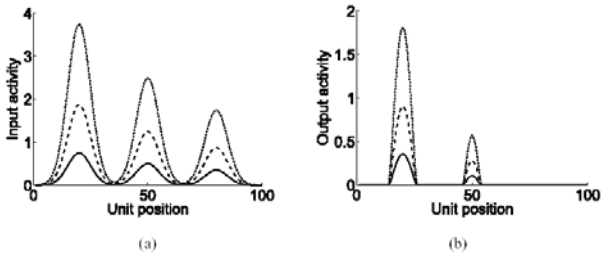
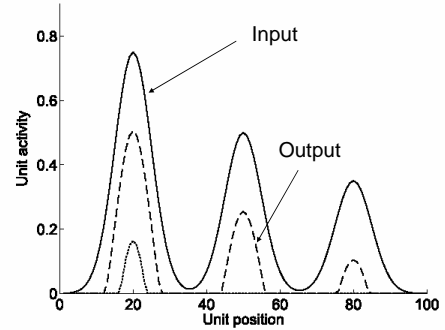


WTA (Winner-Take-All)

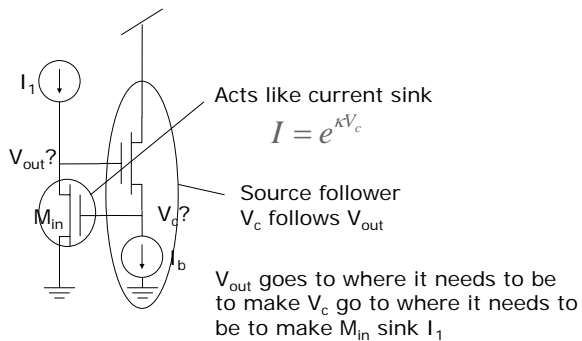
A WTA mechanism is a device that determines the identity and sometimes the amplitude, of its largest input. This mechanism is necessary to enforce competition between different possible outputs of a network. A variant, called *softmax*, assigns each input a weight so that all weights sum to 1 and the largest input has the largest weight. The WTA is the limiting case of the softmax.



