

# RESTful APIS

## Reading / References

- Restful Web Services<sup>1</sup>, chapters 1-5. Optionally 6, 7, 8.
- Current HTTP Specification<sup>2</sup> for some “light reading”.

## Practice questions on the reading

- What is the *method information*? What are different ways it may be specified? What are their advantages/limitations? What are the drawbacks of using a system other than the HTTP verbs to communicate method information?
- What is the *scoping information*? What are various ways it can be communicated?
- How does REST differ from other web service approaches? What characterizes RESTful design?
- Describe what Amazon’s S3 is and what its main components and terms are. What are the URI/URL schemes one would use to access S3 resources?
- Describe what **addressability** for resources means and its consequences.
- Describe what **statelessness** for resources means and its consequences.
- What is the difference between **application state** and **resource state**?
- What is the difference between a **resource** and a **representation**? Give examples.
- Describe various ways in which the same resource can have various representations.
- What are the main two ways that a web service could provide for applications to request different representations of the same resource?
- How is each HTTP method to be used in a RESTful design?
- Explain the differences between PUT and POST, as well as their various usages.
- Explain what the term “overloaded POST” means.

## Notes

### REST

The Internet and the Web did not have to exist. They come to us courtesy of misallocated defense money, skunkworks engineering projects, worse-is-better engineering practices, big science, naive liberal idealism, cranky libertarian politics, techno-fetishism, and the sweat and capital of programmers and investors who thought they’d found an easy way to strike it rich.

The result is, amazingly, a simple, open (for now), almost universal platform for networked applications. This platform contains much of human knowledge and supports most fields of human endeavor. We think it’s time to seriously start applying its rules to distributed programming, to open up

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<sup>1</sup>[http://learning.acm.org/books/book\\_detail.cfm?id=1406352&type=safari](http://learning.acm.org/books/book_detail.cfm?id=1406352&type=safari)

<sup>2</sup><https://tools.ietf.org/html/draft-ietf-httpbis-p2-semantics-21>

that information and those processes to automatic clients. If you agree, this book will show you how to do it.

REST stands for “REpresentational State Transfer”, which is a bit of a mouthful, and is best described in terms of the goals it proposes for a Web API design. A key underlying principle is that REST attempts to use as much of the HTTP protocol as possible to communicate information. This is in contrast to other standards that place all pertinent information about the request mostly in the request’s body.

A key consideration when considering an HTTP request is the difference between **method information** and **scoping information**.

**Method** Method information is the information about “what to do with the data”. For example are we deleting some resource, are we creating some new resource, are we editing an existing resource, or are we simply trying to get some data?

**Scoping** Scoping information tells the server which part of the data it should operate at. For example in an evaluations database we might have different scoping information for student lists, enrollments of students in classes, evaluations for the students to complete, information for a particular class, etc.

Here are some key elements of a REST protocol:

**URIs Scoping Information** should be communicated via the URI/URL. That should contain all the information needed to determine which data is being requested or should change. The server should not need to read the body of the request to determine what data the request is about. And the client should not need to learn how to form the request’s body to obtain the information it needs. This uses the **addressability** of HTTP. This way all the server needs to do to teach the client how to ask for something is to provide the URI for that resource.

**HTTP verbs Method Information**, namely what action should be taken on the data, should be communicated via the choice of HTTP verb/method (i.e. GET, POST, PUT, DELETE etc). This way there is a clear understanding on what should happen when a GET request is made, for instance such an action should never delete anything.

**Response codes** The response codes of the request should be as precise as possible in describing what went wrong with the request, if anything. That information should not be hidden somewhere in the response body.

Chapter 4 of Restful Web Services discusses an approach to achieve RESTfulness, that the authors term “Resource Oriented Architecture”. It emphasizes the concept of **resource**, i.e. any part of the service important enough to be addressed by itself.

