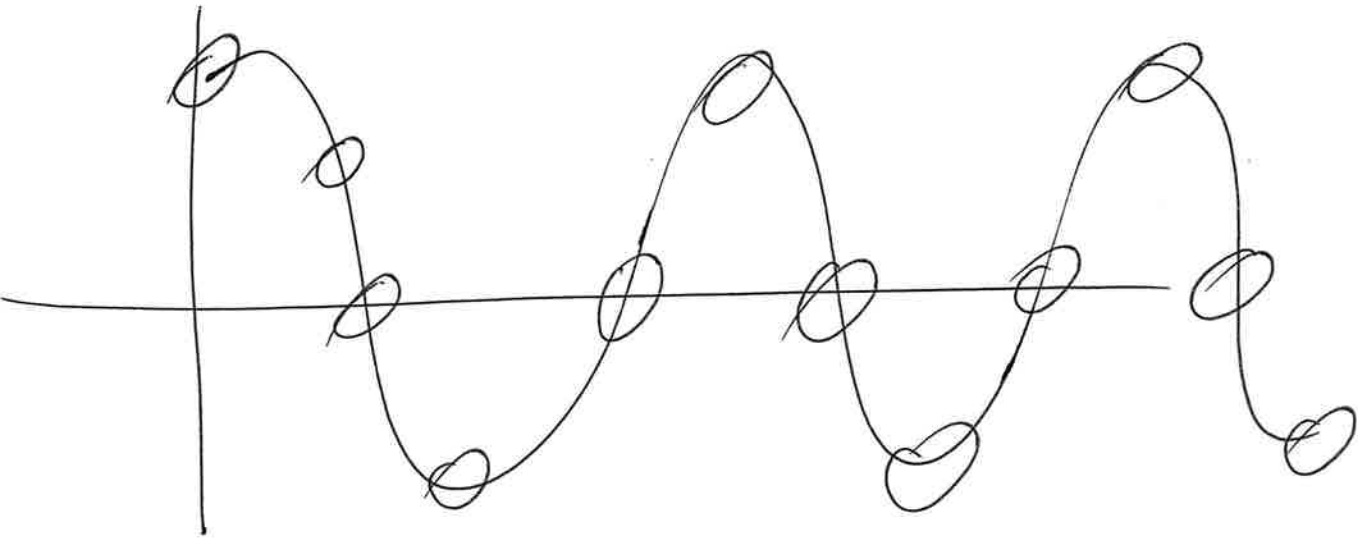


Exercise 1Example:

hummingbird.

Heart : 1200 beats per min

Nyquist theorem:

$$\text{Frequency of sampling} > 2 \times \text{Frequency of the signal.}$$
Frequency: How often over 1 second.

$$F = \frac{1}{T}$$

For the humming bird:

②

$$\begin{aligned} f_{\text{signal}} &= 1200 \text{ per minute} \\ &= 20 \text{ per second} \\ &= 20 \text{ Hz} \end{aligned}$$

$$\begin{aligned} f_{\text{sampling}} &> 2 \times f_{\text{signal}} \\ &> 40 \text{ Hz} \end{aligned}$$

Exercise 2

We have a heart monitor that works at 6 Hz.
Can we use it to monitor the hearts of

- a) Dog: 70 - 120 bpm $\rightarrow 2 \text{ Hz}$
 $2 \times 2 \text{ Hz} < 6 \text{ OK}$
- b) Elephant: 25 - 35 bpm $\rightarrow \frac{35}{60} \text{ Hz}$
 $2 \times \frac{35}{60} < 6 \text{ OK}$
- c) Chicken: 250 - 300 bpm $\rightarrow 5 \text{ Hz}$
 $2 \times 5 = 10 > 6 \text{ X}$
- d) Hamster: 300 - 600 bpm $\rightarrow 10 \text{ Hz}$
 $2 \times 10 = 20 > 6 \text{ X}$

$$F_{\text{sampling}} > 2 \times F_{\text{signal}} \quad (3)$$

Exercise 3: Two guards are standing at the entrance of a cave. You know there is a treasure inside the cave. The treasure is one of copper, gold, platinum, diamonds, silver, or rubies.

Guard 1 lies when guarding copper, silver, or gold and tells the truth otherwise.

Guard 2 lies when guarding platinum, diamonds, or rubies, and tells the truth otherwise.

Guard 1 tells: The treasure is either gold or copper.

Guard 2 tells you: I hate chocolate.

Does guard 2 like chocolate?

Inside the cave:	S_1	Compatibility.
Copper	(T)	X
Silver	(F)	
Gold	(T)	X
Platinum	(F)	X
Diamonds	(F)	X
Rubies	(F)	X

Therefore, the cave contains silver. (4)
Then, Guard 2 tells the truth:
(s)he really hates chocolate.

Exercise 4

We are in an strange island where
visitors can't really say if it is day or
night. On that island, the inhabitants
are knights, but there are 2 types of knights:
Day-knight: tells the truth during the day, and
lies at night time.
Night-knight: tells the truth during night
and lies at day time.

John and Sally.

John: Sally is a day-knight, and
it is day.

Sally: I am a night-knight
and John is also a night-knight.

Is it day or night now?

Day / Night	John	Sally	S ₁	S ₂	Check
→ D	DK	DK	T	F	X
D	DK	NK	F	F	X
D	NK	DK	T	F	X
D	NK	NK	F	T	X
→ N	DK	DK	F	F	
N	DK	NK	F	F	X
N	NK	DK	F	F	X
N	NK	NK	F	T	X

D: day
N: night.

DK: Day bright
NK: night bright.

S₁ Sally is a day bright AND it is day.
S₂ Sally and John are night brights.