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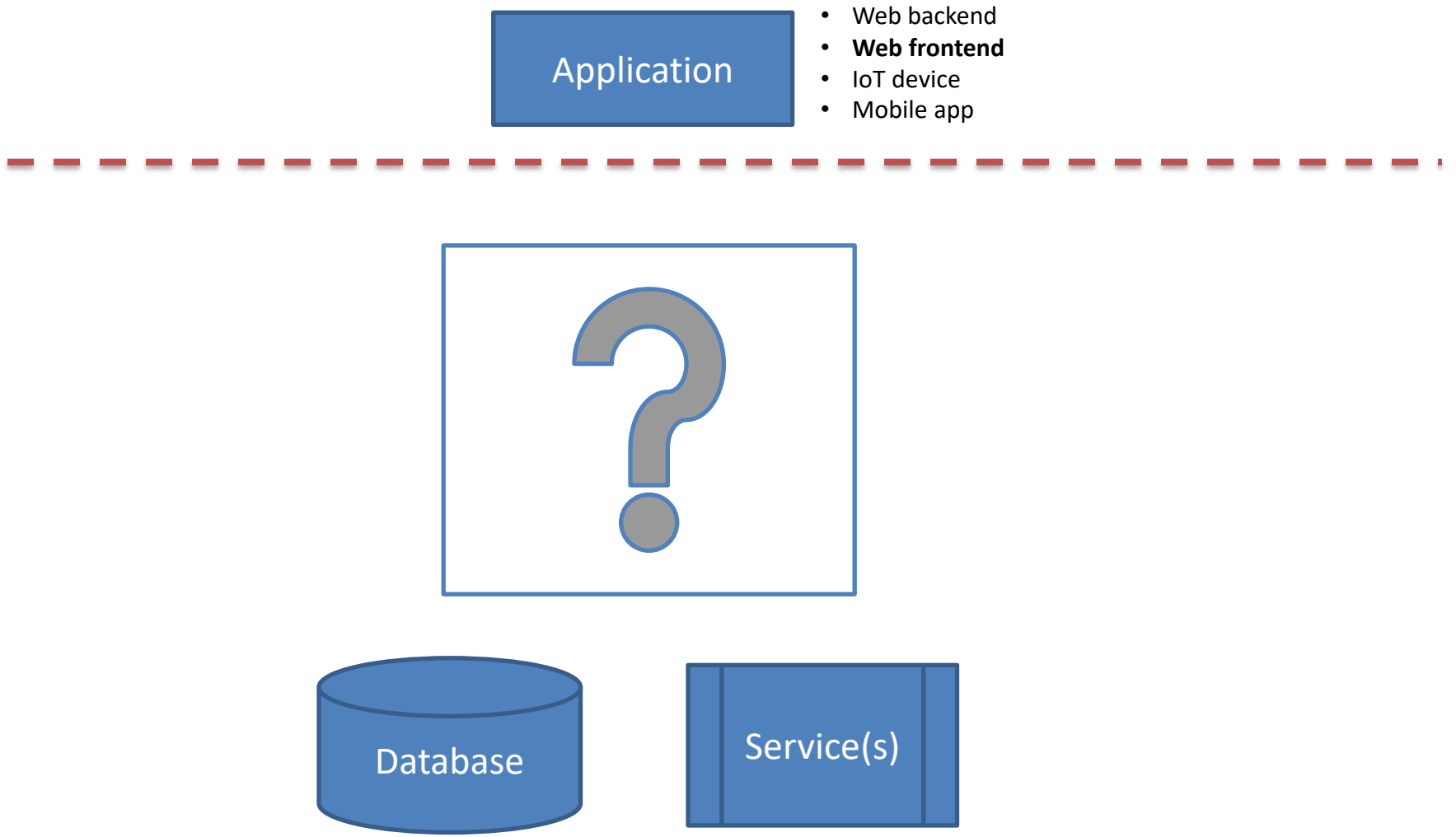
2024

