

Probability and Random Processes

ECS 315

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6.2 Independence



Office Hours:

BKD 3601-7

Monday 14:00-16:00

Wednesday 14:40-16:00

Sally Clark



[<http://www.sallyclark.org.uk/>]

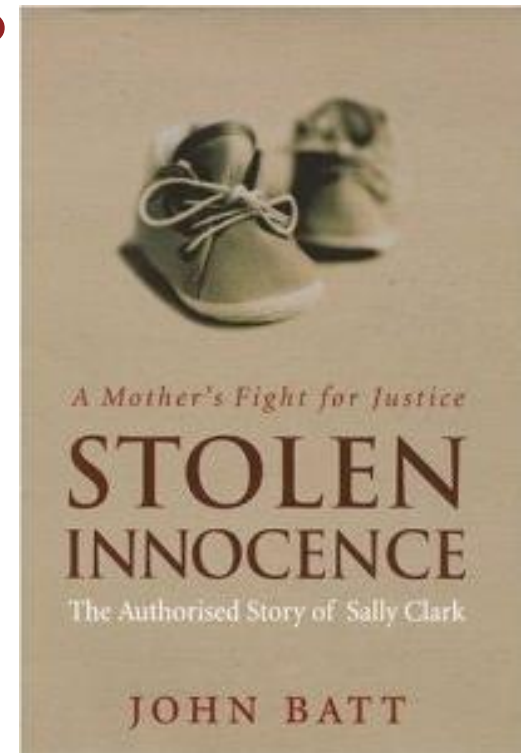
[http://en.wikipedia.org/wiki/Sally_Clark]

[<http://www.timesonline.co.uk/tol/comment/obituaries/article1533755.ece>]



Sally Clark

- Falsely accused of the **murder of her two sons**.
 - Clark's first son died suddenly within a few weeks of his birth in 1996.
 - After her second son died in a similar manner, she was arrested in **1998** and tried for the murder of both sons.
- The case went to appeal, but the convictions and sentences were confirmed in 2000.
- Released in **2003** by Court of Appeal
- Wrongfully imprisoned for more than 3 years
- Never fully recovered from the effects of this appalling miscarriage of justice.



Misuse of statistics in the courts

- Her prosecution was controversial due to **statistical evidence**

- This evidence was presented by a **medical expert** witness

Professor Sir Roy **Meadow**,



$$\left(\frac{1}{8500}\right)^2 \approx 10^{-8}$$

- Meadow testified that the **frequency** of sudden infant death syndrome (SIDS, or “cot death”) in families having some of the characteristics of the defendant’s family is 1 in 8500.
- He went on to **square** this figure to obtain a value of 1 in 73 million for the frequency of two cases of SIDS in such a family.



Royal Statistical Society



- “This approach is, in general, **statistically invalid.**”
- “It would only be valid if SIDS cases arose **independently** within families, an assumption that would need to be justified empirically. “
- “There may well be unknown genetic or environmental factors that predispose families to SIDS, so that **a second case within the family becomes much more likely.**”

[<http://www.rss.org.uk>]



Engineering Ethics: IEEE Code of Ethics

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

1. to accept responsibility in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;
2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. to be honest and realistic in stating claims or estimates based on available data;
4. to reject bribery in all its forms;
5. to improve the understanding of technology; its appropriate application, and potential consequences;
6. to maintain and improve our technical competence and to **undertake technological tasks for others only if qualified by training or experience**, or after full disclosure of pertinent limitations;
7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. to treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or national origin;
9. to avoid injuring others, their property, reputation, or employment by false or malicious action;
10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.



Epilogue

- Clark's release in January 2003 prompted the Attorney General to order a review of hundreds of other cases.
- **Two other** women convicted of murdering their children had their convictions overturned and were released from prison.
- Trupti Patel, who was also accused of murdering her three children, was acquitted in June 2003.
- In each case, Roy Meadow had testified about the unlikelihood of multiple cot deaths in a single family.

