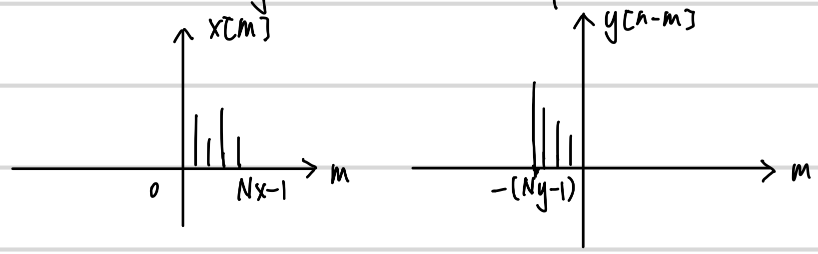
Name : Wenxuan Wang

Q1 : 2h

Q2 : (a) $x[n] * y[n]$ $\because$ $x[n]=0$ for $n<0$ and $n>N_x-1$, $y[n]=0$ for $n<0$ and $n>N_y-1$

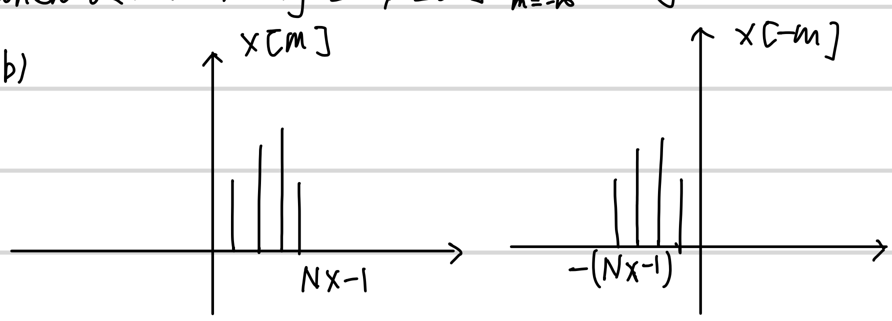


when $n<0$, $y[n-m]$ towards left, and it does not overlap with $x[m]$, so $z[n]=0$

when $n>N_x+N_y-2$, $y[n-m]$ has shifted to the right side of $x[m]$, $z[n]=0$

when $0<n<N_x+N_y-2$, $z[n]=\sum_{m=-\infty}^{\infty} x[m]y[n-m]$

(b)



when $n<-(N_x-1)$, $y[n-m]$ shif left, and in the same situation, $x[-m]=0$, so $c[n]=0$

when $n>N_y-1$, $y[n-m]$ shif right, but it does not overlap with $x[-m]$. so $c[n]=0$

In other occasions, $y[n-m]$ may overlap with $x[-m]$.

so $c[n]=0$ for $n<-(N_x-1)$ and $n>N_y-1$

(c) $\because$ $\left|\sum_{m=-\infty}^{\infty} x[m]y[m]\right|^2 \le \sum_{m=-\infty}^{\infty}|x[m]|^2\sum_{k=-\infty}^{\infty}|y[k]|^2$ and $c[n]=\sum_{m=-\infty}^{\infty} x[m]x[n+m]$

$\therefore$ $|c[n]|^2=\left|\sum_{m=-\infty}^{\infty} x[m]x[n+m]\right|^2 \le \sum_{m=-\infty}^{\infty}|x[m]|^2\sum_{k=-\infty}^{\infty}|x[n+m]|^2$

And when $|c[n]|^2=\sum_{m=-\infty}^{\infty}|x[m]|^2\sum_{k=-\infty}^{\infty}|x[n+m]|^2$, $c[n]$ can be largest, so under this condition, $n=0$.

when $n=0$, the left side $=(c[n])^2=\left(\sum_{m=-\infty}^{\infty} x^2[m]\right)^2=\sum_{m=-\infty}^{\infty} x^4[m]$

the right side $=\sum_{m=-\infty}^{\infty}|x[m]|^2\sum_{m=-\infty}^{\infty}|x[m]|^2$ //

Therefore, $n=0$, $c[n]$ is largest.

