

ECS404 Computer Systems and Networks

Computer Architecture
Week 4 Pt 2: CPU Registers and SRAM

Aims

- Show how SRAM, the memory used for cpu registers, works.

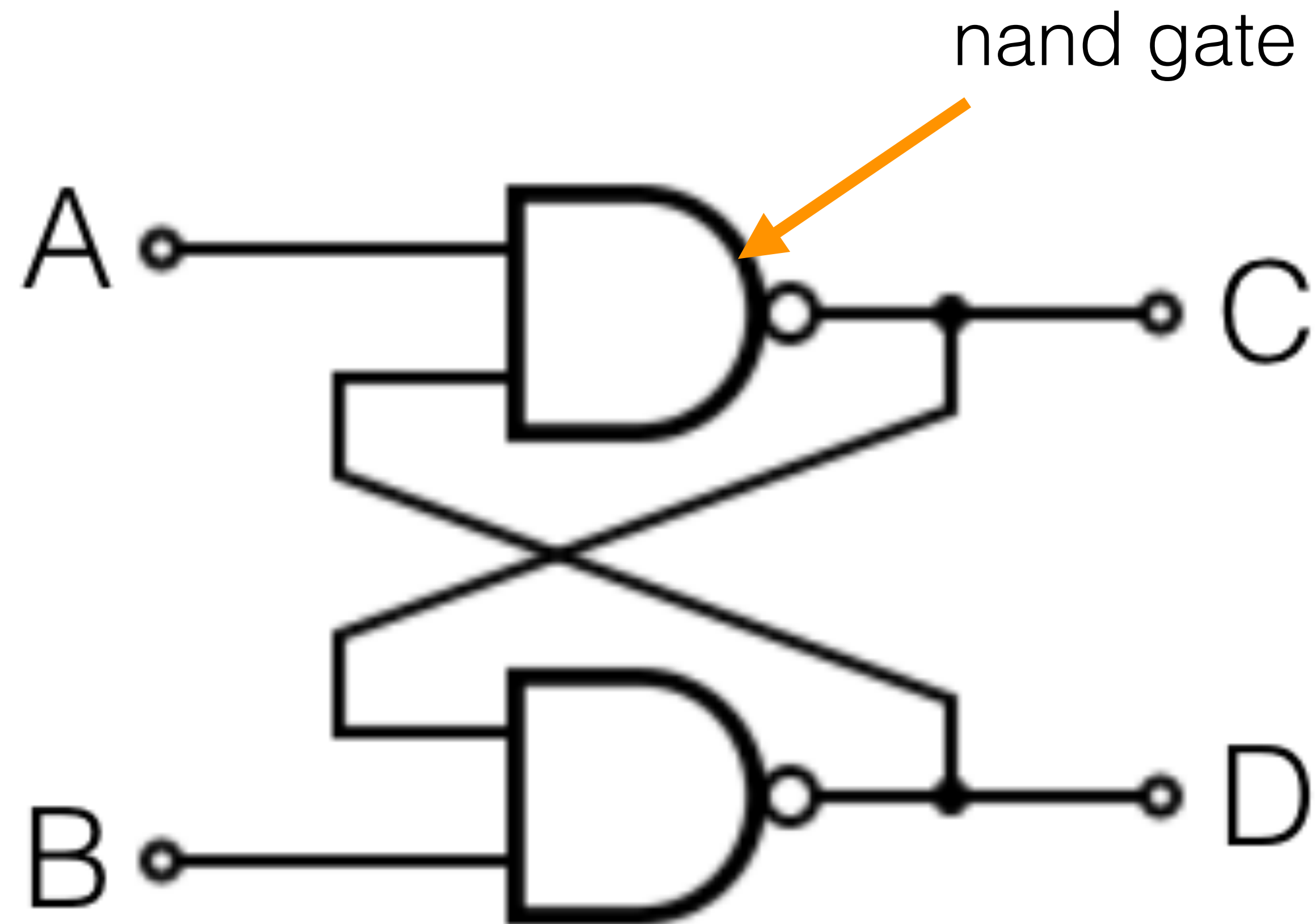
Learning Objectives

- Understand the construction of a flipflop, and understand how these are used to implement high-speed memory, for example in cpu registers and high-speed caches

Logic Gates

- In week 3 we looked at how to build logic gates.
- Gates have inputs and they produce outputs.
- In the jargon they are **combinational circuits**: their state depends only on the current inputs.
- Memory cells incorporate feedback and their state depends on past inputs as well as the current ones. They are **sequential circuits** (state depends on sequence of inputs).

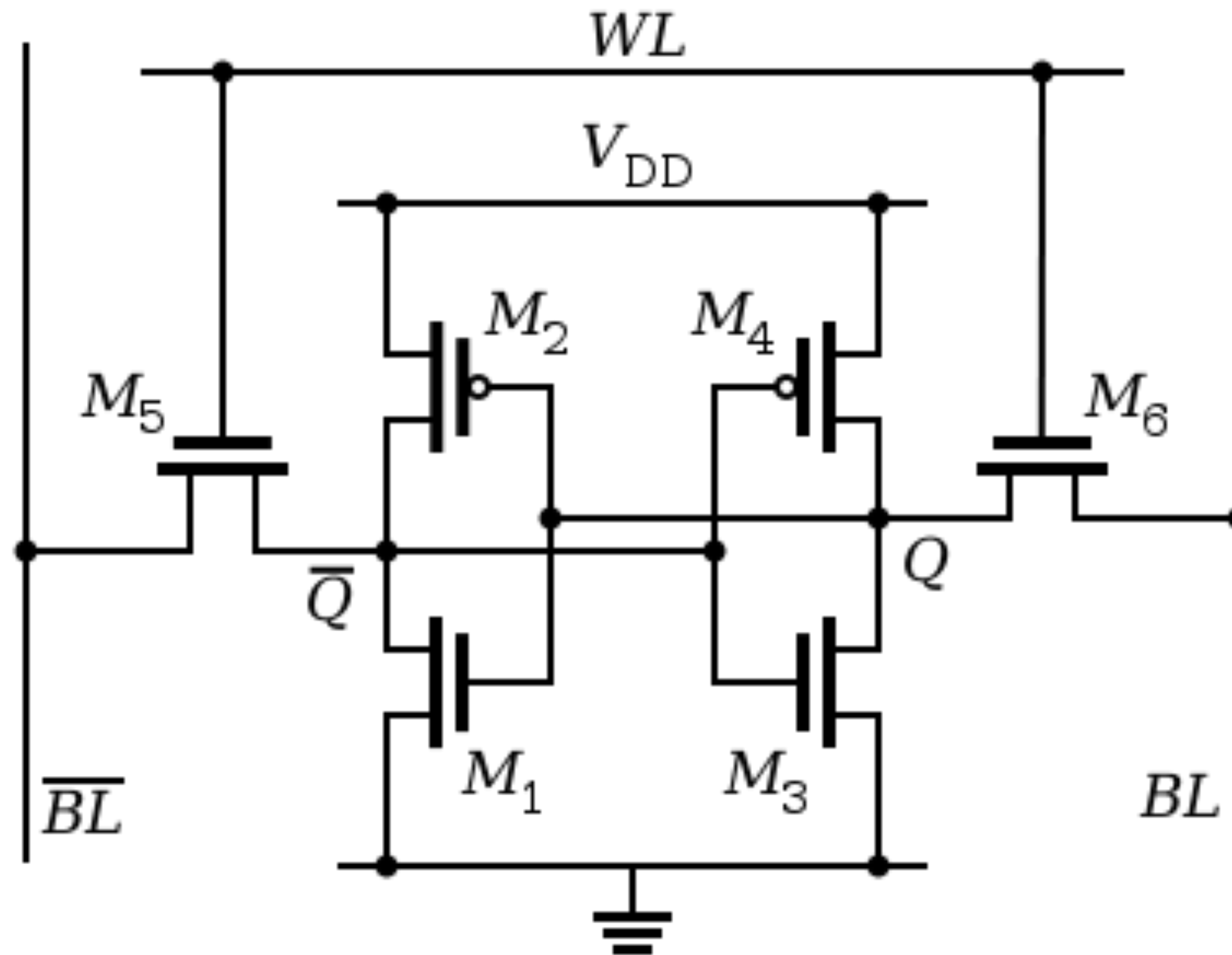
Basic Flip Flop (see lecture notes)



