Microsoft Research

Each year Microsoft Research hosts hundreds of influential speakers from around the world including leading scientists, renowned experts in technology, book authors, and leading academics, and makes videos of these lectures freely available.

Speaker

Louis Lafreniere

Principal Software Engineer Manager, Chakra

Louis was hired by Microsoft to work on its first shipping 32bit compiler backend for C/C++. His first task was to add the C++ support. After 18 years of squeezing perf out of C++ and working on security features and 3 backends later, Louis jumped on the opportunity to work on Chakra during the early IE9 days to write a JIT for JavaScript. That was before he realized what JavaScript was all about...

Web tech talks Platform

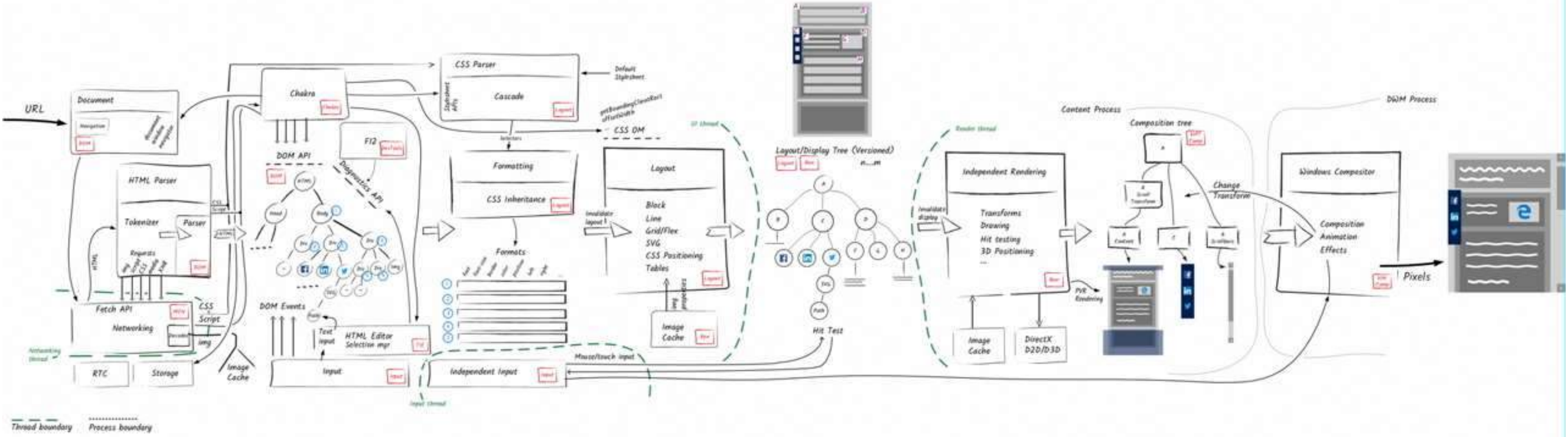
Microsoft

Chakra: From Script to Optimized Code

By some accounts, JavaScript is the most popular programming language in the world. Yet it's also not a language that was designed with fast performance in mind. The Chakra team embarked on a journey to make JavaScript fast in IE9 and the Chakra runtime can today power everything from tiny scripts on a page to modern applications and services running on Azure. In this talk, we'll cover the basic architecture of the engine that transforms JavaScript into fast native code

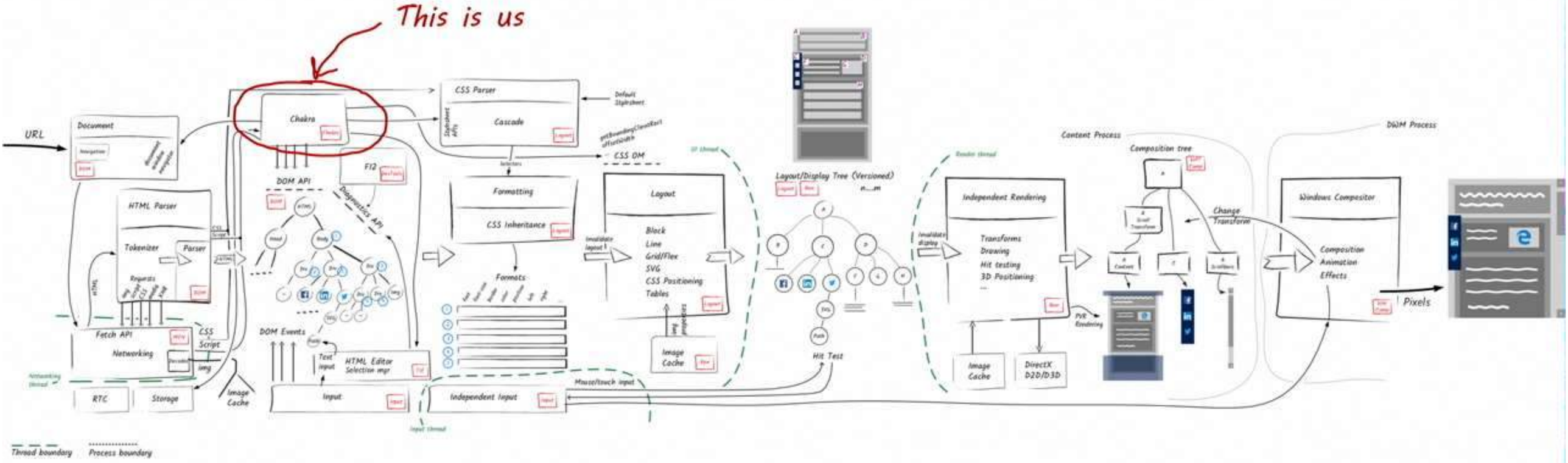
Web tech talks Platform

Where are we in the Web Platform?



Web tech talks Platform

Where are we in the Web Platform?

