

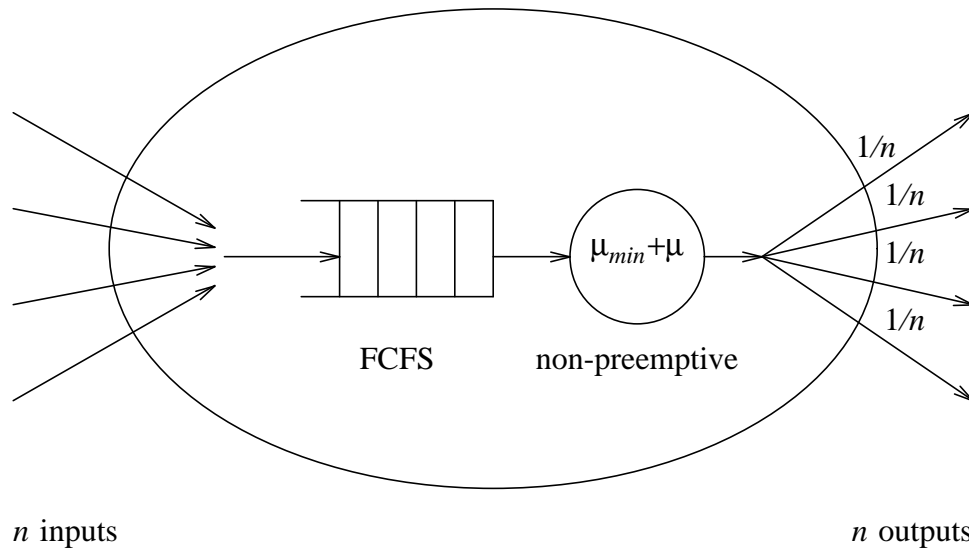
**The Impact of Lookahead on the  
Performance of Conservative Distributed  
Simulation**

