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1. Spring Boot Maven Project

1.1. Create a Spring boot maven project with the following dependencies from start.spring.io

The screenshot shows the Spring Initializr web form with the following configuration:

- Project:** ☒ Maven
- Language:** ☒ Java
- Spring Boot:** ☐ 3.3.0 (SNAPSHOT) ☐ 3.3.0 (M2) ☐ 3.2.4 (SNAPSHOT) ☒ 3.2.3
- Project Metadata:**
 - Group:
 - Artifact:
 - Name:
 - Description:
 - Package name:
- Packaging:** ☒ Jar ☐ War
- Java:** ☐ 21 ☒ 17

Dependencies:

- H2 Database** (SQL): Provides a fast in-memory database that supports JDBC API and R2DBC access, with a small (2mb) footprint. Supports embedded and server modes as well as a browser based console application.
- Spring Data JPA** (SQL): Persist data in SQL stores with Java Persistence API using Spring Data and Hibernate.
- Spring Boot DevTools** (DEVELOPER TOOLS): Provides fast application restarts, LiveReload, and configurations for enhanced development experience.
- Spring Web** (WEB): Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.

ADD DEPENDENCIES... 35 + 8

- 1.2. Unzip the project and open in the editor
- 1.3. The embedded tomcat with spring boot web includes a light weight server which is the tomcat core and is capable of processing HTTP requests and send JSON as a response
- 1.4. Applications that use devtools will automatically restart whenever files on the classpath change

2. Understand web environment and H2 database

2.1. Run the main method and observe the console.

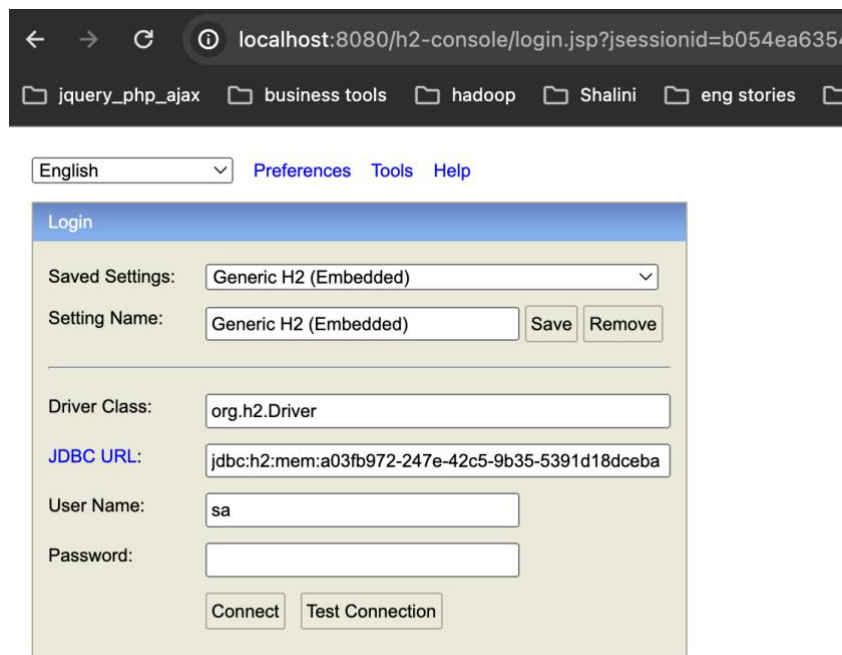
```
2024-03-06 15:26:50.743 INFO 75368 --- [ restartedMain] .s.d.r.c.RepositoryConfigurationDelegate : Finished Spring Data repository scanning in 102 ms. Found 0 JDBC Repository interfaces.
2024-03-06 15:26:50.765 INFO 75368 --- [ restartedMain] .s.d.r.c.RepositoryConfigurationDelegate : Multiple Spring Data modules found, entering strict repository configuration mode
2024-03-06 15:26:50.766 INFO 75368 --- [ restartedMain] .s.d.r.c.RepositoryConfigurationDelegate : Bootstrapping Spring Data JPA repositories in DEFAULT mode.
2024-03-06 15:26:50.807 INFO 75368 --- [ restartedMain] .s.d.r.c.RepositoryConfigurationDelegate : Finished Spring Data repository scanning in 36 ms. Found 6 JPA repository interfaces.
