ECE 238L
Digital Computers and Number Systems
Lecture lab 3

September 14, 2006

Problem 2.3a

$$
\begin{aligned}
AB + BC'D' + A'BC + C'D &= B + C'D \\
B(A + A'C) + C'(D + BD') &= \\
B(A + AC + A'C) + C'(D + BD + BD') &= \\
B(A + C) + C'(D + B) &= \\
AB + BC + C'D + B'C &= \\
B(C + C' + A) + C'D &= \\
B(1 + A) + C'D &= \\
B + C'D &=
\end{aligned}
$$

Problem 2.3b

$$
\begin{aligned}
wy + w'yz' + wxz + w'xy' &= wy + w'xz' + x'yz' + xy'z \\
&= wy + wxyz + w'xyz' + w'xy'z' + \\
&\quad wx'yz' + w'x'yz' + wxy'z + w'xy'z \\
&= wy + w'xyz' + w'x'yz' + wxyz + \\
&\quad wxy'z + w'xy'z + w'xy'z' + wx'yz' \\
&= wy + wx'yz' + w'yz'(x + x') + wxz(y + y') \\
&\quad + w'xy'(z + z') \\
&= wy(1 + x'z') + w'yz' + wxz + w'xy' \\
&= wy + w'yz' + wxz + w'xy'
\end{aligned}
$$

Problem 2.3b

$$
\begin{aligned}
AC' + A'B + B'C + D' &= (A' + B' + C' + D')(A + B + C + D') \\
&= AA' + AB' + AC' + AD' + \\
&\quad A'B + BB' + BC' + BD' + \\
&\quad A'C + B'C' + CC' + CD' + \\
&\quad A'D' + B'D' + C'D' + D'D' \\
&= AB' + AC' + A'B + BC' + A'C \\
&\quad + B'C + D' + AB'C' \\
&= AB'C + AB'C' + AC' + A'B + ABC' + A'BC' + \\
&\quad A'BC + A'B'C + B'C + D'
\end{aligned}
$$

Problem 2.3b

$$
\begin{aligned}
AC' + A'B + B'C + D' &= \\
&= AC' + AB'C' + A'BC' + \\
&\quad A'B + A'BC + A'BC' + \\
&\quad B'C + AB'C + A'B'C + D' \\
&= AC'(1 + B' + B) + A'B(1 + C' + C) + \\
&\quad B'C(1 + A + A') + D' \\
&= AC' + A'B + B'C + D'
\end{aligned}
$$

Problem Statement

Design a circuit which selects between two inputs (A and B) and pass the selected input to the output Q.

The desired circuit is called a multiplexer or mux.

Multiplexers

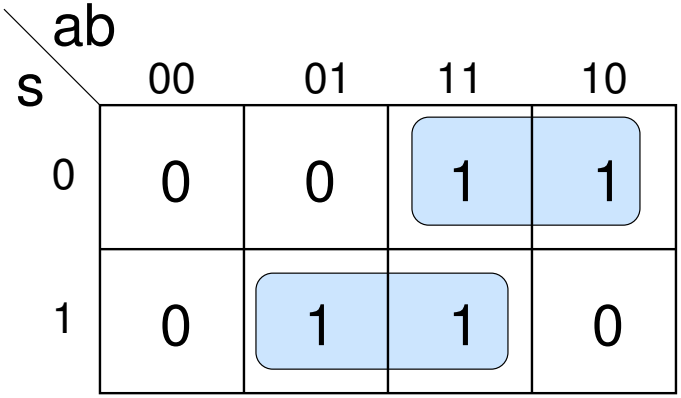
A	B	S	F
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Multiplexers

