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IOT Homework - Exercise 2

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Contents

1 | Exercise 2

1.1. 1

Setting $X \sim \text{Pois}(\lambda = 0.15)$ as the number of people in a frame, the PMF is:

$P(X = k) = \frac{e^{-\lambda}\lambda^k}{k!}$

In each of the 3 cases, the PMF is:

- $P(r = r_0) = P(X = 0) = e^{-0.15} = 0.86071$
- $P(r = r_1) = P(X = 1) = e^{-0.15} * 0.15 = 0.12911$
- $P(r = r_2) = P(X \geq 2) = 1 - P(X = 0) - P(X = 1) = 0.01018$
  (considering all the cases in which there are more than 1 people in the frame)

1.2. 2

At a bit rate of $R = 250$ kbps, the slot time for a packet of 128 bytes is:

$T_S = \frac{128*8 \text{ b}}{250000 \text{ bps}} = 4.096 \text{ ms}$

To guarantee every message in CFP, each camera node must be able to send up to 6 KB/128 B = 46.875 $\approx$ 47 slots, since we have 3 camera nodes:

$N_{slots-CFP} = 3 * 47 = 141$

Including 1 beacon slot, the active period is given by:

$T_{active} = (141 + 1) * T_S = 581.632 \text{ ms}$

Since the `process_frame` function is called every 10 seconds, the inactive time is:

$T_{inactive} = 10000 \text{ ms } - 581.632 \text{ ms } = 9418.368 \text{ ms}$

And the duty cycle is given by:

$DC = \frac{T_{active}}{T_{active}+T_{inactive}} = \frac{581.632 \text{ ms}}{10000 \text{ ms}} \approx 5.82\%$

1.3. 3

Setting x as the number of cameras, each needs 47 slots so the active time depends on x:

$T_{active}(x) = x * 47 * 4.096 \text{ ms } = x * 192.512 \text{ ms}$

The duty cycle is computed as:

$DC = \frac{T_{active}}{10000 \text{ ms}} = \frac{x * 192.512 \text{ ms}}{10000 \text{ ms}}$

So to get $DC < 0.10$

$\frac{x * 192.512 \text{ ms}}{10000 \text{ ms}} < 0.10 \implies x < \frac{1000}{192.512} \approx 5$

Since we already have 3 cameras, we can add up to 2 more cameras to keep the duty cycle below 10%.