Elm - functional programming language for the web

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Who am I?

Which front end framework to choose?

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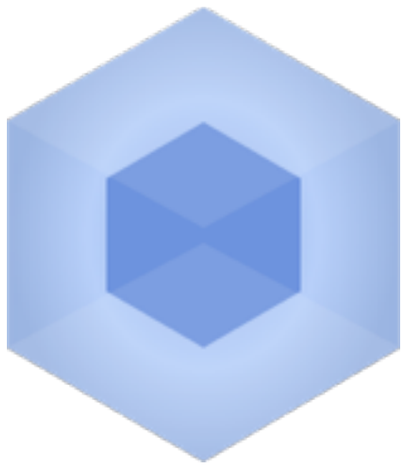
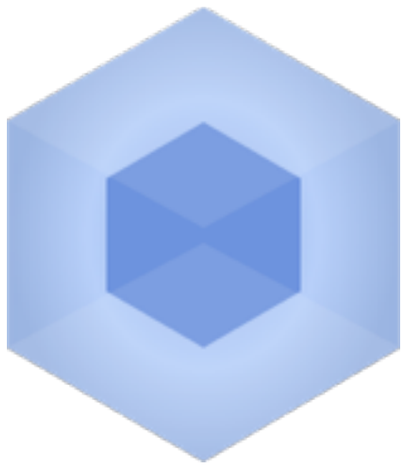
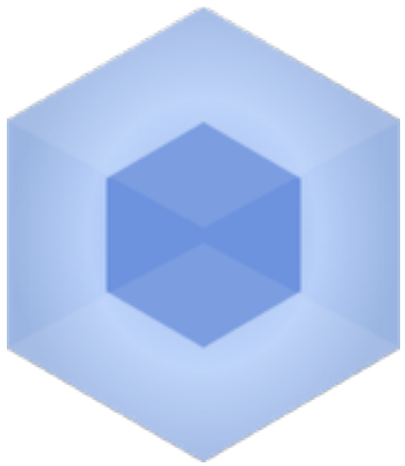
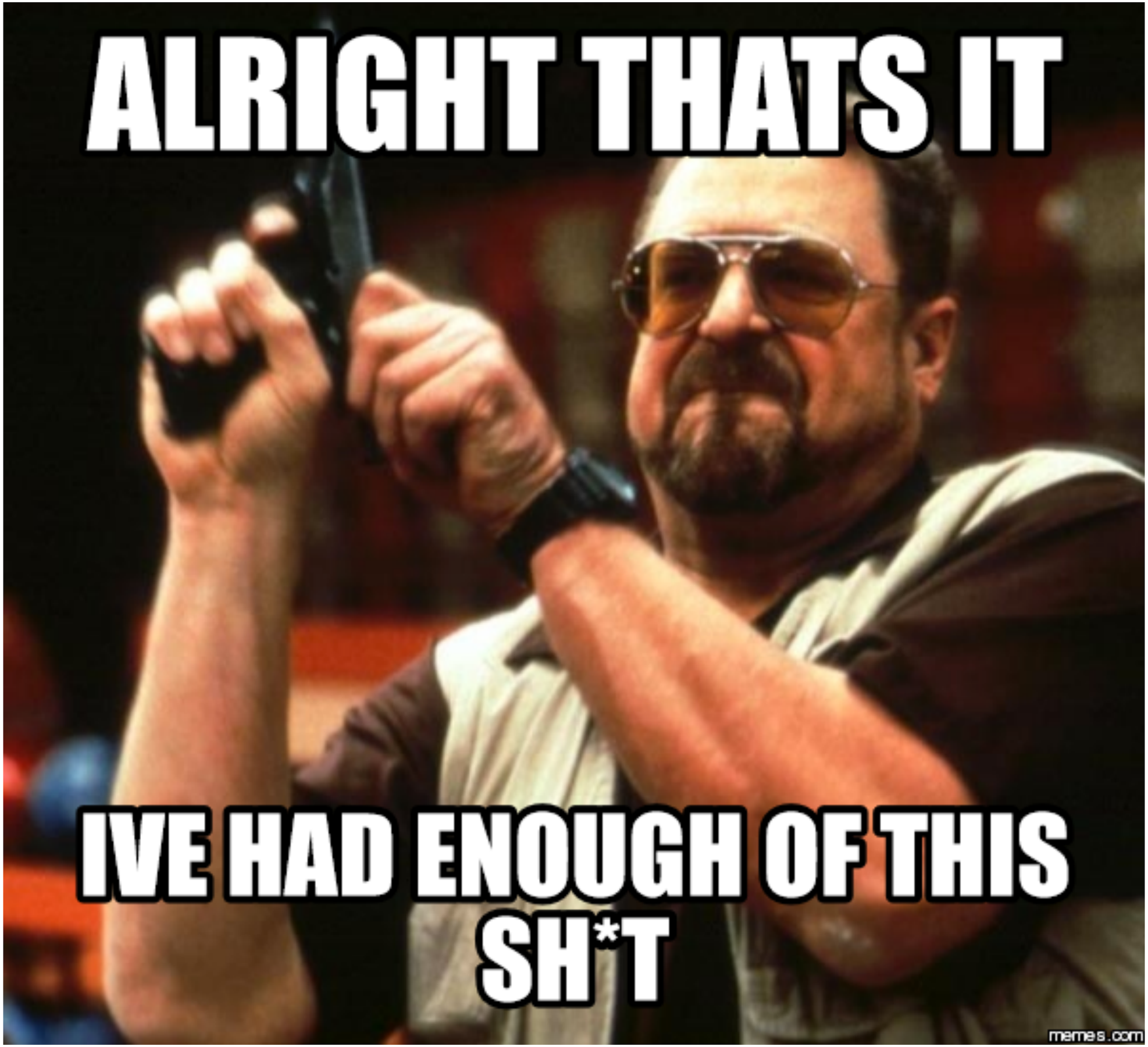


