

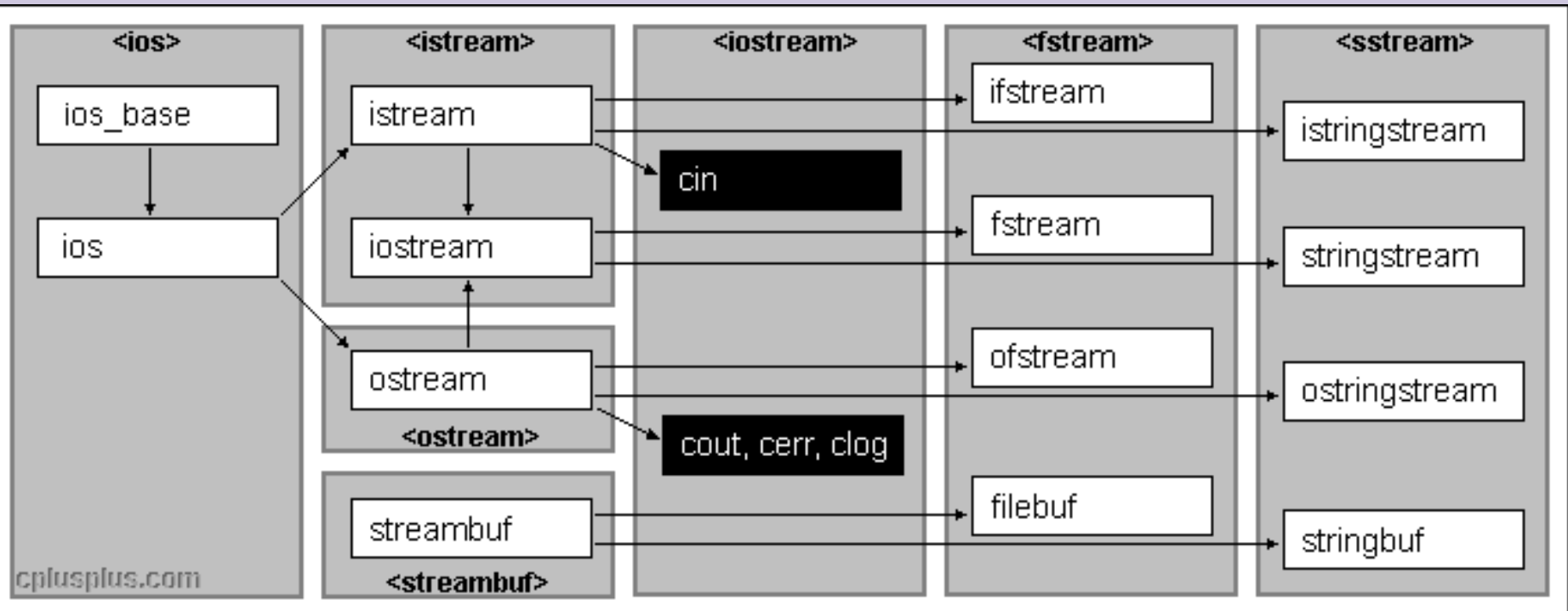


Streams

Version 1: Dr. Ofir Pele

Version 2: Dr. Erel Segal-Halevi

Class hierarchy



Output stream

- The `ostream` object overloads the `<<` operator for each basic type.
- The operator returns a reference to the output stream, which allows combined output:

```
std::cout << "2 + 3 = " << 2 + 3 << std::endl;
```

Output stream continued

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```

- `endl` is an example of **manipulator**. `endl` sends a ‘\n’ character to the stream and flushes it.
- In fact `endl` is a function:
 `<<` operator has a version that accepts a function pointer

Standard output stream objects

- **cout** – attached to stdout.
- **cerr** – attached to stderr, unbuffered.
- **clog** – attached to stderr, buffered.

Other output stream objects

- `ostream` - attached to a string.
- `ofstream` - attached to a file.

