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- Date Performed (d/m/y): 22/09/2021
- Disclaimer: values of the used variables varies for every execurtion as these are dependent on the randomly defined values of 1s and 0s in N, answers that require particular values are directed to the variable where it is stored.

I. Binary Symmetric Channel

Consider a random transmission of 100 bits on a BSC with a 1-p=0.05 and p=0.95, determine the probabiities of the ff. Let T = Transmitted and R = Received.

```
N_100 = 100; % number of bits to be generated
tx_100 = rand(1,N_100) > 0.5; % generate 100 random bits
tx0_100 = (sum(tx_100(:)==0))/N_100 % rate of transmitted 0's from 100
 sample bits
tx1_100 = (sum(tx_100(:)==1))/N_100 % rate of transmitted 1's from 100
 sample bits
txe_100 = 0.05; % transmission error probability rate
txs_100 = 0.95; % transmission success probability rate
```

```
tx0_100 =

    0.5200


tx1_100 =

    0.4800
```

1. Manual Computation of P()

To determine error and success P(Rx) and P(Tx) through MANUAL computations, the ff. equations must be considered:

```
% Manually computed P(R) - vector | manual XOR implementation
manual_rx_100 = tx_100.*txs_100+tx_100.*txe_100;
```

a.1 P(R'1'): P() rxing 1s

$$P(R'1') = P(T'1') \times P(R'1' \mid T'1') + P(T'0') \times P(R'1' \mid T'0')$$

```
rx1_100 = tx1_100*txs_100+tx0_100*txe_100; % computes the P(R'1')
fprintf('Given the conditions above, the probability that the receiver
 receive 1s from 100 sample bits is %.4f',rx1_100); % display P(R'1')
```

```
Given the conditions above, the probability that the receiver receive
 1s from 100 sample bits is 0.4820
```

a.2 P(R'0'): P() rxing 0s

$$P(R'0') = P(T'0') \times P(R'0' \mid T'0') + P(T'1') \times P(R'0' \mid T'1')$$

```
rx0_100 = tx0_100*txs_100+tx1_100*txe_100; % computes the P(R'0')
fprintf('Given the conditions above, the probability that the receiver
 receive 0s from 100 sample bits is %.4f',rx0_100); % display P(R'0')
```

Given the conditions above, the probability that the receiver receive 0s from 100 sample bits is 0.5180

b.1 P(R'1'|T'1') - conditional P() aka priti

$$P(R'1'|T'1') = \frac{P(T'1'|R'1') \times P(R'1')}{P(T'1')}$$

```
PR1T1_100 = (txs_100*rx1_100)/tx1_100; % computes P(R'1'|T'1')
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 1
 is %.4f', PR1T1_100); %display P(R'1'|T'1')
```

Given the conditions above, the probability that the receiver receive bit 1 when the transmitted data by the transmitter is bit 1 is 0.9540

b.2 P(R'0'|T'1') - conditional P() aka proti

$$P(R'0'|T'1') = \frac{P(T'1'|R'0') \times P(R'0')}{P(T'1')}$$

```
PR0T1_100 = (txe_100*rx0_100)/tx1_100; % computes P(R'0'|T'1')
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitter transmitted bit 1 is %.4f',
 PR0T1_100); %display P(R'0'|T'1')
```

Given the conditions above, the probability that the receiver receive bit 0 when the transmitter transmitted bit 1 is 0.0540

b.3 P(R'1'|T'0') - conditional P() aka prito

$$P(R'1'|T'0') = \frac{P(T'0'|R'1') \times P(R'1')}{P(T'0')}$$

```
PR1T0_100 = (txe_100*rx1_100)/tx0_100; % computes P(R'1'|T'0')
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 0
 is %.4f', PR1T0_100); %display P(R'1'|T'0')
```

Given the conditions above, the probability that the receiver receive bit 1 when the transmitted data by the transmitter is bit 0 is 0.0463

b.4 P(R'0'|T'0') - conditional P() aka proto

$$P(R'0'|T'0') = \frac{P(T'0'|R'0') \times P(R'0')}{P(T'0')}$$

```
PR0T0_100 = (txs_100*rx0_100)/tx0_100; % computes P(R'0'|T'0')
```

```
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitter transmitted bit 0 is %.4f',
 PR0T0_100); %display P(R'0'|T'0')
```

Given the conditions above, the probability that the receiver receive bit 0 when the transmitter transmitted bit 0 is 0.9463

c.1 P(T'1'|R'1') - bayesian P() aka P'tiri

$$P(T'1'|R'1') = \frac{P(R'1'|T'1') \times P(T'1')}{P(R'1'|T'1') \times P(T'1') + P(R'1'|T'0') \times P(T'0')}$$

```
PT1R1_100 = (txs_100*tx1_100)/((txs_100*tx1_100)+(txe_100*tx0_100)); %
 computes P(T'1'|R'1')
fprintf('Given the conditions above, the probability that the
 transmitter transmitted bit 1 when the received data by the receiver
 is bit 1 is %.4f', PT1R1_100); %display P(T'1'|R'1')
```

Given the conditions above, the probability that the transmitter transmitted bit 1 when the received data by the receiver is bit 1 is 0.9461

c.2 P(T'0'|R'1') - bayesian P() aka P'tori

$$P(T'0'|R'1') = \frac{P(R'1'|T'0') \times P(T'0')}{P(R'1'|T'0') \times P(T'0') + P(R'1'|T'1') \times P(T'1')}$$

```
PT0R1_100 = (txe_100*tx0_100)/((txe_100*tx0_100)+(txs_100*tx1_100)); %
 computes P(T'0'|R'1')
fprintf('Given the conditions above, the probability that the
 transmitter transmitted bit 0 when then receiver received bit 1 is
 %.4f', PT0R1_100); %display P(T'0'|R'1')
```

Given the conditions above, the probability that the transmitter transmitted bit 0 when then receiver received bit 1 is 0.0539

c.3 P(T'1'|R'0') - bayesian P() aka P'tiro

$$P(T'1'|R'0') = \frac{P(R'0'|T'1') \times P(T'1')}{P(R'0'|T'1') \times P(T'1') + P(R'0'|T'0') \times P(T'0')}$$

```
PT1R0_100 = (txe_100*tx1_100)/((txe_100*tx1_100)+(txs_100*tx0_100)); %
 computes P(T'1'|R'0')
fprintf('Given the conditions above, the probability that the
 transmitter transmitted bit 1 when the received data by the receiver
 is bit 0 is %.4f', PT1R0_100); %display P(T'1'|R'0')
```

Given the conditions above, the probability that the transmitter transmitted bit 1 when the received data by the receiver is bit 0 is 0.0463

c.4 P(T'0'|R'0') - bayesian P() aka P'toro

$$P(T'0'|R'0') = \frac{P(R'0'|T'0') \times P(T'0')}{P(R'0'|T'0') \times P(T'0') + P(R'0'|T'1') \times P(T'1')}$$

