

In-Class Handout Version

15-213

“The Class That Gives CMU Its Zip!”

Bits and Bytes

Aug. 30, 2001

Topics

- **Why bits?**
- **Representing information as bits**
 - **Binary/Hexadecimal**
 - **Byte representations**
 - » **numbers**
 - » **characters and strings**
 - » **Instructions**
- **Bit-level manipulations**
 - **Boolean algebra**
 - **Expressing in C**

Wh

Base 10 Number Representation

- That's why fingers are known as "digits"
- Natural representation for financial transactions
 - Floating point number cannot exactly represent \$1.20
- Even carries through in scientific notation
 - 1.5213×10^4

Implementing Electronically

- Hard to store
 - ENIAC (First electronic computer) used 10 vacuum tubes / digit
- Hard to transmit
 - Need high precision to encode signal levels on single wire
- Messy to implement digital logic functions
 - Addition, multiplication, etc.

Bas e 10?

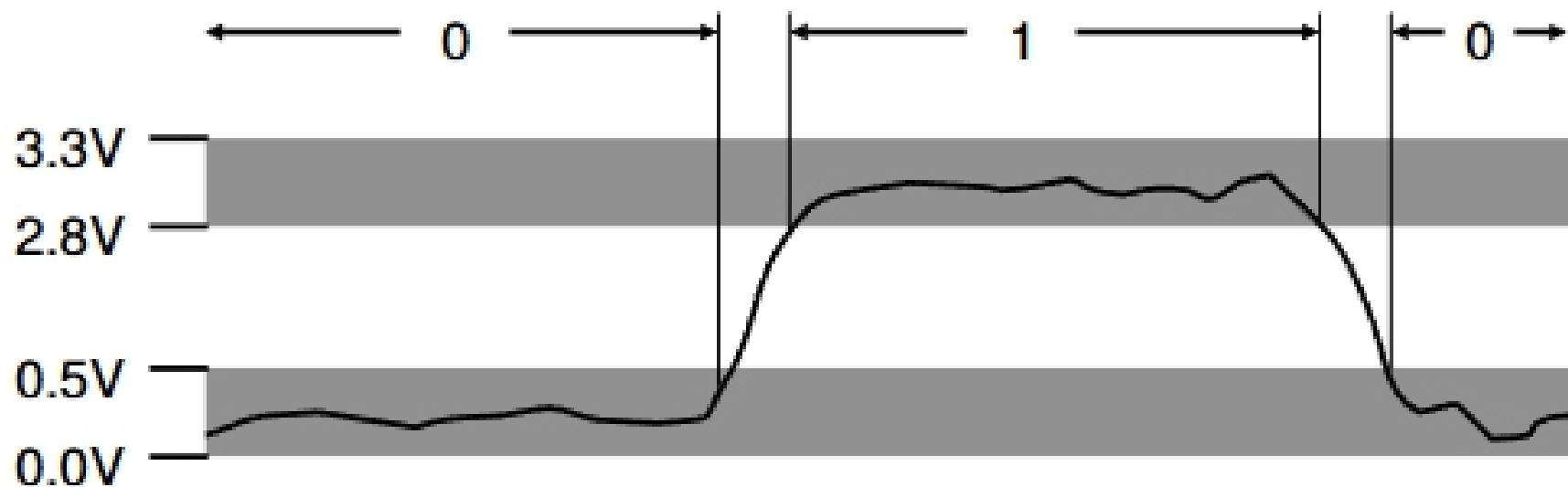
Binary

Base 2 Number Representations

- Represent 15213_{10} as 11101101101101_2
- Represent 1.20_{10} as $1.0011001100110011[0011]..._2$
- Represent 1.5213×10^4 as $1.1101101101101_2 \times 2^{13}$

Electronic Implementation

- Easy to store with bistable elements
- Reliably transmitted on noisy and inaccurate wires



- Straightforward implementation of arithmetic functions