Discrete-time signal:

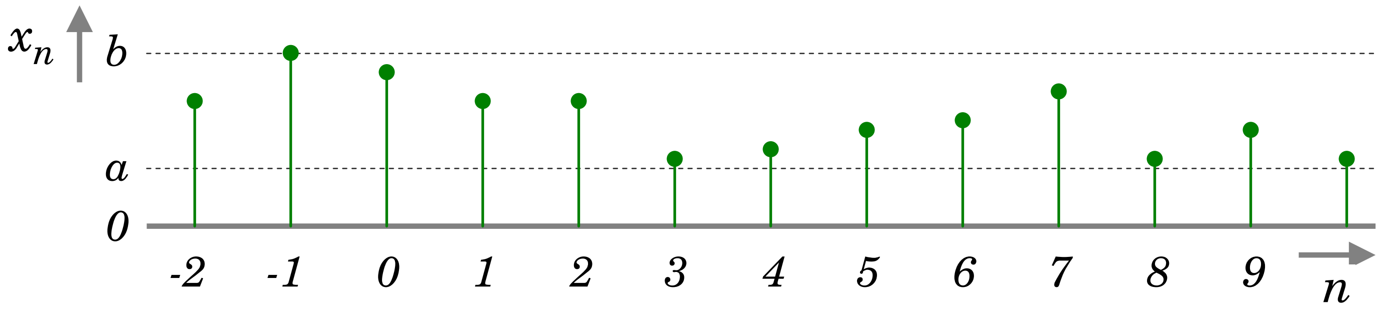
Errata

- A signal is discrete-time if it is defined only at discrete time points.
- Usually denoted by x_n, where n is an integer, and depicted as a **sequence of numbers** such as

$$x_0, x_1, \cdots\cdots, x_n, \cdots\cdots$$

- Discrete-time signals may evolve naturally, for instance the daily closing stock market average which occurs only at the close of each day, or obtained by sampling a continuous-time signal $x(t)$ such as $x_n = x(t_n)$ where t_n are discrete time points.
- In general, a discrete-time signal can take on any value in the continuous interval (a,b), where a may be $-\infty$ and b may be $+\infty$.

Graphical representation:



Example 1-5:

I. $\boldsymbol{x(t)=\begin{cases}\exp(-\alpha t); & t\ge 0\\ 0; & t<0\end{cases};\quad \alpha>0}$

Total energy: $\int_{-\infty}^{\infty} x^2(t)\,dt=\int_0^{\infty}\exp(-2\alpha t)\,dt=\left[\dfrac{\exp(-2\alpha t)}{-2\alpha}\right]_0^{\infty}=\dfrac{1}{2\alpha}$

Finite total energy ➔ Zero average power ➔ $x(t)$ *is an* ***energy signal***

II. $\boldsymbol{x(t)=\begin{cases}\alpha t; & t\ge 0\\ 0; & t<0\end{cases};\quad \alpha\ne 0}$

Errata

Total energy : $\int_{-\infty}^{\infty} x^2(t)\,dt=\int_{0}^{\infty}\alpha^2t^2\;dt=\left[\dfrac{\alpha^2t^3}{3}\right]_0^{\infty}=\infty$

Average power : $\begin{cases}\lim\limits_{T\to\infty}\dfrac{1}{T}\displaystyle\int_{-T/2}^{T/2}|x(t)|^2\,dt=\lim\limits_{T\to\infty}\dfrac{1}{T}\displaystyle\int_0^{T/2}\alpha^2t^2dt=\lim\limits_{T\to\infty}\dfrac{1}{T}\left[\dfrac{\alpha^2t^3}{3}\right]_0^{T/2}\\ \qquad=\lim\limits_{T\to\infty}\dfrac{\alpha^2T^2}{24}=\infty\end{cases}$

Infinite total energy and average power ➔ $x(t)$ *is neither an energy nor a power signal.*

III. $\boldsymbol{x(t)=\alpha\cos(2\pi t+\beta)}$

$x(t)$ *is a sinusoid ➔* $x(t)$ *is a* ***power signal*** *with average power* $\alpha^2/2$.