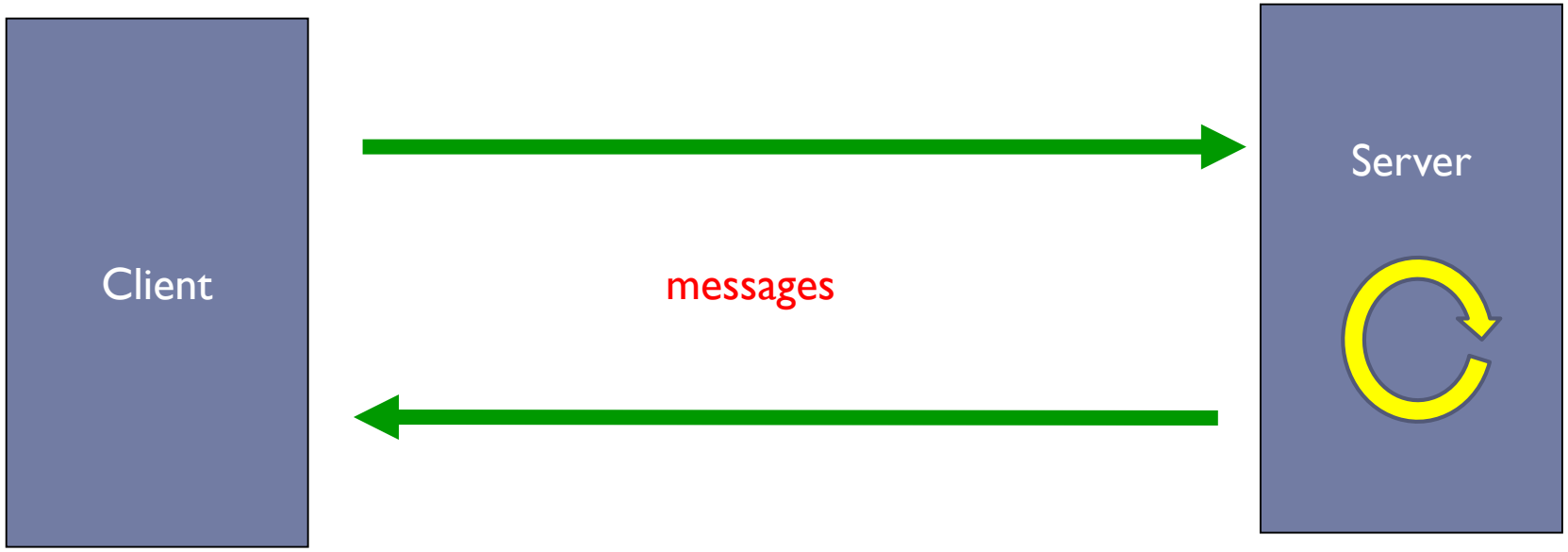
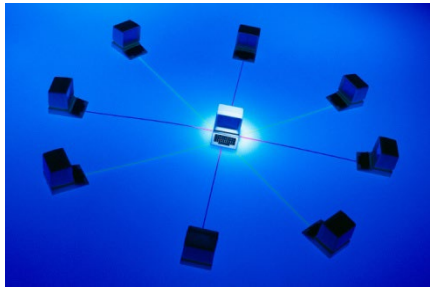
Communicating entities – Client/server concept



- In a distributed system, there are communications between at least two entities.
- An exchange of messages is called a **dialog**.
- The entity initiating the dialog is called the **client**.
- The entity responding is called the **server**.
- Server **sits in a loop** waiting to be contacted.



Services and servers

- Often there are multiple, co-operating servers providing a service
- A computer may be a server in the context of one service and a client in another. Some services are peer to peer
- Services and protocols (such as IMAP and CalDAV) determined by the IETF (https://www.ietf.org/)

Key internet concepts

- Port – computer's virtual connector for data connection, e.g., port 22
- MAC address – computer's low-level address on LAN, e.g. 1d:01:17:04:c2:78
- IP address – computer's globally routable address: 146.141.16.252
- Domain name – volt.ee.wits.ac.za