2024-03-06 15:26:51.914 INFO 75368 --- [ restartedMain] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat initialized with port(s): 8080 (http)
2024-03-06 15:26:51.930 INFO 75368 --- [ restartedMain] o.apache.catalina.core.StandardService : Starting service [Tomcat]
2024-03-06 15:26:51.930 INFO 75368 --- [ restartedMain] org.apache.catalina.core.StandardEngine : Starting Servlet engine: [Apache Tomcat/9.0.65]
2024-03-06 15:26:52.310 INFO 75368 --- [ restartedMain] org.apache.jasper.servlet.TldScanner : At least one JAR was scanned for TLDs yet contained no TLDs. Enable debug logging for this logger for a complete list of JARs that were scanned but no TLDs were found in them. Skipping unnneeded JARs during scanning can improve startup time and JSP compilation time.
2024-03-06 15:26:52.330 INFO 75368 --- [ restartedMain] o.a.c.c.C.[Tomcat].[localhost].[/] : Initializing Spring embedded WebApplicationContext
2024-03-06 15:26:52.330 INFO 75368 --- [ restartedMain] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext: initialization completed in 2855 ms
2024-03-06 15:26:52.418 INFO 75368 --- [ restartedMain] com.zaxxer.hikari.HikariDataSource : HikariPool-1 - Starting...
2024-03-06 15:26:52.615 INFO 75368 --- [ restartedMain] com.zaxxer.hikari.HikariDataSource : HikariPool-1 - Start completed.
2024-03-06 15:26:52.615 INFO 75368 --- [ restartedMain] o.s.b.a.h2.H2ConsoleAutoConfiguration : H2 console available at '/h2-console'. Database available at 'jdbc:h2:mem:a03fb972-247e-42c5-9b35-5391d18dceba'
2024-03-06 15:26:53.030 INFO 75368 --- [ restartedMain] o.hibernate.jpa.internal.util.LogHelper : HHH000204: Processing PersistenceUnitInfo [name: default]
2024-03-06 15:26:53.082 INFO 75368 --- [ restartedMain] org.hibernate.Version : HHH0000412: Hibernate ORM core version 5.6.11.Final
2024-03-06 15:26:53.193 INFO 75368 --- [ restartedMain] o.hibernate.annotations.common.Version : HCN000001: Hibernate Commons Annotations {5.1.2.Final}
2024-03-06 15:26:53.293 INFO 75368 --- [ restartedMain] org.hibernate.dialect.Dialect : HHH000400: Using dialect: org.hibernate.dialect.H2Dialect
```

