IT2805 - Web Technologies
History, development and the architecture of the Web, Client, Server and the Internet

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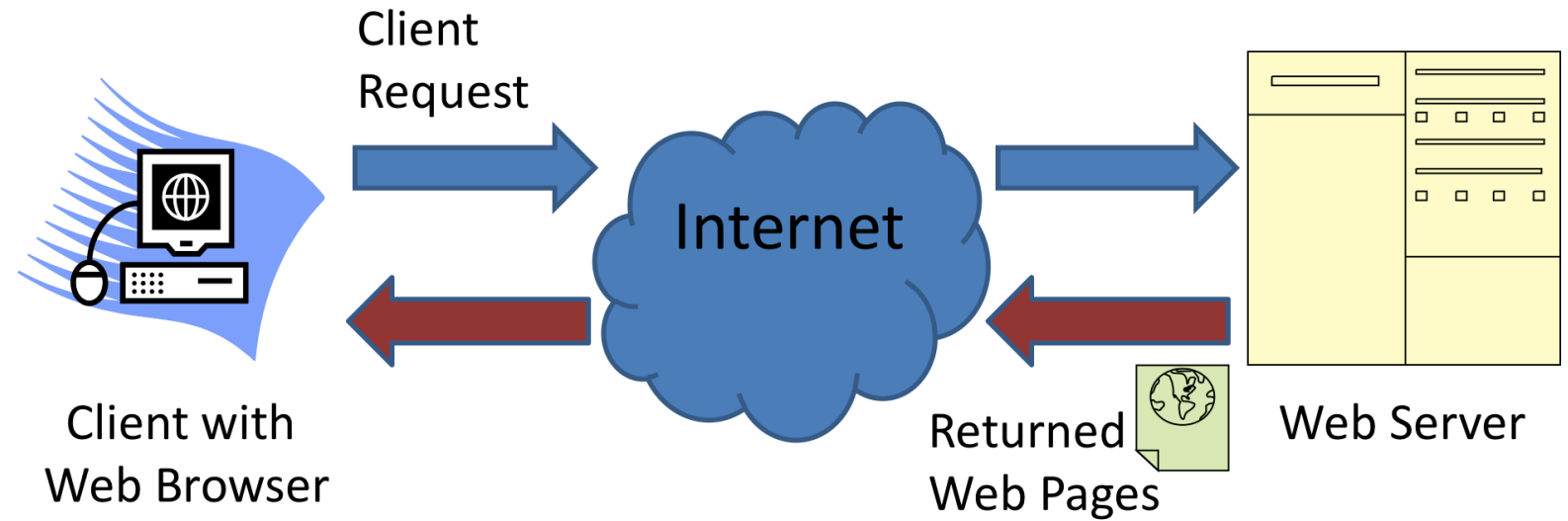
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Agenda

- How does the Internet work

    – Client Server Architecture

    – Connections

    – Communications Protocols

    – Addressing

    – Routing

- One of the important Internet Applications: WWW

- Intro to HTML

What are the main components here?

Client Request

Internet

Client with Web Browser
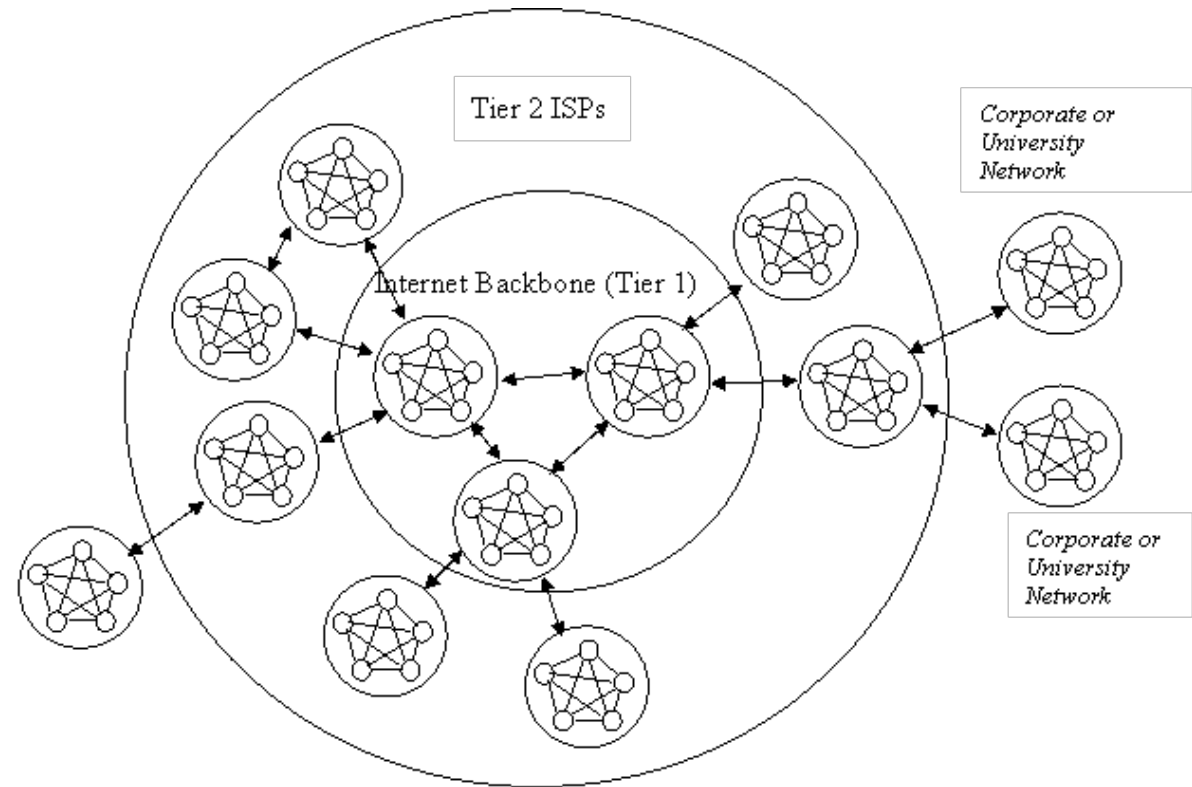
Returned Web Pages

