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2023

HTTP APIs

The glue between clients and servers

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Goal

Application

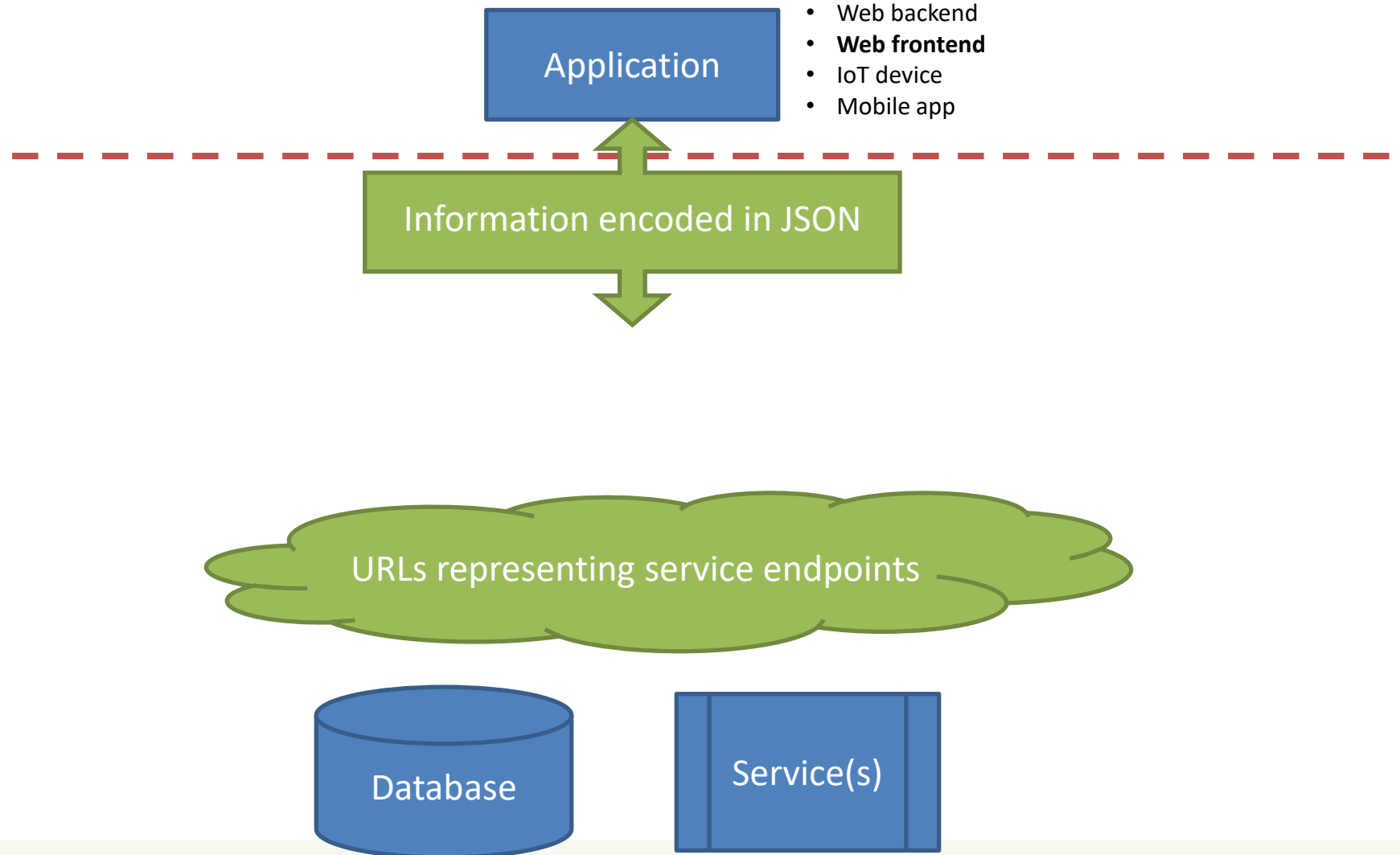
- Web backend
- **Web frontend**
- IoT device
- Mobile app



Database

Service(s)