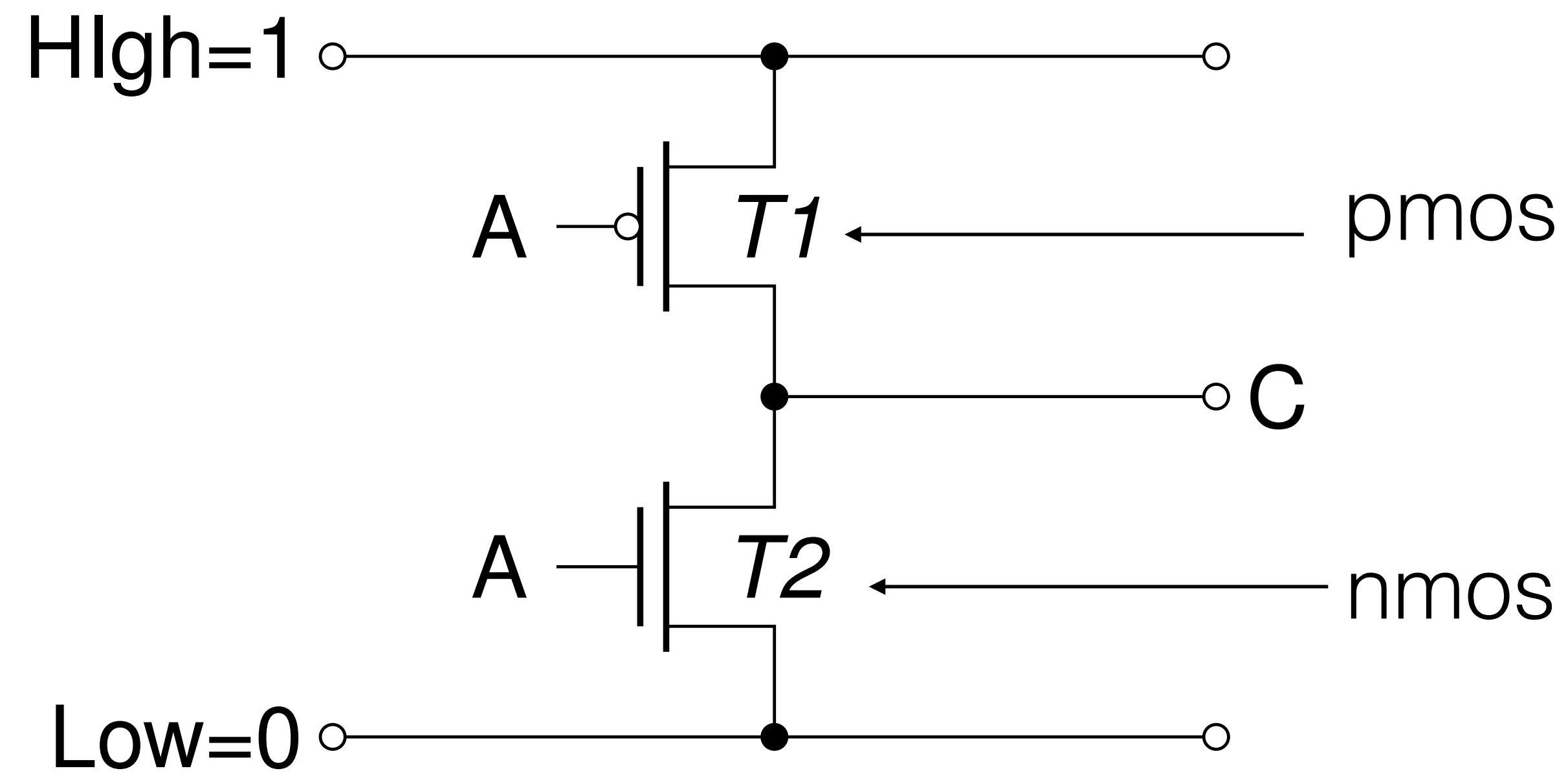
Memory

- .. and that is enough.
- If we can store one bit, then we can build whole computer memories.

