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FOREWORD

The Web has revolutionized the way the world accesses and shares information. Early on, the Web was a primarily passive, unidirectional platform for serving static HTML pages on demand to people. In no time, business users discovered that the Web not only enabled them to present unified views of products and services to customers around the clock, but that with some programming effort, the Web could support transactional customer-to-business interactions. Today, major corporations world wide increasingly depend on the Web for deploying widely distributed business-to-business processes both within and across the corporate boundary. These applications typically provide services that integrate data from Web and non-Web sources and coordinate interactions with existing business processes – a long way from one-page-at-a-time HTML programming.

The Web's core technologies – HTML and HTTP – were strained to the limit by this rapid evolution. In response, an alphabet soup of new technologies emerged to do what HTML and HTTP could not. XML, XSLT, DTD, JSP, SOAP, WSDL, and UDDI are just a few of the myriad technologies that promise to make the Web application developer's job easier. Developers, however, sit uncomfortably between the promise and the reality of Web technologies. The XML and Web technologies at their disposal are immature. Many are just emerging from standardization, have few robust or interoperable implementations, and lack the application development environments available for more mature technologies.

In 'An Introduction to XML and Web Technologies', Anders Møller and Michael Schwartzbach expertly decipher the alphabet soup of Web technologies. They lucidly describe the technical features of each technology, compare closely related technologies, and show how to apply them in various application scenarios. In Part I, they describe XML's genesis from SGML to become the standard data format on the Web, compare various XML schema languages including DTD and XML Schema, contrast the XML query languages XPath, XSLT, and XQuery, and most importantly, explain how XML technologies can co-exist with general purpose programming languages. In Part II, they describe technologies for building stateful Web servers – Servlets and JSP – as well as the standards for defining, publishing, and connecting to Web services.

Anders and Michael hold their readers in high regard. They write in a clear and plain-spoken voice that disguises their deep understanding of their subject. Each carefully crafted example teaches several concepts at once, and when put together, the examples yield

non-trivial (and entertaining!) results. Anders and Michael also describe the cutting-edge research that will effect the way we program for the Web in the future, which is invaluable to the reader who wants to develop a deep and lasting understanding of these technologies.

This book is a genuine pleasure to read – I learned a lot, and I learned it fast! I hope that Anders and Michael continue to track the Web's rapid changes and provide us with more valuable information in future editions.

Mary Fernández
AT&T Labs Research

PREFACE

XML and Web Technologies

In the early 1990s, the World Wide Web was defined by a triumvirate consisting of the HTML language for writing hypertext documents, the HTTP communication protocol, and the URL notation for addressing resources. Today, new Web technologies are being developed and deployed at amazing rates, building on top of the early foundations. This book offers a comprehensive introduction to the area.

There are two main threads of development, corresponding to the two parts of this book. *XML technologies* generalize the notion of data on the Web from hypertext documents to arbitrary data, including those that have traditionally been the realm of databases. In this book we cover the basic XML technology and the supporting technologies of XPath, DTD, XML Schema, DSD2, RELAX NG, XSLT, XQuery, DOM, JDOM, JAXB, SAX, STX, XDuce, and XACT. *Web technologies* build on top of the HTTP protocol to provide richer languages for constructing applications and services. In this book we cover the basic HTTP protocol and the increasingly abstract technologies of Servlets, JSP, JWIG, WSDL, SOAP, and UDDI.

These are, for better or worse, core technologies that will exist for many years or provide the foundation for future developments.

Aims of This Book

The topics covered by this book are, of course, all richly described in free online standards documents, totaling several thousand pages, but those are wholly unsuited for a self-contained course. This book is unique in providing a coherent overview of the most important XML and Web technologies. It goes into great detail but still aims for conciseness, thereby enabling the reader to see the big picture and yet obtain practical experience with the technologies and supporting tools.

The book also contains critical analyses and discussions of the technologies, in contrast to standards documents and technical manuals, which mainly present and exemplify features. It also provides a uniform terminology that is familiar to readers with a standard computer science background.

The book describes the newest technologies, including XML 1.1, XPath 2.0, XSLT 2.0, XQuery 1.0, JDOM 1.0, SAX2, JAXB 1.0, STX 1.0, HTTP/1.1, Java Servlet 2.4, JSP 2.0, JSTL 1.1, SOAP 1.2, WSDL 2.0, and UDDI 3.0. It focuses on concepts and technologies, rather than on vendor-specific tools. Moreover, the book presents selected research projects – DSD2, RELAX NG, STX, XDuce, XACT, and JWIG – that may influence future technologies.

How to Use This Book

The intended audience of this book includes computer science students, computer professionals, and researchers that want an overview of the area. Preliminary versions of this book have been used several times for undergraduate courses at the University of Aarhus and at the IT University of Copenhagen, and have been the basis for numerous industrial courses. The book can be the complete curriculum for an XML/Web course, or it may be used as a supplement for database or programming courses.

