



Golang Programming

Methods. Composing Structs by Type Embedding

Where to Find The Code and Materials?

<https://github.com/iproduct/coursego>

Methods

```
type Vertex struct {  
    X, Y float64  
}
```

```
func (v Vertex) Abs() float64 {  
    return math.Sqrt(v.X*v.X + v.Y*v.Y)  
}
```

```
func main() {  
    v := Vertex{3, 4}  
    fmt.Println(v.Abs())  
    abs := Vertex.Abs  
    fmt.Println(abs(v))  
}
```

Methods on Non Structs

```
type MyFloat float64
```

```
func (f MyFloat) Abs() float64 {  
    if f < 0 {  
        return float64(-f)  
    }  
    return float64(f)  
}
```

```
func main() {  
    f := MyFloat(-math.Sqrt2)  
    fmt.Println(f.Abs())  
}
```

Methods on Non Structs

```
type Role int

const (
    User Role = 1 << iota
    Manager
    Admin
    RoleMask = (1 << (iota)) - 1
)

func (r Role) String() string {
    switch r {
    case User:
        return "User"
    case Manager:
        return "Manager"
    case Admin:
        return "Admin"
    default:
        return "Invalid role"
    }
}
```

```
// Status type
type Status int
```

```
// User statuses enum
const (
    Registered Status = iota
    Active
    Disabled
)
```

```
// Returns string representation of the Role
func (r Status) String() string {
    switch r {
    case Registered:
        return "Registered"
    case Active:
        return "Active"
    case Disabled:
        return "Disabled"
    default:
        return "Invalid status"
    }
}
```

Value and Pointer Receivers

```
type Vertex struct {  
    X, Y float64  
}  
  
func (v Vertex) Abs() float64 {  
    return math.Sqrt(v.X*v.X + v.Y*v.Y)  
}  
  
func (v *Vertex) Scale(f float64) {  
    v.X = v.X * f  
    v.Y = v.Y * f  
}  
  
func main() {  
    v := Vertex{3, 4}  
    v.Scale(10)  
    fmt.Println(v.Abs())  
}
```

Methods Are Just Like Functions

```
type Vertex struct {  
    X, Y float64  
}  
  
func Abs(v Vertex) float64 {  
    return math.Sqrt(v.X*v.X + v.Y*v.Y)  
}  
  
func Scale(v *Vertex, f float64) {  
    v.X = v.X * f  
    v.Y = v.Y * f  
}  
  
func main() {  
    v := Vertex{3, 4}  
    Scale(&v, 10)  
    fmt.Println(Abs(v))  
}
```

Methods and Pointer Indirection

```
type Vertex struct {
    X, Y float64
}
func (v *Vertex) Scale(f float64) {
    v.X = v.X * f
    v.Y = v.Y * f
}
func ScaleFunc(v *Vertex, f float64) {
    v.X = v.X * f
    v.Y = v.Y * f
}
func (v Vertex) Abs() float64 {
    return math.Sqrt(v.X*v.X + v.Y*v.Y)
}
func AbsFunc(v Vertex) float64 {
    return math.Sqrt(v.X*v.X + v.Y*v.Y)
}
```

```
func main() {
    // Pointer receiver methods
    v := Vertex{3, 4}
    v.Scale(2)
    ScaleFunc(&v, 5)

    p := &Vertex{4, 3}
    p.Scale(5)
    ScaleFunc(p, 2)
    fmt.Println(v, p)

    // Value receiver methods
    fmt.Println(v.Abs())
    fmt.Println(AbsFunc(v))

    fmt.Println(p.Abs())
    fmt.Println(AbsFunc(*p))
}
```


Methods: Value and Pointer Receivers

```
type ByteSlice []byte
```

```
func (slice ByteSlice) Append(data []byte) []byte {  
    return append([]byte(slice), data...)  
}
```

```
func (slice *ByteSlice) AppendPointer(data []byte) {  
    *slice = append([]byte(*slice), data...)  
}
```

```
func (slice *ByteSlice) Write(data []byte) (n int, err error) {  
    *slice = append([]byte(*slice), data...)  
    return len(data), nil  
}
```

```
func main() {  
    var b ByteSlice  
    fmt.Fprintf(&b, "This hour has %d days\n", 7)  
    fmt.Printf("%v", b)  
}
```

Choosing Value or Pointer Receiver

There are two reasons to use a pointer receiver:

- The first is so that the **method can modify the value** that its receiver points to.
- The second is to **avoid copying the value** on each method call. This can be more efficient if the receiver is a large **struct**, for example.
- In general, **all methods** on a given type **should have either value or pointer receivers**, but not a mixture of both.
- More about selectors and method expressions:
<https://golang.org/ref/spec#Selectors>

Method Receivers and Interfaces

```
type Abser interface {
    Abs() float64
}

func main() {
    var a Abser
    f := MyFloat(-math.Sqrt2)
    v := Vertex{3, 4}

    a = f // MyFloat implements Abser
    fmt.Println(a.Abs())
    a = &v // *Vertex implements Abser

    // Vertex do not implement Abser
    //a = v

    fmt.Println(a.Abs())
}
```

```
type MyFloat float64

func (f MyFloat) Abs() float64 {
    if f < 0 {
        return float64(-f)
    }
    return float64(f)
}

type Vertex struct {
    X, Y float64
}

func (v *Vertex) Abs() float64 {
    return math.Sqrt(v.X*v.X + v.Y*v.Y)
}
```

