**Practice 1 :**

**Ex1:**

a)performance expressed in instructions per second of P1,P2,P3:

IPS=Clock rate/CPI

P1==2.0×109

P2= 2.5×109

P3= =1.818×109

=>P2 has the highest performance expressed in instructions per second

b) Instruction=Clock rate \* time / CPI

Cycle=Instruction \* CPI

P1:Instruction = =20×109

Cycle=20×109×1.5=30×109

P2:Instruction = =25×109

Cycle=25×109×1.0=25×109

P3:Instruction ==18.18×109

Cycle=18.18×109×2.2=40×109

c) Reduce **execution time by 30% =>new time = 10**×70%=7 second

CPI increase 20% =>new CPI: P1=1.5×(1+20%)=1.8

P2=1.0×(1+20%)=1.2

P3=2.2×(1+20%)=2.64

Clock rate =

P1 = =5.14GHz

P2 = =4.29GHz

P3 = =6.86GHz

**Ex2:**

1.0E6=1000000

Class A=1000000×10%=100000

Class B=1000000×20%=200000

Class C=1000000×50%=500000

Class D=1000000×20%=200000

a)Global CPI =)

Global CPIP1==2.6

Global CPIP2==2.0

b)Clock cycle = Instructions×Global CPI

Cycle P1=1000000×2.6 =2.6×106 cycle

Cycle P2=1000000×2.0 =2.0×106 cycle

Execution time =

P1=1.04×10-3 s

P2= =0.667×10-3s

=>P2 faster

**Ex3:**

a)

Clock rate = =

CPI =

CPIA==1.1

CPIB==1.25

b)Clock rate =

A=×109 Hz

B= = 1.5×109

How much faster of A versus B : =0.733

=>B faster than A

c)Execution time===0.66

Speedup A= =1.67

Speedup B= = 2.27

**Ex4:**

a) Cycle time =

p=1:

Arithmetic cycle = 2.56×109

Load/store = 1.28×109×12=15.36×109

Branch:0.256×109×5=1.28×109

Total =(2.56+15.36+1.28) ×109=19.2×109

Execution time = =9.6 second

Speedup = =1

p=2: divide 0.7×2=1.4 for arithmetic and load/store , branch constant

Arithmetic cycle = =1.8286×109

Load/store = = 10.9716×109

Branch =1.28×109

Total = (1.8286+10.9716+1.28) ×109=14.0802×109

Execution time ==7.04 second

Speedup = =1.36

p=4: divie 0.7×4=2.8 for arithmetic and load/store , branch constant

Arithmetic cycle= =0.9143×109

Load/store = = 5.4857×109

Branch =1.28×109

Total =( 0.9143+5.4857+1.28)×109=7.68×109

Execution time ==3.84 second

Speedup ==2.5

p=8: divie 0.7×8=5.6 for arithmetic and load/store , branch constant

Arithmetic cycle= =0.4571 ×109

Load/store = = 5.4857×109

Branch =1.28×109

Total = (0.4571+2.7432+1.28)×109=4.48×109

Execution time ==2.24 second

Speedup ==4.29

b) new CPI =2 => arithmetic double

p=1:

Arithmetic =2.56×109 ×2=5.12×109

Load/store: 15.36×109

Branch: 1.28×109

Total =(5.12+15.36+1.28) ×109=21.76×109

Time = =10.88 second

p=2:

Arithmetic =1.8286×109 ×2=3.6572×109

Load/store:10.9716×109

Branch: 1.28×109

Total = (3.6572+10.9716+1.28)×109=15.9088×109

Time = =7.95 second

p=4:

Arithmetic =0.9143×109 ×2=1.8286×109

Load/store:5.4857×109

Branch: 1.28×109

Total = (1.8286+5.4857+1.28) ×109=8.5943×109

Time ==4.30 second

p=8:

Arithmetic =0.4571×109 ×2=0.9143×109

Load/store:2.7432×109

Branch: 1.28×109

Total = (0.9143+2.7432+1.28) ×109=4.9375×109

Time = =2.47 second

c) Execution time on 4 processors: T(4)=3.84 second

Arithmetic = 2.56×109

Load/Store = 1.28×109

Branch = 2.56×108

CPI:

Arithmetic = 1(unchange)

Load/Store =X

Branch = 5 (unchange)

Total cycle = (2.56×109×1)+(1.28×109×x)+(2.56×108×5) =(3.84×109)+(1.28×109⋅x)

