Assignment 4

April 28, 2014

I have to speak with Judy about the due date for this. I am fine with you turning it in to me as late as May 16th but I need to check with her on when she wants the grades. I will get back to you on this soon.

This assignment is worth 20 points. Make sure you name your .tex file with your full name like this: `DavidGoulette.tex` Also provide the picture files you use as well as the .bib file for the bibliography.

You need all of the following in your preamble for this assignment. (Of course you don't need the comments, I just threw those in for reminders and explanation.)

```
\documentclass{article}

%stuff for math
\usepackage{amssymb}
\usepackage{amsthm}
\usepackage{amsmath}
\usepackage{mathtools}

%picture packages
\usepackage{graphicx}
\usepackage{caption}

%%uncomment the following line if you want subfigures with captions.
%\usepackage{subcaption}

%margin stuff
\usepackage[top=1in, bottom=1in, left=1in, right=1.5in]{geometry}

%hyperref with some global opitons using the \hypersetup function.
%This makes the TOC, list of figures and references live links.
%The links will be blue.  The citations will still be black.
%You probably won't have a url but if you did they would be blue.
\usepackage{hyperref}
\hypersetup{
colorlinks=true,
citecolor=black,
linkcolor=blue,
urlcolor=blue
}
```

First make sure your document has a table of contents and a list of figures (the functions are `\tableofcontents` and `\listoffigures`). If you do everything correctly below, there should be at least two figures entered into your list of figures when your document is complete. Your document needs the following three sections but in this assignment you don't have to copy anything exactly as we did before.

1 Adding pictures in fixed position.

In this section I want you to add pictures in fixed position using the function `\includegraphics[options]{filename}`. So NONE of the pictures in this section will be inside of the `figure` environment. I want you to add pictures to show me you can handle the following three scenarios (you can use the same picture file for all three of these like I did with Alice):

1. Add a picture that is flushleft (against the left column) and with a width of 4 inches.
2. Add a picture that is centered (so inside the center environment) and takes up 40% of the columnwidth (you will need to have `0.4\columnwidth` for your optional argument.)
3. Add a picture that is inside of the center environment (*not in the figure environment!*) with a caption and a label. You can choose the size and shape of the picture as long as the label and caption are clear. Since this picture *is not* in the figure environment, you will need to use the `\captionof{float type}[list entry]{caption text}`. Set the `float type` to be "`figure`" and make sure you have a short `list entry` that is *different than* your caption so it shows up nicely in your list of figures. Then label it with `\label{figurename}`.

Write one sentence that references the labeled picture with `\ref{figurename}`. Note that the first two pictures you added above will not have figure numbers and will not show up in the list of figures at the beginning of your document, but the third one will.

2 Math free choice with a figure

This is a free choice section but this time I want you to explain something as if you are a teacher and you are writing an explanation of a mathematical topic to a student. This example must be accompanied by at least one figure. You must have this figure inside of the `figure` environment with a caption and a label. You must reference this label in your explanation somewhere. Since this caption will be inside of the `figure` environment, then it is a float, so you will need to use the the following for your caption: `\caption[list entry]{caption text}`.

The topic can be any topic at any level of difficulty. You can do physics or another science topic as long as the explanation requires some mathematical symbols or equations etc. But it should be a topic that is made clearer with a picture. You can scan a hand-drawn picture if you want or you can use any drawing software you like to create a picture file. Or you can scan and crop a picture straight from a textbook if you want, but you must give the author credit by citing your source and putting a citation for the text in your bibliography (see the instruction for the works cited in the section that follows). Here are some suggestions of things you could do in this section. These are just things I thought of off the top of my head. You can pick one of the following or come up with your own.

- Show the steps for deriving the quadratic equation in general and then show an example of how to find the roots of a specific quadratic function. Show a graph of the function where the x-intercepts are clearly shown. Reference the graph to show that the roots are the intercepts.
- Show the steps for completing the square of a quadratic function to put it in the form $f(x) = a(x-h)^2 + k$ and show an example with a graph. Label the vertex etc.
- Explain the concept of the slope of a line to a basic algebra student. Show pictures that make "rise over run" clear (or however you want to do it).
- Explain the equation $y = mx + b$ and show what m and b represent with an example.
- Explain the definition of the derivative from basic calculus and why it is the limit of secant lines. And/or show an example of a basic derivative (of say $f(x) = x^2 + 1$ at the value $x = 1$) and find the equation of the tangent line and show a picture of the graph along with the tangent line.

