Learn the Go Programming Language

For experienced developers or
those of an adventurous nature

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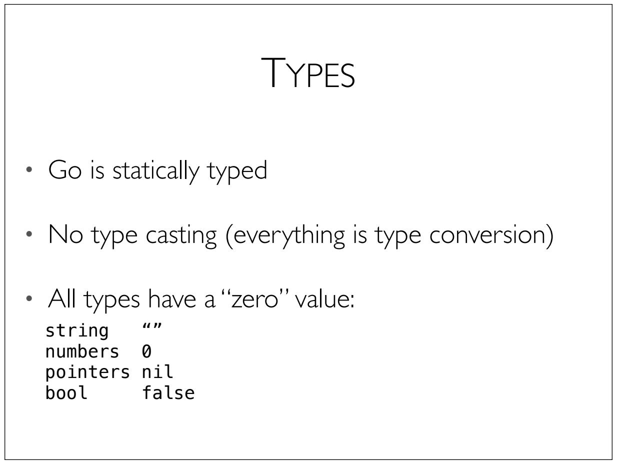
Level 03

Intro to Types
Composite Types

v0.5 draft

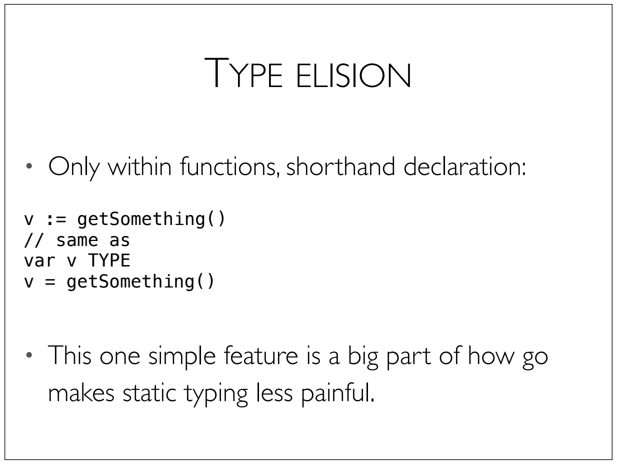


Types

- Go is statically typed
- No type casting (everything is type conversion)
- All types have a "zero" value:

```
string   “”
numbers  0
pointers nil
bool     false
```

http://golang.org/ref/spec#Conversions


TYPE ELISION

- Only within functions, shorthand declaration:

```
v := getSomething()
// same as
var v TYPE
v = getSomething()
```

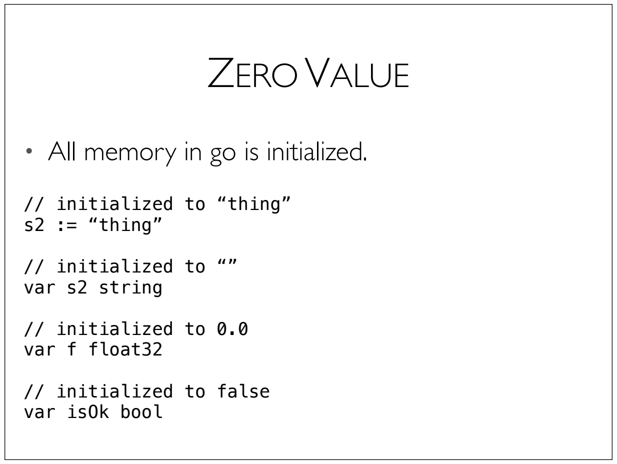
- This one simple feature is a big part of how go makes static typing less painful.

You will use and love this.

As an aside, the noun form is elision, the verb is to elide.

Comes from linguistics (skipping sounds to make a word easier to say):

http://en.wikipedia.org/wiki/Elision



ZERO VALUE

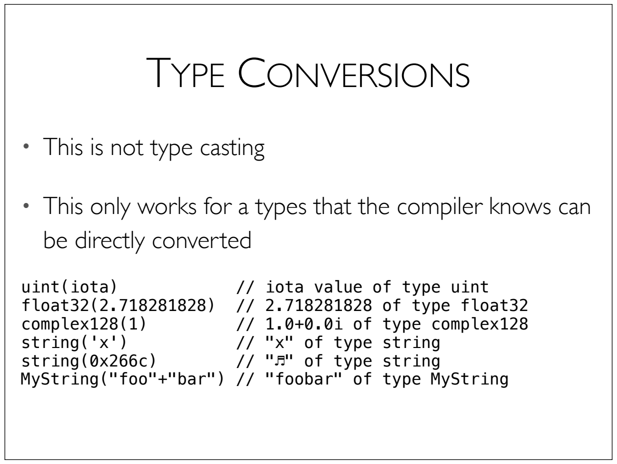
- All memory in go is initialized.

```
// initialized to “thing”
s2 := “thing”

// initialized to “”
var s2 string

// initialized to 0.0
var f float32

// initialized to false
var isOk bool
```