(d) let $y[n]=x[n-n_0]$, $c[n]=\sum_{m=-\infty}^{\infty} x[m]x[m+n-n_0]$

While using the Cauchy-Schwarz inequality, $|c[n]|^2\le\sum_{m=-\infty}^{\infty}|x[m]|^2\sum_{m=-\infty}^{\infty}|x[m+n-n_0]|^2$

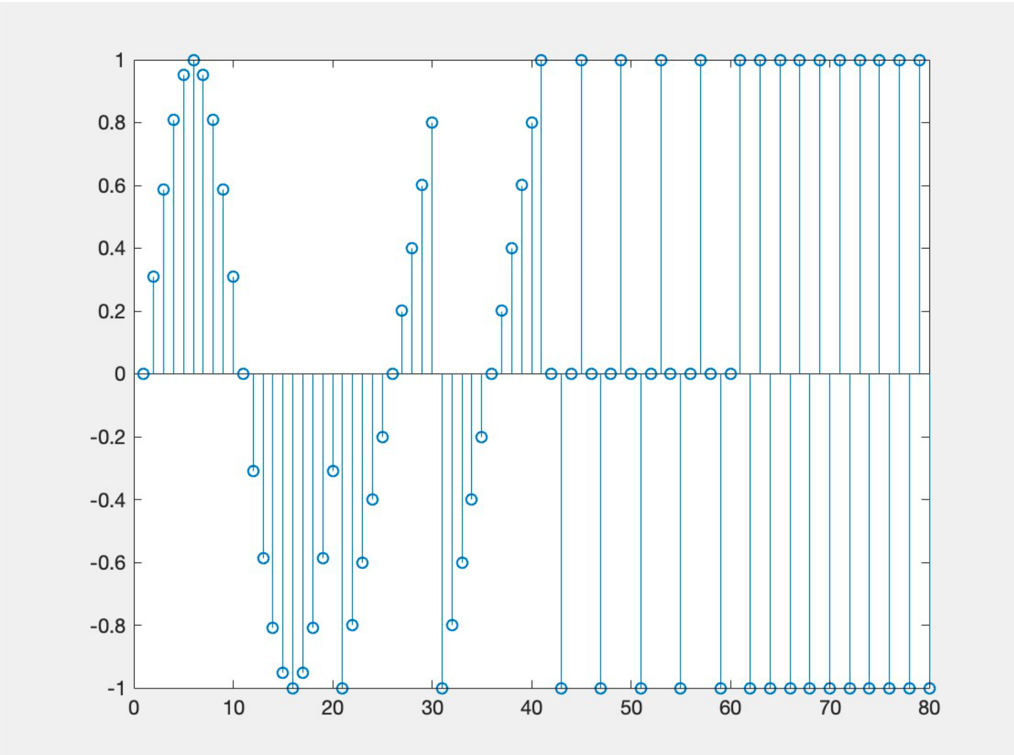
When $n=n_0$, $x[m+n-n_0]=x[m+0]=x[m]$

The same as (c), $|c[n]|^2=\sum_{m=-\infty}^{\infty}|x[m]|^2$ = the right side

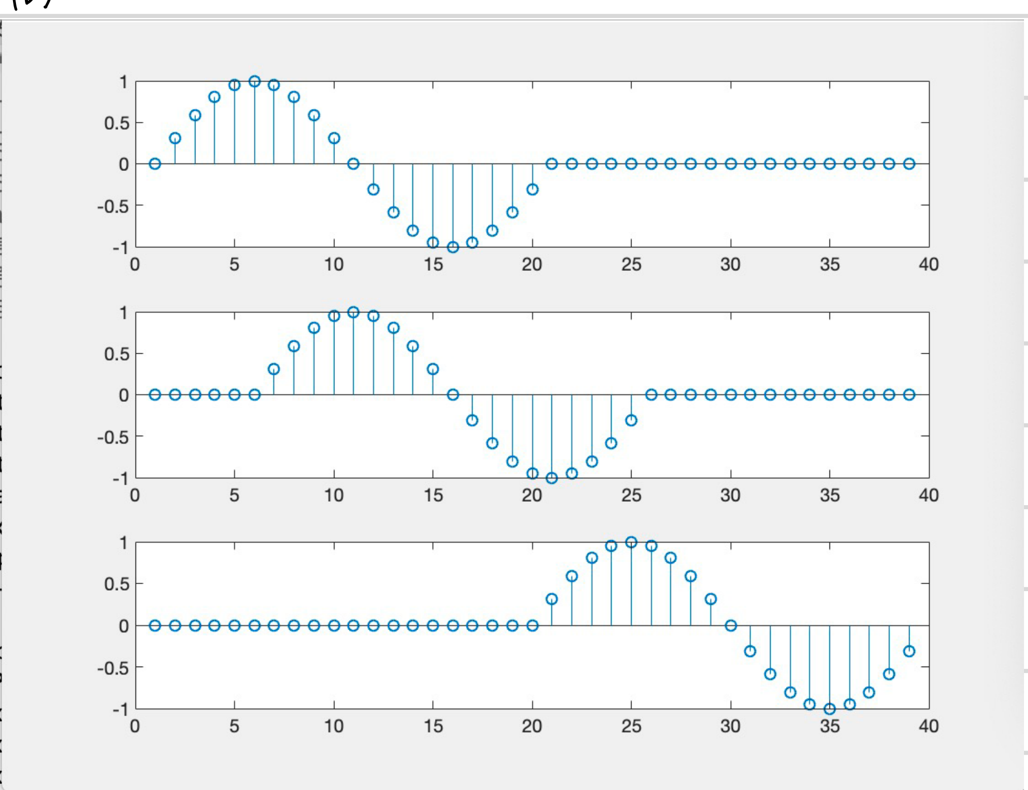
Therefore, $c[n]$ is largest when $n=n_0$.