A	B	S	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

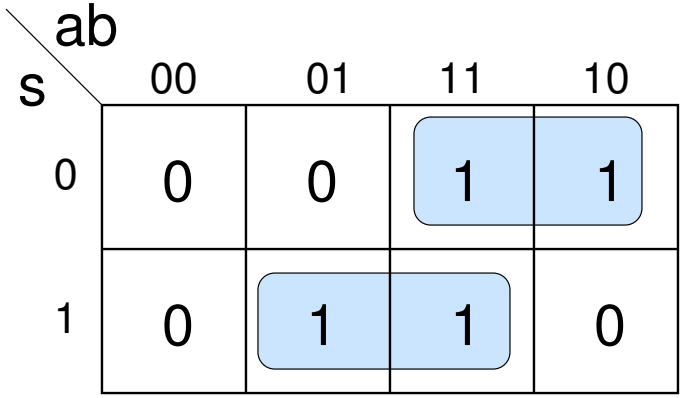
Multiplexers

A	B	S	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

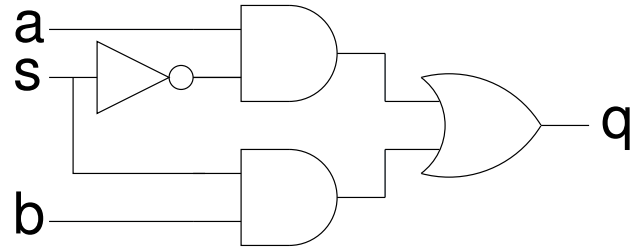


Multiplexers

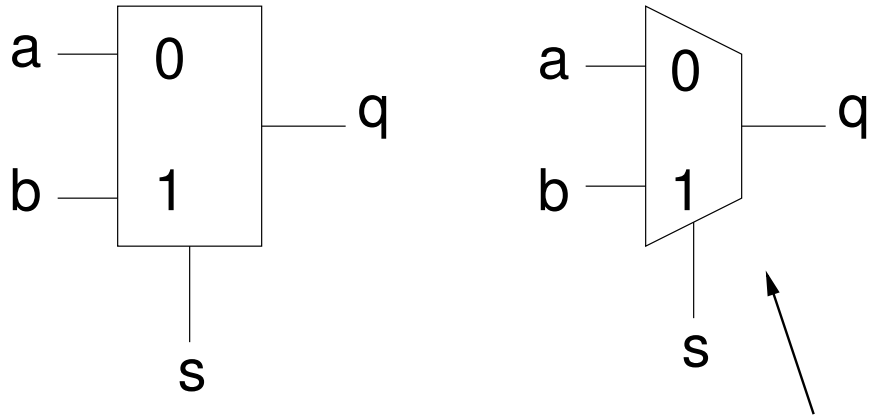
A	B	S	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1



$q = s'a + sb$

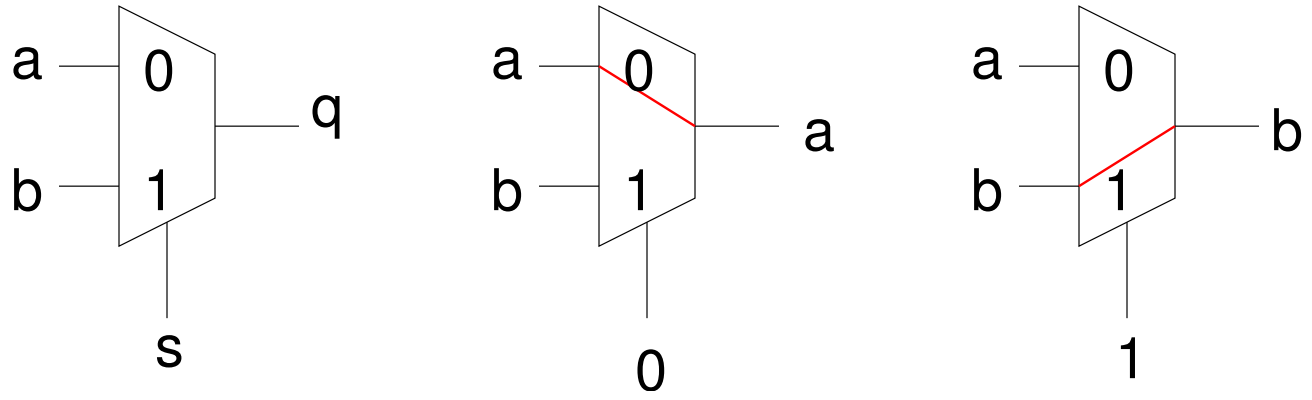


Multiplexer Symbols



This is the preferred symbol.

Data Steering



Key idea: The select input wire selects one of the inputs and passes it out to the output.