COMP519 Web Programming

Lecture 1: Overview of COMP519

Handouts

Ullrich Hustadt

Department of Computer Science
School of Electrical Engineering, Electronics, and Computer Science
University of Liverpool

Contents

COMP519 Web Programming

- Module co-ordinator: Dr Ullrich Hustadt
  U.Hustadt@liverpool.ac.uk

University home > Computer Science > People > Ullrich Hustadt

Ullrich Hustadt

About

Position

Reader

Address

Department of Computer Science
University of Liverpool
Liverpool L69 3BX
United Kingdom

Contact Details

E-mail: U.Hustadt@liverpool.ac.uk
Phone: +44 (0)151 79-54231
Mobile: +44 (0)7970 24 7431
Fax: +44 (0)151 79-54235

Qualifications

PhD in Computer Science, Universität des Saarlandes, November 1999.
Thesis: Resolution-Based Decision Procedures for Subclasses of First-Order Logic.
MSc in Computer Science, University of Dortmund, March 1991.
Thesis: Unifikation höherer Stufe: Techniken und Anwendungen.

Research
- Research interests
- Papers and Publications
- Project involvement
- Software

Professional Activities
- Scientific initiatives
- Scientific meetings

Teaching
- COMP284
- COMP519
- Supervision of BSc Projects
- Supervision of MSc Projects

Administration
- Duties

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

We will cover the following languages

- HTML/CSS
- JavaScript
- PHP

We rely on knowledge of

- programming in general
  $\leadsto$ acquired via COMP517
- databases (creation, querying, transactions)
  $\leadsto$ acquired via COMP518

Delivery

- Normally 3 lectures per week
  2 practical sessions per week
  for 10 weeks

University Higher Level Principles for Teaching (2020-21)

- Module content not delivered via synchronous small-group teaching will be delivered asynchronously via the VLE
- As far as is possible the synchronous small-group sessions should be delivered on campus face-to-face

Delivery

- Lectures notes
  Pre-recorded lectures
  Exercise sheets
  available at
  `http://cgi.csc.liv.ac.uk/~ullrich/COMP519/notes/`
  and on Canvas
- Study guide
  to indicate how you should proceed through these

Delivery

On the Departmental Website the Study Guide is under ‘Module notes and Practical worksheets’

Study Guide

Below you find the study guide for COMP519. It's complete for Weeks 1 to 8, but Weeks 9 and 10 need a bit more work and will be later in the semester.

Week 1 –

Lecture 1: Overview of COMP519	PDF: 1spp PDF: 8spp HTML Video
Lab Intro 1: Preparation for COMP519 Exercises, Labs, and Assignments	PDF: 1spp
Lab Intro 2: Using the Departmental Windows Systems	PDF: 1spp
Lab Intro 3: Using the Departmental Linux Systems	PDF: 1spp
Lab Intro 4: Access Control, Synchronisation and Remote Access	PDF: 1spp
Lecture 2: HTML (Part 1): HTTP, HTML5, HTML Elements, HTML Characters	PDF: 1spp PDF: 8spp HTML Video

J. Niederst Robbins: Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics (5th ed). O'Reilly, 2018.

- Chapter 2: How the Web Works
- Chapter 4: Creating a Simple Web Page

Exercises 1: HTML (1)	PDF: 1spp
Lecture 3: HTML (Part 2): Structure, Headings, Lists, Paragraphs, Div, Span, Hyperlinks	PDF: 1spp PDF: 8spp HTML Video

J. Niederst Robbins: Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics (5th ed). O'Reilly, 2018.

- Chapter 4: Creating a Simple Web Page
- Chapter 5: Marking Up Text
- Chapter 6: Adding Links

Week 2 +

Delivery

On Canvas the Study Guide is under ‘Modules’

- Week 1
  - Lecture 1: Overview of COMP519 (PDF)
    - Lab Intro 1: Preparation for COMP519 Exercises, Labs, and Assignments
    - Lab Intro 2: Using the Departmental Linux Systems
    - Lab Intro 3: Access Control, Synchronisation and Remote Access
  - Lecture 2: HTML (Part 1): HTTP, HTML5, HTML Elements, HTML Characters (PDF)
  - Lecture 2: HTML (Part 1): HTTP, HTML5, HTML Elements, HTML Characters (Video)
  - Lecture 2 Reading
    - Exercises 1: HTML (1)
  - Lecture 3: HTML (Part 2): Structure, Headings, Lists, Paragraphs, Div, Span, Hyperlinks (PDF)
  - Lecture 3: HTML (Part 2): Structure, Headings, Lists, Paragraphs, Div, Span, Hyperlinks (Video)
  - Lecture 3 Reading

Delivery

- $\approx$10 timetabled on-line practical sessions
  to allow you to ask questions about exercise sheets and lecture material

- Completion of exercises will be tracked

Recommended Books

1. J. Niederst Robbins: Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics (5th ed). O'Reilly, 2018.
2. R. Nixon: Learning PHP, MySQL & JavaScript: with jQuery, CSS & HTML5. O'Reilly, 2018.
3. A. Beautieu: Learning SQL (2nd ed). O'Reilly, 2009.
4. N. C. Zakas: Professional Javascript for Web Developers (2nd ed). Wiley, 2009.

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

Assessment

- Assessment:

  Four programming assignments each worth 25% of the module mark (64 hours, one working day per week)

  1. HTML/CSS
  2. JavaScript
  3. PHP
  4. REST (PHP)

  First three already available at

  `http://cgi.csc.liv.ac.uk/~ullrich/COMP519/`

- Assignments are like exams

  $\leadsto$ you can ask what something in an assignment means

  $\leadsto$ you cannot ask how to solve an assignment

  $\leadsto$ you cannot ask whether a solution is correct

Assessment

- Assignments have equal weight but are not equally difficult

	A1	A2	A3	A4
2017-18	78.9	73.6	46.0	
2018-19	70.7	63.5	59.5	
2019-20	74.2	73.2	59.9	52.8

Web $\neq$ 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 $\neq$ 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 communication infrastructure for that
- The world wide web further eases the development of distributed systems by providing an appropriate infrastructure for computation
- 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

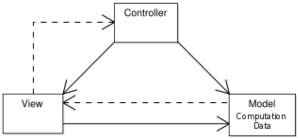
Software developers have to consider a wide, but rather stable, range of questions including:

- 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:

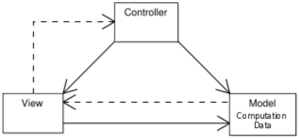


- The model manages the behaviour and data
- The view renders the model into a form suitable for interaction
- The controller receives user input and translates it into instructions for the model

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

Distributed Systems: Model-View-Controller

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

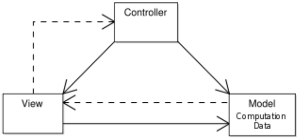


- The model manages the behaviour and data
- The view renders the model into a form suitable for interaction
- The controller receives user input and translates it into instructions for the model

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

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

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

The Pre-PC Era

- 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`

The Pre-PC Era

- 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
  $\leadsto$ the possible answers to the fundamental questions stay the same
- The PC gave very different answers to the fundamental questions
  $\leadsto$ the 'right' answers change with time
- The Google Chromebook is more advanced than the DEC VT100 in (almost) every aspect
  $\leadsto$ 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