CMSC 405 Week 1 Homework

Calculating frame buffer load time

Formula:

$$\text{frame buffer load time in ms} = (\text{vertical resolution})(\text{horizontal resolution})\left(\frac{\text{bits}}{\text{pixel}}\right)\left(\frac{1000\text{ ms}}{1\text{ s}}\right)\times \left(\frac{1}{\text{memory bandwidth in GB/s}}\right)\left(\frac{1{,}000{,}000{,}000\text{ bytes}}{1\text{ GB}}\right)\left(\frac{8\text{ bits}}{1\text{ byte}}\right) \quad (1)$$

Using the following variable assignments allows the equation to be simplified:

$$\begin{aligned} x &= \text{vertical resolution} \\ y &= \text{horizontal resolution} \\ z &= \text{bits per pixel} \\ M &= \text{memory bandwidth} \end{aligned} \quad (2)$$

$$\text{frame buffer load time in ms} = \frac{xyz}{(M)(8{,}000{,}000)} \quad (3)$$

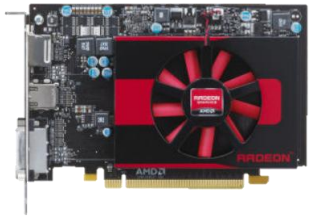
Utilizing the specifications from the NVIDIA GeForce GTX 690 as shown in Table 1:

$$\begin{aligned} x &= 2048 \\ y &= 1536 \\ z &= 32 \\ M &= 384 \end{aligned} \quad (4)$$

$$\text{frame buffer load time in ms} = \frac{(2048)(1536)(32)}{(384)(8{,}000{,}000)} = \frac{100{,}663{,}296}{3{,}072{,}000{,}000} = 0.032768 \quad (5)$$

Table 1

A comparison of various graphics processing units.

Manufacturer	Product	OpenGL version	Maximum VGA Resolution	Memory Bandwidth (GB/s)	Frame buffer load time (ms)	Cost	URL reference
NVIDIA	 GeForce GTX 690	4.2	2048 x 1536	384	0.032768	$1,049.99 (newegg.com)	visit website
AMD	 Radeon HD 7970	4.2	2048 x 1536	264	0.047663	$399.99 (newegg.com)	visit website
NVIDIA	 Tesla c2070	4.2	2560 x 1600	144	0.113778	$2,199.99 (tigerdirect.com)	visit website
AMD	 Radeon HD 7750	4.2	2048 x 1536	72	0.174763	$109.99 (newegg.com)	visit website
S3 GRAPHICS	 Chrome 530 GT	3.0	2048 x 1536	8	1.572864	$44.95 (msrp)	visit website

Results Interpretation

From interpreting the frame load buffer times and costs plotted in Figure 1, it can be clearly seen that there is an inverse relationship between the two. Lower buffer loading times are associated with higher costs. The laggard of the group, the S3 Chrome 530 GT, is about eight times slower than the slowest of the more expensive graphics cards. All other cards have buffer load times under 0.2 milliseconds (ms). Overall, as cost increases, load times decrease until the NVIDIA Tesla c2070 is encountered. This GPU has the third slowest load time but yet is the most expensive. This however may not be a fair comparison as the Tesla is built on the massively parallel Compute Unified Device Architecture (CUDA) used for general purpose GPU (GPGPU) data processing.