Methods with Nil Receivers

// Path represents a sequence of Vertices. A nil Path represents empty sequence.

```
type Path []Vertex
func (p *Path) Distance() (dist float64) {
    dist = 0
    if *p == nil || len(*p) == 0 {
        return 0
    }
    v1 := (*p)[0]
    var v2 Vertex
    for i := 1; i < len(*p); i++ {
        v2 = (*p)[i]
        dist += v1.Distance(v2)
        v1 = v2
    }
    return
}

func main() {
    var path Path
    path = Path{{1, 1}, {4, 5}, {4, 1}, {1, 1}}
    fmt.Println("Perimeter = ", path.Distance())
}
```

Composing structs by Type Embedding

```
type ColorVertex struct {  
    Vertex  
    Color color.RGBA  
}  
  
func main() {  
    green := color.RGBA{0, 255, 0, 255}  
    yellow := color.RGBA{255, 255, 0, 255}  
    cv1 := ColorVertex{Vertex{2, 3}, green}  
    cv2 := ColorVertex{Vertex{6, 6}, yellow}  
    fmt.Println(cv1.Distance(cv2.Vertex)) // 5  
    cv1.Scale(4)  
    cv2.Scale(4)  
    fmt.Println(cv1.Distance(cv2.Vertex)) // 20  
    // cv1.Distance(cv2) // no cv1.Distance(ColorVertex)  
}
```

```
type Vertex struct {  
    X, Y float64  
}  
  
func (v Vertex) Distance(o Vertex) float64 {  
    return math.Hypot(o.X-v.X, o.Y-v.Y)  
}  
  
func (v *Vertex) Scale(f float64) {  
    v.X = v.X * f  
    v.Y = v.Y * f  
}
```

Composing structs by Pointer Type Embedding

```
type ColorVertexP struct {  
    *Vertex  
    Color color.RGBA  
}
```

```
cvp1 := ColorVertexP{&Vertex{2, 7}, green}  
cvp2 := ColorVertexP{&Vertex{5, 3}, yellow}  
fmt.Println(cvp1.Distance(*cvp2.Vertex)) // "5"  
cvp1.Vertex = cvp2.Vertex  
cvp1.Scale(3)  
fmt.Println(*cvp1.Vertex, *cvp2.Vertex) // {15 9} {15 9}
```

Rules for Method Promotion – Value vs. Pointer Fields

Given a **struct** type S and a **defined type** T , promoted methods are included in the **method set** of the **struct** as follows:

- If S contains an embedded field T , the method sets of S and $*S$ both include promoted methods with **receiver** T . The method set of $*S$ also includes promoted methods with **receiver** $*T$.
- If S contains an embedded field $*T$, the method sets of S and $*S$ both include promoted methods with **receiver** T or $*T$.

Method Values and Expressions

```
a := Vertex{2, 7}
b := Vertex{5, 3}
```

```
distance := Vertex.Distance // method expression
fmt.Println(distance(a, b)) // 5
fmt.Printf("%T\n", distance) // func(main.Vertex, main.Vertex) float64
```

```
scale := (*Vertex).Scale // method expression
scale(&a, 2)
fmt.Println(a) // {4 14}
fmt.Printf("%T\n", scale) // func(*main.Vertex, float64)
```

```
scaleB := (&b).Scale // method value
fmt.Printf("%T\n", scaleB) // func(float64)
scaleB(2)
fmt.Printf("Scaling b with factor 2: b now is %f\n", b) //{10 6}
```

```
distanceFromA := a.Distance // method value
fmt.Printf("%T\n", distanceFromA) // func(*Vertex, float64)
fmt.Printf("Distance from A of B is %f\n", distanceFromA(b)) //10
```


Encapsulation

- State encapsulation:

```
type IntSet struct {  
    words []uint64  
}
```

- No state encapsulation:

```
type IntSet []uint64
```

Examples

- IntBitSet
- PriorityQueue
- HttpServer

Homework 2 (More Methods of the Path)

Extend the `Path` type from slide 12 by adding:

- two more fields: `StrokeColor` and `FillColor`
- methods: `Scale(f float64)`, `Translate(vector Vertex)`, `Rotate(angle float64)`
- methods: `Add(v Vertex, position int)`, `Remove(v Vertex, position int)`
- method: `Draw() image.Image` – implement the `Image` interface and return it

package image

```
type Image interface {
```

```
    ColorModel() color.Model // should return color.RGBAModel.
```

```
    Bounds() Rectangle // should return a image.Rectangle - e.g. image.Rect(0, 0, w, h)
```

```
    At(x, y int) color.Color // should return color.RGBAModel- e.g. color.RGBA{v,v,255,255}
```

```
}
```

- method: `EncodePNG(file *os.File) error` - using: `png.Encode(f File, i Image)`
- function `main()`, that should demonstrate the use of all above methods. It should create new file in the directory of the project and encode the resulting `Image` (with drawn `Path`) into it.

Recommended Literature

- The Go Documentation - <https://golang.org/doc/>
- The Go Bible: Effective Go - https://golang.org/doc/effective_go.html
- David Chisnall, *The Go Programming Language Phrasebook*, Addison Wesley, 2012
- Alan A. A. Donovan, Brian W. Kernighan, *The Go Programming Language*, Addison Wesley, 2016
- Nathan Youngman, Roger Peppé, *Get Programming with Go*, Manning, 2018
- Naren Yellavula, *Building RESTful Web Services with Go*, Packt, 2017

Thank's for Your Attention!



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