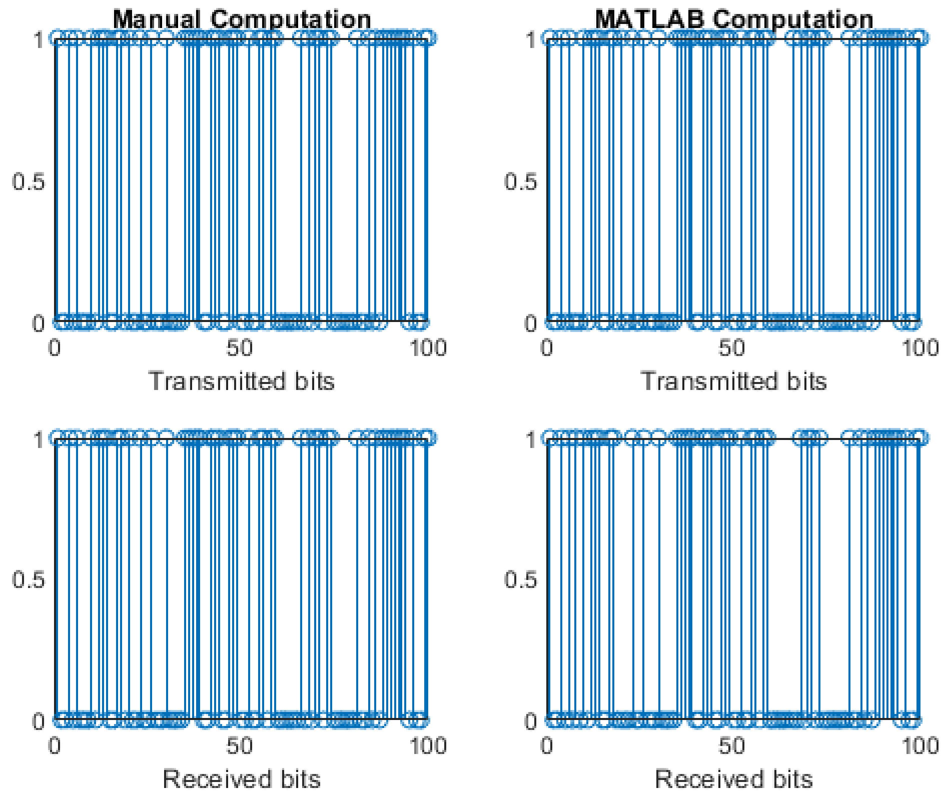
```
PT0R0_100 = (txs_100*tx0_100)/((txs_100*tx0_100)+(txe_100*tx1_100)); %
 computes P(T'0'|R'0')
fprintf('Given the conditions above, the probability that the
 transmitter send bit 0 when the receiver received bit 0 is %.4f',
 PT0R0_100); %display P(T'0'|R'0')
```

Given the conditions above, the probability that the transmitter send bit 0 when the receiver received bit 0 is 0.9537

2. MATLAB Computation of P()

To determine error and success P(Rx) and P(Tx) through MATLAB, the ff. codes must be considered:

```
% For comparison, this figure show the Tx and Rx of both the manually
% computed (see line 25) and MATLAB-generated Rx vectors.

% lines 13-14 must be inserted here!!!
figure(); subplot(2,2,2)
stem(tx_100);
xlabel('Transmitted bits'); title('MATLAB Computation');
% determine is successfully transmitted or not
ch_100 = rand(1,N_100) > txs_100;
rx_100 = xor(tx_100, ch_100);
%plot the results'
subplot(2,2,4), stem(rx_100);
xlabel('Received bits');
subplot(2,2,1), stem(tx_100); xlabel('Transmitted bits');
 title('Manual Computation');
subplot(2,2,3), stem(manual_rx_100); xlabel('Received bits');
```




```
% P(R'1') and P(R'0') - MATLAB values

% rate of received 0's from 100 sample bits
matlab_rx0_100 = (sum(rx_100(:)==0))/N_100

% rate of received 1's from 100 sample bits
matlab_rx1_100 = (sum(rx_100(:)==1))/N_100
```

```
matlab_rx0_100 =

    0.5400


matlab_rx1_100 =

    0.4600
```

```
% PR1T1 from MATLAB gen values
matlab_PR1T1_100 = (txs_100*matlab_rx1_100)/tx1_100
```

```
matlab_PR1T1_100 =

    0.9104
```

```
% PR0T1 from MATLAB gen values
matlab_PR0T1_100 = (txe_100*matlab_rx0_100)/tx1_100


matlab_PR0T1_100 =

    0.0563


% PR0T1 from MATLAB gen values
matlab_PR1T0_100 = (txe_100*matlab_rx1_100)/tx0_100


matlab_PR1T0_100 =

    0.0442


% PR0T0 from MATLAB gen values
matlab_PR0T0_100 = (txs_100*matlab_rx0_100)/tx0_100


matlab_PR0T0_100 =

    0.9865


% PT1R1 from MATLAB gen values
matlab_PT1R1_100 = (txs_100*tx1_100)/
((txs_100*tx1_100)+(txe_100*tx0_100))


matlab_PT1R1_100 =

    0.9461


% PT0R1 from MATLAB gen values
matlab_PT0R1_100 = (txe_100*tx0_100)/
((txe_100*tx0_100)+(txs_100*tx1_100))


matlab_PT0R1_100 =

    0.0539


% PT1R0 from MATLAB gen values
matlab_PT1R0_100 = (txe_100*tx1_100)/
((txe_100*tx1_100)+(txs_100*tx0_100))


matlab_PT1R0_100 =

    0.0463
```

```
% PT0R0 from MATLAB gen values
matlab_PT0R0_100 = (txs_100*tx0_100)/
((txs_100*tx0_100)+(txe_100*tx1_100))
```

```
matlab_PT0R0_100 =

    0.9537
```

Discussion for 1 and 2

- The calculated P(R'1') and P(R'0') values are defined by the variables 'rx1_100' and 'rx0_100' for manual computation (see sec.a1-a2) and 'matlab_rx0_100' and 'matlab_rx1_100'. Although the small variance between the manually computed and MATLAB-generated received bits are not visible from the figure above, the numbers of these variables show that the there exist an error rate of up to ~5% (depending on the computed values in line 14) within the transmission channel.
- Similarly, the manually computed (sec.b1-c4) and MATLAB-generated (lines 116-157) PR0T0, PR0T1, PR1T0, PR1T1, T1R1, R1T1, R1T0, and R0T0 show a tiny variance to none from each other assuring that there is only a chance of up to ~5% that the received or transmitted bits are erroneous. Moreover, the success transmission/receving rate of correct 1 or 0 bits ccording to these probabilities is up to ~95%, which is aligned to the provided specification above.
- By inspection, the values from the manually computed probabilities of the samples by conditional differ when the same means applied onto the MATLAB generated bits. In contrast to when these probabilities are computed through Bayesian theorem, the computed values do not change.

3. Repeat experiment for N=1000 and N=10000 bits.

To determine error and success P(Rx) and P(Tx) when N=1k and N=10k bits, the ff. codes must be realized.

3.a.1 N=1000 bits (Manual Computation)

```
N_1k = 1000; % number of bits to be generated
tx_1k = rand(1,N_1k) > 0.5; % generate 1000 random bits
tx0_1k = (sum(tx_1k(:)==0))/N_1k % rate of tx 0's from 1k sample bits
tx1_1k = (sum(tx_1k(:)==1))/N_1k % rate of tx 1's from 1k sample bits
txe_1k = 0.05; % transmission error probability rate
txs_1k = 0.95; % transmission success probability rate

% Manually computed P(R) - vector | manual XOR implementation
manual_rx_1k = tx_1k.*txs_1k+tx_1k.*txe_1k;
```

```
tx0_1k =

    0.4900
```

```
tx1_1k =

    0.5100


% P(R'1') of 1k bits
rx1_1k = tx1_1k*txs_1k+tx0_1k*txe_1k;
fprintf('Given the conditions above, the probability that the receiver
 receive 1s from 1000 sample bits is %.4f',rx1_1k);

Given the conditions above, the probability that the receiver receive
 1s from 1000 sample bits is 0.5090

% P(R'0') of 1k bits
rx0_1k = tx0_1k*txs_1k+tx1_1k*txe_1k;
fprintf('Given the conditions above, the probability that the receiver
 receive 0s from 1000 sample bits is %.4f',rx0_1k);

Given the conditions above, the probability that the receiver receive
 0s from 1000 sample bits is 0.4910

% P(R'1'|T'1') of 1k bits
PR1T1_1k = (txs_1k*rx1_1k)/tx1_1k;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 1
 is %.4f', PR1T1_1k);

Given the conditions above, the probability that the receiver receive
 bit 1 when the transmitted data by the transmitter is bit 1 is 0.9481

% P(R'0'|T'1') of 1k bits
PR0T1_1k = (txe_1k*rx0_1k)/tx1_1k;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitter transmitted bit 1 is %.4f',
 PR0T1_1k);

Given the conditions above, the probability that the receiver receive
 bit 0 when the transmitter transmitted bit 1 is 0.0481

% P(R'1'|T'0') of 1k bits
PR1T0_1k = (txe_1k*rx1_1k)/tx0_1k;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 0
 is %.4f', PR1T0_1k);

Given the conditions above, the probability that the receiver receive
 bit 1 when the transmitted data by the transmitter is bit 0 is 0.0519

% P(R'0'|T'0') of 1k bits
PR0T0_1k = (txs_1k*rx0_1k)/tx0_1k;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitter transmitted bit 0 is %.4f',
 PR0T0_1k);
```