Input stream

- `istream` is the type defined by the library for input streams.
- `cin` is a global object of type `istream` attached to `stdin`.
- Example:

```
#include <iostream>
int i;
std::cin >> i; // reads an int
```

- Note that `>>` skips whitespaces.

Other input stream objects

- **istringstream** - attached to a string.
- **ifstream** - attached to a file.

Input stream continued

- When an error occurs (typically because the input format is not what we expect) `cin` enters a `failed` state and evaluates to `false`.
 - `istream` overloads the `!` operator and the `void*` (conversion) operator
- normal usage:

```
ifstream fin("database.tsv");  
while (fin >> name >> phone) {  
    // do something with name, phone  
}
```

Input stream errors

- In failed state **istream** will produce no input.
- **istream** rewinds on error.
- Use **clear()** method to continue reading.

More I/O methods (folder 5)

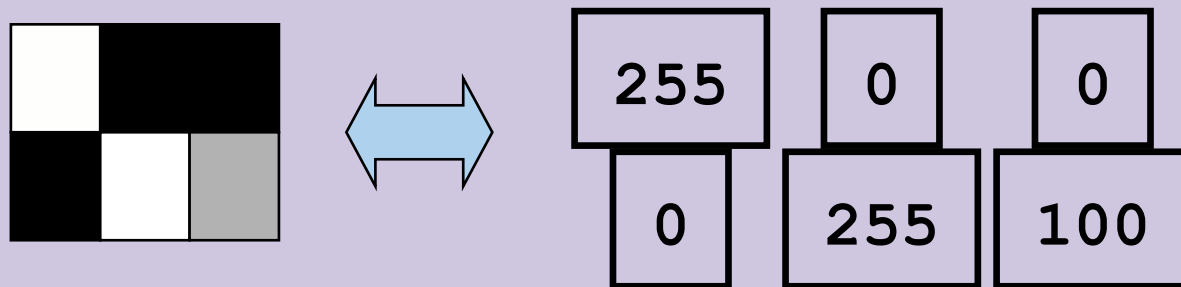
- Both `ostream` and `istream` have additional methods:
 - `ostream& put(char ch)`
 - `ostream& write(char const *str, int length)`
 - `int get() // read one char`
 - `istream& get(char& ch) // read one char`
 - `getline(char *buffer, int size, int delimiter = '\n')`
- Examples:

```
std::cout.put('a');  
char ch1, ch2, str[256];  
std::cin.get(ch1).get(ch2);  
std::cin.getline(str, 256);
```

Binary files

Leading example: image files

- Images are stored as matrices of numbers (pixels)
- Here, we deal with gray-scale images
- 8 bits per pixel
 - i.e. each pixel between 0 and 255
- 255 is white, 0 is black, others are gray



storing images

- How can we store images on files?
- For each image we want to store:
 - width
 - height
 - number of bytes per pixel
 - the pixels
- Requirements: read/write easily, save space, save computation, etc.

storing images

First try: **text files**

cons:

- long
- needs parsing

pros:

- readable by humans
- easy to edit

"myImg.txt"

```
width = 3
height = 2
bytes_per_pixel = 1
255 0 0
0 255 100
```

storing images

Better solution: **Binary files**

- Save the data the way the computer holds it

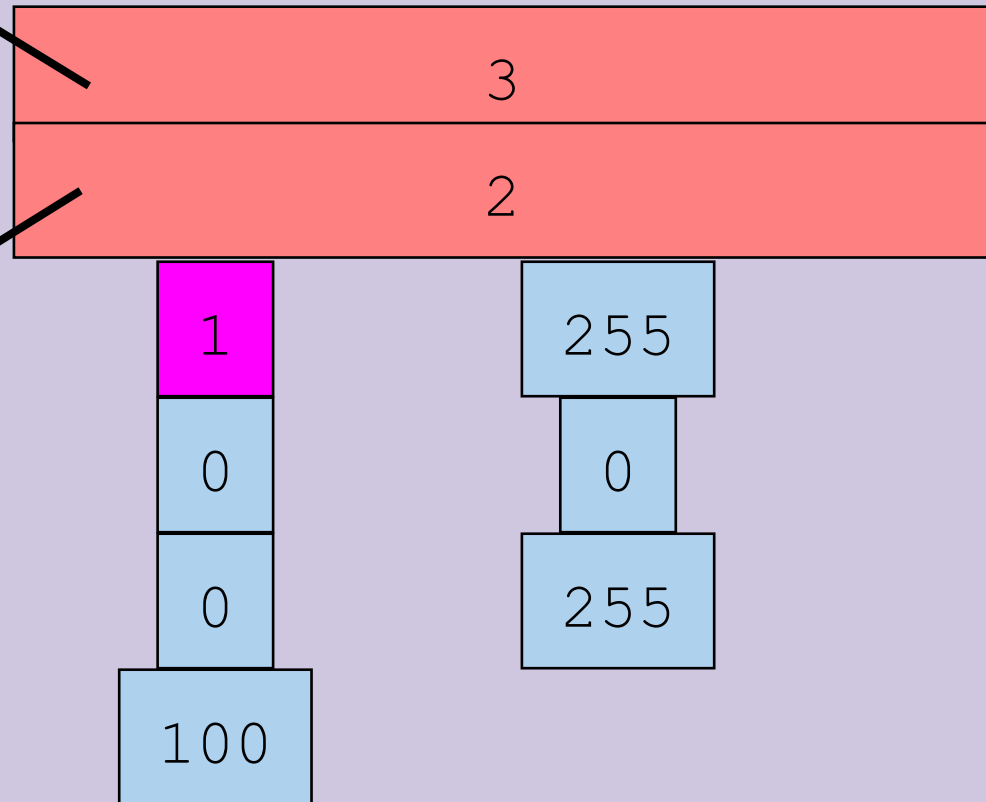
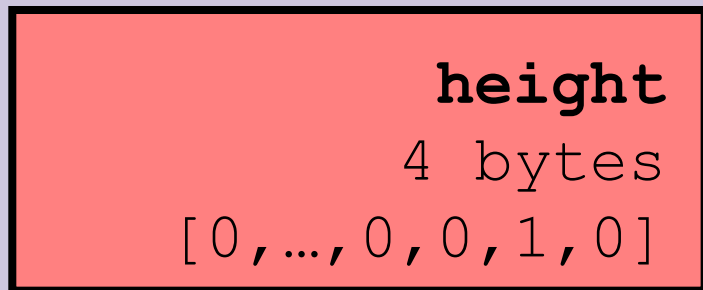
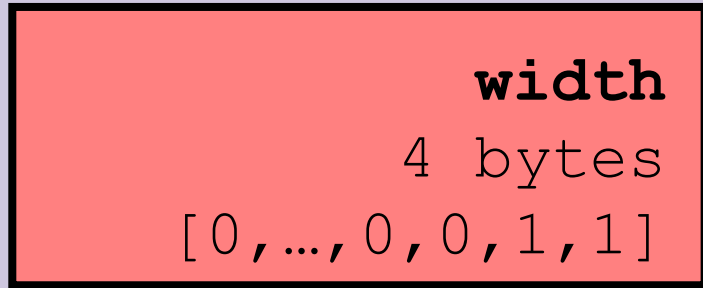
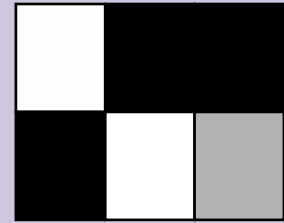
pros:

- Smaller
- No parsing (faster)
- Widely used:
JPEG, mp3, BMP, other data

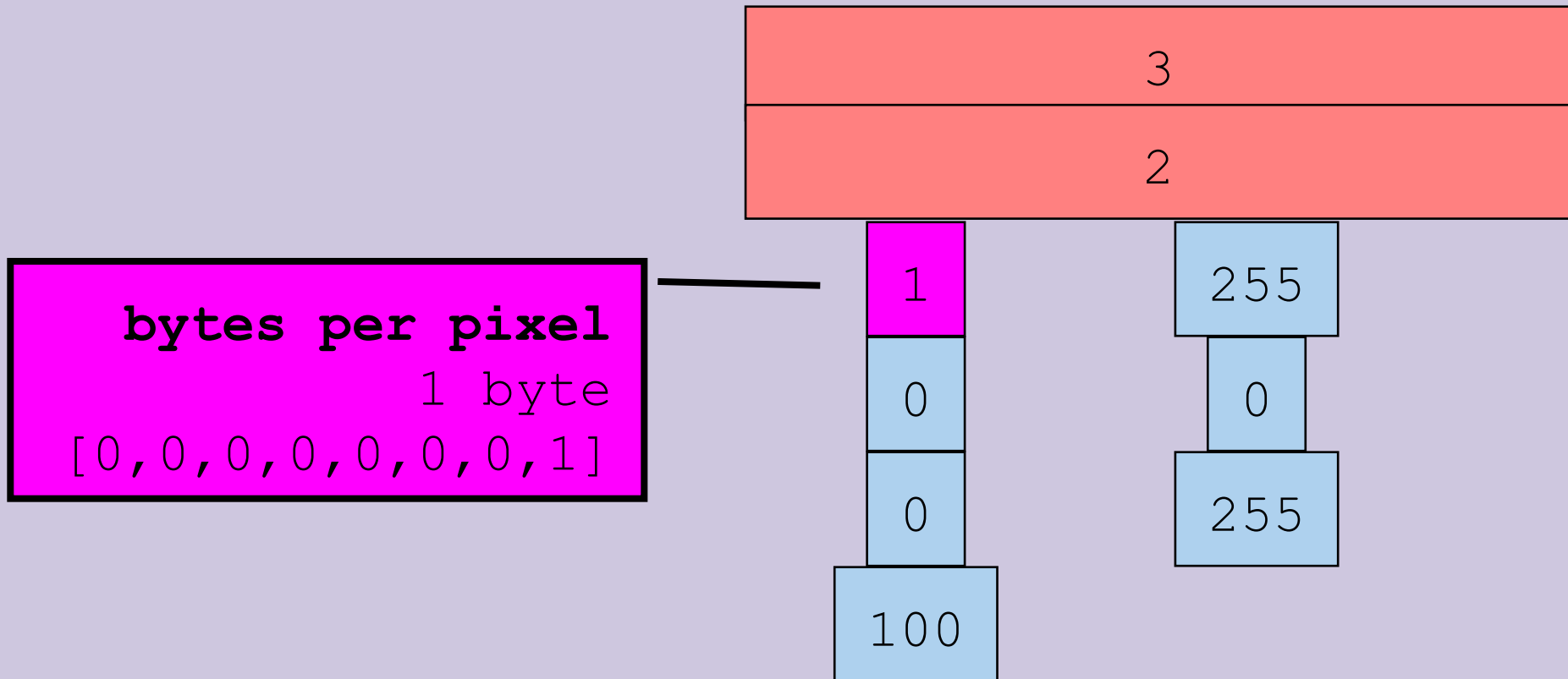
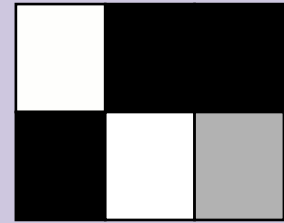
cons:

- hard to read for humans
- Machine dependant

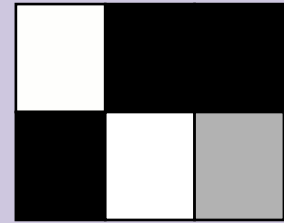
Images as binary files



Images as binary files



Images as binary files



pixel

1 byte

[1,1,1,1,1,1,1,1]

3

2

1

0

0

100

255

0

255

pixel

1 byte

[0,0,0,0,0,0,0,0]