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Introduction to Agile Web Development

CITS3403 and CITS5505 - Agile Web Development

Unit Coordinator: Matthew Daggitt

2025 - Semester 1

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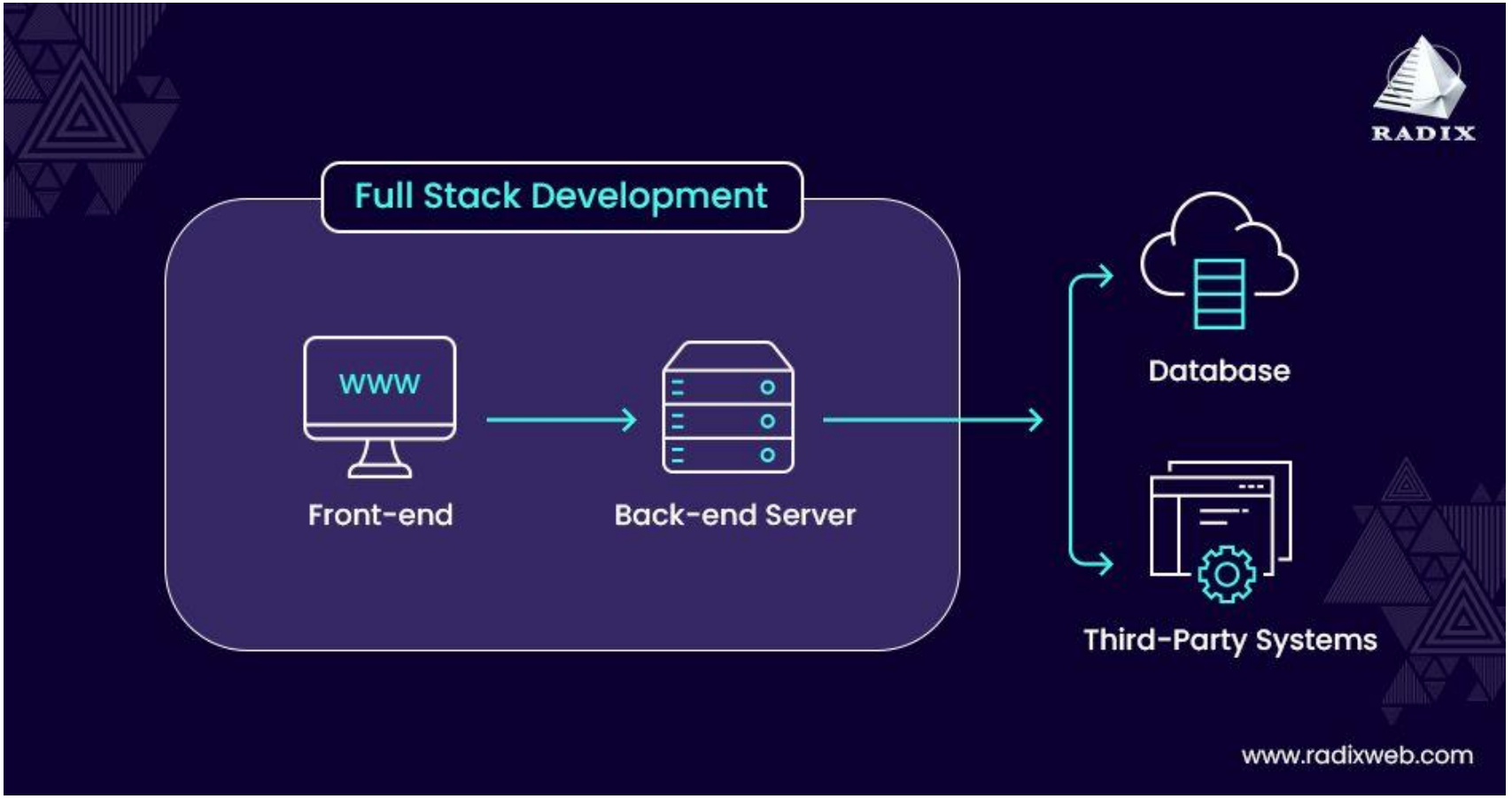
Welcome to Agile Web Development

- Focus on ***Programming*** for the Web and ***Agile software development.***



The syllabus

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- First 6 weeks – Front-end:
  - How the web works
  - Constructing web pages with HTML
  - Web Styling with CSS and Bootstrap
  - Client-side scripting with JavaScript, jQuery and AJAX
  - Document object models and event handling
  - Agile development and GIT

