Pointers

02-201 / 02-601

Complex Literal Data Example

```go
func main() {
    company := make(map[string]TeamInfo)

    company["appleWatch"] = TeamInfo{
        teamName: "appleWatch",
        meetingTime: 10,
        members: []Employee{
            Employee{id: 7, name: "Carl", salary: 1.0},
            Employee{id: 3, name: "Dave", salary: 50.0},
        },
    }

    company["iPhone"] = TeamInfo{
        teamName: "iPhone",
        meetingTime: 3,
        members: []Employee{
            Employee{id: 4, name: "Mike", salary: 101.0},
            Employee{id: 8, name: "Sally", salary: 151.0},
        },
    }

    company["iMac"] = TeamInfo{
        teamName: "iMac",
        meetingTime: 10,
        members: []Employee{
            Employee{id: 7, name: "Carl", salary: 1.0},
            Employee{id: 10, name: "George", salary: 75.0},
            Employee{id: 11, name: "Teresa", salary: 92.0},
        },
    }

    fmt.Println(teamCost(company, "appleWatch"))
    fmt.Println(timeConflict(company))
}
```

- Notice the data duplication

Changing salary here

Has no effect here

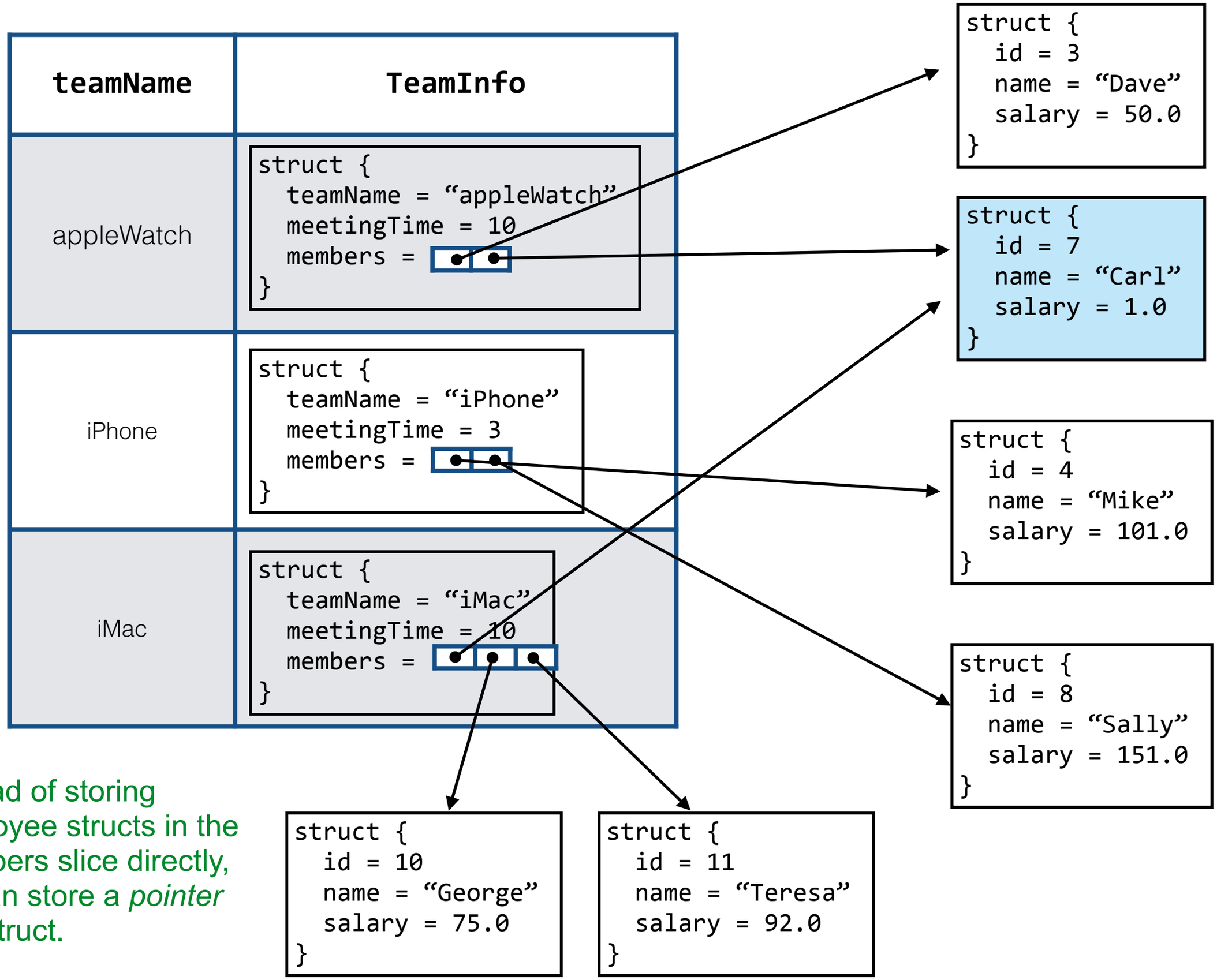
- Error prone
- Waste of memory
- Updating information slower because every instance must be found

