DEPARTAMENTO DE ELETRÓNICA, TELECOMUNICAÇÕES E INFORMÁTICA

MESTRADO INTEGRADO EM ENG. DE COMPUTADORES E TELEMÁTICA

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DESEMPENHO E DIMENSIONAMENTO DE REDES

ASSIGNMENT GUIDE NO. 1

APPLICATION EXAMPLES OF PROBABILITIES, RANDOM VARIABLES AND MARKOV CHAINS

Assignment Guide No. 1

Assignment Description

Implement the following tasks using MATLAB to obtain the requested numerical solutions and conclusions. At the end, submit a report with the answers to the questions of the tasks requested for reporting including the numerical results, the MATLAB codes duly explained and the requested conclusions.

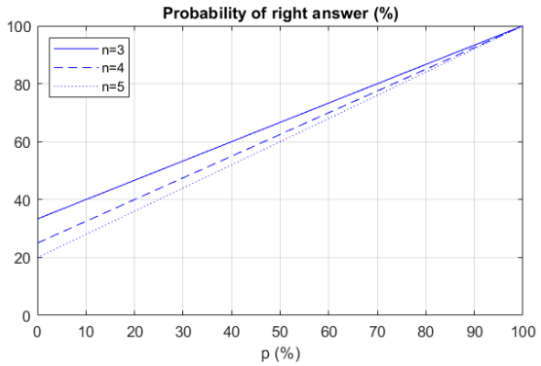
Task 1

Consider a multiple choice test such that each question has *n* possible answers and only one is correct. Assume that the student has studied a percentage p (with $0\% \leq p \leq 100\%$) of the test content. When a question addresses the content the student has studied, he selects the right answer with 100% of probability. Otherwise, he selects randomly one of the *n* answers with a uniform distribution.

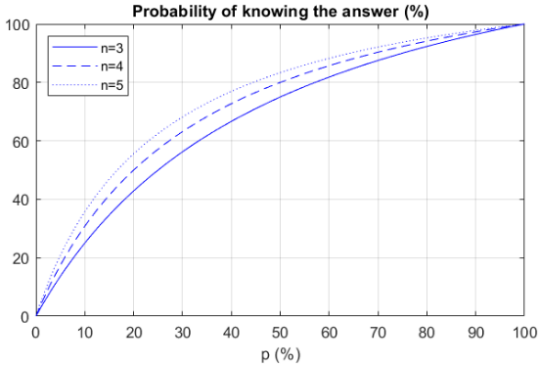
1.a. When $p = 60\%$ and $n = 4$, determine the probability of the student to select the right answer. Answer: 70%

1.b. When $p = 70\%$ and $n = 5$, determine the probability of the student to known the answer when he selects the right answer. Answer: 92.1%

1.c. Draw a plot with the same look as the answer below of the probability of the student to select the right answer as a function of the probability p (consider $n = 3, 4$ and 5). Answer:



1.d. Draw a plot with the same look as the answer below of the probability of the student to know the answer when he selects the right answer as a function of the probability p (consider $n = 3, 4$ and 5). Answer:



Task 2

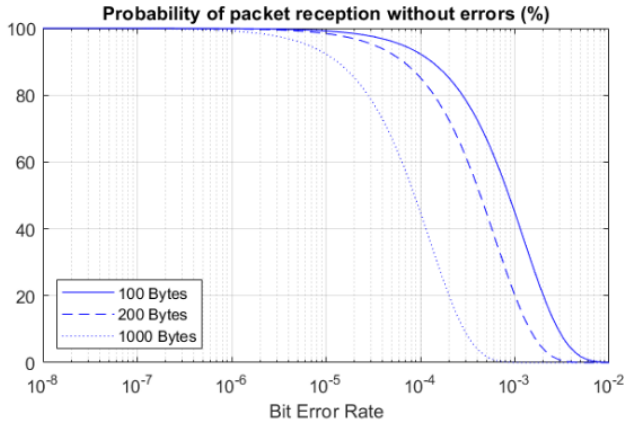
Consider a wireless link between multiple stations for data communications with a bit error rate (*ber*) of p. Assume that errors in the different bits of a data packet are statistically independent (i.e., the number of errors of a data packet is a binomial random variable).

