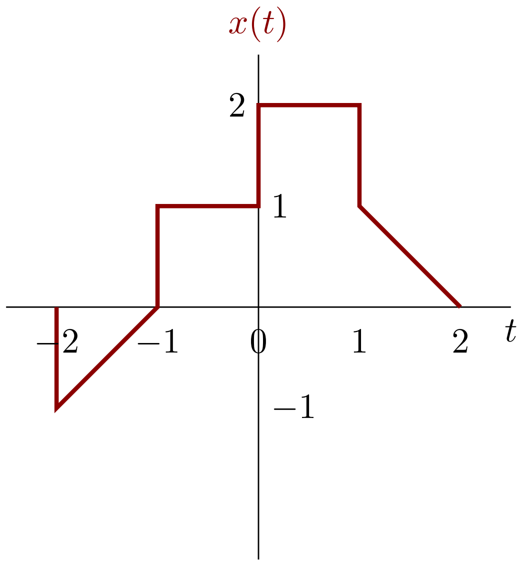
Problem 0.1

A continuout-time signal $x(t)$ is shown below. Sketch and label carefully each of the following signals:

(**a**) : $x(t-1)$	(**b**) : $x(2-t)$
(**c**) : $x(2t+1)$	(**d**) : $x(4-\frac{t}{2})$
(**e**) : $[x(t)+x(-t)]u(t)$	(**f**) : $x(t)\delta(t+\frac{3}{2})-\delta(t-\frac{3}{2})$

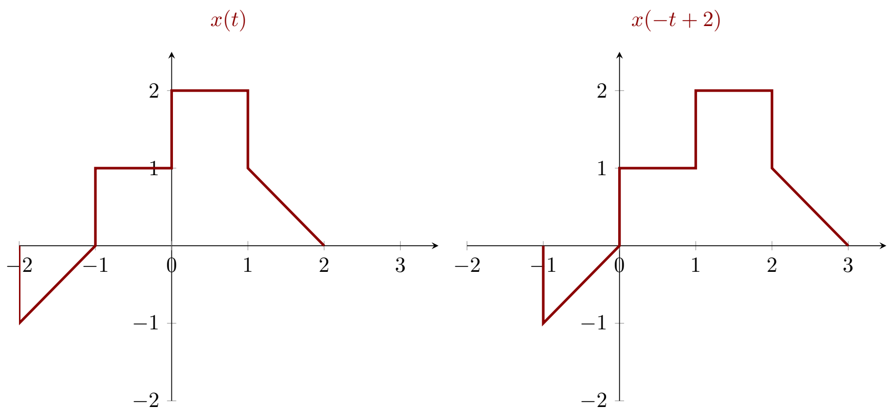


Before we figure all the sub-problem out. Let's review how a and b affect $x(at+b)$. we know that:

1. when $|a|<1$, $x(t)$ will be linearly stretched;
2. when $|a|>1$, $x(t)$ will be linearly compressed;
3. when $a<0$, $x(t)$ will be reversed;
4. when $b\neq 0$, $x(t)$ will be shifted in time.
5. when $a>0, b>0$, $x(t)$ will be shifted left.
6. when $a>0, b<0$, $x(t)$ will be shifted right.
7. when $a<0, b>0$, $x(t)$ will be reversed first then shifted right.
8. when $a<0, b<0$, $x(t)$ will be reversed first, then shifted left.

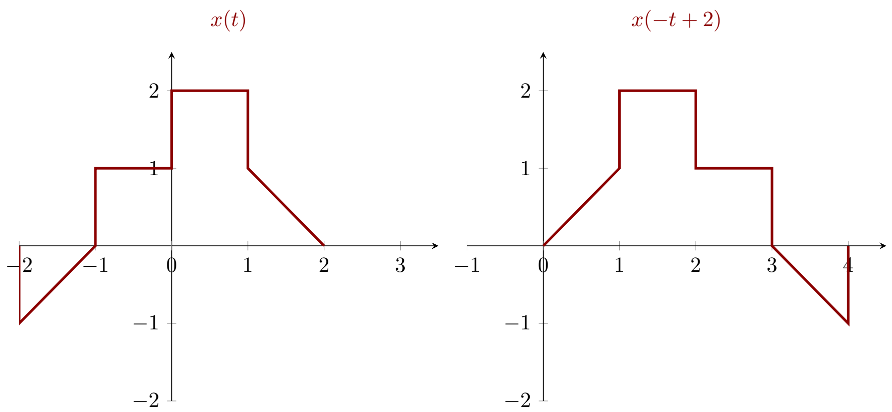
Problem 1.21a

Based on the conclusion given above, we know that $x(t-1)$ can be obtained by right shifting $x(t)$ with step 1. So the result can be visualized as follows.



