



# VARIABLES & MEMORY ADDRESSES

All variables have an address



# VARIABLES

- Variables have
  - Name
  - Address or location in memory
  - Content

counter

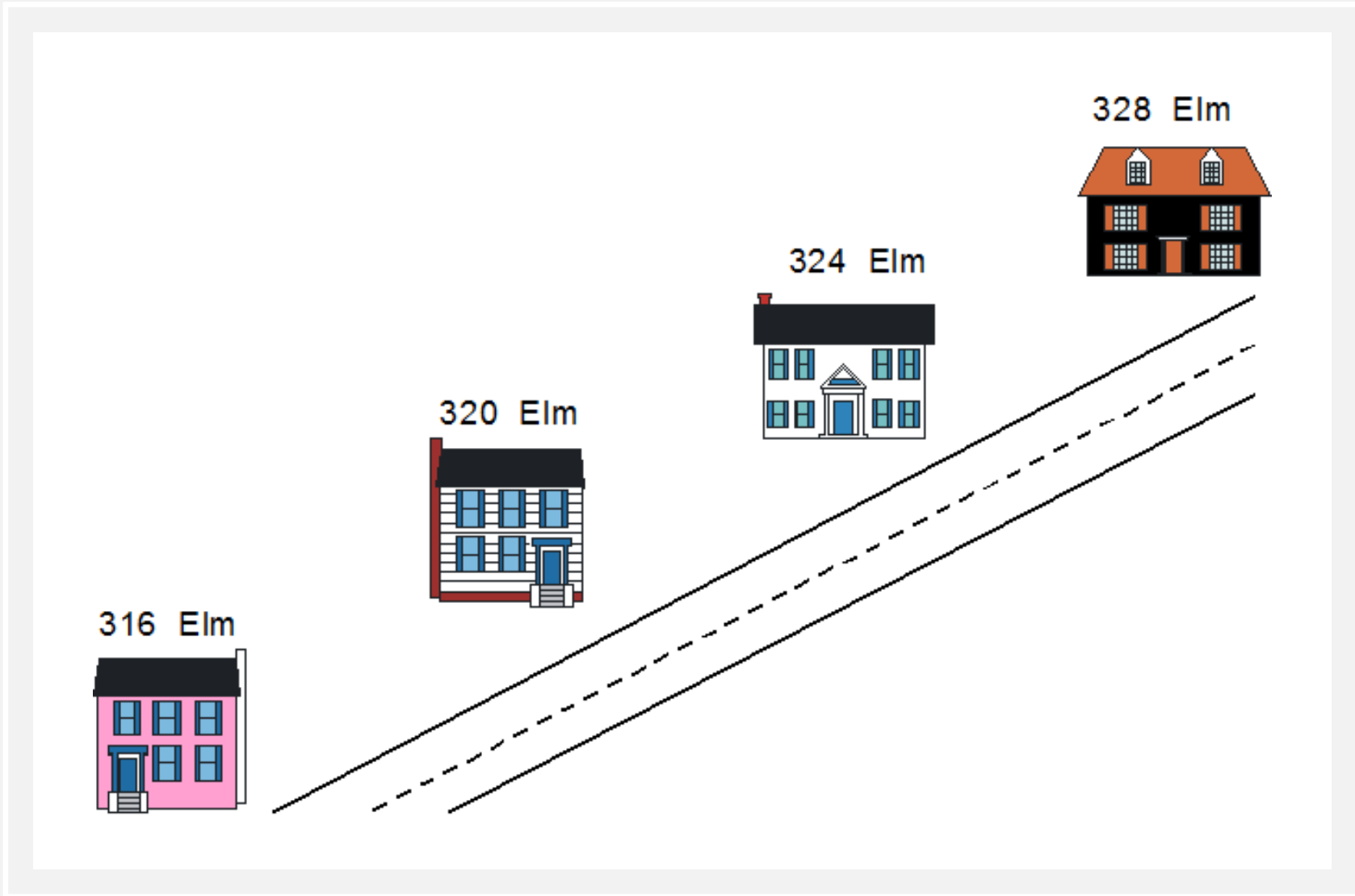
123

0x000000ab



# VARIABLE CONCEPTS

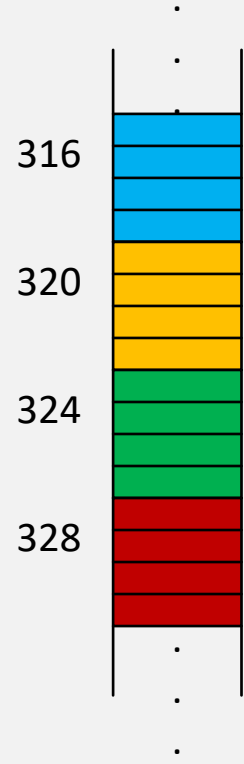
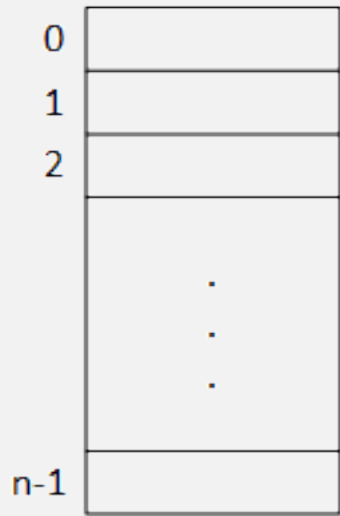
- Machine code does not use variable names, it uses the variable's address
- The compiler maps the name to an address
- In a program, the name can represent the address or the content stored at that address
  - Name used as an address
    - `counter = 5;`
  - Name used as the content
    - `balance = counter * 10;`
    - `cout << counter << endl;`



MEMORY METAPHOR



# MEMORY VIEWED AS AN ARRAY





# POINTER VARIABLES

- Pointers are variables that hold or store the memory addresses of other variables or data
- An address is a location in main memory that cannot change
- C++ provides several operators that operate on pointers