

An Introduction to

# LAW & TECHNOLOGY

Edited by  
Eva Lievens  
Simon Verschaeve  
Carl Vander Maelen

OWL PRESS  
LEGAL

CONTENTS

Preface ..... 7

List of Abbreviations ..... 9

**PART I. TECHNOLOGY, ECONOMY & SOCIETY ..... 13**

Chapter 1. An introduction to information technology for lawyers ..... 15

*Yvan Saeys*

Chapter 2. Digital infrastructure ..... 43

*Carl Vander Maelen*

Chapter 3. The rise of platforms in the digital economy ..... 65

*Tom Evens*

Chapter 4. A societal perspective on technology and new media ..... 81

*Ralf De Wolf*

**PART II. INTERACTION BETWEEN TECHNOLOGY & LAW ..... 97**

**HUMAN RIGHTS ..... 99**

Chapter 5. Freedom of expression and digital technologies ..... 101

*Lien Stolle*

Chapter 6. The right to privacy and data protection in a digital era ..... 123

*Ingrida Milkaite & Liesa Keunen*

Chapter 7. Digital discrimination ..... 145

*Eva Lievens*

Chapter 8. Children's rights in the digital environment ..... 159

*Valerie Verdoodt*

**DATA PROTECTION ..... 179**

Chapter 9. Personal data and non-personal data ..... 181

*Ingrida Milkaite*

Chapter 10. Data protection actors ..... 195

*Yueming Zhang & Ingrida Milkaite*

Chapter 11. Data protection principles ..... 209

*Ingrida Milkaite & Eva Lievens*

Chapter 12. Data subject rights ..... 227

*Ruben Roex*

Chapter 13. Data protection compliance ..... 245

*Simon Verschaeve*

Chapter 14. Data protection enforcement ..... 267

*Simon Verschaeve & Liesa Keunen*

|  |            |
|--|------------|
| <b>DIGITAL ECONOMY</b>   | <b>293</b> |
| Chapter 15. The regulation of electronic commerce and digital services | 295        |
| <i>Pieterjan Declerck &amp; Eva Lievens</i>                            |            |
| Chapter 16. The liability of online intermediaries                     | 315        |
| <i>Lien Stolle</i>   |            |
| Chapter 17. Consumer protection in the online environment              | 329        |
| <i>Pieterjan Declerck &amp; Valerie Verdoodt</i>                       |            |
| Chapter 18. The regulation of data-related products and services       | 347        |
| <i>Griet Verhenneman &amp; Simon Verschaeve</i>                        |            |
| Chapter 19. Electronic contracts and electronic signatures             | 377        |
| <i>Ruben Roex</i>  |            |
| Chapter 20. Cookies and similar tracking technologies                  | 391        |
| <i>Simon Verschaeve</i>  |            |
| Chapter 21. Online advertising   | 405        |
| <i>Simon Verschaeve</i>  |            |
| Chapter 22. Cryptocurrencies   | 437        |
| <i>Carl Vander Maelen</i>  |            |
| <b>CYBERCRIME AND CYBERSECURITY</b>                                    | <b>453</b> |
| Chapter 23. Cybercrime and cybersecurity                               | 455        |
| <i>Eva Lievens</i>   |            |
| <b>ARTIFICIAL INTELLIGENCE</b>   | <b>477</b> |
| Chapter 24. The regulation of artificial intelligence                  | 479        |
| <i>Valerie Verdoodt</i>  |            |
| <b>PART III. TECHNOLOGY &amp; THE LEGAL PROFESSION</b>                 | <b>503</b> |
| Chapter 25. Legal Tech   | 505        |
| <i>Carl Vander Maelen</i>  |            |
| <b>PART IV. REGULATING TECHNOLOGY</b>                                  | <b>517</b> |
| Chapter 26. Regulating technology: whether, when and how?              | 519        |
| <i>Carl Vander Maelen &amp; Eva Lievens</i>                            |            |
| Authors  | 535        |

## PREFACE

In 2019, the Faculty of Law and Criminology of Ghent University decided to include a new compulsory course 'Law & Technology' in the Bachelor of Laws programme. The rationale was that every student who graduates in this programme needs to have a basic understanding of the impact of technology on society, the interaction between technology and law, and the impact of technology on legal professionals. In the academic year 2022–2023 the course was taught for the first time. This book aims to familiarise readers in general and students in particular with a selection of important topics in the field of law and technology. It aims to identify challenges, map the legal framework and offer triggers to reflect critically on the importance of (digital) technologies in our lives.