Type Conversions

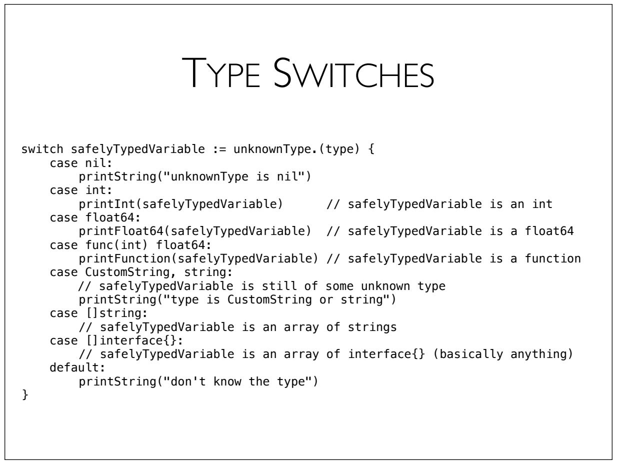
- This is not type casting
- This only works for a types that the compiler knows can be directly converted

```
uint(iota)            // iota value of type uint
float32(2.718281828)  // 2.718281828 of type float32
complex128(1)         // 1.0+0.0i of type complex128
string('x')           // "x" of type string
string(0x266c)        // "♬" of type string
MyString("foo"+"bar") // "foobar" of type MyString
```

Type Assertions

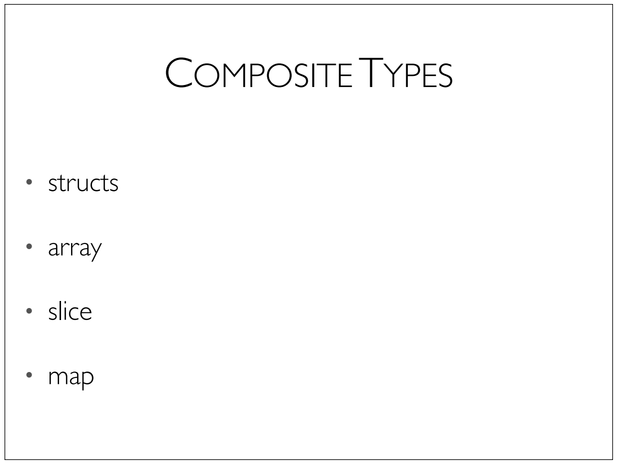
```
v, ok := unknownThing.(<TYPE>)

    if ok {
        // v has a type of <TYPE>,
        // v is assigned unknownThing
    } else {
        // v has a type of <TYPE>
        // v is nil or zero value
    }
```



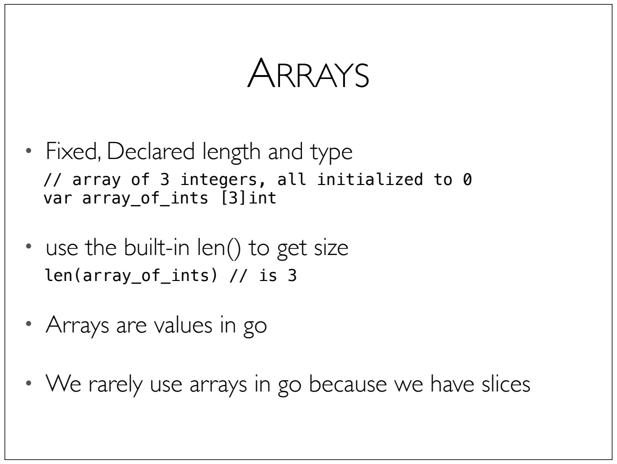
Type Switches

```
switch safelyTypedVariable := unknownType.(type) {
    case nil:
        printString("unknownType is nil")
    case int:
        printInt(safelyTypedVariable)      // safelyTypedVariable is an int
    case float64:
        printFloat64(safelyTypedVariable)  // safelyTypedVariable is a float64
    case func(int) float64:
        printFunction(safelyTypedVariable) // safelyTypedVariable is a function
    case CustomString, string:
        // safelyTypedVariable is still of some unknown type
        printString("type is CustomString or string")
    case []string:
        // safelyTypedVariable is an array of strings
    case []interface{}:
        // safelyTypedVariable is an array of interface{} (basically anything)
    default:
        printString("don't know the type")
}
```



