HELLO WORLD

FROM THE CODE TO THE SCREEN

JESÚS ESPINO – SOFTWARE ENGINEER

Introduction

Disclaimer

Our example code

```go
package main

import "fmt"

func main() {
	fmt.Println("hello world!")
}
```

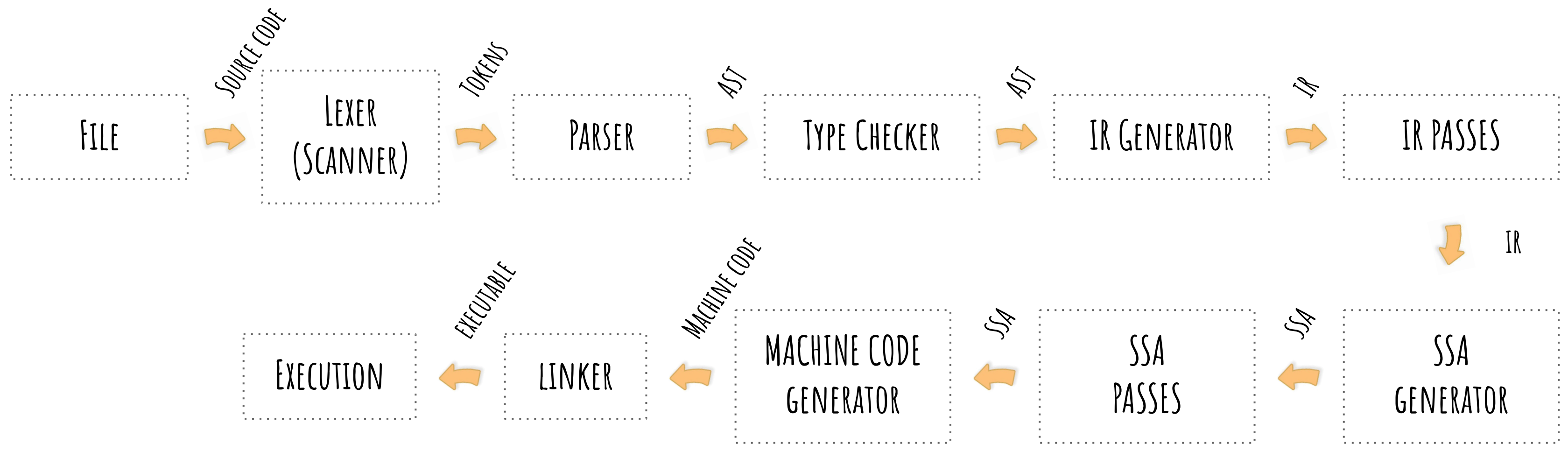
The Go Compiler

(1.19)

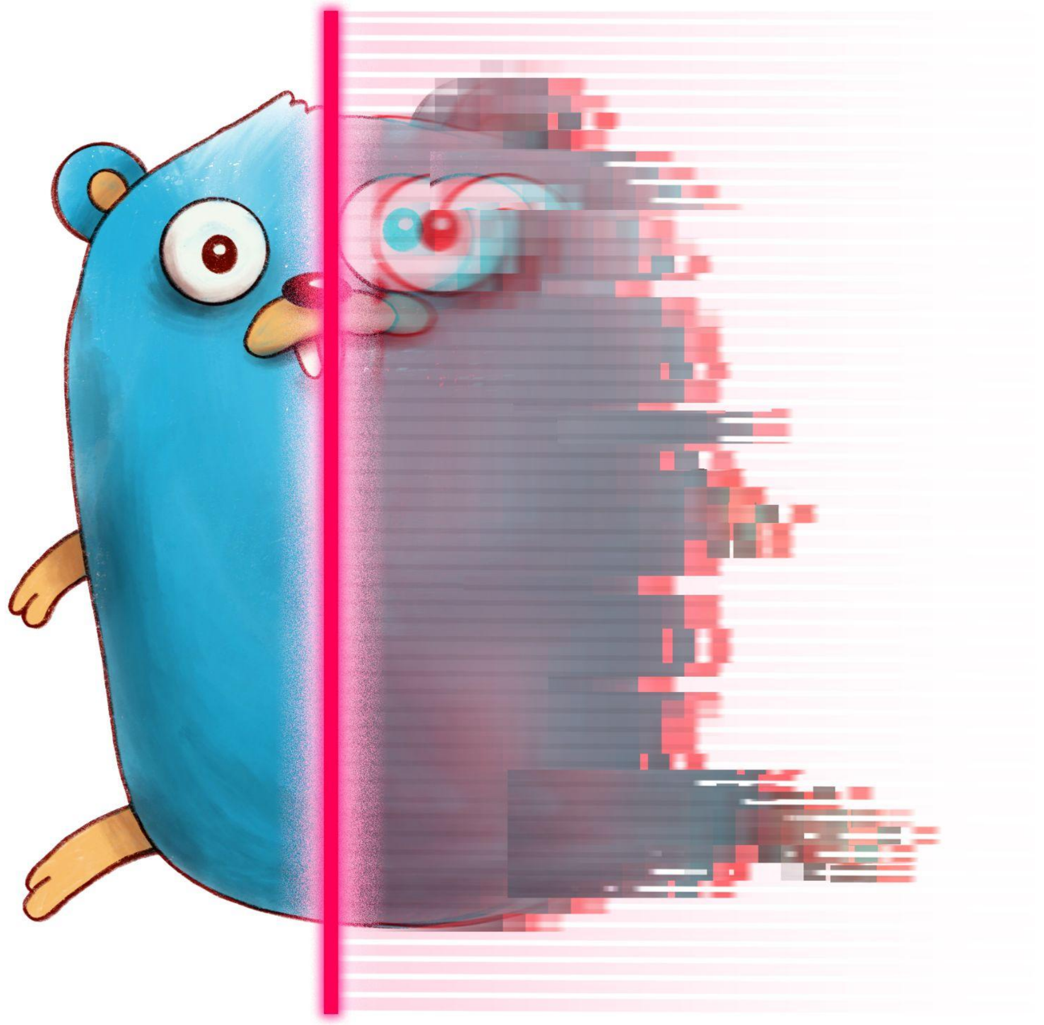
The Go Compiler

The Go Compiler

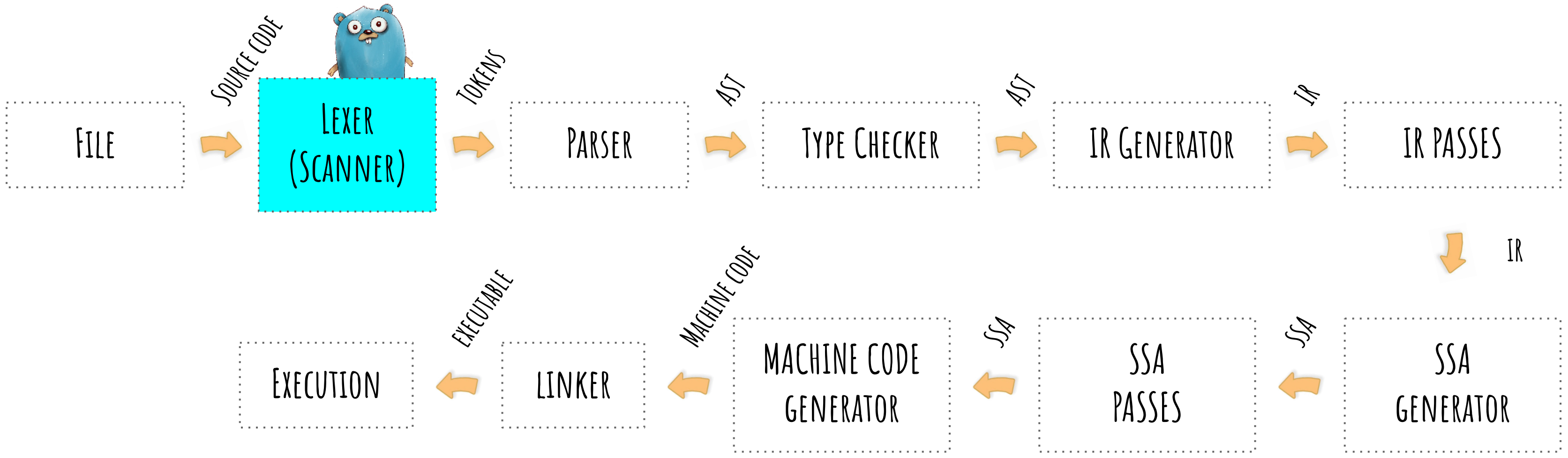
Phases of the Go Compiler



The Lexer (Scanner)



The Lexer (Scanner)



The Lexer (Scanner)

```
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

The Lexer (Scanner)

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
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The Lexer (Scanner)

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```

The Lexer (Scanner)

```
Line 1: package (package)
```

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

Generated with go/scanner package

The Lexer (Scanner)

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

```
Line 1: package (package)
Line 1: IDENT (main)
Line 1: ; ()
```

Generated with go/scanner package

The Lexer (Scanner)

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

```
Line 1: package (package)
Line 1: IDENT (main)
Line 1: ; ()
Line 3: import (import)
Line 3: STRING ("fmt")
Line 3: ; ()
```

Generated with go/scanner package

The Lexer (Scanner)

```
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

```
Line 1: package (package)
Line 1: IDENT (main)
Line 1: ; ()
Line 3: import (import)
Line 3: STRING ("fmt")
Line 3: ; ()
Line 5: func (func)
Line 5: IDENT (main)
Line 5: ( ()
Line 5: ) ()
Line 5: { ()
```

Generated with go/scanner package

The Lexer (Scanner)

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

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Line 1: package (package)
Line 1: IDENT (main)
Line 1: ; ()
Line 3: import (import)
Line 3: STRING ("fmt")
Line 3: ; ()
Line 5: func (func)
Line 5: IDENT (main)
Line 5: ( ()
Line 5: ) ()
Line 5: { ()
Line 6: IDENT (fmt)
Line 6: . ()
Line 6: IDENT (Println)
Line 6: ( ()
Line 6: STRING ("hello-world!")
Line 6: ) ()
Line 6: ; ()
Line 7: } ()
Line 7: ; ()
```

Generated with go/scanner package

Sample scanner cases

```
case ';':
    tok = token.SEMICOLON
    lit = ";"
```

```
case '.':
    tok = token.PERIOD
    if s.ch == '.' && s.peek() == '.' {
        s.next()
        s.next() // consume last '.'
        tok = token.ELLIPSIS
    }
```

```
func (s *Scanner) switch2(tok0, tok1 token.Token) token.Token {
    if s.ch == '=' {
        s.next()
        return tok1
    }
    return tok0
}
...
case '*':
    tok = s.switch2(token.MUL, token.MUL_ASSIGN)
```

```
src/cmd/compile/internal/syntax/scanner.go:152
src/cmd/compile/internal/syntax/scanner.go:181
src/cmd/compile/internal/syntax/scanner.go:219
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        s.next() // consume last '.'
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        s.next()
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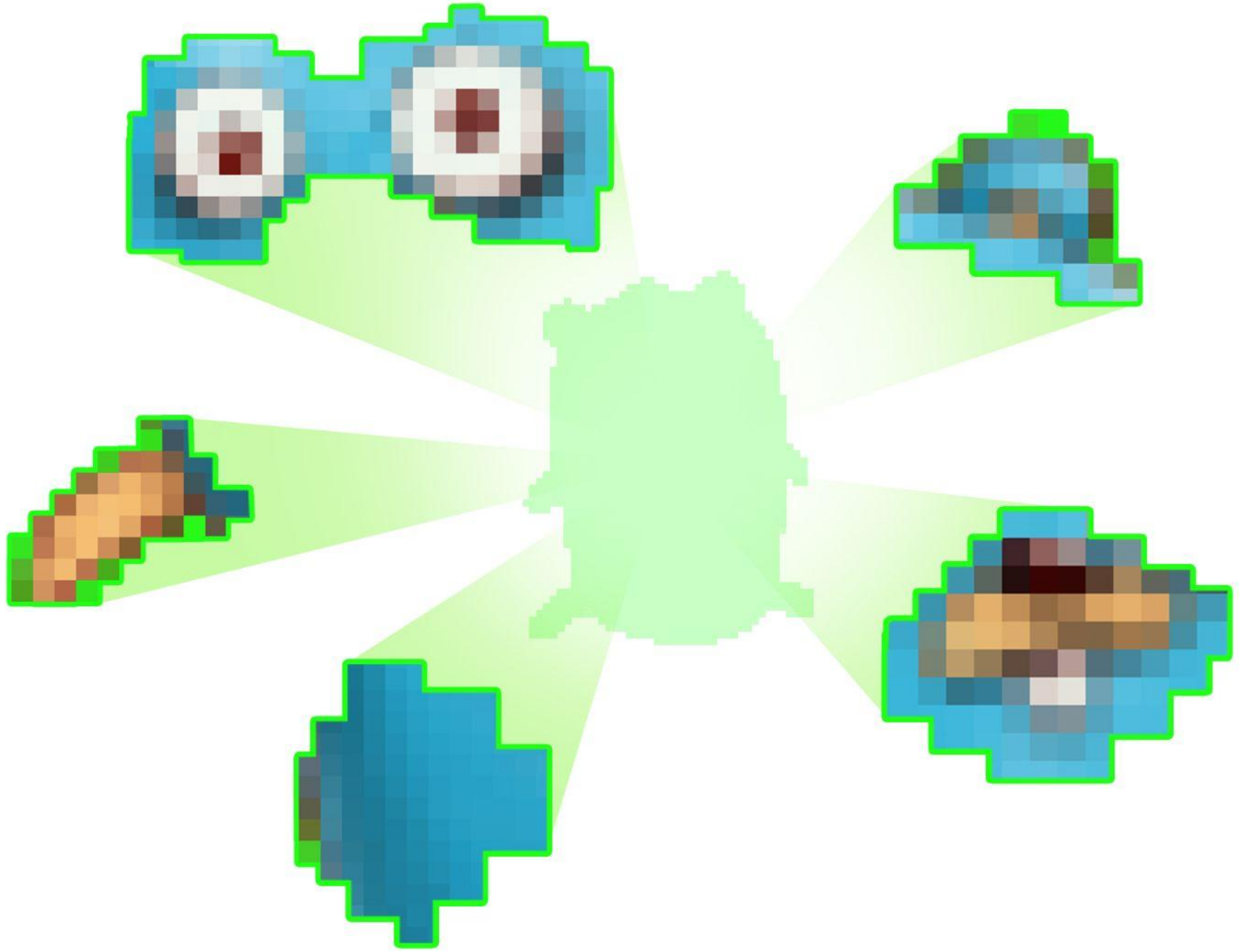
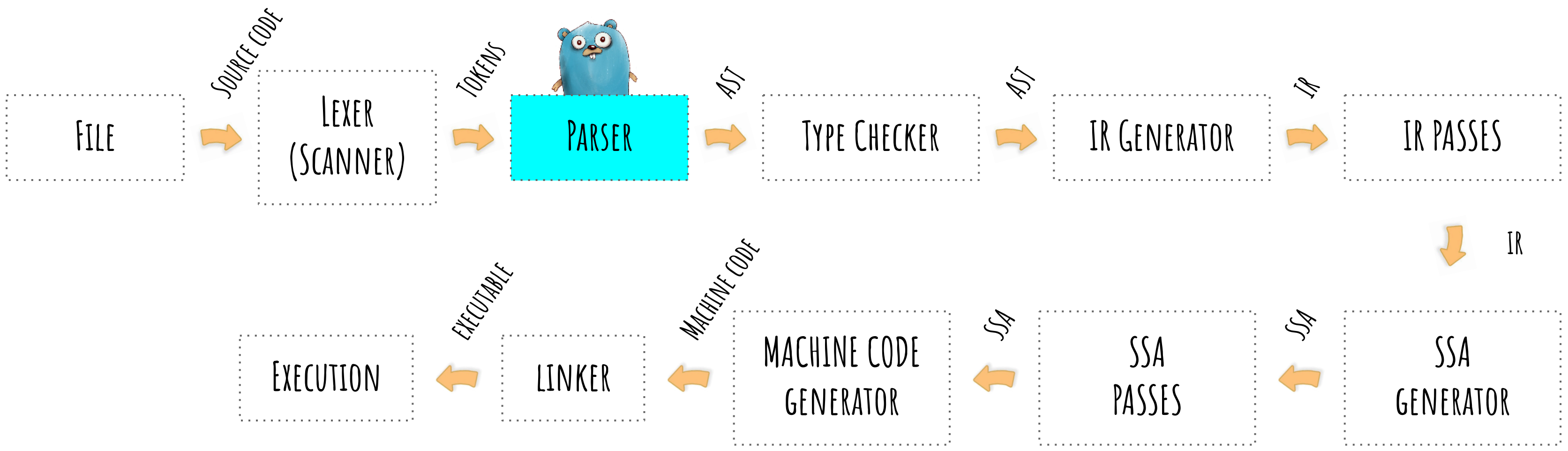
```

The Parser



The Parser


File
Source code
Lexer (Scanner)
Tokens
Parser
AST
Type Checker
AST
IR Generator
IR
IR Passes
IR
SSA Generator
SSA
SSA Passes
SSA
Machine code generator
Machine code
Linker
Executable
Execution

The Parser

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

```
 0  *ast.File {
 1  .  Package: helloworld.go:1:1
 2  .  Name: *ast.Ident {
 3  .  .  NamePos: helloworld.go:1:9
 4  .  .  Name: "main"
 5  .  }
 6  .  Decls: []ast.Decl (len = 2) {
 7  .  .  0: *ast.GenDecl {
 8  .  .  .  TokPos: helloworld.go:3:1
 9  .  .  .  Tok: import
10  .  .  .  Lparen: -
11  .  .  .  Specs: []ast.Spec (len = 1) {
12  .  .  .  .  0: *ast.ImportSpec {
13  .  .  .  .  .  Path: *ast.BasicLit {
14  .  .  .  .  .  .  ValuePos: helloworld.go:3:8
15  .  .  .  .  .  .  Kind: STRING
16  .  .  .  .  .  .  Value: "\"fmt\""
17  .  .  .  .  .  }
18  .  .  .  .  .  EndPos: -
19  .  .  .  .  }
20  .  .  .  }
21  .  .  .  Rparen: -
22  .  .  }
23  .  .  1: *ast.FuncDecl {
24  .  .  .  Name: *ast.Ident {
25  .  .  .  .  NamePos: helloworld.go:5:6
26  .  .  .  .  Name: "main"
27  .  .  .  .  Obj: *ast.Object {
28  .  .  .  .  .  Kind: func
29  .  .  .  .  .  Name: "main"
30  .  .  .  .  .  Decl: *(obj @ 23)
31  .  .  .  .  }
32  .  .  .  }
33  .  .  .  Type: *ast.FuncType {
34  .  .  .  .  Func: helloworld.go:5:1
35  .  .  .  .  Params: *ast.FieldList {
36  .  .  .  .  .  Opening: helloworld.go:5:10
37  .  .  .  .  .  Closing: helloworld.go:5:11
38  .  .  .  .  }
39  .  .  .  }
40  .  .  .  Body: *ast.BlockStmt {
41  .  .  .  .  Lbrace: helloworld.go:5:13
42  .  .  .  .  List: []ast.Stmt (len = 1) {
43  .  .  .  .  .  0: *ast.ExprStmt {
44  .  .  .  .  .  .  X: *ast.CallExpr {
45  .  .  .  .  .  .  .  Fun: *ast.SelectorExpr {
46  .  .  .  .  .  .  .  .  X: *ast.Ident {
47  .  .  .  .  .  .  .  .  .  NamePos: helloworld.go:6:2
48  .  .  .  .  .  .  .  .  .  Name: "fmt"
49  .  .  .  .  .  .  .  .  }
50  .  .  .  .  .  .  .  .  Sel: *ast.Ident {
51  .  .  .  .  .  .  .  .  .  NamePos: helloworld.go:6:6
52  .  .  .  .  .  .  .  .  .  Name: "Println"
53  .  .  .  .  .  .  .  .  }
54  .  .  .  .  .  .  .  }
55  .  .  .  .  .  .  .  Lparen: helloworld.go:6:13
56  .  .  .  .  .  .  .  Args: []ast.Expr (len = 1) {
57  .  .  .  .  .  .  .  .  0: *ast.BasicLit {
58  .  .  .  .  .  .  .  .  .  ValuePos: helloworld.go:6:14
59  .  .  .  .  .  .  .  .  .  Kind: STRING
60  .  .  .  .  .  .  .  .  .  Value: "\"hello-world!\""
61  .  .  .  .  .  .  .  .  }
62  .  .  .  .  .  .  .  }
63  .  .  .  .  .  .  .  Ellipsis: -
64  .  .  .  .  .  .  .  Rparen: helloworld.go:6:28
65  .  .  .  .  .  .  }
66  .  .  .  .  .  }
67  .  .  .  .  }
68  .  .  .  .  Rbrace: helloworld.go:7:1
69  .  .  .  }
70  .  .  }
71  .  }
72  .  Scope: *ast.Scope {
73  .  .  Objects: map[string]*ast.Object (len = 1) {
74  .  .  .  "main": *(obj @ 27)
75  .  .  }
76  .  }
77  .  Imports: []*ast.ImportSpec (len = 1) {
78  .  .  0: *(obj @ 12)
79  .  }
80  .  Unresolved: []*ast.Ident (len = 1) {
81  .  .  0: *(obj @ 46)
82  .  }
83  }
```

Generated with go/ast package

The Parser

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

