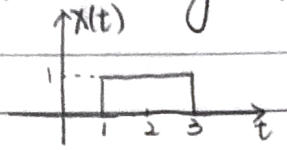
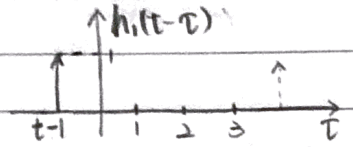
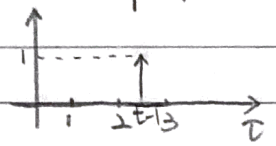
Prelab-3 dynthia Li

Q1.



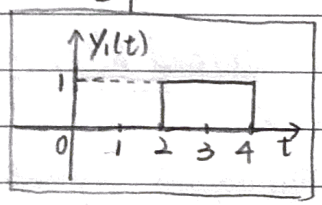


when $t-1<1$ or $t-1>3$, $\rightarrow t<2$ or $t>4$,
there is no overlap, $y_1(t) = x(t) * h_1(t) = 0$

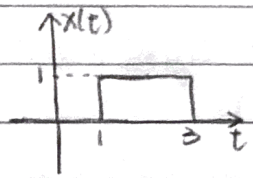


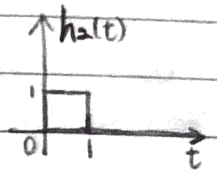
when $1<t-1<3 \rightarrow 2<t<4$,

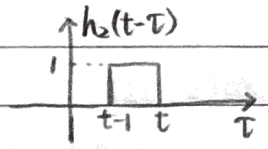
$$y_1(t) = x(t) * h_1(t) = \int_{-\infty}^{\infty} [u(\tau-1) - u(\tau-3)]\,\delta(t-(\tau-1))\,d\tau$$
$$= 1 \cdot \int_{-\infty}^{\infty} \delta(t-(\tau-1))\,d\tau$$
$$= 1$$

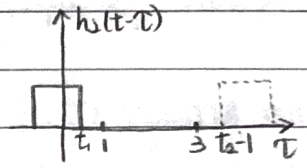


∴ The results of convolving $x(t)$ with $h_1(t)$ and $h_2(t)$ are the graph for $y_1(t)$, $y_2(t)$ correspondingly.

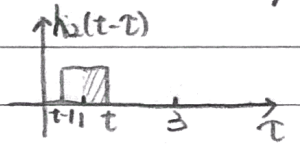






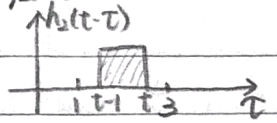


when $t<1$ or $t-1>3 \rightarrow t<1$ or $t>4$,
there is no overlap between $h_2(t-\tau)$ and $x(\tau)$, thus $y_2(t) = x(t) * h_2(t) = 0$



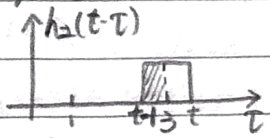
when $t>1$, $t-1<1 \rightarrow 1<t<2$,

$y_2(t) = 1 \cdot (t-1) = t-1$



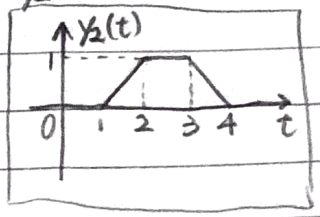
when $t-1>1$, $t<3 \rightarrow 2<t<3$,

$y_2(t) = 1$



when $t>3$, $t-1<3 \rightarrow 3<t<4$,

$y_2(t) = 1 \cdot (3-(t-1)) = 4-t$



Q2. to create signal x and $h_1(t)$

```
def u(t):
    return 1.0*(t>0)

def delta(t, fs):
    return fs*np.concatenate([[0], np.diff(u(t))])

t = np.arrange(0.4 + 1/fs, 1/fs)
x = u(t-1) - u(t-3)
h1 = delta(t-1, fs)
```

Q3. System 1 delay the input by 1 unit, similar to x(t) and $h_1(t)$ in Q1, the impulse response is $\delta(t-1)$. ($h_1(t) = \delta(t-1)$).
System 2 scales the input by a factor of 10, the impulse response is $h_2(t) = 10\,\delta(t)$
System 3 delay the input by 2 unit, similar to $x_1(t)$ and $h_1(t)$ in Q1, the impulse response is $h_3(t) = \delta(t-2)$.
∴ $h_1(t) = \delta(t-1)$
$h_2(t) = 10\,\delta(t)$
$h_3(t) = \delta(t-2)$