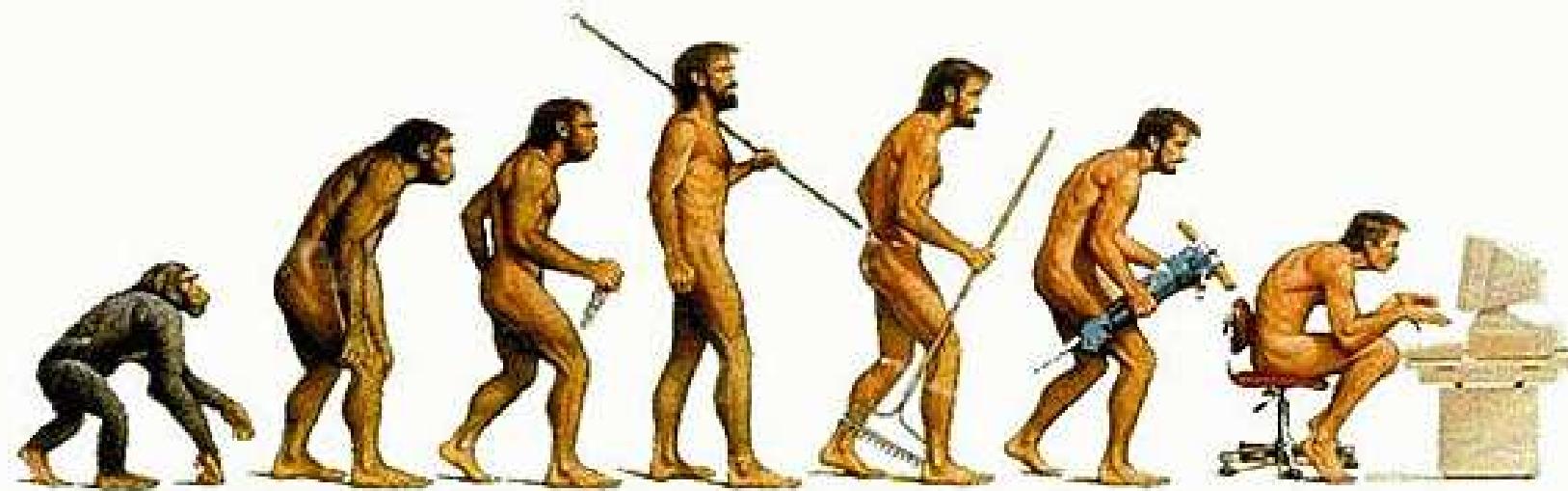


# A Determinizing Compiler

Nalini Vasudevan      Stephen A. Edwards

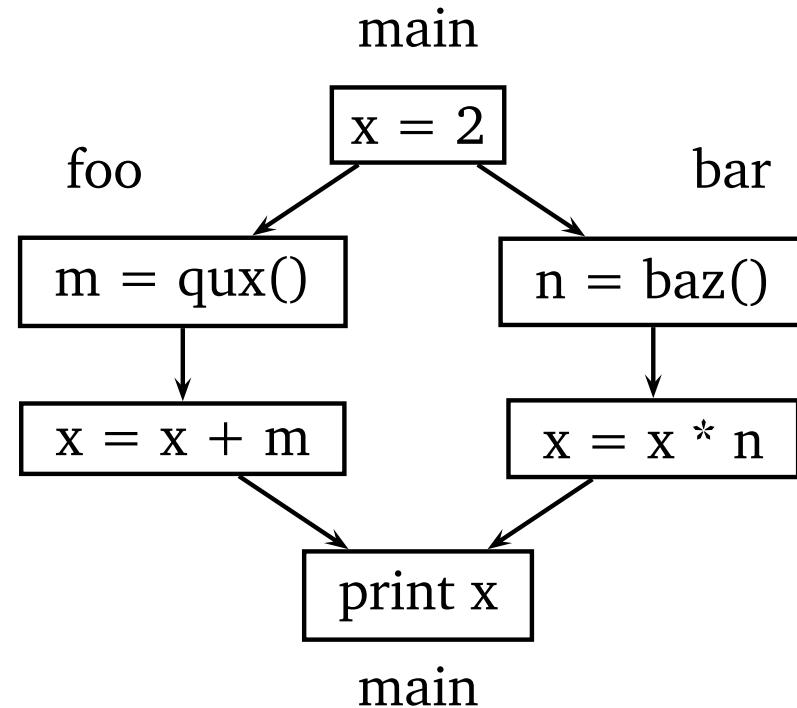
Columbia University



Parallel Computers	<b>Library Support</b>	<b>Performance Parallel Languages</b>	<b>Data Races</b>	<b>Non- Determinism</b>	<b>Hard-to-debug</b>
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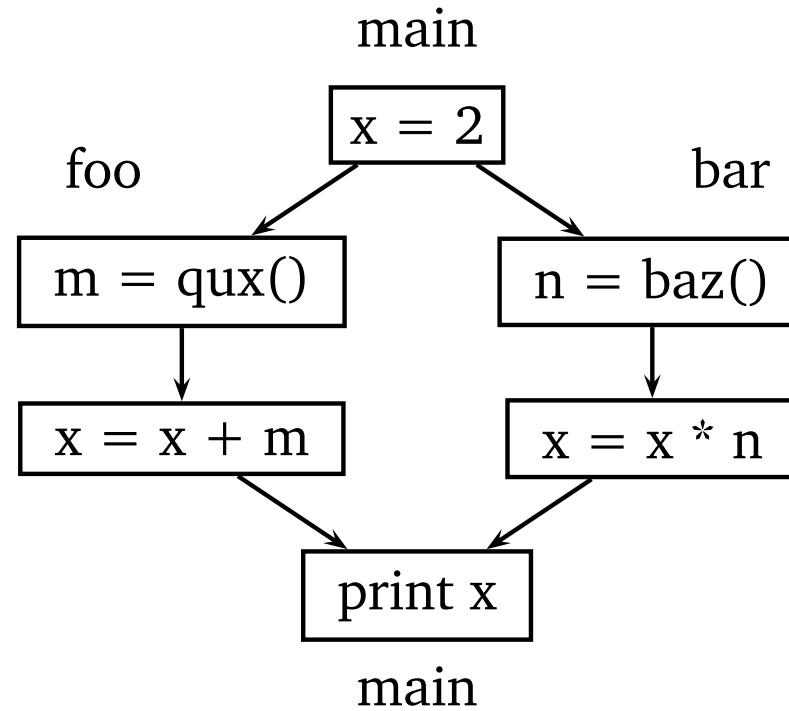
# An Example

```
int x;
foo(){
    int m;
    m = qux();
    x = x + m;
}
bar(){
    int n;
    n = baz();