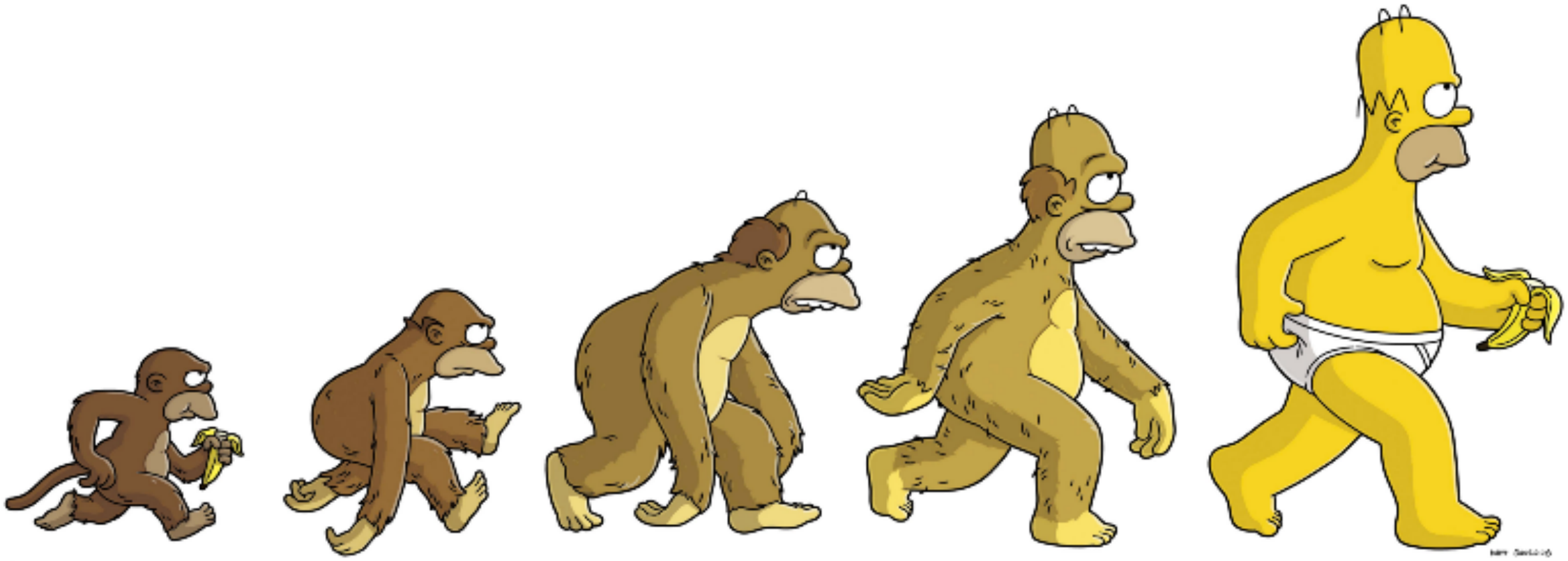
Which front end framework to choose?



Which front end framework to choose?




