Programming Languages and Formal Models
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Models and Abstraction

- Reasoning about “real” programming systems is difficult
- Hence, we build models, i.e. abstractions
- A good model
  - focuses on the chosen aspects and removes other aspects
  - allows formal reasoning
  - transfers results back to reality (soundness)
Ongoing projects

- Models for trust in computing
- Models for secure computation
- Models for functional programming
- Models for Web/XML programs
Is the response always valid XHTML?
Program Analysis

Everything interesting about the behavior of programs is undecidable.
H.G. Rice, 1953

A pragmatic solution: conservative approximations
Analyzing Web Applications

Knuth 1967, Mohri & Nederhof 2001

context-free grammar

\[
\begin{align*}
N_1 & \rightarrow N_2 \\
N_2 & \rightarrow N_3 N_3 \\
N_3 & \rightarrow N_4 N_5 \\
N_4 & \rightarrow N_6 N_7 \\
N_5 & \rightarrow \epsilon \\
N_6 & \rightarrow \epsilon \\
N_7 & \rightarrow N_8 N_9 \\
N_8 & \rightarrow R_8 N_8 \\
N_9 & \rightarrow R_9 N_9 \\
N_{10} & \rightarrow \epsilon \\
N_{11} & \rightarrow \epsilon \\
N_{12} & \rightarrow N_{14} N_{15} \\
N_{13} & \rightarrow \epsilon \\
N_{14} & \rightarrow N_{16} N_{16} \\
N_{15} & \rightarrow \epsilon \\
N_{16} & \rightarrow \epsilon
\end{align*}
\]

\[
R_3 \rightarrow [\text{form action="..." method="POST"} ... \text{/form}] \\
R_8 \rightarrow [\text{b} \text{Phone:/b}] \\
R_{12} \rightarrow [\text{html xmlns="http://www.w3.org/1999/xhtml">} \\
\text{<head><title>...</title></head><\text{body}>}] \\
R_{15} \rightarrow [\text{hr size="1"/>}</text/body>]</text/html>]
\]

Java Servlet / JSP source code

XML graph analyzer

XML graph
Current and future work

- Prototype implementation
- Experiments to test precision and performance
- Develop new program analyses building on context-free grammars and XML graphs