```
 0  *ast.File {
 1  .  Package: helloworld.go:1:1
 2  .  Name: *ast.Ident {
 3  .  .  NamePos: helloworld.go:1:9
 4  .  .  Name: "main"
 5  .  }
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 7  .  .  0: *ast.GenDecl {
 8  .  .  .  TokPos: helloworld.go:3:1
 9  .  .  .  Tok: import
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11  .  .  .  Specs: []ast.Spec (len = 1) {
12  .  .  .  .  0: *ast.ImportSpec {
13  .  .  .  .  .  Path: *ast.BasicLit {
14  .  .  .  .  .  .  ValuePos: helloworld.go:3:8
15  .  .  .  .  .  .  Kind: STRING
16  .  .  .  .  .  .  Value: "\"fmt\""
17  .  .  .  .  .  }
18  .  .  .  .  .  EndPos: -
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29  .  .  .  .  .  Name: "main"
30  .  .  .  .  .  Decl: *(obj @ 23)
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33  .  .  .  Type: *ast.FuncType {
34  .  .  .  .  Func: helloworld.go:5:1
35  .  .  .  .  Params: *ast.FieldList {
36  .  .  .  .  .  Opening: helloworld.go:5:10
37  .  .  .  .  .  Closing: helloworld.go:5:11
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43  .  .  .  .  .  0: *ast.ExprStmt {
44  .  .  .  .  .  .  X: *ast.CallExpr {
45  .  .  .  .  .  .  .  Fun: *ast.SelectorExpr {
46  .  .  .  .  .  .  .  .  X: *ast.Ident {
47  .  .  .  .  .  .  .  .  .  NamePos: helloworld.go:6:2
48  .  .  .  .  .  .  .  .  .  Name: "fmt"
49  .  .  .  .  .  .  .  .  }
50  .  .  .  .  .  .  .  .  Sel: *ast.Ident {
51  .  .  .  .  .  .  .  .  .  NamePos: helloworld.go:6:6
52  .  .  .  .  .  .  .  .  .  Name: "Println"
53  .  .  .  .  .  .  .  .  }
54  .  .  .  .  .  .  .  }
55  .  .  .  .  .  .  .  Lparen: helloworld.go:6:13
56  .  .  .  .  .  .  .  Args: []ast.Expr (len = 1) {
57  .  .  .  .  .  .  .  .  0: *ast.BasicLit {
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59  .  .  .  .  .  .  .  .  .  Kind: STRING
60  .  .  .  .  .  .  .  .  .  Value: "\"hello-world!\""
61  .  .  .  .  .  .  .  .  }
62  .  .  .  .  .  .  .  }
63  .  .  .  .  .  .  .  Ellipsis: -
64  .  .  .  .  .  .  .  Rparen: helloworld.go:6:28
65  .  .  .  .  .  .  }
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Generated with go/ast package

The Parser

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package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
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 1  .  Package: helloworld.go:1:1
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 8  .  .  .  TokPos: helloworld.go:3:1
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13  .  .  .  .  .  Path: *ast.BasicLit {
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52  .  .  .  .  .  .  .  .  .  Name: "Println"
53  .  .  .  .  .  .  .  .  }
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58  .  .  .  .  .  .  .  .  .  ValuePos: helloworld.go:6:14
59  .  .  .  .  .  .  .  .  .  Kind: STRING
60  .  .  .  .  .  .  .  .  .  Value: "\"hello-world!\""
61  .  .  .  .  .  .  .  .  }
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75  .  .  }
76  .  }
77  .  Imports: []*ast.ImportSpec (len = 1) {
78  .  .  0: *(obj @ 12)
79  .  }
80  .  Unresolved: []*ast.Ident (len = 1) {
81  .  .  0: *(obj @ 46)
82  .  }
83  }
```

Generated with go/ast package

The Parser

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

```
 0  *ast.File {
 1  .  Package: helloworld.go:1:1
 2  .  Name: *ast.Ident {
 3  .  .  NamePos: helloworld.go:1:9
 4  .  .  Name: "main"
 5  .  }
 6  .  Decls: []ast.Decl (len = 2) {
 7  .  .  0: *ast.GenDecl {
 8  .  .  .  TokPos: helloworld.go:3:1
 9  .  .  .  Tok: import
10  .  .  .  Lparen: -
11  .  .  .  Specs: []ast.Spec (len = 1) {
12  .  .  .  .  0: *ast.ImportSpec {
13  .  .  .  .  .  Path: *ast.BasicLit {
14  .  .  .  .  .  .  ValuePos: helloworld.go:3:8
15  .  .  .  .  .  .  Kind: STRING
16  .  .  .  .  .  .  Value: "\"fmt\""
17  .  .  .  .  .  }
18  .  .  .  .  .  EndPos: -
19  .  .  .  .  }
20  .  .  .  }
21  .  .  .  Rparen: -
22  .  .  }
23  .  .  1: *ast.FuncDecl {
24  .  .  .  Name: *ast.Ident {
25  .  .  .  .  NamePos: helloworld.go:5:6
26  .  .  .  .  Name: "main"
27  .  .  .  .  Obj: *ast.Object {
28  .  .  .  .  .  Kind: func
29  .  .  .  .  .  Name: "main"
30  .  .  .  .  .  Decl: *(obj @ 23)
31  .  .  .  .  }
32  .  .  .  }
33  .  .  .  Type: *ast.FuncType {
34  .  .  .  .  Func: helloworld.go:5:1
35  .  .  .  .  Params: *ast.FieldList {
36  .  .  .  .  .  Opening: helloworld.go:5:10
37  .  .  .  .  .  Closing: helloworld.go:5:11
38  .  .  .  .  }
39  .  .  .  }
40  .  .  .  Body: *ast.BlockStmt {
41  .  .  .  .  Lbrace: helloworld.go:5:13
42  .  .  .  .  List: []ast.Stmt (len = 1) {
43  .  .  .  .  .  0: *ast.ExprStmt {
44  .  .  .  .  .  .  X: *ast.CallExpr {
45  .  .  .  .  .  .  .  Fun: *ast.SelectorExpr {
46  .  .  .  .  .  .  .  .  X: *ast.Ident {
47  .  .  .  .  .  .  .  .  .  NamePos: helloworld.go:6:2
48  .  .  .  .  .  .  .  .  .  Name: "fmt"
49  .  .  .  .  .  .  .  .  }
50  .  .  .  .  .  .  .  .  Sel: *ast.Ident {
51  .  .  .  .  .  .  .  .  .  NamePos: helloworld.go:6:6
52  .  .  .  .  .  .  .  .  .  Name: "Println"
53  .  .  .  .  .  .  .  .  }
54  .  .  .  .  .  .  .  }
55  .  .  .  .  .  .  .  Lparen: helloworld.go:6:13
56  .  .  .  .  .  .  .  Args: []ast.Expr (len = 1) {
57  .  .  .  .  .  .  .  .  0: *ast.BasicLit {
58  .  .  .  .  .  .  .  .  .  ValuePos: helloworld.go:6:14
59  .  .  .  .  .  .  .  .  .  Kind: STRING
60  .  .  .  .  .  .  .  .  .  Value: "\"hello-world!\""
61  .  .  .  .  .  .  .  .  }
62  .  .  .  .  .  .  .  }
63  .  .  .  .  .  .  .  Ellipsis: -
64  .  .  .  .  .  .  .  Rparen: helloworld.go:6:28
65  .  .  .  .  .  .  }
66  .  .  .  .  .  }
67  .  .  .  .  }
68  .  .  .  .  Rbrace: helloworld.go:7:1
69  .  .  .  }
70  .  .  }
71  .  }
72  .  Scope: *ast.Scope {
73  .  .  Objects: map[string]*ast.Object (len = 1) {
74  .  .  .  "main": *(obj @ 27)
75  .  .  }
76  .  }
77  .  Imports: []*ast.ImportSpec (len = 1) {
78  .  .  0: *(obj @ 12)
79  .  }
80  .  Unresolved: []*ast.Ident (len = 1) {
81  .  .  0: *(obj @ 46)
82  .  }
83  }
```

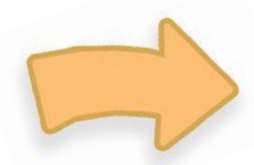
Generated with go/ast package

The Parser

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```



```
 0  *ast.File {
 1  .  Package: helloworld.go:1:1
 2  .  Name: *ast.Ident {
 3  .  .  NamePos: helloworld.go:1:9
 4  .  .  Name: "main"
 5  .  }
 6  .  Decls: []ast.Decl (len = 2) {
 7  .  .  0: *ast.GenDecl {
 8  .  .  .  TokPos: helloworld.go:3:1
 9  .  .  .  Tok: import
10  .  .  .  Lparen: -
11  .  .  .  Specs: []ast.Spec (len = 1) {
12  .  .  .  .  0: *ast.ImportSpec {
13  .  .  .  .  .  Path: *ast.BasicLit {
14  .  .  .  .  .  .  ValuePos: helloworld.go:3:8
15  .  .  .  .  .  .  Kind: STRING
16  .  .  .  .  .  .  Value: "\"fmt\""
17  .  .  .  .  .  }
18  .  .  .  .  .  EndPos: -
19  .  .  .  .  }
20  .  .  .  }
21  .  .  .  Rparen: -
22  .  .  }
23  .  .  1: *ast.FuncDecl {
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26  .  .  .  .  Name: "main"
27  .  .  .  .  Obj: *ast.Object {
28  .  .  .  .  .  Kind: func
29  .  .  .  .  .  Name: "main"
30  .  .  .  .  .  Decl: *(obj @ 23)
31  .  .  .  .  }
32  .  .  .  }
33  .  .  .  Type: *ast.FuncType {
34  .  .  .  .  Func: helloworld.go:5:1
35  .  .  .  .  Params: *ast.FieldList {
36  .  .  .  .  .  Opening: helloworld.go:5:10
37  .  .  .  .  .  Closing: helloworld.go:5:11
38  .  .  .  .  }
39  .  .  .  }
40  .  .  .  Body: *ast.BlockStmt {
41  .  .  .  .  Lbrace: helloworld.go:5:13
42  .  .  .  .  List: []ast.Stmt (len = 1) {
43  .  .  .  .  .  0: *ast.ExprStmt {
44  .  .  .  .  .  .  X: *ast.CallExpr {
45  .  .  .  .  .  .  .  Fun: *ast.SelectorExpr {
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47  .  .  .  .  .  .  .  .  .  NamePos: helloworld.go:6:2
48  .  .  .  .  .  .  .  .  .  Name: "fmt"
49  .  .  .  .  .  .  .  .  }
50  .  .  .  .  .  .  .  .  Sel: *ast.Ident {
51  .  .  .  .  .  .  .  .  .  NamePos: helloworld.go:6:6
52  .  .  .  .  .  .  .  .  .  Name: "Println"
53  .  .  .  .  .  .  .  .  }
54  .  .  .  .  .  .  .  }
55  .  .  .  .  .  .  .  Lparen: helloworld.go:6:13
56  .  .  .  .  .  .  .  Args: []ast.Expr (len = 1) {
57  .  .  .  .  .  .  .  .  0: *ast.BasicLit {
58  .  .  .  .  .  .  .  .  .  ValuePos: helloworld.go:6:14
59  .  .  .  .  .  .  .  .  .  Kind: STRING
60  .  .  .  .  .  .  .  .  .  Value: "\"hello-world!\""
61  .  .  .  .  .  .  .  .  }
62  .  .  .  .  .  .  .  }
63  .  .  .  .  .  .  .  Ellipsis: -
64  .  .  .  .  .  .  .  Rparen: helloworld.go:6:28
65  .  .  .  .  .  .  }
66  .  .  .  .  .  }
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72  .  Scope: *ast.Scope {
73  .  .  Objects: map[string]*ast.Object (len = 1) {
74  .  .  .  "main": *(obj @ 27)
75  .  .  }
76  .  }
77  .  Imports: []*ast.ImportSpec (len = 1) {
78  .  .  0: *(obj @ 12)
79  .  }
80  .  Unresolved: []*ast.Ident (len = 1) {
81  .  .  0: *(obj @ 46)
82  .  }
83  }
```

Generated with go/ast package

The Parser

```
Line 1: package (package)
Line 1: IDENT (main)
Line 1: ; ()
Line 3: import (import)
Line 3: STRING ("fmt")
Line 3: ; ()
Line 5: func (func)
Line 5: IDENT (main)
Line 5: ( ()
Line 5: ) ()
Line 5: { ()
Line 6: IDENT (fmt)
Line 6: . ()
Line 6: IDENT (Println)
Line 6: ( ()
Line 6: STRING ("hello-world!")
Line 6: ) ()
Line 6: ; ()
Line 7: } ()
Line 7: ; ()
```

```
 0  *ast.File {
 1  .  Package: helloworld.go:1:1
 2  .  Name: nil
 6  .  Decls: []ast.Decl (len = 0) {
71  .  }
72  .  Scope: *ast.Scope {
76  .  }
77  .  Imports: []*ast.ImportSpec (len = 0) {
79  .  }
80  .  Unresolved: []*ast.Ident (len = 0) {
82  .  }
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```

Generated with go/ast package

The Parser

```
Line 1: package (package)
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Line 5: ) ()
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Line 6: IDENT (fmt)
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Line 6: IDENT (Println)
Line 6: ( ()
Line 6: STRING ("hello-world!")
Line 6: ) ()
Line 6: ; ()
Line 7: } ()
Line 7: ; ()
```

```
 0  *ast.File {
 1  .  Package: helloworld.go:1:1
 2  .  Name: nil
 6  .  Decls: []ast.Decl (len = 0) {
71  .  }
72  .  Scope: *ast.Scope {
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Generated with go/ast package

The Parser

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Line 6: ( ()
Line 6: STRING ("hello-world!")
Line 6: ) ()
Line 6: ; ()
Line 7: } ()
Line 7: ; ()
```

```
 0  *ast.File {
 1  .  Package: helloworld.go:1:1
 2  .  Name: *ast.Ident {
 3  .  .  NamePos: helloworld.go:1:9
 4  .  .  Name: "main"
 5  .  }
 6  .  Decls: []ast.Decl (len = 0) {
71  .  }
72  .  Scope: *ast.Scope {
76  .  }
77  .  Imports: []*ast.ImportSpec (len = 0) {
79  .  }
80  .  Unresolved: []*ast.Ident (len = 0) {
82  .  }
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```

Generated with go/ast package

The Parser

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Line 6: IDENT (Println)
Line 6: ( ()
Line 6: STRING ("hello-world!")
Line 6: ) ()
Line 6: ; ()
Line 7: } ()
Line 7: ; ()
```

```
 0  *ast.File {
 1  .  Package: helloworld.go:1:1
 2  .  Name: *ast.Ident {
 3  .  .  NamePos: helloworld.go:1:9
 4  .  .  Name: "main"
 5  .  }
 6  .  Decls: []ast.Decl (len = 1) {
 7  .  .  0: *ast.GenDecl {
 8  .  .  .  TokPos: helloworld.go:3:1
 9  .  .  .  Tok: import
10  .  .  .  Lparen: -
11  .  .  .  Specs: []ast.Spec (len = 0) {
12  .  .  .  .  0: *ast.ImportSpec {
20  .  .  .  }
21  .  .  .  Rparen: -
22  .  .  }
71  .  }
72  .  Scope: *ast.Scope {
76  .  }
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82  .  }
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```

Generated with go/ast package

The Parser

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Line 1: package (package)
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Line 6: IDENT (fmt)
Line 6: . ()
Line 6: IDENT (Println)
Line 6: ( ()
Line 6: STRING ("hello-world!")
Line 6: ) ()
Line 6: ; ()
Line 7: } ()
Line 7: ; ()
```

```
 0  *ast.File {
 1  .  Package: helloworld.go:1:1
 2  .  Name: *ast.Ident {
 3  .  .  NamePos: helloworld.go:1:9
 4  .  .  Name: "main"
 5  .  }
 6  .  Decls: []ast.Decl (len = 1) {
 7  .  .  0: *ast.GenDecl {
 8  .  .  .  TokPos: helloworld.go:3:1
 9  .  .  .  Tok: import
10  .  .  .  Lparen: -
11  .  .  .  Specs: []ast.Spec (len = 1) {
12  .  .  .  .  0: *ast.ImportSpec {
13  .  .  .  .  .  Path: *ast.BasicLit {
14  .  .  .  .  .  .  ValuePos: helloworld.go:3:8
15  .  .  .  .  .  .  Kind: STRING
16  .  .  .  .  .  .  Value: "\"fmt\""
17  .  .  .  .  .  }
18  .  .  .  .  .  EndPos: -
19  .  .  .  .  }
20  .  .  .  }
21  .  .  .  Rparen: -
22  .  .  }
71  .  }
72  .  Scope: *ast.Scope {
76  .  }
77  .  Imports: []*ast.ImportSpec (len = 1) {
78  .  .  0: *(obj @ 12)
79  .  }
80  .  Unresolved: []*ast.Ident (len = 0) {
82  .  }
83  }
```