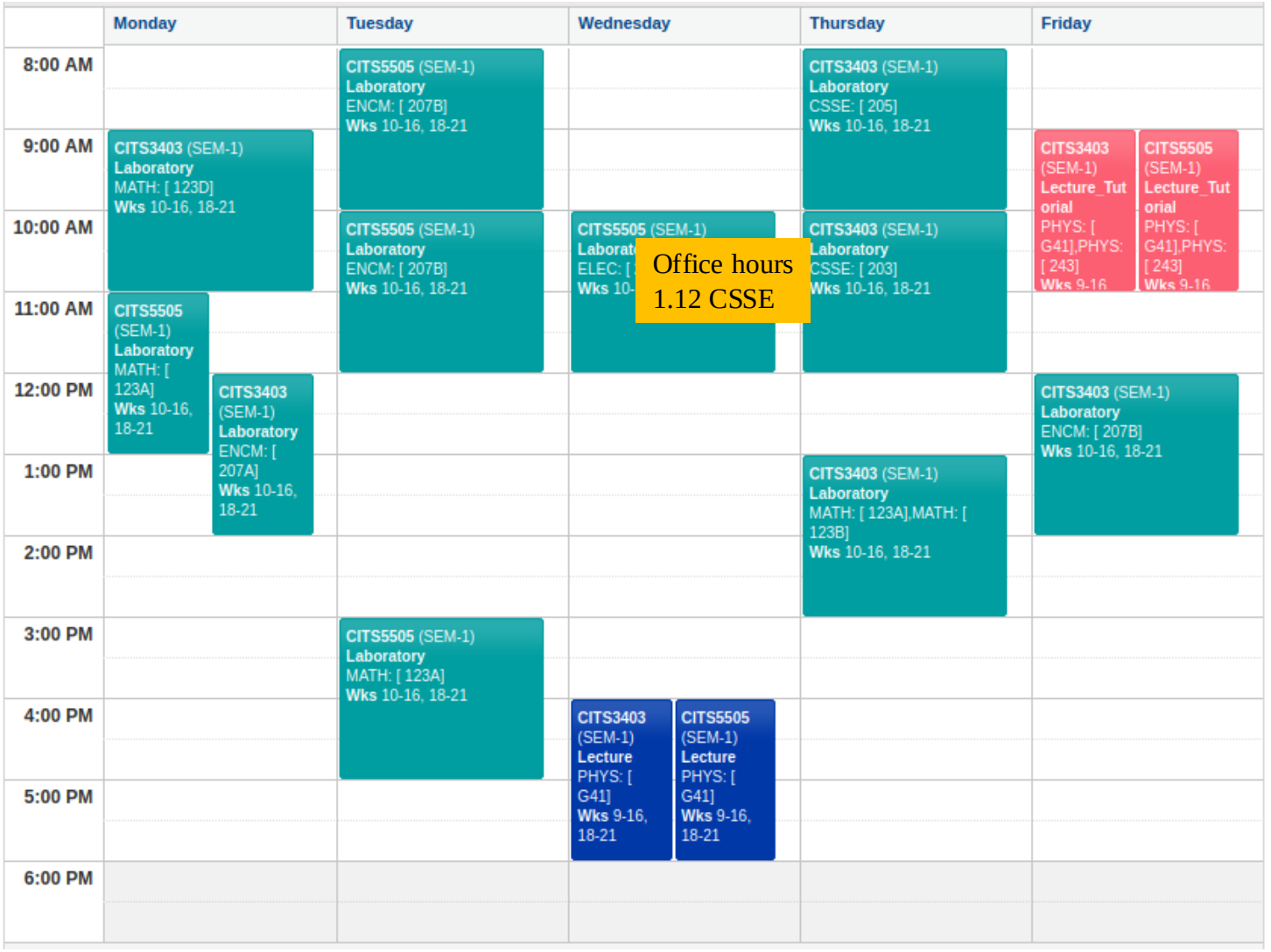
- Second half – Back-end
  - Flask Python web application development
  - MVC architecture and object relational modelling
  - Security, testing
  - Deployment
  - REST API design

- We use open source and free technologies
  - You can use it at home!

Unit admin

- Unit links:
  - LMS: https://lms.uwa.edu.au/
  - Help forum: Microsoft Teams
  - Email: cits-3403-5505@uwa.edu.au

Weekly timetabling



Recommended Reading

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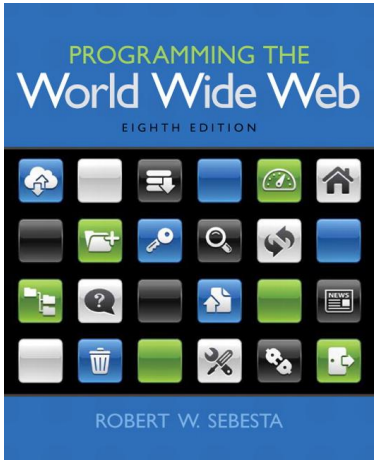
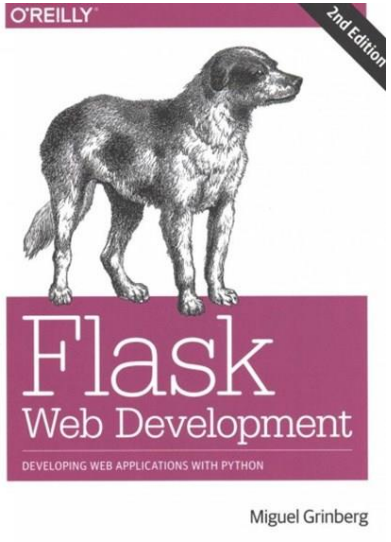
General references

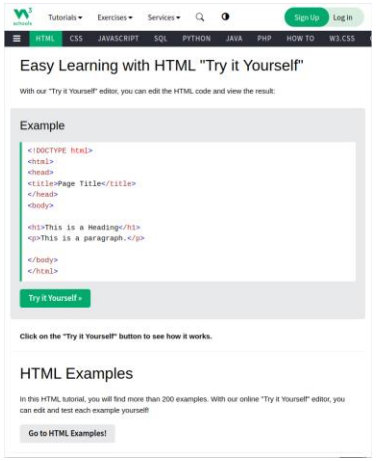


Robert W. Sebesta,
Programming the World Wide Web 2015,
8th Edition,
Pearson/Addison Wesley.