    x = x * n;
}
main() {
    x = 2;
    thread_create(foo);
    thread_create(bar);
    thread_join(foo);
    thread_join(bar);
    print(x);
}
```



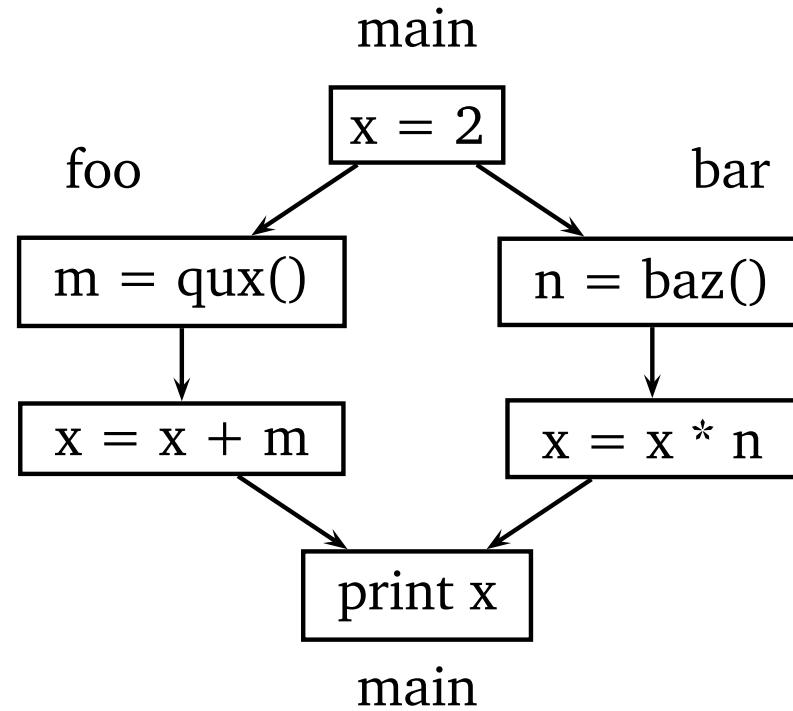
# An Example

```
int x;
foo(){
    int m;
    m = qux();
    lock(x);
    x = x + m;
    unlock(x);
}
bar(){
    int n;
    n = baz();
    lock(x);
    x = x * n;
    unlock(x);
}
main() {
    x = 2;
    thread_create(foo);
    thread_create(bar);
    thread_join(foo);
    thread_join(bar);
    print(x);
}
```