COMPOSITE TYPES

- structs
- array
- slice
- map



ARRAYS

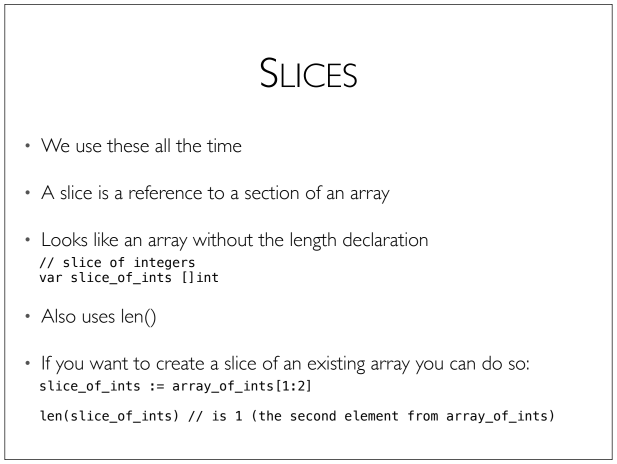
- Fixed, Declared length and type

```
// array of 3 integers, all initialized to 0
var array_of_ints [3]int
```

- use the built-in len() to get size

```
len(array_of_ints) // is 3
```

- Arrays are values in go
- We rarely use arrays in go because we have slices



Slices

- We use these all the time
- A slice is a reference to a section of an array
- Looks like an array without the length declaration

```
// slice of integers
var slice_of_ints []int
```

- Also uses len()
- If you want to create a slice of an existing array you can do so:

```
slice_of_ints := array_of_ints[1:2]

len(slice_of_ints) // is 1 (the second element from array_of_ints)
```

slices are not usually passed around as pointers because they are already references to an underlying array.

SLICING

- When slicing, first index defaults to 0:
  `aoi[:n] means the same as aoi[0:n]`
- Second index defaults to len(array/slice):
  `aoi[n:] means the same as aoi[n:len(aoi)]`
- Thus to create a slice from an array:
  `aoi[:] means the same as aoi[0:len(aoi)]`

MAKING SLICES

- Slice Literal (create a slice and it's underlying array)

```
var slice = []int{1,2,3,4,5}
```

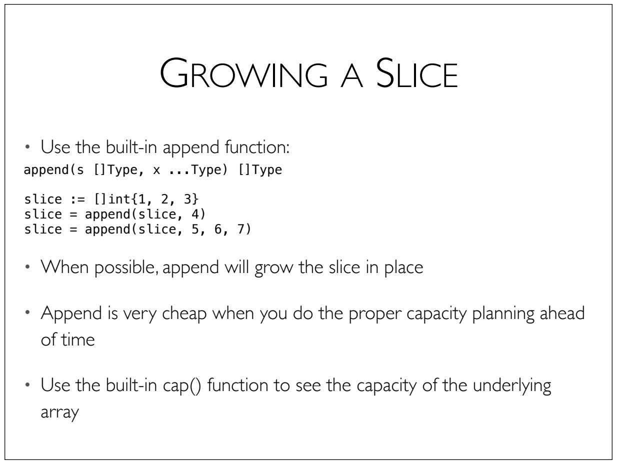
- Slice Allocations (allocate a slice and underlying array with the built-in function `make`)

```
// returns []int with 10 zeroed ints
var intSlice = make([]int, 10)

// returns []int with capacity for 20 ints total
var intSlice = make([]int, 0, 20)

// returns []int with 10 zeroed ints and capacity for 20 ints total
var intSlice = make([]int, 10, 20)

// returns *[]int
var intSlicePtr = new([]int)
```