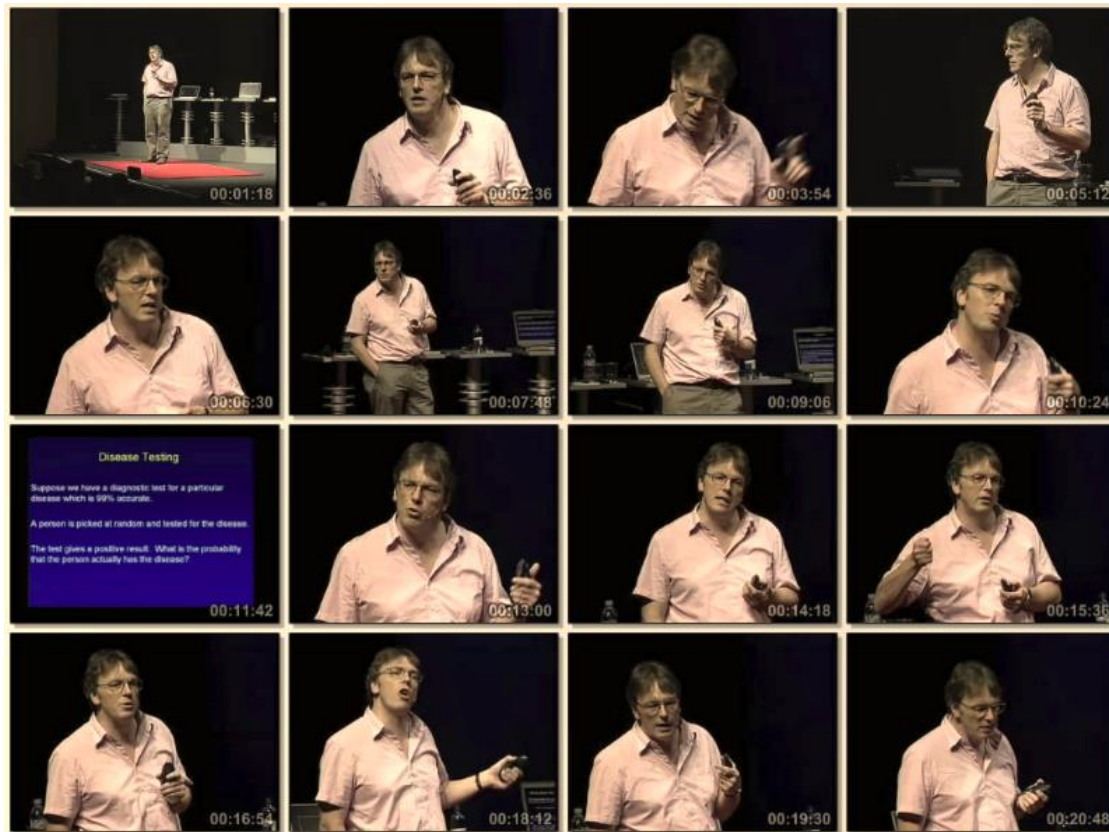


How Juries Are Fooled by Statistics

- By Peter Donnelly

Professor of Statistical
Science (Dept Statistics) at
University of Oxford

@ 11:15-13:50 Disease Testing
@ 13:50-18:30 Sally Clark



Prosecutor's Fallacy

- Aside from its invalidity, figures such as the 1 in 73 million are very easily misinterpreted.
- Some press reports at the time stated that this was the chance that the deaths of Sally Clark's two children were accidental.
- This (mis-)interpretation is a serious error of logic known as the **Prosecutor's Fallacy**.
- The jury needs to weigh up two competing explanations for the babies' deaths: 1) SIDS or 2) murder.
- Two deaths by SIDS or two murders are each quite unlikely, but one has apparently happened in this case.
- What matters is the relative likelihood of the deaths under each explanation, not just how unlikely they are under one explanation (in this case SIDS, according to the evidence as presented).



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6.3 Bernoulli Trials



Office Hours:

