

How High can Animals Jump?

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Abstract

I present an explanation for why all animals can jump the same height.

1 Introduction

A lion runs faster than a mouse. But what about jumping? I once trapped a mouse behind the bin in my kitchen. I was amazed to see it jump to a height of four feet. With this olympic feat, the mouse got away.

2 Theory of jumping

An animal is mainly muscle. If we assume that all animals' muscles have the same physiology, we might guess that in a single big jump, each little mass δm of muscle can liberate an energy proportional to δm :

$$\delta E = \lambda \delta m, \quad (1)$$

where λ is the constant of proportionality. Thus the total kinetic energy of an animal with mass m , immediately after it jumps, is $E = \lambda m$. Once the animal reaches the top of its trajectory, all this energy gets turned into potential energy: $E = mgh_{\max}$. So the maximum height reached is

$$h_{\max} = \frac{\lambda}{g}, \quad (2)$$

independent of the animal's size, m . For similar reasons, while animals have different speeds on the flat, the top speed of an animal running up a hill is the same for all animals. For my next trick, I will explain why all birds have the same flying range – from seagulls to Boeing 747s.

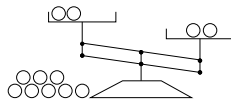


Figure 1: This animal has one leg and two arms.

3 Discussion

Figure 1 shows a picture of an animal juggling 4 balls. Shannon [1948] was an expert juggler.

Good error-correcting codes exist [Shannon, 1948]. I can refer to equation (1) or to section 2.

You can get more help on L^AT_EX here: <http://www.aims.ac.za/resources/tutorials/latex-xfig/>
The source of this file is /home/mackay/tex/LatexExample.tex. My .bib file is /home/mackay/bibs.bib.
Feel free to use these files as templates.

References

C. E. Shannon. A mathematical theory of communication. *Bell Sys. Tech. J.*, 27:379–423, 623–656, 1948.