Binary!

00101001001100100010101

Why do computers use binary?

- Easy to detect the state of a switch – they’re either on or off!

- Using another base makes computers more prone to error.

Counting

In decimal (base 10), we have digits 0-9. In binary, we only have digits 0 and 1.

0

Counting

In decimal (base 10), we have digits 0-9. In binary, we only have digits 0 and 1.

1

Counting

In decimal (base 10), we have digits 0-9. In binary, we only have digits 0 and 1.

10

Counting

In decimal (base 10), we have digits 0-9. In binary, we only have digits 0 and 1.

11

Counting

In decimal (base 10), we have digits 0-9. In binary, we only have digits 0 and 1.

100

Counting

In decimal (base 10), we have digits 0-9. In binary, we only have digits 0 and 1.

101

Counting

In decimal (base 10), we have digits 0-9. In binary, we only have digits 0 and 1.

110

Counting

In decimal (base 10), we have digits 0-9. In binary, we only have digits 0 and 1.

111

Counting

In decimal (base 10), we have digits 0-9. In binary, we only have digits 0 and 1.

1000

Places

1011

1’s

Places

1011

2’s

Places

1011

4’s

Places

1011

8’s

Places

4853

10^0

1011

2^0

Places

4853

10^1

1011

2^1

Places

4853

10^2

1011

2^2

Places

4853

10^3

1011

2^3

Translating Binary to Decimal

1011

1

Translating Binary to Decimal

1011

2 + 1

Translating Binary to Decimal

1011

0 + 2 + 1

Translating Binary to Decimal

1011

8 + 0 + 2 + 1

Translating Binary to Decimal

101100

Answer: 44

Translating Binary to Decimal

10001110

Answer: 142

Zorah's favorite things about Binary

Adding is the easiest. EVER.

100101

110110

1

Zorah's favorite things about Binary

Adding is the easiest. EVER.

100101

110110

11

Zorah's favorite things about Binary

Adding is the easiest. EVER.

100101

110110

011

Zorah's favorite things about Binary

Adding is the easiest. EVER.

100101

110110

1011

Zorah's favorite things about Binary

Adding is the easiest. EVER.

100101

110110

11011

Zorah's favorite things about Binary

Adding is the easiest. EVER.

100101

110110

011011

Zorah’s favorite things about Binary

Adding is the easiest. EVER.

100101	37
110110	54
1011011	91

Zorah’s favorite things about Binary

Dividing by 2 is neat-o.

101100

44

Zorah’s favorite things about Binary

Dividing by 2 is neat-o

0 1 0 1 1 0

2 2

Zorah’s favorite things about Binary

Dividing by 2 is neat-o

0 0 1 0 1 1

1 1

Zorah’s favorite things about Binary

Dividing by 2 is neat-o

000101.1

5.5

Zorah’s favorite things about Binary

Dividing by 2 is neat-o

00010.11

2.75

Zorah's favorite things about Binary

You can count to, like, a bajillion on your fingers in binary.

Try it. I know you want to.