Generated with go/ast package

Sample Parser Functions

```go
// ImportSpec = [ "." | PackageName ] ImportPath .
// ImportPath = string_lit .
func (p *parser) importDecl(group *Group) Decl {
	if trace {
		defer p.trace("importDecl")()
	}

	d := new(ImportDecl)
	d.pos = p.pos()
	d.Group = group
	d.Pragma = p.takePragma()

	switch p.tok {
	case _Name:
		d.LocalPkgName = p.name()
	case _Dot:
		d.LocalPkgName = NewName(p.pos(), ".")
		p.next()
	}
	d.Path = p.oliteral()
	if d.Path == nil {
		p.syntaxError("missing import path")
		p.advance(_Semi, _Rparen)
		return d
	}
	if !d.Path.Bad && d.Path.Kind != StringLit {
		p.syntaxError("import path must be a string")
		d.Path.Bad = true
	}
	// d.Path.Bad || d.Path.Kind == StringLit

	return d
}
```

src/cmd/compile/internal/syntax/parser.go:520

Sample Parser Functions

```go
// ImportSpec = [ "." | PackageName ] ImportPath .
// ImportPath = string_lit .
func (p *parser) importDecl(group *Group) Decl {
	if trace {
		defer p.trace("importDecl")()
	}

	d := new(ImportDecl)
	d.pos = p.pos()
	d.Group = group
	d.Pragma = p.takePragma()

	switch p.tok {
	case _Name:
		d.LocalPkgName = p.name()
	case _Dot:
		d.LocalPkgName = NewName(p.pos(), ".")
		p.next()
	}
	d.Path = p.oliteral()
	if d.Path == nil {
		p.syntaxError("missing import path")
		p.advance(_Semi, _Rparen)
		return d
	}
	if !d.Path.Bad && d.Path.Kind != StringLit {
		p.syntaxError("import path must be a string")
		d.Path.Bad = true
	}
	// d.Path.Bad || d.Path.Kind == StringLit

	return d
}
```

src/cmd/compile/internal/syntax/parser.go:520

Sample Parser Functions

```
// ImportSpec = [ "." | PackageName ] ImportPath .
// ImportPath = string_lit .
func (p *parser) importDecl(group *Group) Decl {
	if trace {
		defer p.trace("importDecl")()
	}

	d := new(ImportDecl)
	d.pos = p.pos()
	d.Group = group
	d.Pragma = p.takePragma()

	switch p.tok {
	case _Name:
		d.LocalPkgName = p.name()
	case _Dot:
		d.LocalPkgName = NewName(p.pos(), ".")
		p.next()
	}
	d.Path = p.oliteral()
	if d.Path == nil {
		p.syntaxError("missing import path")
		p.advance(_Semi, _Rparen)
		return d
	}
	if !d.Path.Bad && d.Path.Kind != StringLit {
		p.syntaxError("import path must be a string")
		d.Path.Bad = true
	}
	// d.Path.Bad || d.Path.Kind == StringLit

	return d
}
```

src/cmd/compile/internal/syntax/parser.go:520

Sample Parser Functions

```
// ImportSpec = [ "." | PackageName ] ImportPath .
// ImportPath = string_lit .
func (p *parser) importDecl(group *Group) Decl {
	if trace {
		defer p.trace("importDecl")()
	}

	d := new(ImportDecl)
	d.pos = p.pos()
	d.Group = group
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	switch p.tok {
	case _Name:
		d.LocalPkgName = p.name()
	case _Dot:
		d.LocalPkgName = NewName(p.pos(), ".")
		p.next()
	}
	d.Path = p.oliteral()
	if d.Path == nil {
		p.syntaxError("missing import path")
		p.advance(_Semi, _Rparen)
		return d
	}
	if !d.Path.Bad && d.Path.Kind != StringLit {
		p.syntaxError("import path must be a string")
		d.Path.Bad = true
	}
	// d.Path.Bad || d.Path.Kind == StringLit

	return d
}
```

src/cmd/compile/internal/syntax/parser.go:520

Sample Parser Functions

```
// ImportSpec = [ "." | PackageName ] ImportPath .
// ImportPath = string_lit .
func (p *parser) importDecl(group *Group) Decl {
        if trace {
                defer p.trace("importDecl")()
        }

        d := new(ImportDecl)
        d.pos = p.pos()
        d.Group = group
        d.Pragma = p.takePragma()

        switch p.tok {
        case _Name:
                d.LocalPkgName = p.name()
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                d.LocalPkgName = NewName(p.pos(), ".")
                p.next()
        }
        d.Path = p.oliteral()
        if d.Path == nil {
                p.syntaxError("missing import path")
                p.advance(_Semi, _Rparen)
                return d
        }
        if !d.Path.Bad && d.Path.Kind != StringLit {
                p.syntaxError("import path must be a string")
                d.Path.Bad = true
        }
        // d.Path.Bad || d.Path.Kind == StringLit

        return d
}
```

src/cmd/compile/internal/syntax/parser.go:520

Sample Parser Functions

```
// ImportSpec = [ "." | PackageName ] ImportPath .
// ImportPath = string_lit .
func (p *parser) importDecl(group *Group) Decl {
	if trace {
		defer p.trace("importDecl")()
	}

	d := new(ImportDecl)
	d.pos = p.pos()
	d.Group = group
	d.Pragma = p.takePragma()

	switch p.tok {
	case _Name:
		d.LocalPkgName = p.name()
	case _Dot:
		d.LocalPkgName = NewName(p.pos(), ".")
		p.next()
	}
	d.Path = p.oliteral()
	if d.Path == nil {
		p.syntaxError("missing import path")
		p.advance(_Semi, _Rparen)
		return d
	}
	if !d.Path.Bad && d.Path.Kind != StringLit {
		p.syntaxError("import path must be a string")
		d.Path.Bad = true
	}
	// d.Path.Bad || d.Path.Kind == StringLit

	return d
}
```

src/cmd/compile/internal/syntax/parser.go:520

Sample Parser Functions

```go
// FunctionDecl = "func" FunctionName [ TypeParams ] ( Function | Signature ) .
// FunctionName = identifier .
// Function     = Signature FunctionBody .
// MethodDecl   = "func" Receiver MethodName ( Function | Signature ) .
// Receiver     = Parameters .
func (p *parser) funcDeclOrNil() *FuncDecl {
	if trace {
		defer p.trace("funcDecl")()
	}

	f := new(FuncDecl)
	f.pos = p.pos()
	f.Pragma = p.takePragma()

	if p.got(_Lparen) {
		rcvr := p.paramList(nil, nil, _Rparen, false)
		switch len(rcvr) {
		case 0:
			p.error("method has no receiver")
		default:
			p.error("method has multiple receivers")
			fallthrough
		case 1:
			f.Recv = rcvr[0]
		}
	}

	if p.tok != _Name {
		p.syntaxError("expecting name or (")
		p.advance(_Lbrace, _Semi)
		return nil
	}

	f.Name = p.name()

	context := ""
	if f.Recv != nil {
		context = "method" // don't permit (method) type parameters in funcType
	}
	f.TParamList, f.Type = p.funcType(context)

	if p.tok == _Lbrace {
		f.Body = p.funcBody()
	}

	return f
}
```

src/cmd/compile/internal/syntax/parser.go:754

Sample Parser Functions

```
// FunctionDecl = "func" FunctionName [ TypeParams ] ( Function | Signature ) .
// FunctionName = identifier .
// Function     = Signature FunctionBody .
// MethodDecl   = "func" Receiver MethodName ( Function | Signature ) .
// Receiver     = Parameters .
func (p *parser) funcDeclOrNil() *FuncDecl {
	if trace {
		defer p.trace("funcDecl")()
	}

	f := new(FuncDecl)
	f.pos = p.pos()
	f.Pragma = p.takePragma()

	if p.got(_Lparen) {
		rcvr := p.paramList(nil, nil, _Rparen, false)
		switch len(rcvr) {
		case 0:
			p.error("method has no receiver")
		default:
			p.error("method has multiple receivers")
			fallthrough
		case 1:
			f.Recv = rcvr[0]
		}
	}

	if p.tok != _Name {
		p.syntaxError("expecting name or (")
		p.advance(_Lbrace, _Semi)
		return nil
	}

	f.Name = p.name()

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	}
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		f.Body = p.funcBody()
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}
```

src/cmd/compile/internal/syntax/parser.go:754

Sample Parser Functions

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// FunctionDecl = "func" FunctionName [ TypeParams ] ( Function | Signature ) .
// FunctionName = identifier .
// Function     = Signature FunctionBody .
// MethodDecl   = "func" Receiver MethodName ( Function | Signature ) .
// Receiver     = Parameters .
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	}

	f := new(FuncDecl)
	f.pos = p.pos()
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	if p.got(_Lparen) {
		rcvr := p.paramList(nil, nil, _Rparen, false)
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			p.error("method has no receiver")
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src/cmd/compile/internal/syntax/parser.go:754

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		default:
			p.error("method has multiple receivers")
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		p.syntaxError("expecting name or (")
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	f.Name = p.name()

	context := ""
	if f.Recv != nil {
		context = "method" // don't permit (method) type parameters in funcType
	}
	f.TParamList, f.Type = p.funcType(context)

	if p.tok == _Lbrace {
		f.Body = p.funcBody()
	}

	return f
}
```

src/cmd/compile/internal/syntax/parser.go:754

Sample Parser Functions

```go
// FunctionDecl = "func" FunctionName [ TypeParams ] ( Function | Signature ) .
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src/cmd/compile/internal/syntax/parser.go:754

Sample Parser Functions

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                rcvr := p.paramList(nil, nil, _Rparen, false)
                switch len(rcvr) {
                case 0:
                        p.error("method has no receiver")
                default:
                        p.error("method has multiple receivers")
                        fallthrough
                case 1:
                        f.Recv = rcvr[0]
                }
        }

        if p.tok != _Name {
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        }

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src/cmd/compile/internal/syntax/parser.go:754

Sample Parser Functions

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	}

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	if f.Recv != nil {
		context = "method" // don't permit (method) type parameters in funcType
	}
	f.TParamList, f.Type = p.funcType(context)

	if p.tok == _Lbrace {
		f.Body = p.funcBody()
	}

	return f
}
```
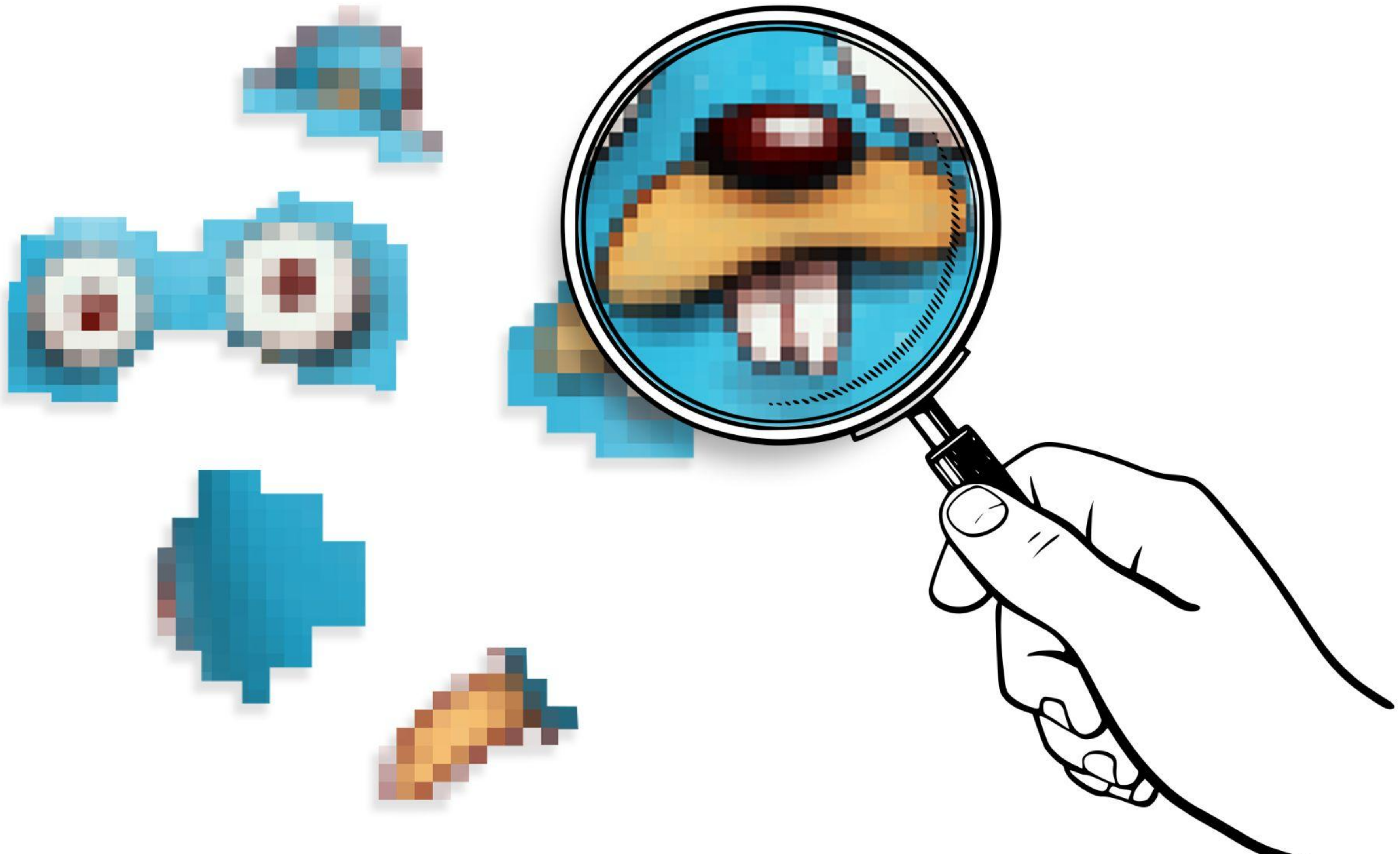
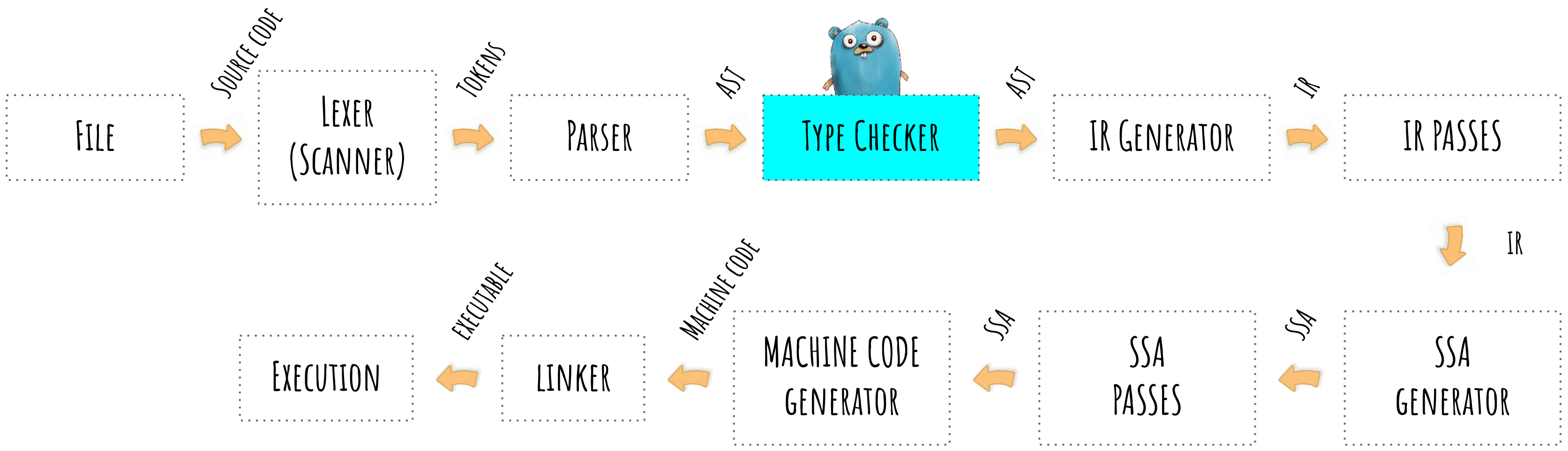

src/cmd/compile/internal/syntax/parser.go:754

Type Checker

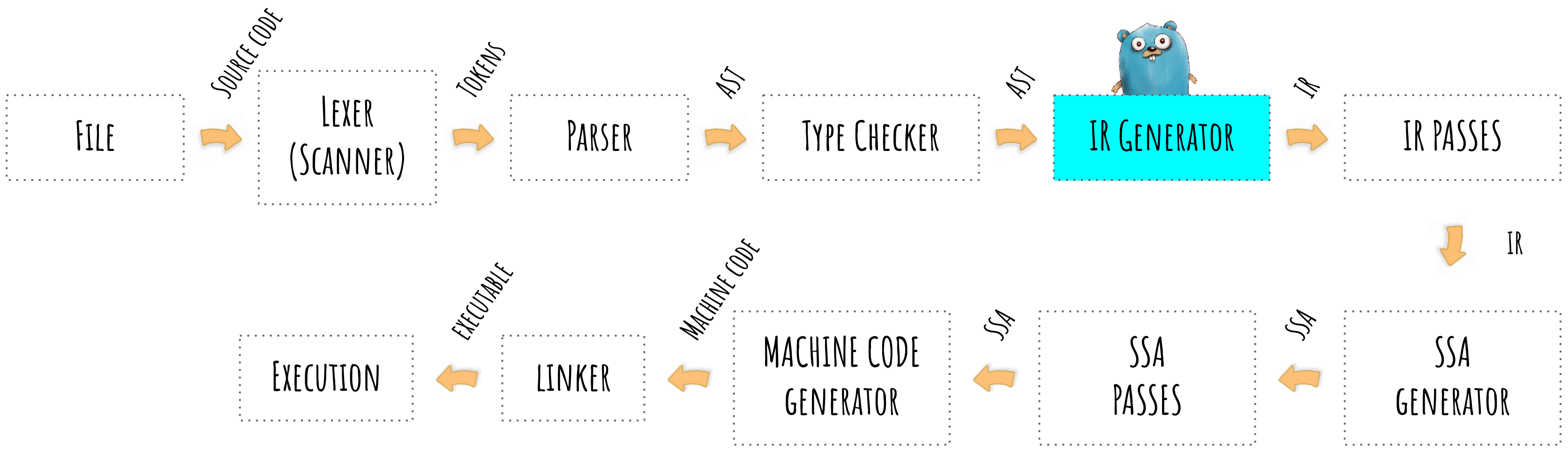


Type Checker



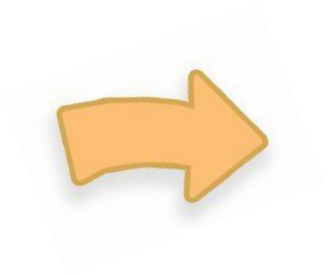
The IR

The IR


File
Source code
Lexer (Scanner)
Tokens
Parser
AST
Type Checker
AST
IR Generator
IR
IR Passes
IR
SSA Generator
SSA
SSA Passes
SSA
Machine code generator
Machine code
Linker
Executable
Execution

The IR

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

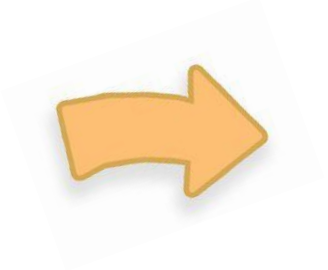


```
*ir.Package {
.   Imports: []*types.Pkg (1 entries) {
.   .   0: *types.Pkg {
.   .   .   Path: "fmt"
.   .   .   Name: "fmt"
.   .   .   Prefix: "fmt"
.   .   .   Syms: map[.inittask:fmt..inittask Append:fmt.Append …]
.   .   .   Height: 10
.   .   .   Direct: true
.   .   .   …
.   .   }
.   }
.   Decls: []ir.Node (1 entries) {
.   .   0: *ir.Func {
.   .   .   Body: ir.Nodes (1 entries) {
.   .   .   .   0: *ir.CallExpr {
.   .   .   .   .   X: *ir.Name {
.   .   .   .   .   .   Class: PFUNC
.   .   .   .   .   .   Func: *ir.Func {
.   .   .   .   .   .   .   Nname: *(@17)
.   .   .   .   .   .   .   FieldTrack: map[]
.   .   .   .   .   .   .   Inl: *ir.Inline {
.   .   .   .   .   .   .   .   Cost: 72
.   .   .   .   .   .   .   .   …
.   .   .   .   .   .   .   }
.   .   .   .   .   .   .   Endlineno: $GOROOT/src/fmt/print.go:295:1
.   .   .   .   .   .   .   WBPos: <unknown line number>
.   .   .   .   .   .   .   ABI: ABIInternal
.   .   .   .   .   .   .   …
.   .   .   .   .   .   }
.   .   .   .   .   .   …
.   .   .   .   .   }
.   .   .   .   .   Args: ir.Nodes (1 entries) {
.   .   .   .   .   .   0: *ir.ConvExpr {
.   .   .   .   .   .   .   X: *ir.ConstExpr {}
.   .   .   .   .   .   }
.   .   .   .   .   }
.   .   .   .   .   …
.   .   .   .   }
.   .   .   }
.   .   .   Nname: *ir.Name {
.   .   .   .   Class: PFUNC
.   .   .   .   Func: *(@14)
.   .   .   .   Defn: *(@14)
.   .   .   .   …
.   .   .   }
.   .   .   Parents: []ir.ScopeID (0 entries) {}
.   .   .   Marks: []ir.Mark (0 entries) {}
.   .   .   FieldTrack: map[]
.   .   .   Endlineno: ../hello.go:7:1
.   .   .   WBPos: <unknown line number>
.   .   .   ABI: ABIInternal
.   .   .   …
.   .   }
.   }
.   …
}
```

Generated with go/src/cmd/compile/internal/ir.DumpAny function

The IR

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```



