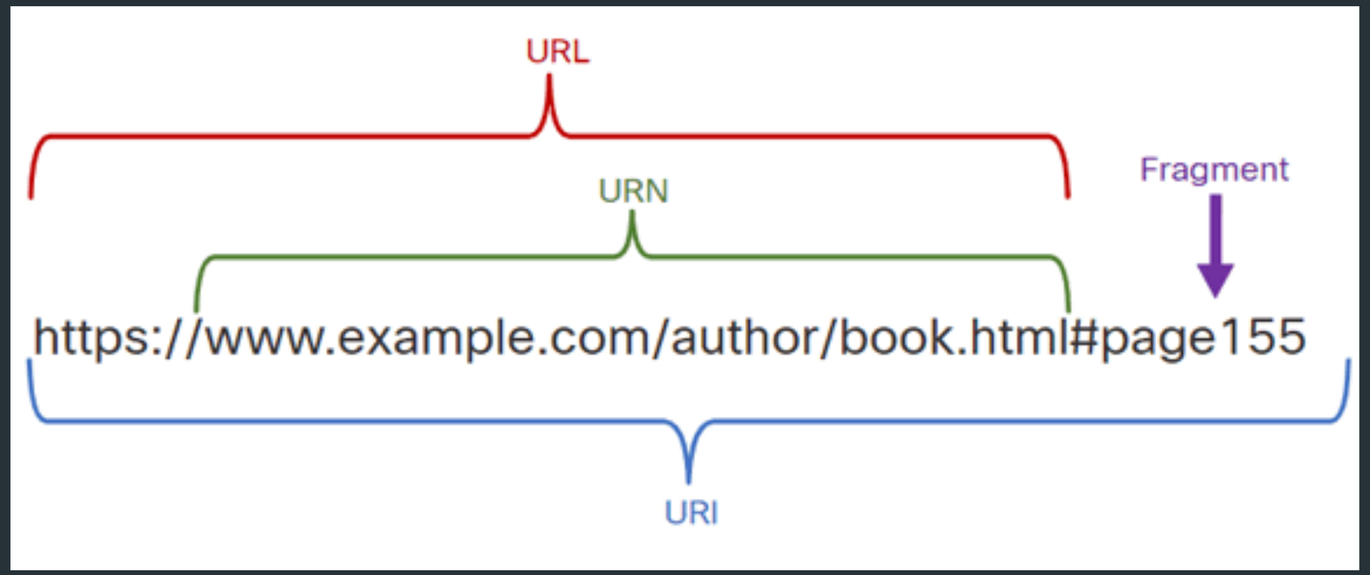
Lecture #5
RESTful Web Services #2

WSMT2023

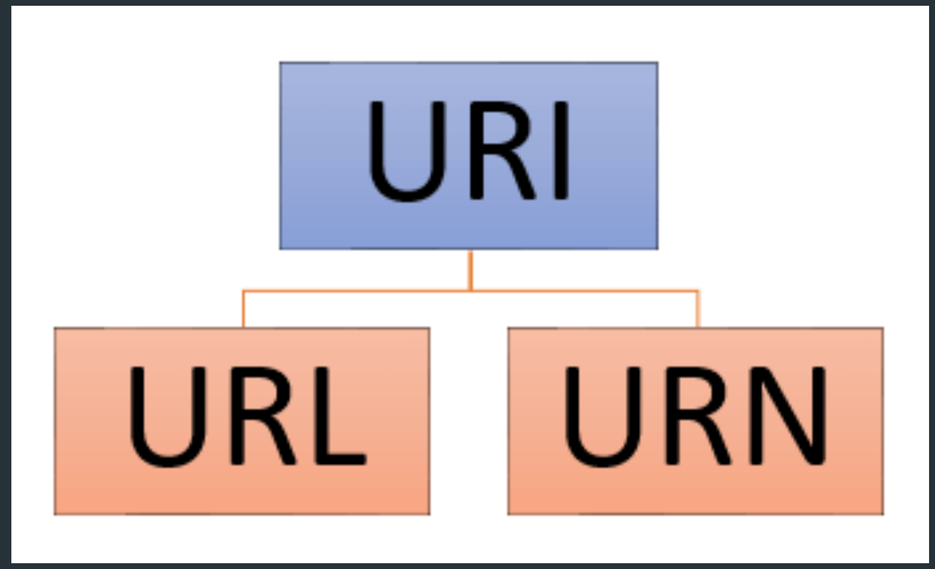
Introduction to Designing URIs for Queries

