



Implementing REST Services in Go

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slides at <https://github.com/mvolkmann/talks>

Why Go, REST, and PostgreSQL?



- **Go** is a fast server-side language
- **REST** services that access relational databases are the most common kind of server-side development
- **PostgreSQL** is a popular open source relational database



Why Go?



- Simple
 - indicated by having a small specification and fewer features than most programming languages
- Fast in compiling and running
- Statically typed
- Great for concurrency and parallelism



Learning Go



- “A Tour of Go” - <https://tour.golang.org/>
- “Effective Go” - https://golang.org/doc/effective_go.html
- My articles
 - **Getting Started With Go** - <https://objectcomputing.com/resources/publications/sett/november-2018-way-to-go-part-1>
 - **Mastering Go Syntax** - <https://objectcomputing.com/resources/publications/sett/january-2019-way-to-go-part-2>
 - **Go Standard Library** - <https://objectcomputing.com/resources/publications/sett/april-2019-way-to-go-part-3>
- and many resources



REST Services in Go



- Supported by many Go libraries
- Popular choice is Gin - <https://gin-gonic.github.io/gin/>
 - install with `go get github.com/gin-gonic/gin`
- Following slides show implementing REST services that manage a collection of dogs in a PostgreSQL database
 - each dog has an id, breed, and name

- 1) create
- 2) retrieve
- 3) update
- 4) delete



Go and PostgreSQL



- Several Go libraries support working with PostgreSQL databases
- Popular choice is pq - <https://github.com/lib/pq>
 - install with `go get github.com/lib/pq`
- DDL to create dog table in `ddl.sql`

```
create table dog (
    id serial primary key,
    breed text,
    name text
);
```

```
createdb pets
psql -d pets -f ddl.sql
```

Cross-Origin Resource Sharing (CORS)



- By default browsers can only send HTTP requests to same origin
- CORS enables sending to other origins
- Services enable CORS by including specific HTTP response headers
- Can allow sending requests from any domain (*) or specific ones
- Can allow only specific HTTP methods

protocol, domain, and port



Preflight Requests



- HTTP methods other than GET send a preflight OPTIONS request to determine allowed methods
 - so POST, PUT, and DELETE requests are preceded by an OPTIONS request
 - then actual request is sent if allowed



CORS Response Headers



- **Access-Control-Allow-Origin**
 - sample value "*" or "http://localhost:8080"
- **Access-Control-Allow-Methods**
 - sample value "DELETE, GET, POST, PUT"
- **Access-Control-Allow-Headers**
 - sample value "Content-Type"
- **Access-Control-Allow-Credentials**
 - set to **true** if request will contain credentials



Imports

all code on following slides
is in the file `main.go`



```
package main

import (
    "database/sql" // to open database connection
    "errors"
    "fmt"
    "log"
    "net/http" // for status constants
    "strconv" // to convert between string and int values

    "github.com/gin-gonic/gin" // HTTP web framework
    _ "github.com/lib/pq"      // Postgres driver
)
```

_ indicates we are not using anything exported by `pq`

Constants and Dog Struct



```
const allowOrigin = "http://localhost:8080"
const badRequest = http.StatusBadRequest
const forbidden = http.StatusForbidden
const ok = http.StatusOK
const serverError = http.StatusInternalServerError
```

```
type Dog struct {
    ID      int     `json:"id"`
    Breed  string  `json:"breed"`
    Name   string  `json:"name"`
}
```

struct field names must start uppercase to be visible outside their source file; the **gin** package needs to access them

don't want uppercase properties in JSON that is produced, so alternate names are provided using struct "tags"

CORS

We are handling CORS details manually here.
Consider using <https://github.com/gin-contrib/cors>.



```
func shouldAllow(c *gin.Context) bool {
    origins := c.Request.Header["Origin"]
    return len(origins) > 0 && origins[0] == allowOrigin
}

// Custom middleware to enable CORS
func cors(c *gin.Context) {
    if shouldAllow(c) {
        c.Header("Access-Control-Allow-Origin", allowOrigin)
    } else {
        c.Status(forbidden)
    }
}

func options(c *gin.Context) {    headers only needed for OPTIONS requests
    c.Header("Access-Control-Allow-Methods", "GET,POST,PUT,DELETE")
    c.Header("Access-Control-Allow-Headers", "Content-Type")
    c.Status(ok)
}
```

use * for
allowOrigin
to allow any

must explicitly allow
Content-Type header
for JSON bodies

several headers are
allowed by default

Error Handling



```
func handleError(c *gin.Context, statusCode int, err error) {  
    c.String(statusCode, err.Error()) // writes to response body  
}
```