```
 1  *ir.Package {
 2  .   Imports: []*types.Pkg (1 entries) {
 3  .   .   0: *types.Pkg {
 4  .   .   .   Path: "fmt"
 5  .   .   .   Name: "fmt"
 6  .   .   .   Prefix: "fmt"
 7  .   .   .   Syms: map[.inittask:fmt..inittask Append:fmt.Append …]
 8  .   .   .   Height: 10
 9  .   .   .   Direct: true
10  .   .   .   …
11  .   .   }
12  .   }
13  .   Decls: []ir.Node (1 entries) {
14  .   .   0: *ir.Func {
15  .   .   .   Body: ir.Nodes (1 entries) {
16  .   .   .   .   0: *ir.CallExpr {
17  .   .   .   .   .   X: *ir.Name {
18  .   .   .   .   .   .   Class: PFUNC
19  .   .   .   .   .   .   Func: *ir.Func {
20  .   .   .   .   .   .   .   Nname: *(@17)
21  .   .   .   .   .   .   .   FieldTrack: map[]
22  .   .   .   .   .   .   .   Inl: *ir.Inline {
23  .   .   .   .   .   .   .   .   Cost: 72
24  .   .   .   .   .   .   .   .   …
25  .   .   .   .   .   .   .   }
26  .   .   .   .   .   .   .   Endlineno: $GOROOT/src/fmt/print.go:295:1
27  .   .   .   .   .   .   .   WBPos: <unknown line number>
28  .   .   .   .   .   .   .   ABI: ABIInternal
29  .   .   .   .   .   .   .   …
30  .   .   .   .   .   .   }
31  .   .   .   .   .   .   …
32  .   .   .   .   .   }
33  .   .   .   .   .   Args: ir.Nodes (1 entries) {
34  .   .   .   .   .   .   0: *ir.ConvExpr {
35  .   .   .   .   .   .   .   X: *ir.ConstExpr {}
36  .   .   .   .   .   .   }
37  .   .   .   .   .   }
38  .   .   .   .   .   …
39  .   .   .   .   }
40  .   .   .   }
41  .   .   .   Nname: *ir.Name {
42  .   .   .   .   Class: PFUNC
43  .   .   .   .   Func: *(@14)
44  .   .   .   .   Defn: *(@14)
45  .   .   .   .   …
46  .   .   .   }
47  .   .   .   Parents: []ir.ScopeID (0 entries) {}
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50  .   .   .   Endlineno: ../hello.go:7:1
51  .   .   .   WBPos: <unknown line number>
52  .   .   .   ABI: ABIInternal
53  .   .   .   …
54  .   .   }
55  .   }
56  .   …
57  }
```

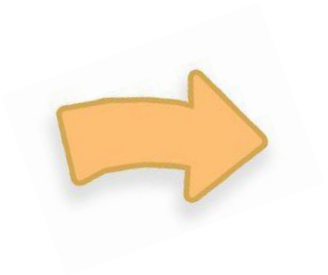
Generated with go/src/cmd/compile/internal/ir.DumpAny function

The IR

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```



```
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10  .   .   .   …
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13  .   Decls: []ir.Node (1 entries) {
14  .   .   0: *ir.Func {
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16  .   .   .   .   0: *ir.CallExpr {
17  .   .   .   .   .   X: *ir.Name {
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54  .   .   }
55  .   }
56  .   …
57  }
```

Generated with go/src/cmd/compile/internal/ir.DumpAny function

The IR

```go
package main

import "fmt"

func main() {
	fmt.Println("hello world!")
}
```

```
 1  *ir.Package {
 2  .   Imports: []*types.Pkg (1 entries) {
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50  .   .   .   Endlineno: ../hello.go:7:1
51  .   .   .   WBPos: <unknown line number>
52  .   .   .   ABI: ABIInternal
53  .   .   .   …
54  .   .   }
55  .   }
56  .   …
57  }
```

Generated with go/src/cmd/compile/internal/ir.DumpAny function

The IR Generation functions

```go
func (g *irgen) constDecl(out *ir.Nodes, decl *syntax.ConstDecl) {
	g.pragmaFlags(decl.Pragma, 0)

	for _, name := range decl.NameList {
		name, obj := g.def(name)

		// For untyped numeric constants, make sure the value
		// representation matches what the rest of the
		// compiler (really just iexport) expects.
		// TODO(mdempsky): Revisit after #43891 is resolved.
		val := obj.(*types2.Const).Val()
		switch name.Type() {
		case types.UntypedInt, types.UntypedRune:
			val = constant.ToInt(val)
		case types.UntypedFloat:
			val = constant.ToFloat(val)
		case types.UntypedComplex:
			val = constant.ToComplex(val)
		}
		name.SetVal(val)

		out.Append(ir.NewDecl(g.pos(decl), ir.ODCLCONST, name))
	}
}
```

```go
func (g *irgen) funcDecl(out *ir.Nodes, decl *syntax.FuncDecl) {
	... // Omitted code

	fn := ir.NewFunc(g.pos(decl))
	fn.Nname, _ = g.def(decl.Name)
	fn.Nname.Func = fn
	fn.Nname.Defn = fn

	... // Omitted code

	if decl.Name.Value == "init" && decl.Recv == nil {
		g.target.Inits = append(g.target.Inits, fn)
	}

	saveHaveEmbed := g.haveEmbed
	saveCurDecl := g.curDecl
	g.curDecl = ""
	g.later(func() {
		defer func(b bool, s string) {
			g.haveEmbed = b
			g.curDecl = s
		}(g.haveEmbed, g.curDecl)

		g.haveEmbed = saveHaveEmbed
		g.curDecl = saveCurDecl
		if fn.Type().HasTParam() {
			g.topFuncIsGeneric = true
		}
		g.funcBody(fn, decl.Recv, decl.Type, decl.Body)
		g.topFuncIsGeneric = false
		if fn.Type().HasTParam() && fn.Body != nil {
			fn.Inl = &ir.Inline{
				Cost: 1,
				Dcl:  fn.Dcl,
				Body: fn.Body,
			}
		}

		out.Append(fn)
	})
}
```

src/cmd/compile/internal/noder/decl.go:63
src/cmd/compile/internal/noder/decl.go:88

The IR Generation functions

```go
func (g *irgen) constDecl(out *ir.Nodes, decl *syntax.ConstDecl) {
	g.pragmaFlags(decl.Pragma, 0)

	for _, name := range decl.NameList {
		name, obj := g.def(name)

		// For untyped numeric constants, make sure the value
		// representation matches what the rest of the
		// compiler (really just iexport) expects.
		// TODO(mdempsky): Revisit after #43891 is resolved.
		val := obj.(*types2.Const).Val()
		switch name.Type() {
		case types.UntypedInt, types.UntypedRune:
			val = constant.ToInt(val)
		case types.UntypedFloat:
			val = constant.ToFloat(val)
		case types.UntypedComplex:
			val = constant.ToComplex(val)
		}
		name.SetVal(val)

		out.Append(ir.NewDecl(g.pos(decl), ir.ODCLCONST, name))
	}
}
```

```go
func (g *irgen) funcDecl(out *ir.Nodes, decl *syntax.FuncDecl) {
	... // Omitted code

	fn := ir.NewFunc(g.pos(decl))
	fn.Nname, _ = g.def(decl.Name)
	fn.Nname.Func = fn
	fn.Nname.Defn = fn

	... // Omitted code

	if decl.Name.Value == "init" && decl.Recv == nil {
		g.target.Inits = append(g.target.Inits, fn)
	}

	saveHaveEmbed := g.haveEmbed
	saveCurDecl := g.curDecl
	g.curDecl = ""
	g.later(func() {
		defer func(b bool, s string) {
			g.haveEmbed = b
			g.curDecl = s
		}(g.haveEmbed, g.curDecl)

		g.haveEmbed = saveHaveEmbed
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		if fn.Type().HasTParam() {
			g.topFuncIsGeneric = true
		}
		g.funcBody(fn, decl.Recv, decl.Type, decl.Body)
		g.topFuncIsGeneric = false
		if fn.Type().HasTParam() && fn.Body != nil {
			fn.Inl = &ir.Inline{
				Cost: 1,
				Dcl:  fn.Dcl,
				Body: fn.Body,
			}
		}

		out.Append(fn)
	})
}
```

src/cmd/compile/internal/noder/decl.go:63
src/cmd/compile/internal/noder/decl.go:88

The IR Generation functions

```go
func (g *irgen) constDecl(out *ir.Nodes, decl *syntax.ConstDecl) {
	g.pragmaFlags(decl.Pragma, 0)

	for _, name := range decl.NameList {
		name, obj := g.def(name)

		// For untyped numeric constants, make sure the value
		// representation matches what the rest of the
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			val = constant.ToFloat(val)
		case types.UntypedComplex:
			val = constant.ToComplex(val)
		}
		name.SetVal(val)

		out.Append(ir.NewDecl(g.pos(decl), ir.ODCLCONST, name))
	}
}
```

```go
func (g *irgen) funcDecl(out *ir.Nodes, decl *syntax.FuncDecl) {
	... // Omitted code

	fn := ir.NewFunc(g.pos(decl))
	fn.Nname, _ = g.def(decl.Name)
	fn.Nname.Func = fn
	fn.Nname.Defn = fn

	... // Omitted code

	if decl.Name.Value == "init" && decl.Recv == nil {
		g.target.Inits = append(g.target.Inits, fn)
	}

	saveHaveEmbed := g.haveEmbed
	saveCurDecl := g.curDecl
	g.curDecl = ""
	g.later(func() {
		defer func(b bool, s string) {
			g.haveEmbed = b
			g.curDecl = s
		}(g.haveEmbed, g.curDecl)

		g.haveEmbed = saveHaveEmbed
		g.curDecl = saveCurDecl
		if fn.Type().HasTParam() {
			g.topFuncIsGeneric = true
		}
		g.funcBody(fn, decl.Recv, decl.Type, decl.Body)
		g.topFuncIsGeneric = false
		if fn.Type().HasTParam() && fn.Body != nil {
			fn.Inl = &ir.Inline{
				Cost: 1,
				Dcl:  fn.Dcl,
				Body: fn.Body,
			}
		}

		out.Append(fn)
	})
}
```

src/cmd/compile/internal/noder/decl.go:63
src/cmd/compile/internal/noder/decl.go:88

The IR Generation functions

```go
func (g *irgen) constDecl(out *ir.Nodes, decl *syntax.ConstDecl) {
	g.pragmaFlags(decl.Pragma, 0)

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			val = constant.ToInt(val)
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		case types.UntypedComplex:
			val = constant.ToComplex(val)
		}
		name.SetVal(val)

		out.Append(ir.NewDecl(g.pos(decl), ir.ODCLCONST, name))
	}
}
```

```go
func (g *irgen) funcDecl(out *ir.Nodes, decl *syntax.FuncDecl) {
	... // Omitted code

	fn := ir.NewFunc(g.pos(decl))
	fn.Nname, _ = g.def(decl.Name)
	fn.Nname.Func = fn
	fn.Nname.Defn = fn

	... // Omitted code

	if decl.Name.Value == "init" && decl.Recv == nil {
		g.target.Inits = append(g.target.Inits, fn)
	}

	saveHaveEmbed := g.haveEmbed
	saveCurDecl := g.curDecl
	g.curDecl = ""
	g.later(func() {
		defer func(b bool, s string) {
			g.haveEmbed = b
			g.curDecl = s
		}(g.haveEmbed, g.curDecl)

		g.haveEmbed = saveHaveEmbed
		g.curDecl = saveCurDecl
		if fn.Type().HasTParam() {
			g.topFuncIsGeneric = true
		}
		g.funcBody(fn, decl.Recv, decl.Type, decl.Body)
		g.topFuncIsGeneric = false
		if fn.Type().HasTParam() && fn.Body != nil {
			fn.Inl = &ir.Inline{
				Cost: 1,
				Dcl:  fn.Dcl,
				Body: fn.Body,
			}
		}

		out.Append(fn)
	})
}
```

src/cmd/compile/internal/noder/decl.go:63
src/cmd/compile/internal/noder/decl.go:88

The IR Generation functions

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			val = constant.ToComplex(val)
		}
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		out.Append(ir.NewDecl(g.pos(decl), ir.ODCLCONST, name))
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```
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				Body: fn.Body,
			}
		}

		out.Append(fn)
	})
}
```

src/cmd/compile/internal/noder/decl.go:63
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		}
		name.SetVal(val)

		out.Append(ir.NewDecl(g.pos(decl), ir.ODCLCONST, name))
	}
}
```

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	fn := ir.NewFunc(g.pos(decl))
	fn.Nname, _ = g.def(decl.Name)
	fn.Nname.Func = fn
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		if fn.Type().HasTParam() && fn.Body != nil {
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				Body: fn.Body,
			}
		}

		out.Append(fn)
	})
}
```

src/cmd/compile/internal/noder/decl.go:63
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The IR Generation functions

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		}
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```go
func (g *irgen) funcDecl(out *ir.Nodes, decl *syntax.FuncDecl) {
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	fn := ir.NewFunc(g.pos(decl))
	fn.Nname, _ = g.def(decl.Name)
	fn.Nname.Func = fn
	fn.Nname.Defn = fn

	... // Omitted code

	if decl.Name.Value == "init" && decl.Recv == nil {
		g.target.Inits = append(g.target.Inits, fn)
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	saveHaveEmbed := g.haveEmbed
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			g.haveEmbed = b
			g.curDecl = s
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		g.haveEmbed = saveHaveEmbed
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		if fn.Type().HasTParam() {
			g.topFuncIsGeneric = true
		}
		g.funcBody(fn, decl.Recv, decl.Type, decl.Body)
		g.topFuncIsGeneric = false
		if fn.Type().HasTParam() && fn.Body != nil {
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				Body: fn.Body,
			}
		}

		out.Append(fn)
	})
}
```

src/cmd/compile/internal/noder/decl.go:63
src/cmd/compile/internal/noder/decl.go:88

The IR Generation functions

```
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			val = constant.ToFloat(val)
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		}
		name.SetVal(val)

		out.Append(ir.NewDecl(g.pos(decl), ir.ODCLCONST, name))
	}
}
```

```
func (g *irgen) funcDecl(out *ir.Nodes, decl *syntax.FuncDecl) {
	... // Omitted code

	fn := ir.NewFunc(g.pos(decl))
	fn.Nname, _ = g.def(decl.Name)
	fn.Nname.Func = fn
	fn.Nname.Defn = fn

	... // Omitted code

	if decl.Name.Value == "init" && decl.Recv == nil {
		g.target.Inits = append(g.target.Inits, fn)
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	saveHaveEmbed := g.haveEmbed
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		if fn.Type().HasTParam() {
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		if fn.Type().HasTParam() && fn.Body != nil {
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				Body: fn.Body,
			}
		}

		out.Append(fn)
	})
}
```

src/cmd/compile/internal/noder/decl.go:63
src/cmd/compile/internal/noder/decl.go:88

The IR Generation functions

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			val = constant.ToFloat(val)
		case types.UntypedComplex:
			val = constant.ToComplex(val)
		}
		name.SetVal(val)

		out.Append(ir.NewDecl(g.pos(decl), ir.ODCLCONST, name))
	}
}
```

```go
func (g *irgen) funcDecl(out *ir.Nodes, decl *syntax.FuncDecl) {
	... // Omitted code

	fn := ir.NewFunc(g.pos(decl))
	fn.Nname, _ = g.def(decl.Name)
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	fn.Nname.Defn = fn

	... // Omitted code

	if decl.Name.Value == "init" && decl.Recv == nil {
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		defer func(b bool, s string) {
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			g.curDecl = s
		}(g.haveEmbed, g.curDecl)

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		if fn.Type().HasTParam() {
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		}
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				Body: fn.Body,
			}
		}

		out.Append(fn)
	})
}
```
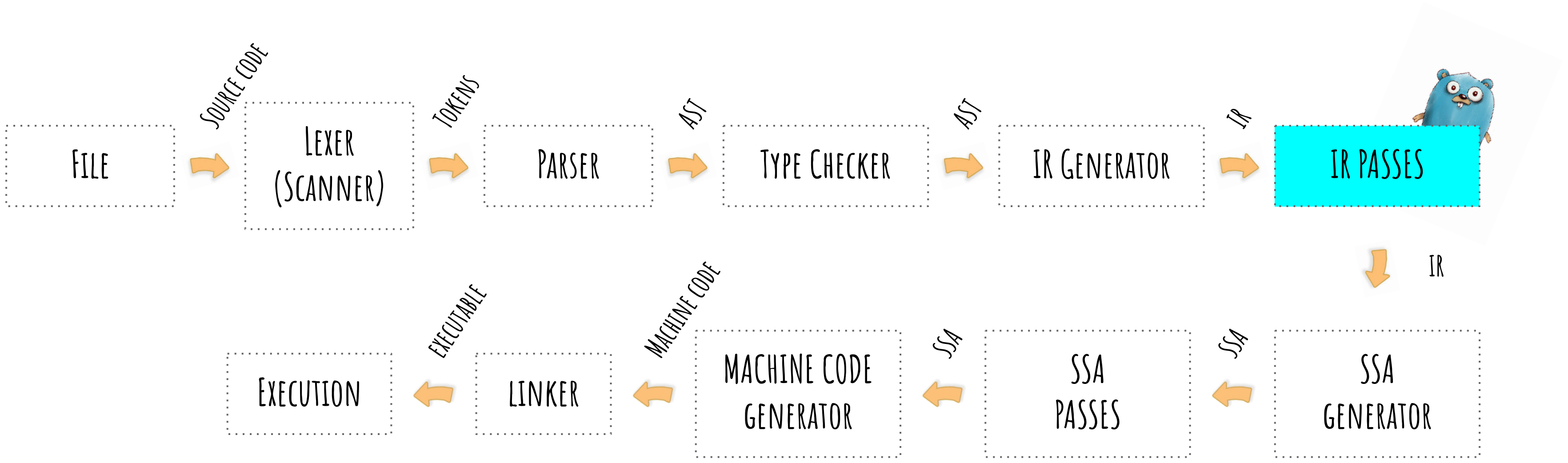

src/cmd/compile/internal/noder/decl.go:63
src/cmd/compile/internal/noder/decl.go:88

The IR


File
Source code
Lexer (Scanner)
Tokens
Parser
AST
Type Checker
AST
IR Generator
IR
IR passes
IR
SSA Generator
SSA
SSA passes
SSA
Machine code generator
Machine code
Linker
Executable
Execution

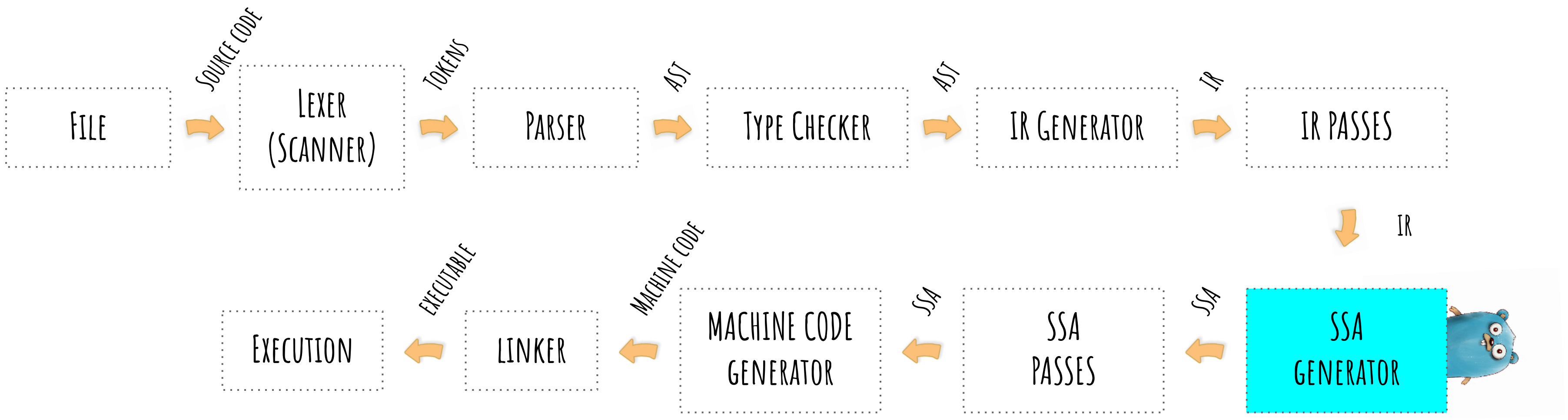
The IR Passes

- Dead code elimination
- Function call inlining
- Devirtualize functions
- Escape analysis