- URI - uniform resource identifier
- URL - uniform resource locator
- URN - uniform resource name



URI - Essential Component

- Consistency
- Clarity
- Predictability
- Security
- Persistence



URI - Essential Component

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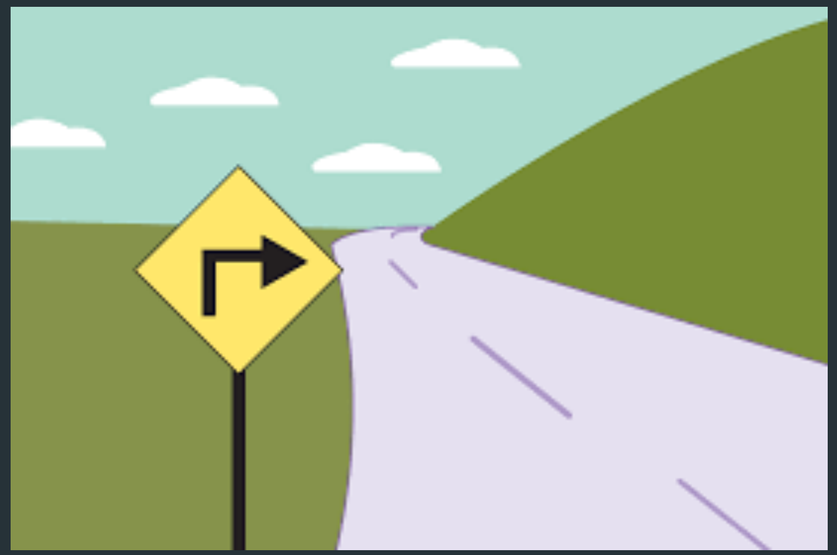
- Consistency
- Clarity

