Compiler M(ang)o

Project Report

YurongYou ACM 2014

Features & Basic Info

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Overview

OverView

.mx
source code

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CST

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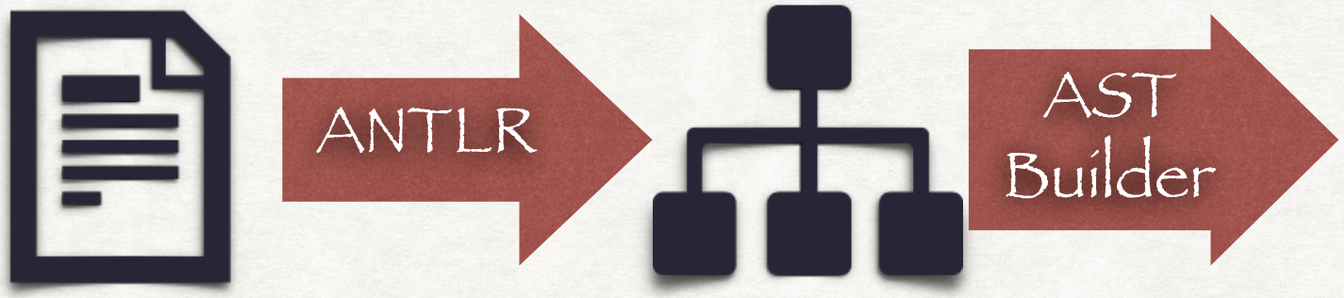

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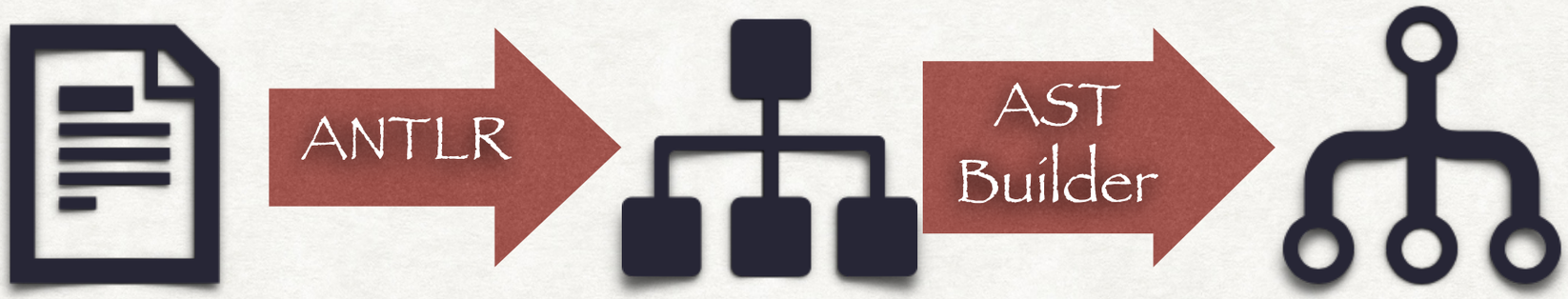