Too much info? Take a break.
Look... here is a Kitten

SSA (Static Single Assignment)

SSA (Static Single Assignment)



SSA (Static Single Assignment)

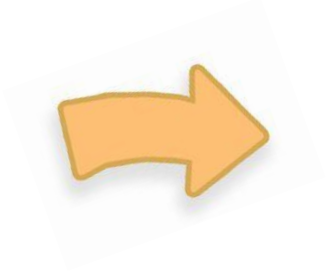
```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

```
b1:
        v1 (?) = InitMem <mem>
        v2 (?) = SP <uintptr>
        v3 (?) = SB <uintptr>
        v4 (?) = ConstInterface <any>
        v5 (?) = ArrayMake1 <[1]any> v4
        v6 (6) = VarDef <mem> {.autotmp_8} v1
        v7 (6) = LocalAddr <*[1]any> {.autotmp_8} v2 v6
        v8 (6) = Store <mem> {[1]any} v7 v5 v6
        v9 (6) = LocalAddr <*[1]any> {.autotmp_8} v2 v8
        v10 (?) = Addr <*uint8> {type.string} v3
        v11 (?) = Addr <*string> {main..stmp_0} v3
        v12 (6) = IMake <any> v10 v11
        v13 (6) = NilCheck <void> v9 v8
        v14 (?) = Const64 <int> [0] (fmt.n[int], fmt..autotmp_0[int])
        v15 (?) = Const64 <int> [1]
        v16 (6) = PtrIndex <*any> v9 v14
        v17 (6) = Store <mem> {any} v16 v12 v8
        v18 (6) = NilCheck <void> v9 v17
        v19 (6) = Copy <*any> v9
        v20 (6) = IsSliceInBounds <bool> v14 v15
        v25 (?) = ConstInterface <error> (fmt.err[error], fmt..autotmp_1[error])
        v28 (?) = Addr <*uint8> {go.itab.*os.File,io.Writer} v3
        v29 (?) = Addr <**os.File> {os.Stdout} v3
If v20 → b2 b3 (likely) (6)

b2: ← b1
        v23 (6) = Sub64 <int> v15 v14
        v24 (6) = SliceMake <[]any> v19 v23 v23 (fmt.a[[]any])
        v26 (6) = Copy <mem> v17
        v27 (+6) = InlMark <void> [0] v26
        v30 (294) = Load <*os.File> v29 v26
        v31 (294) = IMake <io.Writer> v28 v30
        v32 (294) = StaticLECall <int,error,mem> {AuxCall{fmt.Fprintln}} [40] v31 v24 v26
        v33 (294) = SelectN <mem> [2] v32
        v34 (294) = SelectN <int> [0] v32
        v35 (294) = SelectN <int> [0] v32 (fmt.n[int], fmt..autotmp_0[int])
        v36 (294) = SelectN <error> [1] v32 (fmt.err[error], fmt..autotmp_1[error])
Plain → b4 (+6)

b3: ← b1

        v21 (6) = Copy <mem> v17
        v22 (6) = PanicBounds <mem> [6] v14 v15 v21
Exit v22 (6)

b4: ← b2

        v38 (7) = Copy <mem> v33
        v37 (7) = MakeResult <mem> v38
Ret v37 (7)

name fmt.a[[]any]: v24
name fmt.n[int]: v14 v35
name fmt.err[error]: v25 v36
name fmt..autotmp_0[int]: v14 v35
name fmt..autotmp_1[error]: v25 v36
```

Generated with GOSSAFUNC=main.main go build hello.go

SSA (Static Single Assignment)

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```



```
b1:
        v1 (?) = InitMem <mem>
        v2 (?) = SP <uintptr>
        v3 (?) = SB <uintptr>
        v4 (?) = ConstInterface <any>
        v5 (?) = ArrayMake1 <[1]any> v4
        v6 (6) = VarDef <mem> {.autotmp_8} v1
        v7 (6) = LocalAddr <*[1]any> {.autotmp_8} v2 v6
        v8 (6) = Store <mem> {[1]any} v7 v5 v6
        v9 (6) = LocalAddr <*[1]any> {.autotmp_8} v2 v8
        v10 (?) = Addr <*uint8> {type.string} v3
        v11 (?) = Addr <*string> {main..stmp_0} v3
        v12 (6) = IMake <any> v10 v11
        v13 (6) = NilCheck <void> v9 v8
        v14 (?) = Const64 <int> [0] (fmt.n[int], fmt..autotmp_0[int])
        v15 (?) = Const64 <int> [1]
        v16 (6) = PtrIndex <*any> v9 v14
        v17 (6) = Store <mem> {any} v16 v12 v8
        v18 (6) = NilCheck <void> v9 v17
        v19 (6) = Copy <*any> v9
        v20 (6) = IsSliceInBounds <bool> v14 v15
        v25 (?) = ConstInterface <error> (fmt.err[error], fmt..autotmp_1[error])
        v28 (?) = Addr <*uint8> {go.itab.*os.File,io.Writer} v3
        v29 (?) = Addr <**os.File> {os.Stdout} v3
If v20 → b2 b3 (likely) (6)

b2: ← b1
        v23 (6) = Sub64 <int> v15 v14
        v24 (6) = SliceMake <[]any> v19 v23 v23 (fmt.a[[]any])
        v26 (6) = Copy <mem> v17
        v27 (+6) = InlMark <void> [0] v26
        v30 (294) = Load <*os.File> v29 v26
        v31 (294) = IMake <io.Writer> v28 v30
        v32 (294) = StaticLECall <int,error,mem> {AuxCall{fmt.Fprintln}} [40] v31 v24 v26
        v33 (294) = SelectN <mem> [2] v32
        v34 (294) = SelectN <int> [0] v32
        v35 (294) = SelectN <int> [0] v32 (fmt.n[int], fmt..autotmp_0[int])
        v36 (294) = SelectN <error> [1] v32 (fmt.err[error], fmt..autotmp_1[error])
Plain → b4 (+6)

b3: ← b1

        v21 (6) = Copy <mem> v17
        v22 (6) = PanicBounds <mem> [6] v14 v15 v21
Exit v22 (6)

b4: ← b2

        v38 (7) = Copy <mem> v33
        v37 (7) = MakeResult <mem> v38
Ret v37 (7)

name fmt.a[[]any]: v24
name fmt.n[int]: v14 v35
name fmt.err[error]: v25 v36
name fmt..autotmp_0[int]: v14 v35
name fmt..autotmp_1[error]: v25 v36
```

Generated with GOSSAFUNC=main.main go build hello.go

SSA (Static Single Assignment)

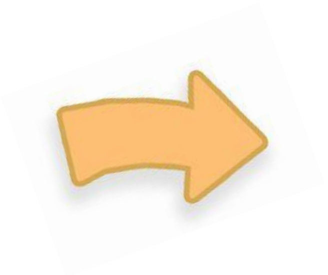
```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

```
b1:
        v1 (?) = InitMem <mem>
        v2 (?) = SP <uintptr>
        v3 (?) = SB <uintptr>
        v4 (?) = ConstInterface <any>
        v5 (?) = ArrayMake1 <[1]any> v4
        v6 (6) = VarDef <mem> {.autotmp_8} v1
        v7 (6) = LocalAddr <*[1]any> {.autotmp_8} v2 v6
        v8 (6) = Store <mem> {[1]any} v7 v5 v6
        v9 (6) = LocalAddr <*[1]any> {.autotmp_8} v2 v8
        v10 (?) = Addr <*uint8> {type.string} v3
        v11 (?) = Addr <*string> {main..stmp_0} v3
        v12 (6) = IMake <any> v10 v11
        v13 (6) = NilCheck <void> v9 v8
        v14 (?) = Const64 <int> [0] (fmt.n[int], fmt..autotmp_0[int])
        v15 (?) = Const64 <int> [1]
        v16 (6) = PtrIndex <*any> v9 v14
        v17 (6) = Store <mem> {any} v16 v12 v8
        v18 (6) = NilCheck <void> v9 v17
        v19 (6) = Copy <*any> v9
        v20 (6) = IsSliceInBounds <bool> v14 v15
        v25 (?) = ConstInterface <error> (fmt.err[error], fmt..autotmp_1[error])
        v28 (?) = Addr <*uint8> {go.itab.*os.File,io.Writer} v3
        v29 (?) = Addr <**os.File> {os.Stdout} v3
If v20 → b2 b3 (likely) (6)

b2: ← b1
        v23 (6) = Sub64 <int> v15 v14
        v24 (6) = SliceMake <[]any> v19 v23 v23 (fmt.a[[]any])
        v26 (6) = Copy <mem> v17
        v27 (+6) = InlMark <void> [0] v26
        v30 (294) = Load <*os.File> v29 v26
        v31 (294) = IMake <io.Writer> v28 v30
        v32 (294) = StaticLECall <int,error,mem> {AuxCall{fmt.Fprintln}} [40] v31 v24 v26
        v33 (294) = SelectN <mem> [2] v32
        v34 (294) = SelectN <int> [0] v32
        v35 (294) = SelectN <int> [0] v32 (fmt.n[int], fmt..autotmp_0[int])
        v36 (294) = SelectN <error> [1] v32 (fmt.err[error], fmt..autotmp_1[error])
Plain → b4 (+6)

b3: ← b1

        v21 (6) = Copy <mem> v17
        v22 (6) = PanicBounds <mem> [6] v14 v15 v21
Exit v22 (6)

b4: ← b2

        v38 (7) = Copy <mem> v33
        v37 (7) = MakeResult <mem> v38
Ret v37 (7)

name fmt.a[[]any]: v24
name fmt.n[int]: v14 v35
name fmt.err[error]: v25 v36
name fmt..autotmp_0[int]: v14 v35
name fmt..autotmp_1[error]: v25 v36
```

Generated with GOSSAFUNC=main.main go build hello.go

SSA (Static Single Assignment)

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```



```
# Name: hello.init
# Package: hello
# Synthetic: package initializer
func init():
0:                                                                  entry P:0 S:2
        t0 = *init$guard                                                     bool
        if t0 goto 2 else 1
1:                                                             init.start P:1 S:1
        *init$guard = true:bool
        t1 = fmt.init()                                                        ()
        jump 2
2:                                                              init.done P:2 S:0
        return

# Name: hello.main
# Package: hello
# Location: hello.go:8:6
func main():
0:                                                                  entry P:0 S:0
        t0 = new [1]any (varargs)                                        *[1]any
        t1 = &t0[0:int]                                                     *any
        t2 = make any <- string ("hello world!":string)                      any
        *t1 = t2
        t3 = slice t0[:]                                                   []any
        t4 = fmt.Println(t3...)                               (n int, err error)
        return
```

Generated with golang.org/x/tools/go/ssa

SSA (Static Single Assignment)

```go
// stmtList converts the statement list n to SSA and adds it to s.
func (s *state) stmtList(l ir.Nodes) {
	for _, n := range l {
		s.stmt(n)
	}
}

// stmt converts the statement n to SSA and adds it to s.
func (s *state) stmt(n ir.Node) {




case ir.ODCL:
	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}




case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```go
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
		if ir.BoolVal(n.Cond) {
			s.stmtList(n.Body)
		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
	if n.Likely {
		likely = 1
	}
	var bThen *ssa.Block
	if len(n.Body) != 0 {
		bThen = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bThen = bEnd
	}
	var bElse *ssa.Block
	if len(n.Else) != 0 {
		bElse = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bElse = bEnd
	}
	s.condBranch(n.Cond, bThen, bElse, likely)

	if len(n.Body) != 0 {
		s.startBlock(bThen)
		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	if len(n.Else) != 0 {
		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	s.startBlock(bEnd)
```

SSA (Static Single Assignment)

```go
// stmtList converts the statement list n to SSA and adds it to s.
func (s *state) stmtList(l ir.Nodes) {
	for _, n := range l {
		s.stmt(n)
	}
}

// stmt converts the statement n to SSA and adds it to s.
func (s *state) stmt(n ir.Node) {




case ir.ODCL:
	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}




case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```go
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
		if ir.BoolVal(n.Cond) {
			s.stmtList(n.Body)
		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
	if n.Likely {
		likely = 1
	}
	var bThen *ssa.Block
	if len(n.Body) != 0 {
		bThen = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bThen = bEnd
	}
	var bElse *ssa.Block
	if len(n.Else) != 0 {
		bElse = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bElse = bEnd
	}
	s.condBranch(n.Cond, bThen, bElse, likely)

	if len(n.Body) != 0 {
		s.startBlock(bThen)
		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	if len(n.Else) != 0 {
		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	s.startBlock(bEnd)
```

SSA (Static Single Assignment)

```go
// stmtList converts the statement list n to SSA and adds it to s.
func (s *state) stmtList(l ir.Nodes) {
	for _, n := range l {
		s.stmt(n)
	}
}

// stmt converts the statement n to SSA and adds it to s.
func (s *state) stmt(n ir.Node) {
```

```go
case ir.ODCL:
	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}
```

```go
case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```go
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
		if ir.BoolVal(n.Cond) {
			s.stmtList(n.Body)
		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
	if n.Likely {
		likely = 1
	}
	var bThen *ssa.Block
	if len(n.Body) != 0 {
		bThen = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bThen = bEnd
	}
	var bElse *ssa.Block
	if len(n.Else) != 0 {
		bElse = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bElse = bEnd
	}
	s.condBranch(n.Cond, bThen, bElse, likely)

	if len(n.Body) != 0 {
		s.startBlock(bThen)
		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	if len(n.Else) != 0 {
		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	s.startBlock(bEnd)
```

SSA (Static Single Assignment)

```
// stmtList converts the statement list n to SSA and adds it to s.
func (s *state) stmtList(l ir.Nodes) {
	for _, n := range l {
		s.stmt(n)
	}
}

// stmt converts the statement n to SSA and adds it to s.
func (s *state) stmt(n ir.Node) {




case ir.ODCL:
	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}




case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
		if ir.BoolVal(n.Cond) {
			s.stmtList(n.Body)
		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
	if n.Likely {
		likely = 1
	}
	var bThen *ssa.Block
	if len(n.Body) != 0 {
		bThen = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bThen = bEnd
	}
	var bElse *ssa.Block
	if len(n.Else) != 0 {
		bElse = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bElse = bEnd
	}
	s.condBranch(n.Cond, bThen, bElse, likely)

	if len(n.Body) != 0 {
		s.startBlock(bThen)
		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	if len(n.Else) != 0 {
		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	s.startBlock(bEnd)
```

SSA (Static Single Assignment)

```go
// stmtList converts the statement list n to SSA and adds it to s.
func (s *state) stmtList(l ir.Nodes) {
	for _, n := range l {
		s.stmt(n)
	}
}

// stmt converts the statement n to SSA and adds it to s.
func (s *state) stmt(n ir.Node) {
```

```go
case ir.ODCL:
	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}
```

```go
case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```go
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
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			s.stmtList(n.Body)
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		break
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	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
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	if len(n.Body) != 0 {
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	if len(n.Else) != 0 {
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	} else {
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	if len(n.Body) != 0 {
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		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
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		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
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```
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func (s *state) stmt(n ir.Node) {




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	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}




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	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```
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	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
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		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
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		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
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		}
	}
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```

SSA (Static Single Assignment)

```
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	}
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func (s *state) stmt(n ir.Node) {




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	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}




case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
		if ir.BoolVal(n.Cond) {
			s.stmtList(n.Body)
		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
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	}
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	if len(n.Body) != 0 {
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	}
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	if len(n.Else) != 0 {
		bElse = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bElse = bEnd
	}
	s.condBranch(n.Cond, bThen, bElse, likely)

	if len(n.Body) != 0 {
		s.startBlock(bThen)
		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	if len(n.Else) != 0 {
		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	s.startBlock(bEnd)
```

SSA (Static Single Assignment)

```
// stmtList converts the statement list n to SSA and adds it to s.
func (s *state) stmtList(l ir.Nodes) {
	for _, n := range l {
		s.stmt(n)
	}
}

// stmt converts the statement n to SSA and adds it to s.
func (s *state) stmt(n ir.Node) {




case ir.ODCL:
	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}




case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
		if ir.BoolVal(n.Cond) {
			s.stmtList(n.Body)
		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
	if n.Likely {
		likely = 1
	}
	var bThen *ssa.Block
	if len(n.Body) != 0 {
		bThen = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bThen = bEnd
	}
	var bElse *ssa.Block
	if len(n.Else) != 0 {
		bElse = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bElse = bEnd
	}
	s.condBranch(n.Cond, bThen, bElse, likely)

	if len(n.Body) != 0 {
		s.startBlock(bThen)
		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	if len(n.Else) != 0 {
		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	s.startBlock(bEnd)
```

SSA (Static Single Assignment)

```go
// stmtList converts the statement list n to SSA and adds it to s.
func (s *state) stmtList(l ir.Nodes) {
	for _, n := range l {
		s.stmt(n)
	}
}

// stmt converts the statement n to SSA and adds it to s.
func (s *state) stmt(n ir.Node) {




case ir.ODCL:
	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}




case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```go
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
		if ir.BoolVal(n.Cond) {
			s.stmtList(n.Body)
		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
	if n.Likely {
		likely = 1
	}
	var bThen *ssa.Block
	if len(n.Body) != 0 {
		bThen = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bThen = bEnd
	}
	var bElse *ssa.Block
	if len(n.Else) != 0 {
		bElse = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bElse = bEnd
	}
	s.condBranch(n.Cond, bThen, bElse, likely)

	if len(n.Body) != 0 {
		s.startBlock(bThen)
		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	if len(n.Else) != 0 {
		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	s.startBlock(bEnd)
```

SSA (Static Single Assignment)

```
// stmtList converts the statement list n to SSA and adds it to s.
func (s *state) stmtList(l ir.Nodes) {
	for _, n := range l {
		s.stmt(n)
	}
}

// stmt converts the statement n to SSA and adds it to s.
func (s *state) stmt(n ir.Node) {
```

