Evolution Gaming

Scala.js in a modern web application.

Vladimir Pavkin

Riga Dev Days 2017

About the speaker

Evolution Gaming

10 YEARS ALIVE

Vladimir Pavkin

Scala Developer at Evolution Gaming

- JavaScript since 2012
- Scala & Scala.js since 2014

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http://pavkin.ru

Agenda

I. Brief introduction into Scala.js (5 min)
II. How we use Scala.js in Evolution Gaming (5 min)
III. Examples, **pros** and **cons**, based on our real experience (30 min)
IV. Conclusion, Q&A (5 min)

I. What is Scala.js ?

What Scala.js is not:

- a framework for web apps like Angular, React, GWT, etc.
- a new language

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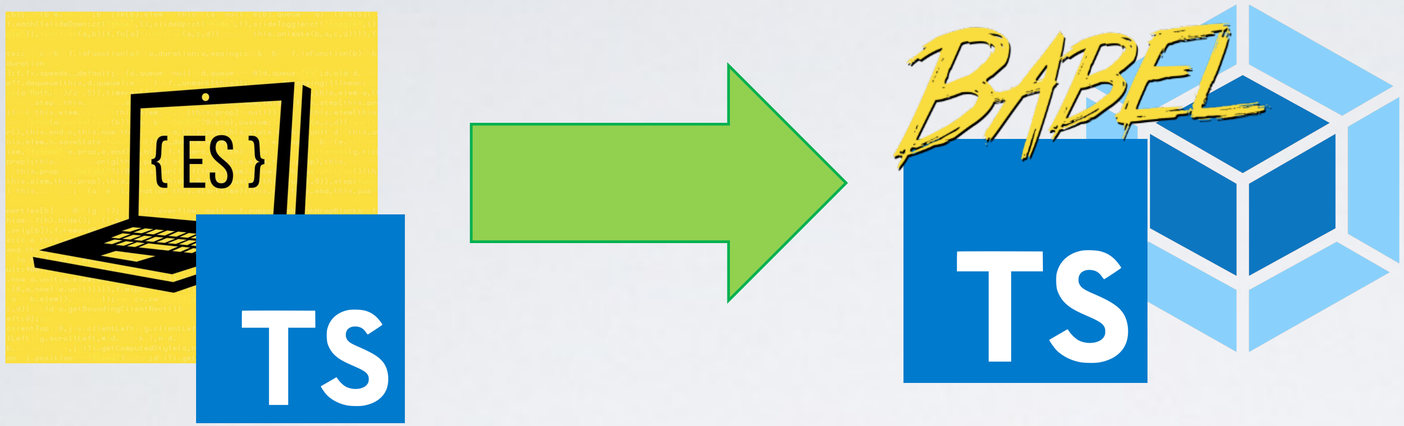
- a framework for web apps like Angular, React, GWT, etc.
- a new language

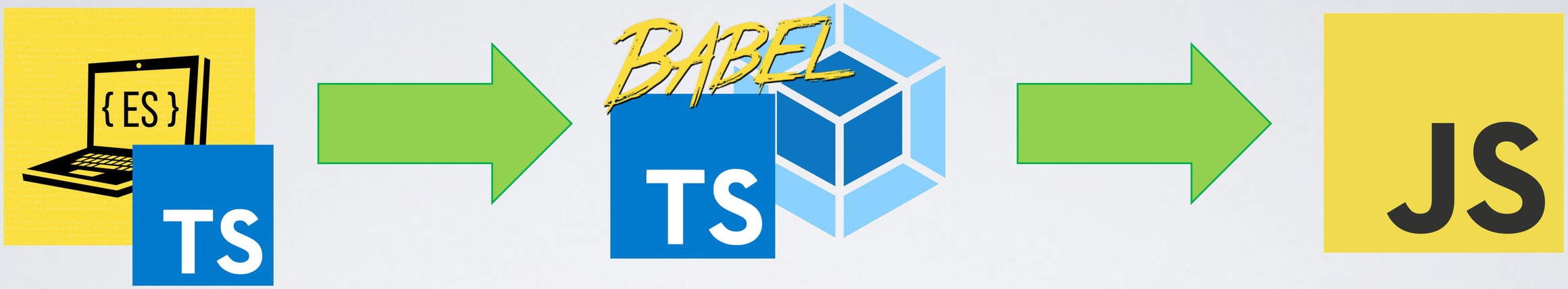
Scala.js is a transpiler from Scala to JS.

Is it really different?

Is it really different?



Is it really different?



Is it really different?