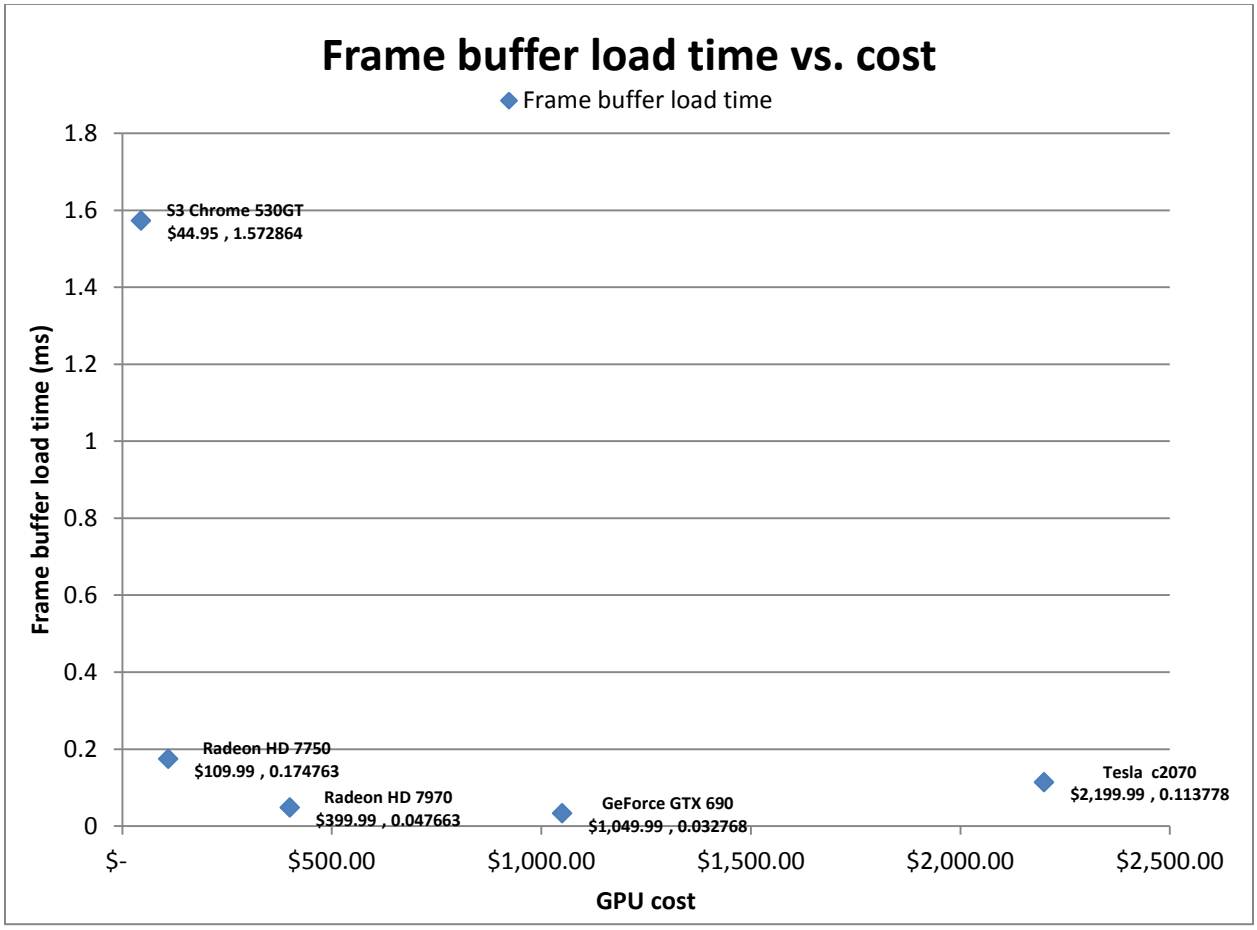


Figure 1. Scatter-plot graph showing the relationship between graphics card frame buffer load time and cost.

Determining Dollar Value with Respect to Frame Buffer Load Time

Figure 2 shows cost per millisecond plotted against GPU cost. Clearly, the Radeon HD 7970 and GeForce GTX 690 offer the greatest value with respect to frame buffer load times. The most expensive GPU, the Tesla c2070 offers the least value.

