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2025

HTTP APIs

The glue between clients and servers

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Goal

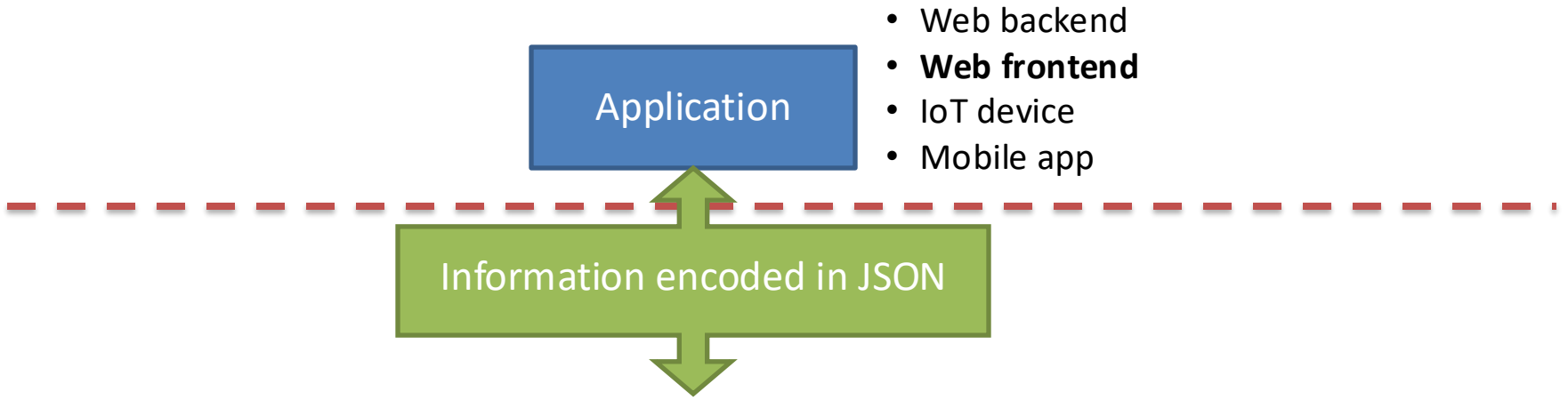
Application

- Web backend
- **Web frontend**
- IoT device
- Mobile app

Database

Service(s)

Architecture



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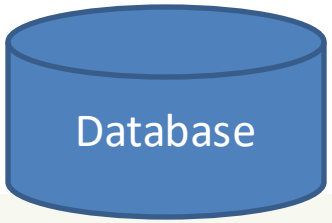


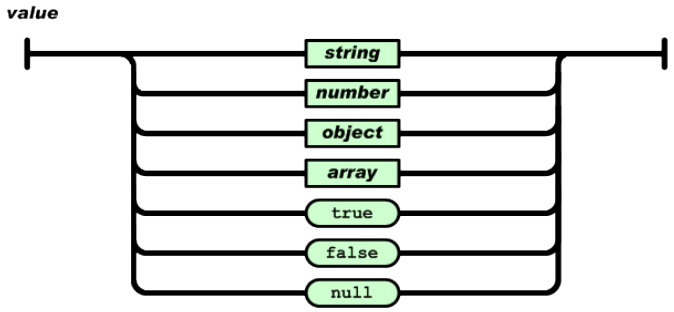
JSON - JavaScript Object Notation

/ˈdʒeɪ·sən/

- Lightweight Data Interchange Format
  - Subset of JavaScript syntax for object literals
  - Easy for humans to read and write
  - Easy for machines to parse and generate
  - https://www.json.org/
  - ECMA 404 Standard: http://www.ecma-international.org/publications/files/ECMA-ST/ECMA-404.pdf
  - RFC 8259: https://tools.ietf.org/html/rfc8259
- Media type: `application/json`

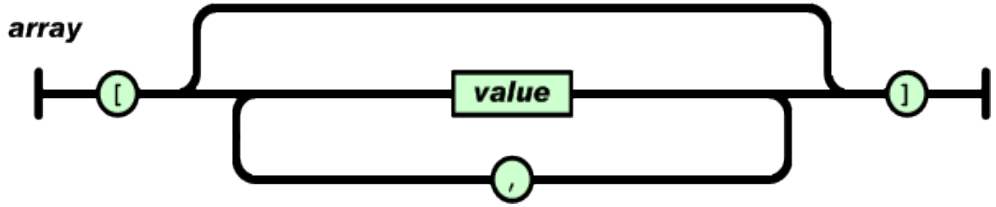
JSON Logical Structure

- Primitive types: string, number, true/false/null
  - Strings MUST use "double" quotes, not 'single'