Given that (digital) technologies are omnipresent in today's society and that this extends the scope of questions and topics that could fall within the field of law and technology, this book does not aim to be comprehensive. As editors, we selected themes that we appreciate to be important and relevant at this moment in time. This book is regularly revised to keep up with trends and developments in society. Structural changes in this 4th edition include a new chapter on the recent EU data-related regulations, and the integration of a new chapter on 'Digital infrastructure' in the first part. This chapter combines the previous chapters on ICANN and net neutrality in one chapter. The discussion of each topic offers the reader a sketch of the context, and an explanation of the legal framework at the international, regional and national level.

The book is divided into four thematic parts. Part 1 explains important concepts and terms from other disciplines such as computer sciences, communication sciences and sociology that are necessary to be able to identify and assess the legal impact of technology. It also discusses digital infrastructure and the concept of net neutrality. Part 2 reflects critically on the interaction between technology and law, and discusses topics such as human rights, data protection, digital economy, cybercrime, and artificial intelligence. Part 3 discusses legal tech, which facilitates legal processes and is increasingly used by lawyers, judges and other legal professionals. Finally, Part 4 examines the various instruments and strategies that are used to regulate technology.

Technology evolves at breakneck speed, and traditionally the legislator struggles to keep up. In recent times, however, and especially at the level of the European Union, legislative initiatives have been introduced in rapid succession. Several legislative instruments that are still going through the motions of the legislative process, have just been adopted or are being implemented at national level. The text is up to date until 30 June 2025.

We would like to extend our sincere thanks to all authors. This book is the fruit of a real team effort by the Law & Technology research group of Ghent University and as editors we are proud of what we achieved together. We are grateful as well to Yvan Saeys, Tom Evens and Ralf De Wolf who contributed essential insights from their own

disciplines. Finally, we would also like to thank Nancy De Braekeleer, Freya Maenhout, Paulien Vandenberghe and Nina Waegemans at Owl Press for their enthusiasm and patience.

*Eva Lievens, Simon Verschaeve and Carl Vander Maelen, 30 June 2025*

LIST OF ABBREVIATIONS

|         |  |
|---------|--|
| 5G      | 5th generation broadband network for cellular phone networks               |
| ADR     | Alternative dispute resolution   |
| AI      | Artificial intelligence  |
| AI HLEG | High-Level Expert Group on Artificial Intelligence (European Union)        |
| AML/CFT | Anti-money laundering and countering terrorism financing                   |
| ANN     | Artificial neural network  |
| ARI     | Alternative regulatory instrument  |
| AVMS    | Audiovisual media services   |
| AVMSD   | Audiovisual Media Services Directive                                       |
| BCEL    | Belgian Code on Economic Law   |
| BEREC   | Body of European Regulators for Electronic Communications                  |
| BEUC    | Bureau Européen des Unions de Consommateurs                                |
| BIPT    | Belgisch Instituut voor Postdiensten en Telecommunicatie                   |
| CAHAI   | Ad Hoc Committee on Artificial Intelligence (Council of Europe)            |
| CASP    | Crypto-asset service provider  |
| CBDC    | Central bank digital currency  |
| CCTV    | Closed-circuit television  |
| CEDAW   | Convention on the Elimination of All Forms of Discrimination against Women |
| CEO     | Chief executive officer  |
| CFREU   | Charter on the Fundamental Rights of the European Union                    |
| CJEU    | Court of Justice of the European Union                                     |
| CoE     | Council of Europe  |
| CRC     | Committee on the Rights of the Child (United Nations)                      |
| CRD     | Consumer Rights Directive  |
| CSAM    | Child sexual abuse material  |
| CSR     | Corporate social responsibility  |
| CSIRT   | Computer Security Incident Response Team                                   |
| DA      | Data Act   |
| DCD     | Digital Content Directive  |

