

Information Theory

A Tutorial Introduction

James V Stone

$$H(X) \equiv -\sum p(x_i) \log \frac{1}{p(x_i)}$$



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**Information Theory
A Tutorial Introduction**
by
Dr James V Stone
2015

Sebtel Press.

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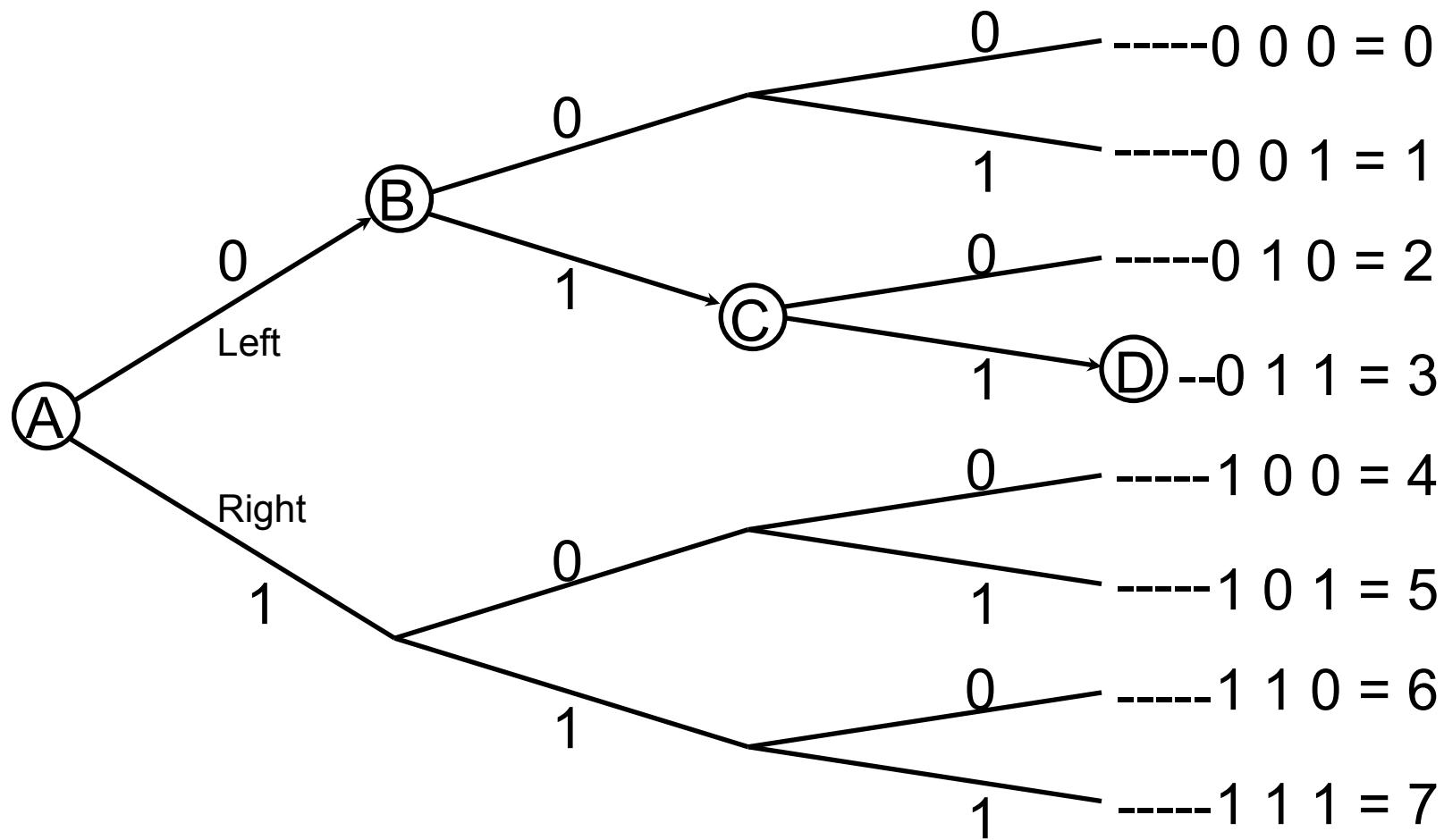
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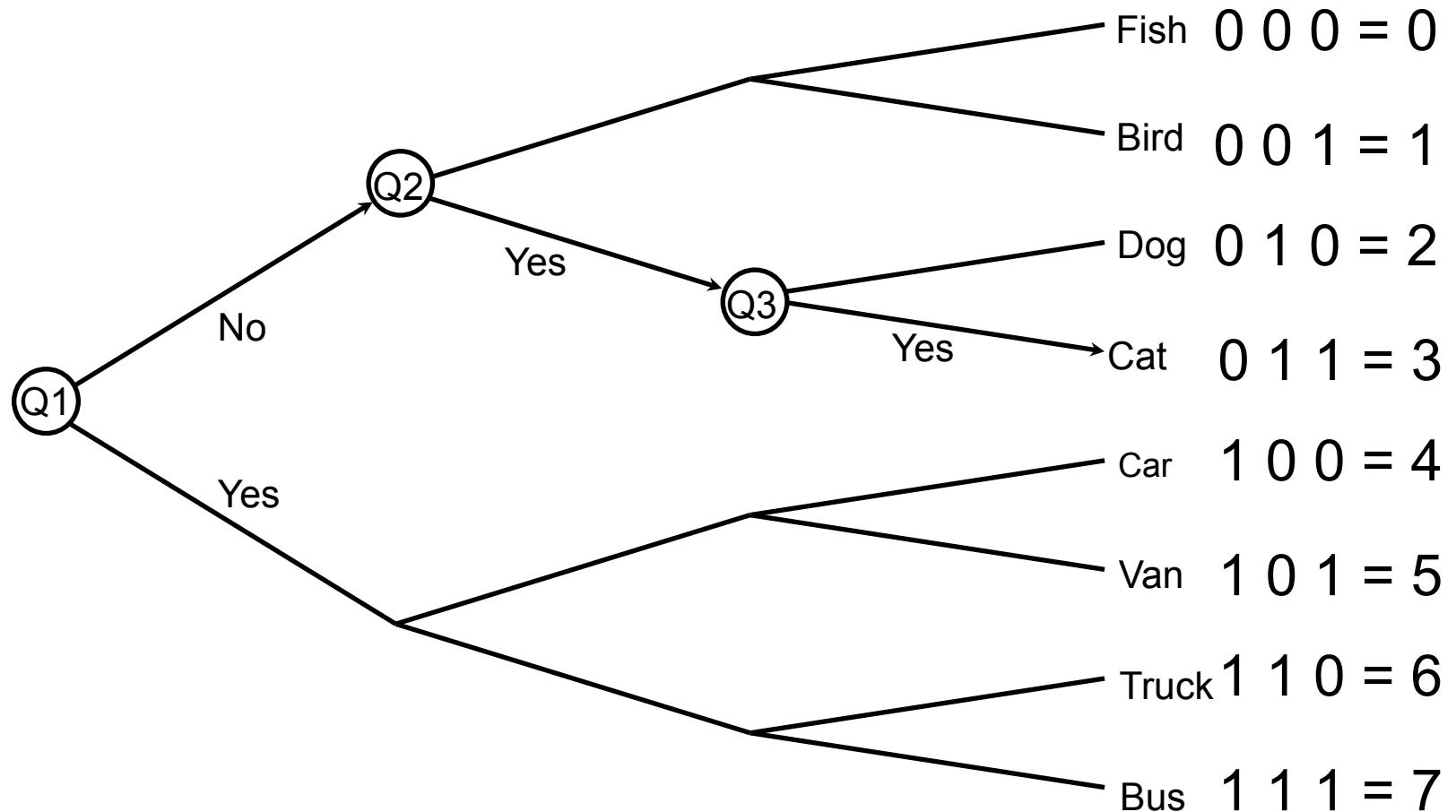
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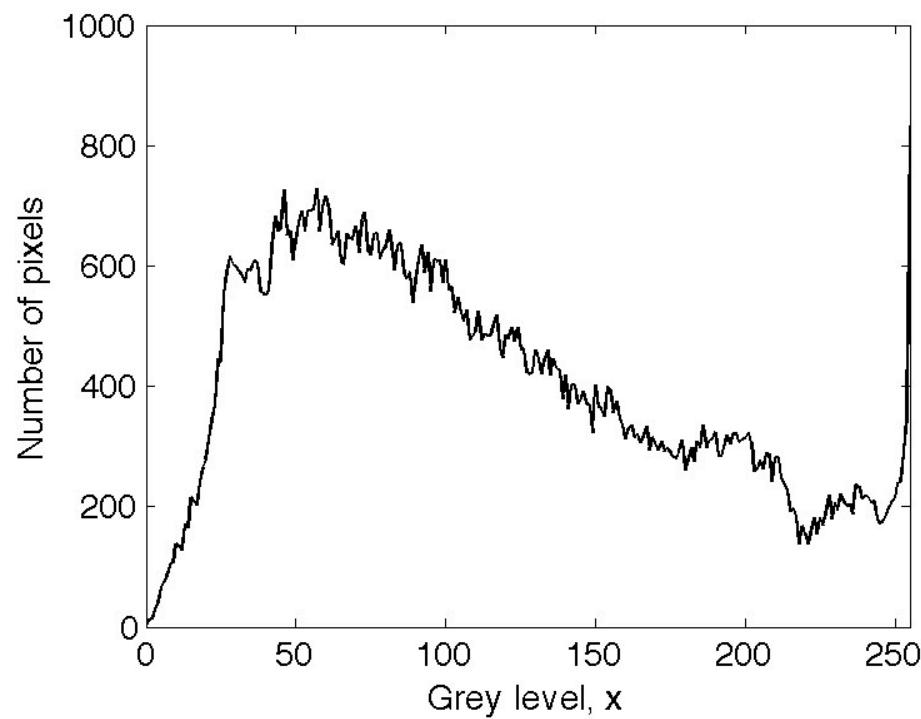
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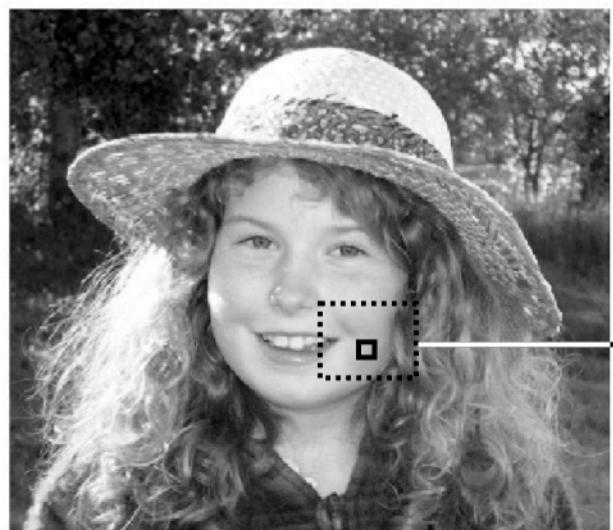
Chapter 1



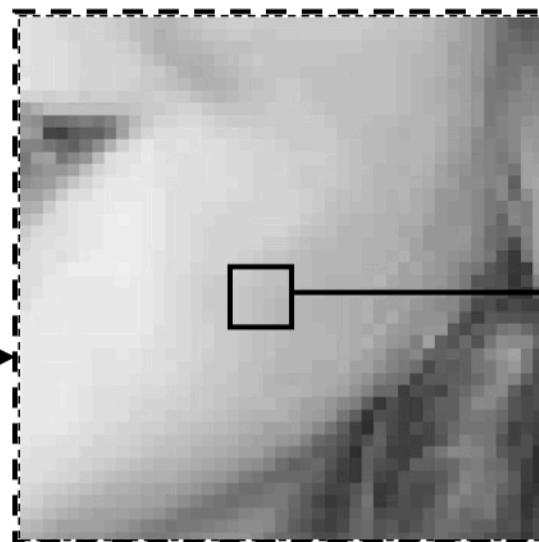








(a)

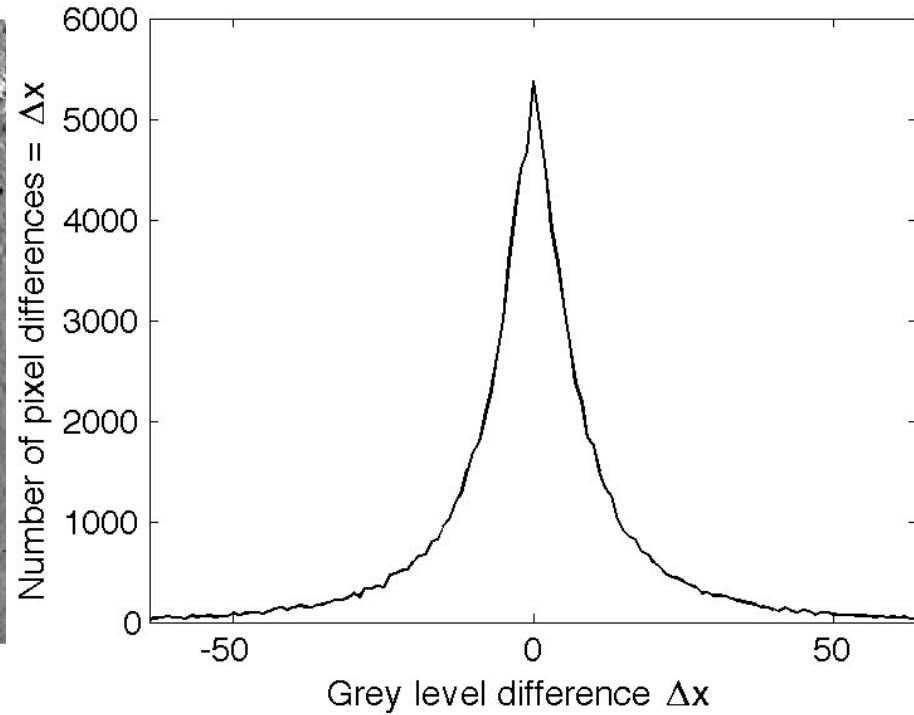


(b)

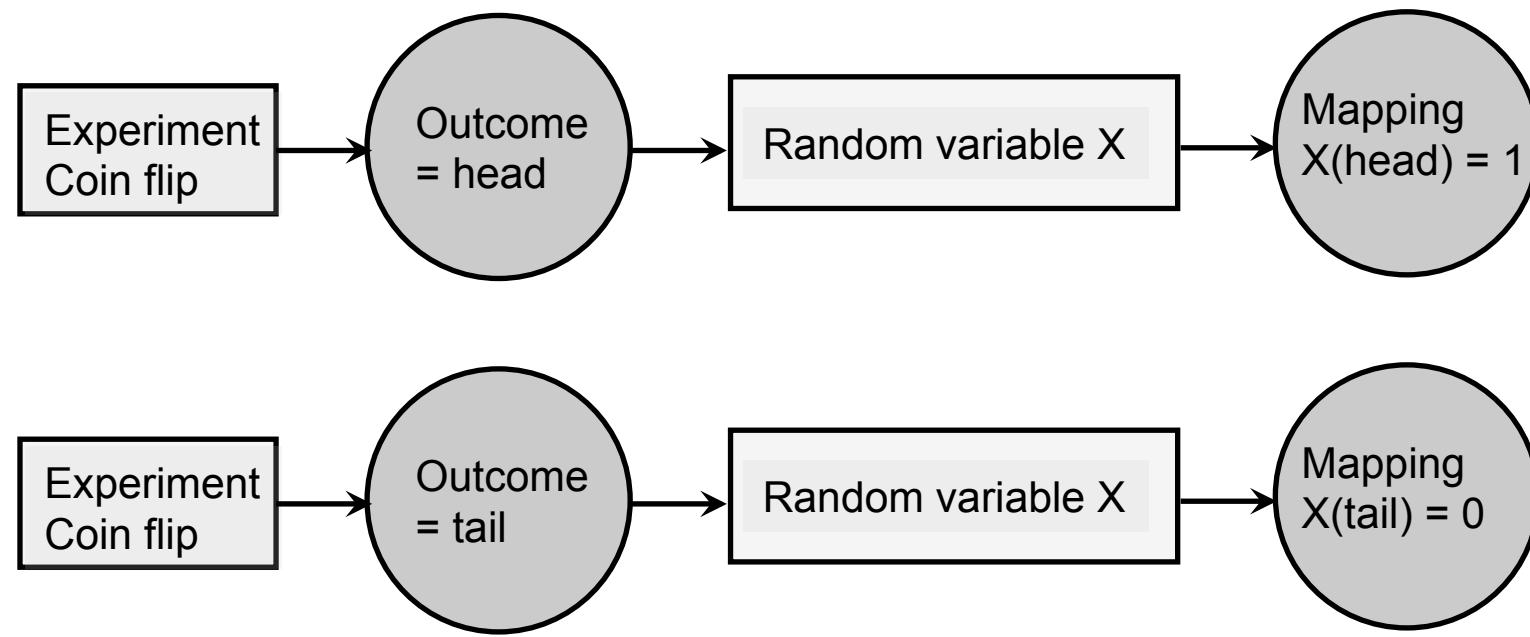
A 5x5 grid of numerical values representing the pixel intensities of the crop in (b). The values range from 61 to 71, with higher values indicating brighter pixels.

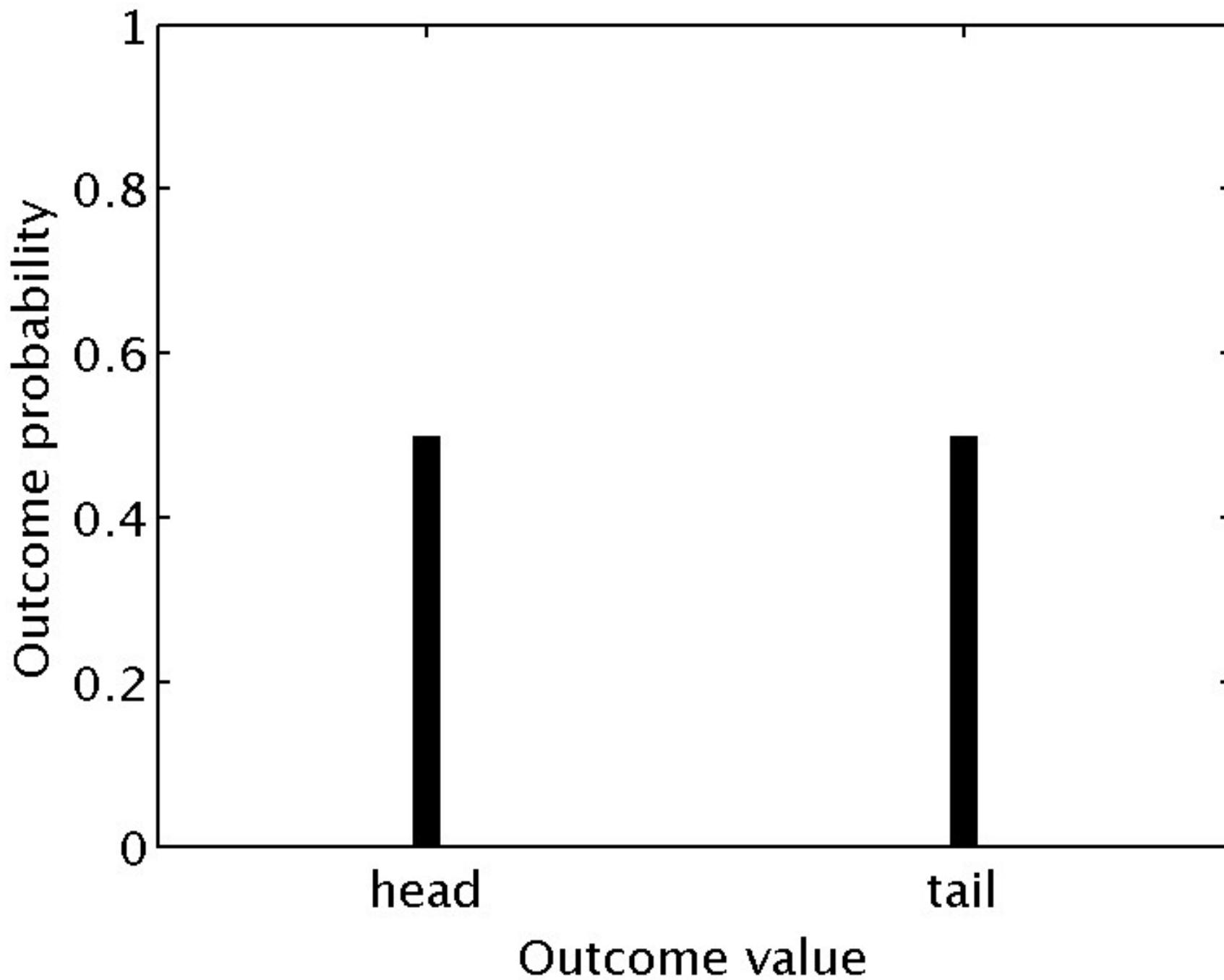
71	68	67	66	66
68	66	66	65	63
67	64	64	63	62
65	63	63	62	61
62	62	62	62	61

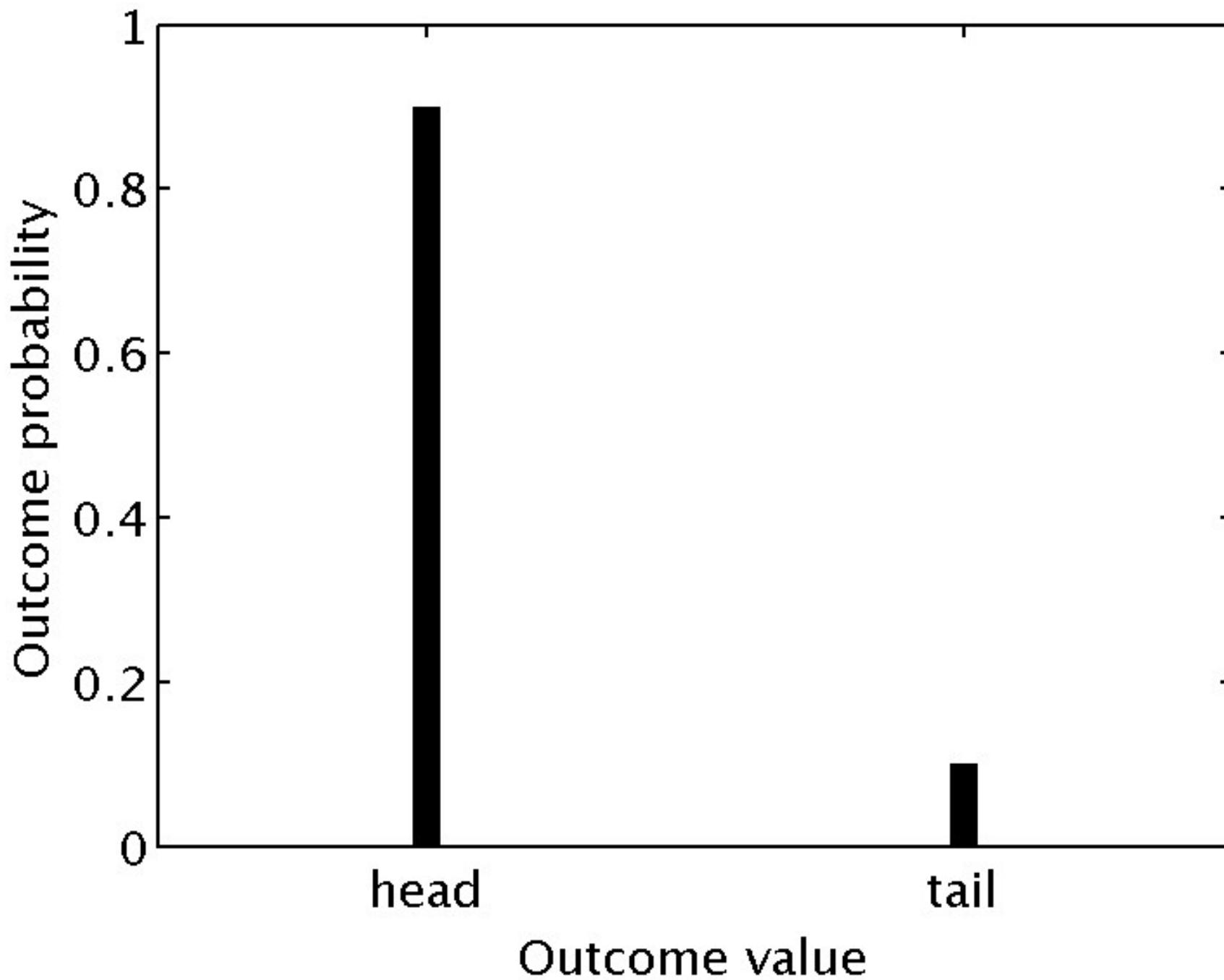
(c)