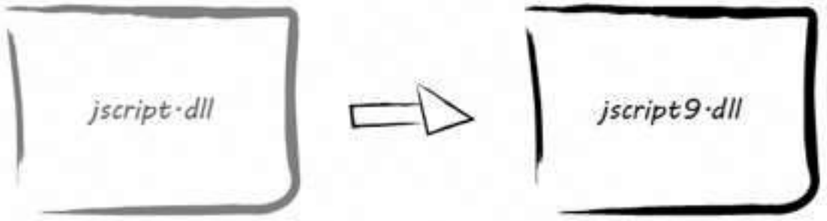


Web tech talks Platform

Evolution of Chakra

IE3 to IE8

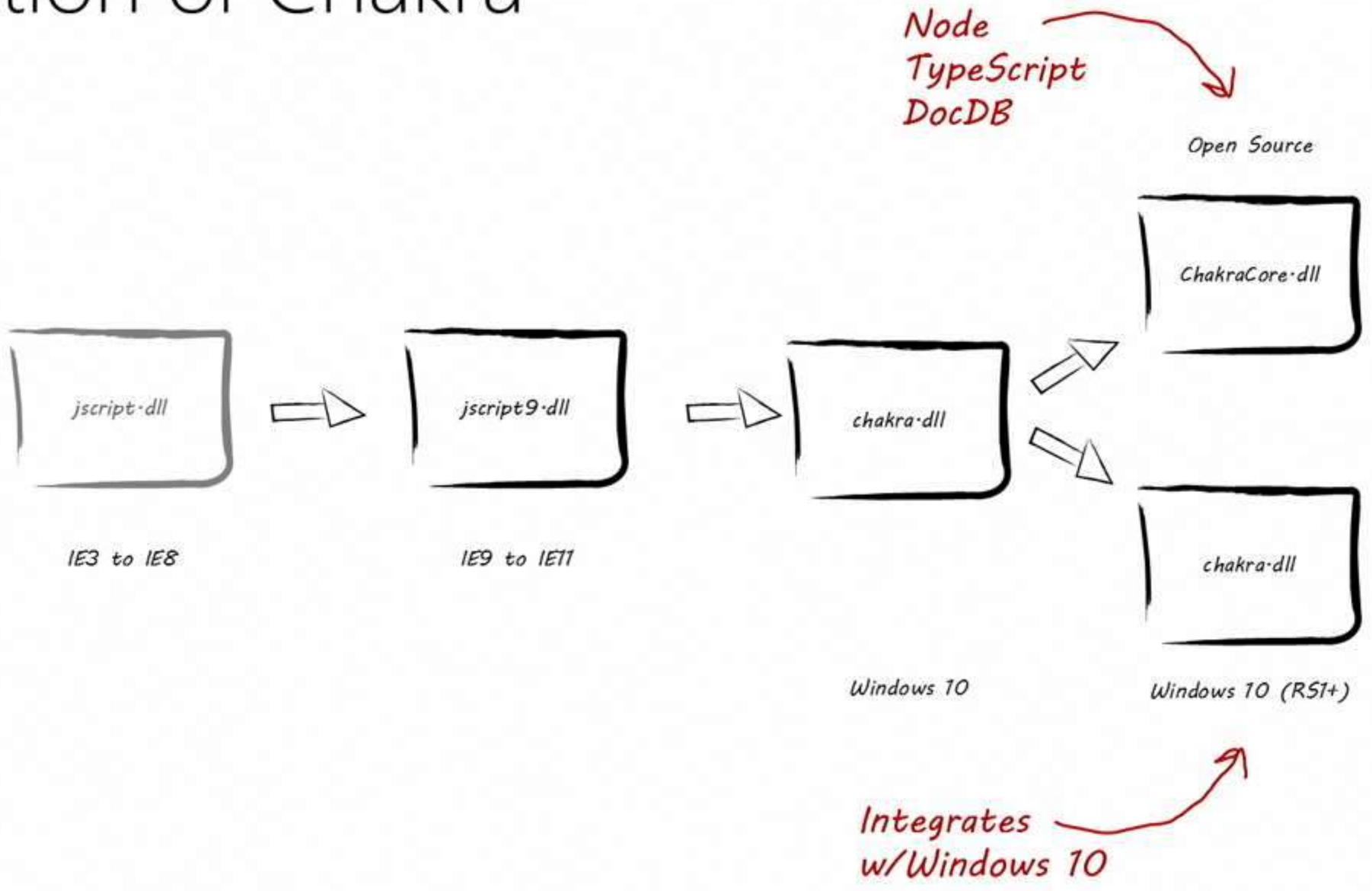
Evolution of Chakra



IE3 to IE8

IE9 to IE11

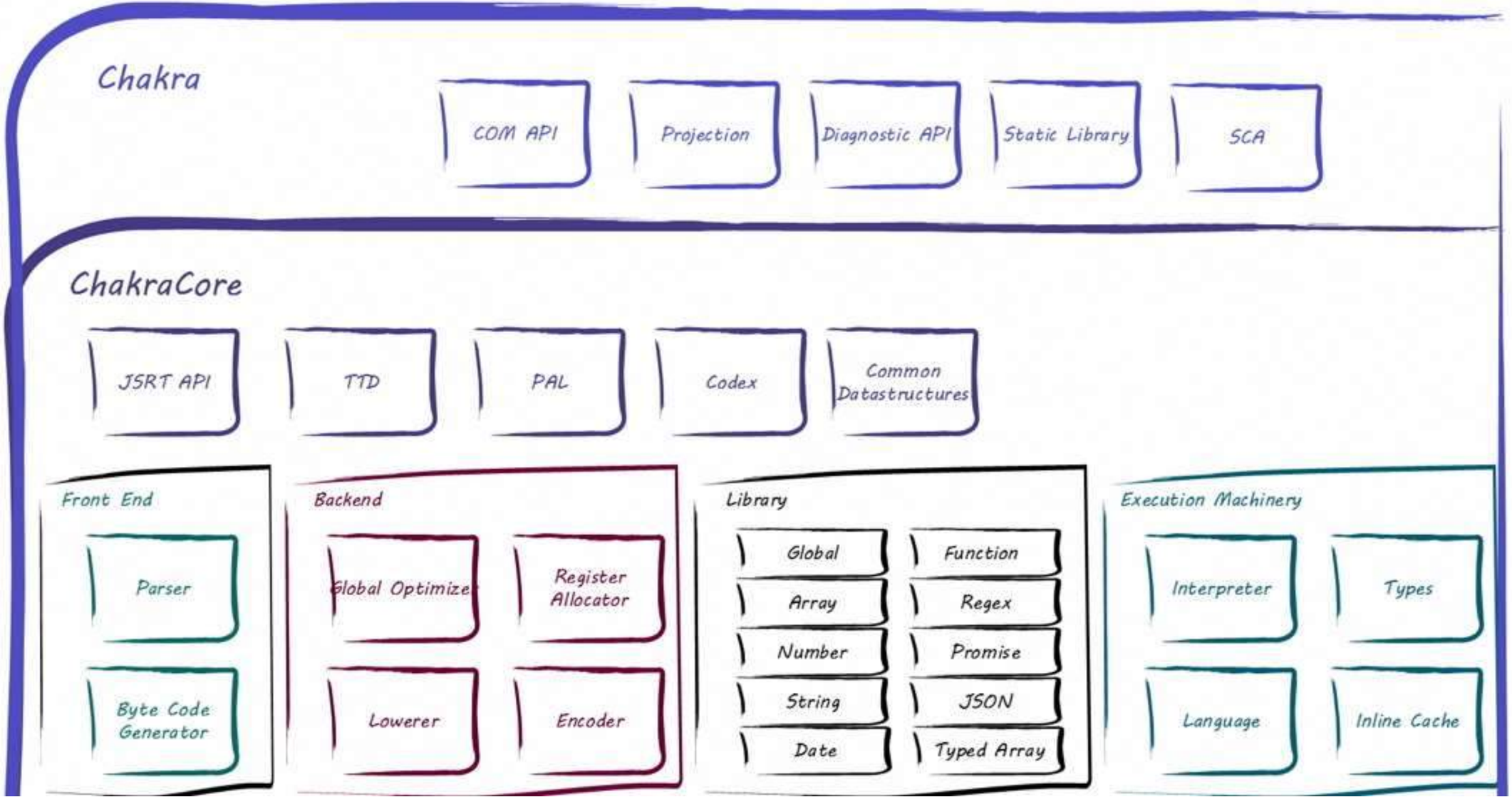
Evolution of Chakra



Architecture of Chakra

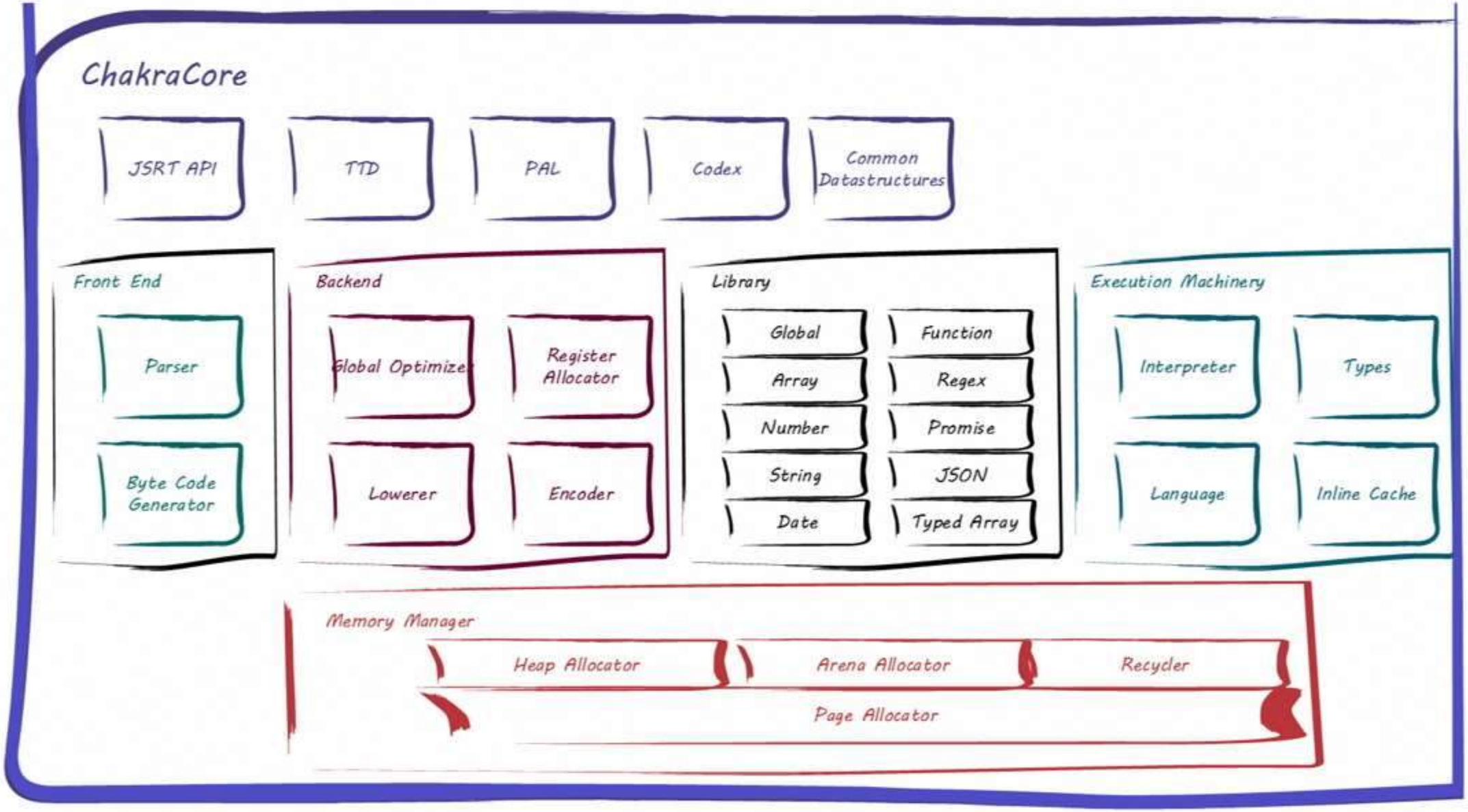
Web tech talks Platform

Chakra and ChakraCore

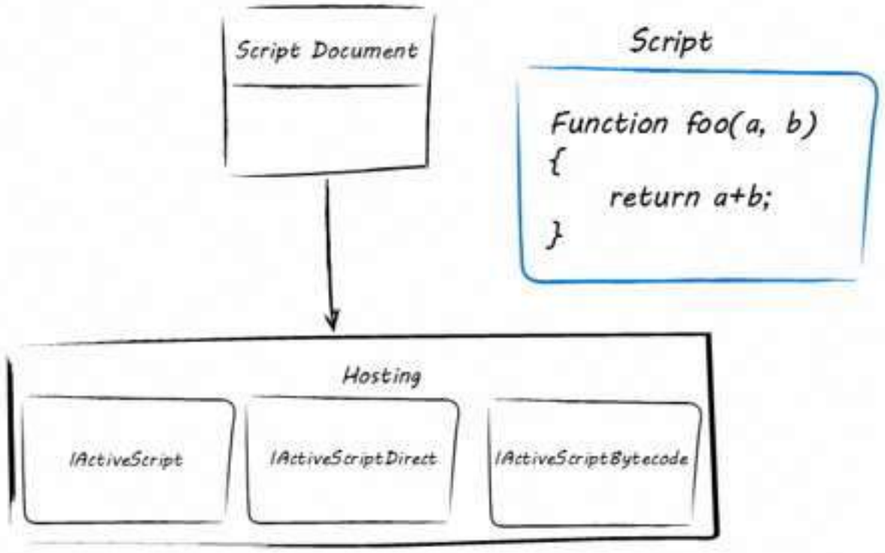


Web tech talks Platform

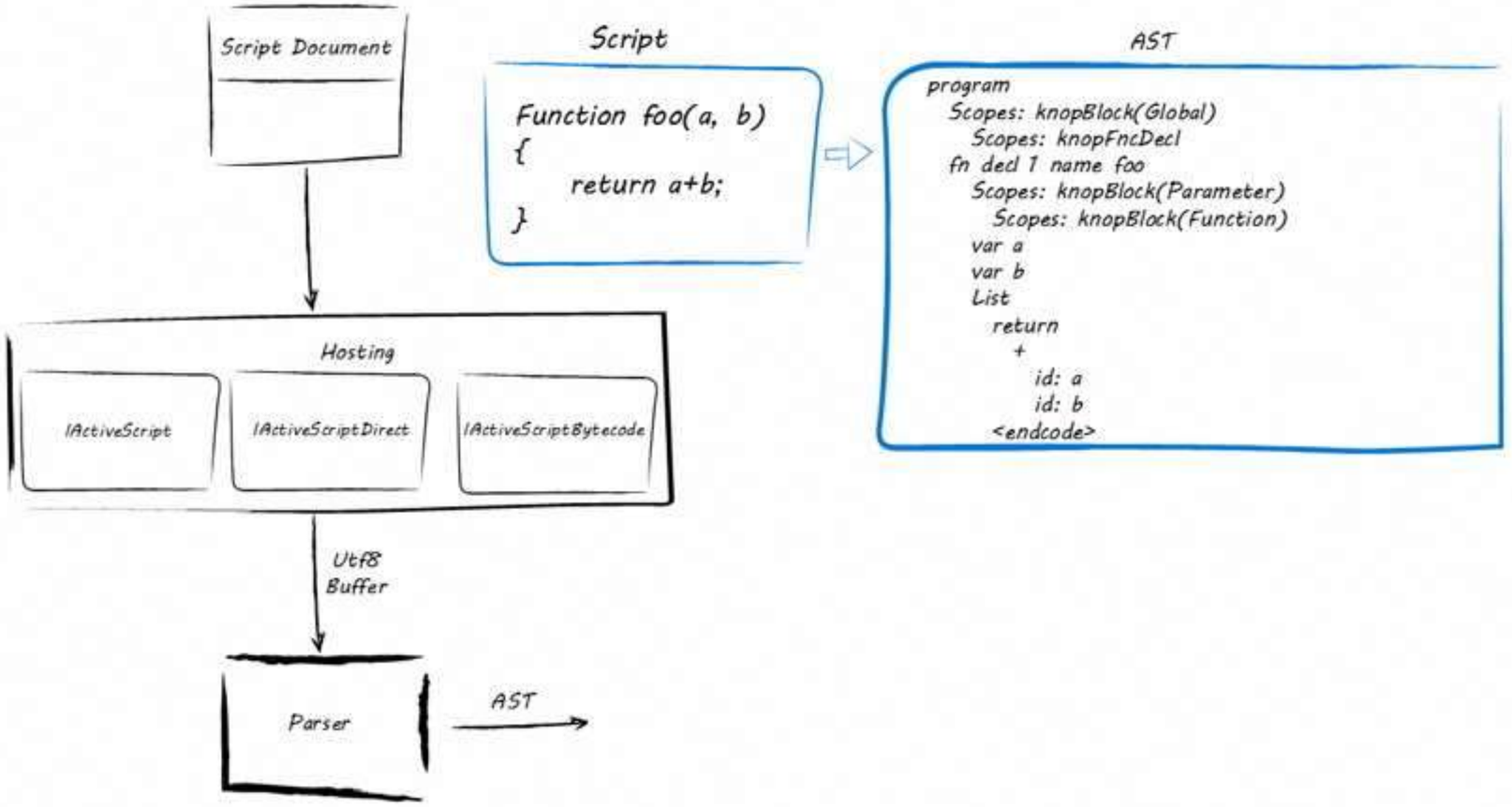
Chakra and ChakraCore



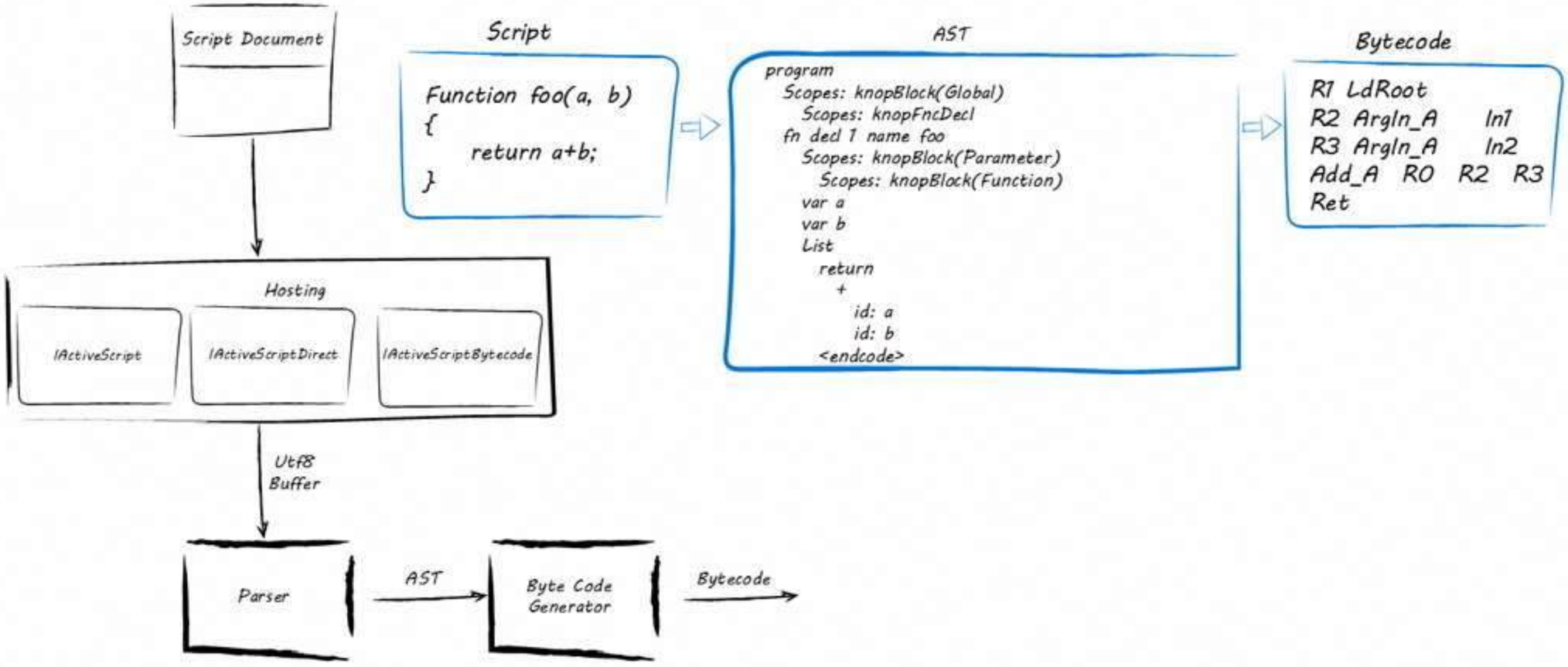
Making script executable



Making script executable