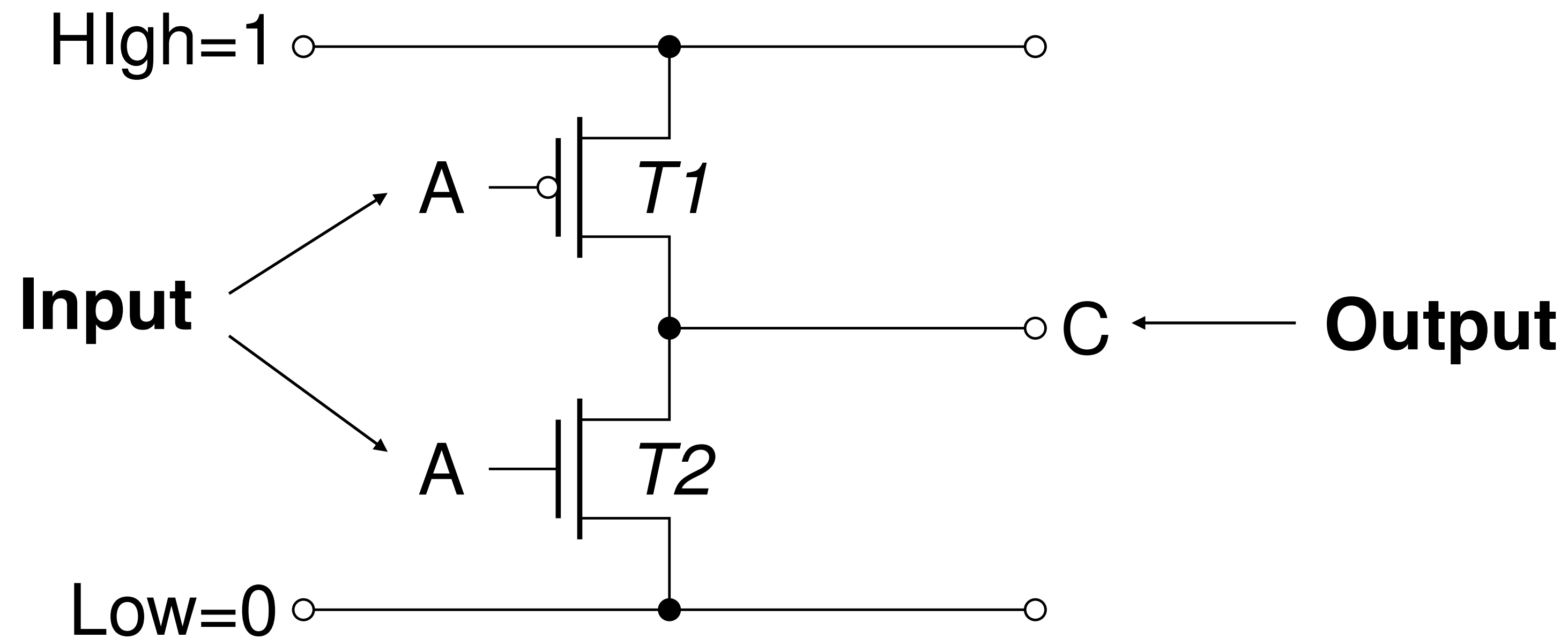
An actual SRAM



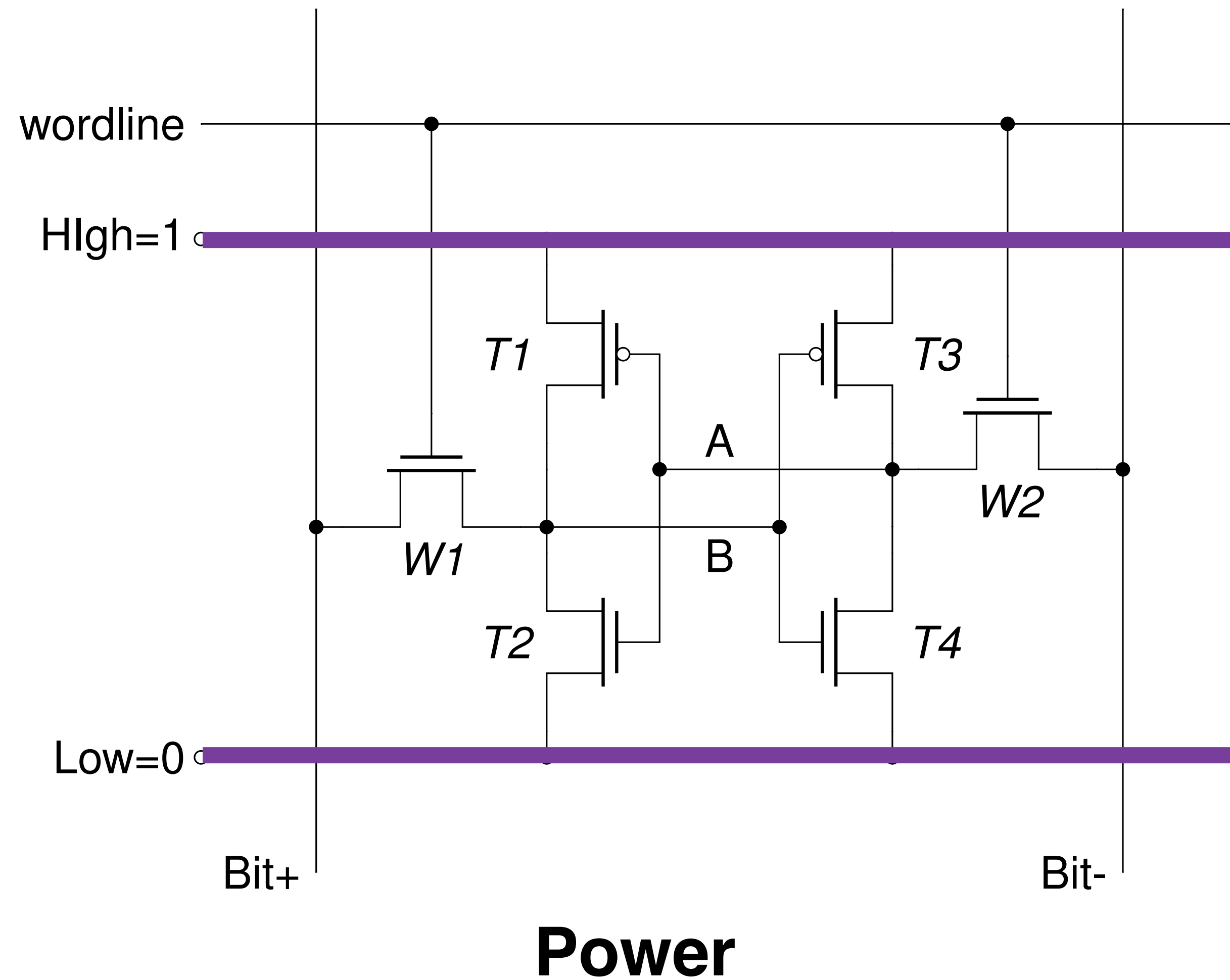
Inverter or not gate



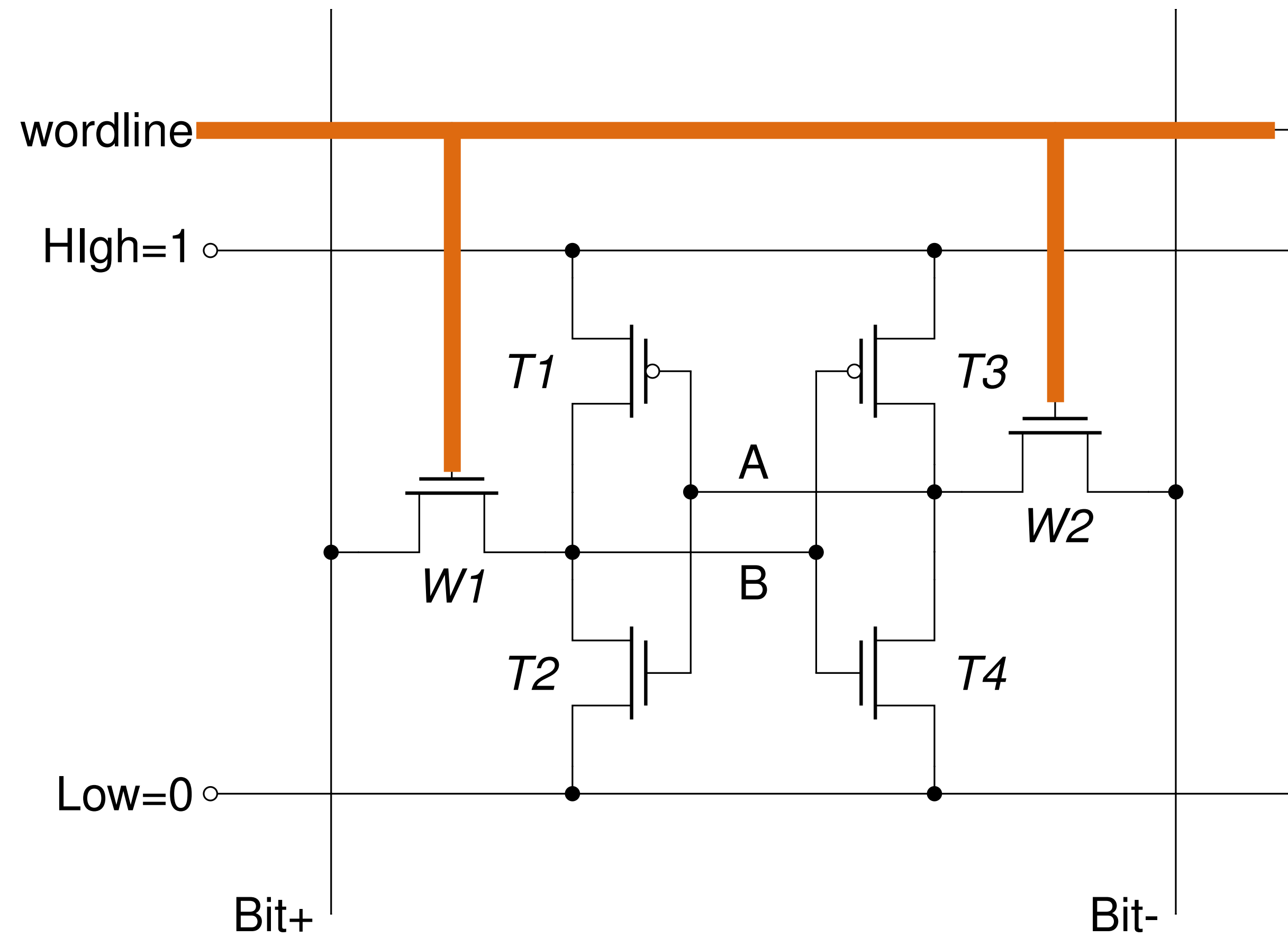
Inverter or not gate



SRAM cell