2.a. Determine the probability of a data packet of 100 Bytes to be received without errors when $p = 10^{-2}$. Answer: 0.0322%

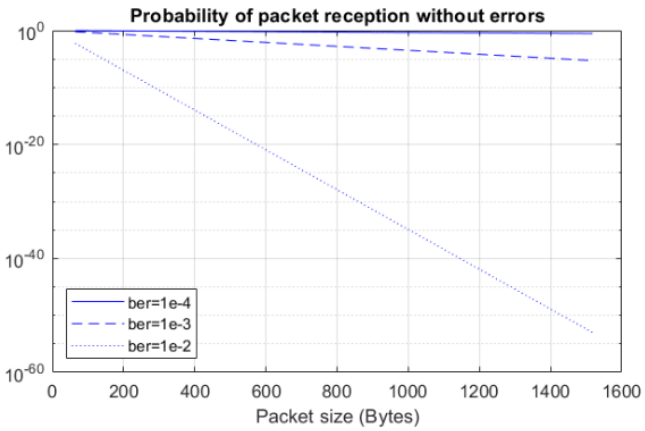
2.b. Determine the probability of a data packet of 1000 Bytes to be received with exactly one error when $p = 10^{-3}$. Answer: 0.2676%

2.c. Determine the probability of a data packet of 200 Bytes to be received with one or more errors when $p = 10^{-4}$. Answer: 14.7863%

2.d. Draw a plot with the same look as the answer below of the probability of a data packet (of size 100 Bytes, 200 Bytes or 1000 Bytes) being received without errors as a function of the *ber* (from $p = 10^{-8}$ up to $p = 10^{-2}$). Answer:

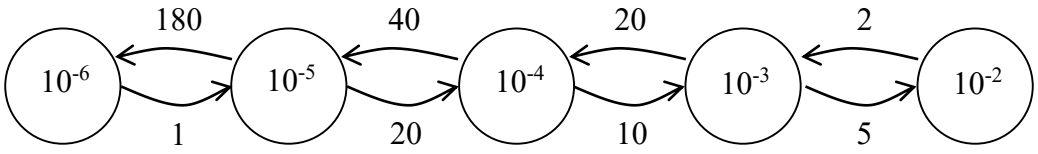


2.e. Draw a plot with the same look as the answer below of the probability of a data packet being received without errors (for $p = 10^{-4}$, 10^{-3} and 10^{-2}) as a function of the packet size (from 64 Bytes up to 1518 Bytes). Answer:



Task 3

Consider a wireless link between multiple stations for data communications. The bit error rate (*ber*) introduced by the wireless link (due to the variation of the propagation and interference factors along with time) is approximately given by the following Markov chain:



where the state transition rates are in number of transitions per hour. Consider that the link is in an interference state when its *ber* is at least 10^{-3} and in a normal state, otherwise. Determine:

3.a. the probability of the link being in one of the five states; answer: 9.87×10^{-1} (10^{-6}), 5.48×10^{-3} (10^{-5}), 2.74×10^{-3} (10^{-4}), 1.37×10^{-3} (10^{-3}), 3.43×10^{-3} (10^{-2})

3.b. the average percentage of time the link is in each of the five states; answer: 9.87×10^{-1} (10^{-6}), 5.48×10^{-3} (10^{-5}), 2.74×10^{-3} (10^{-4}), 1.37×10^{-3} (10^{-3}), 3.43×10^{-3} (10^{-2})

3.c. the average *ber* of the link; answer: 3.70×10^{-5}

3.d. the average time duration (in minutes) that the link stays in each of the five states; answer: 60.0 (10^{-6}), 0.30 (10^{-5}), 1.20 (10^{-4}), 2.40 (10^{-3}), 30.0 (10^{-2})

3.e. the probability of the link being in interference state; answer: 4.80×10^{-3}

3.f. the average *ber* of the link when it is in the interference state. Answer: 7.43×10^{-3}

Task 4 – for reporting

To be completed…

Task 5 – for reporting

To be completed…