Given the conditions above, the probability that the receiver receive bit 0 when the transmitter transmitted bit 0 is 0.9519

```
% P(T'1'|R'1') of 1k bits
PT1R1_1k = (txs_1k*tx1_1k)/((txs_1k*tx1_1k)+(txe_1k*tx0_1k));
fprintf('Given the conditions above, the probability that the
 transmitter transmitted bit 1 when the received data by the receiver
 is bit 1 is %.4f', PT1R1_1k);
```

Given the conditions above, the probability that the transmitter transmitted bit 1 when the received data by the receiver is bit 1 is 0.9519

```
% P(T'0'|R'1') of 1k bits
PT0R1_1k = (txe_1k*tx0_1k)/((txe_1k*tx0_1k)+(txs_1k*tx1_1k));
fprintf('Given the conditions above, the probability that the
 transmitter transmitted bit 0 when then receiver received bit 1 is
 %.4f', PT0R1_1k);
```

Given the conditions above, the probability that the transmitter transmitted bit 0 when then receiver received bit 1 is 0.0481

```
% P(T'1'|R'0') of 1k bits
PT1R0_1k = (txe_1k*tx1_1k)/((txe_1k*tx1_1k)+(txs_1k*tx0_1k));
fprintf('Given the conditions above, the probability that the
 transmitter transmitted bit 1 when the received data by the receiver
 is bit 0 is %.4f', PT1R0_1k);
```

Given the conditions above, the probability that the transmitter transmitted bit 1 when the received data by the receiver is bit 0 is 0.0519

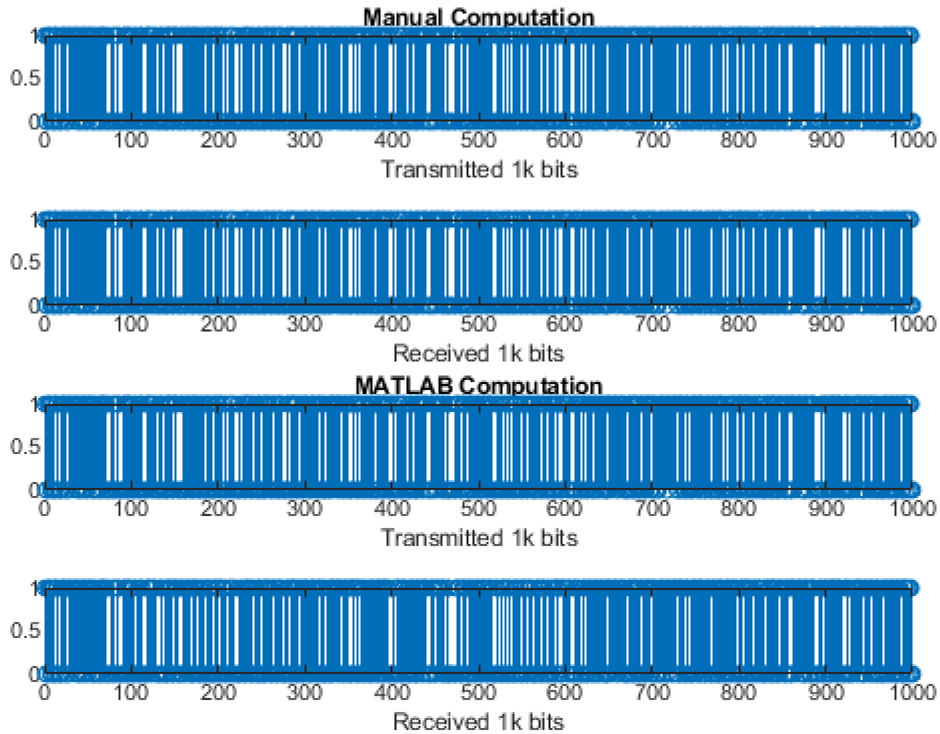
```
% P(T'0'|R'0') of 1k bits
PT0R0_1k = (txs_1k*tx0_1k)/((txs_1k*tx0_1k)+(txe_1k*tx1_1k));
fprintf('Given the conditions above, the probability that the
 transmitter send bit 0 when the receiver received bit 0 is %.4f',
 PT0R0_1k);
```

Given the conditions above, the probability that the transmitter send bit 0 when the receiver received bit 0 is 0.9481

3.a.2 N=1000 bits (MATLAB Computation)

```
% lines 184-185 must be inserted here!!!
figure(); subplot(4,1,3)
stem(tx_1k);
xlabel('Transmitted 1k bits'); title('MATLAB Computation');
% determine is successfully transmitted or not
ch_1k = rand(1,N_1k) > txs_1k;
rx_1k = xor(tx_1k, ch_1k);
%plot the results'
subplot(4,1,4), stem(rx_1k);
xlabel('Received 1k bits');
```

```
subplot(4,1,1), stem(tx_1k); xlabel('Transmitted 1k bits');
 title('Manual Computation');
subplot(4,1,2), stem(manual_rx_1k); xlabel('Received 1k bits');
```




```
% P(R'1') and P(R'0') - MATLAB values

% rate of received 0's from 1k sample bits
matlab_rx0_1k = (sum(rx_1k(:)==0))/N_1k

% rate of received 1's from 1k sample bits
matlab_rx1_1k = (sum(rx_1k(:)==1))/N_1k


matlab_rx0_1k =

    0.4900


matlab_rx1_1k =

    0.5100


% PR1T1 from MATLAB gen values - 1k bits
matlab_PR1T1_1k = (txs_1k*matlab_rx1_1k)/tx1_1k
```

```
matlab_PR1T1_1k =

    0.9500


% PR0T1 from MATLAB gen values - 1k bits
matlab_PR0T1_1k = (txe_1k*matlab_rx0_1k)/tx1_1k


matlab_PR0T1_1k =

    0.0480


% PR0T1 from MATLAB gen values - 1k bits
matlab_PR1T0_1k = (txe_1k*matlab_rx1_1k)/tx0_1k


matlab_PR1T0_1k =

    0.0520


% PR0T0 from MATLAB gen values - 1k bits
matlab_PR0T0_1k = (txs_1k*matlab_rx0_1k)/tx0_1k


matlab_PR0T0_1k =

    0.9500


% PT1R1 from MATLAB gen values - 1k bits
matlab_PT1R1_1k = (txs_1k*tx1_1k)/((txs_1k*tx1_1k)+(txe_1k*tx0_1k))


matlab_PT1R1_1k =

    0.9519


% PT0R1 from MATLAB gen values - 1k bits
matlab_PT0R1_1k = (txe_1k*tx0_1k)/((txe_1k*tx0_1k)+(txs_1k*tx1_1k))


matlab_PT0R1_1k =

    0.0481


% PT1R0 from MATLAB gen values - 1k bits
matlab_PT1R0_1k = (txe_1k*tx1_1k)/((txe_1k*tx1_1k)+(txs_1k*tx0_1k))


matlab_PT1R0_1k =
```

```
    0.0519
```

```
% PT0R0 from MATLAB gen values - 1k bits
matlab_PT0R0_1k = (txs_1k*tx0_1k)/((txs_1k*tx0_1k)+(txe_1k*tx1_1k))
```

```
matlab_PT0R0_1k =

    0.9481
```

Discussion for 3a1-2

- The calculated P(R'1') and P(R'0') values are defined by the variables 'rx1_1k' and 'rx0_1k' for manual computation (see sec.3a1) and 'matlab_rx0_1k' and 'matlab_rx1_1k'. Although the small variance between the manually computed and MATLAB-generated received bits are not visible from the figure above, the numbers of these variables show that the there exist an error rate of up to ~5% (depending on the computed values of N) within the transmission channel.
- Similarly, the manually computed (sec.b1-c4) and MATLAB-generated (lines 271-300) PR0T0, PR0T1, PR1T0, PR1T1, T1R1, R1T1, R1T0, and R0T0 show a tiny variance to none from each other assuring that there is only a chance of up to ~5% that the received or transmitted bits are erroneous. Moreover, the success transmission/receving rate of correct 1 or 0 bits ccording to these probabilities is up to ~95%, which is aligned to the provided specification above.
- By inspection, the values from the manually computed probabilities of the samples by conditional differ when the same means applied onto the MATLAB generated bits. In contrast to when these probabilities are computed through Bayesian theorem, the computed values do not change.

