In-Class Exercise
Overview of Memory Technology
SOLUTIONS

1. We are starting a project on non-volatile memory for portable applications. First introduce yourself to your team members. Exchange emails and talk about your schedules: when is a good time and place for everyone to meet.

2. This project is on non-volatile memory. What does that mean?

Non-volatile memory stays recorded when power to the device is turned off. Volatile memory, on the other hand, is cleared when the power turns off.

3. What are some examples of non-volatile memory?

Traditional Non-volatile Examples

Magnetic hard drives: These are magnetic thin films that are deposited on a substrate. 1s and 0s are written by aligning the magnetic field of each bit in a certain direction.

Traditional storage media: floppy discs, Zip discs, CD, DVD

FLASH/ NAND: This is the most common non-volatile memory used in portable devices. 1s and 0s are electrons (or lack of) stored in capacitors. However, due to limitations of scaling the transistors (which means a limitation in increasing the storage density), new forms are being researched. The newer forms will likely take over in the coming decade.

Newer forms we will talk about in this module:

Phase-change RAM (PRAM, OUM: Ovonyx Unified Memory): This technique uses a chalcogenide alloy which has a phase change (amorphous to crystalline) due to an applied voltage. The two phases have drastically different resistances. So, the 1 and 0 states have different currents in an applied voltage.

M-RAM: A magnetic tunnel junction transistor changes its resistance when the magnetic field is switched.

Other forms we won't talk about:

Fe-RAM: This technique uses a perovskite crystal. The atom in the center of the crystal is polarizable: it shifts it's position in an applied electric field.
Resistance Polymer Memory: Polymer that has a change in resistance with an applied field due to ionic diffusion along the polymer chain.
Ferroelectric Polymer Memory: Polymer chains where an applied field changes the polarization of the polymer chain.
Carbon Nanotube: Applied electric field moves location of C nanotube in a grid.
Molecular Memory: Applied field changes the position of electrons on a molecule, changing the localized charge state of the molecule.

(NOTE: Some volatile examples you may have heard of are DRAM and SRAM. These aren't correct answers to the question!)

4. What are some portable devices that need memory?

- Cell phone
- MP3 players
- Digital cameras
- advanced pagers (like a Blackberry)
- handheld web browsers
- PDAs
- Next generation- ultra small, notebook computers
- Handheld navigation systems

5. What are unique constraints for portable devices?

Of concern for all memory

- Cost
- Read/write capability (long term repeatable use)
- Storage density

Unique Concerns for Portable Devices

- Weight
- Size
- Read/write unit must be small (not the case for magnetic hard drives, floppy discs, and Zip discs)
- Reliability (a lot of jarring motion)
- Power consumption
- Integratable with electronics of device (Magnetic hard drives and traditional storage media use different materials and processing than electronics. They can't be integrated together on the same component.)