- Prove a basic geometry or trigonometry theorem or identity with the help of a picture. This can be high school level.
- Derive the basic euclidean distance formula and the midpoint formula in the plane. Do it with a basic plot showing the two points and the triangle required for deriving the distance formula.
- Solve and explain a non-trivial applied math problem. It could be something from a calculus or physics textbook like the motion of a projectile, or parametrization of a cycloid, or motion of a pendulum, or motion of a spring and weight using Hooke's law. etc. etc. This can come right out of a textbook. Just make sure you are explaining the answer in detail to a student who is learning the material.
- Explain the concept of probability being the area under a probability distribution function. Give a specific example with a picture.
- Solve an interesting combinatorial problem that involves some arrangement of things where a picture will help understand the possibilities, like seating people around a circular table with some constraints or something.
- Explain a basic graph theory concept like the 7-bridges of Königsberg problem and the concept of an Eulerian path.
- If you are into more advanced algebra, describe the symmetries of a square or some other polygon and explain the connection to the associated symmetric group.
- Solve a minimization or maximization problem that is based on a real life situation that is clearer with a picture (maximizing the volume of some box with some constraint, or minimizing the cost of fencing with some constraint etc.)
- Describe the idea of finding the centroid of a 2D or 3D object. Solve an example.
- Explain the concept of a level curve of a quadric surface and why it is intuitively like a topographical map.

Again, these were just ideas. You could solve some example homework problems that you are currently doing if you want, as long as you add explanation as if you are teaching. So give some explanation. This does not have to be long. Just a brief explanation or proof and/or an example with a picture. Make it about 1 page long including the picture (make sure the picture alone doesn't take up all the space!). Stick to what you know and what you know well enough to explain. The key things I am looking for is a clearly defined topic, a clear explanation and/or example, a figure that makes sense in context and a reference to this figure in a helpful way using `\ref{}`.

3 Bibliography

This last "section" will only have few sentences. I just want you to cite a few sources that will appear in a bibliography that you will create with BiBTEX. Write a few sentences stating what a couple of your favorite books are and refer to your bibliography with the function `\cite{key}`, like this example:

```
If you want an easy-to-read introduction to hyperbolic geometry, read
\cite{anderson2006hyperbolic}.  One of my favorite novels is \emph{The Idiot}
by Fyodor Dostoevsky. I specificially recommend \cite{dostoevsky2012idiot} because
the translation is fabulous.
```

Here is the result:

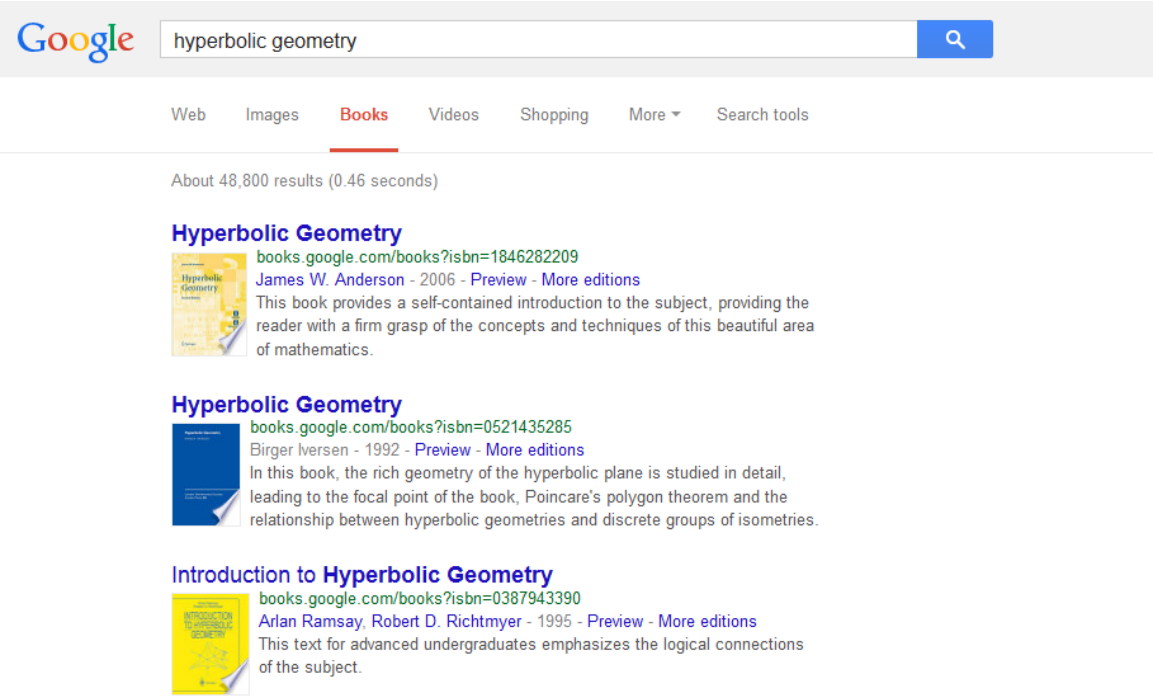
If you want an easy-to-read introduction to hyperbolic geometry, read [And06]. One of my favorite novels is *The Idiot* by Fyodor Dostoevsky. I specificially recommend [DPV12] because the translation is fabulous.