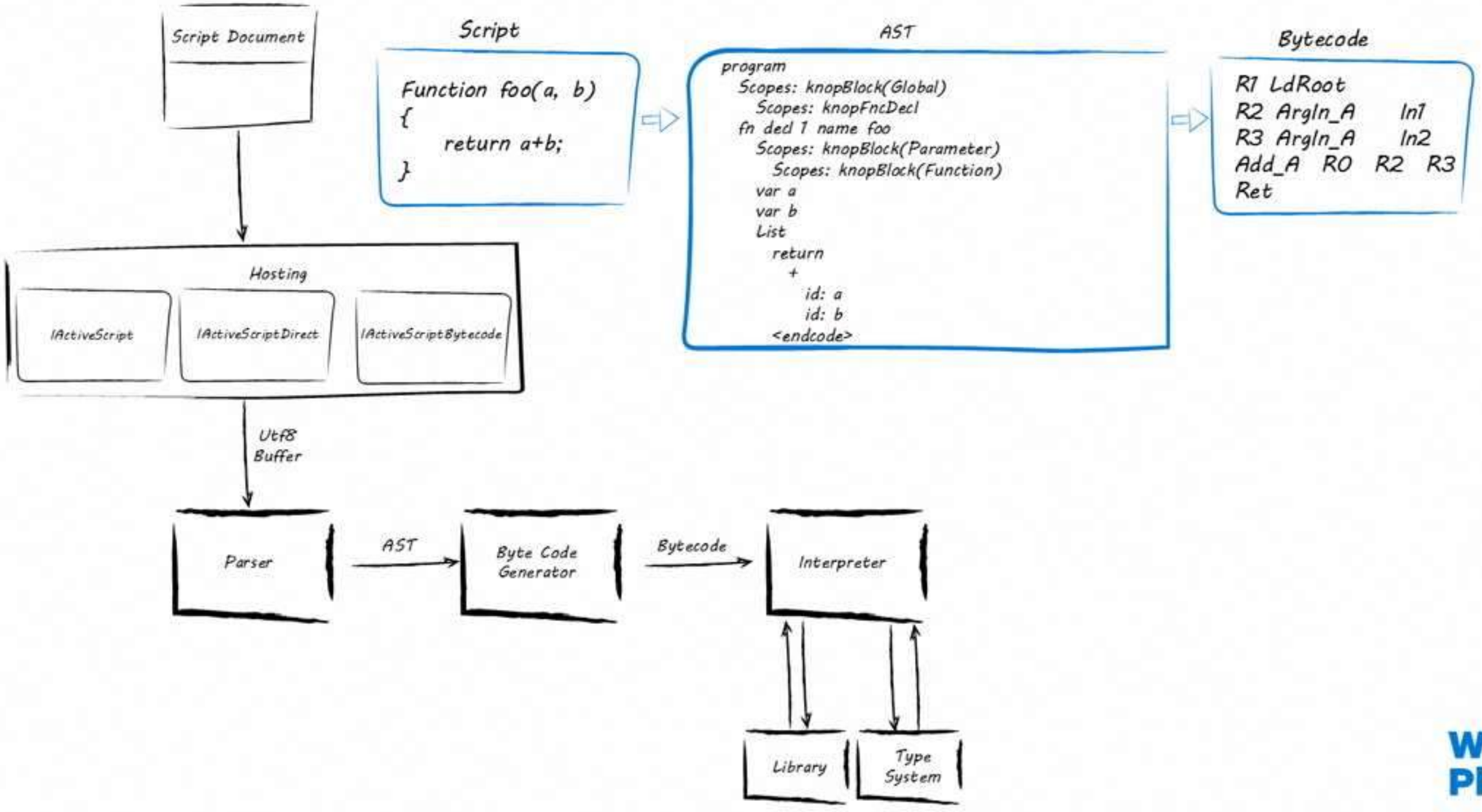


Making script executable



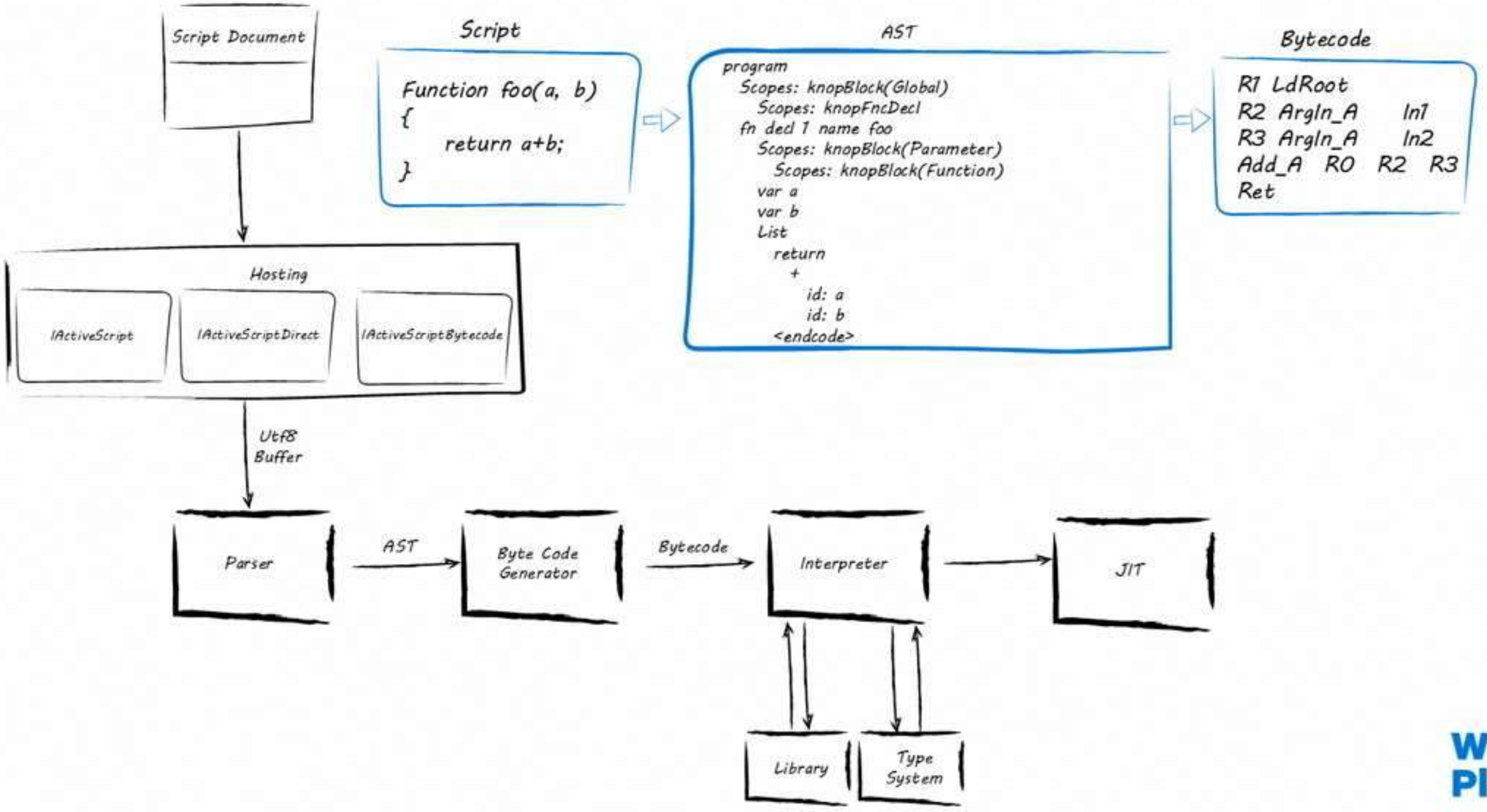
Web tech talks Platform

Making script executable



Web tech talks Platform

Making script executable



Web Platform tech talks

```
/* Examples of a+b */

> 1 + 1
2
```

```
/* Examples of a+b */

> 1 + 1
2
> 1 + ""
'1'
```

```
/* Examples of a+b */

> 1 + 1
2
> 1 + ""
'1'
> "a" + "b"
'ab'
```

```
/* Examples of a+b */

> 1 + 1
2
> 1 + ""
'1'
> "a" + "b"
'ab'
> "a" + 1
'a1'
```

```
/* Examples of a+b */

> 1 + 1
2
> 1 + ""
'1'
> "a" + "b"
'ab'
> "a" + 1
'a1'
> {} + {}
'[object Object][object Object]'