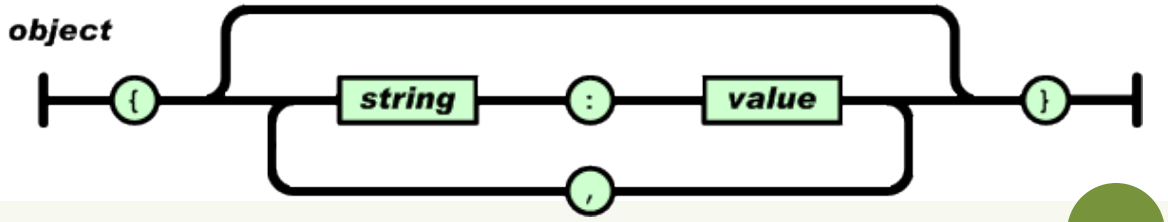
- Composite type – Array: ordered lists of values

[...]



- Composite type – Objects: list of key-value pairs
  - Keys are strings (not identifiers)
  - MUST be "quoted"

{...}



JSON Example


```
{
    "firstName": "John",
    "lastName": "Smith",
    "address": {
        "streetAddress": "21 2nd Street",
        "city": "New York",
        "state": "NY",
        "postalCode": 10021
    },
    "phoneNumbers": [
        "212 555-1234",
        "646 555-4567"
    ]
}
```