# HTTP APIs

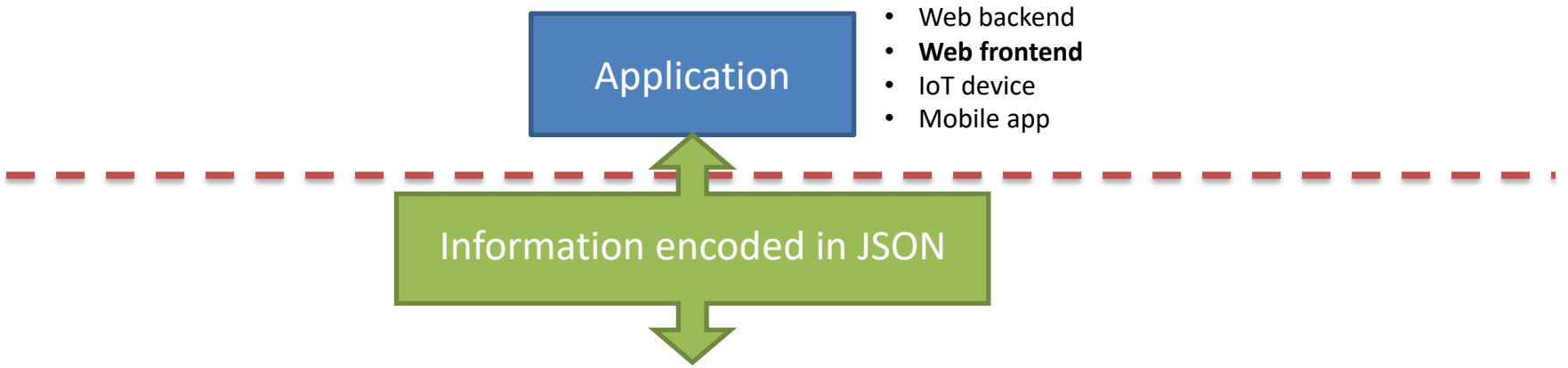
## The glue between clients and servers

Fulvio Corno
Luigi De Russis

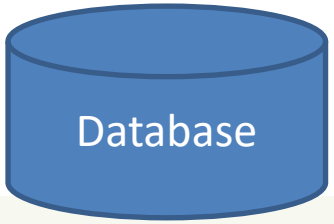
# Goal


Application
Web backend
Web frontend
IoT device
Mobile app
Database
Service(s)