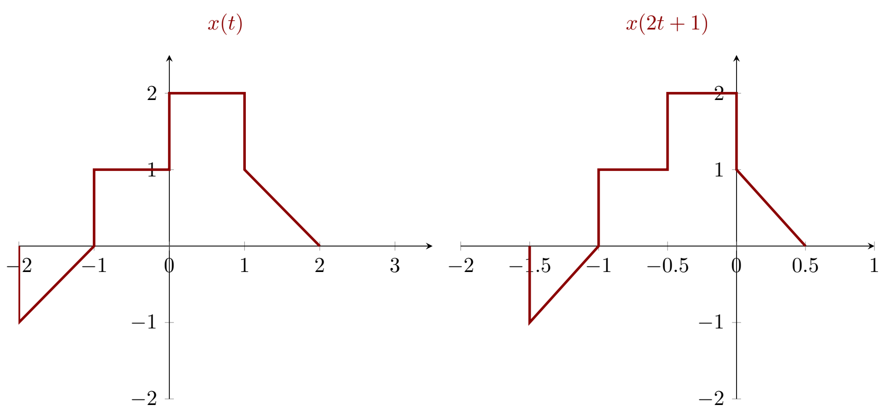
Problem 1.21b

For $x(2-t)$, we re-write it as $x(-(t-2))$ which can be obtained by first reversing $x(t)$ then right shifting it with step 2. The result can be shown as follows



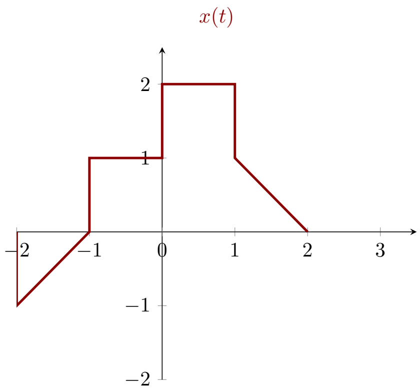
Problem 1.21c

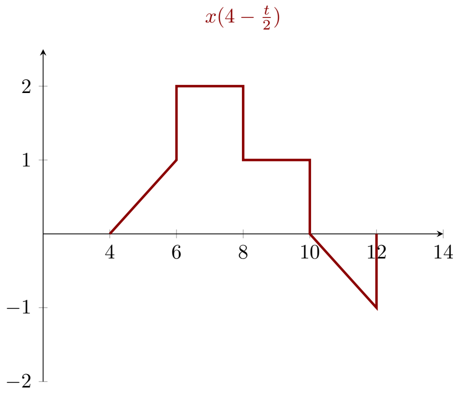
$x(2t+1)$ can be re-written as $x(2(t+\frac{1}{2}))$ which means that $x(2t+1)$ can be obtained by first linearly compressing $x(t)$ with factor 2 then left shifting compressed signal by $\frac{1}{2}$.



Problem 1.21d

$x(4-\frac{t}{2})$ can be re-written as $x(-\frac{1}{2}(t-8))$ which means that $x(4-\frac{t}{2})$ can be obtained by first linearly stretching $x(t)$ by factor 2 then right shifting it with step 8.

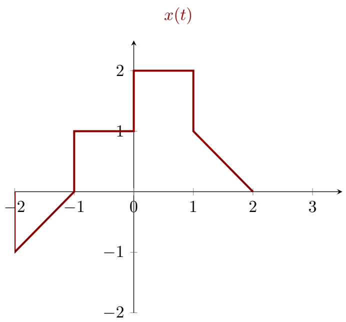


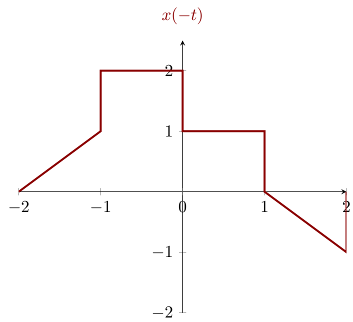


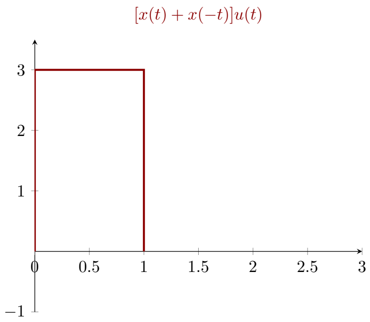
Problem 1.21e

At first glance, $\left[x(t)+x(-t)\right]u(t)$ is 0 if $t<0$.

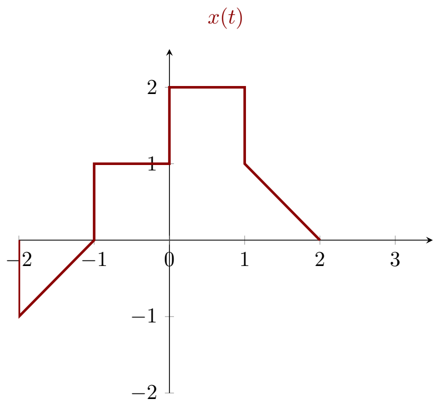
If $t>0$, we have to figure out $x(-t)$. After obtaining $x(-t)$, we add the right part of $x(t)$ and left part of $x(-t)$ then we have $[x(t)+x(-t)]u(t)$

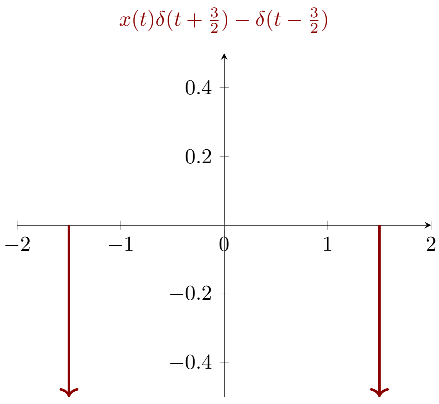






$x(t)\delta(t+\frac{3}{2})-\delta(t-\frac{3}{2})$ only have two points with non-negative values: $t=\frac{3}{2}$ and $t=-\frac{3}{2}$.


$x(t)$
2
1
−2
−1
0
1
2
3
−1
−2


$x(t)\delta(t+\frac{3}{2})-\delta(t-\frac{3}{2})$
0.4
0.2
−2
−1
0
1
2
−0.2
−0.4