1.9

[10/10/20/20] <1.5> Server farms such as Google and Yahoo! provide enough compute capacity for the highest request rate of the day. Imagine that most of the time these servers operate at only 60% capacity. Assume further that the power does not scale linearly with the load; that is, when the servers are operating at 60% capacity, they consume 90% of maximum power. The servers could be turned off, but they would take too long to restart in response to more load. A new system has been proposed that allows for a quick restart but requires 20% of the maximum power while in this "barely alive" state.

a. [10] <1.5> How much power savings would be achieved by turning off 60% of the servers?

b. [10] <1.5> How much power savings would be achieved by placing 60% of the servers in the "barely alive" state?

c. [20] <1.5> How much power savings would be achieved by reducing the voltage by 20% and frequency by 40%?

d. [20] <1.5> How much power savings would be achieved by placing 30% of the servers in the "barely alive" state and 30% off?

a. 由于耗能正比于 Capacitive * Voltage^2 所以60%负载意味着60%的能源开支

b.bare alive将会作用在0.6的Capacity上。所以优化部分的耗能是0.6*0.2=0.12，没有优化部分的耗能还是0.4，加起来0.52

c.E正比于Capacitive * Voltage^2，电压比值为0.8 负载比值为0.6，所以总耗能变为0.64*0.6=0.256E

d.有0.3的服务器关闭，0.3的服务器优化，0.4的服务器正常运行，优化部分耗能为0.3*0.2=0.06，未优化部分为0.4，加起来0.46

1.11 (a) (b)

1.11 [20/20/20] <1.1, 1.2, 1.7> In a server farm such as that used by Amazon or eBay, a single failure does not cause the entire system to crash. Instead, it will reduce the number of requests that can be satisfied at any one time.

a. [20] <1.7> If a company has 10,000 computers, each with an MTTF of 35 days, and it experiences catastrophic failure only if 1/3 of the computers fail, what is the MTTF for the system?

b. [20] <1.1, 1.7> If it costs an extra $1000, per computer, to double the MTTF, would this be a good business decision? Show your work.

a.系统失败率 = 10000/35 系统MTTF是失败率的倒数 = 35/10000.这是假定坏一个电脑系统就崩溃的MTTF

现在认为1/3的电脑 坏了系统才崩溃了，所以MTTF = 1/3 * 10000 * 35 / 10000 = 35/3 = 12

b双倍的MTTF，现在考虑系统的MTTF = 1/3 * 10000 * 70 / 10000 = 70/3 = 27

花费是$ 1000 * 10000 = 1E7 换来系统MTTF变为原来的两倍

如果是一个大系统，相当于比原来减少了一半的故障 还是值得的

1.16

1.16 [10/20/20/20/25] <1.10> When parallelizing an application, the ideal speedup is speeding up by the number of processors. This is limited by two things: percentage of the application that can be parallelized and the cost of communication. Amdahl's Law takes into account the former but not the latter.

a. [10] <1.10> What is the speedup with *N* processors if 80% of the application is parallelizable, ignoring the cost of communication?

b. [20] <1.10> What is the speedup with eight processors if, for every processor added, the communication overhead is 0.5% of the original execution time.

c. [20] <1.10> What is the speedup with eight processors if, for every time the number of processors is doubled, the communication overhead is increased by 0.5% of the original execution time?

d. [20] <1.10> What is the speedup with *N* processors if, for every time the number of processors is doubled, the communication overhead is increased by 0.5% of the original execution time?

e. [25] <1.10> Write the general equation that solves this question: What is the number of processors with the highest speedup in an application in which P% of the original execution time is parallelizable, and, for every time the number of processors is doubled, the communication is increased by 0.5% of the original execution time?

a

加速比 = 1/ (0.2 + 0.8 /N) 0.8的部分得到了1/N的优化

b

N=8 1/{0.2 + 0.8 / 8 + 0.005 *8 } = 2.9

c

log 2 8 = 3， 1/{0.2 + 0.8 / 8 + 0.005 *3 } = 3.2

d

1/{0.2 + 0.8 / N + 0.005 *log_2 N }

e

加速比= 1/{（1-P） + P / N + 0.005 *log_2 N }

为了获取其极大值，对N求导，导数 = 0