1.10 [10/10/20] <1.7> Availability is the most important consideration for designing servers, followed closely by scalability and throughput.

a. [10] <1.7> We have a single processor with a failure in time (FIT) of 100. What is the mean time to failure (MTTF) for this system?

b. [10] <1.7> If it takes one day to get the system running again, what is the availability of the system?

c. [20] <1.7> Imagine that the government, to cut costs, is going to build a supercomputer out of inexpensive computers rather than expensive, reliable computers. What is the MTTF for a system with 1000 processors? Assume that if one fails, they all fail.

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a. $MTTF = \frac{10^9}{FIT} = \frac{10^9}{100} = 10^7$ (hr)

b. $availability = MTTF / (MTTF + MTTR)$

$MTTR = 24$ (hr) $\Rightarrow availability = \frac{10^7}{10^7+24} \doteqdot 1$

c. ∵ one fails, they all fail ∴ 總 $FIT = \underset{(FIT)}{100} \times \underset{(processors)}{1000} = 10^5$

$\therefore MTTF = \frac{10^9}{FIT} = \frac{10^9}{10^5} = 10^4$

1.13 [15/10] <1.9> Assume that we make an enhancement to a computer that improves some mode of execution by a factor of 10. Enhanced mode is used 50% of the time, measured as a percentage of the execution time *when the enhanced mode is in use.* Recall that Amdahl's Law depends on the fraction of the original, unenhanced execution time that could make use of enhanced mode. Thus we cannot directly use this 50% measurement to compute speedup with Amdahl's Law.

a. [15] <1.9> What is the speedup we have obtained from fast mode?

b. [10] <1.9> What percentage of the original execution time has been converted to fast mode?

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a. $Fraction_{enhanced} = X$ $Speedup_{enhanced} = 10$ $Fraction_{not\text{-}enhanced} = 1-X$

$\Rightarrow \frac{\frac{X}{10}}{\frac{X}{10}+(1-X)} = \frac{1}{2} \Rightarrow \frac{X}{5} = \frac{X}{10} + (1-X) \Rightarrow \frac{X}{10} = (1-X) \Rightarrow X = \frac{10}{11}$

$Speedup_{overall} = \frac{1}{(1-X)+\frac{X}{10}} = \frac{1}{\frac{1}{11}+\frac{1}{11}} = \frac{11}{2}$

b. 即為 X 值 $= \frac{10}{11}$