Web Server

What is the Internet?
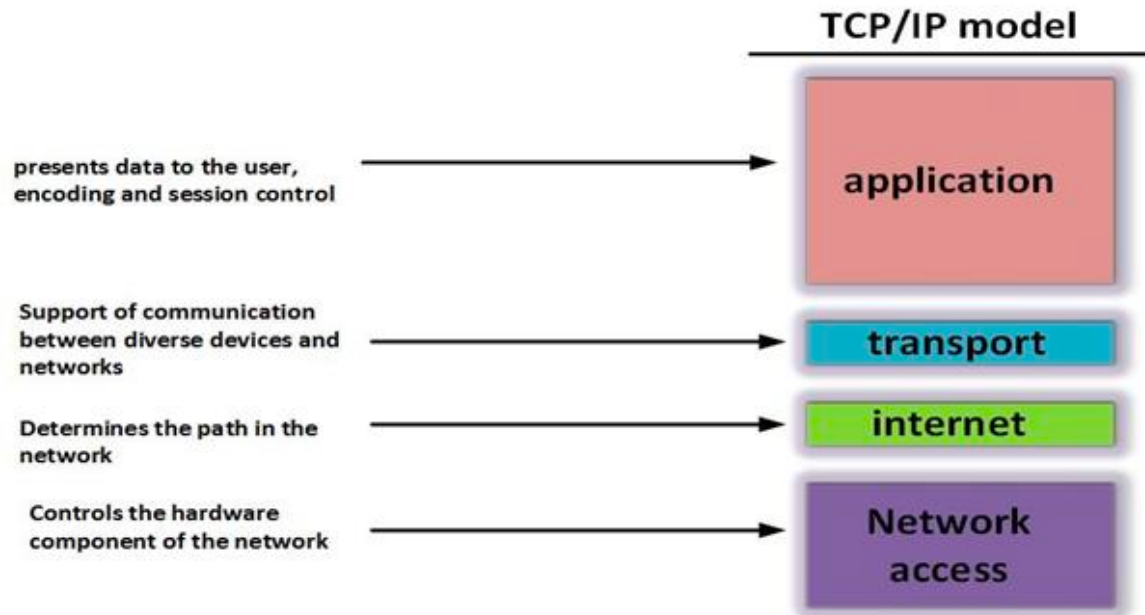
How the Internet works?

- Transmission Control Protocol/Internet Protocol (TCP/IP) (Common language between machines)

- Addressing Schemes (Where to go)

- Domain names (for human to understand)

- Routing Traffic Across the Internet (How to go)

TCP/IP

- Every computer and network on the Internet uses the same protocols -the Transmission Control Protocol/Internet Protocol, or TCP/IP.

- No matter what type of computer system you connect to the Internet, if it uses TCP/IP, it can exchange data with any other type of computer.

- TCP/IP was developed to tolerate unreliable sub-networks and the protocol guarantees proper transmission of data, since the physical network can't.

TCP/IP Layers

TCP/IP model

presents data to the user, encoding and session control → **application**

Support of communication between diverse devices and networks → **transport**

Determines the path in the network → **internet**

Controls the hardware component of the network → **Network access**

- The **Application layer** provides applications the ability to access the services of the other layers and defines the protocols that applications use to exchange data.

- The **Transport Layer** is responsible for making sure that complete messages are delivered end to end.

- The **Network/Internet Layer** is responsible for routing messages from one place to another. All routers on the Internet run the IP protocol.

- The bottom layer is the **Physical Layer**. This is responsible for actually translating the software message into a physical representation and putting them on the wire (or through the air in a wireless network or fiber-optic wire).

Examples of protocols per layer

There are many different protocols at each level. Here are some representative protocols for the Internet.

Application Layer	HTTP, telnet, ftp, email, VoIP
Transport Layer	TCP, UDP
Network Layer	IP
Physical Layer	Ethernet, WiFi, ATM, X.25, Frame Relay

The application prepares a message in its protocol (HTTP for example).

HTTP message

It passes this to the Transport layer, (e.g TCP) which attaches a transport layer header to the front.

TCP Hdr | **HTTP message**

This is passed to the Network layer, which attaches an IP header onto the front.

