# Contents

**The Authors** ix

**List of Contributors** xi

**Preface** xiii

1 Introduction 1

2 Agent Technology Overview 3
   2.1 About agents 3
   2.2 The Foundation for Intelligent, Physical Agents (FIPA) 10

3 The JADE Platform 29
   3.1 Brief history 29
   3.2 JADE and the agents paradigm 30
   3.3 JADE architecture 32
   3.4 Compiling the software and launching the platform 34
   3.5 JADE packages 37
   3.6 Message transport service 39
   3.7 Admin and debugging tools 42

4 Programming with JADE – Basic Features 51
   4.1 Creating agents 51
   4.2 Agent tasks 57
   4.3 Agent communication 65
   4.4 Agent discovery: the yellow pages service 72
   4.5 Agents with a GUI 75

5 Programming with JADE – Advanced Features 77
   5.1 Ontologies and content languages 77
   5.2 Composing behaviours to create complex tasks 91
   5.3 Threaded behaviours 99
   5.4 Interaction protocols 100
   5.5 Interacting with the AMS 107
   5.6 Starting JADE from an external Java application 111

6 Agent Mobility 115
   6.1 Agent mobility 115
   6.2 Intra-platform mobility 117
   6.3 Inter-platform mobility service 119
   6.4 Usage of the JADE mobility services 121
7 JADE Internal Architecture
   7.1 Distributed coordinated filters 131
   7.2 Creating a JADE kernel service 136

8 Running JADE Agents on Mobile Devices
   8.1 Main limitations of the mobile environment 145
   8.2 The LEAP add-on 146
   8.3 The split container execution mode 150
   8.4 Developing MIDP agents 154
   8.5 LEAP add-on advanced 161

9 Deploying a Fault-Tolerant JADE Platform
   9.1 The main replication service 173
   9.2 Attaching the DF to a relational DB 176

10 The JADE Web Services Integration Gateway
    10.1 Web service technology 181
    10.2 The utility of agent and Web service integration 182
    10.3 The WSIG architecture 182
    10.4 Installation requirements 184
    10.5 WSIG installation procedure 185
    10.6 WSIG operation 186
    10.7 Example 1: Web service client invokes an agent service 193
    10.8 Example 2: Agent service invokes a Web service 203

11 Agent-Society Configuration Manager and Launcher
    11.1 Basic terms and concepts 207
    11.2 Book-trading example 209
    11.3 Distributed deployment 215
    11.4 The XML meta-model 218
    11.5 Inside the ASCML 220
    11.6 Distributed monitoring, logging and debugging 222
    11.7 Outlook 223

12 JADE Semantics Framework
    12.1 FIPA-SL language 225
    12.2 Interpretation engine 230
    12.3 Basic semantic agent 231
    12.4 Specializing the interpretation activity 234
    12.5 Customizing belief handling 237
    12.6 Handling Actions 240
    12.7 Synthesizing standard and advanced use of the JSA 245
    12.8 Conclusions 245

13 A Selection of Other Relevant Tools
    13.1 The Bean Generator 247
    13.2 JADEMEX 250
    13.3 The Java Sniffer 251
    13.4 JADEX – engineering goal-oriented agents 254