2.2. Notice tomcat is running on port 8080

2.3. H2 console is available at /h2-console with the url starting with jdbc:h2:mem:<some id>. Default username is sa and no password.

This id is random and keeps changing whenever the server is restarted

2.4. Open browser and type in the url <http://localhost:8080/h2-console> and copy paste the h2 url from the console as shown in below screen:



2.5. Since url keeps on changing lets override the default url and update the application.properties as follows:

```
spring.h2.console.enabled=true
spring.datasource.url=jdbc:h2:mem:testdb
spring.jpa.show-sql=true
#spring.jpa.generate-ddl=true
```

- 2.6. Now stop the server and restart to see the output in console for the changed url for h2-console.
Login to h2 database on the browser using **jdbc:h2:mem:testdb**
- 2.7. Tomcat server bby default runs on port 8080. To change the port add below in application.properties file
server.port=8081
- 2.8. Stop the server and restart, you will notice now tomcat is available at port 8081. Verify by going on the browser and typing <http://localhost:8081/h2-console>

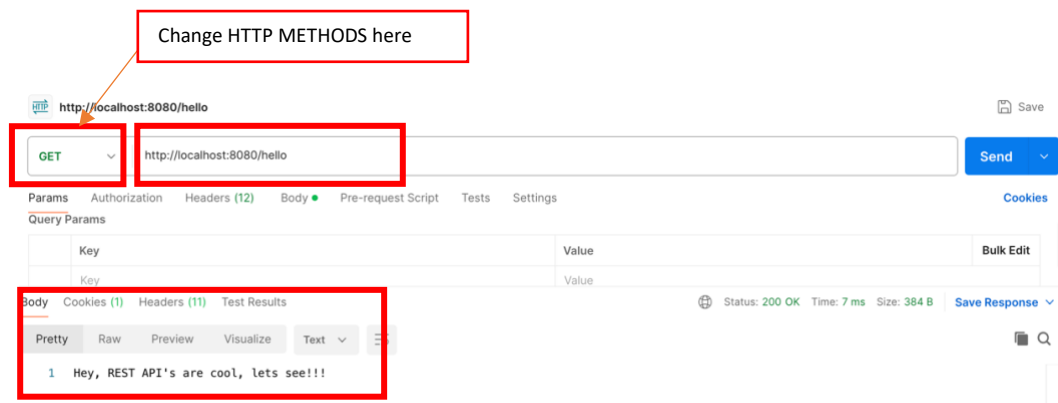
3. Rest Controller

- 3.1. Create a class HelloRestController as follows:

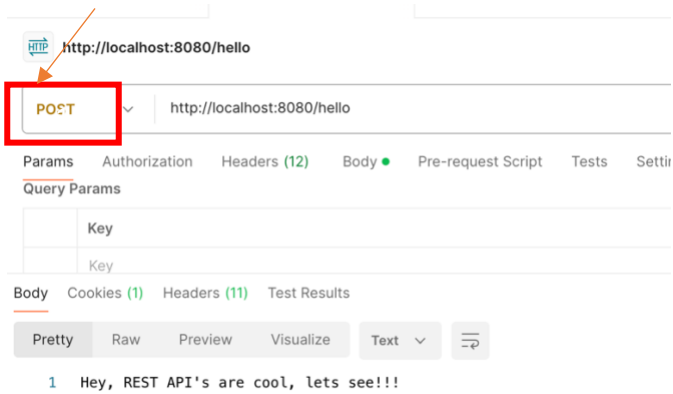
```
@RestController // @Controller + @ResponseBody
public class HelloRestController{

    @RequestMapping("/hello")
    public String greet()
    {
        return "Hey, REST API's are cool, lets see!!! ";
    }
}
```

- 3.2. Run the class with main method and open the browser at url:
<http://localhost:8080/hello>
- 3.3. The output should be the message as returned by the greet()
- 3.4. Open postman and type url in address bar, select various HTTP methods on the left as shown below and you should get the same message as output for all HTTP methods:



Even post we get the same message and same is with other methods



4. HTTP METHODS Mapping

4.1. Let's add specific methods to map for specific HTTP requests since methods are used as follows:

- 4.1.1. GET: fetch data
- 4.1.2. PUT : update data
- 4.1.3. POST : insert data
- 4.1.4. DELETE : delete data

4.2. Update HelloRestController as follows:

```
@GetMapping("/get")
public String send()
{
    return "FROM GET ONLY";
}
@PostMapping("/add")
public String post()
{
    return "FROM POST ONLY";
}
@PutMapping("/update")
public String put()
{
    return "FROM PUT ONLY";
}
@DeleteMapping("/delete")
public String delete()
{
    return "FROM DELETE ONLY";
}
```

4.3. Now restart the server and test above methods via postman. The urls for request will be as follows:

- 4.3.1. Change the HTTP method in postman to GET and type in below url to see message from GetMapping
<http://localhost:8080/get>
- 4.3.2. Change the HTTP method in postman to POST and type in below url to see message from PostMapping
<http://localhost:8080/add>

- 4.3.3. Change the HTTP method in postman to PUT and type in below url to see message from PutMapping
<http://localhost:8080/update>
- 4.3.4. Change the HTTP method in postman to DELETE and type in below url to see message from DeleteMapping
<http://localhost:8080/delete>
- 4.4. Conventionally, REST URI should only contain noun and verbs are passed as part of HTTP method. Modify the above class to have a single URI for the respective HTTP method:

```
@RestController()
@RequestMapping("/api")
public class HelloRestController{

    ....
    @GetMapping()
    public String send()
    {
        return "FROM GET ONLY";
    }
    @PostMapping()
    public String post()
    {
        return "FROM POST ONLY";
    }
    @PutMapping()
    public String put()
    {
        return "FROM PUT ONLY";
    }
    @DeleteMapping()
    public String delete()
    {
        return "FROM DELETE ONLY";
    }
}
```

- 4.5. Now restart the server, type below url in postman and just by changing the HTTP methods, respective messages will be displayed.

