2.

(a)

```
Ready to serve...
Received a connection from: ('127.0.0.1', 53743)
GET /index.html HTTP/1.1
Host: 127.0.0.1:6062
Upgrade-Insecure-Requests: 1
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/605.1.15
 (KHTML, like Gecko) Version/16.0 Safari/605.1.15
Accept-Language: zh-TW,zh-Hant;q=0.9
Accept-Encoding: gzip, deflate
Connection: keep-alive


/index.html
```

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helloworld

http://127.0.0.1:6062/Index.html

```
Ready to serve...
Received a connection from: ('127.0.0.1', 53752)
GET /helloworld.html HTTP/1.1
Host: 127.0.0.1:6062
Upgrade-Insecure-Requests: 1
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/605.1.15
 (KHTML, like Gecko) Version/16.0 Safari/605.1.15
Accept-Language: zh-TW,zh-Hant;q=0.9
Accept-Encoding: gzip, deflate
Connection: keep-alive


/helloworld.html
```

Hello World!

http://127.0.0.1:6062/helloworld.html

```
Received a connection from: ('127.0.0.1', 53760)
GET /NotFound.html HTTP/1.1
Host: 127.0.0.1:6062
Upgrade-Insecure-Requests: 1
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/605.1.15
 (KHTML, like Gecko) Version/16.0 Safari/605.1.15
Accept-Language: zh-TW,zh-Hant;q=0.9
Accept-Encoding: gzip, deflate
Connection: keep-alive


/NotFound.html
404 Not Found
```

404 Not Found

http://127.0.0.1:6062/NotFound.html

(b)

The "TODO" part is implemented similar to the server part of problem 1. Instead when sending html file, we need to send HTTP header, Status and Content-Type before sending the contents. If the file is not in the server, we return 404 Not Found. Finally, to access helloworld in index, we add a html hyperlink that gets the file through the same server.

3.
(a)

```
Ready to serve...
Received a connection from: ('127.0.0.1', 53699)
GET /index.html HTTP/1.1
Host: 127.0.0.1:6063
Upgrade-Insecure-Requests: 1
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/605.1.15
 (KHTML, like Gecko) Version/16.0 Safari/605.1.15
Accept-Language: zh-TW,zh-Hant;q=0.9
Accept-Encoding: gzip, deflate
Connection: keep-alive


/index.html
index.html
/index.html
host name is index.html
try to connect to the web_server
connected successfully
GET http:///index.html HTTP/1.1

get the file successfully
open the file successfully
```

```
Ready to serve...
Received a connection from: ('127.0.0.1', 53717)
GET /index.html HTTP/1.1
Host: 127.0.0.1:6063
Upgrade-Insecure-Requests: 1
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/605.1.15
 (KHTML, like Gecko) Version/16.0 Safari/605.1.15
Accept-Language: zh-TW,zh-Hant;q=0.9
Accept-Encoding: gzip, deflate
Connection: keep-alive


/index.html
index.html
/index.html
Read from cache
```

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[helloworld](#)

http://127.0.0.1:6063/index.html

```
Ready to serve...
Received a connection from: ('127.0.0.1', 53726)
GET /NotFound.html HTTP/1.1
Host: 127.0.0.1:6063
Upgrade-Insecure-Requests: 1
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/605.1.15
 (KHTML, like Gecko) Version/16.0 Safari/605.1.15
Accept-Language: zh-TW,zh-Hant;q=0.9
Accept-Encoding: gzip, deflate
Connection: keep-alive


/NotFound.html
NotFound.html
/NotFound.html
host name is NotFound.html
try to connect to the web_server
connected successfully
GET http:///NotFound.html HTTP/1.1

get the file successfully
```

404 Not Found

http://127.0.0.1:6063/NotFound.html

(b) To avoid collision the port is open on 6063 (6062 + 1).
The "TODO" part of "request is in buffer" is implemented similar to the server part of problem 2 and the "TODO" part of "get request from server" is implemented similar to the client part of problem 1. To avoid data duplication, we split the received string carefully to only save useful datas. Finally, when the request is not in the previous server, we return 404 Not Found.