*Bruno R. Preiss*

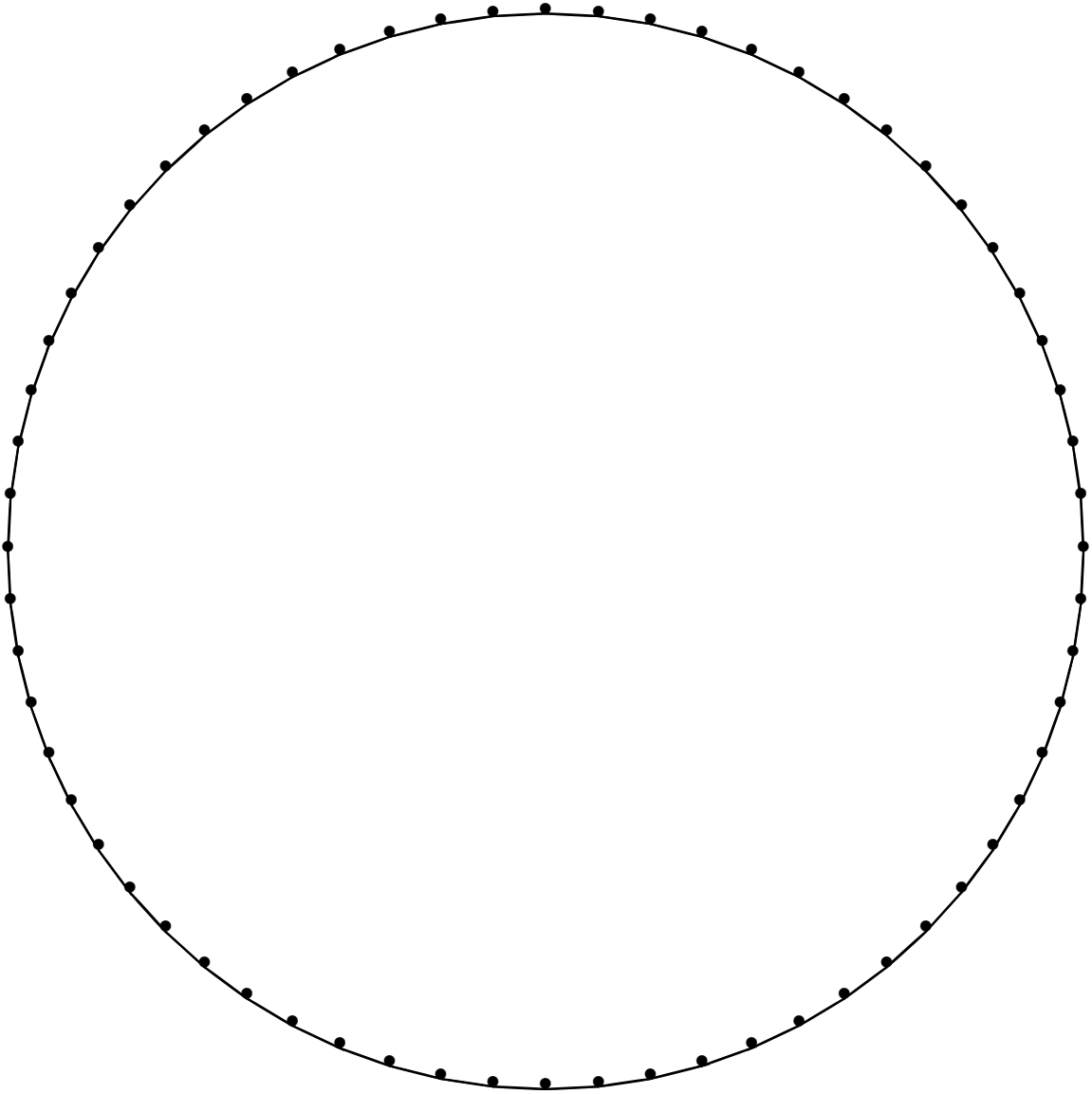
*Wayne M. Loucks*

Department of Electrical and Computer Engineering  
University of Waterloo  
Waterloo, Ontario, Canada  
N2L 3G1