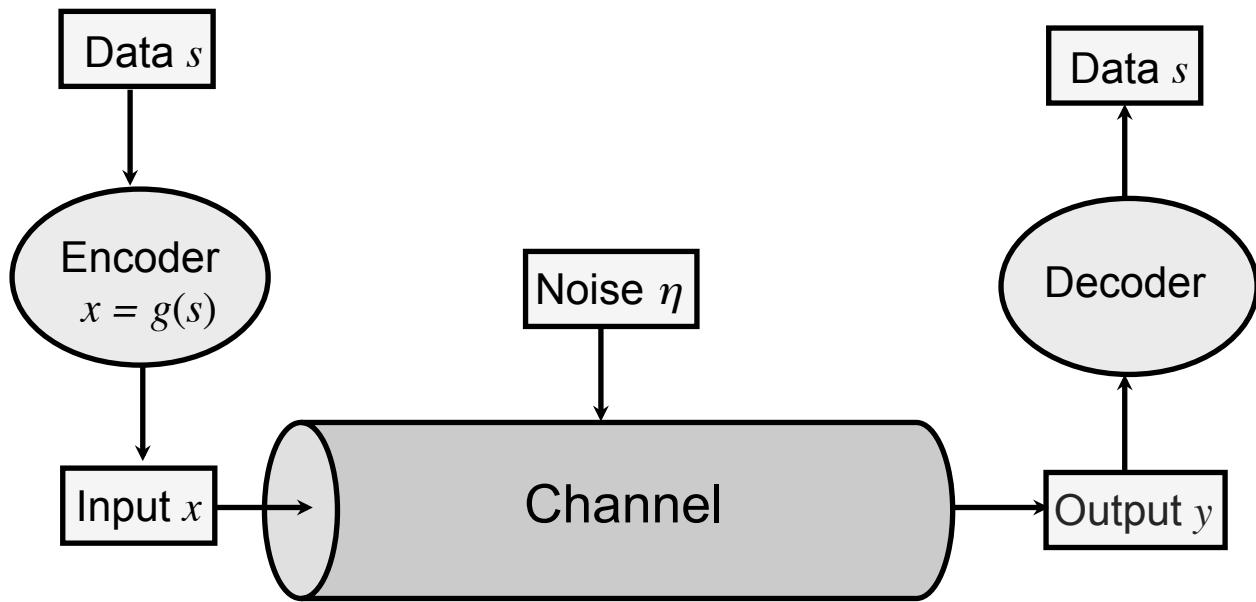


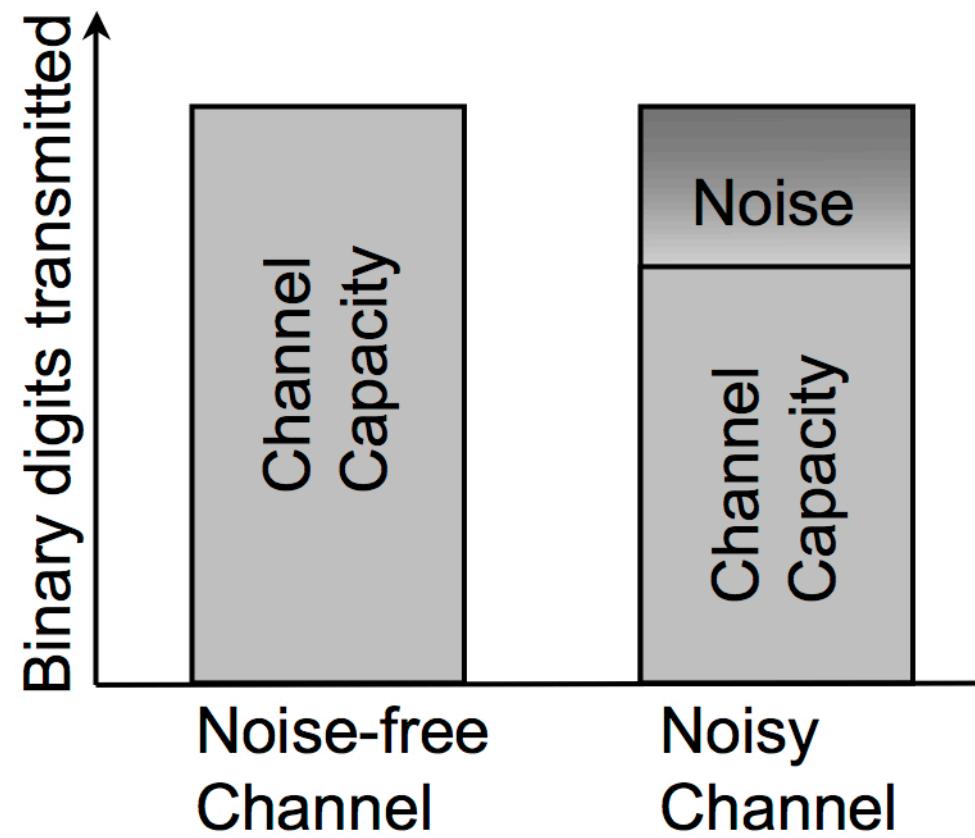
Chapter 2

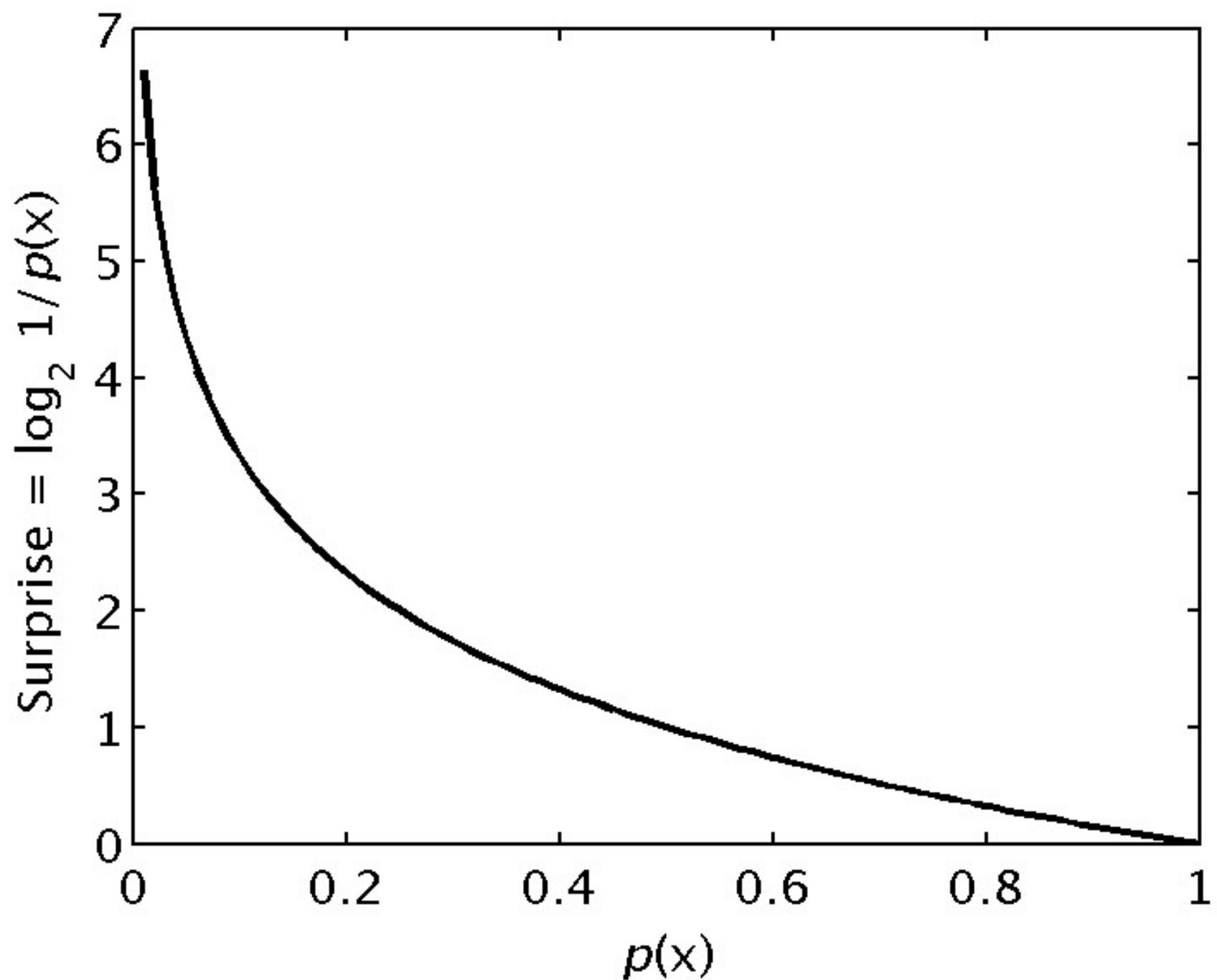


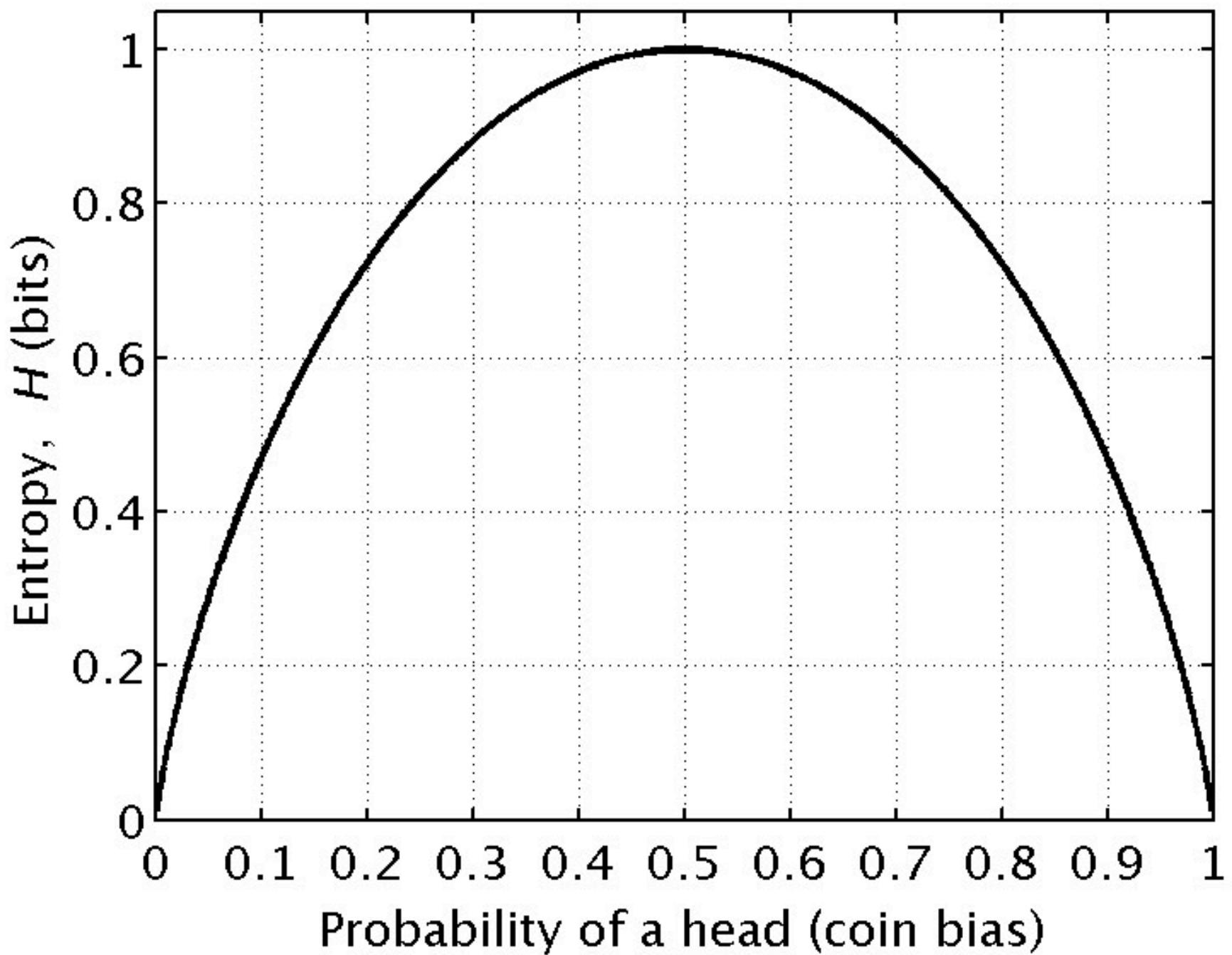














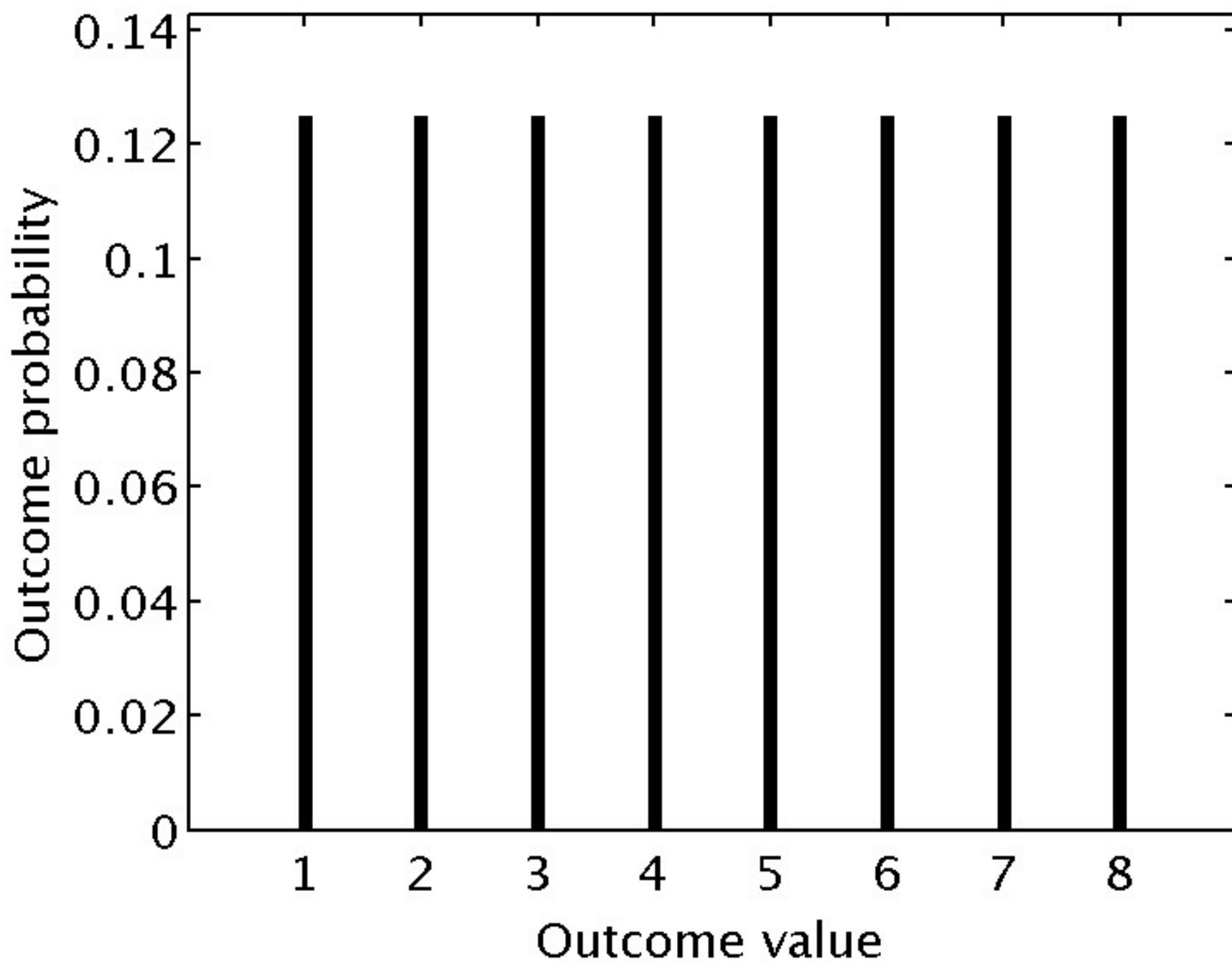
A white rectangular tile with rounded corners, featuring black ink numbers. The top edge shows the number 1. The left side shows 3 and 5. The right side shows 8. The bottom edge shows 9.

1

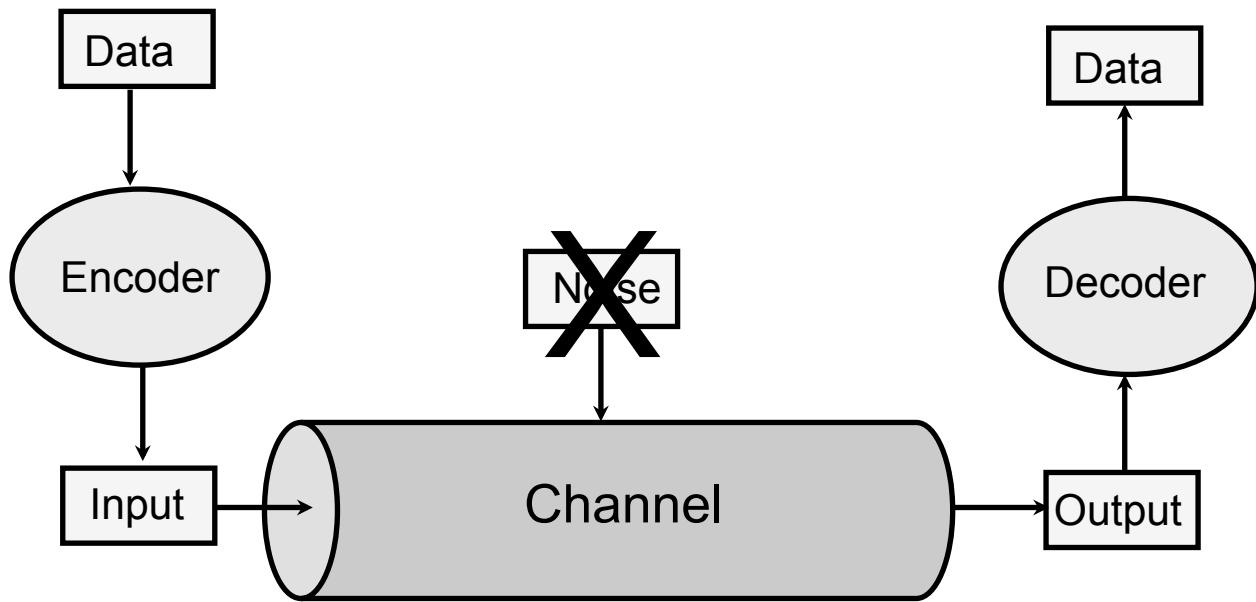
3 5

8

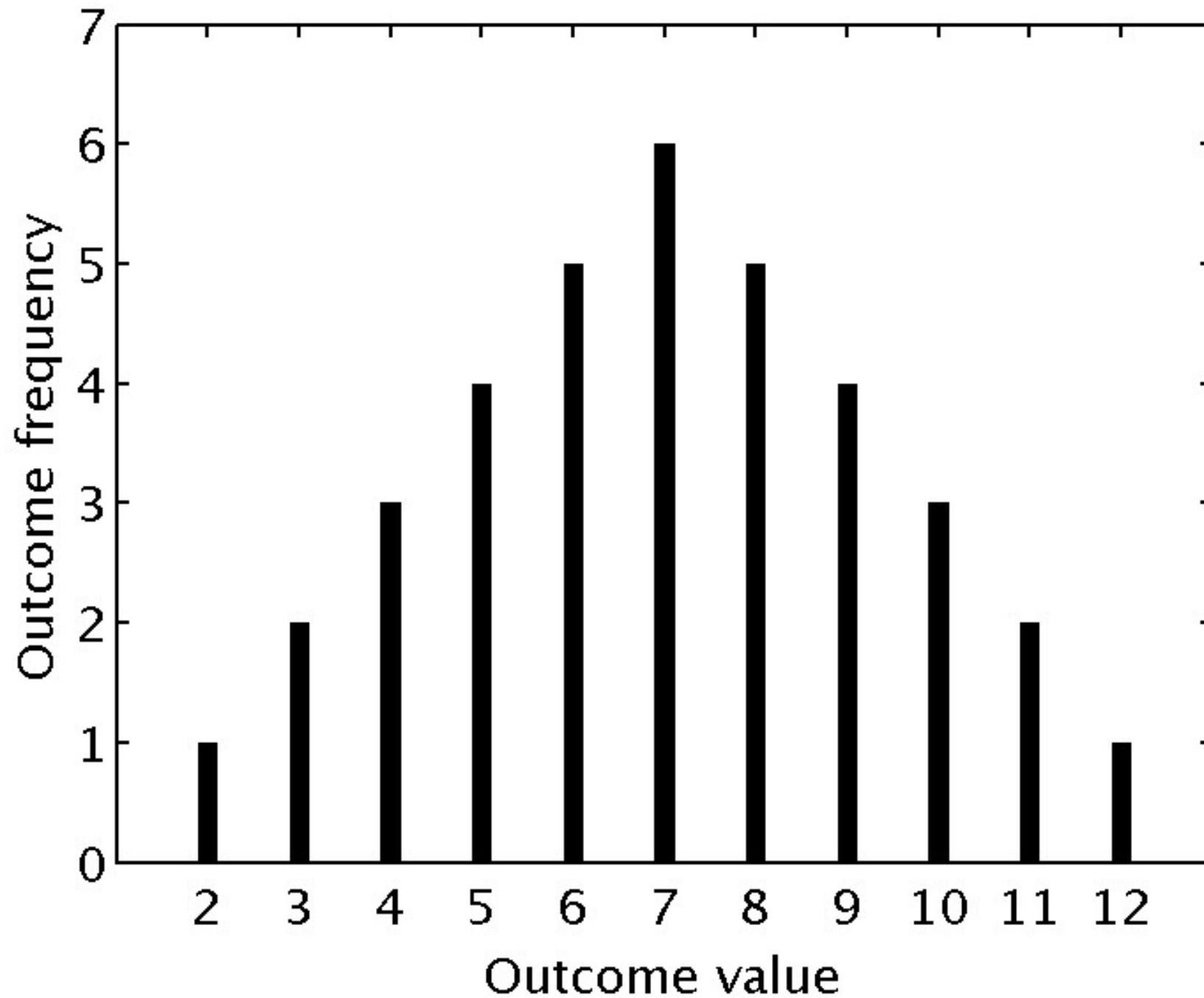
9



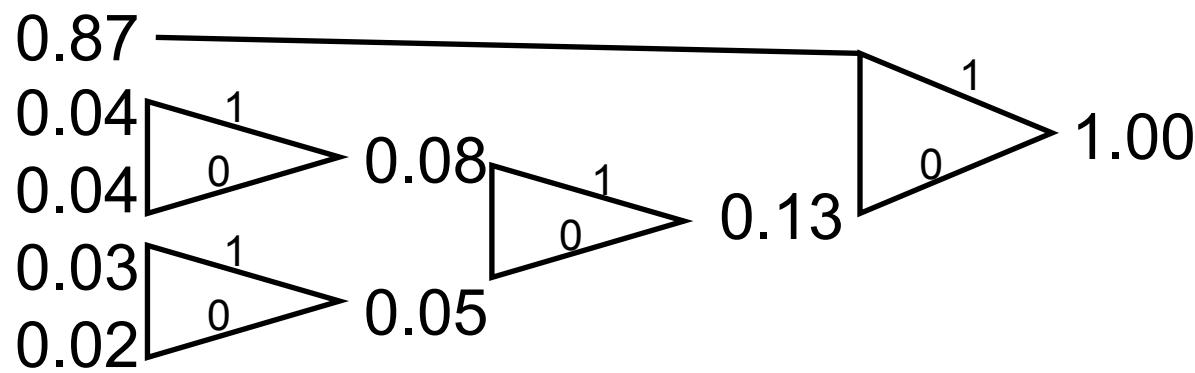
Chapter 3







A
B
C
D
E





from xkcd.com

a)

T

H

E

b)

