I2 BIT I/O

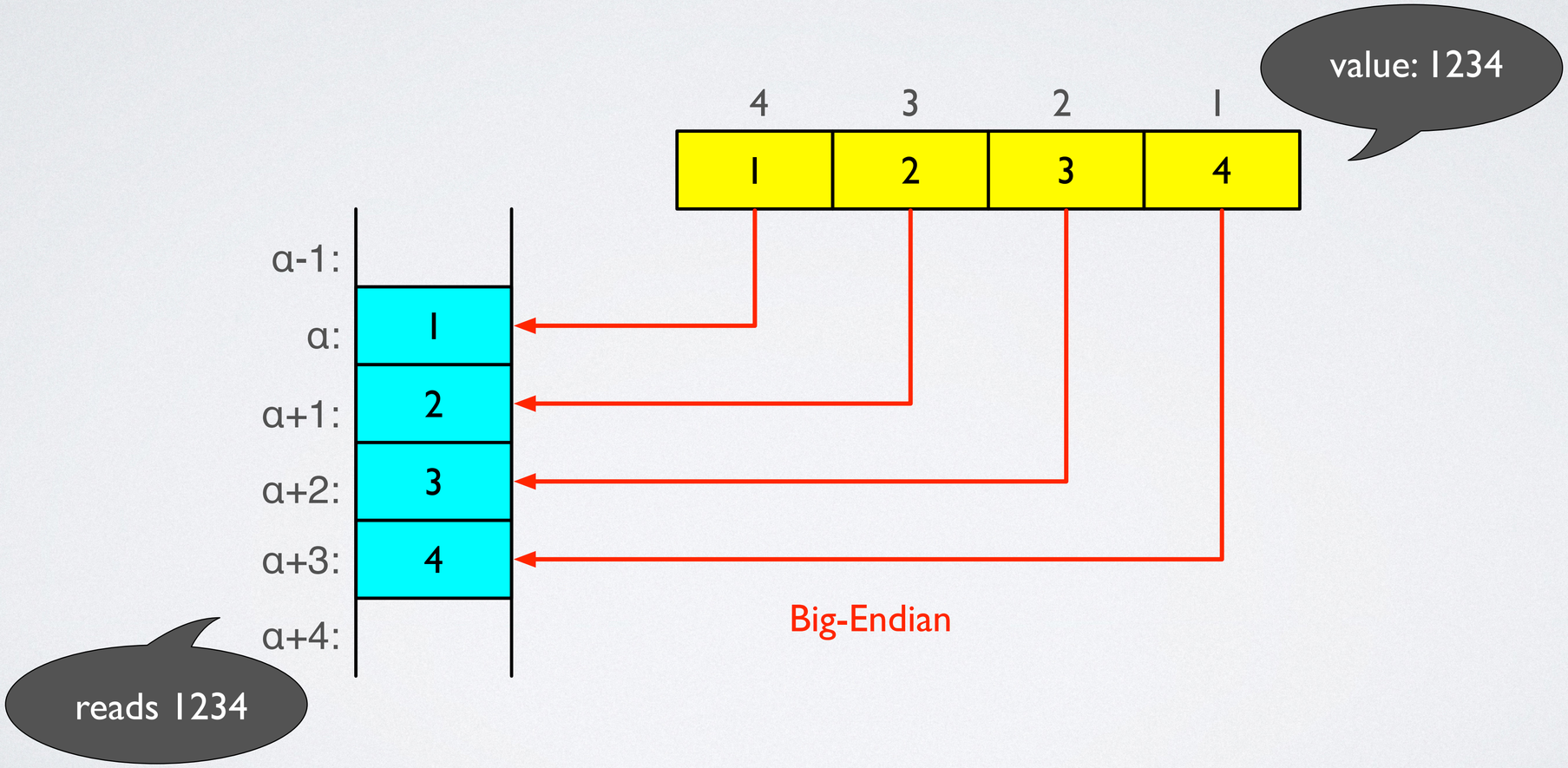
Design Pattern

ENDIANNESS

- When two parties wish to exchange information, then they need to agree on an ordering convention if the data being exchanged is too large to be sent in one piece.
- In computing, endianness refers to the byte or bit ordering of data stored in the computer memory or send over the network.
- We distinguish two orderings:
  - Big-endian order
  - Little-endian order

