6.009
Fundamentals of Programming

Interlude:
Python, Sockets, and the Web

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CAT-SOOP

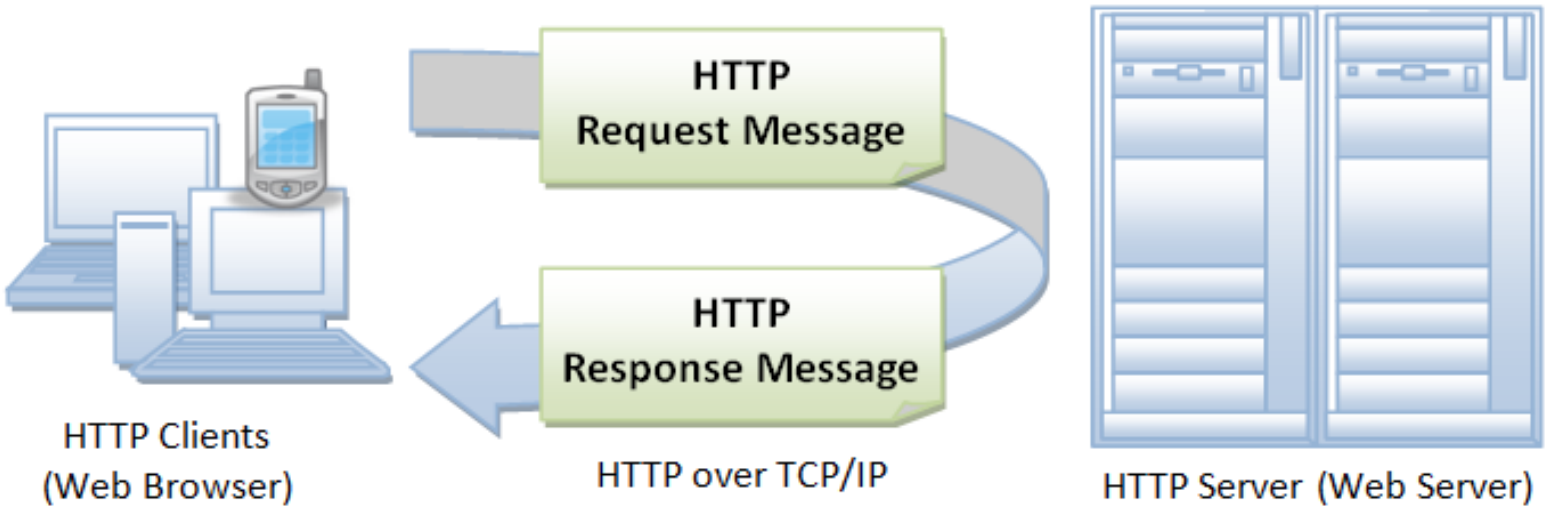
An "automatic tutor": collect and assess online exercises
Written in Python, 2011-now, rewritten completely multiple times

Based on a program called "the tutor" by
Tomás Lozano-Pérez (written in Scheme!)

CAT-SOOP is a fairly standard web application. What does it do?

- Receive request from user
  ("show me a page," "submit this answer," etc)
- Find relevant information
  (page content, user info, history of submissions, etc)
- Log new information if necessary, and
- Send response
  (typically, HTML to be displayed in the browser)