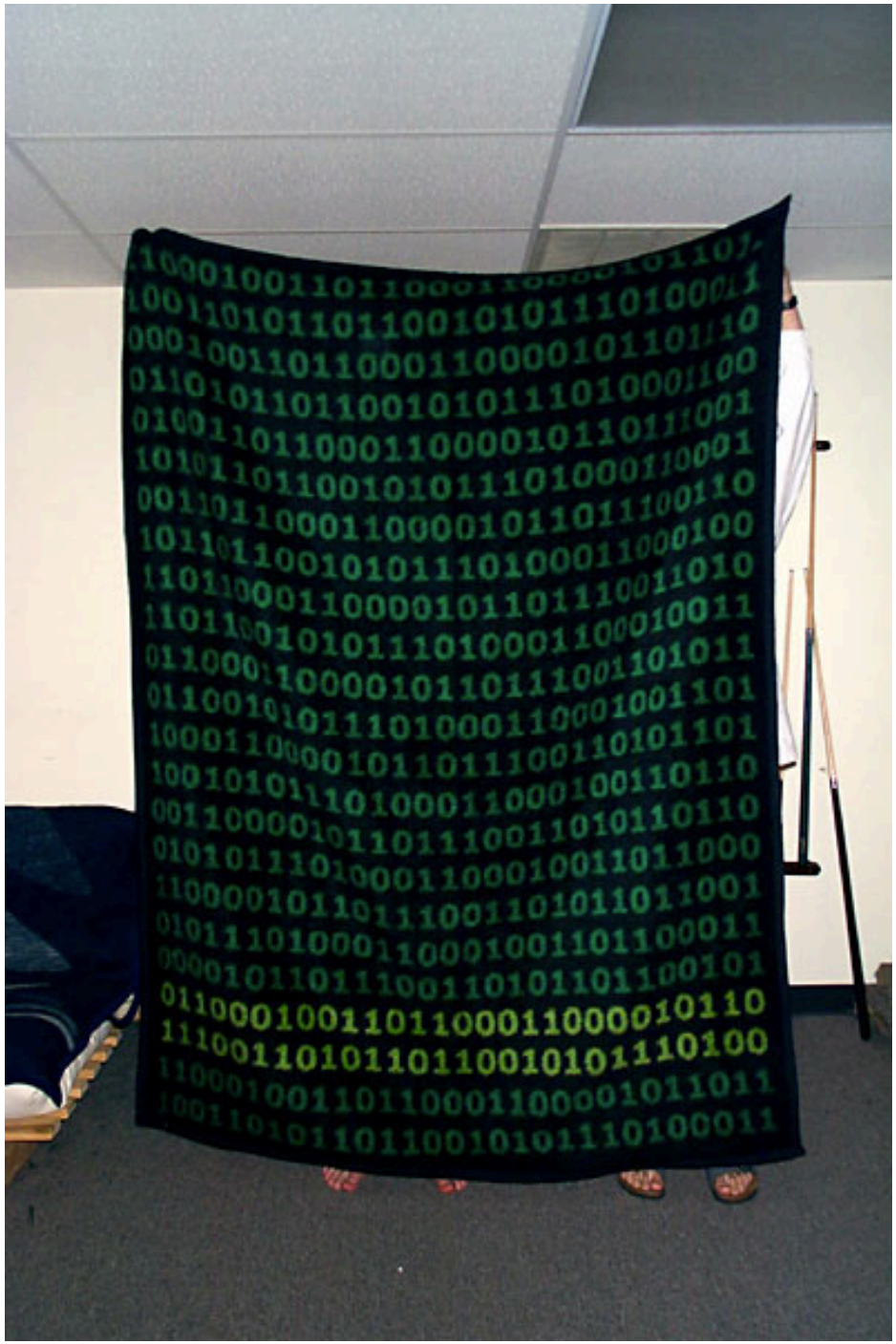
ASCII – Mapping of numbers to characters