# An Example

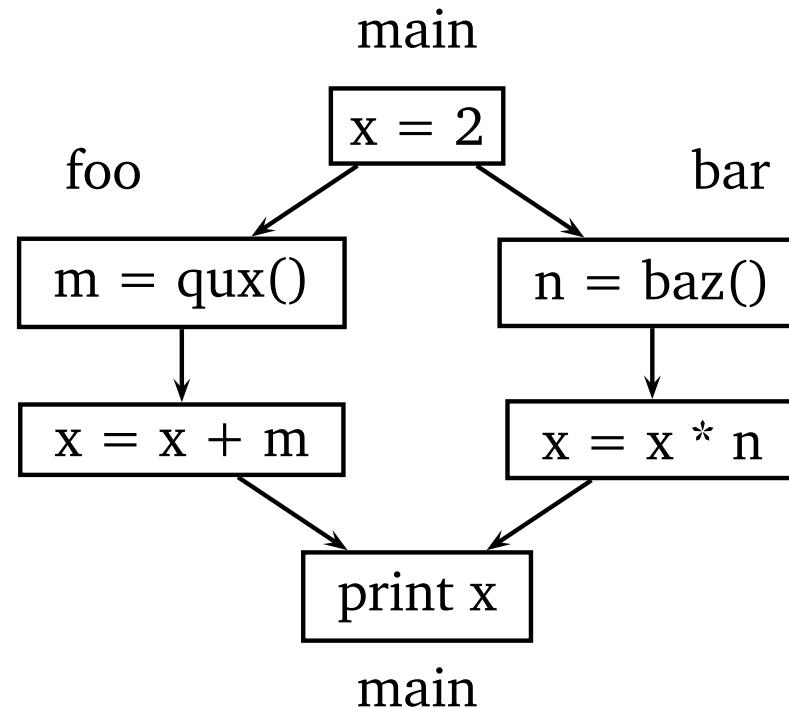
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if  $m = n = 2$