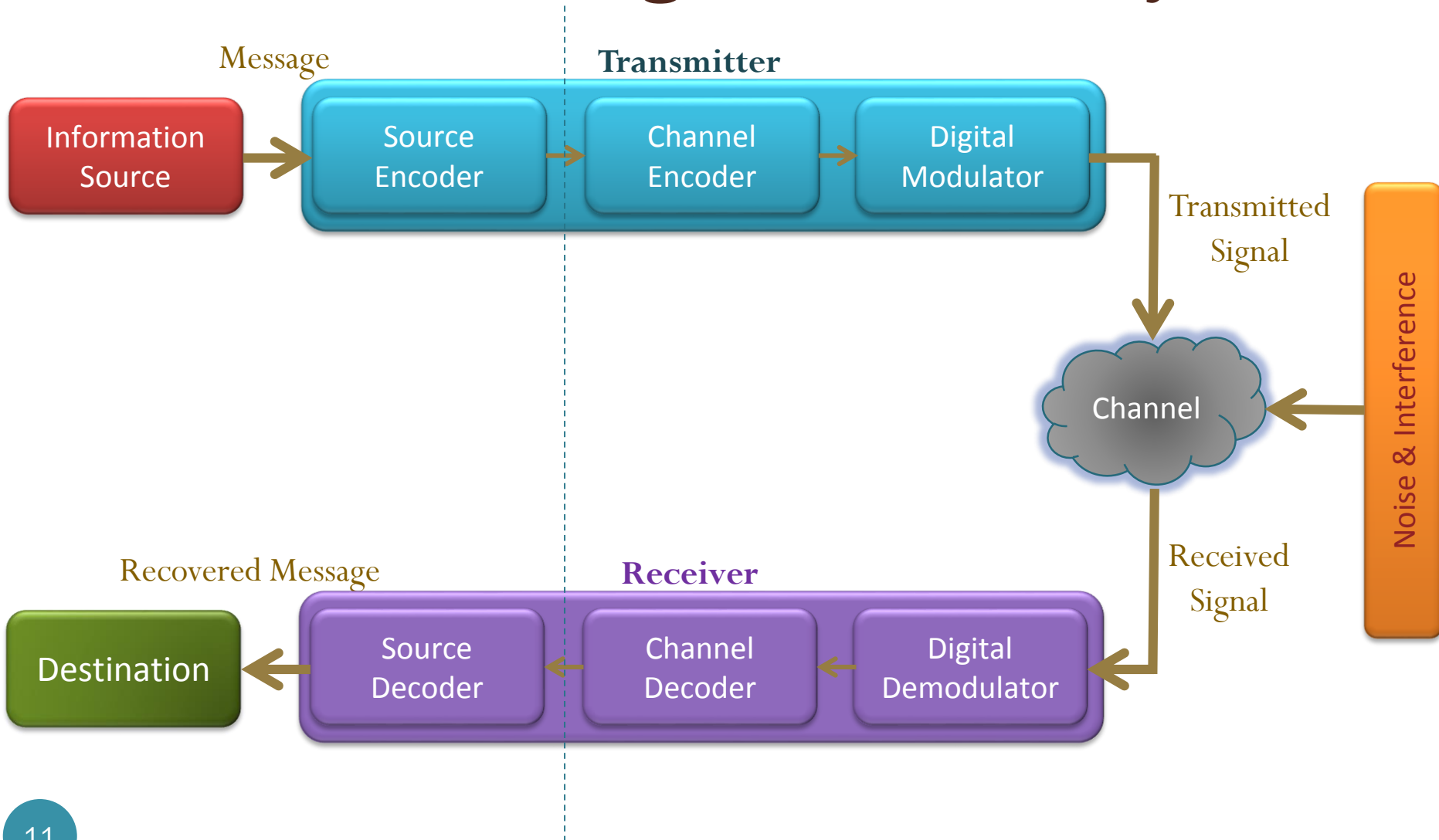
Rangsit Library:

Tuesday 16:20-17:20

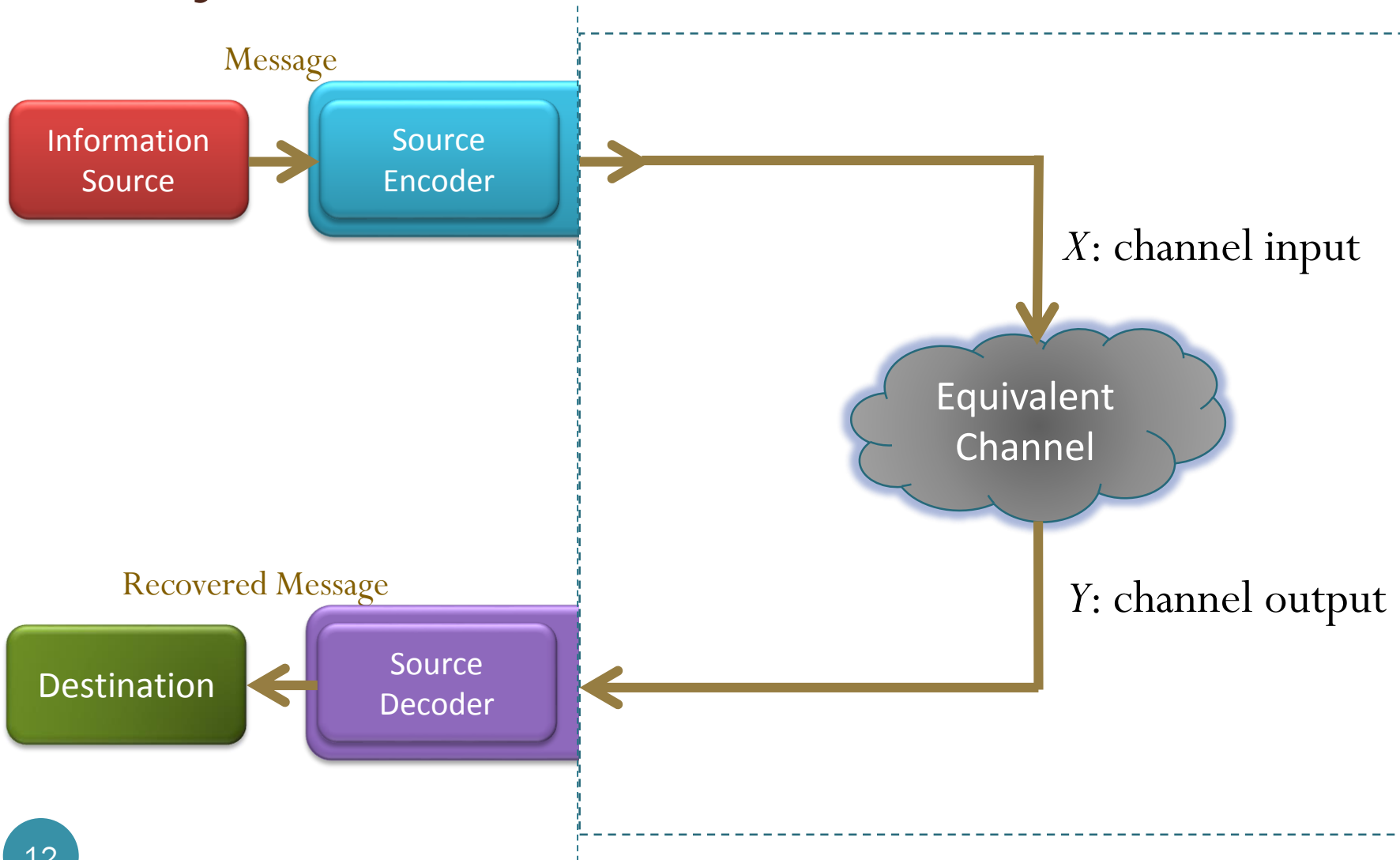
BKD3601-7:

Thursday 16:00-17:00

Elements of digital commu. sys.



System considered



The ASCII Coded Character Set

					6	0	0	0	0	1	1	1	1
					5	0	0	1	1	0	0	1	1
					4	0	1	0	1	0	1	0	1
					1st	0	1	2	3	4	5	6	7
				Hex									
3	2	1	0	2nd									
0	0	0	0	0									
0	0	0	1	1									
0	0	1	0	2									
0	0	1	1	3									
0	1	0	0	4									
0	1	0	1	5									
0	1	1	0	6									
0	1	1	1	7									
1	0	0	0	8									
1	0	0	1	9									
1	0	1	0	A									
1	0	1	1	B									
1	1	0	0	C									
1	1	0	1	D									
1	1	1	0	E									
1	1	1	1	F									