IP Hdr | **TCP Hdr** | **HTTP message**

This is passed to the Physical layer (e.g. Ethernet) which attaches its own header to the front, and a checksum at the end.
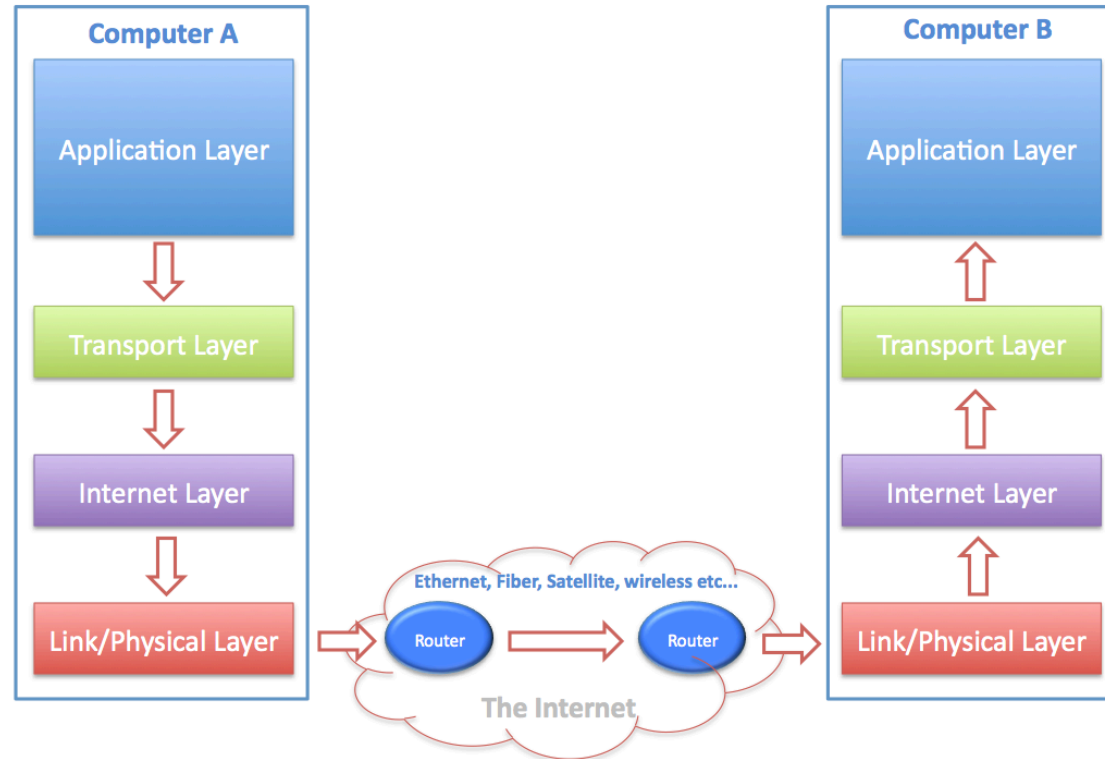
Ethernet Hdr | **IP Hdr** | **TCP Hdr** | **HTTP message** | **Checksum**

When the node at the other end receives this, it strips off the Ethernet Header and the checksum and passes the packet up to the Network Layer. This layer reads the IP Header and decides where to send the packet.

When the packet reaches its final destination, the IP layer strips off the IP Header and passes the remaining packet up to the TCP layer, which strips off the TCP header, processes it, and passes the HTTP message to the application layer at the receiving end.

Data Transmission over the Internet through TCP/IP
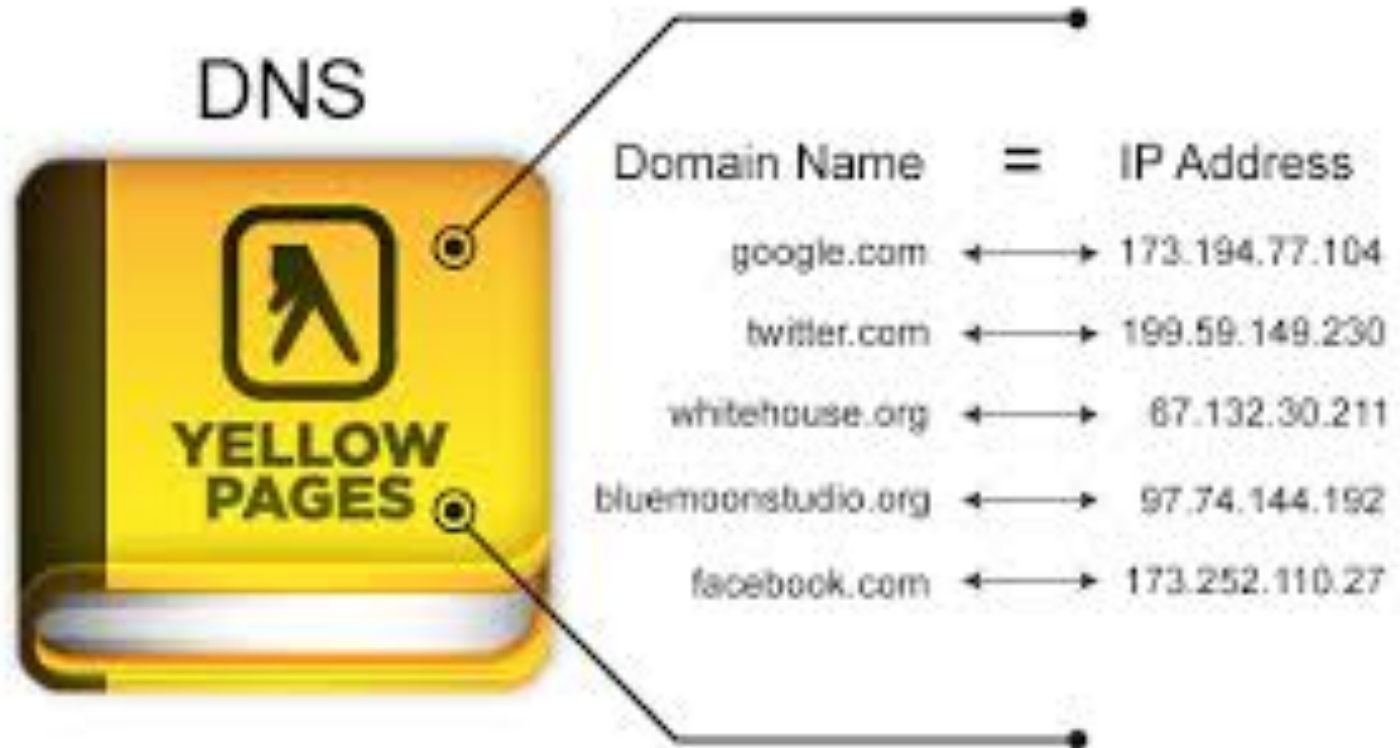
How the Internet works - Addressing

- In order to communicate across the Internet, a computer must have a **unique address**.