Architecture



JSON - JavaScript Object Notation

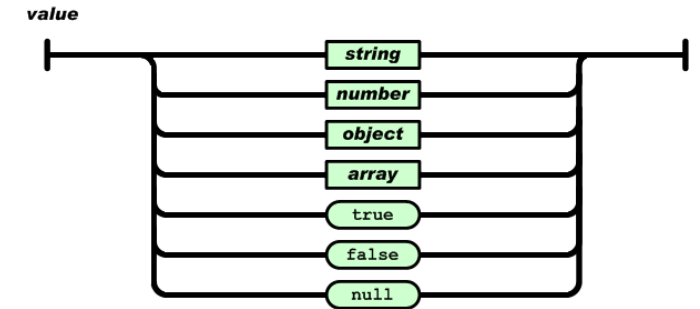


- Lightweight Data Interchange Format
 - Subset of JavaScript syntax for object literals
 - Easy for humans to read and write
 - Easy for machines to parse and generate
 - <https://www.json.org/>
 - ECMA 404 Standard: <http://www.ecma-international.org/publications/files/ECMA-ST/ECMA-404.pdf>
 - RFC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

JSON Logical Structure

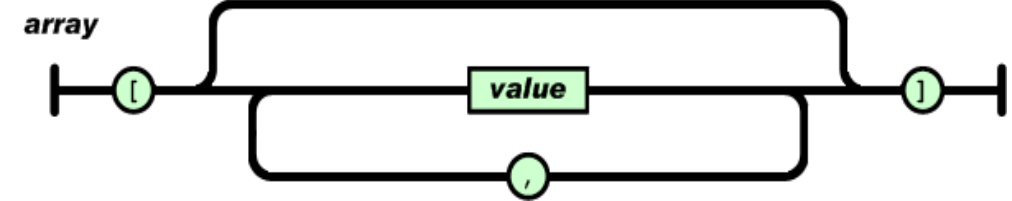


- **Primitive** types: string, number, true/false/null
 - Strings **MUST** use "double" quotes, not 'single'



- Composite type – **Array**: ordered lists of values

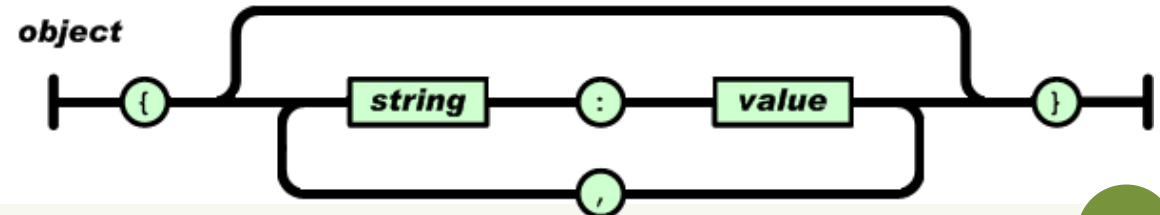
[...]