|              |  |
|--------------|--|
| <b>DGA</b>   | Data Governance Act  |
| <b>DLT</b>   | Distributed ledger technology  |
| <b>DMA</b>   | Digital Markets Act  |
| <b>DNS</b>   | Domain name system   |
| <b>DPA</b>   | Data Protection Authority  |
| <b>DPbDD</b> | Data protection by design and by default                             |
| <b>DPD</b>   | Data Protection Directive  |
| <b>DPIA</b>  | Data protection impact assessment                                    |
| <b>DPO</b>   | Data protection officer  |
| <b>DSA</b>   | Digital Services Act   |
| <b>DSG</b>   | Directive on the Sale of Goods                                       |
| <b>DSR</b>   | Data subject request   |
| <b>ECB</b>   | European Central Bank  |
| <b>ECD</b>   | E-Commerce Directive   |
| <b>ECHR</b>  | European Convention on Human Rights and Fundamental Freedoms         |
| <b>ECtHR</b> | European Court of Human Rights                                       |
| <b>EDIB</b>  | European Data Innovation Board                                       |
| <b>EDPB</b>  | European Data Protection Board                                       |
| <b>EEA</b>   | European Economic Area   |
| <b>EECC</b>  | European Electronic Communications Code                              |
| <b>EHDS</b>  | European health data space   |
| <b>EHDSR</b> | European Health Data Space Regulation                                |
| <b>EHR</b>   | Electronic health record   |
| <b>ESC</b>   | European Social Charter  |
| <b>EU</b>    | European Union   |
| <b>FCC</b>   | Federal Communications Commission (United States of America)         |
| <b>FIRM</b>  | Federal Institute for Human Rights (Belgium)                         |
| <b>FRA</b>   | Fundamental Rights Agency (European Union)                           |
| <b>FSMA</b>  | Financial Services and Markets Authority (Belgium)                   |
| <b>FTC</b>   | Federal Trade Commission (United States of America)                  |
| <b>GAN</b>   | Generative adversarial networks                                      |
| <b>GBA</b>   | Gegevensbeschermingsautoriteit [Data Protection Authority] (Belgium) |

|                   |   |
|-------------------|---|
| <b>GC</b>         | General Comment (by United Nations institutions)                |
| <b>GDPR</b>       | General Data Protection Regulation                              |
| <b>GPAI</b>       | General-Purpose AI  |
| <b>GPT-3</b>      | Generative pre-trained transformer 3                            |
| <b>HTML</b>       | HyperText Markup Language                                       |
| <b>HTTP</b>       | HyperText Transfer Protocol                                     |
| <b>IaaS</b>       | Infrastructure as a Service                                     |
| <b>IANA</b>       | Internet Assigned Numbers Authority                             |
| <b>ICANN</b>      | Internet Corporation for Assigned Names and Numbers             |
| <b>ICCPR</b>      | International Covenant on Civil and Political Rights            |
| <b>ICESCR</b>     | International Covenant on Economic, Social, and Cultural Rights |
| <b>ICT</b>        | Information and communications technology                       |
| <b>IEEE</b>       | Institute of Electrical and Electronics Engineers               |
| <b>iOS</b>        | iPhone Operating System   |
| <b>IoT</b>        | Internet of Things  |
| <b>IP</b>         | Internet Protocol   |
| <b>IP address</b> | Internet Protocol address                                       |
| <b>ISP</b>        | Internet service provider                                       |
| <b>ISS</b>        | Information society service                                     |
| <b>LED</b>        | Law Enforcement Directive                                       |
| <b>LPWAN</b>      | Low-Power Wide-Area Networking                                  |
| <b>LSA</b>        | Lead Supervisory Authority                                      |
| <b>MiCA</b>       | (Regulation on) Markets in Crypto-Assets                        |
| <b>ML</b>         | Machine learning  |
| <b>MLP</b>        | Multi-layer perceptron models                                   |
| <b>NBCC</b>       | New Belgian Civil Code  |
| <b>NGO</b>        | Non-governmental organisation                                   |
| <b>NLP</b>        | Natural language processing                                     |
| <b>NSA</b>        | National Security Agency  |
| <b>ODR</b>        | Online dispute resolution                                       |
| <b>OECD</b>       | Organisation for Economic Co-operation and Development          |
| <b>OSS</b>        | One-stop shop mechanism   |

