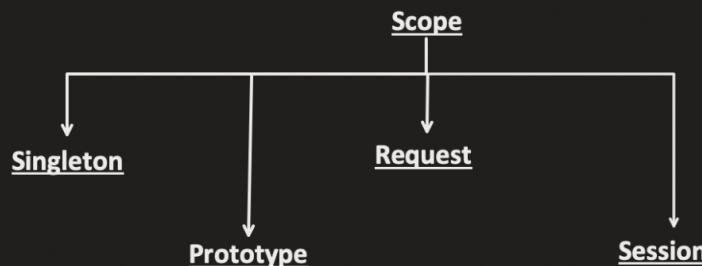


## Springboot: Bean Scopes by Concept && Coding



### Singleton:

- Default scope
- Only 1 instance created per IOC.
- Eagerly initialized by IOC (means at the time of application startup, object get created)

```

@RequestScoped
@Scope("singleton")
public class TestController {
    @Autowired
    User user;

    public TestController() {
        System.out.println("TestController instance initialization");
    }

    @PostConstruct
    public void init() {
        System.out.println("TestController object hashCode: " + this.hashCode());
        System.out.println("User object hashCode: " + user.hashCode());
    }

    @RequestMapping("/*")
    public ResponseEntity<String> retrieveUser(@PathVariable("id") Integer id) {
        System.out.println("retrieveUser api invoked");
        return ResponseEntity.status(HttpStatus.OK).body("");
    }
}

UserInitialization
User object hashCode: 114022235
TestController1 instance initialization
User object hashCode: 104630251 User object hashCode: 114022235
TestController2 instance initialization
TestController2 object hashCode: 1525241607 User object hashCode: 114022235
2024-05-01T13:12:47.754+05:30 INFO 36566 --- [main] c.c.l.SpringbootApplication
2024-05-01T13:12:47.755+05:30 INFO 36566 --- [main] c.c.l.SpringbootApplication
2024-05-01T13:12:48.182+05:30 INFO 36566 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer
2024-05-01T13:12:48.188+05:30 INFO 36566 --- [main] o.apache.catalina.core.StandardService
2024-05-01T13:12:48.189+05:30 INFO 36566 --- [main] o.apache.catalina.core.StandardEngine
2024-05-01T13:12:48.213+05:30 INFO 36566 --- [main] o.a.c.c.C.[Tomcat].[localhost].[/]
2024-05-01T13:12:48.213+05:30 INFO 36566 --- [main] w.s.c.ServletWebServerApplicationContext
TestController1 instance initialization
User initialization
User object hashCode: 114022235
TestController1 object hashCode: 104630251 User object hashCode: 114022235
TestController2 instance initialization
TestController2 object hashCode: 1525241607 User object hashCode: 114022235
2024-05-01T13:12:48.365+05:30 INFO 36566 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer
2024-05-01T13:12:48.369+05:30 INFO 36566 --- [main] c.c.l.SpringbootApplication
2024-05-01T13:13:50.207+05:30 INFO 36566 --- [nio-8090-exec-1] o.a.c.c.C.[Tomcat].[localhost].[/]
2024-05-01T13:13:50.207+05:30 INFO 36566 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet
2024-05-01T13:13:50.208+05:30 INFO 36566 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet
  
```

Report Abuse

localhost:8090/api/fetchUser

```

2024-05-01T13:12:47.754+05:30 INFO 36566 --- [main] c.c.l.SpringbootApplication
2024-05-01T13:12:47.755+05:30 INFO 36566 --- [main] c.c.l.SpringbootApplication
2024-05-01T13:12:48.182+05:30 INFO 36566 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer
2024-05-01T13:12:48.188+05:30 INFO 36566 --- [main] o.apache.catalina.core.StandardService
2024-05-01T13:12:48.189+05:30 INFO 36566 --- [main] o.apache.catalina.core.StandardEngine
2024-05-01T13:12:48.213+05:30 INFO 36566 --- [main] o.a.c.c.C.[Tomcat].[localhost].[/]
2024-05-01T13:12:48.213+05:30 INFO 36566 --- [main] w.s.c.ServletWebServerApplicationContext
TestController1 instance initialization
User initialization
User object hashCode: 114022235
TestController1 object hashCode: 104630251 User object hashCode: 114022235
TestController2 instance initialization
TestController2 object hashCode: 1525241607 User object hashCode: 114022235
2024-05-01T13:12:48.365+05:30 INFO 36566 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer
2024-05-01T13:12:48.369+05:30 INFO 36566 --- [main] c.c.l.SpringbootApplication
2024-05-01T13:13:50.207+05:30 INFO 36566 --- [nio-8090-exec-1] o.a.c.c.C.[Tomcat].[localhost].[/]
2024-05-01T13:13:50.207+05:30 INFO 36566 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet
2024-05-01T13:13:50.208+05:30 INFO 36566 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet
fetchUser api invoked
  