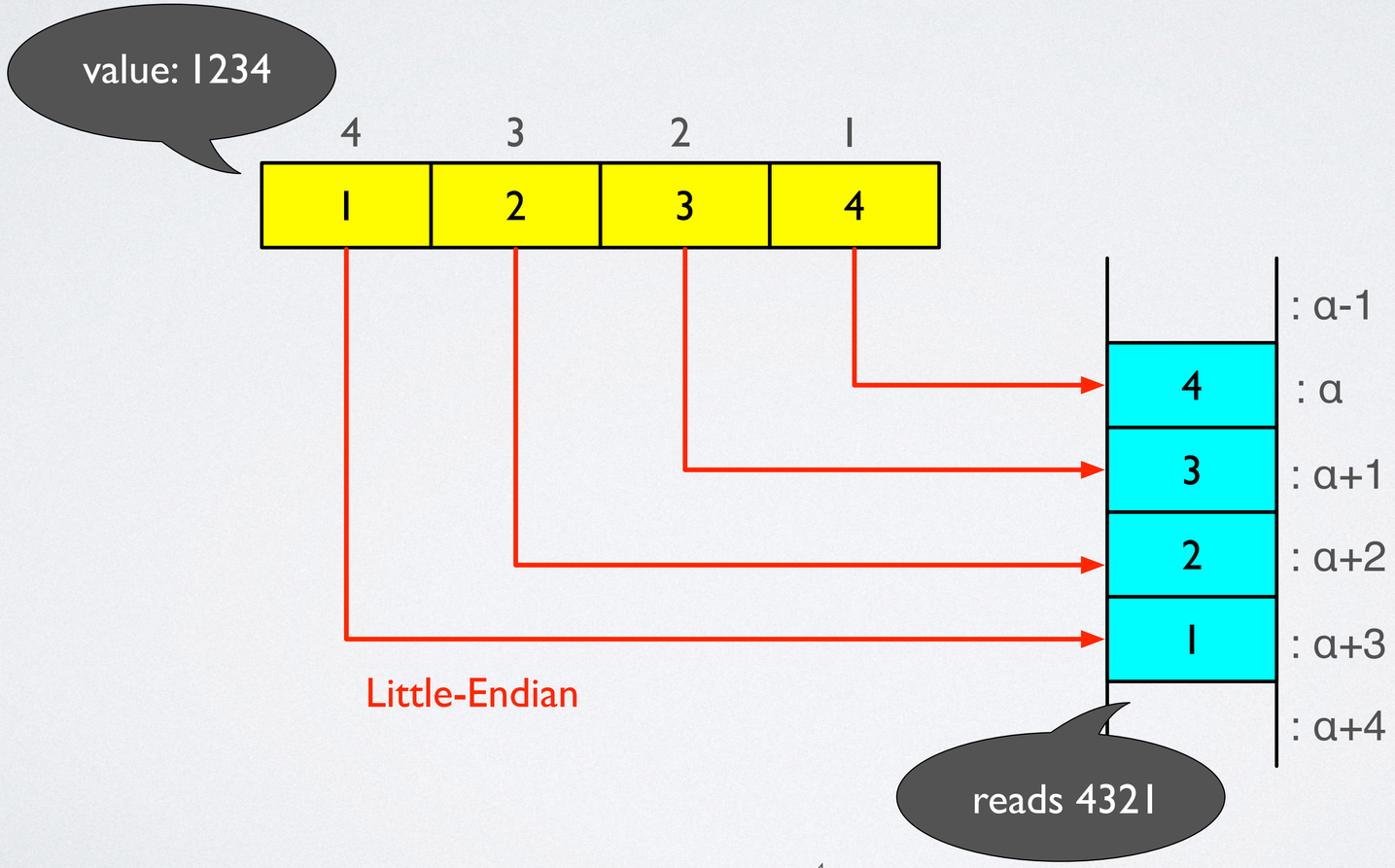
BIG-ENDIAN

- The most significant byte or bit (MSB) is stored at the memory location with the lowest address:



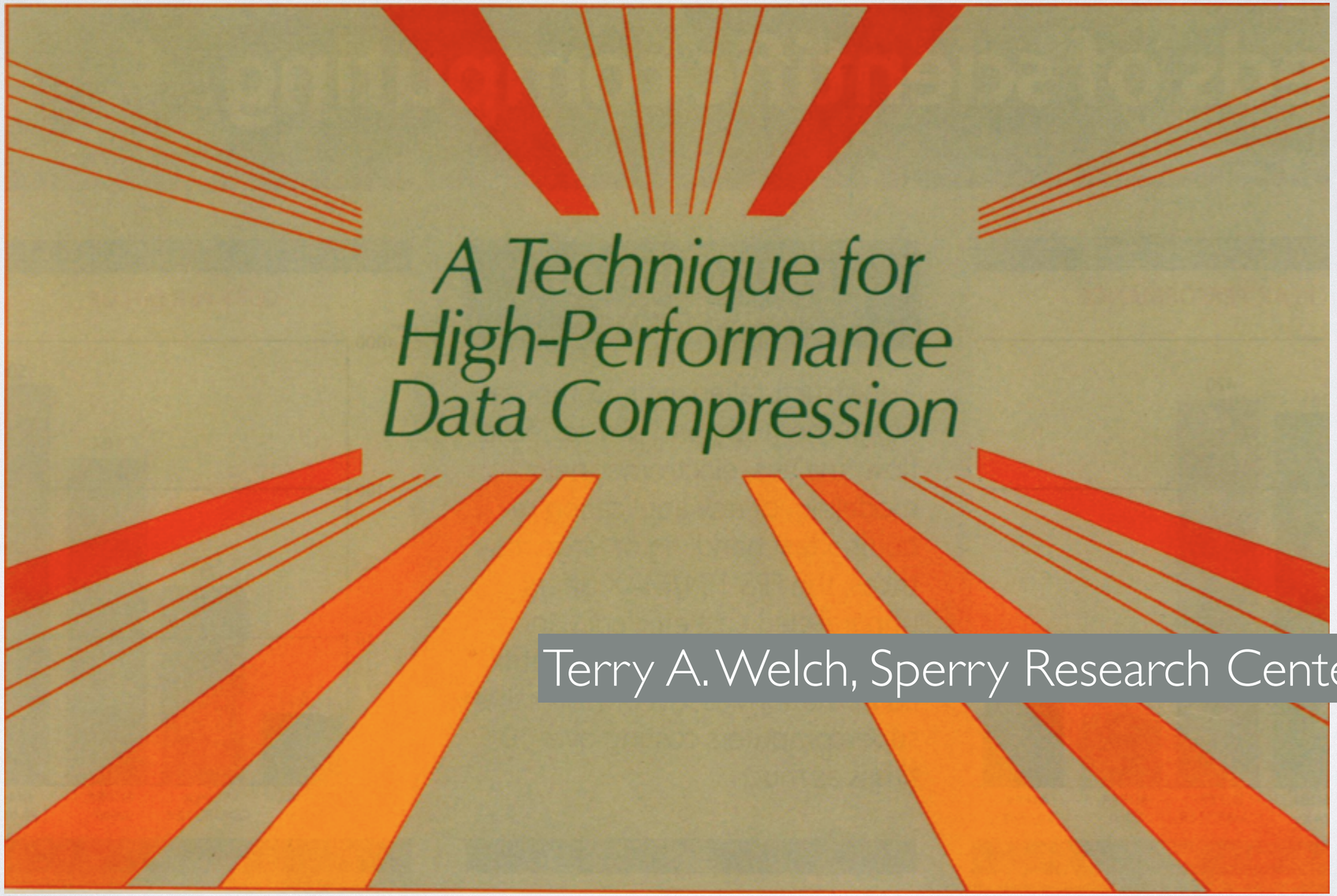
LITTLE ENDIAN

- The least significant byte or bit (LSB) is stored at the memory location with the lowest address:



12 BIT VALUES

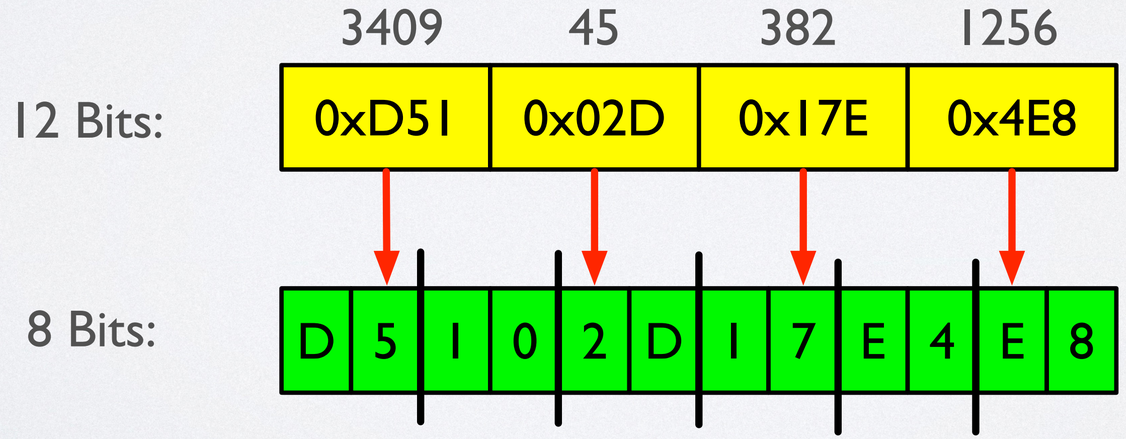
LZW COMPRESSION