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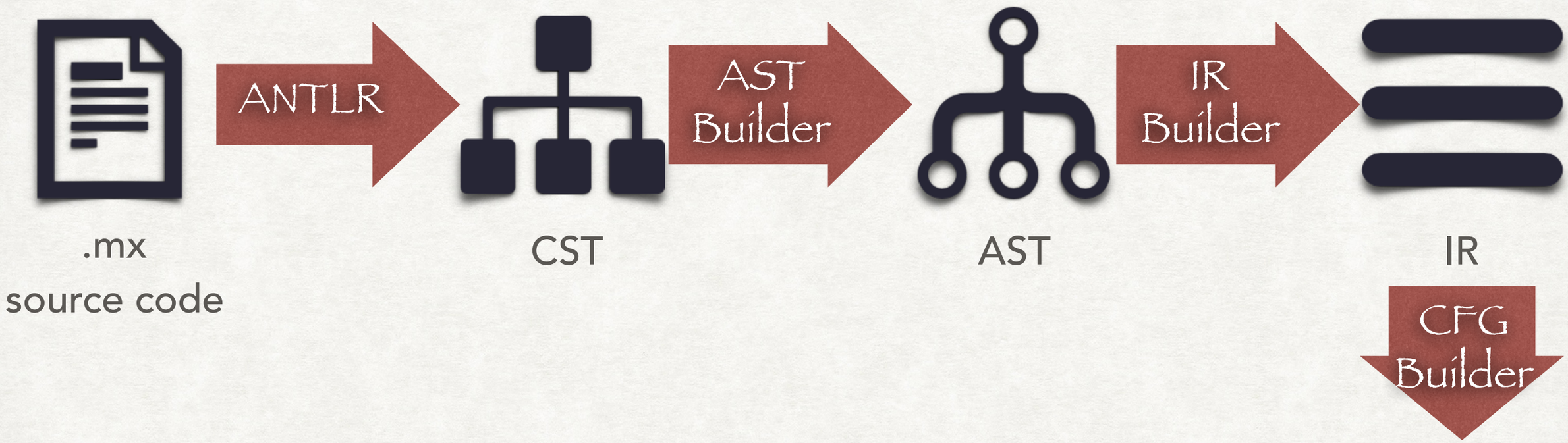
ANTLR
AST Builder
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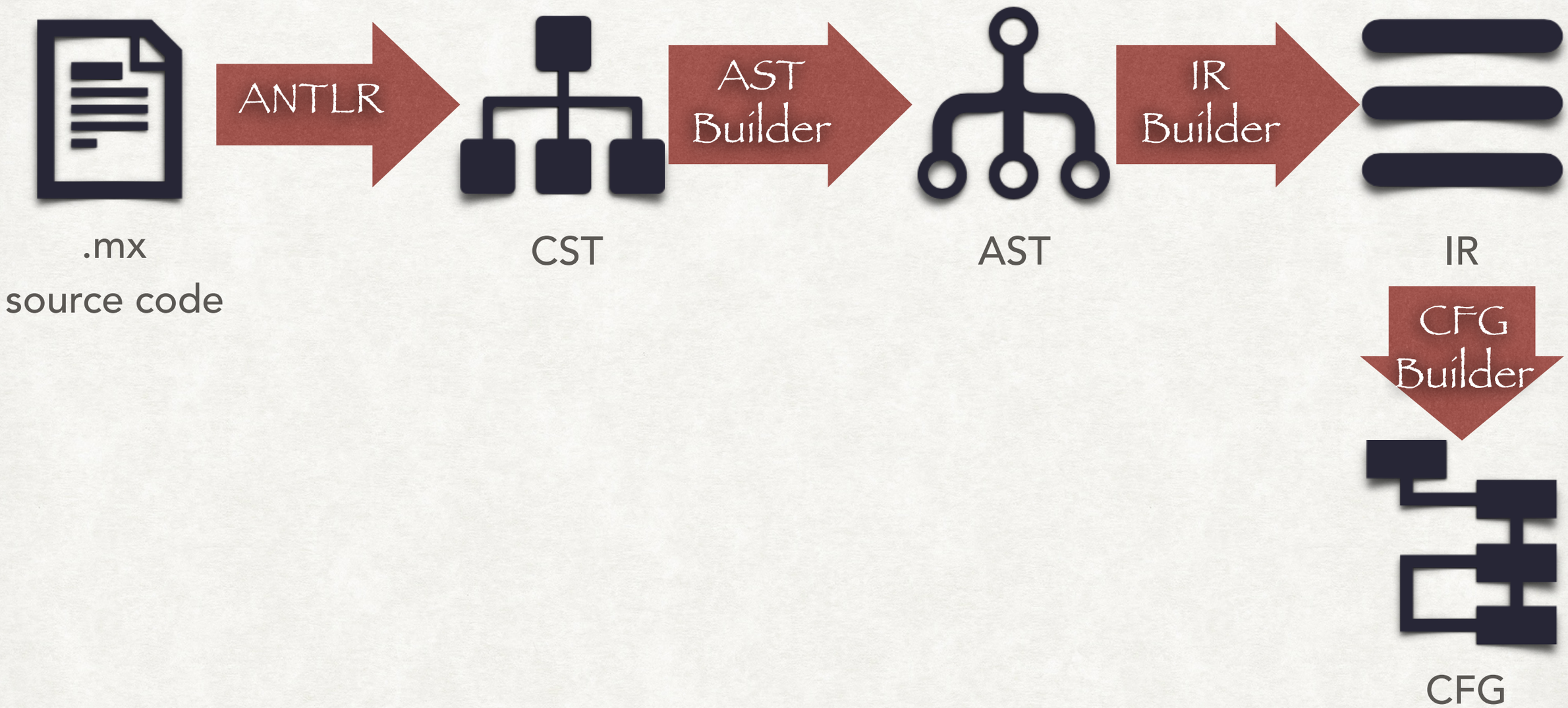
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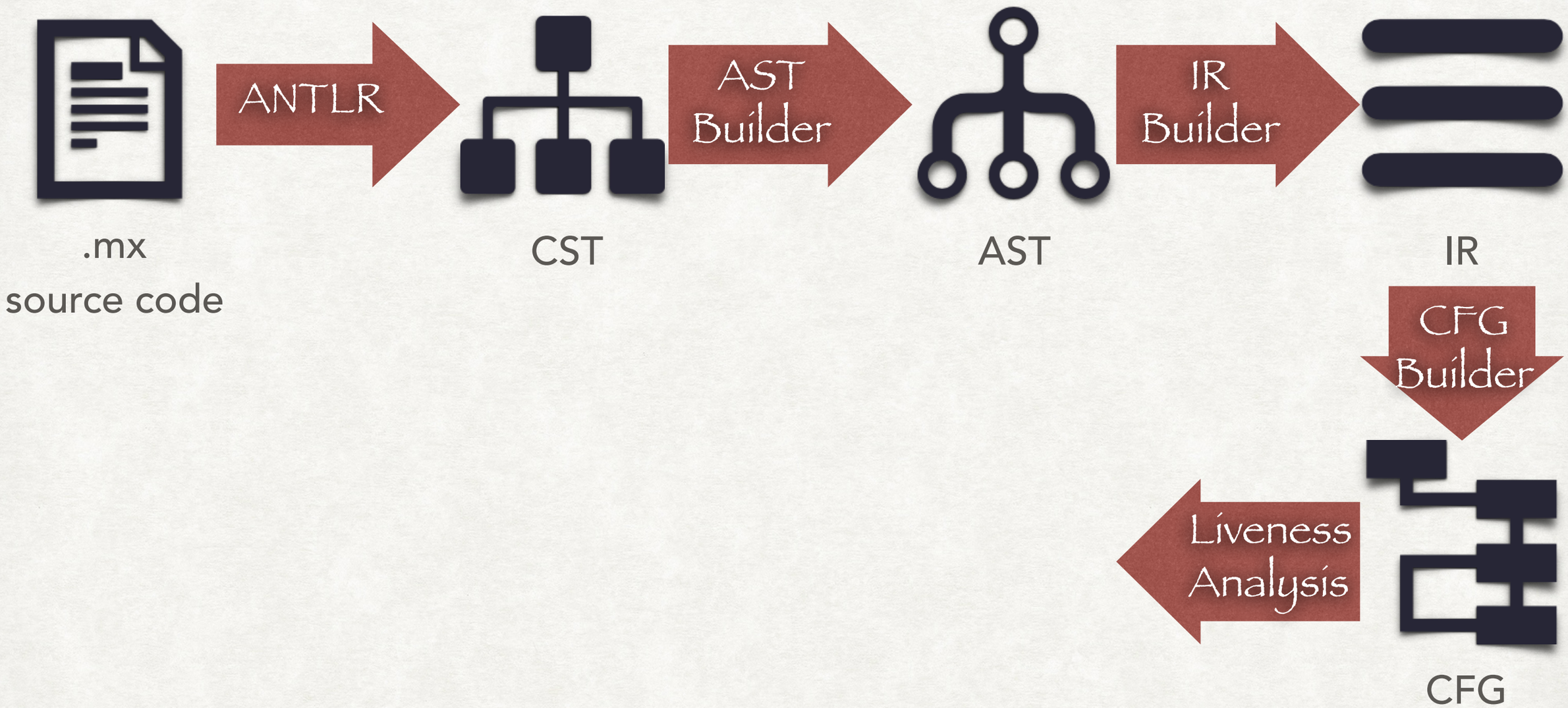
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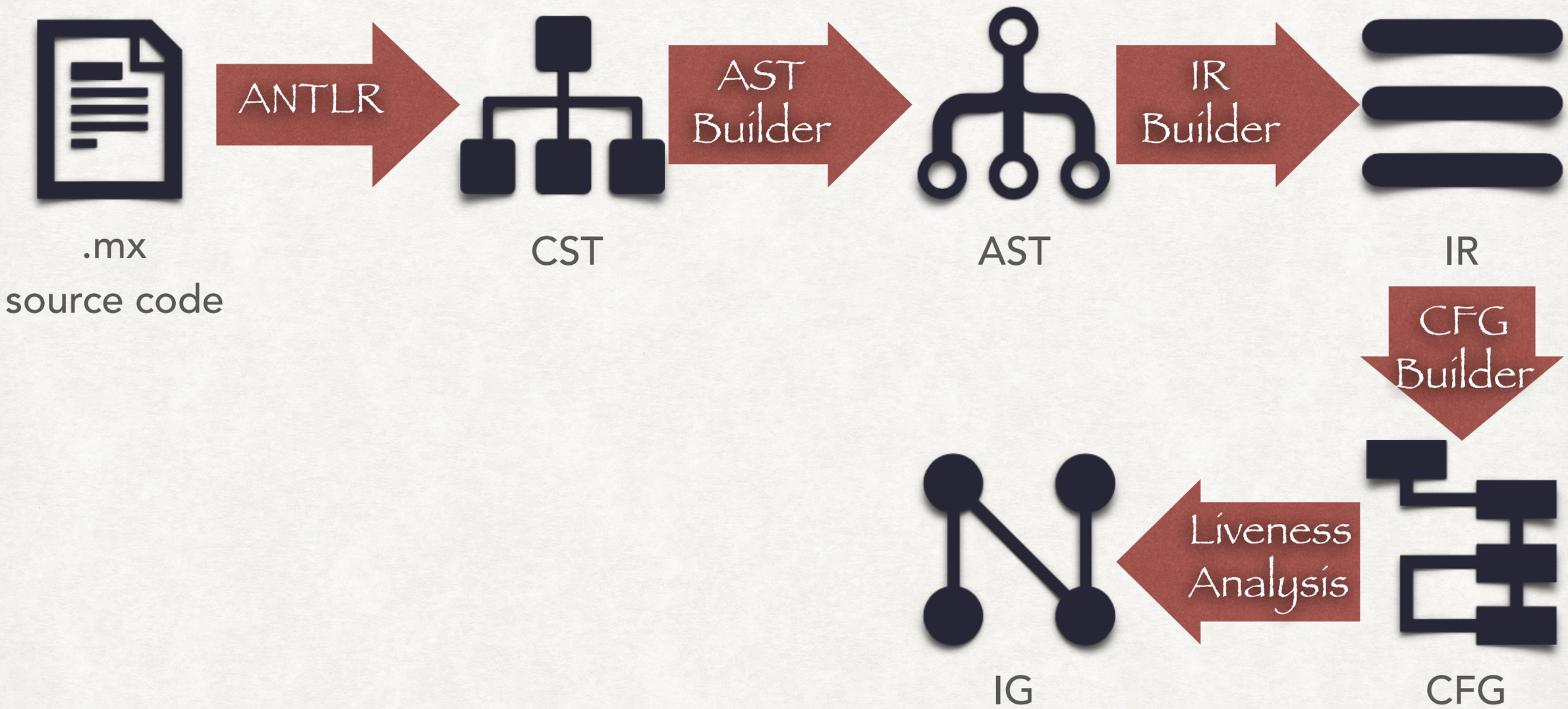
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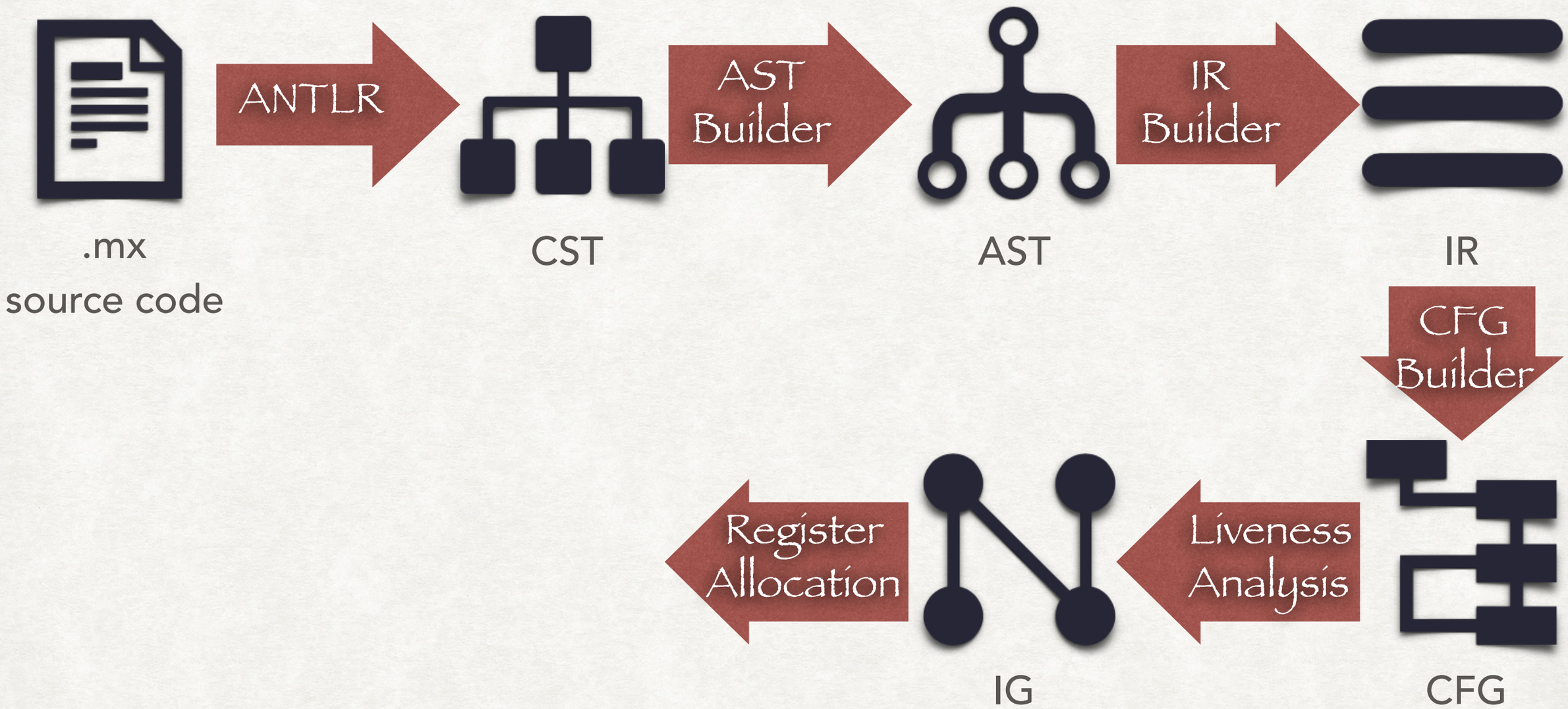
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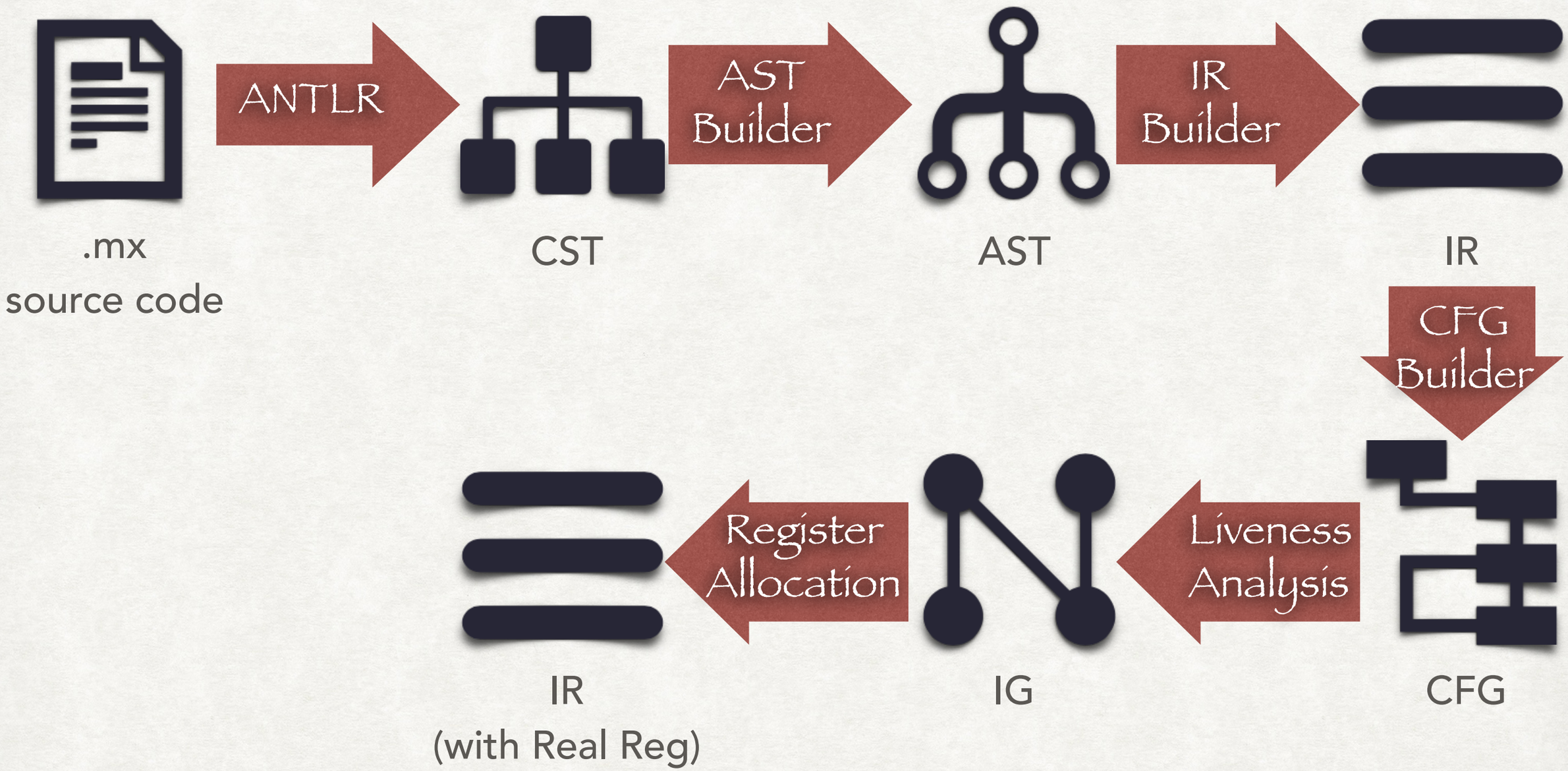
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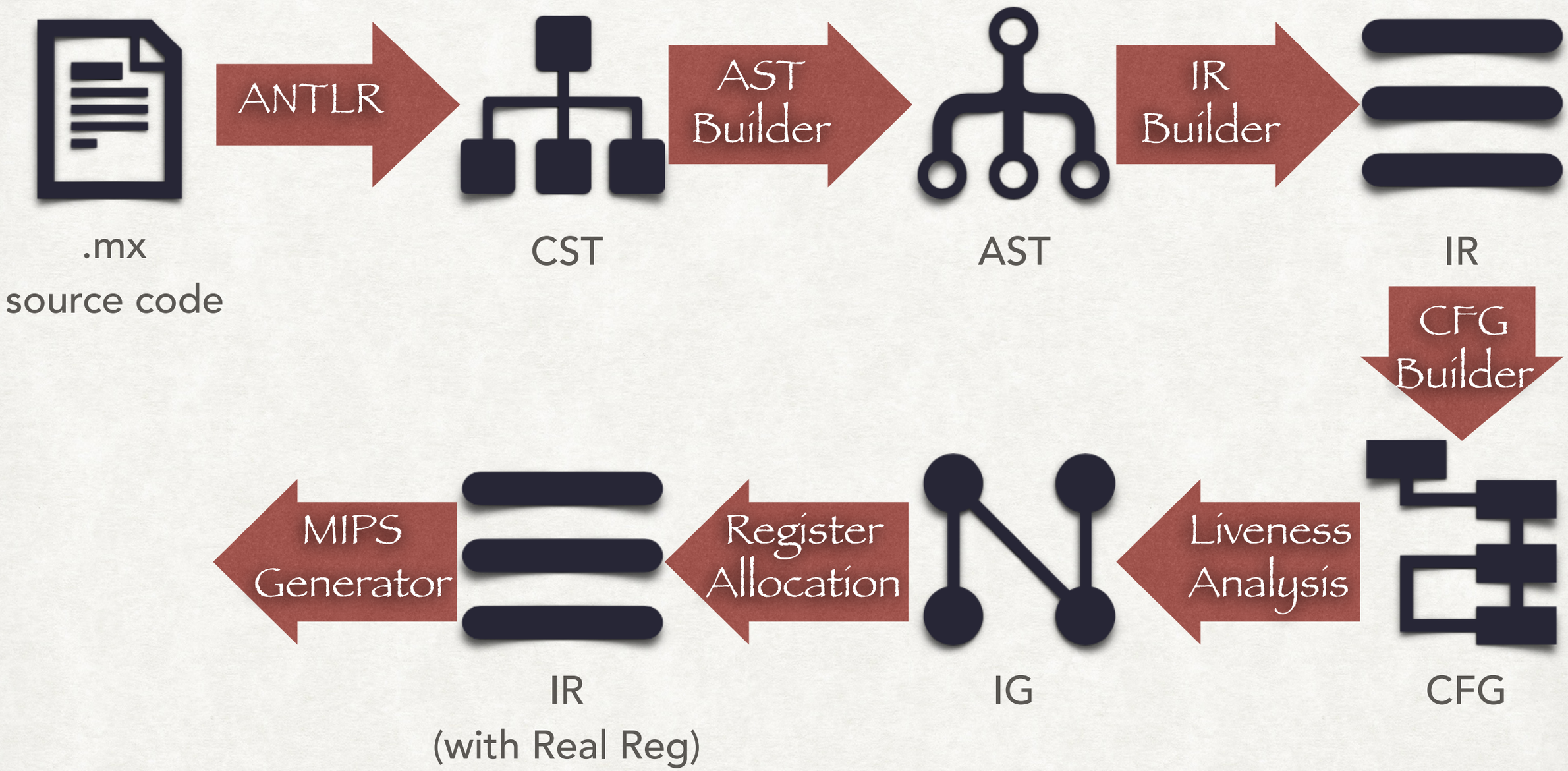
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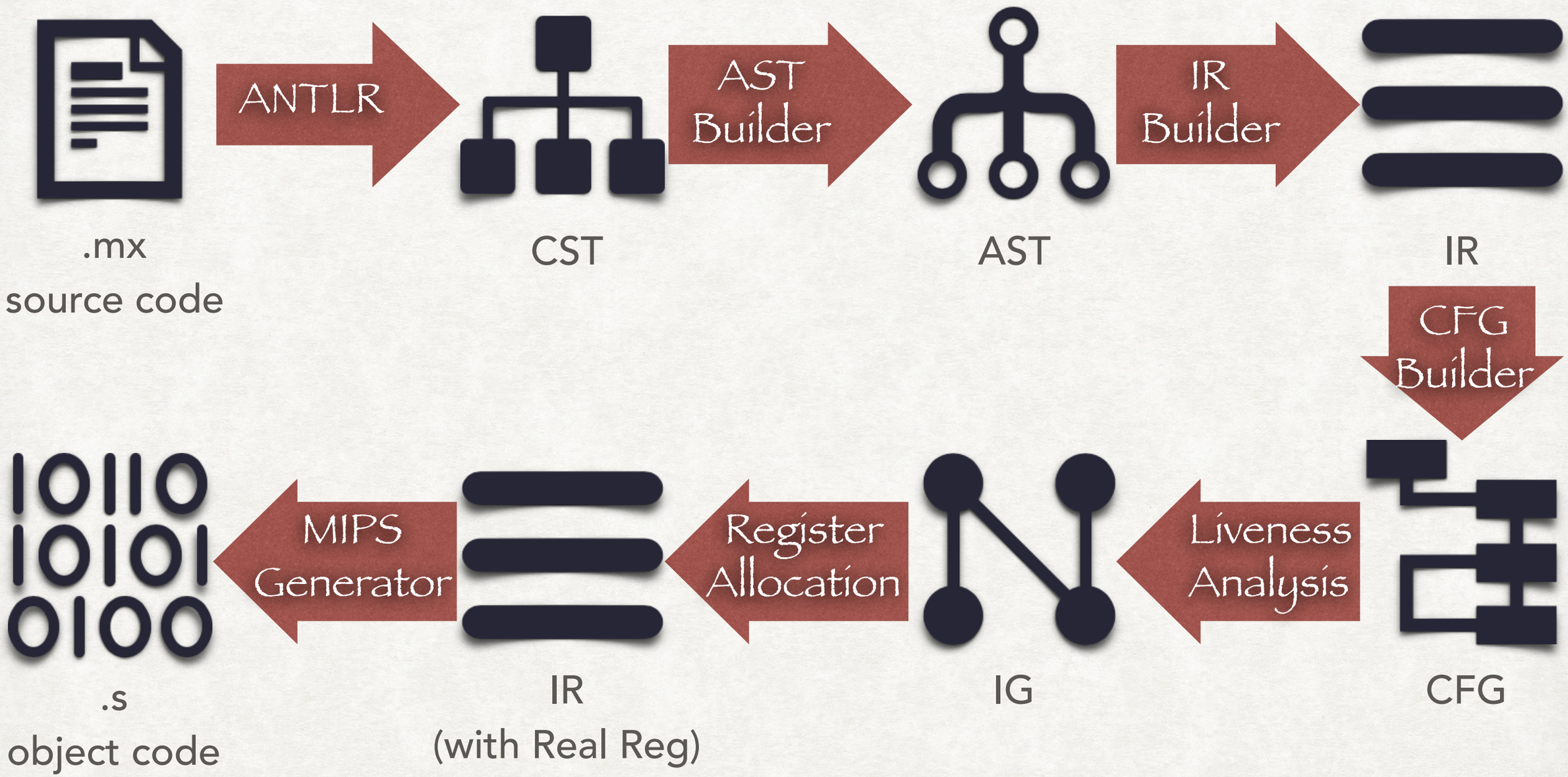
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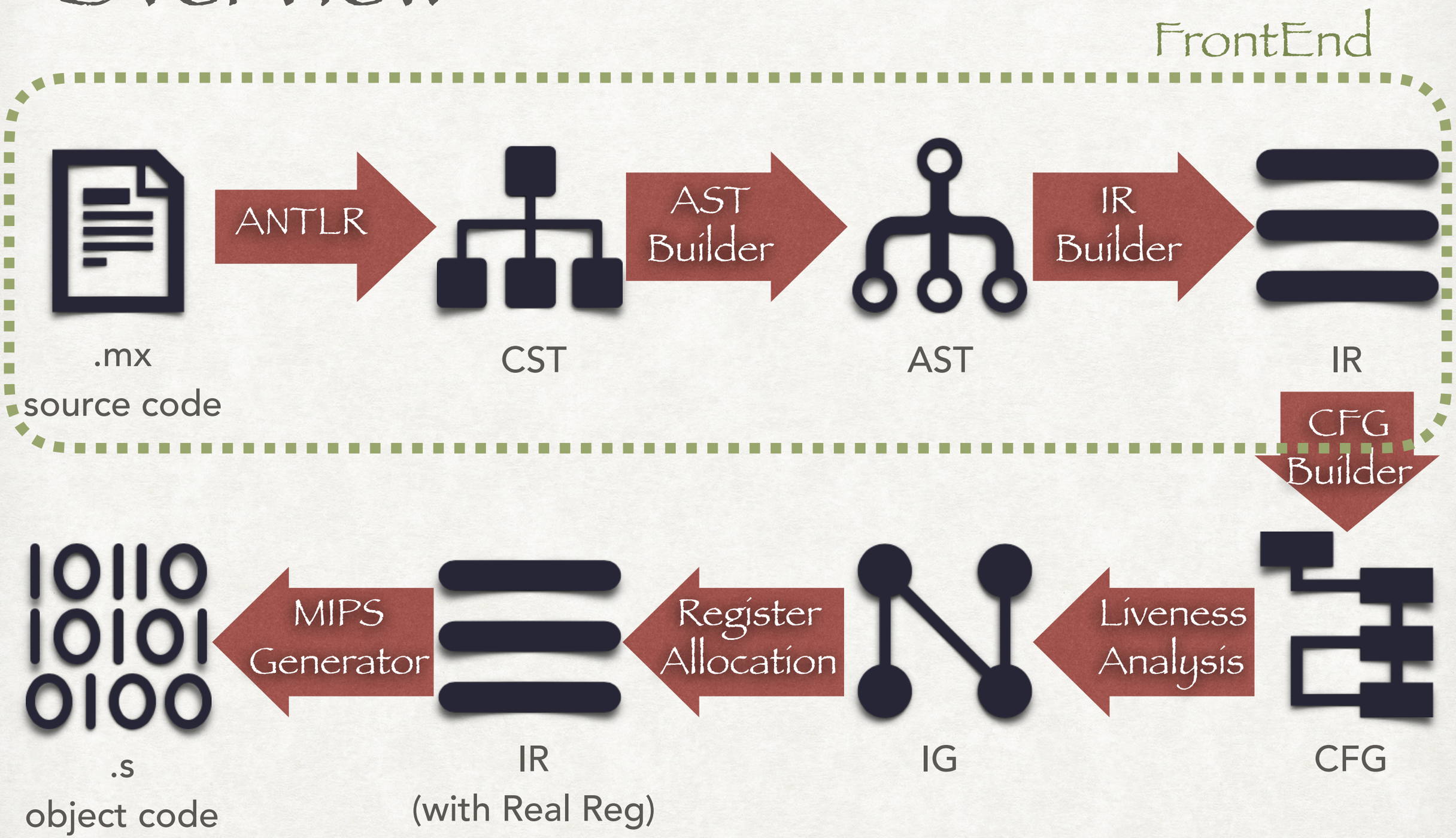
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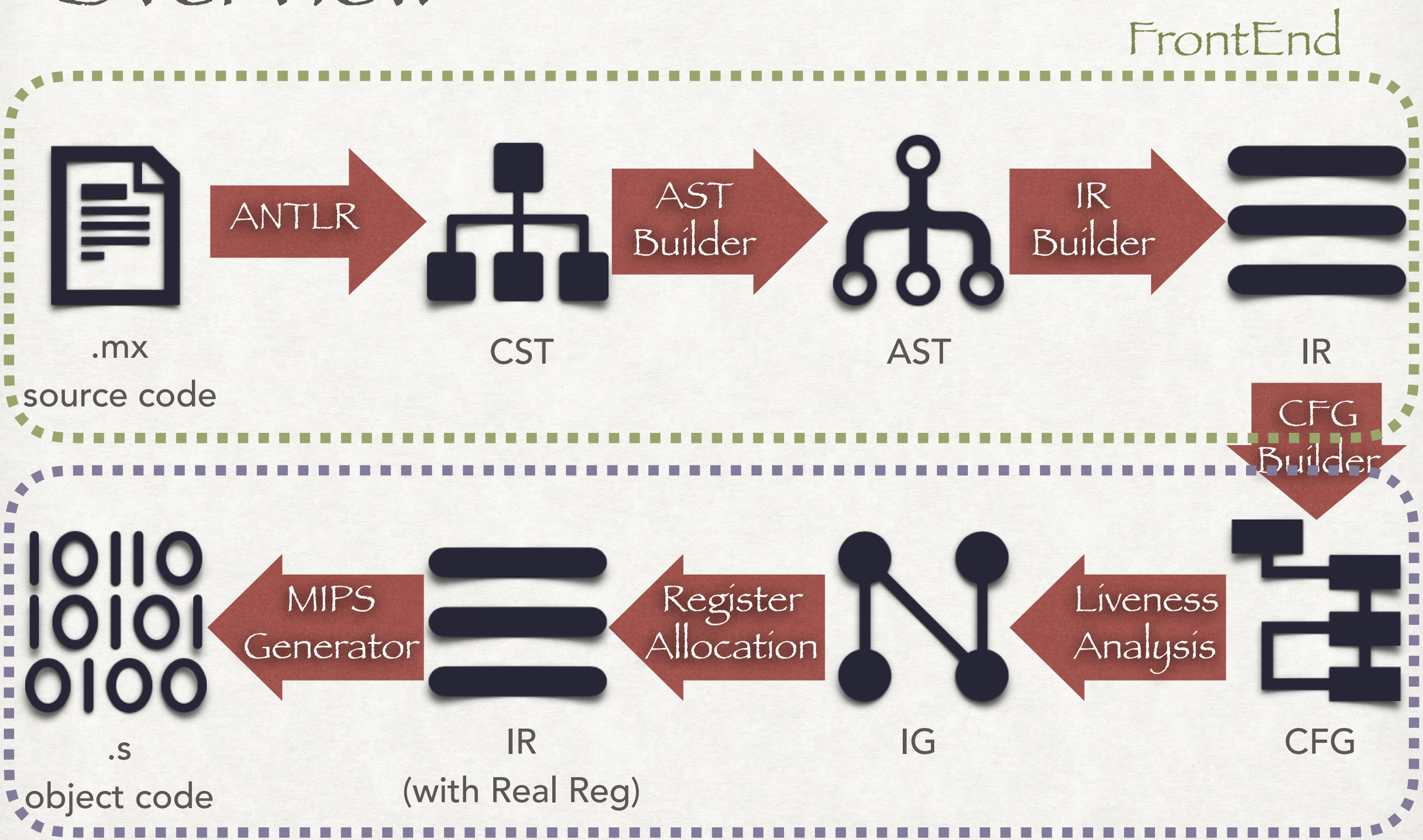
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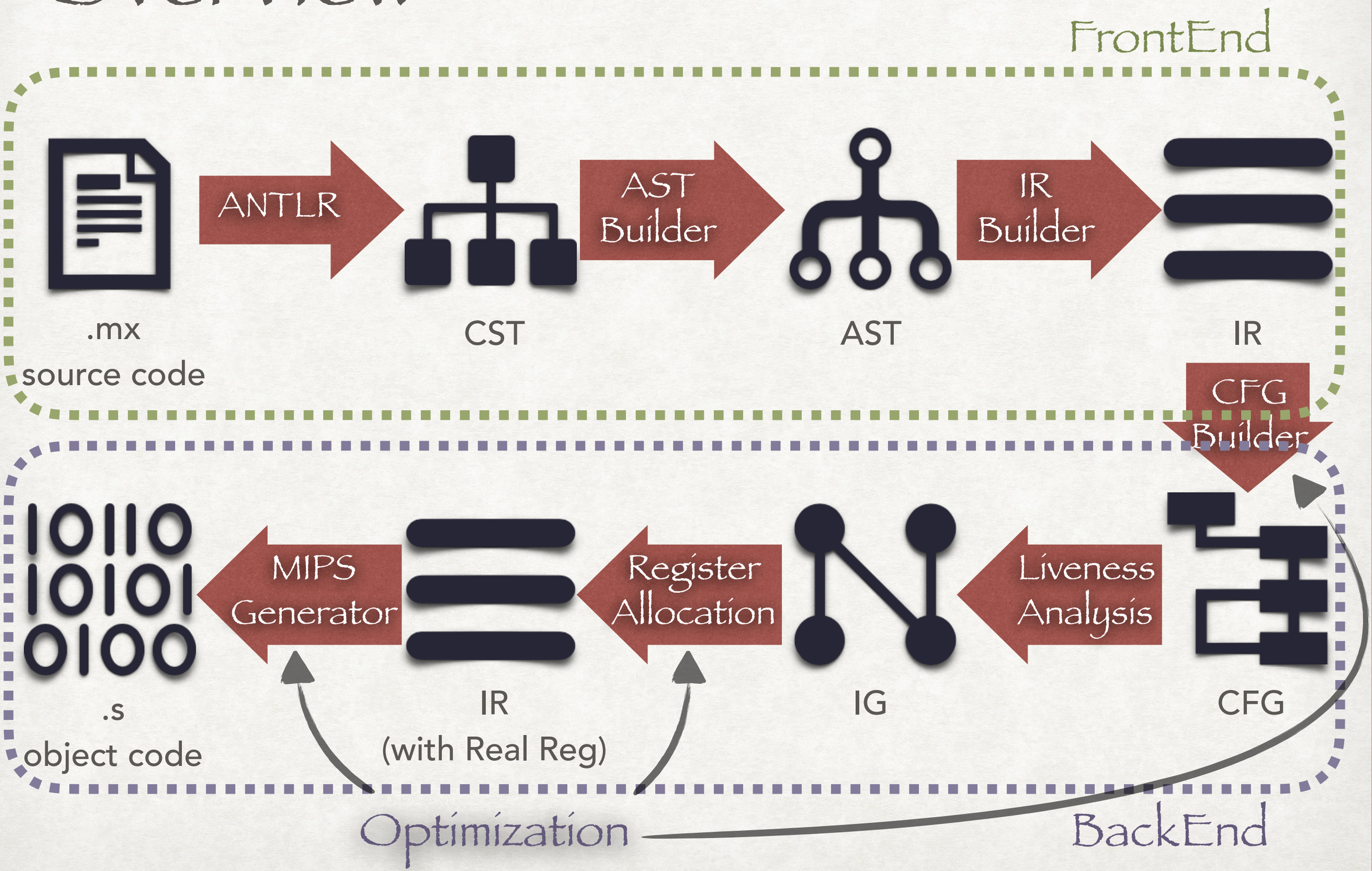
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    '(' expr ')'                                  # Bracket
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    | ID                                          # IDLeaf
    | expr op = (PPLUS|MMINUS)                    # SelfOpPost
    | ID '(' exprList? ')'                        # Call
    | expr '[' expr ']'                           # Index
    | expr '.' ID                                 # FieldAccess
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    | op = (PPLUS|MMINUS) expr                    # SelfOpPre
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    | creationExpr                                # Creation
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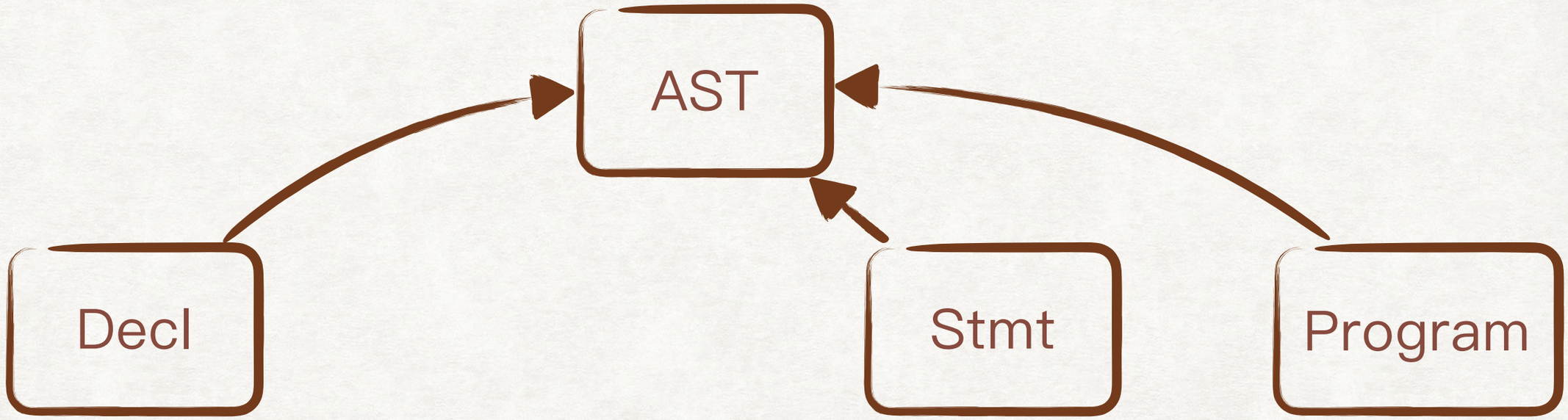