ALRIGHT THATS IT
IVE HAD ENOUGH OF THIS SH*T
memes.com



MACHINE ASSEMBLY PROCEDURAL OBJECT ORIENTED FUNCTIONAL

Functional programming languages (web)

Functional programming languages (web)

elm

Why Elm?

No **runtime** errors.

No **null**.

No **undefined** is not a function.

Friendly error messages


What did you say?

Friendly error messages

```
1
2  import Html exposing (..)
3
4
5  view users =
6    div [] (List.nap viewUser users)
7
8
9  viewUser user =
10   span [] [text user.name]
11
```

```
-- NAMING ERROR ------------------------------------- naming/unknown-name.elm

Cannot find variable `List.nap`.

6|   div [] (List.nap viewUser users)
             ^^^^^^^^

`List` does not expose `nap`. Maybe you want one of the following?

    List.map
    List.any
    List.map2
    List.map3
```

Friendly error messages

```
1
2   import Html exposing (..)
3   import Html.Attributes exposing (..)
4
5
6   alice =
7     img [src "/users/alice/pic"] []
8
9
10  bob =
11    img [src "/users/bob/pic"] []
12
13
14  userPics =
15    [ alice, bob, "/users/chuck/pic" ]
16
```

```
-- TYPE MISMATCH ------------------------------------------------ types/list.elm

The 3rd element of this list is an unexpected type of value.

15|   [ alice, bob, "/users/chuck/pic" ]
                    ^^^^^^^^^^^^^^^^^^^

All elements should be the same type of value so that we can iterate over the
list without running into unexpected values.

As I infer the type of values flowing through your program, I see a conflict
between these two types:

    Html

    String
```

Friendly error messages

```
1
2  hermann =
3      { first = "Hermann"
4      , last = "Hesse"
5      }
6
7
8  isOver50 person =
9      person.age > 50
10
11
12 answer =
13     isOver50 hermann
14
15
```

```
-- TYPE MISMATCH ------------------------------------ types/missing-field.elm

The 1st argument to function `isOver50` has an unexpected type.

13|    isOver50 hermann
                ^^^^^^^

Looks like a record is missing the field `age`

As I infer the type of values flowing through your program, I see a conflict
between these two types:

    { a | age : comparable }

    { first : String, last : String }
```

Automatically enforced semantic versioning

Good architecture

Elm

1. Core Language
2. Elm Architecture
3. Elm Ecosystem

Elm language - literals

```
True  : Bool
False : Bool

42    : number  -- Int or Float depending on usage
3.14  : Float
```

```
'a'   : Char
"abc" : String
```

```
[1, 2, 3, 4, 5]                  : List number
1 :: [2, 3, 4, 5]                : List number
1 :: 2 :: 3 :: 4 :: 5 :: []      : List number

[1.0, 2.0, 3.0, 4.0, 5.0]        : List float
```

Elm language - Conditionals

```
if key == 40 then
    n + 1
else if key == 38 then
    n - 1
else
    n
```

Elm language - Conditionals

```
if key == 40 then
    n + 1
else if key == 38 then
    n - 1
else
    n
```

```
if powerLevel > 9000 then "OVER 9000!!!" else "meh"
```

Elm language - Conditionals

```
if key == 40 then
    n + 1
else if key == 38 then
    n - 1
else
    n
```

```
if powerLevel > 9000 then "OVER 9000!!!" else "meh"
```

```
case maybe of
  Just xs -> xs
  Nothing -> []

case xs of
  hd::tl -> Just (hd,tl)
  []     -> Nothing
```

Elm language - Union Types

```
type Some
    = New
    | InProgress
    | Done
    | Error String

status = New
```

```
showStatus status =
    case status of
        New -> "new"
        InProgress -> "progress"
        Done -> "done"
        Error msg -> "error: " ++ msg

showStatus New                  -- "new"
showStatus (Error "WTF?")       -- "error: WTF?"
```

Elm language - records

```
bill =
  { name = "Gates", age = 57 }

steve =
  { name = "Jobs", age = 56 }

people =
  [ bill, steve]

point2D =
  { x = 0, y = 0}

point3D =
  { x = 3, y = 4, z = 12}
```

Elm language - records

```elm
bill =
  { name = "Gates", age = 57 }

steve =
  { name = "Jobs", age = 56 }

people =
  [ bill, steve]

point2D =
  { x = 0, y = 0}

point3D =
  { x = 3, y = 4, z = 12}
```

```elm
point3D.z                  -- 12
bill.name                  -- "Gates"
.name bill                 -- "Gates"
List.map .age people       -- [57,56]

.x point2D      -- 0
.x point3D      -- 3
.x { x = 4 }    -- 4
```