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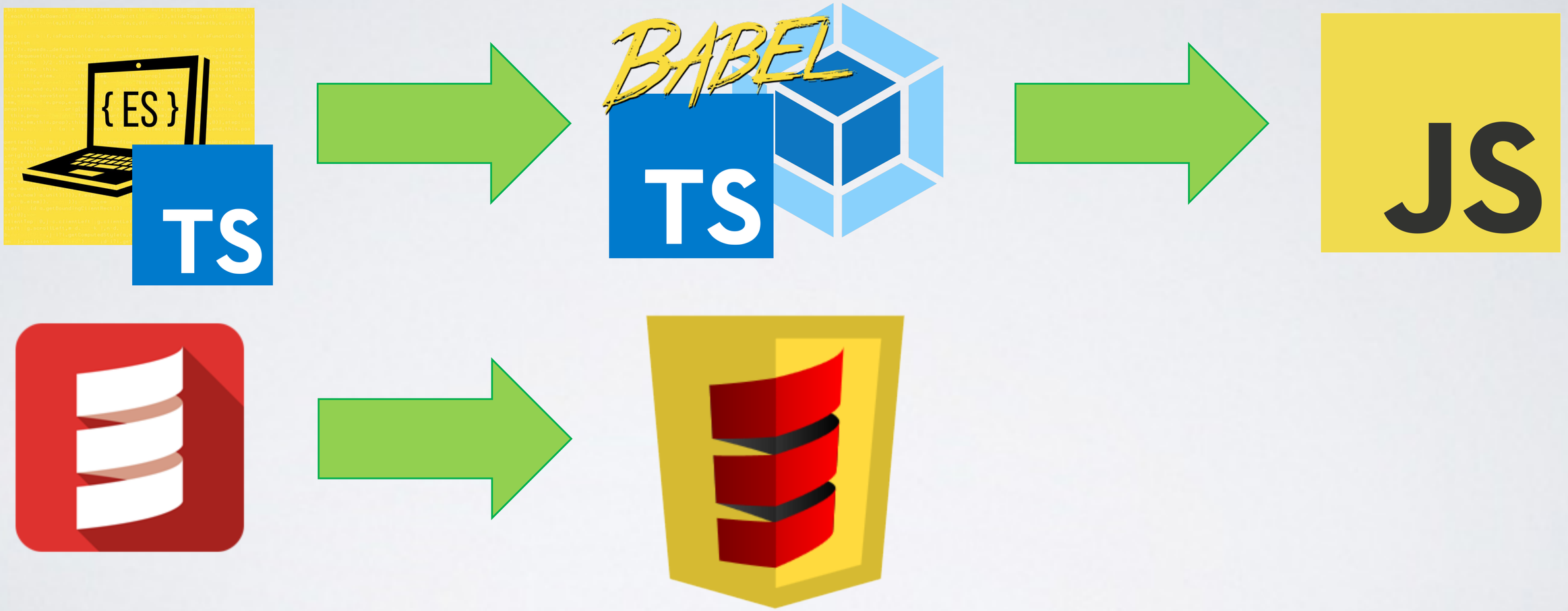
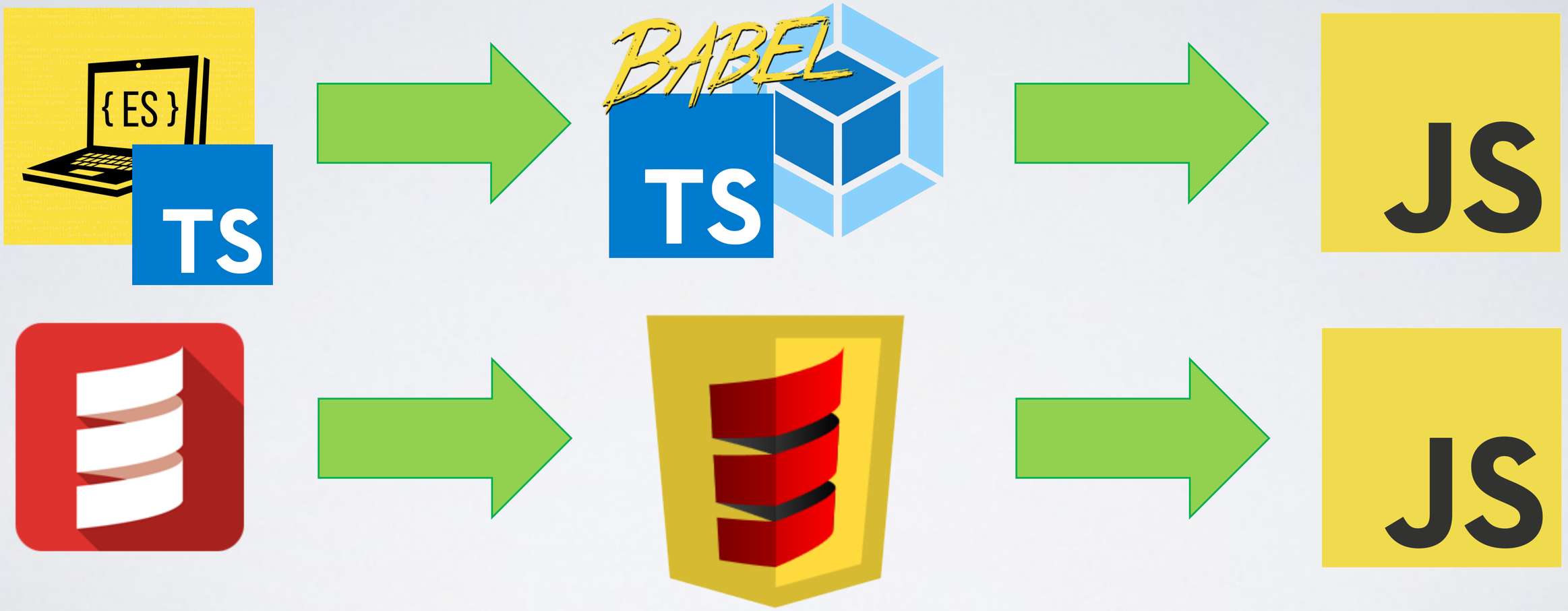


Is it really different?