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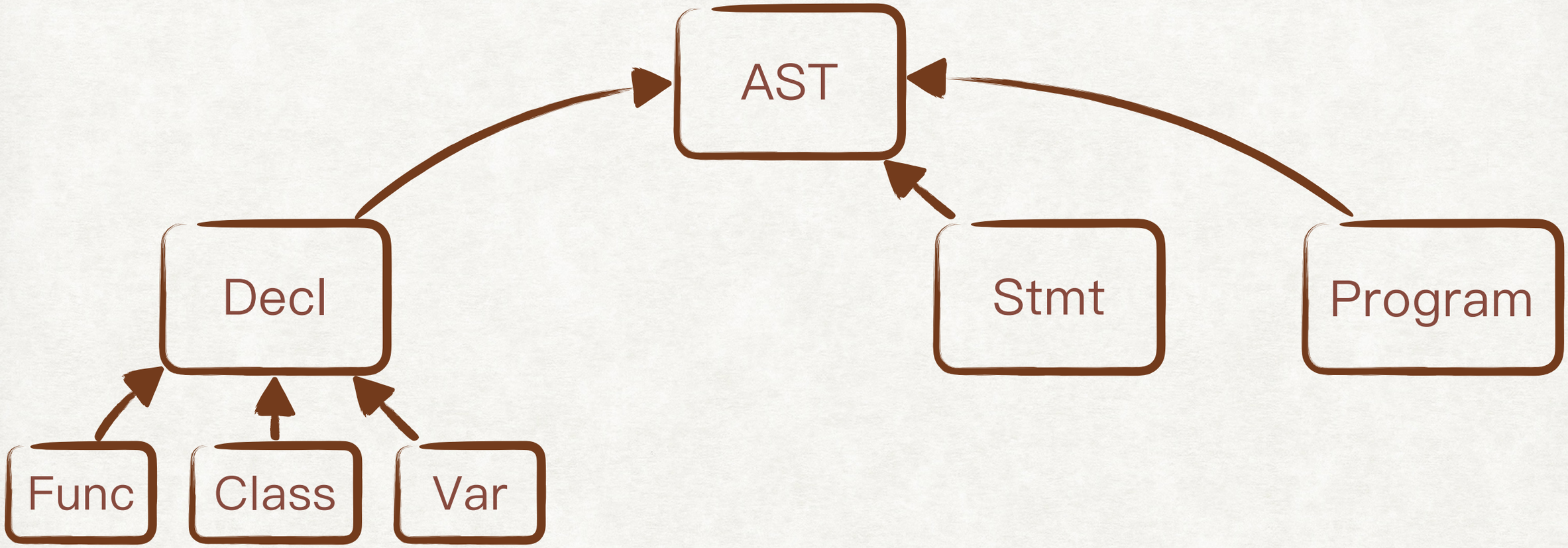

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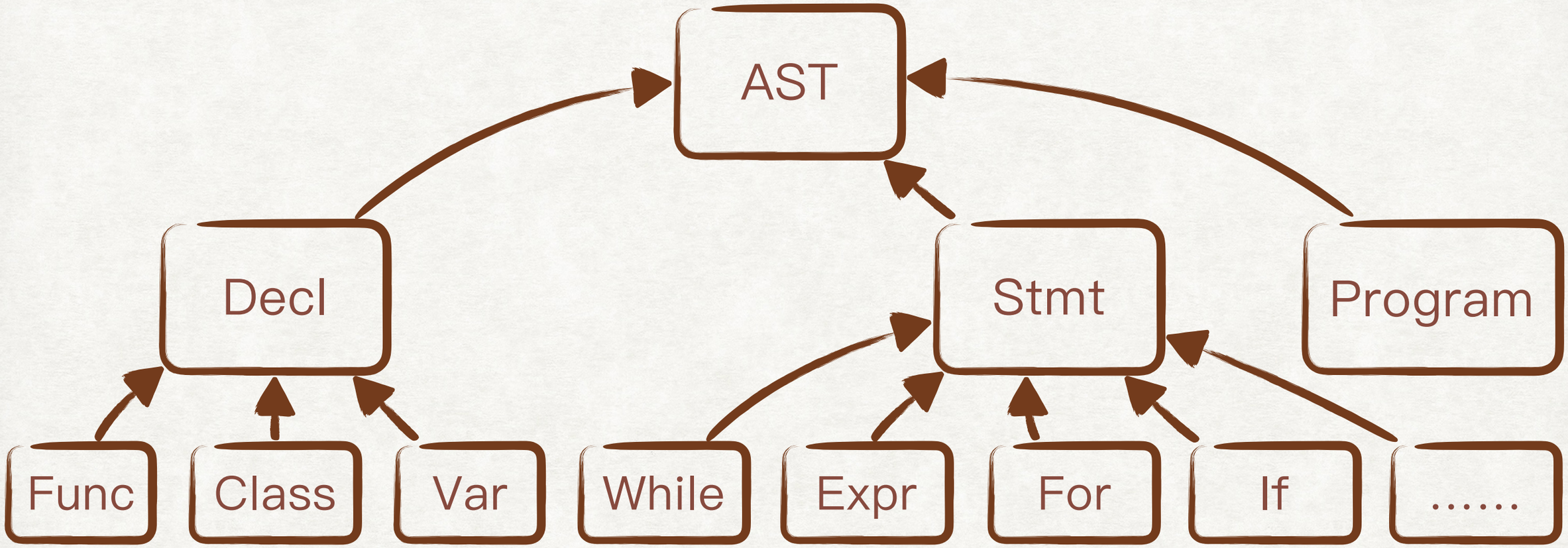

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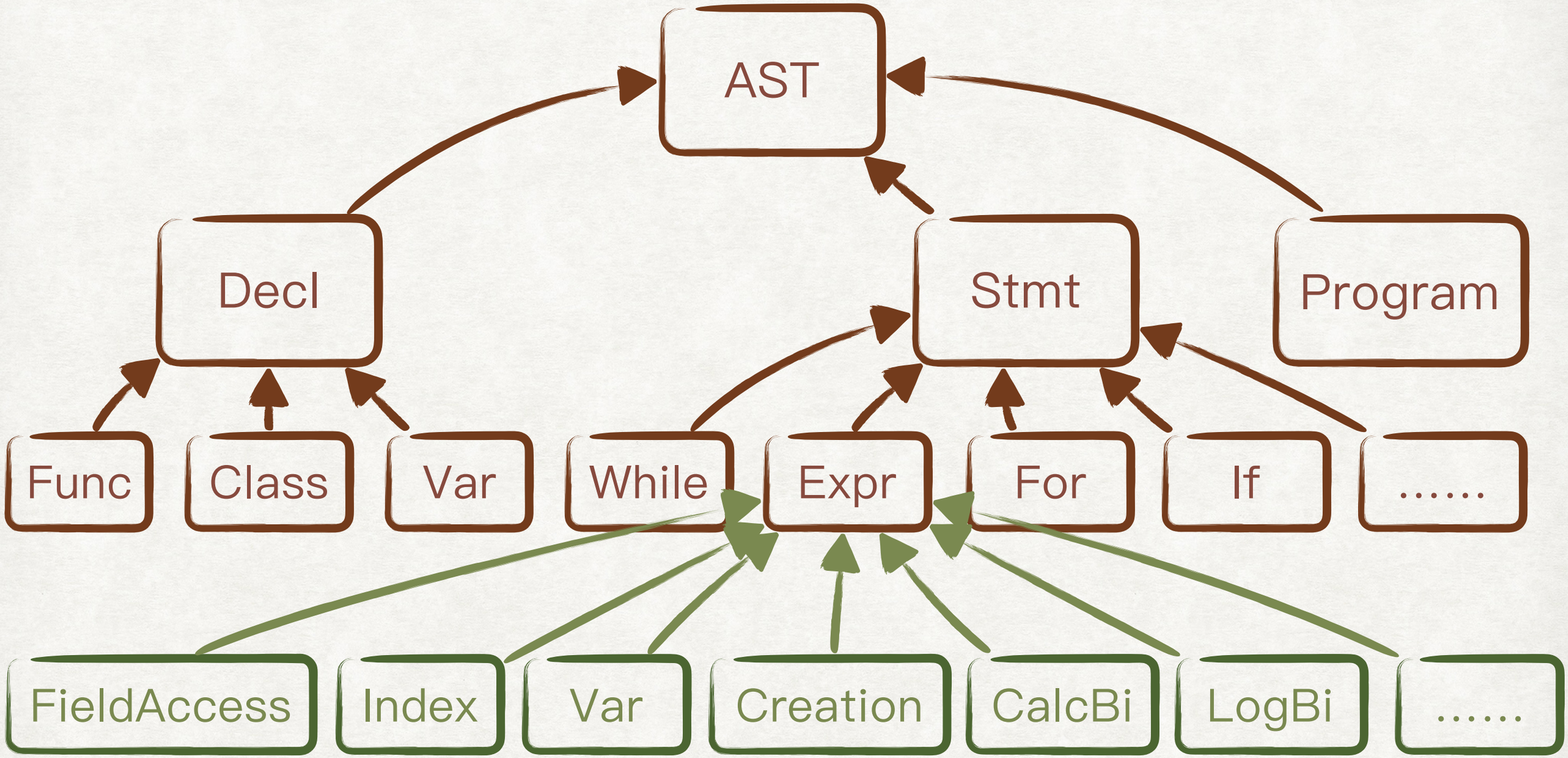

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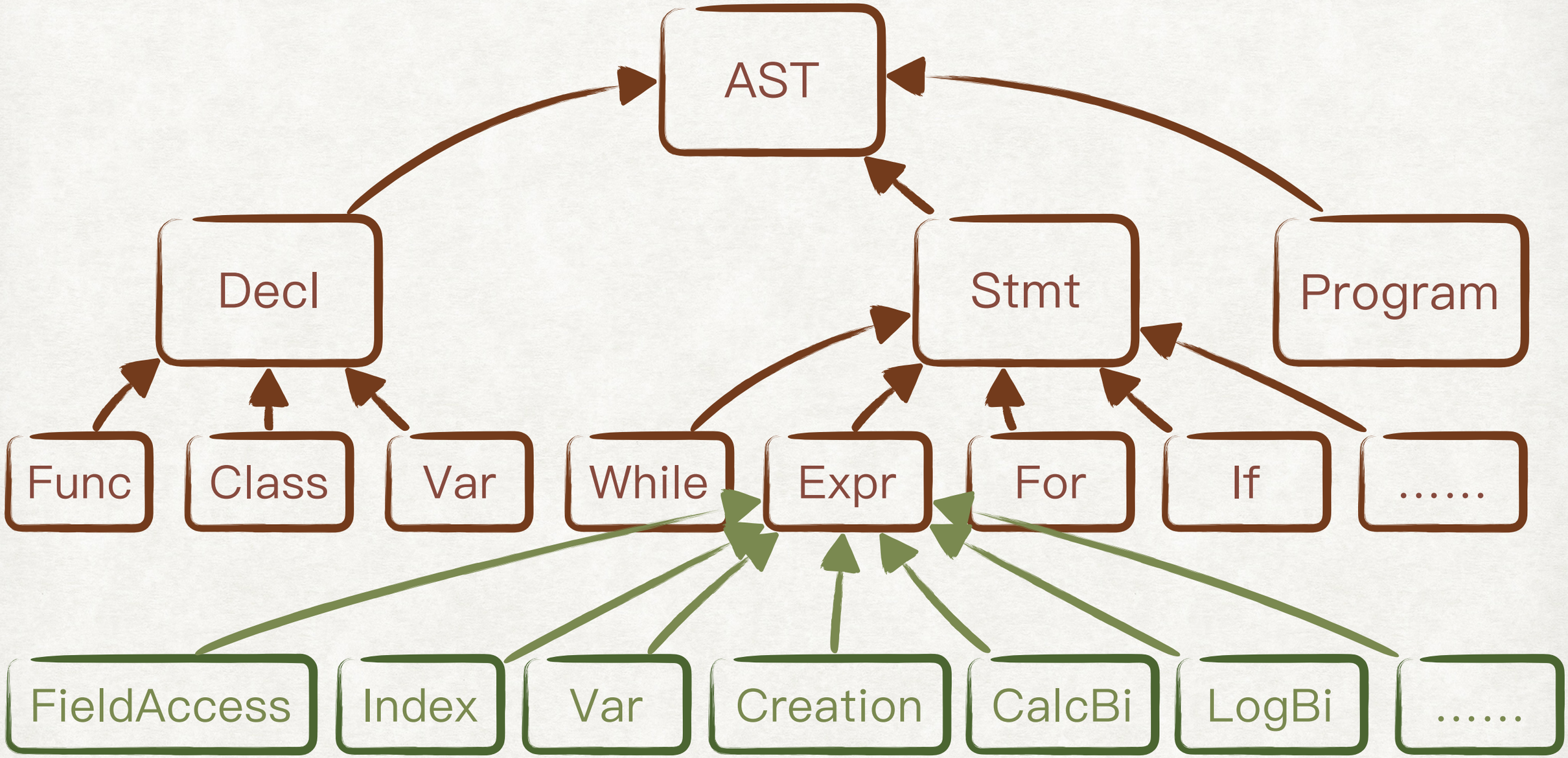

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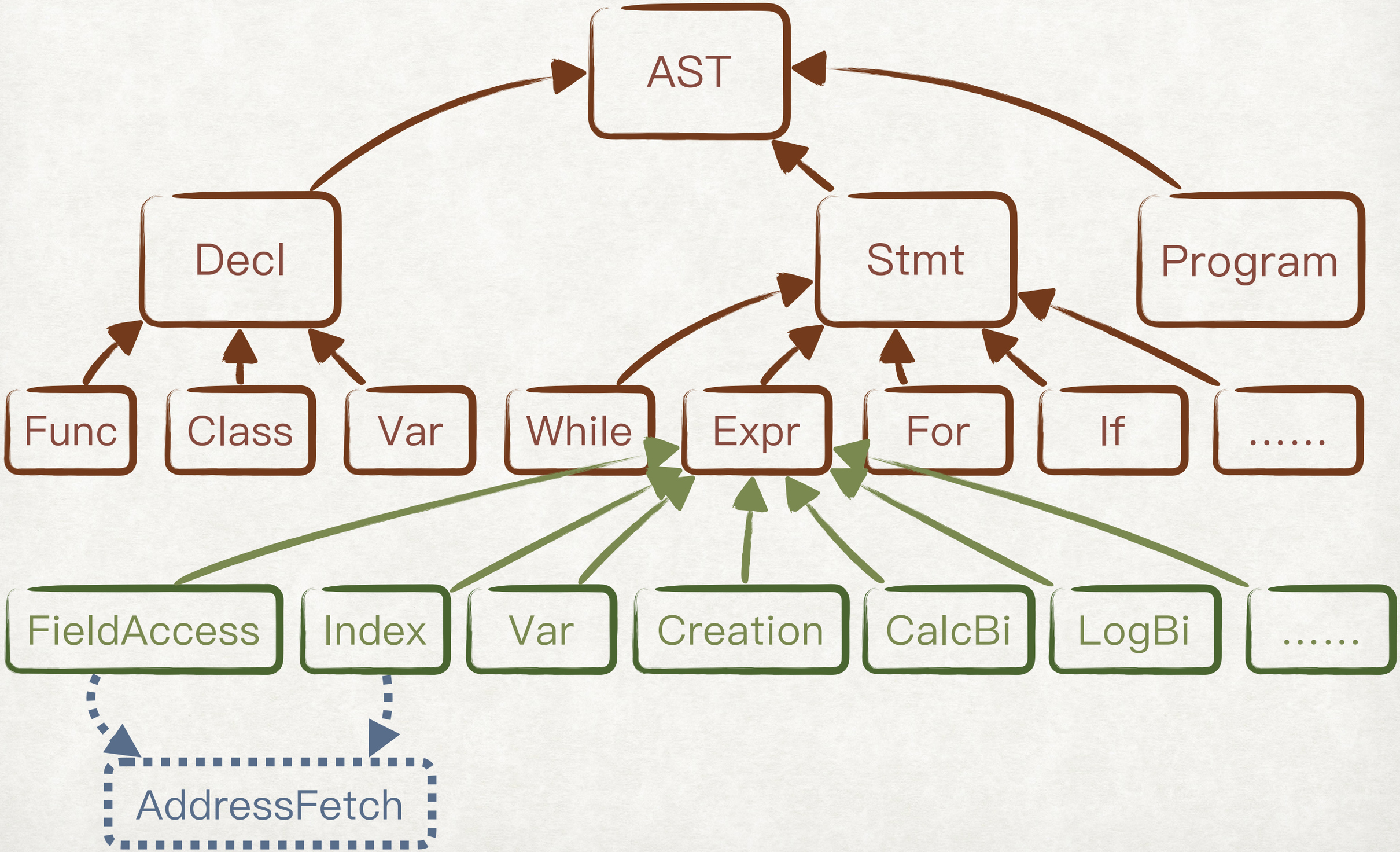

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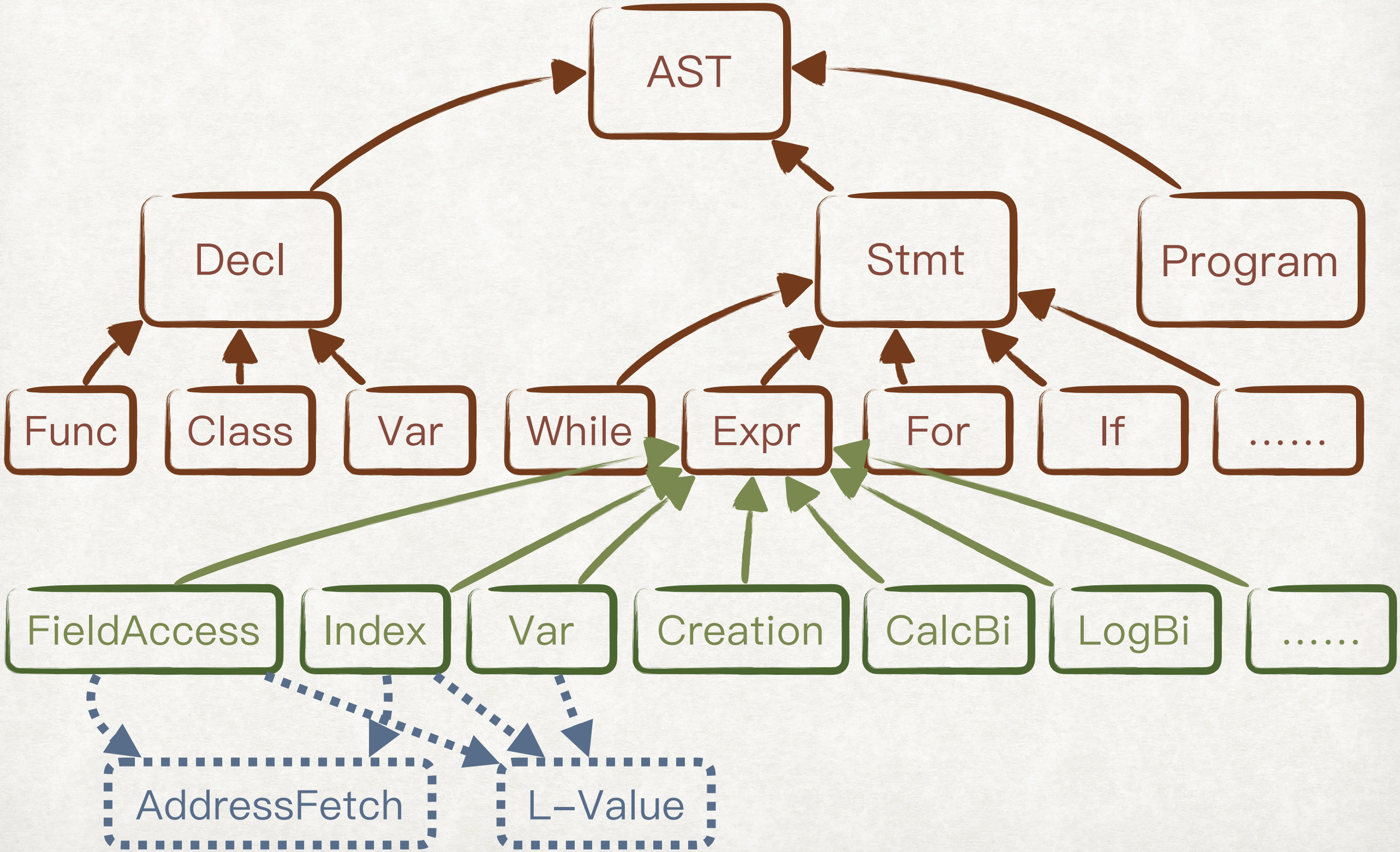

