COMP519 Web Programming

Lecture 1: Overview of COMP519

Handouts

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Contents

COMP519 Web Programming

- Module co-ordinator:
  Dr Ullrich Hustadt, Ashton Building, Room 1.03,
  U.Hustadt@liverpool.ac.uk
- Delivery:
  - Two or three lectures per week (≈28 in total)
  - Two lab sessions per week (≈18 in total)

  Refer to your personal timetable for dates, times, and places
- On-line resources:
  `http://cgi.csc.liv.ac.uk/~ullrich/COMP519/`
- Assessment:
  Four programming assignments each worth 25% of the module mark
  (68 hours vs 48 hours on COMP518; one working day per week)

Recommended Books

1. R. Nixon: Learning PHP, MySQL & JavaScript : with jQuery, CSS & HTML5. O'Reilly, 2018.
2. A. Beautieu: Learning SQL (2nd ed). O'Reilly, 2009.
3. N. C. Zakas: Professional Javascript for Web Developers (2nd ed). Wiley, 2009.

`http://readinglists.liverpool.ac.uk/modules/comp519.html`

Learning Outcomes

By the end of this module, a student should

1. be able to use a range of technologies and programming languages available to organisations and businesses and be able to choose an appropriate architecture for a web application
2. be able to develop reasonably sophisticated client-side web applications using one or more suitable technologies and to make informed and critical decisions in that context
3. be able to develop reasonably sophisticated server-side web applications using one or more suitable technologies and to make informed and critical decisions in that context

Learning Outcomes in a Nutshell

By the end of this module, a student should

- be able to develop web applications

Web ≠ Internet

Internet

A physical network of networks connecting billions of computers and other devices using common protocols (TCP/IP) for sharing and transmitting information

World Wide Web [Old]

A collection of interlinked multimedia documents
(web pages stored on internet connected devices and accessed using a common protocol (HTTP))

Key distinction:

- The internet is hardware plus protocols while the world wide web is software plus protocols
- The world wide web is an application using the internet to transmit information, just like many others, for example, email, SSH, FTP

History (1)

- 1969: ARPANET (precursor of the Internet)
- 1971: First e-mail transmission
- 1971: File Transfer Protocol (FTP)
- 1972: Vadic VA3400 modem (1,200 bit/s over phone network)
- 1977: RSA public-key cryptography
- 1977-79: EPSS/SERCnet (first UK networks between research institutions)
- 1981: IBM PC 5150
- 1981: Hayes Smartmodem (300 bit/s; computer controlled)
- 1982: TCP/IP standardised
- 1985: FTP on TCP standardised

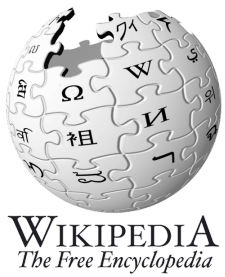
History (2)

- mid 1980s: Janet (UK network between research institutions with 2 Mbit/s backbone and 64 kbit/s access links)
- 1986: U.S. Robotics HST modem (9600 bit/s)
- late 1980s: TCP/IP networks expand across the world
- 1991: Janet adds IP service
- 1991: Gopher / World Wide Web
- 1991: GSM (second generation cellular network) digital, circuit switched network for full duplex voice telephony
- 1995: First public releases of JavaScript and PHP
- 1997: World Wide Web slowly arrives on mobile phones

History (3)

Current Applications:

- Communication via e-mail, Twitter, etc
- Joint manipulation of concepts and actions: Collaborative editing, Crowd sourcing, Wikis (Wikipedia)
- E-Commerce: Online auctions and markets
- Social media, social networks, virtual learning environments



Web $\neq$ Internet

World Wide Web [New]

An infrastructure that allows to easily develop, deploy, and use distributed systems

Distributed systems

A system in which components located on networked computers communicate and coordinate their actions by passing messages in order to achieve a common goal

Web ≠ Internet

World Wide Web [New]

An infrastructure that allows to easily develop, deploy, and use distributed systems