Miguel Grinberg,
Flask Web Development,
2nd Edition,
O'Rielly, 2018

Lab material



Part I

W3Schools

https://www.w3schools.com

Part II

Miguel Grinberg
Flask Mega-Tutorial

https://blog.miguelgrinberg.com/post/the-flask-mega-tutorial-part-i-hello-world

Assessment

- CITS3403 Mid-semester test: Friday April 4th, 9am LMS Online.
  - 10% or final grade
  - < 10 questions, written answers, 60 minutes
- CITS5505 Individual Project: Due Friday April 4th, 11:59pm
  - 10% of final grade
  - Write a basic web page, with researched content
- Group Project: Sunday, Friday May 16th, 11:59pm.
  - 40% of final grade
  - Done in groups of 4.
  - Fully dynamic website with backend!
  - Lab work will step through this process.
- Written final exam: exam period
  - 50% of final grade

- Please ensure you have consulted the Unit Outline for information on:
  - unsatisfactory progress
  - late assessment penalties
  - plagiarism and AI tools policy
  - including ACE and academic misconduct
  - faculty marks adjustment policy

AI use policy

- LLM-based tools are awesome at many parts of web-development and are seeing rapid adoption in industry.

- This course **explicitly encourages** your use of AI tools to generate code. The tutorial sessions will explain how to setup your dev environment to use GitHub CoPilot.

- However, you are still expected to be able to read, write and critique code on your own.
  - **Tutorials:** will label which parts you should use CoPilot for and which parts you should not.
  - **Individual (CITS5505) and group projects**: you can use it freely if you cite it properly.
  - **Tests (CITS3403)**: you can use it freely but may be of only limited help for certain questions.
  - **Exams:** closed book so you may not use it. You will be expected to read, but not write, code.

- If you don't understand the code being generated, you will not pass the exam!

A project success story

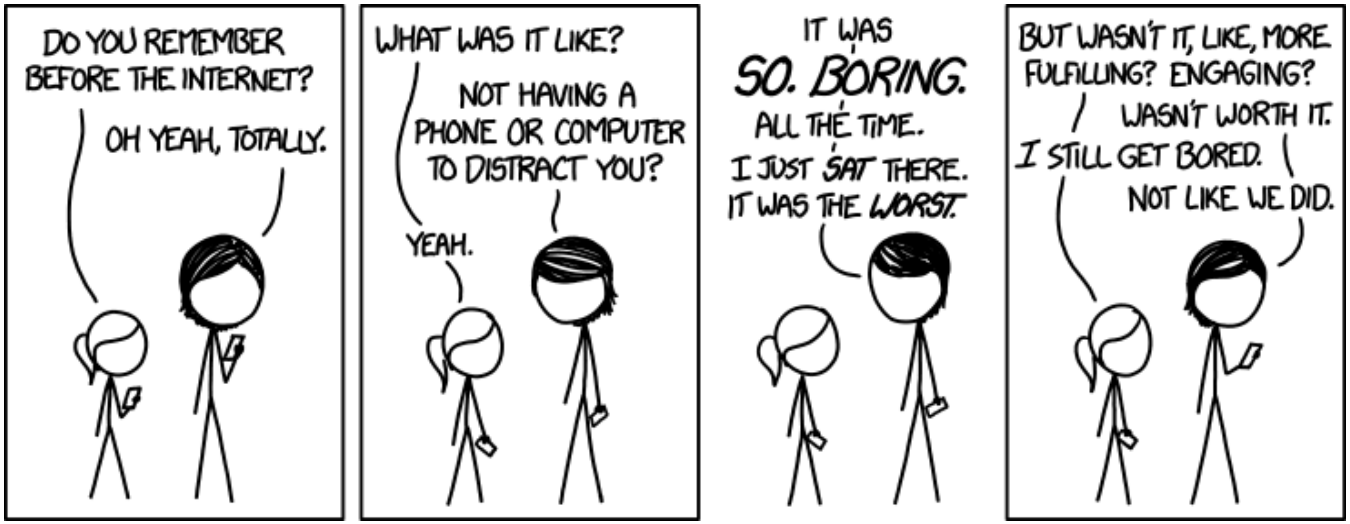
Email received on February 26th 2024...

I took CITS3403 in 2022 semester 1, it was one of the best units in the whole degree. For the final project we built Minecraftle which was wordle + minecraft crafting recipes. When we completed the project, we deployed it online using a small server. Since the unit finished, I gave it a few more updates to fix bugs and forgot about it.

Near the end of last year someone on YouTube started making videos of the game and it has since become quite popular. As of yesterday, it just hit 1 million players! The game has contributed to getting a software engineering job in Melbourne that I started in January.

https://github.com/zachpmanson/minecraftle/
https://minecraftle.zachmanson.com/

A (very) brief history of the Internet



https://xkcd.com/1348/

What is a computer network?

