LONDON METROPOLITAN UNIVERSITY

ICRTCCM17 Invited Talk

Programming vs. Component Development

Evolution of Enterprise Computing and its Challenges to University Education

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1 Past and present – my own programming experience

- Initially fascinated by the idea of *modelling physical processes* – studied Control Theory for BSc and programmed numerical methods
- Hooked by the idea of *modelling abstract processes* – switched to Computer Science at my MSc and programmed language processors
- Always seriously attracted by the idea of *modelling intelligent behaviour* – did AI in my PhD years and programmed knowledge-based systems

More recent focus

- Dived deeper into *data representation* – did databases in industry, designing databases and developing information systems using Oracle
- Dived deeper into *data modelling* – did semantic modelling at university, developing ontologies and semantic applications
- Recently dived deeper into *data processing* – did BigData and data analytics industrial training for data analytics

Programming and Languages

- Numerical calculations: **Fortran** (1979-1983)
- Language processors: **Pascal** (1984-1985)
- Symbolic computation: **Lisp** (1986-1993)
- Database applications: **PL/SQL** (1994-1999)
- Network programming: **Java** (2002-)
- Real-time data processing: **Python** (2014-)

Academic roles

- **Senior Lecturer in Computer Science**

  (teaching Introduction to Computer Science, Formal Specification, Distributed and Internet Systems, Enterprise Components and Systems and BigData Management)

- **Course Leader at the School of Computing**

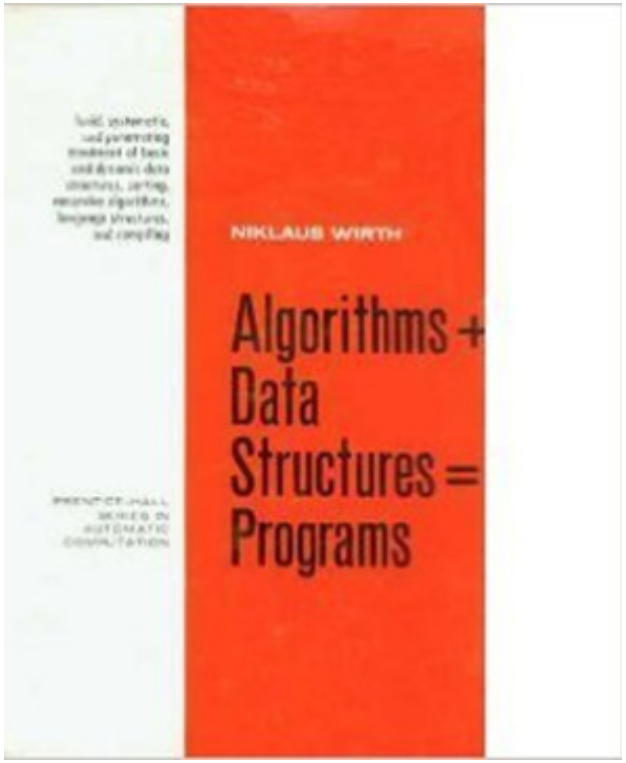
  (BSc Computer Science, MSc Computer Science, MSc Professional Engineering and Technology, MSc Computing and Information Systems)

- **Senior Manager of the Cyber Security Research Centre of Londonmet**

  (projects for Cross-channel fraud detection in banking, Online customer analysis using Web microservices and Individual and Group Dynamic Behaviour Analysis in CCTV

