CPSC 418	Advanced Computer Architecture	Handout 8
Spring 1996		January 18, 1996

Standard Formulas and Information

1 Naming Convention for Variables

#INST	Number of instructions in trace (dynamic inst count)
%INST	Percentage of dynamic instruction count for a particular instruction (*e.g.* $\%INST_{BRA}$ or $\%BRA$ for branch instructions)
CPI	Cycles per instruction ($CPI_{BRA} = CPI\ for\ branch\ instructions$)
CLOCK	Clock cycle in seconds
SPEED	Clock speed in MHz ($SPEED = 1/CLOCK$)
%UTIL	Percentage utilization

2 Time and Performance

Run time for a program:

$$\frac{Time}{Trace} = \frac{Inst}{Trace} * \frac{Cycles}{Inst} * \frac{Time}{Cycle} * \frac{1}{\%Util}$$

Written in simpler format:

$$Time = \#Inst * CPI * CLOCK * \frac{1}{\%UTIL}$$

or, for clock speed, instead of length of clock cycle:

$$Time = \#Inst * CPI * \frac{1}{SPEED} * \frac{1}{\%UTIL}$$

Remember: $Performance \propto \frac{1}{Time}$

A is $n\%$ faster than B: $\frac{Time_B - Time_A}{Time_A} * 100\%$

3 CPI

CPI calculation:

$$CPI = (\%BRA * CPI_{BRA}) + (\%LOAD * CPI_{LOAD}) + (\%STORE * CPI_{STORE}) + \ldots$$

4 Exponential Growth

P increases by a factor of n every T units of time:

$$\frac{P_t}{P_0} = n^{\frac{t}{T}}$$

P_0 = initial value of P
P_t = value of P at time t

Example: Performance doubles every year. After six months, performance increases by:

$2^{6/12} = 2^{0.5} = 1.41$

5 Instruction Statistics

Instruction	**Dynamic Count**	**CPI**
Arith/Logical	35.0%	1.7
Load/Store	28.8%	2.5
Load	17.3%	2.4
Store	8.5%	2.6
LoadH	1.7%	2.4
StoreH	0.8%	2.6
LoadB	0.3%	2.4
StoreB	0.2%	2.6
Control	9.8%	2.3
Jump	8.0%	2.2
Call	1.8%	2.6
Floating Point	7.5%	3.7
Other	18.9%	1.5