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.

\[ p' = P[\text{segment is affected and no further failures occur in that segment}] \]

\[ = P[\text{segment is affected}] \times P[\text{after recovering, no further failures happen in that segment}] \]

\[ = (1 - P[\text{segment was affected}]) \times P[\text{no further failures in that segment after recovery}] \]

\[ = \left[ 1 - e^{-\frac{te}{n} + t_e} \right] \times e^{-\lambda \left( \frac{te}{n} + t_e \right)} \]

\[ \overline{P} \left[ 2 \text{ transients affect a given segment} \right] = \left[ 1 - e^{-\lambda \left( \frac{te}{n} + t_e \right)} \right] \times \overline{P} \left[ \text{exactly 1 transient affects the segment} \right] \]
The number of failures suffered over an execution,

\[ N_f = \sum_{i=1}^{n_c} N_{i} \]

denote by \( N_i \).

\[
P[N_f = m] = P[N_1 + N_2 + \ldots + N_{n_c} = m] = \sum_{k=0}^{m} P[N_1 + \ldots + N_{n_c} = m \mid N_1 = k] P[N_1 = k]
\]

\[
P[N_1 + \ldots + N_{n_c} = m \mid N_1 = k] = P[N_2 + \ldots + N_{n_c} = m - k] = \sum_{k'=0}^{m-k} P[N_2 + \ldots + N_{n_c} = m - k \mid N_2 = k'] P[N_2 = k']
\]
Time lost per failure = $T_i + t_{rec}$.

$T_i$ is uniformly distributed in the range $[0, \frac{t_e}{n_c} + t_c]$.

If we have a total of $m$ failures during the task execution, the total time lost is

$$= T_1 + t_{rec} + T_2 + t_{rec} + \ldots + T_m + t_{rec}$$

$$= mt_{rec} + \sum_{i=1}^{m} T_i.$$  

A deadline will be missed if the total time lost $> t_{slack}$.

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\therefore \text{We want } P\left[m t_{rec} + \sum_{i=1}^{m} T_i > t_{slack}\right]
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\therefore P \left[ \sum_{i=1}^{m} T_i > t_{slack} - mt_{rec} \right].
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N version programming

Recovery Block Approach

- Version 1 → Acceptance Test → Yes
- Version 2 → Acceptance Test → No
False negative $\rightarrow$ Acceptance

test says nothing is wrong, even if the output is wrong

False positive $\rightarrow$ False alarm