# An Example

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int x;
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    thread_create(bar);
    thread_join(foo);
    thread_join(bar);
    print(x);
}
```



$$\text{if } m = n = 2$$

$$x = (2 + 2) * 2 = 8$$

$$x = (2 * 2) + 2 = 6$$

THE NEW YORK  
TIMES

# The New York Times.

LATE EDITION  
Newspaper for Sunday  
and National Edition  
Sunday edition

1982, Sunday, July 10, 1982

THEATRE

SUNDAY TRAVEL

HOME & GARDEN

## BANK OF ARTICA EMPLOYEE FIRED

### Bank loses 10 million in a day

#### U.S. BANK ASKS FED TO REIN

American Across the Sea in Strength  
Have Fired Reuters Who Were  
Ousted Offshore From Oil

#### UNITED TRAC, WITH WORLDWIDE

United Trac Received \$1 Billion From Commercial  
Bank—British Bank Based in the U.S.—  
Banking Crisis—Canadian Prime Minister

By JOHN L. HARRIS  
Times Staff Writer  
The latest banking crisis in the United States has hit another major institution, this time a large commercial bank based in Canada. The Canadian Prime Minister, Pierre Trudeau, has announced that the Bank of Montreal will receive \$1 billion in federal funds to help it meet its obligations to depositors and other creditors. The move comes as the Canadian economy continues to struggle with high inflation and interest rates, and as concerns grow about the stability of the Canadian banking system.