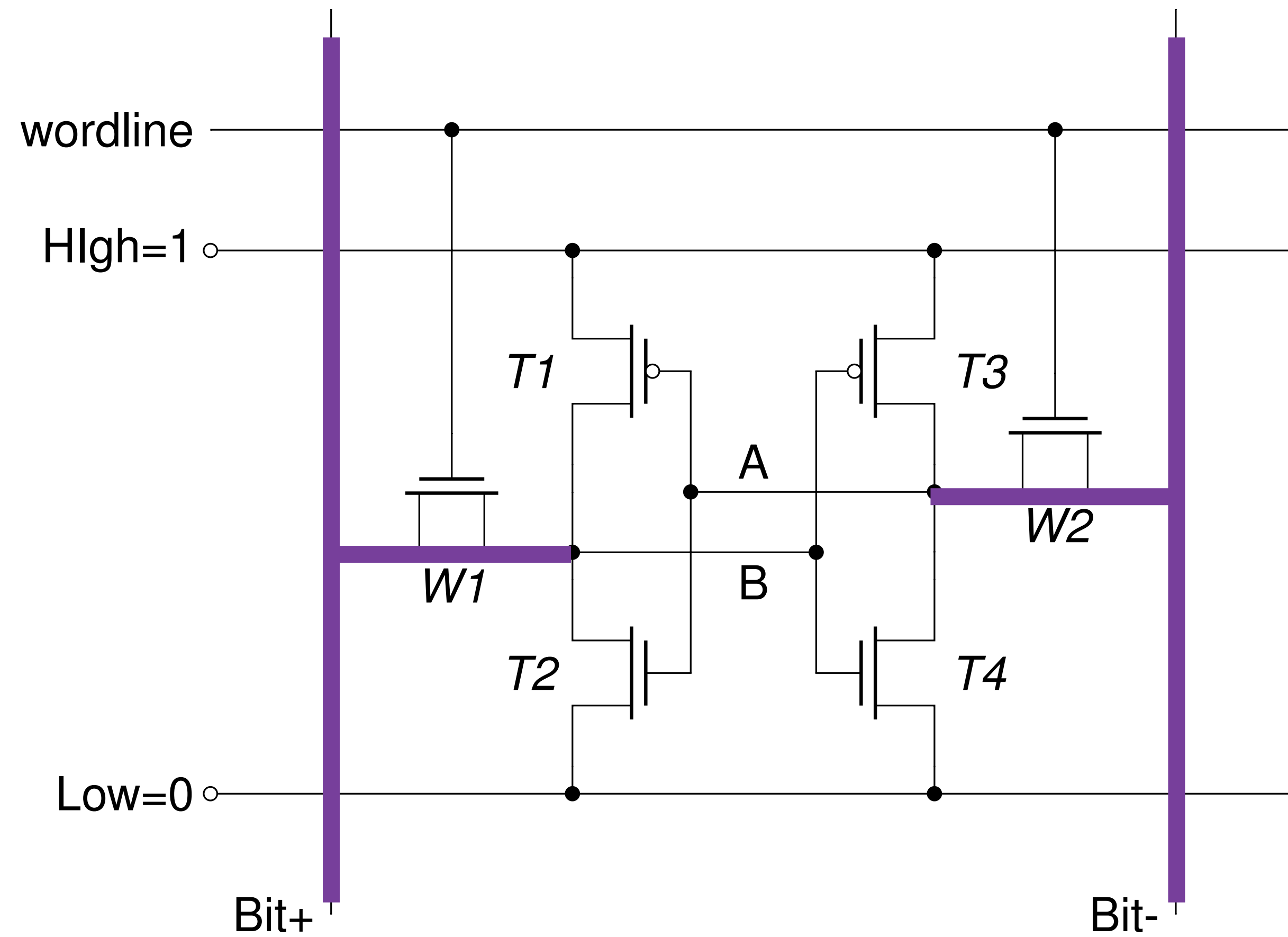


SRAM cell



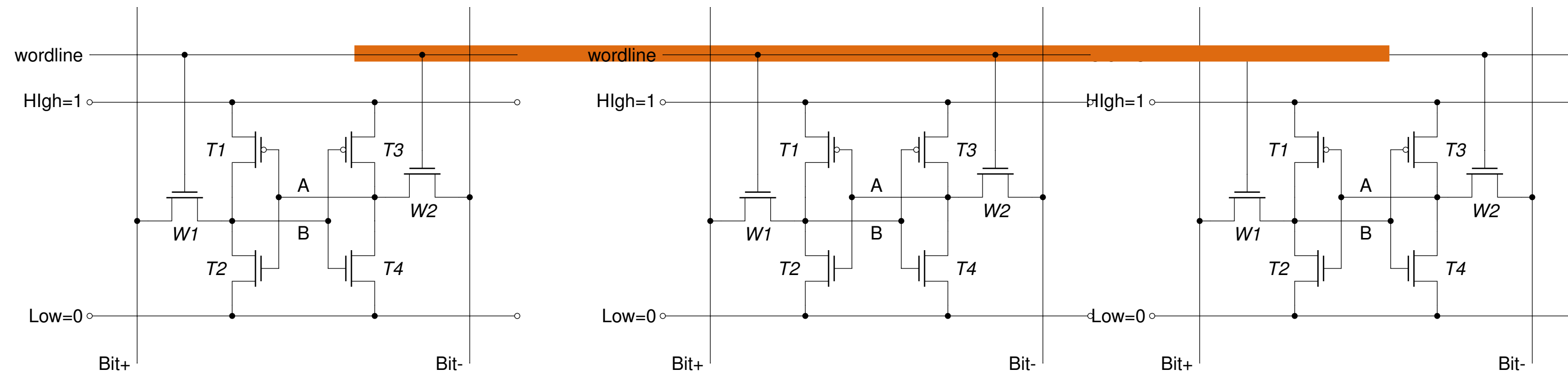
Access control

SRAM cell



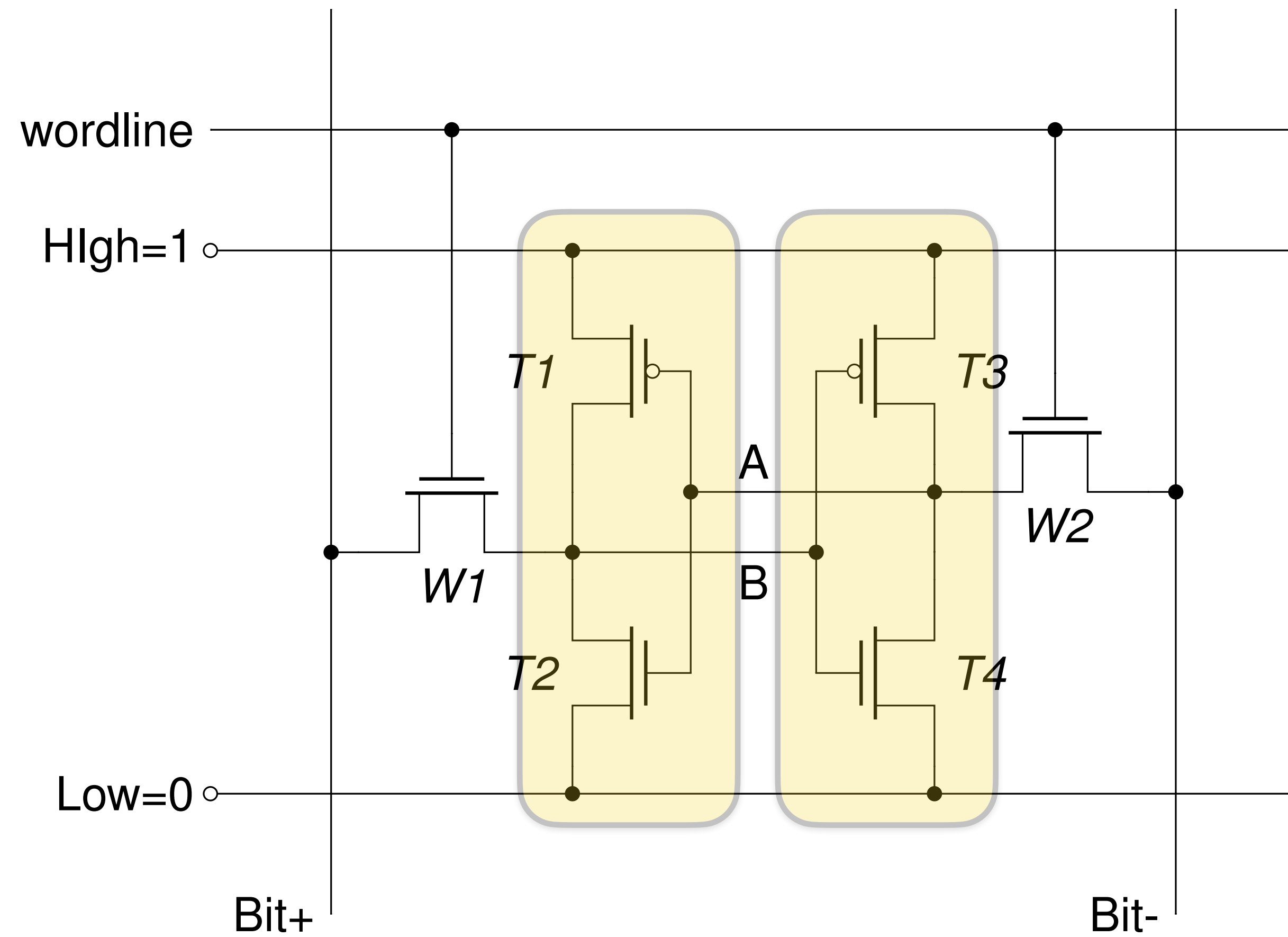
Data input and output

SRAM cell



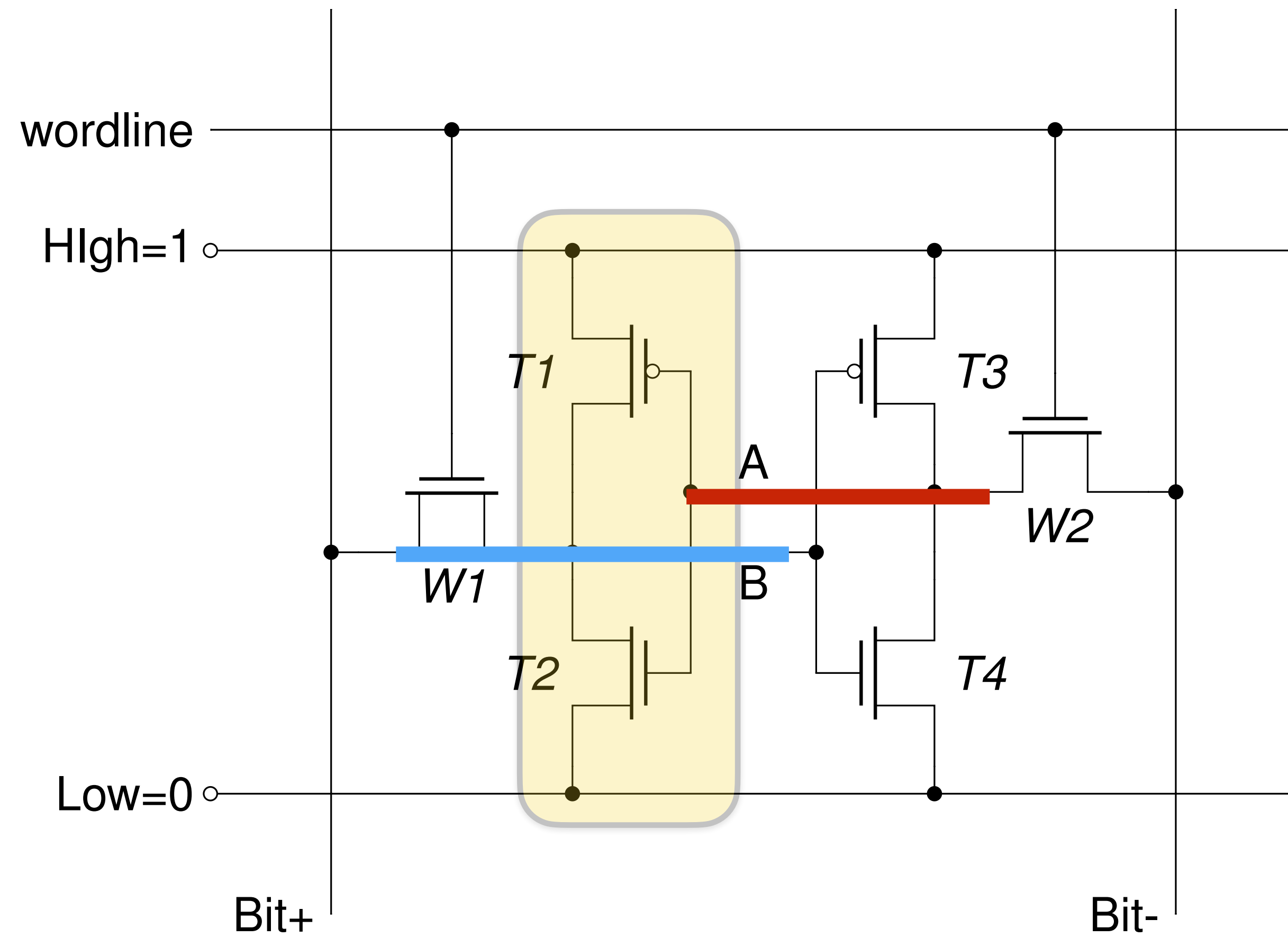
