Faculty of Information Engineering & Technology
The Networking Department
Course: Modeling & Simulation [NETW 707]

Spring 2023 Project
(Deadline May 30th 2023)

Part A:

Consider a data link layer that operates as follows:

- Each packet received from the upper layer is fragmented into M sub-packets.
- The M sub-packets are then encoded together to generate N coded sub-packets where $N>>M$.
- The transmitter starts sending the encoded sub-packets sequentially each time slot without waiting for any acknowledgements.
- On the receiver side once the receiver correctly receives ***any*** M of the encoded sub-packets correctly (assuming the transmitter has sent K packets at that point of time where $M \leq K \leq N$), it has the ability to reconstruct the original M sub-packets and forward the re-assembled packet to the upper layer. It will also send an ACK to the transmitter.
- Upon receiving an ACK, the transmitter stops sending any further encoded sub-packets (i.e., N-K sub-packets). The transmitter will get a new packet from the upper layer, fragment it, encode it and send it similar the operation previously described above.

Use Markov modeling to **CALCUATE *the delay*** for sending each upper layer packet given the operation of the data link layer described above assuming $N \rightarrow \infty$ (i.e., the receiver will always be able to receive correctly M encoded sub-packets before all N generated encoded sub-packets have been sent).
Assume that BPSK is used with E_b derived from your ID gh-xyzwv as E_b = 1.5+0.xyzwv and $N_0 = 1$.
Assume the probability of error p_e of the transmitted sub-packets could be evaluated given that the sub-packet length $L = 100\ bit$ and assume that the ACK channel is error free.

z	Q(z)	z	Q(z)	z	Q(z)	z	Q(z)
0.0	0.50000	**1.0**	0.15866	**2.0**	0.02275	**3.0**	0.00135
0.1	0.46017	**1.1**	0.13567	**2.1**	0.01786	**3.1**	0.00097
0.2	0.42074	**1.2**	0.11507	**2.2**	0.01390	**3.2**	0.00069
0.3	0.38209	**1.3**	0.09680	**2.3**	0.01072	**3.3**	0.00048
0.4	0.34458	**1.4**	0.08076	**2.4**	0.00820	**3.4**	0.00034
0.5	0.30854	**1.5**	0.06681	**2.5**	0.00621	**3.5**	0.00023
0.6	0.27425	**1.6**	0.05480	**2.6**	0.00466	**3.6**	0.00016
0.7	0.24196	**1.7**	0.04457	**2.7**	0.00347	**3.7**	0.00011
0.8	0.21186	**1.8**	0.03593	**2.8**	0.00256	**3.8**	0.00007
0.9	0.18406	**1.9**	0.02872	**2.9**	0.00187	**3.9**	0.00005

Q-function table

Part B:

Build a python model to simulate the system shown in Problem 4 with the parameters corresponding to your ID. Compare between the simulation and analytical results for the delay. Sketch the delay as a function of the packet length from $L = 10\ bits$ to $L = 100\ bits$.