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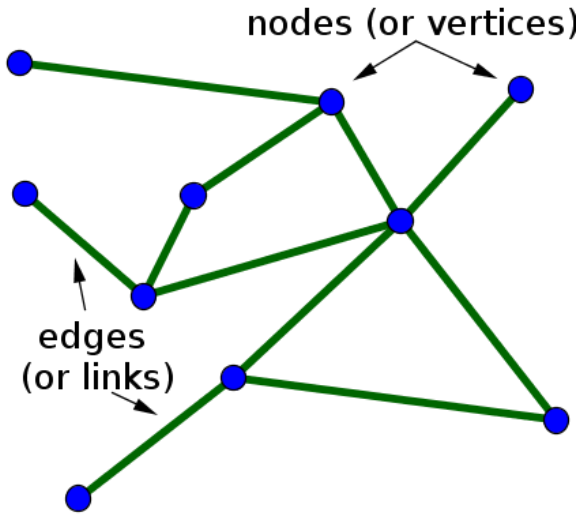
- A **network** is a structure linking devices together for the purpose of communication and can be modelled as a graph.



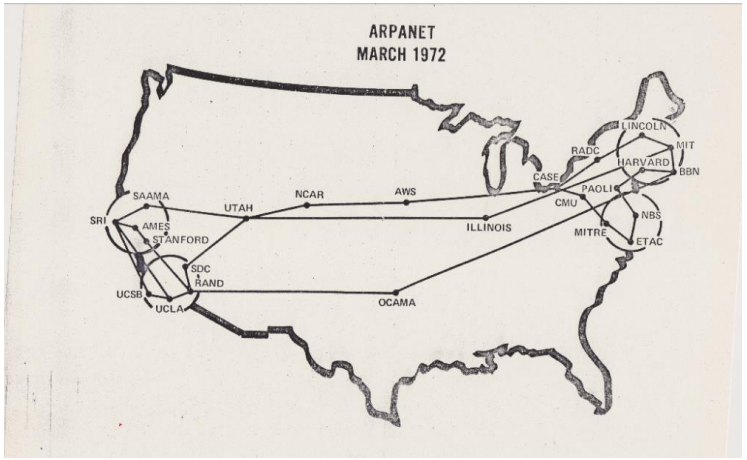
- Each individual device is modelled as a node in the graph.
- The physical connection between two devices is modelled as an edge in the graph.

Networks before the Internet

- In the US, the DoD created the Advanced Research Projects Agency (ARPA, now DARPA) in 1958. ARPA was interested in creating networks that:
  - allowed communications, program sharing, remote computer access.
  - were robust and would continue to work if some nodes "taken out" by malicious forces.

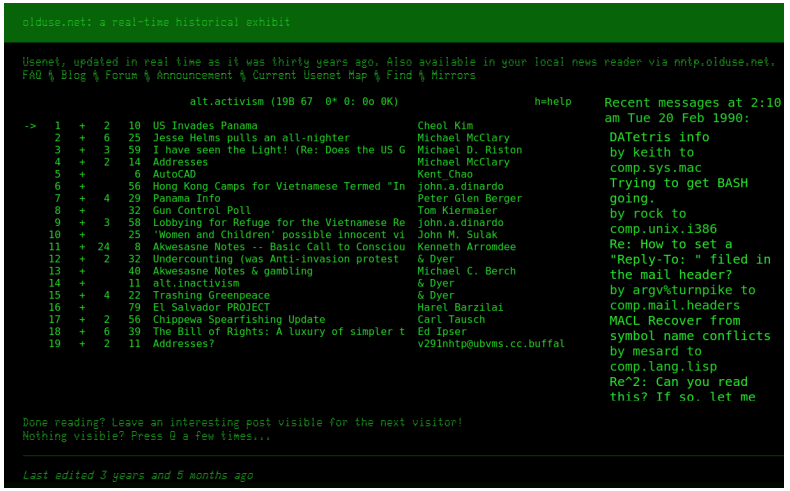
- This resulted in the ARPAnet in the late 1960s and early 1970s
  - linked about a dozen ARPA-funded research labs and universities.
  - graduate students played a large part in its development!
  - didn't live up to intentions - mostly text-based email and limited reach.
  - but still useful and the snowball had started to roll…

- Non-ARPA-funded Universities wanted in, so other networks were created in the late 70s and early 80s
  - BITnet (Because It's Time Network), initially electronic mail and file transfer
  - CSnet (Computer Science Network), primarily email



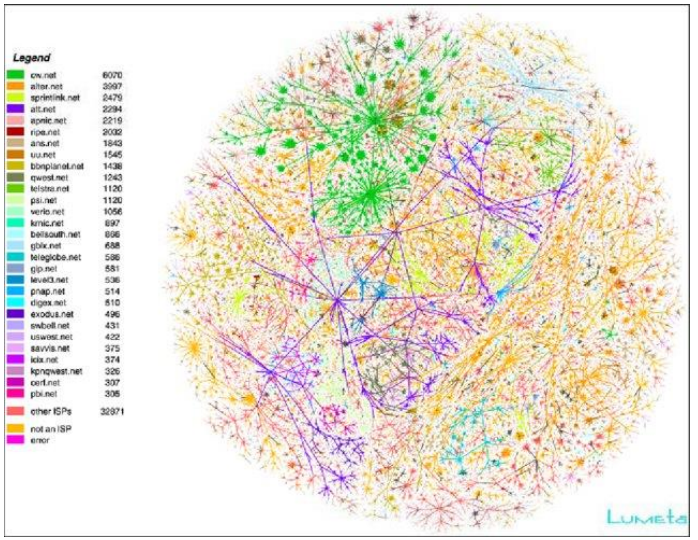
The Birth of the Internet

- NSFnet was created in 1986 by the National Science Foundation (NSF).
- Originally for non-DoD funded organisations, it initially connected five supercomputer centres but quickly spread to other academic institutions and research labs.
- By 1988/89 - began to be used commercially - mail, ISPs.
- By 1990, it had replaced ARPAnet for non-military uses and it soon became the network for everyone.
- Other networks created gateways and eventually merged with NSFNet (e.g. JANET, BITnet, Usenet, …).
- By 1992 connected more than 1 million computers around the world and eventually became known as "the Internet".