teamName	TeamInfo

“appleWatch”	struct {
	teamName = “appleWatch”
	meetingTime = 10
	members = { struct { id = 7, name = “Carl”, salary = 1.0 } ; struct { id = 3, name = “Dave”, salary = 50.0 } }
	}

“iPhone”	struct {
	teamName = “iPhone”
	meetingTime = 3
	members = { struct { id = 4, name = “Mike”, salary = 101.0 } ; struct { id = 8, name = “Sally”, salary = 151.0 } }
	}

“iMac”	struct {
	teamName = “iMac”
	meetingTime = 10
	members = { struct { id = 7, name = “Carl”, salary = 1.0 } ; struct { id = 11, name = “Teresa”, salary = 92.0 } ; struct { id = 10, name = “George”, salary = 75.0 } }
	}



Instead of storing Employee structs in the members slice directly, we can store a *pointer* to a struct.

Pointer Types

```
type TeamInfo struct {
  teamName string
  meetingTime int
  members []*Employee
}
```

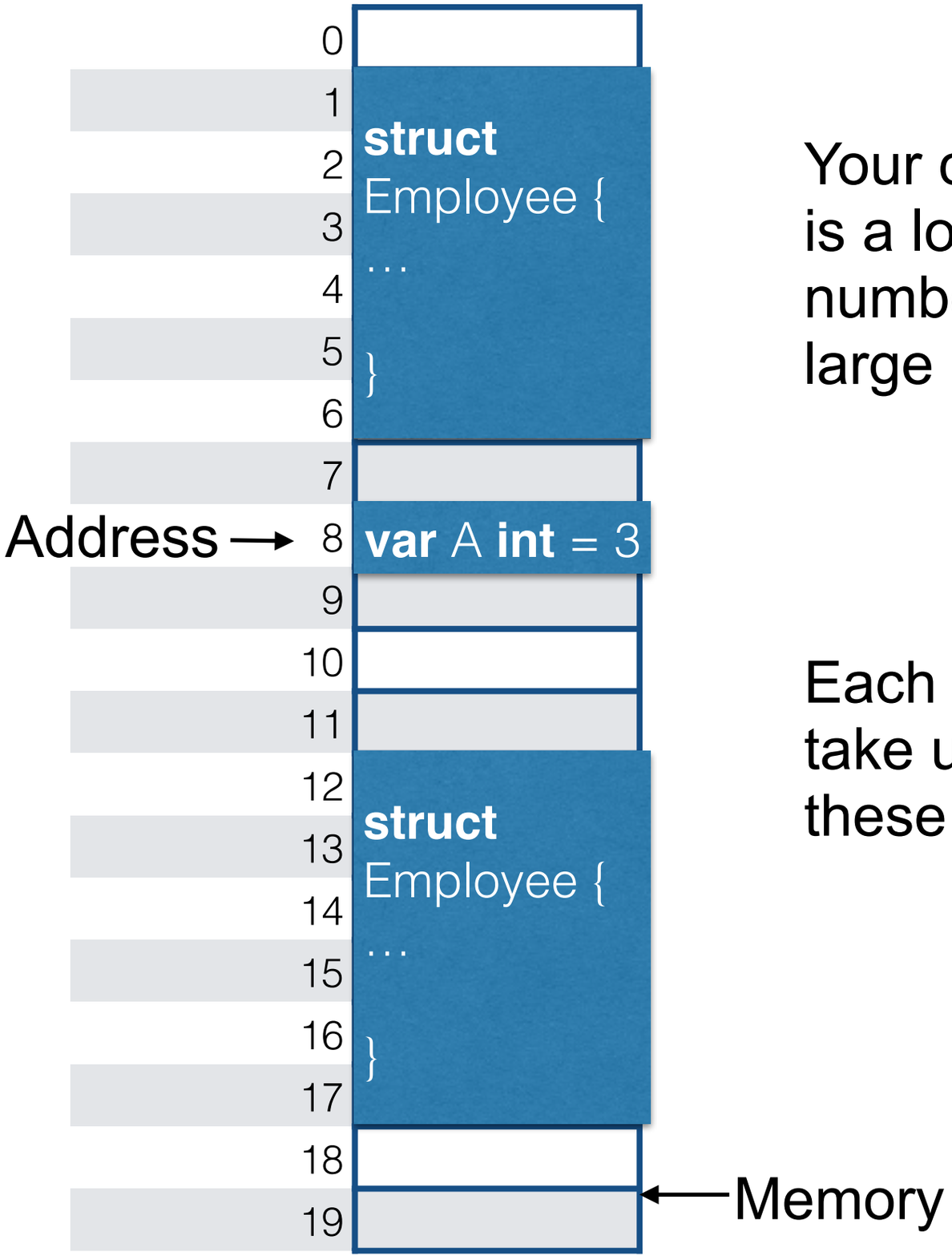
The "*" means "pointer to"