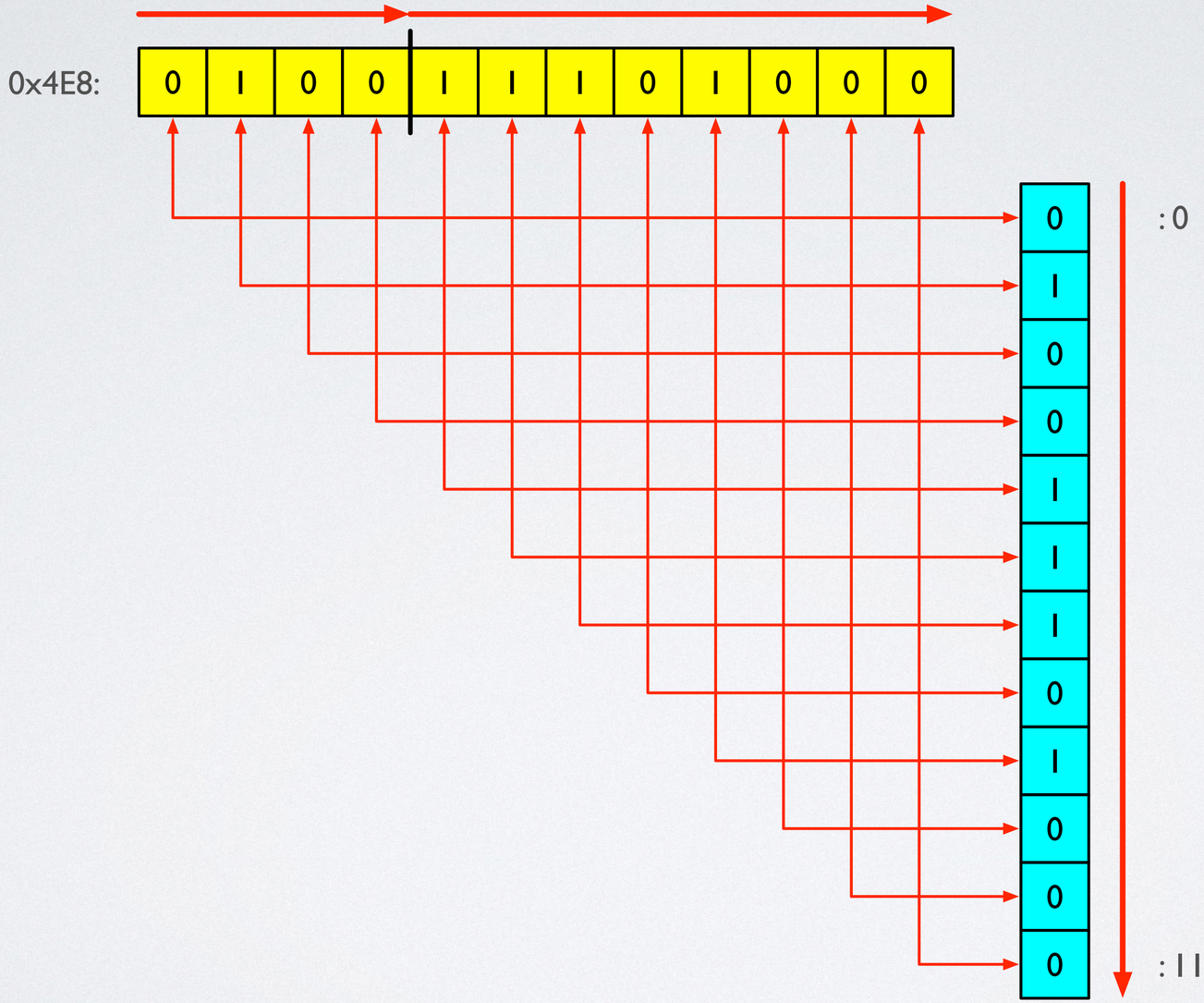
Terry A. Welch, Sperry Research Center, 1984