## **Addressability**

Any resource should be addressable via at least one URI (though it is possible for multiple URIs to refer to the same resource). This is a key feature afforded to us by

the use of the web. Statelessness is another key part of this: That URI should be all the information you need to get to the resource. The server should not have to remember anything from your prior activities on the site.

As an example let us consider the following entity-relation graph for the student evaluations database:

There are numerous resources in this instance. We name just two:

Resource	Description	URI Scheme	Properties	Links
students	Represents the list of students	/student		students
student	Represents a student	/student/{login}	login first last	enrollments
section	Represents a specific offering of a course	/section/{year}/{term}/{no}	state	course enrolled year term

Inclass activity: Consider what other resources we have, what URIs we might use for them, and what links to other resources they would have.

## Connectivity

In the above example we also see another key feature of a RESTful design, using the “hypermedia” feature of the HTTP protocol. It may be a trivial thought these days, but the fact that we can link different pages together is key. For instance in the example above the student resource would include in it a link to the enrollment resources for that student. RESTful resources are fundamentally linked to one another, so that a client of our service can navigate their way by following these links, in much the same way that a user of a website navigates taht site by following links.

## Uniform Interface

Another key feature of a RESTful design is the use of a common “interface”, via consistent use of the HTTP method verbs:

**GET** Used to fetch a resource at the given URI.

**PUT** When used with a URI for a non-existent resource, it is used to create the resource. If the resource at that URI exists, it replaces it. The body of the request contains the information necessary for the creation or replacement of the resource.