This is a slice of pointers to Employee structs

Can have pointers to most types:

```
var name *string
var person *Employee
var pj *int
var m map[string]*Employee
var pA *[10]float64
var Apf [10]*float64
```

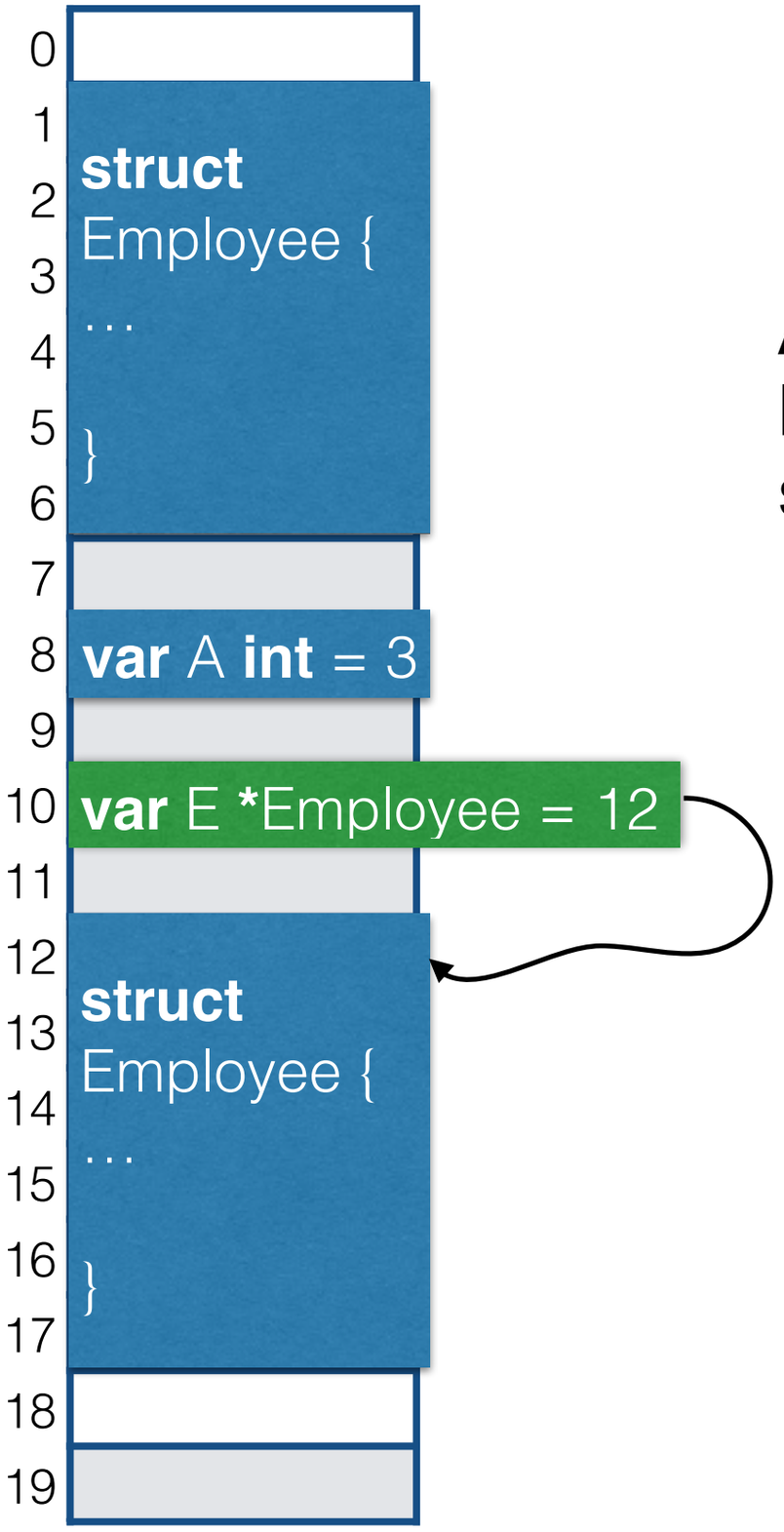
RAM



Your computer's memory is a long chain of cells numbered 0 to some large number.