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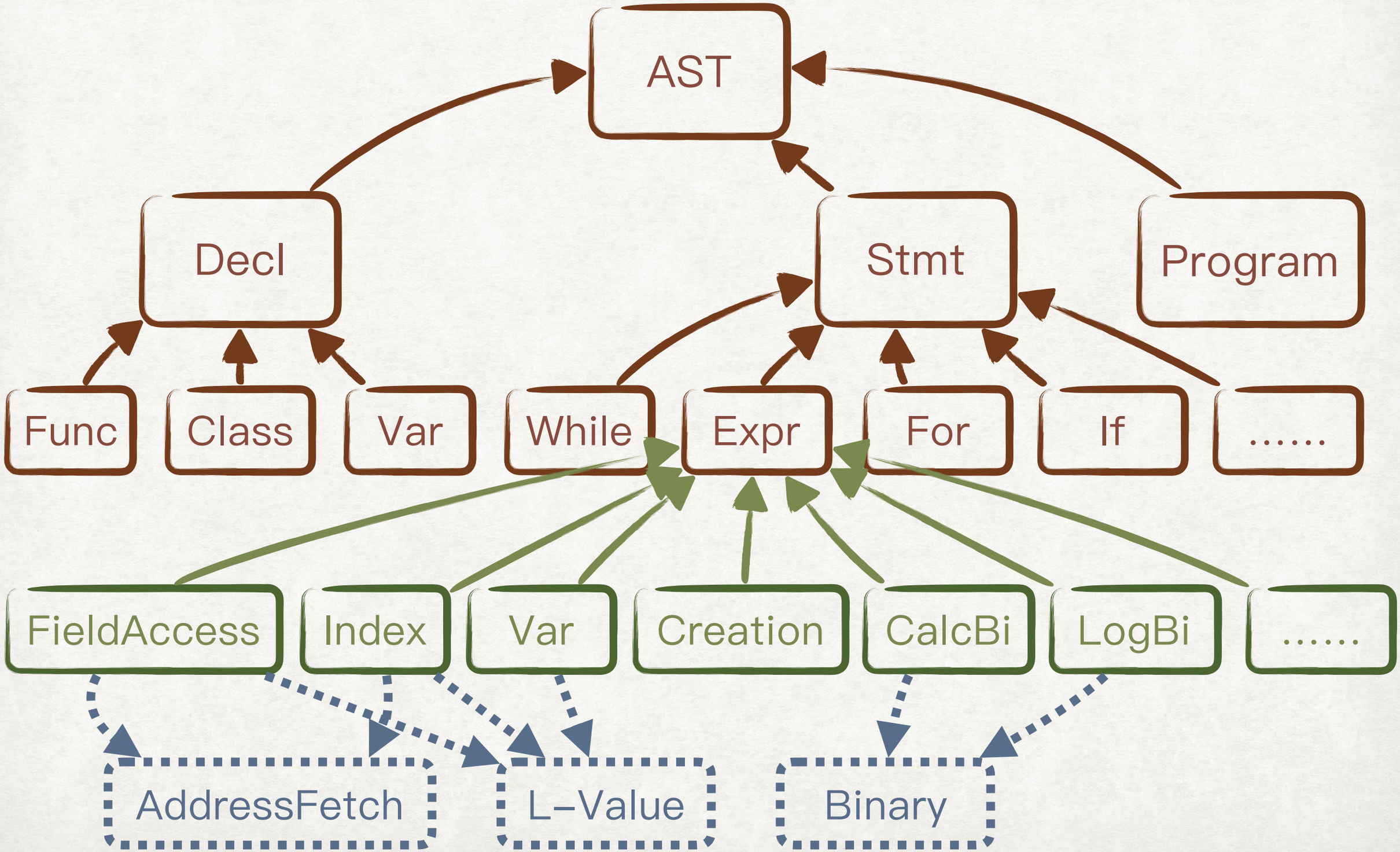

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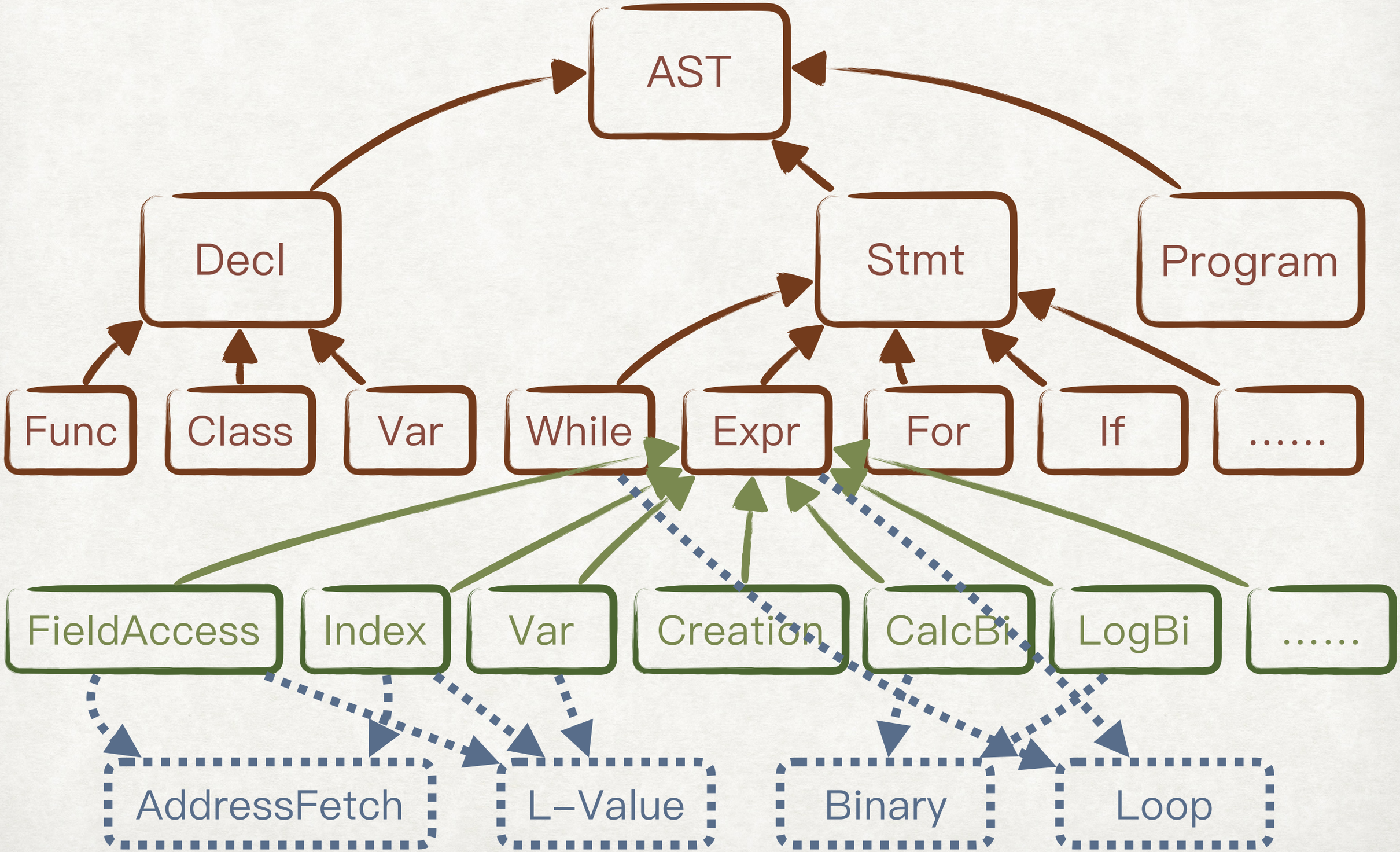

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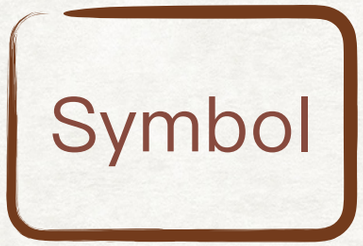

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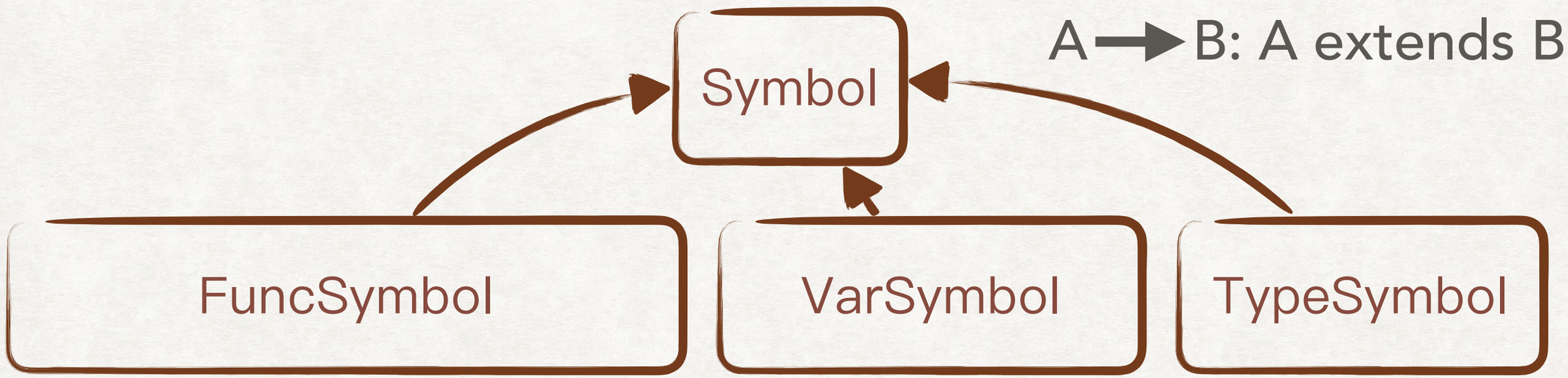

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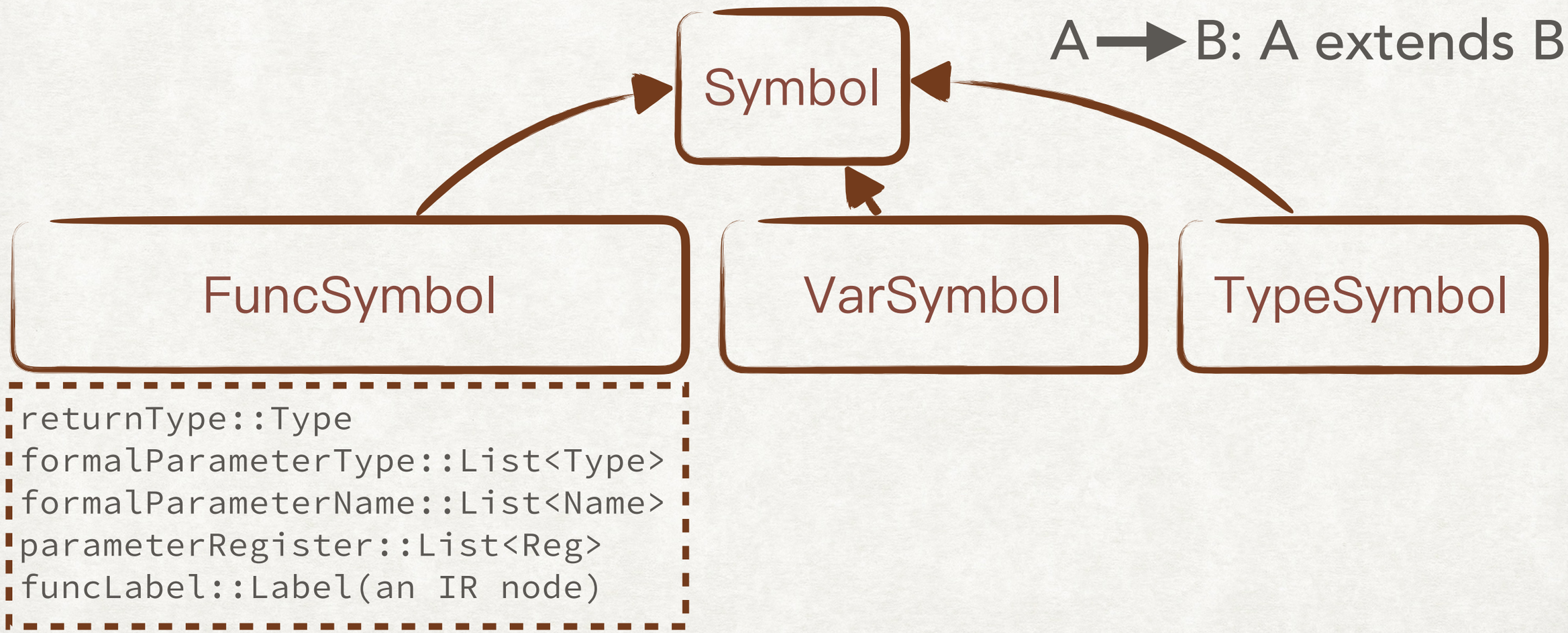

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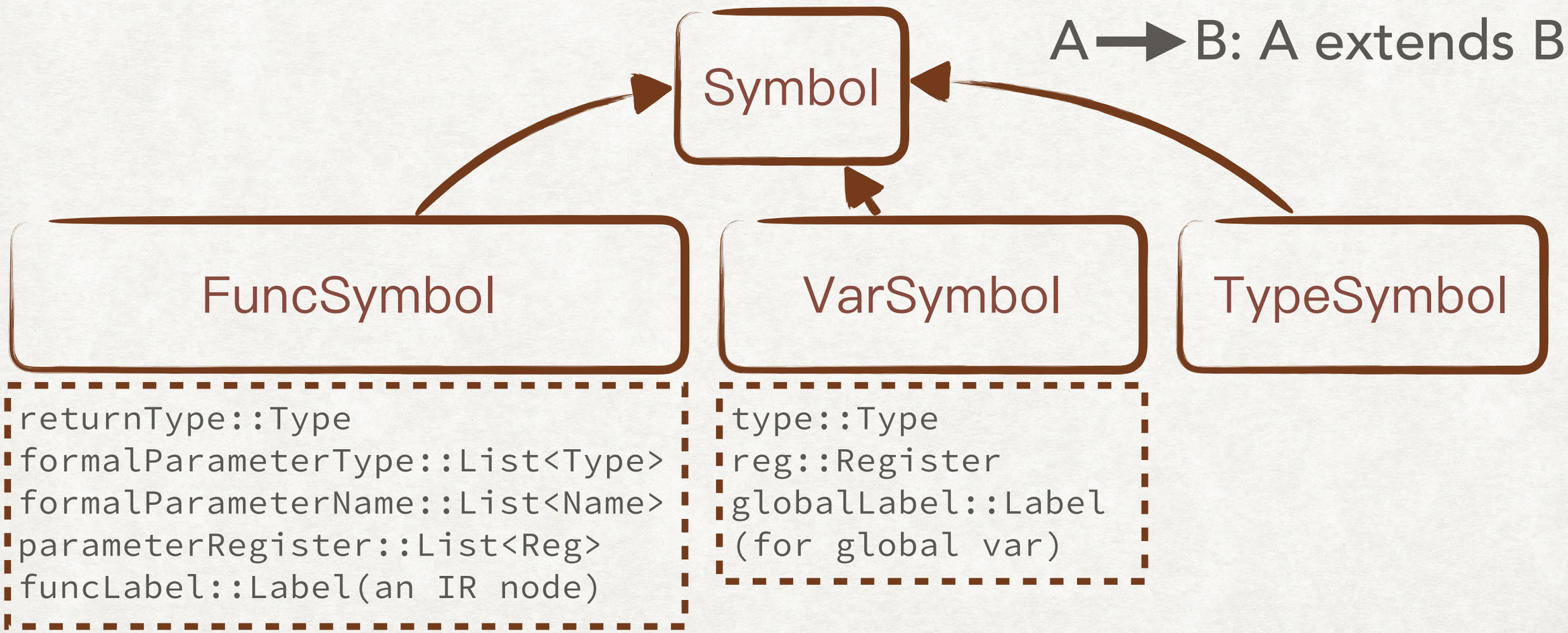

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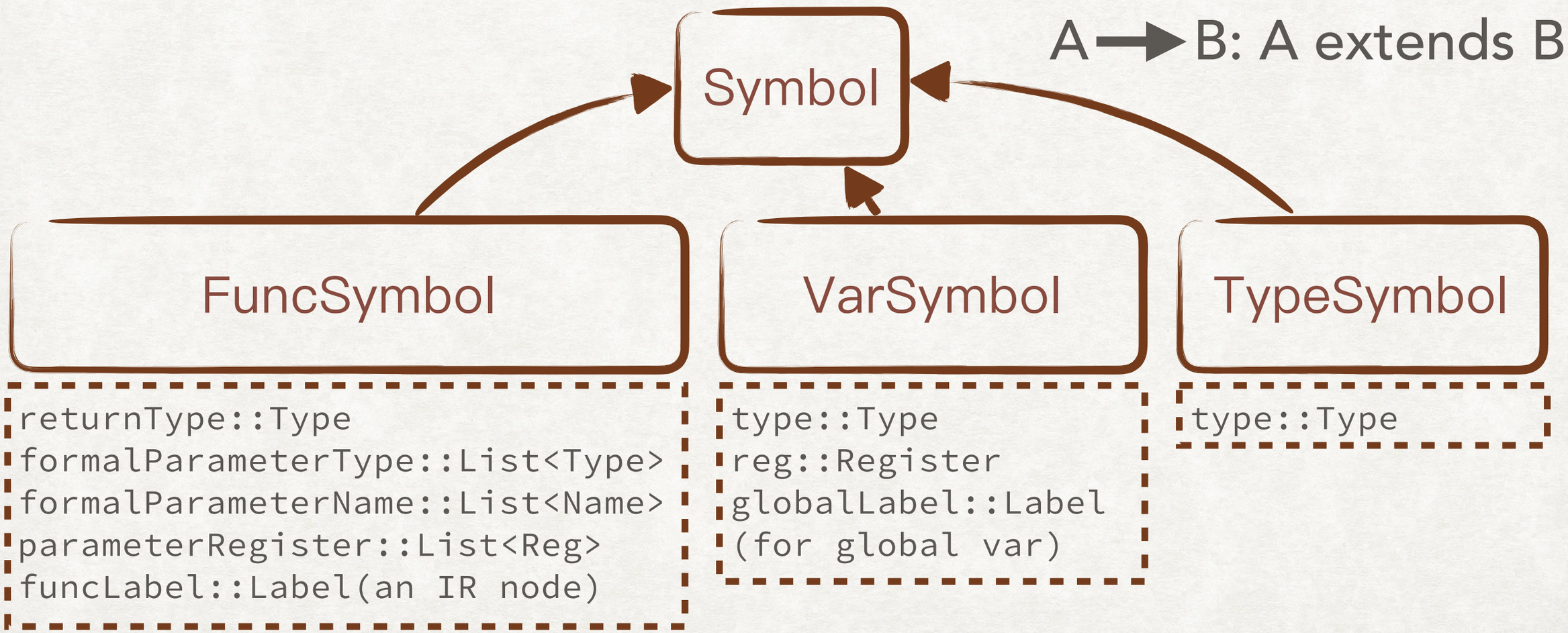

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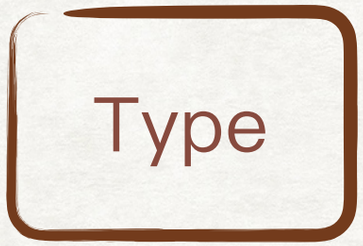

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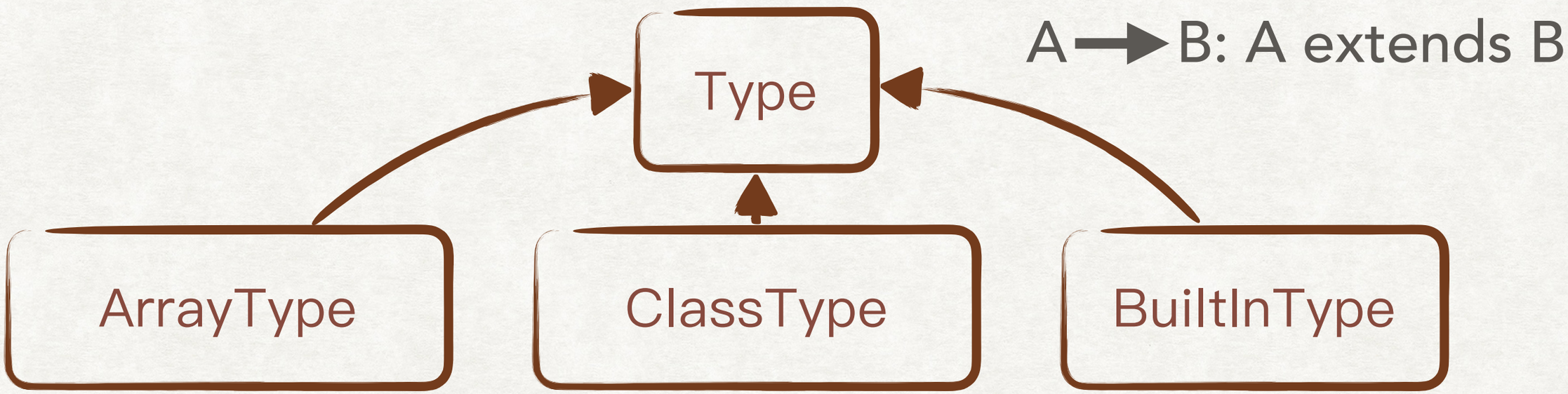

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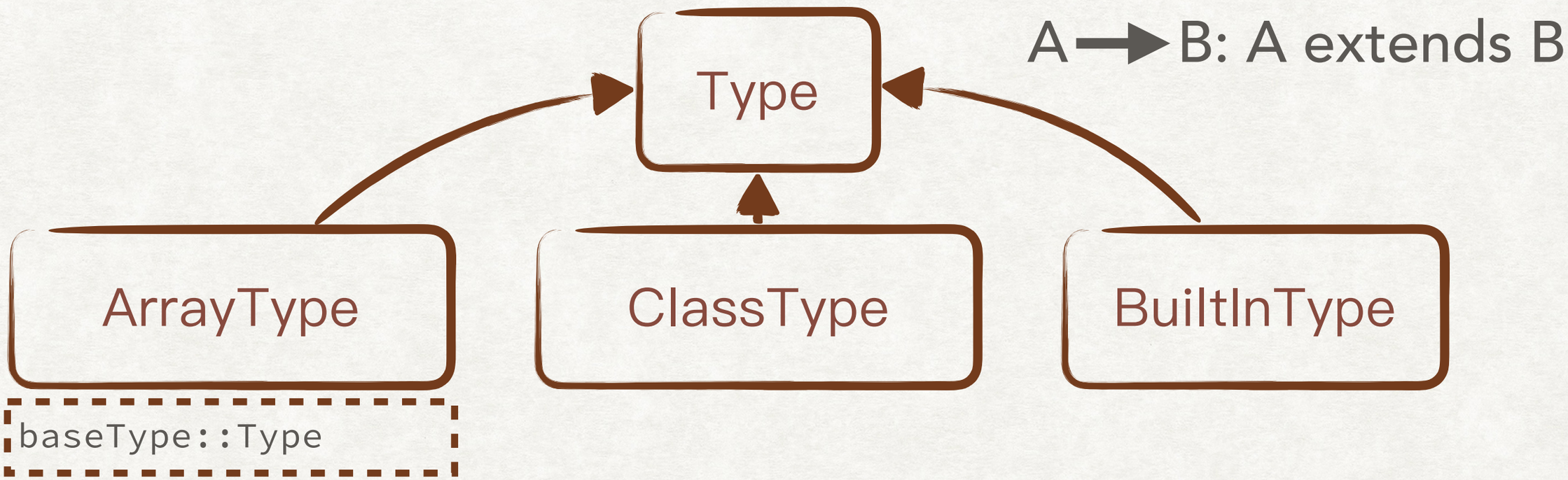