|        |  |
|--------|--|
| OTT    | Over-the-top (services)  |
| PaaS   | Platform as a Service  |
| PID    | Price Indication Directive                                       |
| PSP    | Payment services providers                                       |
| RFID   | Radio-Frequency Identification                                   |
| SA     | Supervisory Authority  |
| SaaS   | Software as a Service  |
| SAC    | Supervisory Authority Concerned                                  |
| SDK    | Software Development Kit   |
| SEA    | Search engine advertising  |
| SME    | Small and medium-sized enterprises                               |
| TCP/IP | Transmission Control Protocol/Internet Protocol                  |
| TEU    | Treaty on European Union   |
| TFEU   | Treaty on the Functioning of the European Union                  |
| TLD    | Top-level domain   |
| UCPD   | Unfair Commercial Practices Directive                            |
| UCTD   | Unfair Contract Terms Directive                                  |
| UDHR   | Universal Declaration of Human Rights                            |
| UDRP   | Uniform Dispute Resolution Policy                                |
| UNCRC  | United Nations Convention on the Rights of the Child             |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| URL    | Uniform Resource Locator   |
| UTXO   | Unspent Transaction Output                                       |
| UX     | User experience  |
| VAE    | Variational AutoEncoders   |
| VLOP   | Very large online platform                                       |
| VLOSE  | Very large online search engine                                  |
| VPN    | Virtual private network  |
| VSP    | Video sharing platform   |
| WEF    | World Economic Forum   |
| WP29   | Article 29 Working Party   |
| WWW    | World Wide Web   |