```

```
/* Examples of a+b */

> 1 + 1
2
> 1 + ""
'1'
> "a" + "b"
'ab'
> "a" + 1
'a1'
> {} + {}
'[object Object][object Object]'
> {} + ''
0
```

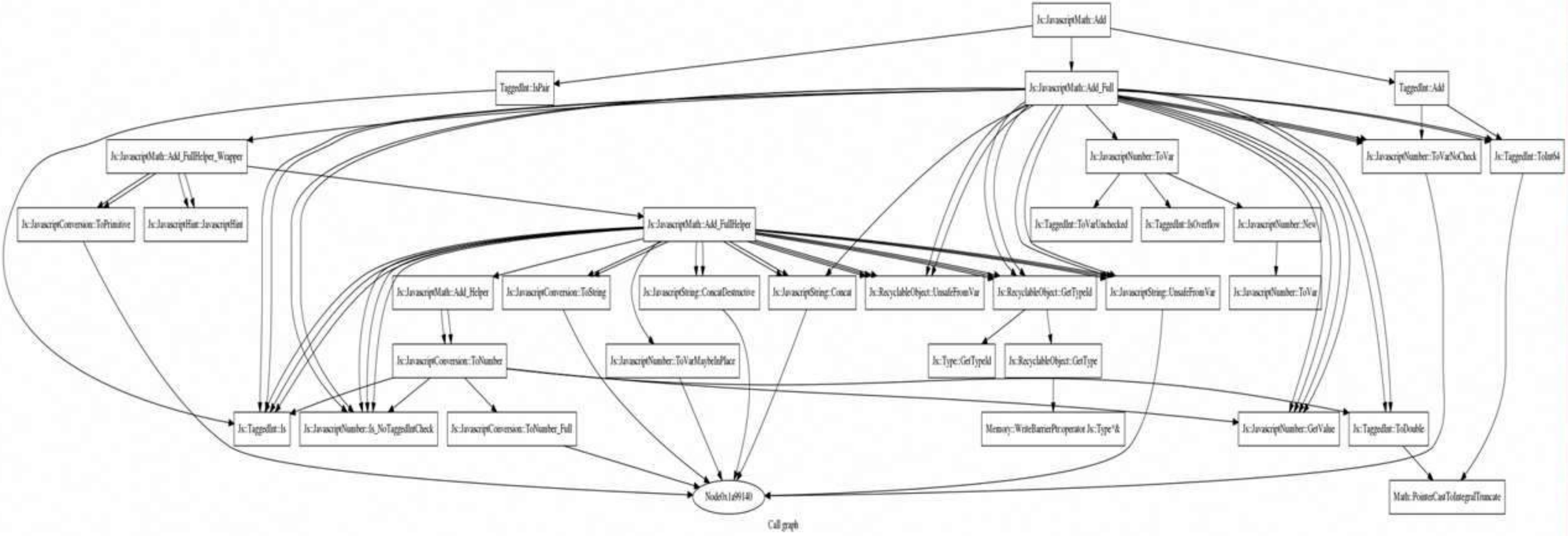
```
/* Examples of a+b */

> 1 + 1
2
> 1 + ""
'1'
> "a" + "b"
'ab'
> "a" + 1
'a1'
> {} + {}
'[object Object][object Object]'
> {} + ''
0
> '' + {}
'[object Object]'
```

```
/* Examples of a+b */

> 1 + 1
2
> 1 + ""
'1'
> "a" + "b"
'ab'
> "a" + 1
'a1'
> {} + {}
'[object Object][object Object]'
> {} + ''
0
> '' + {}
'[object Object]'
> ({}) + ''
'[object Object]'
```

```
/* Examples of a+b */

> 1 + 1
2
> 1 + ""