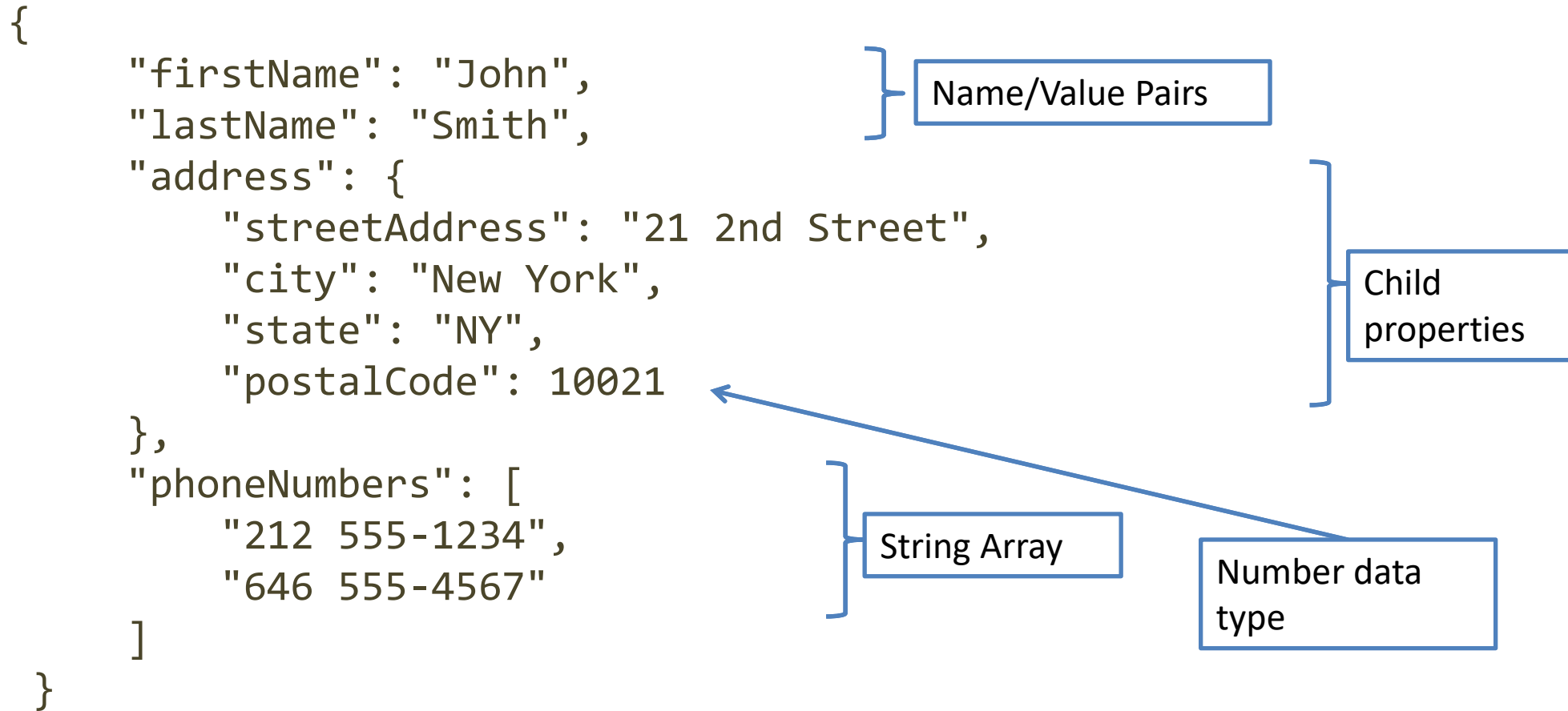
- Composite type – **Objects**: list of key-value pairs

{...}

- Keys are strings (not identifiers)
- **MUST** be "quoted"