URI - Essential Component

- Consistency
- Clarity
- Predictability



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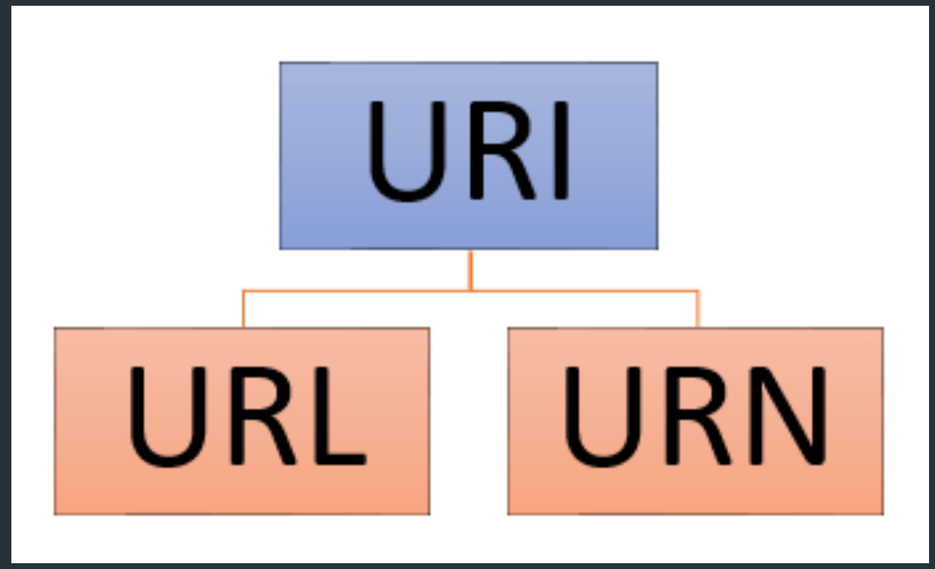
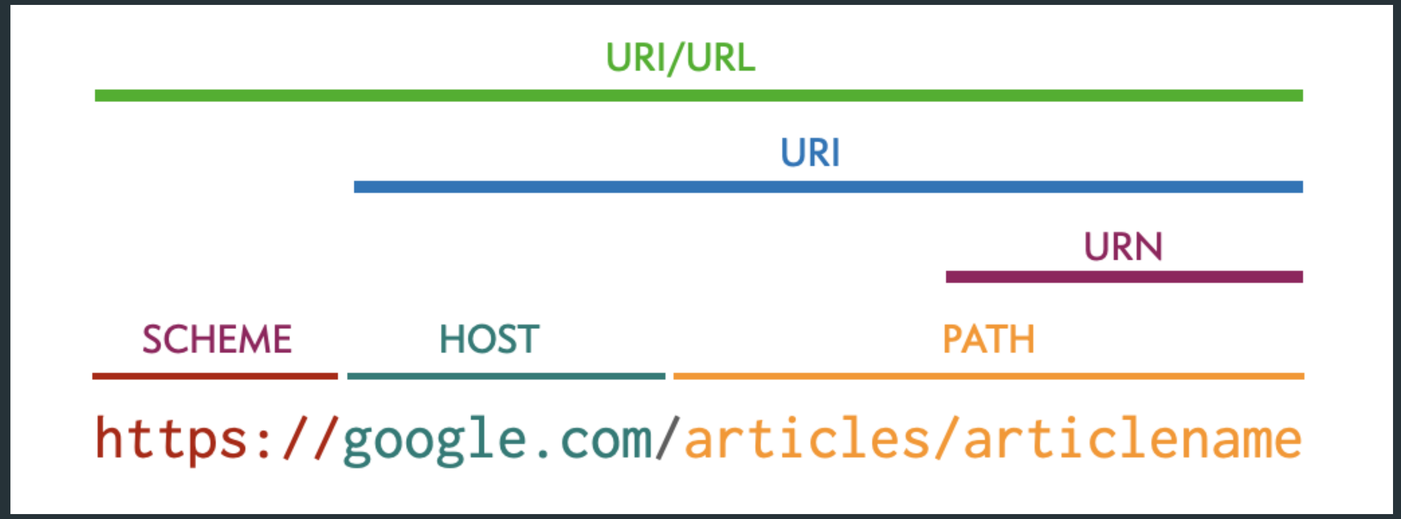