Name/Value Pairs

Child properties

String Array

Number data type

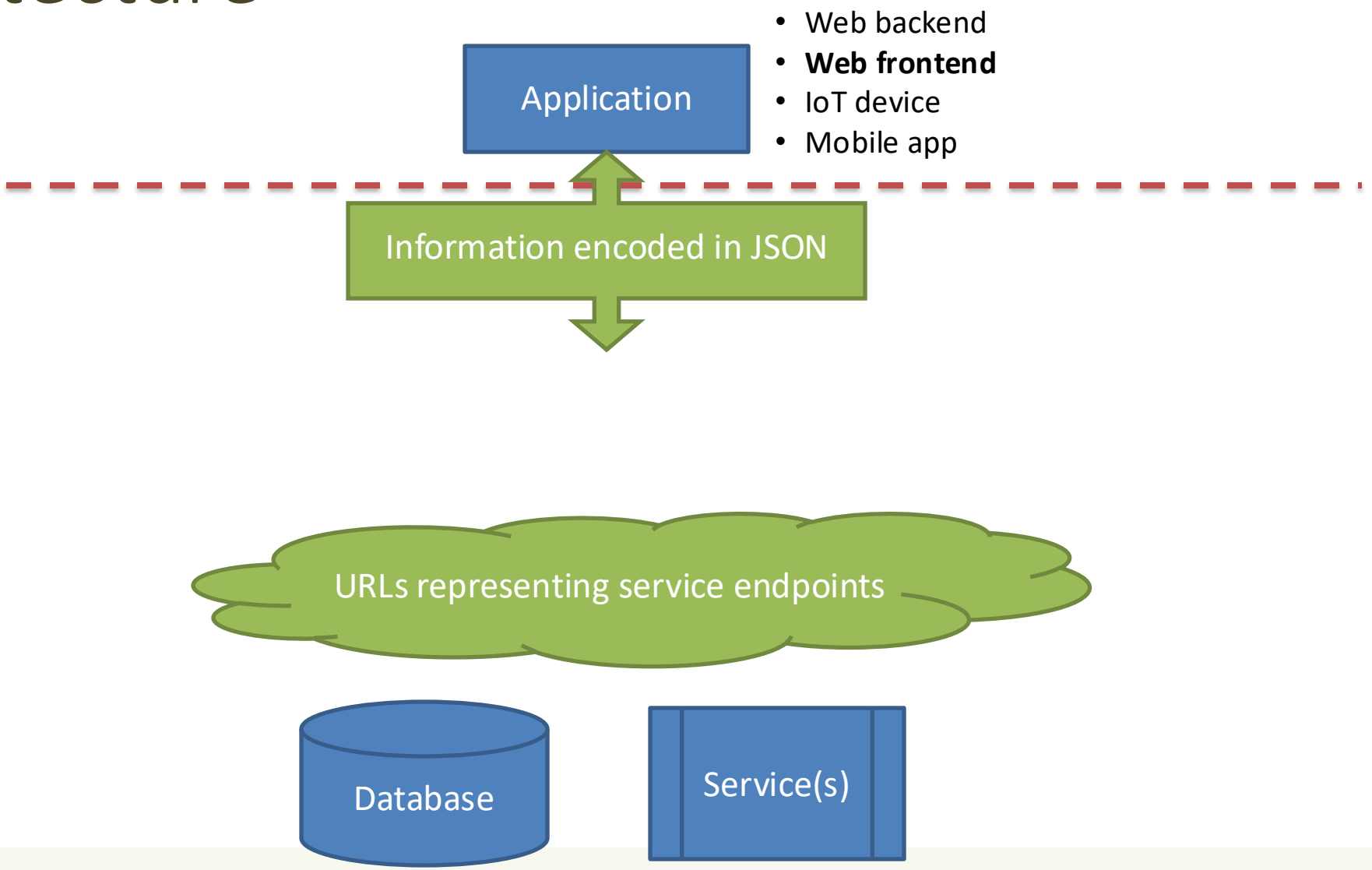
Using JSON in JavaScript

- `JSON.stringify` to convert objects into JSON
  - `const jsonString = JSON.stringify(myObj)`
  - Works recursively also on nested objects/arrays
  - Excludes function properties (methods) and undefined-valued properties

- `JSON.parse` to convert JSON back into an object
  - `const myObj = JSON.parse(jsonString)`
  - All created objects have the default `{}` Object prototype
    - Can fix with a *reviver* callback

https://javascript.info/json

Architecture



Main Types of URLs

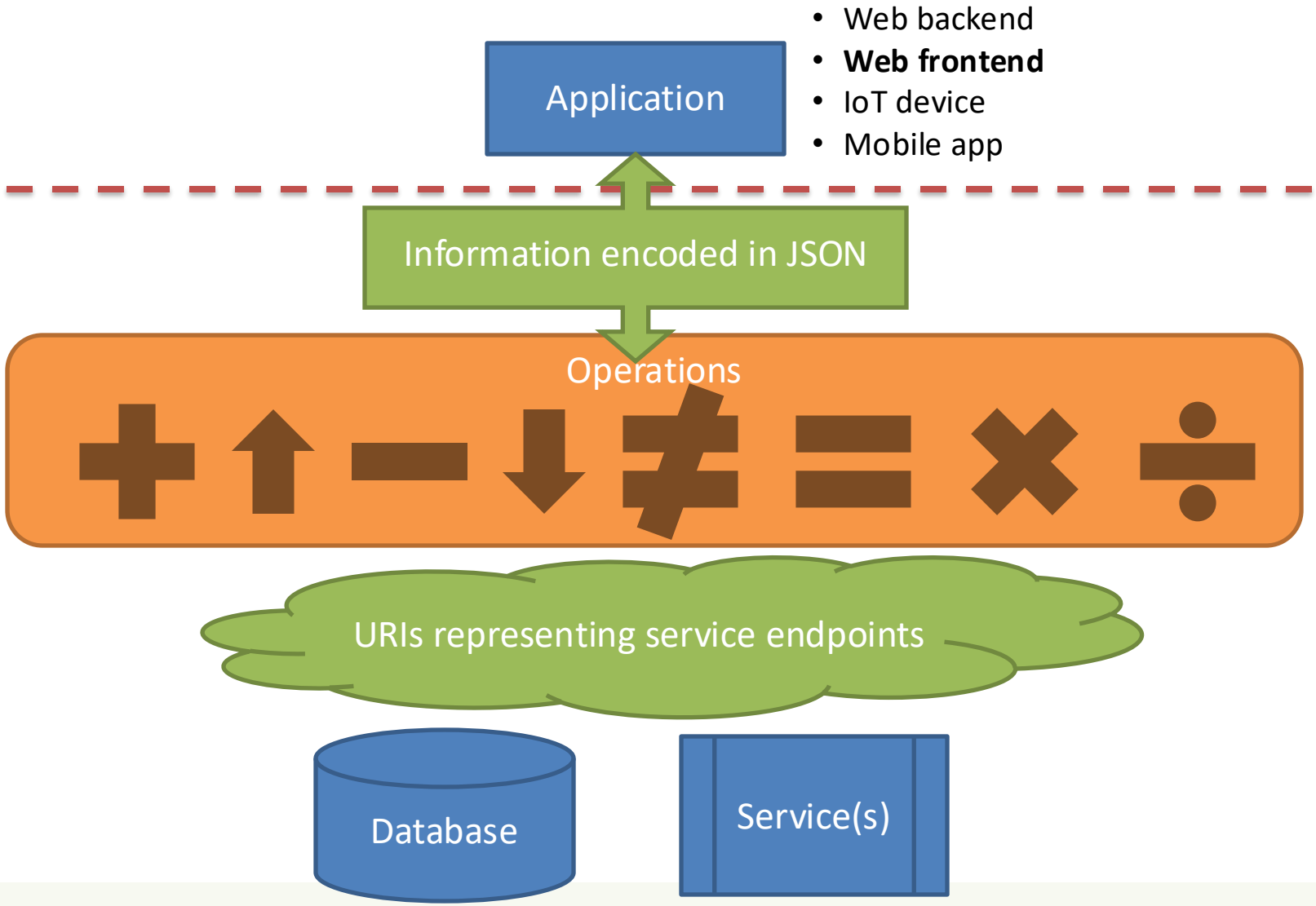
- **Collection** URL
  - Represents a **set** (or list) of objects (or items) of the same type
  - Format: /collection
    - `http://api.polito.it/`**`students`**
    - `http://api.polito.it/`**`courses`**

