

Need a Graphing Calculator/CAS App? You're in the Right Place!

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Sometimes, having the right technology is great... But, what if you don't have the right apps installed, or don't have anyone around to give you great recommendations? Well, you might as well use it as a doorstop unless you're really good at randomly searching for quality apps! I've narrowed down the topic to a select group, but think these apps could really "add life" to your tablet or laptop! I'll be talking primarily about graphing and CAS apps, but I'll start with just a "bare bones" calculator...

If you've been teaching for any amount of time, you'll know there's times when you just need a quick/easy-to-access and super-functional calculator. Nothing fancy, just something to compute things like: final grade/percentages on exams, or even just adding up the possible points on given exam, etc. I understand, if you go to the Apple AppStore (or Google Play, I presume) and just randomly search "calculator"... you'll find hundreds, if not thousands of such apps. The reason I am recommending *Calculator HD Pro* is quite simply, it looks nice (in either portrait or landscape modes) and is both super easy to use and functional at the same time! I actually find the design/color scheme used very calming...so for very basic calculations on iPad/iPhone, it's definitely my "go to" app!



They've got a very basic mode and a scientific mode built into the app:



...and this app even looks very nice if you have your iPad in landscape mode (basically it combines both basic/scientific modes into one, easy to read and use landscape view)



Since *Calculator HD Pro* by Cider Software is only \$2.99 in the AppStore, I think it's a pretty cheap solution for everyday/basic calculator needs...highly recommended.

Onto the topic of a quality graphing calculator app...where to turn, who to trust? I used to have a small group of apps, I'd like one feature in one app but then some other app would handle something else a little bit better... for the longest while, I couldn't find the one "killer app" for basic graphing needs. This all changed in one recent course, I was about to use one of my many graphing calculator apps when I had a student that spoke up "...have you ever tried DESMOS? I know they have a web-interface but I'm not sure if they have an app or not". Well, because of the student mentioning the name I went out and investigated...sure enough, they did have an app and it functions VERY nicely!!! This app is *Desmos Graphing Calculator* by Desmos, and it is free in the Apple AppStore:



It does lots of things on a par with many graphing calculator apps, but what are a couple of things that I find this app truly excels at above most other apps? Well...I'm glad you asked! First, the app graphs "in real time" right as you enter the function formula! That means, if you're graphing $f(x) = -2x^2 + 5x - 3$, as you type you'll see the graphs of $-2x^2$, and then see the impact of adding the "x term" and finally see the impact of subtracting the 3 at the end; would be great in trying to show the immediate impact of various transformations in a College Algebra class! Another thing *Desmos* excels at is graphing multiple graphs on the same coordinate axes in different colors! You might be thinking many, many apps will do this...and you'd be right, but how many of them are limited to 3, 4 or 5 colors (and then start repeating)? This can be incredibly annoying, especially if you're graphing many of the partial sums for the Taylor series for the sine or cosine

function! Simply have each new function/partial sum in a different color, the students can really see how the picture is truly becoming the sine or cosine function AND see how each one relates to the previous graph(s); as well as the affect of adding in the last term. I've looked at many, many graphing calculator apps and if you're not graphing that many functions differentiated by color on the same axes then they're almost all adequate. But I had not found a single FREE app that seemingly had an unlimited number of colors to associate with your list of functions until *Desmos*... For this reason alone, but it's also a very nicely designed and functional graphing calculator app, *Desmos* has definitely become my favorite graphing calculator app on the iPad.

The last of my introductory apps I'd like to share with you, before two great CAS apps that I will recommend, is one for those teachers that either like to prepare electronic materials for your classes (either online or for later use by your face-to-face ones) or do a lot of grading for assignments that students will submit electronically; e.g., in PDF format. I recently started investigating this area when I was assigned a course in Numerical Analysis to be delivered by ITV! Admittedly, I was terrified at the thought of delivering the content to students who were with me at the host site and at the same time trying to deliver a quality experience for students at the remote site. But one thing I really hadn't considered was how difficult the logistics of having an assignment picked up at the remote site...getting the assignment to me in a timely manner so I could grade it with the others I collected at the host site, and then returned to the remote site so we could discuss all the details before we'd long since been past the material. Unfortunately, I spent weeks struggling with an inadequate solution before I had students suggest they could scan in their assignment... I wasn't sure how I'd handled it, but so frustrated with how things had gone I asked them to do so and I'd try my best. I obtained a nice stylus and attempted to grade their work with annotations on top of their PDF. It was possible, but nothing was "satisfactory" in my opinion...until I remembered an app I'd downloaded a few years back at ICTCM! The app is *Notability*, by *Ginger Labs* and is currently \$5.99 in the Apple AppStore.



