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

```go
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"
    }
}
```

```go
// 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("Sacling 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

JSON Marshalling and Unmarshalling

```
// Structs --> JSON
data, err := json.Marshal(goBooks)
if err != nil {
        log.Fatalf("JSON marshaling failed: %s", err)
}
fmt.Printf("%s\n", data)

// Prettier formatting
data, err = json.MarshalIndent(goBooks, "", "     ")
if err != nil {
        log.Fatalf("JSON marshaling failed: %s", err)
}
fmt.Printf("%s\n", data)

// JSON -> structs
var books []Book
if err := json.Unmarshal(data, &books); err != nil {
        log.Fatalf("JSON unmarshaling failed: %s", err)
}
fmt.Println("AFTER UNMARSHAL:\n", books)
```

HTTP Client Example (from Lesson 1)

```
import ("bufio"; "fmt"; "log"; "net/http")

func main() {
	//resp, err := http.Get("http://localhost:8080/headers")
	//resp, err := http.Get("http://google.com")
	req, err := http.NewRequest("GET", "http://localhost:8080/headers", nil)
	req.Header.Add("Accept", `Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8`)
	req.Header.Add("Custom-Header", `Custom Value`)
	resp, err := http.DefaultClient.Do(req)
	if err != nil {
		log.Fatal(err)
	}

	fmt.Println("Response status:", resp.Status)
	scanner := bufio.NewScanner(resp.Body)
	for i := 0; scanner.Scan() && i < 10; i++ {
		fmt.Println(i+1, ": ", scanner.Text())
	}
}
```

Homework 2 (GitHub API Client)

Implement GItHub API HTTP client that will:

- Read a text file given as command line argument to the program and parse different Github usernames – each username on separate line in the file
- Fetch GitHub users data in JSON format using public GitHub API: https://api.github.com/users/${username}
- Fetch GitHub user repositories data in JSON format from: https://api.github.com/users/${username}/repos
- Parse the JSON data using json.Unmarshal into appropriate data stuctures in Go.
- Print a statistics report containing the information about the user and the languages used and number of files in different repositories.

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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