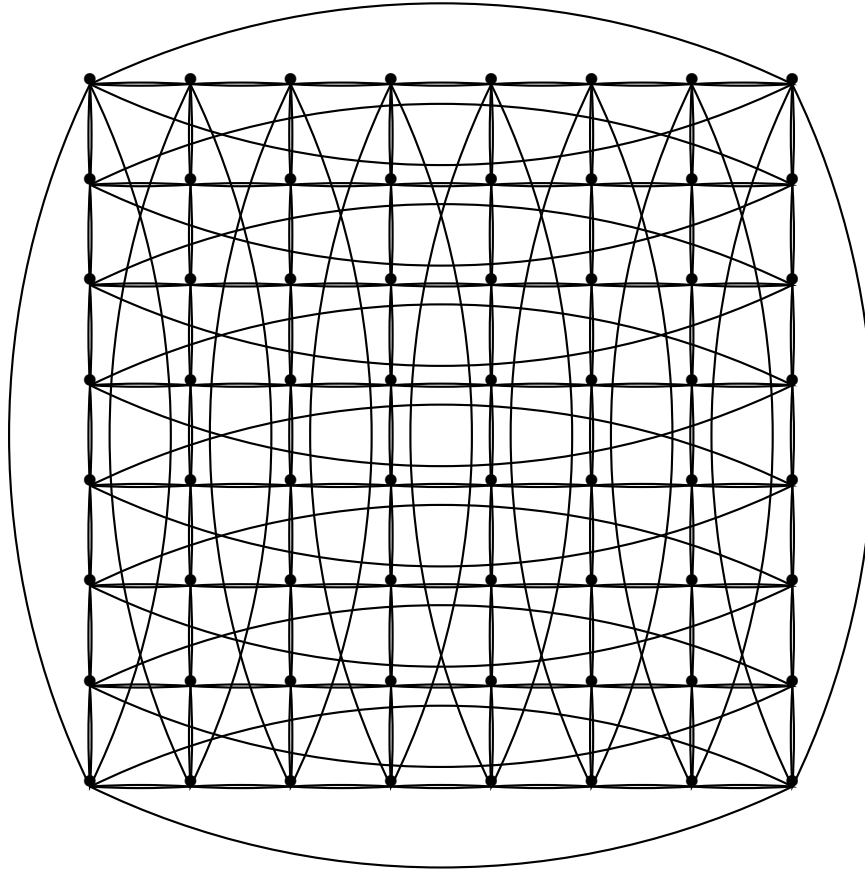
# Benchmark Logical Process



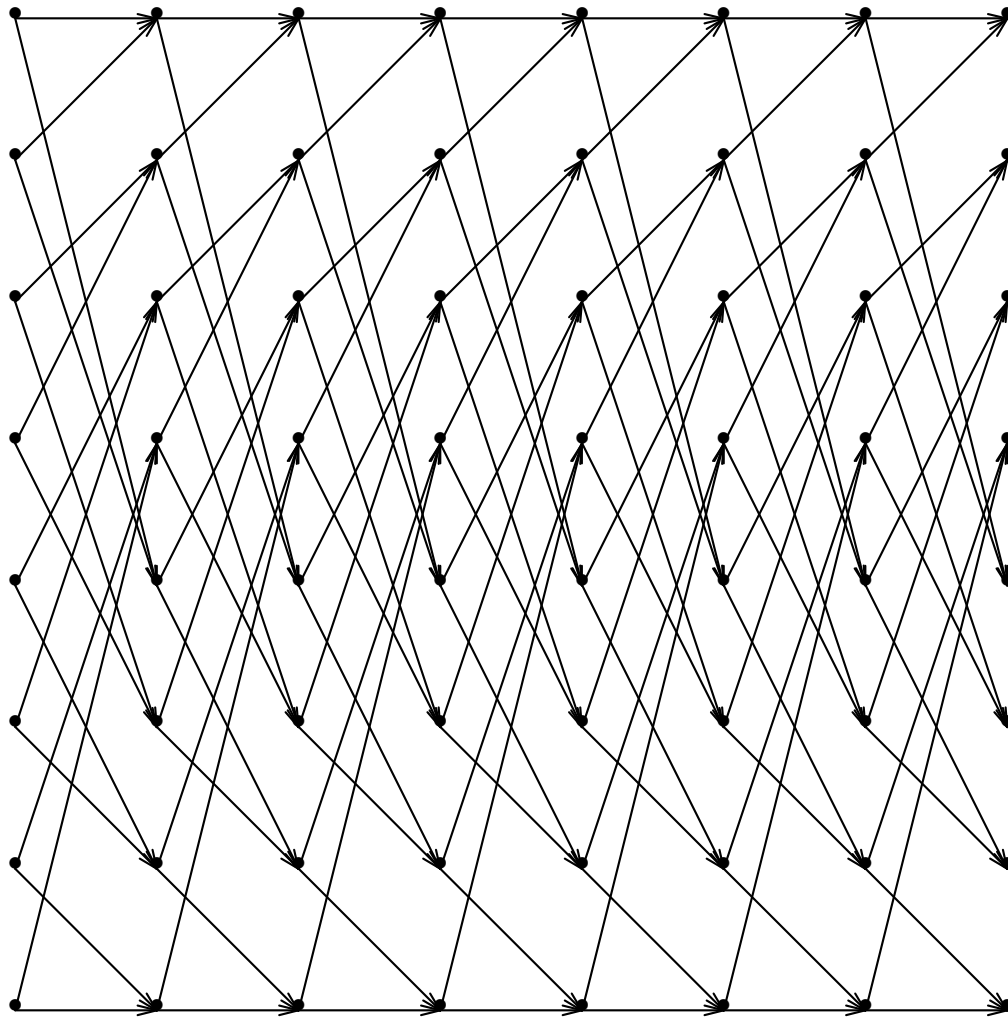
# Ring Topology



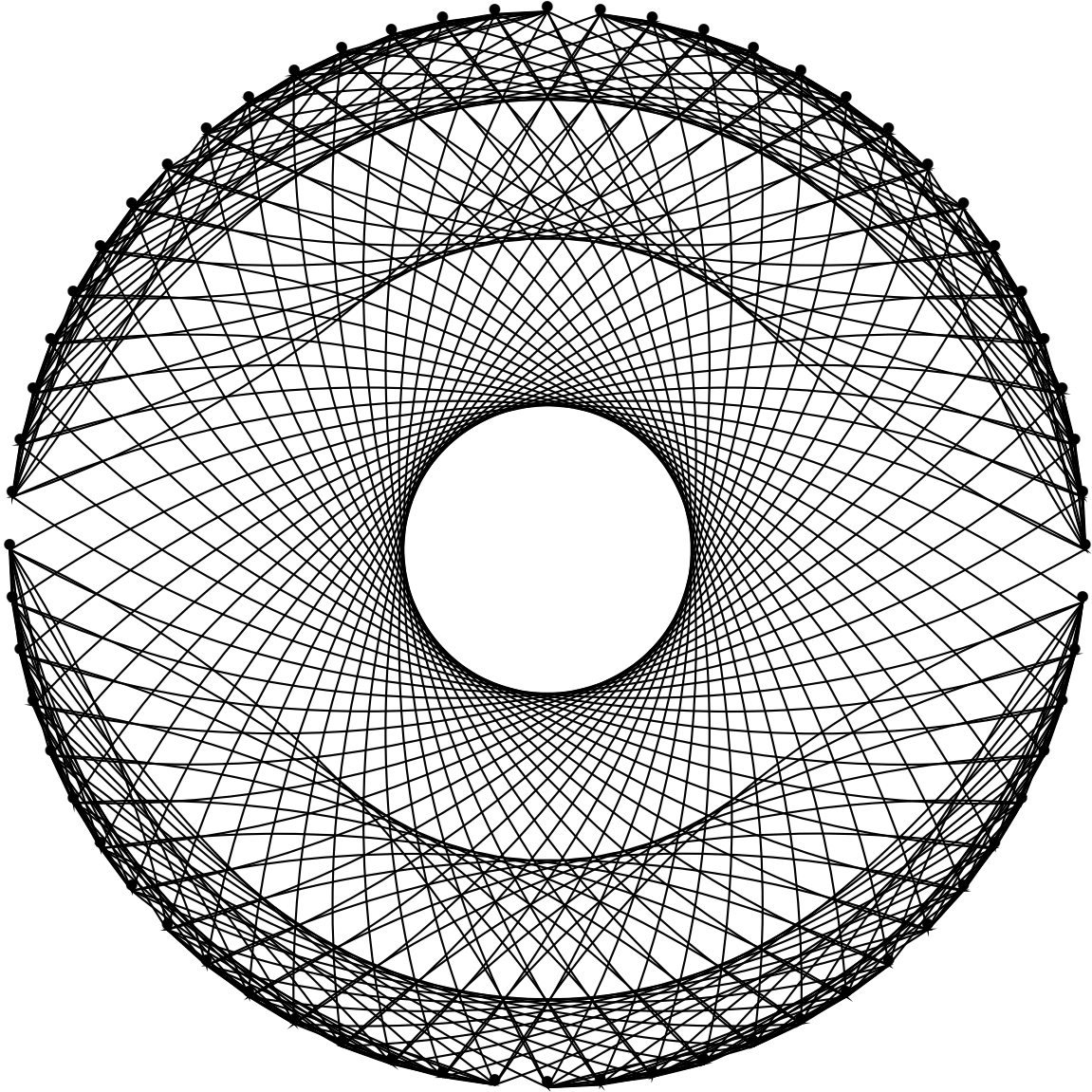
## 2D Mesh Topology



## Multistage Network Topology



## 6D Hypercube Topology

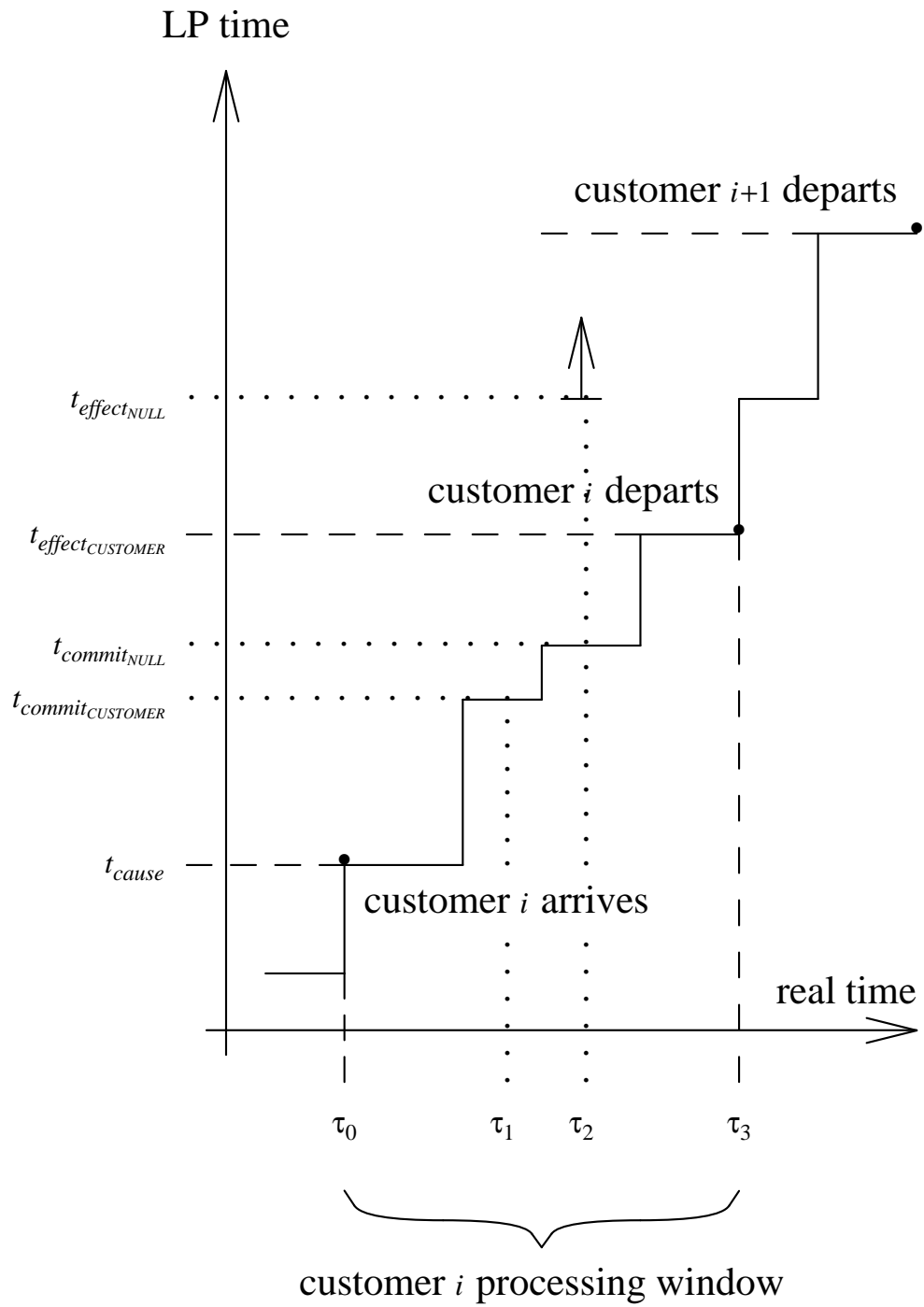


Yaddes Project

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foi106

# Logical Process Time vs. Real Time



## Lookahead and Lookahead Ratio

- Fujimoto 1988

