

Lecture 4: Truth Tables and More Boolean Functions

CSE 370, Autumn 2007
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Last Lecture's Daily Quiz

- In 2's complement, the number of bits matters
 - 110 is not a 4-bit 2's comp. number
 - 0110 is
- "Flip the bits" means replace 1's with 0's and 0's with 1's in each bit position
- Remember to add 1

Where We Are

- Last lecture: Boolean algebra
- This lecture: Truth tables and lots of "useful" Boolean functions
- Next lecture: Canonical forms
- Homework 1 due today. Homework 2 out
- In the midst of lab 1
 - Slight modification of lab late policy

Truth Tables (0-7)

| A | B | F ₀ | F ₁ | F ₂ | F ₃ | F ₄ | F ₅ | F ₆ | F ₇ |
|---|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |

Constant 0 $A \cdot \neg B$ $\neg A \cdot B$ $A \oplus B$
 $A \cdot B$ A B $A + B$

Truth Tables (8-15)

| A | B | F ₈ | F ₉ | F ₁₀ | F ₁₁ | F ₁₂ | F ₁₃ | F ₁₄ | F ₁₅ |
|---|---|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |

$\neg A \cdot \neg B$ $\neg B$ $\neg A$ $\neg A + \neg B$
 $\neg(A \oplus B)$ $A + \neg B$ $\neg A + B$ Constant 1

Proof by Truth Table

| A | B | $\overline{A \cdot B}$ | $\overline{A + B}$ | $\overline{A \cdot \overline{B}}$ | $\overline{\overline{A} \cdot \overline{B}}$ | $\overline{A \cdot B}$ | $\overline{A \cdot \overline{B}}$ | $\overline{\overline{A} + \overline{B}}$ |
|---|---|------------------------|--------------------|-----------------------------------|--|------------------------|-----------------------------------|--|
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

Comparing Two Numbers

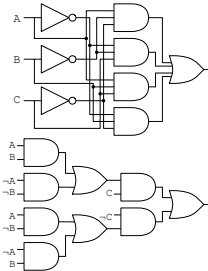
| A | B | C | D | F |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 0 |

| A | B | C | D | F |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 |

Full Adder

$$S = A\bar{B}\bar{C} + \bar{A}B\bar{C} + ABC + \bar{A}\bar{B}C$$

| A | B | C _{in} | S | C _{out} |
|---|---|-----------------|---|------------------|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |



Now You Try

$$F = \bar{A} + BC$$

| A | B | C | F |
|---|---|---|---|
| 0 | 0 | 0 | |
| 0 | 0 | 1 | |
| 0 | 1 | 0 | |
| 0 | 1 | 1 | |
| 1 | 0 | 0 | |
| 1 | 0 | 1 | |
| 1 | 1 | 0 | |
| 1 | 1 | 1 | |

Now You Try

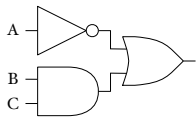
$$F = \neg A + BC$$

| A | B | C | F |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

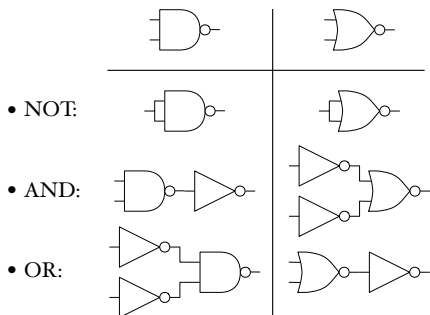
Now You Try

$$F = \neg A + BC$$

| A | B | C | F |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |



Universal Gates



Thank You for Your Attention

- Start looking at homework 2
- Continue reading the book