Growing a Slice

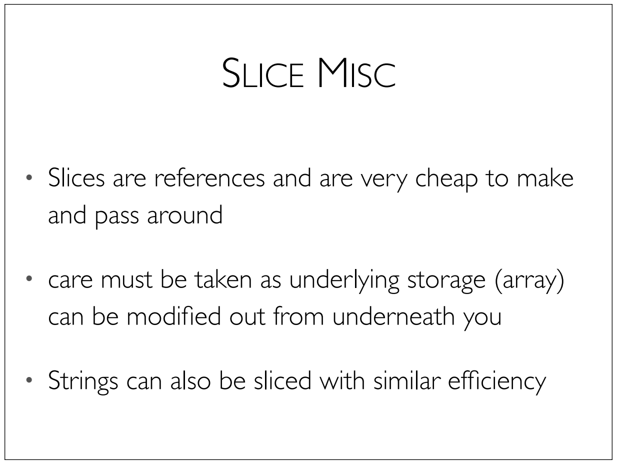
- Use the built-in append function:

```
append(s []Type, x ...Type) []Type

slice := []int{1, 2, 3}
slice = append(slice, 4)
slice = append(slice, 5, 6, 7)
```

- When possible, append will grow the slice in place
- Append is very cheap when you do the proper capacity planning ahead of time
- Use the built-in cap() function to see the capacity of the underlying array

I believe the current implementations are smart about growing the underlying arrays. They usually add w/ some space to grow…



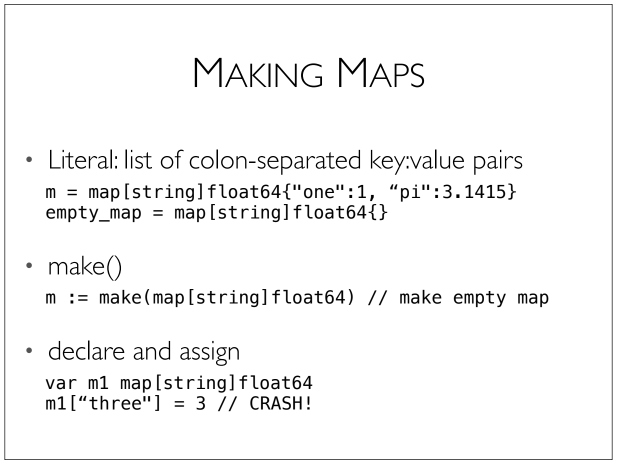
SLICE MISC

- Slices are references and are very cheap to make and pass around
- care must be taken as underlying storage (array) can be modified out from underneath you
- Strings can also be sliced with similar efficiency

Maps

- maps aka kv, dictionaries, associative arrays, hash tables, etc.
- in go map types are references
- len() returns the number of keys
- This is a map name m where the key is a string and the value is a float

```
var m map[string]float64
```



MAKING MAPS

- Literal: list of colon-separated key:value pairs

```
m = map[string]float64{"one":1, “pi":3.1415}
empty_map = map[string]float64{}
```

- make()

```
m := make(map[string]float64) // make empty map
```

- declare and assign

```
var m1 map[string]float64
m1[“three"] = 3 // CRASH!
```

If you use new() you will get a pointer to a map. sometimes you want this, but it’s pretty rare

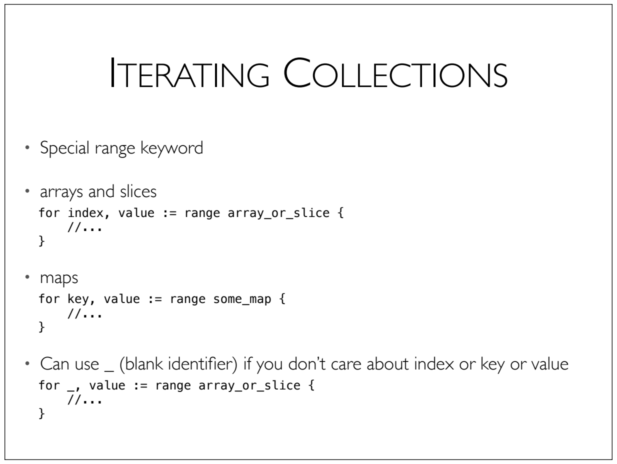
Using Maps

```
m := map[string]int{“one”:1, “two”:2}

// indexing a map
x = m[“one”]         // x is 1
x = m[“no such key”] // x is 0 (zero value)

// check existence
x, exists := m[key]
if exists == true {
    // key exists, x is assigned the value for key
} else {
    // key DNE, x is the zero value
}

// removing key/values
delete(m, “two”)
// if map or key is nil, delete is a no-op
```