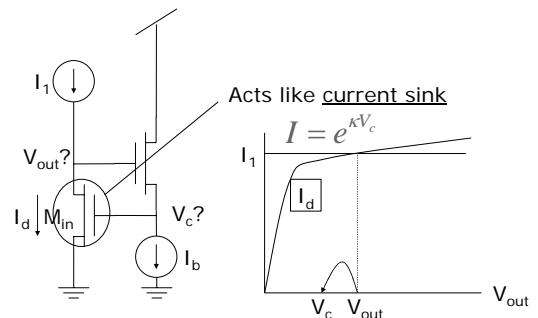
Current-Mode WTA Circuit

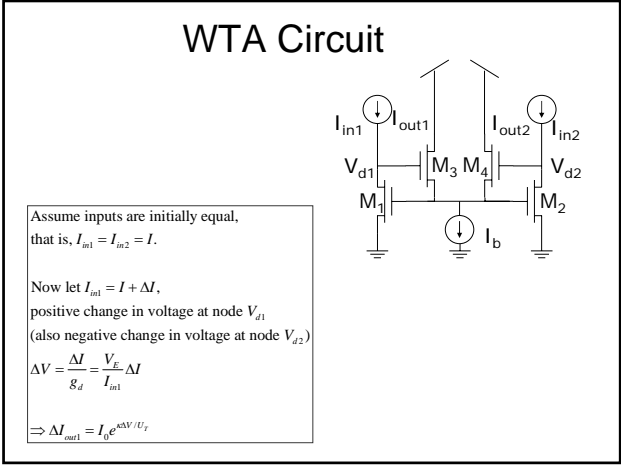
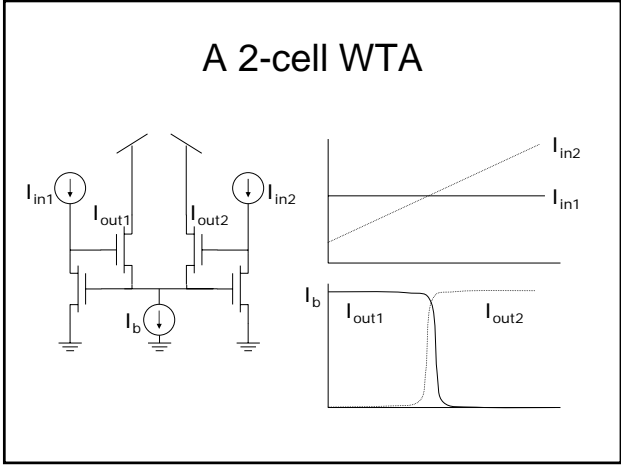
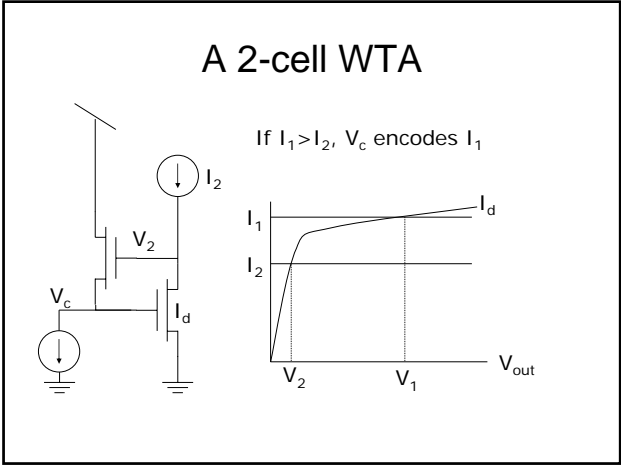
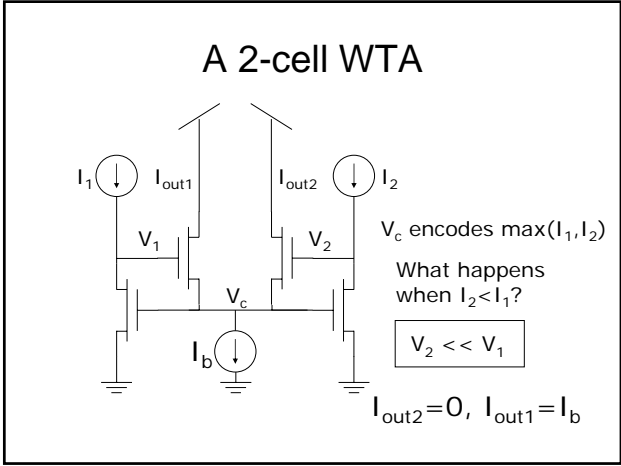
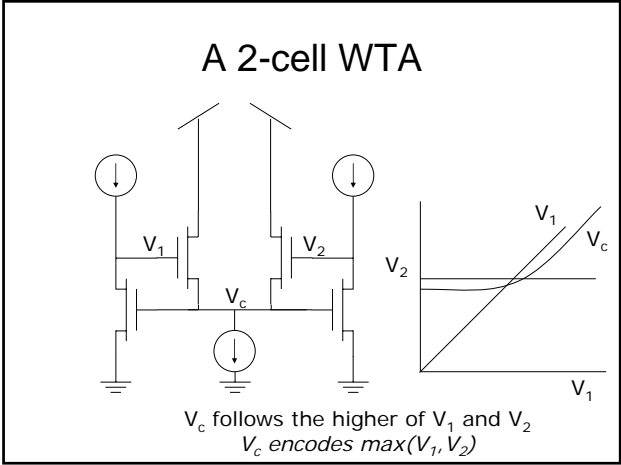
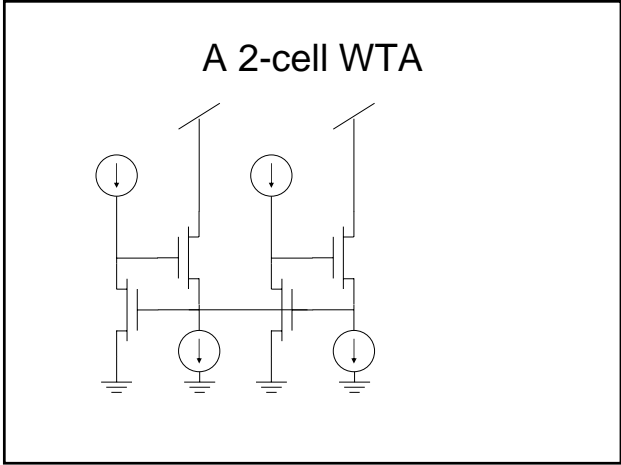
A continuous-time analog circuit that receives analog inputs and implements the WTA function. It was originally designed by Lazzaro et al. in 1989.