```
case ir.ODCL:
	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}
```

```
case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

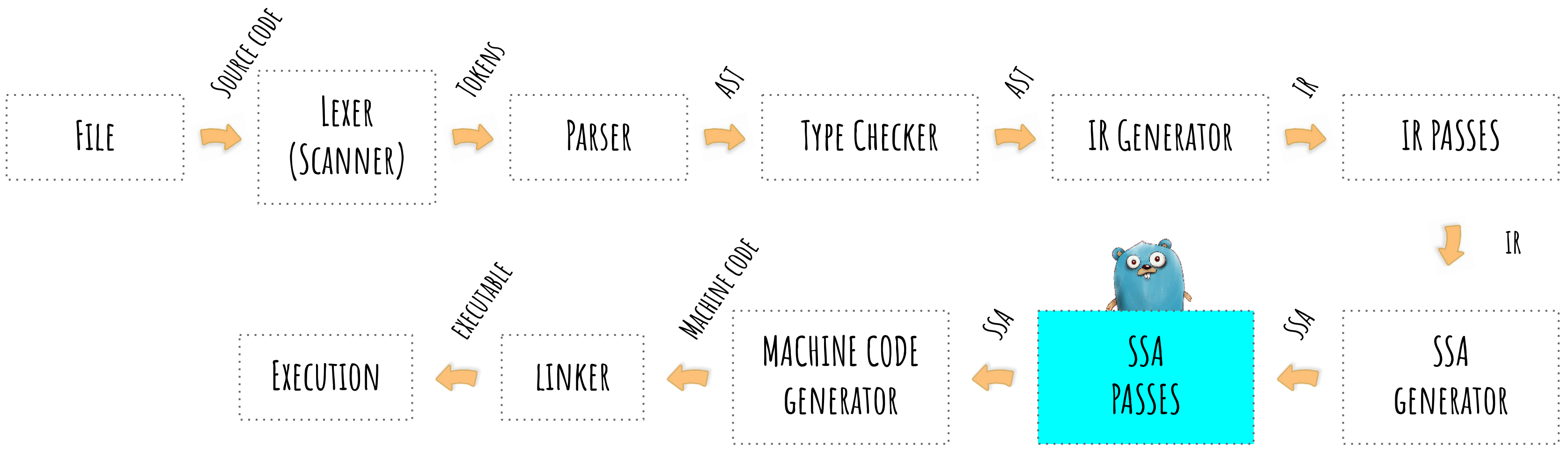
```
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
		if ir.BoolVal(n.Cond) {
			s.stmtList(n.Body)
		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
	if n.Likely {
		likely = 1
	}
	var bThen *ssa.Block
	if len(n.Body) != 0 {
		bThen = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bThen = bEnd
	}
	var bElse *ssa.Block
	if len(n.Else) != 0 {
		bElse = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bElse = bEnd
	}
	s.condBranch(n.Cond, bThen, bElse, likely)

	if len(n.Body) != 0 {
		s.startBlock(bThen)
		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	if len(n.Else) != 0 {
		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	s.startBlock(bEnd)
```

SSA (Static Single Assignment)

```go
// stmtList converts the statement list n to SSA and adds it to s.
func (s *state) stmtList(l ir.Nodes) {
	for _, n := range l {
		s.stmt(n)
	}
}

// stmt converts the statement n to SSA and adds it to s.
func (s *state) stmt(n ir.Node) {




case ir.ODCL:
	n := n.(*ir.Decl)
	if v := n.X; v.Esc() == ir.EscHeap {
		s.newHeapaddr(v)
	}




case ir.OVARDEF:
	n := n.(*ir.UnaryExpr)
	if !s.canSSA(n.X) {
		s.vars[memVar] = s.newValue1Apos(ssa.OpVarDef, types.TypeMem, n.X.(*ir.Name), s.mem(), false)
	}
```

```go
case ir.OIF:
	n := n.(*ir.IfStmt)
	if ir.IsConst(n.Cond, constant.Bool) {
		s.stmtList(n.Cond.Init())
		if ir.BoolVal(n.Cond) {
			s.stmtList(n.Body)
		} else {
			s.stmtList(n.Else)
		}
		break
	}

	bEnd := s.f.NewBlock(ssa.BlockPlain)
	var likely int8
	if n.Likely {
		likely = 1
	}
	var bThen *ssa.Block
	if len(n.Body) != 0 {
		bThen = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bThen = bEnd
	}
	var bElse *ssa.Block
	if len(n.Else) != 0 {
		bElse = s.f.NewBlock(ssa.BlockPlain)
	} else {
		bElse = bEnd
	}
	s.condBranch(n.Cond, bThen, bElse, likely)

	if len(n.Body) != 0 {
		s.startBlock(bThen)
		s.stmtList(n.Body)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	if len(n.Else) != 0 {
		s.startBlock(bElse)
		s.stmtList(n.Else)
		if b := s.endBlock(); b != nil {
			b.AddEdgeTo(bEnd)
		}
	}
	s.startBlock(bEnd)
```

SSA Passes


File
Source code
Lexer (Scanner)
Tokens
Parser
AST
Type Checker
AST
IR Generator
IR
IR Passes
IR
SSA Generator
SSA
SSA Passes
SSA
Machine code generator
Machine code
Linker
Executable
Execution

SSA Passes

- deadcode
- shortcircuit
- cse
- lower
- and a lot more

SSA (Before the passes)

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

```
b1:
        v1 (?) = InitMem <mem>
        v2 (?) = SP <uintptr>
        v3 (?) = SB <uintptr>
        v4 (?) = ConstInterface <any>
        v5 (?) = ArrayMake1 <[1]any> v4
        v6 (6) = VarDef <mem> {.autotmp_8} v1
        v7 (6) = LocalAddr <*[1]any> {.autotmp_8} v2 v6
        v8 (6) = Store <mem> {[1]any} v7 v5 v6
        v9 (6) = LocalAddr <*[1]any> {.autotmp_8} v2 v8
        v10 (?) = Addr <*uint8> {type.string} v3
        v11 (?) = Addr <*string> {main..stmp_0} v3
        v12 (6) = IMake <any> v10 v11
        v13 (6) = NilCheck <void> v9 v8
        v14 (?) = Const64 <int> [0] (fmt.n[int], fmt..autotmp_0[int])
        v15 (?) = Const64 <int> [1]
        v16 (6) = PtrIndex <*any> v9 v14
        v17 (6) = Store <mem> {any} v16 v12 v8
        v18 (6) = NilCheck <void> v9 v17
        v19 (6) = Copy <*any> v9
        v20 (6) = IsSliceInBounds <bool> v14 v15
        v25 (?) = ConstInterface <error> (fmt.err[error], fmt..autotmp_1[error])
        v28 (?) = Addr <*uint8> {go.itab.*os.File,io.Writer} v3
        v29 (?) = Addr <**os.File> {os.Stdout} v3
If v20 → b2 b3 (likely) (6)

b2: ← b1
        v23 (6) = Sub64 <int> v15 v14
        v24 (6) = SliceMake <[]any> v19 v23 v23 (fmt.a[[]any])
        v26 (6) = Copy <mem> v17
        v27 (+6) = InlMark <void> [0] v26
        v30 (294) = Load <*os.File> v29 v26
        v31 (294) = IMake <io.Writer> v28 v30
        v32 (294) = StaticLECall <int,error,mem> {AuxCall{fmt.Fprintln}} [40] v31 v24 v26
        v33 (294) = SelectN <mem> [2] v32
        v34 (294) = SelectN <int> [0] v32
        v35 (294) = SelectN <int> [0] v32 (fmt.n[int], fmt..autotmp_0[int])
        v36 (294) = SelectN <error> [1] v32 (fmt.err[error], fmt..autotmp_1[error])
Plain → b4 (+6)

b3: ← b1

        v21 (6) = Copy <mem> v17
        v22 (6) = PanicBounds <mem> [6] v14 v15 v21
Exit v22 (6)

b4: ← b2

        v38 (7) = Copy <mem> v33
        v37 (7) = MakeResult <mem> v38
Ret v37 (7)

name fmt.a[[]any]: v24
name fmt.n[int]: v14 v35
name fmt.err[error]: v25 v36
name fmt..autotmp_0[int]: v14 v35
name fmt..autotmp_1[error]: v25 v36
```

Generated with GOSSAFUNC=main.main go build hello.go

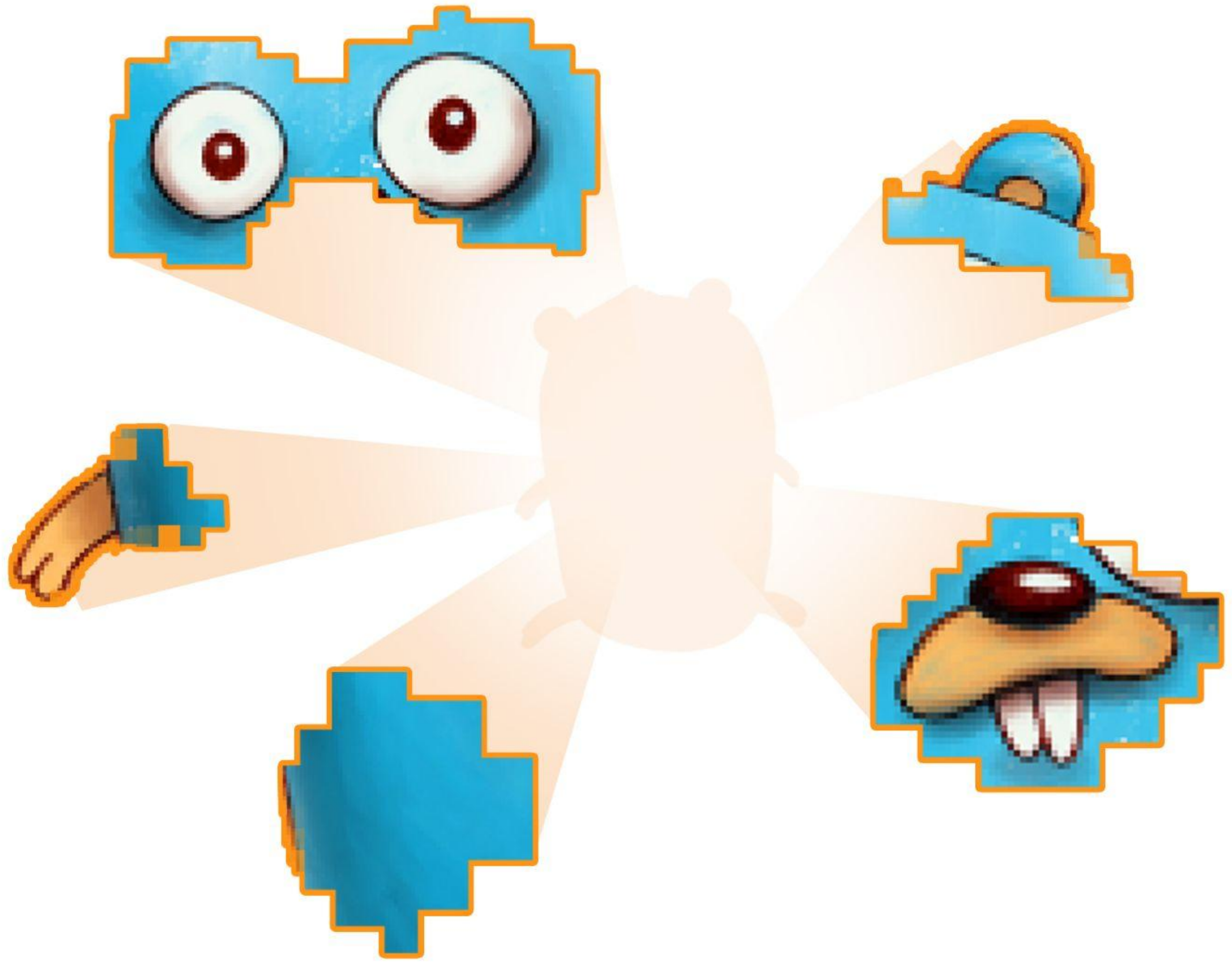
SSA (After the passes)

```go
package main

import "fmt"

func main() {
    fmt.Println("hello world!")
}
```

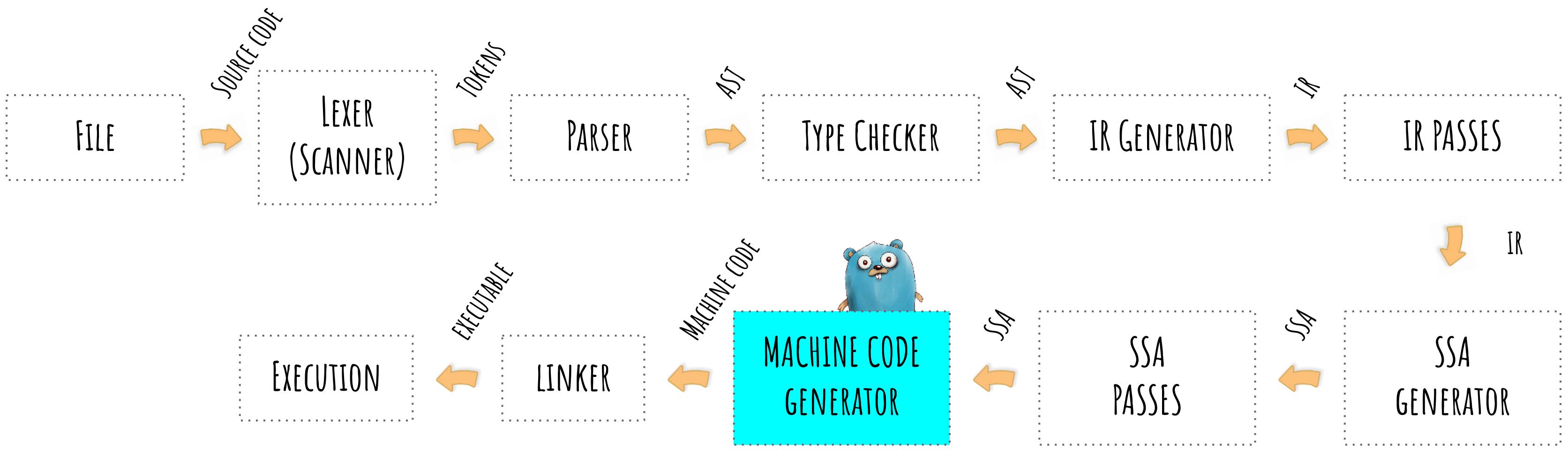
```
b4:
        v1 (?) = InitMem <mem>
        v6 (6) = VarDef <mem> {.autotmp_8} v1
        v2 (?) = SP <uintptr> : SP
        v35 (6) = MOVOstoreconst <mem> {.autotmp_8} [val=0,off=0] v2 v6
        v3 (?) = SB <uintptr> : SB
        v14 (6) = LEAQ <*uint8> {type.string} v3 : DX
        v5 (+6) = MOVQstore <mem> {.autotmp_8} v2 v14 v35
        v20 (6) = LEAQ <*string> {main..stmp_0} v3 : DX
        v36 (+6) = MOVQstore <mem> {.autotmp_8} [8] v2 v20 v5
        v27 (+6) = InlMark <void> [0] v36
        v30 (+294) = MOVQload <*os.File> {os.Stdout} v3 v36 : BX
        v22 (294) = LEAQ <*uint8> {go.itab.*os.File,io.Writer} v3 : AX
        v13 (294) = LEAQ <*[1]any> {.autotmp_8} v2 : CX
        v16 (294) = MOVQconst <int> [1] : DI
        v7 (294) = Copy <int> v16 : SI
        v32 (294) = CALLstatic <int,unsafe.Pointer,unsafe.Pointer,mem> {AuxCall{fmt.Fprintln}} [40]...
        v33 (294) = SelectN <mem> [3] v32
        v37 (+7) = MakeResult <mem> v33
Ret v37 (7)

name a.ptr[*any]: v9
name a.len[int]: v15
name a.cap[int]: v15
```

Generated with GOSSAFUNC=main.main go build hello.go

Machine Code Generation



Machine Code Generation



Machine Code Generation

```
b4:
        v1 (?) = InitMem <mem>
        v6 (6) = VarDef <mem> {.autotmp_8} v1
        v2 (?) = SP <uintptr> : SP
        v35 (6) = MOVOstoreconst <mem> {.autotmp_8} [val=0,off=0] v2 v6
        v3 (?) = SB <uintptr> : SB
        v14 (6) = LEAQ <*uint8> {type.string} v3 : DX
        v5 (+6) = MOVQstore <mem> {.autotmp_8} v2 v14 v35
        v20 (6) = LEAQ <*string> {main..stmp_0} v3 : DX
        v36 (+6) = MOVQstore <mem> {.autotmp_8} [8] v2 v20 v5
        v27 (+6) = InlMark <void> [0] v36
        v30 (+294) = MOVQload <*os.File> {os.Stdout} v3 v36 : BX
        v22 (294) = LEAQ <*uint8> {go.itab.*os.File,io.Writer} v3 : AX
        v13 (294) = LEAQ <*[1]any> {.autotmp_8} v2 : CX
        v16 (294) = MOVQconst <int> [1] : DI
        v7 (294) = Copy <int> v16 : SI
        v32 (294) = CALLstatic <int,unsafe.Pointer,unsafe.Pointer,mem>
{AuxCall{fmt.Fprintln}} [40]...
        v33 (294) = SelectN <mem> [3] v32
        v37 (+7) = MakeResult <mem> v33
Ret v37 (7)

name a.ptr[*any]: v9
name a.len[int]: v15
name a.cap[int]: v15
```

```
      # /hello.go
      00000 (5) TEXT main.main(SB), ABIInternal
      00001 (5) FUNCDATA $0, gclocals·g2BeySu+wFnoycgXfElmcg==(SB)
      00002 (5) FUNCDATA $1, gclocals·EaPwxsZ75yY1hHMVZLmk6g==(SB)
      00003 (5) FUNCDATA $2, main.main.stkobj(SB)
v35   00004 (+6) MOVUPS X15, main..autotmp_8-16(SP)
v14   00005 (6) LEAQ type.string(SB), DX
v5    00006 (6) MOVQ DX, main..autotmp_8-16(SP)
v20   00007 (6) LEAQ main..stmp_0(SB), DX
v36   00008 (6) MOVQ DX, main..autotmp_8-8(SP)
v27   00009 (?) NOP
      # $GOROOT/src/fmt/print.go
v30   00010 (+294) MOVQ os.Stdout(SB), BX
v22   00011 (294) LEAQ go.itab.*os.File,io.Writer(SB), AX
v13   00012 (294) LEAQ main..autotmp_8-16(SP), CX
v16   00013 (294) MOVL $1, DI
v7    00014 (294) MOVQ DI, SI
v32   00015 (294) PCDATA $1, $0
v32   00016 (294) CALL fmt.Fprintln(SB)
      # /home/jespino/Projects/Github/go/hello.go
b4

      00017 (7) RET
      00018 (?) END
```

Generated with GOSSAFUNC=main.main go build hello.go

Machine Code Generation

```
b4:
          v1 (?) = InitMem <mem>
          v6 (6) = VarDef <mem> {.autotmp_8} v1
          v2 (?) = SP <uintptr> : SP
          v35 (6) = MOVOstoreconst <mem> {.autotmp_8} [val=0,off=0] v2 v6
          v3 (?) = SB <uintptr> : SB
          v14 (6) = LEAQ <*uint8> {type.string} v3 : DX
          v5 (+6) = MOVQstore <mem> {.autotmp_8} v2 v14 v35
          v20 (6) = LEAQ <*string> {main..stmp_0} v3 : DX
          v36 (+6) = MOVQstore <mem> {.autotmp_8} [8] v2 v20 v5
          v27 (+6) = InlMark <void> [0] v36
          v30 (+294) = MOVQload <*os.File> {os.Stdout} v3 v36 : BX
          v22 (294) = LEAQ <*uint8> {go.itab.*os.File,io.Writer} v3 : AX
          v13 (294) = LEAQ <*[1]any> {.autotmp_8} v2 : CX
          v16 (294) = MOVQconst <int> [1] : DI
          v7 (294) = Copy <int> v16 : SI
          v32 (294) = CALLstatic <int,unsafe.Pointer,unsafe.Pointer,mem>
{AuxCall{fmt.Fprintln}} [40]...
          v33 (294) = SelectN <mem> [3] v32
          v37 (+7) = MakeResult <mem> v33
Ret v37 (7)

name a.ptr[*any]: v9
name a.len[int]: v15
name a.cap[int]: v15
```

```
         # /hello.go
         00000 (5) TEXT main.main(SB), ABIInternal
         00001 (5) FUNCDATA $0, gclocals·g2BeySu+wFnoycgXfElmcg==(SB)
         00002 (5) FUNCDATA $1, gclocals·EaPwxsZ75yY1hHMVZLmk6g==(SB)
         00003 (5) FUNCDATA $2, main.main.stkobj(SB)
v35      00004 (+6) MOVUPS X15, main..autotmp_8-16(SP)
v14      00005 (6) LEAQ type.string(SB), DX
v5       00006 (6) MOVQ DX, main..autotmp_8-16(SP)
v20      00007 (6) LEAQ main..stmp_0(SB), DX
v36      00008 (6) MOVQ DX, main..autotmp_8-8(SP)
v27      00009 (?) NOP
         # $GOROOT/src/fmt/print.go
v30      00010 (+294) MOVQ os.Stdout(SB), BX
v22      00011 (294) LEAQ go.itab.*os.File,io.Writer(SB), AX
v13      00012 (294) LEAQ main..autotmp_8-16(SP), CX
v16      00013 (294) MOVL $1, DI
v7       00014 (294) MOVQ DI, SI
v32      00015 (294) PCDATA $1, $0
v32      00016 (294) CALL fmt.Fprintln(SB)
         # /home/jespino/Projects/Github/go/hello.go
b4

         00017 (7) RET
         00018 (?) END
```

