ECE264: Advanced C Programming

Summer 2019

Week 2: Addresses, Pointers, Pointer Arithmetic

Addresses

- Humans are not good at remembering numerical addresses.
  - What are the GPS coordinates (latitude and longitude) of your residence?

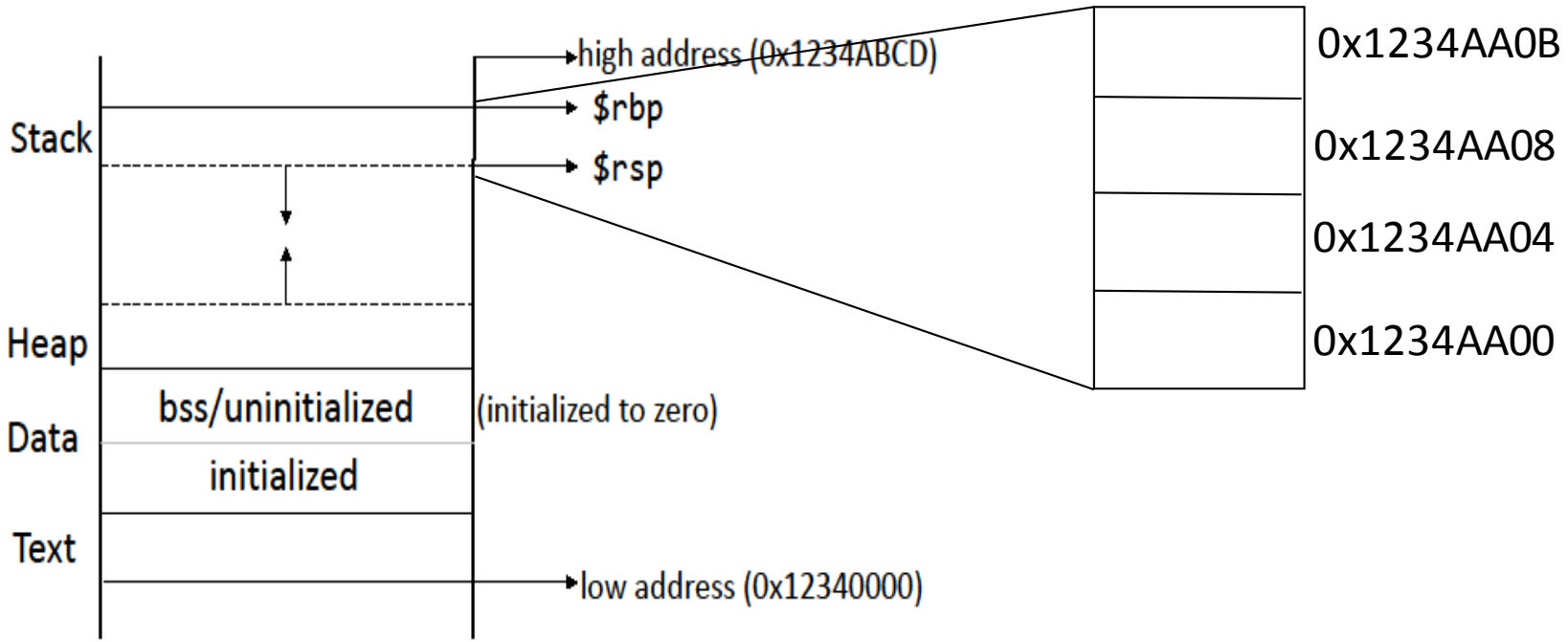
- Addresses in computer programs are just numbers.

Addresses

- Addresses in computer programs identify memory locations.

- Computer programs think and live in terms of memory locations.

Program Memory Layout - Revisited



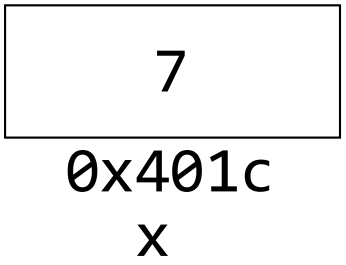
- Every memory location is a box holding data
- Each box has an address

Addresses

- A program navigates by visiting one address after another.
- We (humans) choose convenient ways to identify addresses so that we can give directions to a program
  - Variables

Addresses - Handles

- What is a variable?
  - Its just a handle to an address / program memory location
- `int x = 7;`



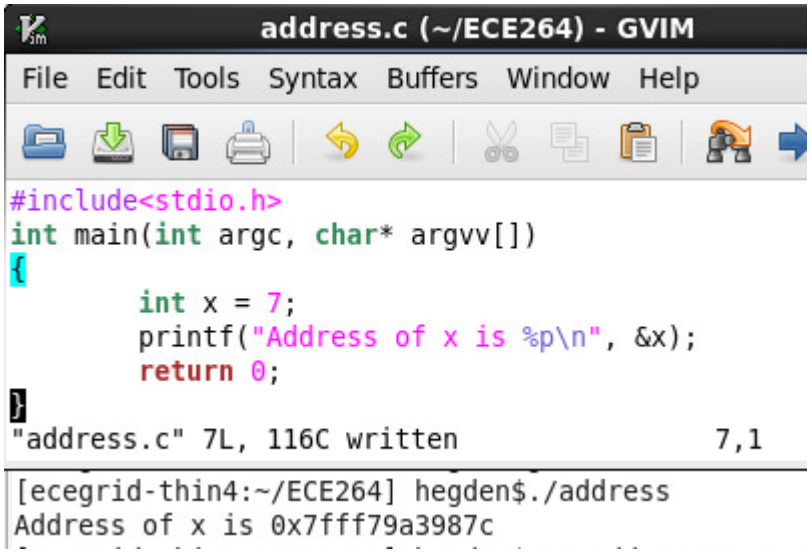
- Read `x` => Read the content at address `0x401C`
- Write `x`=> Write at address `0x401C`

Addresses - Visualizing

- The *address of* (&) operator fetches a variable's address in C.
- &x would return the address `0x401C`.
- Format specifier `'p'`:

  `printf("%p\n",&x)`

  prints the Hexadecimal address of x



Pointers

- Pointer is a data type that *holds an address*.

  `<type>* <pointer_name>;`

  We read it as "pointer to `<type>`"

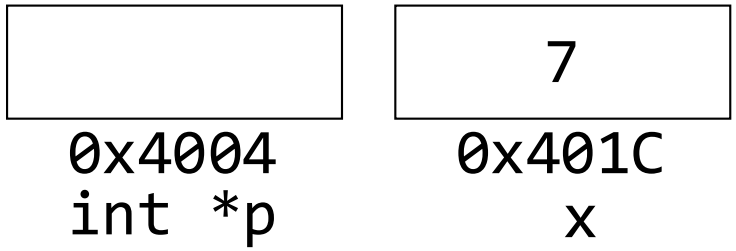
- Example:
  - `int* p;`

  is a variable named p whose type is pointer to `int`
  OR p is an integer pointer

  Note that the variable declared is p, *not* *p

Pointers

- A pointer always stores an address
- `<type>` of the pointer tells us what kind of data is stored at that address
- Example:
  - `int* p;` //declares a pointer variable p holding an address, which can store an integer.
- Remember p is a variable and all variables are just names identifying addresses. E.g.



Initializing Pointers

- `int* p=&x;`

  //p holds the address of a memory location that stores an integer.

0x401C	7
0x4004	0x401C
int *p	x

- We say `p` *points to* `x`