How to develop a mobile computer algebra system

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Plan of this tutorial

- About Infty Project
- Computer Algebra in Education
- Porting a CAS to mobile devices
- Making a GUI for some tablets
- Further development
- Application demo





Infty Project

• The beginning:

Started as a research project to help visually impaired people in scientific fields in 1995.

- Current research subjects :
 - Recognition and editing of math documents,
 - User interface, data conversion, etc.
- Software
 - InftyReader / InftyEditor / ChattyInfty / AsirPad ...
- Active Members
 - 10 people





InftyReader

Math OCR software

InftyReader	
le R <u>e</u> cognition <u>O</u> ption <u>H</u> elp	
nput File / Folder	☐ File
Input File Format	Search subfolders
English Image dpi	Math Level All Math Symbols High School Level Math Symbols
Putput File	Browse
Output File Output File Format IML C LaTeX HR-TeX XHTML(MathML) C Set Newline Code at the End of Each Line C the End of Each Paragraph	Browse Microsoft Word 2007(XML) Open Result File by the Related Application h Yes No

InftyEditor

- Mathematics Typesetting Tool for Windows
- Three Input Methods for Math Expressions
 - Mouse / Keyboard / Tablet
- Internal Data Format is XML
- Export to LaTeX(PDF), MathML, HTML, Braill codes and MS Word2010 are supported.
- Computing functions for Math Expressions





AsirPad

A computer algebra system with a Pen-based Interface on PDA



Educational use of CAS

- Lecture on RSA cryptography
- At junior high school (Grade 8)
- Handwriting is effective to input a

exponentiation.







Rubik's cube solver using Gap



Lecture on Rubik's cube for visually impaired students

Compute the order of operation and a solution of Rubik's cube using Gap









CAS on tablets

- CAS is effective and feasible in school education.
- Devices for learning demand
 - Portability
 - Quick power on/off
 - High resolution screen
 - Simple manipulation
 - \rightarrow Tablet devices are optimal.

CAS on tablets will be useful.







Current Tablets / OS

iPad

iOS

Android tablets

Android

Windows tablets

Windows 8.1





Use of CAS from Tablets

Method 1

Native application including CAS engine

Method 2

Access to CAS on the other machine through an application on tablets

Method 3

Access to CAS on the other machine through a Web browser on tablets

Method 4

Work sheet including CAS kernel



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CASs on tablets

Method	App name	CAS engine	OS	Paid
	MathStudio	original	Android/iOS	\checkmark
	Mathomatic	Mathomatic	Android/iOS	\checkmark
	PariDroid	PARI	Android	
	Maxima on Android	Maxima	Android	
Method 1	JavaYacas	Yacas	Android	
(Native CAS App)	Yacas for iPhone	Yacas	iOS	\checkmark
	iCAS	Reduce	iOS	\checkmark
	PocketCAS	$\operatorname{Giac}/\operatorname{Xcas}$	iOS	\checkmark
	Pi Cubed	original	iOS	\checkmark
	Python Math	SymPy	iOS	
Method 2	WolframAlpha	Mathematica	Android/iOS	\checkmark
(CAS through App)	SageMath	GAP, Maxima, etc.	Android/iOS	
	WolframAlpha	Mathematica	N/A	
Method 3	Sage	GAP, Maxima, etc.	N/A	
(CAS through Web)	FriCAS	Axiom	N/A	
	Omega	Maxima	N/A	
Method 4	Maple Player	Maple	iOS	
(CAS work sheet)	Wolfram CDF Player	Mathematica	iOS (not yet)	





Features of our App

- Target devices
 - Android / Windows tablets
- Native App (Method 1)
- CAS engine
 - Risa/Asir
- Communication method with CAS engine
 - File I/O
- GUI
 - Simple UI by Qt Quick