Is it statically typed?

Is it statically typed?

Yes.

It supports 100% of Scala language and almost the entire standard library.

You get one of the most powerful type systems in the world.

Can I do everything I can do in JS?

Can I do everything I can do in JS?

Yes.

- All standard ECMAScript APIs are provided
- You can write dynamic code that will compile directly to native JS (but why?)
- You can (and probably will) use existing JS libraries

Is it production ready?

Is it production ready?

Yes.

- 1.0.0 is coming this year, though 0.6.16 is production ready
- Very good performance: https://www.scala-js.org/doc/internals/performance.html
  - Most of the times has the same performance as native JavaScript
  - Up to 2 times slower in worst cases
- Small runtime size: 100Kb minified
- Supported by all major Scala libraries

II. Scala.js in 

Scala.js in Evolution Gaming

Projects:

- Currently we have 2 internal projects, written entirely in Scala.js:
  - Big employee scheduling application (desktop only)
  - Mobile-first web app
- We plan to do more Scala.js development for new projects

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Scala.js in Evolution Gaming

Showcase:

- SPA
- Thousands of scheduled employees
- Complex and heavy UI

Position Requirements | Hide Allocation Control | ← | [redacted] | → | 05.2017 | Fluid since: 05.05.2017

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Morning 07 - 15	✓	8	8	✓	8	8	✓	✓	8	8	8	8	✓	✓	8	8	8	8	✓	✓	8	8	8	8	✓	✓	8	8	8	8	✓
Afternoon 15 - 23	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Night 23 - 07	8	8	✓	✓	8	8	8	8	✓	✓	8	8	8	8	✓	✓	8	8	8	8	✓	✓	8	8	8	8	✓	✓	8	8	8

Employee	I/O	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1. Afu Popova	277.34	07-15	07-15	07..23	07..23	15-23	15-23	07-15	07-15	07..23	07..23	15-23	15-23	07-15	07-15	07..23	07..23	15-23	15-23	07-15	07-15	07..23	07..23	15-23	15-23	07-15	07-15	07..23	07..23	15-23	15-23	07-15
2. Akp Motruk	344.66																															
3. Alb Yecoshenko	218.66		07-15	07-15	07-15																											
4. Ang Pymonenko	338.66			07-15																												
5. Bas Honchar	18.66	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15
6. Bel Gurka	346.66																															
7. Bil Babenko	26.66			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15	
8. Bir Khomenko	18.66	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15
9. Cel Lyakh	18.66	15-23	15-23	15-23	15-23			15-23	15-23	15-23	15-23			15-23	15-23	15-23	15-23			15-23	15-23	15-23	15-23			15-23	15-23	15-23	15-23			15-23
10. Cip Kurylenko	346.66																															
11. Cir Kovalenko	18.66	15-23	15-23			15-23	15-23	15-23	15-23			15-23	15-23	15-23	15-23			15-23	15-23	15-23	15-23			15-23	15-23	15-23	15-23			15-23	15-23	15-23
12. Cos Herasymenko	26.66	07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15	07-15	07-15	07-15			07-15
13. Dog Dzubenko	18.66	15-23	15-23	15-23	15-23			15-23	15-23	15-23	15-23			15-23	1											15-23	15-23	15-23	15-23			15-23
14. Hys Romanenko	26.66	15-23	15-23			15-23	15-23	15-23	15-23			15-23	15-23	15-23	1											15-23	15-23			15-23	15-23	15-23
15. Kar Palamarchuk	26.66			15-23	15-23	15-23	15-23			15-23	15-23	15-23	15-23															15-23	15-23	15-23	15-23	
16. Kil Doroshenko	18.66	23-07	23-07	23-07	23-07			23-07	23-07	23-07	23-07			23-07	2											23-07	23-07	23-07	23-07			23-07
17. Kiz Lutsenko	15.66	23-07	23-07			23-07	23-07	23-07	23-07			23-07	23-07	23-07	2											23-07	23-07			23-07	23-07	23-07
18. Kra Miroshnychenko	26.66			23-07	23-07	23-07	23-07			23-07	23-07	23-07	23-07															23-07	23-07	23-07	23-07	
19. Kur Tsvyk	346.66																															
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21. Ruz Fop	26.66			23-07	23-07	23-07	23-07			23-07	23-07	23-07	23-07															23-07	23-07	23-07	23-07	
22. Sag Motruk	346.66																															
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24. She Mishchenko	346.66																															
25. Smi Pylypenko	338.66																															