**DELETE** Used to delete a resource at a given URI (when permitted).

**HEAD** Used to fetch the metadata of a resource, that are present in the HTTP headers.

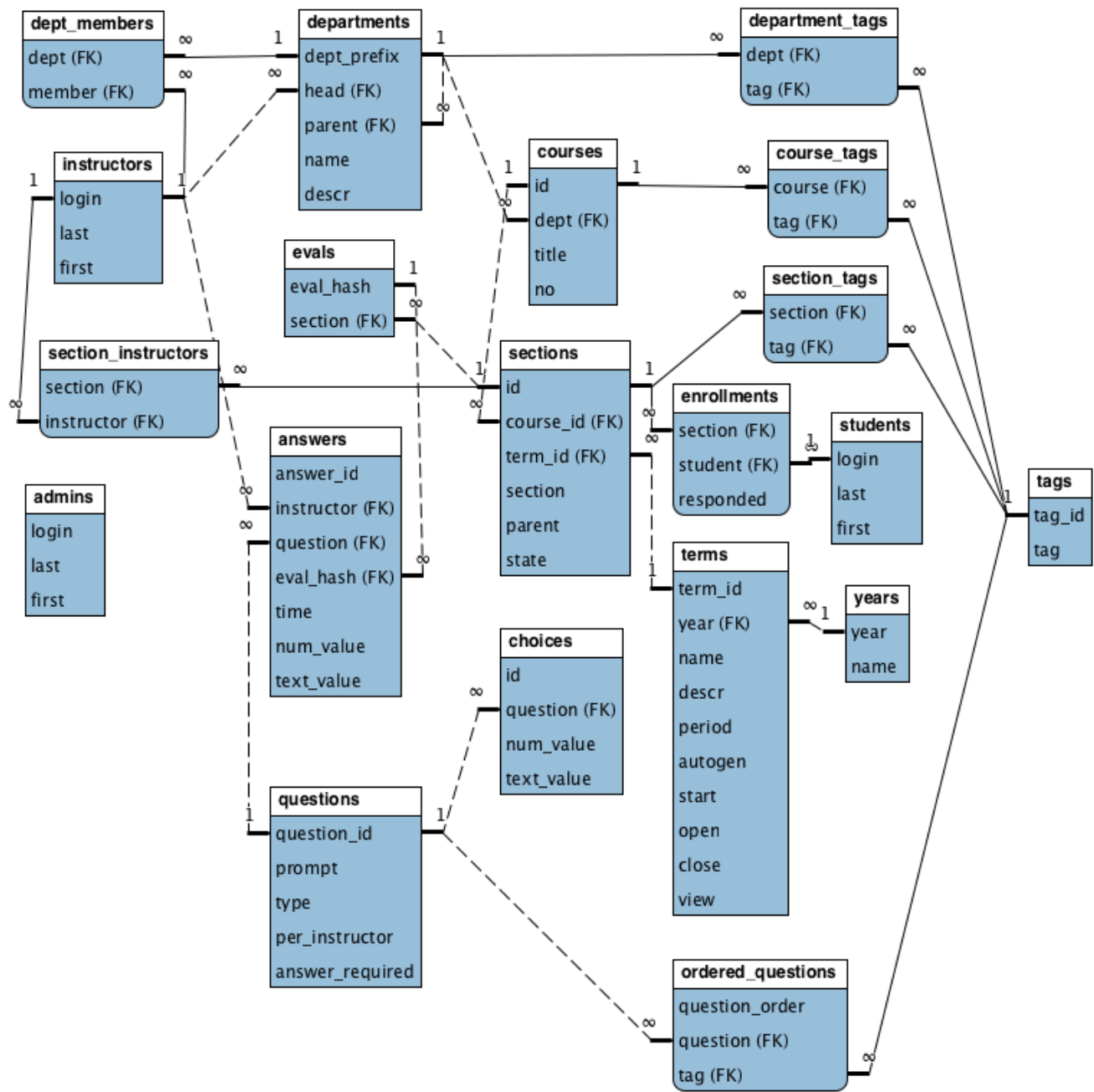


Figure 1:

**OPTIONS** Reports which HTTP methods a certain resource supports (e.g. to determine if DELETE is possible). This will be communicated in a header called “Allow”.

**POST** Used for essentially two purposes. One is to create “subordinate resources”. For instance, performing a POST in the “students” resource earlier could be used to create a new student. It would be similar in effect to performing a PUT at the student resource directly. In order to determine which of the two should be used, we need to ask who is responsible for generating the new resource’s “name” and URI. If it is the client, then a PUT is used; If it is the server, then a POST on the parent is used.

The second use of POST is to update information of a resource. For example if a student changes name, we would update that information via a POST request to the specific student’s URI.

In both usages the key is that POST is used to update subordinate information for a resource, be they resources themselves or just properties/data associated with the resource.

## Safety and Idempotence

Two important concepts that emerge from proper usage of HTTP methods are safety and idempotence.

A **safe** request is one that does not change the server state. For instance in a proper design, all GET and HEAD requests are safe, as they simply fetch information. By contrast, DELETE, PUT and POST are not safe, as they are fundamentally designed to change the server state.

This may seem like a minor point, but it has some important consequences. In earlier days, before some of these notions were crystallized, GET requests were often used to delete resources. For instance a GET request to “/yourresourceURI/delete” would delete the resource. Around the same time some of the popular browsers attempted to speed up your work by following via GET any links in a webpage, and prefetching them so they can show them to the user faster should the user click one of those links. These browsers had no way of knowing whether the GET request they made would end up deleting something or not. Disaster ensued. *We need to be able to trust that GET operations are safe, so that we can perform them as a way of prefetching without worrying about changing server data.*

Idempotence is a slightly different idea. An operation is **idempotent**, if repeating it has no effect. Sending two identical DELETE requests for example should result in the second request doing nothing; the resource was already deleted from the first request. In general we expect GET, HEAD, DELETE and PUT to all be idempotent. This allows clients to safely send such a request a second time and not worry about the effect to the server.

The idempotence of PUT should be kept in mind. PUT creates or replaces a resource, it does not update it in the way that POST does. You can send a PUT request multiple times and expect the effect to be the same as if you used it once, in the same way that

having multiple “ $x=5$ ” assignments is the same as having only one such assignment. By contrast, POST is more analogous to a “ $x++$ ” statement. Multiple POSTs could have accumulated effects.