$$LAR = \frac{\text{mean time stamp increase}}{\text{lookahead}}$$

- Fujimoto 1990

$$LAR = E \left\{ \frac{t_{\text{effect}} - t_{\text{cause}}}{\text{lookahead}} \right\}$$

- Wagner and Lazowska

$$LAR = \frac{E\{t_{\text{effect}} - t_{\text{cause}}\}}{E\{\text{lookahead}\}}$$

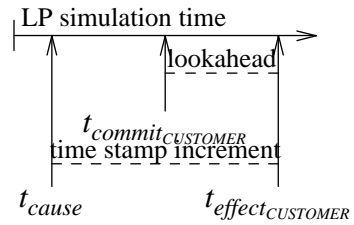
- Preiss and Loucks

$$LAR = \frac{E\{t_{\text{effect}} - t_{\text{cause}}\}}{E\{t_{\text{effect}} - t_{\text{commit}}\}}$$

## Inverse Lookahead Ratio

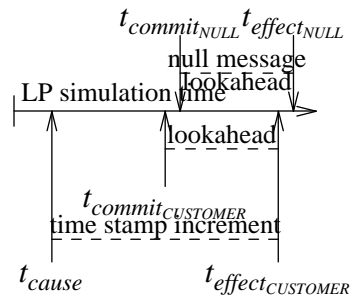
- since  $0 \leq \text{lookahead} \leq \text{time stamp increment}$ , LAR is in the interval  $1 \leq LAR < \infty$
- use the reciprocal of LAR (inverse lookahead ratio or ILAR)

## Inverse Lookahead Ratio



$$ILAR = \frac{E\{t_{effect_{CUSTOMER}} - t_{commit_{CUSTOMER}}\}}{E\{t_{effect_{CUSTOMER}} - t_{cause}\}}$$

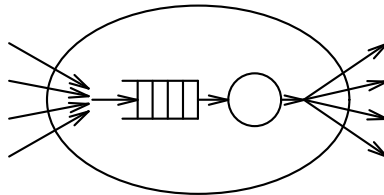
## Null Message Inverse Lookahead Ratio (NILAR)



$$NILAR = \frac{E\{t_{effect\_NULL} - t_{commit\_NULL}\}}{E\{t_{effect\_CUSTOMER} - t_{cause}\}}$$

## Lookahead Models

null message lookahead	customer lookahead		
	$\epsilon$	$t_{service}$	$t_{queueing} + t_{service}$
$\epsilon$	epsilon	–	–
$t_{service} + \mu_{min}$	–	service time	–
$t_{queueing} + t_{service} + \mu_{min}$	–	–	system time
$t_{queueing} + t_{service} + t_{prediction}$	–	–	system time + presampling