Hys Romanenko, 13.05.2017

15:00-23:00 **Work** *Dealer* Edit Remove

One-click add shift:

Morning | Afternoon | Night | Morning 12 | Night 12 | Custom

Role: Dealer

Add absence

Position Requirements | Monthly Schedule | ← | [redacted] | → | Wednesday, 03.05.2017 | Morning

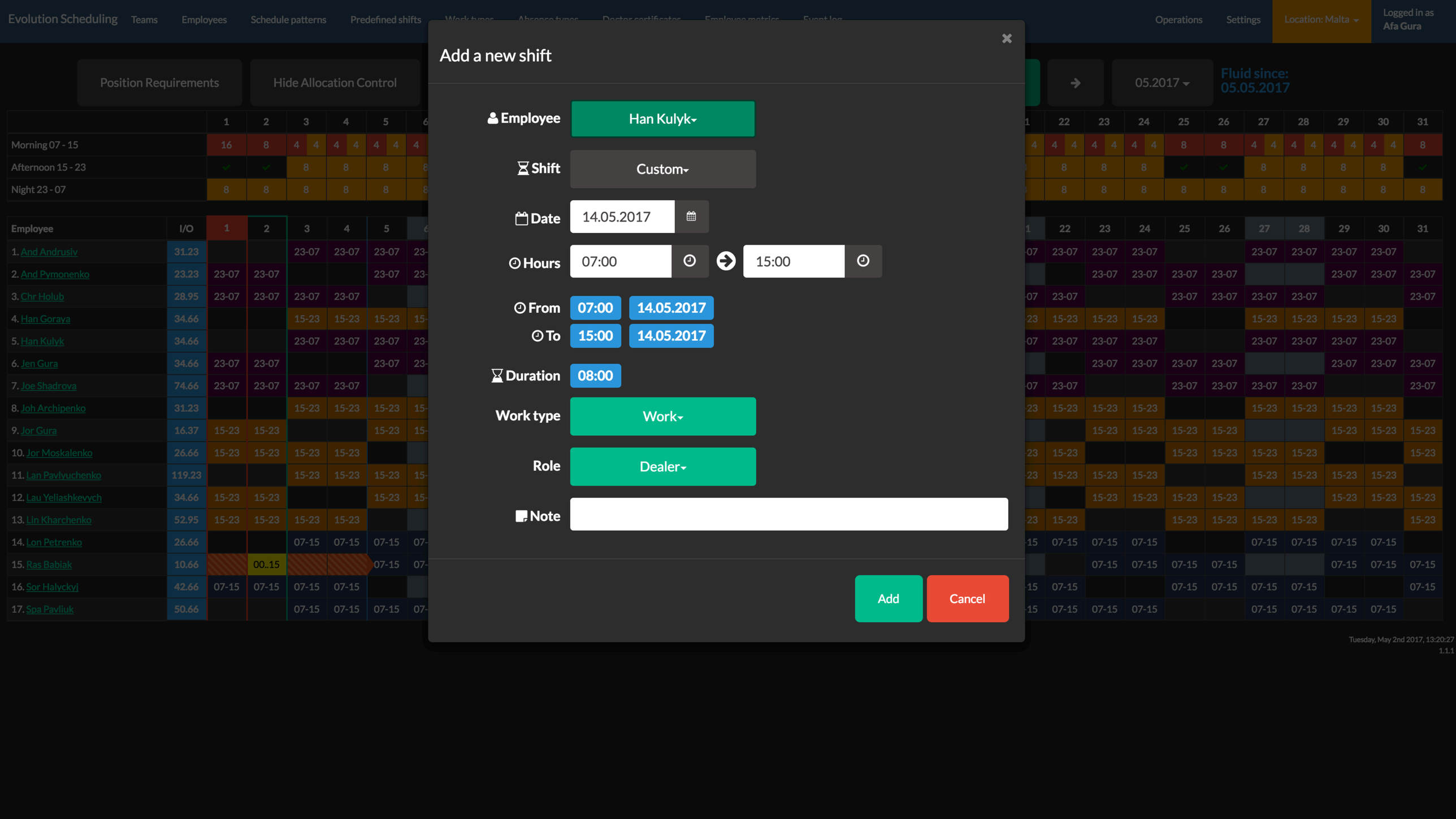
Position	Uncovered	23:00	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
Overallocation		✓	✓	✓	✓	2	2	2	2	1	1	1	1	✓	✓	✓	✓	1	1	1	1	1	1	1	1
Dealer 1	✓	23 - 07, Chr Holub								07 - 15, Lon Petrenko								15 - 23, Joh Archipenko							
Dealer 2	✓	23 - 07, And Pymonenko								07 - 15, Sor Halyckyj								15 - 23, Lan Pavlyuchenko							
Dealer 3	✓	23 - 03, Joe Shadrova												11 - 15, Spa Pavliuk				15 - 23, Han Goraya							
Dealer 4	4	23 - 03, Jen Gura												11 - 15				15 - 23, Lin Kharchenko							

