
WEBINAR

# Implementing REST Services in Go

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# 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 currency and parallelism

# Learning Go


- "A Tour of Go" - https://tour.golang.org/
- "Effective Go" - https://golang.org/doc/effective_go.html
- My articles
  - https://objectcomputing.com/resources/publications/sett/november-2018-way-to-go-part-1
  - https://objectcomputing.com/resources/publications/sett/january-2019-way-to-go-part-2
- 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

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

# Cross-Origin Resource Sharing (CORS)


- By default browsers can only send HTTP requests to same origin
- CORS enables sending to other origins

protocol, domain, and port

- Services enable CORS by including specific HTTP response headers
- Can allow sending from any domain (*) or specific ones
- Can allow only specific HTTP methods

# 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 credentials are required

# 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 and 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.

OBJECT COMPUTING

```
func shouldAllow(c *gin.Context) bool {
    origin := c.Request.Header["Origin"][0] // 1st array element
    return origin == 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) {
    c.Header("Access-Control-Allow-Methods", "GET,POST,PUT,DELETE")
    c.Header("Access-Control-Allow-Headers", "Content-Type")
    c.Status(ok)
}
```

use * for URL to allow any

headers only needed for OPTIONS requests

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())
}
```

# Database Connection


```
func main() {
    // Connect to database.
    connStr := "user=postgres dbname=survey 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)

// For OPTIONS request before POST.
router.OPTIONS("/dog", options)

// 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

OBJECT COMPUTING

```
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, getting 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()
```

get all dogs from database

# ... Retrieve Dogs


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

        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)
    })
```

create array of **Dog** structs

return JSON representation of dog 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
    }
```

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

OBJECT COMPUTING

```
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)
})
```

delete dog from database

# Start Router


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

# Running REST Server

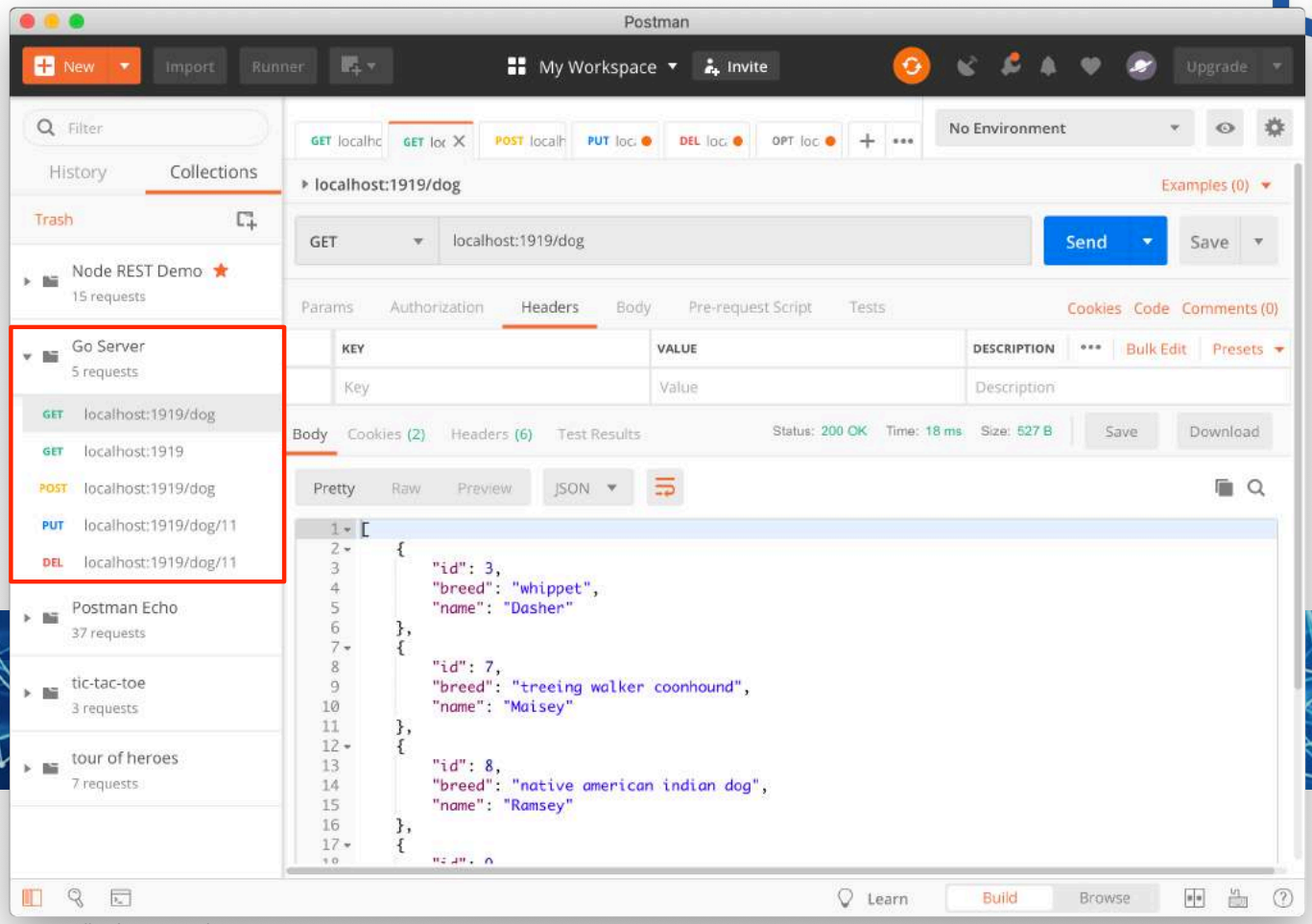

- **`go run main.go`**
  or
  **`go build main.go; ./main`**

```
[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



# 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`**
  - 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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