# CS 354
# Machine Organization and Programming

Week 8a

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Spring 2021

Casting Review and Endianness
Bitwise Operations
Binary Arithmetic
File Input/Output
Introduction to Assembly

# Casting Review

Type casting short to unsigned int

```
short x  = 0xCFC7; //-12345
unsigned int y = (unsigned)x;
```

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We're making two changes. Which comes first?

- 2 bytes to 4 bytes
- Signed to unsigned

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Size comes first: Remember sign extension

0xCFC7  -> 0xFFFF CFC7     //42945495

# Casting Review

Type casting short to unsigned int

```
short x  = 0xCFC7; //-12345
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```

Size comes first: Remember sign extension
0xCFC7  -> 0xFFFF CFC7     //42,945,495

Then signed to unsigned
0xFFFF CFC7  -> 0xFFFF CFC7     //still 42,945,495
Changing signedness doesn’t change the binary representation

# Casting Review

Type casting short to unsigned int

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short x  = 0xCFC7; //-12345
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What if we had done this operation in reverse?
Then signed to unsigned
0xCFC7  -> 0xCFC7.
Changing signedness doesn’t change the binary representation

# Casting Review

Type casting short to unsigned int

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short x  = 0xCFC7; //-12345
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What if we had done this operation in reverse?
Then signed to unsigned
0xCFC7  -> 0xCFC7u
Changing signedness doesn't change the binary representation

2 Bytes to 4 Bytes with unsigned numbers just extends with 0s
0xCFC7u  -> 0x0000CFC7u
// 53191

# Default Casting

Comparison operators need to compare like types

-1 < 0
-1 < 0U

U makes the literal value into an unsigned number

# Default Casting

Comparison operators need to compare like types

-1 < 0 true
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# Default Casting

Comparison operators need to compare like types

| | |
|---|---|
| -1 < 0 | true |
| -1 < 0U | false |

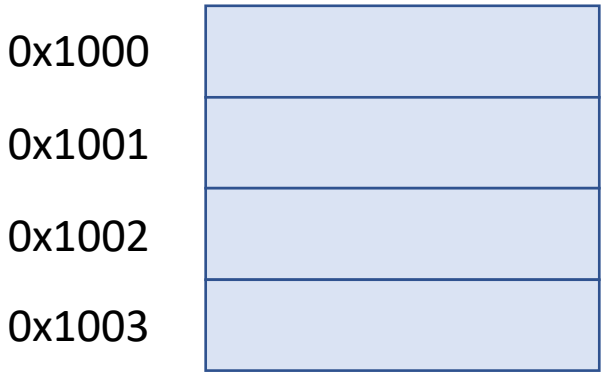
U makes the literal value into an unsigned number

Signed type is converted to unsigned type by default

# Endianness

Consider 4-byte integer

int n = 0x87654321;

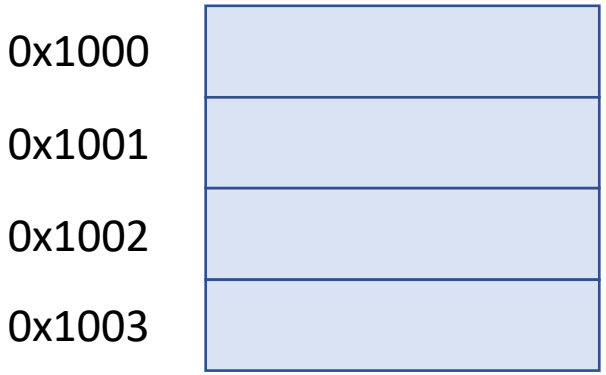


# Endianness

Consider 4-byte integer

int n = 0x87654321;

$b_3$ $b_2$ $b_1$ $b_0$



# Endianness

Consider 4-byte integer

int n = 0x87654321;

| | |
|---|---|
| 0x1000 | 87 |
| 0x1001 | 65 |
| 0x1002 | 43 |
| 0x1003 | 21 |

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Big Endian
MSB first

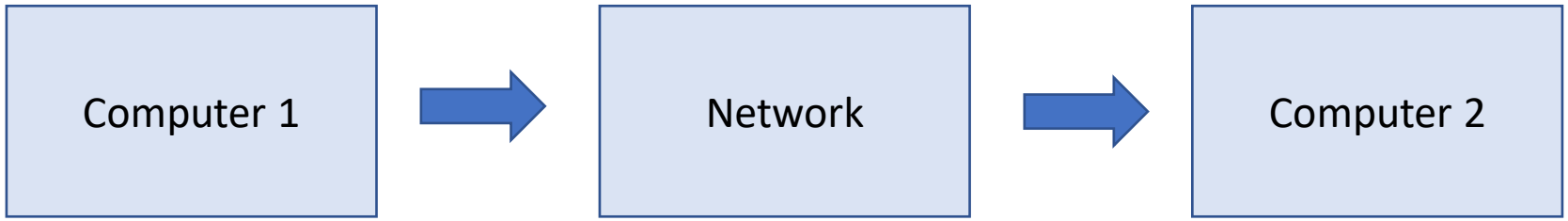
| | |
|---|---|
| 0x1000 | 21 |
| 0x1001 | 43 |
| 0x1002 | 65 |
| 0x1003 | 87 |

Little Endian
LSB first

> . . . Lilliput and Blefuscu . . . have, as I was going to tell you, been engaged in a most obstinate war for six-and-thirty moons past. It began upon the following occasion. It is allowed on all hands, that the primitive way of breaking eggs, before we eat them, was upon the larger end; but his present majesty's grandfather, while he was a boy, going to eat an egg, and breaking it according to the ancient practice, happened to cut one of his fingers. Whereupon the emperor his father published an edict, commanding all his subjects, upon great penalties, to break the smaller end of their eggs. The people so highly resented this law, that our histories tell us, there have been six rebellions raised on that account; wherein one emperor lost his life, and another his crown. These civil commotions were constantly fomented by the monarchs of Blefuscu; and when they were quelled, the exiles always fled for refuge to that empire. It is computed that eleven thousand persons have at several times suffered death, rather than submit to break their eggs at the smaller end. Many hundred large volumes have been published upon this controversy: but the books of the Big-endians have been long forbidden, and the whole party rendered incapable by law of holding employments.

In his day, Swift was satirizing the continued conflicts between England (Lilliput) and France (Blefuscu). Danny Cohen, an early pioneer in networking protocols, first applied these terms to refer to byte ordering [25], and the terminology has been widely adopted.

# Data Transfer Between Computers




Little Endian

Big Endian

Big Endian