Software engineering

Topics

- Application architecture
  - Client/Server
  - HTTP and ReST
  - Layered architecture
- Object-oriented programming
  - strongly typed language
  - information hiding
  - interfaces
  - dependency injection
  - polymorphism

Section 1

Application architecture

Client/Server

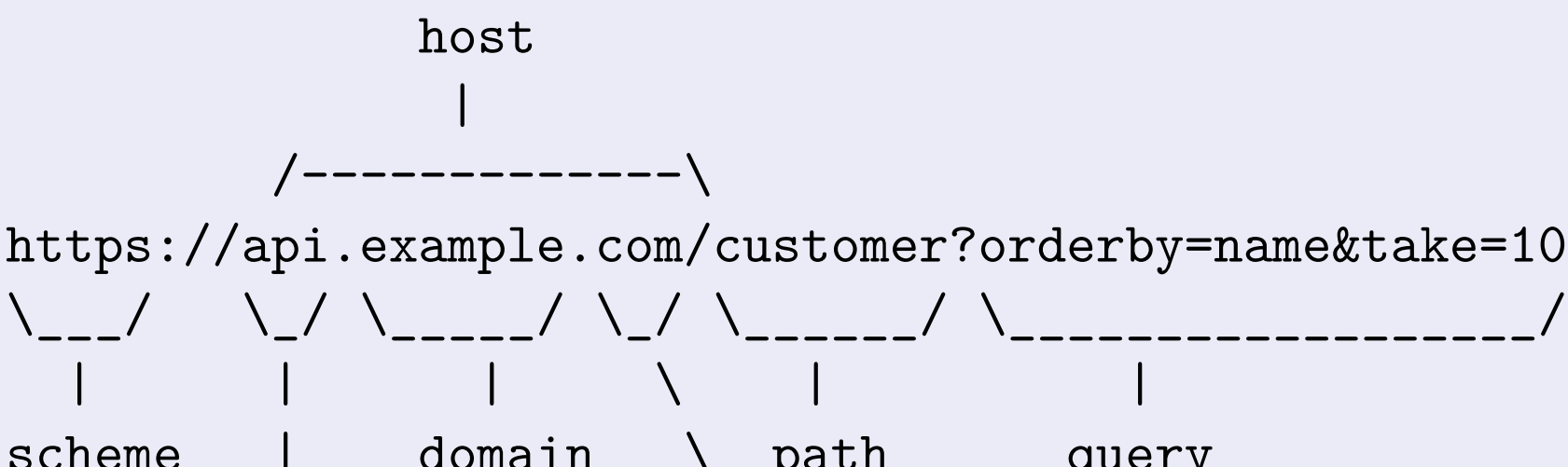
- Two applications communicate, mostly over a network
- Client sends a request
- Server returns a response
- Well defined protocol
  - proprietary
  - open

HTTP and ReST

- Representational State Transfer
- Resource oriented
  - `/customer/1234/invoices/9832`
- use of features of http
  - http verbs (GET, POST, PUT, DELETE, OPTIONS, etc.)
  - stateless
  - http body for payload
  - query parameter for queries

HTTP anatomy (1)

Anatomy of an URL (universal resource locator)



HTTP anatomy (2)

Request

- Request line
- Zero or more headers
- An empty line
- An optional body

Example

```
POST /customer HTTP/1.1
Host: api.example.com
Content-Type: application/json

{
  "firstName": "Eric",
  "lastName": "Idle"
}
```

HTTP verbs to manipulate resources

- `GET`
  - no body
  - read resources
  - query parameters
- `POST`
  - body
  - sending data to the server
  - creates a sub-resorce
- `PUT`
  - body
  - sending data to the server
  - places or replaces a resource
- `DELETE`
  - no body
  - removes a resource

Reading resources

- `GET /customers/`
  - all customers
- `GET /customers?nameStartsWith=eric`
  - filters the customers
- `GET /customers/1234`
  - customer with id `1234`
- `GET /customers/1234/invoices`
  - all invoices of customer `1234`
- `GET /customers/1234/invoices/9832`
  - invoice `9832` of customer `1234`

POST (create)

POST /customers/

- creates a new resource under /customers
  - e.g customers/2234
- returns status code 201 created
- returns header Location: /customers/3134

PUT (create/update)

PUT /customers/1234

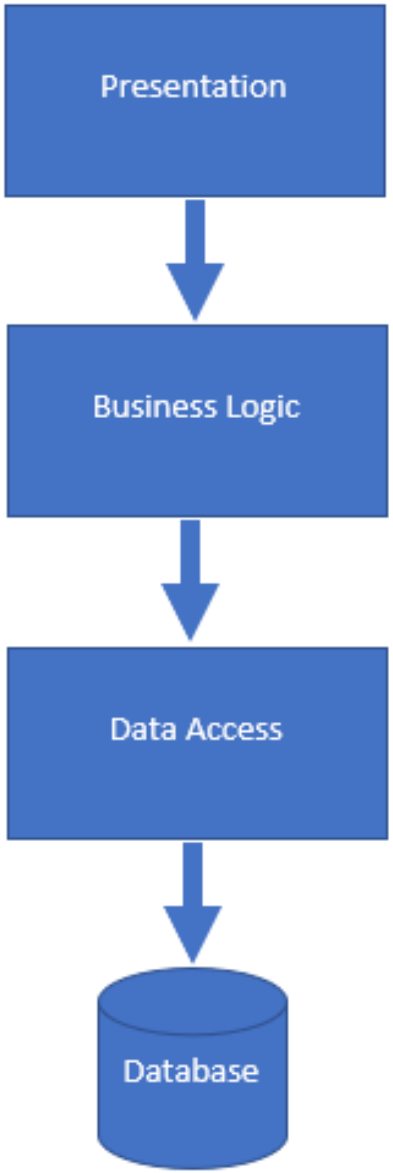
- replaces the resource `/customers/1234`
- creates it, if it doesn't exist
- returns status code `204 No Content`