```

### Prototype:

- Each time new Object is created.
- Its Lazily Initialized, means when object is created only when its required.

```

@Component
public class Student {
    @Autowired
    User user;

    public Student() {
        System.out.println("Student instance initialization");
    }

    @PostConstruct
    public void init() {
        System.out.println("Student object hashCode: " + this.hashCode() +
                           " User object hashCode: " + user.hashCode());
    }
}

@RequestScoped
  
```

```

@Scope("ConfigurableBeanFactory.SCOPE_PROTOTYPE")
@RequestMapping(value = "/api/")
public class TestController1 {
    ...
}

```

```

User user;
Student student;

public TestController1() {
    System.out.println("TestController1 instance initialization");
}

@PostConstruct
public void init() {
    System.out.println("TestController1 object hashCode: " + this.hashCode());
    System.out.println("User object hashCode: " + user.hashCode());
    System.out.println("Student object hashCode: " + student.hashCode());
}

@GetMapping(path = "/fetchUser")
public ResponseEntity<String> getUserDetails() {
    System.out.println("fetchUser api invoked");
    return ResponseEntity.status(HttpStatus.OK).body("");
}
}

```

```

2024-05-01T13:32:00.689+05:30 INFO 37722 --- [main] c.c.l.SpringbootApplication
2024-05-01T13:32:00.691+05:30 INFO 37722 --- [main] c.c.l.SpringbootApplication
2024-05-01T13:32:01.130+05:30 INFO 37722 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer
2024-05-01T13:32:01.136+05:30 INFO 37722 --- [main] o.apache.catalina.core.StandardService
2024-05-01T13:32:01.136+05:30 INFO 37722 --- [main] o.apache.catalina.core.StandardEngine
2024-05-01T13:32:01.160+05:30 INFO 37722 --- [main] o.a.c.c.c.[Tomcat].[localhost].[/]
2024-05-01T13:32:01.160+05:30 INFO 37722 --- [main] w.s.c.ServletWebServerApplicationContext
Student instance initialization
User initialization
User object hashCode: 1510009630
Student object hashCode: 2092450685 User object hashCode: 1510009630
2024-05-01T13:32:01.328+05:30 INFO 37722 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer
2024-05-01T13:32:01.333+05:30 INFO 37722 --- [main] c.c.l.SpringbootApplication

```

localhost:8090/api/fetchUser

```

2024-05-01T13:32:00.689+05:30 INFO 37722 --- [main] c.c.l.SpringbootApplication : Starting
2024-05-01T13:32:00.691+05:30 INFO 37722 --- [main] c.c.l.SpringbootApplication : No active
2024-05-01T13:32:01.130+05:30 INFO 37722 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat i
2024-05-01T13:32:01.136+05:30 INFO 37722 --- [main] o.apache.catalina.core.StandardService : Starting
2024-05-01T13:32:01.136+05:30 INFO 37722 --- [main] o.apache.catalina.core.StandardEngine : Starting
2024-05-01T13:32:01.160+05:30 INFO 37722 --- [main] o.a.c.c.c.[Tomcat].[localhost]. [/] : Initiali
2024-05-01T13:32:01.160+05:30 INFO 37722 --- [main] w.s.c.ServletWebServerApplicationContext : Root Web
Student instance initialization
User initialization
User object hashCode: 1510009630
User object hashCode: 1510009630
Student object hashCode: 2092450685 User object hashCode: 1510009630
2024-05-01T13:32:01.328+05:30 INFO 37722 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat s
2024-05-01T13:32:01.333+05:30 INFO 37722 --- [main] c.c.l.SpringbootApplication : Started
2024-05-01T13:32:50.142+05:30 INFO 37722 --- [nio-8090-exec-1] o.a.c.c.c.[Tomcat].[localhost]. [/] : Initiali
2024-05-01T13:32:50.142+05:30 INFO 37722 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet : Initiali
2024-05-01T13:32:50.143+05:30 INFO 37722 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet : Complete
TestController1 instance initialization
User initialization
User object hashCode: 1984730322
TestController1 object hashCode: 1786739287 User object hashCode: 1984730322 Student object hashCode: 2092450685
fetchUser api invoked

