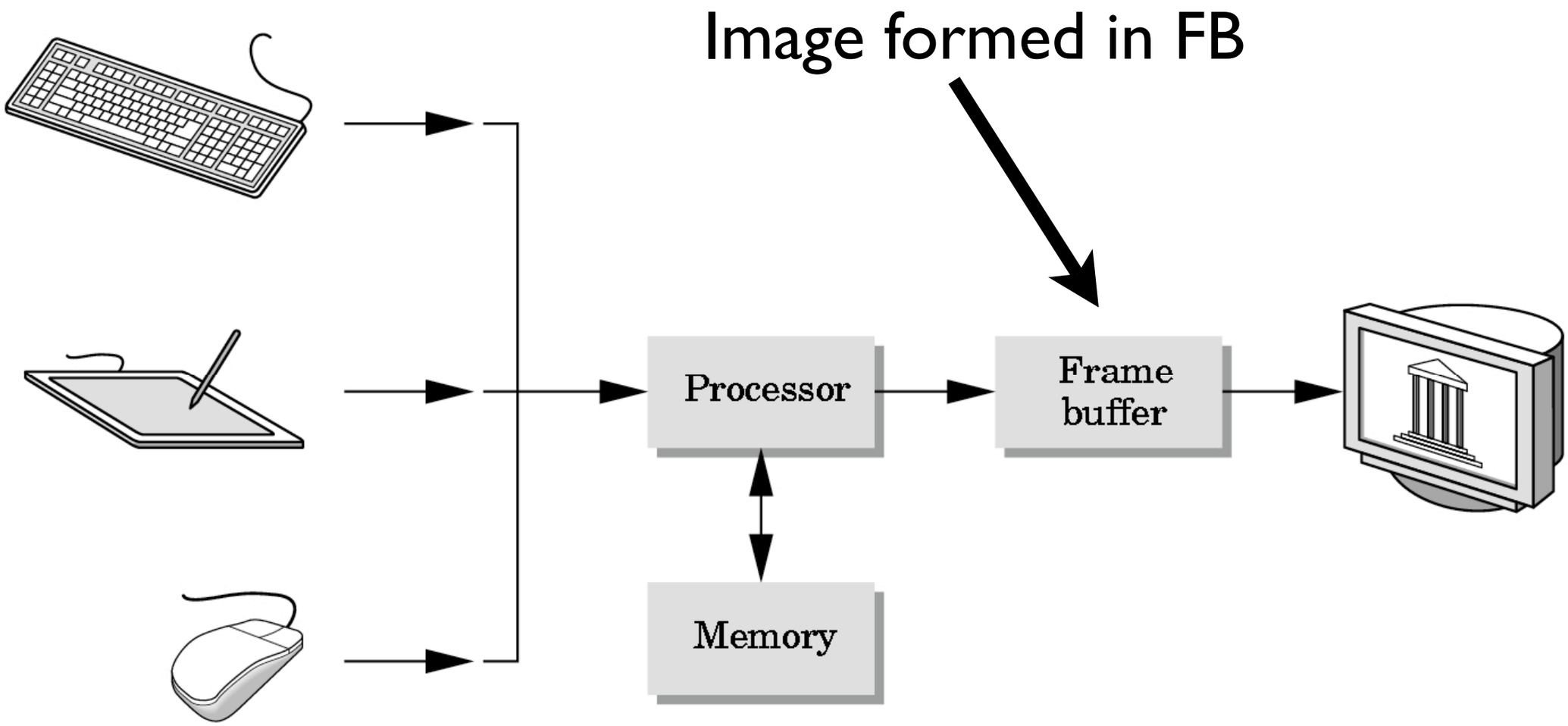
Monash University • Clayton's School of Information Technology

CSE3313 Computer Graphics

Lecture 3: Raster Display Systems

Basic Graphics System



Hardware Display Systems

- **Resolution** — the maximum number of points that can be displayed without overlap. It can be different in the horizontal and vertical directions (e.g. 1280 x 1024 [h x v]).

- **Aspect Ratio** — ratio of horizontal to vertical points necessary to produce equal length lines in both directions. E.g. PAL television has an aspect ratio of 4:3 [h:v]. HDTV has an aspect ratio of 16:9.