Mobile CAS for Windows



Mobile CAS for Android

Hello Asir [1] diff(log(x),x); (1)/(x) [2] fctr(x^3-1); [[1,1],[x-1,1],[x^2+x+1,1]] ([1,1],[x-1,1],[x^2+x+1,1]]	
$ \begin{array}{c} [1] diff(log(x),x); \\ (1)/(x) \\ [2] fctr(x^3-1); \\ [[1,1],[x-1,1],[x^2+x+1,1]] \end{array} $	sa/Asir
$[2] fctr(x^3-1);$ [[1,1],[x-1,1],[x^2+x+1,1]]	3-1);
$[[1,1],[x-1,1],[x^2+x+1,1]]$	Execute

Porting a CAS engine





Porting a CAS engine

- A lot of CASs were designed for UNIX OS.
- If the target device is a desktop PC, we can use gcc/g++ on the PC.
- Generally, Apps for tablets are developed by cross-build environments on PC.
- Google provides cross-build environments
 - Android SDK for Java
 - Android NDK for C/C++





Arm rootfs + QEMU + chroot

- C library of Android NDK is not glibc but Bionic libc.
- CAS needs some external libraries.
 - e.g., Garbage collector, GMP, etc
 - Some of them are not presumed to be built by cross-build.
- To avoid troublesome issues,
- We use the cross-build environment by Arm rootfs + QEMU + chroot.





Make Debian/arm in Debian/x86-64

Create arm rootfs in Linux box

\$ sudo apt-get install debootstrap \$ mkdir armel_wheezy \$ sudo debootstrap --foreign --arch armel wheezy armel_wheezy http://ftp.debian.org/debian/

Copy arm emulator QEMU to rootfs

\$ sudo apt-get install qemu qemu-user-static \$ sudo cp /usr/bin/qemu-arm-static armel_wheezy/usr/bin/

Execute debootstrap again

\$ sudo chroot armel_wheezy /debootstrap/debootstrap --second-stage

Arm rootfs + QEMU + chroot







Arm rootfs + QEMU + chroot

Install gcc/g++ in chroot environment

\$ apt-get install build-essential m4 bison file

Modify a header file /usr/include/paths.h in arm rootfs

#if defined(ANDROID)
#define _PATH_BSHELL "/system/bin/sh"
#else
#define _PATH_BSHELL "/bin/sh"
#endif

Create a symbolic link

\$ mkdir -p /system/bin
\$ In -s /bin/sh /system/bin/sh

Build Risa/Asir for Android

```
$ sudo chroot ./armel_wheezy
# uname –m
armv7l
# cd /home/devel/asir2000
# export CFLAGS="-O2 -Wall -D ANDROID -fsigned-char -static"
# ./configure --prefix=/data/data/com.spartacusrex.spartacuside/files/local
# make
# make install
# make install-lib
# file ./asir
./asir: ELF 32-bit LSB executable, ARM, version 1 (SYSV), statically
linked, for GNU/Linux 2.6.26, not stripped
```

We can build source codes in this environment as if we are in a self-build environment.

Execute Risa/Asir for Android

root@debian7:/home/devel/asir2000# ./asir This is Risa/Asir, Version 20140224 (Kobe Distribution). Copyright (C) 1994-2000, all rights reserved, FUJITSU LABORATORIES LIMITED. Copyright 2000-2007, Risa/Asir committers, http://www.openxm.org/.

GC 7.2 copyright 1988-2012, H-J. Boehm, A. J. Demers, Xerox, SGI, HP.

PARI 2.0.17, copyright 1989-1999, C. Batut, K. Belabas, D. Bernardi, H. Cohen and M. Olivier.

```
[0] fctr(x^3-1);
[[1,1],[x-1,1],[x^2+x+1,1]]
[1]
```

We can run Risa/Asir binary for Android on Linux box.