- Every computer on the Internet has a **unique numeric identifier**, called an Internet Protocol (IP) address.

- Each IP address has four parts – each part a number between 0 and 255. An IP address can have up to 12 digits and might look like: 205.46.117.104.

- Our institutional web site has the IP address, 129.241.160.102, and no other machine in the world has this IP number. Otherwise you wouldn't be able to find the right website.
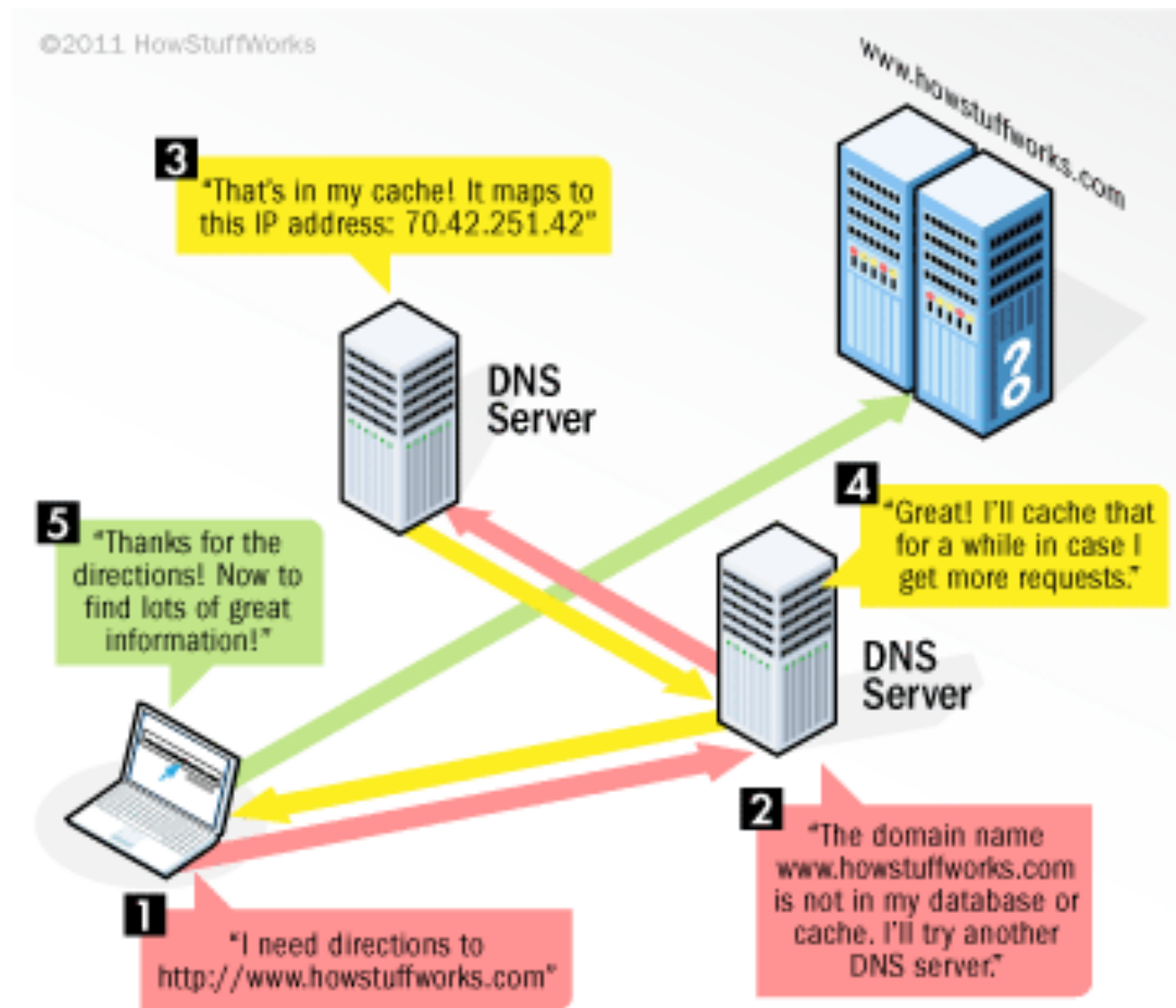
How the Internet works - Domains

ZONE	DEFINITION	FOR USE BY
.com	Commercial	Businesses
.edu	Education	Universities
.gov	Government	U.S. federal government agencies
.int	International	Organizations established by international treaties
.mil	Military	U.S. military
.net	Network	Network providers, administrator computers, network node computers
.org	Organization	Non-profit and miscellaneous organizations

- So in addition to an IP address, most Internet hosts or servers have a domain name address, using words.

- A domain name identifies the type of institution that owns the computer. For example, an Internet server owned by IBM might have the domain name ibm.com.

- The domain name is itself made up of name levels so that, .no is Norway, NTNU is NTNU's web site.

- Some enterprises have multiple servers, and identify them with subdomains, such as products.ibm.com or idi.ntnu.no

DNS is the phonebook of the internet

DNS

Domain Name = IP Address

google.com	← →	173.194.77.104
twitter.com	← →	199.59.149.230
whitehouse.org	← →	87.132.30.211
bluemoonstudio.org	← →	97.74.144.192
facebook.com	← →	173.252.110.27

Example

Example

- Say I have a 300 Kb file to transmit to Brussels.

- The software sending that file first splits it into reasonable size packets, say 15Kb each.

- Each packet has a header containing essential information like, **destination** IP address, **source** IP address, **size** of the transmission and **packet position** in the original file.

