



The Islamic University of Gaza
Faculty of Engineering
Department of Computer Engineering



LCOM 3010 - Computer Architecture

Lab 4

Register File

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Introduction

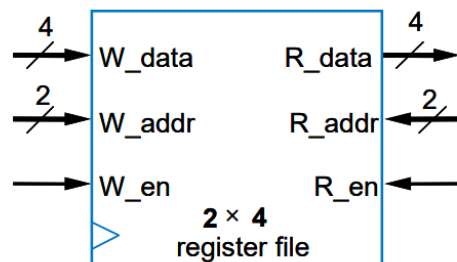
Registers are temporary storage locations inside the CPU that hold data and addresses.

What is the Register File?

A register file is a collection of registers in which any register can be read or written by specifying the number of the register in the file. The register file contains the register state of the computer. In addition, we will need an ALU to operate on the values read from the registers. A few CPUs also place special registers such as the PC and the status register in the register file. Other CPUs keep them separate.

A register file is typically implemented as an array of registers, where each register is a collection of storage elements. The register file has two major operations: read and write. During a read operation, the contents of a register are transferred to an output port. During a write operation, the contents of an input port are transferred to a register.

A typical datapath has multiple registers. The construction of a bus system with a large number of registers requires different techniques. A set of registers having common operations performed on them maybe organized into a register file . A block diagram of a 2×4 register file is shown in Figure. Note that in general a register file is denoted as $2^m \times n$, where m is the number of register address bits and n is the number of bits per register. In our case it is better to use a notation $2^2 \times 4$ register file

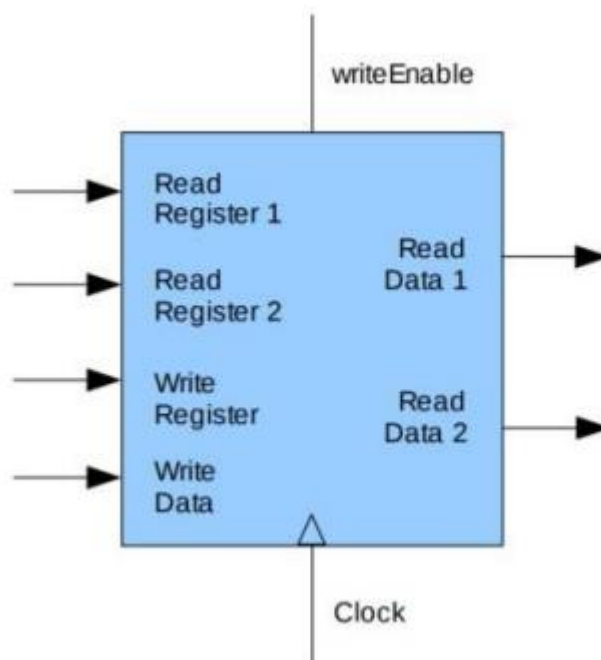


Register files have a memory-like behavior. However, they are very different from memories like SRAM, ROM, etc. as will be explained in more detail in class. They are generally used as fast temporary storage. Brief comparative properties are outlined in Table below.

Register File	Memory (SRAM)
m n-bit storage words	m n-bit storage words
Few words (<256), many ports, dedicated read/write ports, so that read and write operations can be done simultaneously.	Many words (>1024), few ports, shared read/write ports. Read and write operations cannot be done simultaneously
Writing to a register takes just one clock cycle. Read op doesn't require a clock or additional control inputs.	Writing to a register can take many clock cycles. Read op requires a clock and other CTRL.
Logically Static Content	Logically Dynamic Content
Synchronous	Different implementations but mostly asynchronous