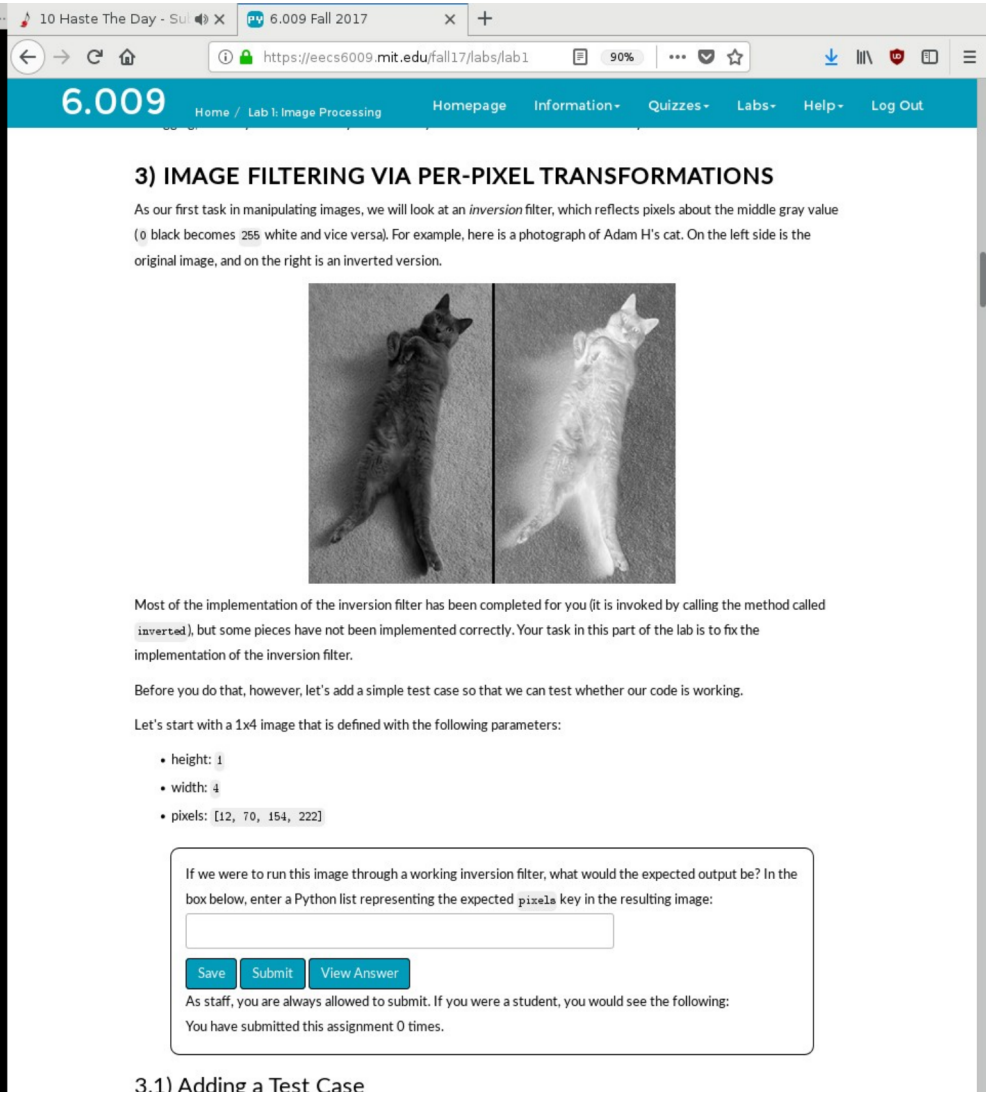
The World Wide Web



https://www.ntu.edu.sg/home/ehchua/programming/webprogramming/HTTP_Basics.html

CAT-SOOP

```
136 `255` white and vice versa).  For example, here is a photograph of Adam H's cat.  On
137 the left side is the original image, and on the right is an inverted version.
138
139 <center>
140 ![Stronger the cat](CURRENT/stronger.jpg)
141 </center>
142
143
144 Most of the implementation of the inversion filter has been completed for you
145 (it is invoked by calling the method called `inverted`), but some pieces have
146 not been implemented correctly.  Your task in this part of the lab is to fix
147 the implementation of the inversion filter.
148
149 Before you do that, however, let's add a simple test case so that we can test
150 whether our code is working.
151
152 Let's start with a 1x4 image that is defined with the following parameters:
153
154 <python>
155 tutor.init_random()
156 img1_lo = cs_random.randint(0, 32)
157 img1_mid = cs_random.randint(64, 96)
158 img1_mid2 = cs_random.randint(128, 160)
159 img1_high = cs_random.randint(192, 224)
160 img1_pixels = [img1_lo, img1_mid, img1_mid2, img1_high]
161 </python>
162
163 * height: `1`
164 * width: `4`
165 * pixels: `@{img1_pixels}`
166
167
168 <question pythonliteral>
169 csq_prompt='''
170 If we were to run this image through a working inversion filter, what would the
171 expected output be?  In the box below, enter a Python list representing the
172 expected `pixels` key in the resulting image:<br/>
173 '''
174
175 csq_soln = [255-i for i in img1_pixels]
176 def csq_check_function(sub, sol):
177     if not(isinstance(sub, list)):
178         return (0.0, 'Please enter a Python list.')
179     if len(sub) != len(sol):
180         return (0.0, 'Double-check the length of the list you provided.')
181     elif not all(type(i)==type(j) and i==j for i,j in zip(sub, sol)):
182         return (0.0, 'Make sure that all of the elements in the given list are integers.')
183     return 1.0
184 </question>
185
186 <subsection>Adding a Test Case</subsection>
187
188 Let's also add this test case to the lab's regular tests so that it is run when we
189 execute `test.py`.  If you open `test.py` in a text editor, you will see that
190 it is a Python file that makes use of Python's [`unittest`
191 module](https://docs.python.org/3/library/unittest.html) for unit testing.
192
193 Each class in this file serves as a collection of test cases, and each method
194 within a class represents a particular test case.
195
196 Running `test.py` will cause Python to run and report on _all_ of the tests in
197 the file.  However, you can make Python run only a subset of the tests by
198 running, for example:
199
200 ```
:nohl
```