Each variable you declare take up some number of these cells.

What's a Pointer



A pointer is a variable that holds the address of some other variable.

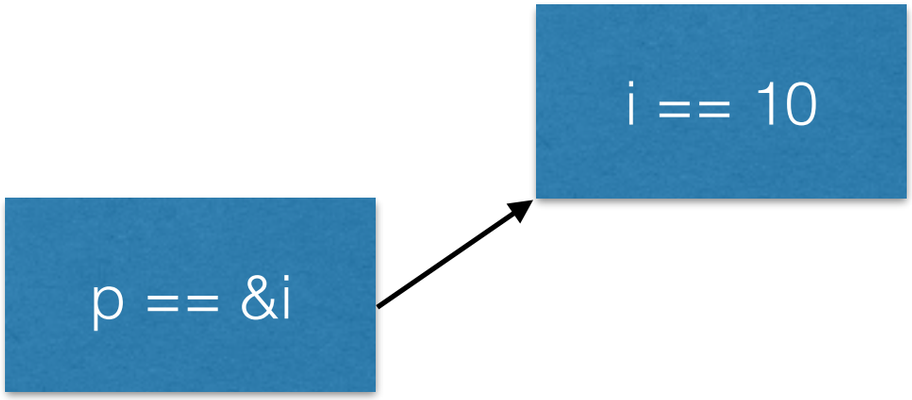
Setting What a Pointer Points To

```
var P Employee = createEmployee()
var person *Employee

// at this point, person == nil

person = &P
```

The “&” operator
means “address of”

Another example:

```
var i int = 10
var p *int = &i
```



Accessing What a Pointer Points To

```
var i int = 10
var j int = 10
var p *int = &i

i = 11
fmt.Println(*p) ............... 11
fmt.Println(p) ............... some big number

*p = 300
fmt.Println(*p) ............... 300
fmt.Println(p) ............... the same big number
fmt.Println(i) ............... 300

p = &j
fmt.Println(*p) ............... 10
*p = 12
fmt.Println(*p) ............... 12
```

You access what p points to by prefixing p with *

p = 300

René Magritte

Pointers are “meta” things:

An Employee is a piece of data, an “object” of your program.

A *Employee is a reference to that object.

A variable of type *Employee is not an Employee.

Accessing the fields of a struct through a pointer

```
var P Employee = createEmployee()
var person *Employee

// at this point, person == nil

person = &P


(*person).name = “Jerry”
```

This is so common, Go provides a shortcut: just use the pointer to a struct like a struct:

```
person.name = “Jerry”
```

```go
type Contact struct {
   name string
   id int
}

func main() {
   var c Contact = Contact{name:"Dave", id:33}
   var p *Contact = &c

   fmt.Println(c)
   fmt.Println(*p)
   (*p).name = "Holly"
   p.id = 33
   fmt.Println(*p)
}
```

Example: Passing A Struct to a Function

What's wrong with this code?

```
type Contact struct {
   name string
   id int
}

func setContactInfo(c Contact) {
   c.name = "Holly Golightly"
   c.id = 101
}

func main() {
   var c Contact = Contact{name:"Dave", id:33}
   setContactInfo(c)
   fmt.Println(c)
}
```

How do we fix it?

Example: Passing A Struct to a Function

Pass the *address* of a Contact to setContactInfo:

```
type Contact struct {
   name string
   id int
}

func setContactInfo(c *Contact) {
   c.name = "Holly Golightly"
   c.id = 101
}

func main() {
   var c Contact = Contact{name:"Dave", id:33}
   setContactInfo(&c)
   fmt.Println(c)
}
```

Example: How is a Slice Implemented

- Conceptually, a slice is a struct containing 3 things:

```
struct {
   startIndex int
   endIndex int
   array *[100]float64
}
```

- This is why:
  - Subslices point to the original data
  - Passing slices to functions doesn't copy the data

3.1	12.2	3.1	3.0	7.3	8.6	10.2	-2.7	30.9	6.1	11.5	11.5	11.6	32.7	64.9	80.2	99.1	-1.1	0.0	12.1

- This is only a *conceptual* equivalence.
  Go treats slices differently than these structs.

Pointer Summary

- Pointers store addresses of other variables.
- Declare by prefixing type with *
- Access the variable they point to by prefixing the pointer with *
- Get the address of a variable (to assign to a pointer) via &
- Most common use: pointers to structures