Overallocated work

-	8																	15 - 23, Jor Moskalenko							
-	4					03 - 07, Joe Shadrova																			
-	4					03 - 07, Jen Gura																			
-	4									07 - 11, Spa Pavliuk															

Absent

Employee	Absence type	Period	Note
Ras Babiak	Sick	14.04.2017 — +∞	
Joe Shadrova	MARRIAGE	13.04.2017 — 16.04.2017	
Jen Gura	INJURY	14.04.2017 — 16.04.2017	
Lon Petrenko	UNJUSTIFIED	14.04.2017 — 14.04.2017	
Joh Archipenko	NOTPAYED	14.04.2017 — 30.04.2017	
Jor Moskalenko	Paid Vacation	14.04.2017 — 28.04.2017	
And Pymonenko	ANNUAL_PAID	14.04.2017 — 30.04.2017	
Chr Holub	ANNUAL_UNPAID	14.04.2017 — 29.04.2017	
And Andrusiv	ACADEMIC	14.04.2017 — 30.04.2017	
Han Kulyk	BIRTH	14.04.2017 — 14.04.2017	
Sor Halyckyj	Sick	14.04.2017 — 20.04.2017	
Jor Gura	OTHER_PAID	14.04.2017 — 27.04.2017	
Lin Kharchenko	SICK_UNPAID	14.04.2017 — 22.04.2017	
Lau Yeliashkevych	Sick	14.04.2017 — 18.04.2017	
Han Goraya	BEREAVMENT	14.04.2017 — 15.04.2017	
Lan Pavlyuchenko	PREGNANCY	14.04.2017 — 30.04.2017	


Evolution Scheduling
Teams
Employees
Schedule patterns
Predefined shifts
Operations
Settings
Location: Malta
Logged in as
Afa Gura
Position Requirements
Hide Allocation Control
05.2017
Fluid since:
05.05.2017
Add a new shift
Employee
Han Kulyk
Shift
Custom
Date
14.05.2017
Hours
07:00
15:00
From
07:00
14.05.2017
To
15:00
14.05.2017
Duration
08:00
Work type
Work
Role
Dealer
Note
Add
Cancel
Tuesday, May 2nd 2017, 13:20:27
1.1.1

Scala.js in Evolution Gaming

Front-end Stack:

- **Scala.js React**. Scala bindings for ReactJS
- **Diode**. Redux-like state management (close to Elm)
- **ScalaCSS**. Type safe embedded DSL for CSS
- Native JS: **Bootstrap** + **jQuery**, **moment-js**

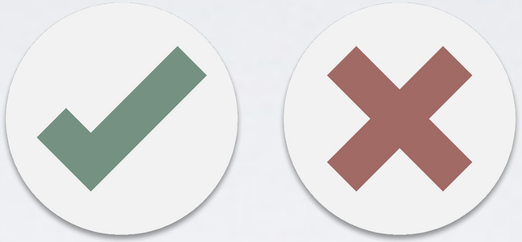
Other, not front-end-specific libraries:

- Cats, shapeless, circe, monix, spire, scalatest, scalacheck, ...

Scala.js in Evolution Gaming

Random facts:

- ~1000 Scala files, < 0.1% JS code (our own code in LOC)
- Production minified JS file size: **3.2 Mb**, **+850Kb** JS dependencies (before gzip)
- Compile time: **4.5 minutes**
- JS optimization + emission time (CI build only): **2.5 minutes**
- "Hot reload" time: **10-15 seconds**



III. Our experience

Hard things

You have to know both

- Scala.js is just a transpiler, all design choices are up to you
- You'll have to:
  - Know how frontend works in general
  - Be aware of current best practices and trends (react, redux, SPA, etc.)
  - Have a basic understanding of how HTML, CSS and JS work
  - Know how ReactJS works if you're going to use scalajs-react.
  - Know Scala