ITERATING COLLECTIONS

- Special range keyword
- arrays and slices

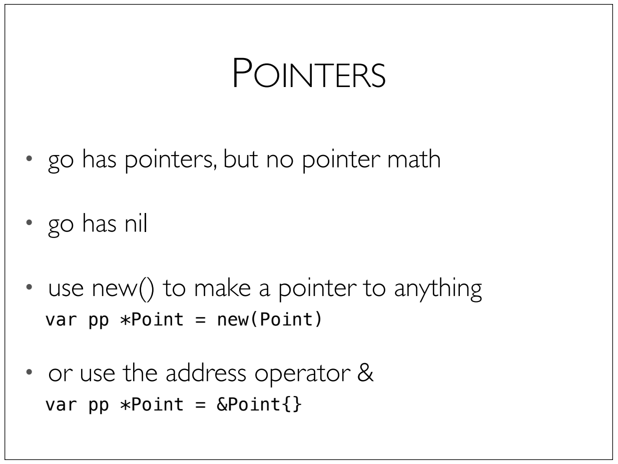
```
for index, value := range array_or_slice {
    //...
}
```

- maps

```
for key, value := range some_map {
    //...
}
```

- Can use _ (blank identifier) if you don't care about index or key or value

```
for _, value := range array_or_slice {
    //...
}
```



Pointers

- go has pointers, but no pointer math
- go has nil
- use new() to make a pointer to anything

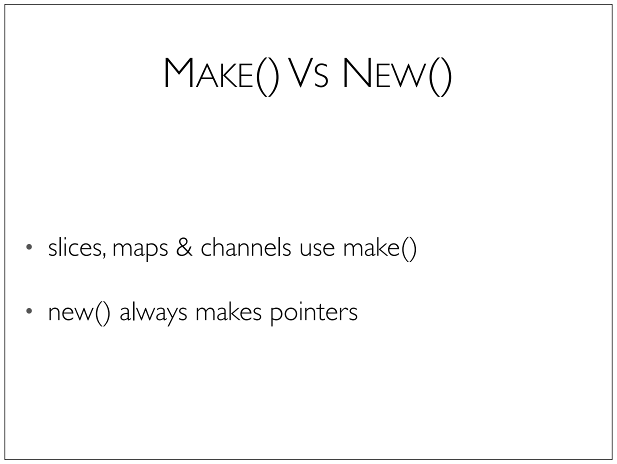
```
var pp *Point = new(Point)
```

- or use the address operator &

```
var pp *Point = &Point{}
```

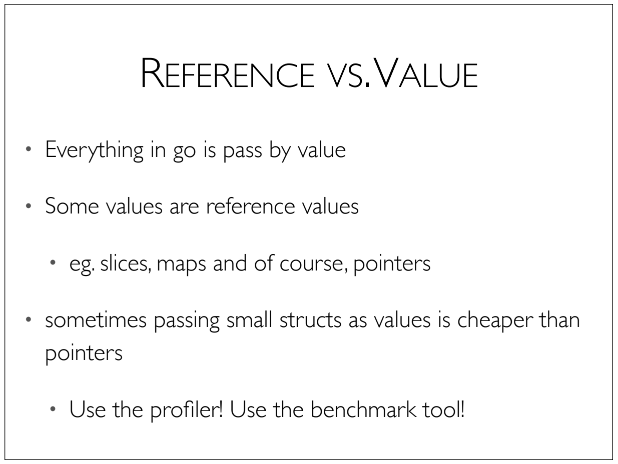
no pointer math means pointers are significantly safer

TODO: rewrite example… haven’t covers structs yet



MAKE() VS NEW()

- slices, maps & channels use make()
- new() always makes pointers



Reference vs. Value

- Everything in go is pass by value
- Some values are reference values
  - eg. slices, maps and of course, pointers
- sometimes passing small structs as values is cheaper than pointers
  - Use the profiler! Use the benchmark tool!