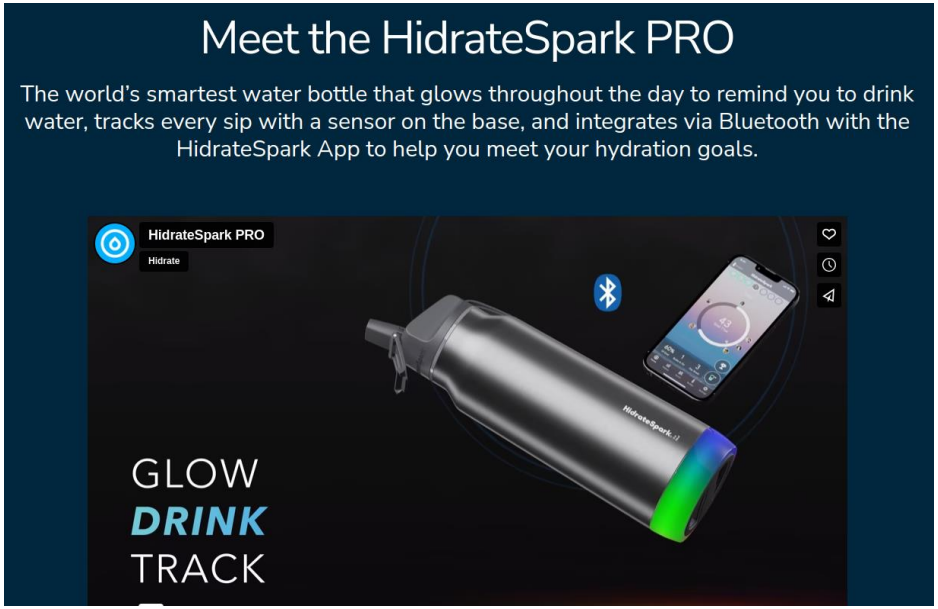
The Evolution of the Internet

- The Internet is still a network of interconnected networks.
- As it evolved high-speed backbone links were created to carry large amounts of data.
- Smaller networks connect to the backbone, enabling any user on any network to exchange data with any other user.
- Both backbone links and individual networks can be owned by companies, universities or nation states.
- It achieved ARPA's original goal that if part of its infrastructure is destroyed, data can still flow through the remaining networks (in principle).
- By the 2000s it had become indispensable global infrastructure.



The Internet Today

- Today the Internet has grown to include tens of billions of interconnected computers, smart phones, televisions, printers, fridges, watches and most crucially... *water bottles*.



- All these devices on the Internet are connected using a wide range of different types of links: copper cables, fibre-optic cables, satellites, phone lines etc.

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How does the internet work?

Communication protocols

- No matter whether using fibre-optics, satellite links etc, the physical connections all send data as a sequence of bits, e.g. 10101111011010000011001.

- Network communication is possible only if computers “speak” a common language and know how to interpret the bits. These common languages are known as *protocols.*

- *It's protocols all the way down:*
  - IP – consistent addressing of entities on the internet
  - BGP – finding the best routes across the internet
  - TCP – error-free delivery of streams of data
  - SMTP – sending and receiving emails.
  - FTP – sending and receiving files.
  - etc. etc.

The TCP/IP model

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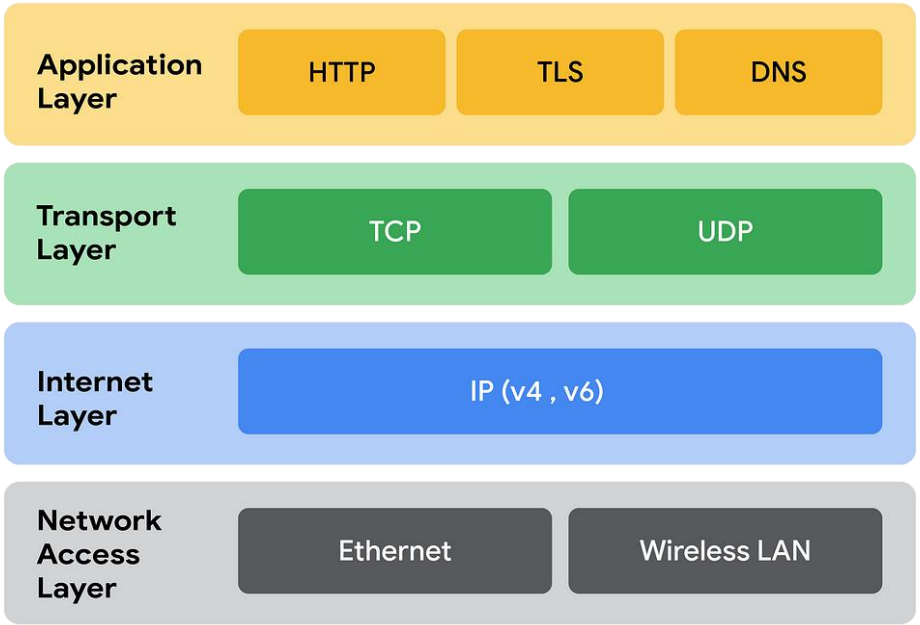
- Every computer and network on the Internet uses the same set of protocols - the Transmission Control Protocol/Internet Protocol, or TCP/IP for short.
- No matter what type of computer system you connect to the Internet, if it uses TCP/IP, it can exchange data with any other type of computer.
- TCP/IP was developed to guarantee the proper transmission of data, since the physical layer (e.g. wires/wi-fi/satellite) in the network may be unreliable.
- For transmission not needing guarantees, one can use User Datagram Protocol (UDP) instead of TCP. Data transmitted by UDP arrive faster, with none of the error detection or correction overheads that are in TCP/IP.
- In TCP/IP a stream of data is split into packets which are sent individually over the network.

