COMP9121 Week 3

Parity-Check Code Simulation

In this lab, you are going to understand a simulator of parity-check code and test its performance. The almost-ready skeleton code is provided at Paritycheckskeleton.py. You task is to understand each line of the codes.

The simulator is summarized as follows:

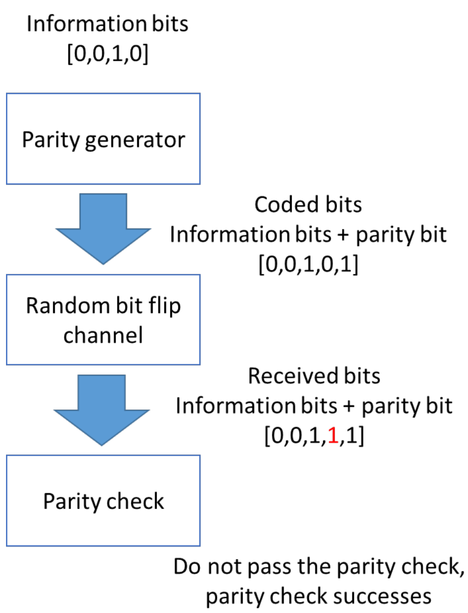


Fig. 1 parity-check code simulation

(1) Randomly generate an N-bit information stream. (Feel free to choose N. You are recommended to choose N=4 or 5. N=5 in the skeleton code. The variable name is infolength). This is done in the skeleton code. You need to locate the lines in the skeleton code.

(2) Generate the parity bit and you can derive an (N+1)-bit coded stream. This is done in the function def GenerateParity(information) in the skeleton code. You need to locate the lines in the skeleton code.

(3) Send the coded stream into a random flipping channel with bit-flip probability p=0.1. For each bit, you need to randomly flip it. The resultant bit stream is received by the receiver. This is done in the function def ErrorChannel(coded) in the skeleton code. You need to locate the lines in the skeleton code.

(4) The receiver checks the received bits. This is done in def CheckParity(received) in the skeleton code. Then, there will be three possibilities:

    A) None of the bits are flipped.
    B) Some of the bits are flipped, and this is detected by the parity check (Shown in Fig. 1).
    C) Some of the bits are flipped, but this is not detected by the parity check.

    You need to locate the lines in the skeleton code.

(5) Repeat the above procedure many times (e.g., 10000). Find out the probabilities of A), B), and C). You need to locate the lines in the skeleton code.

Questions

1. Theoretically, let N denote the bit length of the original information (N+1 is the length of the coded bits), and p denote the probability of bit-flip. Then, Event A) happens with a probability

$$(1-p)^{N+1}$$

Could you verify this theoretical result by your simulator?

Simply running the skeleton code.

p=0.1, N=5, $P_A = (1-p)^{N+1}$=0.5314

2. What are the theoretical probabilities of events B) and C)? Could you verify them by your simulator?

Single-bit error is the most common error. Probabilities of other odd-bit errors can be ignored.

B: $P_B = (\mathrm{N}+1)\mathrm{p}(1-p)^N + \binom{N+1}{3}\mathrm{p}^3(1-p)^{N-2} + \binom{N+1}{5}\mathrm{p}^5(1-p)^{N-4}$ (accurate)

$\approx (\mathrm{N}+1)\mathrm{p}(1-p)^N$ (approximate)

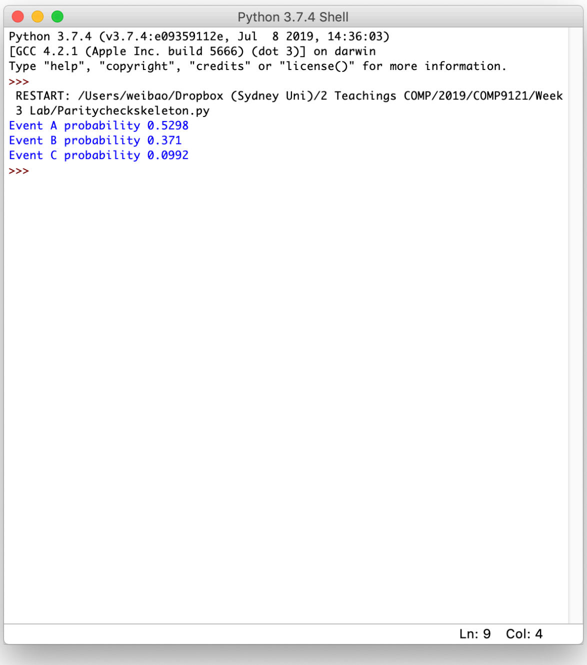
$\binom{N+1}{1}$

C: $P_C = 1 - P_A - P_B$

p=0.1, N=5,
$P_A = (1-p)^{N+1}$=0.5314

P_B =0.3689 (accurate) 0.3543 (approximate)

P_C=0.0997 (accurate) 0.1143 (approximate)



3. Let $p = 0.05$ and N=6. Modify the skeleton code to find out the simulated probabilities of events A, B, and C.

In the code rand<=0.1 is changed to rand<=0.05

infolength=5 is changed to infolength=6

Rerun the code