'1'
> "a" + "b"
'ab'
> "a" + 1
'a1'
> {} + {}
'[object Object][object Object]'
> {} + ''
0
> '' + {}
'[object Object]'
> ({}) + ''
'[object Object]'
> "" + ({})
'[object Object]'
> 1 + {}
'1[object Object]'
> {} + 1
1
> 1 + ({})
'1[object Object]'
> ({}) + 1
'[object Object]1'
> [] + {}
'[object Object]'
> {} + []
0
> 0 + []
'0'
```

Web tech talks Platform

To get a+b correct…



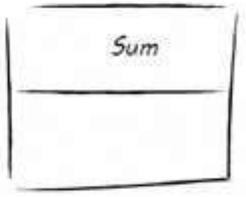
Web tech talks Platform

Optimizing and Executing code

Web tech talks Platform

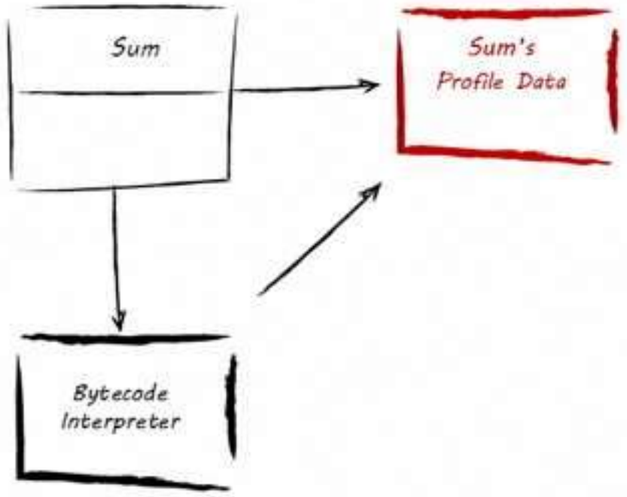
Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```



Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```



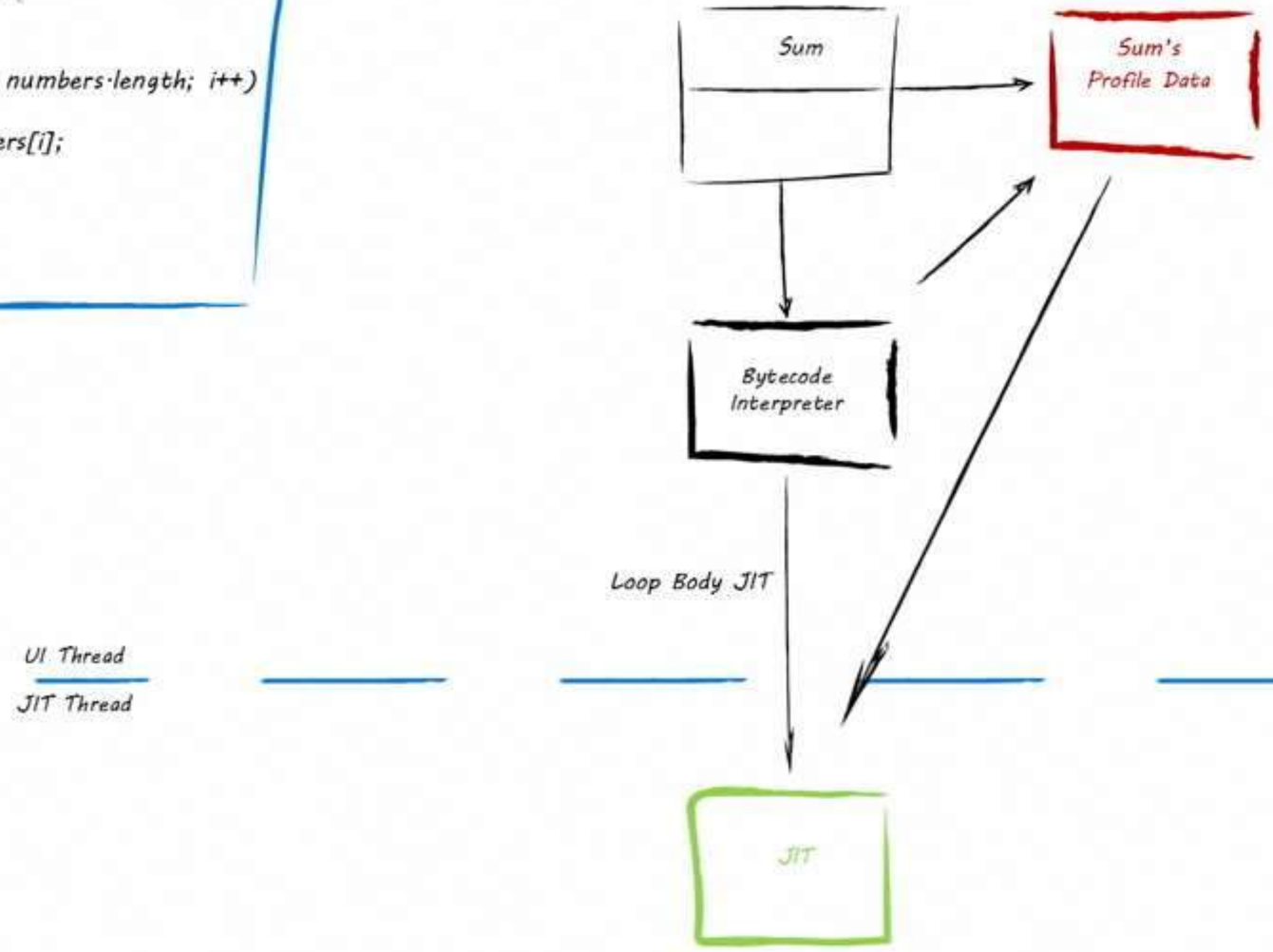
Bytecode

```
R1 LdRoot
R2 LdC_A_I4   0
R3 LdC_A_I4   1
R4 ArgIn_A    In1
LdUndef       R6
Ld_A          R5  R2
Ld_A          R6  R2
LoopStart:
  LdLen_A     R7 = R4.length
  BrGe_A      LoopEnd  R6  R7
  LdElemI_A   R7 = R4[R6]
  Add_A       R5  R5  R7
  Incr_A      R6  R6
  Br          LoopStart
LoopEnd:
Ld_A          R0  R5
Ret           R0
```

Web tech talks Platform

Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```



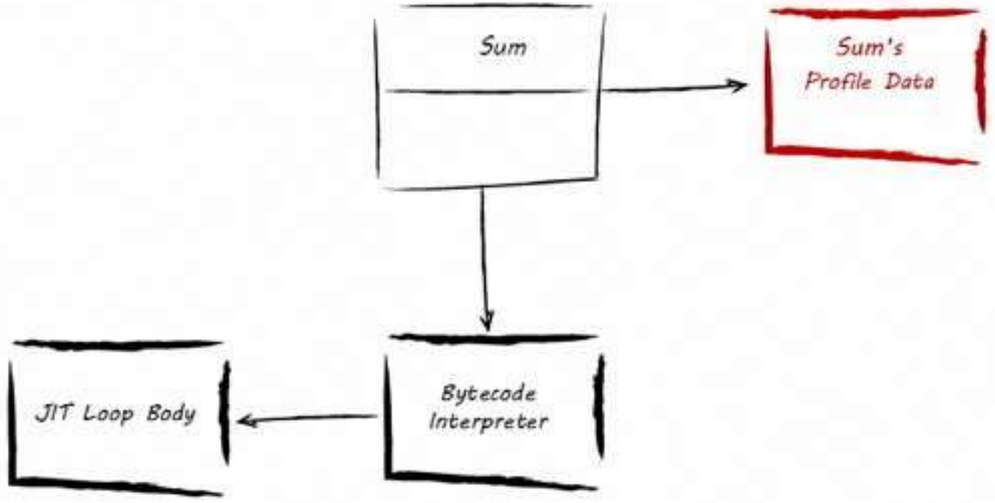
Bytecode

```
R1 LdRoot
R2 LdC_A_I4   0
R3 LdC_A_I4   1
R4 Argin_A    in1
LdUndef       R6
Ld_A          R5  R2
Ld_A          R6  R2
LoopStart:
  LdLen_A     R7 = R4.length
  BrGe_A      LoopEnd  R6  R7
  LdElemI_A   R7 = R4[R6]
  Add_A       R5  R5  R7
  Incr_A      R6  R6
  Br          LoopStart
LoopEnd:
Ld_A          R0  R5
Ret           R0
```

Web tech talks Platform

Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```

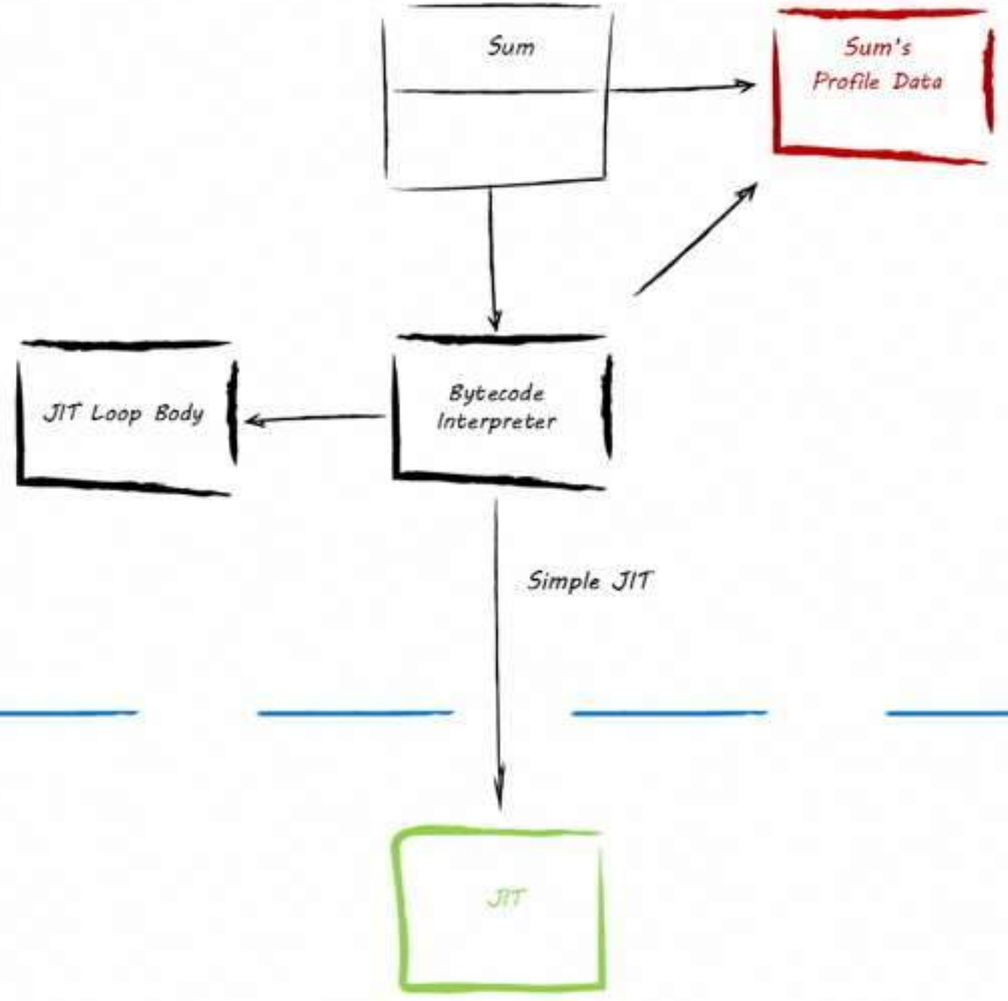



```
if (IsInt(i))
    bailout()
i_i = ToInt32(i)

if (IsInt(total))
    bailout()
total_i = ToInt32(total)

if (IsIntArray(number))
    bailout()

l = number.length
d = number.data

loop:
    if (i_i >= l)
        break;
    total_i += d[i_i]
    i_i++
    goto loop

i = ToVar(i_i)
total = ToVar(total_i)

return
```