3.b.1 N=10000 bits (Manual Computation)

```
N_10k = 10000; % number of bits to be generated
tx_10k = rand(1,N_10k) > 0.5; % generate 10000 random bits
tx0_10k = (sum(tx_10k(:)==0))/N_10k % rate of tx 0's from 10k sample
 bits
tx1_10k = (sum(tx_10k(:)==1))/N_10k % rate of tx 1's from 10k sample
 bits
txe_10k = 0.05; % transmission error probability rate
txs_10k = 0.95; % transmission success probability rate

% Manually computed P(R) - vector | manual XOR implementation
manual_rx_10k = tx_10k.*txs_10k+tx_10k.*txe_10k;
```

```
tx0_10k =

    0.5061


tx1_10k =
```

```
    0.4939

% P(R'1') of 10k bits
rx1_10k = tx1_10k*txs_10k+tx0_10k*txe_10k;
fprintf('Given the conditions above, the probability that the receiver
 receive 1s from 10000 sample bits is %.4f',rx1_10k);

Given the conditions above, the probability that the receiver receive
 1s from 10000 sample bits is 0.4945

% P(R'0') of 10k bits
rx0_10k = tx0_10k*txs_10k+tx1_10k*txe_10k;
fprintf('Given the conditions above, the probability that the receiver
 receive 0s from 10000 sample bits is %.4f',rx0_10k);

Given the conditions above, the probability that the receiver receive
 0s from 10000 sample bits is 0.5055

% P(R'1'|T'1') of 10k bits
PR1T1_10k = (txs_10k*rx1_10k)/tx1_10k;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 1
 is %.4f', PR1T1_10k);

Given the conditions above, the probability that the receiver receive
 bit 1 when the transmitted data by the transmitter is bit 1 is 0.9512

% P(R'0'|T'1') of 10k bits
PR0T1_10k = (txe_10k*rx0_10k)/tx1_10k;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitter transmitted bit 1 is %.4f',
 PR0T1_10k);

Given the conditions above, the probability that the receiver receive
 bit 0 when the transmitter transmitted bit 1 is 0.0512

% P(R'1'|T'0') of 10k bits
PR1T0_10k = (txe_10k*rx1_10k)/tx0_10k;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 0
 is %.4f', PR1T0_10k);

Given the conditions above, the probability that the receiver receive
 bit 1 when the transmitted data by the transmitter is bit 0 is 0.0489

% P(R'0'|T'0') of 10k bits
PR0T0_10k = (txs_10k*rx0_10k)/tx0_10k;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitter transmitted bit 0 is %.4f',
 PR0T0_10k);

Given the conditions above, the probability that the receiver receive
 bit 0 when the transmitter transmitted bit 0 is 0.9489
```

```
% P(T'1'|R'1') of 10k bits
PT1R1_10k = (txs_10k*tx1_10k)/((txs_10k*tx1_10k)+(txe_10k*tx0_10k));
fprintf('Given the conditions above, the probability that the
 transmitter transmitted bit 1 when the received data by the receiver
 is bit 1 is %.4f', PT1R1_10k);
```

Given the conditions above, the probability that the transmitter transmitted bit 1 when the received data by the receiver is bit 1 is 0.9488

```
% P(T'0'|R'1') of 10k bits
PT0R1_10k = (txe_10k*tx0_10k)/((txe_10k*tx0_10k)+(txs_10k*tx1_10k));
fprintf('Given the conditions above, the probability that the
 transmitter transmitted bit 0 when then receiver received bit 1 is
 %.4f', PT0R1_10k);
```

Given the conditions above, the probability that the transmitter transmitted bit 0 when then receiver received bit 1 is 0.0512

```
% P(T'1'|R'0') of 10k bits
PT1R0_10k = (txe_10k*tx1_10k)/((txe_10k*tx1_10k)+(txs_10k*tx0_10k));
fprintf('Given the conditions above, the probability that the
 transmitter transmitted bit 1 when the received data by the receiver
 is bit 0 is %.4f', PT1R0_10k);
```

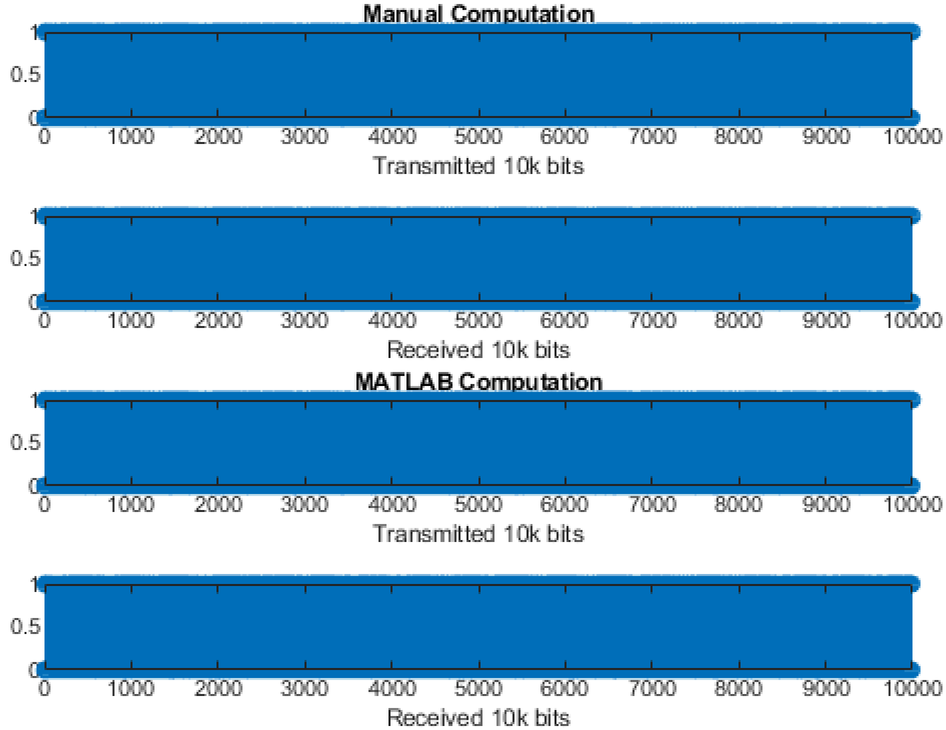
Given the conditions above, the probability that the transmitter transmitted bit 1 when the received data by the receiver is bit 0 is 0.0489

```
% P(T'0'|R'0') of 10k bits
PT0R0_10k = (txs_10k*tx0_10k)/((txs_10k*tx0_10k)+(txe_10k*tx1_10k));
fprintf('Given the conditions above, the probability that the
 transmitter send bit 0 when the receiver received bit 0 is %.4f',
 PT0R0_10k);
```

Given the conditions above, the probability that the transmitter send bit 0 when the receiver received bit 0 is 0.9511