Just so you know, I am using the `amsalpha` bibliography style which is why the citations have an abbreviated name and year instead of just a number from a list.

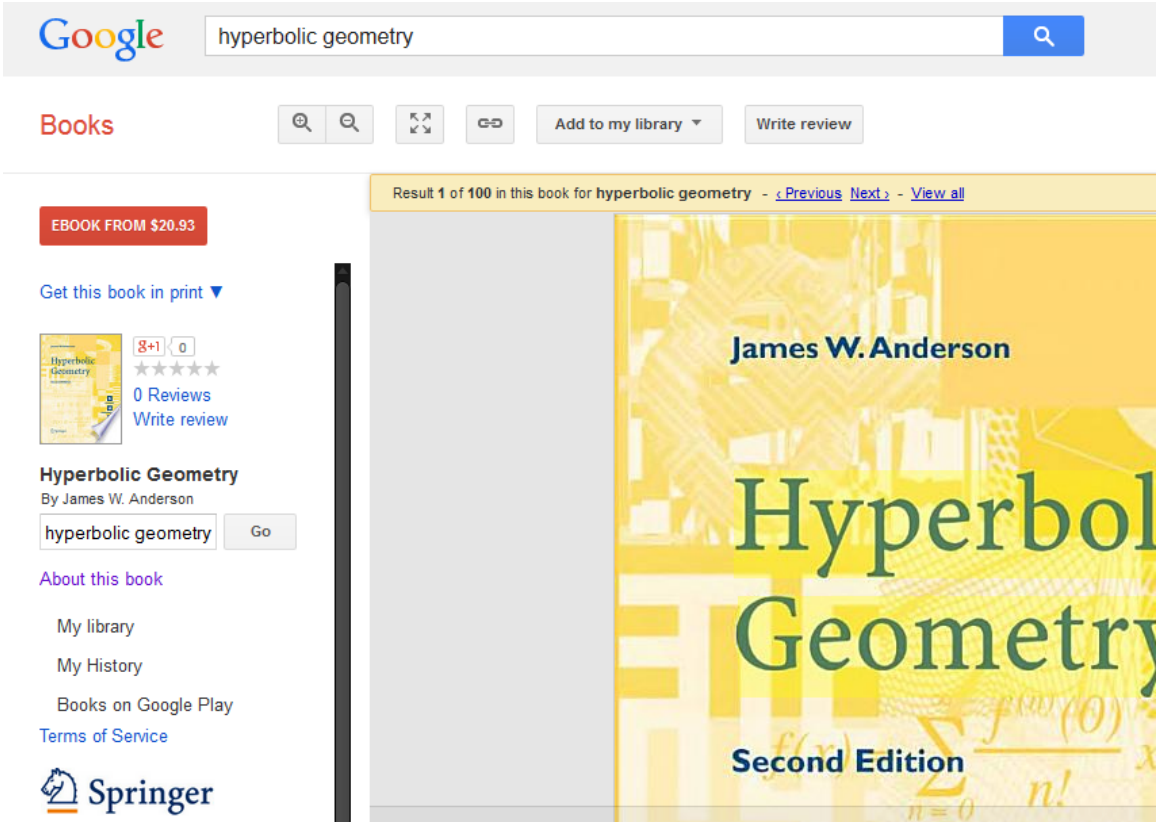
At least one of the books you cite needs to be scientific/mathematical in nature. Any book that you reference must be cited in your bibliography. Put your bibliography on it's own page just as I have done it in the introduction to LaTeX part 2. Have at least 4 references and at least one of them needs to be an academic journal article. These references do not have to have anything to do with anything in this paper. But if you used a source for your example or picture in the previous section, give them credit.

Here are some helpful tips on how you can make a BiBTeX bibliography in less than 10 minutes!