Generated with GOSSAFUNC=main.main go build hello.go

Machine Code Generation

```go
case ssa.OpAMD64MOVQload, ssa.OpAMD64MOVLload, ssa.OpAMD64MOVWload, ssa.OpAMD64MOVBload, ssa.OpAMD64MOVOload,
     ssa.OpAMD64MOVSSload, ssa.OpAMD64MOVSDload, ssa.OpAMD64MOVBQSXload, ssa.OpAMD64MOVWQSXload, ssa.OpAMD64MOVLQSXload,
     ssa.OpAMD64MOVBEQload, ssa.OpAMD64MOVBELload:
     p := s.Prog(v.Op.Asm())
     p.From.Type = obj.TYPE_MEM
     p.From.Reg = v.Args[0].Reg()
     ssagen.AddAux(&p.From, v)
     p.To.Type = obj.TYPE_REG
     p.To.Reg = v.Reg()

case ssa.OpAMD64CALLstatic, ssa.OpAMD64CALLtail:
     if s.ABI == obj.ABI0 && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABIInternal {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
     if v.Op == ssa.OpAMD64CALLtail {
         s.TailCall(v)
         break
     }
     s.Call(v)
     if s.ABI == obj.ABIInternal && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABI0 {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
```

```go
// Call returns a new CALL instruction for the SSA value v.
// It uses PrepareCall to prepare the call.
func (s *State) Call(v *ssa.Value) *obj.Prog {
    pPosIsStmt := s.pp.Pos.IsStmt() // The statement-ness fo the call comes from ssaGenState
    s.PrepareCall(v)

    p := s.Prog(obj.ACALL)
    if pPosIsStmt == src.PosIsStmt {
        p.Pos = v.Pos.WithIsStmt()
    } else {
        p.Pos = v.Pos.WithNotStmt()
    }
    if sym, ok := v.Aux.(*ssa.AuxCall); ok && sym.Fn != nil {
        p.To.Type = obj.TYPE_MEM
        p.To.Name = obj.NAME_EXTERN
        p.To.Sym = sym.Fn
    } else {
        // TODO(mdempsky): Can these differences be eliminated?
        switch Arch.LinkArch.Family {
        case sys.AMD64, sys.I386, sys.PPC64, sys.RISCV64, sys.S390X, sys.Wasm:
            p.To.Type = obj.TYPE_REG
        case sys.ARM, sys.ARM64, sys.Loong64, sys.MIPS, sys.MIPS64:
            p.To.Type = obj.TYPE_MEM
        default:
            base.Fatalf("unknown indirect call family")
        }
        p.To.Reg = v.Args[0].Reg()
    }
    return p
}
```

src/cmd/compile/internal/amd64/ssa.go:792
src/cmd/compile/internal/amd64/ssa.go:1064
src/cmd/compile/internal/ssagen/ssa.go:7603

Machine Code Generation

```go
case ssa.OpAMD64MOVQload, ssa.OpAMD64MOVLload, ssa.OpAMD64MOVWload, ssa.OpAMD64MOVBload, ssa.OpAMD64MOVOload,
	ssa.OpAMD64MOVSSload, ssa.OpAMD64MOVSDload, ssa.OpAMD64MOVBQSXload, ssa.OpAMD64MOVWQSXload, ssa.OpAMD64MOVLQSXload,
	ssa.OpAMD64MOVBEQload, ssa.OpAMD64MOVBELload:
	p := s.Prog(v.Op.Asm())
	p.From.Type = obj.TYPE_MEM
	p.From.Reg = v.Args[0].Reg()
	ssagen.AddAux(&p.From, v)
	p.To.Type = obj.TYPE_REG
	p.To.Reg = v.Reg()

case ssa.OpAMD64CALLstatic, ssa.OpAMD64CALLtail:
	if s.ABI == obj.ABI0 && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABIInternal {
		// zeroing X15 when entering ABIInternal from ABI0
		if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
			opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
		}
		// set G register from TLS
		getgFromTLS(s, x86.REG_R14)
	}
	if v.Op == ssa.OpAMD64CALLtail {
		s.TailCall(v)
		break
	}
	s.Call(v)
	if s.ABI == obj.ABIInternal && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABI0 {
		// zeroing X15 when entering ABIInternal from ABI0
		if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
			opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
		}
		// set G register from TLS
		getgFromTLS(s, x86.REG_R14)
	}
```

```go
// Call returns a new CALL instruction for the SSA value v.
// It uses PrepareCall to prepare the call.
func (s *State) Call(v *ssa.Value) *obj.Prog {
	pPosIsStmt := s.pp.Pos.IsStmt() // The statement-ness fo the call comes from ssaGenState
	s.PrepareCall(v)

	p := s.Prog(obj.ACALL)
	if pPosIsStmt == src.PosIsStmt {
		p.Pos = v.Pos.WithIsStmt()
	} else {
		p.Pos = v.Pos.WithNotStmt()
	}
	if sym, ok := v.Aux.(*ssa.AuxCall); ok && sym.Fn != nil {
		p.To.Type = obj.TYPE_MEM
		p.To.Name = obj.NAME_EXTERN
		p.To.Sym = sym.Fn
	} else {
		// TODO(mdempsky): Can these differences be eliminated?
		switch Arch.LinkArch.Family {
		case sys.AMD64, sys.I386, sys.PPC64, sys.RISCV64, sys.S390X, sys.Wasm:
			p.To.Type = obj.TYPE_REG
		case sys.ARM, sys.ARM64, sys.Loong64, sys.MIPS, sys.MIPS64:
			p.To.Type = obj.TYPE_MEM
		default:
			base.Fatalf("unknown indirect call family")
		}
		p.To.Reg = v.Args[0].Reg()
	}
	return p
}
```

src/cmd/compile/internal/amd64/ssa.go:792
src/cmd/compile/internal/amd64/ssa.go:1064
src/cmd/compile/internal/ssagen/ssa.go:7603

Machine Code Generation

```go
case ssa.OpAMD64MOVQload, ssa.OpAMD64MOVLload, ssa.OpAMD64MOVWload, ssa.OpAMD64MOVBload, ssa.OpAMD64MOVOload,
     ssa.OpAMD64MOVSSload, ssa.OpAMD64MOVSDload, ssa.OpAMD64MOVBQSXload, ssa.OpAMD64MOVWQSXload, ssa.OpAMD64MOVLQSXload,
     ssa.OpAMD64MOVBEQload, ssa.OpAMD64MOVBELload:
     p := s.Prog(v.Op.Asm())
     p.From.Type = obj.TYPE_MEM
     p.From.Reg = v.Args[0].Reg()
     ssagen.AddAux(&p.From, v)
     p.To.Type = obj.TYPE_REG
     p.To.Reg = v.Reg()

case ssa.OpAMD64CALLstatic, ssa.OpAMD64CALLtail:
     if s.ABI == obj.ABI0 && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABIInternal {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
     if v.Op == ssa.OpAMD64CALLtail {
         s.TailCall(v)
         break
     }
     s.Call(v)
     if s.ABI == obj.ABIInternal && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABI0 {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
```

```go
// Call returns a new CALL instruction for the SSA value v.
// It uses PrepareCall to prepare the call.
func (s *State) Call(v *ssa.Value) *obj.Prog {
    pPosIsStmt := s.pp.Pos.IsStmt() // The statement-ness fo the call comes from ssaGenState
    s.PrepareCall(v)

    p := s.Prog(obj.ACALL)
    if pPosIsStmt == src.PosIsStmt {
        p.Pos = v.Pos.WithIsStmt()
    } else {
        p.Pos = v.Pos.WithNotStmt()
    }
    if sym, ok := v.Aux.(*ssa.AuxCall); ok && sym.Fn != nil {
        p.To.Type = obj.TYPE_MEM
        p.To.Name = obj.NAME_EXTERN
        p.To.Sym = sym.Fn
    } else {
        // TODO(mdempsky): Can these differences be eliminated?
        switch Arch.LinkArch.Family {
        case sys.AMD64, sys.I386, sys.PPC64, sys.RISCV64, sys.S390X, sys.Wasm:
            p.To.Type = obj.TYPE_REG
        case sys.ARM, sys.ARM64, sys.Loong64, sys.MIPS, sys.MIPS64:
            p.To.Type = obj.TYPE_MEM
        default:
            base.Fatalf("unknown indirect call family")
        }
        p.To.Reg = v.Args[0].Reg()
    }
    return p
}
```

src/cmd/compile/internal/amd64/ssa.go:792
src/cmd/compile/internal/amd64/ssa.go:1064
src/cmd/compile/internal/ssagen/ssa.go:7603

Machine Code Generation

```go
case ssa.OpAMD64MOVQload, ssa.OpAMD64MOVLload, ssa.OpAMD64MOVWload, ssa.OpAMD64MOVBload, ssa.OpAMD64MOVOload,
     ssa.OpAMD64MOVSSload, ssa.OpAMD64MOVSDload, ssa.OpAMD64MOVBQSXload, ssa.OpAMD64MOVWQSXload, ssa.OpAMD64MOVLQSXload,
     ssa.OpAMD64MOVBEQload, ssa.OpAMD64MOVBELload:
     p := s.Prog(v.Op.Asm())
     p.From.Type = obj.TYPE_MEM
     p.From.Reg = v.Args[0].Reg()
     ssagen.AddAux(&p.From, v)
     p.To.Type = obj.TYPE_REG
     p.To.Reg = v.Reg()

case ssa.OpAMD64CALLstatic, ssa.OpAMD64CALLtail:
     if s.ABI == obj.ABI0 && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABIInternal {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
     if v.Op == ssa.OpAMD64CALLtail {
         s.TailCall(v)
         break
     }
     s.Call(v)
     if s.ABI == obj.ABIInternal && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABI0 {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
```

```go
// Call returns a new CALL instruction for the SSA value v.
// It uses PrepareCall to prepare the call.
func (s *State) Call(v *ssa.Value) *obj.Prog {
    pPosIsStmt := s.pp.Pos.IsStmt() // The statement-ness fo the call comes from ssaGenState
    s.PrepareCall(v)

    p := s.Prog(obj.ACALL)
    if pPosIsStmt == src.PosIsStmt {
        p.Pos = v.Pos.WithIsStmt()
    } else {
        p.Pos = v.Pos.WithNotStmt()
    }
    if sym, ok := v.Aux.(*ssa.AuxCall); ok && sym.Fn != nil {
        p.To.Type = obj.TYPE_MEM
        p.To.Name = obj.NAME_EXTERN
        p.To.Sym = sym.Fn
    } else {
        // TODO(mdempsky): Can these differences be eliminated?
        switch Arch.LinkArch.Family {
        case sys.AMD64, sys.I386, sys.PPC64, sys.RISCV64, sys.S390X, sys.Wasm:
            p.To.Type = obj.TYPE_REG
        case sys.ARM, sys.ARM64, sys.Loong64, sys.MIPS, sys.MIPS64:
            p.To.Type = obj.TYPE_MEM
        default:
            base.Fatalf("unknown indirect call family")
        }
        p.To.Reg = v.Args[0].Reg()
    }
    return p
}
```

src/cmd/compile/internal/amd64/ssa.go:792
src/cmd/compile/internal/amd64/ssa.go:1064
src/cmd/compile/internal/ssagen/ssa.go:7603

Machine Code Generation

```go
case ssa.OpAMD64MOVQload, ssa.OpAMD64MOVLload, ssa.OpAMD64MOVWload, ssa.OpAMD64MOVBload, ssa.OpAMD64MOVOload,
     ssa.OpAMD64MOVSSload, ssa.OpAMD64MOVSDload, ssa.OpAMD64MOVBQSXload, ssa.OpAMD64MOVWQSXload, ssa.OpAMD64MOVLQSXload,
     ssa.OpAMD64MOVBEQload, ssa.OpAMD64MOVBELload:
     p := s.Prog(v.Op.Asm())
     p.From.Type = obj.TYPE_MEM
     p.From.Reg = v.Args[0].Reg()
     ssagen.AddAux(&p.From, v)
     p.To.Type = obj.TYPE_REG
     p.To.Reg = v.Reg()

case ssa.OpAMD64CALLstatic, ssa.OpAMD64CALLtail:
     if s.ABI == obj.ABI0 && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABIInternal {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
     if v.Op == ssa.OpAMD64CALLtail {
         s.TailCall(v)
         break
     }
     s.Call(v)
     if s.ABI == obj.ABIInternal && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABI0 {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
```

```go
// Call returns a new CALL instruction for the SSA value v.
// It uses PrepareCall to prepare the call.
func (s *State) Call(v *ssa.Value) *obj.Prog {
    pPosIsStmt := s.pp.Pos.IsStmt() // The statement-ness fo the call comes from ssaGenState
    s.PrepareCall(v)

    p := s.Prog(obj.ACALL)
    if pPosIsStmt == src.PosIsStmt {
        p.Pos = v.Pos.WithIsStmt()
    } else {
        p.Pos = v.Pos.WithNotStmt()
    }
    if sym, ok := v.Aux.(*ssa.AuxCall); ok && sym.Fn != nil {
        p.To.Type = obj.TYPE_MEM
        p.To.Name = obj.NAME_EXTERN
        p.To.Sym = sym.Fn
    } else {
        // TODO(mdempsky): Can these differences be eliminated?
        switch Arch.LinkArch.Family {
        case sys.AMD64, sys.I386, sys.PPC64, sys.RISCV64, sys.S390X, sys.Wasm:
            p.To.Type = obj.TYPE_REG
        case sys.ARM, sys.ARM64, sys.Loong64, sys.MIPS, sys.MIPS64:
            p.To.Type = obj.TYPE_MEM
        default:
            base.Fatalf("unknown indirect call family")
        }
        p.To.Reg = v.Args[0].Reg()
    }
    return p
}
```

src/cmd/compile/internal/amd64/ssa.go:792
src/cmd/compile/internal/amd64/ssa.go:1064
src/cmd/compile/internal/ssagen/ssa.go:7603

Machine Code Generation

```
case ssa.OpAMD64MOVQload, ssa.OpAMD64MOVLload, ssa.OpAMD64MOVWload, ssa.OpAMD64MOVBload, ssa.OpAMD64MOVOload,
     ssa.OpAMD64MOVSSload, ssa.OpAMD64MOVSDload, ssa.OpAMD64MOVBQSXload, ssa.OpAMD64MOVWQSXload, ssa.OpAMD64MOVLQSXload,
     ssa.OpAMD64MOVBEQload, ssa.OpAMD64MOVBELload:
     p := s.Prog(v.Op.Asm())
     p.From.Type = obj.TYPE_MEM
     p.From.Reg = v.Args[0].Reg()
     ssagen.AddAux(&p.From, v)
     p.To.Type = obj.TYPE_REG
     p.To.Reg = v.Reg()

case ssa.OpAMD64CALLstatic, ssa.OpAMD64CALLtail:
     if s.ABI == obj.ABI0 && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABIInternal {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
     if v.Op == ssa.OpAMD64CALLtail {
         s.TailCall(v)
         break
     }
     s.Call(v)
     if s.ABI == obj.ABIInternal && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABI0 {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
```

```
// Call returns a new CALL instruction for the SSA value v.
// It uses PrepareCall to prepare the call.
func (s *State) Call(v *ssa.Value) *obj.Prog {
    pPosIsStmt := s.pp.Pos.IsStmt() // The statement-ness fo the call comes from ssaGenState
    s.PrepareCall(v)

    p := s.Prog(obj.ACALL)
    if pPosIsStmt == src.PosIsStmt {
        p.Pos = v.Pos.WithIsStmt()
    } else {
        p.Pos = v.Pos.WithNotStmt()
    }
    if sym, ok := v.Aux.(*ssa.AuxCall); ok && sym.Fn != nil {
        p.To.Type = obj.TYPE_MEM
        p.To.Name = obj.NAME_EXTERN
        p.To.Sym = sym.Fn
    } else {
        // TODO(mdempsky): Can these differences be eliminated?
        switch Arch.LinkArch.Family {
        case sys.AMD64, sys.I386, sys.PPC64, sys.RISCV64, sys.S390X, sys.Wasm:
            p.To.Type = obj.TYPE_REG
        case sys.ARM, sys.ARM64, sys.Loong64, sys.MIPS, sys.MIPS64:
            p.To.Type = obj.TYPE_MEM
        default:
            base.Fatalf("unknown indirect call family")
        }
        p.To.Reg = v.Args[0].Reg()
    }
    return p
}
```

src/cmd/compile/internal/amd64/ssa.go:792
src/cmd/compile/internal/amd64/ssa.go:1064
src/cmd/compile/internal/ssagen/ssa.go:7603

Machine Code Generation

```go
case ssa.OpAMD64MOVQload, ssa.OpAMD64MOVLload, ssa.OpAMD64MOVWload, ssa.OpAMD64MOVBload, ssa.OpAMD64MOVOload,
     ssa.OpAMD64MOVSSload, ssa.OpAMD64MOVSDload, ssa.OpAMD64MOVBQSXload, ssa.OpAMD64MOVWQSXload, ssa.OpAMD64MOVLQSXload,
     ssa.OpAMD64MOVBEQload, ssa.OpAMD64MOVBELload:
     p := s.Prog(v.Op.Asm())
     p.From.Type = obj.TYPE_MEM
     p.From.Reg = v.Args[0].Reg()
     ssagen.AddAux(&p.From, v)
     p.To.Type = obj.TYPE_REG
     p.To.Reg = v.Reg()

case ssa.OpAMD64CALLstatic, ssa.OpAMD64CALLtail:
     if s.ABI == obj.ABI0 && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABIInternal {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
     if v.Op == ssa.OpAMD64CALLtail {
         s.TailCall(v)
         break
     }
     s.Call(v)
     if s.ABI == obj.ABIInternal && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABI0 {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
```

```go
// Call returns a new CALL instruction for the SSA value v.
// It uses PrepareCall to prepare the call.
func (s *State) Call(v *ssa.Value) *obj.Prog {
    pPosIsStmt := s.pp.Pos.IsStmt() // The statement-ness fo the call comes from ssaGenState
    s.PrepareCall(v)

    p := s.Prog(obj.ACALL)
    if pPosIsStmt == src.PosIsStmt {
        p.Pos = v.Pos.WithIsStmt()
    } else {
        p.Pos = v.Pos.WithNotStmt()
    }
    if sym, ok := v.Aux.(*ssa.AuxCall); ok && sym.Fn != nil {
        p.To.Type = obj.TYPE_MEM
        p.To.Name = obj.NAME_EXTERN
        p.To.Sym = sym.Fn
    } else {
        // TODO(mdempsky): Can these differences be eliminated?
        switch Arch.LinkArch.Family {
        case sys.AMD64, sys.I386, sys.PPC64, sys.RISCV64, sys.S390X, sys.Wasm:
            p.To.Type = obj.TYPE_REG
        case sys.ARM, sys.ARM64, sys.Loong64, sys.MIPS, sys.MIPS64:
            p.To.Type = obj.TYPE_MEM
        default:
            base.Fatalf("unknown indirect call family")
        }
        p.To.Reg = v.Args[0].Reg()
    }
    return p
}
```

src/cmd/compile/internal/amd64/ssa.go:792
src/cmd/compile/internal/amd64/ssa.go:1064
src/cmd/compile/internal/ssagen/ssa.go:7603