T	H
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E	SP
---	----

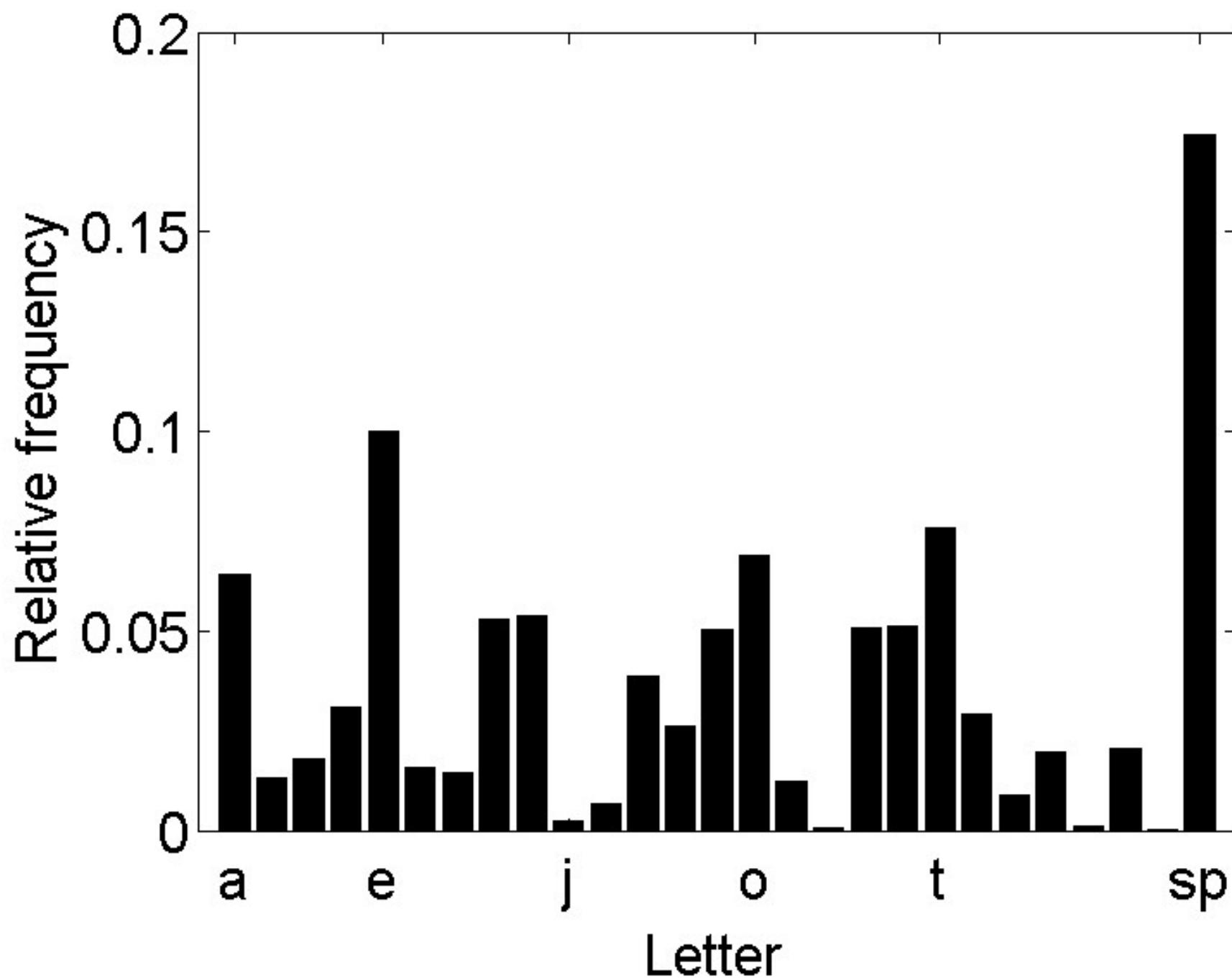
W	O
---	---

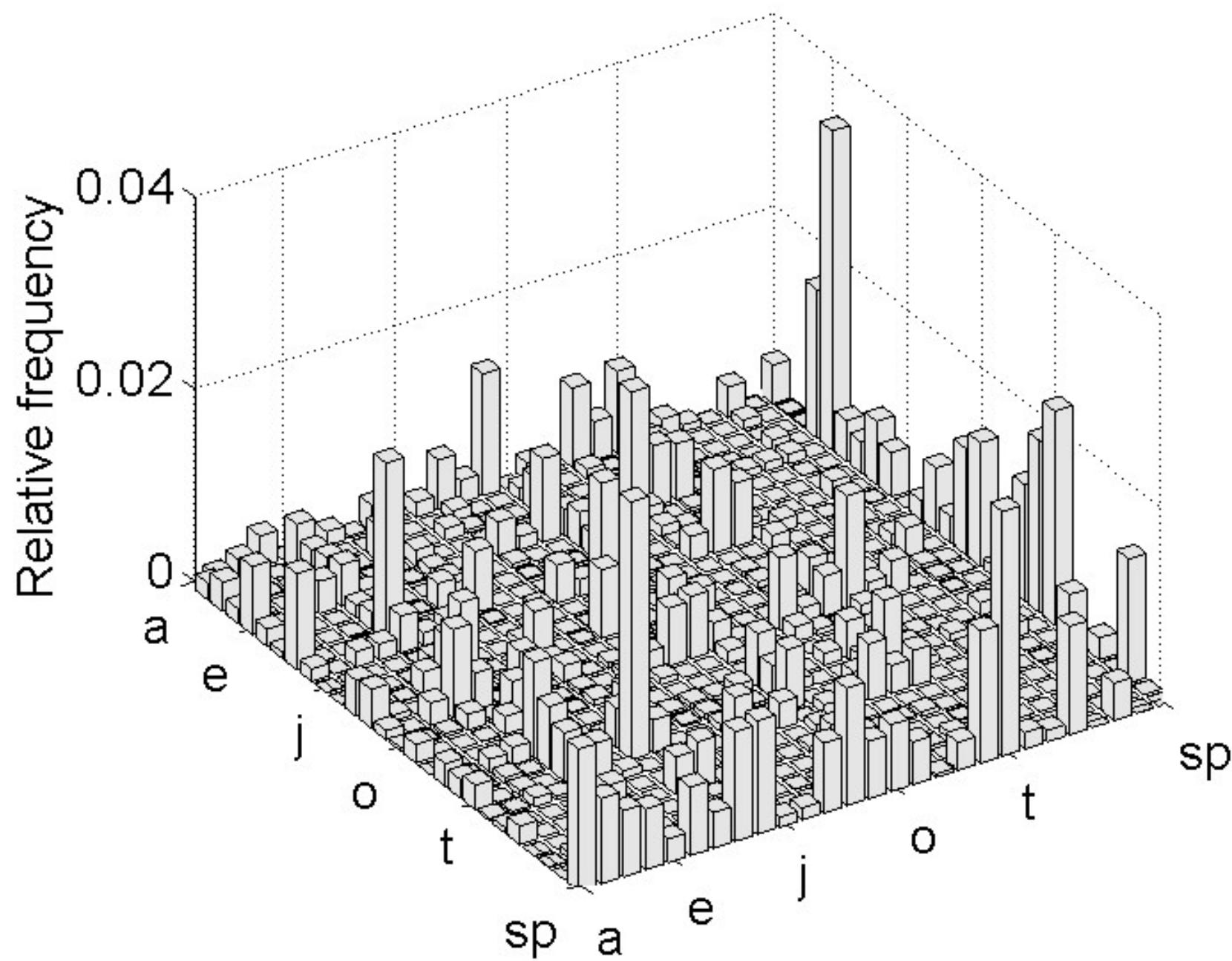
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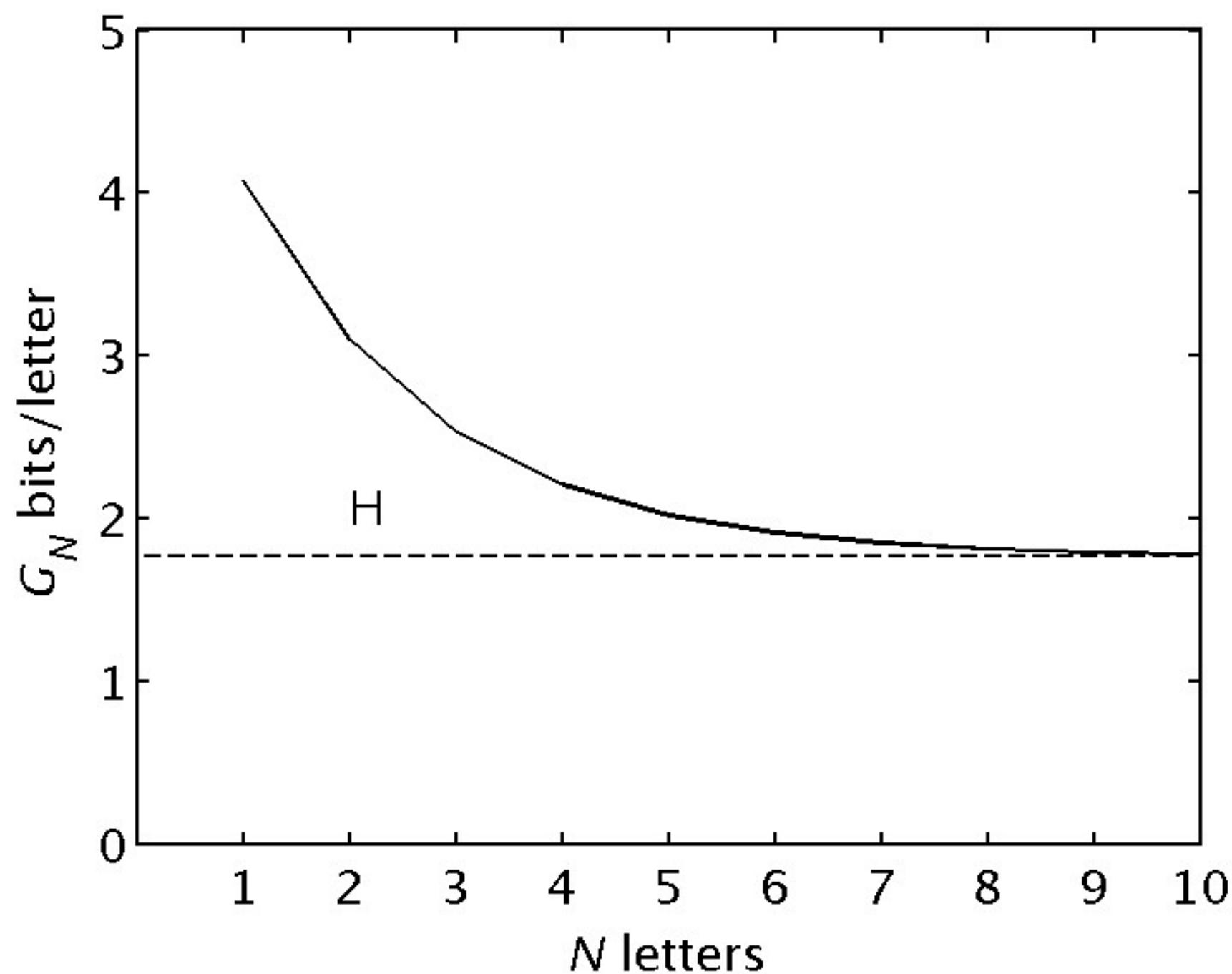
T	H	E
---	---	---

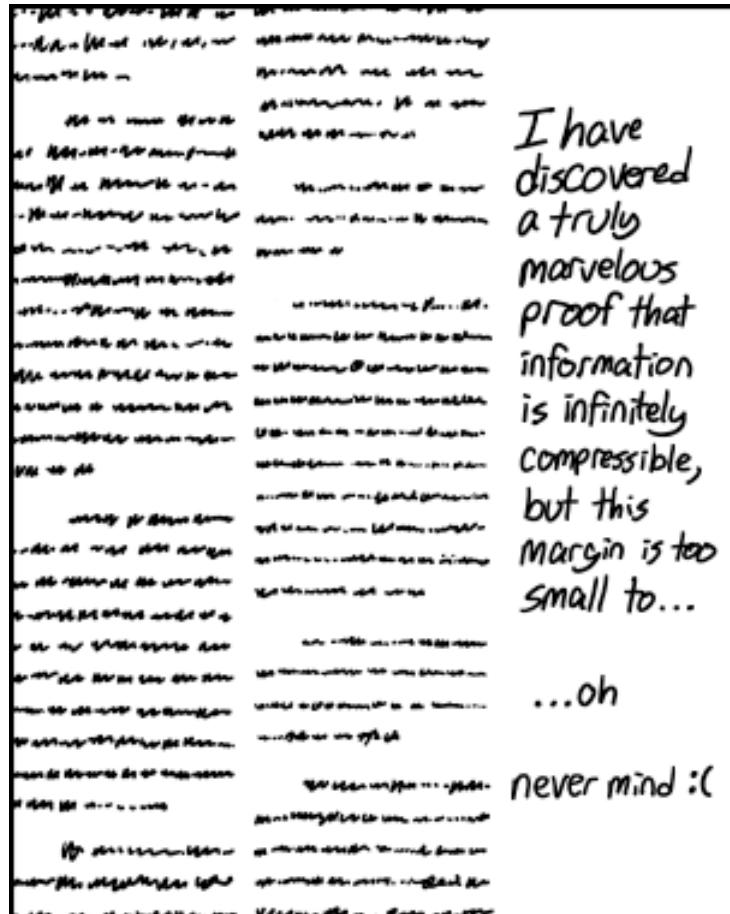
SP	W	O
----	---	---

R	L	D
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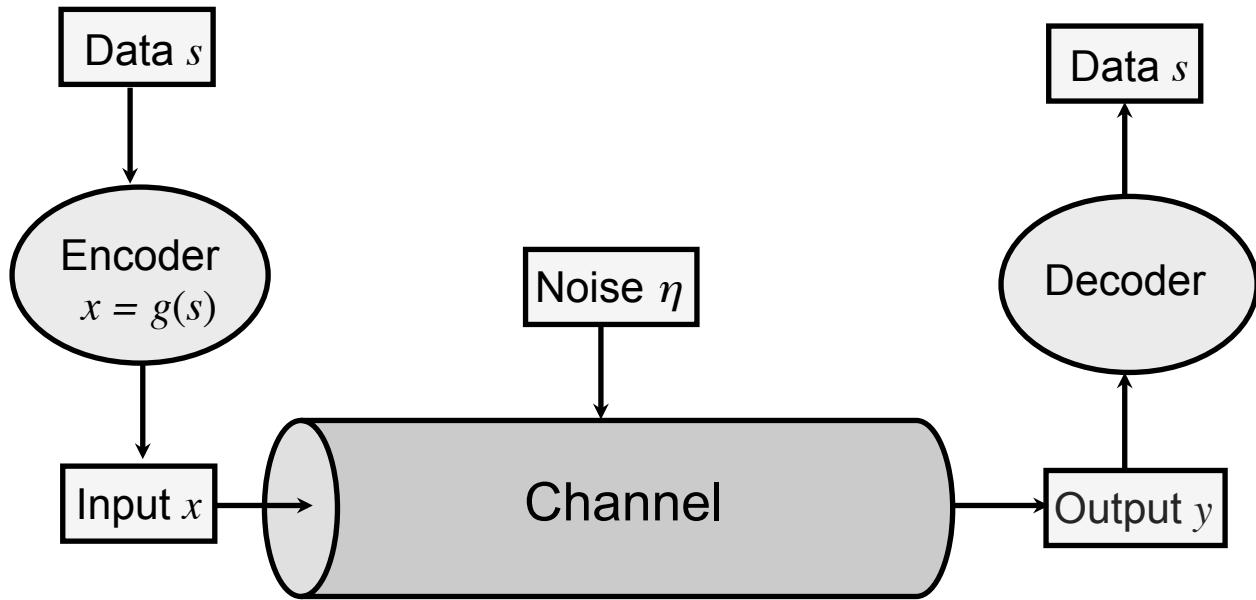


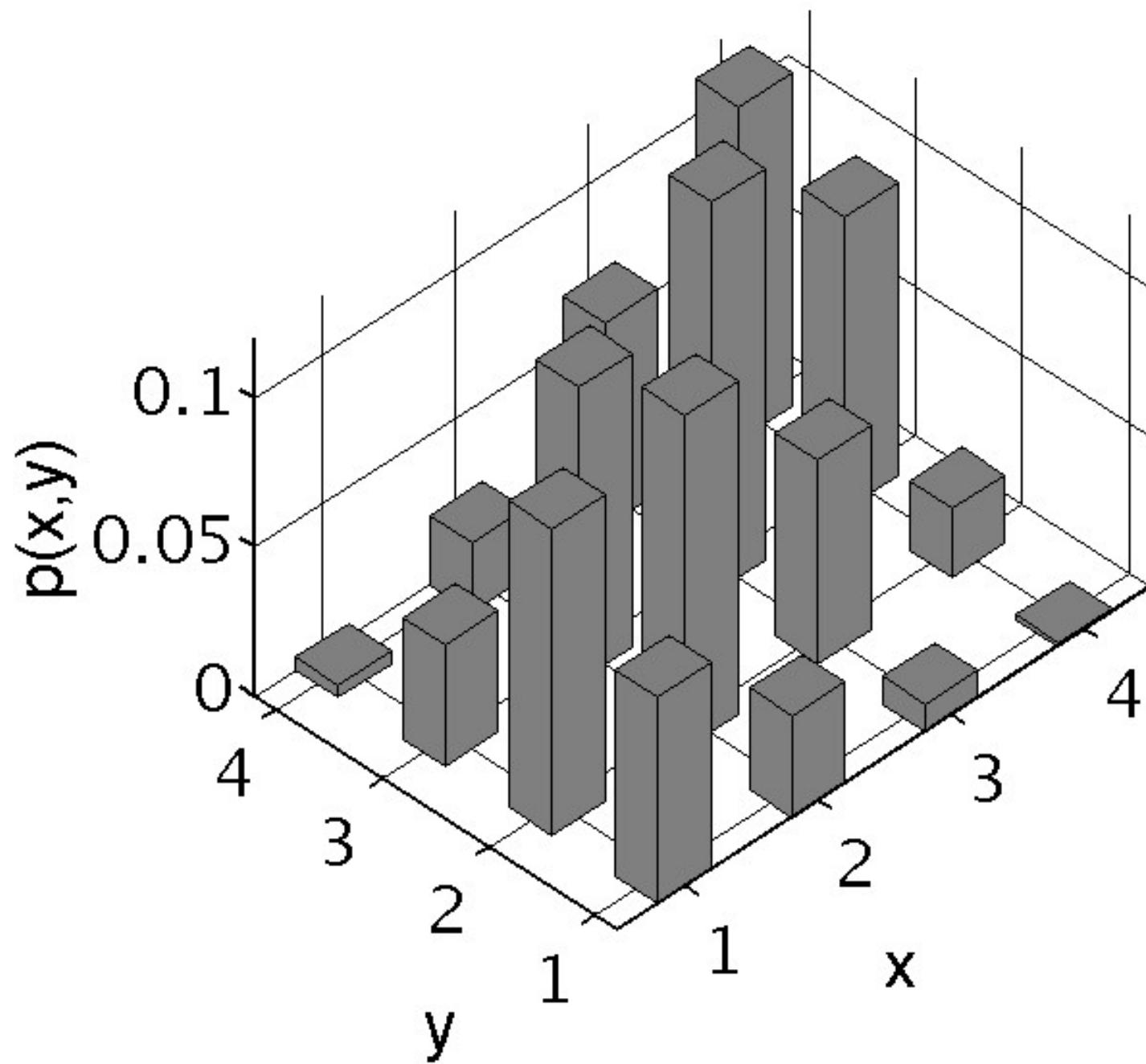


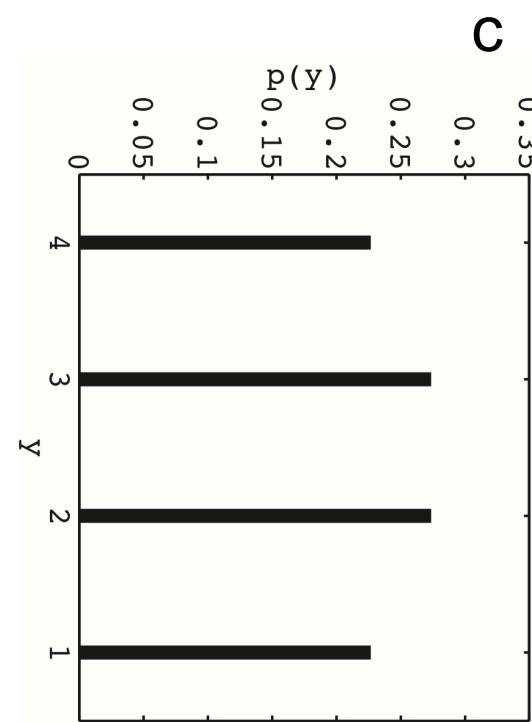
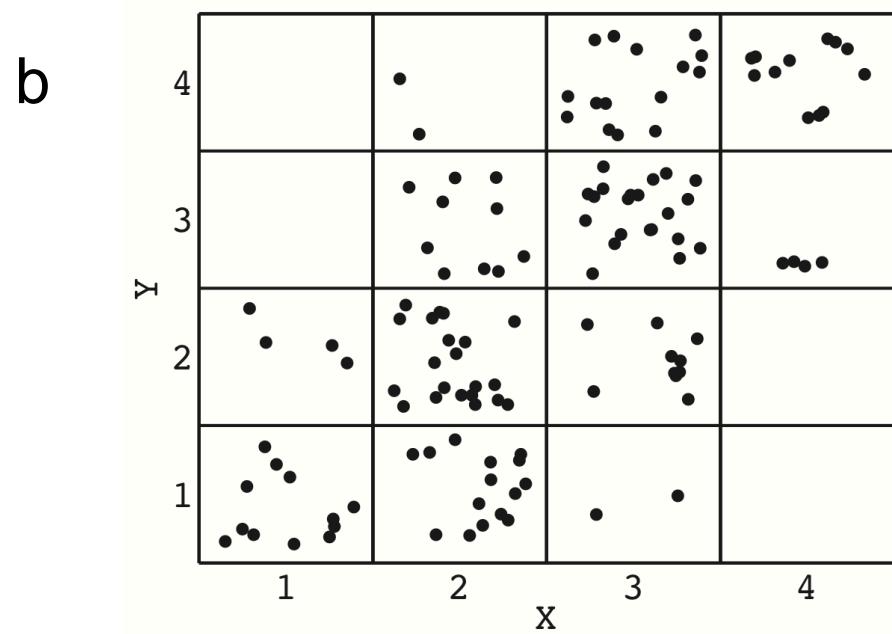
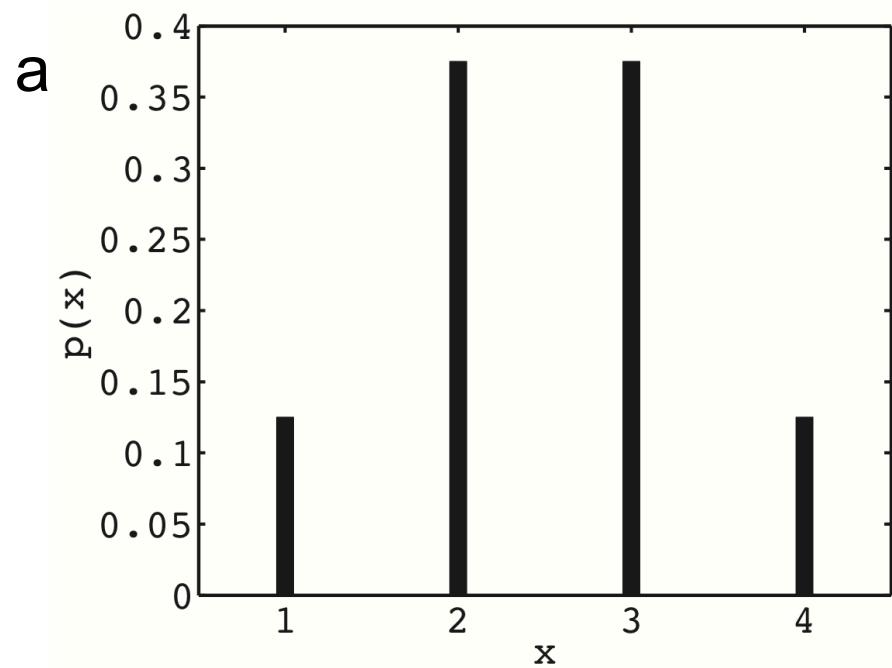