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#### 100 MILLION DOLLARS DOWN THE PLUNGE

From the Faculty Association of Columbia  
as Columbia Under Heavy Siege  
To Another's Letter of Job

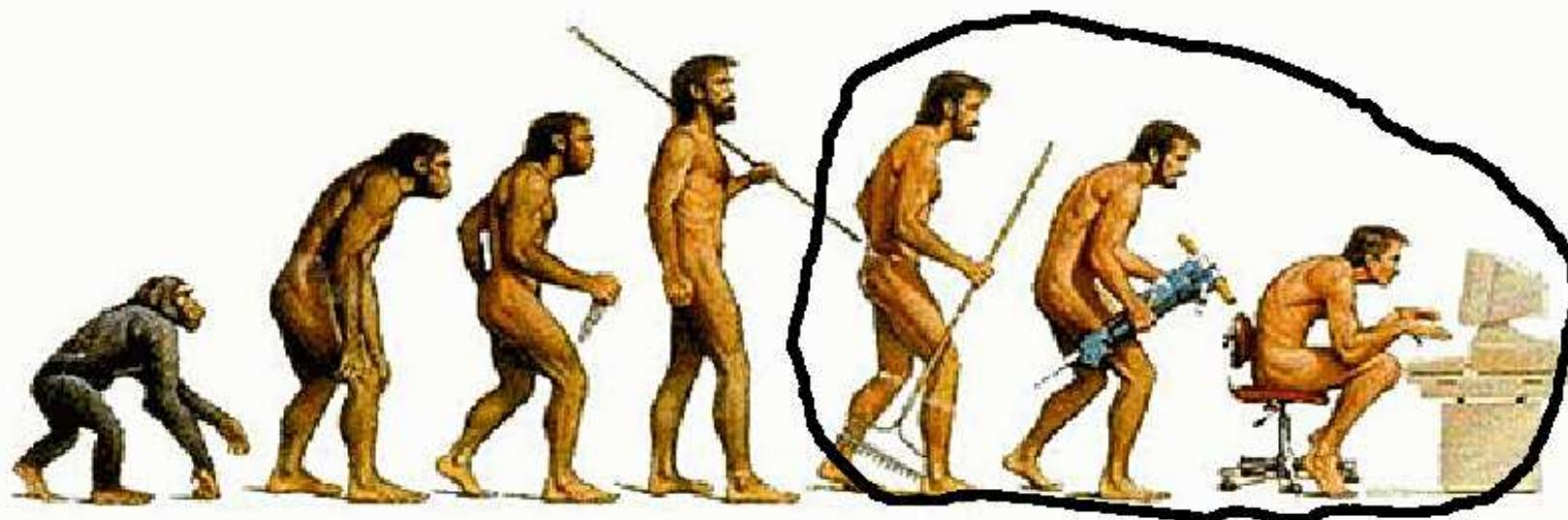
#### ALL CURRENT REPORTS TO KEEP PACE

Power Is Out in Many Major Cities  
the Loss of Power May Be  
Report of Power Outage

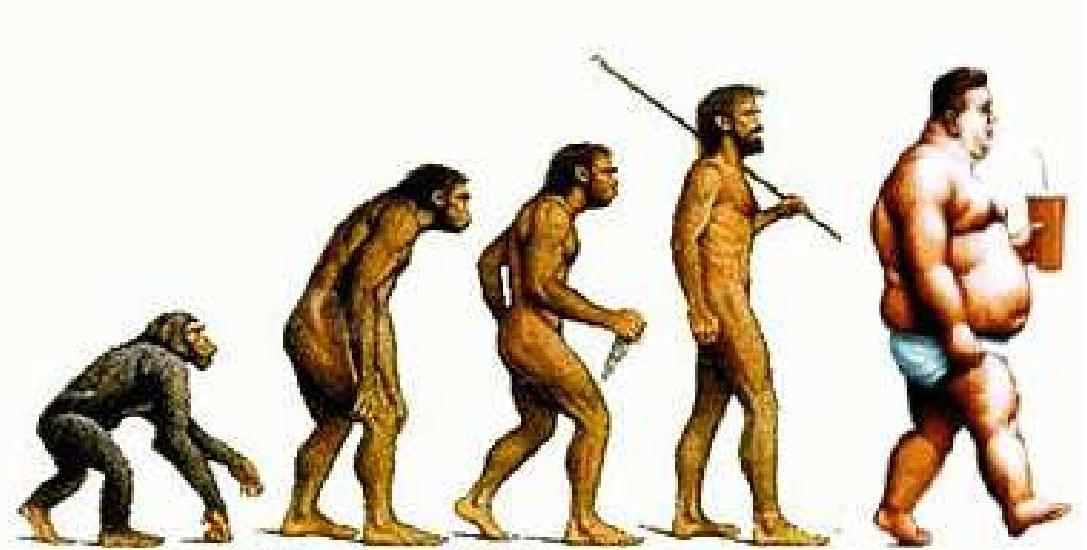
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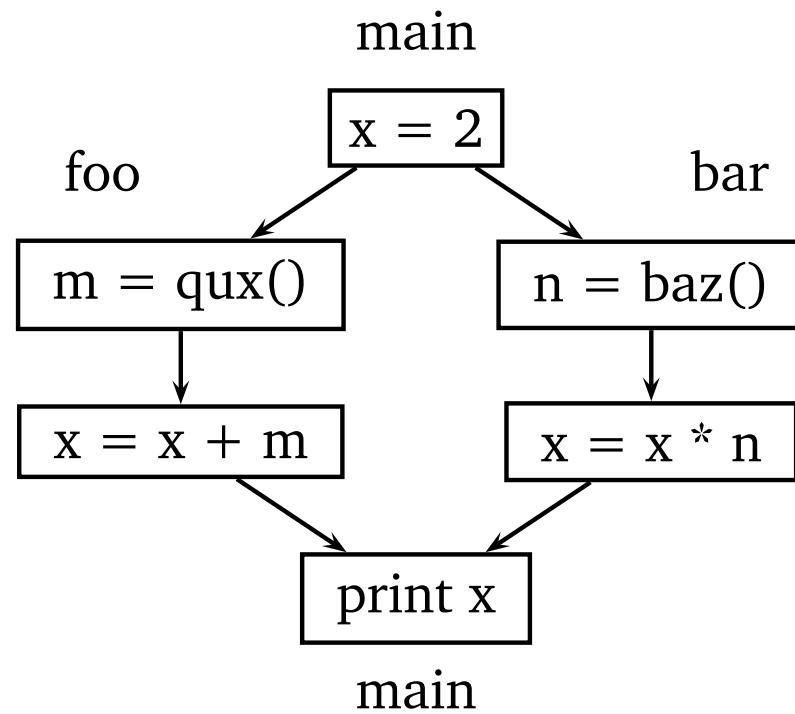
	Library	Performance	Non-		
Parallel Computers	Support Languages	Parallel Languages	Data Races	Determinism	Hard-to-debug



Parallel Computers      Library Support      Performance Parallel Languages      A  
**Determinizing Compiler!**

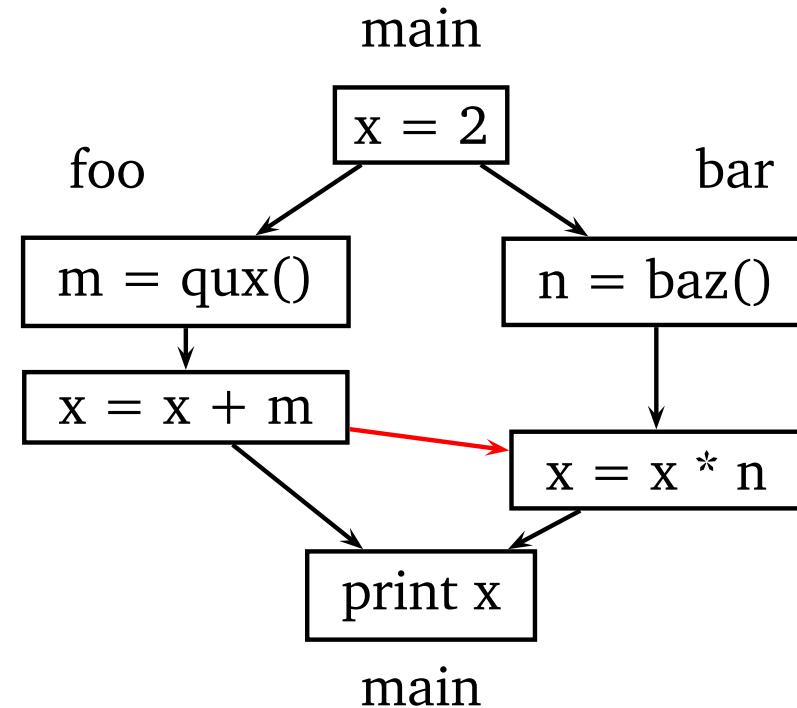
# The Example

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bar(){
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    x = 2;
    thread_create(foo);
    thread_create(bar);
    thread_join(foo);
    thread_join(bar);
    print(x);
}
```