Q3:

(a)



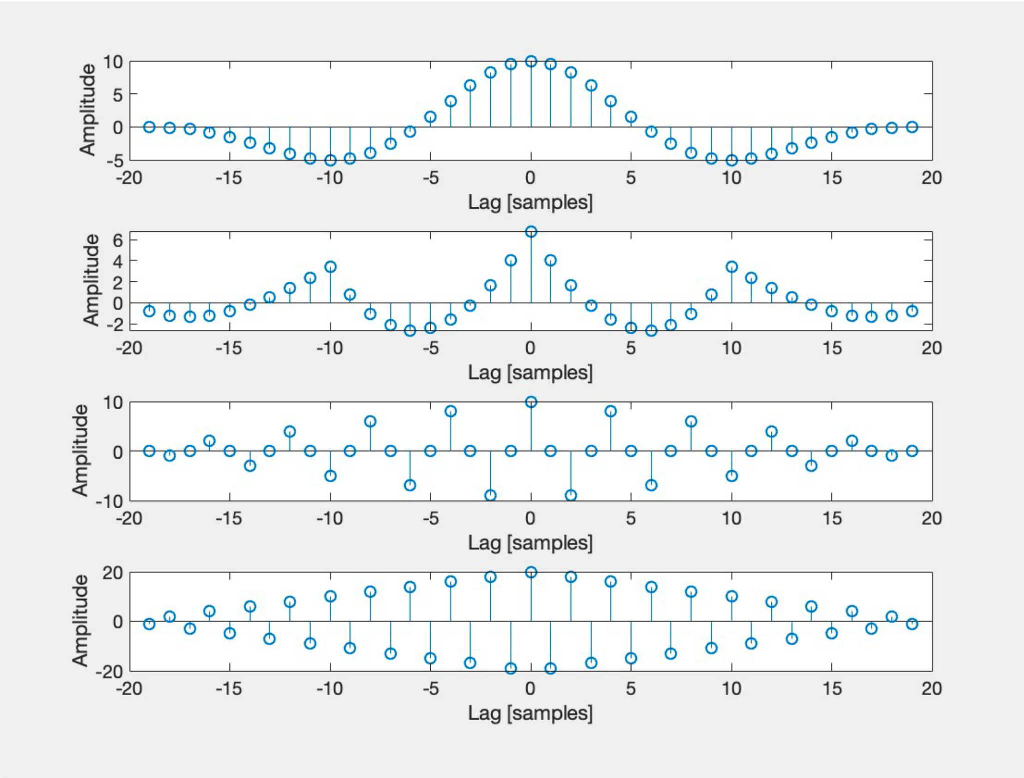
(b)



