Homework 1971 **********************************
COMMUNISTRICAL (13)
COMMUNISTRICAL (13)
1.3)
1) Compilete. The MILL is translated the Assembly code larguage, such as assembly. 2) Assembly. An absembler Probable the Assembly code into a bingy controller than is martine code that can be extend by the position. 1.4) (A) Pin size in bytes. 8 the per color > 1 byte per color 3 alors per posal > 3 ** 1.5.1; 3 bytes per pinal (1200 × 1024) pinols + 3 bytes = 3.43 2160 bytes for a frome buffer. b) 100 Minols => 12.5 MB/S 2 3.43 216 MB 1.5) P1 3 GHz; CPI = 1.5 P2 2.5 GHz, CPI = 1.0 P3 4.0 GHz; CPI = 2.2 a) Highert instructions/ second? P1 => 3×10° : 2500 MIPS P1 => 3×10° : 2500 MIPS P2 > 1.5×10° : 2500 MIPS P3 => 1.0×10° 100 MIPS P3 => 1.0×10° 2.200 MIPS
2) Assently. As obsently Provides the Assently code into a bing exortate that is motival code that can be exceeded by the pastuser. 1.4) A) Pin size in bytes 8 has per calor 3 lyte per color 3 other per list 3 3# layle: 3 lytes per pinel (1280 × 1024) pinds # 3 lytes = 3432160 lytes for a frame buffer b) 100 Mix/s => 12.5 MB/s 2 3.43216 MB 1.5 had 1 Grane: 3.43216 MB /12.5 MB = 3145728 Seconds 1.5) P1 3 GHz; CPT = 1.5 P2 2.5 GHz; CPT = 1.5 P2 2.5 GHz; CPT = 2.0 P3 4.0 GHz; CPT = 2.0 P3 4.0 GHz; CPT = 2.0 P1 3 SA10 ⁴ : 2000 MTPS 1.5 x 10 ⁴ P1 => 3x10 ⁴ : 2000 MTPS 1.5 x 10 ⁴ P2 > 2.5 x10 ⁴ 2 500 MZPS P2 is the fastest P3 => 1.0 x10 ⁴ P4 => 1.0 x10 ⁴ P3 => 1.0 x10 ⁴ P4 => 1.0 x10 ⁴ P5 => 1.0 x10 ⁴ P6 => 1.0 x10 ⁴ P7 => 1.0
1.4) A) Pin size in bytes 8 the per ceter > 1 byte per ceter 3 artes per pixel >> 3 # laste: 3 84 sept bytes for a frame buffer (12 40 × 1024) pixels + 3 bytes = [34 32 160 bytes for a frame buffer] b) 100 Mbir/s => 12.5 MB/s **8 bytes To smal 1 theme: 3.43216 MB / 12.5 MB = [3145728 seconds) 1.5) P1 3 61tz / CPT = 1.5 P2 2.56tt+, CPT = 1.0 P3 4.0 Gitz / CPT = 2.2 a) Higher instructions/ second! MTPS = Clock Rate CPT x10 ⁴ P1 => 3x10 ⁴ P2 > 2x500 MTPS P2 > 2x10 ⁴ = 2500 MTPS P3 > 4,0 x10 ⁵ P4 5,0 x10 ⁵ P5 7,0 x10 ⁵ P6 7,0 x10 ⁵ P7 7,0 x10 ⁵ P7 1,0 x10 ⁵
1.4) (1) (in size in bytes 8 ths per clin > 1 byte per clin 3 obrs per pixel => 3* lbyte: 3 bytes pixel (12 40 × 1024) pixes + 3 bytes = 34 32 160 bytes for a frame buffer b) 100 Mbiz/s => 12.5 MB/s 2 3.43 216 MB b) 100 Mbiz/s => 12.5 MB/s 2 8 bytes 7. smal 60 me: 3.43 216 MB / 12.5 MB = 3145 7 28 secons) 1.5) P1 3 6 Hz; CPT = 1.5 P2 2.5 6 Hz; CPT = 1.0 P3 4.0 6 Hz; CPT = 2.2 a) Higher instructions/sound! MTPS = Clock Rate CPT × 10 ⁴ P1 => 3× 10 ⁴ 2 5000 MTPS P2 2.5 × 10 ⁵ 1.5 × 10 ⁴ P3 => 4.0 ×
2 abrs per plat => 3 ** layle: 3 layles per plat (1290 x 1024) plats * 3 layles = 39932160 layles for a frame buffer = 3.93216 MB b) 100 MLie/s => 12.5 MB/s = 8 layles To send Game: 3.93216 MB / 12.5 MB = 3.145728 secons 1.5) P1 3 61Hz / CPT = 1.5 P2 2.56Hz / CPT = 1.0 P3 4.0 GHz / CPT = 2.2 a) Higher indirections/ second? MTPS = Clock Rate CPT x106 P1 => 3 x 106 1.5 x 106 P2 2.5 x 106 1.5 x 106 P3 => 14.0 x 106 P4 => 15.5 x 106 P5 => 16.5 x 106 P5 => 16.5 x 106 P6 => 16.5 x 106 P6 => 16.5 x 106 P7 => 1
3 also per pixel => 3* hyst. = 34,76 per pixel (1250 x 1024) pixel * 3 bytes = 34,32160 bytes for a frame buffer = 3.43216 MB b) 100 MLix/s => 12.5 MB/s = 8 bytes 71 smd 6mme: 3.43216 MB / 12.5 MB = 3/45728 seconds 1.5) P1 3 (5Hz, CPI = 1.5 P2 2.5 6Hz, CPI = 1.0 P3 4.0 GHz, CPI = 2.2 a) Hyster instructions/ second? MTPS = Clock Pate CPI x 10* P1 => 3x10* 1.5x vol P2 => 2.5 x10* 1.5x vol P3 => 4.0 x10* 2 500 MTPS P2 => 4.0 x10* P3 => 4.0 x10* 2 1818MPPS b) Program in 10s => bt gelly # Instructions
(1280 x 1024) plato # 3 bytes = 3432160 bytes for a frame buffer) = 3.43216 MB b) 100 MLic/s => 12.5 MB/s = 4 bytes To send 1 Mane: 3.43216 MB / 12.5 MB = 3/45728 seconds 1.5) P1 3 GHz / CPI = 1.5 P2 2.5 GHz / CPI = 1.0 P3 4.0 GHz / CPI = 2.2 a) Higher instructions/ second? MIPS = Clock Rate CPI x 10 ⁴ P1 => 3x10 ⁴ 1.5x 10 ⁴ P2 => 2.5 x10 ⁴ 1.0 x 10 ⁴ P3 => 4.0 x10 ⁴ P4 => 4.0 x10 ⁴ P5 => 4.0 x10 ⁴ P6 => 4.0 x10 ⁴ P7 => 4.0 x10 ⁴
2. 3.43 216 MB b) 100 MLR/s => 12.5 MB/s To send 1 Grane: 3.43 216 MB / 12.5 MB = 3.448 7 28 secons 1.S.) P1 3 GHz, CPT = 1.S P2 2.5 GHz, CPT = 1.0 P3 4.0 GHz, CPT = 2.2 B) Higher instructions/second? MTPS = Clock Rate CPT × 10 ⁴ P1 => 3×10 ⁴ 1.5×10 ⁴ P2 => 2.5×10 ⁿ 2500 MTPS P2 => 1.0×10 ⁴ P3 => th gelly th instructions