```

#### Request:

- New Object is created for each HTTP request.
- Lazily initialized.

```

@RestController
@Scope("request")
@RequestMapping(value = "/api/")
public class TestController1 {
    ...
}

```

```

User user;
Student student;

public TestController1() {
    System.out.println("TestController1 instance initialization");
}

@PostConstruct
public void init() {
    System.out.println("TestController1 object hashCode: " + this.hashCode());
    System.out.println("User object hashCode: " + user.hashCode());
    System.out.println("Student object hashCode: " + student.hashCode());
}

@GetMapping(path = "/fetchUser")
public ResponseEntity<String> getUserDetails() {
    System.out.println("fetchUser api invoked");
    return ResponseEntity.status(HttpStatus.OK).body("");
}
}

```

```

@Component
@Scope("prototype")
public class User {
    ...
}

@Component
@Scope("prototype")
public class Student {
    ...
}

```

```

2024-05-01T14:13:02.583+05:30 INFO 40344 --- [main] c.c.l.SpringbootApplication : Starting SpringbootApplication using Java 21.0.
2024-05-01T14:13:02.584+05:30 INFO 40344 --- [main] c.c.l.SpringbootApplication : No active profile set, falling back to 1 default
2024-05-01T14:13:03.024+05:30 INFO 40344 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat initialized with port 8890 (http)
2024-05-01T14:13:03.033+05:30 INFO 40344 --- [main] o.apache.catalina.core.StandardService : Starting service [Tomcat]
2024-05-01T14:13:03.033+05:30 INFO 40344 --- [main] o.apache.catalina.core.StandardEngine : Starting Servlet engine: [Apache Tomcat/10.1.19]
2024-05-01T14:13:03.059+05:30 INFO 40344 --- [main] o.a.c.c.c.[Tomcat].[localhost]. [/] : Initializing Spring embedded WebApplicationCont
2024-05-01T14:13:03.059+05:30 INFO 40344 --- [main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext: initialization comp
2024-05-01T14:13:03.205+05:30 INFO 40344 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat started on port 8890 (http) with context
2024-05-01T14:13:03.209+05:30 INFO 40344 --- [main] c.c.l.SpringbootApplication : Started SpringbootApplication in 0.795 seconds

```

```

① localhost:8090/api/fetchUser

2024-05-01T14:13:03.033+05:30 INFO 40344 --- [main] o.apache.catalina.core.StandardEngine : Starting Servlet engine:
2024-05-01T14:13:03.059+05:30 INFO 40344 --- [main] o.a.c.c.C.[Tomcat].[localhost].[] : Initializing Spring embedded WebApplicationContext
2024-05-01T14:13:03.089+05:30 INFO 40344 --- [main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext is starting
2024-05-01T14:13:03.205+05:30 INFO 40344 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat started on port 8080
2024-05-01T14:13:03.289+05:30 INFO 40344 --- [main] c.c.l.SpringbootApplication : Started SpringbootApplication in 0.011 seconds (JVM: 0.011s)
2024-05-01T14:13:03.291+05:30 INFO 40344 --- [nio-8090-exec-1] o.a.c.c.C.[Tomcat].[localhost].[] : Initializing Spring DispatcherServlet
2024-05-01T14:13:03.291+05:30 INFO 40344 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet : Initializing Servlet 'dispatcherServlet'
2024-05-01T14:13:03.292+05:30 INFO 40344 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet : Completed initialization
TestController1 instance initialization
User initialization
User object hashCode: 39793904
Student instance initialization
Student object hashCode: 275139209 User object hashCode: 39793904
TestController1 object hashCode: 898967761 User object hashCode: 39793904 Student object hashCode: 275139209
fetchUser api invoked

```

```

① localhost:8090/api/fetchUser

2024-05-01T14:13:03.205+05:30 INFO 40344 --- [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat started on port 8080
2024-05-01T14:13:03.289+05:30 INFO 40344 --- [main] c.c.l.SpringbootApplication : Started SpringbootApplication in 0.011 seconds (JVM: 0.011s)
2024-05-01T14:14:05.931+05:30 INFO 40344 --- [nio-8090-exec-1] o.a.c.c.C.[Tomcat].[localhost].[] : Initializing Spring DispatcherServlet
2024-05-01T14:14:05.931+05:30 INFO 40344 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet : Initializing Servlet 'dispatcherServlet'
2024-05-01T14:14:05.932+05:30 INFO 40344 --- [nio-8090-exec-1] o.s.web.servlet.DispatcherServlet : Completed initialization
TestController1 instance initialization
User initialization
User object hashCode: 39793904
Student instance initialization
Student object hashCode: 275139209 User object hashCode: 39793904
TestController1 object hashCode: 898967761 User object hashCode: 39793904 Student object hashCode: 275139209
fetchUser api invoked
TestController1 instance initialization
User initialization
User object hashCode: 1227388929
Student instance initialization
Student object hashCode: 1206886228 User object hashCode: 1227388929
TestController1 object hashCode: 1137709937 User object hashCode: 1227388929 Student object hashCode: 1206886228
fetchUser api invoked