Web services and addressing

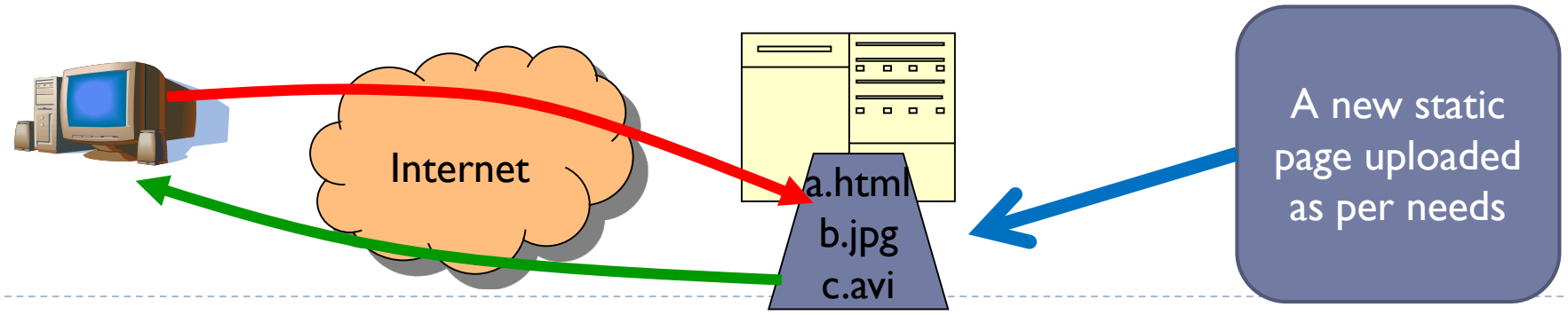
Services are addressed using URLs (uniform resource locator)

- Web page consists of objects
- Object can be HTML file, JPEG image, Java applet, audio file,…
- Web page consists of base HTML-file which includes several referenced objects
- Each object is addressable by a URL
- Example URL:

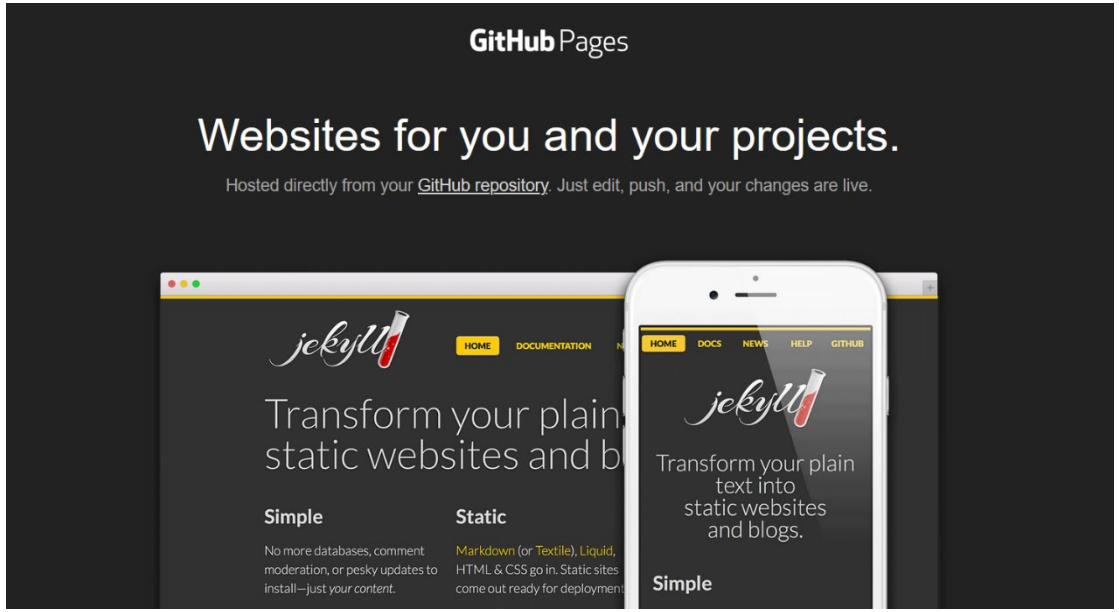
`http://www.someschool.edu:80/pic.gif`

The early web – A publishing medium

- The initial web (sometimes referred to as web 1.0) was primarily used as a publishing medium.
- People published documents (HTML) about many different things:
  - Entertainment, education, news, General information
- For the most part the information did not change very often e.g. a company website.
- Thus the content was considered static.