3.b.2 N=10000 bits (MATLAB Computation)

```
% lines 302-303 must be inserted here!!!
figure(); subplot(4,1,3)
stem(tx_10k);
xlabel('Transmitted 10k bits'); title('MATLAB Computation');
% determine is successfully transmitted or not
ch_10k = rand(1,N_10k) > txs_10k;
rx_10k = xor(tx_10k, ch_10k);
%plot the results'
subplot(4,1,4), stem(rx_10k);
xlabel('Received 10k bits');
subplot(4,1,1), stem(tx_10k); xlabel('Transmitted 10k bits');
 title('Manual Computation');
subplot(4,1,2), stem(manual_rx_10k); xlabel('Received 10k bits');
```




```
% P(R'1') and P(R'0') - MATLAB values

% rate of received 0's from 10k sample bits
matlab_rx0_10k = (sum(rx_10k(:)==0))/N_10k

% rate of received 1's from 10k sample bits
matlab_rx1_10k = (sum(rx_10k(:)==1))/N_10k


matlab_rx0_10k =

    0.5049


matlab_rx1_10k =

    0.4951


% PR1T1 from MATLAB gen values - 10k bits
matlab_PR1T1_10k = (txs_10k*matlab_rx1_10k)/tx1_10k


matlab_PR1T1_10k =

    0.9523
```

```
% PR0T1 from MATLAB gen values - 10k bits
matlab_PR0T1_10k = (txe_10k*matlab_rx0_10k)/tx1_10k


matlab_PR0T1_10k =

    0.0511


% PR0T1 from MATLAB gen values - 10k bits
matlab_PR1T0_10k = (txe_10k*matlab_rx1_10k)/tx0_10k


matlab_PR1T0_10k =

    0.0489


% PR0T0 from MATLAB gen values - 10k bits
matlab_PR0T0_10k = (txs_10k*matlab_rx0_10k)/tx0_10k


matlab_PR0T0_10k =

    0.9477


% PT1R1 from MATLAB gen values - 10k bits
matlab_PT1R1_10k = (txs_10k*tx1_10k)/
((txs_10k*tx1_10k)+(txe_10k*tx0_10k))


matlab_PT1R1_10k =

    0.9488


% PT0R1 from MATLAB gen values - 10k bits
matlab_PT0R1_10k = (txe_10k*tx0_10k)/
((txe_10k*tx0_10k)+(txs_10k*tx1_10k))


matlab_PT0R1_10k =

    0.0512


% PT1R0 from MATLAB gen values - 10k bits
matlab_PT1R0_10k = (txe_10k*tx1_10k)/
((txe_10k*tx1_10k)+(txs_10k*tx0_10k))


matlab_PT1R0_10k =

    0.0489
```

```
% PT0R0 from MATLAB gen values - 10k bits
matlab_PT0R0_10k = (txs_10k*tx0_10k)/
((txs_10k*tx0_10k)+(txe_10k*tx1_10k))
```

```
matlab_PT0R0_10k =

    0.9511
```

Discussion for 3b1-2

- The calculated P(R'1') and P(R'0') values are defined by the variables 'rx1_10k' and 'rx0_10k' for manual computation (see sec.3b1) and 'matlab_rx0_10k' and 'matlab_rx1_10k'. Although the small variance between the manually computed and MATLAB-generated received bits are not visible from the figure above, the numbers of these variables show that the there exist an error rate of up to ~5% (depending on the computed values of N) within the transmission channel.

- Similarly, the manually computed (sec.b1-c4) and MATLAB-generated (lines 401-439) PR0T0, PR0T1, PR1T0, PR1T1, T1R1, R1T1, R1T0, and R0T0 show a tiny variance to none from each other assuring that there is only a chance of up to ~5% that the received or transmitted bits are erroneous. Moreover, the success transmission/receving rate of correct 1 or 0 bits ccording to these probabilities is up to ~95%, which is aligned to the provided specification above.

- By inspection, the values from the manually computed probabilities of the samples by conditional differ when the same means applied onto the MATLAB generated bits. In contrast to when these probabilities are computed through Bayesian theorem, the computed values do not change.

Conclusion for sec.3

- Regardless of the length of N or bits transmitted in the BSC configuration above, both the manual computations and MATLAB-generated simulations and probabilities suggested that the success rate of transmission and receiving over the BSC is ~95% with an error rate of ~5%. By inspection, it is also observed that the computed probabilities by 'conditional method' provide values with tiny variances between the manual computations and MATLAB-generated whilst there are none when using 'Bayesian method'. Overall, like the corss-validation formulas of confusion matrix, the equations above determine only the probabilities of success and error rates of data transmission and receiving the generated N-bits over the BSC and the combination of both values of Tx and Rx. Moreover, the computed values of these probabilistic equations proved that the success Tx(1,0,1,0)/Rx(1,1,0,0) rates of the considered BSC are ~95% when alike bits and ~5% when different bit value.

II. Non-Symmetric Channel

Assume the channel is non-symmetric. The probability that a '1' is correctly received as '1' is 0.95 while the probability that a '0' is correctly received as '0' is 0.85.

Unlike the previous cases, the transmission rates of 0 and 1 are required to be identified since sucessful receive rate of 0 and 1 are already provided. Moreover, P(T'1') and P(T'0') must be determined to compute the same probabilities above. The following equations below are necessary to suffice these requirements.

1.a Manual Computation

- For this section of the lab activity, the author considered generating 100 random bits to

```
N_100_NS = 100; % number of bits to be generated
rx_100_NS = rand(1,N_100_NS) > 0.5; % generate 100 random bits
rx0_100_NS = (sum(rx_100_NS(:)==0))/N_100_NS % rate of rx 0's from 100
 sample bits
rx1_100_NS = (sum(rx_100_NS(:)==1))/N_100_NS % rate of rx 1's from 100
 sample bits
rxe1_100_NS = 0.05; % rx 1 error probability rate
rxs1_100_NS = 0.95; % rx 1 success probability rate
rxe0_100_NS = 0.15; % rx 0 error probability rated
rxs0_100_NS = 0.85; % rx 0 success probability rate
```

```
rx0_100_NS =

    0.5000


rx1_100_NS =

    0.5000
```

a.1 P(T'1'): P() txing 1s

$$P(T'1') = P(R'1') \times P(T'1' \mid R'1') + P(R'0') \times P(T'1' \mid R'0')$$

```
manual_tx1_100_NS = rx_100_NS.*rxs1_100_NS+rx_100_NS.*rxe1_100_NS;
manual_tx0_100_NS = rx_100_NS.*rxs0_100_NS+rx_100_NS.*rxe0_100_NS;
manual_tx_100_NS = manual_tx1_100_NS .* manual_tx0_100_NS; %anding ops

% computes the P(T'1')
tx1_100_NS = rx1_100_NS*rxs1_100_NS+rx0_100_NS*rxe1_100_NS;
fprintf('Given the conditions above, the probability that
 the transmitter transmitted 1s from 100 sample bits is
 %.4f',tx1_100_NS); % display P(T'1')
```

```
Given the conditions above, the probability that the transmitter
 transmitted 1s from 100 sample bits is 0.5000
```

a.2 P(T'0'): P() txing 1s

$$P(T'0') = P(R'0') \times P(T'0' \mid R'0') + P(R'1') \times P(T'0' \mid R'1')$$

```
% computes the P(T'0')
tx0_100_NS = rxs1_100_NS*rxs0_100_NS+rx1_100_NS*rxe0_100_NS;
fprintf('Given the conditions above, the probability that
 the transmitter transmitted 0s from 100 sample bits is
 %.4f',tx0_100_NS); % display P(T'0')
```

```
Given the conditions above, the probability that the transmitter
 transmitted 0s from 100 sample bits is 0.8825
```

b. PR1T1, PR0T1, PR1T0, PR0T0

```
% PR1T1
PR1T1_100_NS = (rxs1_100_NS*rx1_100_NS)/tx1_100_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 1
 is %.4f', PR1T1_100_NS);
```

```
Given the conditions above, the probability that the receiver receive
 bit 1 when the transmitted data by the transmitter is bit 1 is 0.9500
```

```
% PR0T1
PR0T1_100_NS = (rxe1_100_NS*rx0_100_NS)/tx1_100_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitted data by the transmitter is bit 1
 is %.4f', PR0T1_100_NS);
```

```
Given the conditions above, the probability that the receiver receive
 bit 0 when the transmitted data by the transmitter is bit 1 is 0.0500
```

```
% PR1T0
PR1T0_100_NS = (rxe0_100_NS*rx1_100_NS)/tx0_100_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 0
 is %.4f', PR1T0_100_NS);
```

```
Given the conditions above, the probability that the receiver receive
 bit 1 when the transmitted data by the transmitter is bit 0 is 0.0850
```

```
% PR0T0
PR0T0_100_NS = (rxs0_100_NS*rx0_100_NS)/tx0_100_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitted data by the transmitter is bit 0
 is %.4f', PR0T0_100_NS);
```

```
Given the conditions above, the probability that the receiver receive
 bit 0 when the transmitted data by the transmitter is bit 0 is 0.4816
```

```
% PT1R1
PT1R1_100_NS = (rxs1_100_NS*tx1_100_NS)/
((rxs1_100_NS*tx1_100_NS)+(rxe0_100_NS*tx0_100_NS))
```

```
PT1R1_100_NS =

    0.7821
```

