**Lecture #18 Worksheet**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Classification/section: \_\_\_\_\_\_\_\_\_\_\_\_\_**

**Fill in blanks to answer questions below. Then email this sheet to your TA.**

1. **Define computer architecture.**
2. **Lecture 18 covers the so-called ALU (or “datapath,” in the Patterson and Hennessy textbook). What is the purpose of the ALU?**

1. **The ALU is primarily composed of an adder/subtractor circuit and some related units. Name at least three other processing elements in the ALU.**

1. **The ALU contains adder elements in bit-slice form, in addition to AND and OR circuits. What other familiar element is included in each bit-slice?**

1. **What do we call the components that carry data to the ALU and back from the register block?**

1. **Notice that a square blue block is used to represent memory in the ALU diagrams, a green rectangle represents the Program Counter register, and a trapezoid on its side represents an adder—and also an ALU. Why does the trapezoid with a notch represent both ALU and adder circuits?**

1. **The diagram on slide 10 shows how the Program Counter points to the memory address of the next instruction. Why is an adder included?**

1. **As noted, the ALU also is represented by a trapezoid.** 
   1. **What is its extra output bit?**
   2. **The register block has four input and two output buses. Name them.**

**Inputs:**

**Outputs:**

1. **Slide 12 shows the register block hookup to the ALU. Where does the ALU result go?**

1. **Slide 13 introduces data memory. What is the difference between data memory and instruction memory.**
2. **Slide 14 illustrates the sign extender. Why do we need a sign extender?**

1. **Slides 15 & 16 shows the paths for data to/from memory. How is this different from the path of instructions into the CPU?**

1. **Branch instructions compare two values and make a decision to execute the instruction after the branch or go elsewhere in the program. Define the “elsewhere” (branch) address based on the current program counter.**

1. **Why is the sign-extended immediate shifted left two digits or spaces to make the branch new address?**

1. **Explain how the actual jump address is created from the 26-bit field in the jump instruction.**
2. **Why is the jump instruction executed so rapidly?**

1. **Why are multiplexers added to the register block and ALU inputs?**
2. **Define the components of read and write addresses in data memory.**

1. **Slide 24 shows the two memory elements, which are the same memory, but use different paths. Although data memory only goes to the register block, it turns out that part of the instruction go to the register block as well. What part of the instruction is that?**

1. **Define the two inputs to the Program Counter multiplexer.**

1. **Why is the CPU called a “single-cycle CPU?”**

1. **Review slide 31 and be sure that you can answer all the questions shown, then check your answers on slide 32.**