<http://localhost:8080/api>

5. Prepare model

- 5.1. Create Employee class as follows:

```
import jakarta.persistence.*;
import org.hibernate.validator.constraints.NotNull;

@Entity
public class Employee {
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    @NotNull
    private int eid;
```

```
@Column(nullable = true)
private String ename;
private String email;
private String phone;

private String password;

public Employee() {
}

public Employee(int eid, String ename, String email, String phone, String password) {
    this.eid = eid;
    this.ename = ename;
    this.email = email;
    this.phone = phone;
    this.password = password;
}
// getters and setters
// constructor

public int getEid() {
    return eid;
}

public void setEid(int eid) {
    this.eid = eid;
}

public String getEname() {
    return ename;
}

public void setEname(String ename) {
    this.ename = ename;
}

public String getEmail() {
    return email;
}

public void setEmail(String email) {
    this.email = email;
}

public String getPhone() {
    return phone;
}

public void setPhone(String phone) {
    this.phone = phone;
}

public String getPassword() {
    return password;
}
```

```

    public void setPassword(String password) {
        this.password = password;
    }

    @Override
    public String toString() {
        return "Employee{" +
            "eid=" + eid +
            ", ename=" + ename + "\" +
            ", email=" + email + "\" +
            ", phone=" + phone + "\" +
            ", password=" + password + "\" +
            '}'";
    }
}

```

6. Prepare repository

6.1. Create EmployeeRepository as follows:

```

import com.mvc.SpringBootMVCDemo.entity.Employee;
import org.springframework.data.jpa.repository.JpaRepository;
import org.springframework.data.jpa.repository.Query;

import java.util.List;

public interface EmployeeRepository extends JpaRepository<Employee, Integer> {

    public Employee findByEmail(String email);

    // select password from employee where email=?
    @Query("select password from Employee where email=:email")
    public String findPasswordByEmployeeEmail(String email);
}

```

7. Prepare service layer

7.1. Create EmployeeService as follows:

```

import com.mvc.SpringBootMVCDemo.entity.Employee;
import com.mvc.SpringBootMVCDemo.exception.InvalidCredentialsException;
import com.mvc.SpringBootMVCDemo.repo.EmployeeRepository;
import jakarta.persistence.EntityExistsException;
import jakarta.persistence.EntityNotFoundException;
import jakarta.transaction.Transactional;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.data.domain.Page;
import org.springframework.data.domain.PageRequest;
import org.springframework.data.domain.Pageable;
import org.springframework.data.domain.Sort;
import org.springframework.stereotype.Service;

import java.util.ArrayList;
import java.util.List;
import java.util.Optional;

```



```

@Service
public class EmployeeService {
    @Autowired
    private EmployeeRepository employeeRepository;

    public EmployeeService() {
        System.out.println("emp service");
    }

    public Employee insertEmployee(Employee employee) {
        if (!employeeRepository.existsById(employee.getId())) {
            Employee savedEmployee = this.employeeRepository.save(employee);
            return savedEmployee;
        }
        throw new EntityExistsException("Employee with id "+employee.getId()+" already exists, hence cannot save");
    }

    public Employee findEmployeeByEmail(String email){
        return this.employeeRepository.findByEmail(email);
    }

    public Employee getEmployeeById(int eid) {
        System.out.println("Emp service "+eid);
        return this.employeeRepository
            .findById(eid).orElseThrow(()-> new EntityNotFoundException("Employee "+eid+" not found"));
    }

    public List<Employee> getEmployees(){
        List<Employee> employees = new ArrayList<Employee>();
        this.employeeRepository.findAll().forEach(employees::add);
        return employees;
    }

    public Page<Employee> getFilteredEmployees(Integer pageno, Integer size){

        Pageable pageable = PageRequest.of(pageno, size, Sort.by(Sort.Direction.DESC, "email"));
        List<Employee> employees = new ArrayList<Employee>();
        return this.employeeRepository.findAll(pageable);

    }

    public Employee updateEmployee(Employee employee) {
        if(!this.employeeRepository.existsById(employee.getId()))
            throw new EntityNotFoundException("Employee "+employee.getId()+" not found and cannot be updated");
        return this.employeeRepository.save(employee);
    }

    @Transactional
    public boolean deleteEmployee(int eid) {
        if(!this.employeeRepository.existsById(eid))
            throw new EntityNotFoundException("Employee "+eid+" not found and cannot be deleted");
        this.employeeRepository.deleteById(eid);
    }

