Real-Time Systems Lecture 15
These were some of the more important things written out during the class. Please note that these notes are not meant to be comprehensive: they are simply what was written down during the lecture.
\[ t_e \text{ - exec. time w/o checkpoints} \]
\[ t_c \text{ - checkpointing cost} \]
\[ T = t_e + n_c t_c \]
\[ t_{slack} = t_{\text{deadline}} - T. \]

\[
\text{Cond:} \quad \text{Prob}[ \text{deadline is not missed} ] \\
\downarrow \\
\sum_{n=0}^{\infty} P\left[ \text{not missed} \left| n \text{ transients affect the execution} \right. \right] \\
\quad \times P\left[ n \text{ transients affect the execution} \right]
\]
Suppose only transients happen
- Poisson process with rate $\lambda$
- Recovery time = $t_{rec}$
- Assume that while a processor is undergoing one transient, it is immune to further transients.

The prob. that a segment is not hit

$$p'' = e^{-\lambda t_{seg}}$$

$$t_{seg} = \frac{te}{n} + t_c$$

The prob. of being hit by just one fault during the entire execution

$$= \binom{n_c}{1} (p'')^{n_c-1}$$
\[ P \left[ n \text{ transients affect the execution} \right] \]

\[ e^{-\lambda(t_e + n t_c)} \]

\( n = 0 \):

\[ e \]

\( n = 1 \):

\underline{Approach:} Approximate it:

\underline{Lower Bound:} \( \lambda t_e e^{-\lambda t_e} \)

where \( t_e = t_e + n_c t_c \)

\underline{Upper Bound:} \( \lambda t_u e^{-\lambda t_u} \)

where \( t_u = t_e + n_c t_c + \frac{t_e}{n} + t_c \)

Suppose \( p' \) is the probability that an individual segment is hit by a single event.
Note: After the lecture, someone pointed out to me that $P[n\text{ transient}]$ is not always maximized when one maximizes the interval: that is because $\lambda t e^{-\lambda t}$ looks like this: 

However, that does not affect our bound calculation because:

1. Over the interest parameter ranges of interest, $\lambda t u$ is small enough that $\lambda t e^{-\lambda t u}$ is an increasing function, and

2. Even if 1 were untrue, then we would still get an upper bound to the failure probability because $P[n=0]$ goes down monotonically as $t$ goes up.