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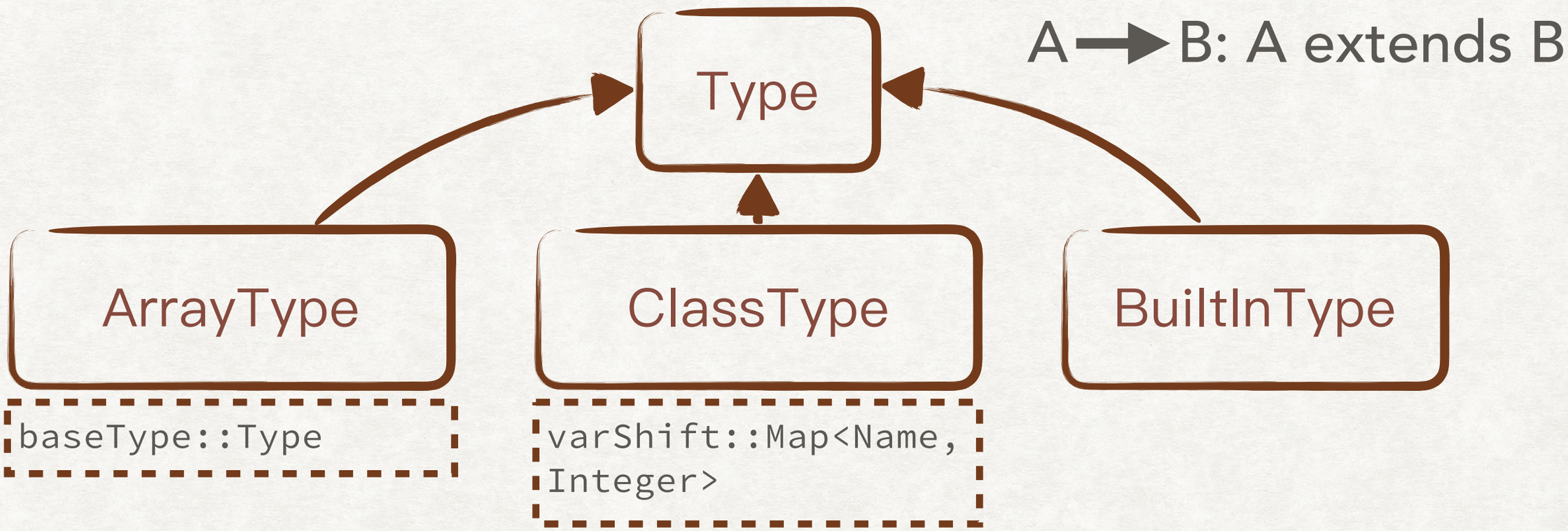

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2. Type A is an `ArrayType`

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The suit-check between Types:

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1. Type A is a `ClassType` / `builtInType`

   `check A == B`

2. Type A is an `ArrayType`

   `if (B == null) return true`

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foo.isSuitableAs(bar)?
```

Structure: SymbolTable

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SymbolTable: An Object that

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Building AST

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- Use ANTLR's Listener and Visitor Pattern

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- Java's exception handling provides great convenience

Building AST

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What needs to be store in the AST node?

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We don't need SymbolTable after building AST, for all useful infos have been stored in AST node!!

Building AST

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Why do I store infos in AST?

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```
int a = 1;
int main(){
    int a = a + 1;
    print(toString(a));
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If we don's store infos in AST, we'll have to rebuild the SymbolTable when we want to walk through AST to gather more infos!!

Building AST

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Building AST

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- transform string op to function call, e.g.

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  - BinaryAdd(1, 1) => IntExpr(2)

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Friendly Error report: e.g.

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`final/compile_error/asiop-1-5100379071-puyouer.mx`

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line 7: Function call parameter mismatching, see function declaration at <f>
```

Structure: IR

Structure: IR

Why do we need IR?

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Why do we need IR?

A step further to lower the abstraction level!

Structure: IR

Why do we need IR?

A step further to lower the abstraction level!

- Branch
- Jump
- Return
- Label
- Binary
- LoadImm
- Move
- Call
- Neg
- New
- Not
- Load
- Load Parameter
- Load Address
- Load FromLabel
- Store
- StoreLabel

Structure: IR

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    7. Short-cut evaluation

Structure: IR

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Structure: IR

String Constant:

MIPS:

```
.data
    .word 4
str:.asciiz “haha”
    .align 2
.text
    ……
    la $a0, str
    li $v0, 4
    syscall
    ……
```

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We need the `la` to support string constant!

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We need the `la` to support string constant!

Then there is a `LoadAddress` in my IR

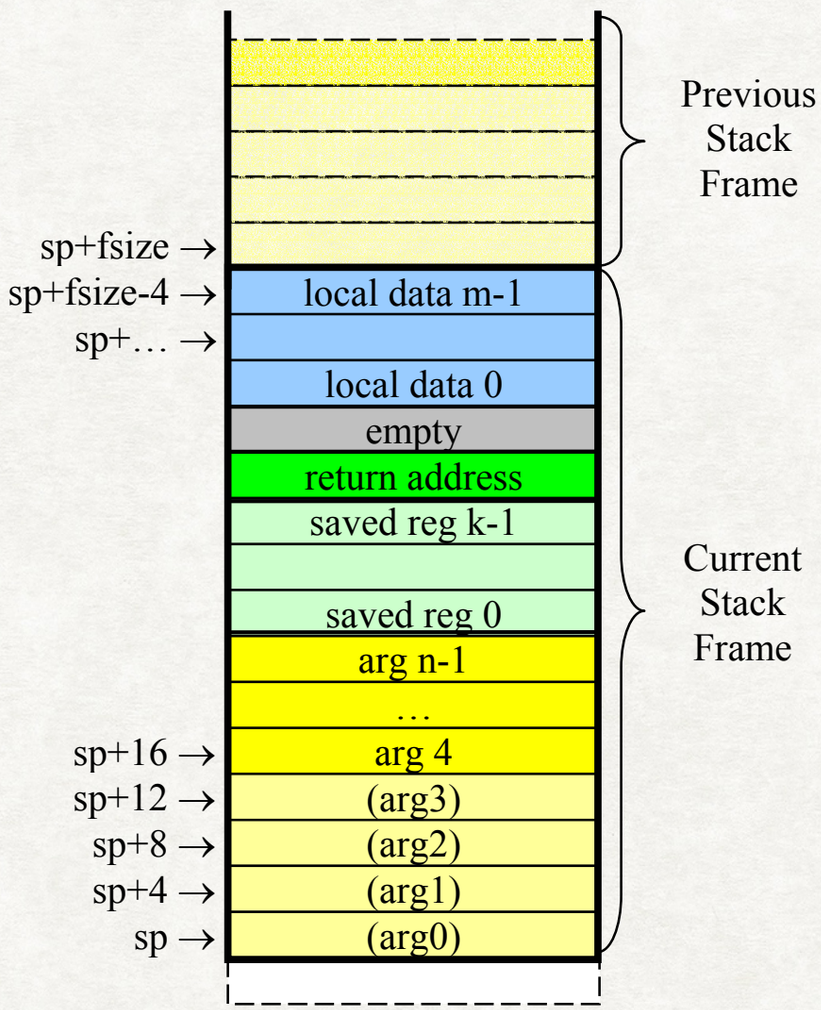
Structure: IR

Structure: IR

Function parameters

Structure: IR

Function parameters



Structure: IR

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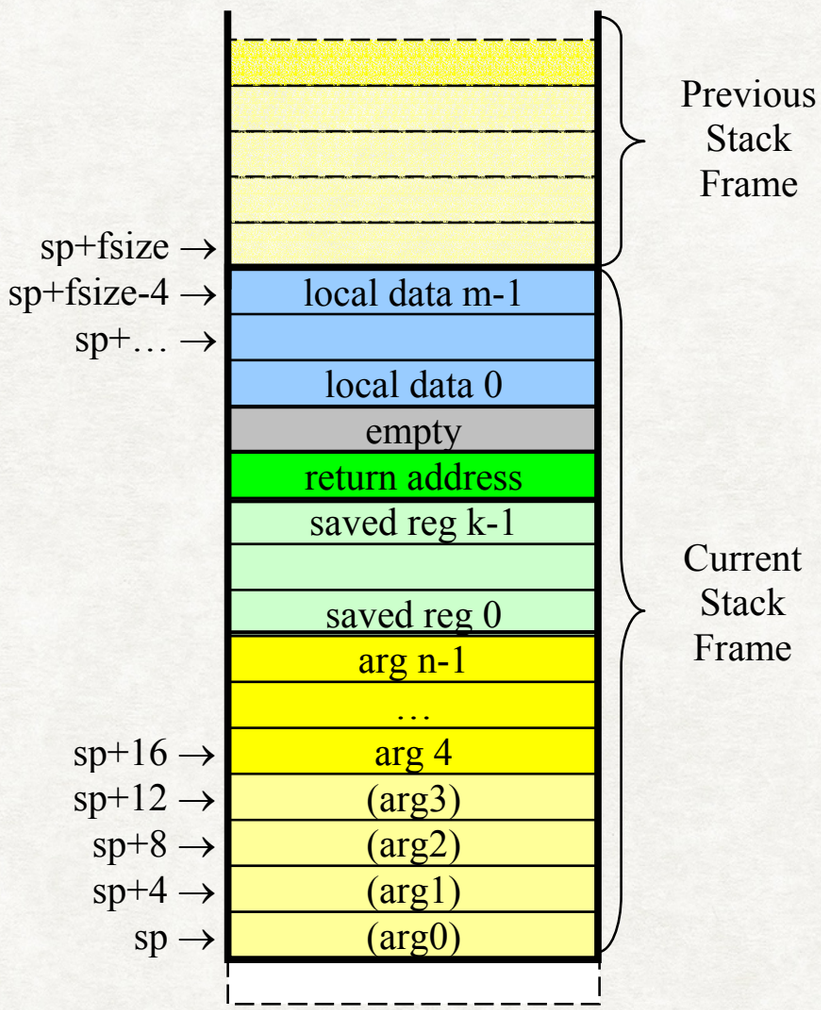

Parameters are stored in stack, but we now know nothing about how large the stack is!

Structure: IR

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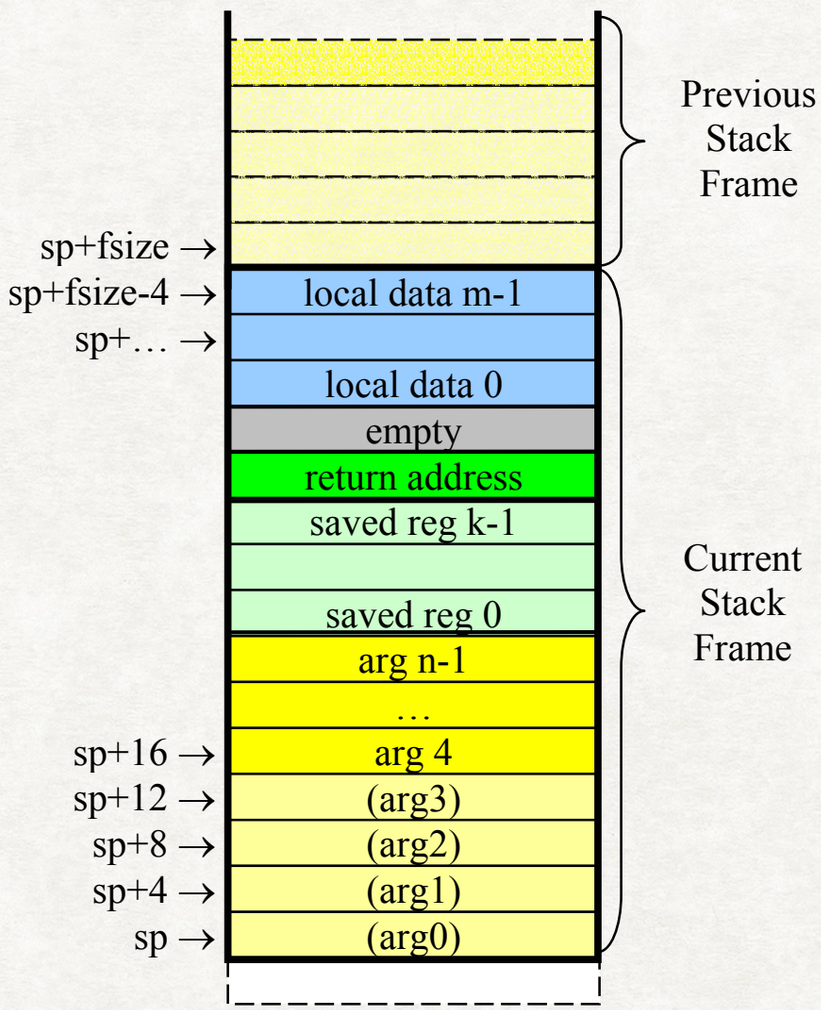

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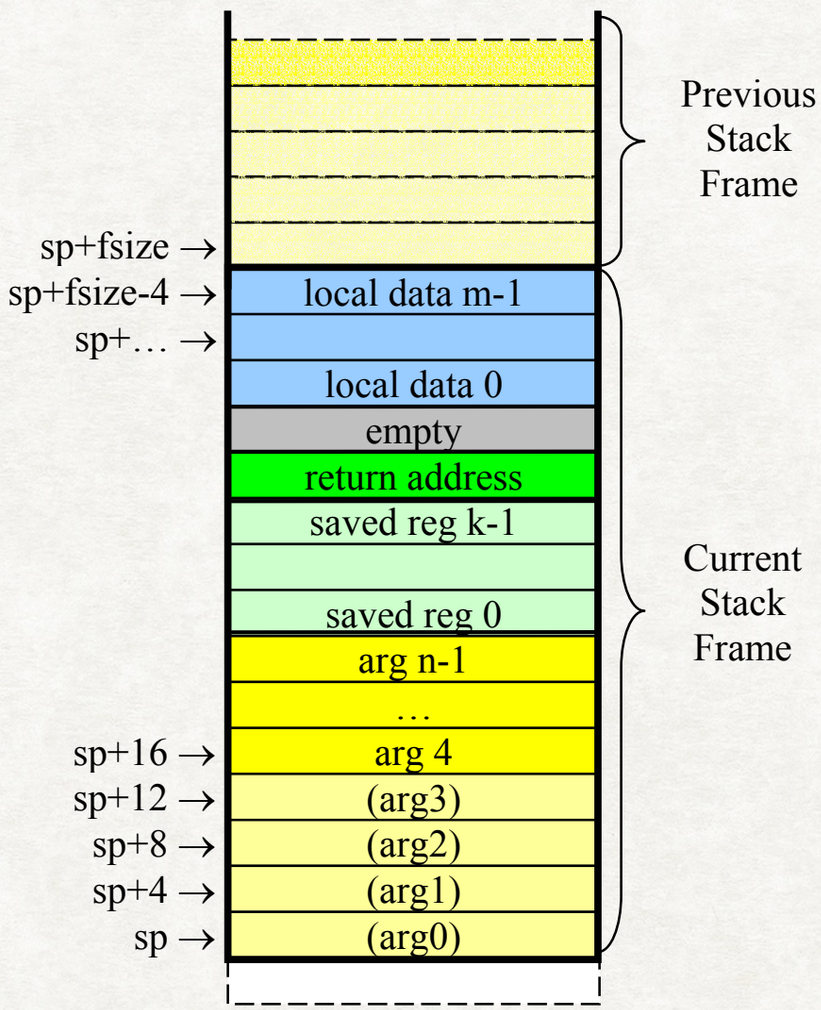

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int main(){
    a = a + 1;
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MIPS:

```
.data
var_a:.word 0
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    ......
    lw  $t0, var_a
    add $t0, $t0, 1
    sw  $t0, var_a
    ......
```

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We need `LoadLabel` and `StoreLabel` to support global variable!

Structure: IR

Structure: IR

Array

Structure: IR

Array

```
class A{
    int a;
}
int main(){
    A[] test = new A[10];
    test[0] = new A;
    test[0].a = 1;
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Structure: IR

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```

- store size of array in front of the initial place
- count the shift!

Structure: IR

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Loop

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Loop

```
for (init; cond; increment)
    body
```

Structure: IR

Loop

```
for (init; cond; increment)
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```
init
branch cond T=for_begin F=for_end
Label:for_begin
body
increment
branch cond T=for_begin F=for_end
Label:for_end
```

Structure: IR

Structure: IR

Short-cut evaluation

Structure: IR

Short-cut evaluation

```
void buildCondition(T, F, condition)
    Label temp
    if (condition is LogAnd)
        buildCondition(temp, F, condition.lhs)
        place(temp)
        buildCondition(T, F, condition.lhs)
    else if (condition is LogOr)
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superloop-5090379042-jiaxiao.mx

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FinalMIPS: 976129
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Experience on IR building:

1. we have to have a deep understanding on what kind of IR do we want to have when we designing IR
2. It will be much better to have a clear idea on what object code looks like before building IR
3. pay special notice on operations that have side-effect: assign, selfIncrement and selfDecrement

Structure: CFG

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Why do we want to have CFGs?

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for the convenience of Liveness Analysis

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Very very simple to build!

Liveness Analysis

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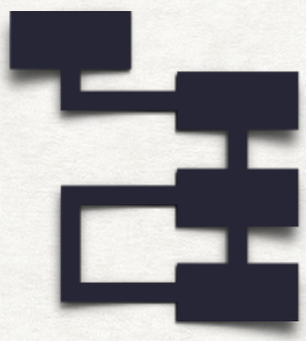

CFG

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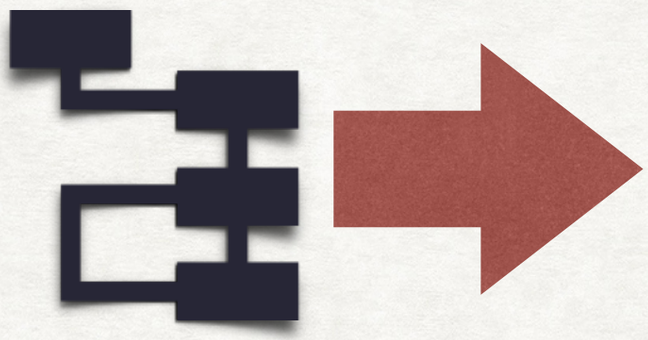

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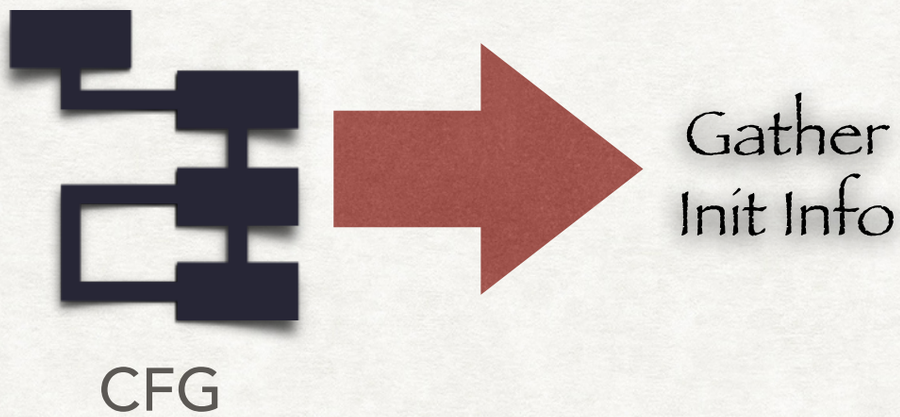

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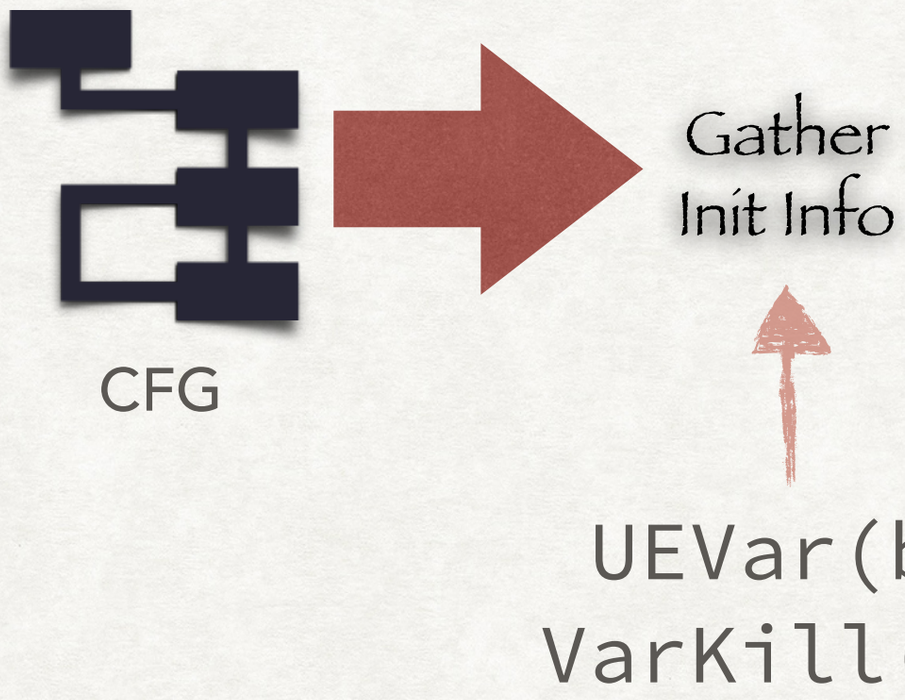