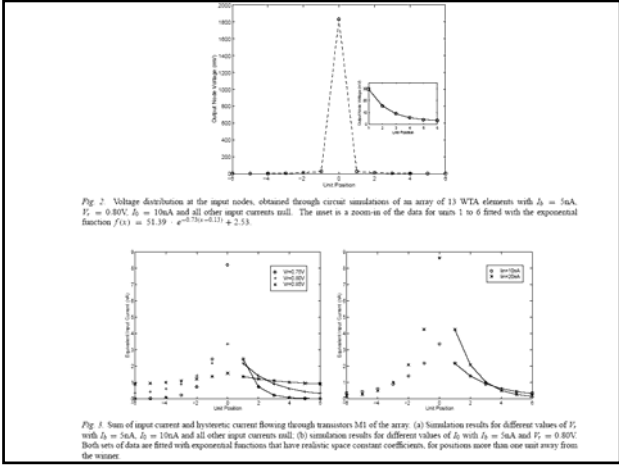
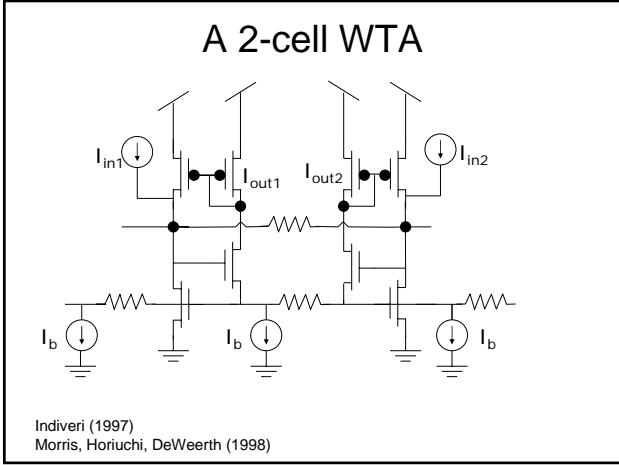
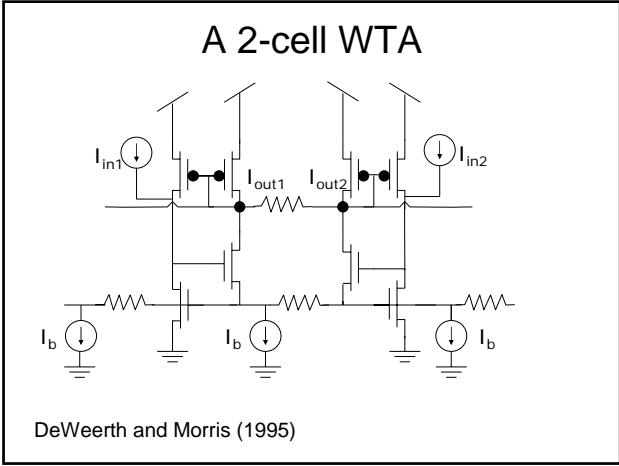
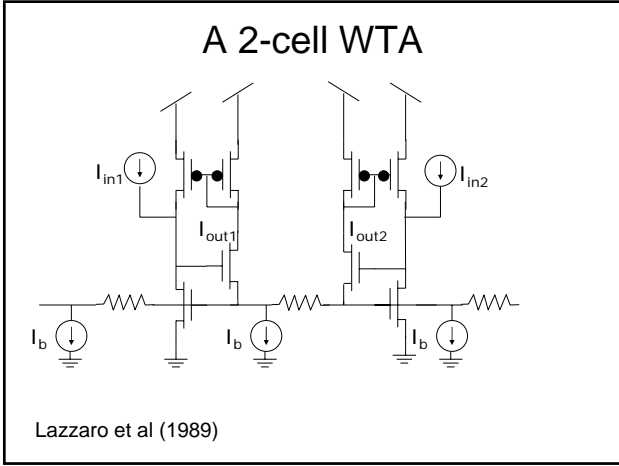
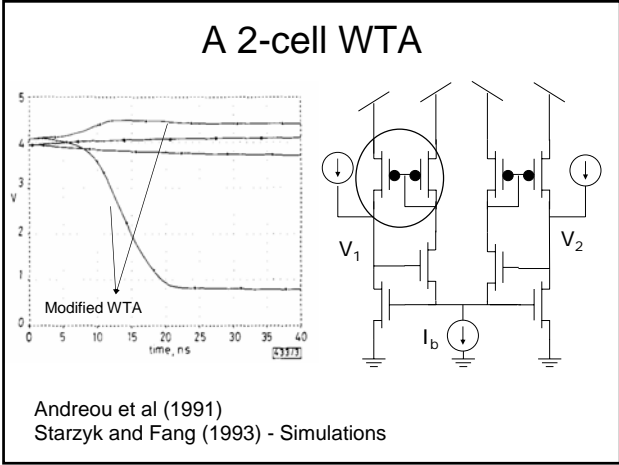
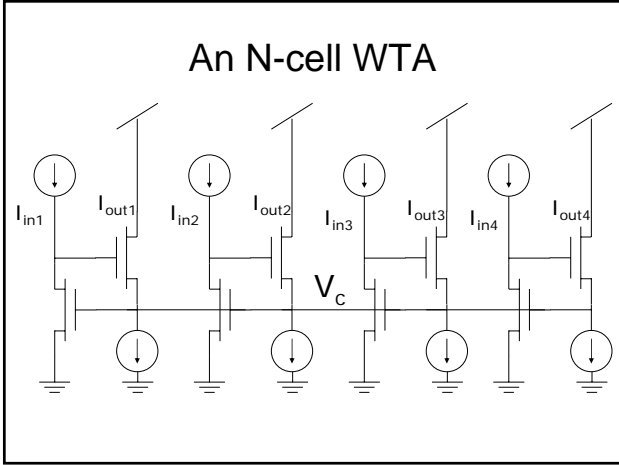
A buffered current mirror