Database Connection



```
func main() {
    // Connect to database.
    connStr := "user=postgres dbname=pets sslmode=disable"
    db, err := sql.Open("postgres", connStr)
    if err != nil {
        log.Fatal(err)
    }
}
```

requires SSL
by default



HTTP Router Setup and Heartbeat



```
// Configure HTTP request routes.  
router := gin.Default()  
router.Use(cors)           cors function defined earlier  
  
// For OPTIONS request before POST.  
router.OPTIONS("/dog", options)    options function defined earlier  
  
// For OPTIONS request before PUT and DELETE.  
router.OPTIONS("/dog/:id", options)  
  
// Heartbeat  
router.GET("/", func(c *gin.Context) {  
    c.String(ok, "I'm alive!")  
})
```

Create Dog



```
router.POST("/dog", func(c *gin.Context) {
    var dog Dog
    if err := c.ShouldBindJSON(&dog); err != nil {
        handleError(c, badRequest, err)
        return
    }

    sql := fmt.Sprintf(
        "insert into dog (breed, name) values ('%s', '%s') returning id",
        dog.Breed,
        dog.Name)
    var id int
    err := db.QueryRow(sql).Scan(&id)
    if err != nil {
        handleError(c, serverError, err)
        return
    }

    dog.ID = id
    c.JSON(ok, dog)
})
```

get dog from request body

insert dog into database and get assigned id

return JSON representation of new dog including assigned id

Retrieve Dogs ...



```
router.GET("/dog", func(c *gin.Context) {
    if !shouldAllow(c) {
        c.Status(forbidden)
        return
    }

    rows, err := db.Query("select id, breed, name from dog")
    if err != nil {
        c.String(serverError, err.Error())
        return
    }
    defer rows.Close()
```

manually checking whether request
should be allowed because GET requests
are not preceded by an OPTIONS request

get all dogs
from database

... Retrieve Dogs



```
dogs := []Dog{}           create array of
var id int
var breed, name string    Dog structs

for rows.Next() {
    if err := rows.Scan(&id, &breed, &name); err != nil {
        c.String(serverError, err.Error())
        return
    }
    dogs = append(dogs, Dog{id, breed, name})
}

c.JSON(ok, dogs)          return JSON representation
                           of dog array
```

create new **Dog** object and append to array

Update Dog ...



```
router.PUT("/dog/:id", func(c *gin.Context) {
    id, err := strconv.Atoi(c.Param("id"))
    if err != nil {
        handleError(c, badRequest, errors.New("id must be int"))
        return
    }

    var dog Dog
    if err := c.ShouldBindJSON(&dog); err != nil {
        handleError(c, badRequest, err)
        return
    }
```

convert string URL parameter to integer

get dog from request body

... Update Dog



```
sql := fmt.Sprintf(  
    "update dog set breed=%s, name=%s where id=%d",  
    dog.Breed,  
    dog.Name,  
    id)  
if _, err := db.Query(sql); err != nil {  
    handleError(c, serverError, err)  
    return  
}  
  
c.Status(ok)  
})
```

update breed and
name of dog in
database

Delete Dog



```
router.DELETE("/dog/:id", func(c *gin.Context)
    id, e := strconv.Atoi(c.Param("id"))
    if e != nil {
        handleError(c, badRequest, errors.New("id must be int"))
        return
    }

    sql := fmt.Sprintf("delete from dog where id=%d", id)
    if _, err := db.Query(sql); err != nil {
        handleError(c, serverError, err)
        return
    }

    c.Status(ok)
})
```

convert string URL parameter to integer

delete dog from database

Start Router



```
router.Run(":1919") starts server  
} // end of main function started on slide 14
```



Running REST Server



- **go run main.go**

or

go build main.go; ./main

logs all configured routes

```
[GIN-debug] OPTIONS /dog                                     --> main.options (4 handlers)
[GIN-debug] OPTIONS /dog/:id                                --> main.options (4 handlers)
[GIN-debug] GET    /                                       --> main.main.func1 (4 handlers)
[GIN-debug] POST   /dog                                    --> main.main.func2 (4 handlers)
[GIN-debug] GET    /dog                                    --> main.main.func3 (4 handlers)
[GIN-debug] PUT    /dog/:id                               --> main.main.func4 (4 handlers)
[GIN-debug] DELETE /dog/:id                             --> main.main.func5 (4 handlers)
[GIN-debug] Listening and serving HTTP on :1919
```

Testing REST Services ...