JSON Example



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`



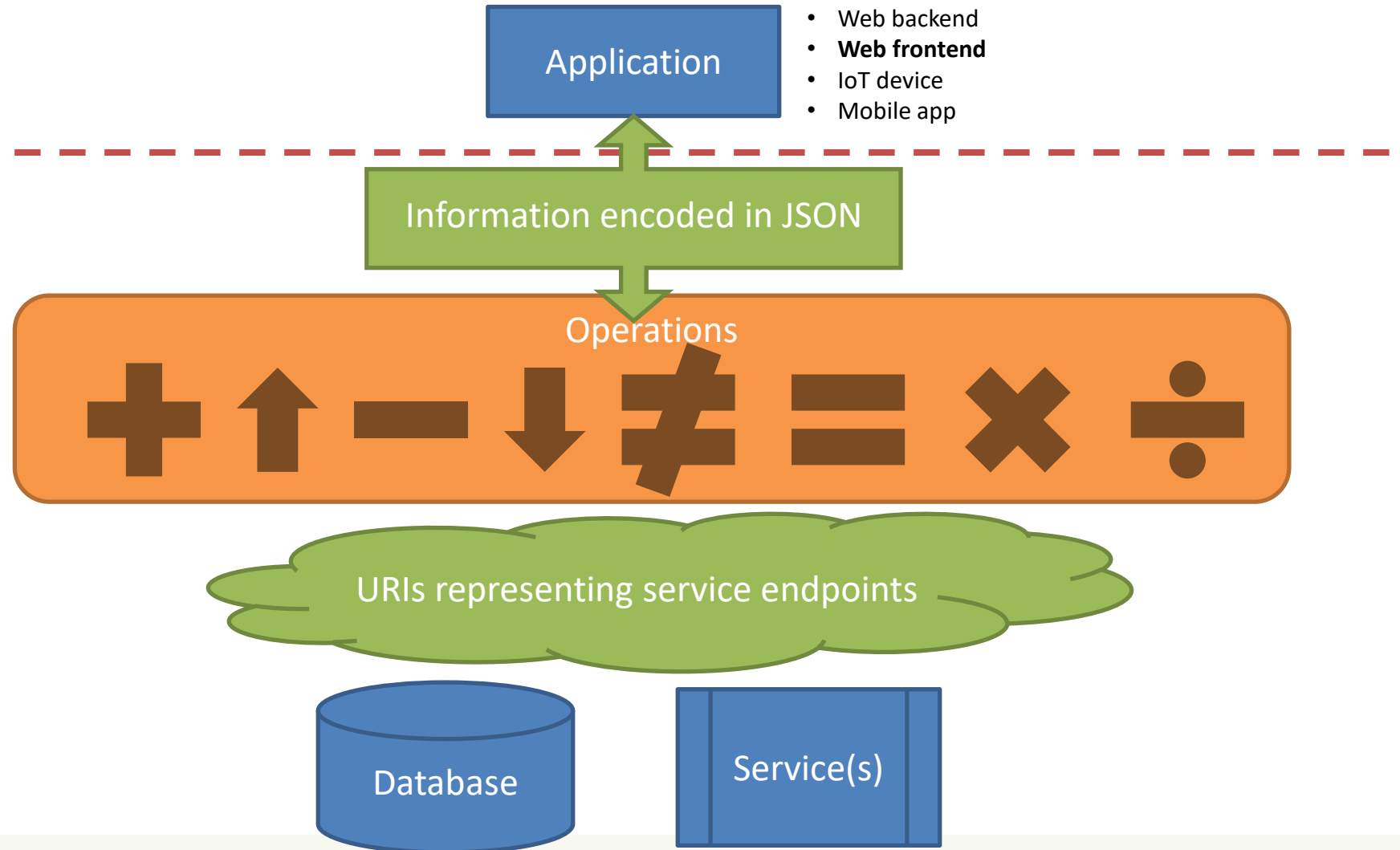
Best Practice for URIs Definition

- 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 (<u>avoid</u>)	Delete all dogs (<u>avoid</u>)
/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`

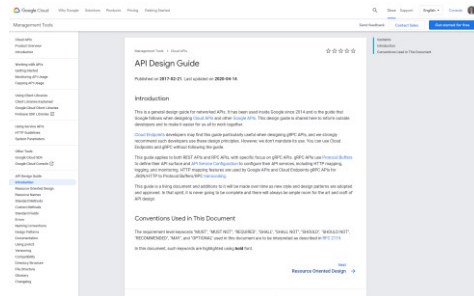
Errors

- 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

```
app.get('/answers', (req, res) => {
  dao.listAnswers().then((answers) => {
    res.json(answers);
  });
});
```

GET

Elements

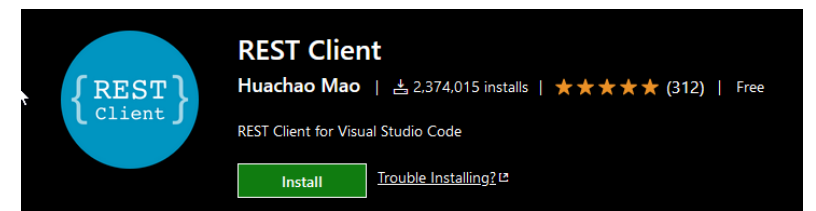
```
app.get('/answers/:id', (req, res) => {
  // TODO: validation of req.params.id
  dao.readAnswer(req.params.id)
    .then((answer)=>res.json(answer));
});
```

```
app.use(express.json());
```

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

POST

Testing HTTP APIs



<https://marketplace.visualstudio.com/items?itemName=huachao.rest-client>

- 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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