# Architecture




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

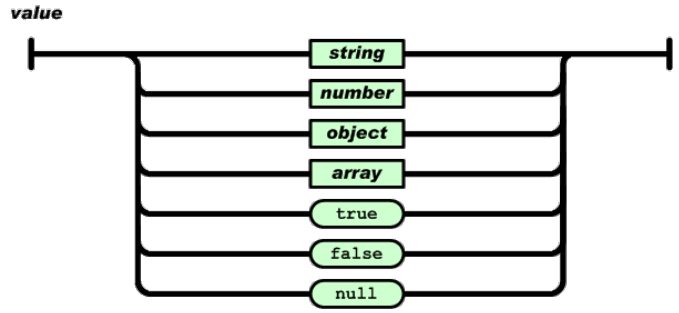

# JSON - JavaScript Object Notation


/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`

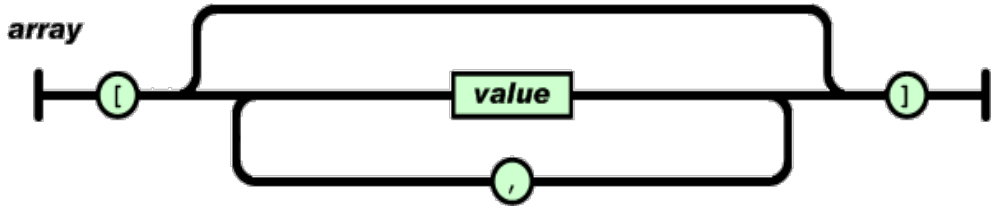
# JSON Logical Structure


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



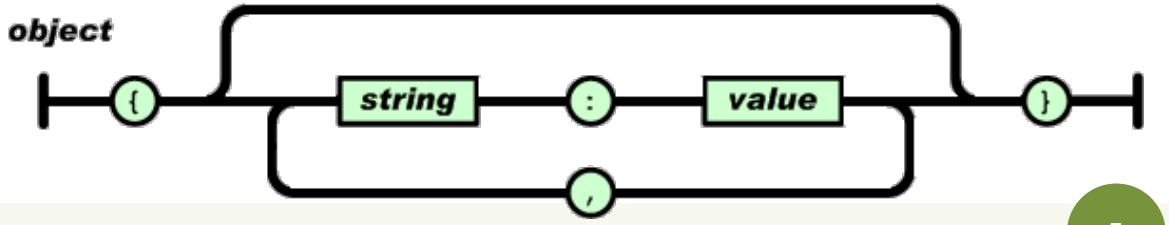

- Composite type – Array: ordered lists of values

[...]




- 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

# Main Types of URIs

- **Collection** URI
  - 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** (Item, Simple) URI
  - Represents a single item, and its properties
  - Format: /collection/identifier
    - `http://api.polito.it/students/s123456`
    - `http://api.polito.it/courses/01zqp`