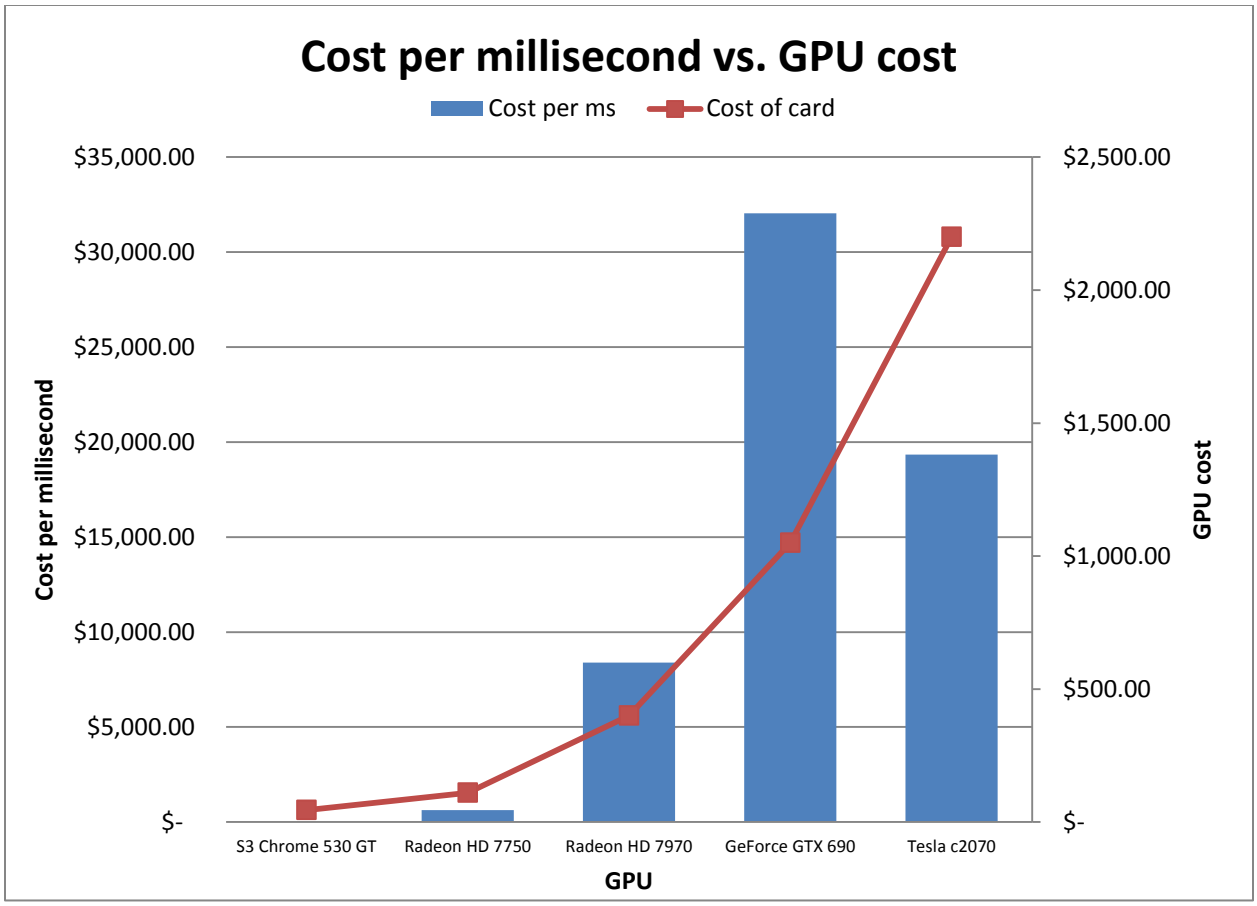


Figure 3. Cost per millisecond compared to device cost.

Recommendations

For my common everyday uses and moderate graphics intense applications, I would choose the Radeon HD 7750. Although it is over-priced when considering the cost per ms, it is the most inexpensive GPU of those in the sub 0.2 ms buffer load time group but yet delivers load times comparable to GPUs costing many times more. The S3 Chrome 530 GT would be avoided because for a little over twice its low-cost, eight times the buffer speed can be had.

References

AMD. (2011). Radeon hd 7970. [Online image]. Retrieved from http://www.theregister.co.uk/2011/12/22/radeon_hd_7970/

AMD. (2012). Specifications. *AMD Radeon hd 7750 graphics*. Retrieved from http://www.amd.com/us/products/desktop/graphics/7000/7750/Pages/radeon-7750.aspx

AMD. (2012). Specifications. *AMD Radeon hd 7970 graphics*. Retrieved from http://www.amd.com/us/products/desktop/graphics/7000/7970/Pages/radeon-7970.aspx#/5

NVIDIA. (2012). GeForce gtx 690. [Online image]. Retrieved from http://www.geforce.com/hardware/desktop-gpus/geforce-gtx-690/product-images

NVIDIA. (2012). Specifications. *GeForce gtx 690*. Retrieved from http://www.geforce.com/hardware/desktop-gpus/geforce-gtx-690/specifications

NVIDIA. (2010). Tesla c2050 / c2070 gpu computing processor. Retrieved from http://www.nvidia.com/docs/IO/43395/NV_DS_Tesla_C2050_C2070_jul10_lores.pdf

S3 Graphics. (2012). Crome 530 gt. [Online image]. Retrieved from http://www.s3graphics.com/en/products/class3.aspx?productId=8

S3 Graphics. (2012). Specifications. Chrome 530 gt. Retrieved from http://www.s3graphics.com/en/products/class3.aspx?productId=8

[Untitled image of an AMD Radeon HD 7750 GPU]. Retrieved from http://www.hardwarereview.net/Reviews/ATI%20Radeon%207770/AMD_Radeon_HD7770.htm

[Untitled image of an NVIDIA Tesla c2070 GPU]. Retrieved from http://www.tigerdirect.com/applications/SearchTools/item-details.asp?EdpNo=7194549&CatId=4044