Q: So, what exactly is a storage cell? How is it made?

A: There are two primary types of memory cells that are used: static and dynamic. The result is two types of semiconductor memories: Static RAM (SRAM) and Dynamic RAM (DRAM).

Static Memory Cells

We’ve already studied this! The basic SRAM memory cell is a S/R flip-flop:
In this figure, “Bit Line” refers to the column at which the cell resides, and “Word Line” refers to the row at which the column resides.

Hence, by enabling the proper row (by selecting the proper M-bit word), the S/R flip-flop is enabled (a conducting path is established between it and the bit lines). We can then enable the proper column (by selecting the proper N-bit word) and then either:

1. **Read** the latch state by sensing the bit lines

2. **Write** to the latch by driving the bit lines to the proper digital state.

Once we are done, we can disable the memory cell, and the latch will remain at its present state—until some later time when we need to either read from it or write to it again!

**Dynamic Memory Cells**

The basic memory cell of a DRAM is simply a small capacitor!
Q: Yikes! How can a capacitor be used as memory cell?

A: It’s actually pretty simple: a charged capacitor can represent a binary state of 1 and a discharged capacitor can represent a binary state of 0!

Just as with a static cell, enabling a word line results in a conducting path connecting the storage cell (i.e., capacitor) to the bit line.

Then, by enabling the bit line we can either:

1. Read the cell by sensing if it is charged or discharged.

2. Write to the cell by either charging or discharging the capacitor.

Q: I see! Once the memory cell is disabled (disconnected from the bit line), the capacitor retains its charge until we need to read or write again, right?

A: Ideally this would be true, but in actuality it is not. The problem is that these integrated circuit capacitors are very small, and so they do not hold much charge!
Additionally, the capacitor dielectrics are **not** (in fact cannot) be **perfect** insulators. As a result, the charge will “leak” from the capacitor—the capacitor will **discharge** over time.

The real problem is that it **does not take long** for this charge to completely leak away!

As a result, a dynamic memory cell (capacitor) must be **refreshed**.

The process of refreshing a memory cell is actually quite **simple**—we simply **read** the value of the cell (before it completely discharges) and then **write** the same value back to it (e.g., recharge the capacitor).

Therefore:

**Advantages of DRAM:**

1. Less space.
2. Less cost.

**Advantages of SRAM:**

1. Faster speed.
2. Lower power.
3. No refresh required!