What Is A Server?

What Is A Server?

Sockets

Sockets allow communication across processes (on the same machine or different machines).

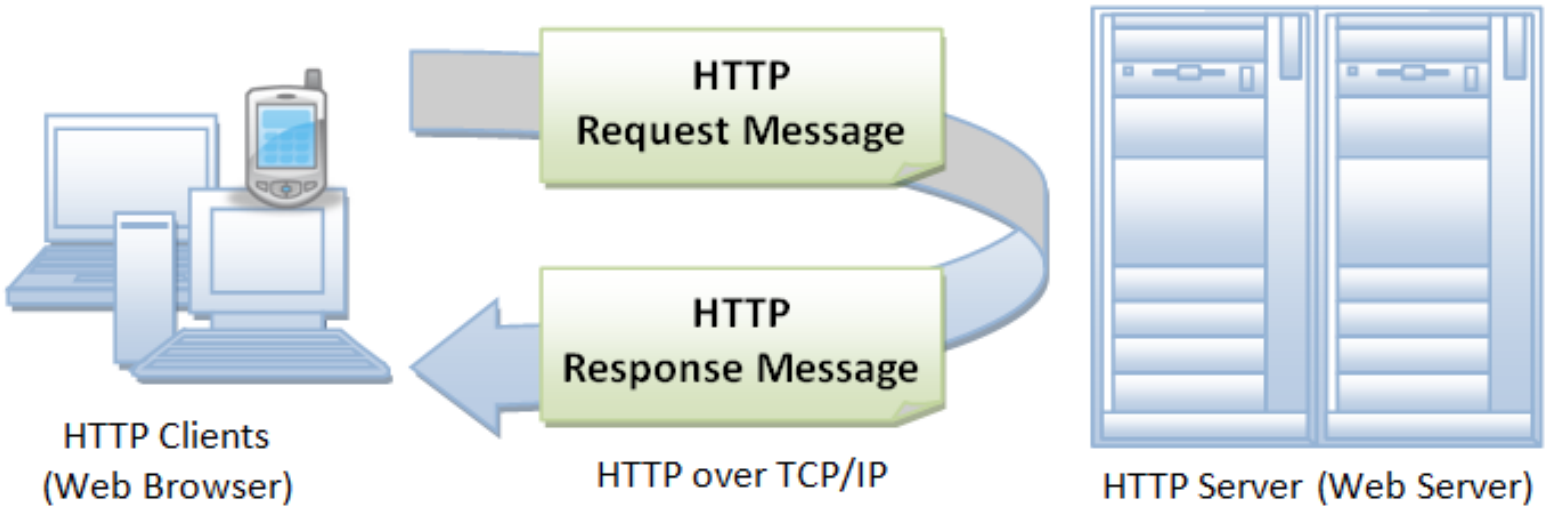
Typically, a *server* will wait for a *client* to make a connection on a designated *port* (a virtual endpoint for a connection).