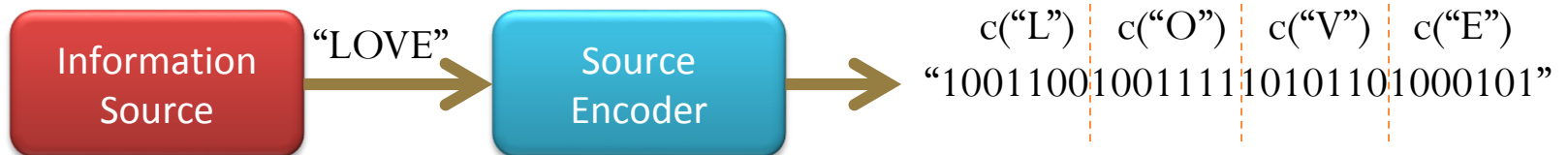
0	16	32	48	64	80	96	112
NUL	DLE	SP	0	@	P	p	
SOH	DC1	!	1	A	Q	a	q
STX	DC2	"	2	B	R	b	r
ETX	DC3	#	3	C	S	c	s
EOT	DC4	\$	4	D	T	d	t
ENQ	NAK	%	5	E	U	e	u
ACK	SYN	&	6	F	V	f	v
BEL	ETB	'	7	G	W	g	w
BS	CAN	(	8	H	X	h	x
HT	EM	)	9	I	Y	i	y
LF	SUB	*	:	J	Z	j	z
VT	ESC	+	;	K	[	k	{
FF	FS	,	<	L	\	l	|
CR	GS	-	=	M	]	m	}
SO	RS	.	>	N	^	n	~
SI	US	/	?	O	_	o	DEL

Example: ASCII Encoder

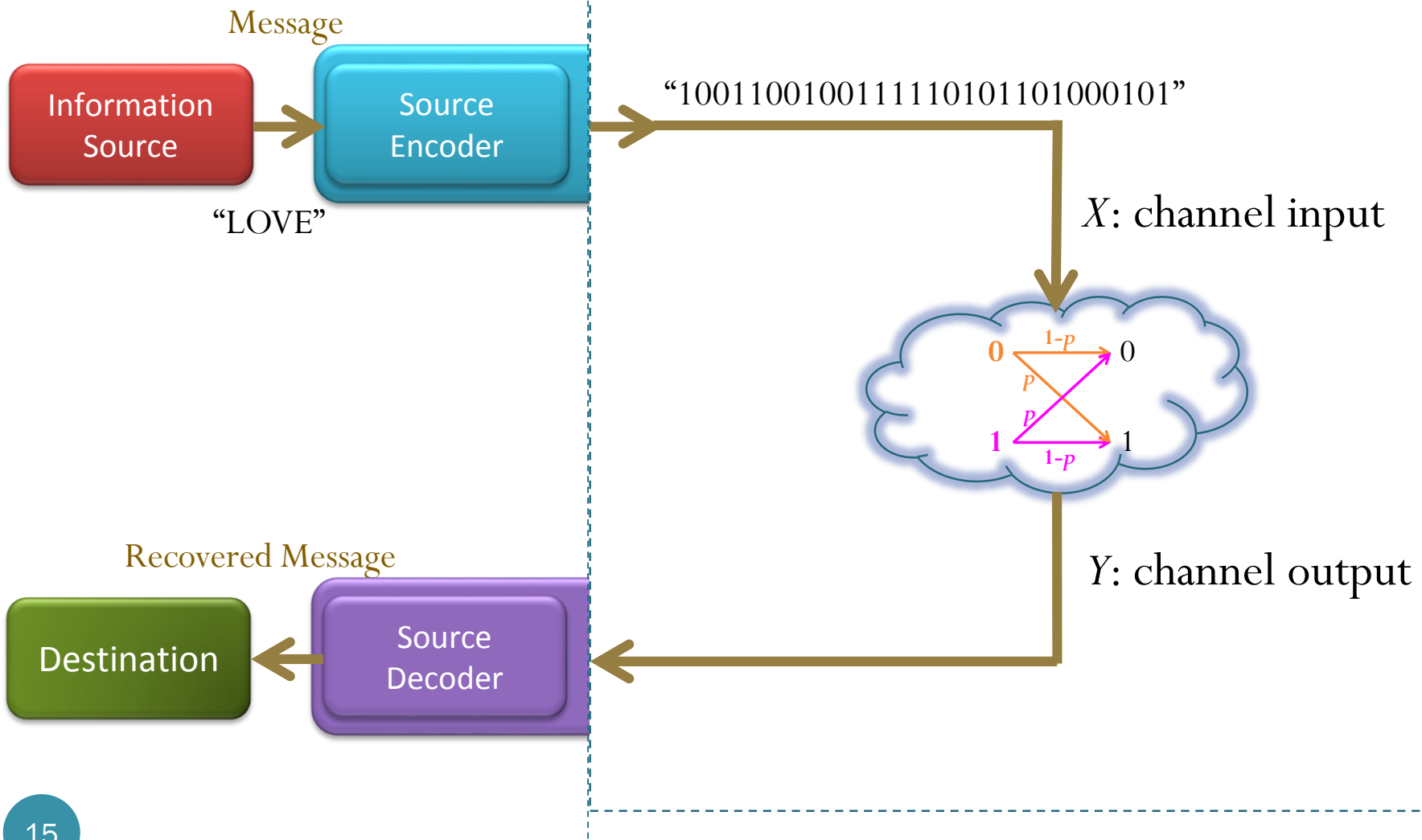
Character	Codeword
:	
E	1000101
:	
L	1001100
:	
O	1001111
:	
V	1010110
:	

