

# 不插电的计算机科学

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COMPUTER SCIENCE  
*Unplugged*

Understanding computing  
through games and puzzles

Tim Bell  
Andrea Arpaci-Dusseau @  
in Milan  
Mila Fellows

Scott Praman  
MOT Power  
也

刘江峰 译  
也

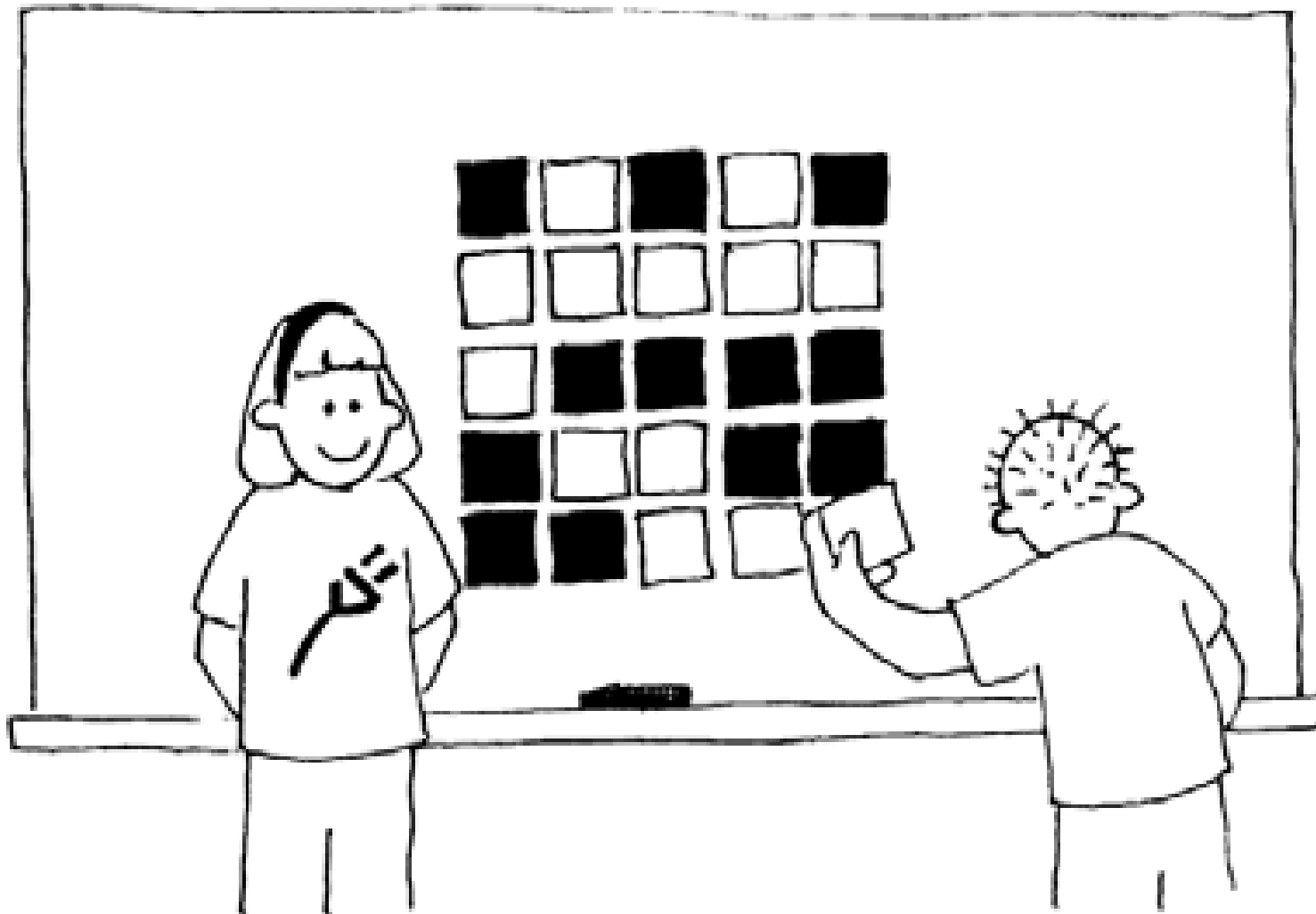
不插电的  
计算机科学

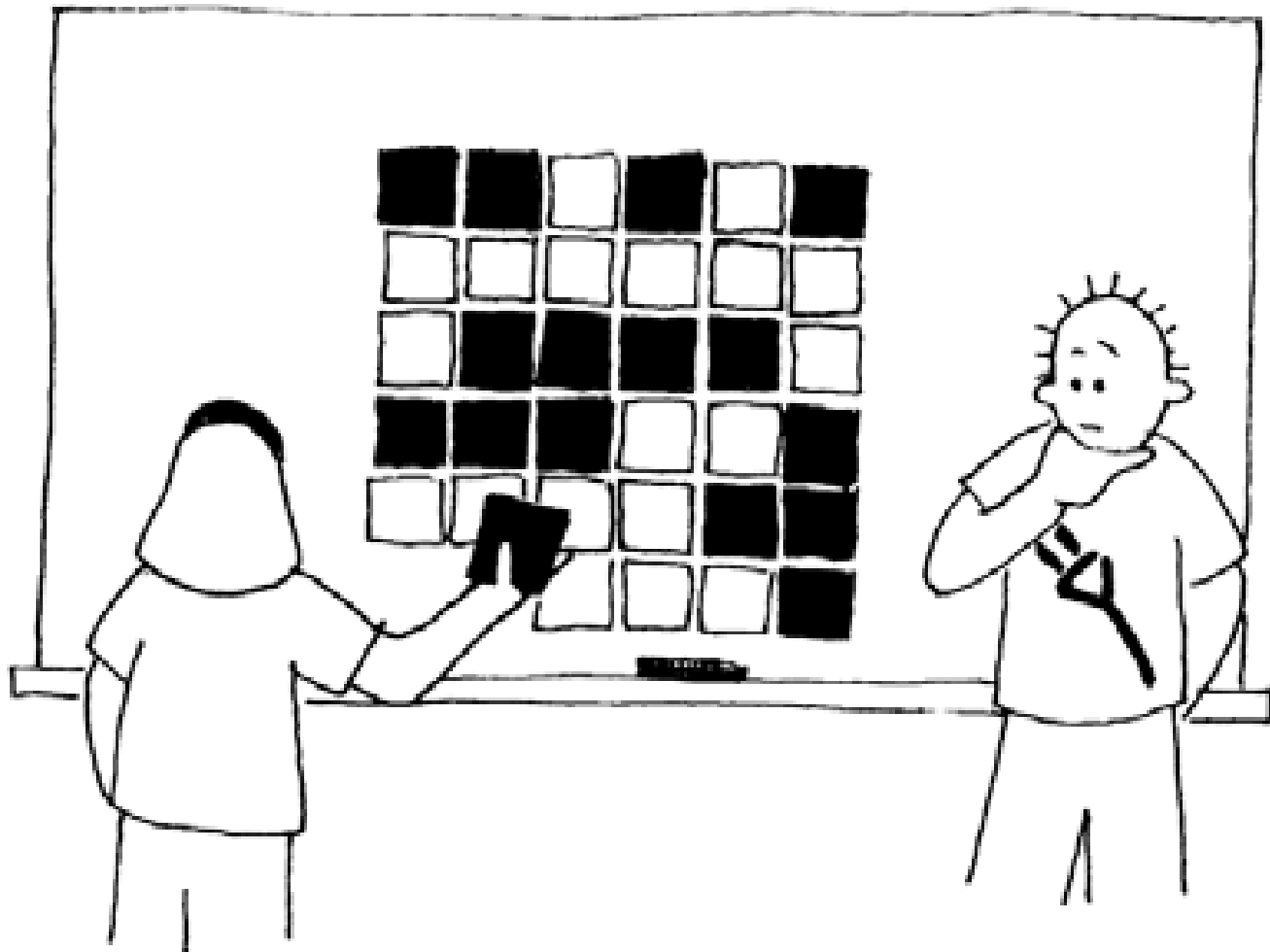
玩智力游戏 学信息知识

# CARD FLIP MAGIC

- When data is stored on a disk or transmitted from one computer to another, we usually assume that it doesn't get changed in the process. But sometimes things go wrong and the data is changed accidentally.
- This activity uses a magic trick to show how to detect when data has been corrupted, and to correct it.







# CARD FLIP MAGIC



# CARD FLIP MAGIC

- This exercise illustrates even parity.
- When computer data is transmitted to another computer, extra bits are added so that the number of 1s is even.
- The receiving computer can detect if something gets messed up during the transmission and can correct it if there is one error.
- What happens if there are two errors?

# CARD FLIP MAGIC

- Here is an example of parity in real life:

$$\begin{array}{r} 1 \times 10 = 10 \\ 4 \times 9 = 36 \\ 2 \times 8 = 16 \\ 5 \times 7 = 35 \\ 9 \times 6 = 54 \\ 3 \times 5 = 15 \\ 7 \times 4 = 28 \\ 6 \times 3 = 18 \\ 7 \times 2 = \underline{14} \end{array}$$