Static sites

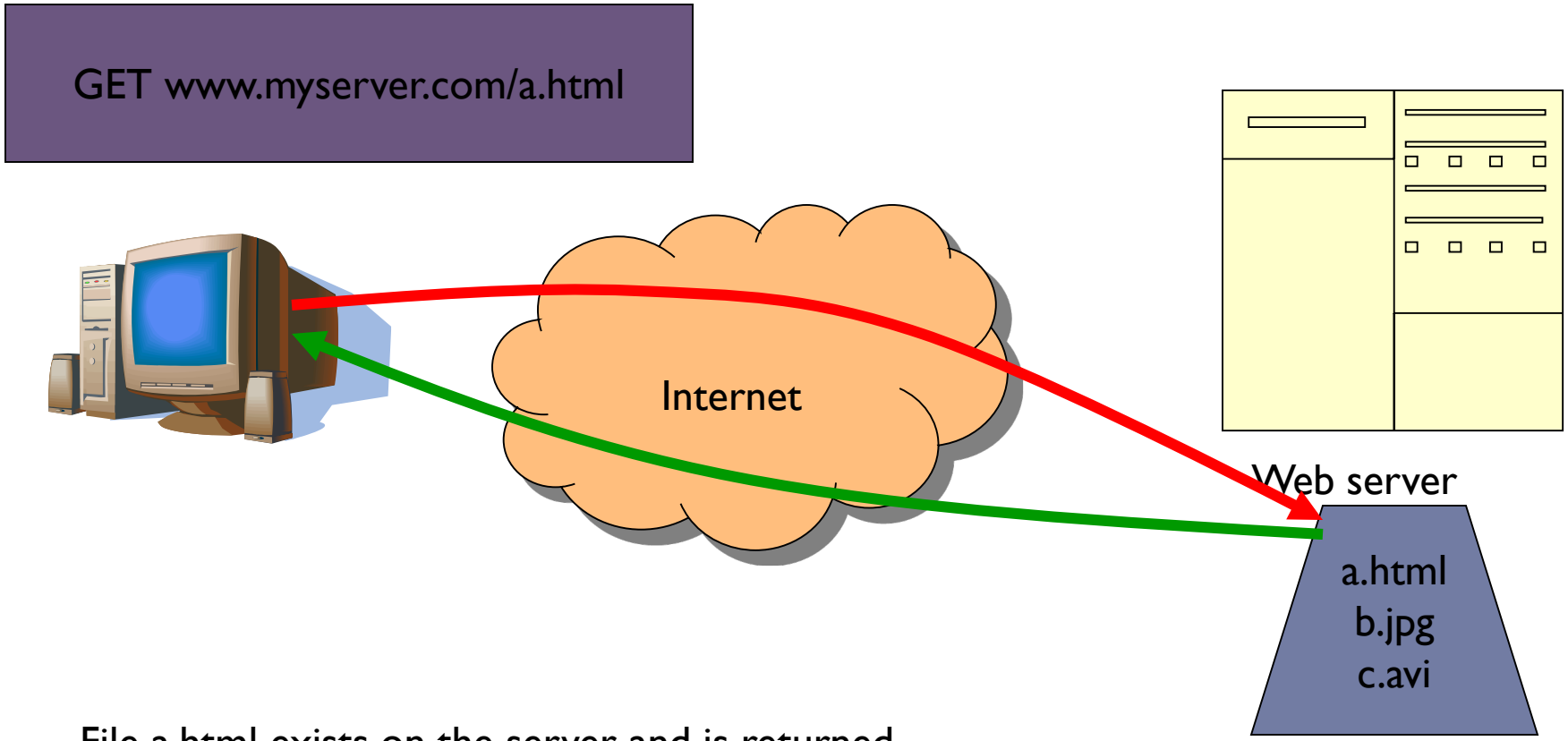


- Eleventy: https://www.11ty.dev/
- Jekyll: https://jekyllrb.com/

Limitations of statically authored HTML

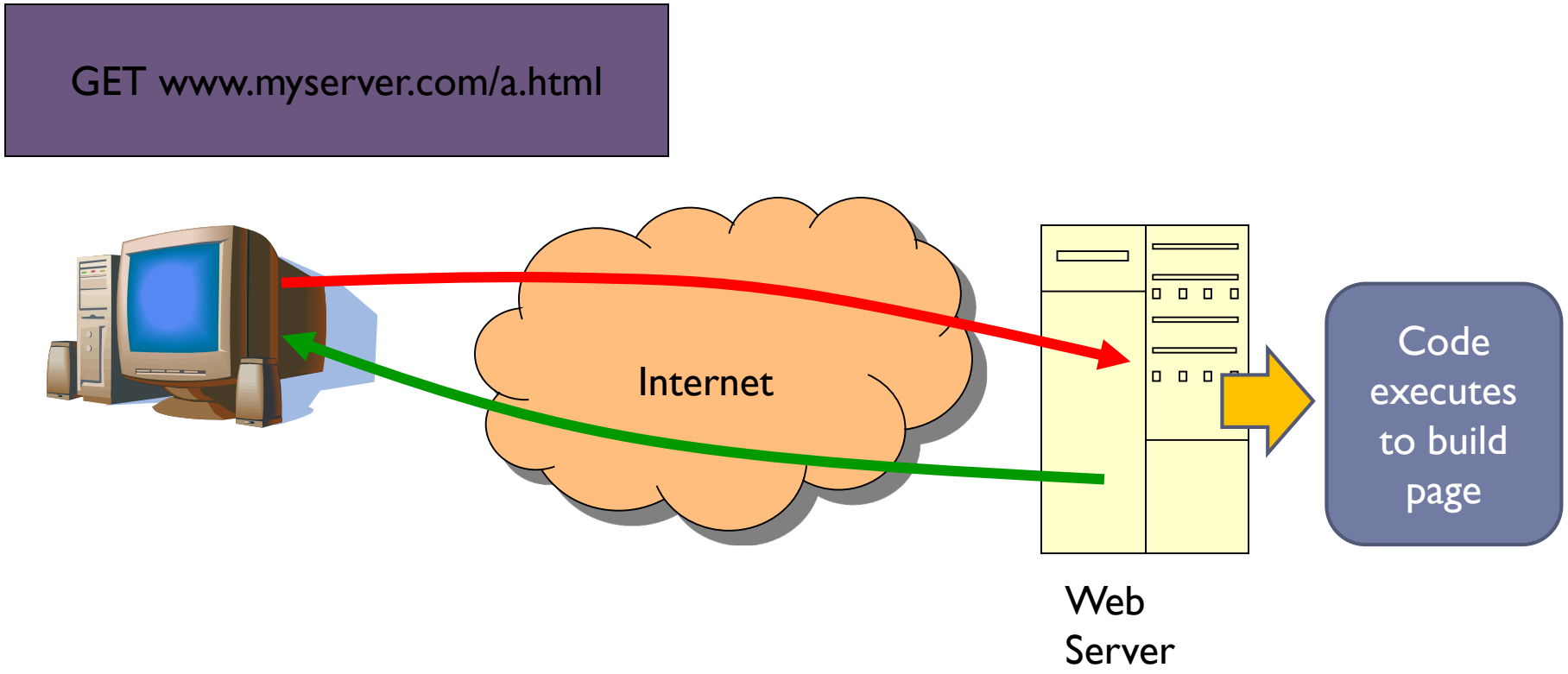
- Certain classes of applications saw the need for regular updates e.g. a news site like CNN.com
- The manual update-publish cycle was too slow and error-prone.
- HTML by itself was intended for presentation and did not contain any other capabilities.
- Thus tools and programming languages were applied to generate HTML documents dynamically when they were requested. This is known as web 2.0.