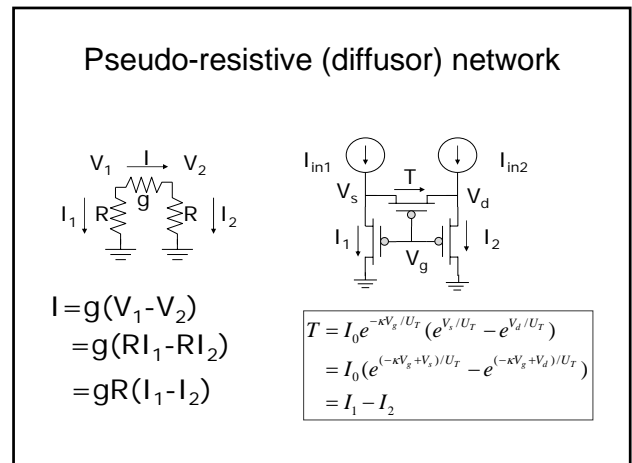
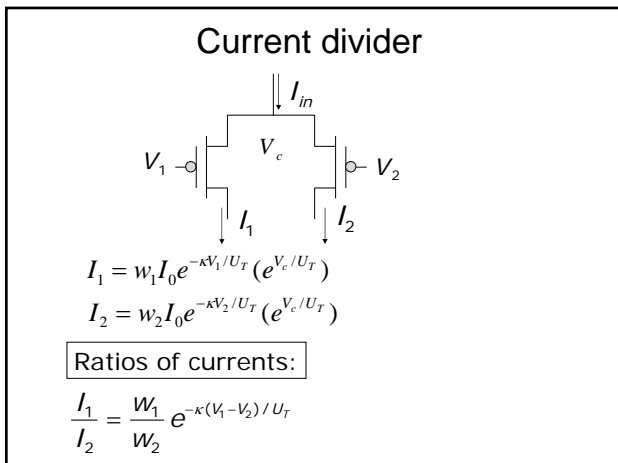
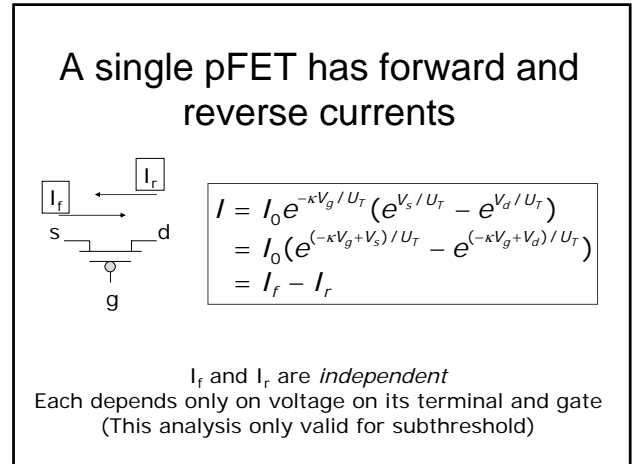
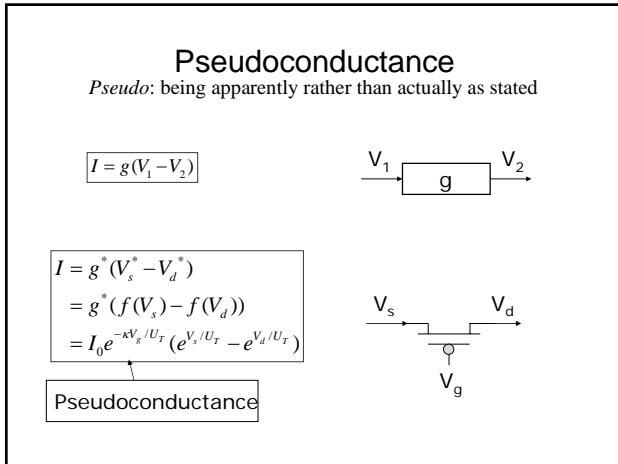
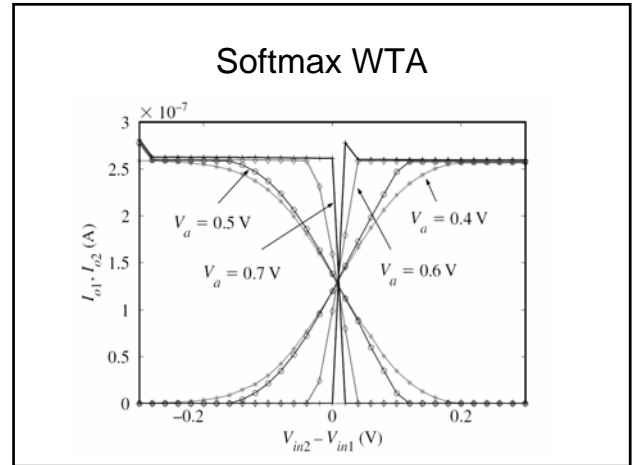
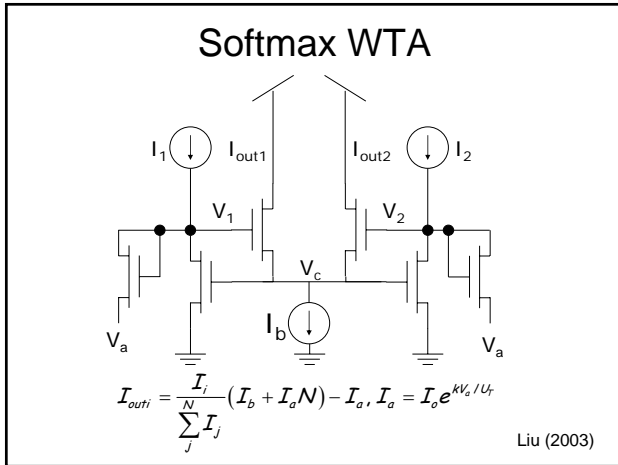