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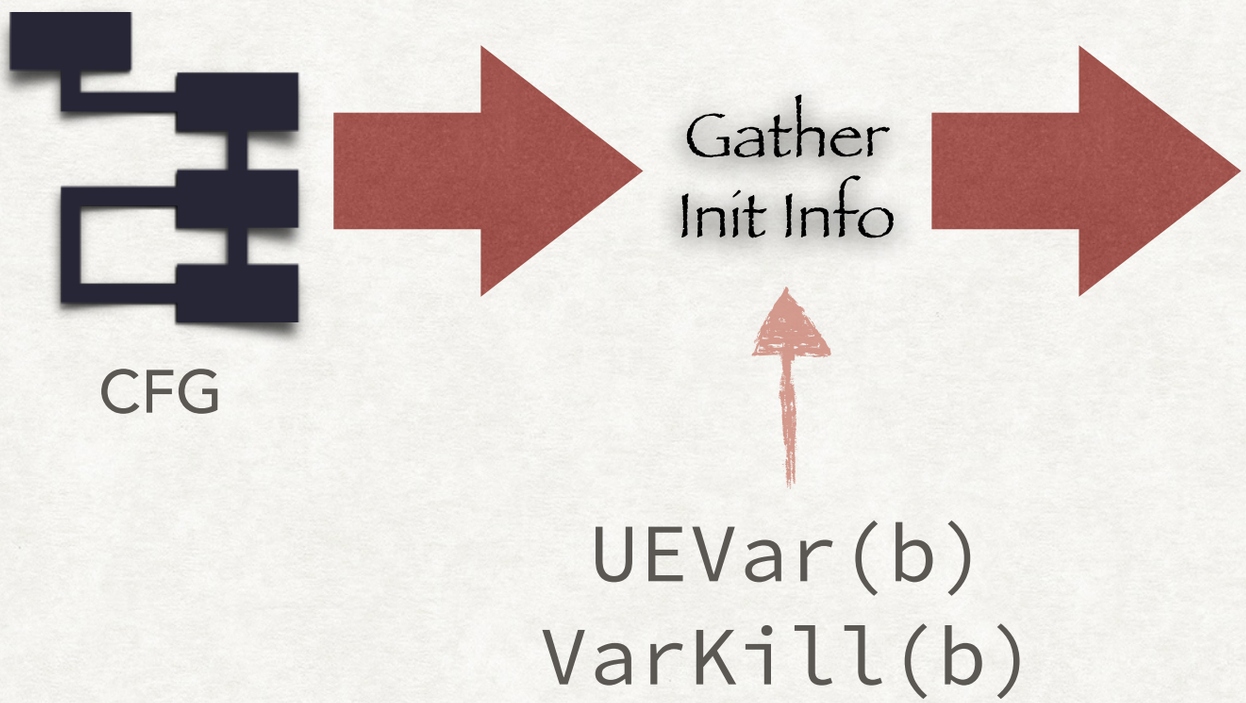

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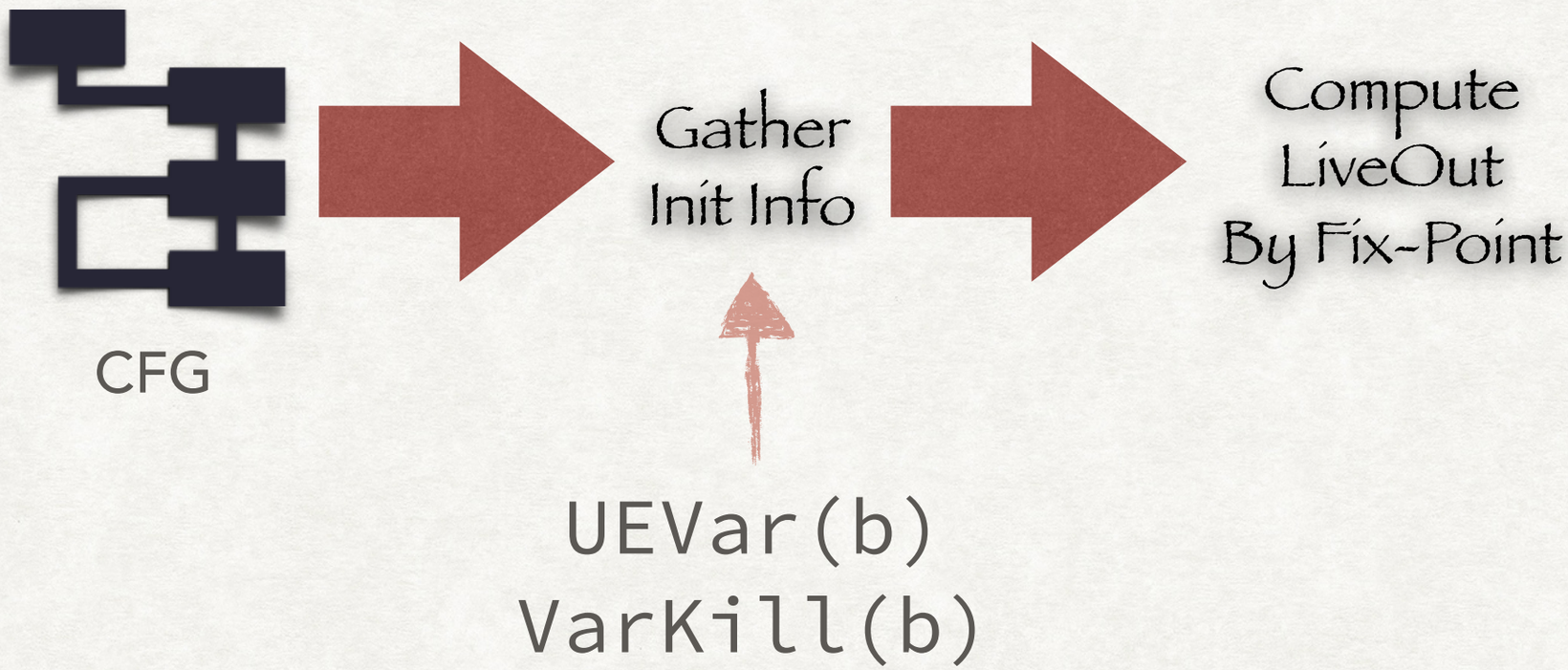

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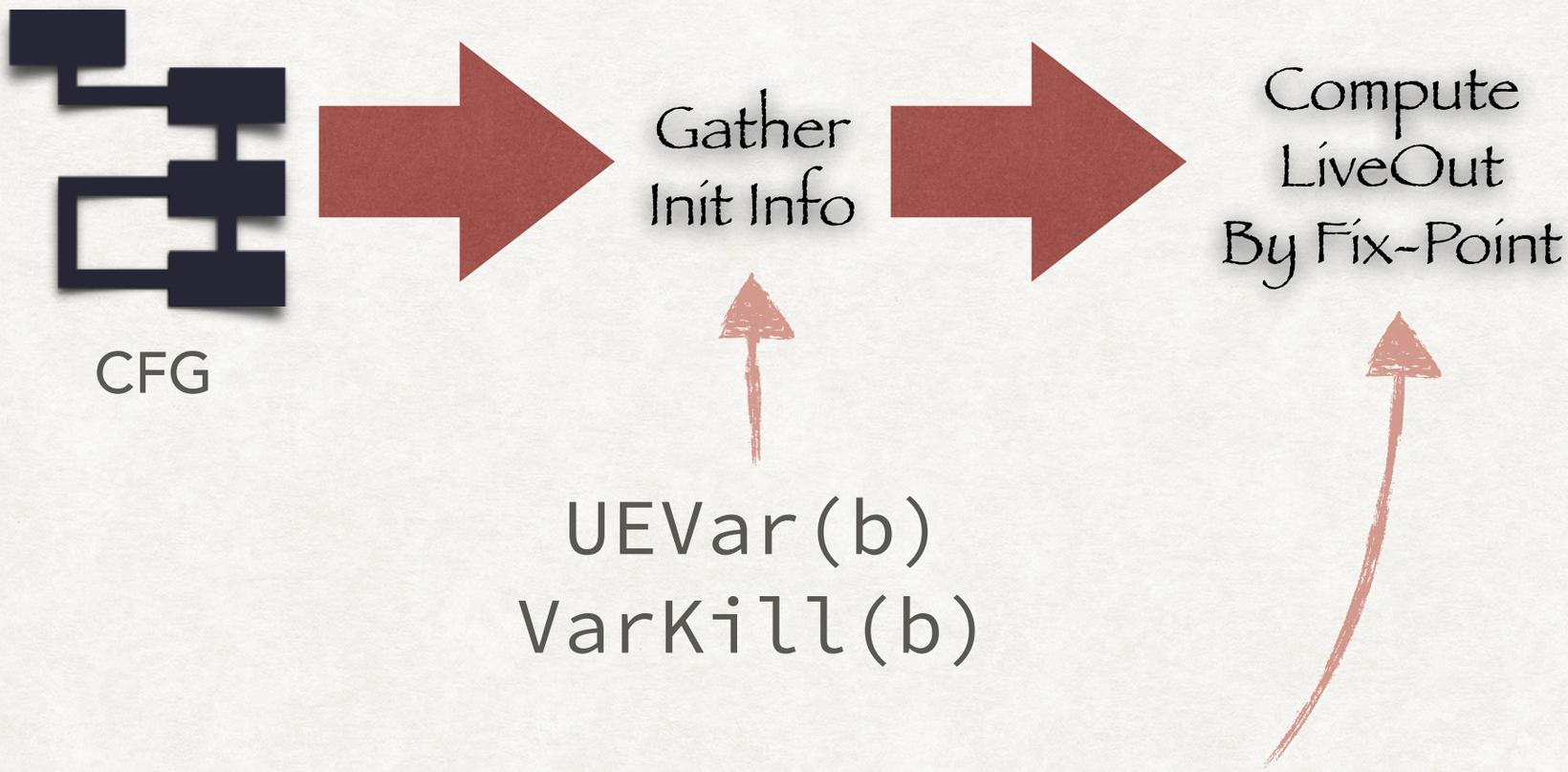

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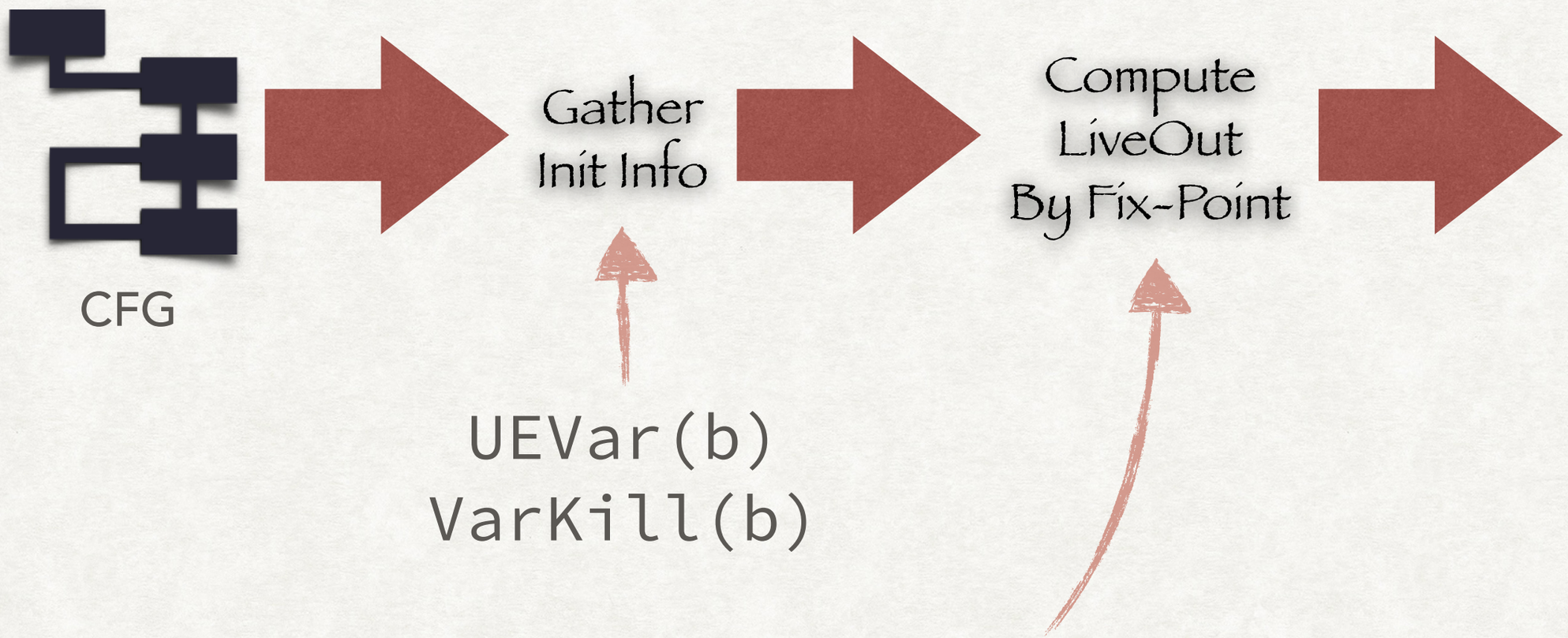

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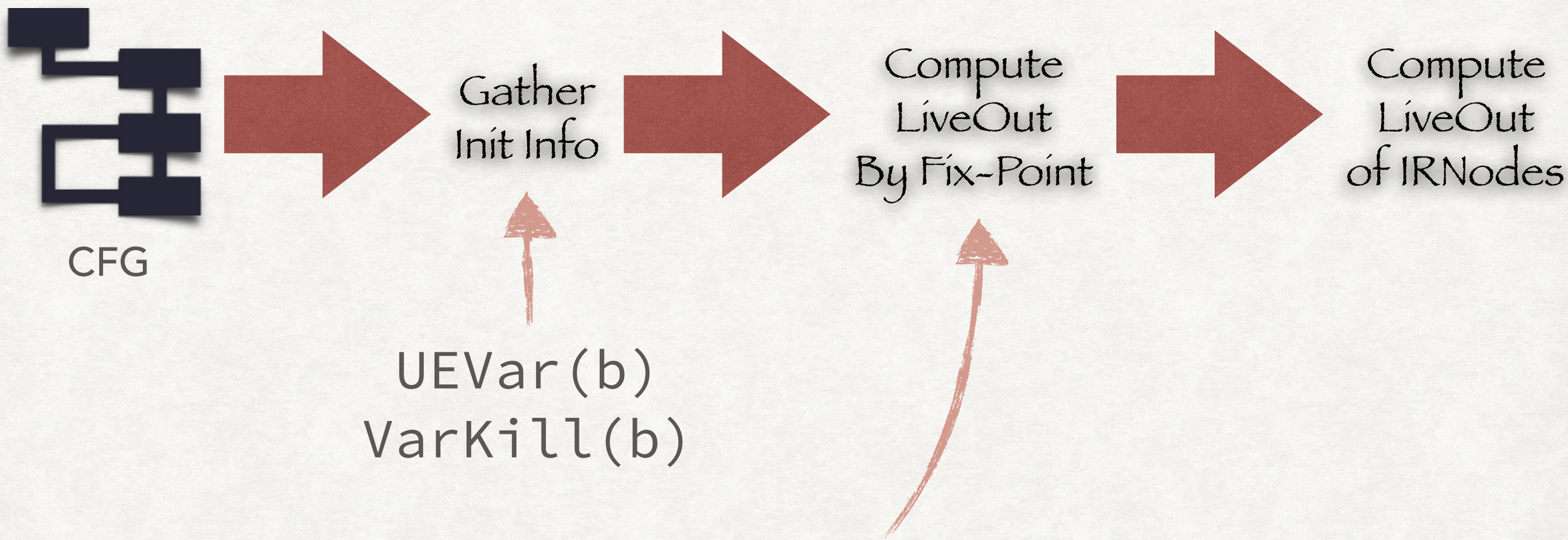

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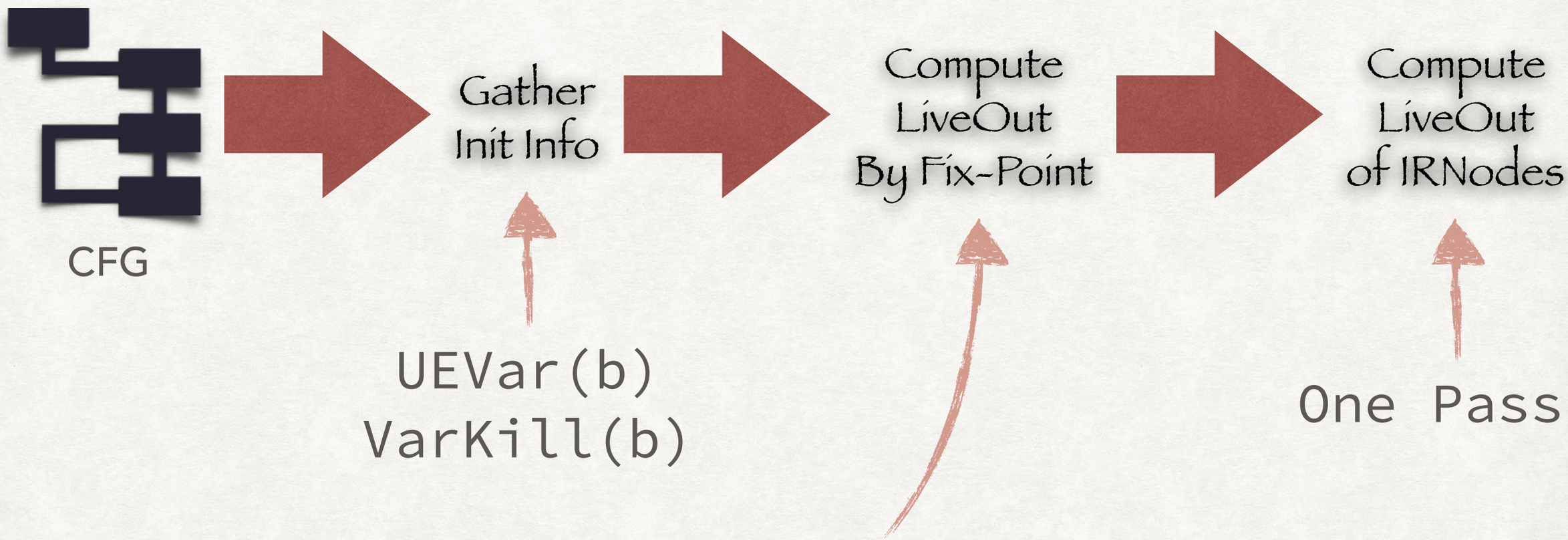

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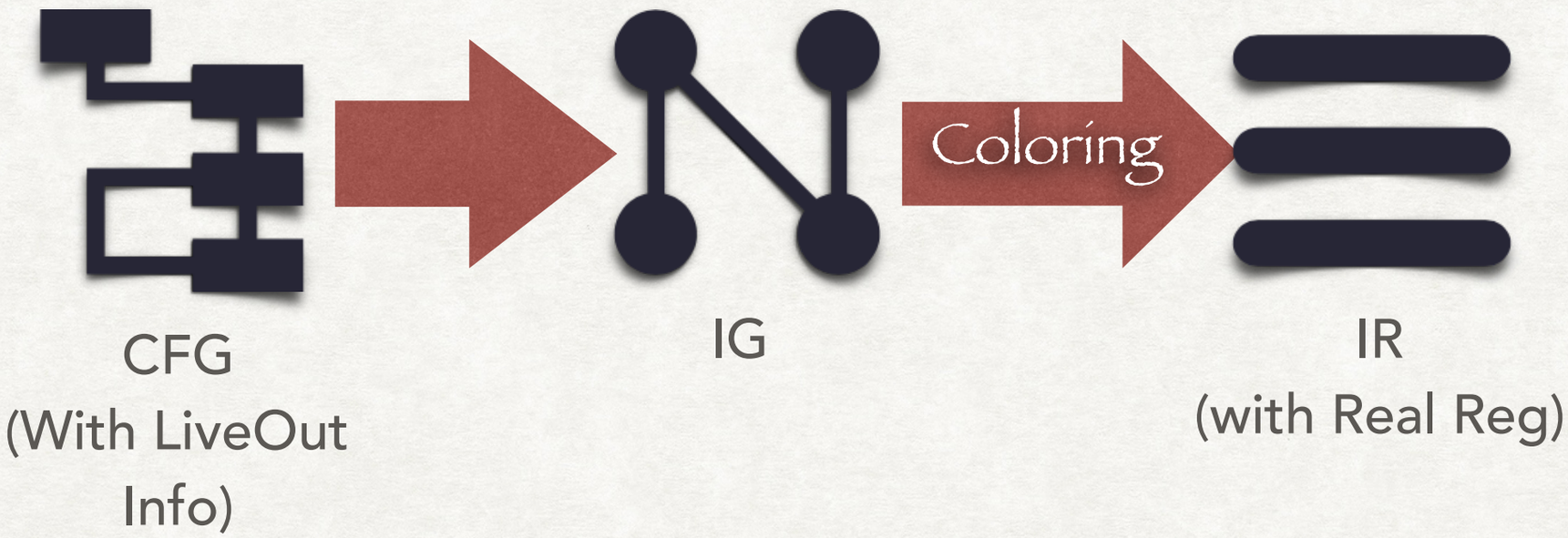

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I don't need to worry about spill, for I reserve 2 regs for load/store!

