SOA: Service-Oriented Architecture

- Services? “A procedure, method, or object with a stable, published interface that can be invoked by clients”
- Popular means to establish services is Web Services
Web Services

“Web Services are a new breed of Web application. They are self-contained, self-describing, modular applications that can be published, located, and invoked across the Web. Web services perform functions, which can be anything from simple requests to complicated business processes...Once a Web service is deployed, other applications (and other Web services) can discover and invoke the deployed service…” [IBM]

Web Services

- XML-based framework for machine interoperability
  - API: WSDL
  - Communication: SOAP
  - Yellow Page: UDDI
- Disguised RPC or CORBA in XML
- Let S/W agents communicate each other w/o human intervention (in theory)
Web Services

- Web services market will be **$21 billion** by 2007 and will peak at $27 billion in 2010 [IDC, 2003]
- **80%** of US enterprises will have some type of Web services project under way by 2008 [IDC, 2003]
- **41%** percent of enterprise software purchased in 2007 will be Web-services-enabled [Gartner, 2004]
- Tools for Web Services are needed to:
  - Discover
  - Compose
  - Analyze
  - Optimize
  - …
Web Services Research @ IST/Penn State

- **Atherton** project is to develop tools/methodology for Web Services
  - [http://nike.psu.edu/atherton/](http://nike.psu.edu/atherton/)

- **Sub-projects**
  - Analysis & Optimization: **MISQ** [BSN 05]
  - Generation: **Pollock** [ACM SAC 05, ECDL 04, IBM Eclipse Grant 04]
  - Discovery and Composition: **BF** [IEEE EEE 05, Microsoft SciData Grant 05]
  - …

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1. **MISQ : Motivation**

- Composing various services in various ways can yield value-added services in BSN
- Finding an optimal configuration in general settings is *NP-complete* (proof via a reduction to SAT problem)
- Nevertheless, optimization is still feasible for a small-size setting => How?
  - People start from graphical model: UML, ER, …
  - Other mathematical models are good for analysis: Petri Net, Automata, …
1. MISQ: Optimize UML

- High-Level UML (Sequence, State)
- High-Fidelity UML (Class, Activity)
- Implementation (BPEL, WSDL)

2. Pollock: Data in “Hidden” Web
2. Pollock: WS Generator

WWW

Human → Internet → FORM → Server

Semantic Web

Machines → Internet → Web Services Layer → Server

Virtual Web Services
3. BF*: WS Composition

- What to do when single WS cannot satisfy given task? => Combine multiple WS
- Can be cast to classical Graph Planning/Search problem
  - Partial Order Planning
  - Integer Programming
- We attack “Large-Scale” WS composition problem – 10,000 WS
  - Heuristic greedy algorithm (eg, A*, Tabu)
  - Novel index structure – Bloom Filter

Conclusion

- Exciting research going on @ IST
- Current major focus is on Computational aspect, but like to expand to ...
- Detailed information are available at:
  - Project Homepage: http://nike.psu.edu/atherton
  - Prototype: http://nike.psu.edu/atherton/bfstar/
  - Demo: http://opendblp.psu.edu/bfstar/

- Thanks !!