```

```

        return true;
    }

    public boolean loginEmployee(String email, String password) throws InvalidCredentialsException
    {

        String pwd = this.employeeRepository.findPasswordByEmployeeEmail(email);
        if(pwd!=null)
        {
            if(pwd.equals(password))
                return true;
        }
        throw new InvalidCredentialsException("Invalid credentials, Please try again");
    }
}

```

8. Prepare Seed Data

8.1. Update application.properties file:

```

spring.h2.console.enabled=true
spring.datasource.url=jdbc:h2:mem:testdb
spring.jpa.show-sql=true
spring.jpa.generate-ddl=true

```

8.2. Add below code in class with main method to create seed data

```

@Autowired
private EmployeeService employeeService;

@PostConstruct
public void initialize()
{
    Employee emp = new Employee();
    emp.setName("Sia");
    emp.setEmail("sia@test.com");
    emp.setPassword("sia123");
    emp.setPhone("9898989898");

    Employee e = employeeService.insertEmployee(emp);

    Employee em = new Employee();
    em.setName("John");
    em.setEmail("john@test.com");
    em.setPassword("john1235");
    em.setPhone("7654323456");

    Employee e = employeeService.insertEmployee(em);
}

```

9. Expose REST API GET for Employees

9.1. Create EmployeeRestController as follows:

```
@RestController
@RequestMapping("/employees")
public class EmployeeRestController {

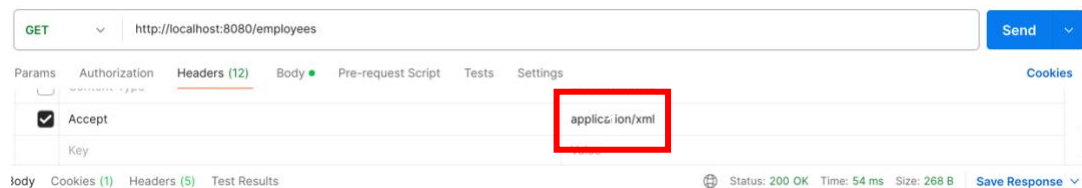
    @Autowired
    private EmployeeService employeeService;

    @GetMapping()
    public List<Employee> getAllEmployees()
    {
        return this.employeeService.getEmployees();
    }
}
```

9.2. Restart the server and get employees data by sending request to :

// Will return all employees
<http://localhost:8080/employees>

9.3. Now try modifying the postman to accept response of type XML



9.4. Postman thrown error as converter not found to convert employees to XML

10. XML as response

10.1. Add below dependency in pom.xml

```
<dependency>
    <groupId>com.fasterxml.jackson.dataformat</groupId>
    <artifactId>jackson-dataformat-xml</artifactId>
</dependency>
```

10.2. Modify the getEmployees method as follows to produce data of type JSON and XML both:

```
@GetMapping(produces = {MediaType.APPLICATION_JSON_VALUE,
    MediaType.APPLICATION_XML_VALUE})
public List<Employee> getAllEmployees()
{
    return employeeService.getEmployees();
}
```

10.3. Restart the server and try on postman and you should get XML data

11. Expose REST API GET for Employee BY Id

11.1. Update EmployeeRestController as follows:

```
@GetMapping("/{id}")
public Employee getEmployeeById(@PathVariable("id") int id)
{
    return this.employeeService.getEmployeeById(id);
}
```

11.2. Restart the server and test below on postman

// Will return employee by id

<http://localhost:8080/employees/1>

11.3. Trying passing the id of an employee that does not exist and you will see an exception which is not the right way of sending an error response:

<http://localhost:8080/employees/10>.

12. Handle error message : ResponseEntity

12.1. Instead of returning Employee object, better to wrap Object instance within the ResponseEntity.

12.2. ResponseEntity : represents the whole HTTP response: status code, headers, and body. As a result, we can use it to fully configure the HTTP response.

If we want to use it, we have to return it from the endpoint; Spring takes care of the rest.