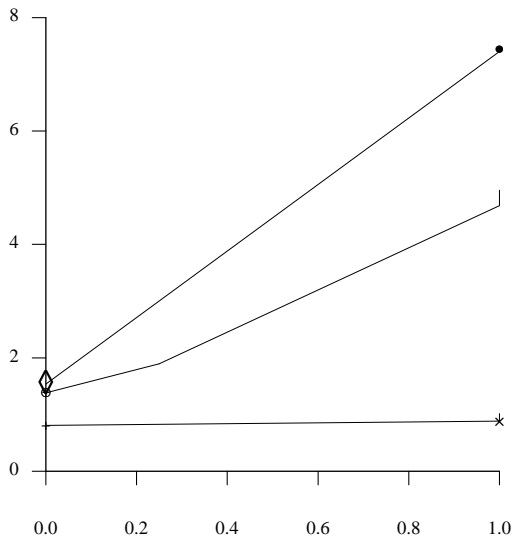


## Inverse Lookahead Ratios

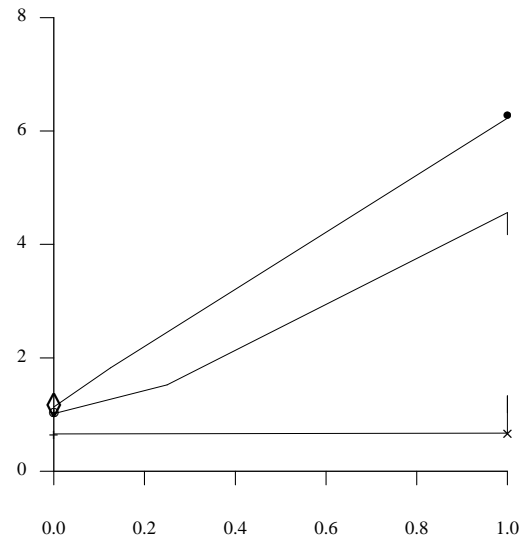
model	ILAR	NILAR
epsilon	$\frac{\varepsilon/\mu}{N}$	$\frac{2\varepsilon/\mu}{N}$
service time	$\frac{1}{N}$	$\frac{1+\mu_{min}/\mu}{N}$
system time	1	$\frac{N+\mu_{min}/\mu}{N}$
system time + presampling	1	$\frac{N+f_{out}}{N}$