01100001 -- a

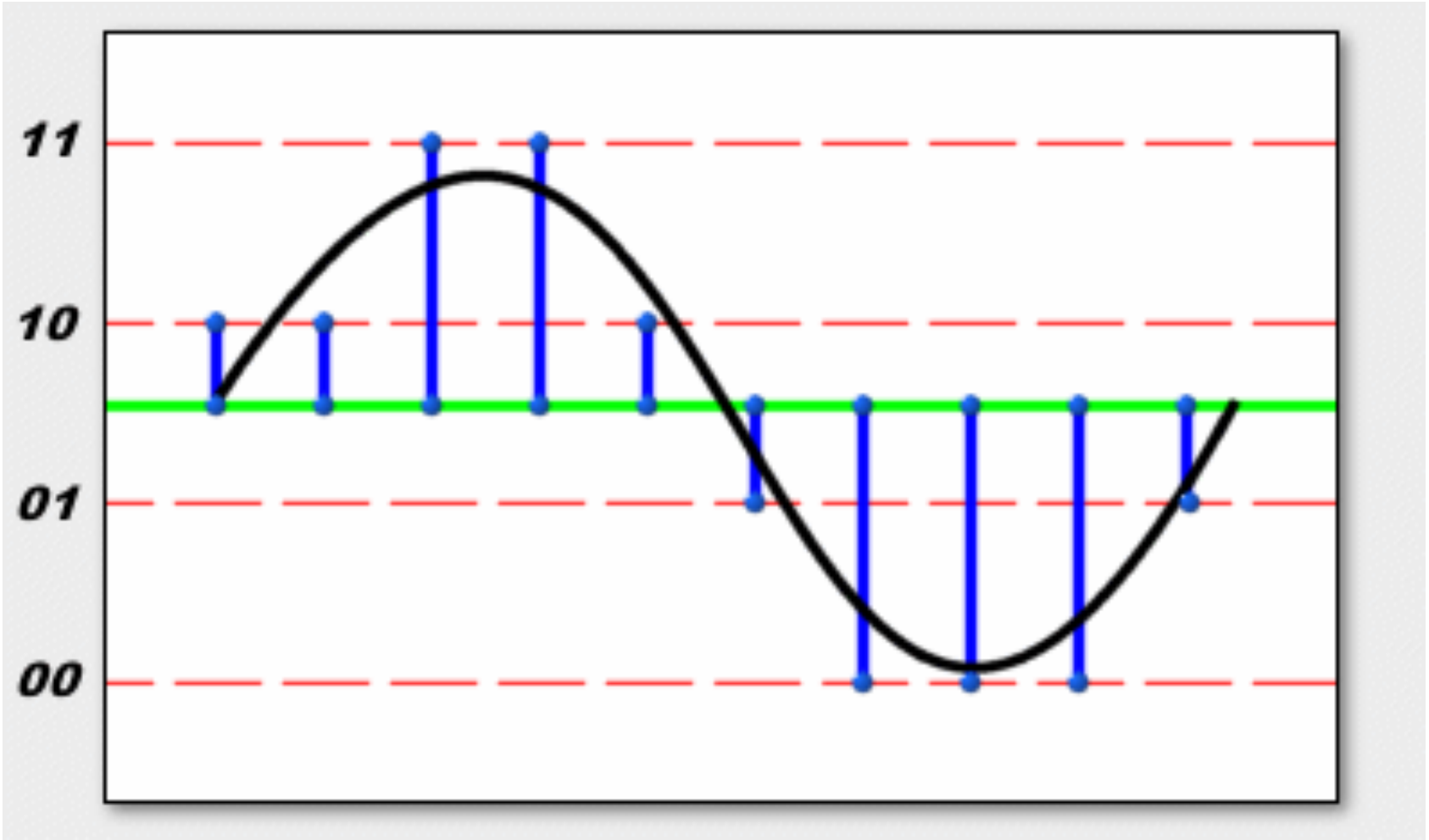
01000001 -- A

011 – lowercase, 010 – uppercase,
00001 – first letter of the alphabet

What does the secret message (in light green) say?