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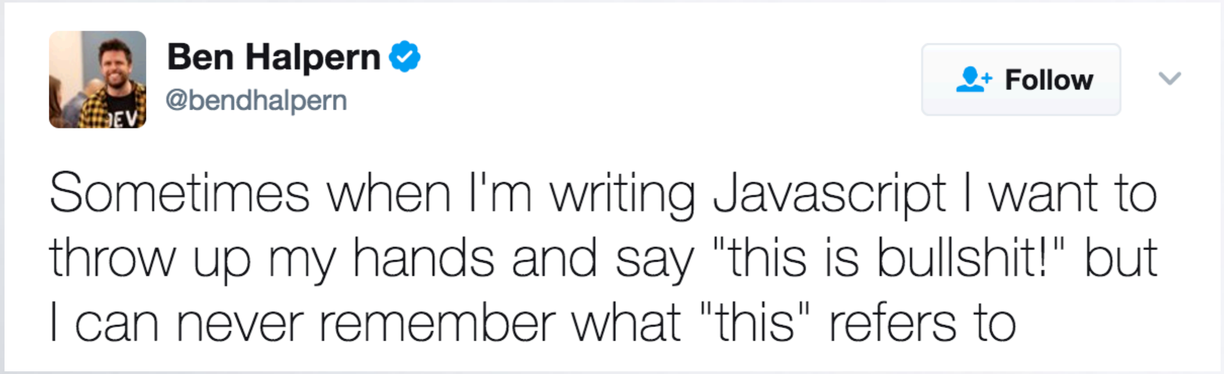
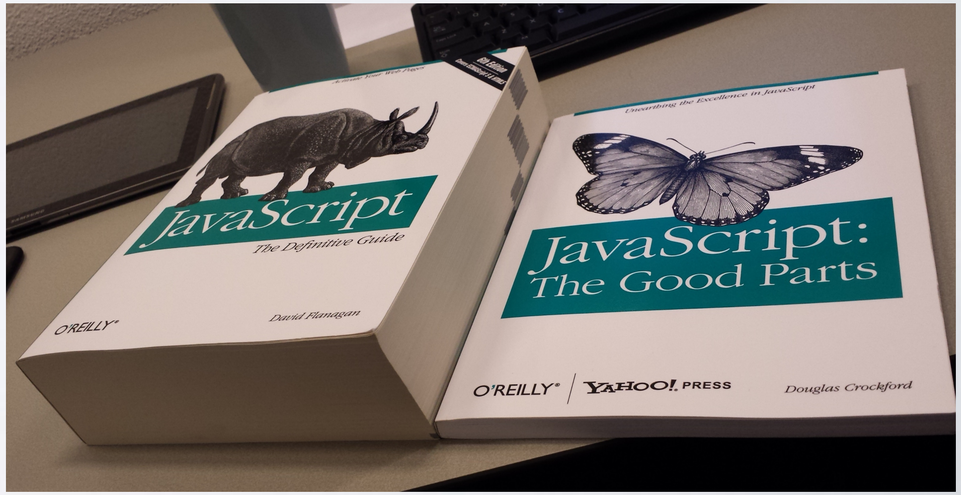
  - Have a basic understanding of how HTML, CSS and JS work
  - Know how ReactJS works if you're going to use scalajs-react.
  - Know Scala
- Luckily, you're guarded from all the tricky JS stuff





Output file size

- Scala.js runtime itself is quite small, but…
- Really joyful Scala development requires libraries, they add up a bit
- Optimizer aggressive inlining does not help
- Not a big problem for desktop apps, mobile is another question

Optimizer slowdowns

- In general, optimizer does an awesome job
- As usual, you can't make everyone happy: specific rare cases can lead to exponential output file growth and optimization slowdowns
- Our case was fixed in 2 hours by just adding one `@noinline` annotation in Diode 1.1.0
- General advice: keep inlining in mind in case of drastic optimization/emission slowdown

More on our case:
https://gitter.im/scala-js/scala-js?at=5820353445c9e3eb4308d2e3

Reload is not so hot

- React hot reload is awesome
- Unfortunately, incremental compilation + optimization + emission take time
- Lots of natural inherent restrictions to implement hot reload, comparable to ReactJS one
- Play Framework live reload gives some fresh air
- There's a limited experimental hot reload at lihaoyi/workbench

Unexpected semantics

Unexpected semantics

```
val a: Float = 5.71F

println(a.toString)
```

Unexpected semantics


```
val a: Float = 5.71F

println(a.toString) // 5.710000038146973
```

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Unexpected semantics

```
val a: Float = 5.71F

println(a.toString) // 5.710000038146973
```

The more you know. Semantics of Scala.js:
https://www.scala-js.org/doc/semantics.html

Coverage support

- Scoverage claims to support Scala.js
- In reality, any code, involving dynamic JS calls, doesn't even compile
- There are several other issues, like incorrect environment detection

See #176 and #183 on scoverage/scalac-scoverage-plugin.

Sometimes IDEA just gives up

- Overall IDE support is wonderful, esp. comparing to JS
- When project becomes big, some big files can kill typechecker
- In some cases even highlighting refuses to work
- Minor issues with cross-project support

Good things

Code sharing

- Just **insanely useful**
- Shared core domain business logic
- Shared API protocols and Data Transfer Objects (DTO)
- Rich client and various “optimistic” scenarios **for free**
- Automatic 100% safe API synchronization **for free**
- No communication overhead on API development/synchronization
- You can even write and reuse abstract cross-platform code for things, that don’t have unified cross-platform APIs (e.g. with type classes)

Code sharing (example)

Shared DTO and codecs

```
case class Shift(
  start: LocalTime,
  end: LocalTime)

case class Schedule(
  employeeId: UUID,
  date: LocalDate,
  shifts: List[Shift])
```

```
object Codecs {

  implicit lazy val decoderLocalDate: Decoder[LocalDate] = ???
  implicit lazy val encoderLocalDate: Encoder[LocalDate] = ???

  implicit lazy val decoderLocalTime: Decoder[LocalTime] = ???
  implicit lazy val encoderLocalTime: Encoder[LocalTime] = ???

  implicit lazy val shiftEncoder = Encoder[Shift]
  implicit lazy val shiftDecoder = Decoder[Shift]

  implicit lazy val scheduleEncoder = Encoder[Schedule]
  implicit lazy val scheduleDecoder = Decoder[Schedule]
}
```