# Speedup vs. ILAR

Speedup, Ring

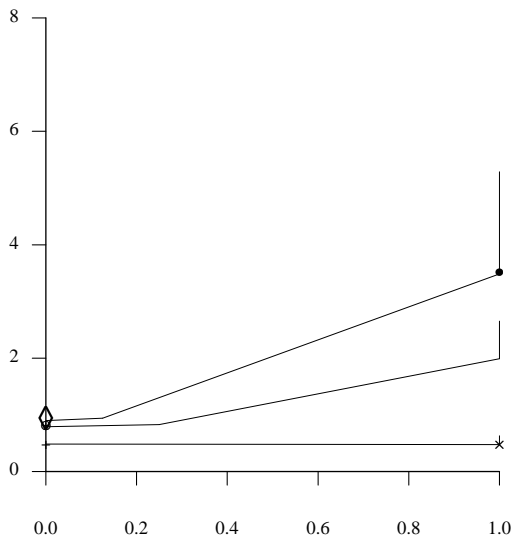


Speedup, Multistage



ILAR

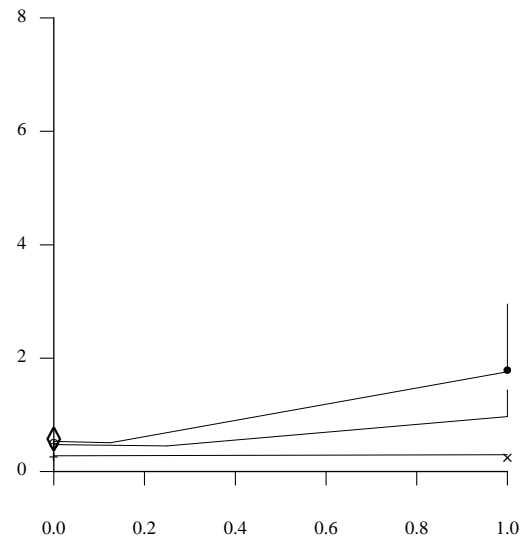
Speedup, Mesh



ILAR

ILAR

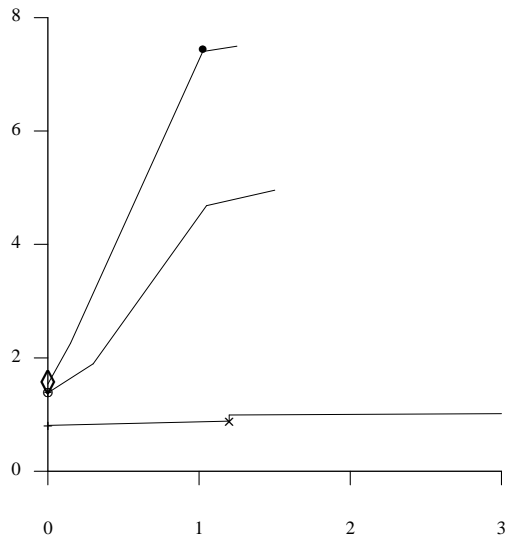
Speedup, Hypercube



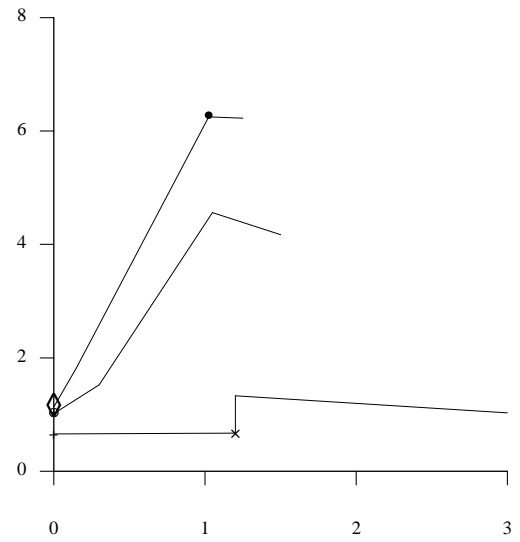
ILAR

# Speedup vs. NILAR

Speedup, Ring



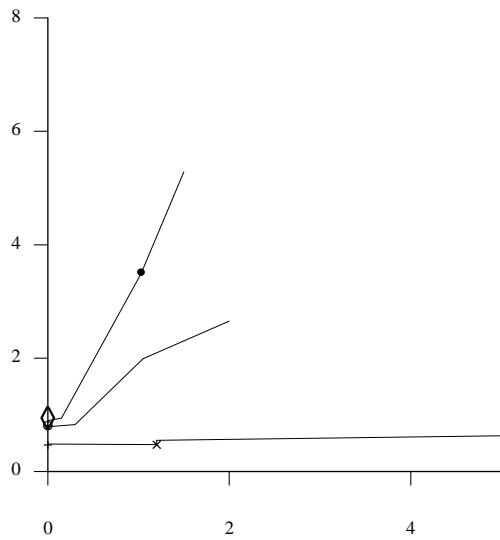
Speedup, Multistage



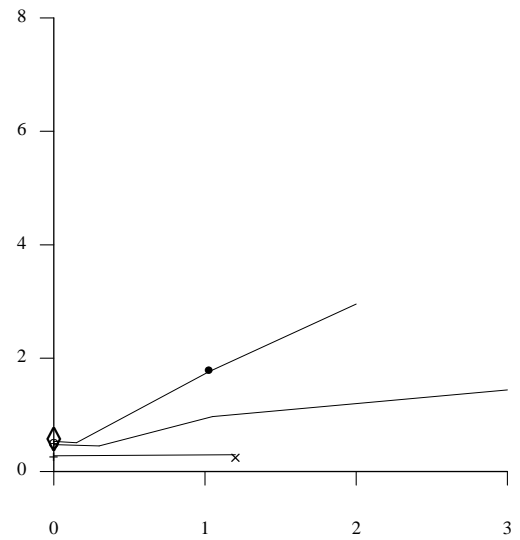
NILAR

NILAR

Speedup, Mesh



Speedup, Hypercube



NILAR

NILAR