- **Element** URL
  - Represents a **single item**, and its properties
  - Format: /collection/identifier
    - `http://api.polito.it/`**`students/s123456`**
    - `http://api.polito.it/`**`courses/01zqp`**

Best Practice for URLs Definition

- Nouns (not verbs)
- Plural nouns
- Concrete names (not abstract or generic names)
  - /courses, not /items

Architecture



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Retrieve
Add
Update
Delete
Search
…

Actions on Resources

Resource	GET	POST	PUT	DELETE
Collection	Retrieve the list of items	Add a new element to the collection	-	-
Single Element	Retrieve the properties of the element	-	Replace the values of the properties of the element	Delete the element

Actions on Resources: Example

GET /dogs POST /dogs

Resource	GET	POST	PUT	DELETE
/dogs	List dogs	Create a new dog item	Bulk update dogs **(avoid)**	Delete all dogs **(avoid)**
/dogs/12	Show info about the dog with id 12	**ERROR**	If exists, update the info about dog #12	Delete the dog #12

GET /dogs/12 PUT /dogs/12 DELETE /dogs/12

See also suggestions for standard methods usage: https://cloud.google.com/apis/design/standard_methods

Relationships: Guidelines

- A given Element may have a (1:1 or 1:N) relationship with other Element(s)
- Represent with: /collection/identifier/relationship
- `http://api.polito.it/`**`students/s123456/courses`** (list of courses followed by student `s123456`)
- `http://api.polito.it/`**`courses/01qzp/students`** (list of students enrolled in course `01qzp`)

Complex Resource Search

- Use `?`*`parameter`*`=`*`value`* for more advanced resource filtering (or search operations) in GET operations
  - E.g., `https://api.abc.com/1.1/timeline`**`?name=full&maxcount=2`**

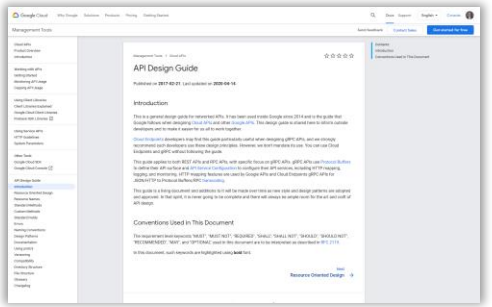
Errors

- When errors or exceptions are encountered,
  use meaningful HTTP Status Codes (e.g., 404 Not Found)
  - The Response Body may contain additional information
    (e.g., informational error messages)