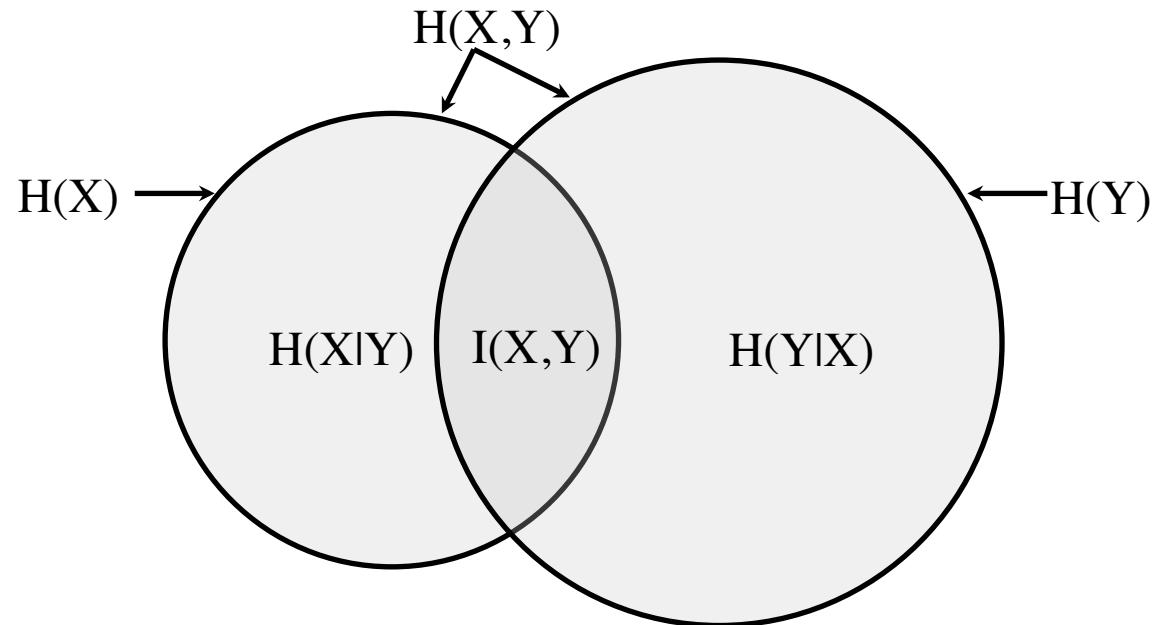
From xkcd.com

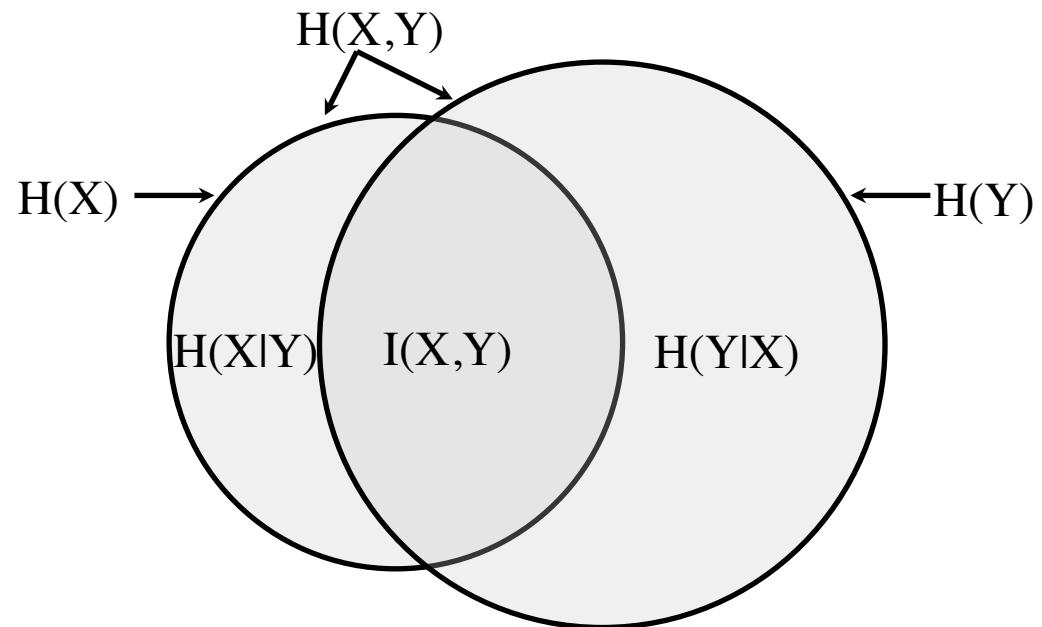
Chapter 4











$H(X, Y)$ joint entropy

$H(Y)$ output entropy

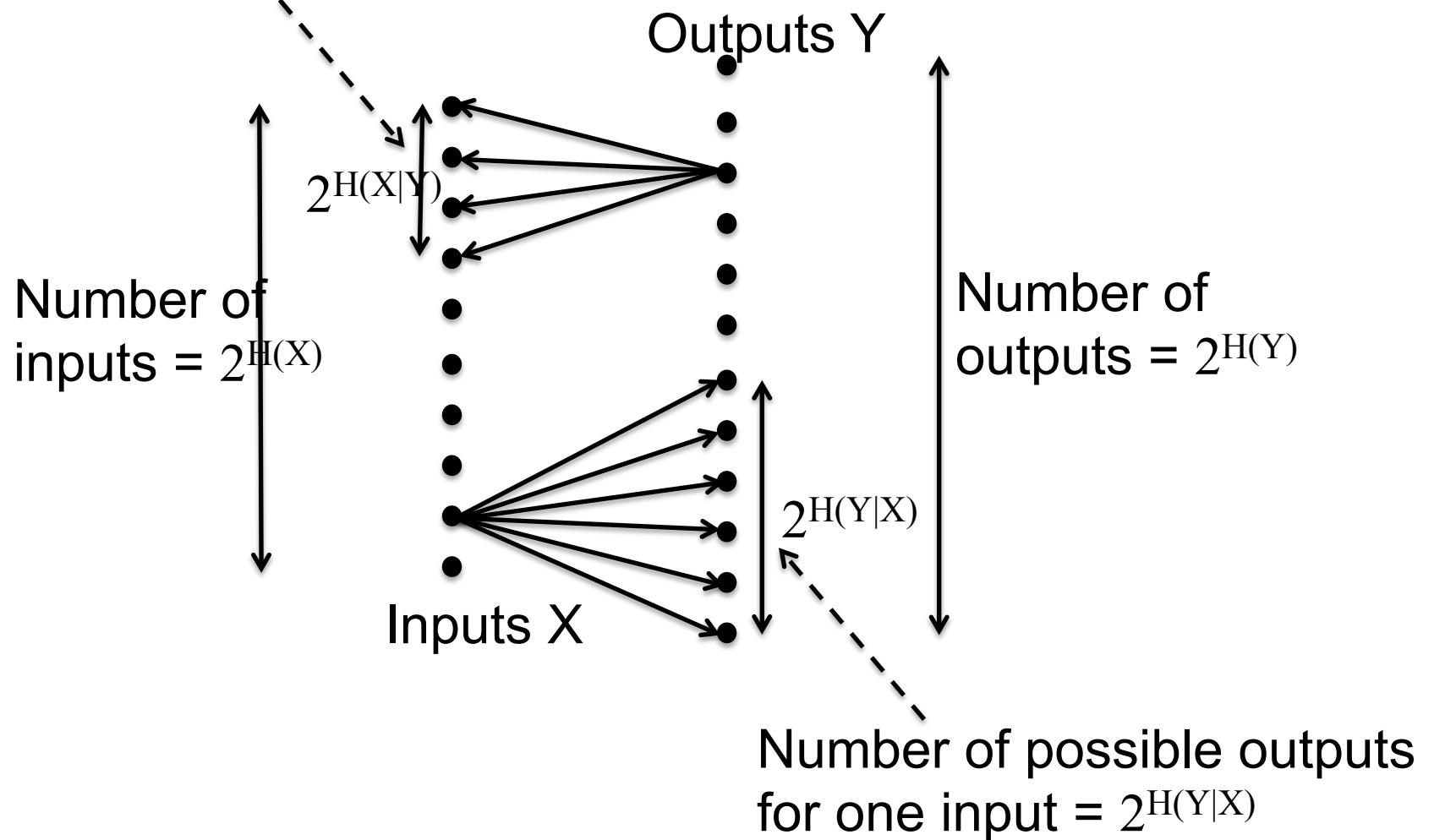
$H(X)$ input entropy

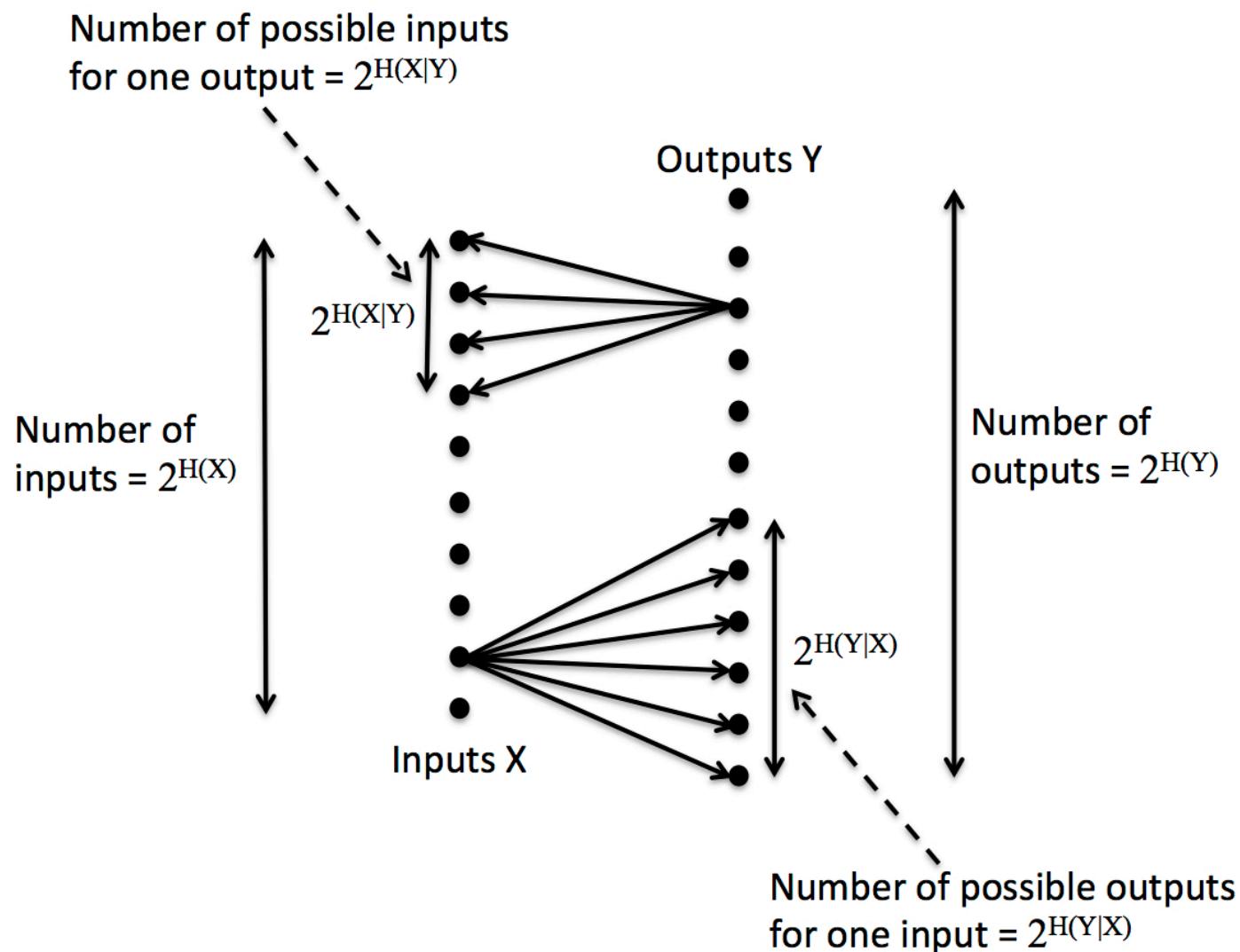
$H(Y|X)$ conditional

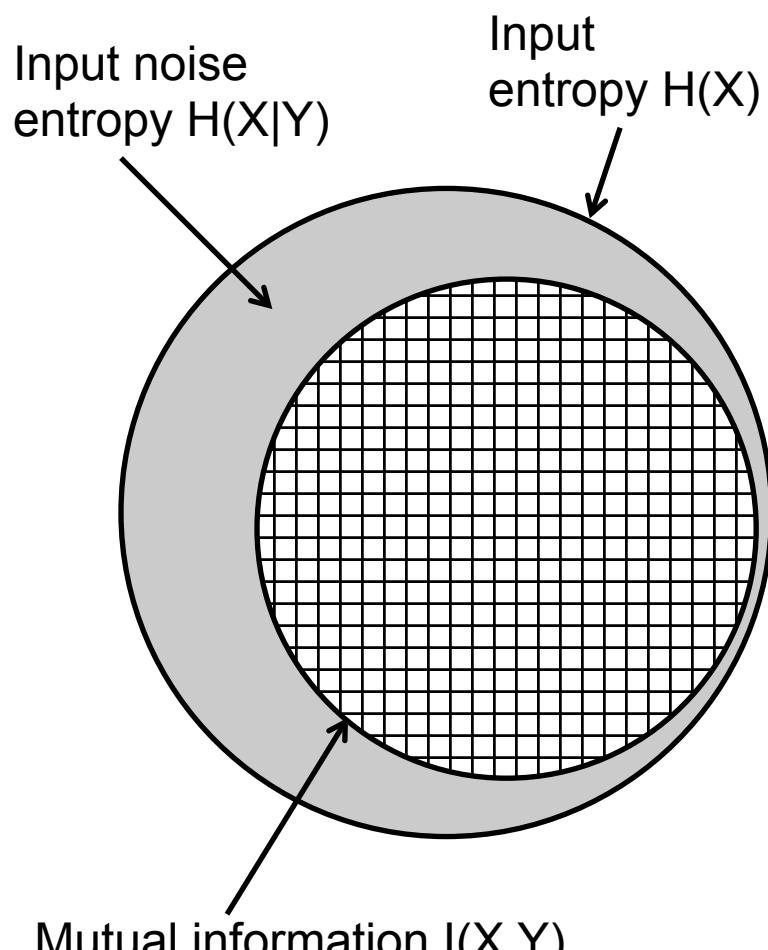
$I(X, Y)$

$H(X|Y)$ cond.

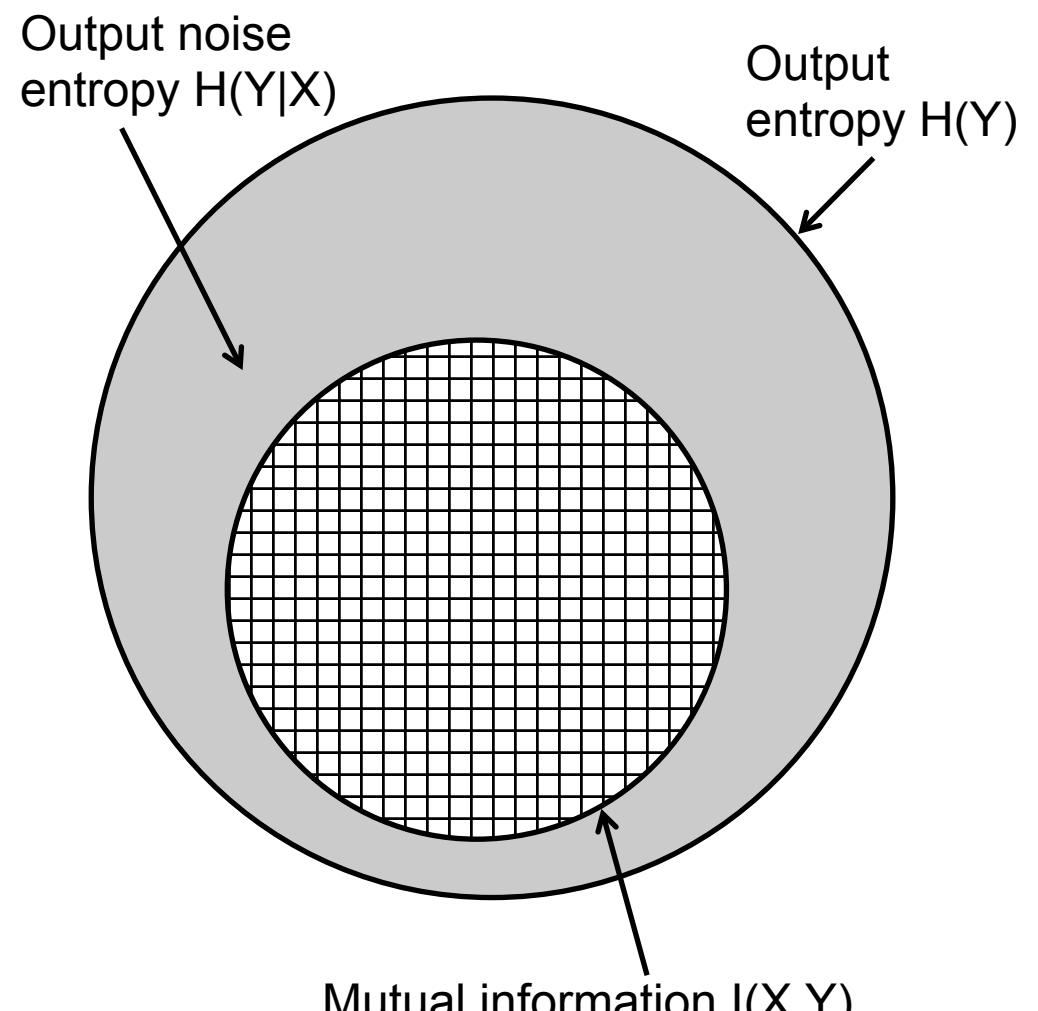
Number of possible inputs
for one output = $2^{H(X|Y)}$







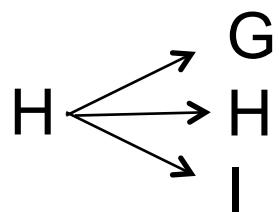
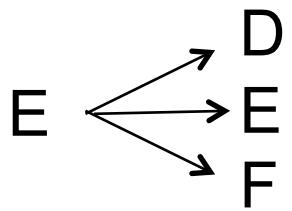
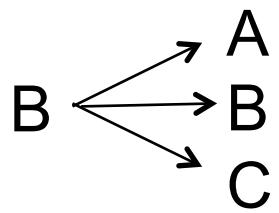
(a)

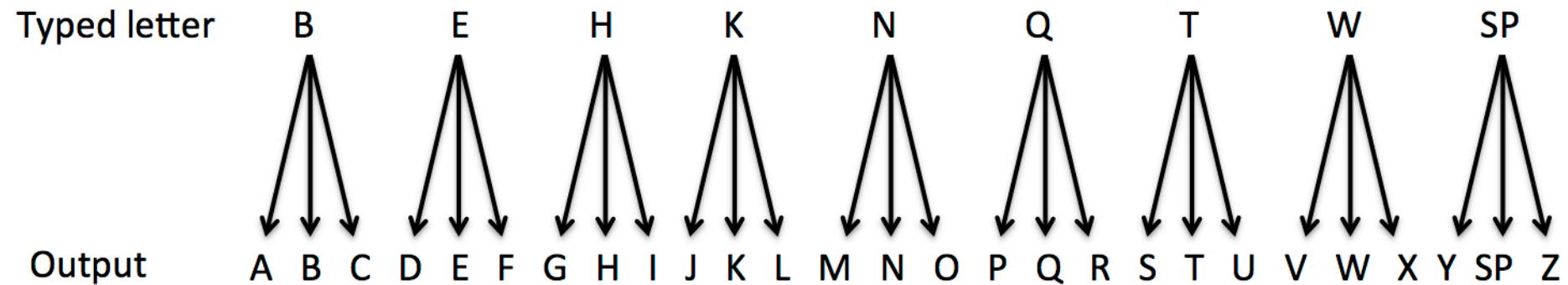
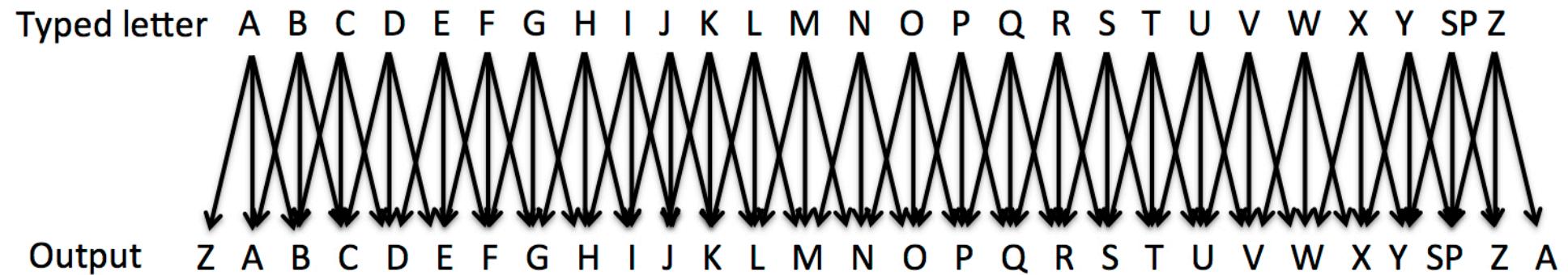


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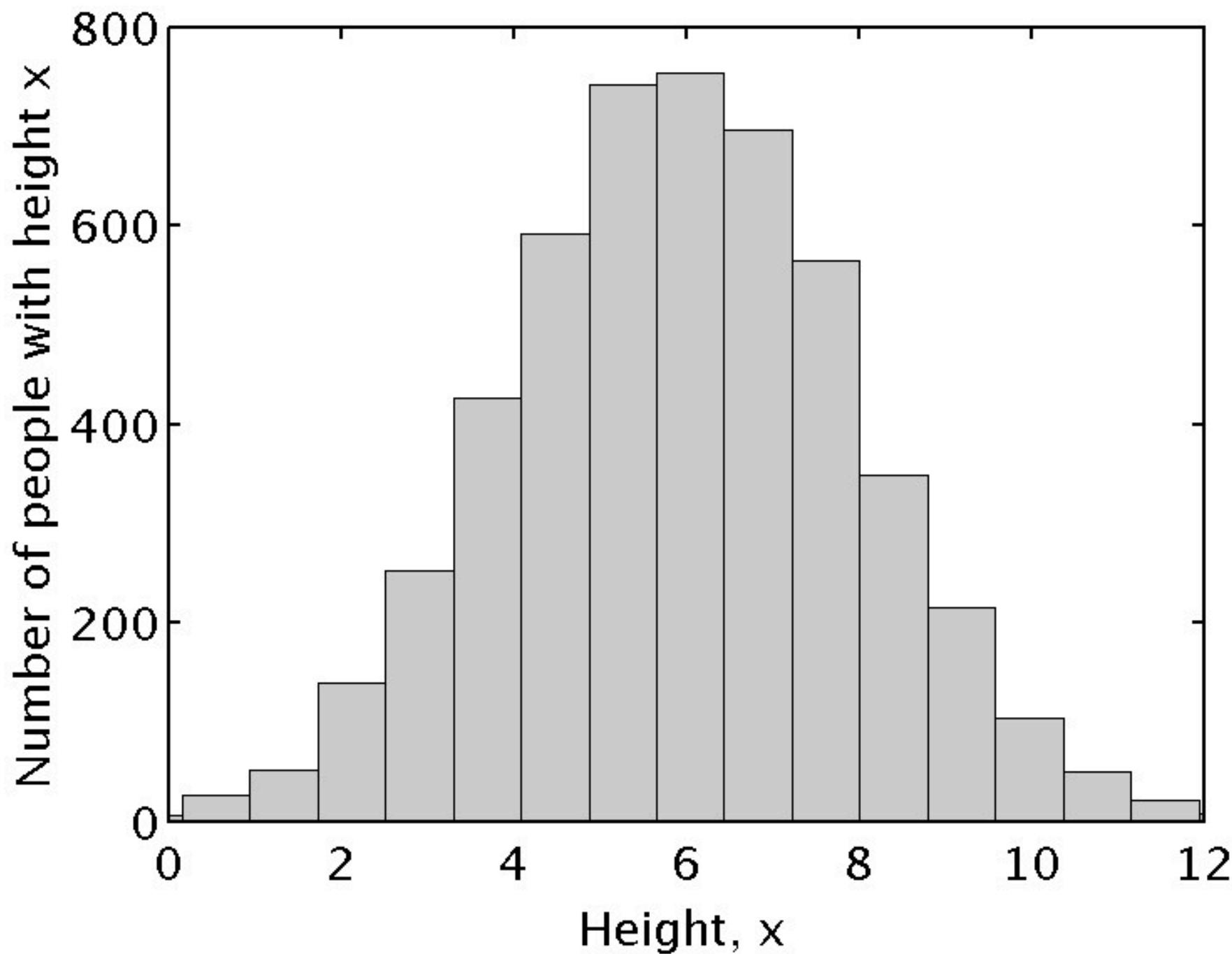


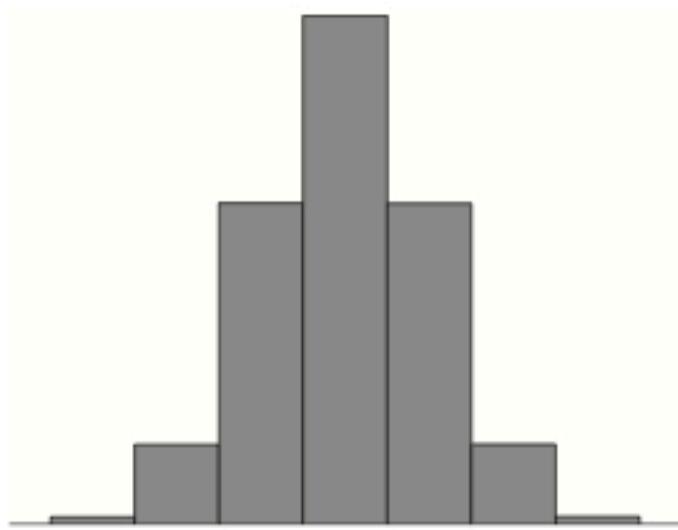




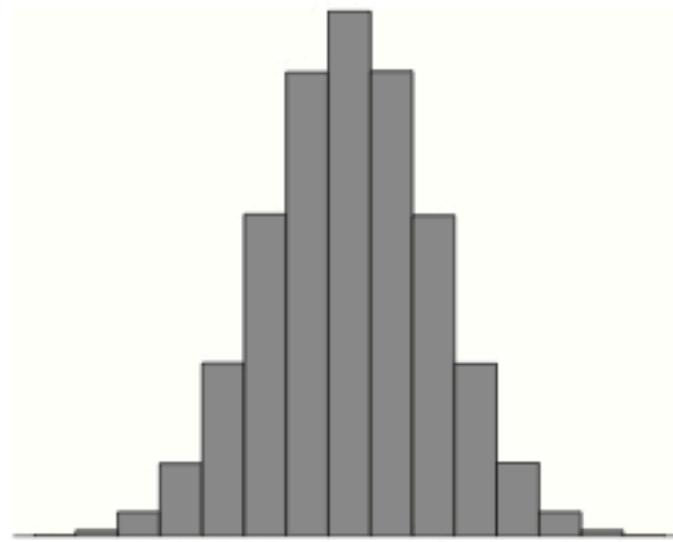


Chapter 5

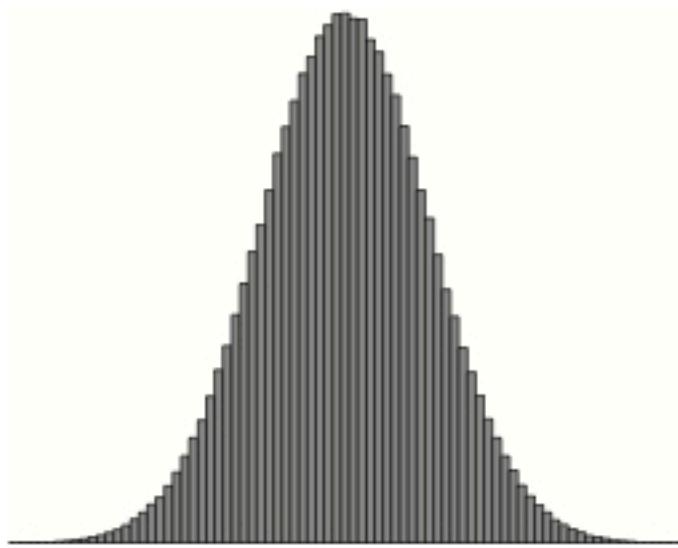




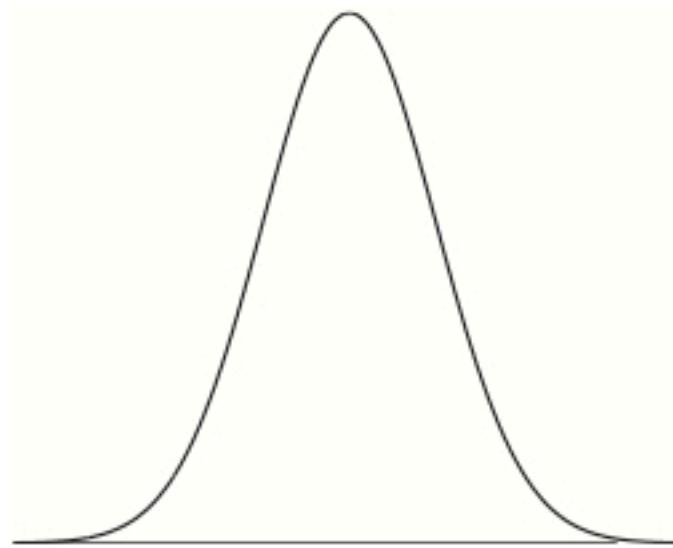
(a) Binwidth=1, $H = 2.104$ bits.



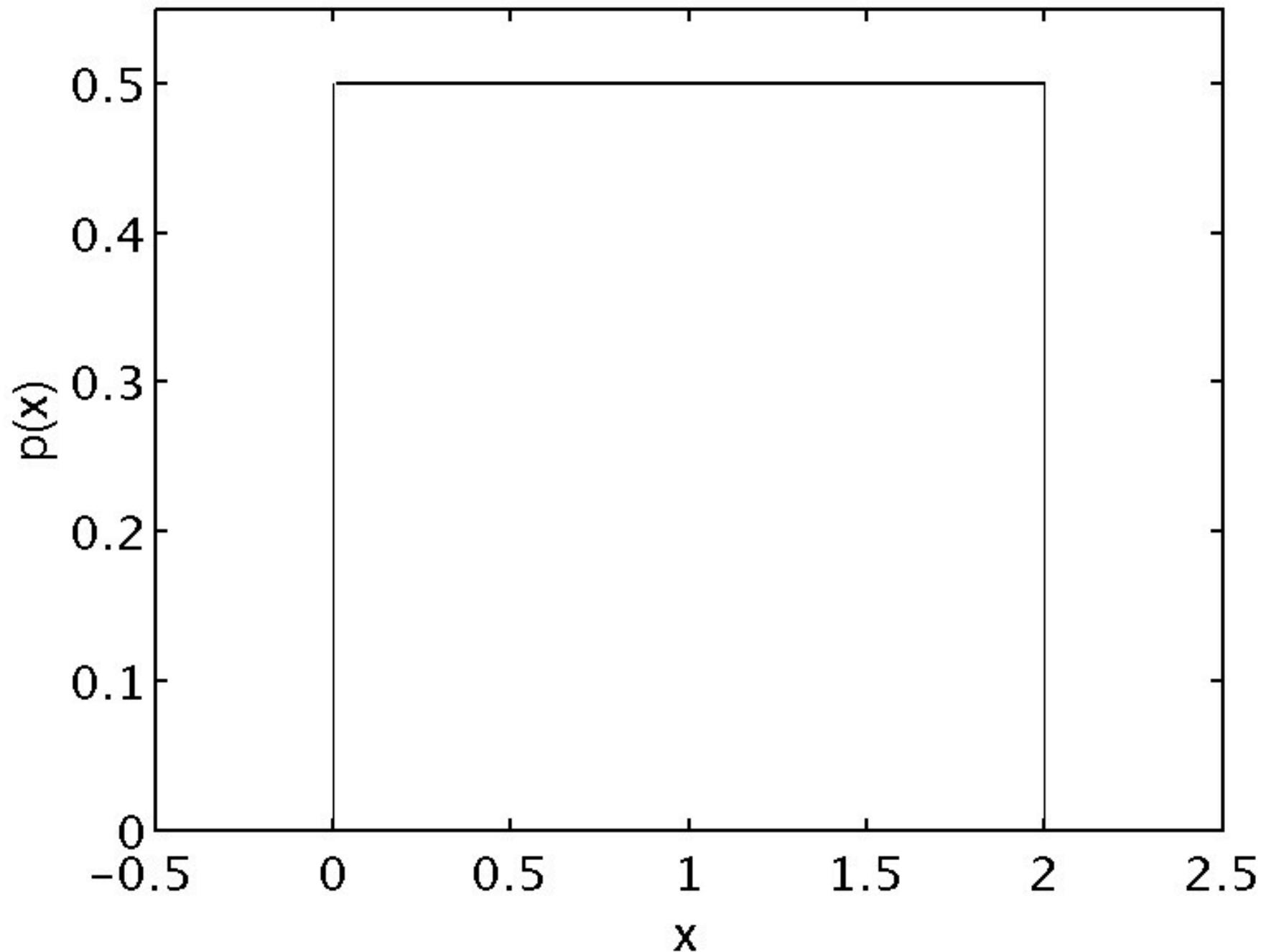
(b) Binwidth=0.5, $H = 3.061$ bits.