Elm language - records

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bill =
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people =
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```
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.name bill                 -- "Gates"
List.map .age people       -- [57,56]

.x point2D       -- 0
.x point3D       -- 3
.x { x = 4 }     -- 4

under50 {age} =
  age < 50
```

Elm language - records

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  { name = "Gates", age = 57 }

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  [ bill, steve]

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```
point3D.z                    -- 12
bill.name                    -- "Gates"
.name bill                   -- "Gates"
List.map .age people         -- [57,56]

.x point2D       -- 0
.x point3D       -- 3
.x { x = 4 }     -- 4

under50 {age} =
  age < 50
```

```
  { point2D | y = 1 }              -- { x=0, y=1 }
  { point3D | x = 0, y = 0 }       -- { x=0, y=0, z=12 }
  { steve | name = "Wozniak" }     -- { name="Wozniak", age=56 }
```

Elm language - type annotations

```elm
answer : Int
answer =
  42

factorial : Int -> Int
factorial n =
  List.product [1..n]

distance : { x : Float, y : Float } -> Float
distance {x,y} =
  sqrt (x^2 + y^2)
```

Elm language - type aliases

```elm
origin : { x : Float, y : Float }
origin = { x = 0, y = 0 }

type alias Point =
  { x : Float, y : Float }

origin : Point
origin = { x = 0, y = 0}

type alias Positioned a =
  { a | x : Float, y : Float }

type alias Named a =
  { a | name : String }

type alias Moving a =
  { a | velocity : Float, angle : Float }
```

```elm
lady : Named { age:Int }
lady =
  { name = "Lois Lane"
  , age = 31
  }

dude : Named (Moving (Positioned {}))
dude =
  { x = 0
  , y = 0
  , name = "Clark Kent"
  , velocity = 42
  , angle = degrees 30
  }
```

Elm language - functions

```
sayHello name =
    String.append "Hello " name

names = ["Adam", "Przemek", "Andrzej"]

List.map sayHello names      -- ["Hello Adam","Hello Przemek","Hello Andrzej"]
```

Elm language - anonymous functions

```elm
greet name  = "Hello, " ++ name
greet = \name -> "Hello, " ++ name

greet "Adam"                                -- "Hello, Adam"

numbers = List.range 1 10                   -- [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
List.filter (\x -> x < 5) numbers           -- [1, 2, 3, 4]
```

Elm language - piping

```
String.repeat 3 (String.toUpper (String.append "h" "i"))
-- "HIHIHI" : String

String.append "h" "i" |> String.toUpper |> String.repeat 3
-- "HIHIHI" : String

String.repeat 3 <| String.toUpper <| String.append "h" "i"
-- "HIHIHI" : String
```

Elm language - piping

```
String.repeat 3 (String.toUpper (String.append "h" "i"))
-- "HIHIHI" : String

String.append "h" "i" |> String.toUpper |> String.repeat 3
-- "HIHIHI" : String

String.repeat 3 <| String.toUpper <| String.append "h" "i"
-- "HIHIHI" : String



String.append "h" “i"
  |> String.toUpper
  |> String.repeat 3
```

Elm language - currying

```
threeTimes = String.repeat 3
-- <function> : String -> String

threeTimes "hi"
-- "hihihi" : String
```

Elm language - Maybe

```elm
type Maybe a
    = Nothing
    | Just a

type alias User =
  { name : String
  , age : Maybe Int
  }

sue : User
sue =
  { name = "Sue", age = Nothing }

tom : User
tom =
  { name = "Tom", age = Just 24 }
```

```elm
canBuyAlcohol : User -> Bool
canBuyAlcohol user =
  case user.age of
    Nothing ->
      False

    Just age ->
      age >= 21

canBuyAlcohol sue          -- False
canBuyAlcohol tom          -- True
```

Elm language - Result

```elm
type Result error value
  = Err error
  | Ok value

String.toInt x              -- String -> Result.Result String Int
String.toInt "10"           -- Ok 10 : Result.Result String Int
String.toInt "asdas"        -- Err "could not convert string 'asdas' to an Int" :
                               Result.Result String Int

isValidAge : String -> Bool
isValidAge age =
  case String.toInt age of
    Err msg ->
      False

    Ok age ->
      True

isValidAge "10"                 -- True
isValidAge "asdas"              -- False
```

Elm language - Task

```
type alias Task err ok =
    Task err ok

Task.succeed 42                 -- Task x String
Task.fail "reason"              -- Task String a
```