Access control

SRAM cell



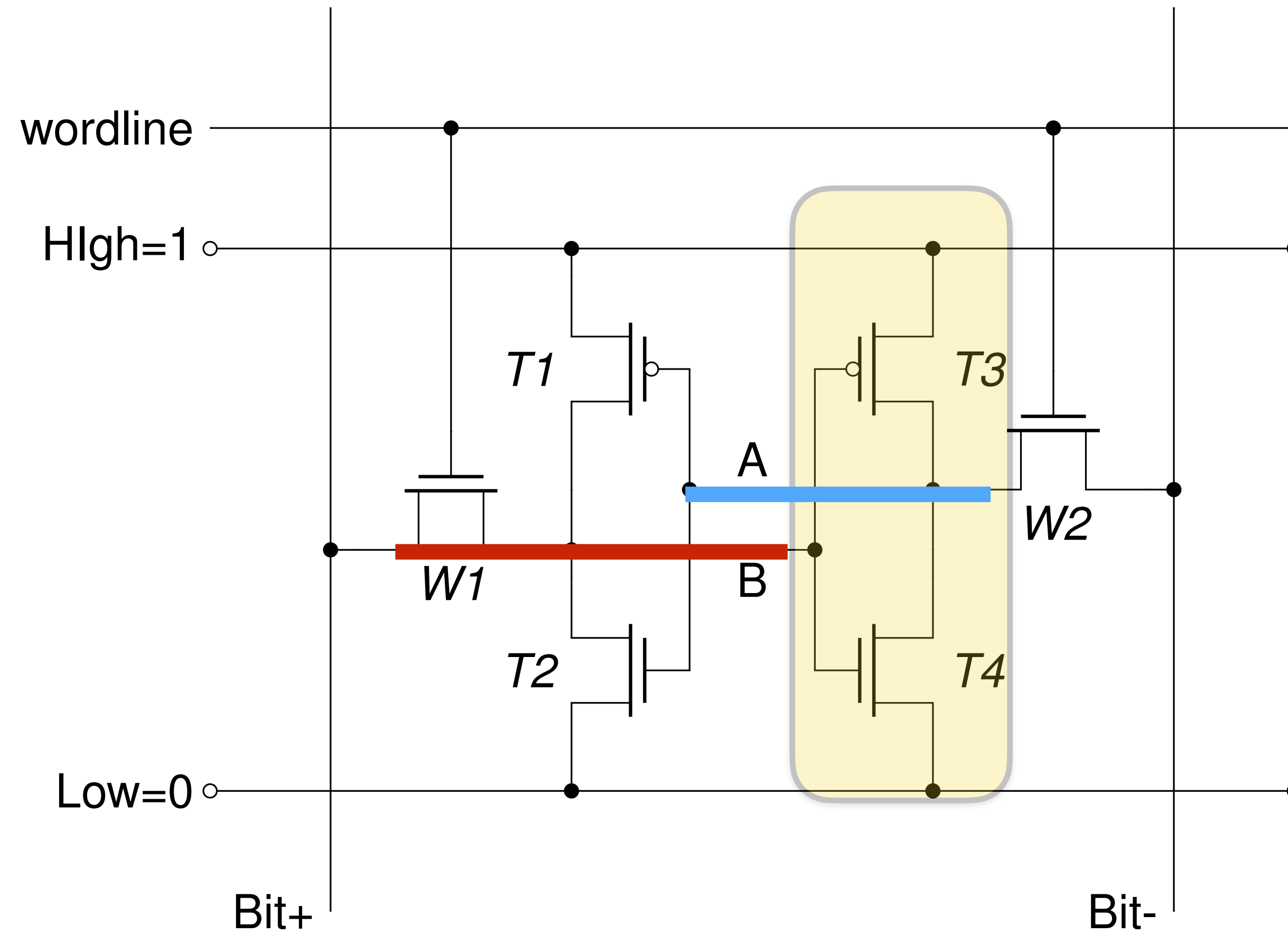
Inverters

SRAM cell



Inverter 1: **input** and **output**

SRAM cell

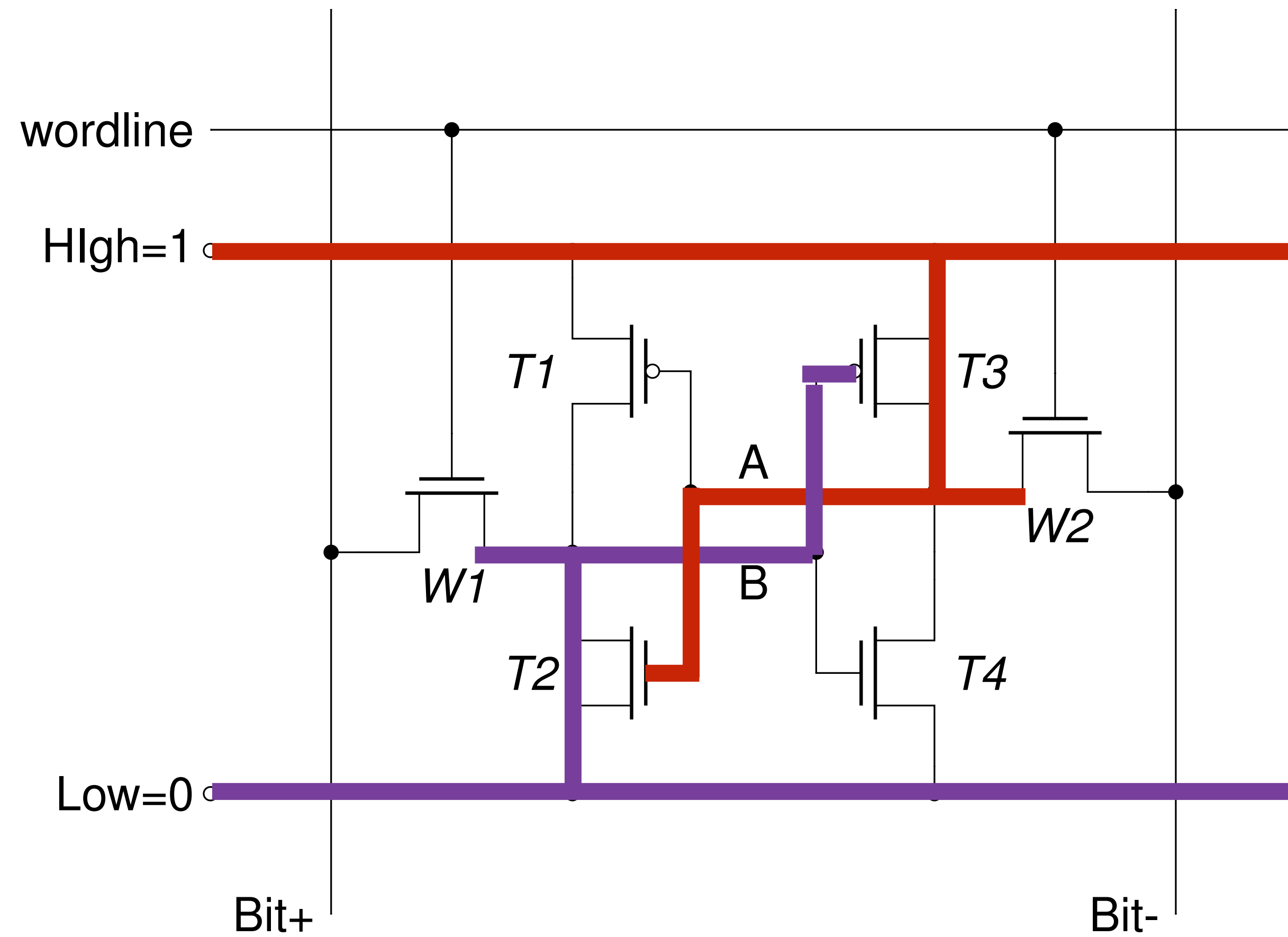


Inverter 2: input and output