The TCP/IP model layers

- The TCP/IP model is split up into four layers:
  - The application layer protocols dictate what format the stream of data should be in for different high-level applications.
  - The transport layer protocols convert the stream of data to and from a sequence of packets and are responsible for detecting and fixing packets that are lost or corrupted during transport.
  - The internet layer protocols are responsible for transmitting a single packet from the source device to the destination device across the network.
  - The network access layer protocols describe how a single packet is transmitted across a single physical link in the network.



Client-Server Architecture

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- Most communication on the internet takes the form of a client-server relationship.
  - The server is computer whose address is known, and which stores information on its file system.
  - The clients sends a request for information to the server via an agreed protocol (FTP, SMTP etc.).
  - The server transmits the requested information back to the clients.

- Advantages
  - Multiple clients can use a single server.
  - New clients can join the system without having to be registered in advance.
  - We have a single, central source of information.

- Disadvantages:
  - There is a single point of failure – the server.
  - If too many clients, the server may be overloaded with requests.

- To get around the disadvantages, we can have many duplicate servers containing the same content, at the cost that more work must be done to keep the copies of information synchronised...

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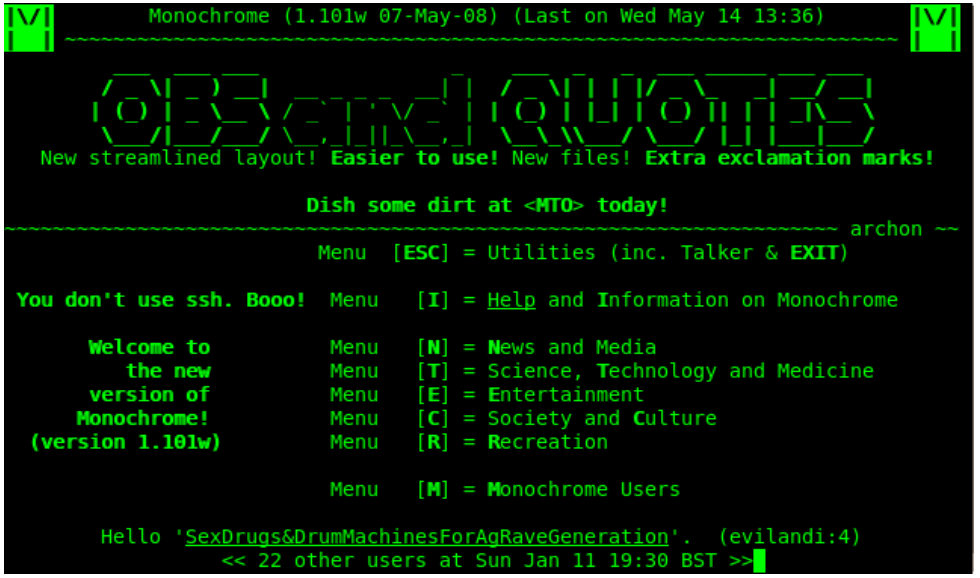
Internet Applications

Bulletin Board System (BBS)