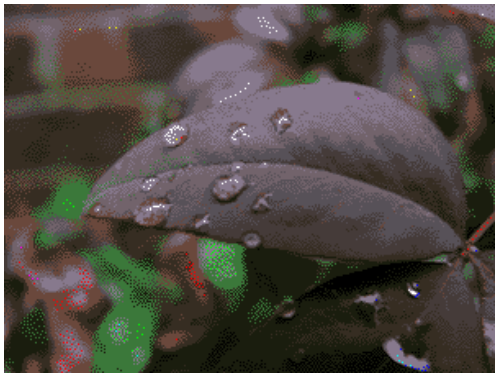
Representing a sound wave



Representing Color

1-bit

2-bit



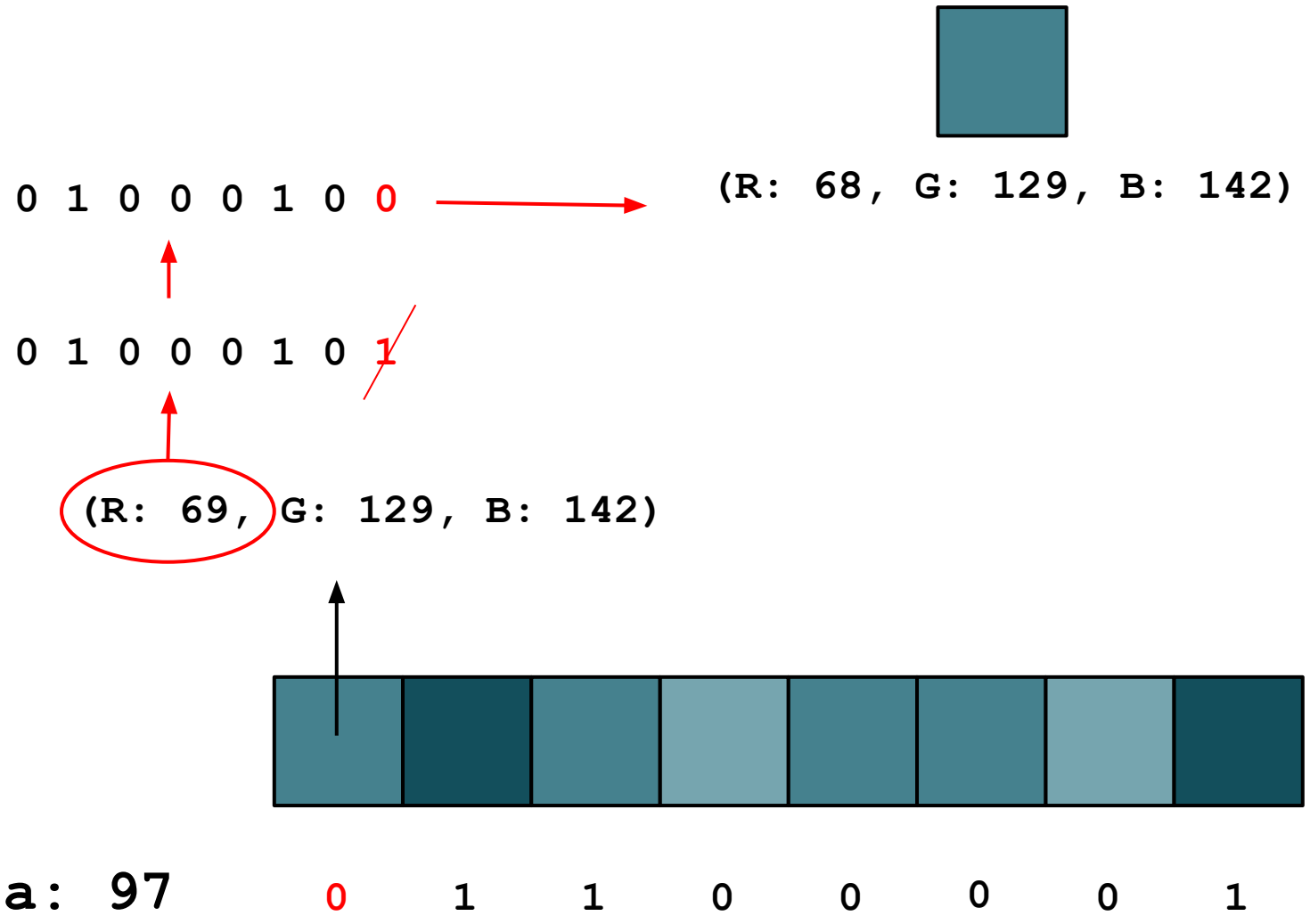
4-bit

8-bit

24-bit

Can you see the secret message hidden in this picture?

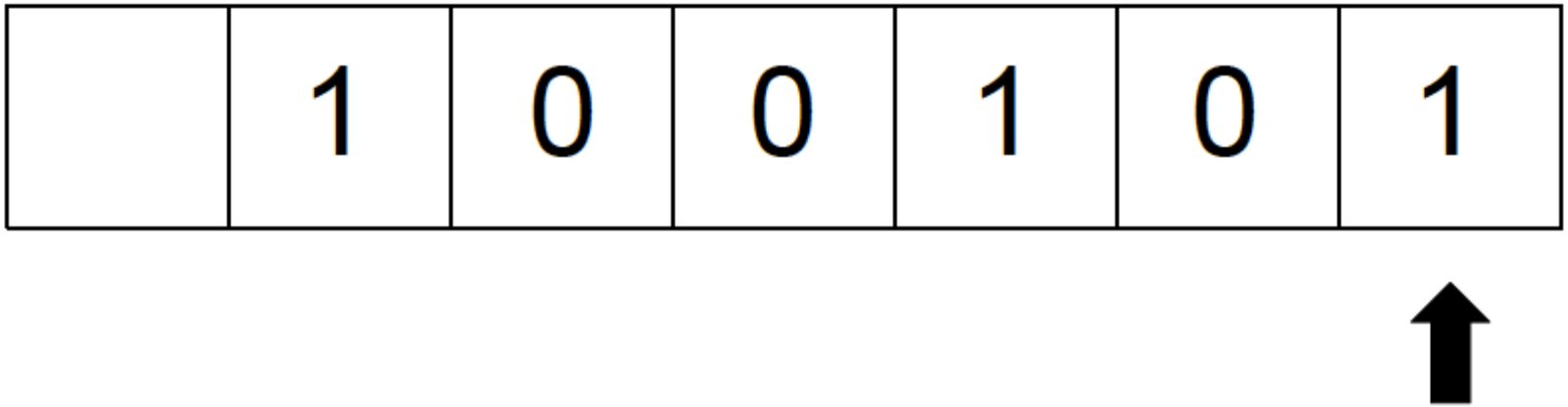
Example on encrypting the letter ‘a’