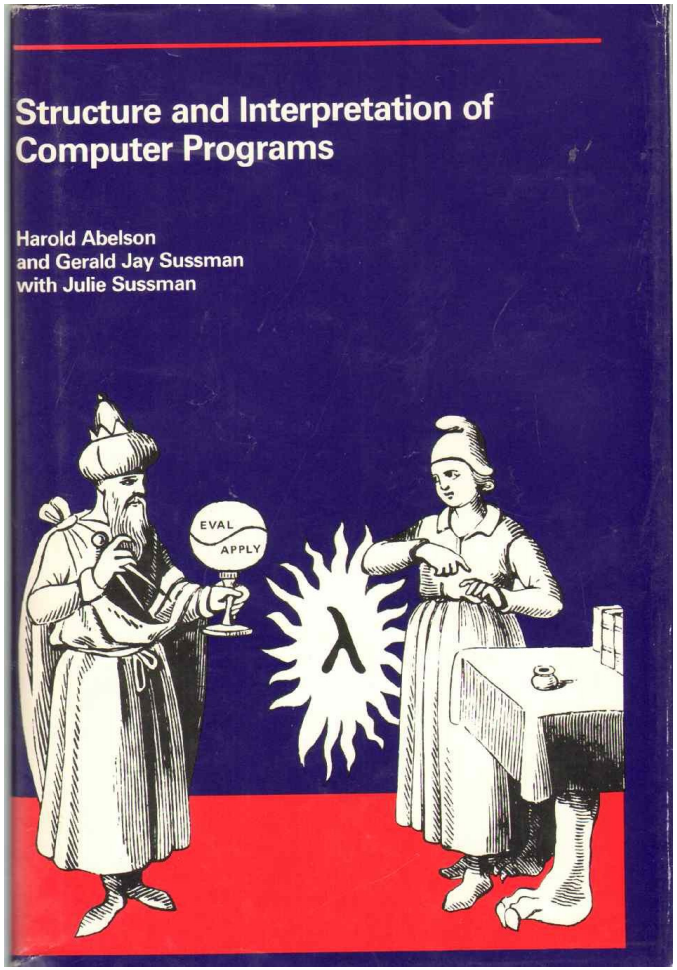
2 My bibles – the books I have used to teach programming

- **Programming as implementing algorithms for processing data (Pascal)**



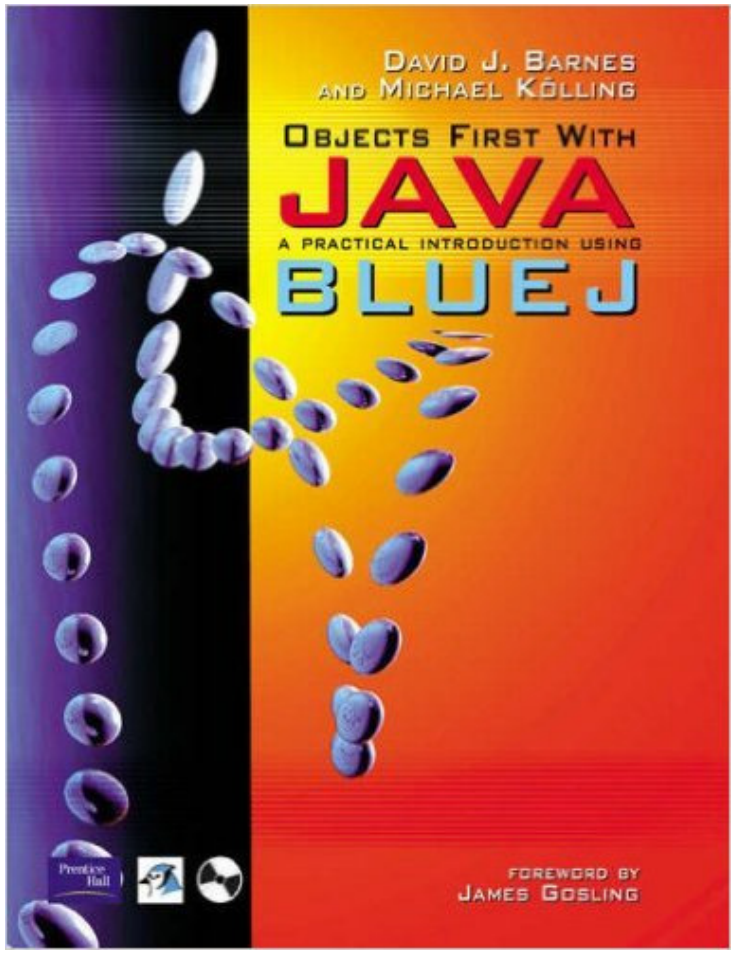
Niklaus Wirth, *Algorithms + Data Structures = Programs* (Prentice-Hall Series in Automatic Computation), 1st ed., Englewood Cliffs NJ: Prentice-Hall (1976).