- Early interactive software, late 1970s to 1980s

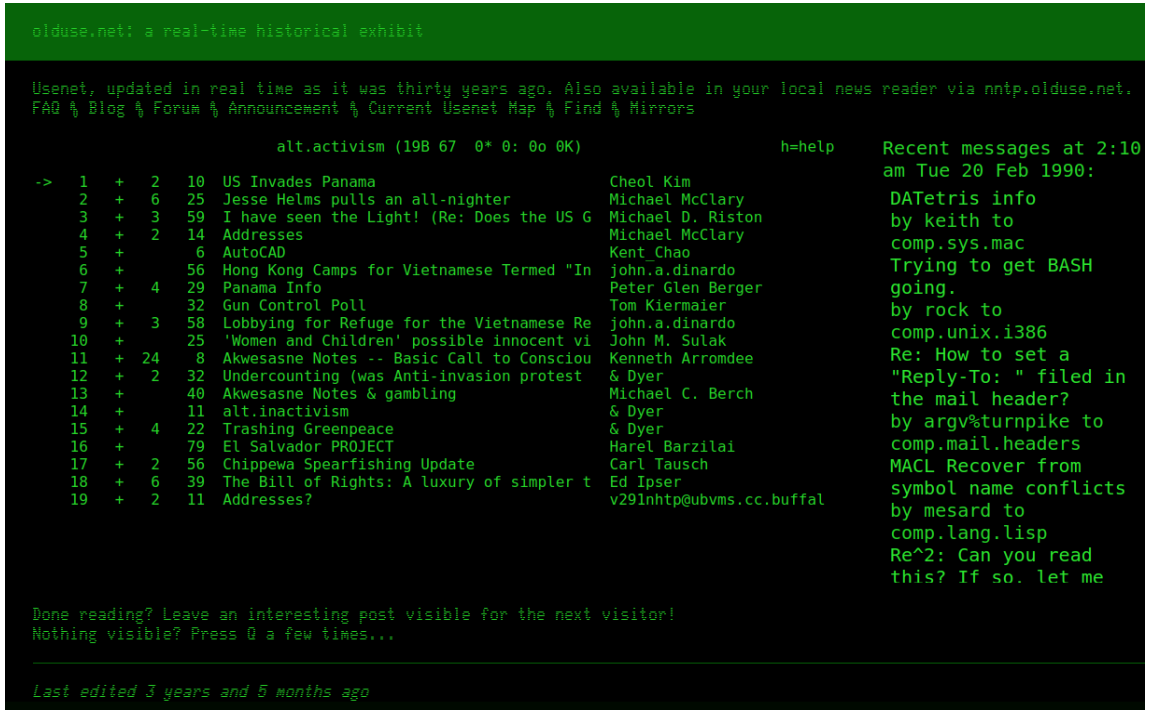
- Users could login to:
  - exchange messages through mail or public message boards
  - read news and bulletins
  - upload/download software
  - even on-line games
  - accessed using modem and phone line
  - precursor to today's WWW

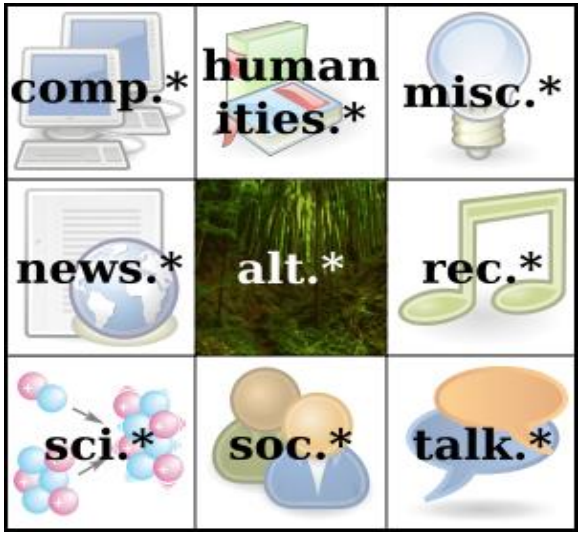


http://en.wikipedia.org/wiki/File:Monochrome-bbs.png

Usenet

- Idea conceived by Duke University grad students in 1979
- Unlike BBS, distributed network of servers (e.g. each university)
- A variety of forums called *newsgroups* (not just news - users posts)
- Threaded discussions
- Formed social communities
- Precursor to Internet forums





Source: Benjamin D. Esham, Wikimedia Commons
http://en.wikipedia.org/wiki/File:Usenet_Big_Nine.svg

The "killer app" - the World Wide Web

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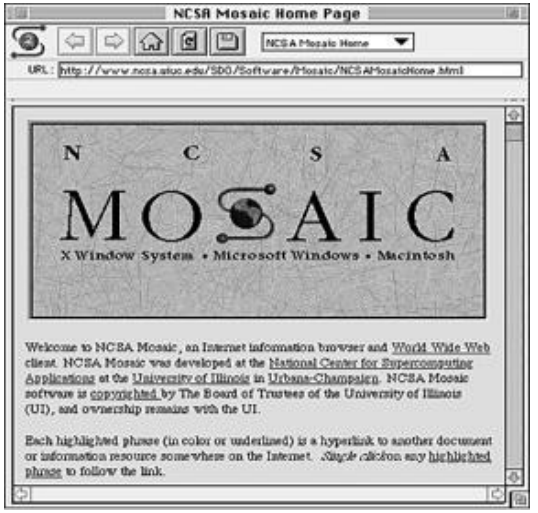
- Early internet was mainly used by people in universities and research labs.
  - Lots of information but very difficult to access.
  - You needed the IP address of the computer you wanted to connect to.
  - No uniform way of visualising the information.

- In 1991, CERN publicised new World Wide Web project, invented earlier by Tim Berners-Lee and colleagues in 1989:
  - DNS (Domain Name System) resolves URLs (names) to IP addresses.
  - Included the first browser "WorldWideWeb" on the NeXTSTEP platform
  - First ever website still online!



- In 1993, the National Center for Supercomputing Applications (NCSA) at the University of Illinois released v1.0 of Mosaic browser:
  - written by a student, Marc Andreessen, and Eric Bina
  - first multimedia browser (mixed images and text)!