Elm language - Task

```
type alias Task err ok =
    Task err ok

Task.succeed 42                    -- Task x String
Task.fail "reason"                 -- Task String a

type Msg =
    CurrentTime Time

Task.perform : (a -> msg) -> Task Never a -> Cmd msg
Task.perform CurrentTime Time.now

Time.now : Task x Time
```

Elm language - Task

```elm
type alias Task err ok =
    Task err ok

Task.succeed 42                     -- Task x String
Task.fail "reason"                  -- Task String a

type Msg =
    CurrentTime Time
    | CurrentUser (Result Error User)

Task.perform : (a -> msg) -> Task Never a -> Cmd msg
Task.perform CurrentTime Time.now

Time.now : Task x Time

Task.attempt : (Result x a -> msg) -> Task x a -> Cmd msg
Task.attempt CurrentUser GetCurrentUser

GetCurrentUser : Task Error User
```

Elm language - modules

```elm
module MyModule exposing (..)

-- qualified imports
import List                         -- List.map, List.foldl
import List as L                    -- L.map, L.foldl

-- open imports
import List exposing (..)                   -- map, foldl, concat, ...
import List exposing ( map, foldl )         -- map, foldl

import Maybe exposing ( Maybe )             -- Maybe
import Maybe exposing ( Maybe(..) )         -- Maybe, Just, Nothing
import Maybe exposing ( Maybe(Just) )       -- Maybe, Just
```

Elm language - Interop Html

```
<div id="main"></div>
<script src="main.js"></script>
<script>
    var node = document.getElementById('main');
    var app = Elm.Main.embed(node);
</script>
```

```
elm-make src/Main.elm
elm-make src/Main.elm --output=main.js
```

Elm language - Interop Javascript Ports

```
<div id="spelling"></div>
<script src="spelling.js"></script>
<script>
    var app = Elm.Spelling.fullscreen();

    app.ports.check.subscribe(function(word) {
        var suggestions = spellCheck(word);
        app.ports.suggestions.send(suggestions);
    });

    function spellCheck(word) {
        // have a real implementation!
        return [];
    }
</script>
```

```
port module Spelling exposing (..)

...
-- port for sending strings out to JavaScript
port check : String -> Cmd msg

-- port for listening for suggestions from JavaScript
port suggestions : (List String -> msg) -> Sub msg
...
```

Elm language - Interop Javascript Flags

```
var node = document.getElementById('my-app');
var app = Elm.MyApp.embed(node, {
    user: 'Tom',
    token: '12345'
});
```

```
type alias Flags =
  { user : String
  , token : String
  }

init : Flags -> ( Model, Cmd Msg )
init flags =
  ...

main =
  programWithFlags { init = init, ... }
```

Elm architecture

```
import Html exposing (..)

-- MODEL
type alias Model = { ... }


-- UPDATE
type Msg = Reset | ...

update : Msg -> Model -> Model
update msg model =
  case msg of
    Reset -> ...
    ...

-- VIEW
view : Model -> Html Msg
view model =
  ...

main =
    Html.program
        { init = init
        , view = view
        , update = update
        , subscriptions = \_ -> Sub.none
        }
```

Elm architecture - code example

Elm ecosystem

Elm Package

```
elm-package install elm-lang/html          # Install latest version
elm-package install elm-lang/html 1.0.0    # Install version 1.0.0

elm-package diff elm-lang/core 3.0.0 4.0.0

elm-package publish

elm-package bump
```

Elm Package

elm-package.json

```
{
    "version": "1.0.0",
    "summary": "Project summary",
    "repository": "url",
    "license": "BSD3",
    "source-directories": [
        "."
    ],
    "exposed-modules": [],
    "dependencies": {
        "elm-lang/core": "5.0.0 <= v < 6.0.0",
        "elm-lang/dom": "1.1.1 <= v < 2.0.0",
        "elm-lang/html": "2.0.0 <= v < 3.0.0",
        "elm-lang/http": "1.0.0 <= v < 2.0.0"
    },
    "elm-version": "0.18.0 <= v < 0.19.0"
}
```

Elm Package

- Versions all have exactly three parts: MAJOR.MINOR.PATCH
- All packages start with initial version 1.0.0
- Versions are incremented based on how the API changes:
    - PATCH - the API is the same, no risk of breaking code
    - MINOR - values have been added, existing values are unchanged
    - MAJOR - existing values have been changed or removed
- elm-package will bump versions for you, automatically enforcing these rules

Elm REPL

Elm Reactor

Elm Make

Pros

Cons

Questions?

About