- **Programming as implementing models for solving problems (Scheme Lisp)**



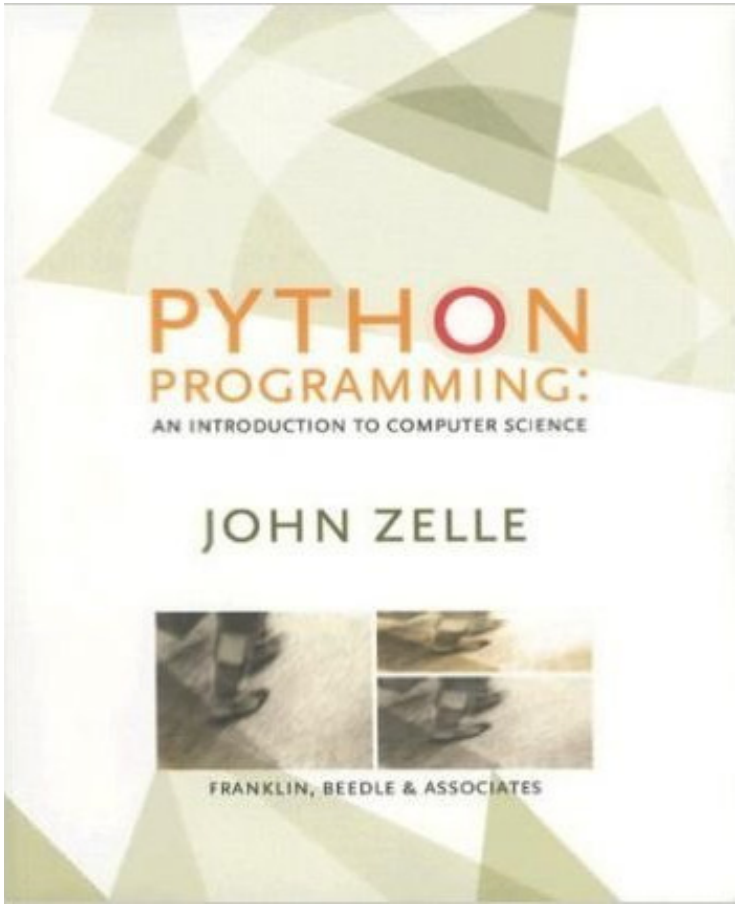
Harold Abelson, Gerald Jay Sussman and Julie Sussman, *Structure and Interpretation of Computer Programs* (MIT Electrical Engineering and Computer Science), Cambridge MA: The MIT Press (1984).

- **Programming as constructing objects for exchanging information (Java)**



David Barnes, Michael Kolling, *Objects First with Java: a Practical Introduction Using Bluej,* London: Addison Wesley, 1st ed. (2003)

- **Programming as a quick fix (Python)**



John Zelle, *Python Programming: An Introduction to Computer Science*, 1st ed., Portland OR: Franklin, Beedle & Associates (2004)

