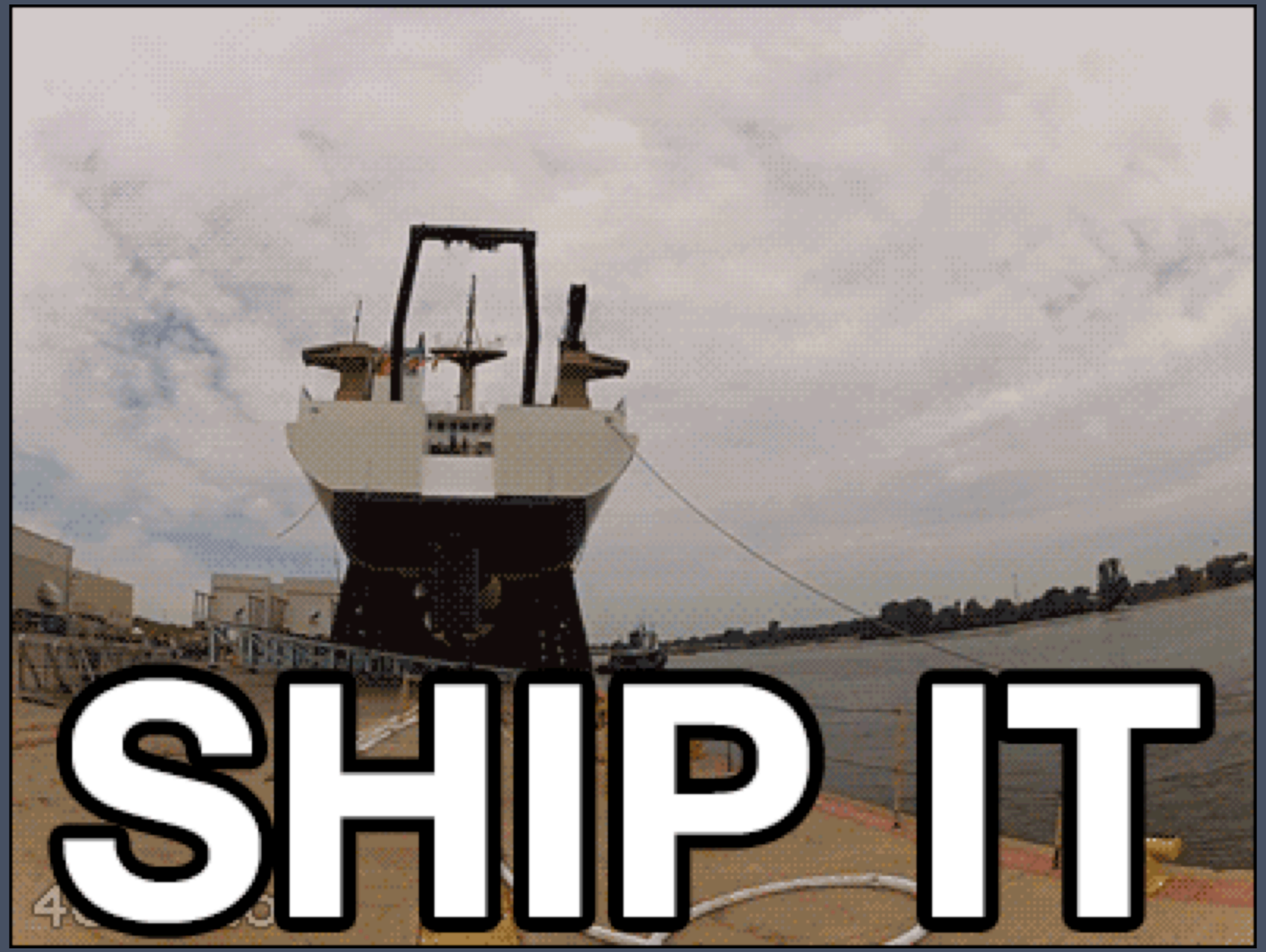
TYPES OF DSLS

- EXTERNAL
- INTERNAL / EMBEDDED

PROBLEM:

HOW CAN WE WRITE CONCISE TYPE-SAFE QUERIES?

```
let query = [
    "{",
    "  repository(owner:\"pinterest\", name:\"plank\") {",
    "    name,",
    "    description,",
    "    homepageURL,",
    "    owner {",
    "      avatarURL",
    "    }",
    "    issues(first:10) {",
    "      nodes {",
    "        title,",
    "        state",
    "      }",
    "    }",
    "  }",
    "}"].joined(separator: " ")
```


SHIP IT

QUERY

STRUCTURE

```
repository(owner: "pinterest", name: "plank") {
    name,
    description,
    owner {
        avatarURL
    }
}
```

STRUCTURE

```
object(arguments) {
    field1,
    field2,
    object {
        field3
    }
}
```

REIFY 🎉

```
enum Node {
    case Scalar(label: String)
    indirect case Object(label: String, arguments: [InputArgument]?, fields:[Node])
}

enum InputType {
    case string(String)
    case integer(Int)
}

typealias InputArgument = (String, InputType)
```

QUERY WITH NODES : REPOSITORY

```
.Object(label: "repository",
        arguments: [("owner", .string("pinterest")), ("name", .string("plank"))],
        fields: [.Scalar(label: "name"),
                 .Scalar(label: "description"),
                 .Scalar(label: "homepageURL"),
        ]
)
```

QUERY WITH NODES : REPOSITORY OWNER

```
.Object(label: "repository",
        arguments: [("owner", .string("pinterest")), ("name", .string("plank"))],
        fields: [.Scalar(label: "name"),
                 .Scalar(label: "description"),
                 .Scalar(label: "homepageURL"),
                 .Object(label: "owner",
                         arguments: nil,
                         fields: [.Scalar(label: "avatarURL")]),
        ]
)
```