- Packages travel across multiple networks

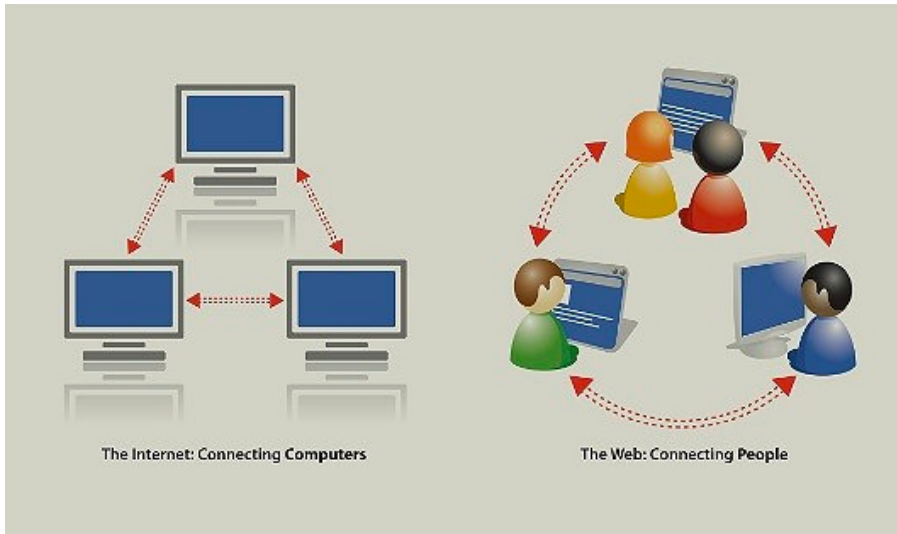- And at the end are being reassembled at their destination

Dynamic routing continued

- Back to our example
  - The message packets **need not** to travel in order, or follow the same path.
  - At every point in time, the current router decides where to send the packets next.
  - The packets are transmitted with the intermediate destinations assigned as they go.

Popular applications of the Internet

The Internet: Connecting **Computers**
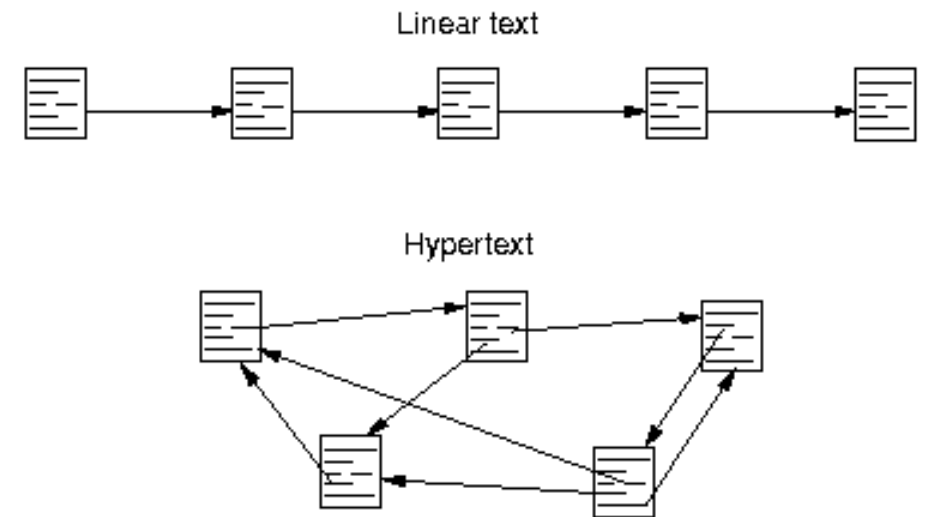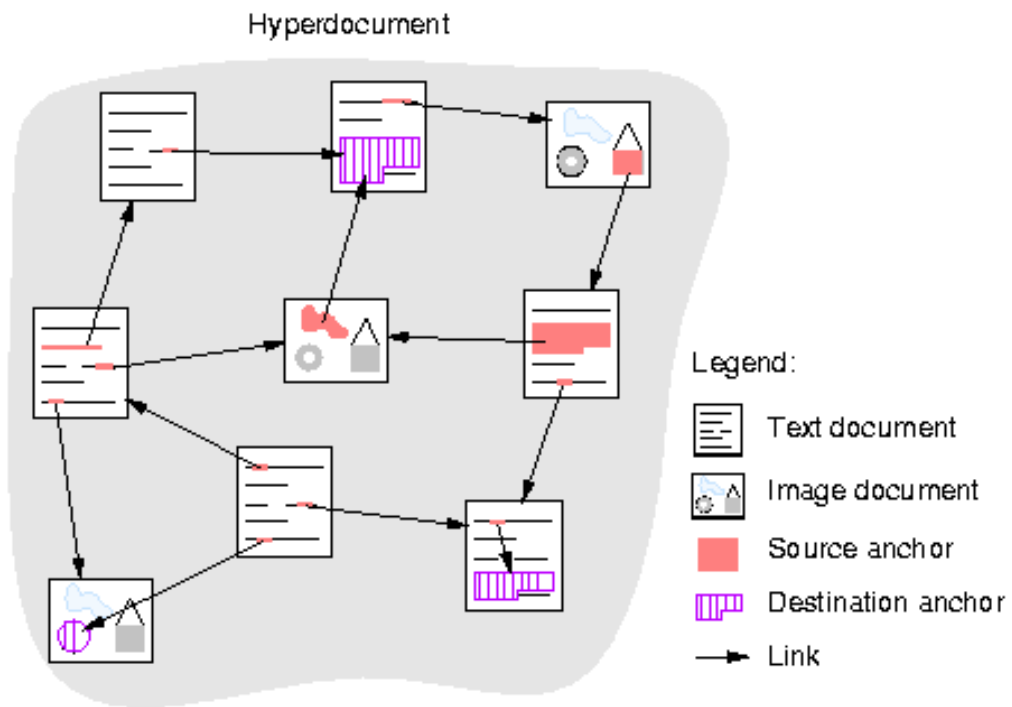
The Web: Connecting **People**