3 Evolution of Programming – from Algorithms to Frameworks

Algorithm Specification and Coding

Program Design and Implementation

Software Components and Development

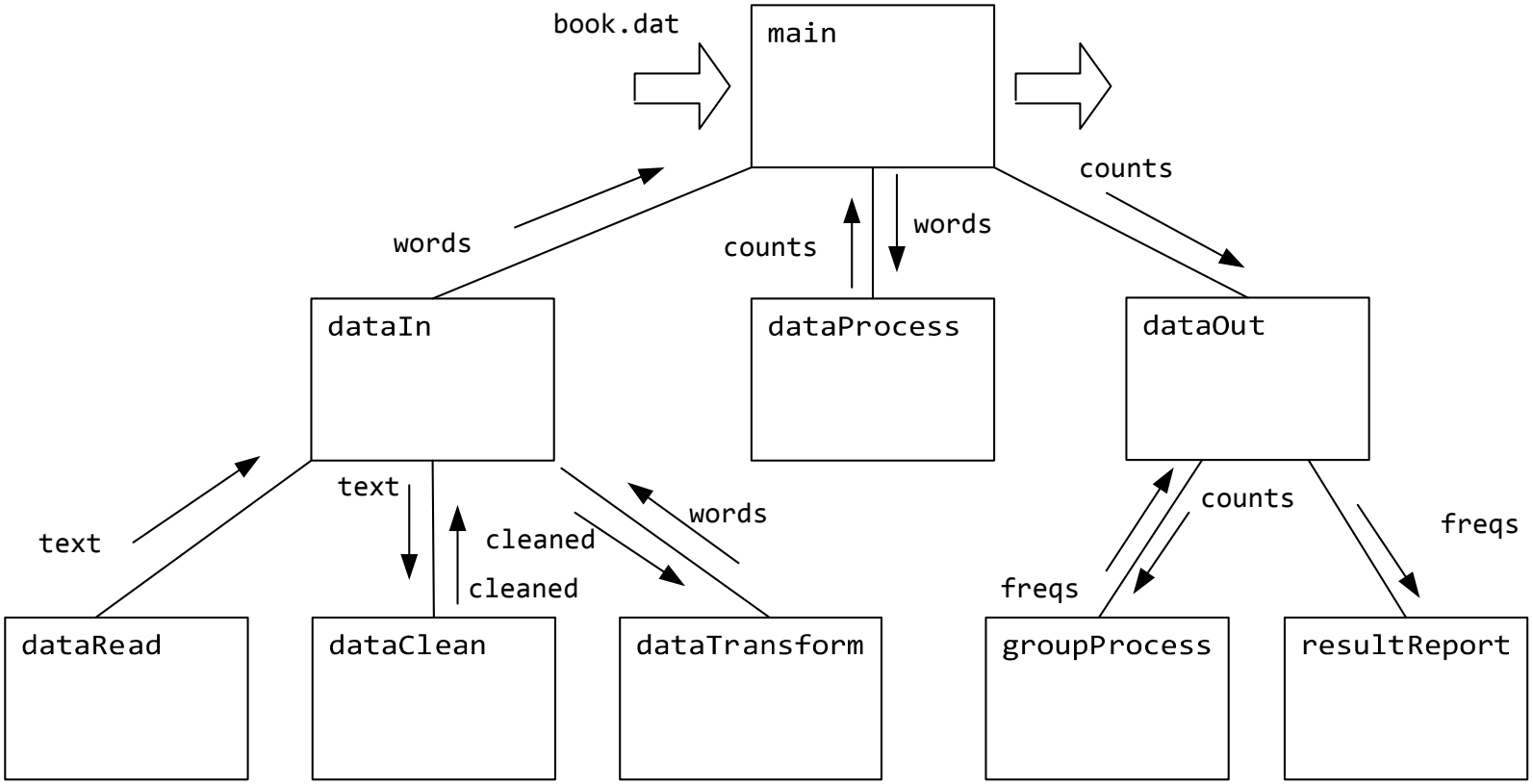
Software Systems and Integration

Software Frameworks and Configuration

Example 1: Algorithms
The insertion sort algorithm

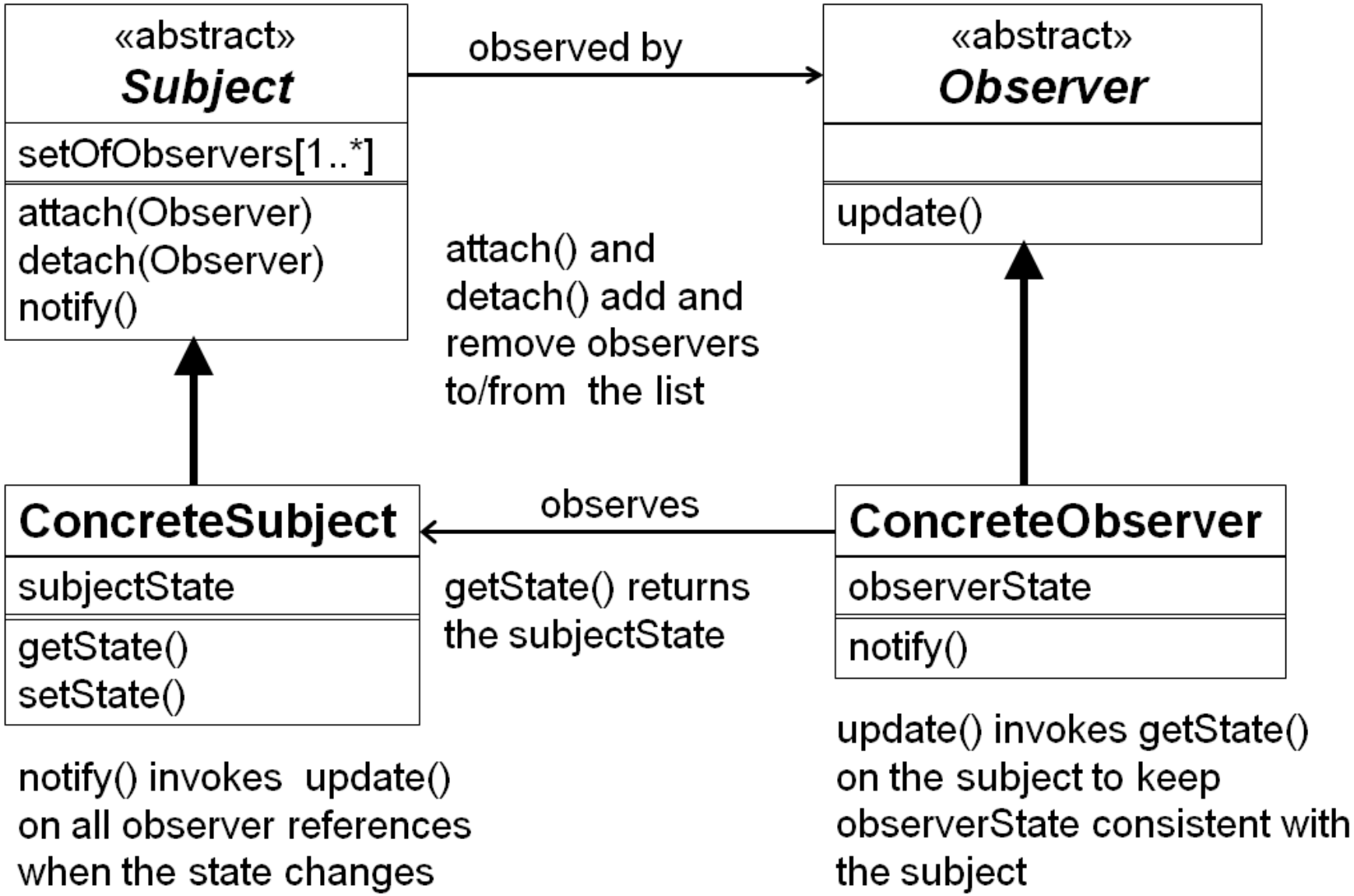
```
define Sort(List):
    initialize N = 2
    while (N <= length of List) repeat
        Pivot = Nth entry in List
        Remove Nth entry leaving a hole in List
        while (there is an Entry above the hole
                        and Entry > Pivot) repeat
            Move Entry down into the hole
        stop repeating
        Move Pivot into the hole
        increment N
     stop repeating
finish
```