URI Structure

- Usability
- Scalability
- RESTful Architecture



URI Structure

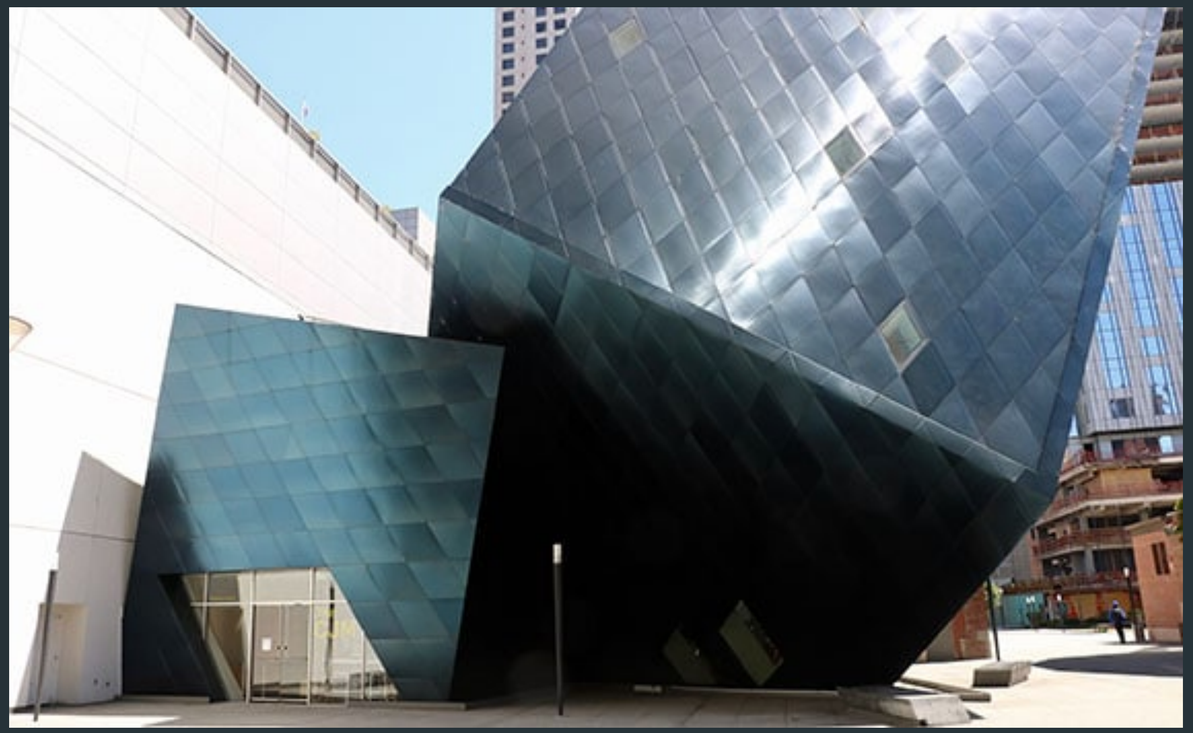
- Usability
  - Intuitive
  - Consistent
  - Easy to understand

URI Structure

- Usability
- Scalability

URI Structure

- Usability
- Scalability
- RESTful Architecture



Understanding Query Parameters

https://example.com/api/books?author=Mark+Twain&page=2

Parameters

- Optional
- Required

Parameters

- Optional

```
https://example.com/api/products?category=electronics
    &price_range=100-500
    &sort=price_asc
    &page=2
    &limit=10
```

Parameters

- Required

https://example.com/api/products?product_id=12345

Well-designed URI for a RESTful service

https://example.com/api/cars

Well-designed URI for a RESTful service

https://example.com/api/cars

- https:// - protocol
- example.com - domain name
- /api/cars - endpoint

More expressive

https://example.com/api/cars?price_min=10000&price_max=20000

- Query Parameters
  - price_min
  - price_max

Well-designed

- Easy to read
- Easy to remember
- Expressive to convert the purpose

Define Query Responses

- HTTP Status Codes:
  - 200 OK
  - 400 Bad Request
  - 404 Not Found
  - 500 Internal Server Error

Responses Body

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "data": [
    {
      "id": 1,
      "name": "John Doe",
      "age": 30
    },
    {
      "id": 2,
      "name": "Jane Doe",
      "age": 25
    }
  ]
}
```

Web Caching

- Caching improves performance by storing frequently accessed data in memory.
- Caching can reduce server load and improve response times.
- Web caching can be implemented using browser caching or server-side caching.

Setting Expiration Caching Headers

- The Expires header specifies a date and time after which the cached content is considered stale.
- The Cache-Control header provides more granular control over caching by allowing you to specify caching behavior, such as the maximum age of the content and whether it can be cached by intermediate proxies.
- The ETag header allows the server to check whether the cached content has changed before returning it.

Setting Cache-Control Header in Java

- Use the HttpServletResponse class to set the Cache-Control header.
- Call the setHeader method and pass "Cache-Control" as the first argument and the caching behavior as the second argument.
- For example, to set a maximum age of 3600 seconds (1 hour), use the following code:

```
response.setHeader("Cache-Control", "max-age=3600");
```

Extensibility and Versioning

- Extensibility is the ability to add new features and functionality to an API without breaking existing clients.
- Versioning is the practice of creating new versions of an API to introduce breaking changes or add new features.
- Deciding when to version an API can be a challenging decision.

When to Version an API

- When adding breaking changes that will affect existing clients.
- When adding new features that are not backwards-compatible.
- When the current API is no longer meeting the needs of users.

Versioning an API in Practice

- Use a version number in the API's URL to indicate the version of the API.
- Create a new version of the API when making breaking changes or adding new features.
- Use API documentation to help clients migrate to the new version.

Enabling Discovery

- nabling discovery allows clients to easily find and understand the functionality of a RESTful API.
- The use of hypermedia links can be a powerful tool for enabling discovery.
- A well-designed API documentation can also greatly aid in the discovery process.

Using Hypermedia Links for Discovery

- Hypermedia links are links that contain information about the resource they point to.
- Hypermedia links can be used to represent relationships between resources in the API.
- Clients can use hypermedia links to navigate the API and discover its functionality.

Using Hypermedia Links in a RESTful API

- Use hypermedia links to represent relationships between resources.
- Include links to related resources in response payloads.
- Use link relation types to define the relationship between resources.

```
{
  "books": [
    {
      "id": 1,
      "title": "The Hitchhiker's Guide to the Galaxy",
      "author": "Douglas Adams",
      "links": [
        {
          "rel": "self",
          "href": "/books/1"
        },
        {
          "rel": "delete",
          "href": "/books/1",
          "method": "DELETE"
        }
      ]
    },
    {
      "id": 2,
      "title": "1984",
      "author": "George Orwell",
      "links": [
        {
          "rel": "self",
          "href": "/books/2"
```

```
    {
      "id": 2,
      "title": "1984",
      "author": "George Orwell",
      "links": [
        {
          "rel": "self",
          "href": "/books/2"
        },
        {
          "rel": "delete",
          "href": "/books/2",
          "method": "DELETE"
        }
      ]
    }
  ],
  "links": [
    {
      "rel": "self",
      "href": "/books"
    },
    {
      "rel": "add",
      "href": "/books",
      "method": "POST"
    }
```

```
      "author": "George Orwell",
      "links": [
        {
          "rel": "self",
          "href": "/books/2"
        },
        {
          "rel": "delete",
          "href": "/books/2",
          "method": "DELETE"
        }
      ]
    }
  ],
  "links": [
    {
      "rel": "self",
      "href": "/books"
    },
    {
      "rel": "add",
      "href": "/books",
      "method": "POST"
    }
  ]
}
```

Using API Documentation for Discovery

- Well-designed API documentation can greatly aid in the discovery process.
- API documentation should include information about the API's resources, operations, and relationships.
- API documentation should be easy to navigate and understand.

Using API Documentation for Discovery

GET /products
Retrieve a list of all products in the collection.

GET /products/{id}
Retrieve a specific product by ID.

POST /products
Add a new product to the collection.

PUT /products/{id}
Update an existing product.

DELETE /products/{id}
Delete a product from the collection.

HATEOAS in RESTful Web Services

- What is HATEOAS?
- Why is it important?
- How can it be implemented in a RESTful API?

What is HATEOAS?

- A constraint of the REST architectural style
- Allows clients to navigate APIs through hypermedia links and controls
- Enables discovery and exploration of APIs

Implementing HATEOAS in a RESTful API

- Define resources and resource relationships
- Include hypermedia links and controls in responses
- Use a standardized format for links and controls

```
{
  "name": "Product 1",
  "description": "A product",
  "price": 19.99,
  "_links": {
    "self": {
      "href": "/products/1"
    },
    "category": {
      "href": "/categories/2"
    }
  }
}
```

Why is HATEOAS important?

- Makes APIs self-describing and easier to use
- Enables discovery and exploration of APIs
- Supports evolution of APIs over time

Lecture outcomes

- Restful
  - Queries
  - Caching
  - Versioning
  - Discovery