QUERY WITH NODES : REPOSITORY ISSUES

```
.Object(label: "repository",
        arguments: [("owner", .string("pinterest")), ("name", .string("plank"))],
        fields: [.Scalar(label: "name"),
                 .Scalar(label: "description"),
                 .Scalar(label: "homepageURL"),
                 .Object(label: "owner",
                         arguments: nil,
                         fields: [.Scalar(label: "avatarURL")]),
                 .Object(label: "issues",
                          arguments: [("first", .integer(10))],
                          fields: [
                              .Object(label: "nodes",
                                      arguments: nil,
                                      fields: [.Scalar(label: "title"),
                                               .Scalar(label: "state")])
                          ])
        ]
)
```

NODE -> QUERY STRING : SCALAR

```
func renderQueryString(node: Node) -> String {
    switch node {
    case .Scalar(label: let label):
        return label
    }
}
```

NODE -> QUERY STRING : OBJECT

```
func renderQueryString(node: Node) -> String {
    switch node {
    case .Scalar(label: let label):
        return label
    case .Object(label: let label, arguments: .none, fields: let fields):
        // Object without arguments
        let fieldString = fields.map(renderQueryString).joined(separator: " ")
        return "\(label) { \(fieldString) }"
    }
}
```

NODE -> QUERY STRING : OBJECT WITH ARGS

```
func renderQueryString(node: Node) -> String {
    switch node {
    case .Scalar(label: let label):
        return label
    case .Object(label: let label, arguments: .none, fields: let fields):
        // Object without arguments
        let fieldString = fields.map(renderQueryString).joined(separator: " ")
        return "\(label) { \(fieldString) }"
    case .Object(label: let label, arguments: .some(let args), fields: let fields):
        // Object with arguments
        let fieldString = fields.map(renderQueryString).joined(separator: " ")
        let argString = args.map(renderArgument).joined(separator: ", ")
        return "\(label) (\(argString)) { \(fieldString) }"
    }
}
```

FIELD ARGUMENTS

```
func renderArgument(arg: InputArgument) -> String {
    switch arg.1 {
    case .string(let argVal):
        return "\(arg.0):\"\(argVal)\""
    case .integer(let argVal):
        return "\(arg.0):\(argVal)"
    }
}
```

TYPES

FIELDS

```
typealias FieldSelection<T> = () -> [T]

enum QueryRoot {
    case repository(owner: String,
                    name: String,
                    FieldSelection<RepositoryField>)
    // Other root cases...
}
```

```
enum RepositoryField {
    case name
    case description
    case homepageURL
    case owner(FieldSelection<UserField>)
    case issues(first: Int, FieldSelection<IssueField>)
}

enum UserField {
    case login
    case avatarURL
}

enum IssueField {
    case title
    case state
}
```

FIELD SELECTION DSL

```
.repository(owner: "pinterest", name: "plank") {[
    .name,
    .description,
    .owner {[
        .login,
        .avatarURL
    ]},
    .issues(first: 10) {[
        .nodes {[
            .title,
            .state
        ]}
    ]}
]}
```

(FIELDS) -> NODES ?

(FIELDS) -> NODES

```
protocol NodeRenderer {
    func renderNode() -> Node
}
```

QUERYROOT

```
enum QueryRoot: NodeRenderer {
    func renderNode() -> Node {
        switch self {
        case .repository(owner: let owner, name: let name, let fieldsFn):
            return Node.Object(label: "repository",
                               arguments: [("owner", .string(owner)),
                                           ("name", .string(name))],
                               fields: fieldsFn().map { $0.renderNode() })
        }
    }
}
```

USER. REPOSITORY. ISSUE...

```
enum UserField: NodeRenderer { /*...*/ }

enum RepositoryField: NodeRenderer { /*...*/ }

enum IssueField: NodeRenderer { /*...*/ }
```

(FIELDS) -> (NODES) -> QUERY

```
func query(_ fields: FieldSelection<QueryRoot>) -> String {
    return "{" +
        fields().map { $0.renderNode() }
                .map { $0.renderQueryString() }
                .joined(separator: " ") +
    "}"
}
```

DEMO


THANK YOU!
@RMALIK

APPENDIX

SWITCH STATEMENT DSL

SWITCH STRUCTURE

```
switch /* variable name */ {
case1:
    / * case 1 logic */
case2:
    / * case 2 logic */
caseN:
    / * case n logic */
default:
    / * default logic */
}
```

SWITCH / SWITCHCASE

```
enum SwitchCase {
    case Case(condition: String, body: CodeGenerator)
    case Default(body: CodeGenerator)
}

func switchStmt(_ switchVariable: String, body: () -> [SwitchCase]) -> [String] {
    return [
        "switch (\(switchVariable)) {",
            body().map { $0.render() }
                  .flatMap { $0 }
                  .joined(separator: "\n"),
        "}"
    ]
}
```

RENDERING CASE STATEMENTS

```
enum SwitchCase {
    func render() -> [String] {
        switch self {
        case .Case(let condition, let body):
            return [
              "case \(condition):",
                body
            ]
        case .Default(let body):
            return [
              "default:",
               body
            ]
        }
    }
}
```

FIBONACCI WITH SWITCH DSL

```
switchStmt("i") {[
    .Case("0") {[
        "return 1"
    ]},
    .Case("1") {[
        "return 1"
    ]},
    .Default {[
        "return fibonacci(i - 1) + fibonacci(i - 2)"
    ]}
]}
```

CUSTOM OPERATORS

```
prefix operator -->

prefix func --> (body: CodeGenerator) -> String {
    return body().flatMap {
        $0.components(separatedBy: "\n").map { "  " + $0 }
    }.joined(separator: "\n")
}
```