Homework 1.1

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1. Correct answers:
   + Digital signal are more robust to noise
   + Digital signal can be easily stored
2. Correct answers:
   + JPEG image on a website
   + Music recorded on a CD
3. $x[n] = \begin{cases} (-1)^n n & , n = 1, 2, 3 \\ 0 & \text{otherwise} \end{cases}$

   $y[n] = \sum_{k=-\infty}^{+\infty} x[n + 7k]$

   + $x[n] = [\underline{0}, -1, 2, -3, 0, \dots]$
   + $E_x = \sum_{n=-\infty}^{+\infty} |x[n]|^2 = \sum_{n=1}^{3} |x[n]|^2 = 1 + 4 + 9 = 14$
4. Because $x[n]$ is a energy signal, $P_x = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |x[n]|^2 = 0$
5. Because $y[n]$ is the periodic version of $x[n]$ with periodicity $= 7$, $E_y = \infty$
6. $P_y = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |y[n]|^2$

   Let T_0 be the length of a period in $y[n]$, we have

   $P_y = \lim_{n\to\infty} \frac{n E_x}{n T_0} = \frac{E_x}{T_0} = \frac{14}{7} = 2$
7. $x[n] = \delta[n] + 2\delta[n-1] + 3\delta[n-2]$
   + $y[n] = \frac{1}{2}(x[n] + x[n-1])$

   $= \frac{1}{2}(\delta[n] + 2\delta[n-1] + 3\delta[n-2] + \delta[n-1] + 2\delta[n-2] + 3\delta[n-3])$

$$= \frac{1}{2}\left(\delta[n] + 3\delta[n-1] + 5\,\delta[n-2] + 3\delta[n-3]\right) = 0 \text{ for } n \geq 4$$

8. $f_s = 44100$ Hz. Number of sample : $f_s . t = 44100 . 2 . 60 = 5292000$
9. $y[n] = b(a\,x[n] + x[n-1]) - (c\,x[n-3] + x[n-4])$
10. $e^{j\frac{2\pi}{3}n}$ has periodicity = 3
11. $e^{j\frac{10\pi}{7}n}$ has periodicity = 7
12. $e^{j\frac{70\pi}{15}n} = e^{j\frac{14\pi}{3}n}$ has periodicity = 3