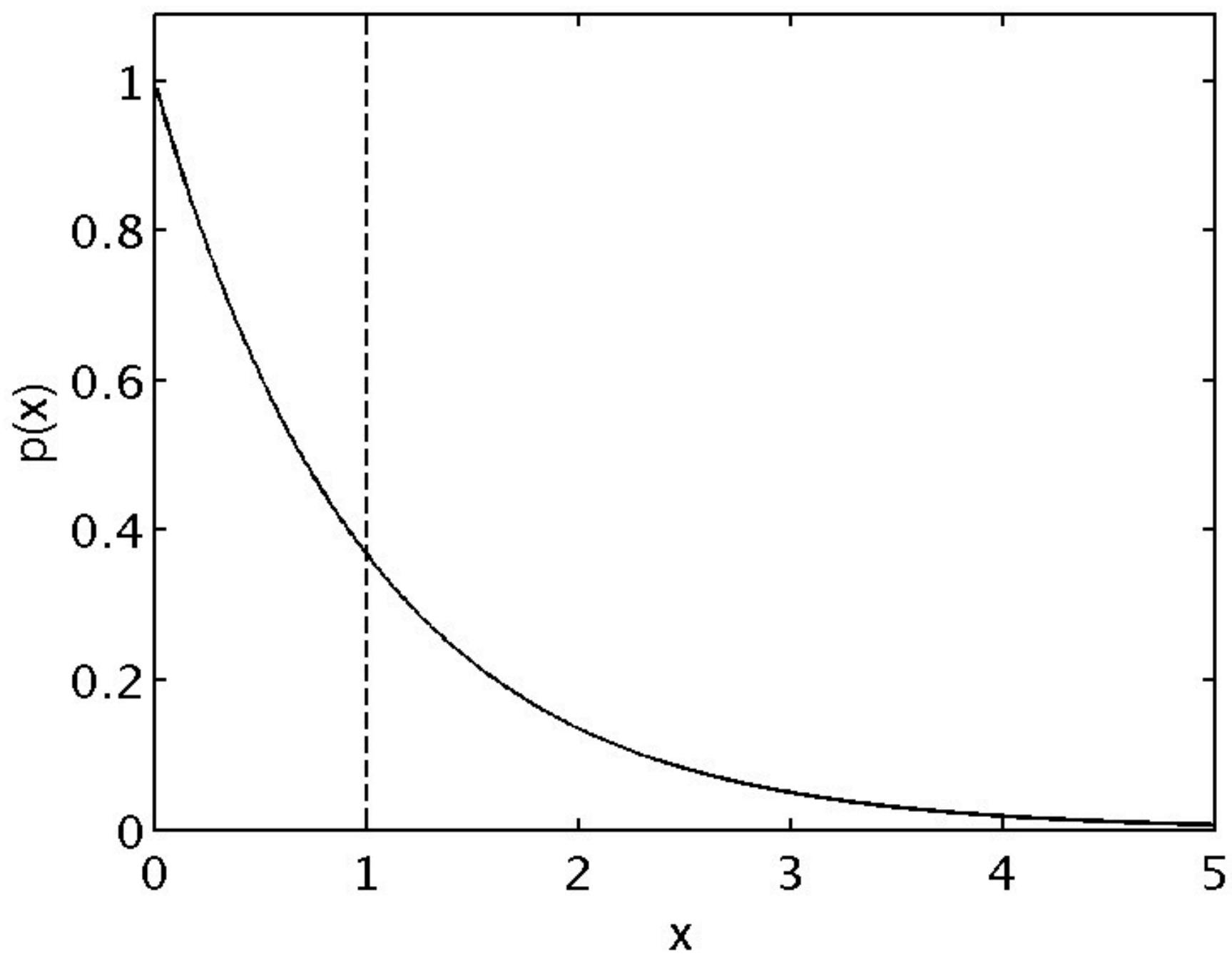


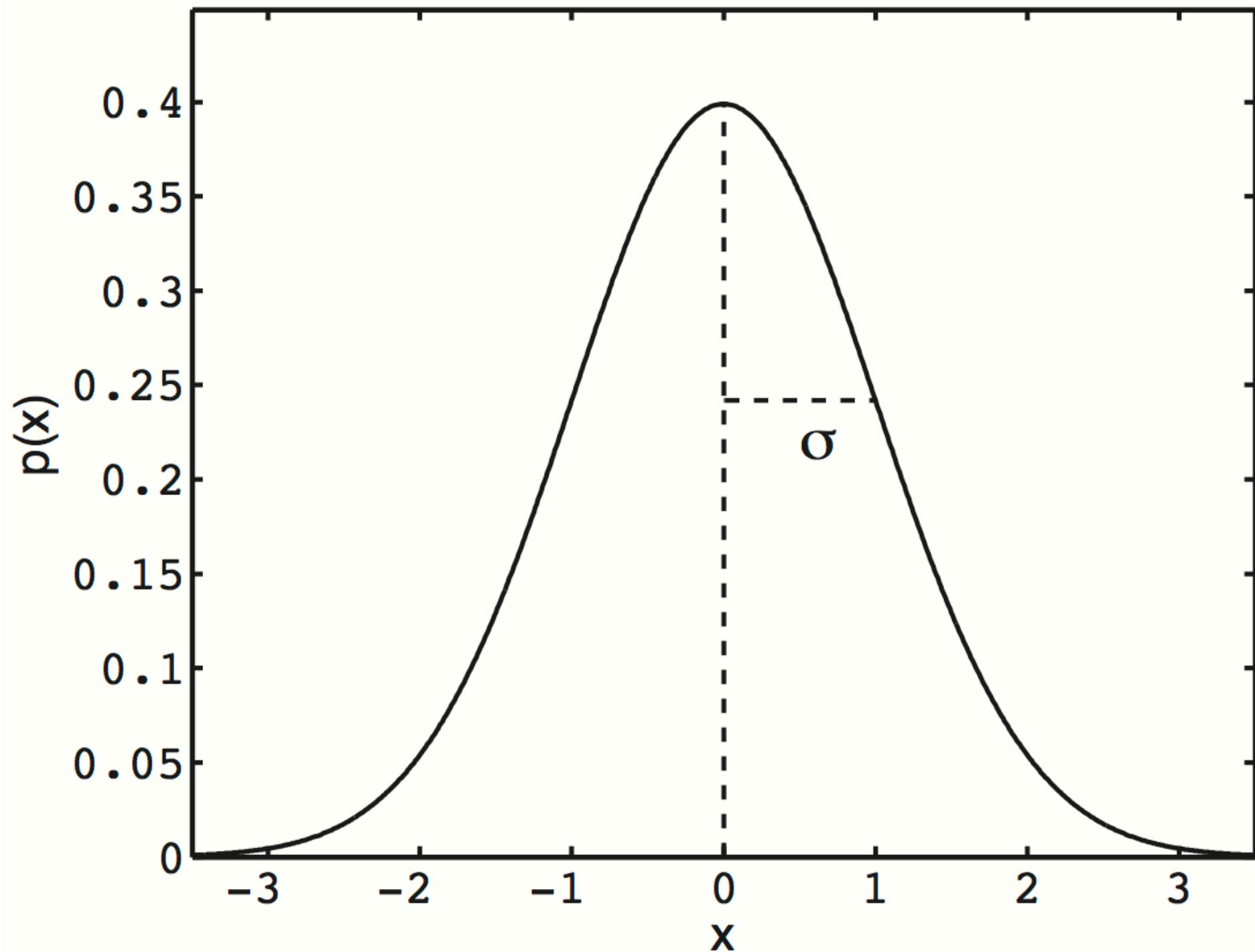
(c) Binwidth=0.1, $H = 5.368$ bits.



(d) $H = 2.047$ bits.



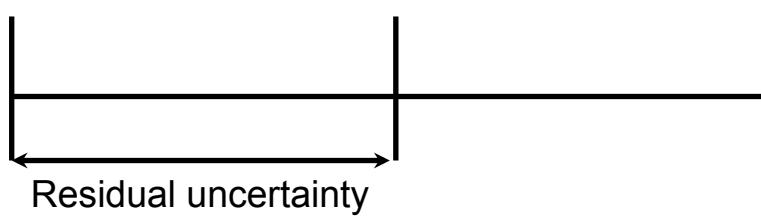




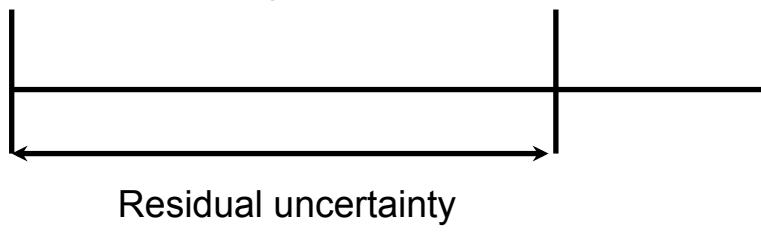
a) After receiving 2 bits, $U=25\%$

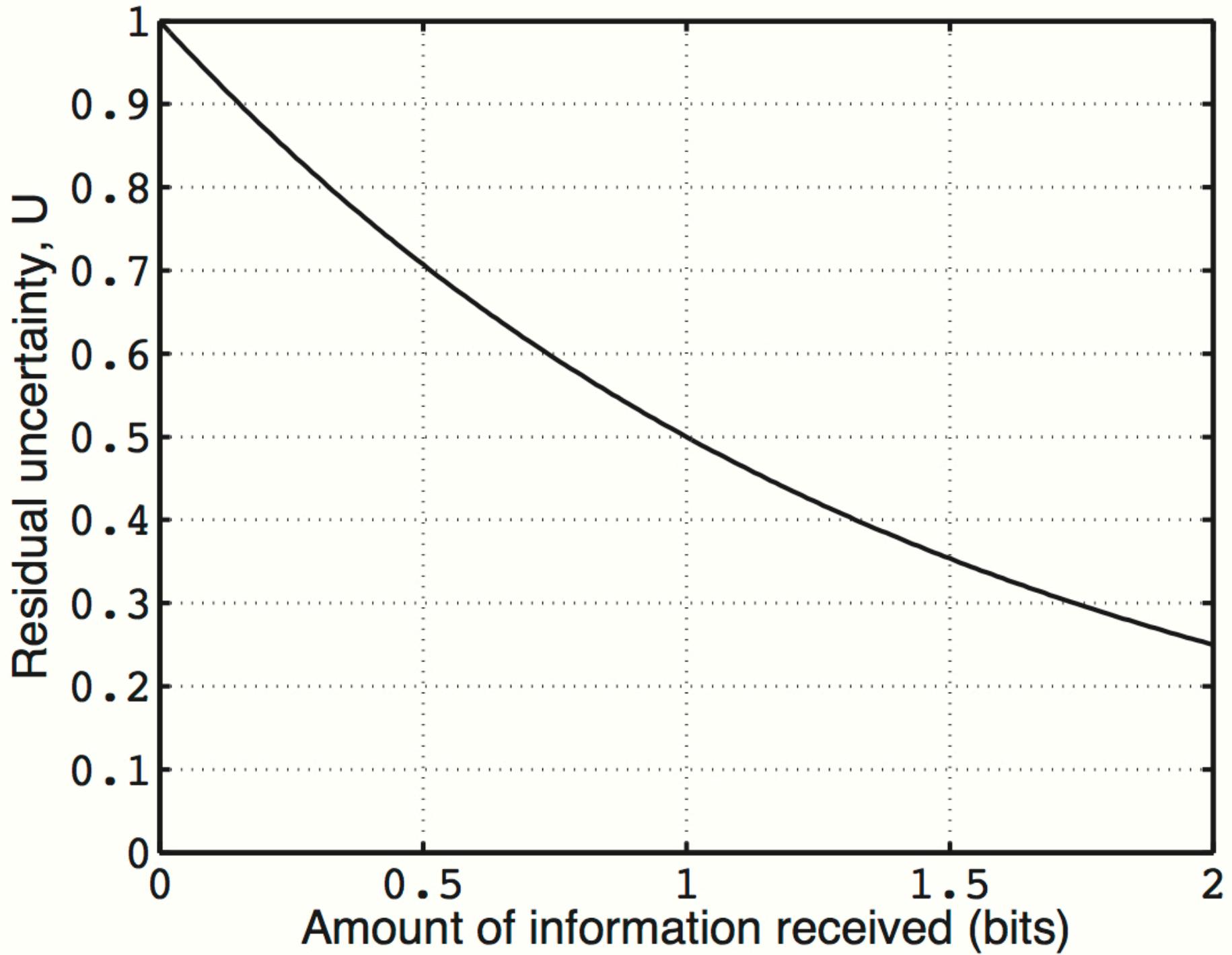


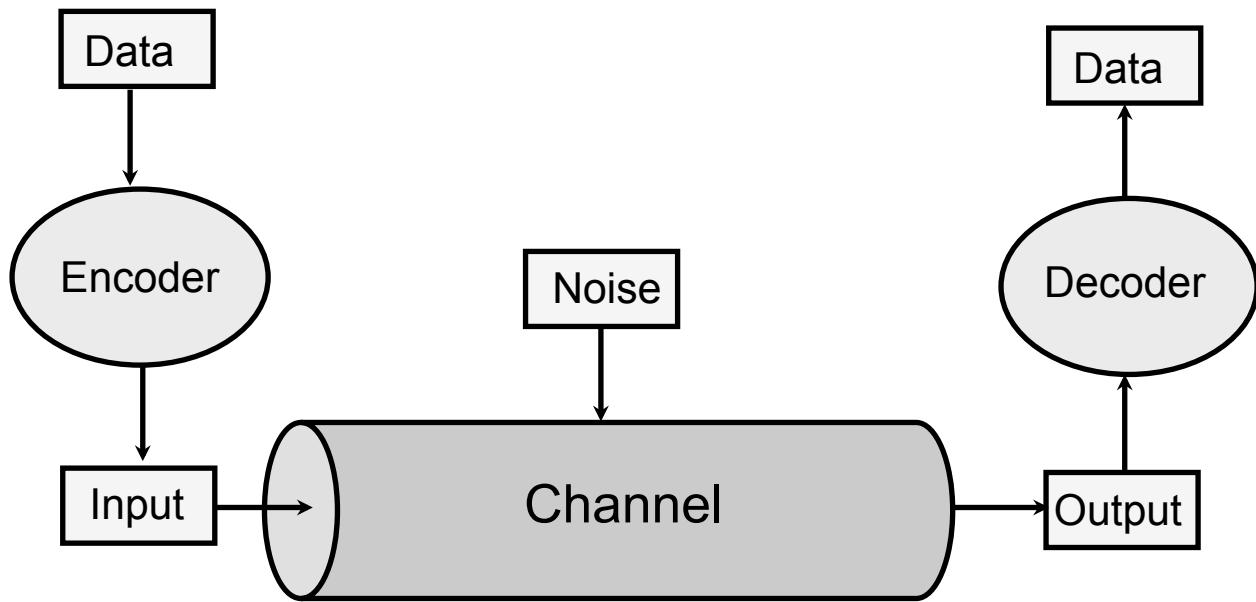
b) After receiving 1 bit, $U=50\%$



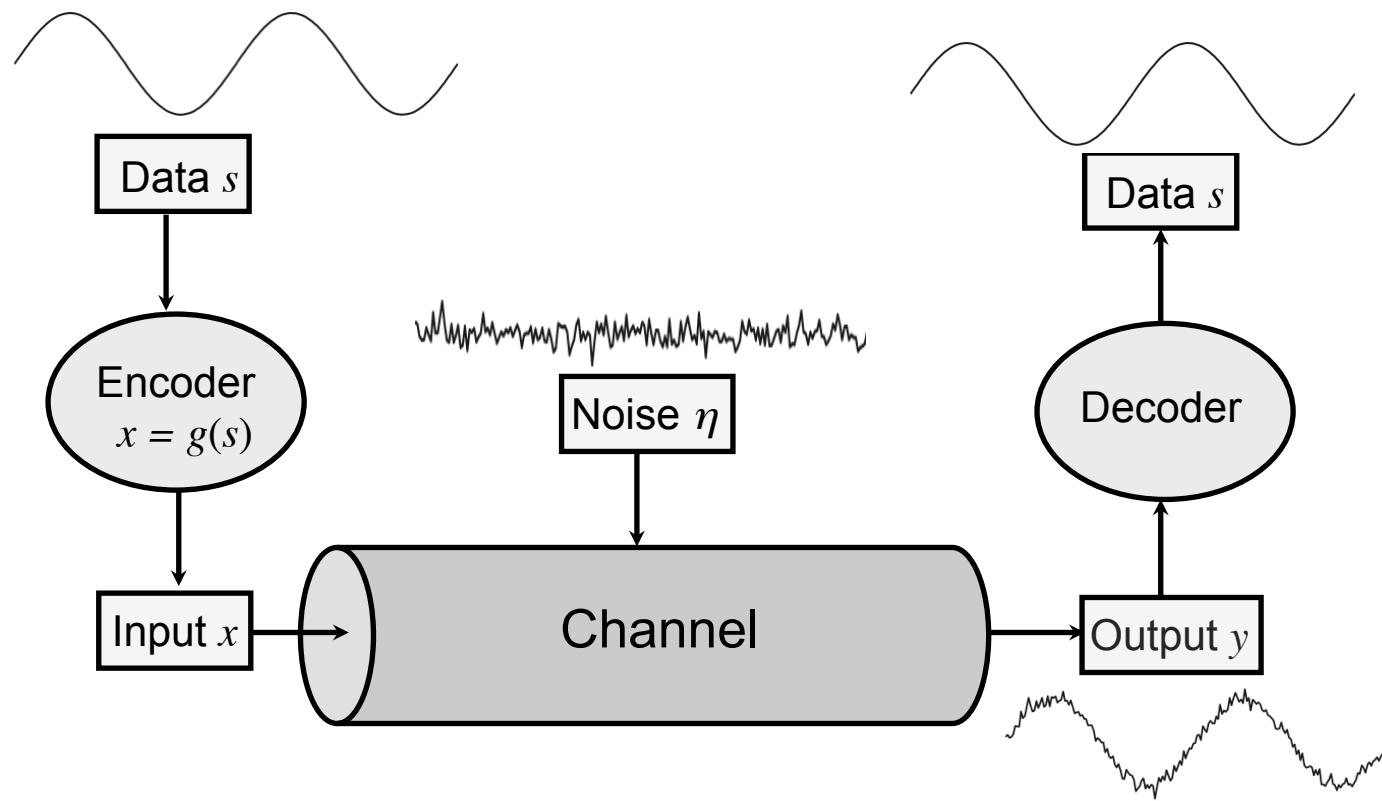
c) After receiving 1/2 a bit, $U=71\%$

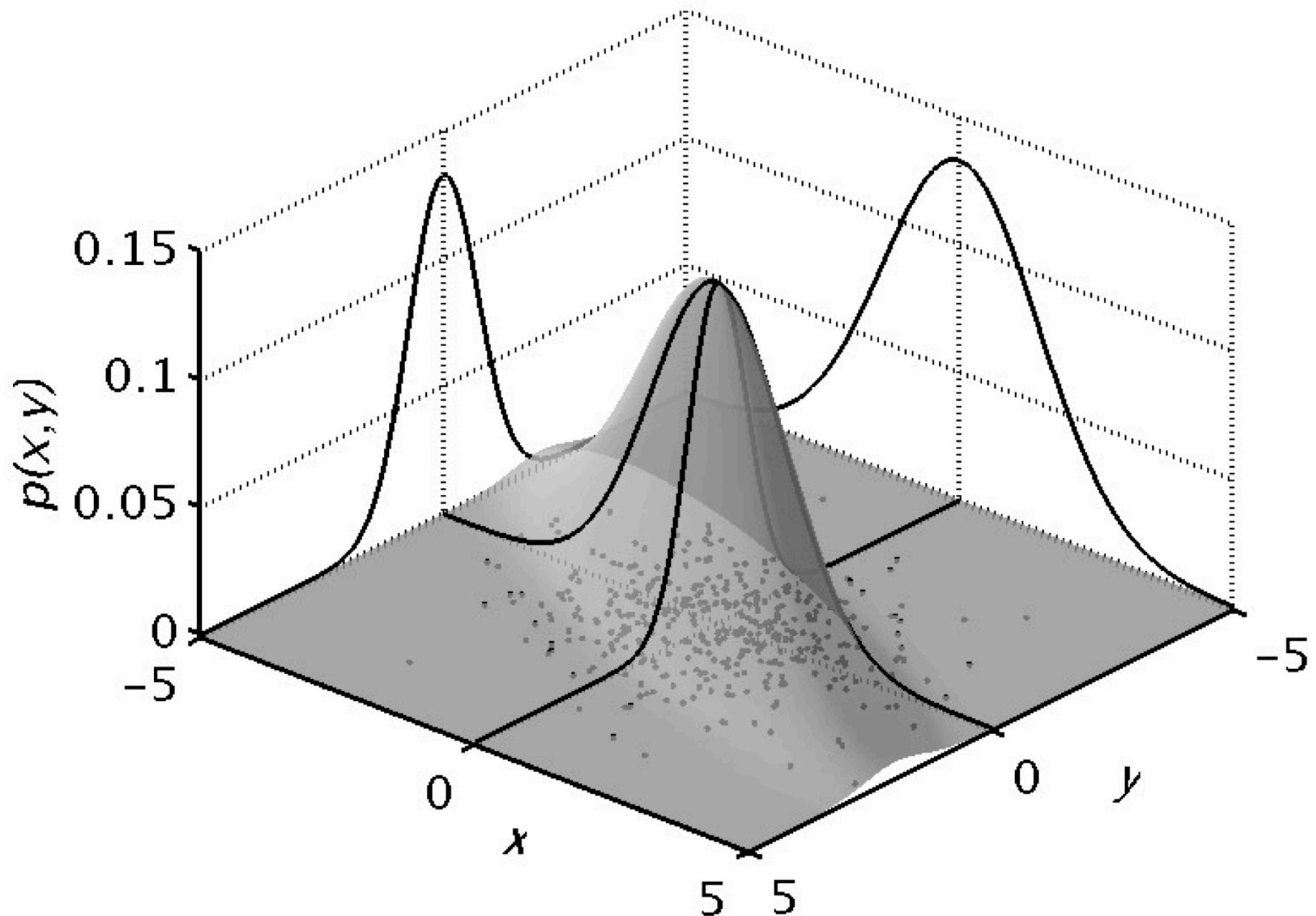


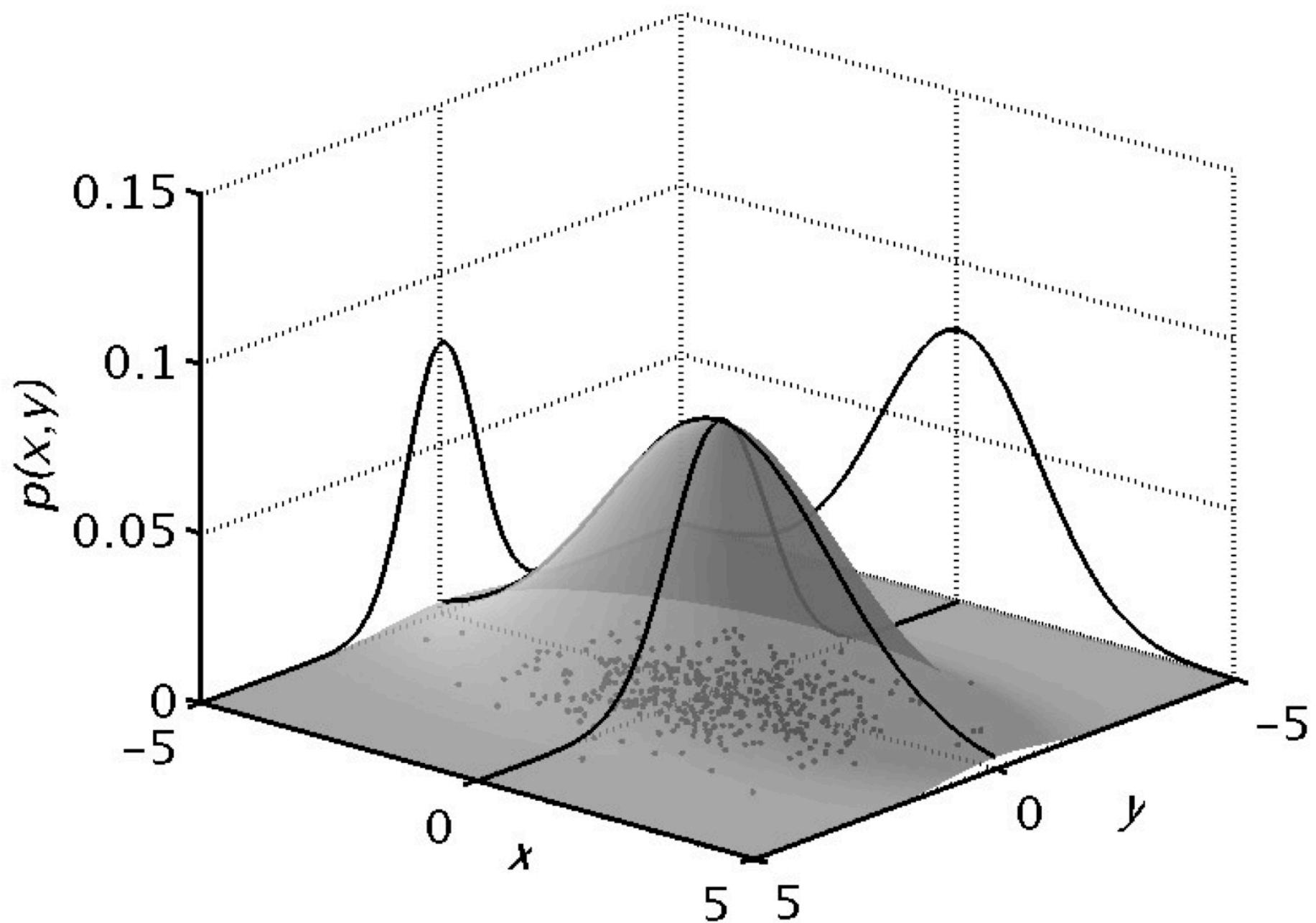


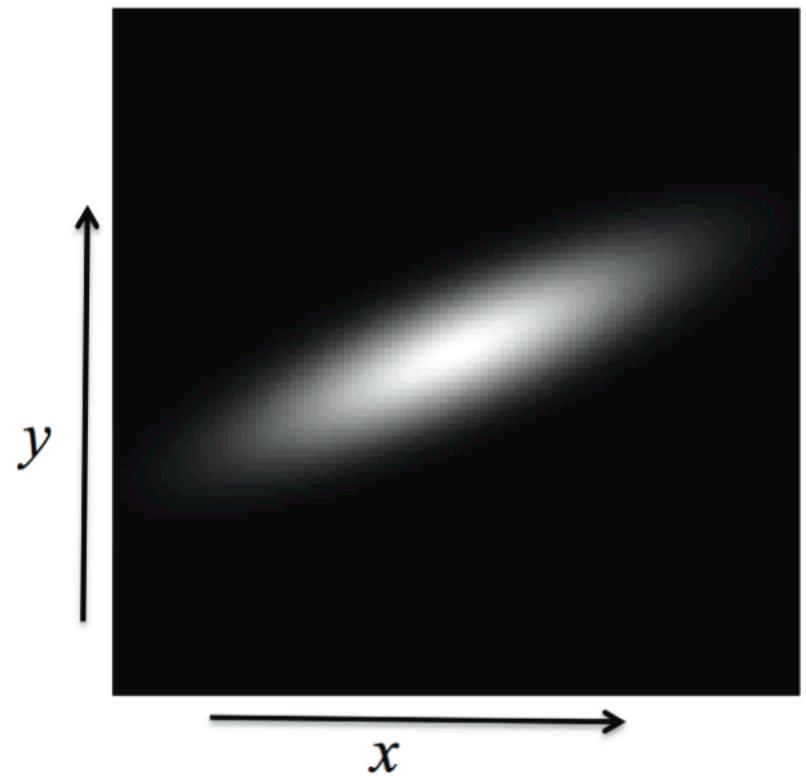


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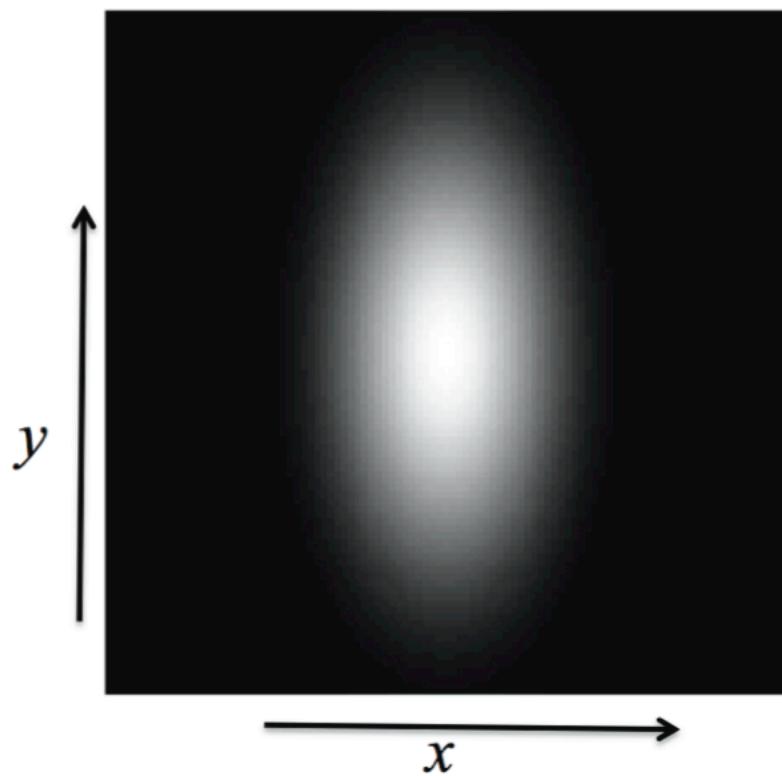




