Program Analysis

Data Flow Analysis (Part 5)
Outline

- First example: Available expressions
- Basic principles
- More examples
- Solving data flow problems
- Inter-procedural analysis
- Sensitivities
Intra- vs. Inter-procedural

- **Intra-procedural analysis**
  - Reason about a function in isolation

- **Inter-procedural analysis**
  - Reason about multiple functions
  - Calls and returns

- Data flow analyses considered so far: Intra-procedural
Inter-procedural Control Flow

- One control flow graph per function
- Connect call sites to entry node of callee
- Connect exit node back to call site
Inter-procedural control flow graph: Example

```javascript
function foo(x) {
    if (x > 1)
        z = bar(5)
    else
        z = bar(3)
}
function bar(y) {
    console.log(y)
    return y + 1
}
```

Analysis considers only "possible" inter-proc. flows:
- After return, don't enter again
- When returning, go back to call site
Propagating Information

- **Arguments** passed into call
  - Propagate to formal parameters of callee

- **Return value**
  - Propagate back to caller

- **Local variables**
  - Do not propagate into callee
  - Instead, when call returned, continue with state just before call
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For backward analysis: Everything in reverse