MATLAB:

```
>> M = 'LOVE';  
>> X = dec2bin(M, 7);  
>> X = reshape(X', 1, numel(X))  
X =  
1001100100111110101101000101
```



Example: ASCII Encoder and BSC



Results

THE WIZARD OF OZ (1900)
written by L. Frank Baum

Introduction

Folklore, legends, myths and fairy tales have followed childhood through the ages, for every healthy youngster has a wholesome and instinctive love for stories fantastic, marvelous and manifestly unreal. The winged fairies of Grimm and Andersen have brought more happiness to childish hearts than all other human creations. Yet the old time fairy tale, having served for generations, may

THE WIZARD _F OZ (19009 written by L. Frank0Baum

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- The whole book which is saved in the file “OZ.txt” has 207760 characters (symbols).
- The ASCII encoded string has $207760 \times 7 = 1454320$ bits.
- The channel corrupts 14545 bits.
- This corresponds to 14108 erroneous characters (symbols).

Results

```
>> ErrorProbabilityoverBSC
biterror =
    14545
BER =
    0.010001237691842
theoretical_BER =
    0.010000000000000
symerror =
    14108
SER =
    0.067905275317674
theoretical_SER =
    0.067934652093010
```

$$\frac{14545}{1454320} \approx 0.01 \quad \leftarrow$$

$$\frac{14108}{207760} \approx 0.0679 \quad \leftarrow$$

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Results

$$\frac{14545}{1454320} \approx 0.01$$

$p = 0.01$

$$\frac{14108}{207760} \approx 0.0679$$

$$1 - (1 - p)^7$$

- The file “OZ.txt” has 207760 characters (symbols).
- The ASCII encoded string has $207760 \times 7 = 1454320$ bits.
- The channel corrupts 14545 bits.
- This corresponds to 14108 erroneous characters (symbols).

A character (symbol) is successfully recovered if and only if none of its bits are corrupted.

Crossover probability and readability

When the first novel of the series, Harry Potter and the Philosopher's Stone (published in some countries as Harry Potter and the Sorcerer's Stone), opens, it is apparent that some significant event has taken place in the wizarding world--an event so very remarkable, even the Muggles notice signs of it. The full background to this event and to the person of Harry Potter is only revealed gradually through the series. After the introductory chapter, the book leaps forward to a time shortly before Harry Potter's eleventh birthday, and it is at this point that his magical background begins to be revealed.

Original

When the first novel of the series, Harry Pottez and the Philosopher's Stone (p5blished in some countries as Harry Potter cnd the Sorcerep's Stone), opens, it i3 apparent that soMe cignifacant event!haS taken0place in the wi~arding 7orld--ao event so `very!bemark!blu, even the Mufgles nodice signs"of it. The fuld background to this event and to the person of Harry P/tTer is only revealed gradually through th series. After the introfactory chapter, the boo+ leaps forward to a time shortly before Harpy Potteb7s eleventh `birthday, and)t is at this poi~t that his -agikal bac{ground begins to be revealed.