- **Pixel Aspect Ratio** — individual pixels may have different widths to heights. A pixel aspect ratio of 1:1 denotes square pixels.

- A typical graphics system uses a special area of memory (RAM) to store the intensity or colour values of each pixel. This memory is known as a *frame buffer.*

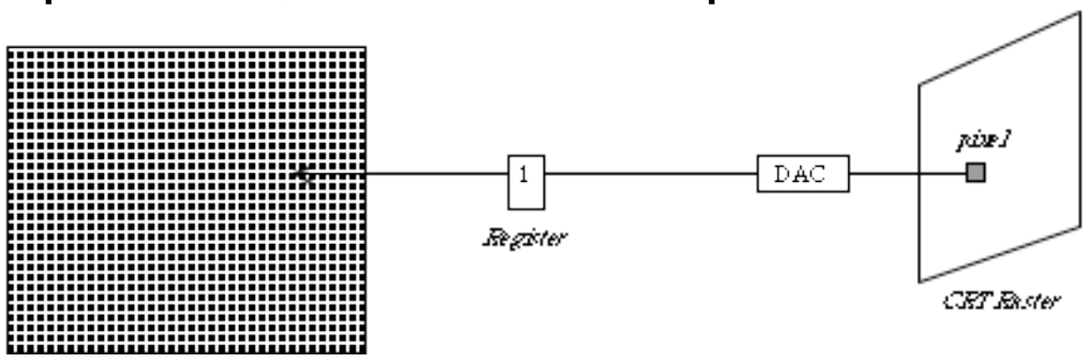
Frame Buffers

- Frame buffer coordinates are non-negative integers, addressed using a Cartesian coordinate system which usually starts at the bottom left-hand corner of the screen.

- Frame buffer memory is specified in terms of *bit planes*. Each pixel has a certain number of bits allocated per pixel.

- With *n* bits per pixel, there are 2^n possible intensities. Bits per pixel is often referred to as *bit depth*.

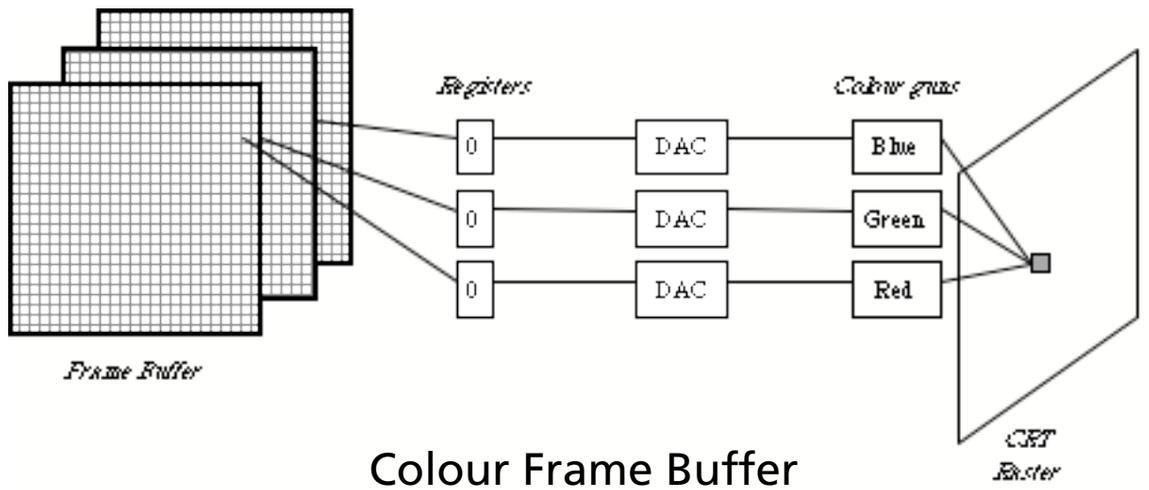
- For example: bit depth == 8, there are 256 possible intensities each pixel can have.



Binary Frame Buffer

Frame Buffers (cont.)

- For colour displays we need bit planes for each primary (R,G,B).
- Suppose we have 2^8 intensities for each primary, we then need 24 bits per pixel (== 3 bytes per pixel).
- For a resolution of 1280 x 1024 we need over 3Mb of memory for the frame buffer.
- A bit depth of 24 gives us a possible *palette* of over 16 million (2^{24}) colours. This is sometimes known as 'truecolour'.