b) 100 MLit/s => 12.5 MB/s - 8 bots To send 1 franc: 3.93216 MB / 12.5 MB = 3.148728 seconds) 1.5) P1 3 Gottz, CPI = 1.5 P2 2.5 Gottz, CPI = 1.0 P3 4.0 Gottz, CPI = 2.2 a) Higher instructions/ second? MTPS = Clock Rote CPI x 10 ⁴ P1 => 3x10 ⁴ - 2500 MIPS P2 => 1.5x vot P3 => 14.0 x 10 ⁴ P4 => 15 th galay th Instructions
1.5) P1 3 6Hz, CPT = 1.5 P2 2.56Hz, CPT = 1.0 P3 4.0 GHz, CPT = 2.2 a) Higher instructions/ second? MTPS = Clock Rate CPT × 10° P1 => 3×10° 1.5×10° P2 > 2.5×10° 1.0×10° P3 => 1.0×10° P4 => 1.5×10° P5 => 1.0×10° P6 => 1.5×10° P7 => 1.0×10° P7 => 1.0
1.5) P1 3 GHz, CPT = 1.5 P2 2.5 GHz, CPT = 1.0 P3 4.0 GHz, CPT = 2.2 A) Higher instructions/ second? MTPS = Clock Rate CPT x10 ⁴ P1 => 3x10 ⁴ 2 500 MTPS P2 => 2.5 x10 ⁷ 1.0 x 10 ⁶ P3 => 4.0 x(0 ⁴) 1.0 x 10 ⁶ P3 => 4.0 x(0 ⁴) 1.0 x 10 ⁶ P3 => 4.0 x(0 ⁴) 2 2 8 secons P2 is the fastost P3 => 4.0 x(0 ⁴) 2 18 18 MTPS
P2 2.56Hz, CP2 = 10 P3 4.0 GHz, CP2 = 2.2 a) HIgher instructions/sound! MIPS = Clock Rate CPI × 10 P1 => 3×10 1.5×10 P2 is the fastest P3 => 4.0×10 Program in 10s => ++ cyclex # Instructions
P2 2.56Hz, CP2 = 1.0 P3 4.0 GHz, CP2 = 2.2 a) HIgher instructions/social! M1PS = Clock Rate CPI x 10 P1 => 3×10 1.5×10 P2 is the fastest P3 => 4.0×10 P3 => 4.0×10 Program in 10s => the cyclex # Instructions
a) Higher instructions/ second? MIPS = Clock Rate CPIXIO* PI=> 3×10° = 2000 MIPS PI=> 2.5×10° = 2500 MIPS P3=> 4.0×10° = 1818.18MIPS 2.2×10° = 1818.18MIPS Program in 10s => ++ cycley # instructions
a) Higher instructions second? MIPS = Clock Rate CPI x10 ⁴ P1 => 3x10 ⁴ = 2000 MIPS P2 => 2.5x10 ⁴ = 2500 MIPS P3 => 4.0x10 ⁴ = 1818.18MIPS Program in 10s => th gelog # Instructions
$P = \frac{2 \times 10^4}{\text{CPI} \times 10^6}$ $P = \frac{3 \times 10^4}{1.5 \times 10^6} = 2000 \text{ MIPS}$ $P \geq \frac{2.5 \times 10^4}{1.0 \times 10^6} = 1818.18\text{MIPS}$ $P \geq \frac{4.0 \times 10^4}{2.2 \times 10^6} = 1818.18\text{MIPS}$ $P \sim \frac{1}{2} \times \frac{1}{2}$
$P = \frac{2 \times 10^4}{\text{CPI} \times 10^6}$ $P = \frac{3 \times 10^4}{1.5 \times 10^6} = 2000 \text{ MIPS}$ $P \geq \frac{2.5 \times 10^4}{1.0 \times 10^6} = 1818.18\text{MIPS}$ $P \geq \frac{4.0 \times 10^4}{2.2 \times 10^6} = 1818.18\text{MIPS}$ $P \sim \frac{1}{2} \times \frac{1}{2}$
$P1 = 3 \times 10^{4} = 2000 \text{ MTPS}$ $P2 = 3 \times 10^{6} = 2500 \text{ MTPS}$ $P3 = 3 \times 10^{6} = 1618 \cdot 18 \dots \text{ MTPS}$ $P3 = 3 \times 10^{6} = 1618 \cdot 18 \dots \text{ MTPS}$ $P3 = 3 \times 10^{6} = 1618 \cdot 18 \dots \text{ MTPS}$ $P = 3 \times 10^{6} = 1618 \cdot 18 \dots \text{ MTPS}$ $P = 3 \times 10^{6} = 1618 \cdot 18 \dots \text{ MTPS}$ $P = 3 \times 10^{6} = 1618 \cdot 18 \dots \text{ MTPS}$
$P2=2 2.5 \times 10^{9} 2500 MIPS \qquad P2 \text{ is the fastest}$ $P3=2 2.5 \times 10^{9} 2500 MIPS \qquad P3=2 2.2 \times 10^{9} 2.2 \times 10^{10} 2.2 \times $
$P2=2 2.5 \times 10^{9} 2500 MIPS \qquad P2 \text{ is the fastest}$ $P3=2 2.5 \times 10^{9} 2500 MIPS \qquad P3=2 2.2 \times 10^{9} 2.2 \times 10^{10} 2.2 \times $
$P3 = > \frac{1.0 \times 10^{6}}{2.2 \times 10^{6}} = 1818.18MPS$ $\frac{1.0 \times 10^{6}}{2.2 \times 10^{6}} = 1818.18MPS$ $\frac{1.0 \times 10^{6}}{2.2 \times 10^{6}} = 1818.18MPS$
$P3 = > \frac{1.0 \times 10^{6}}{2.2 \times 10^{6}} = 1818.18MPS$ $\frac{1.0 \times 10^{6}}{2.2 \times 10^{6}} = 1818.18MPS$ $\frac{1.0 \times 10^{6}}{2.2 \times 10^{6}} = 1818.18MPS$
b) Program in 10s => the cycles # Instructions
b) Program in 10s => the cycles # Instructions
MTP) 3 Historythan and H L I I MER (41 & 126)
-> TP INSTRUCTIONS - /TLFS (Time of 10)
Execution + lane # 100
MIPS: #instructions => # instructions: MIPS (time & 106) CPI: Cycles = CPI * Instructions (not nuctions)
DI: #Instruction = 2000 (10 x 106) = (2 × 106) instructions
Cycles = 1.5 (Zx1010) = { 3 x10 10 Cycles
P2: # Enstructions = 2500 (Ws x106) = 25 x1010 instructions
cycles = 1.0 [7.5 × 103 = 2.5 × 10 10 cycles)
$P2 \cdot A \cdot $
P3: $\# instructions = 1818.18(10s \times 10^{1}) = 1.81 \times 10^{10} instructions$ $\# cycles = 2.1(1.81 \times 10^{10}) = 4.0 \times 10^{10} cycles$
C) exel. time J 30%, +20% CPI. Final clock rate?