PART I

# TECHNOLOGY, ECONOMY & SOCIETY



## 1. INTRODUCTION

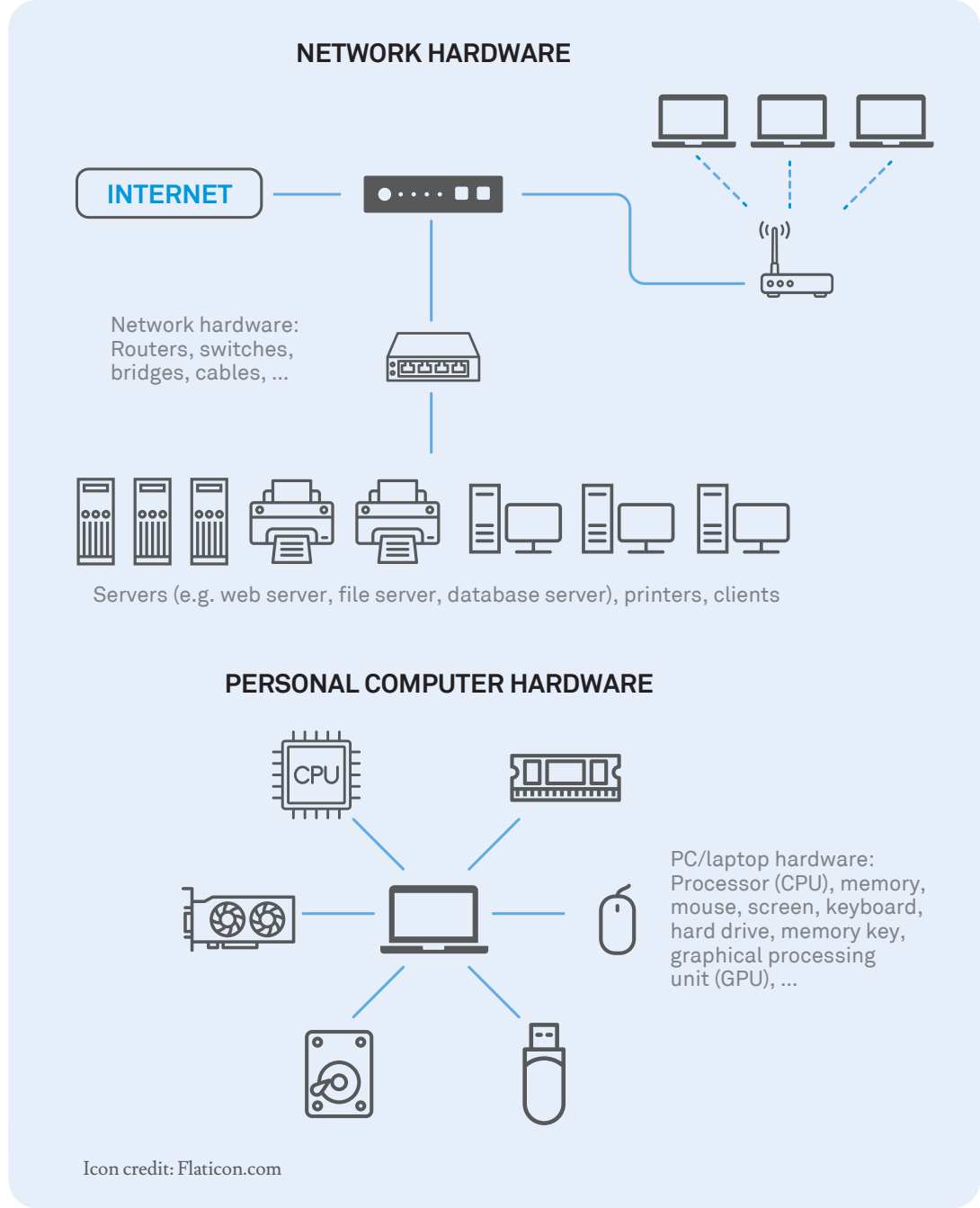
Technological advances during the last decades, and in particular the increased digitisation of information, have strongly shaped and influenced our society. The availability of large volumes of data, together with massive increases in computing power and storage capacity have led to a wealth of information that is now available at our fingertips. At the same time, advances in network technology have radically reshaped the way we communicate, with mobile phones now an integral part of life, making it easier to share and consume information. Novel computational methods such as artificial intelligence (AI) techniques<sup>1</sup> build further on these advances, making it possible to turn these large volumes of data into descriptive and predictive models that can be used to automate decision-making. Together, these technological advances offer a number of opportunities, but also challenges for keeping legal systems in check with the fast-moving technological world. In this chapter, we clarify some of the basics of these recent advances in information technology.

### HARDWARE VERSUS SOFTWARE

Computing systems are built of two large components: hardware and software. Hardware refers to all the physical parts that make up computers and networks. This includes the different computer parts such as hard drives, memory, keyboard, mouse and screen, but also the different parts needed to ensure network connectivity including, *inter alia*, cables, routers and modems. Software on the other hand refers to all the instructions and code that are needed to make the hardware work. Software is typically organised into several layers that build on each other. The lowest layer that directly connects to the hardware is the operating system that makes computers or mobile phones work. On top of the operating system run several types of application software, providing the interface to the end user, such as email clients, text processing software or web browsers.

<sup>1</sup> S Russell, P Norvig, *Artificial Intelligence: A Modern Approach* (Pearson Education Limited 2021).