Web tech talks Platform

Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```

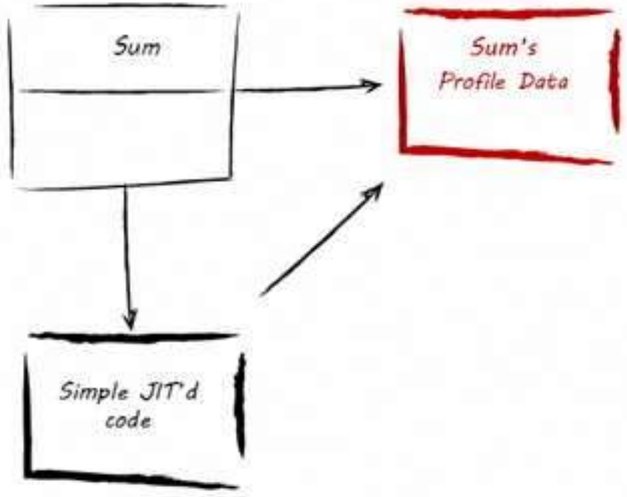



```
if (!isInt(i))
    bailout()
i_i = ToInt32(i)

if (!isInt(total))
    bailout()
total_i = ToInt32(total)

if (!isIntArray(number))
    bailout()

l = number.length
d = number.data

loop:
    if (i_i >= l)
        break;
    total_i += d[i_i]
    i_i++
    goto loop

i = ToVar(i_i)
total = ToVar(total_i)

return
```

Web tech talks Platform

Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```

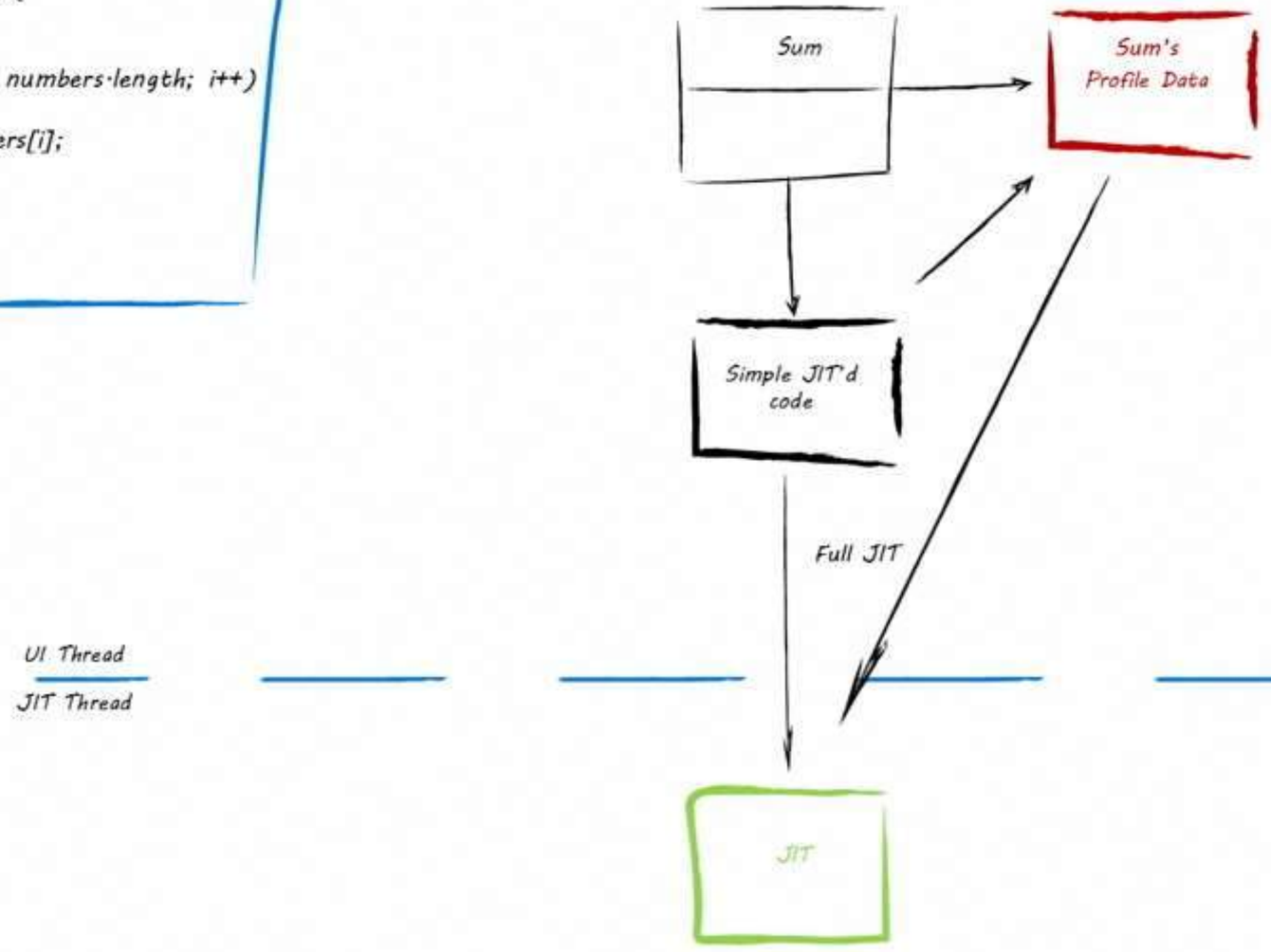



```
total = 0
i = 0

Loop:
    if (isArray(number))
        l = number.length
    else
        l = Js::GetLength(number)

    if (isInt(i) && isInt(l))
        if (i >= l)
            break;
    else
        if (Js::GreaterOrEq(i, l))
            break

    if (isArray(number) && isInt(i)
                && i < number.length)
        n = number.data[i]
    else
        n = Js::GetElementI(number, i);

    if (isInt(n) && isInt(total))
        total += n;
    else
        total = Js::Add(total, n)
    goto Loop

return total
```

Web tech talks Platform

Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```

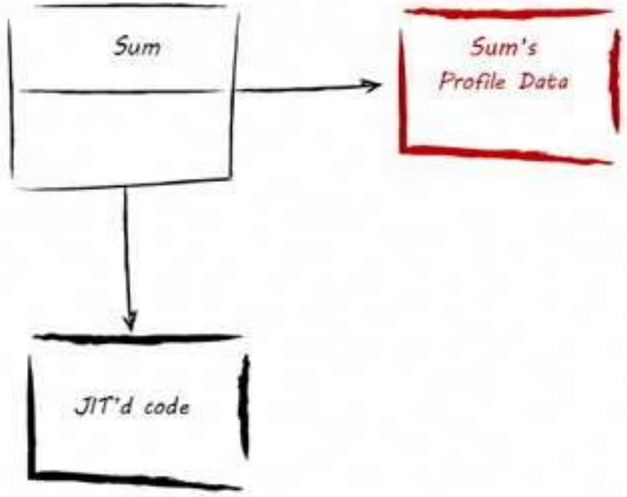



```
total = 0
i = 0

Loop:
    if (isArray(number))
        l = number.length
    else
        l = Js::GetLength(number)

    if (isInt(i) && isInt(l))
        if (i >= l)
            break;
    else
        if (Js::GreaterOrEq(i, l))
            break

    if (isArray(number) && isInt(i)
                && i < number.length)
        n = number.data[i]
    else
        n = Js::GetElementI(number, i);

    if (isInt(n) && isInt(total))
        total += n;
    else
        total = Js::Add(total, n)
    goto Loop

return total
```