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exectlac = (instructions * CAI)
                               Cluit rute
                .7 ( exection) = ( instructions & CPI * 1.2)
                        clook rule = 171 (old clock)
                 3 6 42 × 1.71 - 8.13 6 Hz
2.5 6 Hz × 1.71 = 4.2 75 6 Hz
4.0 G Nz × 1.71 = 6.84 6 Hz
          PI;
          P1 2.5 6H<sub>7</sub> 1 2 3
P2 3 GH<sub>2</sub> 2 2 2
). b
                                  100% 20% 50% 20%
              PI CPI = 10% -1 + 20% · 2 + 50 % · 3 + 20% · 3= 2.6
        £)
              PZ CPI= 10°16. 2+ 20°16. 2+ 50% · 2+ 20°6. 2= 12
             Click cycles
               Cycles = CPI · Instructions
              P1: 2.6 · 1 × 106 = 2 × 106 Cycles
P2: 2 · 1 × 106 = 2 × 106 Cycles
           Running time:
                   t = (y cle)
                         Choic rotc
             P1 = 2.6 × 106 / 2.5 => 1.04 s
P2 = 2.0 × 106 / 3 => 0.66675 => [P2 faster]
1.7
          10 x109 instructions / t=1.15
1.2 × 10 instructions / t=1.5s
         A) CPI2 cycles
                                      - running time / cycle time
                                                                               Ins
                        instructions
                                                    inst ructions
                A: 1.15/12 [2 1.]
                B: 1.5 s/ Ins = 1.25
         b) clock rate = CPI * instructions
```