Register File Design

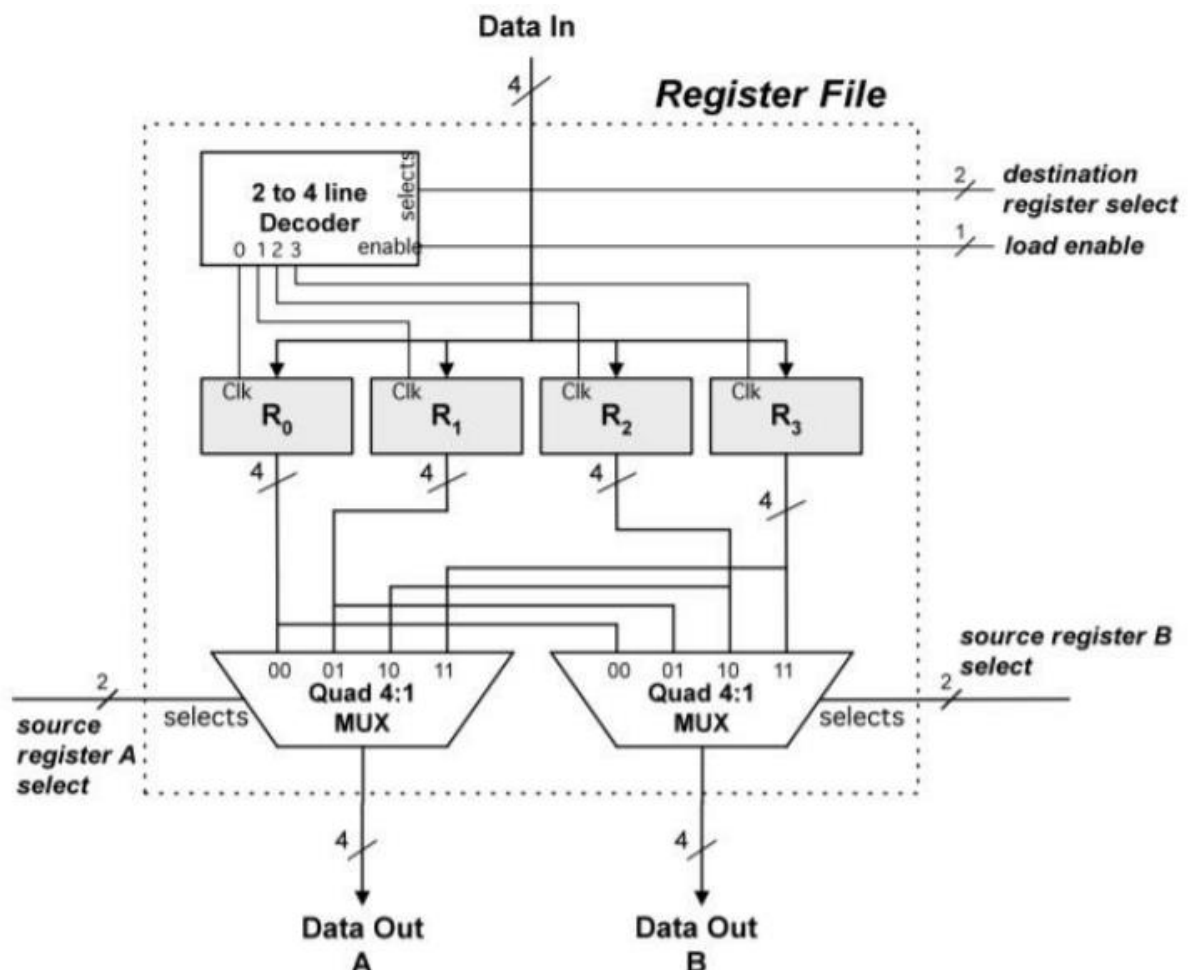
- MIPS register file includes 32 32-bit general purpose registers
- This register file makes possible to simultaneously read from two registers and write into one register as it is appropriate for MIPS processor.



A register file functions as follows:

- ❖ ReadRegister1 specifies which register should be read from. That register's data should be presented on the ReadData1 output.
- ❖ ReadRegister2 specifies which register should be read from. That register's data should be presented on the ReadData2 output.
- ❖ WriteRegister specifies which register should be written to.
- ❖ WriteData is the data that will be written to the register specified by WriteRegister.
- ❖ On a rising clock edge, the data will be written to the specified register.
- ❖ WriteEnable, if true, will cause the WriteData to be written to the register specified by Write-Register; otherwise, WriteData will be ignored and no register will be written to. Clock conveys the clock signal.

Here is a picture of what your register file sub circuit, symbolically, looks like. Bold labels indicate that an input/output contains more than 1 bit of data.



LAB TASK

1. Design a 4 bit Register File.

In your home try to connect the register file with ALU.