- Many users confuse the Internet (network) with the applications that work over the Internet.
  - E-Mail
  - Telnet
  - File Transfer Protocol (FTP)
  - Internet Relay Chat (IRC)
  - The World Wide Web

The World Wide Web (WWW) or the Web

- Tim Berners-Lee et al. at the CERN nuclear research facility near Geneva, Switzerland laid the foundations for the **World Wide Web**, or the **Web**, in 1989
- They developed a system of interconnected **hypertext** documents that allowed their users to easily **navigate** from one topic to another
- **Hypertext** is a method of organizing information that gives the reader control over the order in which the information is presented
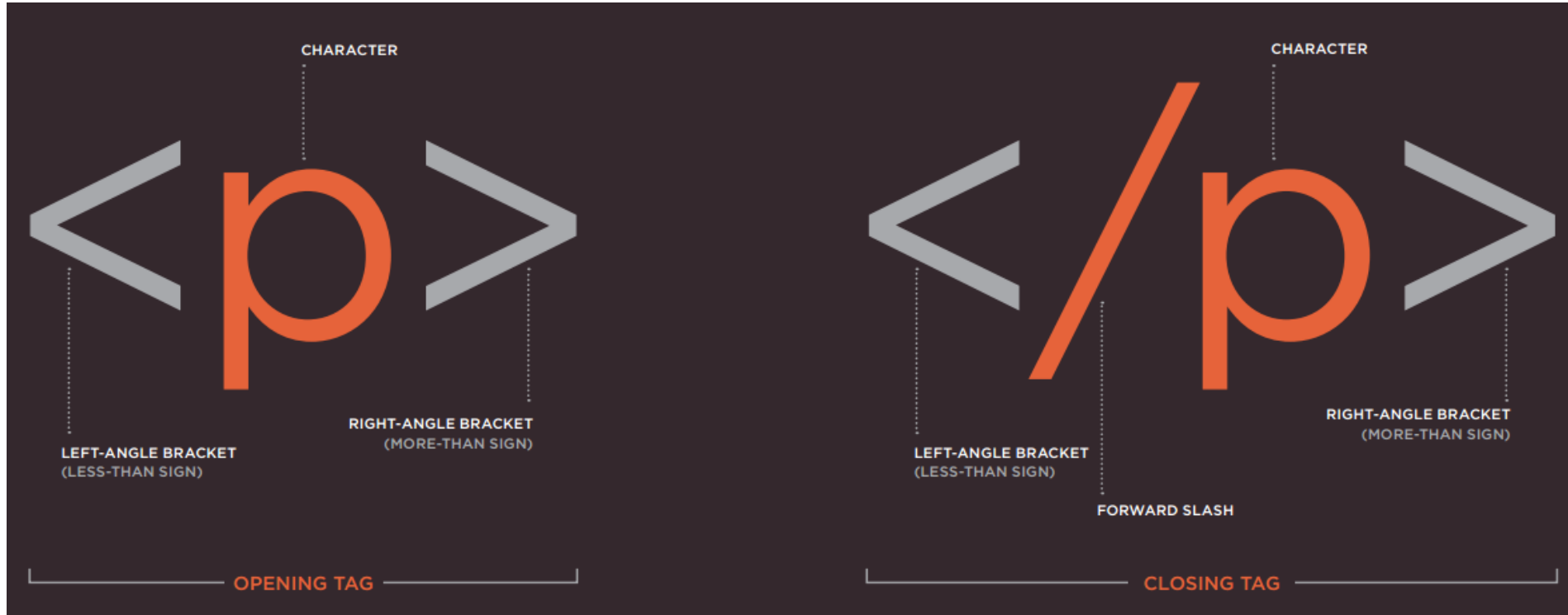
Linear and hypertext documents

Hyperdocument

Legend:
- Text document
- Image document
- Source anchor
- Destination anchor
- Link

Linear text

Hypertext

In Summary, the World Wide Web is

- A distributed hypertext system
- Defined by a set of common communication protocols
- Accessible from a variety of platforms

- Resources on the Web about WWW and its protocols:
  - http://www.w3.org/History.html
  - http://www.rfc-editor.org/rfc.html

HTML

- HTML
  - Markup: annotation. In this case, we mean annotation to describe document **structure** and formatting
  - Publishing language of the World Wide Web
- Standardized by the World Wide Web Consortium (W3C)
  - HTML 5
    - Newest HTML specification, being released in sections

Tags-Elements

The characters in the brackets indicate the tag's purpose.

The closing tag has a forward slash after the less than (<) symbol.

For example, p stands for paragraph.

An element comprises the opening tag and the closing tag and any content that lies between them.

HTML uses elements to describe the structure of pages

CODE

DESCRIPTION

`<html>`

The opening `<html>` tag indicates that anything between it and a closing `</html>` tag is HTML code.

`<body>`

The `<body>` tag indicates that anything between it and the closing `</body>` tag should be shown inside the main browser window.

`<h1>This is the Main Heading</h1>`

Words between `<h1>` and `</h1>` are a main heading.

```
<p>This text might be an introduction to the rest of
   the page. And if the page is a long one it might
   be split up into several sub-headings.</p>
```

A paragraph of text appears between these `<p>` and `</p>` tags.

`<h2>This is a Sub-Heading</h2>`

Words between `<h2>` and `</h2>` form a sub-heading.

```
<p>Many long articles have sub-headings to help you
   follow the structure of what is being written.
   There may even be sub-sub-headings (or lower-level
   headings).</p>
```

Here is another paragraph between opening `<p>` and closing `</p>` tags.