WHICH ORDERING WOKS BEST FOR 12 BIT I/O

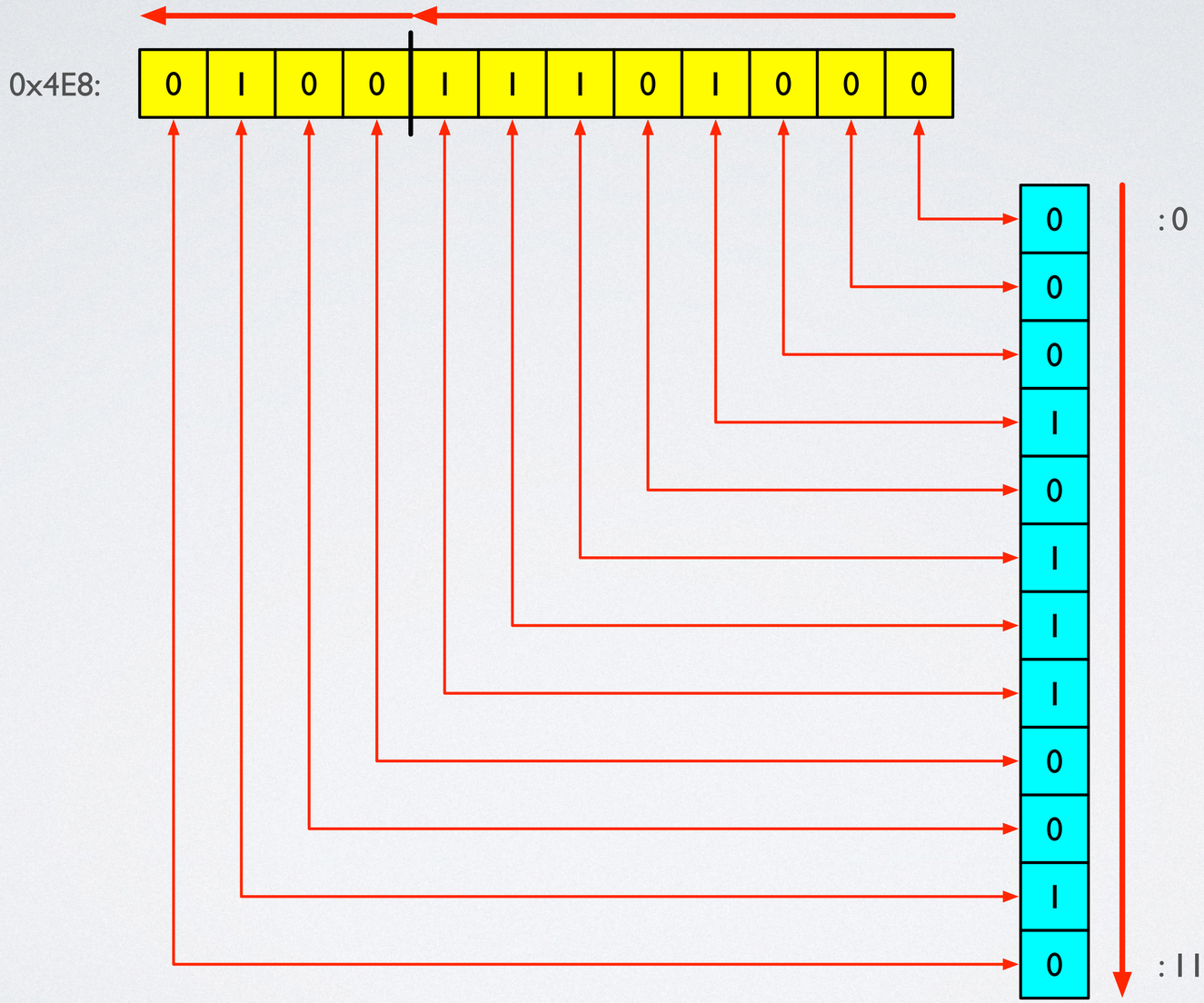
- Consider four 12-bit numbers: 1256, 382, 45, and 3409:
  - 12-bit values cannot be stored in a byte.
  - We could use a 16-bit word, but this would waste 4 bits per value.
  - We need to devise an approach where we store the 12-bit values as a consecutive bitstream, each value requiring 12 bits.
  - Which ordering works better: little endian or big endian?