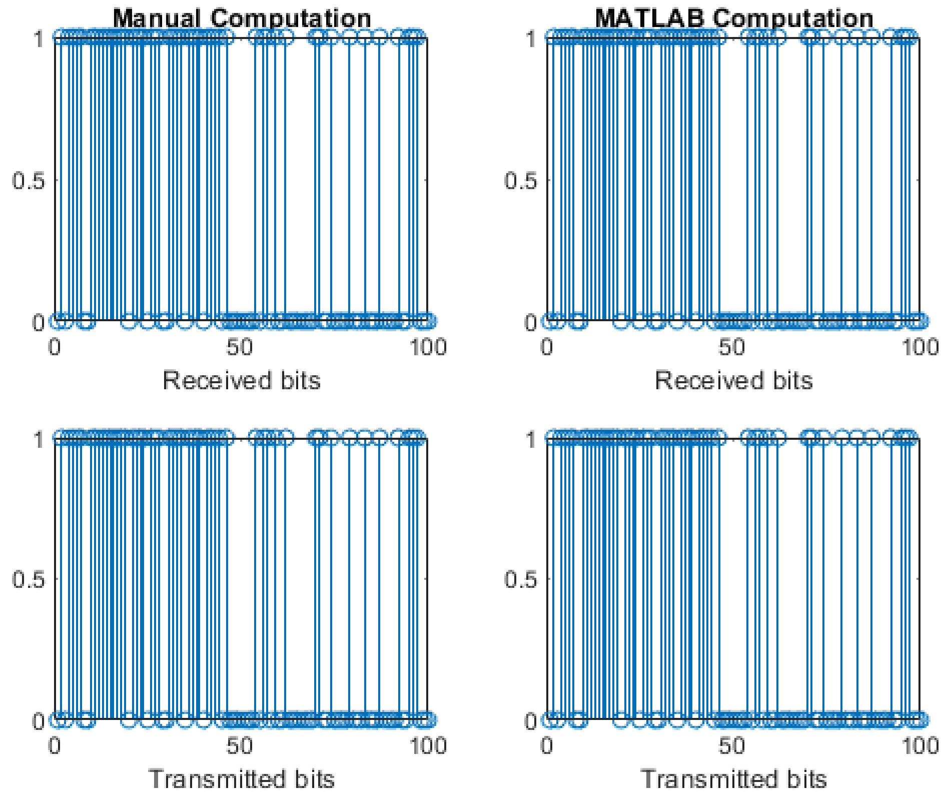
```
% PT0R1
PT0R1_100_NS = (rxe0_100_NS*tx0_100_NS)/
((rxe0_100_NS*tx0_100_NS)+(rxs1_100_NS*tx1_100_NS))
```

```
PT0R1_100_NS =

    0.2179


% PT1R0
PT1R0_100_NS = (rxe1_100_NS*tx1_100_NS)/
((rxe1_100_NS*tx1_100_NS)+(rxs0_100_NS*tx0_100_NS))


PT1R0_100_NS =

    0.0323


% PT0R0
PT0R0_100_NS = (rxs0_100_NS*tx0_100_NS)/
((rxs0_100_NS*tx0_100_NS)+(rxe1_100_NS*tx1_100_NS))


PT0R0_100_NS =

    0.9677
```

1.b MATLAB Computation

```
figure(); subplot(2,2,2)
stem(rx_100_NS);
xlabel('Received bits'); title('MATLAB Computation');
% determine is successfully received or not
ch1_100_NS = rand(1,N_100_NS) > 0.95;
ch0_100_NS = rand(1,N_100_NS) > 0.85;
ch_100_NS = and(ch1_100_NS, ch0_100_NS);
tx_100_NS = xor(rx_100_NS, ch_100_NS);
%plot the results'
subplot(2,2,4), stem(rx_100_NS);
xlabel('Transmitted bits');
subplot(2,2,1), stem(manual_tx_100_NS); xlabel('Received bits');
 title('Manual Computation');
subplot(2,2,3), stem(rx_100_NS); xlabel('Transmitted bits');

matlab_tx0_100_NS = (sum(tx_100_NS(:)==0))/N_100_NS % rate of tx 0's
 from 100 sample bits
matlab_tx1_100_NS = (sum(tx_100_NS(:)==1))/N_100_NS % rate of tx 1's
 from 100 sample bits


matlab_tx0_100_NS =

    0.4900


matlab_tx1_100_NS =
```

0.5100




```
% PR1T1
matlab_PR1T1_100_NS = (rxs1_100_NS*rx1_100_NS)/matlab_tx1_100_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 1
 is %.4f', PR1T1_100_NS);
```

Given the conditions above, the probability that the receiver receive bit 1 when the transmitted data by the transmitter is bit 1 is 0.9500

```
% PR0T1
matlab_PR0T1_100_NS = (rxe1_100_NS*rx0_100_NS)/matlab_tx1_100_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitted data by the transmitter is bit 1
 is %.4f', PR0T1_100_NS);
```

Given the conditions above, the probability that the receiver receive bit 0 when the transmitted data by the transmitter is bit 1 is 0.0500

```
% PR1T0
matlab_PR1T0_100_NS = (rxe0_100_NS*rx1_100_NS)/matlab_tx0_100_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 0
 is %.4f', PR1T0_100_NS);
```

Given the conditions above, the probability that the receiver receive bit 1 when the transmitted data by the transmitter is bit 0 is 0.0850

```
% PR0T0
matlab_PR0T0_100_NS = (rxs0_100_NS*rx0_100_NS)/matlab_tx0_100_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitted data by the transmitter is bit 0
 is %.4f', PR0T0_100_NS);
```

Given the conditions above, the probability that the receiver receive bit 0 when the transmitted data by the transmitter is bit 0 is 0.4816

```
% PT1R1
matlab_PT1R1_100_NS = (rxs1_100_NS*matlab_tx1_100_NS)/
((rxs1_100_NS*matlab_tx1_100_NS)+(rxe0_100_NS*matlab_tx0_100_NS))
```

```
matlab_PT1R1_100_NS =

    0.8683
```

```
% PT0R1
matlab_PT0R1_100_NS = (rxe0_100_NS*matlab_tx0_100_NS)/
((rxe0_100_NS*matlab_tx0_100_NS)+(rxs1_100_NS*matlab_tx1_100_NS))
```

```
matlab_PT0R1_100_NS =

    0.1317
```

```
% PT1R0
matlab_PT1R0_100_NS = (rxe1_100_NS*matlab_tx1_100_NS)/
((rxe1_100_NS*matlab_tx1_100_NS)+(rxs0_100_NS*matlab_tx0_100_NS))
```

```
matlab_PT1R0_100_NS =

    0.0577
```

```
% PT0R0
matlab_PT0R0_100_NS = (rxs0_100_NS*matlab_tx0_100_NS)/
((rxs0_100_NS*matlab_tx0_100_NS)+(rxe1_100_NS*matlab_tx1_100_NS))
```

```
matlab_PT0R0_100_NS =

    0.9423
```

Discussion of section II-1a-b

- Given the specifications above, the probabilities computed manually are defined by the variables 'tx0_100_NS', 'tx1_100_NS' for P(T'0') and P(T'1'), 'PR1T1_100_NS', 'PR0T1_100_NS', 'PR1T0_100_NS', 'PR0T0_100_NS' for P(R'1'|T'1'), P(R'0'|T'1'), P(R'1'|T'0'), and P(R'0'|T'0'), respectively. The variables 'PT1R1_100_NS', 'PT1R0_100_NS', 'PT0R1_100_NS', 'PT0R0_100_NS' define the P(T'1'|R'1'), P(T'0'|R'1'), P(T'1'|R'0'), and P(T'0'|R'0') respectively.