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Code sharing (example)

Back-end controller

```
def schedule = Action { req =>
  val schedule: Schedule = ???
  Ok(schedule.asJson)
}
```

Front-end

```
def getSchedule: Future[Either[Error, Schedule]] =
  Ajax.get("http://my.service.com/schedule")
    .map(response =>
      decode[Schedule](response.responseText)
    )
```

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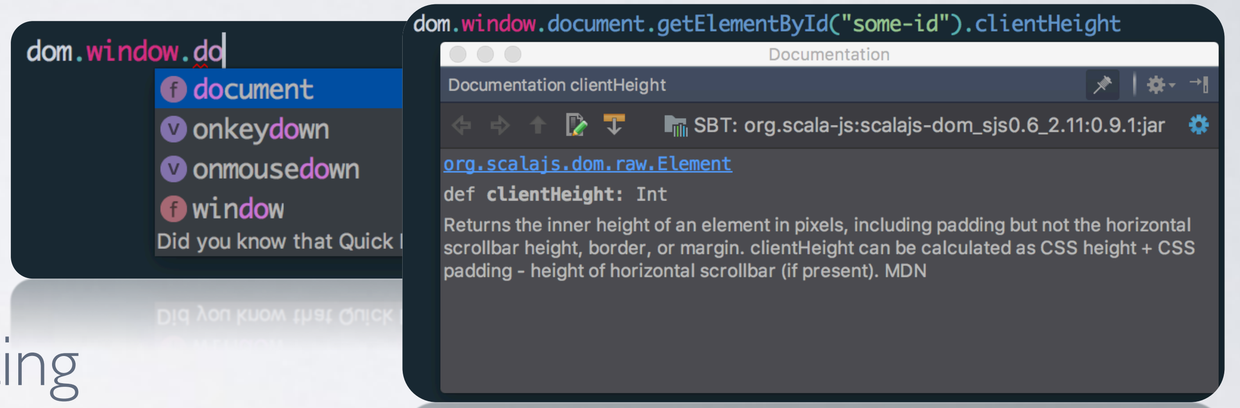
IDE and tooling

- All that works for Scala, works for Scala.js **out of the box**:
  - Autocomplete
  - Code navigation
  - Rich refactoring and code-generation
  - Syntax, error and code-smells highlighting



- Including various browser APIs (like DOM) and native JS library facades
- Much more **reliable** than WebStorm and alike, due to static type system
- No special plugin or IDE is required

Type safe markup

```
val items: List[String] = ???
div(
  h1(items.length, " items found:"),
  ol(
    items.map(li(_)).toTagMod
  )
)
```

Rich type system

- **Imagine the possibilities!**
- **All** Scala features are available: implicits, macros & scala-meta, type classes, higher-kinded types, etc...
- Maximum power of expression and design thought

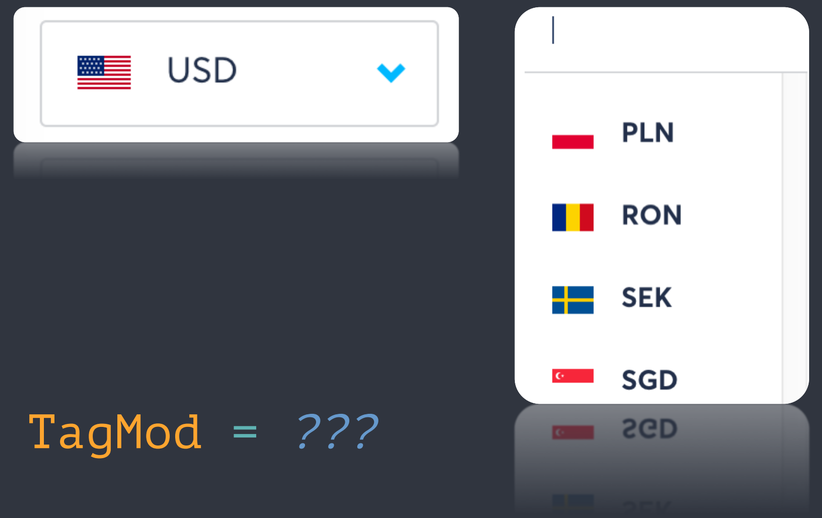
Rich type system (example)

```
class GenericSelector {

  case class Props(
    selected: String,
    onChange: String => Callback,
    all: List[String])

  def renderElement(props: Props)(element: String): TagMod = ???

  def render(props: Props) = div(props.all.map(renderElement(props)).toTagMod)
}
```



Rich type system (example)

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class GenericSelector {

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}
```

Rich type system (example)

```
class GenericSelector[T] {

  case class Props(
    selected: T,
    onChange: T => Callback,
    all: List[T])

  // how to get id for the element?
  // how to render element to html? Don't say .toString
  def renderElement(props: Props)(element: T): TagMod = ???

  def render(props: Props) = div(props.all.map(renderElement(props)).toTagMod)
}
```

Rich type system (example)