SRAM cell

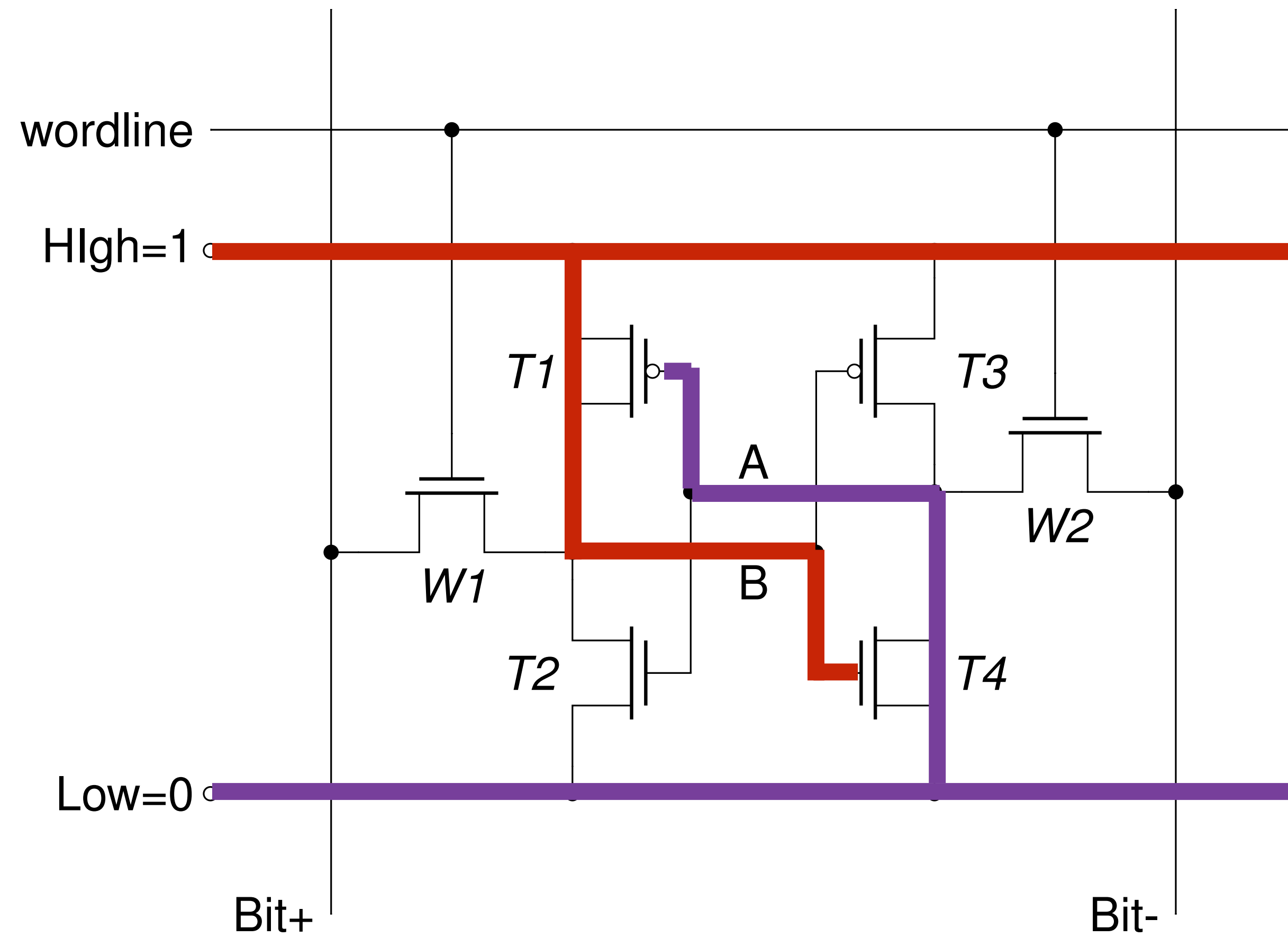
- Input of each inverter is output of other.
- So we can have
 - $A=1$ and $B=0$
 - Or $A=0$ and $B=1$
- We can't have
 - $A=1$ and $B=1$
 - $A=0$ and $B=0$