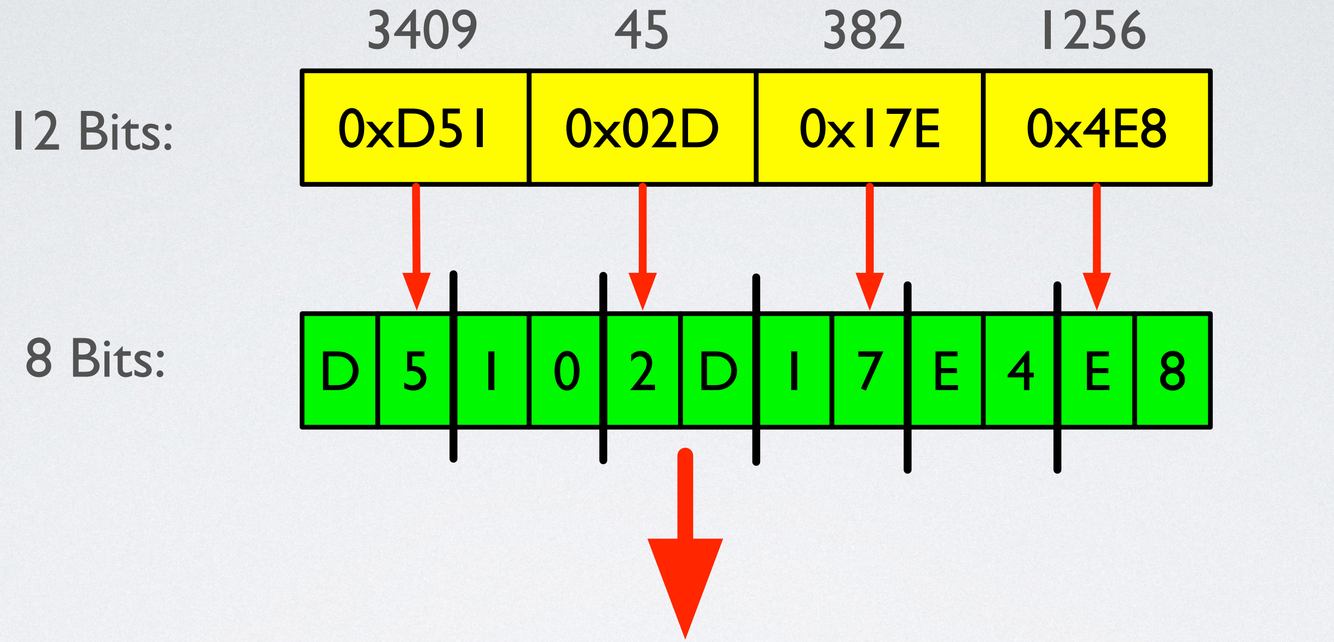
PROCESSING 0X4E8: BIG-ENDIAN

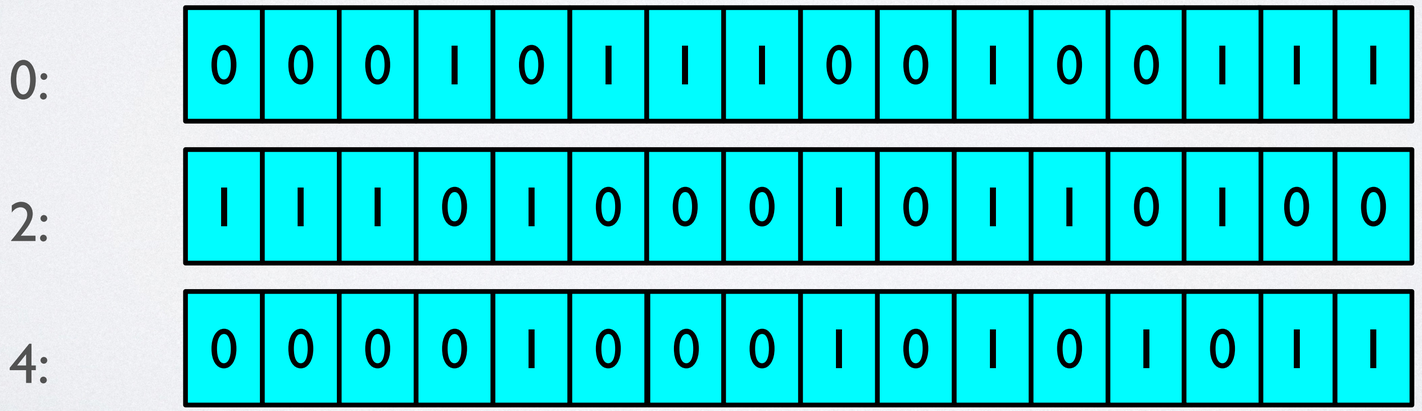


PROCESSING 0X4E8: LITTLE-ENDIAN



4E8 17E 02D D51





WRITE 12 BIT VALUES (PSEUDOCODE)

```
write12Bits( aValue : 12Bit ) =

  for i = 1 to 12

    do

      if (aValue & 0x1)          // fetch lowest bit

        then send 1 to output;

        else send 0 to output;

      aValue := aValue / 2;     // divide by 2

    od;
```