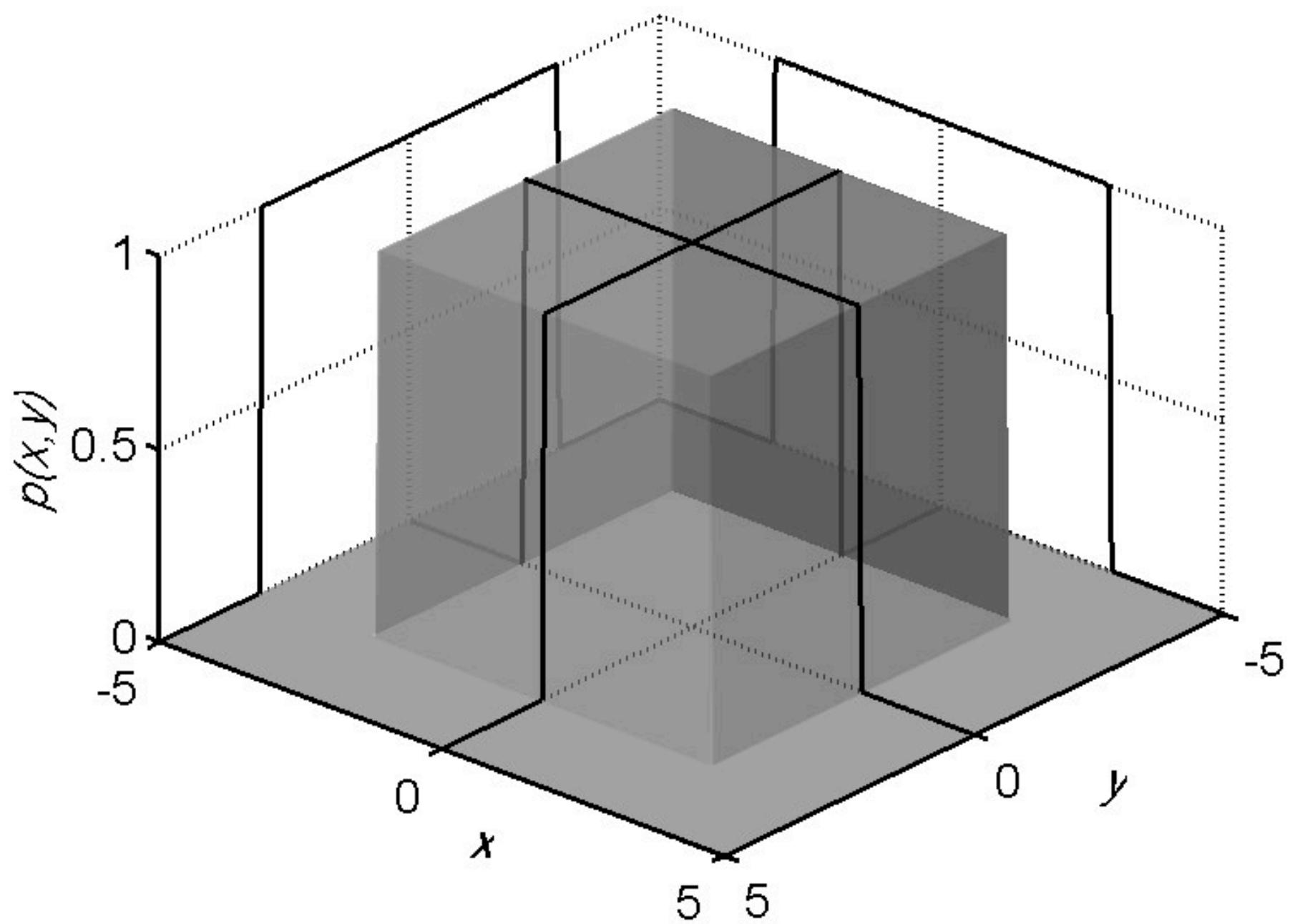


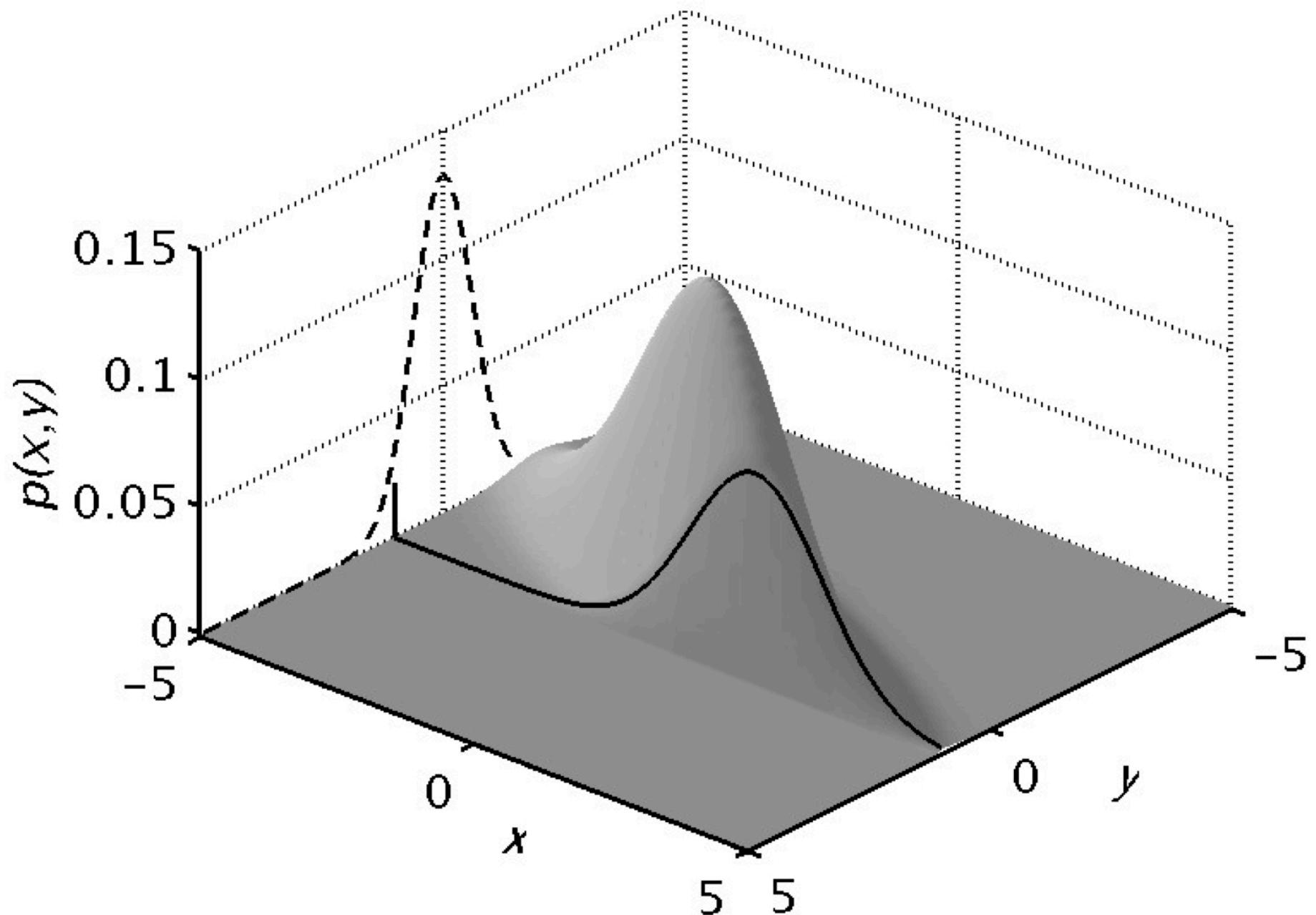


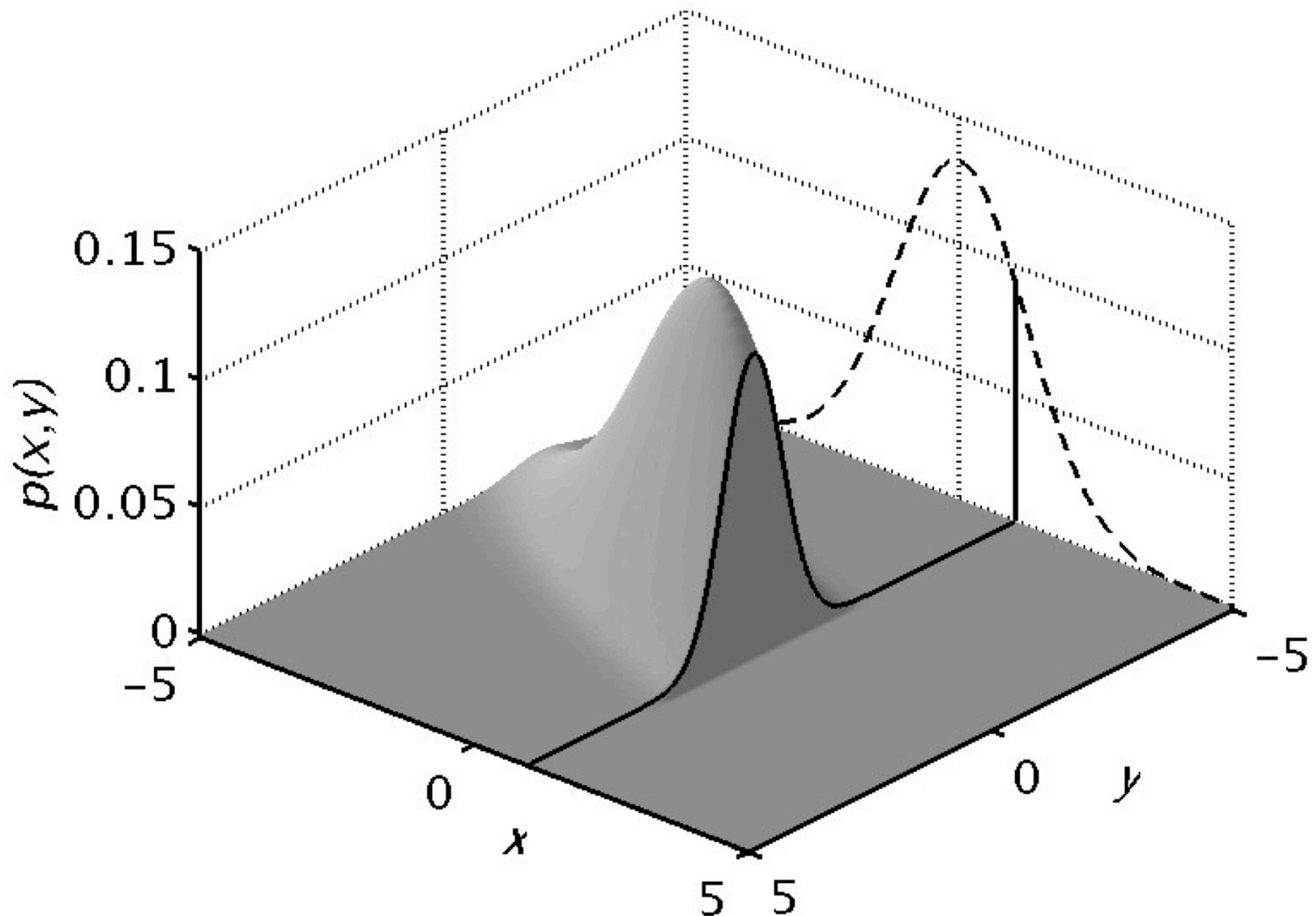
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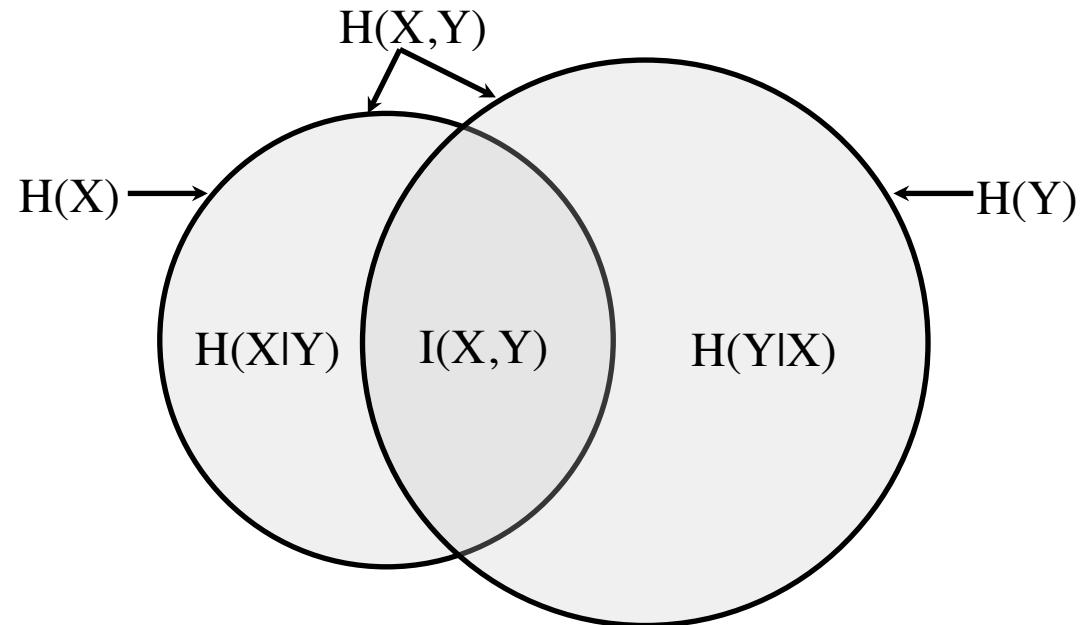


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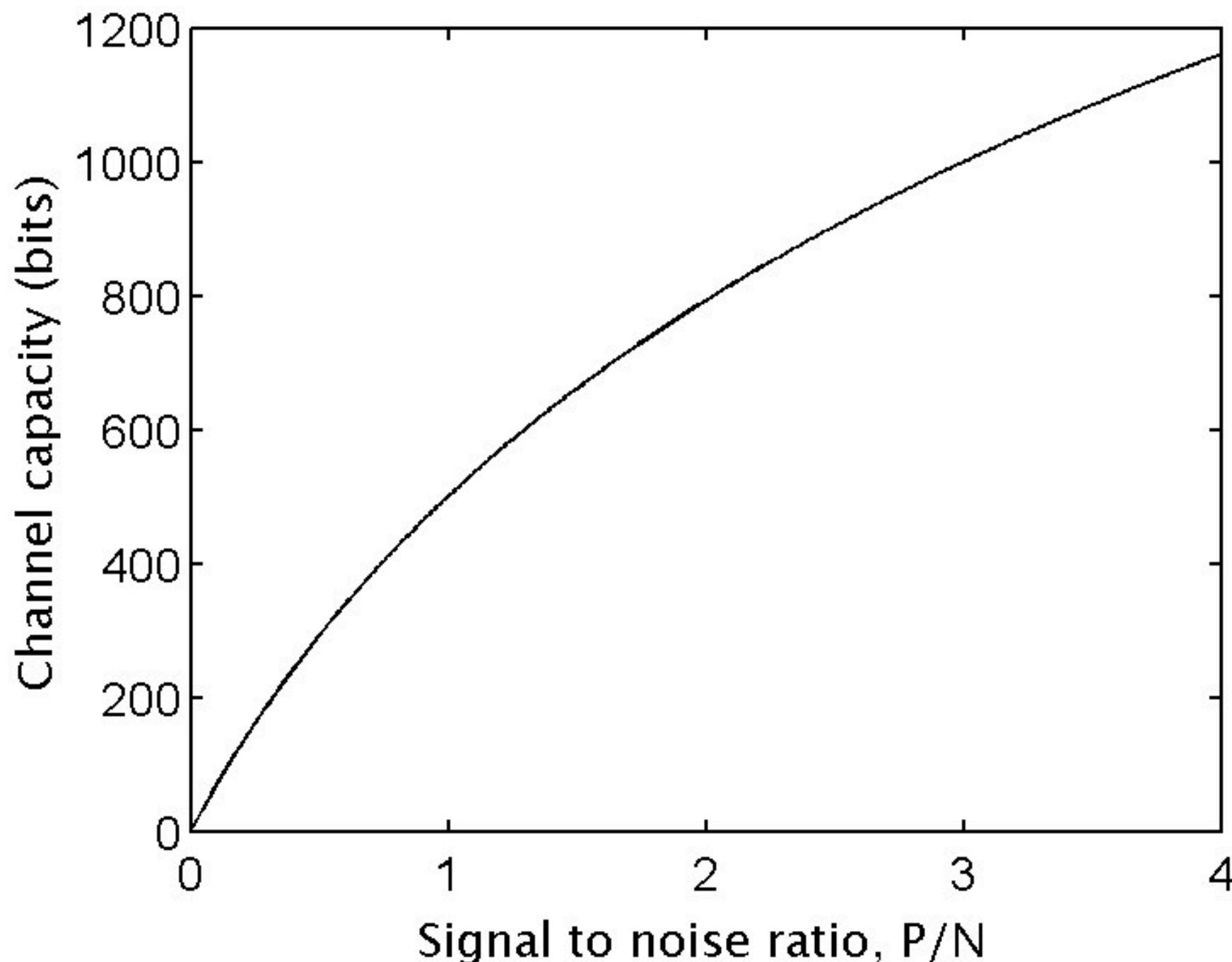


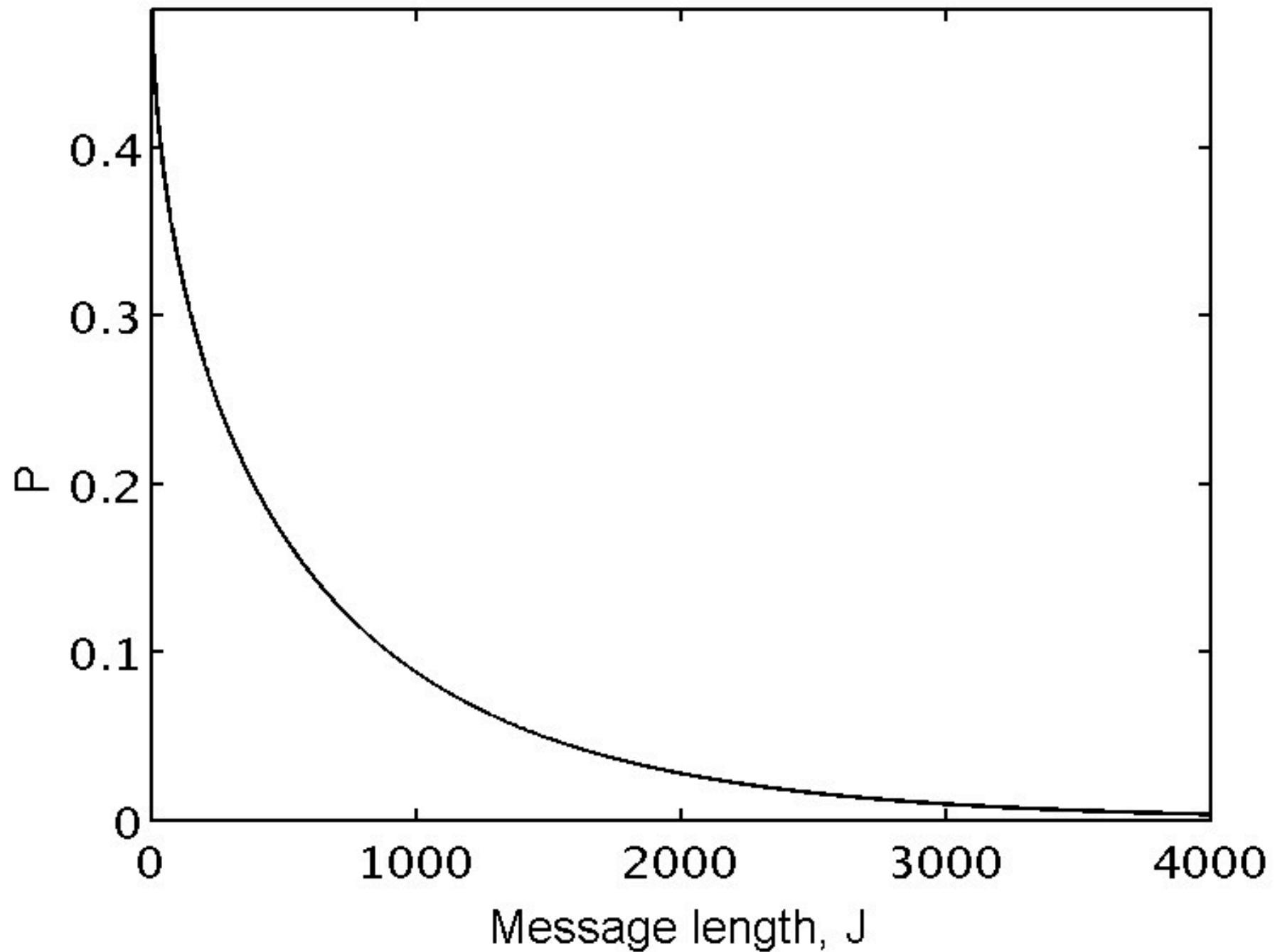


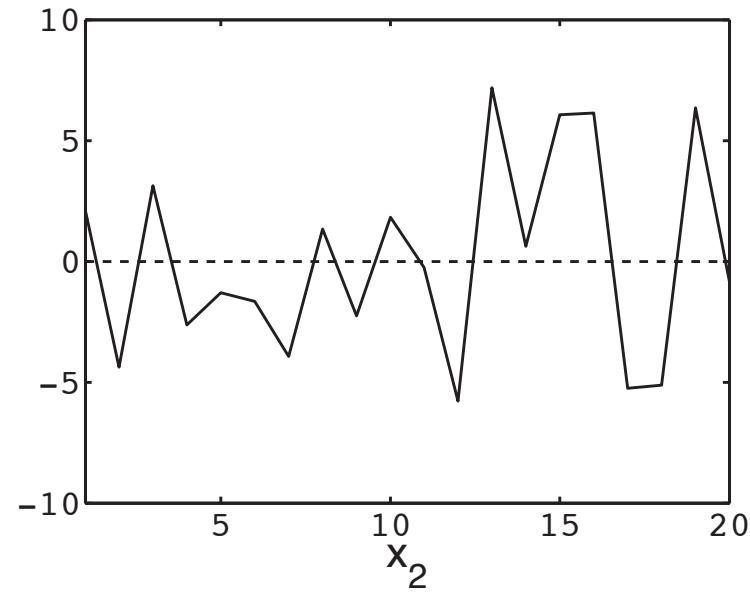
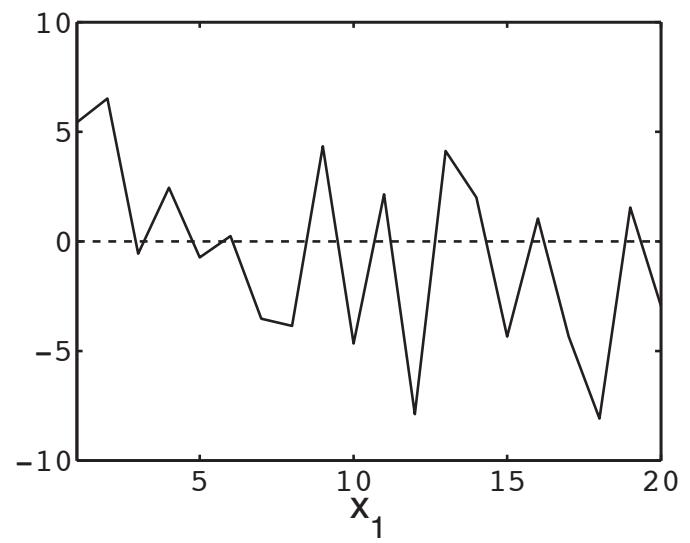