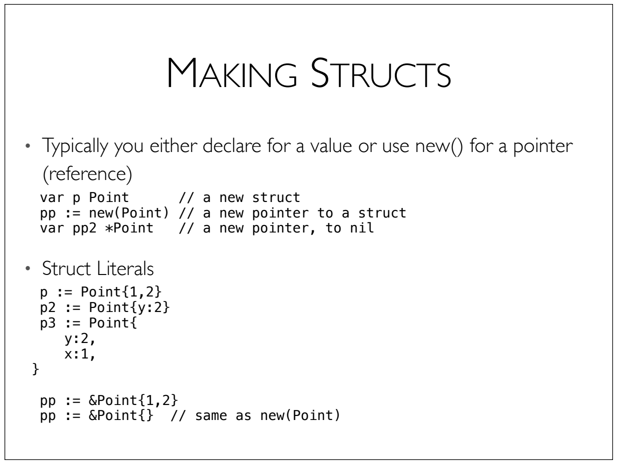
Structs

- Fairly obvious at first glance:

```
type Point struct {
    x int
    y int
}
var p Point
```

- Structs are values
- Init'd to all zero values
- always use the dot notation to access fields

```
p.x = 1
p.y = 2
```



Making Structs

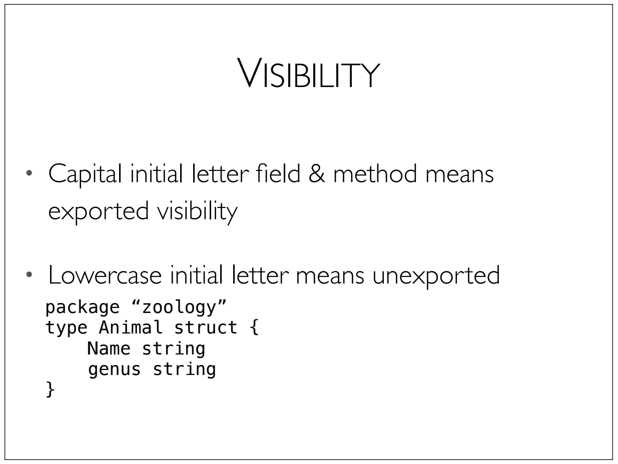
- Typically you either declare for a value or use new() for a pointer (reference)

```
var p Point      // a new struct
pp := new(Point) // a new pointer to a struct
var pp2 *Point   // a new pointer, to nil
```

- Struct Literals

```
 p := Point{1,2}
 p2 := Point{y:2}
 p3 := Point{
    y:2,
    x:1,
}

 pp := &Point{1,2}
 pp := &Point{}  // same as new(Point)
```



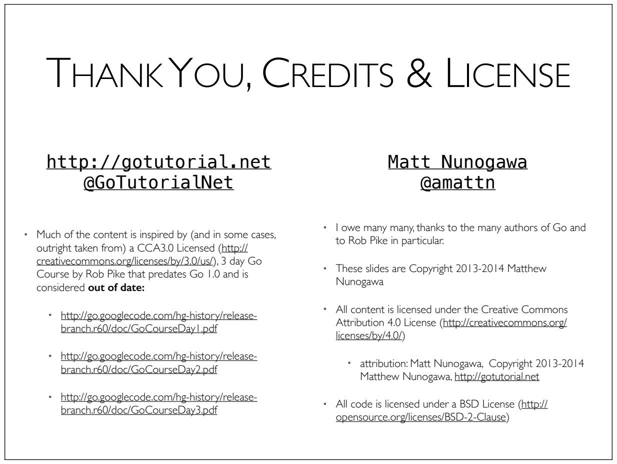
VISIBILITY

- Capital initial letter field & method means exported visibility
- Lowercase initial letter means unexported

```
package “zoology”
type Animal struct {
    Name string
    genus string
}
```

Go 101 ☑

- At this point, you have a basic understand of the go syntax and it's low level building blocks
  - basic syntax, numbers, strings, expressions, flow control, slices, maps, structs
- The Real Power™ of go comes after this:
  - Composition via methods, anonymous fields and interfaces
  - Concurrency via goroutines and channels
  - The great advances made in the compilers and associated tooling
  - The breath and depth of the standard library



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These are the slides that I used to learn go back in 2011.
“out of date”: The actually syntax has not significantly changed. Some of the terminology is no longer in use, typically because after contact with the community, misunderstandings have occurred.

In the creation of these slides, I have, to the utmost of my ability, attempted to make sure that these are correct and updated. Any errors are likely my fault. I make no guarantee that these slides are correct or will remain correct under the inevitable progression of time.