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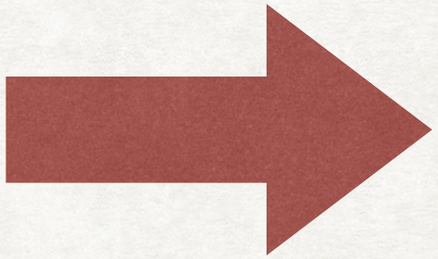

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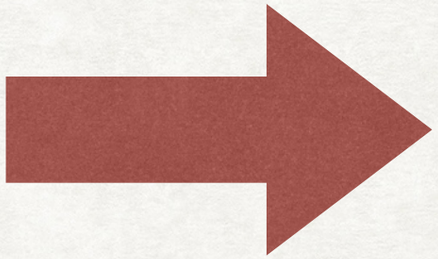

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print("four");
print(" ");
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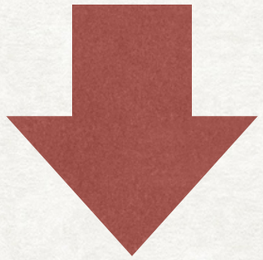

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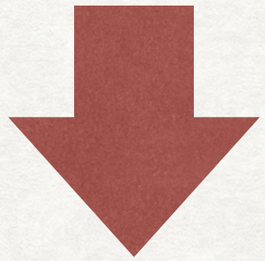

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StringBuilder x;
X.append("four").append(" ").append("score");
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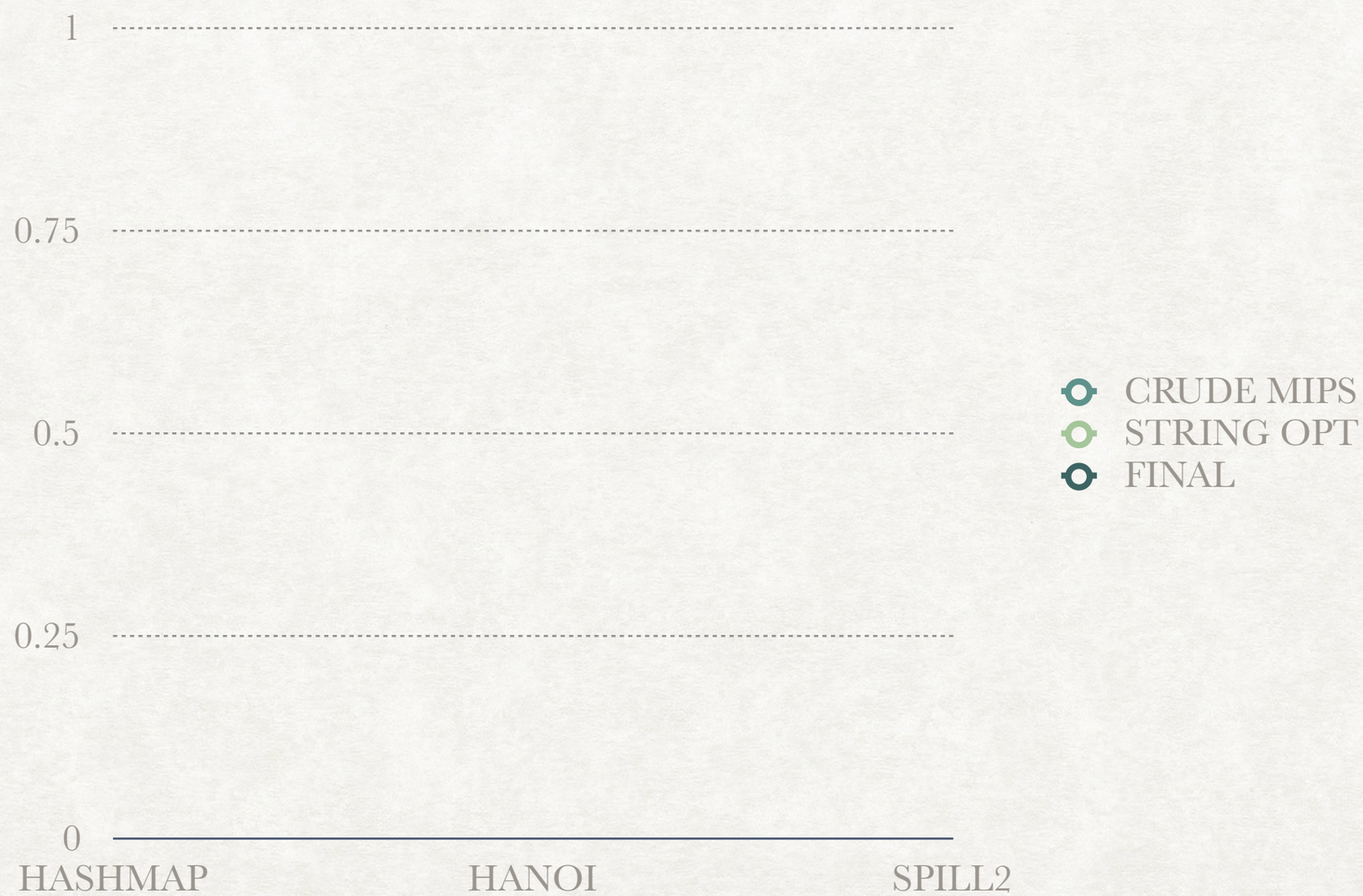

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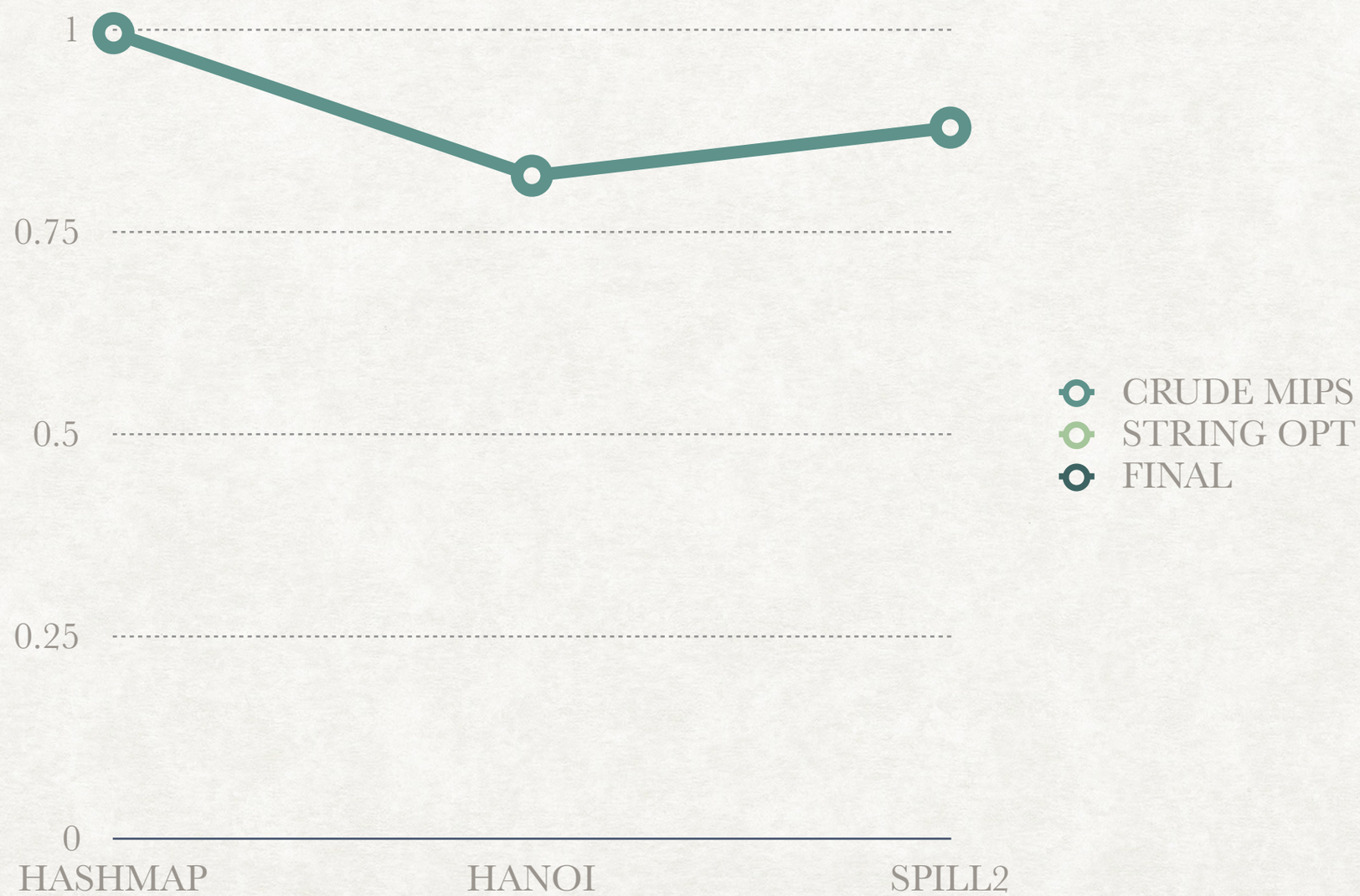

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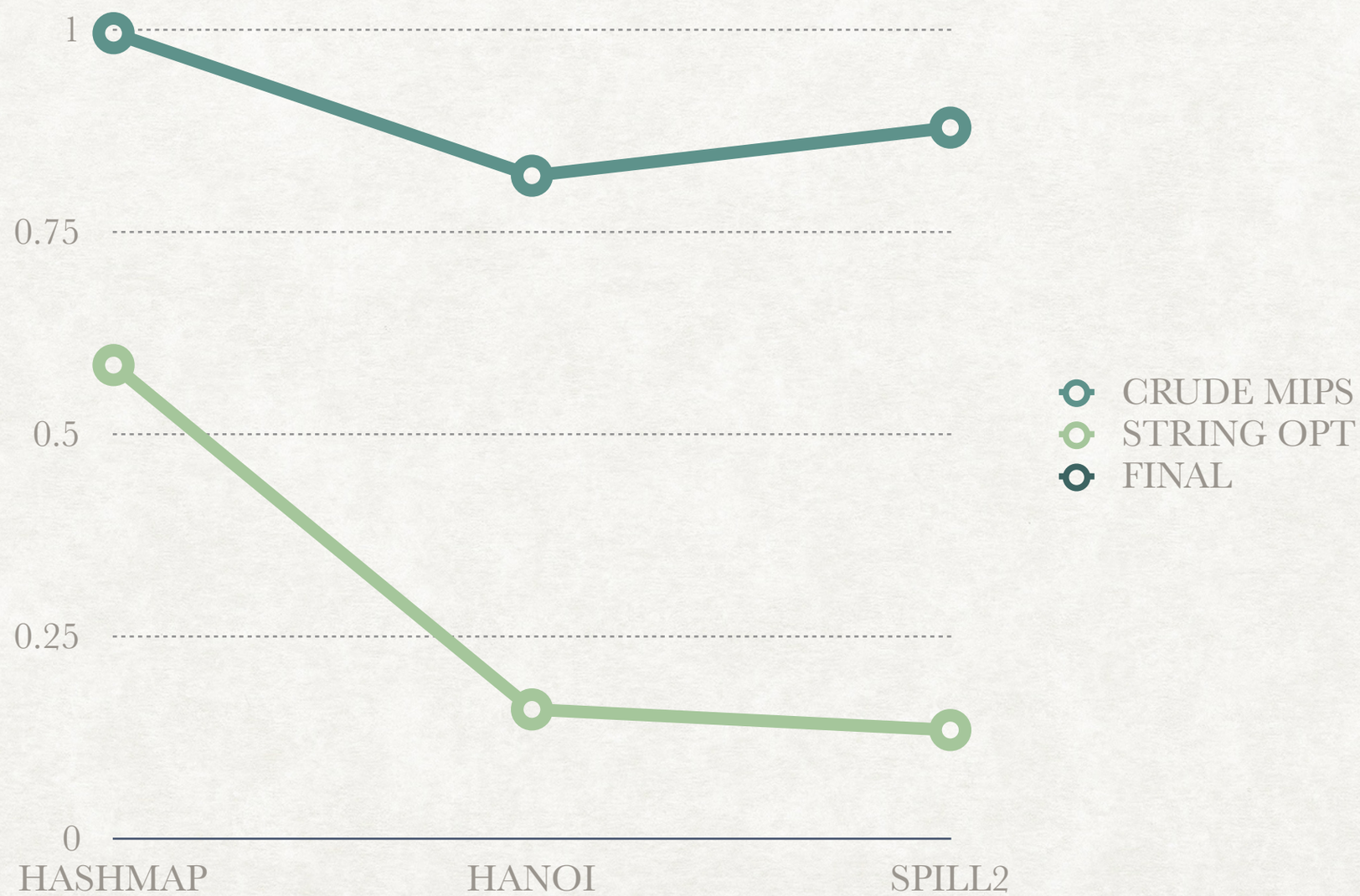

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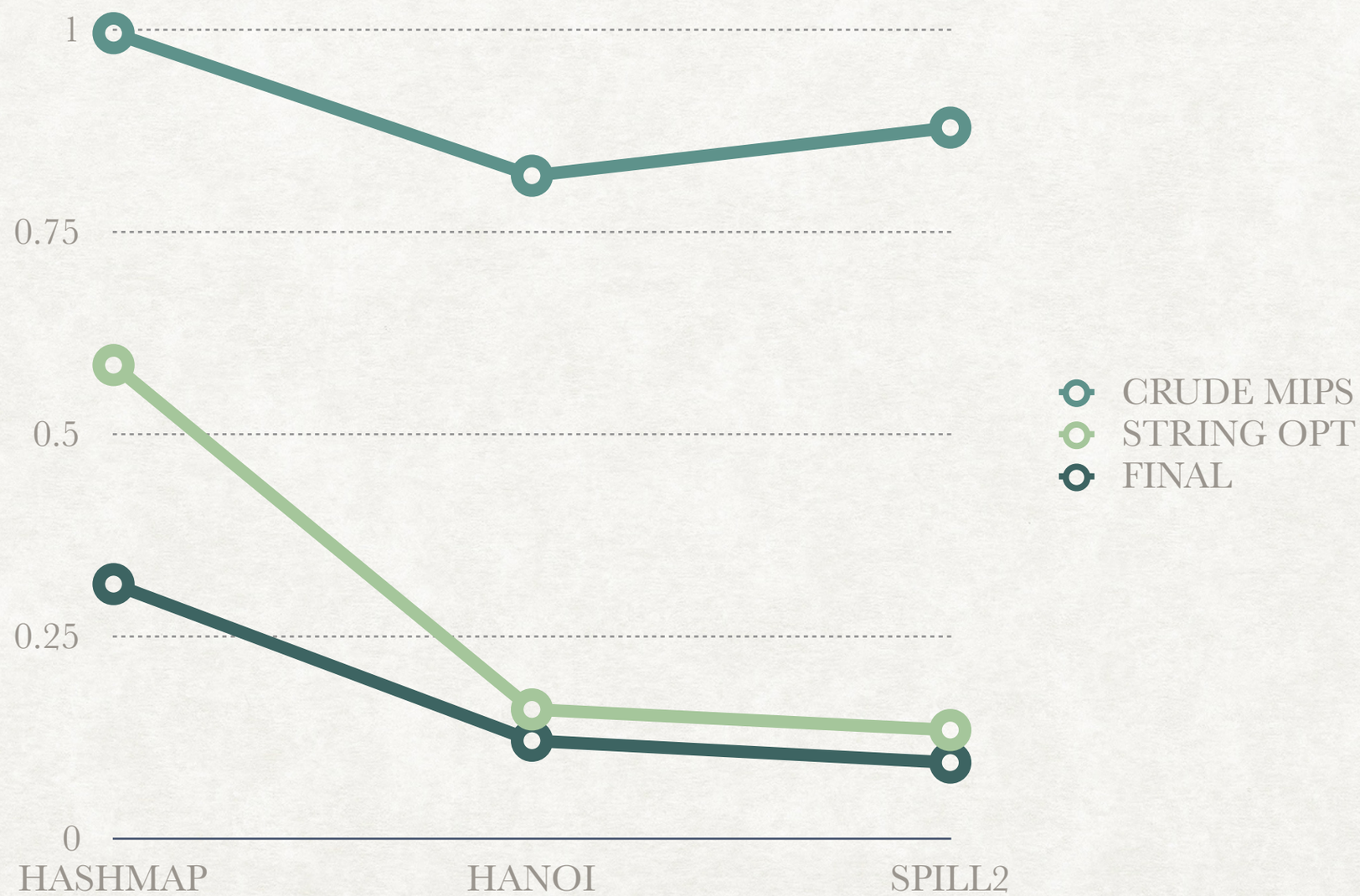

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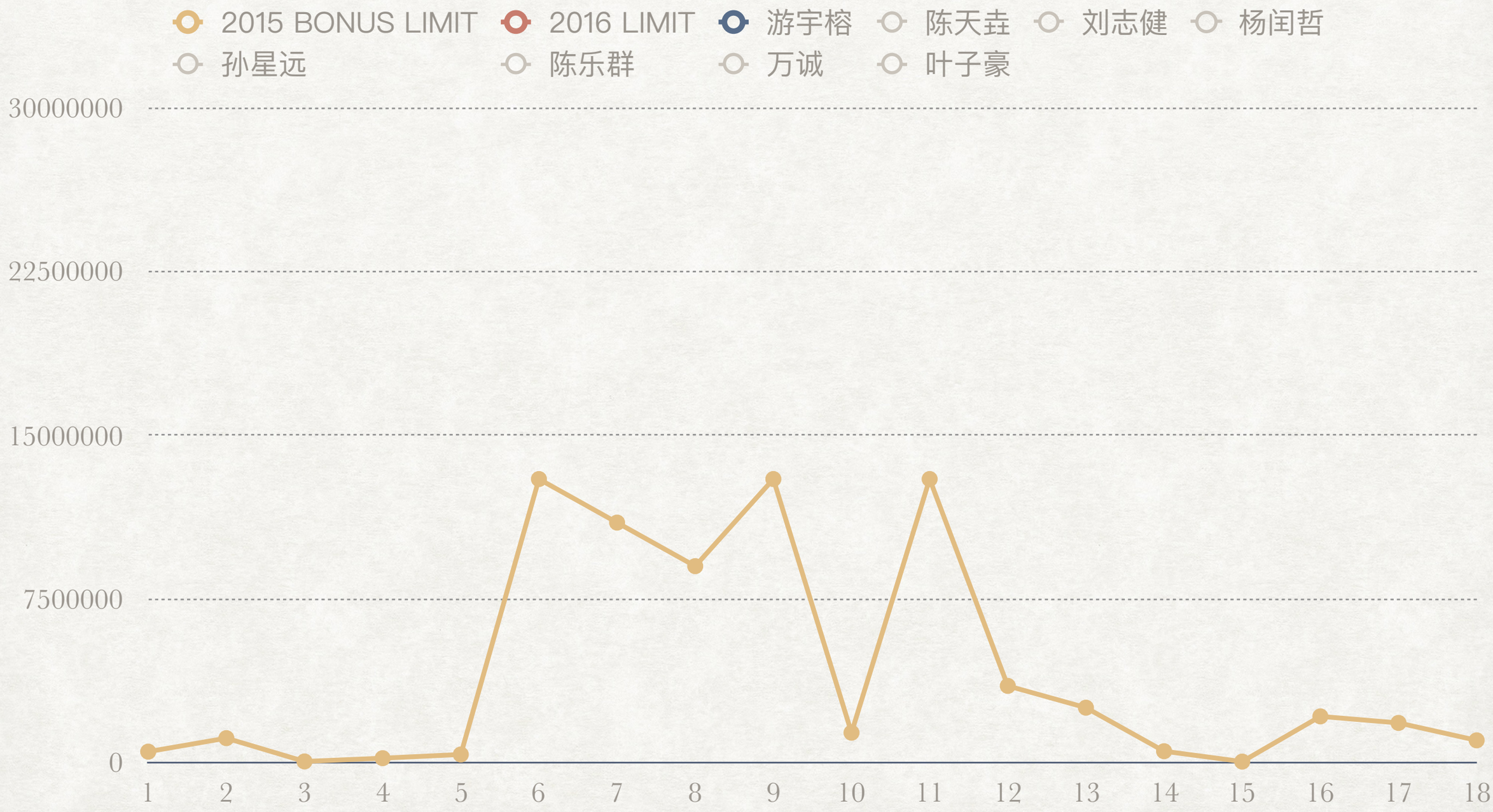

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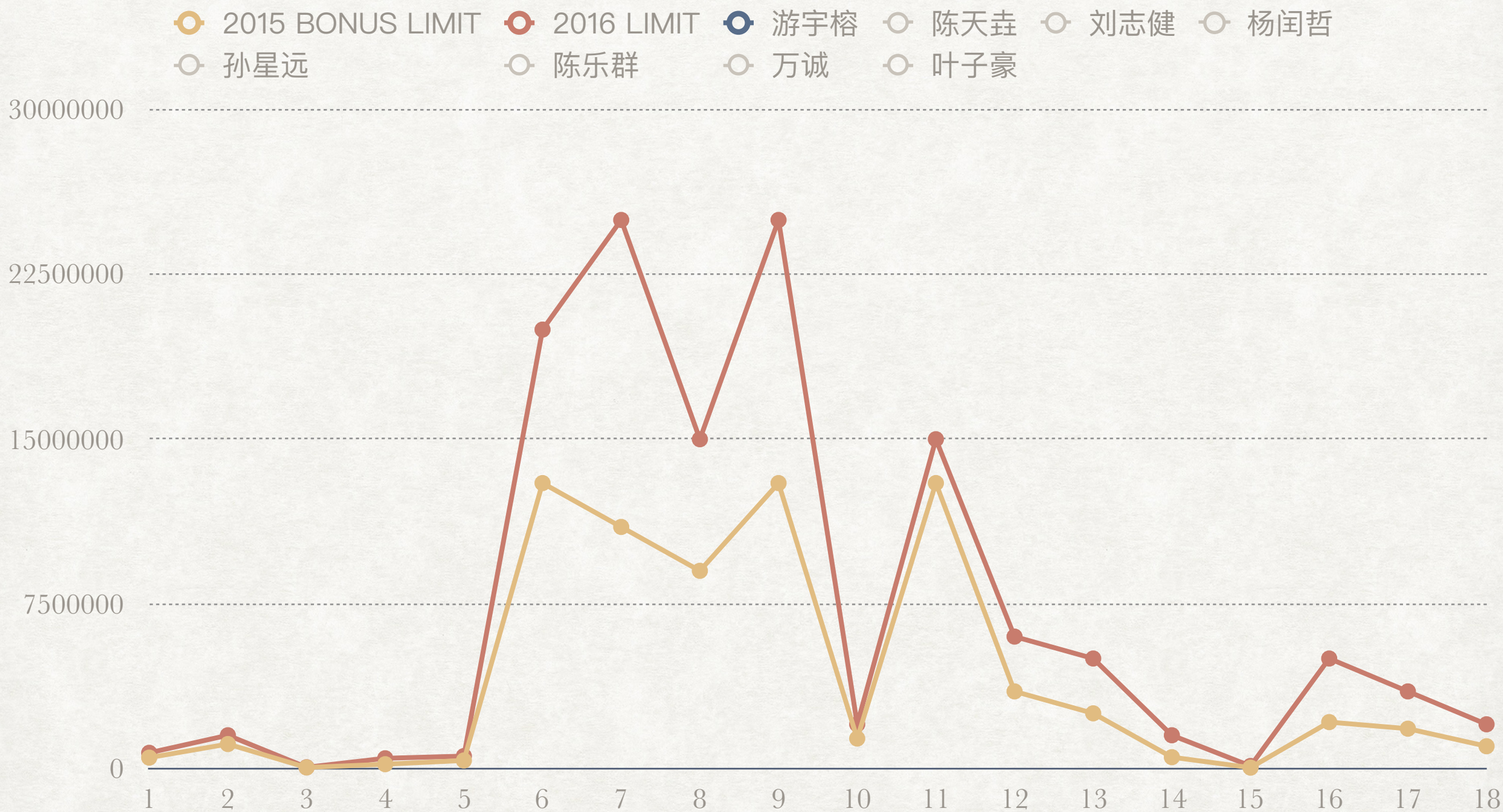