`<h2>Another Sub-Heading</h2>`

Another sub-heading inside `<h2>` and `</h2>` tags.

`<p>Here you can see another sub-heading.</p>`

Another paragraph inside `<p>` and `</p>` tags.

`</body>`

The closing `</body>` tag indicates the end of what should appear in the main browser window.

`</html>`

The closing `</html>` tag indicates that it is the end of the HTML code.

NTNU

Knowledge for a better world

Body, Head and Title

<body>

Everything inside this element is shown inside the main browser window.

<head>

Before the <body> element you will often see a <head> element. This contains information about the page (rather than information that is shown within the main part of the browser window that is highlighted in blue on the opposite page). You will usually find a <title> element inside the <head> element.

<title>

The contents of the <title> element are either shown in the top of the browser, above where you usually type in the URL of the page you want to visit, or on the tab for that page (if your browser uses tabs to allow you to view multiple pages at the same time).
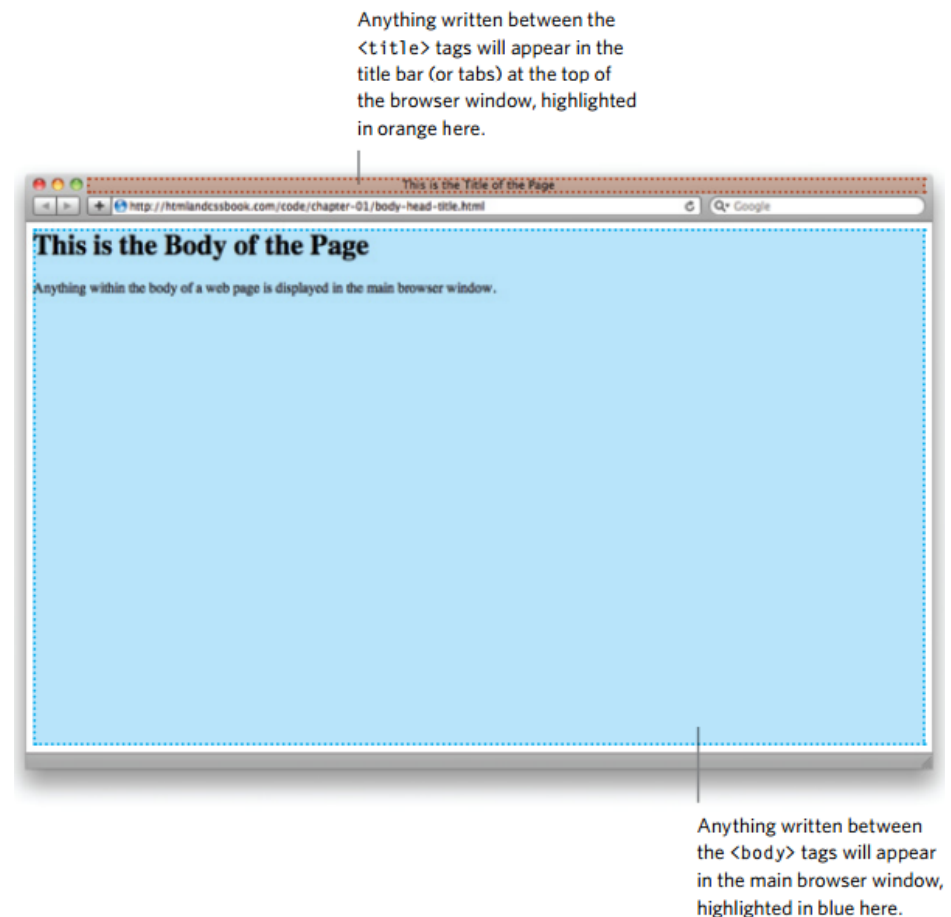
Page Structure

```
<html>
  <body>
    <h1>This is the Main Heading</h1>
    <p>This text might be an introduction to the rest of the page. And if the
       page is a long one it might be split up into several sub-headings.</p>
    <h2>This is a Sub-Heading</h2>
    <p>Many long articles have sub-headings to help you follow the
       structure of what is being written. There may even be sub-sub-
       headings (or lower-level headings).</p>
    <h2>Another Sub-Heading</h2>
    <p>Here you can see another sub-heading.</p>
  </body>
</html>
```

The HTML code (in blue) is made up of characters that live inside angled brackets — these are called HTML **elements**. Elements are usually made up of two tags: an opening tag and a closing **tag**. (The closing tag has an extra forward slash in it.) Each HTML element tells the browser something about the information that sits between its opening and closing tags.
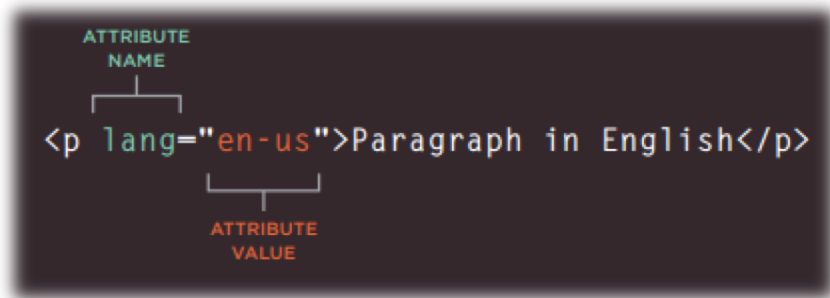
Type your first HTML code

```html
<html>
  <head>
    <title>This is the Title of the Page</title>
  </head>
  <body>
    <h1>This is the Body of the Page</h1>
    <p>Anything within the body of a web page is
    displayed in the main browser window.</p>
  </body>
</html>
```

Anything written between the `<title>` tags will appear in the title bar (or tabs) at the top of the browser window, highlighted in orange here.

http://htmlandcssbook.com/code/chapter-01/body-head-title.html

This is the Title of the Page

This is the Body of the Page

Anything within the body of a web page is displayed in the main browser window.