DELETE (delete)

DELETE /customers/1234

- deletes the resource /customers/1234
- returns status code 204 No Content

Layered application (1)



Layered application (2)

Presentation layer

Presents the data

- Userinterface
- API for other applications

Business logic layer

Handles to business logic

- Business rules
- Calculations

Data access layer

Manages the data

- Abstraction to the data source
  - database
  - file
  - other application (e.g web interface)

Section 2

Object-oriented programming

Type system

Loosley typed (JS)

```
function multiply(x, y) {
  return x * y;
}

multiply("a", "b") // <-- returns NaN
```

Strongly typed (C#)

```
public int Multiply(int x, int y)
{
  return x * y;
}

Multiply("a", "b"); // <-- doesn't compile
```

Types

Simple types (value types)

- bool
- byte (8 bit)
- short (16 bit)
- int (32 bit)
- long (64 bit)
- float (32 bit)
- double (64 bit)
- decimal (128 bit)
- char (character, 16 bit)

Class types (reference types)

- object
- string

Classes and objects

Class

- Template
- Defines datastructures and functionality

Object

- Concrete instance of a class

Example

```
public class Circle
{
  public double Radius { get; set; }
  public double CalculateArea()
  {
    return Radius ^ 2 * Math.PI
  }
}
```

Information hiding

```
public class Employee
{
  private double _salary;
  public double Salary
  {
    get => _salary;
    set
    {
      if (value < 4000) _salary = 4000;
      else _salary = value;
    }
  }
}
```

Access modifiers

- `public`: Accessible for everybody
- `private`: Accessible only inside the class
- `protected`: Accessible for derived classes
- `internal`: Accessible for code inside the same assembly

Encapsulation

```
public class EmailService
{
  public void Create(string email)
  {
    if (ValidateEmail(email)) _emailRepo.Create(email);
  }

  public void Update(string email)
  {
    if (ValidateEmail(email)) _emailRepo.Update(email);
  }

  private bool ValidateEmail(string email)
    => email.Contains("@");
}
```

Abstractions

Interfaces

- Contract, without implementation
- Define members and method signatures
- Classes can implement multiple interfaces

Abstract classes

- Contract with (default) implementation
- Define members and method signatures
- Classes can only inherit from one class

Interface example

```
public interface IEmailService
{
  void Create(string email);
}

public class EmailService : IEmailService
{
  public void Create(string email)
  {
    if (ValidateEmail(email)) _emailRepo.Create(email);
  }
}
```

Interface example (cont.)

```
public class InMemoryEmailService : IEmailService
{
  public void Create(string email)
  {
    if (ValidateEmail(email)) _emailList.Add(email);
  }
}
```

Interface usage

```
public class CreateEmailView
{
  private IEmailService _emailService;

  public CreateEmailView(IEmailService emailService)
  {
    _emailService = emailService;
  }
}
```

Abstract classes example

Definition

```
public class BaseEmailService
{
  public abstract void Create(string email);

  protected bool ValidateEmail(string email)
    => email.Contains("@");
}
```

Implementation

```
public class EmailService : BaseEmailService
{
  public override void Create(string email)
  {
    if (ValidateEmail(email)) _emailRepo.Create(email);
  }
}
```

Composition over inheritance

- Inheritance creates a tight coupling between classes
  - Changes in one module can cause changes in the other
  - They depend on each other
  - Modules are harder to reuse or test
- Composition creates new functionality by reusing existing functionality

Decorator

Interface

```
public interface IEmailService
{
  void Create(string email);
}
```

Base implementation

```
public class EmailService : IEmailService
{
  public void Create(string email)
  {
    _emailRepo.Create(email);
  }
}
```

Decorator (cont.)

Decorator class

```
public class ValidatedEmailService : IEmailService
{
  private IEmailService _emailService;
  public ValidatedEmailService(IEmailService emailService)
  {
    _emailService = emailService;
  }

  public void Create(string email)
  {
    if (ValidateEmail(email)) _emailService.Create(email);
  }

  private bool ValidateEmail(string email)
    => email.Contains("@");
}
```

Decorator (cont.)

Decorator class

```
public class ValidatedEmailService : IEmailService
{
  private IEmailService _emailService;
  private IEmailValidator _emailValidator;
  public ValidatedEmailService(IEmailService emailService,
    IEmailValidator emailValidator)
  {
    _emailService = emailService;
    _emailValidator = emailValidator;
  }
  public void Create(string email)
  {
    if (_emailValidator.ValidateEmail(email))
      _emailService.Create(email);
  }
}
```