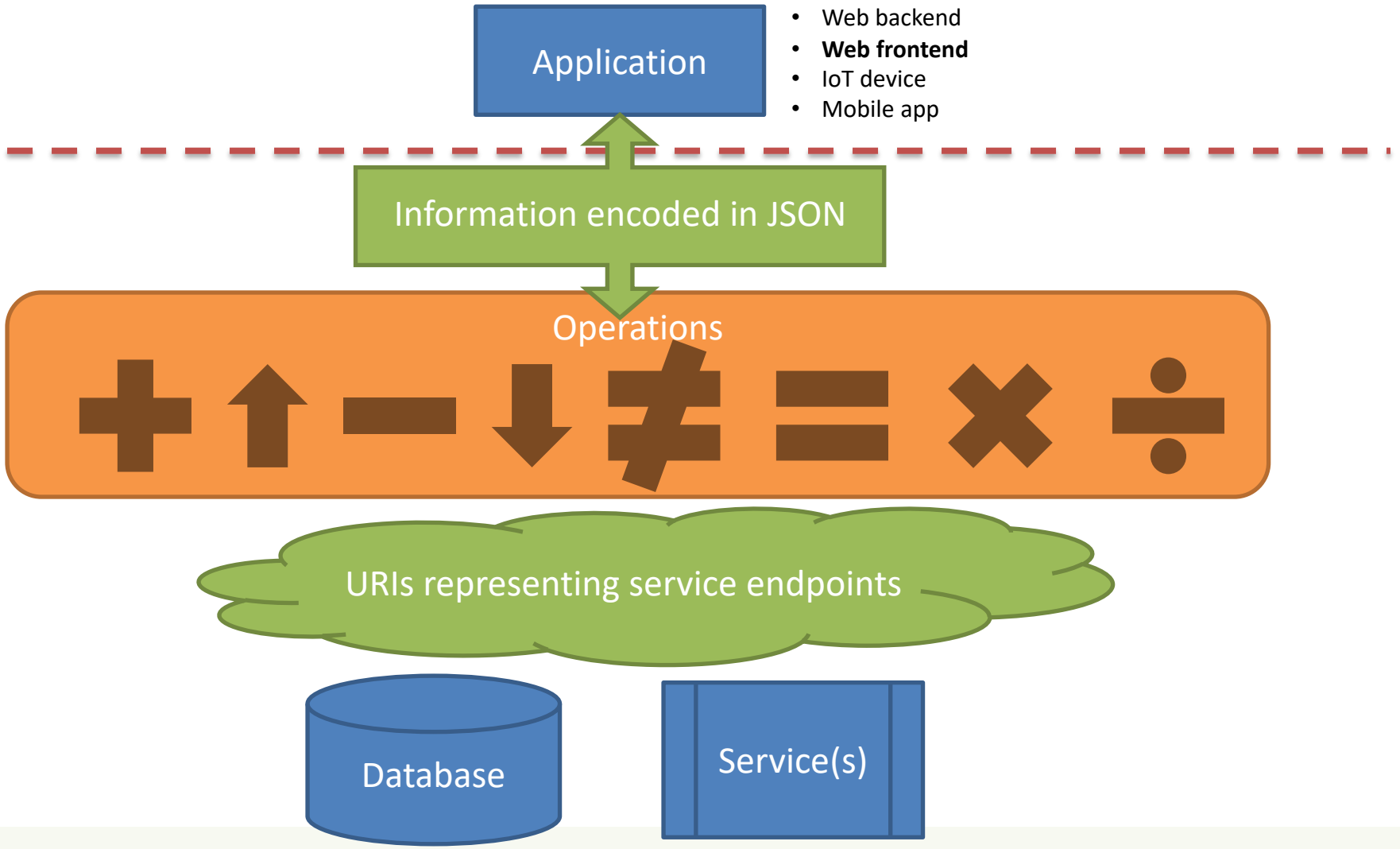
# Best Practice for URIs Definition

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

# Operations on Server URIs

- The server supports operations on the specified object/collection(s)
  - Add
  - Delete
  - Update
  - Find
  - Search
  - …

# Architecture



# Actions Use HTTP Methods

- GET
  - Retrieve the representation of the resource (in the HTTP response body)
  - Collection: the list of items
  - Element: the properties of the element
- POST
  - Create a new resource (data in the HTTP request body)
  - Use a URI for a Collection
- PUT
  - Update an existing element (data in the HTTP request body)
  - Mainly for elements' properties
- DELETE

# 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 element properties | Delete the element |

# Actions on Resources: Example

| Resource | GET | POST | PUT | DELETE |
|---|---|---|---|---|
| /dogs | List dogs | Create a new dog | Bulk update dogs (avoid) | Delete all dogs (avoid) |
| /dogs/1234 | Show info about the dog with id 1234 | ERROR | If exists, update the info about dog #1234 | Delete the dog #1234 |

# Standard Methods

| Standard Method | HTTP Mapping | HTTP Request Body | HTTP Response Body |
|---|---|---|---|
| List | GET <collection URL> | N/A | Resource* list |
| Get | GET <resource URL> | N/A | Resource* |
| Create | POST <collection URL> | Resource | Resource* |
| Update | PUT or PATCH <resource URL> | Resource | Resource* |
| Delete | DELETE <resource URL> | N/A | google.protobuf.Empty** |

https://cloud.google.com/apis/design/standard_methods

# Relationships

- 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)
  - E.g., `https://api.twitter.com/1.1/statuses/user_timeline.json`**`?screen_name=twitterapi&count=2`**

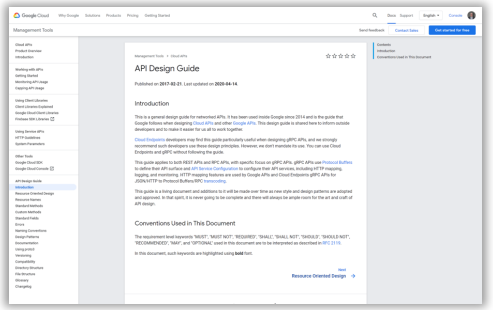
# Errors

- When errors or exceptions are encountered, use meaningful HTTP Status Codes
  - The Response Body may contain additional information (e.g., informational error messages)