Web tech talks Platform

Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```

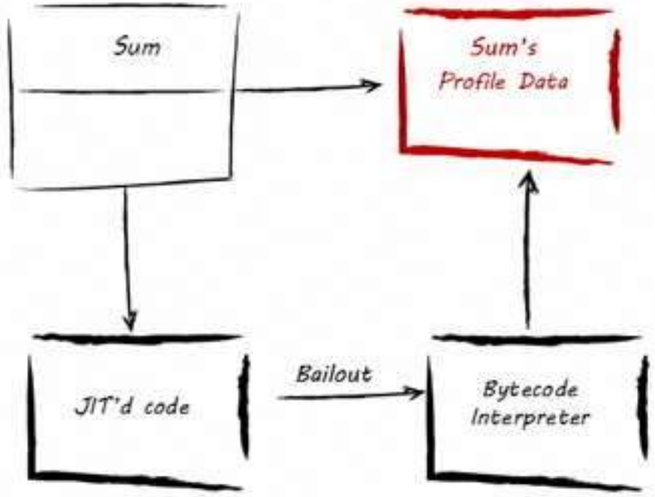



```
total_i = 0

if (!isIntArray(number))
    bailout()

i_i = 0
l = number.length
d = number.data

loop:
    if (i_i >= l)
        break;
    total_i += d[i_i]
    i_i++
    goto loop

total = ToVar(total_i)

return total
```

Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```

```
Sum([1.1, 2.2, 3.3, 4.4, 5.5])
```



Bytecode

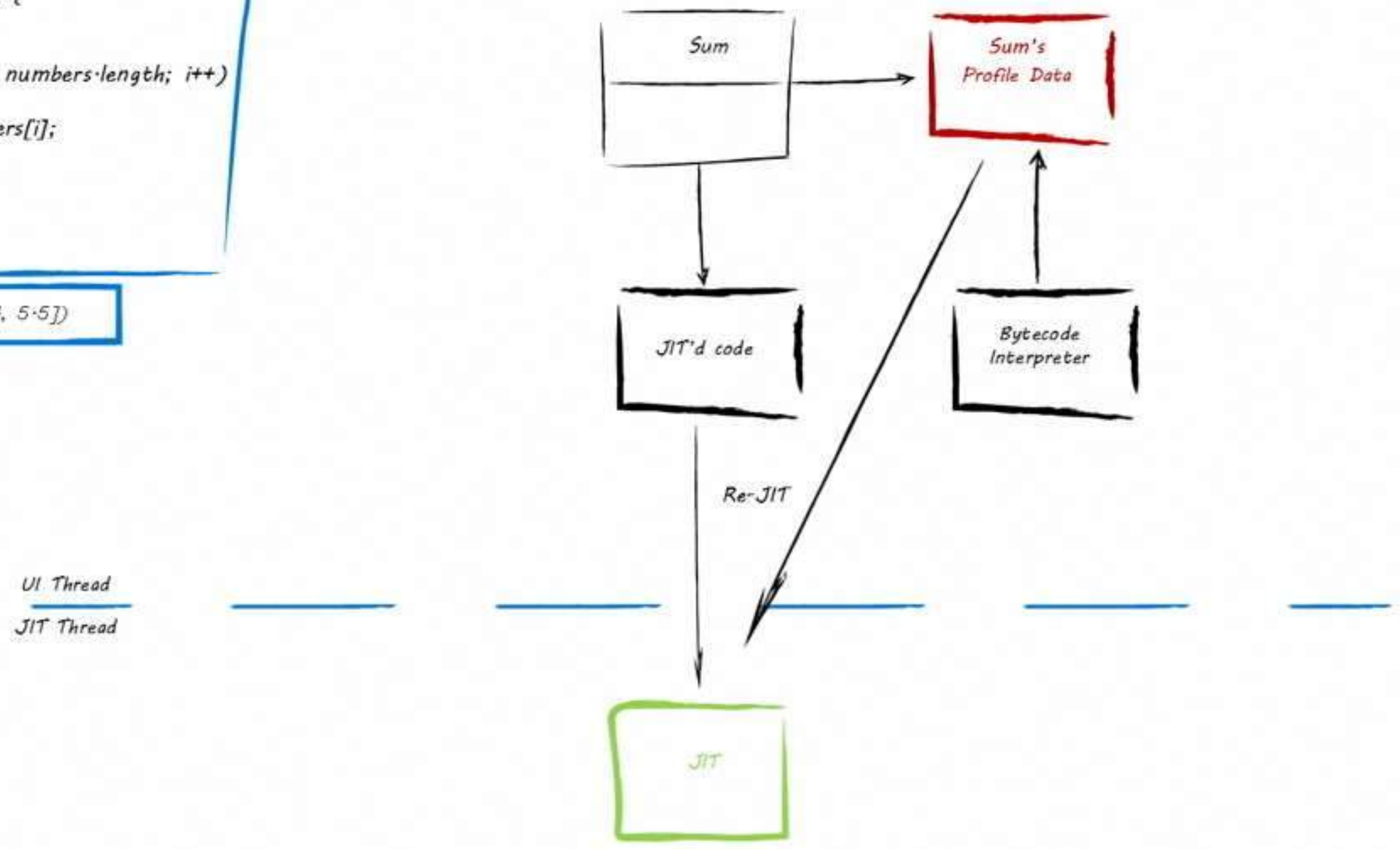
```
R1 LdRoot
R2 LdC_A_I4   0
R3 LdC_A_I4   1
R4 ArgIn_A    In1
LdUndef       R6
Ld_A          R5  R2
Ld_A          R6  R2
LoopStart:
  LdLen_A     R7 = R4.length
  BrGe_A      LoopEnd  R6  R7
  LdElemI_A   R7 = R4[R6]
  Add_A       R5  R5  R7
  Incr_A      R6  R6
  Br          LoopStart
LoopEnd:
Ld_A          R0  R5
Ret           R0
```

Web tech talks Platform

Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```

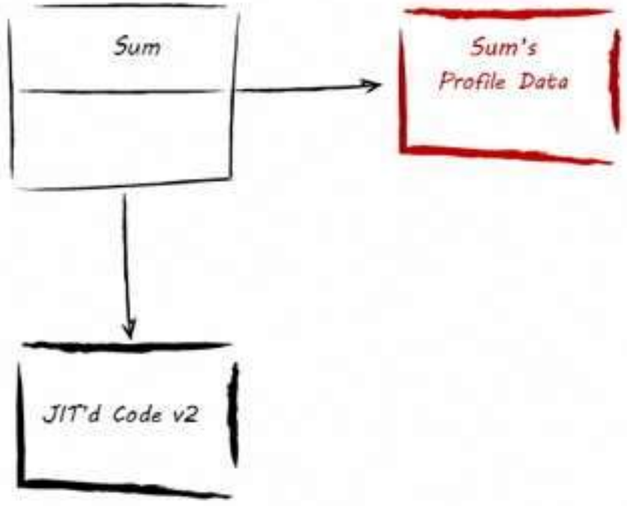
```
Sum([1.1, 2.2, 3.3, 4.4, 5.5])
```



Lifecycle of code

```
function Sum(numbers) {
    var total = 0;

    for (var i = 0; i < numbers.length; i++)
    {
        total += numbers[i];
    }

    return total;
}
```

```
Sum([1.1, 2.2, 3.3, 4.4, 5.5])
```




```
total_f = 0.0

if (!isArray(number))
    bailout()

i_i = 0
l = number.length
d = number.data

loop:
    if (i_i >= l)
        break;

    n = d[i_i]

    if (!isNumber(n))
        bailout()
    n_f = ToFloat(n)

    total_f += n_f

    i_i++
    goto loop

total = ToVar(total_f)

return total
```