8-bits (one byte) per character → 8 pixels for each letter in the message

Turing Machine

Value is printed on infinitely long tape



Pointer to the
specific bit to look at

Instruction Set for Turing Machine

- PRINT 0
- PRINT 1
- GO LEFT
- GO RIGHT
- GO TO STEP i if 0 SCANNED
- GO TO STEP i if 1 SCANNED
- STOP

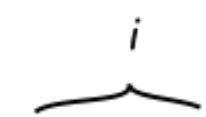
Instruction Set for Turing Machine

000 - PRINT 0

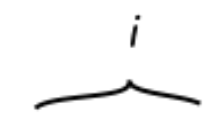
001 - PRINT 1

010 - GO LEFT

011 - GO RIGHT



10100…..01 - GO TO STEP i if 0 SCANNED



11011…..10 - GO TO STEP i if 1 SCANNED

100 - STOP

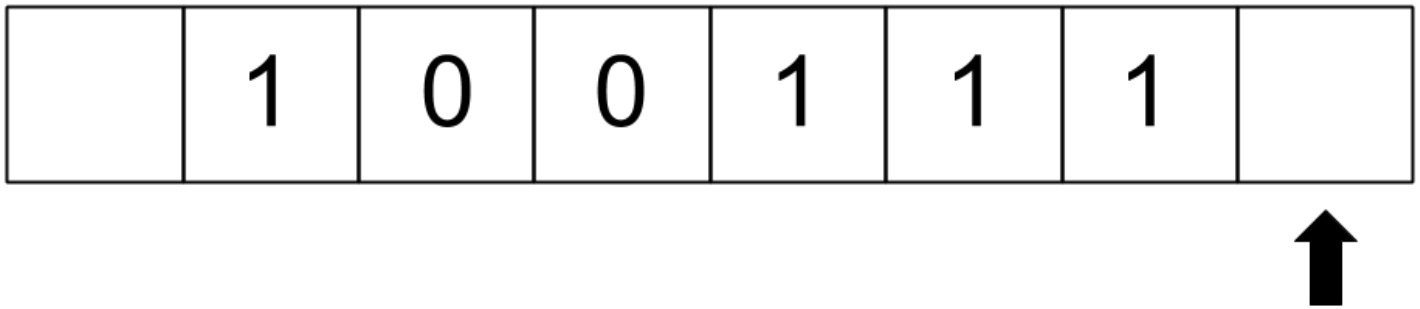
What does this code do?

- 1. GO LEFT
- 2. GO TO STEP 6 IF 0 SCANNED
- 3. PRINT 0
- 4. GO LEFT
- 5. GO TO STEP 3 IF 1 SCANNED
- 6. PRINT 1
- 7. STOP

What does this code do?

1. GO LEFT
2. GO TO STEP 6 IF 0 SCANNED
3. PRINT 0
4. GO LEFT
5. GO TO STEP 3 IF 1 SCANNED
6. PRINT 1
7. STOP

Try executing this code when the Turing machine looks like this



Binary Riddle

A mad scientist has 1000 bottles of wine, but one of them is poisoned. He also has 10 rats, for which the poison bottle will kill in any amount, within 10 days.

The scientist wants to have a party on the 11th day, and remove the poisoned bottle until there. How can he find the right bottle?

“There are 10 types of people in the world: those who understand binary and those who don’t.”