Static page retrieval



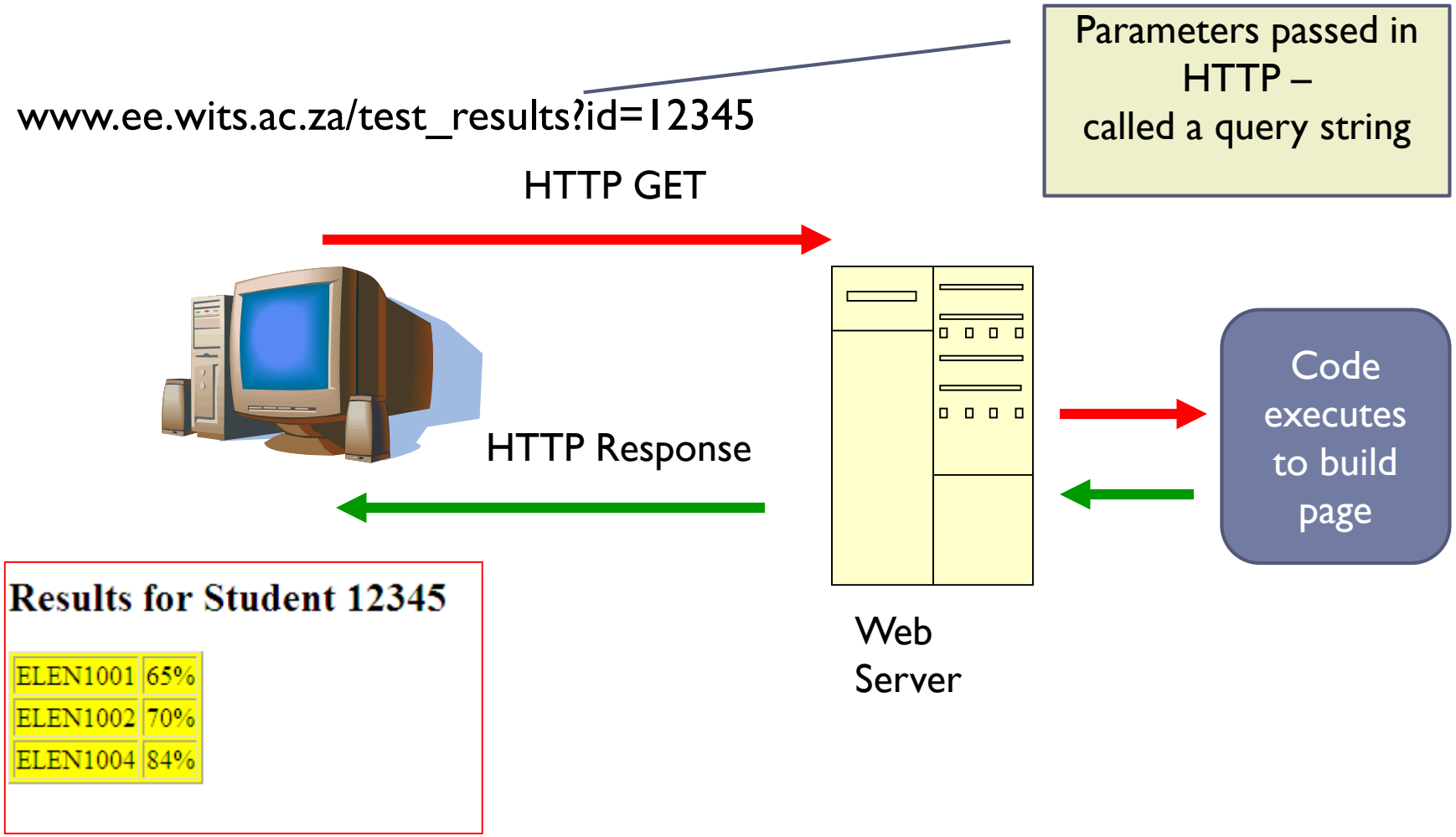
File a.html exists on the server, and is returned

Dynamic page creation

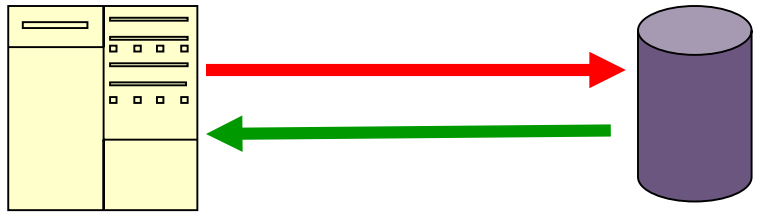


File a.html does not exist.
HTTP request triggers a call to web server.
Web server returns result a.html, which is created dynamically.

An example


Parameters passed in HTTP – called a query string
www.ee.wits.ac.za/test_results?id=12345
HTTP GET
HTTP Response
Code executes to build page
Web Server
Results for Student 12345
ELEN1001 65%
ELEN1002 70%
ELEN1004 84%

```
public HTTPResponse onRequest(HTTPRequest r) {

    //Get the student no
    String student_no = r.getParams("uid");

    //Create HTML Doc for response
    HTMLDoc h = new HTMLDoc();
    HTTPResponse res = new HTTPResponse();
    res.addHTMLDoc(h);

    h.addHeading ("Results for student " + student_no);

    //Search database for results
    DataTable d = db.queryResultsByStudentNo(student_no);

    if(d.rows.Count > 0) {
        //add a results table
        HTMLTable t = h.createTable();

    } else {
        h.addText("No results found");
    }

    whilst (d.hasMoreRows()) {
        t.addRow(d.currentRow("COURSE_NUMBER"),
        d.currentRow("COURSE_RESULT"));
    }

    return res;
}
```