Key points:

- The internet already eased the development of distributed systems by providing an appropriate infrastructure for that
- The world wide web eases the development and deployment of interfaces to such system via a combination of web pages and ubiquitous web browers
- The world wide web then allows every (authorised) person to instantaneously interact with such systems
- Search engines allow users to easily find distributed systems that are useful to them

Distributed Systems: Fundamental Questions

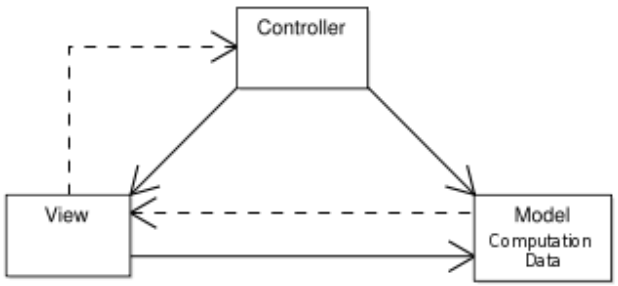
Software developers have to consider a wide, but rather stable, range of questions including:

- Where can or should computations take place?
- Where can or should data be stored?
- How fast can data be transferred/communicated?
- What is the cost of data storage/computations/communication depending on how/where we do it?
- How robustly/securely can data storage/computations/communication be done depending on how/where we do it?
- How much energy is available to support data storage/computations/communication depending on how/where we do it?
- What is the legality of data storage/computations/communications depending on how/where we do it?

The possible answers to each of these questions is also rather stable, but the 'right' answers change

Distributed Systems: Model-View-Controller

We use the Model-View-Controller software design pattern to discuss some of these questions in more detail:



- The model manages the behaviour and data
- The view renders the model into a form suitable for interaction
- The controller receives user input and translates it into instructions for the model

1. Where should the view be rendered?
   - On the user's computer
   - On a central server (farm) possibly shared by a multitude of users

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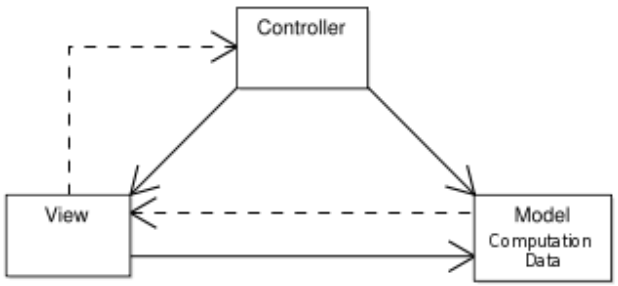

- The model manages the behaviour and data
- The view renders the model into a form suitable for interaction
- The controller receives user input and translates it into instructions for the model

2. Where should the behaviour of the model be computed?
   - Close to the user,
     on a single computer exclusively used by the user
   - Away from the user,
     on a central server (farm) shared by a multitude of users
   - Distributed,
     on several computers owned by a large group of users

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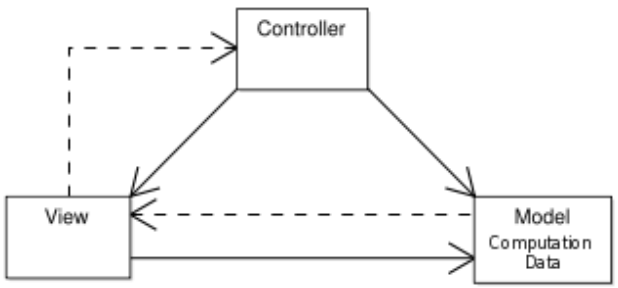

- The model manages the behaviour and data
- The view renders the model into a form suitable for interaction
- The controller receives user input and translates it into instructions for the model

3. Where should the data for the model be held?
   - Close to the user,
     on a single computer exclusively used by the user
   - Away from the user,
     on a central server (farm) shared by a multitude of users
   - Distributed,
     on several computers owned by a large group of users

