Homework 2

CIS 501, Spring 1998
Due on Feb. 4, 1998

1. Let's compare the performance of two computers, the Hexum and the Hexum Pro. They happen to have the same instruction set, which consists of four classes of instructions. The Hexum operates at a clock rate of 500 MHz, while the Pro operates at 750 MHz.

   The average CPI for the various classes of instructions is given below.

Class	Hexum	Hexum Pro
A	1	2
B	2	2
C	3	4
D	4	4

   (a) Assume that peak performance is defined as the fastest rate that a machine could execute an instruction sequence chosen to maximize that rate. What are the peak performances of the two computers in MIPS?

   (b) If the number of instructions executed in a certain program is divided equally among the four classes, which machine is faster?

   (c) Assuming that the instructions are divided equally among the four classes, at what clock rate would Hexum have the same performance as Hexum Pro?

2. Let us now compare the performance of the Hexum II versus the Moon Ultra, which obviously have different instruction sets. They both have three types of instructions, with CPIs as shown below :

Hexum II	CPI	Moon Ultra	CPI
A_1	1.3	A_2	1.5
B_1	1.9	B_2	2.1
C_1	1.5	C_2	2.0

   The Hexum has a clock rate of 1000 Mhz while the Ultra as a clock rate of 1250 Mhz. The same program, when compiled on two different machines, yields instruction counts as shown below :

Hexum II	#Instrs.	Moon Ultra	#Instrs.
A_1	4×10^6	A_2	1×10^6
B_1	2×10^6	B_2	5×10^6
C_1	3×10^6	C_2	1×10^6

   (a) Which system will execute faster according to MIPS (it is average performance this time, not peak performance!)

   (b) Which system will execute the code faster according to execution time?

3. This time the computers to benchmark are the Eniac-2000 and the Eniac-2010. The B-10 employs some hardware optimizations, thus reducing the number of instructions generated for a given program. For the same benchmark, the number of instructions generated (in millions) by the two machines were as shown below:

Machine	ALU ops	Loads/Stores	Branches
B-01	81	70	28
B-10	69	53	26

   Assume that the CPIs are 1, 3 and 5 respectively for the three classes of instructions.

   (a) Find the CPI for the optimized (B-10) and unoptimized(B-01) versions.

   (b) If the clock cycle for the B-01 is 25% faster, which version is better and why?