The probabilities computed through MATLAB are defined by the variables 'matlab_tx0_100_NS', 'matlab_tx1_100_NS' for P(T'0') and P(T'1'), 'matlab_PR1T1_100_NS', 'matlab_PR0T1_100_NS', 'matlab_PR1T0_100_NS', 'matlab_PR0T0_100_NS' for P(R'1'|T'1'), P(R'0'|T'1'), P(R'1'|T'0'), and P(R'0'|T'0'), respectively. The variables 'matlab_PT1R1_100_NS', 'matlab_PT1R0_100_NS', 'matlab_PT0R1_100_NS', 'matlab_PT0R0_100_NS' define the P(T'1'|R'1'), P(T'0'|R'1'), P(T'1'|R'0'), and P(T'0'|R'0') respectively.

By inspection, the the manually computed and those through MATLAB conditional probabilities ahow similar output only that these numbers are farther from the requirement of the Asym BC. In contrast with the probabilities computed using BAyesian theorem, the values appear to be balanced in both Rx and Tx considering the conbitions of 1 and 0 in both ends.Furthermore, we may relate the computed probabilities through conditional method to the outcom of Binary Erasure Channel where a portion of the output had gone missing or erased due to asymmetrical design proabilities of Rx and Tx.

2. MATLAB Asym. N=10000

```
N_10k_NS = 10000; % number of bits to be generated
rx_10k_NS = rand(1,N_10k_NS) > 0.5; % generate 100 random bits
rx0_10k_NS = (sum(rx_10k_NS(:)==0))/N_10k_NS % rate of rx 0's from 100
 sample bits
rx1_10k_NS = (sum(rx_10k_NS(:)==1))/N_10k_NS % rate of rx 1's from 100
 sample bits
rxe1_10k_NS = 0.05; % rx 1 error probability rate
rxs1_10k_NS = 0.95; % rx 1 success probability rate
rxe0_10k_NS = 0.15; % rx 0 error probability rated
rxs0_10k_NS = 0.85; % rx 0 success probability rate
```

```
rx0_10k_NS =

    0.5018


rx1_10k_NS =

    0.4982
```

a.1 P(T'1'): P() txing 1s

$$P(T'1') = P(R'1') \times P(T'1' \mid R'1') + P(R'0') \times P(T'1' \mid R'0')$$

```
manual_tx1_10k_NS = rx_10k_NS.*rxs1_10k_NS+rx_10k_NS.*rxe1_10k_NS;
manual_tx0_10k_NS = rx_10k_NS.*rxs0_10k_NS+rx_10k_NS.*rxe0_10k_NS;
manual_tx_10k_NS = manual_tx1_10k_NS .* manual_tx0_10k_NS; %anding ops

% computes the P(T'1')
tx1_10k_NS = rx1_10k_NS*rxs1_10k_NS+rx0_10k_NS*rxe1_10k_NS;
```

```
fprintf('Given the conditions above, the probability that
 the transmitter transmitted 1s from 100 sample bits is
 %.4f',tx1_10k_NS); % display P(T'1')
```

Given the conditions above, the probability that the transmitter transmitted 1s from 100 sample bits is 0.4984

a.2 P(T'0'): P() txing 1s

$$P(T'0') = P(R'0') \times P(T'0' \mid R'0') + P(R'1') \times P(T'0' \mid R'1')$$

```
% computes the P(T'0')
tx0_10k_NS = rxs1_10k_NS*rxs0_10k_NS+rx1_10k_NS*rxe0_10k_NS;
fprintf('Given the conditions above, the probability that
 the transmitter transmitted 0s from 100 sample bits is
 %.4f',tx0_10k_NS); % display P(T'0')
```

Given the conditions above, the probability that the transmitter transmitted 0s from 100 sample bits is 0.8822

b. PR1T1, PR0T1, PR1T0, PR0T0

```
% PR1T1
PR1T1_10k_NS = (rxs1_10k_NS*rx1_10k_NS)/tx1_10k_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 1
 is %.4f', PR1T1_10k_NS);
```

Given the conditions above, the probability that the receiver receive bit 1 when the transmitted data by the transmitter is bit 1 is 0.9497

```
% PR0T1
PR0T1_10k_NS = (rxe1_10k_NS*rx0_10k_NS)/tx1_10k_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitted data by the transmitter is bit 1
 is %.4f', PR0T1_10k_NS);
```

Given the conditions above, the probability that the receiver receive bit 0 when the transmitted data by the transmitter is bit 1 is 0.0503

```
% PR1T0
PR1T0_10k_NS = (rxe0_10k_NS*rx1_10k_NS)/tx0_10k_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 0
 is %.4f', PR1T0_10k_NS);
```

Given the conditions above, the probability that the receiver receive bit 1 when the transmitted data by the transmitter is bit 0 is 0.0847

```
% PR0T0
PR0T0_10k_NS = (rxs0_10k_NS*rx0_10k_NS)/tx0_10k_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitted data by the transmitter is bit 0
 is %.4f', PR0T0_10k_NS);
```

Given the conditions above, the probability that the receiver receive bit 0 when the transmitted data by the transmitter is bit 0 is 0.4835

```
% PT1R1
PT1R1_10k_NS = (rxs1_10k_NS*tx1_10k_NS)/
((rxs1_10k_NS*tx1_10k_NS)+(rxe0_10k_NS*tx0_10k_NS))
```

```
PT1R1_10k_NS =

    0.7816
```

```
% PT0R1
PT0R1_10k_NS = (rxe0_10k_NS*tx0_10k_NS)/
((rxe0_10k_NS*tx0_10k_NS)+(rxs1_10k_NS*tx1_10k_NS))
```

```
PT0R1_10k_NS =

    0.2184
```

```
% PT1R0
PT1R0_10k_NS = (rxe1_10k_NS*tx1_10k_NS)/
((rxe1_10k_NS*tx1_10k_NS)+(rxs0_10k_NS*tx0_10k_NS))
```

```
PT1R0_10k_NS =

    0.0322
```

```
% PT0R0
PT0R0_10k_NS = (rxs0_10k_NS*tx0_10k_NS)/
((rxs0_10k_NS*tx0_10k_NS)+(rxe1_10k_NS*tx1_10k_NS))
```

