**HW#1 Solution**

**1.2**

(a) 



Profit per wafer = 20 \* 416 \* 0.00663 = 55.16

(b)





Profit per wafer = 25 \* 240 \* 0.00052358 = 3.14

(c) Woods

(d) 50,000 / (416 \* 0.00663) = 18128 > 150 (全部生產Wood chip)

Profit: 150 \* 55.16 = 8,274

Note: 這題的yield rate設太低，導致討論的profit不切實際

**1.10**

Power consumption @ most of time: 0.9

1. Turn off 60%, work load of the other 40% grows to 100%

40% \* 1 = 0.4

Power saving: (0.9 – 0.4) / 0.9 = 55.55%

1. 0.4 \* 1 + 0.6 \* 20% = 0.52

Power saving: (0.9 – 0.52) / 0.9 = 42.22%

1. Max power 降為 0.82 ‧ 0.6 = 0.384 (此時work load應為滿載)

Power saving: (0.9 – 0.384) / 0.9 = 57.3 %

1. 40% + 30% \* 20% + 30% \* 0 = 0.46

Power saving: (0.9 – 0.46) / 0.9 = 48.8%

**1.13**

(a) Itanium 2, better geometric mean of SPECRatio

(b)

Weighted execution time ratio (Opteron / Itanium)= 0.6 \* 0.92 + 0.2 \* 1.03 + 0.2 \* 0.65 = 0.888

Opteron is better!

(c)

Speed-up = 1/0.888 = 1.126

(或者：Speed-up = 106.26 / 88.1 = 1.206，題目並未清楚指出何種speed-up)

**1.14**

**a.**

**b.** 2 = 1/((1 – x) + x /10)

5/9 = x = 0.56 or **56%**

**c.** 0.056/0.5 = 0.11 or **11%**

**d.** Maximum speedup = 1/(1/10) = 10

5 = 1/((1 – x) + x /10)

8/9 = x = 0.89 or **89%**

**e.**

hardware speed-up(70%) = 1/(0.3 + 0.7/20) = 2.985

compiler speed-up = 1/((1-x) + x/10) = 2.985

x = 73.89%

Note: 題目沒說清楚 addition 2X speed-up 指的是變為20x或 12x

若以12X計算如下：

1/(0.3 + 0.7/12) = 1/((1-x) + x/10) = 2.985

x = 71.30%

**1.16**

**a.** 1/(0.8 + 0.20/2) = **1.11**

**b.** 1/(0.7 + 0.20/2 + 0.10 × 3/2) = **1.05**

**c.** fp ops: 0.1/0.95 = 10.5%, cache: 0.15/0.95 = **15.8%**

**1.17**

(a) 1/(0.6 + 0.4/2) = 1.25

(b) 1/(0.01 + 0.99/2) = 1.98

(c) 1/(0.2 + 0.8\*0.6 + 0.8\*0.4/2) = 1.19

(d) 1/(0.8 + 0.2\*0.01 + 0.2\*0.99/2) = 1.11

**Case Study 2: Power Consumption in Computer Systems**

**1.4**

**a.**

|  |  |  |
| --- | --- | --- |
| Processor | DRAM | Hard drive |
| Intel Pentium 4 | (240-pin Kinston) \* 2 | 7200rpm HD |
| 7.9W | 2.3W \* 2 | 7.9W |

→ (66 + 4.6 + 7.9) / 0.8(supply efficiency) = **99 W**

**b.** If full-loaded (always seeking for data), a 7200rpm HD will consume 7.9W.

→ 7.9 \* 40% + 4.0 \* 60% = **5.56W**

**c.** Solve the following four equations:

seek7200 = .75 ×seek5400

seek7200 + idle7200 = 100

seek5400 + idle5400 = 100

seek7200 ×7.9 + idle7200 ×4 = seek5400 ×7 + idle5400 ×2.9

→ idle7200 = **29.8%** of the time.

**1.5**

**a.** Power consumption of the server = 66W + 2.3W + 7.9W = 76.2W,

and a cooling door for a rack can dissipate 14KW

→ $\frac{14 KW}{66 W + 2.3 W + 7.9 W}=183$ **servers**

**b.** Power consumption of the server = 66W + 2.3W + 2×7.9W = 84.1W,

and a cooling door for a rack can dissipate 14KW

→ $\frac{14 KW}{66 W + 2.3 W +2× 7.9 W}=166$ **systems**

**c.** 200 W ×11 = 2200 W

2200 / (76.2) = **28 racks**

Only **1 cooling door** is required.

**1.6**

The IBM x346 could take less space, which would save money in real estate.

The racks might be better laid out. It could also be much cheaper. In addition,

if we were running applications that did not match the characteristics of these

benchmarks, the IBM x346 might be faster. Finally, there are no reliability

numbers shown. Although we do not know that the IBM x346 is better in any

of these areas, we do not know it is worse, either.

**有寫出具體原因就算答對**

**1.7**

**a.** The application is 80% parallelizable.

 → 0.2 + 0.8/2 = 0.2 + 0.4 = 0.6

 → Frequency can be 6**0%**.

**b. core內部都有電晶體的負載電容量, 所以dual core就有兩倍的電容性負載**

 Powerdynamic = 1/2 \* Capacitive load \* Voltage2 \* Frequency switched

(C) (V) (F)

 Powerdual-core / Powersingle-core = [ (2\*C) \* (0.6\*V)2 \* (0.6\*F) ] / [C \* V2 \* F]

 = **0.432 (43.2%)**

**c.** There should be 1/0.75speedup.

 → 1/0.75 = 1/[(1-x)+x/2] → x = 0.5

 → **50%** of application program should be parallelizable.

**d. core內部都有電晶體的負載電容量, 所以dual core就有兩倍的電容性負載**

 Powerdual-core / Powersingle-core= [ (2\*C) \* (0.75\*V)2 \* (0.6\*F) ] / [C \* V2 \* F]

 = **0.675 (67.5%)**