- Can use Postman to create, catalog, and execute HTTP requests
 - <https://www.getpostman.com/>



... Testing REST Services



The screenshot shows the Postman application interface. On the left, the sidebar displays a collection named "Go Server" which contains five requests:

- GET localhost:1919/dog
- GET localhost:1919
- POST localhost:1919/dog
- PUT localhost:1919/dog/11
- DEL localhost:1919/dog/11

The main workspace shows a GET request to "localhost:1919/dog". The "Body" tab is selected, displaying a JSON response:

```
[{"id": 3, "breed": "whippet", "name": "Dasher"}, {"id": 7, "breed": "treeing walker coonhound", "name": "Maisey"}, {"id": 8, "breed": "native american indian dog", "name": "Ramsey"}]
```

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25

Watch and Live Reload



- Go servers can automatically rebuild and restart when changes are detected
- Supported by <https://github.com/codegangsta/gin>
 - not related to Gin web framework, just a naming coincidence



gin Setup



- Install with `go get github.com/codegangsta/gin`
- Verify with `gin -h`
- Run with `gin --appPort 1919 run main.go`

consider putting this
in a `start` script

 - assumes Go REST server is implemented in `main.go` and listens on port `1919`
- Web UI must send requests to gin port which defaults to 3000



Wrap Up



- Now you know all the basics for implementing REST services in Go!



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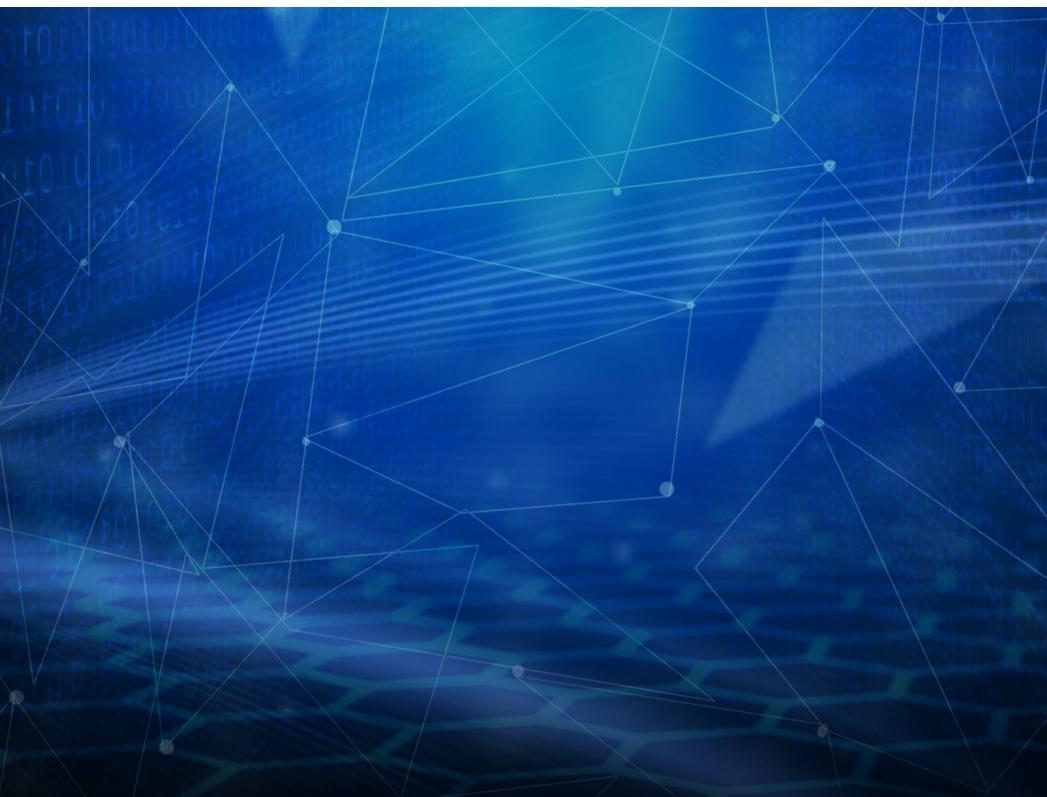
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