Once the client connects, the socket allows for communication between the server and the client.

Client and server can each send/receive data via the socket.

Example: yelling echo server.

The World Wide Web



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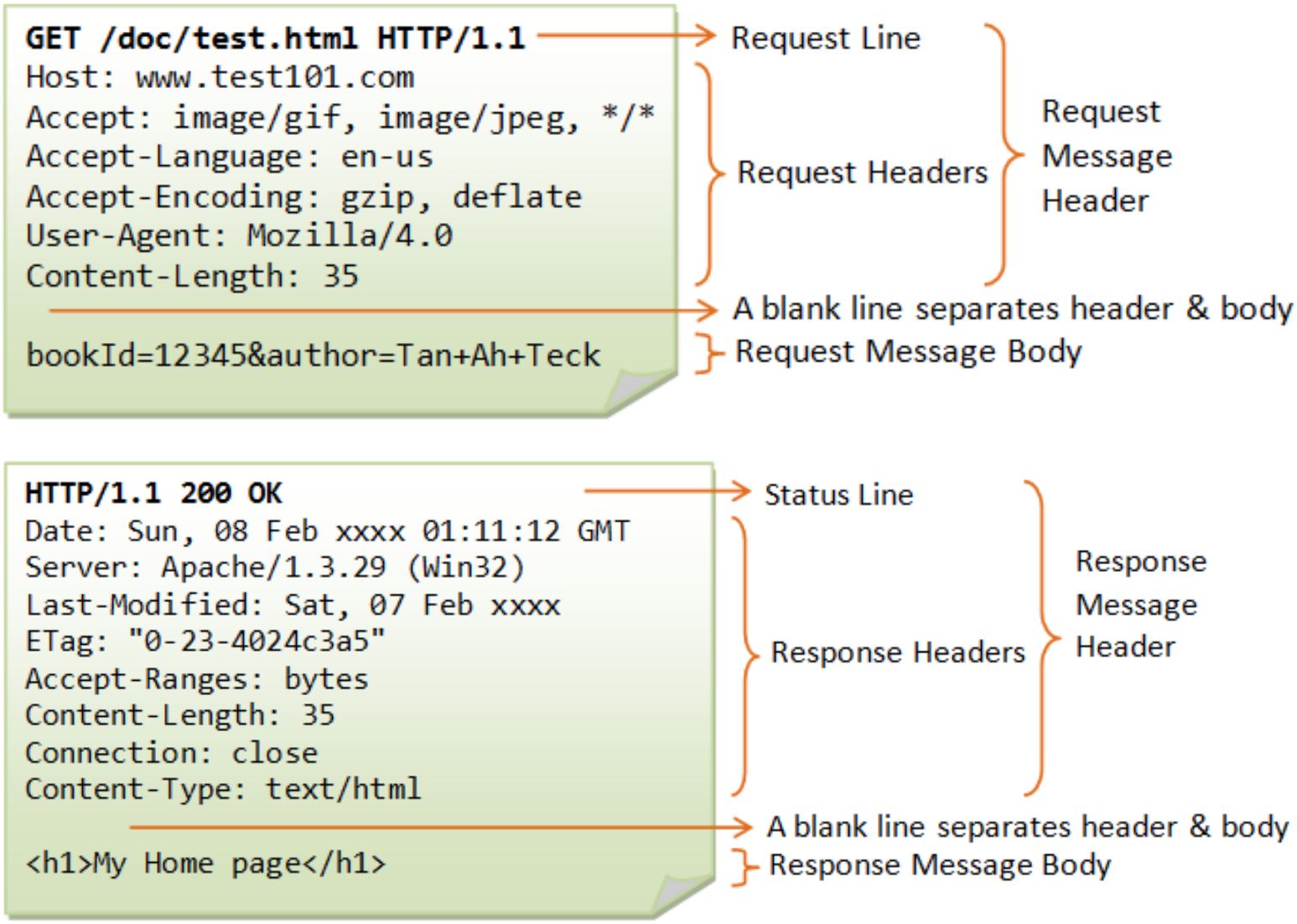
HTTP Request and Response



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The Rest of Today

Designing a:

- Web Server
- Web Application Framework
- Web Application