For this assignment I had to modify my matlab code slightly for the video:

```
function [vid] = video2bin(fin, fout)
    % Construct output file name from input
    if (nargin < 2)
        fout = [fin(1:max(strfind(fin, '.'))), 'bin'];
    end

    % Path correction
    fin = [pwd,'\','resources\',fin];
    fout = [pwd,'\','output\',fout];
    fprintf('Input file = %s\n', fin);
    fprintf('Output file = %s\n', fout);

    % read the video file
    vid = VideoReader(fin);
    M = vid.Height;
    N = vid.Width;
    Fs = vid.FrameRate;
    colors = vid.BitsPerPixel / 8;

    % Write the header
    % ndim = 3 (video)
    % nchan = colors
    % dim0 = M
    % dim1 = N
    % dim2 = Fs
    fid = fopen(fout, 'wb');
    fwrite(fid, [3, colors, M, N, Fs], 'int');

    % Loop over pixel(i = row, j = col) -> R, G, B
    while hasFrame(vid)
        x = readFrame(vid);
        for i = 1:M
            for j = 1:N
                for k = 1:colors
                    fwrite(fid, x(i, j, k), 'float');
                end
            end
        end
    end

    % Release the file handler
    fclose(fid);
end

function [] = bin2video(fin, fout)
    % Construct output file name from input
    if (nargin < 2)
        fout = [fin(1:max(strfind(fin, '.'))), 'mp4'];
    end

    % Path correction
    fin = [pwd,'\','output\',fin];
    fout = [pwd,'\','output\',fout];
    fprintf('Input file = %s\n', fin);
    fprintf('Output file = %s\n', fout);

    % Read the header
    % ndim = 3 (video)
    % nchan = colors
    % dim0 = M
    % dim1 = N
    % dim2 = Fs
    fid = fopen(fin, 'rb');
    ndim = fread(fid, 1, 'int');
    colors = fread(fid, 1, 'int');
    M = fread(fid, 1, 'int');
    N = fread(fid, 1, 'int');
    Fs = fread(fid, 1, 'int');
```

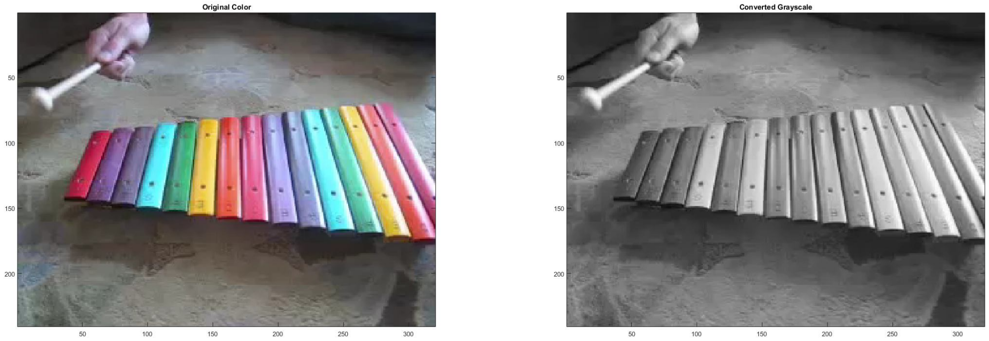
```
            %Write the data
            size_frame = M * N * colors;
            vid = VideoWriter(fout, 'MPEG-4');
            vid.FrameRate = Fs;
            open(vid);

            % Matlab is stupid, so we can only do this wacky control structure
            [a, ~] = fread(fid, size_frame, 'float');
            while size(a, 1) ~= 0 % ~=, really?
                x = zeros(M, N, colors);

                for i = 1:M
                    for j = 1:N
                        for k = 1:colors
                            % 3 dimensional array access with 1-based indexing
                            x(i, j, k) = a(...
                                (i - 1) * N * colors + ...
                                (j - 1) * colors + ...
                                k);
                        end
                    end
                end

                % Convert to uint8 just like images
                x = uint8(x);
                writeVideo(vid, x);

                % Matlab is stupid, read the next frame
                [a, ~] = fread(fid, size_frame, 'float');
            end

            % Release the file handlers
            fclose(fid);
            close(vid);
        end
```

## C++ Code:

```
#include <iostream>
#include <fstream>
#include <string>
#include <vector>

typedef std::vector<float> dsd;
struct dsh { int ndim, nchan, dim0, dim1, dim2; };

//---------------------------------------------------------------------------------------+
// Reads a full binary file into reference passed header and vector<float>               |
//---------------------------------------------------------------------------------------+
bool getData(const std::string file, dsh& header, dsd& data) {
    float temp;
    std::fstream fin(file, std::ios::in | std::ios::binary);

    if (!fin) {
        std::cout << "Error fetching: " << file << std::endl;
        fin.close();
        return false;
    }

    fin.read(reinterpret_cast<char*>(&header), sizeof(dsh));
    while (!fin.eof()) {
        fin.read(reinterpret_cast<char*>(&temp), sizeof(float));
        data.push_back(temp);
    }
    fin.close();
    return true;
}
```

```
void parta() {
    int n;
    dsh h;
    dsd d1, d2;
    const std::string
        f1 = "src\\output\\f1.bin",
        f2 = "src\\output\\f2.bin",
        f3 = "src\\output\\f3.bin";

    // Read f1 and f2
    if (!getData(f1, h, d1)) { return; }
    if (!getData(f2, h, d2)) { return; }

    // Create a coalesced form
    h.nchan = 2;
    n = d1.size();
    float* d3 = new float[2 * n];
    for (int i = 0; i < n; ++i) {
        d3[(2 * i)] = d1[i];
        d3[(2 * i) + 1] = d2[i];
    }

    // Write out the coalesced file
    std::fstream fout(f3, std::ios::out | std::ios::binary | std::ios::trunc);
    fout.write(reinterpret_cast<char*>(&h), sizeof(dsh));
    fout.write(reinterpret_cast<char*>(d3), sizeof(float) * 2 * n);
    fout.close();

    // Free up dynamically allocated memory
    delete[] d3;
}

void partb() {
    int n;
    dsh h;
    dsd d1;
    const std::string
        f1 = "src\\output\\xylophone.bin",
        f2 = "src\\output\\xylophone_gray.bin";

    // Read f1
    if (!getData(f1, h, d1)) { return; }

    // Create a grayscale version
    h.nchan = 1;
    n = d1.size() / 3;
    float* d2 = new float[n];
    for (int i = 0; i < n; ++i) {
        d2[i] =
            (0.2989 * d1[(3 * i) + 0]) + // Red
            (0.5870 * d1[(3 * i) + 1]) + // Green
            (0.1140 * d1[(3 * i) + 2]);  // Blue
    }

    // Write out f2
    std::fstream fout(f2, std::ios::out | std::ios::binary | std::ios::trunc);
    fout.write(reinterpret_cast<char*>(&h), sizeof(dsh));
    fout.write(reinterpret_cast<char*>(d2), sizeof(float) * n);
    fout.close();

    // Free up dynamically allocated memory
    delete[] d2;
}

int main() {
    parta();
    partb();

    system("pause");
    return 0;
}
```

Side by side comparison of the first frame for the video:



Code to generate this figure:

```
clear all;

color = VideoReader('xylophone.mp4');
gray = VideoReader('xylophone_gray.mp4');

x = readFrame(color);
y = readFrame(gray);

figure;

subplot(1, 2, 1);
imagesc(x);
axis image;
title('Original Color');

subplot(1, 2, 2);
imagesc(y);
axis image;
title('Converted Grayscale');
```