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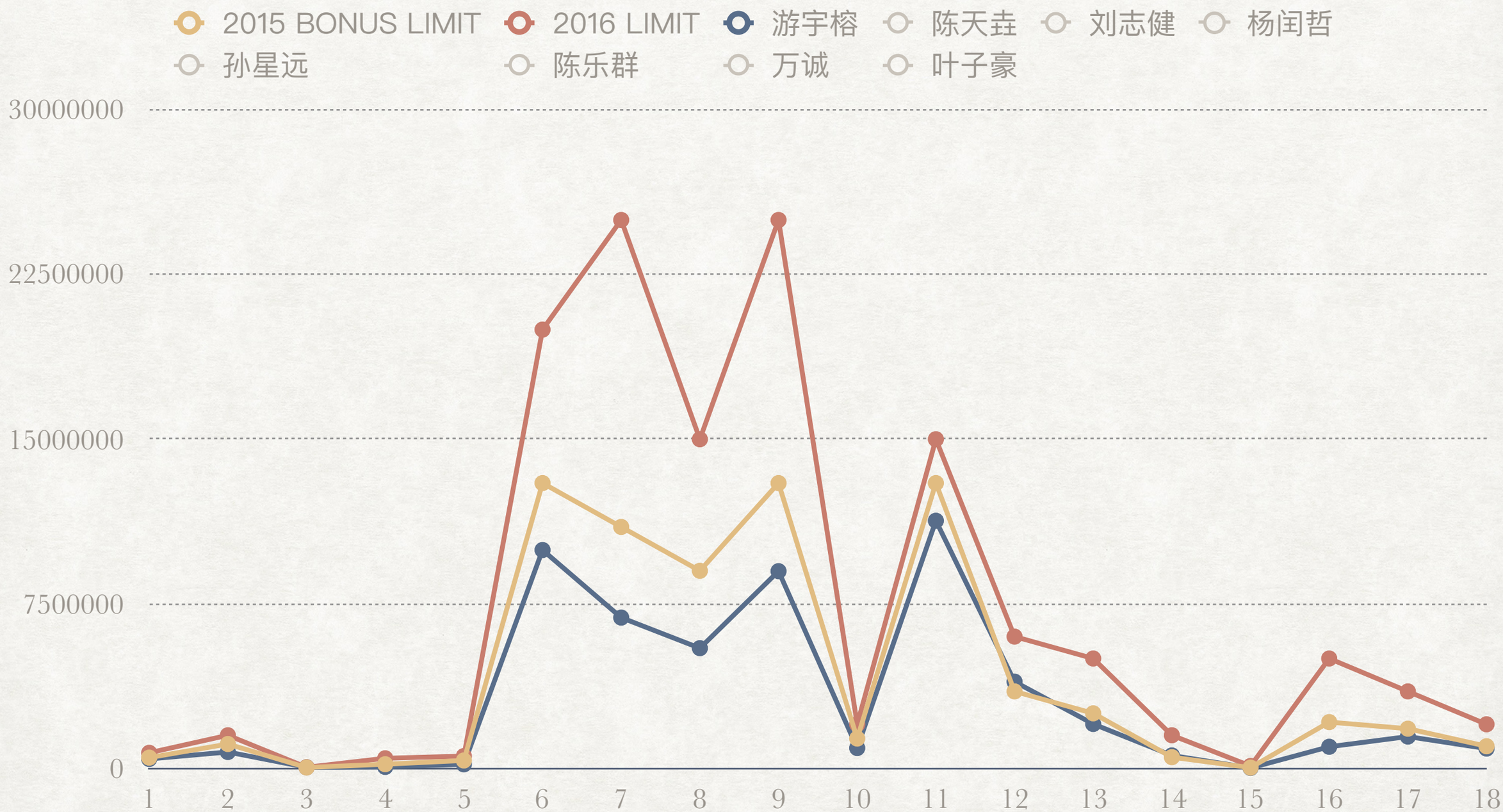

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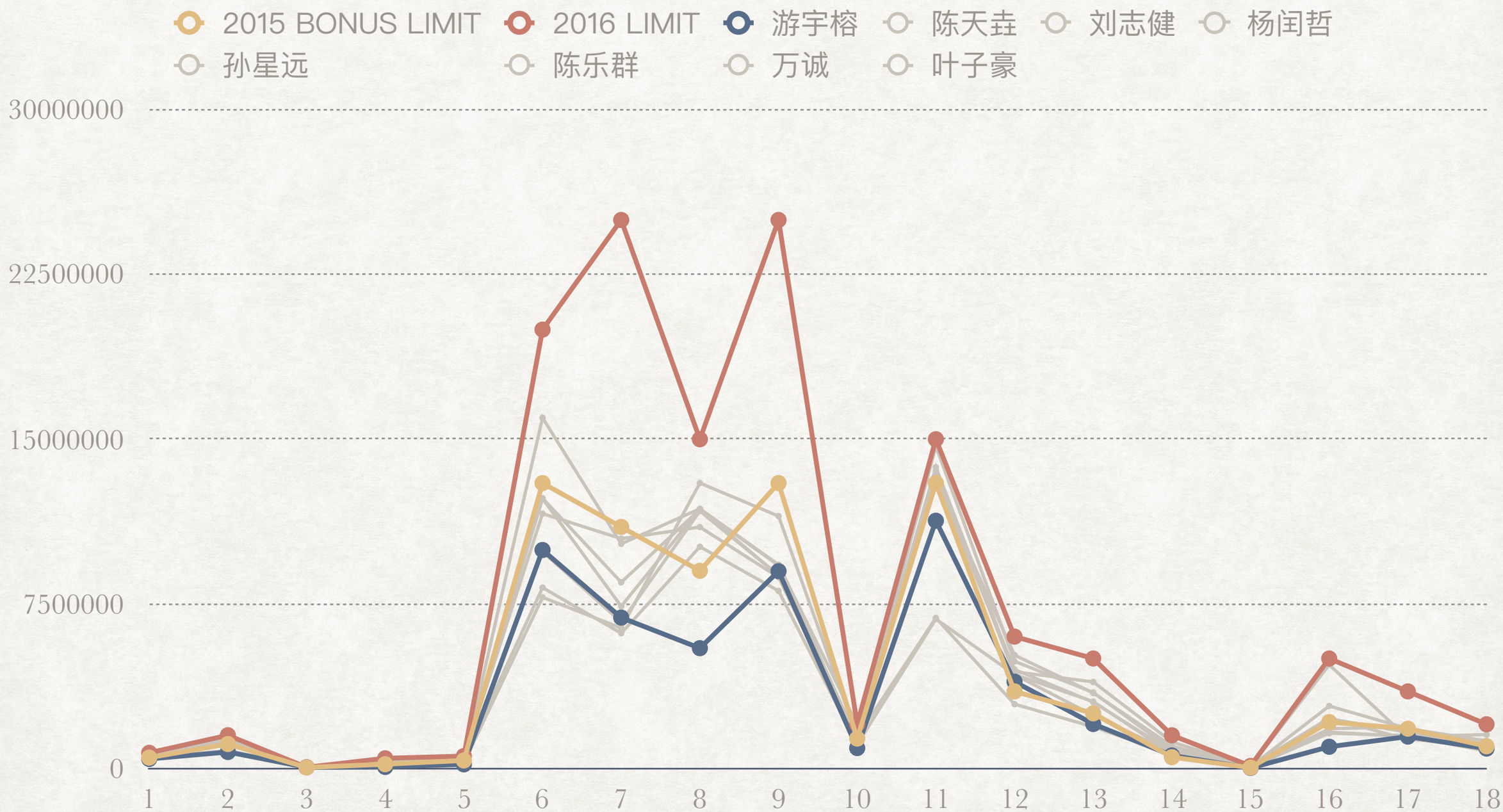

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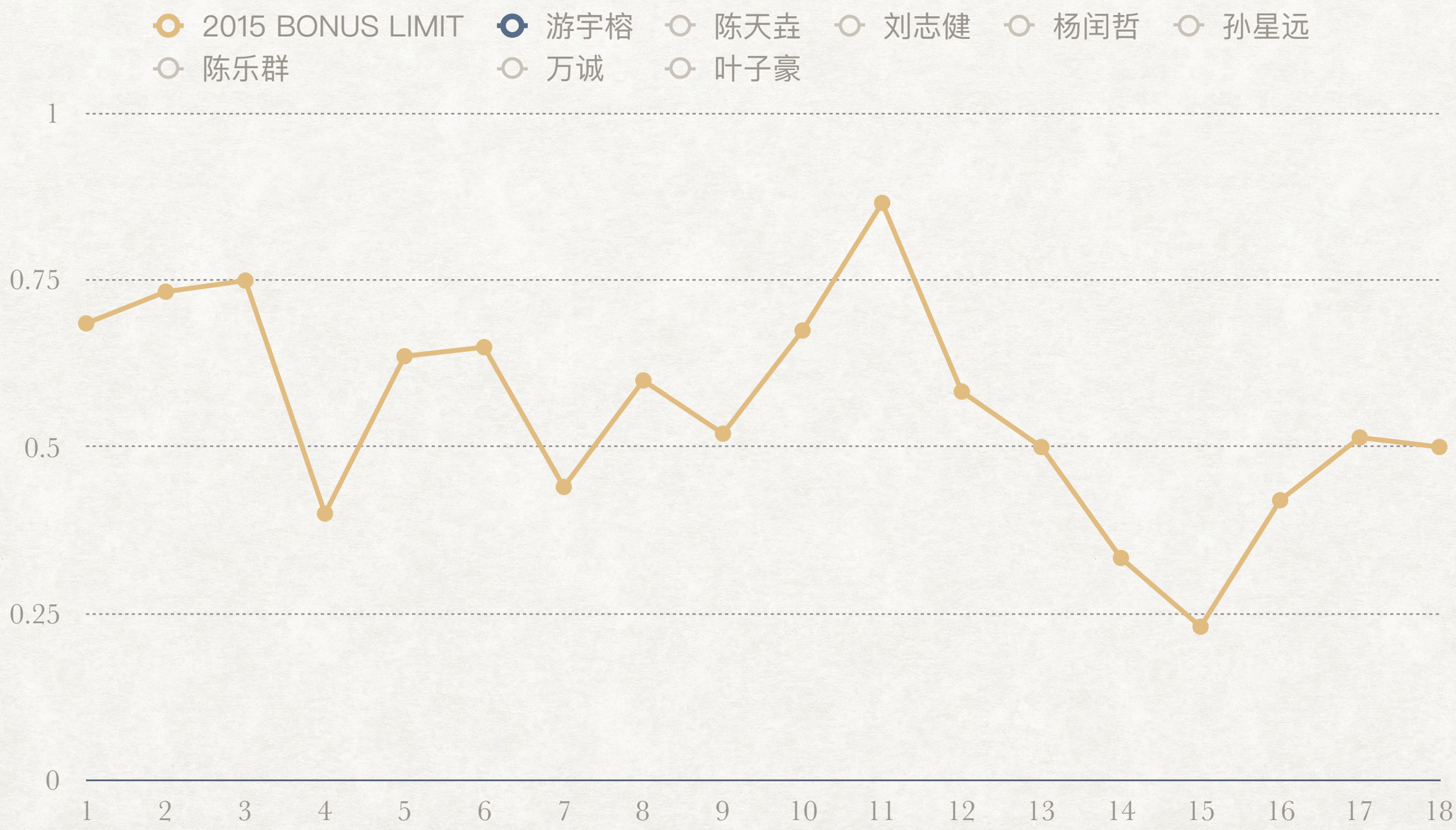

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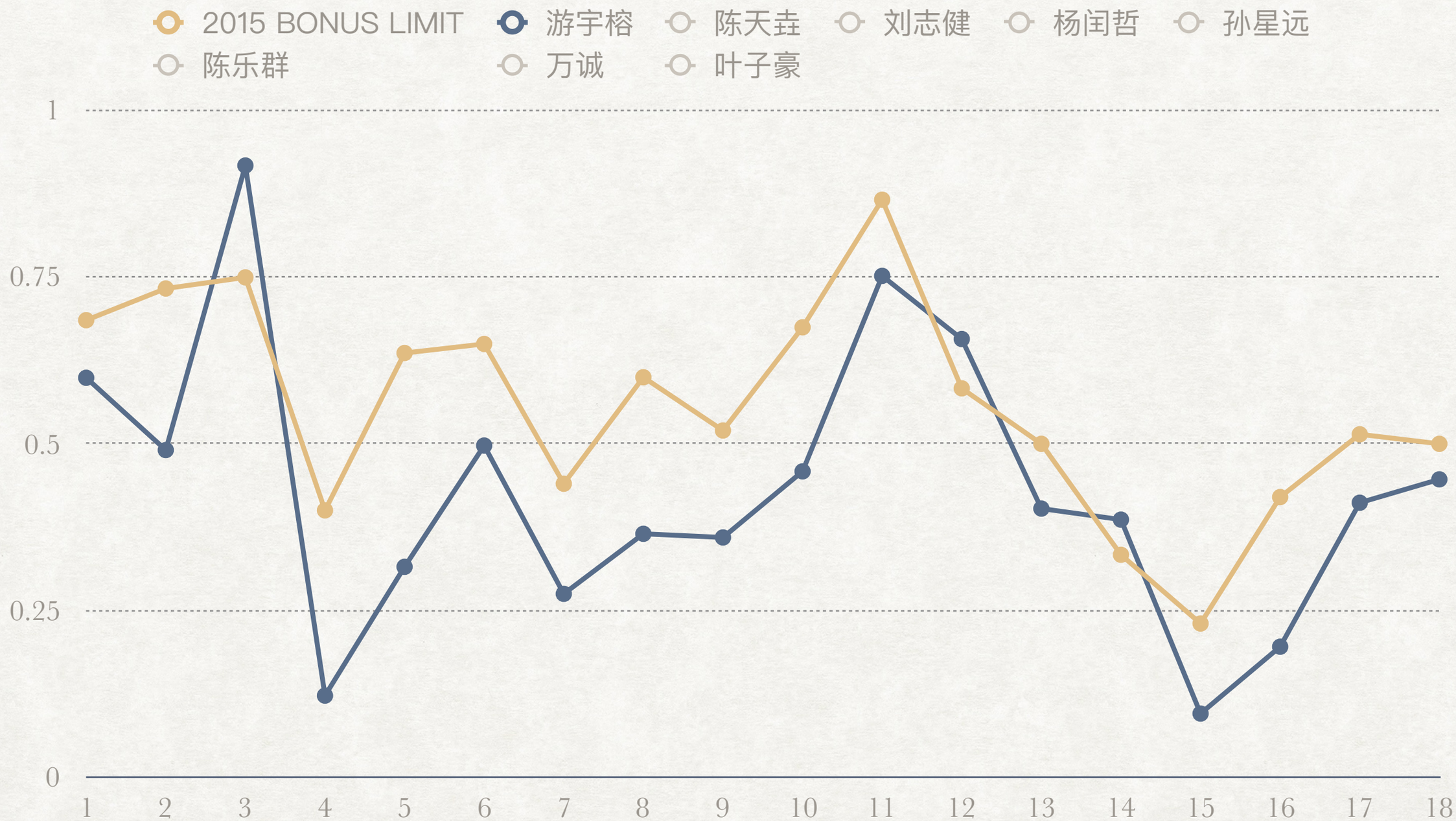

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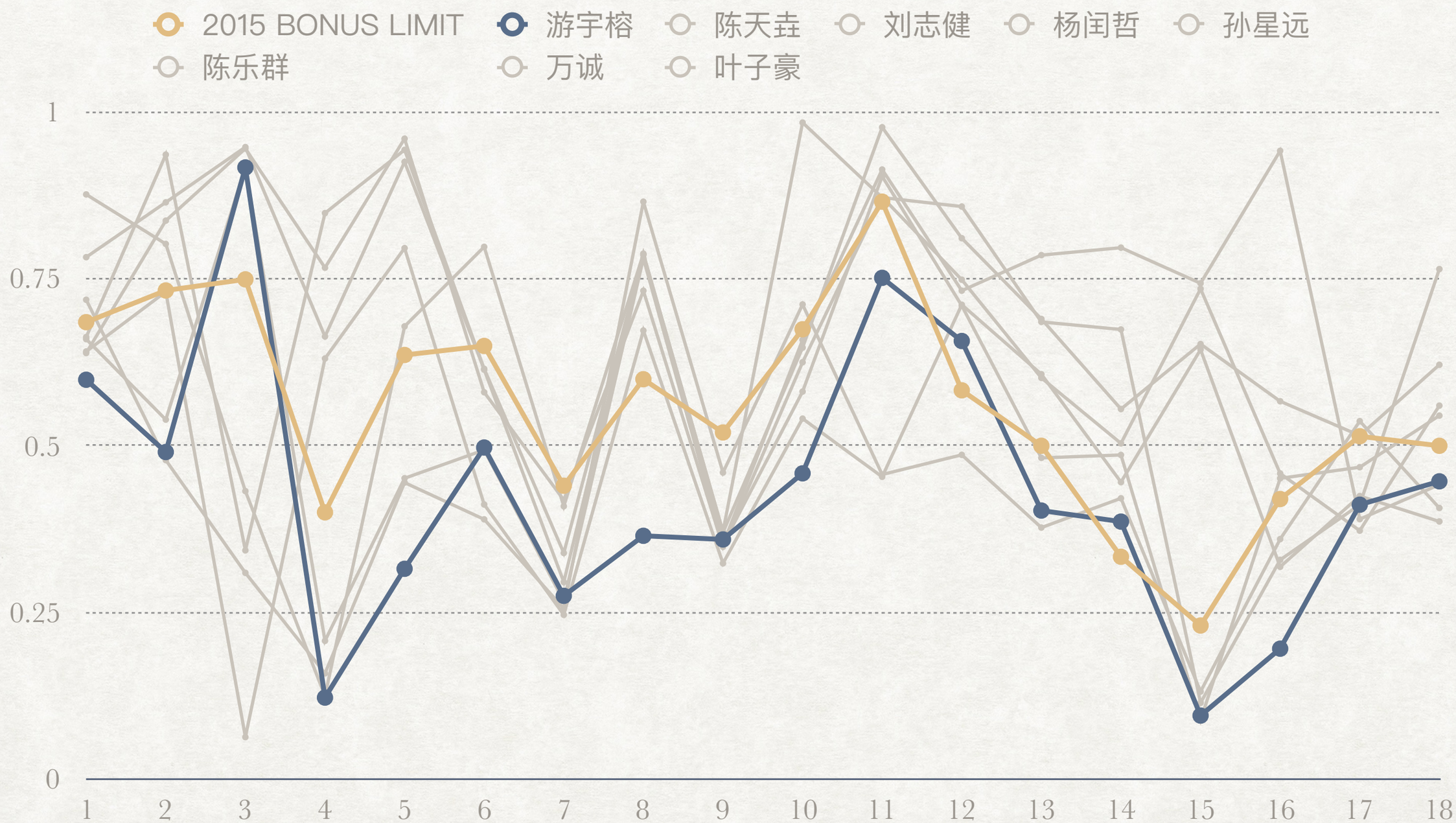

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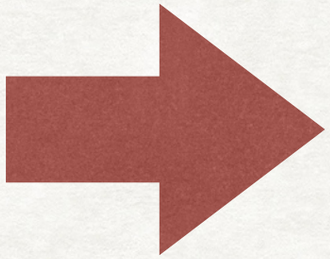

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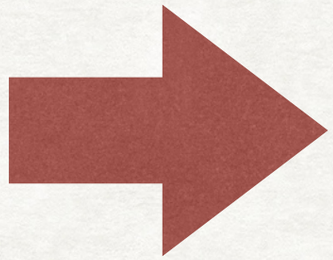

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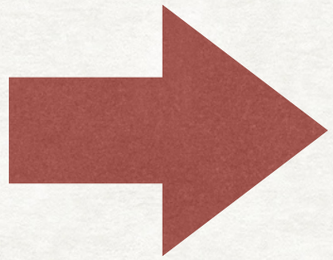

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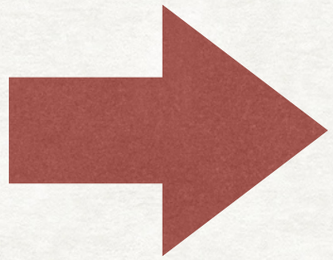

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Class function have no more difference between ordinary function.

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        - Special thanks to 叶子豪，陈天垚，刘志健 and 马豪君
    - Massive Reading: Tiger Book, EaC, MIPS tutorials…
2. Thinking clearly, deep and far is of the most importance

Reflections

1. Why did this projects move on so smoothly?
   - Head Start: began to learn Java since winter vacation
   - Frequent discusses between classmates, TAs & Boss Ma
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   - Massive Reading: Tiger Book, EaC, MIPS tutorials…
2. Thinking clearly, deep and far is of the most importance
3. Good designs can only be created by far-sighted designer.

Reflectio

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2.

3.

CHEERS & THANKS!