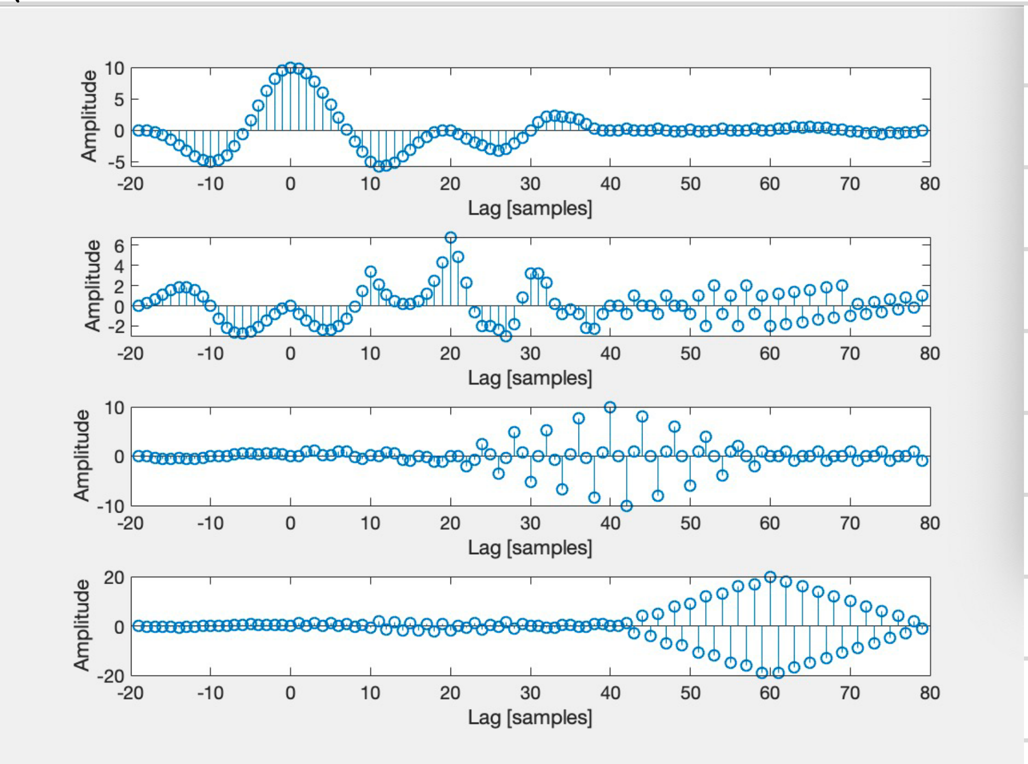
(c) Both the lengths of x[n] and h[n] are 20, so the length of output signals (the length of shifting to overlap) is $20+20-1=39$.

Q4

(a)(b)



(c)

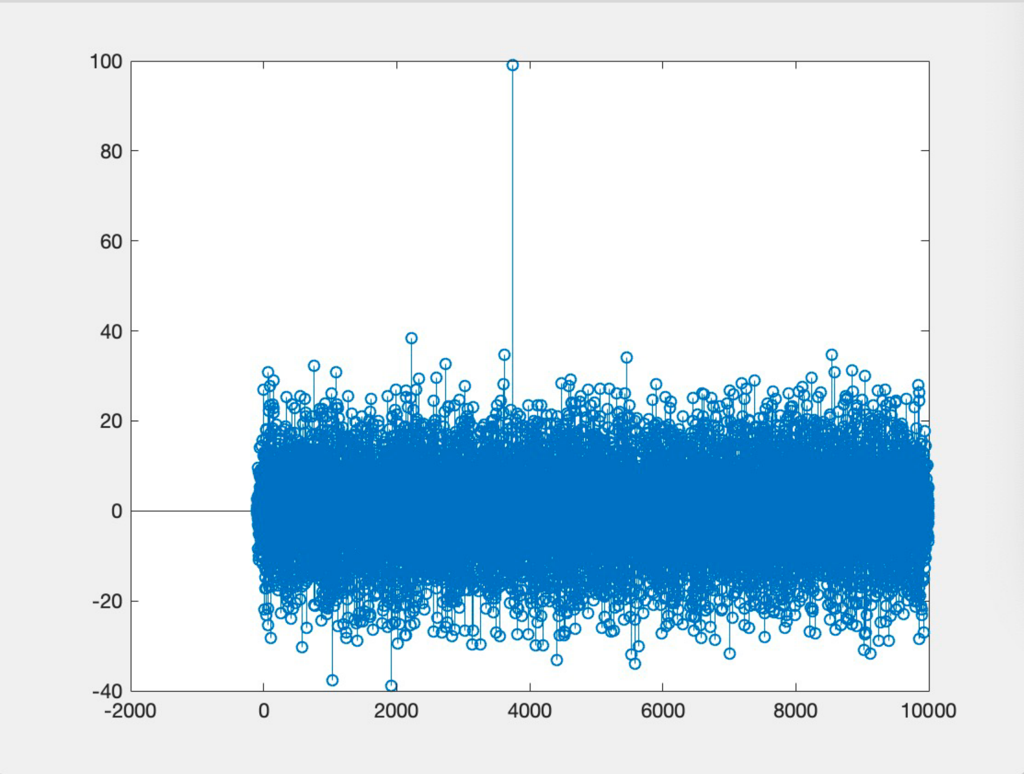


(d) To find the maximum value, and this value is located in the first sample of the signal.
For example, as the first figure shows, it is maximum when $n=0$. We have known that $x_1[n]$ is located from 0 to 20, so the first sample of $x_1[n]$ is the maximum value in the figure.

Q5

My UFID: 64118211

Max: 99.1133



The location is 3839.