Booth's Algorithm
Partial Product

Multiplier X_{i+1},	X_i,	X_{i-1}	Rational	Partial Product weighted with 2^i
0	0	0	no 1 => add zero	+0
0	0	1	end of string	+Y
0	1	0	string of length 1	+Y
0	1	1	end of string	+2Y
1	0	0	start of string	-2Y
1	0	1	end/start of string	-y [-2y + Y= -Y]
1	1	0	start of string	-y
1	1	1	continuation of string	-0

Shift and ADD
Demonstration of Booth [Init]

Let X = 111101 = -3
Y = 000111 = +7

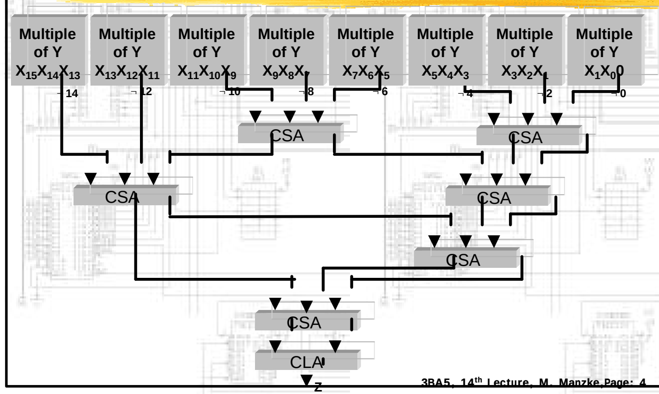
Reg. S.A.Q = 13 bit shift register
Q_{-1} = overlap

+Y = 000111
-Y = 111001

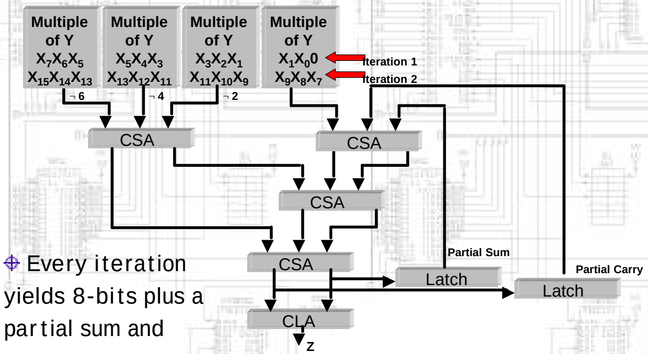
Shift and ADD
Demonstration of Booth

S	A	Q .Q_{-1}	Remark
0	000 000	111 101.0	S.A,Q_{-1} ¬ 0,Q ¬ X
0	000 111	--- ---.-	A ¬ A + Y
0	000 001	111 111.0	2*ashr(S.A.Q)
1	111 010	--- ---.-	A ¬ A - Y
1	111 110	101 111.1	2*ashr(S.A.Q)
-	--- ---	--- ---.-	A ¬ A - 0
1	111 111	101 011.1	2*ashr(S.A.Q)

Parallel Generation of Partial Products and their Sumation
Z=X*Y, X 16bit



Multi Pass Booth-Wallace



- Every iteration yields 8-bits plus a partial sum and carry

Floating-point Numbers

$$X = \pm m \bullet b^e$$


```
b = 2
e = exponent – bias
bias = 2^(j-k-1)-1
if (m ≠ 0)then m = 1.mantissa
if (s = 0)then X > 0
if (s = 1)then X < 0
```


Evaluating Biased Exponents

Exponent = e + bias
= e + 127, e(8 bit)

Exponent	Decimal	Binary
-126	-126 + 127 = 1	00000001
-001	-001 + 127 = 126	01111110
000	000 + 127 = 127	01111111
001	001 + 127 = 128	10000000
126	126 + 127 = 253	11111101
127	127 + 127 = 254	11111110

Normalisation

- In order to preserve maximum precision non-zero members have their exponent adjusted so that their MSB is always 1.
- Hence it does not need to be stored
- Is is called the hidden bit

IEEE 754 Floating-point Standard

- In 1982 twenty different floating-point formats were in use
  - Causing serious portability problems
- In 1985 this standard, derived from a 1979 paper by Kahan, Stone and Coonen, was adopted and remains.

IEEE Specification

Precision	I	j	k	e(bits)	m(bits)	bias
Single	31	30	22	8	24	$127=2^7-1$
Double	63	62	51	11	53	$1023=2^{10}-1$

Single $(-1)^S \times (1.m) \times 2^{e-127}$

Double $(-1)^S \times (1.m) \times 2^{e-1023}$