There are many apps, some of which are completely free, that will allow annotating on PDFs but the stylus control is sub-par at best. *Notability* offered a nice control with my stylus on the iPad and was suitable for my current needs. I don't think it's nearly the quality of the Apple Pencil used on an iPad Pro, but how many people have \$800-1100 for a dedicated electronic grading device?

The last of the apps I'd like to recommend, while also being top quality graphing calculators...both offer so much more. These are actually the two very best CAS apps in the Apple AppStore!!! That's right...full-featured Computer-Algebra Systems, in the convenience of a simple app...amazing! The first of these is *Mathematics with PocketCAS Pro – Symbolic Graphic Calculator for Calculus, Linear Algebra* and it's only \$9.99 in the Apple AppStore.

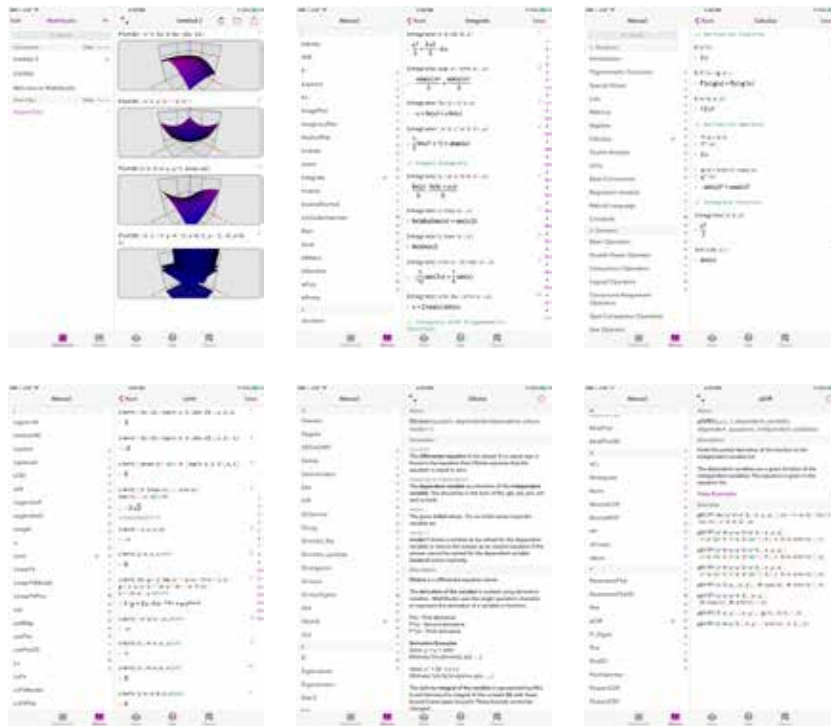


I haven't used this app nearly as much as the last app that I'll discuss, but it seems to be a well-written CAS app and for those who are really trying to limit how much they're spending on apps... the price is pretty appealing!

Now, on to my last and favorite graphing/CAS app, *MathStudio by Pomegranate Apps by Chris DeSalvo*... I will say, it has one feature that is beaten by the previous CAS app and that would be price. In the Apple AppStore, it is currently \$39.99 for the iPad and \$99.99 for the Mac; although it occasionally will be offered at a variety of sale prices.



I agree that this might seem a bit pricey, although it compares very favorably with the \$200+ graphing calculators available...and they really can't begin to touch what this one will accomplish. It's a quality graphing calculator and CAS that compares favorably with a TI-89 Titanium and even does much more...all for only \$39.99. It does a lot of what most people use Mathematica for but at a SMALL fraction of the price! You can do a great variety of things including (but definitely not limited to): basic symbolic differentiation and integration, limits, 2d and 3d graphing (and manipulation of those graphs with a simple swipe of the finger!), solving some differential as well as integral equations, linear systems and... so much more!



and here is a closer look at how nicely the app allows for manipulation of the 3d graph, to allow student to view the surface from basically any angle that you'd like. On the surface (pun intended!) the price might seem a bit steep...but once you see all the features it offers, and realize that if you catch things right you might be able to even purchase it at a much cheaper price at times, I think you'll quickly agree that it's well worth the money. I also like the fact that Chris DeSalvo, the app's developer, is very approachable and always eager to take ideas from users to make his MathStudio app better and better! That said, I think it's nice when we can support developers who are eager to support the Mathematics community...

I hope you'll find that these apps are just as valuable in your daily teaching activities as I've found them to be for mine. I also hope that you'll enthusiastically share these favorite app ideas of mine with your friends and colleagues as appropriate. Most of the apps mentioned are not free, but I think you'll find them very useful and hopefully won't mind the relatively small price they require in order to support developers that are eager to make our professional and mathematical lives much easier...and your support of their current apps will undoubtedly encourage these developers to continue their efforts and make even more useful apps in the future.