Example 2: Programs
Hierarchical Streamlined Text Processing



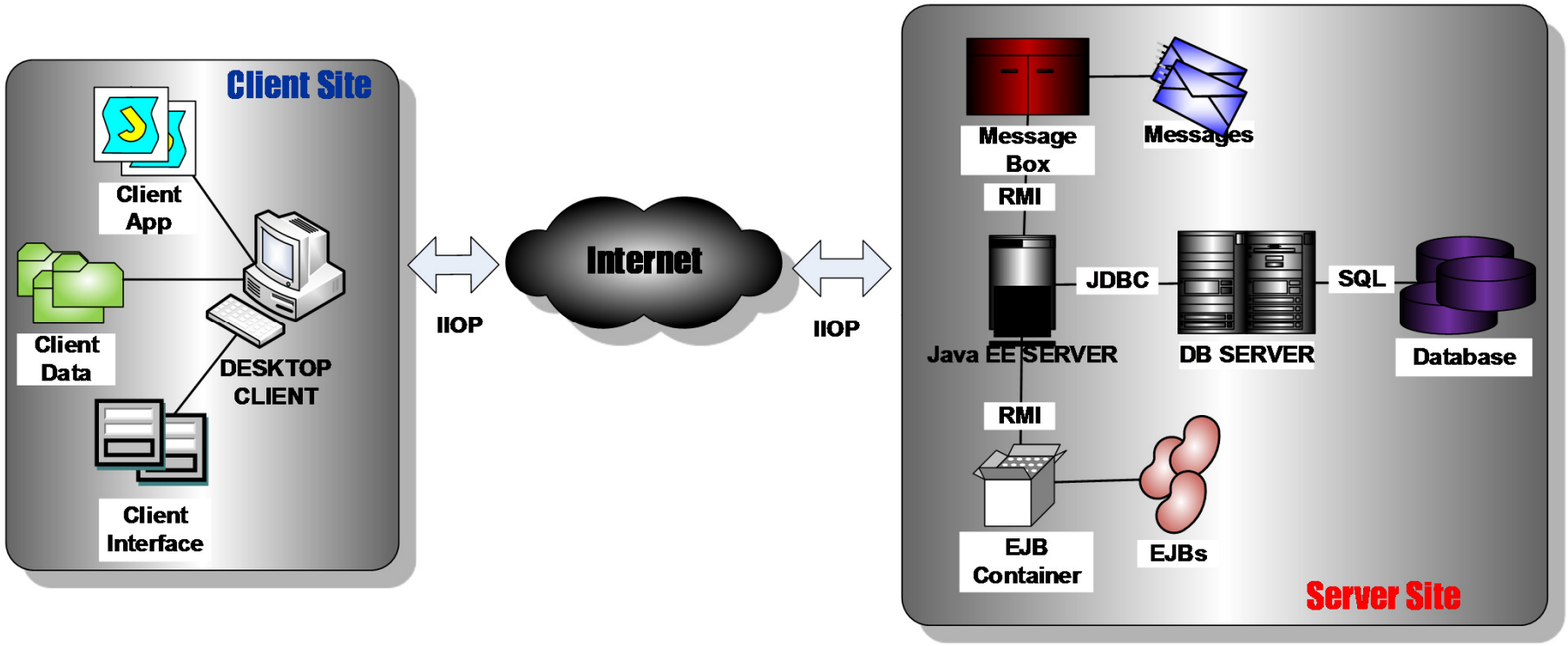

```
def main():
    dataOut(
        dataProcess(
            dataIn()))
```

Example 3: Software Components
Event logger with observer pattern



Example 4: Enterprise Systems

Java EE application with remote desktop client



Example 5: Software Frameworks

Oozie workflow for Pig processing on Hadoop

```
<workflow-app xmlns="uri:oozie:workflow“ name="whitehouse">
  <start to="transform_whitehouse_visitors"/>
  <action name="transform_whitehouse_visitors">
    <pig>
      <job-tracker>${resourceManager}</job-tracker>
      <name-node>${nameNode}</name-node>
      <prepare>
        <delete path="wh_visits"/>
      </prepare>
      <script>whitehouse.pig</script>
    </pig>
    <ok to="end"/>
    <error to="fail"/>
  </action>
  <kill name="fail">
    <message>Job failed, error message
       [${wf:errorMessage(wf:lastErrorNode())}]
    </message>
  </kill>
  <end name="end"/>
</workflow-app>
```

4 Challenges to university education posed by programming

Challenges to the students: (***Examples:*** model-driven *vs.* ad-hoc, command line *vs.* visual drag-end-drop, procedural *vs.* object-oriented)

Challenges to the lecturers: technological advances require insight (***Examples:*** Big Data vs. Small Data, Database vs. Data Lake, vs. Data Fog)

Challenges to the technical teams: new versions require annual software installations, limited resources force centralized maintenance, software interactions requires custom-tailored configurations

Challenges to the management body for managing the changes

Conclusion: Trends and Recommendations

Computing Infrastructure: from native client installation to running within a sandbox on the client to cloud-based

Programming Languages: Introductory (Python), Further (Java/.Net), Specialized (JavaScript, C++, .Net, Java EE)

Programming Environments: BlueJ-NetBeans-Eclipse (Java), Visual Studio (.Net), Idle (Python)

Software Libraries: Using programming APIs and software Libraries vs. ad hoc programming

Software Methodologies: more and more agile development, less and less classical approaches and code generation