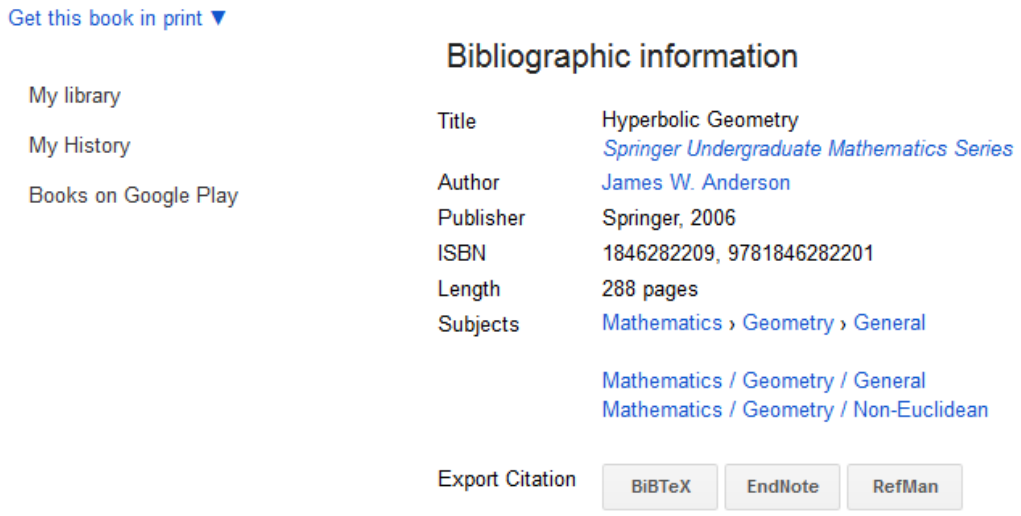
If you search for a book on Google books, http://books.google.com/
then you can get the BiBTeX code directly from google! Here is an example. I searched for "Hyperbolic Geometry" like this:



and then I clicked on the first link which took me to this page:



Then sometimes you will get a page with a preview like the previous picture. Click on "About this book" on the left and scroll down to the bottom of the page. You might not get preview like this example and, if this is the case, then the google books link will probably take you directly to the following picture. Either way, scroll to the bottom of the book information page and look for this:



Then click on the BiBTeX link and open the file in a plain text editor like notepad or just open it directly in your favorite TEX editor. Then copy the result over to your `.bib` file (or save it as your

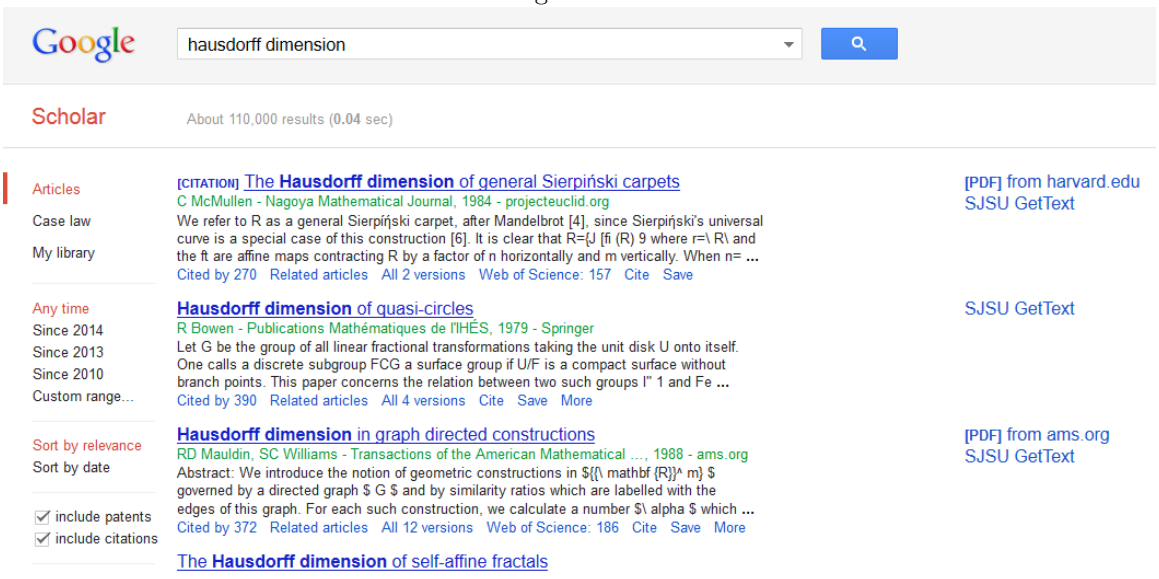
`.bib` file) and you are done. For the above example, google gave me this:

```
@book{anderson2006hyperbolic,
  title={Hyperbolic Geometry},
  author={Anderson, J.W.},
  isbn={9781846282201},
  series={Springer Undergraduate Mathematics Series},
  url={http://books.google.com/books?id=qblHyncrIWYC},
  year={2006},
  publisher={Springer}
}
```