```
C) 6x1,8 CPI 1.1
                  [CPI x lhst luctions]
                  [CP[x instructions] new
             A: \frac{1.1 \times 1.0 \times 10^{4}}{1.1 \times 1.08} = 1.66667 = \frac{1.6667}{1.1 \times 1.08} = 1.66667
             B: 1.25 × 1.2×10 = 2.2727 => (127.27% faster v; B)
1.12) P1 4 GHz CPI = 0.9 instructions = 5269
P2 3 GHz CPI = 0.75 instructions = 12109
112.1) clock rate as highest performance thank execution than
       Pl vaxs w 1/4 w = 1.125
             0.75 *1.104/3 18 2 0.25 => P2 has alone execution time, is faster
                                                but has a larger clock rate
1.12.2) need a larger CPU time?
       P) 1.109

CPV time = CP2. Instructions / clock rate

= 0.4* 1.109 / 4.109 = 0.225
          It instructions = 0.225 *3.109/0.75 = 0.9.109 instructions
1.12.3) MAPS = 1.10-6
(P1/Cloak rute
           P1: \frac{1.10^{-6}}{0.7440^{9}} = 4444 mips => but P2 is tuster in 
P1: 1.10^{-6} = 4000 mlps execution the (1.17.1)
1.12.4) MFLOPS = FP opo / Cexec time * 1.6)
              P1: .4 + 1·10-6 _ 1777.6 FLOPS
              P2: .4 * 1.10-6 [1600 F-LOPS
1.14) 50 × 106 FP, 110×106 INT, 80×106 L/S, 16×106 branch
1.14.1) improve CPI for for to get 2x faster program execution
            Si II Clork Cacle
```

```
1.14.1) improve CPI for for to get 2x faster program execution
             Execution time = \( \left( \frac{\chi_{\text{link}}}{\chi_{\text{link}}} \frac{\chi_{\text{link}}}{\chi_{\text{link}}} \)
             cloule cycle = (50.10 ×1) + (1/0×10 ×1) + (80×10 ×4) + (16×10 ×2)

= 5.12 ×108

Eime = 5.12×108

7×109
            CPIna = 5.12 x10 x - [ (110.106) + (80.106.4) + (16.106.7)
                     = -4.12 X cannot be negative

Ly we cannot improve enough to 1/2 the execution time
 1.14.7) CPI 16 LIS 90 run Z1 Faiter
          CPIna = 5.12 x 108 - [(50.100) + (110.100) + (16.106.2)]
                                       80-106.4
to re 2. faster 4 = 20)
                => 2/5 CPI must improve by 20 times
  1.14.3) CPI ON IN & FP => 40% CPI 4/5 30%
            New execution there = { Chock Cycle
             New Chele rate = (50.106.1(.6))+(110.106.1(.6))+(80.106.4(.7))+(16×106.2(.7))
    nar execution time = 3.424.108 = 1712 sec

2.109

old 11mu - .256 - [. 495 +1m @ faster]

nev time = .1712
```