## 2. INTERNET TECHNOLOGY

The Internet, which represents an international 'network of networks', connects computers and other devices that share a common set of protocols (Transmission Control Protocol/Internet Protocol or TCP/IP for short) for communicating among each other. The Internet facilitates the sharing of information through various protocols, including hyperlinked documents (world wide web), email, telephony and file sharing. Since the 1980s, access to internet technology has become more broadly available, first at universities and academic institutes, then later for the general public by way of internet service providers (ISPs). The Internet has dramatically reshaped the way we communicate and, together with advances in mobile network technology, has now become the major method of communication; this includes social networks, television, video conferencing, online shopping and much more. The omnipresence of internet technology has resulted in new legal challenges, in particular related to cybercrime, fraud, harassment on social media and dealing with private and sensitive information.

### 2.1 THE WORLD WIDE WEB

Pioneered in 1989 by Tim Berners-Lee, the world wide web (WWW) was designed as a collection of documents, linked together by the HyperText Transfer Protocol (HTTP).<sup>2</sup> Every document is characterised by its uniform resource locator (URL), which defines a unique address, and is typically accessed through a web browser. Once a user types in the URL, the web browser translates the URL into an internet protocol address (IP address) using the domain name system (DNS), a hierarchically structured and decentralised naming system that identifies every computer connected to the Internet (see Chapter 2 on 'Digital infrastructure' for more information).

### 2.2 THE INTERNET OF THINGS (IOT)

Building further on internet technology, many devices can now be connected to each other, resulting in the Internet of Things (IoT).<sup>3</sup> Each of these devices could, for example, be equipped with sensors, its own processing power and software running either locally on the device, on a central server or in the cloud. IoT applications are plentiful, including many control and automation applications such as smart homes and smart healthcare systems, but also applications in agriculture, energy management and environmental monitoring. As an example, consider the application of IoT in elderly care homes.<sup>4</sup>

<sup>2</sup> T Berners-Lee, 'The Original HTTP as defined in 1991' (1 January 1991) <www.w3.org>.

<sup>3</sup> M Weiser, R Gold, J S Brown, 'The origins of ubiquitous computing research at PARC in the late 1980s' (1999) 38(4) *IBM Systems Journal* 693.

<sup>4</sup> P A Laplante, M Kassab, N L Laplante, J M Voas, 'Building Caring Healthcare Systems in the Internet of Things' (2018) 12(3) *IEEE Systems Journal*.

Sensors could be embedded in bathrooms and toilets, detecting the location of inhabitants, and measuring weight, pulse and blood pressure. Similarly, sensors in wheel-chairs and walkers could collect data which, when combined with artificial intelligence methods, detect unusual situations or alarming movement patterns, alerting the user to problems.

At the technical level, IoT solutions can be distinguished at two levels: the communication protocols that are used to communicate between the devices and the servers, and the way the data processing is implemented. The communication protocol is often determined by the physical distance between the devices with, for example, Bluetooth and Radio-frequency identification (RFID) frequently being used for short-range wireless communication, and 5G (fifth-generation broadband network for cellular phone networks) and low-power wide-area networking (LPWAN) for medium and long-range distance communication. The data processing can be implemented in several ways, anywhere in between the following two extremes. In the case of edge computing, the largest part of the computation is done on the device itself. This requires the device to have sufficient computing capabilities and is required if, for instance, fast decisions need to be made for which transfer of the data to a remote server is not possible, such as in the camera of a self-driving car. In the case of cloud computing, no computation is carried out on the device itself; instead the data is sent to a remote server or cloud solution for data processing.

### 2.3 BIG DATA AND CLOUD COMPUTING

Due to the digitisation of society, a lot of information can now be collected and stored in digital form, making it easier to use for data-mining purposes. Based on advances in internet technology, a lot of data regarding user behaviour such as surfing, online shopping, music and movie preferences can be collected, and the data subsequently mined for interesting patterns. These patterns can be exploited for many different purposes such as marketing (e.g. defining market segments) and optimising internet traffic, but also surveillance monitoring and internet security. Smart devices such as cameras and sensors are also continuously collecting data, resulting in large data streams that require specific algorithms. These novel types of data result in novel machine-learning models that are now able to automate certain tasks, such as facial recognition or autonomously driving a car.