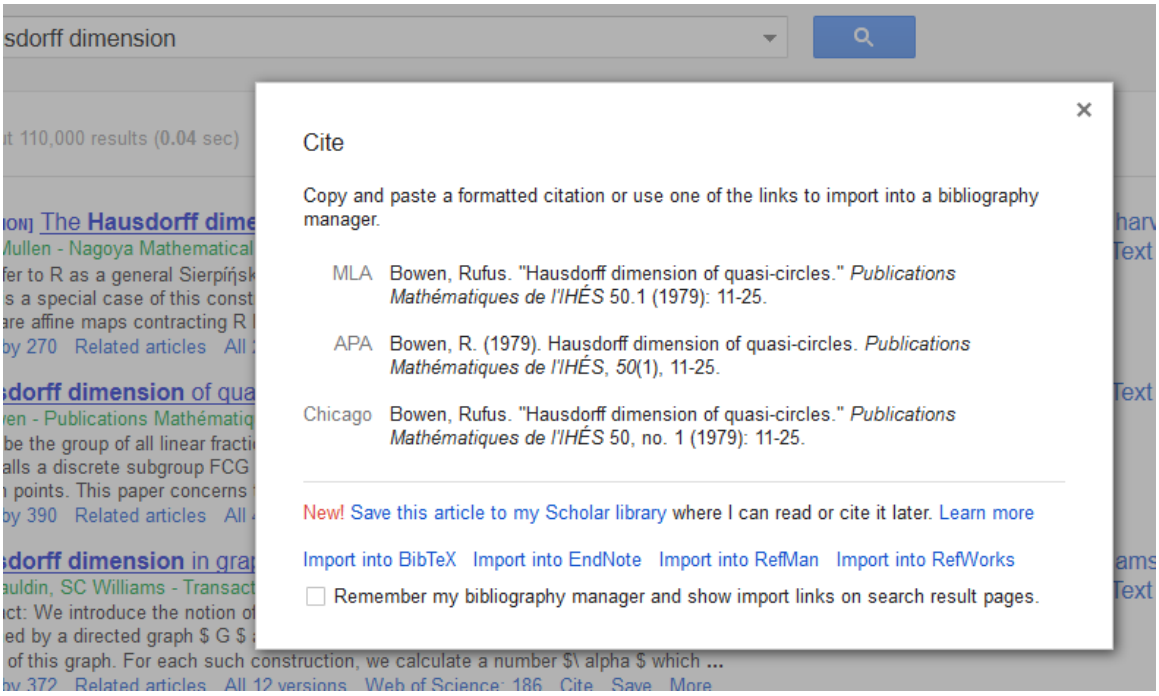
which I would probably shorten to this (but it isn't necessary):

```
@book{anderson2006hyperbolic,
  title={Hyperbolic Geometry},
  author={Anderson, J.W.},
  series={Springer Undergraduate Mathematics Series},
  year={2006},
  publisher={Springer}
}
```

Now if you want to cite a journal article then you can use: http://scholar.google.com/ Just search for key words for an article you want. Here is an example where I searched for the math terms "Hausdorff dimension." Here is what I got:



Then notice that under each entry, there is a link that says "cite." I clicked on the one for the second entry "Haudorff Dimension of quasi-circles" (I don't even know what that means!) and it brings up a pop-up like this:



Then click on "import into BiBTeX" and you will get a screen that gives you the BiBTeX to copy and paste! This is what I got (it appears this article might be in French...):

```
@article{bowen1979hausdorff,
  title={Hausdorff dimension of quasi-circles},
  author={Bowen, Rufus},
  journal={Publications Math{\'e}matiques de l'IH{\'E}S},
  volume={50},
  number={1},
  pages={11--25},
  year={1979},
  publisher={Springer}
}
```

Pretty easy right? Bibliography done fast. The next page has my works cited with the `amsalpha` bibliography style.

References

[And06] J.W. Anderson, *Hyperbolic geometry*, Springer Undergraduate Mathematics Series, Springer, 2006.

[Bow79] Rufus Bowen, *Hausdorff dimension of quasi-circles*, Publications Mathématiques de l'IHÉS **50** (1979), no. 1, 11–25.

[DPV12] F. Dostoevsky, R. Pevear, and L. Volokhonsky, *The idiot (vintage classics)*, Vintage Classics, Knopf Doubleday Publishing Group, 2012.