## CPS311 - Computer Organization

## Addressing Modes

For the examples that follow, assume the registers and memory are set up as follows.

Register 1 contains 3000

Memory Address	Contents (word)
1000	Some word opcode   R1   2000
2000	4000
2FFC 3000 3004	88 12 73
4000	1234
5000	5678
 14000	42

Direct (Absolute) mode - the instruction contains the address of the operand

In the above example, we would use the value at  $2000 \rightarrow 4000$ 

Memory Indirect (Deferred) mode - the instruction contains the address of a location in memory that contains the address of the operand

In the above example, since address 2000 contains 4000, we would use the value at 4000 -> 1234

Register Indirect (Register deferred) mode - the instruction specifies a register that contains the address of the operand

In the above example, since register 1 contains 3000, we would use the value at 3000 -> 12

Auto-increment - same as register indirect, but the register is incremented by the size of the operand <u>after</u> being used as address

In the above example, we would use the value at 3000 -> 12, and then register 1 would then be incremented to 3004 (since a word is 4 bytes long)

Auto-decrement - same as register indirect, but the register is decremented by the size of the operand <u>before</u> being used as address

In the above example, since register 1 contains 3000, we would use the value at 2FFC -> 88, and also register 1 would be decremented to 2FFC

Register + Displacement - the instruction specifies a register and a displacement, and these are added to determine the address of the operand

In the above example, since register 1 contains 3000, we would use the value at  $(3000 + 2000 = 5000) \rightarrow 5678$ 

Indexed - the instruction specifies a register and a base address. The contents of the register is multiplied by the size of the item to be addressed, and this product is added to the base address to yield the address of the operand

In the above example, since register 1 contains 3000, we would use the value at  $(4 * 3000 + 2000 = 14000) \rightarrow 42$ 

PC Relative - the instruction specifies a memory location relative to the value in the program counter (which points to the next instruction)

In the above example, we would use the value at  $(1004 + 2000 = 3004) \rightarrow 73$ 

Register - the instruction specifies a register that contains the value to be used

In the above example, since register 1 contains 3000, we would use 3000

Immediate - the instruction contains the value to be used

In the above example, we would use 2000