A buffered current mirror

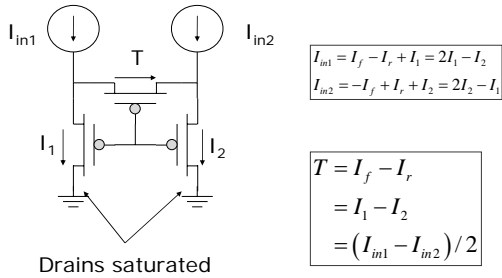






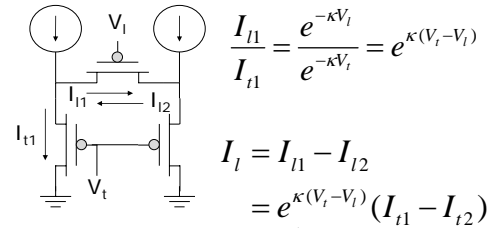


Current divider



Current divider

What if gates are at different potentials?



t "transverse"
l "lateral"

Pseudoconductance!

Various aWTA circuits

- Lazzaro et al (1989) – Winner-take-all networks of O(n) complexity
- Andreou et al (1991) - Subthreshold signal processing
- Starzyk and Fang (1993) – CMOS current mode WTA circuit with both excitatory and inhibitory feedback
- DeWeerth and Morris (1995) – CMOS current mode WTA circuit with distributed hysteresis
- Indiveri (1997) – WTA networks with lateral excitation
- Morris, Horiuchi, and DeWeerth (1998) - Object-based selection system
- Indiveri (2001) – A current-mode hysteretic WTA network with excitatory and inhibitory coupling
- Liu (2003) – A normalizing aVLSI Network with controllable WTA properties

VLSI Systems that use aWTA circuits

- Mahowald and Delbruck (1988) – Marr-Poggio stereo algorithm
- Lazzaro et al (1989) – Winner-take-all networks of O(n) complexity
- Andreou et al (1991) - Subthreshold signal processing
- Mead et al (1991) - Binaural hearing
- Fang et al (1992) - VLSI processor for image data-compression
- Morris, Horiuchi, and DeWeerth (1998) - Object-based selection system
- Horiuchi and Niebur (1999) - 1D attentional system doing serial search using feature conjunction and IOR
- Indiveri, Murer, and Kramer (2001) – Active vision using aVLSI model of selective attention