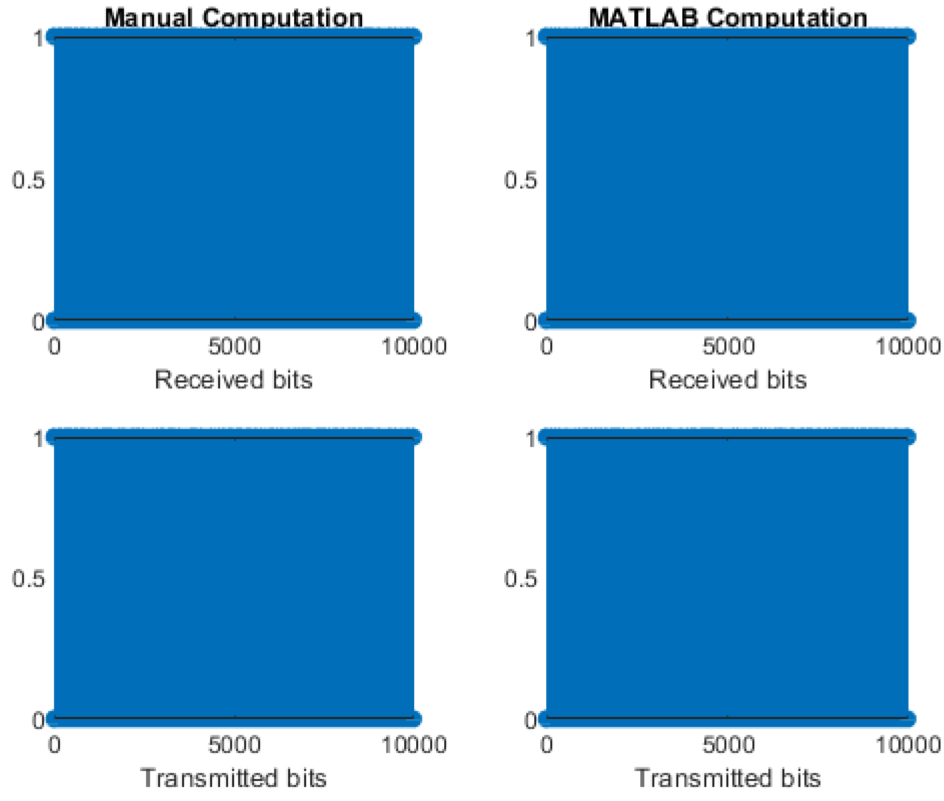
```
PT0R0_10k_NS =

    0.9678
```

2.b MATLAB Computation

```
figure(); subplot(2,2,2)
stem(rx_10k_NS);
xlabel('Received bits'); title('MATLAB Computation');
% determine is successfully received or not
ch1_10k_NS = rand(1,N_10k_NS) > 0.95;
ch0_10k_NS = rand(1,N_10k_NS) > 0.85;
ch_10k_NS = and(ch1_10k_NS, ch0_10k_NS);
tx_10k_NS = xor(rx_10k_NS, ch_10k_NS);
%plot the results'
```

```
subplot(2,2,4), stem(rx_10k_NS);
xlabel('Transmitted bits');
subplot(2,2,1), stem(manual_tx_10k_NS); xlabel('Received bits');
 title('Manual Computation');
subplot(2,2,3), stem(rx_10k_NS); xlabel('Transmitted bits');

matlab_tx0_10k_NS = (sum(tx_10k_NS(:)==0))/N_10k_NS % rate of tx 0's
 from 10k sample bits
matlab_tx1_10k_NS = (sum(tx_10k_NS(:)==1))/N_10k_NS % rate of tx 1's
 from 10k sample bits
```

```
matlab_tx0_10k_NS =

    0.5019


matlab_tx1_10k_NS =

    0.4981
```




```
% PR1T1
matlab_PR1T1_10k_NS = (rxs1_10k_NS*rx1_10k_NS)/matlab_tx1_10k_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 1
 is %.4f', PR1T1_10k_NS);
```

```
Given the conditions above, the probability that the receiver receive
 bit 1 when the transmitted data by the transmitter is bit 1 is 0.9497

% PR0T1
matlab_PR0T1_10k_NS = (rxe1_10k_NS*rx0_10k_NS)/matlab_tx1_10k_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitted data by the transmitter is bit 1
 is %.4f', PR0T1_10k_NS);

Given the conditions above, the probability that the receiver receive
 bit 0 when the transmitted data by the transmitter is bit 1 is 0.0503

% PR1T0
matlab_PR1T0_10k_NS = (rxe0_10k_NS*rx1_10k_NS)/matlab_tx0_10k_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 1 when the transmitted data by the transmitter is bit 0
 is %.4f', PR1T0_10k_NS);

Given the conditions above, the probability that the receiver receive
 bit 1 when the transmitted data by the transmitter is bit 0 is 0.0847

% PR0T0
matlab_PR0T0_10k_NS = (rxs0_10k_NS*rx0_10k_NS)/matlab_tx0_10k_NS;
fprintf('Given the conditions above, the probability that the receiver
 receive bit 0 when the transmitted data by the transmitter is bit 0
 is %.4f', PR0T0_10k_NS);

Given the conditions above, the probability that the receiver receive
 bit 0 when the transmitted data by the transmitter is bit 0 is 0.4835

% PT1R1
matlab_PT1R1_10k_NS = (rxs1_10k_NS*matlab_tx1_10k_NS)/
((rxs1_10k_NS*matlab_tx1_10k_NS)+(rxe0_10k_NS*matlab_tx0_10k_NS))


matlab_PT1R1_10k_NS =

    0.8627


% PT0R1
matlab_PT0R1_10k_NS = (rxe0_10k_NS*matlab_tx0_10k_NS)/
((rxe0_10k_NS*matlab_tx0_10k_NS)+(rxs1_10k_NS*matlab_tx1_10k_NS))


matlab_PT0R1_10k_NS =

    0.1373


% PT1R0
matlab_PT1R0_10k_NS = (rxe1_10k_NS*matlab_tx1_10k_NS)/
((rxe1_10k_NS*matlab_tx1_10k_NS)+(rxs0_10k_NS*matlab_tx0_10k_NS))


matlab_PT1R0_10k_NS =
```

```
    0.0552
```

```
% PT0R0
matlab_PT0R0_10k_NS = (rxs0_10k_NS*matlab_tx0_10k_NS)/
((rxs0_10k_NS*matlab_tx0_10k_NS)+(rxe1_10k_NS*matlab_tx1_10k_NS))
```

```
matlab_PT0R0_10k_NS =

    0.9448
```

Discussion of section II-2a-b

- Given the specifications above, the probabilities computed manually are defined by the variables 'tx0_10k_NS', 'tx1_10k_NS' for P(T'0') and P(T'1'), 'PR1T1_10k_NS', 'PR0T1_10k_NS', 'PR1T0_10k_NS', 'PR0T0_10k_NS' for P(R'1'|T'1'), P(R'0'|T'1'), P(R'1'|T'0'), and P(R'0'|T'0'), respectively. The variables 'PT1R1_10k_NS', 'PT1R0_10k_NS', 'PT0R1_10k_NS', 'PT0R0_10k_NS' define the P(T'1'|R'1'), P(T'0'|R'1'), P(T'1'|R'0'), and P(T'0'|R'0') respectively.

The probabilities computed through MATLAB are defined by the variables 'matlab_tx0_10k_NS', 'matlab_tx1_10k_NS' for P(T'0') and P(T'1'), 'matlab_PR1T1_10k_NS', 'matlab_PR0T1_10k_NS', 'matlab_PR1T0_10k_NS', 'matlab_PR0T0_10k_NS' for P(R'1'|T'1'), P(R'0'|T'1'), P(R'1'|T'0'), and P(R'0'|T'0'), respectively. The variables 'matlab_PT1R1_10k_NS', 'matlab_PT1R0_10k_NS', 'matlab_PT0R1_10k_NS', 'matlab_PT0R0_10k_NS' define the P(T'1'|R'1'), P(T'0'|R'1'), P(T'1'|R'0'), and P(T'0'|R'0') respectively.

By inspection, the the manually computed and those through MATLAB conditional probabilities ahow similar output only that these numbers are farther from the requirement of the Asym BC. In contrast with the probabilities computed using BAyesian theorem, the values appear to be balanced in both Rx and Tx considering the conbitions of 1 and 0 in both ends.Furthermore, we may relate the computed probabilities through conditional method to the outcom of Binary Erasure Channel where a portion of the output had gone missing or erased due to asymmetrical design proabilities of Rx and Tx.

3. When 60% of the tx bits are '1s'.

- Regardless of the statistics of 1s and 0s of the transmitted bits by

```
%the transmitter, whether it is biased by 60% for '1s' or not, the
 probabilities computed
%using conditional or bayesian means will alter as these equations are
%naturally dependent on the P(T'1') and P(T'0') and of the receiver as
 well
%P(R'1') and P(R'0'). Also, whether the gicen channel is symmetric or
 not,
%it also expected that the value of the probabilities might change.
%Consider the codes and executions above or try re-executing the
 sourcefile
%of this lab report and observe the changes it provide for every
 sampled
%bits by rand(). By these inspections, we may conclude that the
```

```
%probabilities studied above are dependent on the probabilities of the
 bits
%tx and rx by the channel hence, alteration their value might happen
 when
%these rx and tx probabilities are changed.
```

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