### ALGORITHMS

The essential building block of all software, an algorithm is defined as a finite sequence of instructions that describes how to realise a specific goal or computation, just as a recipe is used in cooking. A computer program is a specific implementation of such an algorithm, taking into account certain constraints such as specific programming language or hardware of the computer where the program runs.

#### Example of the Bubble sort algorithm to sort a list of numbers

1. Compare the first two elements in the list:  
If the first is greater than the second, swap them.
2. Repeat this with every pair of adjacent elements in the list.
3. Then, repeat from step 1 until the list is fully sorted.

#### Example implementation of the Bubble sort algorithm in Python

```
def bubbleSort(list2sort):
    n = len(list2sort)

    # Go through all list elements for i in
    range(n):
        # Last i elements are already in place for j
        in range(0, n-i-1):

            # traverse the list from 0 to n-i-1
            # Swap if the element is found greater
            # than the next element
            if list2sort[j] > list2sort[j+1]:
                list2sort[j], list2sort[j+1] = list-
                2sort[j+1], list2sort[j]

    # Driver code to test above
    list2sort = [25,22,11,67,91]

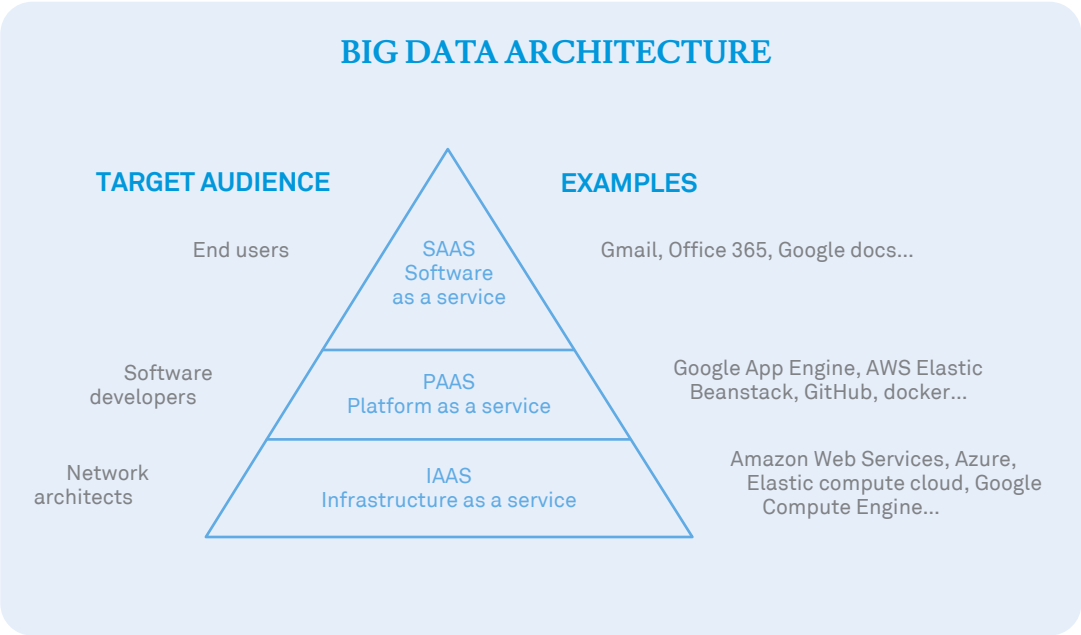
    bubbleSort(list2sort)
    print("Sorted list is:")

    for i in range(len(list2sort)):
        print("%d" % list2sort[i], end=" ")
```

All these digitally generated data result in such large amounts of data that they are simply too much to be handled and stored on a single machine. Therefore, large-scale distributed computing resources, referred to as cloud computing,<sup>5</sup> have become available to offer customers the possibility of outsourcing storage and computing facilities to providers of such resources. Alongside providing large-scale storage and computing resources, these cloud solutions also remove some of the risks of small-scale computing systems, such as vulnerability to hardware crashes, the complexity of which is shielded from the end user and dealt with by the cloud service providers. By offering infrastructure, platforms