ResponseEntity is a generic type. Consequently, we can use any type as the response body:

12.3. Modify the getEmployeeById message to change the response type

```
@GetMapping("/{id}")
public ResponseEntity<Object> getEmployeeById(@PathVariable int id){
    try {
        Employee employee = employeeService.getEmployeeById(id);
        return ResponseEntity.ok(employee);
    }catch (EntityNotFoundException e){
        return ResponseEntity.status(HttpStatus.NOT_FOUND).body(e.getMessage());
    }
}
```

12.4. Restart the server and see for the response in postman

12.5. Alternatively you can choose to send response as json instead of plain string while sending the error message

```
@GetMapping("/{id}")
public ResponseEntity<Map<String,Object>> getEmployeeById(@PathVariable int id){
    Map<String,Object> map = new HashMap();
    try {
        Employee employee = employeeService.getEmployeeById(id);
        return ResponseEntity.ok(employee);
    }catch (EntityNotFoundException e){
        return ResponseEntity.status(HttpStatus.NOT_FOUND).body(e.getMessage());
    }
}
```

13. REST API – POST

13.1. Add below method in EmployeeRestController

```
@PostMapping
public ResponseEntity<Object> insertEmployee(@RequestBody Employee employee)
{
    System.out.println(employee);
    if (employeeService.insertEmployee(employee))
        return ResponseEntity.status(HttpStatus.CREATED).build()

    return ResponseEntity.badRequest();
}

// OR

@PostMapping
public ResponseEntity<Map<String, Object>> insertEmployee(@RequestBody Employee e)
{
    System.out.println(e);
    Map<String , Object> map = new HashMap<>();
    try {
        Employee savedEmployee = employeeService.insertEmployee(e);
        map.put("SUCCESS", savedEmployee);
        return ResponseEntity.status(HttpStatus.CREATED).body(map);
    } catch (EntityExistsException ex){
        map.put("error", ex.getMessage());
        return ResponseEntity.status(HttpStatus.NOT_FOUND).body(map);
    }
}
```

13.2. Restart the server and test for post

14. REST API – DELETE

14.1. Add below method in EmployeeRestController

```
@DeleteMapping("/{eid}")
public Map<String, String> deleteEmployeeById(@PathVariable int eid)
{
    Map<String, String> map = new HashMap<String, String>();
    if(this.employeeService.deleteEmployee(eid))
        map.put("SUCESS", eid+ " deleted");
    else
        map.put("ERROR", eid+ " count not be deleted");
    return map;
}
```

14.2. Restart the server and test for delete

15. REST API – PUT

15.1. Add below method in EmployeeRestController

```
@PutMapping
public ResponseEntity<Object> insertEmployee(@RequestBody Employee employee)
```

```

{
    System.out.println(employee);
    if (employeeService.updateEmployee(employee))
        return ResponseEntity.ok(employee)
    return ResponseEntity.badRequest();
}

```

15.2. Restart the server and test for post

16. Request Param - Filtering

16.1. Add filteredEmployees() of EmployeeRestController to add a limit to number of employees

```

@GetMapping(produces = MediaType.APPLICATION_JSON_VALUE)
public Map<String, Object> filteredEmployees (
    @RequestParam(required = false, defaultValue = "0") Integer pageno,
    @RequestParam(required = false, defaultValue = "5") Integer size)
{
    Map<String, Object> map = new HashMap<String, Object>();
    System.out.println("page no "+pageno);
    Page<Employee> page = this.employeeService.getFilteredEmployees(pageno, size);
    map.put("current", page.getNumber());
    map.put("count", page.getNumberOfElements());
    map.put("total", page.getTotalElements());
    map.put("employees", page.getContent());
    map.put("pages", page.getTotalPages());
    return map;
}

```

16.2. Add below in initilaize() to add some seed data

```

for(int i=1;i<=50;i++)
{
    Employee e1 = new Employee();
    e1.setEname("Emp "+i);
    e1.setEmail("emp"+i+"@test.com");
    e1.setPassword("emp"+i);
    e1.setPhone(i+"234567890");

    employeeService.insertEmployee(e1);
}

```

16.2. Restart server and test above method as follows:

```

http://localhost:8080/employees/filter
http://localhost:8080/employees/filter?pageno=3&size=10

```