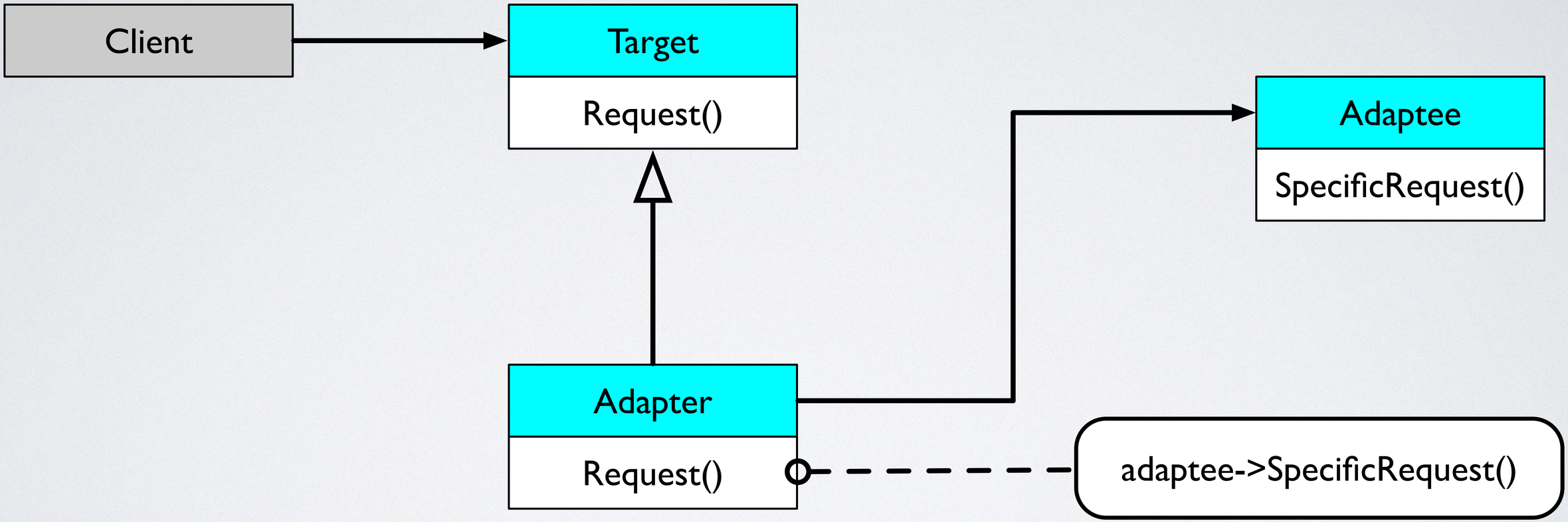
READ 12 BIT VALUES (PSEUDOCODE)

```
read12Bits() : 12Bit =

  declare Result : 12Bit = 0;

  for i = 1 to 12

    do

      declare lBit : Bit = input()              // get next bit

      if ( lBit == 1 )

        then Result = (1 << (i-1)) + Result;  // set bit at index i

    od;

  return Result;
```

ADAPTER DESIGN PATTERN

- Intent:
  - Convert the interface of a class into another interface clients expect. Adapter lets classes work together that could not otherwise because of incompatible interfaces.
- Collaborations:
  - Clients call operations on an Adapter instance. In turn, the adapter calls Adaptee operations that carry out the request.

STRUCTURE OF AN OBJECT ADAPTER



ADAPTER FOR STD::OFSTREAM

class

std::ofstream

<fstream>

```
typedef basic_ofstream<char> ofstream;
```

Output file stream

ios_base ← ios ← ostream ← ofstream

Output stream class to operate on files.

Objects of this class maintain a filebuf object as their ***internal stream buffer***, which performs input/output operations on the file they are associated with (if any).

File streams are associated with files either on construction, or by calling member open.

This is an instantiation of basic_ofstream with the following template parameters:

template parameter	definition	comments
charT	char	Aliased as member char_type
traits	char_traits<char>	Aliased as member traits_type

Apart from the internal ***file stream buffer***, objects of this class keep a set of internal fields inherited from ios_base, ios and istream:

	field	member functions	description
Formatting	format flags	flags setf unsetf	A set of internal flags that affect how certain input/output operations are interpreted or generated. See member type fmtflags.
	field width	width	Width of the next formatted element to insert.
	display precision	precision	Decimal precision for the next floating-point value inserted.
	locale	getloc imbue	The locale object used by the function for formatted input/output operations affected by localization properties.
	fill character	fill	Character to pad a formatted field up to the ***field width*** (width).
State	error state	rdstate setstate clear	The current error state of the stream. Individual values may be obtained by calling good, eof, fail and bad. See member type iostate.
	exception mask	exceptions	The state flags for which a failure exception is thrown. See member type iostate.
Other	callback stack	register_callback	Stack of pointers to functions that are called when certain events occur.
	extensible arrays	iword pword xalloc	Internal arrays to store objects of type long and void*.
	tied stream	tie	Pointer to output stream that is flushed before each i/o operation on this stream.
	stream buffer	rdbuf	Pointer to the associated streambuf object, which is charge of all input/output operations.
	character count	gcount	Count of characters read by last unformatted input operation.

Member types