$$226 / 11 = 20 \text{ remainder } 6$$

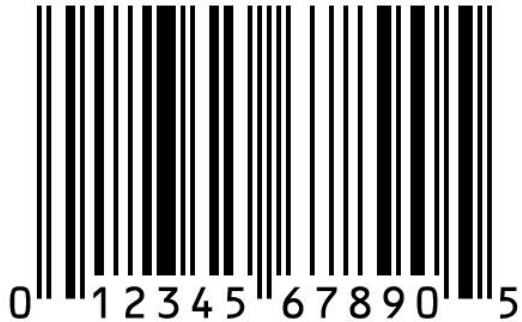
$$\text{Checksum Digit} = 11 - 6 = 5$$





# CARD FLIP MAGIC

- More parity:



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## 第二代居民身份证号码的校验码计算模型

身份证号码前17位	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7
乘以	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
2的n次方	$2^{17}$	$2^{16}$	$2^{15}$	$2^{14}$	$2^{13}$	$2^{12}$	$2^{11}$	$2^{10}$	$2^9$	$2^8$	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$
2 <sup>n</sup> 的实际值	131072	65536	32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2
	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷
	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	余	余	余	余	余	余	余	余	余	余	余	余	余	余	余	余	余
2 <sup>n</sup> ÷11的余数	7	9	10	5	8	4	2	1	6	3	7	9	10	5	8	4	2
号码×2 <sup>n</sup> 的积①	131072	131072	98304	65536	40960	24576	14336	8192	4608	0	128	128	96	64	40	24	14
号码×余数的积②	7	18	30	20	40	24	14	8	54	0	7	18	30	20	40	24	14
①的和, ÷11得余数	519150	÷	11	余	5												
最后得到校验码	7																
②的和, ÷11得余数	368	÷	11	余	5												
最后得到校验码	7																
余数列表	0	1	2	3	4	5	6	7	8	9	10						
校验码对照表	1	0	X	9	8	7	6	5	4	3	2						

注: 沿着红色箭头运算方向也可,  
沿着绿色箭头运算方向也可。