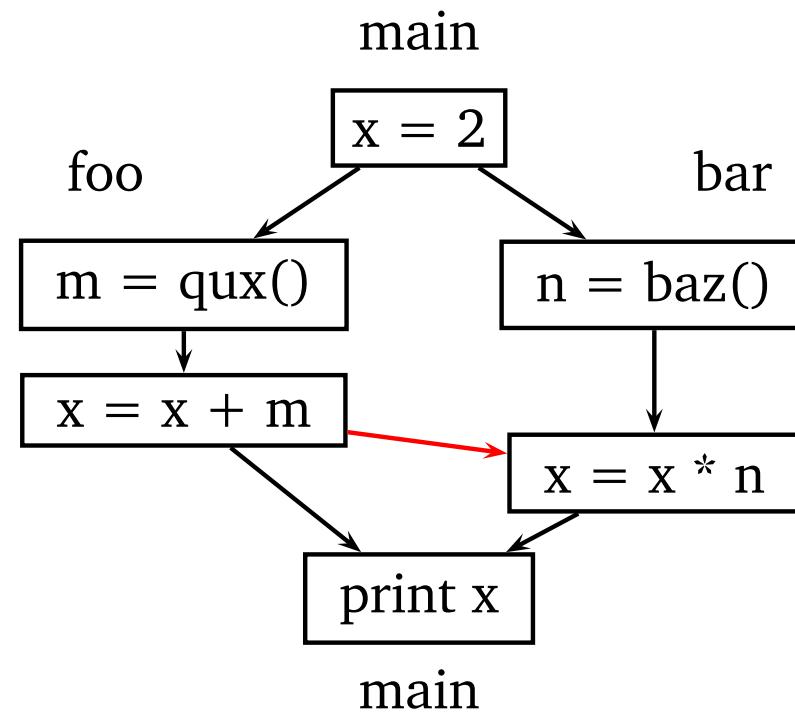
# The Compiler's Role

```
int x;
foo(){
    int m;
    m = qux();
    x = x + m;
    sync(x);
}
bar(){
    int n;
    n = baz();
    sync(x);
    x = x * n;
}
main() {
    x = 2;
    thread_create(foo);
    thread_create(bar);
    thread_join(foo);
    thread_join(bar);
    print(x);
}
```



# The Compiler's Role

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int x;
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    thread_join(foo);
    thread_join(bar);
    print(x);
}
```



if  $m = n = 2$   
 $x = (2 + 2) * 2 = 8$   
Always!

# Interesting Questions

---

- Analysis of the program?
- Performance vs. parallelism tradeoff?
- Which execution to select?
- Avoid deadlocks?

Answers:

- **A Determinizing Compiler.** PLDI '2011. ACM, New York, NY, 1-10.

**WANTED**

A

**Determinizing  
Compiler**

**\$20000  
REWARD**

# A ~~Determinizing~~ Compiler

## The Compiler

Nalini Vasudevan      Stephen A. Edwards

Columbia University