Colour Frame Buffer

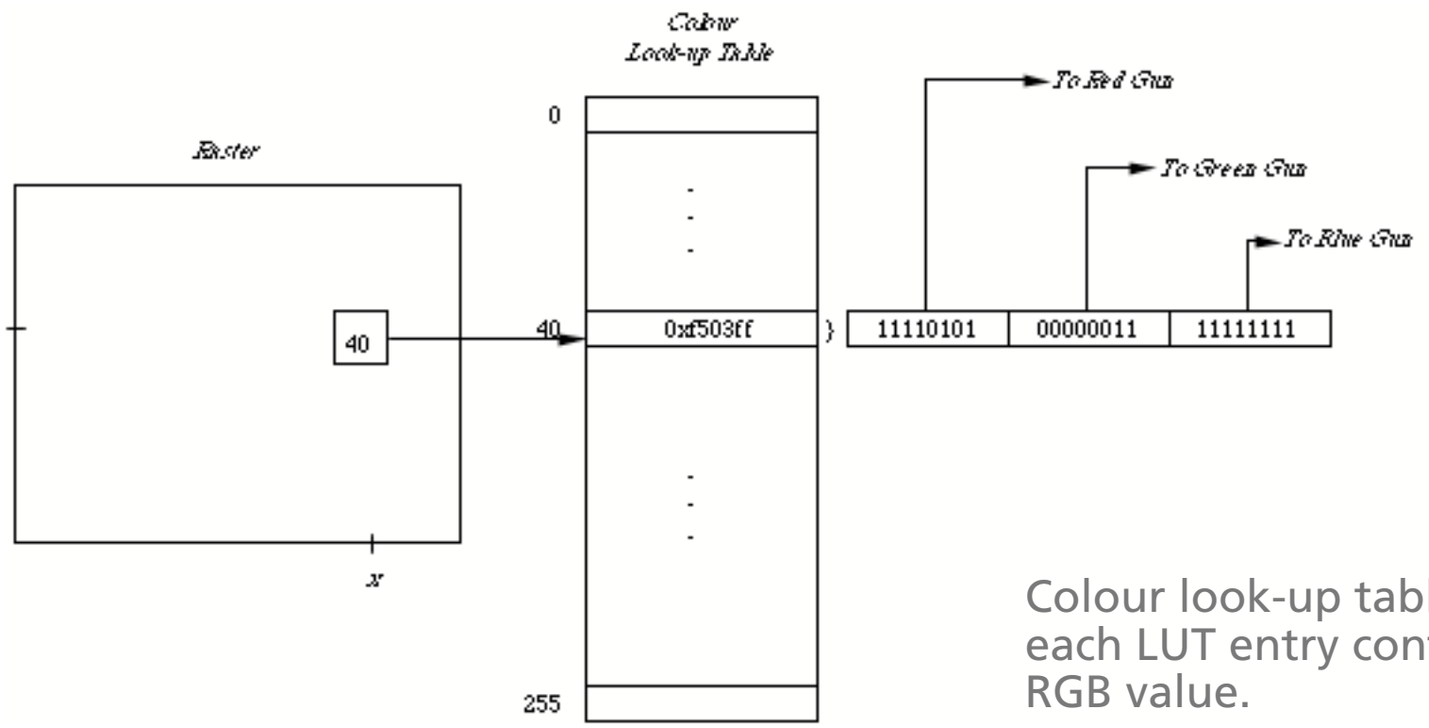
Frame Buffers (cont.)

	Red	*Green*	*Blue*
Black	0	0	0
Red	1	0	0
Green	0	1	0
Blue	0	0	1
Cyan	0	1	1
Magenta	1	0	1
Yellow	1	1	0
White	1	1	1

3 bit colour combinations

Look-up Tables

- Some displays compromise on frame buffer memory. Instead of storing the pixel colour they store a pointer or index to the pixel colour. For example, an 8 bit pointer can be used as an index to a *colour look-up table* (CLT):
  - The pixel location in the frame buffer contains an index to the look-up table;
  - The look-up table contains the R, G, and B intensity values.



Colour look-up table — 8 bit LUT each LUT entry contains a 24 bit RGB value.