<sup>5</sup> L Qian, Z Luo, Y Du, L Guo, 'Cloud Computing: An Overview' in M G Jaatun, G Zhao, C Rong (eds), *Cloud Computing. CloudCom 2009. Lecture Notes in Computer Science* (Springer 2009).

and even software as a service (paradigms referred to as IaaS, PaaS and SaaS),<sup>6</sup> users can now rent these services for as long as they need them, without having to worry about their setup and maintenance. As these services are remotely hosted, they are ubiquitous, available to anyone anywhere and offer flexible payment options: you use and pay as much as required. Companies that work with large amounts of data make use of these cloud solutions as they are extremely well suited to big data mining.



The term big data refers to data-mining problems the volume, diversity and complexity of which requires the development of novel techniques, algorithms and analyses to extract valuable knowledge that is typically hidden inside these data.<sup>7</sup> Big data mining techniques are often characterised by the so-called 5V definition: volume, velocity, variety, veracity and value.<sup>8</sup>

Volume refers to the vast amounts of data that these systems are expected to process. Think for example of the number per minute of tweets that are generated, the images a traffic camera records or the number of status updates on social media. For certain applications, it is important that these data are constantly processed to support downstream decision-making. As the amounts of data become so large, classical databases cannot

adequately handle them and novel, distributed databases have had to be developed, often making use of cloud solutions to deal with them.<sup>9</sup>

The second aspect, velocity, deals with the related aspect of the speed at which the data is generated. This often has consequences for further processing, as certain decisions might be made too late and opportunities may be missed. In some cases, data is arriving at such high speeds that it cannot be stored for further processing, and instant decisions need to be made about whether or not it is useful. Data streams<sup>10</sup> refer to a constant incoming series of data from, for example, sensor networks, weather stations or computer traffic. In the area of machine learning, novel stream-mining algorithms have been developed or adapted to deal with such scenarios.

Another aspect, unrelated to volume and velocity, is the variety of the data. This aspect refers to the many types of data that can be collected, and potentially integrated in order to make further decisions. Two main types of data are typically distinguished: structured and unstructured data.<sup>11</sup> Structured types of data refer to data that are typically stored in tables or relational databases. Think for example of data stored in a spreadsheet, such as expenses or travel distance. Unstructured types of data on the other hand refer to data that you cannot process so easily, such as images, video, sound recordings or social media updates (text). These types of data already require specific expertise to be processed in an automated fashion, such as the natural language processing (NLP) systems that are discussed later in this chapter. Dealing with all these data types is challenging but combining them might be crucial for making important decisions. Imagine the case of patients in a hospital. A lot of clinical information about the patient (e.g. age, sex, blood pressure, weight etc.) might be present as structured data, and stored in a database. Likewise, there might be other types of data, such as radiographic images, the patient's DNA sequence, doctor's notes about the patient or even the patient's social media posts which would all need to be integrated in order to gain a better understanding of the patient's health status.

Another important aspect of big data concerns its veracity: this refers to the fact that data quality might vary, and the accuracy of the information is not always easy to control. Think for example about posts on social media: some information may be ambiguous, missing or sometimes even completely wrong. All this needs to be considered when designing data-mining systems that automatically process such data to yield novel insights.

Finally, all these aspects serve one big goal: to extract value from the data. This could result in the identification of novel patterns, better statistics or machine-learning models, or new opportunities for research and industry. In all these settings it is important that users make a business case for any attempt to collect and leverage big data in order to trade off the costs and benefits of such systems.

6 Y Duan, G Fu, N Zhou, X Sun, N C Narendra, B Hu, 'Everything as a Service (XaaS) on the Cloud: Origins, Current and Future Trends' in *IEEE 8th International Conference on Cloud Computing* (IEEE 2015) 621.  
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8 A Jain, 'The 5 V's of big data', IBM Watson Health Perspectives (17 September 2016) <<https://www.ibm.com/blogs/watson-health/the-5-vs-of-big-data/>>.

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