We have : Execution Time=3.84

=> = 3.84

=>X= =3

=>Reduce form 12 to 3

**Ex5:**

a)Assume Iold=2.389×1012

Since instructions reduced by 15%:

CPInew=

b)Clock rate increase : % = =33.3%

CPI increase : CPIold =

=>

=>Clock rate 33.3%

CPI

=>Not similar because **clock rate increases reduce cycle time,** but **some delays like memory access do not improve proportionally**, causing **CPI to rise.**

**c)CPU time reduction :**

**=27.1% reduction**

**d)New** execution time: 960-960×10%=864 ns

I = = instructions

e)New execution time: 864-864×10%=777.6 ns

f = =4.44 GHz

f)New CPI =1.610.85=1.3685

New time =9600.8=768 ns

Instruction count : I=

f= GHz

**Ex6:**

a)CPU1= =1.125 second

CPU2==0.25 second

Even though **P1 has a higher clock rate, P2 is faster =>false**

**b)Time1 =0.225 second**

**I2 new = =0.9 instructions**

=>**false**: More instructions ≠ more time

c)MIPS =

MIPS1=

MIPS2=

=>So **P1 has higher MIPS**, but **P2 is actually faster**

**d)Instruction count :**

**P1 =** 0.4×5.0×109=2.0×109

P2 = 0.4×1.0×109=0.4×109

MFLOPS1 = =1777.8

MFLOPS2 = =1600

**P1 has higher MFLOPS**, but **P2 is faster**.

**Ex7:**

a)New FP time =70×(1−0.20)=70×0.8=56 seconds

New total time = 250−70+56=236 seconds​

The total time is reduced by :

250-236=14 seconds

b)Time after lower :

250×0.8=200 seconds​

Other time = 70+85+40=195 seconds

Let INT time be reduce to x

=>195+x=200⇒x=200−195=5 seconds​

Reduction = 55-5 =50 seconds

c)All time except branch = 70(FP)+85(L/S)+55(INT)=210 seconds

branch time = 0 => total time =210 > 200 =>No reducing only branch time can’t reduce total time.

**Ex8:**

Total CPU cycles = (50×106×1)+(110×106×1)+(80×106×4)+(16×106×2)

=512×106 cycles

Execution time = =0.256 second

a) New execution time = =0.128 second

Let new FP CPI = x

New CPU time: (50×106×x)+(110×106×1)+(80×106×4)+(16×106×2)

=50x+462

Set : = 0.128 =>x=-4.12

**=>Impossible** to achieve 2× speedup by improving FP CPI **alone**

b)Let new CPI of L/S = y ,other unchange

New total cycles = 50×1+110×1+80×y+16×2=50+110+80y+32=192+80y

Set : =0.128 =>y=0.8

CPI must be improve by factor of = 5

c)CPI of INT and FP reduce by 40% -> new CPI =0.6 × old

CPI of L/S and branch reduced by 30% -> new CPI = 0.7 × old

FP = 1× 0.6=0.6

INT= 1×0.6=0.6

L/S=4 × 0.7=2.8

Branch = 2×0.7=1.4

New total cycle= (50×0.6)+(110×0.6)+(80×2.8)+(16×1.4) =342.4 milion cycles

New execution time = =0.1712 second

Speedup =1.495

The execution time is improved by a factor of 1.5x

**Ex9:**

Excution time per processor

T(p)= +overhead = + 4 sec

Speed up :

S(p) = =

S(ideal)=p

Efficiency ratio=

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Processors (p) | **T(p)** (s) | Speedup S(p) | Ideal Speedup (p) | Ratio |
| 2 | 54 | 1.852 | 2 | 0.926 |
| 4 | 29 | 3.448 | 4 | 0.862 |
| 8 | 16.5 | 6.061 | 8 | 0.758 |
| 16 | 10.25 | 9.756 | 16 | 0.610 |
| 32 | 7.125 | 14.035 | 32 | 0.439 |
| 64 | 5.5625 | 17.981 | 64 | 0.281 |
| 128 | 4.78125 |  | 128 | 0.163 |

**Ex10:**

a)CPIavg=0.70×2+0.10×6+0.20×3=2.6

b) Performance improve 25% =>speedup =1.25

New avg CPI = =2.08

Let x be the new nubmer of cycles for arithmetic , other unchange

=> 2.08=0.70x+0.6+0.6 =>x= 1.257

c) Performance improve 50% => speedup = 1.5

New avg CPI = =1.733

Let x be the new nubmer of cycles for arithmetic , other unchange

=> 1.733=0.70x+0.6+0.6 =>x=0.762