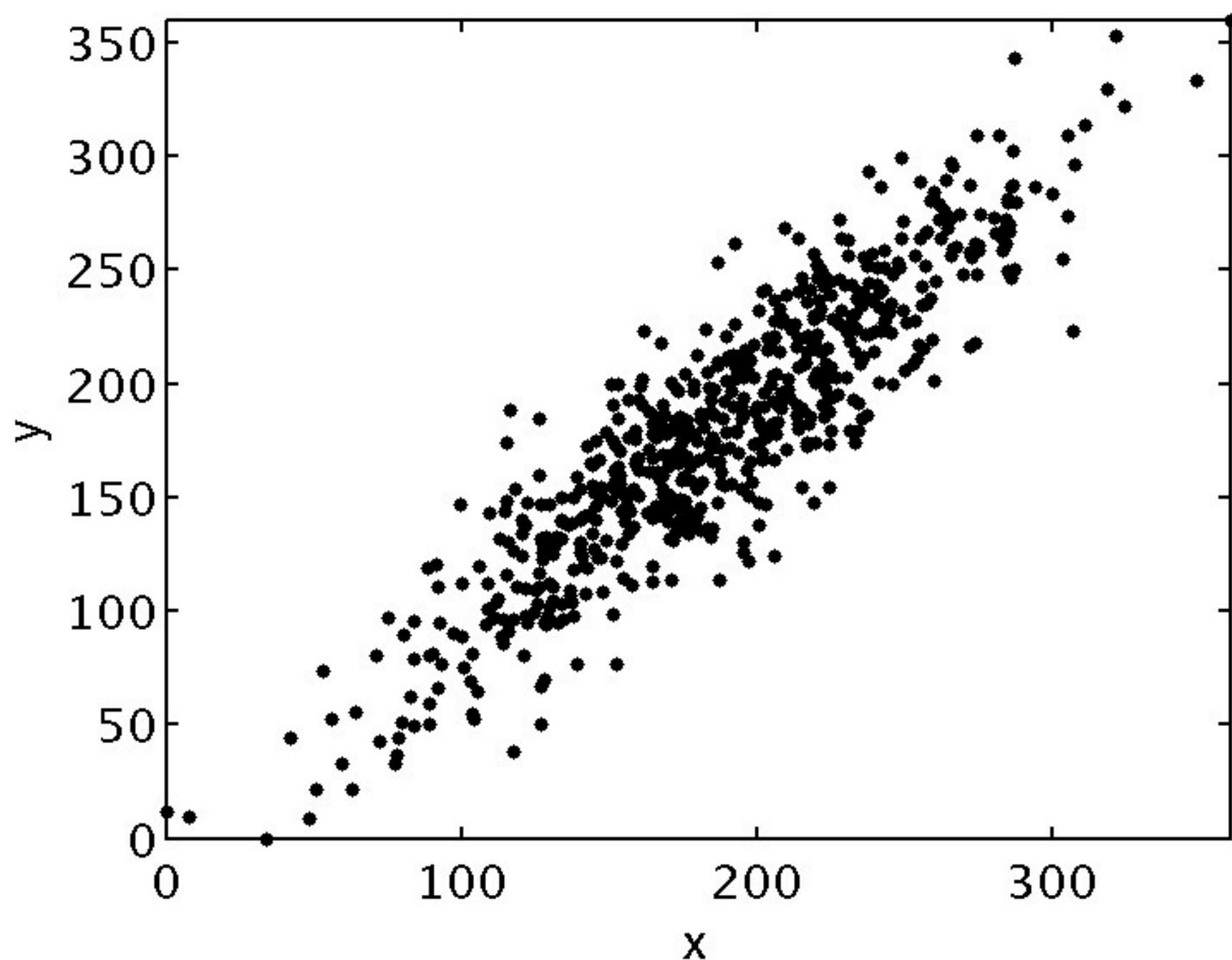


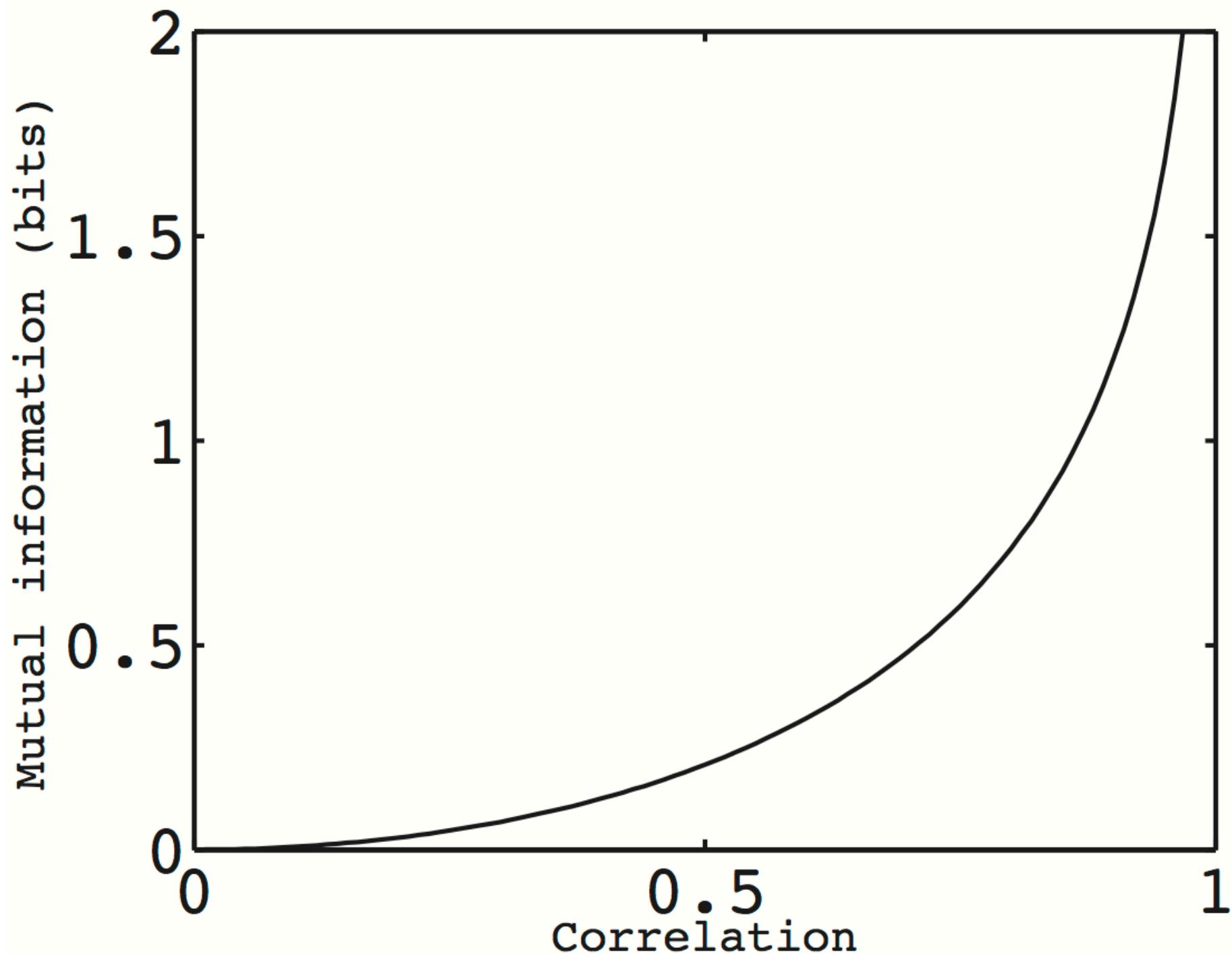
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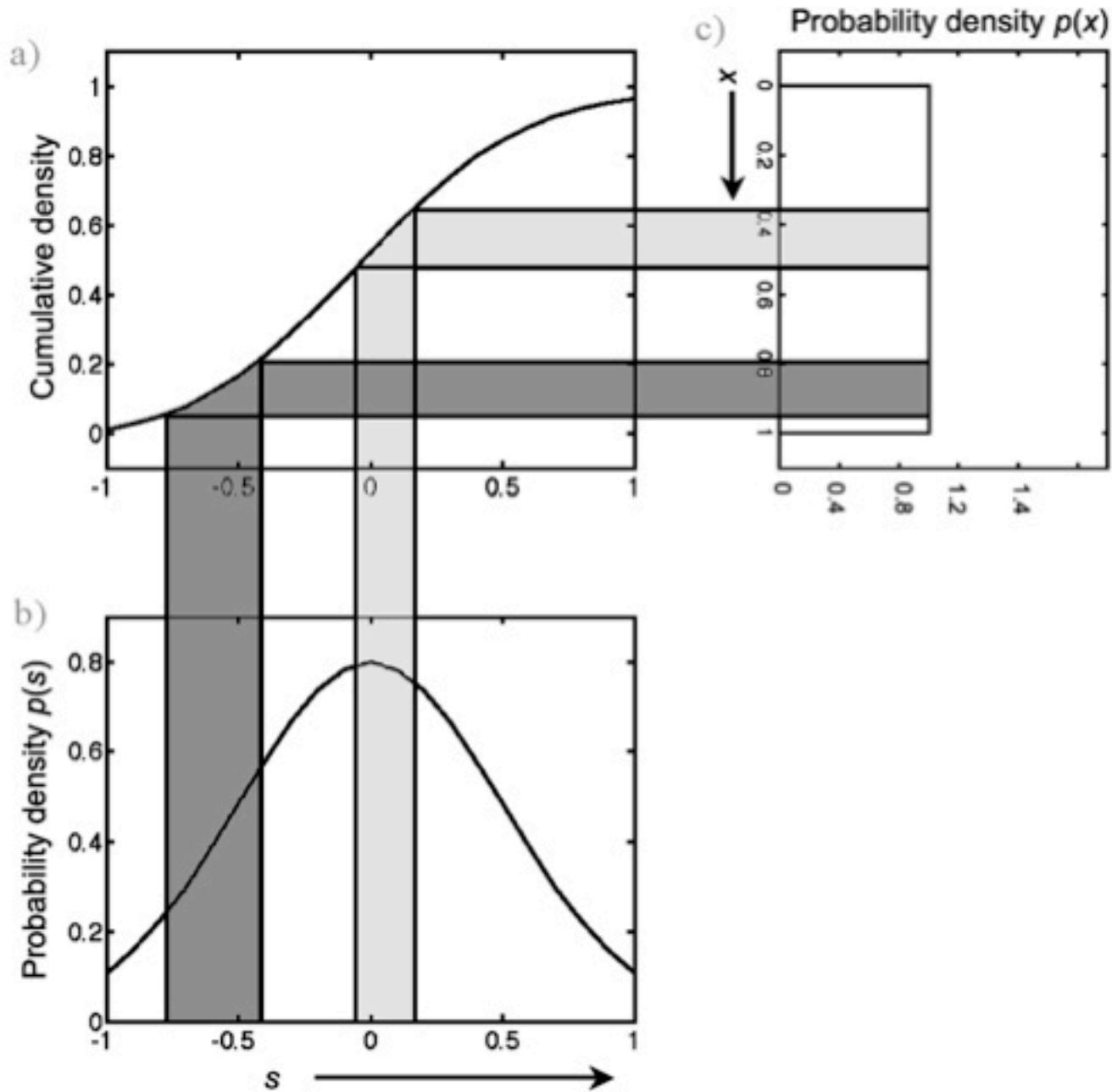