Each chapter contains carefully selected links to the essential online resources, references to further reading, and exercises that help the readers test their understanding and gain familiarity and practical experience with the most important technical specifications and tools.

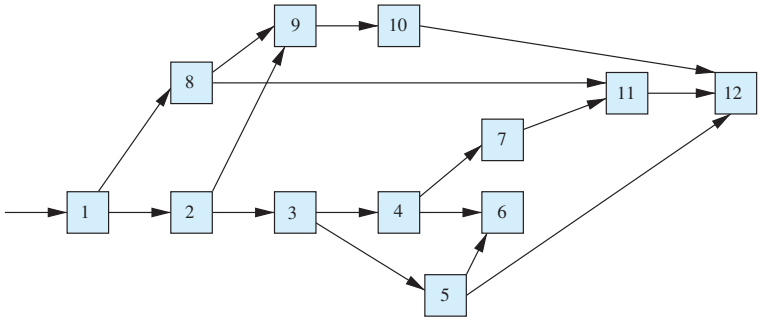
Chapter 1 contains survivor's guides to HTML and CSS, and motivates the need for XML. It also covers technical issues related to Web publication, such as URLs, URNs, URIs, and Unicode. Moreover, this chapter briefly introduces the workings of the World Wide Web Consortium, which develops many of the technologies covered by the book. In Chapter 2, we explain the XML notation, its dual nature as a textual format and a tree structure, and the namespace mechanism. Chapter 3 covers the XPath language, which is used in several other languages for pointing into XML documents and much more. Chapter 4 describes the use of schema languages. It explains the languages DTD and XML Schema, and also two less widely known alternatives, DSD2 and RELAX NG, and compares the languages. Additionally, this chapter contains an introduction to the notion of regular expressions, which is commonly used in schema languages. In Chapters 5 and 6, we show how the XSLT and XQuery languages can be used to define transformations between XML languages, and we provide a thorough comparison between the two. XSLT is mainly targeted at stylesheet transformations for presenting XML data, whereas XQuery is designed primarily for database-like queries. Chapter 7 shows how to work with XML in programming languages using DOM, JDOM, JAXB, SAX, and STX. As a running example, we develop an XML-based language for recipe collections and show how the various technologies become useful.

Chapter 8 contains an introduction to the HTTP protocol and shows how to program HTTP servers and clients. Chapter 9 describes the Servlet platform, which is a convenient API that builds upon HTTP. Closely related technologies are JSP and JSTL, which are the topics of Chapter 10. Chapter 11 explains the basic technologies related to Web services that

communicate XML data on the Web, in particular the WSDL, SOAP, and UDDI initiatives. Finally, Chapter 12 collects the essential knowledge from the other chapters and applies it to a larger project: development of an interactive Web service, *The Web of Jokes*, for sharing jokes on the Web.

All chapters contain numerous 'gold nuggets' showing concrete examples of how typical tasks can be solved with the technologies being described.

The chapter dependencies may be illustrated by the following diagram:



Chapters 7, 8, 9, 10, 11, and 12 assume a basic knowledge of the Java programming language. This language is natural to use when illustrating Web technologies because of its platform independence and native support for Unicode and migration of data and code, and furthermore, a majority of the freely available tools that exist for XML and Web development are based on Java. Except from this prerequisite, the book is self-contained.

Some sections of this book are intended for advanced studies and may safely be skipped by readers who only need to obtain basic familiarity with the presented technologies. These sections, marked with the symbol ★, contain further discussions and presentations of advanced features and research topics.

The Companion Web Site

The book has a companion Web site located at

```
http://www.brics.dk/ixwt/
```

This site contains additional material for teachers and students: an extensive collection of slides, examples from the book, additional projects, and multiple choice tests for each topic. Qualified instructors may obtain solutions to the exercises and the PowerPoint sources for the slides. Moreover, many exercises in the book refer to online data. We use *EX* as an abbreviation of the URL `http://www.brics.dk/ixwt/exercises/`.

A preliminary version of the online material has been continually updated since March 2000 and has been visited by more than 300,000 people (counted as unique IP numbers).

Acknowledgements

Thanks to Claus Brabrand, Mary Fernández, Thomas Hildebrandt, Martin Mosegaard Jensen, Lars Michael Kristensen, Henning Niss, Peter Thiemann, Phil Wadler, and the anonymous reviewers for detailed comments to the contents of this book. The participants of several XML and Web courses at the University of Aarhus and the IT University of Copenhagen have also contributed to structuring and proofreading the presented material. Thanks to the people from Pearson Education: to Sami Taalas and Kate Brewin for persuading us to enter into the project, and to Owen Knight, Mary Lince, Karen McLaren Simon Plumtree, and Simon Turner for guiding us through the process.

Anders Møller
Michael I. Schwartzbach

Publisher's Acknowledgements

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