$p = 0.01$ $P(E) \approx 0.07$

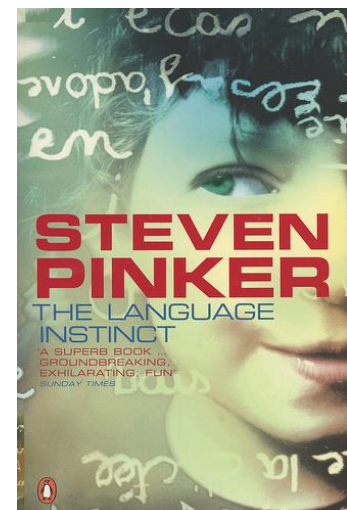
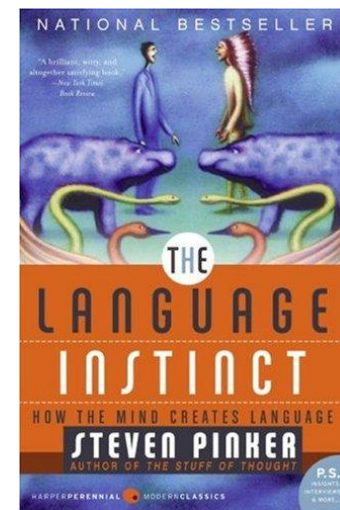
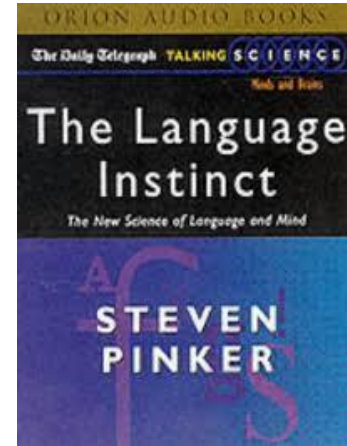
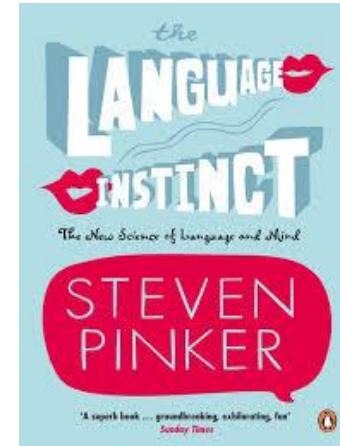
English Redundancy: Ex. 1

J-st tr- t- r--d th-s s-nt-nc-.



English Redundancy: Ex. 2

yxx cxn xndxrstxnd
whxt x xm wrxtxng
xvxn xf x rxplxcx xll
thx vxwxls wxth xn 'x'
(t gts lttl hrdr f y dn't
vn kn whr th vwls r).



English Redundancy: Ex. 3

To be, or xxx xx xx,
xxxx xx xxx xxxxxxxx

Crossover probability and readability

When the first novel of the series, Harry Potter (and the Philosopher's Stone) (published in some countries as Harry Potter and the Sorcerer's Stone) opens, it is apparent that a significant event has taken place in the wizarding world, an event so very remarkable, even the Muggles notice signs of it. The full background to this event and to the person of Harry Potter is only revealed gradually through the series. After the introductory chapter, the book leaps forward to a time shortly before Harry Potter's eleventh birthday and it is at this point that his magical background begins to be revealed.

$$p = 0.02 \quad P(E) \approx 0.13$$

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$$p = 0.03 \quad P(E) \approx 0.19$$

Crossover probability and readability

When the first volume of the series, *Harry Potter and the Sorcerer's Stone* (published in 1997), was published, it was a surprise to many that some of the events in the wizarding world were so very familiar. One of the first things that readers noticed was that the events in the series were so familiar that they felt like they had read them before. This was especially true for the first chapter, where the reader is introduced to the wizarding world and the main character, Harry Potter. The events in the first chapter are so familiar that they feel like they have been read before. This is because the events in the first chapter are so familiar that they feel like they have been read before.

$$p = 0.05 \quad P(E) \approx 0.30$$

When the second volume of the series, *Harry Potter and the Chamber of Secrets* (published in 1998), was published, it was a surprise to many that some of the events in the wizarding world were so very familiar. One of the first things that readers noticed was that the events in the series were so familiar that they felt like they had read them before. This was especially true for the first chapter, where the reader is introduced to the wizarding world and the main character, Harry Potter. The events in the first chapter are so familiar that they feel like they have been read before. This is because the events in the first chapter are so familiar that they feel like they have been read before.

$$p = 0.10 \quad P(E) \approx 0.52$$

BER vs. SER