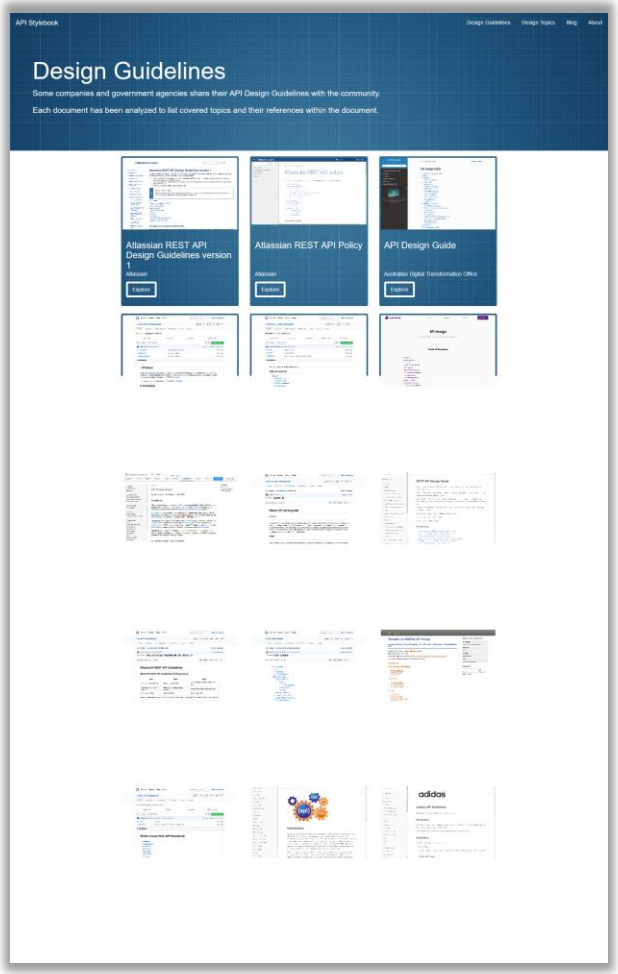
```
{
   "developerMessage" : "Verbose, plain language description of
      the problem for the app developer with hints about how to fix
      it.",
   "userMessage":"Pass this message on to the app user if needed.",
   "errorCode" : 12345,
   "more info": "http://dev.teachdogrest.com/errors/12345"
}
```

API Design

- How to design a set of APIs for your application?
- Practical guidelines, with applied standard practices
- Suggestion: Google API Design Guide
  - https://cloud.google.com/apis/design/



http://apistylebook.com/design/guidelines/



Guidelines for implementing back-end APIs

HTTP APIS IN EXPRESS

HTTP APIs implementation

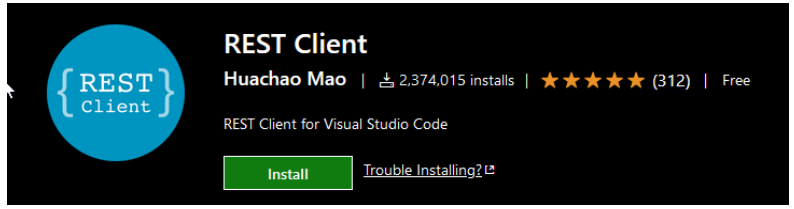
- HTTP API endpoints are just regular HTTP requests
- Request URL contains the Element Identifiers (`/dogs/1234`)
  - Extensive usage of parametric paths (`/dogs/:dogId`)
- Request/response Body contains the Element Representation (in JSON)
  - **Request:** `req.body` populated by the `express.json()` middleware
  - **Response:** `res.json()` to send the response
- Do not forget to validate input parameters (*topic for next lectures*)

	Collections	Elements

GET	`app.get('/answers', (req, res) => {`
	`  dao.listAnswers().then((answers) => {`
	`  **res.json(answers);**`
	`  });`
	`});`
		`app.get('/answers/:id', (req, res) => {`
		`  // TODO: validation of req.params.id`
		`  dao.readAnswer(req.params.id)`
		`  .then((answer)=>res.json(answer));`
		`});`

POST	`app.use(express.json());`
	
	`app.post('/answers', (req, res) => {`
	`  const answer = req.body;`
	`  // TODO: validation of answer`
	`  dao.createAnswer(answer);`
	`});`	

Testing HTTP APIs



https://marketplace.visualstudio.com/items?itemName=humao.rest-client

- May use the "REST Client" extension for VSCode
- Create a text file with extension `.http`
- Write one or more HTTP *Requests* (separated by ###)
  - Method + URL
  - Request headers (optional)
  - Request body (optional, after empty line)
- Click on the 'Send Request' link that will appear
  - A new Tab will open, with the *Response* headers and body

```
GET https://example.com/comments/1 HTTP/1.1

###

GET https://example.com/topics/1 HTTP/1.1

###

POST https://example.com/comments HTTP/1.1
content-type: application/json

{
    "name": "sample",
    "time": "Wed, 21 Oct 2015 18:27:50 GMT"
}
```

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