SRAM cell



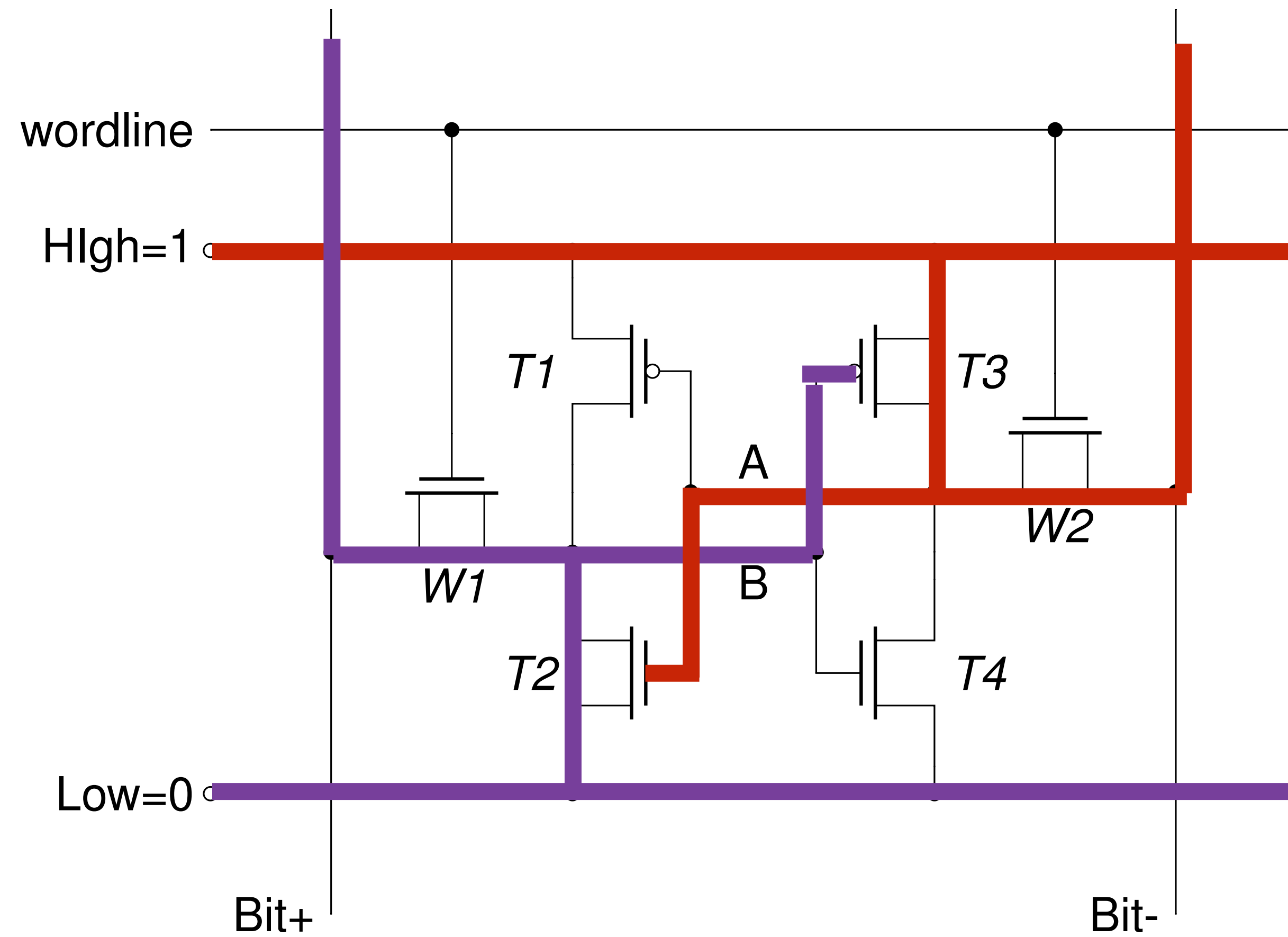
A=1 and B=0

SRAM cell



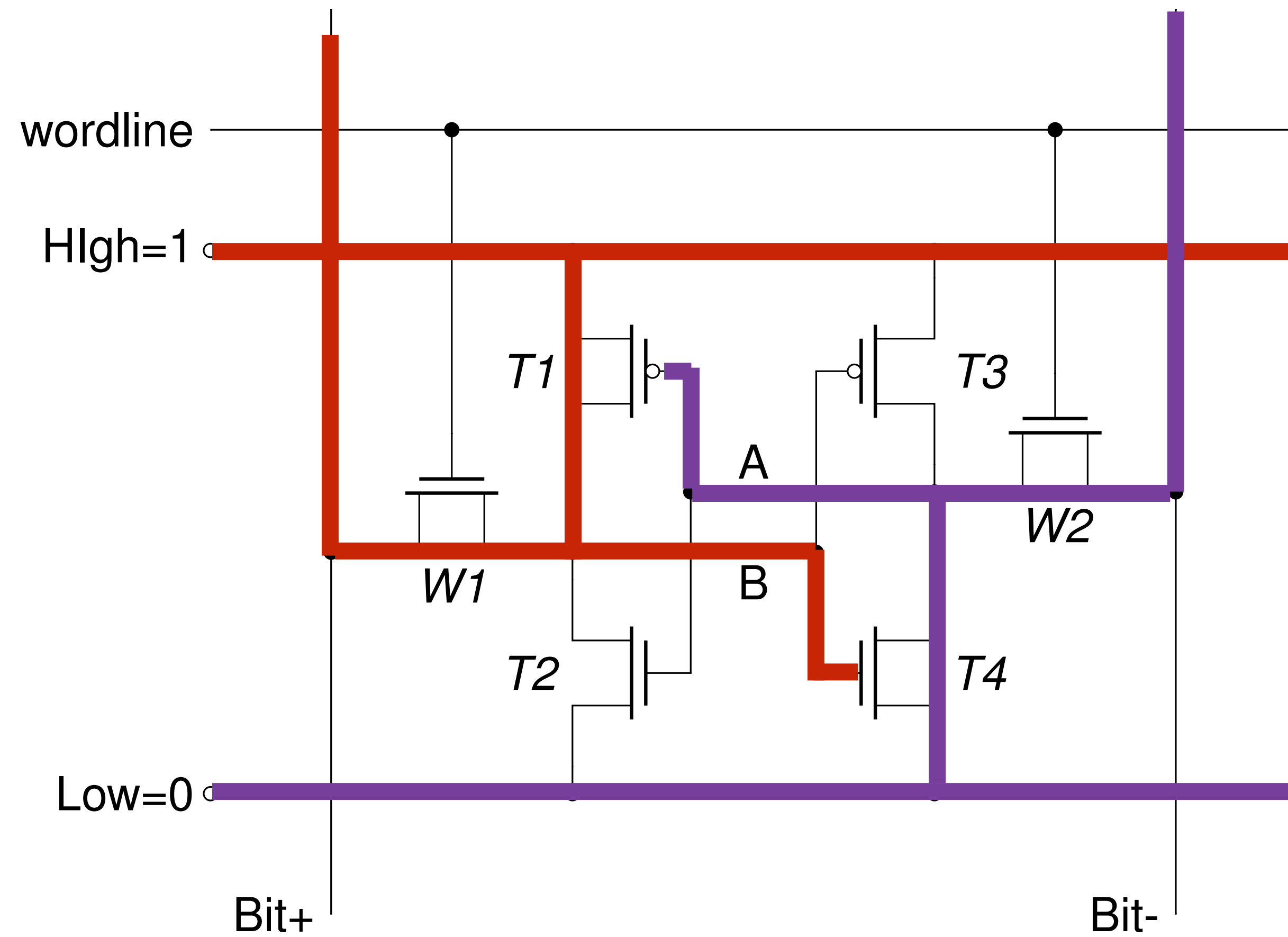
A=0 and B=1

SRAM cell



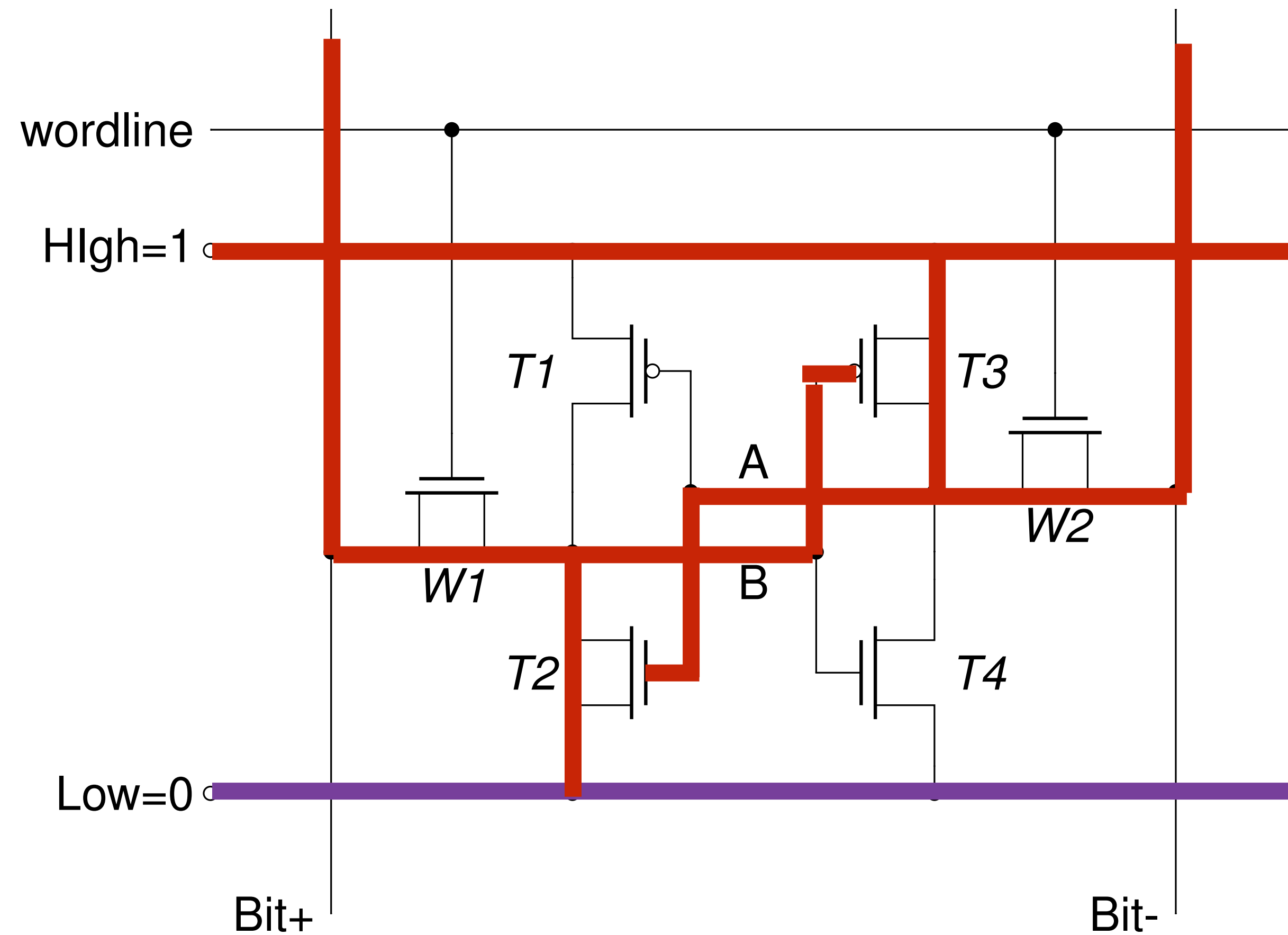
A=1 and B=0: wordline High

SRAM cell



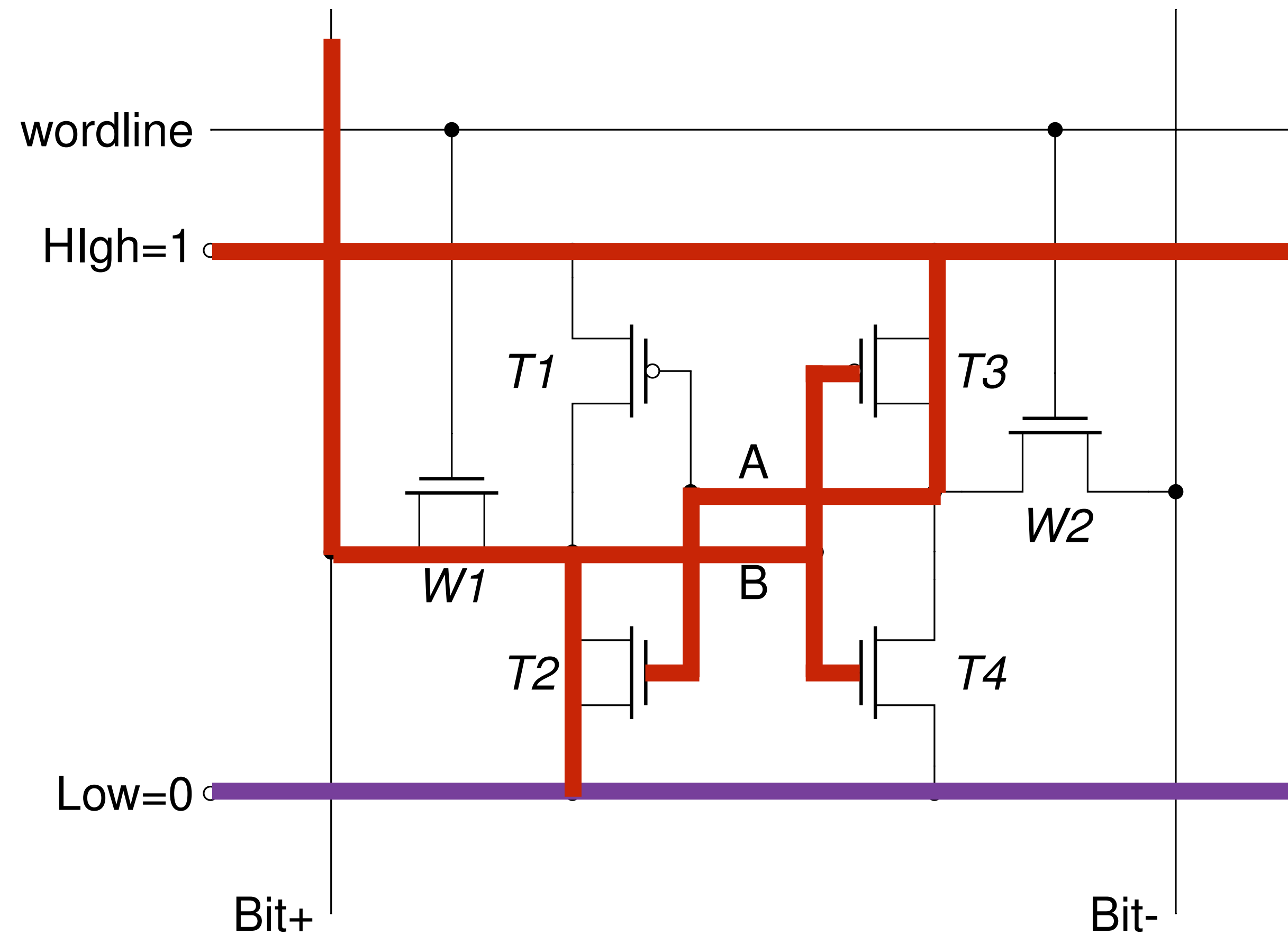
A=0 and B=1: wordline High

SRAM cell



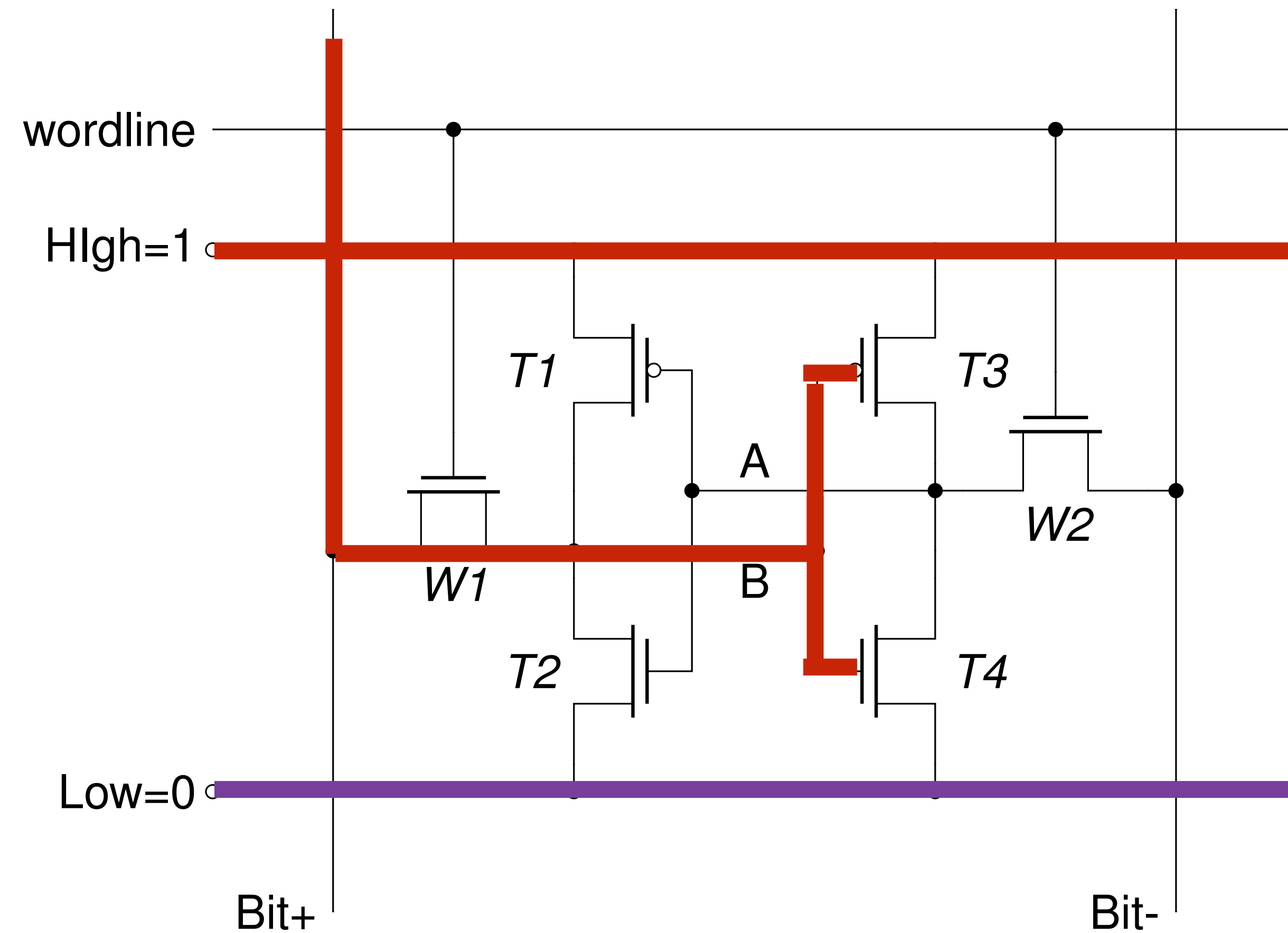