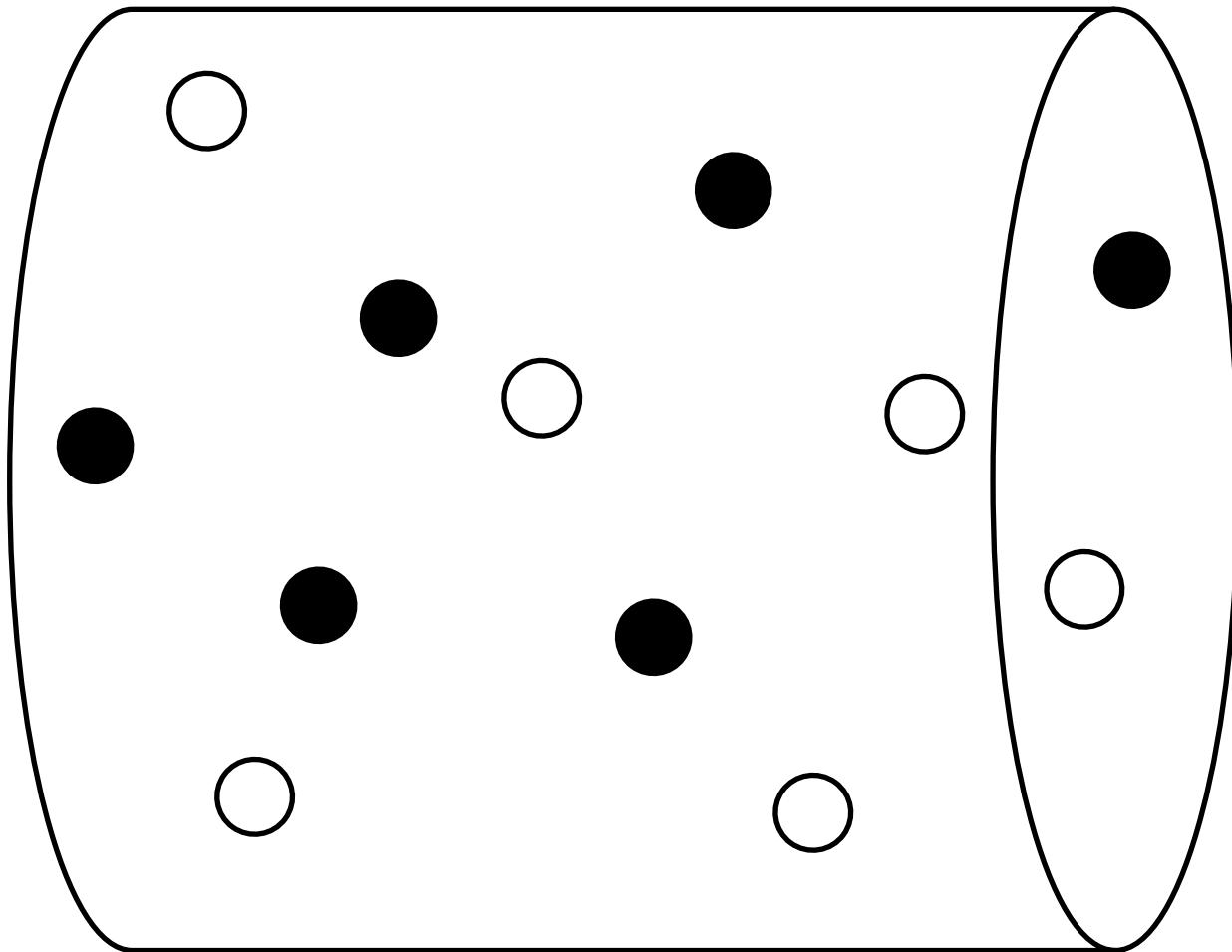


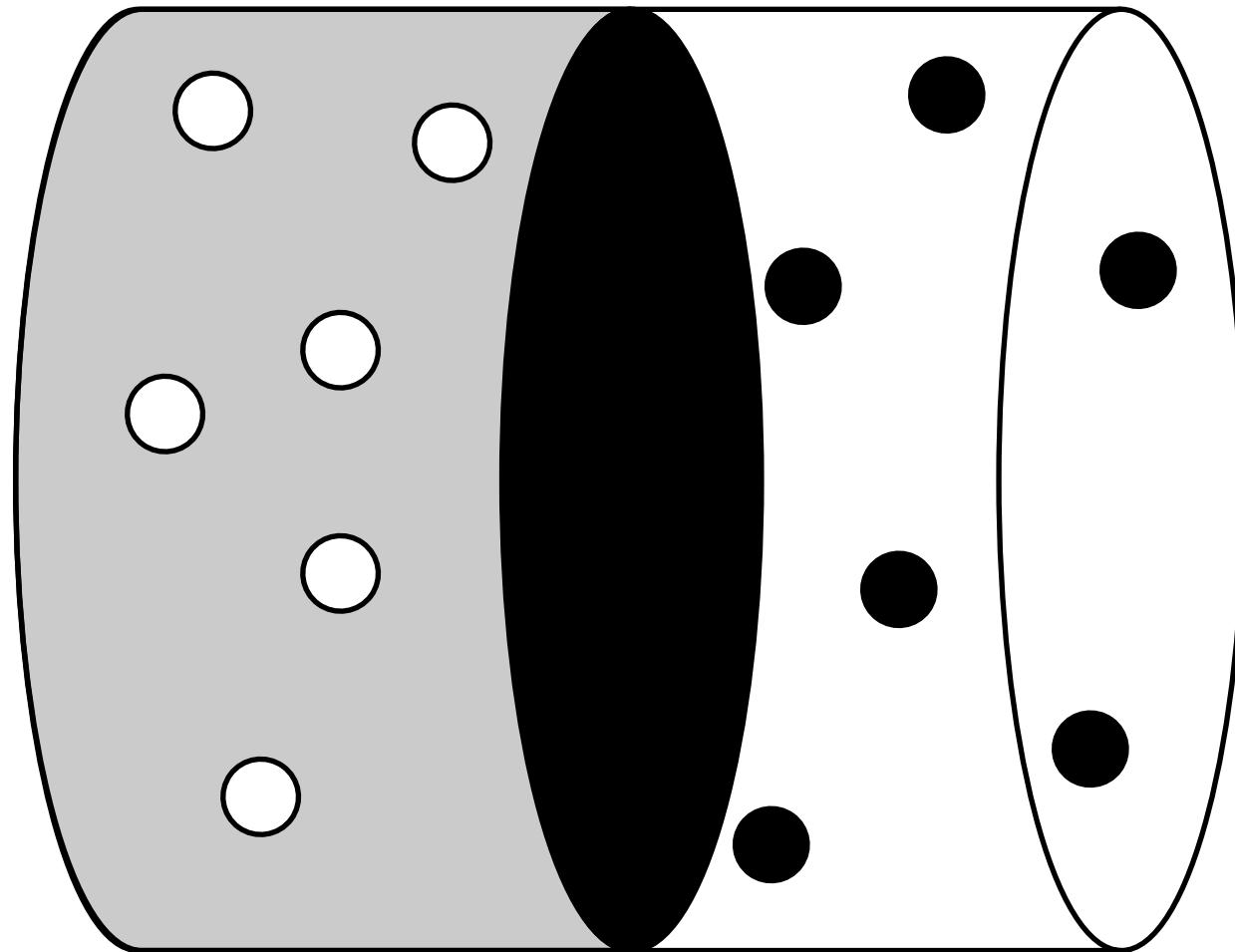


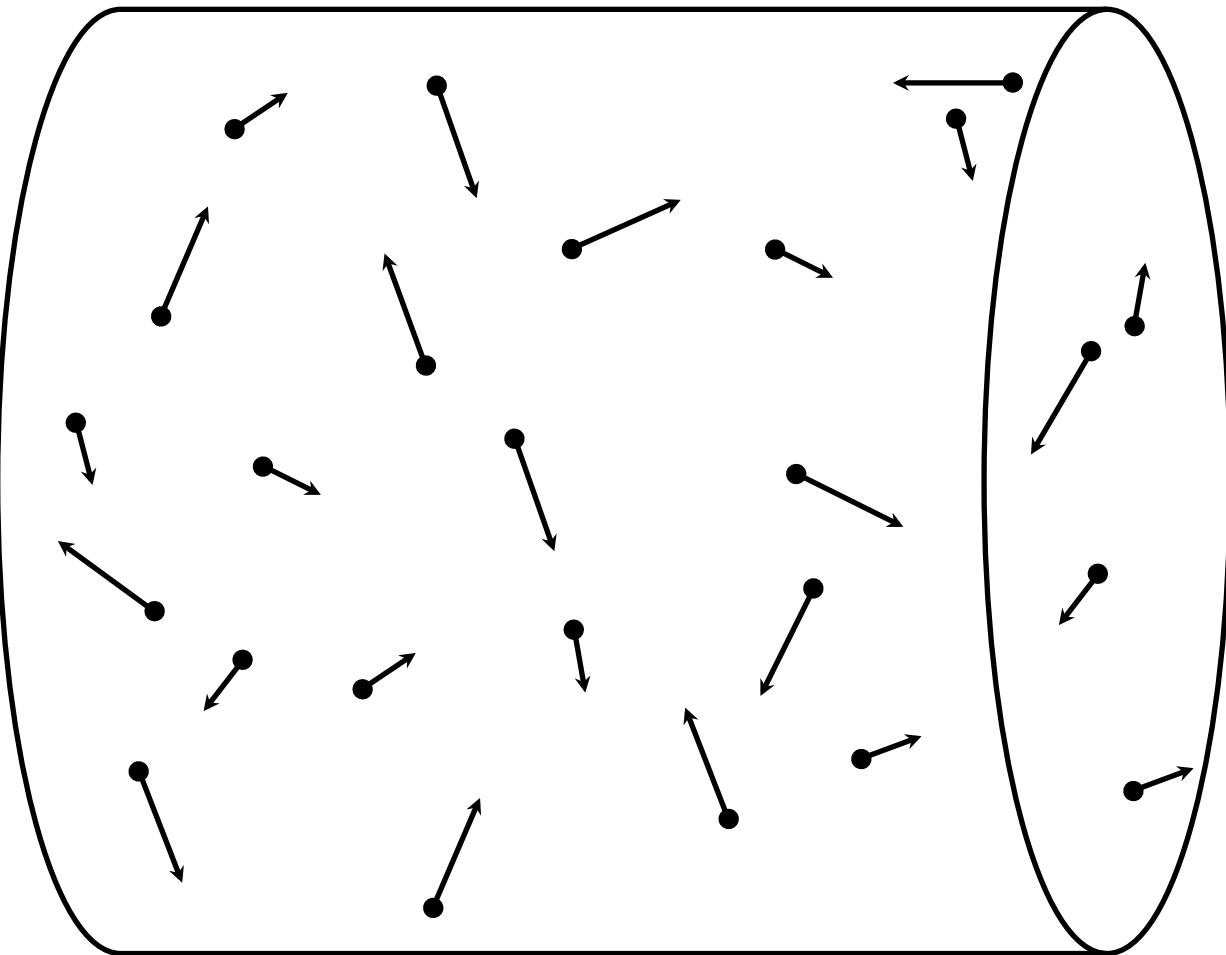


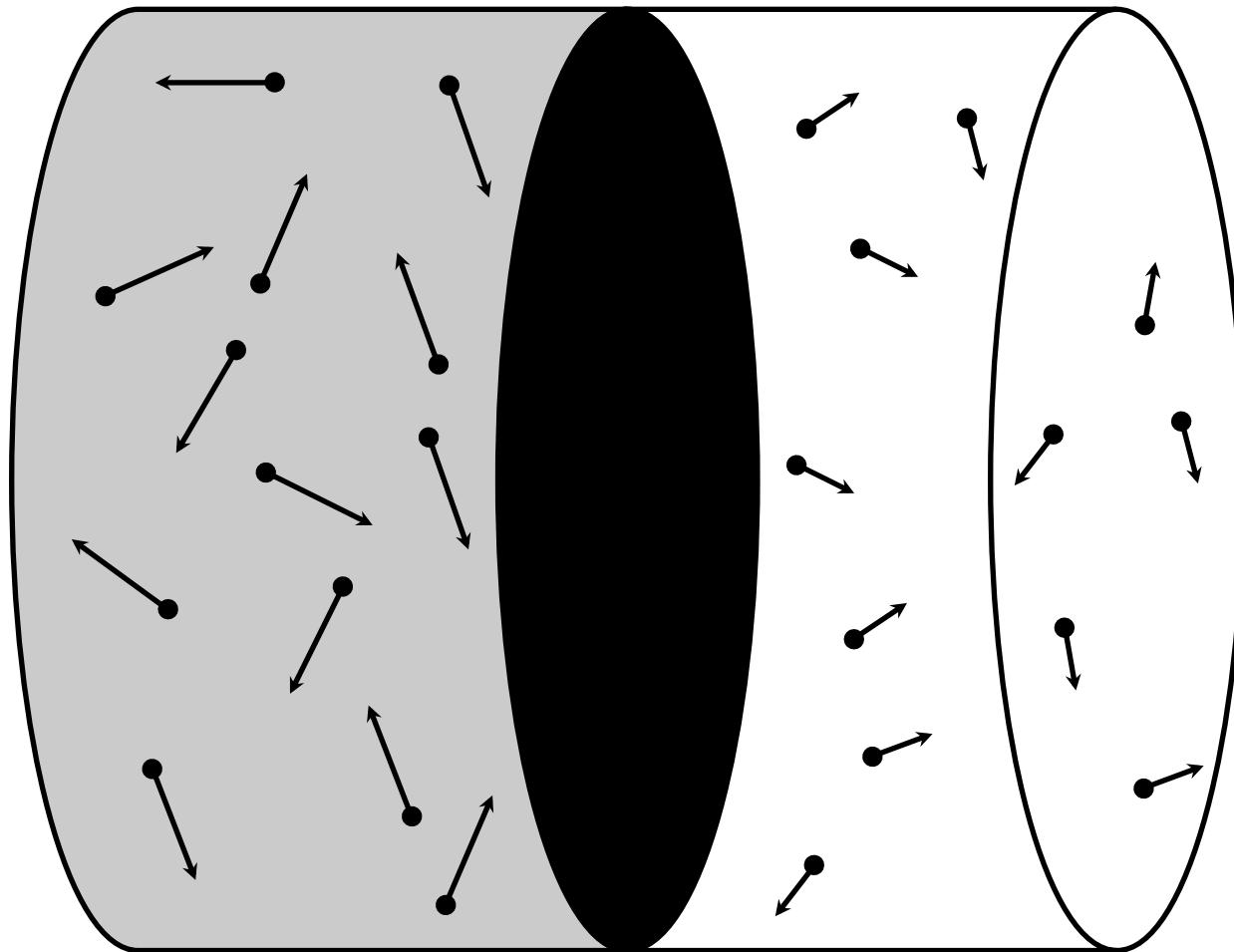


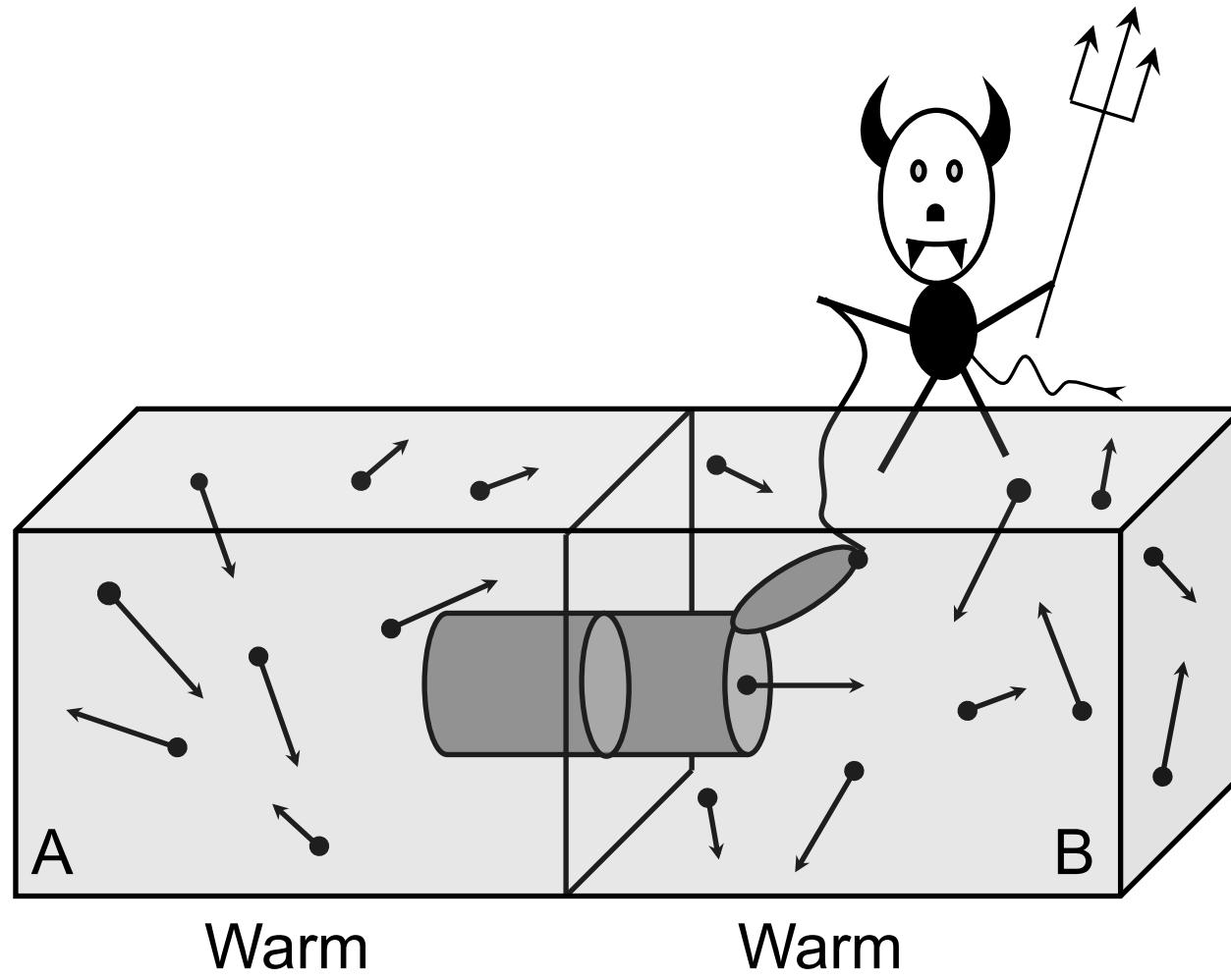
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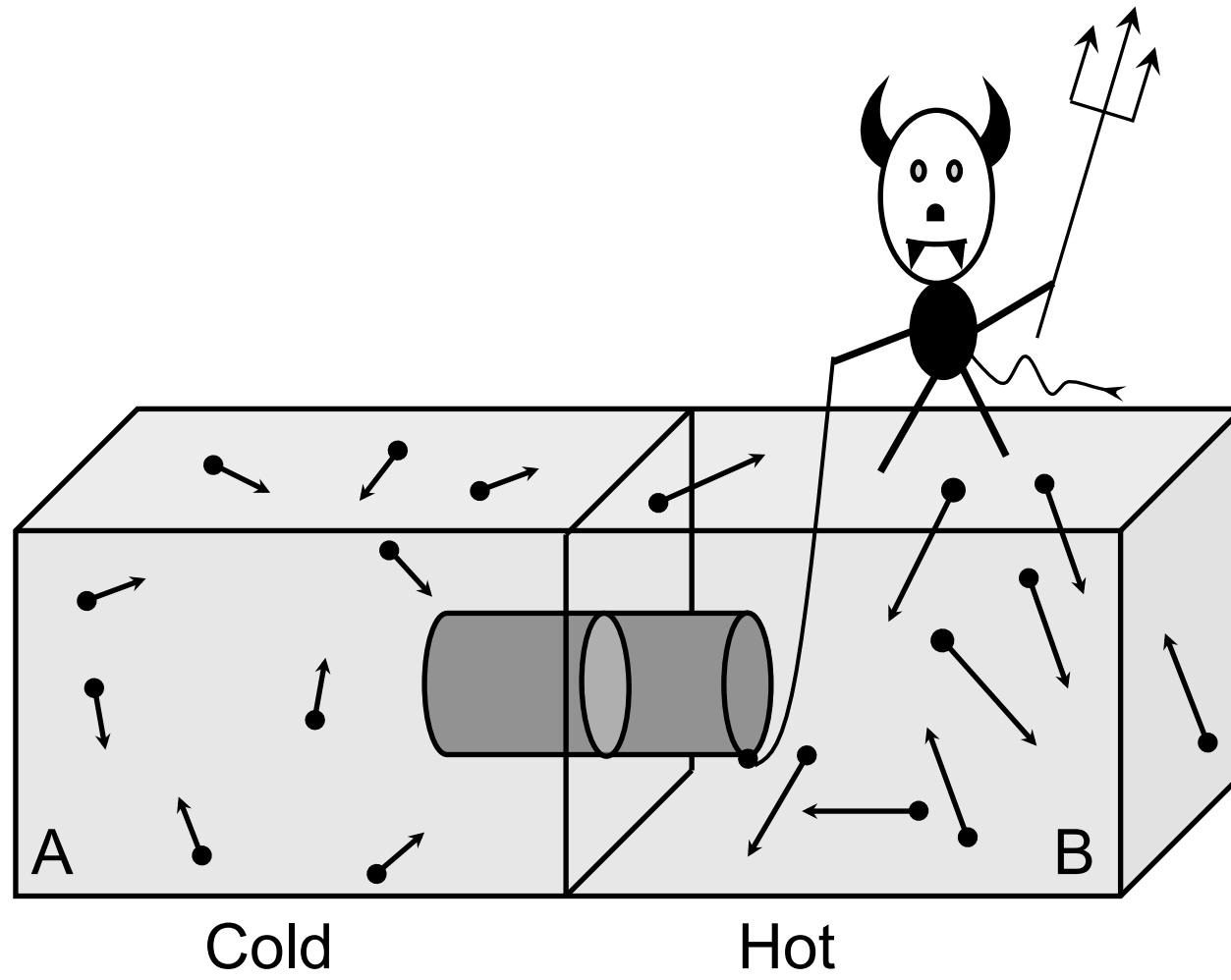




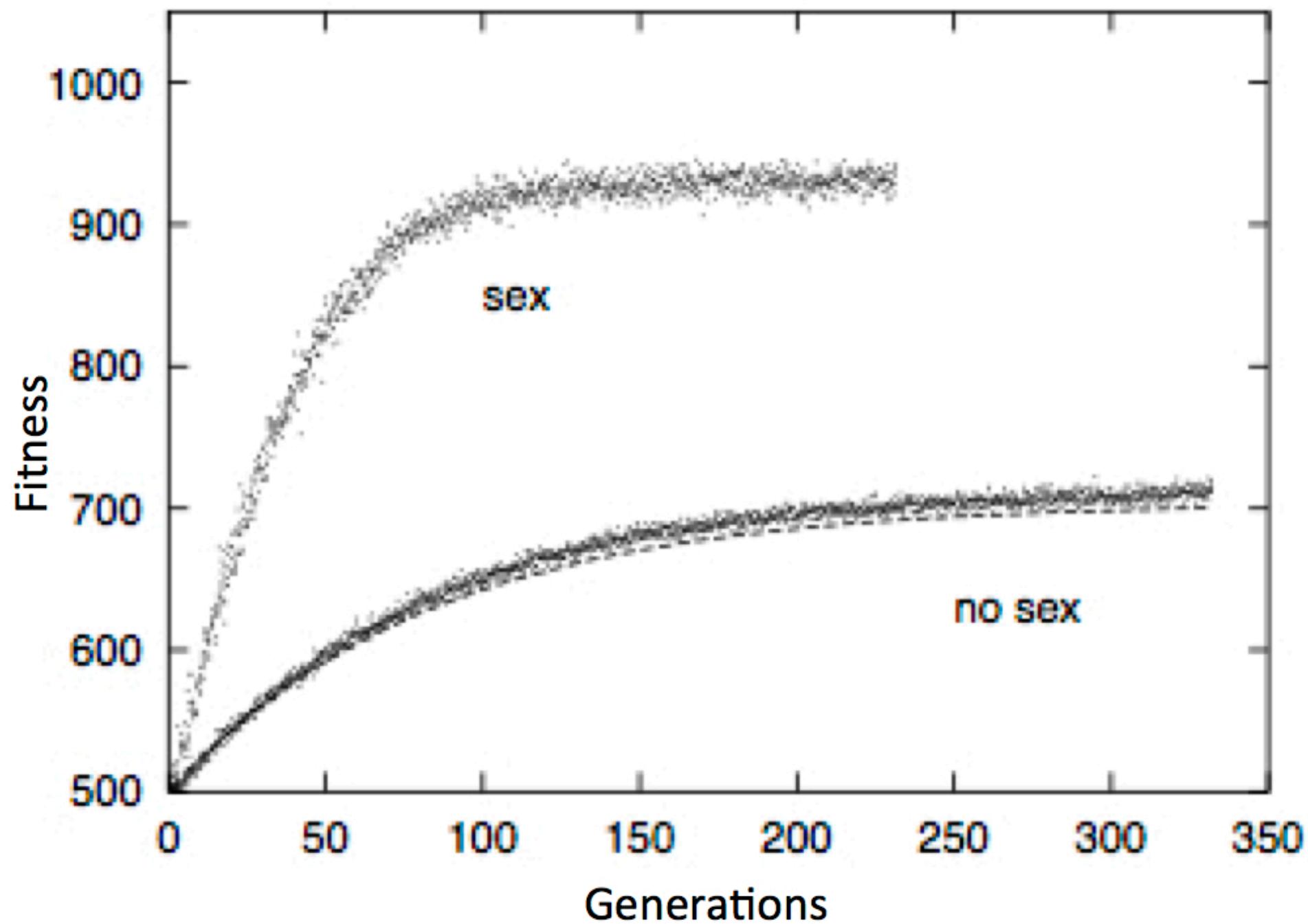


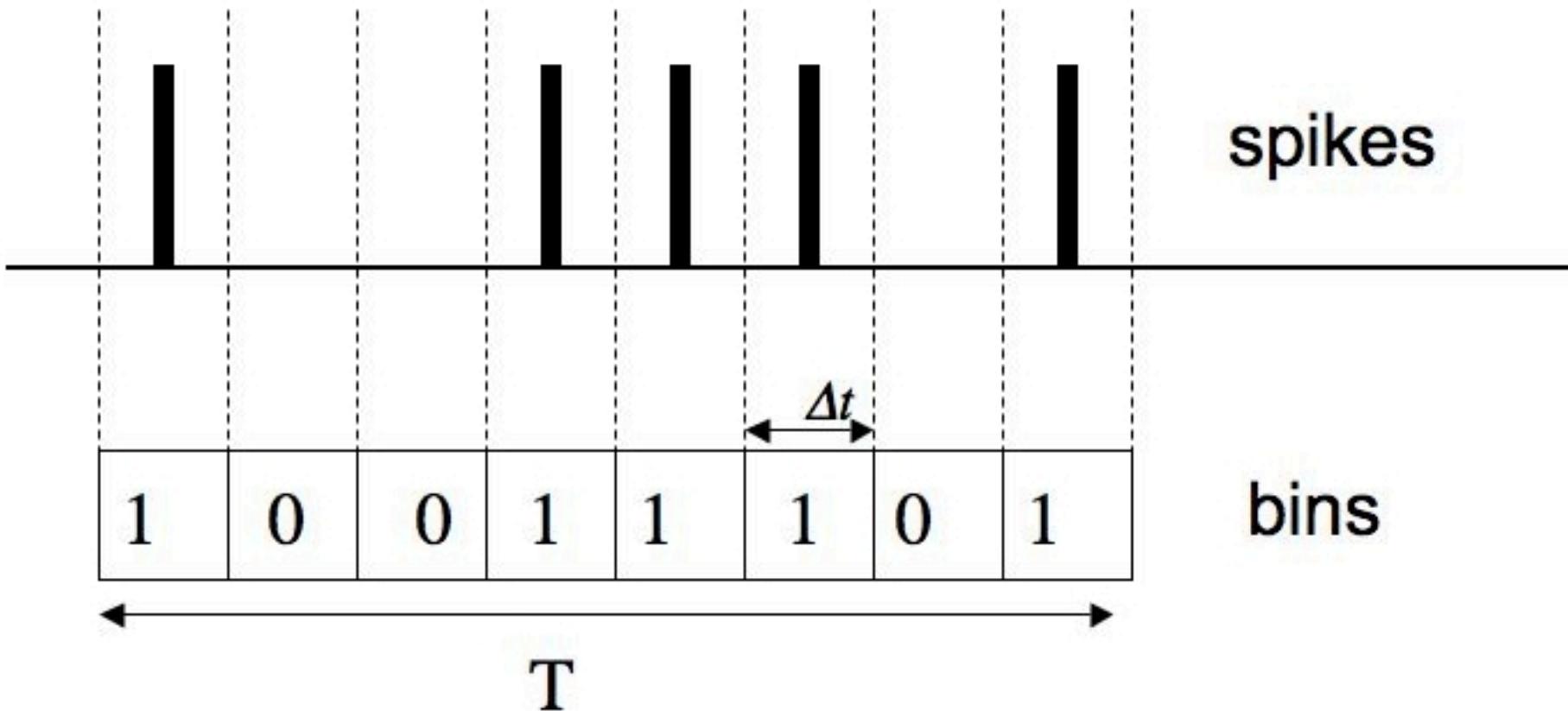


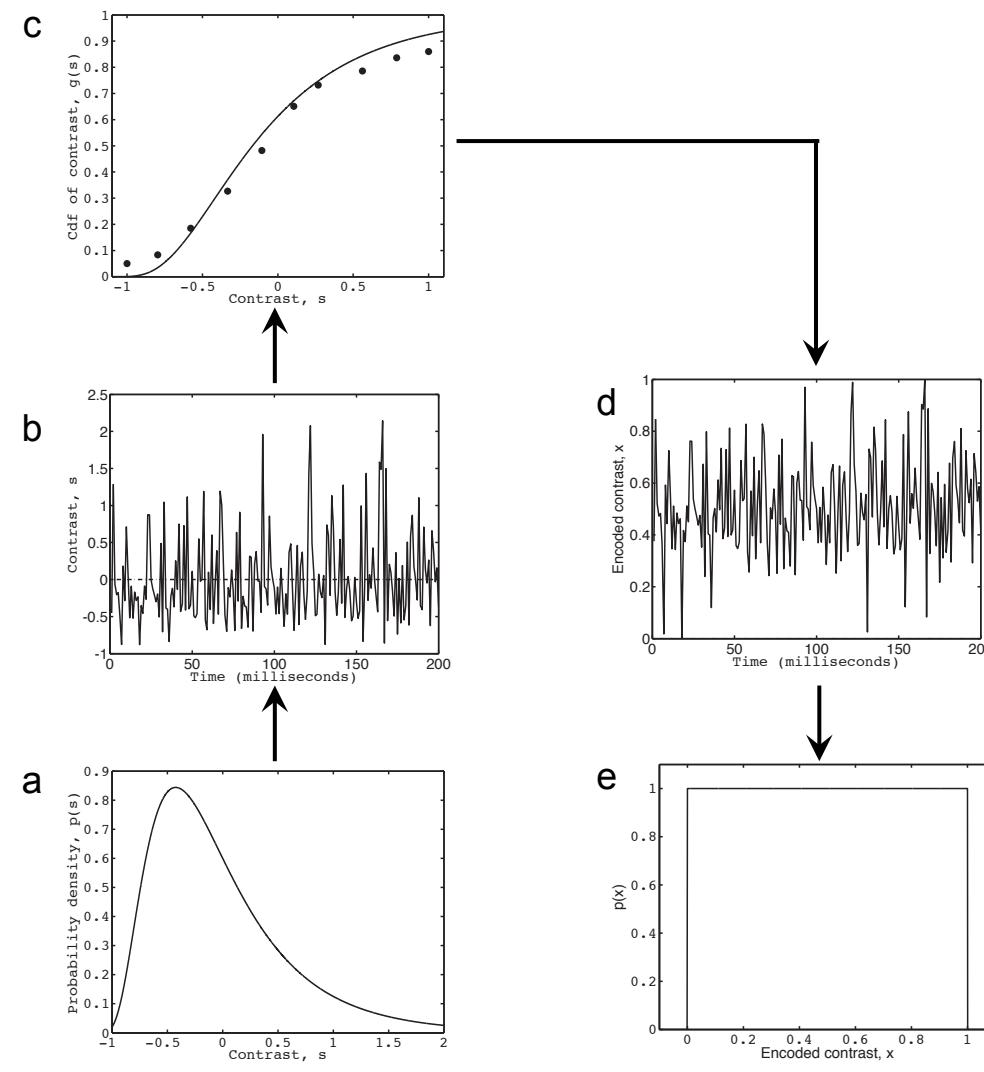


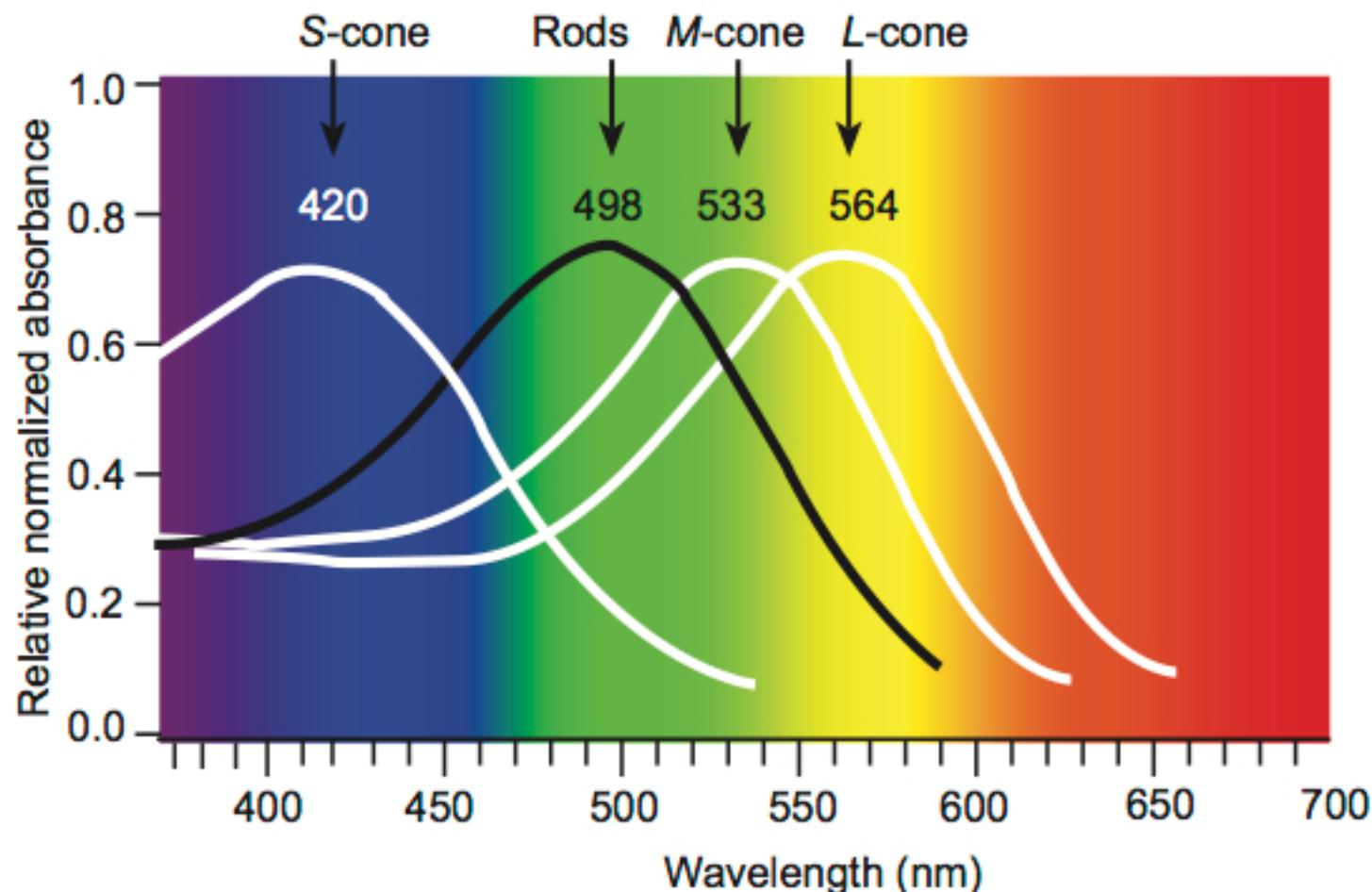


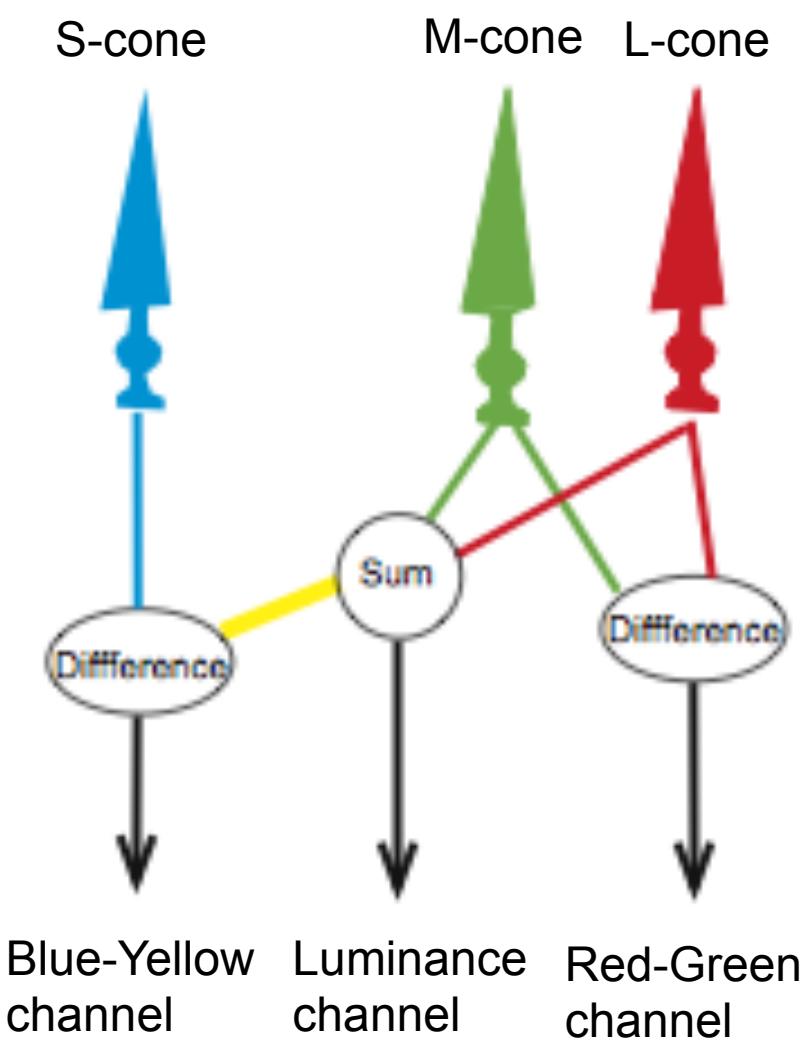
Chapter 9

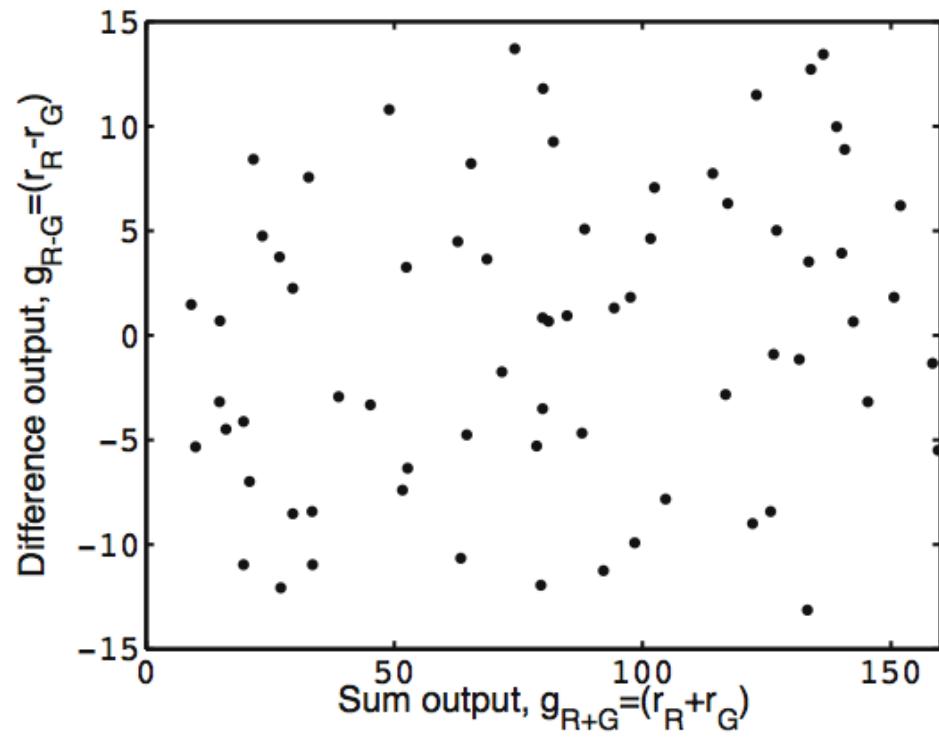
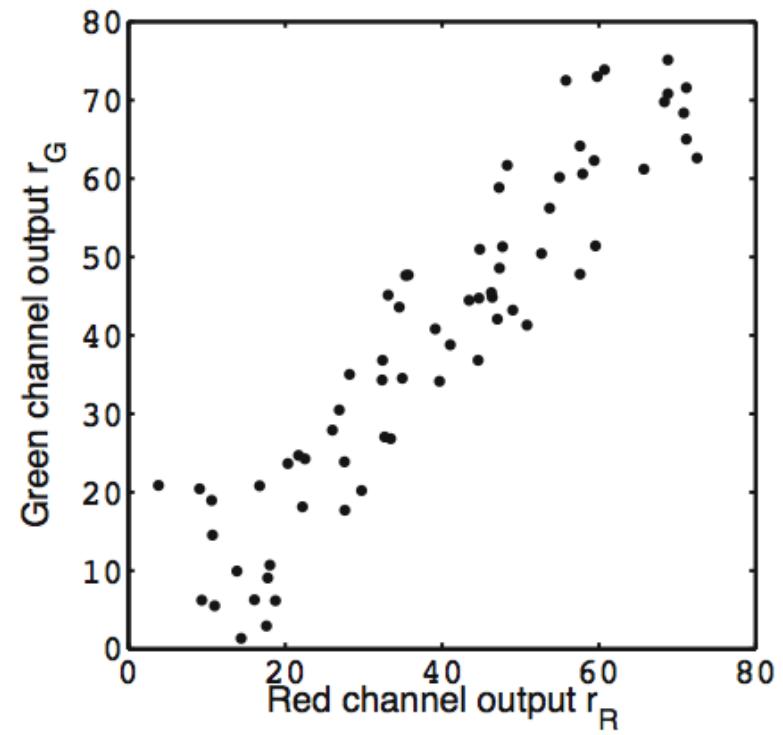












THE END.