- Explosion in internet use!
  - growth of web usage in 1000s of percent
  - changed internet use forever
  - the “killer app” of the 90s

A URL (uniform resource locator)

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http://www.domain.edu.au:1000/path/to/file?parameters=true#fragment

- The protocol used. Typically, *http*, *ftp*, *https*, …
- The domain name. A *domain name server* maps this to an IP address
- The port number. Servers have ports 0-65535, but HTTP defaults to port 80.
- The path (route) to the file to execute. The file is typically an HTML file, but it could also be PHP, text, PDF.
- The parameters of the request. These are specified as a set of key value pairs.
- The fragment. This anchors to a location in a page.
- There are also hidden parts of the request including the browser name and cookies.

Client-Server Architecture of the Web

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- Communication is by an agreed protocol, e.g. the HTTP (HyperText Transfer Protocol).
- The user requests a web page through the browser, a program running locally on their computer.
- The browser, as the client, locates the correct server and communicates the request.
- The server retrieves the web page from its local file system and transmits the files back to the browser.
- The browser receives the files, (usually text file containing HTML instructions) and uses them to render the web page resulting in the intricate graphics and formatting you see on your screen.

The World Wide Web today

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- The world wide web is essentially the fragment of the internet accessible through web browsers.
- It is a unique engineering environment with obscure ownership and control.
- Arguably the most impressive piece of infrastructure ever built by humanity.
- Hundreds of standards have evolved that define interaction over the webpages.
- As search has come to dominate, URLs are now nearly irrelevant to users.

The World Wide Web tomorrow

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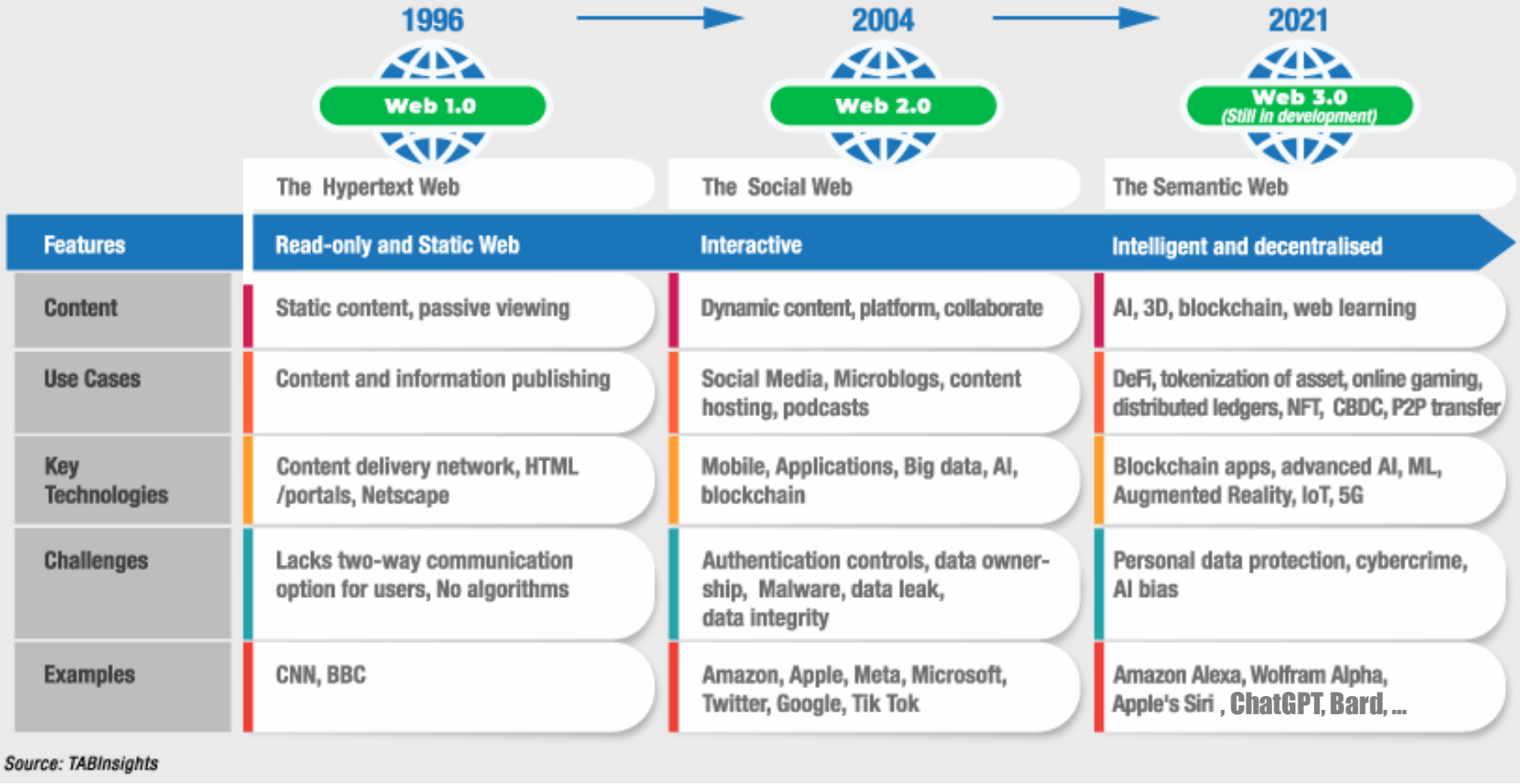
New web technologies that shape future business models

Transition in web technologies



Source: TABInsights