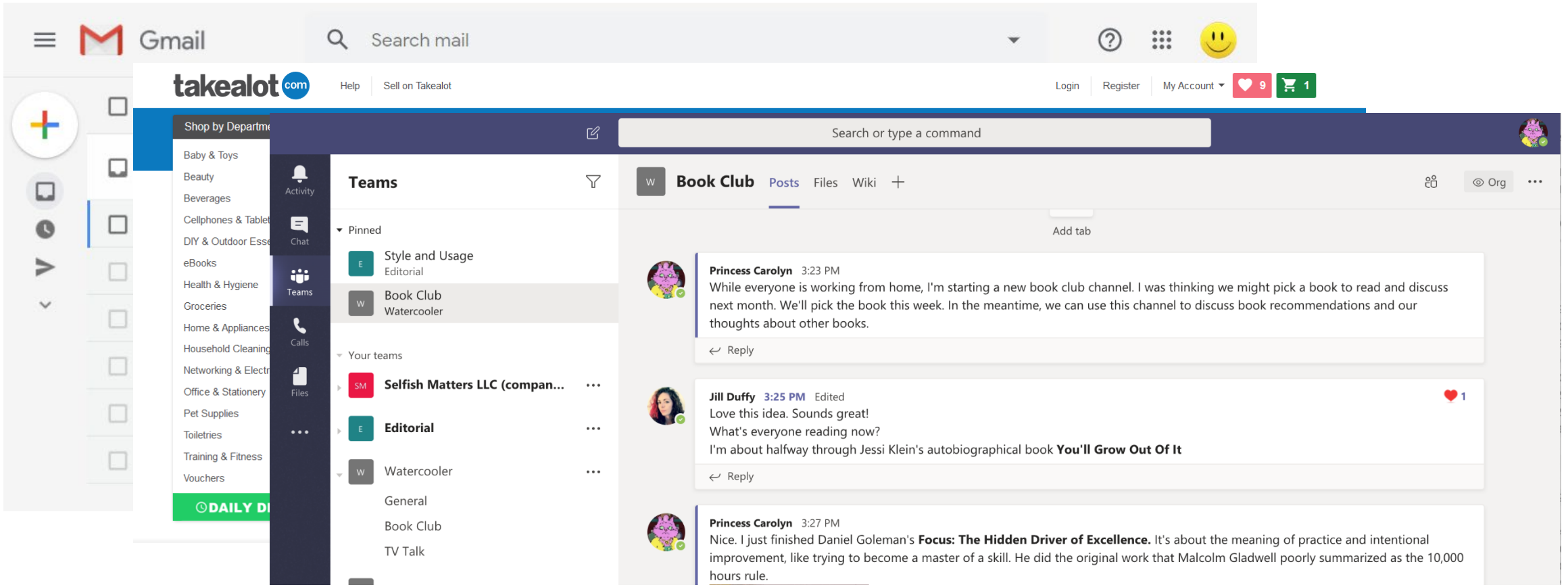
Web Server

Database

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitio

<html>
<head>
<title>Results</title>
</head>
<body>

<h2> Results for Student 12345 </h2>

<table summary="Results" border="1" bgcolor="yellow">
<tr><td>ELEN1001</td><td>65%</td></tr>
<tr><td>ELEN1002</td><td>70%</td></tr>
<tr><td>ELEN1004</td><td>84%</td></tr>
</table>

</body>
</html>
```

Types of applications to emerge

- Server side programming allowed a number of interactive applications to emerge, thus going well beyond the publishing mode.



Web servers and server-side web frameworks

Web server

- Primary function is to deliver web pages in response client requests
- It takes care of issues such as concurrent (parallel) requests, thus simplifying view of application developer.

Web application framework

- Supports the development of dynamic websites, web applications and services
- Uses a web server to deliver responses to the client

Web architecture

Web Architecture 101

The basic architecture concepts I wish I knew when I was getting started as a web developer

Jonathan Fulton Follow

Nov 8, 2017 · 11 min read

Summary

- Client-Server architecture and what this means within the context of a web application
- Static websites
- Dynamic websites
- Web servers and server-side frameworks
- Web architecture