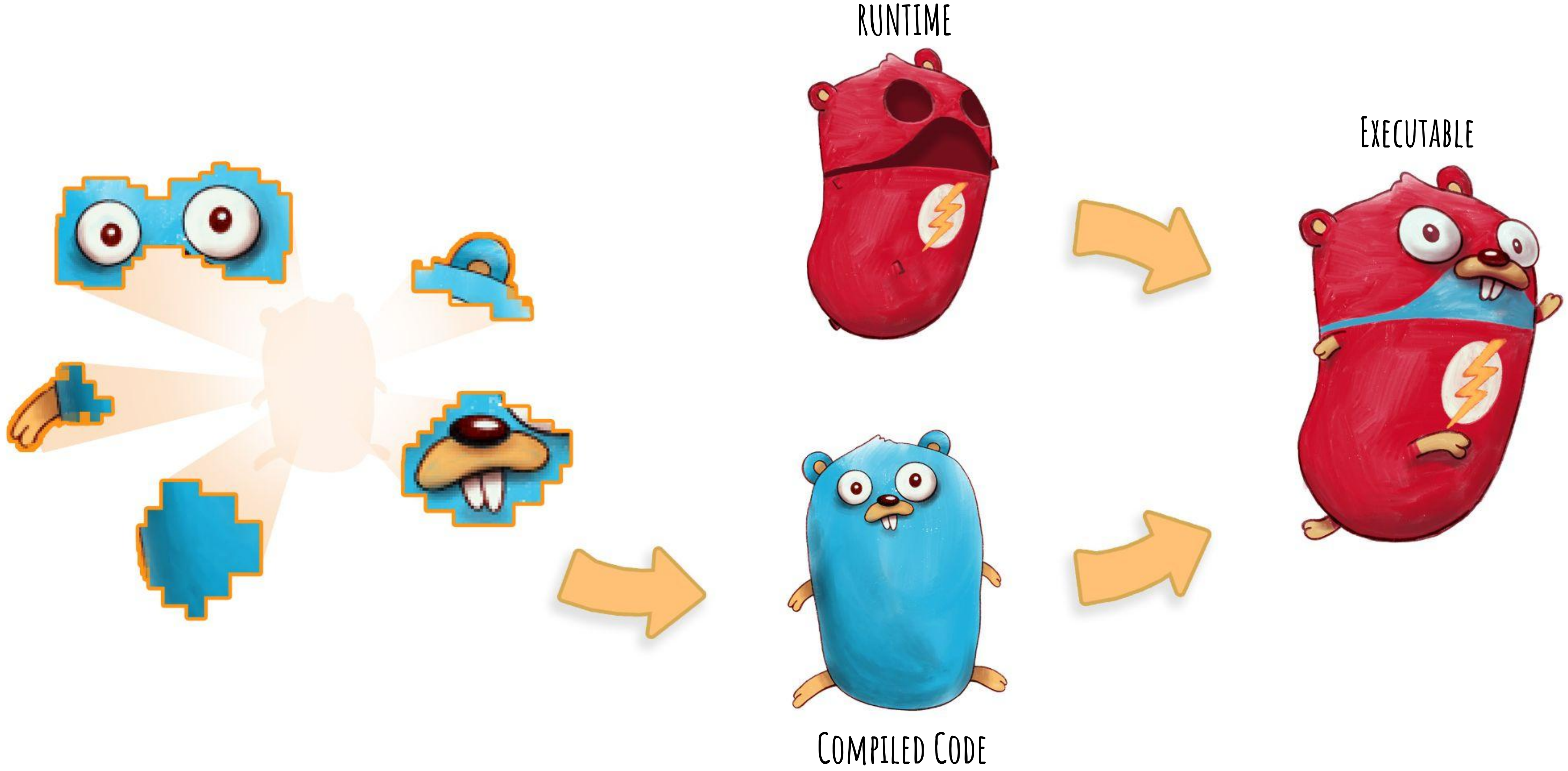
Machine Code Generation

```
case ssa.OpAMD64MOVQload, ssa.OpAMD64MOVLload, ssa.OpAMD64MOVWload, ssa.OpAMD64MOVBload, ssa.OpAMD64MOVOload,
     ssa.OpAMD64MOVSSload, ssa.OpAMD64MOVSDload, ssa.OpAMD64MOVBQSXload, ssa.OpAMD64MOVWQSXload, ssa.OpAMD64MOVLQSXload,
     ssa.OpAMD64MOVBEQload, ssa.OpAMD64MOVBELload:
     p := s.Prog(v.Op.Asm())
     p.From.Type = obj.TYPE_MEM
     p.From.Reg = v.Args[0].Reg()
     ssagen.AddAux(&p.From, v)
     p.To.Type = obj.TYPE_REG
     p.To.Reg = v.Reg()

case ssa.OpAMD64CALLstatic, ssa.OpAMD64CALLtail:
     if s.ABI == obj.ABI0 && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABIInternal {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
     if v.Op == ssa.OpAMD64CALLtail {
         s.TailCall(v)
         break
     }
     s.Call(v)
     if s.ABI == obj.ABIInternal && v.Aux.(*ssa.AuxCall).Fn.ABI() == obj.ABI0 {
         // zeroing X15 when entering ABIInternal from ABI0
         if buildcfg.GOOS != "plan9" { // do not use SSE on Plan 9
             opregreg(s, x86.AXORPS, x86.REG_X15, x86.REG_X15)
         }
         // set G register from TLS
         getgFromTLS(s, x86.REG_R14)
     }
```

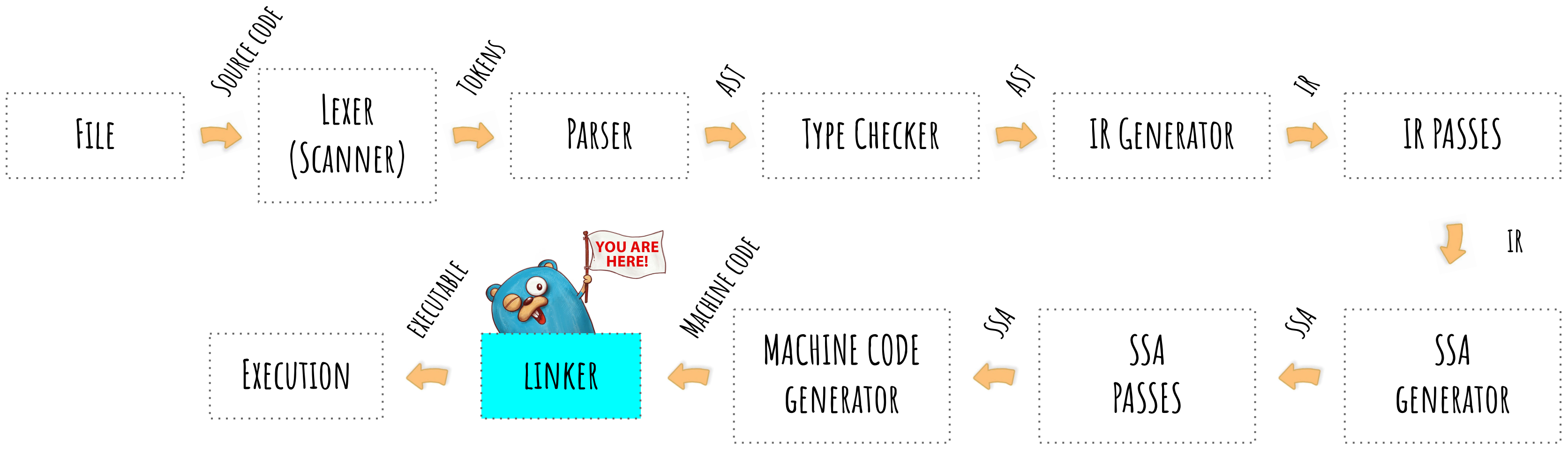
```
// Call returns a new CALL instruction for the SSA value v.
// It uses PrepareCall to prepare the call.
func (s *State) Call(v *ssa.Value) *obj.Prog {
    pPosIsStmt := s.pp.Pos.IsStmt() // The statement-ness fo the call comes from ssaGenState
    s.PrepareCall(v)

    p := s.Prog(obj.ACALL)
    if pPosIsStmt == src.PosIsStmt {
        p.Pos = v.Pos.WithIsStmt()
    } else {
        p.Pos = v.Pos.WithNotStmt()
    }
    if sym, ok := v.Aux.(*ssa.AuxCall); ok && sym.Fn != nil {
        p.To.Type = obj.TYPE_MEM
        p.To.Name = obj.NAME_EXTERN
        p.To.Sym = sym.Fn
    } else {
        // TODO(mdempsky): Can these differences be eliminated?
        switch Arch.LinkArch.Family {
        case sys.AMD64, sys.I386, sys.PPC64, sys.RISCV64, sys.S390X, sys.Wasm:
            p.To.Type = obj.TYPE_REG
        case sys.ARM, sys.ARM64, sys.Loong64, sys.MIPS, sys.MIPS64:
            p.To.Type = obj.TYPE_MEM
        default:
            base.Fatalf("unknown indirect call family")
        }
        p.To.Reg = v.Args[0].Reg()
    }
    return p
}
```

src/cmd/compile/internal/amd64/ssa.go:792
src/cmd/compile/internal/amd64/ssa.go:1064
src/cmd/compile/internal/ssagen/ssa.go:7603

Linking



Linking


File
Source code
Lexer (Scanner)
Tokens
Parser
AST
Type Checker
AST
IR Generator
IR
IR Passes
IR
SSA Generator
SSA
SSA Passes
SSA
Machine Code Generator
Machine code
YOU ARE HERE!
Linker
Executable
Execution

The runtime

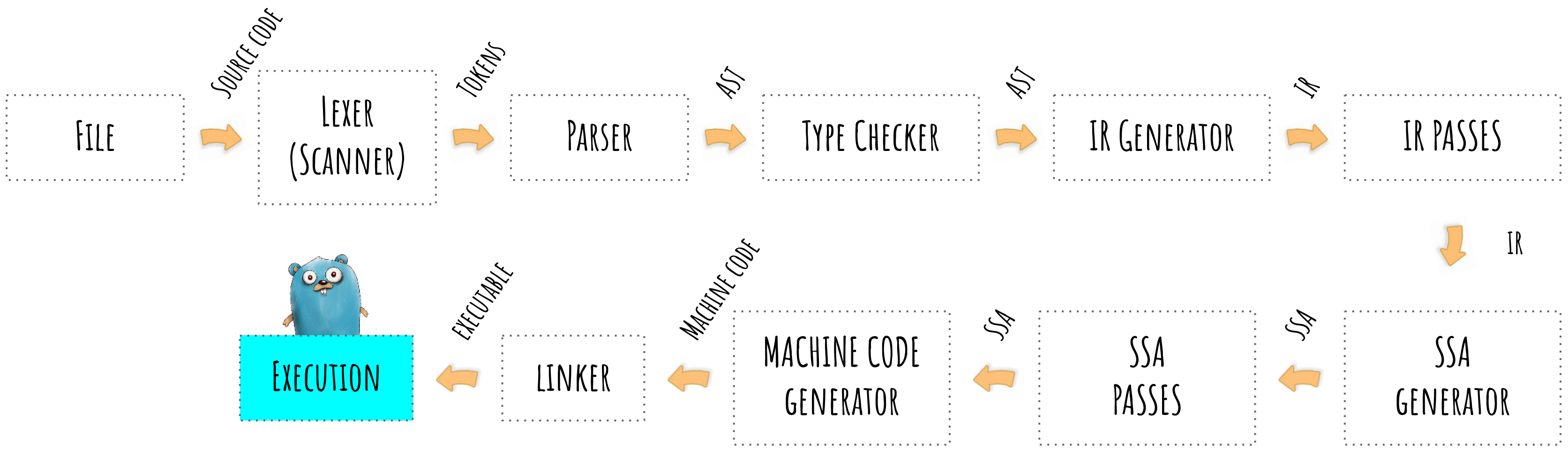
- Maps, slices, channels, goroutines…
- Memory management
- The scheduler
- The startup

And to the screen

The kernel and the stdout

Hello World!
stdout
>_
HELLO,
WORLD_

The kernel and the stdout



Printing to the screen

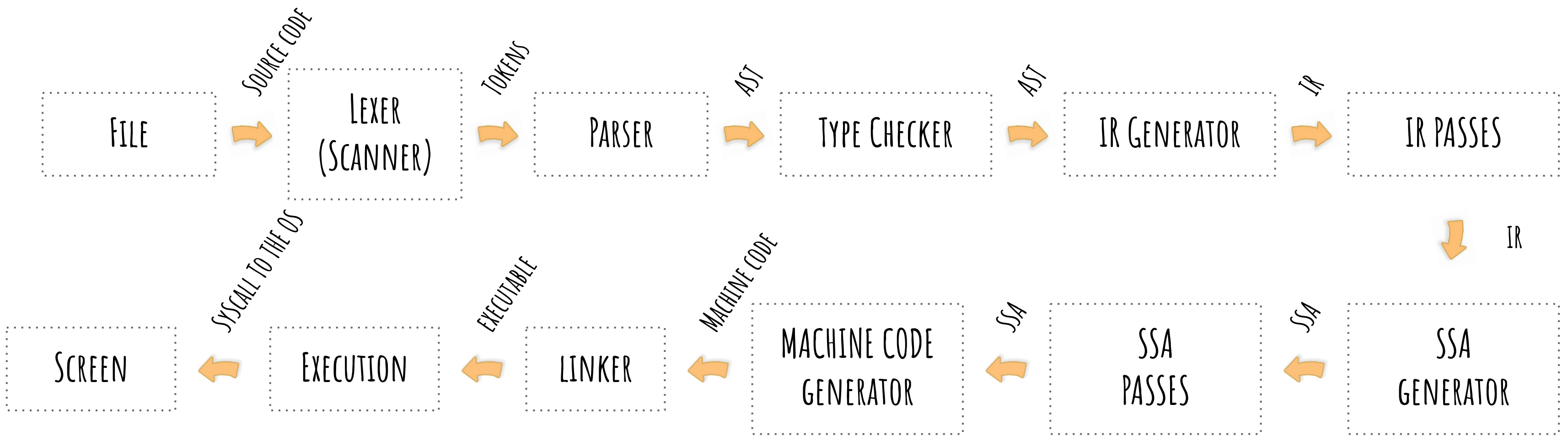
```
$ strace ./a.out

execve("./a.out", ["./a.out"], 0x7ffde58585d0 /* 77 vars */) = 0
arch_prctl(ARCH_SET_FS, 0x528870)       = 0
sched_getaffinity(0, 8192, [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]) = 40
openat(AT_FDCWD, "/sys/kernel/mm/transparent_hugepage/hpage_pmd_size", O_RDONLY) = 3
read(3, "2097152\n", 20)                = 8
close(3)                                = 0

...

write(1, "hello-world!\n", 13hello-world!)            = 13
exit_group(0)                           = ?
+++ exited with 0 +++
```

Printing to the screen

```
$ strace ./a.out

execve("./a.out", ["./a.out"], 0x7ffde58585d0 /* 77 vars */) = 0
arch_prctl(ARCH_SET_FS, 0x528870)       = 0
sched_getaffinity(0, 8192, [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]) = 40
openat(AT_FDCWD, "/sys/kernel/mm/transparent_hugepage/hpage_pmd_size", O_RDONLY) = 3
read(3, "2097152\n", 20)                = 8
close(3)                                = 0

...

write(1, "hello-world!\n", 13hello-world!)          = 13
exit_group(0)                           = ?
+++ exited with 0 +++
```

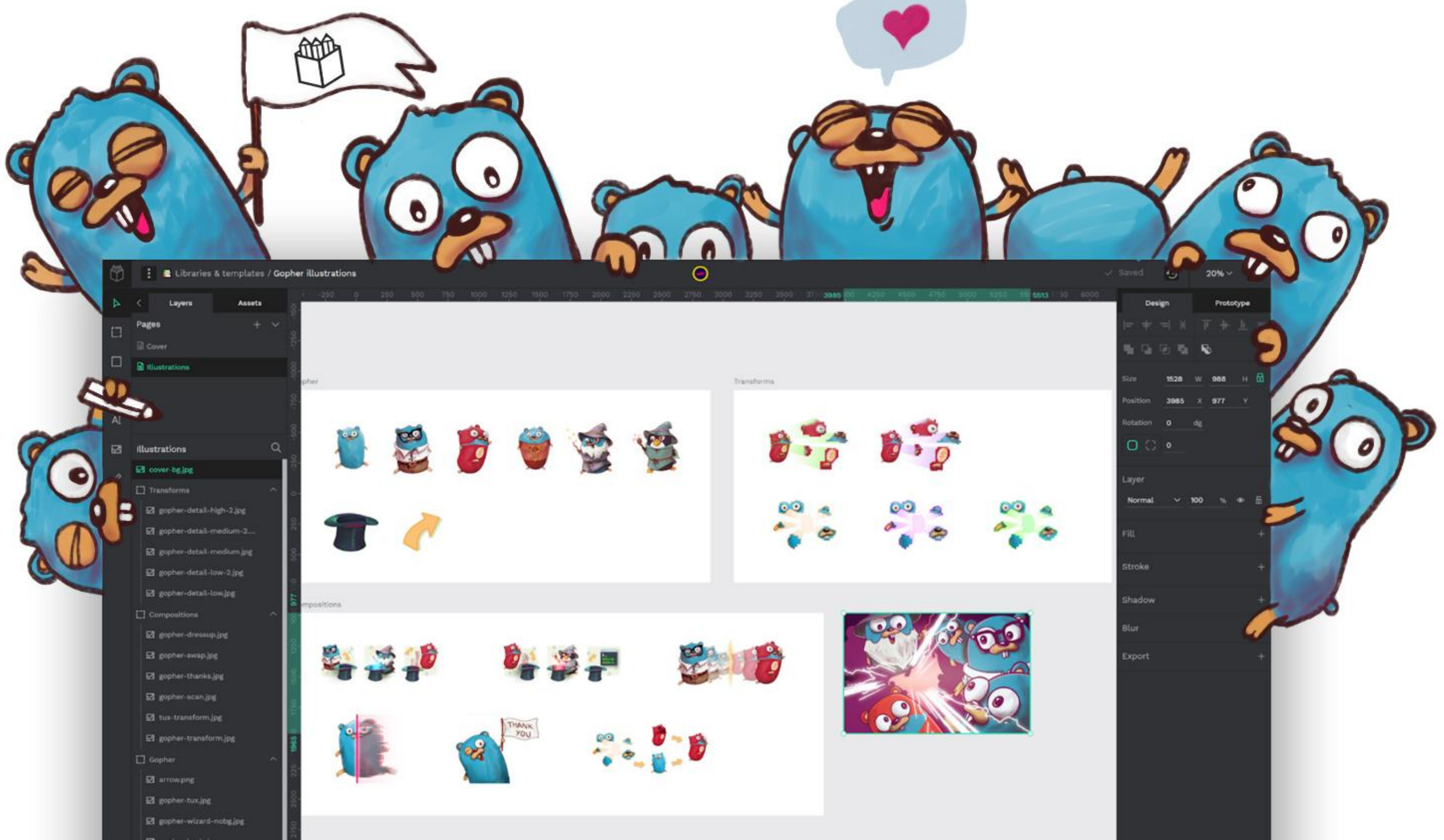
Summary

Summary


File
Source code
Lexer (Scanner)
Tokens
Parser
AST
Type Checker
AST
IR Generator
IR
IR passes
IR
SSA generator
SSA
SSA passes
SSA
Machine code generator
Machine code
Linker
Executable
Execution
Syscall to the OS
Screen

The Illustrations of the Talk

- Made by Juan de la Cruz for this talk
- Creative Commons 0 (Use it however you want)
- Downloadable in Penpot (Open Source Design tool) format
- https://github.com/penpot/penpot-files/raw/main/Gopher-illustrations.penpot



References

- The compile command README: https://go.dev/src/cmd/compile/README
- The SSA README: https://go.dev/src/cmd/compile/internal/ssa/README
- https://go.dev/doc/asm
- https://pkg.go.dev/runtime
- SSA Talks:
  - https://www.youtube.com/watch?v=D2-gaMvWfQY
  - https://www.youtube.com/watch?v=uTMvKVma5ms
- Go Assembler: https://www.youtube.com/watch?v=KINIAgRpkDA

CONCLUSIONS

THANK YOU