```

Consider below, What will happen?

```

@RestController
@Scope("singleton")
@RequestMapping(value = "/api/")
public class TestController1 {

    @Autowired
    User user;

    public TestController1() {
        System.out.println("TestController1 instance initialization");
    }

    @PostConstruct
    public void init() {
        System.out.println("TestController1 object hashCode: " + this.hashCode() +
                           " User object hashCode: " + user.hashCode());
    }

    @GetMapping(path = "/fetchUser")
    public ResponseEntity<String> getUserDetails() {
        System.out.println("fetchUser api invoked");
        return ResponseEntity.status(HttpStatus.OK).body("");
    }
}

```

```

@Component
@Scope("request")
public class User {

    public User() {
        System.out.println("User initialization");
    }

    @PostConstruct
    public void init() {
        System.out.println("User object hashCode: " + this.hashCode());
    }
}

```

```

2024-05-01T14:19:25.563+05:30 INFO 40699 --- [main] o.apache.catalina.core.StandardService : Starting service [Tomcat]
2024-05-01T14:19:25.563+05:30 INFO 40699 --- [main] o.apache.catalina.core.StandardEngine : Starting Servlet engine: [Apache Tomcat/10.1.19]
2024-05-01T14:19:25.590+05:30 INFO 40699 --- [main] o.a.c.c.C.[Tomcat].[localhost].[] : Initializing Spring embedded WebApplicationContext
2024-05-01T14:19:25.591+05:30 INFO 40699 --- [main] o.s.web.server.WebApplicationContext : Root WebApplicationContext: initialization completed in 44ms
TestController1 instance initialization
2024-05-01T14:19:25.617+05:30 WARN 40699 --- [main] ConfigServletWebServerApplicationContext : Exception encountered during context initialization - cancelling refresh attempt: org.springframework.beans.factory.UnsatisfiedDependencyException: Error creating bean with name 'testController1': Unsatisfied dependency expressed through field 'user'; nested exception is org.springframework.beans.factory.BeanCreationException: Error creating bean with name 'User': Bean instantiation via constructor failed; nested exception is java.lang.NullPointerException
2024-05-01T14:19:25.619+05:30 INFO 40699 --- [main] o.apache.catalina.core.StandardService : Stopping service [Tomcat]
2024-05-01T14:19:25.626+05:30 INFO 40699 --- [main] o.s.a.i.ConditionEvaluationReporter : Error starting ApplicationContext. To display the condition evaluation report re-run your application with 'debug' enabled.
2024-05-01T14:19:25.635+05:30 ERROR 40699 --- [main] o.s.boot.SpringApplication : Application run failed
org.springframework.beans.factory.UnsatisfiedDependencyException Create breakpoint: Error creating bean with name 'testController1': Unsatisfied dependency expressed through field 'user'; nested exception is org.springframework.beans.factory.BeanCreationException: Error creating bean with name 'User': Bean instantiation via constructor failed; nested exception is java.lang.NullPointerException

```

Spring creates Request scope bean only when there is active HTTP request present.  
Since Singleton, is eagerly initialized, there is no active HTTP request present in current thread. So it wont create a bean for User.

```

@RestController
@Scope("singleton")
@RequestMapping(value = "/api/")
public class TestController1 {

    @Autowired
    User user;

    public TestController1() {
        System.out.println("TestController1 instance initialization");
    }

    @PostConstruct
    public void init() {
        System.out.println("TestController1 object hashCode: " + this.hashCode() +
                           " User object hashCode: " + user.hashCode());
    }

    @GetMapping(path = "/fetchUser")
    public ResponseEntity<String> getUserDetails() {
        System.out.println("fetchUser api invoked");
    }
}

```

```

@Component
@Scope(value = "request", proxyMode = ScopedProxyMode.TARGET_CLASS)
public class User {

    public User() {
        System.out.println("User initialization");
    }

    @PostConstruct
    public void init() {
        System.out.println("User object hashCode: " + this.hashCode());
    }

    public void dummyMethod(){}
}

```