Anything written between the `<body>` tags will appear in the main browser window, highlighted in blue here.

Attributes

- Attributes provide additional information about the contents of an element. They appear on the opening tag of the element and are made up of two parts: a name & a value, separated by an equals sign.

HTML Summary

- HTML pages are text documents.

- HTML uses tags, tags are often referred to as elements.

- Tags usually come in pairs. The opening tag denotes the start of a piece of content; the closing tag denotes the end.

- Attributes require a name and a value.

- To learn HTML you need to know what tags are available for you to use, what they do, and where they can go.

HTML

- Save your web pages as plain text with .htm or .html filename extensions.

- If possible, save your files in a location that does not contain any spaces in the path.

- Do not put spaces in your filenames under any circumstances

- Avoid capitalizing any letter in an html file name

Thank you!

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NTNU IN BRUSSELS

NTNU IN TOKYO

TRONDHEIM

ÅLESUND

GJØVIK

Create a webpage

To create your first web page on a PC, start up Notepad. You can find this by going to:

1

Start
All Programs (or Programs)
Accessories
Notepad

You might also want to download:
- Atom, a free open-source and source code-based editor which is available for Microsoft Windows, Mac and Linux systems
- Visual Studio Code is a source code editor which is available for Windows, Linux and MacOS. (+ IntelliSense support, automatic completions whilst the user codes).

Create a webpage

Go to the File menu and select **Save as...** You will need to save the file somewhere you can remember. If you like, you could create a folder for any examples that you try out from this book.

Save this file as `first-test.html`. Make sure that the **Save as type** drop down has **All Files** selected.

Start your web browser. Go to the **File** menu and select **Open**. Browse to the file that you just created, select it and click on the **Open** button. The result should look something like the screen shot to the left.

If it doesn't look like this, find the file you just created on your computer and make sure that it has the file extension `.html` (if it is `.txt` then you need to go back to Notepad and save the file again, but this time put quote marks around the name `"first-test.html"`).

Create a webpage (mac)

To create your first web page on a Mac, start up TextEdit. This should be in your **Applications** folder.
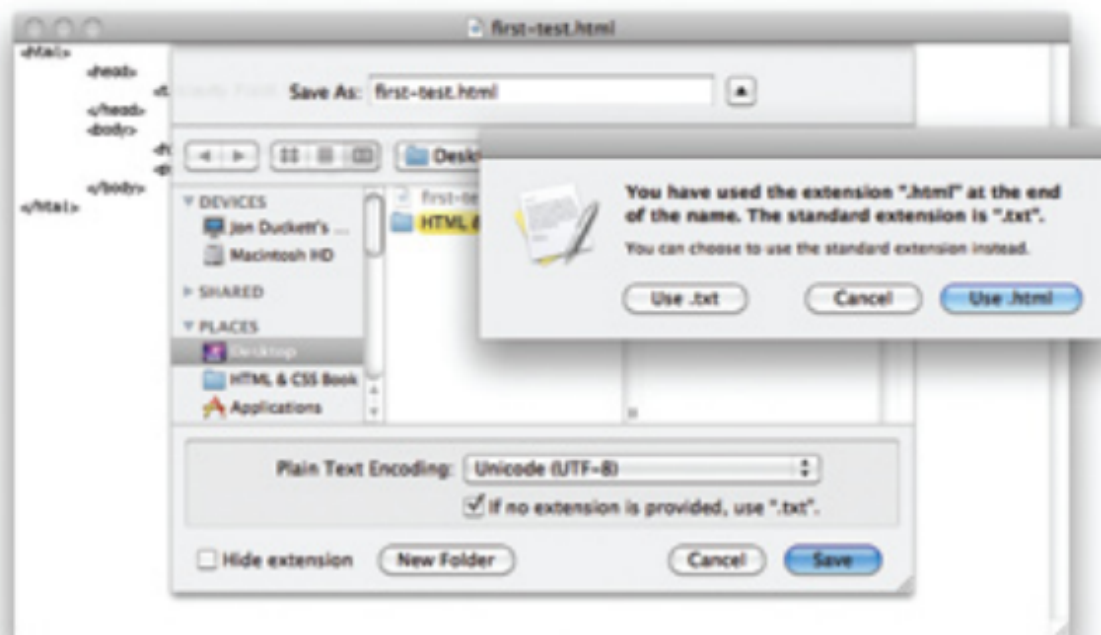
1

You might also want to download:
- Atom, a free open-source and source code-based editor which is available for Microsoft Windows, Mac and Linux systems
- Visual Studio Code is a source code editor which is available for Windows, Linux and MacOS. (+ IntelliSense support, automatic completions whilst the user codes).

Create a webpage (mac)

3

Now go to the **File** menu and select **Save as...** You will need to save the file somewhere you can remember.

If you like, you could create a folder for any examples that you try out from this book. Save this file as `first-test.html`. You will probably see a window like the screen shot to the left.

You want to select the **Use .html** button.

Next, start your web browser, go to the **File** menu, and select **Open**. You should browse to the file that you just created, select it and click on the **Open** button. The result should look like the screen shot to the left.

If it doesn't look like this, you might need to change one of the settings in TextEdit. Go to the TextEdit menu and select **Preferences**. Then on the preferences for **Open and Save**, tick the box that says **Ignore rich text commands in HTML files**. Now try to save the file again.

Establish a directory to store your web pages

https://innsida.ntnu.no/wiki/-/wiki/English/Create+your+own+website