```
// proves that instances of type T have a human readable name
@typeclass trait Named[T] {
  def name(t: T): String
}

// Proves that instance of type T can be uniquely identified among other T's by a string.
@typeclass trait Identified[T] {
  def uid(t: T): String
}
```

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Rich type system (example)

```
class GenericSelector[T: Named : Identified] {

  case class Props(
    selected: T,
    onChange: T => Callback,
    all: List[T])

  def renderElement(props: Props)(element: T): TagMod = ???

  def render(props: Props) = div(props.all.map(renderElement(props)).toTagMod)
}
```

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Rich type system (example)

```
class GenericSelector[F[_]: Applicative : Foldable, T: Named : Identified] {

  case class Props(
    selected: F[T],
    onChange: F[T] => Callback,
    all: List[T])

  def renderElement(props: Props)(element: T): TagMod = ???

  def render(props: Props) = div(props.all.map(renderElement(props)).toTagMod)
}
```

Rich type system (example)

```
val strictCurrencySelector = new GenericSelector[cats.Id, Currency] { /* ... */ }

val optionalCurrencySelector = new GenericSelector[Option, Currency] { /* ... */ }

val currencyMultiSelect = new GenericSelector[List, Currency] { /* ... */ }
```

Rich type system (example)

```
val strictCurrencySelector = new GenericSelector[cats.Id, Currency] { /* ... */ }

val optionalCurrencySelector = new GenericSelector[Option, Currency] { /* ... */ }

val currencyMultiSelect = new GenericSelector[List, Currency] { /* ... */ }
```

- Yes, this kind of design power is available today in the browser
- 100% type safe, checked by compiler
- No monkey-patching, dynamic casting or other nightmare

You don’t need JS developers

You don’t need JS developers

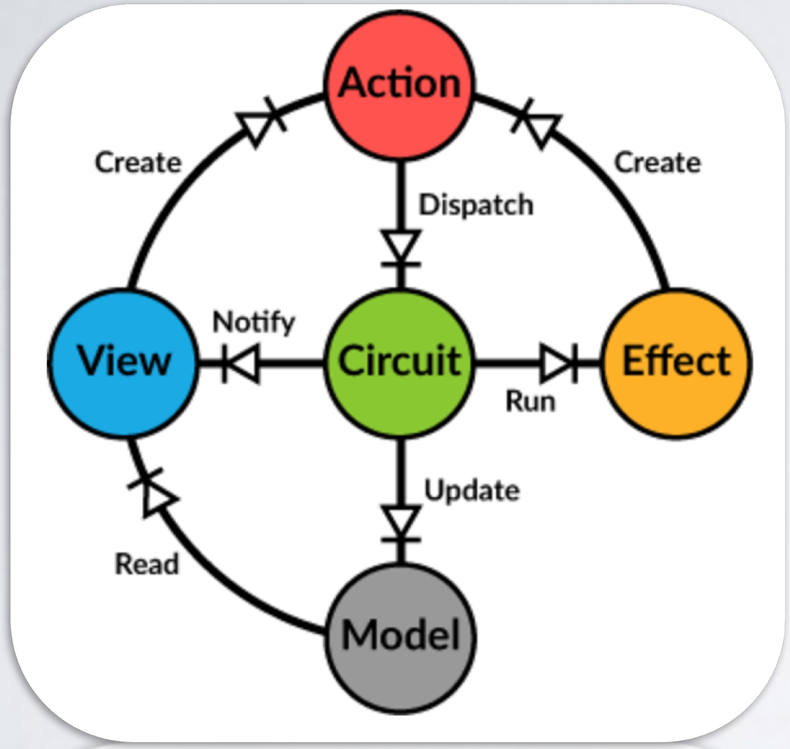
You don’t need JS developers

- Can be a great advantage for internal systems, where it’s too expensive to have a dedicated JS developer
- Scala developers own the whole codebase, eliminating cross-team (or cross-language) synchronization overhead

Seamless JS interop

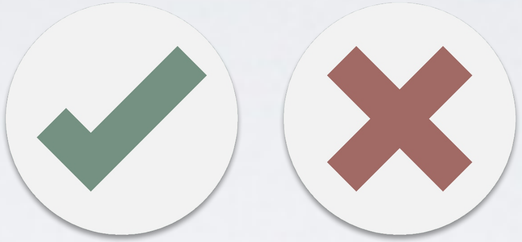
- **Very important!**
- Scala.js interop is very simple and natural in both directions
- You can easily use libraries from JS ecosystem (with additional type safety)
- You can write JS libraries in Scala and publish them for JS devs to use
- In you application code you can freely mix pure Scala and JS façade code
- Dealing with JS APIs from Scala.js is more efficient (IDE FTW)

Diode state management



- Scala type system provides a more pleasant & powerful redux experience than JS ecosystem
- **Pot** monad holds a piece of application state and supports all frontend-specific effects in a very natural way
- Really shines in combination with scalajs-react

Evolution Gaming 10 YEARS ALIVE



Wrap-up

IV. Conclusion

Thank you!
Q&A