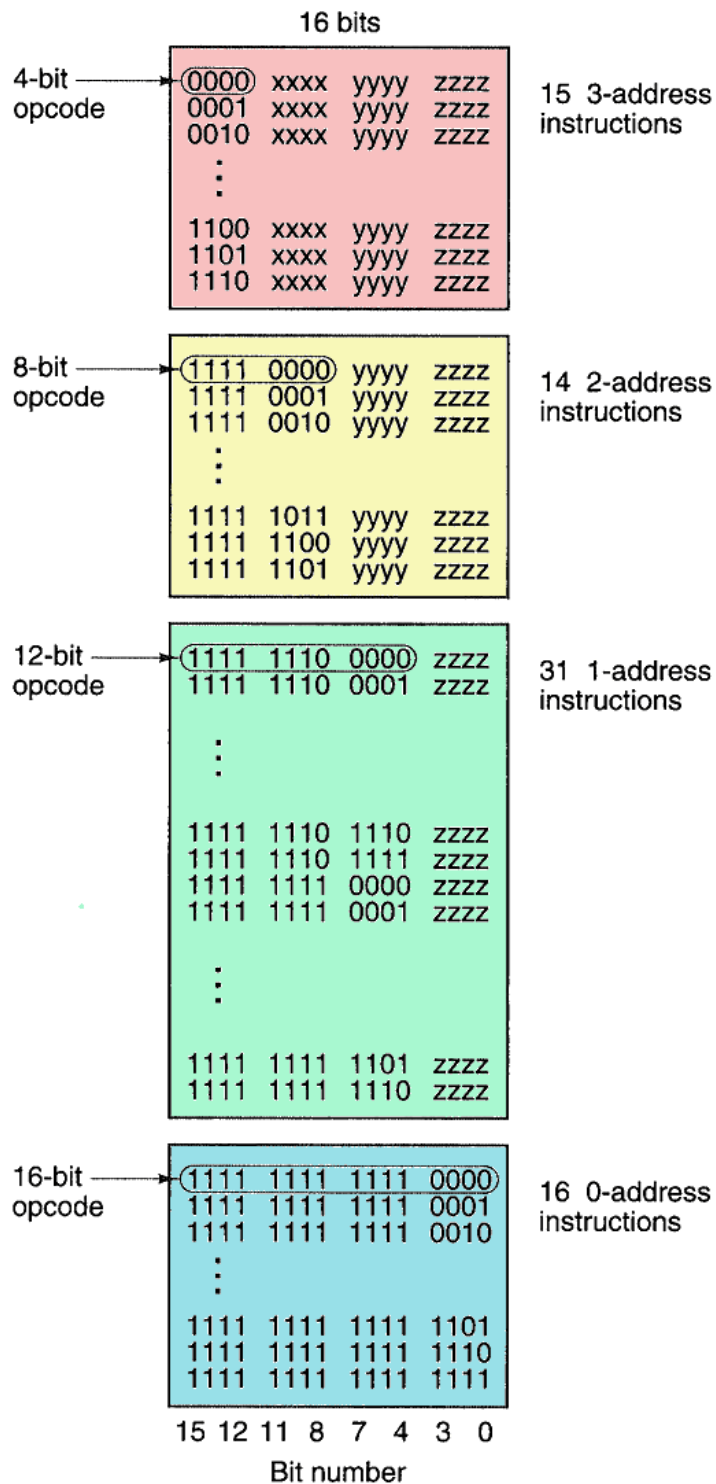


CS 210: Principles of Computer Organization

Expanding Op-codes



Consider a $(n+k)$ -bit instruction with a k -bit opcode and a single n -bit address. It allows for:

- 2^k different operations, and
- 2^n addressable memory cells

Example:

1. Design an expanding opcode to allow all of the following to be encoded in a 32-bit instruction:
 - 15 instructions with two 12-bit addresses and one 4-bit register number
 - 650 instructions with one 12-bit address and one 4-bit register number
 - 80 instructions with no addresses or registers

2. Is it possible to design an expanding opcode to allow the following to be encoded in a 12-bit instruction? A register is 3 bits.
 - 4 instructions with three registers
 - 255 instructions with one register
 - 16 instructions with zero registers

3. A certain machine has 16-bit instructions and 6-bit addresses. Some instructions have one address and others have two. If there are n two-address instructions, what is the maximum number of one address instructions?