Distributed Systems: Fundamental Questions

- Software developers have to consider a wide, but rather stable, range of questions
- The possible answers to each of these questions is also rather stable
- The 'right' answer to each these questions will depend on
  - the domain in which the question is posed
  - available technology
  - available resources
- The 'right' answer to each of the questions changes over time
- We may go back and forth between the various answers
- The reasons for that are not purely technological, but includes
  - legal factors
  - social factors
  - economic factors

NLS

- 1960ies: Computer terminals start to be used to interact with computers
- 1968: NLS "oN-Line System" (Douglas Engelbart, SRI)

A 'networked' computer system with GUI, off-line mode, 'e-mail', collaborative word processing, hypertext, video conferencing and mouse is demonstrated

(The picture shows one of several terminals connected to a mainframe computer)

Videos of the demo are available at
`http://www.youtube.com/watch?v=JfIgzSoTMOs`

Thin clients, fat clients and cloud clients

- 1970ies: Computer terminals continue to dominate
- 1978: DEC VT100

  Intel 8080 processor
  3 kb main memory
  Monochrome graphics

  Like NLS, this is a terminal connected to a mainframe computer via serial lines

Key points:

- The data is stored on the mainframe computer which also computes the behaviour of the model
- The view is computed on the mainframe computer and only displayed on the terminal
- The terminal receives user inputs and relays it to the mainframe computer that translates it into instructions for the model
- This architecture dominated the industry for about 20 years

The PC Era

- 1981: IBM PC 5150
- 1983: Apple Lisa
  First PC with a graphical user interface
- 1985: Microsoft Windows 1.0
- 1987: HyperCard
  Hypermedia system for Mac OS
- 1988: HyperStudio
  HyperCard clone for MS Windows
- 1991: Instant Update
  Collaborative editor for Mac OS
- 1992: CU-SeeMe Video Conferencing

Key points:

- Model, View and Controller are stored and computed locally on the PC
- It took 24 years to catch up with NLS
- This architecture dominated the industry for about 20 years

The Post-PC Era

- 1992: IBM Simon Personal Communicator (First smartphone)
- 1996: Nokia 9000 Communicator
- 2007: Apple iPhone
  Samsung 32-bit RISC ARM
  128MB main memory
  4-16GB flash memory
  'Apps' / Web browser

- 2011: Google Chromebook
  Intel Atom processor
  2GB main memory
  16GB SSD
  Web-based applications

In effect the Chromebook is a 'terminal' connected to Google's servers and others via a wireless network

The Post-PC Era

- 2011: Google Chromebook
  Intel Atom processor
  2GB main memory
  16GB SSD
  Web-based applications

Key points:

- The data is stored on a server farm (the 'cloud') which also computes the behaviour of the model
- The view is either computed on a server farm or on the terminal
- The terminal receives user inputs and either relays those to the server farm or directly translates it into instructions for the model
- This architecture has fought for dominance for 15 years
- Will it dominate the future?

Thin clients, fat clients and cloud clients

- The Google Chromebook gives very similar answers to the fundamental questions as the DEC VT100
  $\rightsquigarrow$ the possible answers to the fundamental questions stay the same
- The PC gave very different answers to the fundamental questions
  $\rightsquigarrow$ the 'right' answers change with time
- The Google Chromebook is more advanced than the DEC VT100 in (almost) every aspect
  $\rightsquigarrow$ we are not going around in circles,
  we always advance technologically

Web Programming versus App Programming

- Web Programming relies on web browsers as means to render user interfaces that are coded in HTML/CSS
- Web Programming relies on HTTP as the main protocol to exchange information within a distributed system
- Web-based apps use a mix of server-side and client-side computing
- Web-based apps can be changed almost instantaneously and on a per-user / per-use basis
- App Programming relies on directly coded 'native' interfaces (Swift/Java)
- App Programming can rely on arbitrary protocols to exchange information within a distributed system
- Programmers have more flexibility and more control when developing 'traditional' apps

It is not obvious which approach is better and in which situation