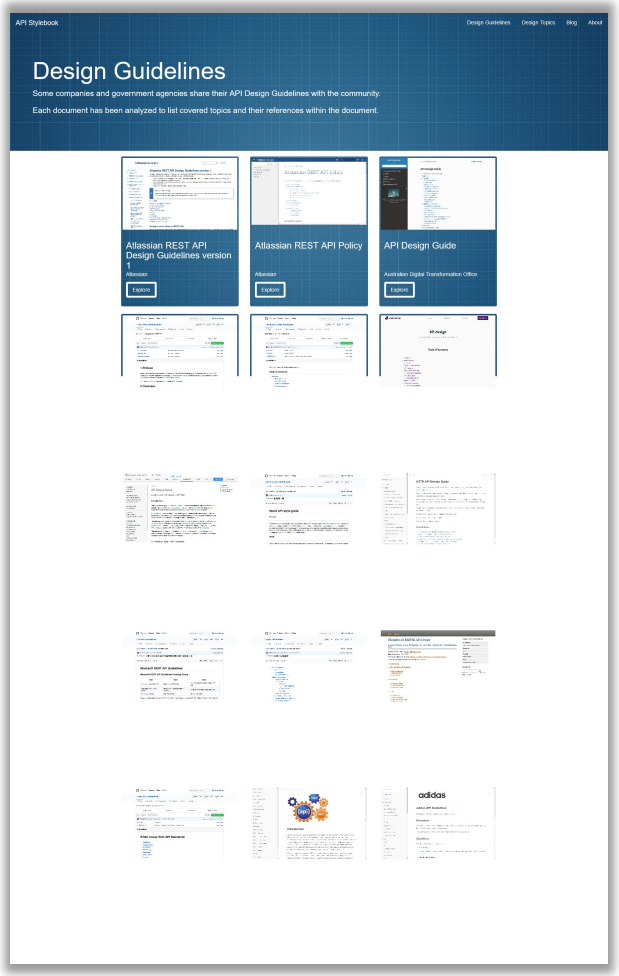
```
{
   "developerMessage" : "Verbose, plain language description of
the problem for the app developer with hints about how to fix
it.",
   "userMessage":"Pass this message on to the app user if
needed.",
   "errorCode" : 12345,
   "more info": "http://dev.teachdogrest.com/errors/12345"
}
```

# 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

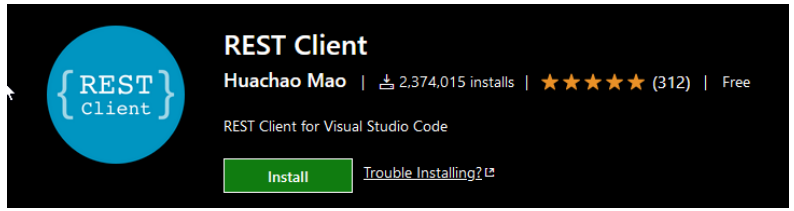
# HTTP APIS IN EXPRESS

# 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
- Always validate input parameters
- Always validate input parameters
- Really, always validate input parameters

| | Collections | Elements |
|---|---|---|
| GET | `app.get('/answers', (req, res) => {`<br>`  dao.listAnswers().then((answers) => {`<br>`  **res.json(answers);**`<br>`  });`<br>`});` | `app.get('/answers/:id', (req, res) => {`<br>`  // TODO: validation of req.params.id`<br>`  dao.readAnswer(req.params.id)`<br>`  .then((answer)=>res.json(answer));`<br>`});` |
| POST | `app.use(express.json());`<br><br>`app.post('/answers', (req, res) => {`<br>`  const answer = req.body;`<br>`  // TODO: validation of answer`<br>`  dao.createAnswer(answer);`<br>`  res.end();`<br>`});` | |

# Testing HTTP APIs




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

- You may use the "REST Client" extension for VSCode
- Create a 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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