A=1 and B=0: wordline High bit lines as driver

SRAM cell



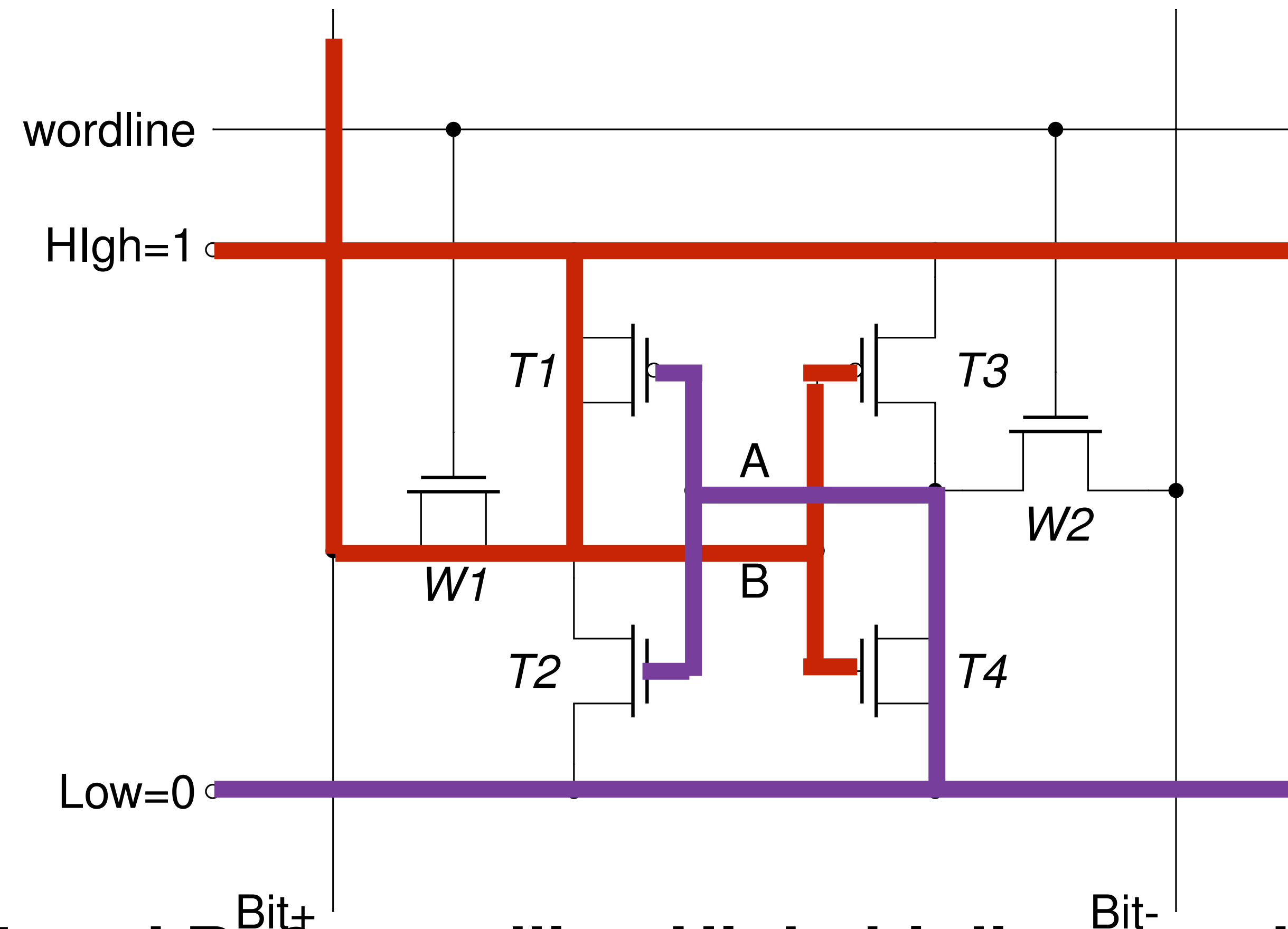
A=1 and B=0: wordline High bit lines as driver

SRAM cell



A=1 and B=0: wordline High bit lines as driver

SRAM cell



A=1 and B=0: wordline High bit lines as driver
Configuration flipped and stable

Summary