Risa/Asir on Android

🖬 🖾 📟 👼 🤝 🦁 1:33

terminal++@192.168.11.2:~\$ uname -a Linux localhost 3.1.10-g05b777c #1 SMP PREEMPT Thu Nov 29 10: 35:37 PST 2012 armv71 GNU/Linux terminal++@192.168.11.2:~\$ fep asir Welcome to fep! Editmode is emacs I'm a front end processor for asir History will be saved to .fephistory This is Risa/Asir, Version 20130215 (Kobe Distribution). Copyright (C) 1994-2000, all rights reserved, FUJITSU LABORAT ORIES LIMITED. Copyright 2000-2007, Risa/Asir committers, http://www.openxm. org/. GC 7.2 copyright 1988-2012, H-J. Boehm, A. J. Demers, Xerox, SGI, HP. [0] load("cyclic"); [10] C=cvclic(7); [c6*c5*c4*c3*c2*c1*c0-1,(((((c5+c6)*c4+c6*c5)*c3+c6*c5*c4)*c2 +c6*c5*c4*c3)*c1+c6*c5*c4*c3*c2)*c0+c6*c5*c4*c3*c2*c1,((((c4+ c6)*c3+c6*c5)*c2+c6*c5*c4)*c1+c6*c5*c4*c3)*c0+c5*c4*c3*c2*c1+ c6*c5*c4*c3*c2,(((c3+c6)*c2+c6*c5)*c1+c6*c5*c4)*c0+c4*c3*c2*c 1+c5*c4*c3*c2+c6*c5*c4*c3,((c2+c6)*c1+c6*c5)*c0+c3*c2*c1+c4*c 3*c2+c5*c4*c3+c6*c5*c4,(c1+c6)*c0+c2*c1+c3*c2+c4*c3+c5*c4+c6* c5,c0+c1+c2+c3+c4+c5+c61 [11] cputime(1)\$ 0sec(3.886e-05sec) [12] nd_gr(C,vars(C),31991,0)\$ 19.21sec + gc : 0.23sec(20.16sec) [13]



Risa/Asir on Android

This binary and source codes is available from http://www.fue.ac.jp/~fujimoto/asiroid/

🔒 🕂 🚼 - flabo م (🗲) 🛞 www.fukuoka-edu.ac.jp/~fujimoto/asiroid/index.html ▽ 연 ☆ 自 🔛 Asir on Android This is a binary of Risa/Asir for Android OS. This binary was checked on Android 3.2.1(Honeycomb), 4.0.3(Ice Cream Sandwich), 4.2.2/4.3.1(Jelly Bean) and 4.4.2/4.4.3/4.4.4(KitKat). binary with PARI library asiroid.tar.gz including fep (a frontend for asir) and ng (a editor like emacs). source asir20140226.tar.gz screenshot on Google Nexus7 Installation: 1. Install Terminal IDE to your Android device through Google Play. Then, click 'Install System' in the menu of Terminal IDE. 2. Install Hacker's Keyboard to your Android device through Google Play. Then, select 'Hacker's Keyboard' in the 'Keyboard' menu of Terminal IDE. Execute the following on Terminal IDE: \$ cd \$ install gcc \$ mkdir bin \$ cd bin \$ In -s ../android-gcc-4.4.0/bin/arm-eabi-cpp cpp \$ cd ... \$ wget http://133.81.157.19/~fujimoto/android/asiroid.tar.gz \$ tar zxvf asiroid.tar.gz \$ cp local/lib/asir/feprc.sample .feprc Run asir by 'fep asir' on Terminal IDE.

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Creation of GUI for CAS





Creation of GUI for CAS

- Console based computer algebra systems are useful as CAS engines.
- Interaction with CAS engine through terminal is inefficient.
 - \rightarrow We need GUI for CAS.
- GUI should be developed by the method not depending on platform.
 - + WebView \rightarrow Maxima on Android
 - ♦ QtQuick / Qt → AsirPad







About Qt

- A cross-platform application and UI development framework
- Target
 - Desktop Windows / Linux / Mac OS X
 - Embedded Windows Embedded / Embedded Linux / QNX / VxWorks
 - Mobile Android / iOS / Windows RT
- Available language
 - ♦ C++ / QML







About Qt

- License
 - ♦ GPL v3
 - ✦LGPL v2
 - Qt commercial license
- Examples of Qt application
 - Google Earth
 - Skype
 - TeXworks
 - Photoshop Elements
 - Maya 2011



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About Qt

Trolltech(1994) -> Nokia(2008) -> Digia(2012) Development environment Qt Creator Visual Studio Add-in Current Version ♦ Qt 5.3.1 Project URL http://qt-project.org





Requirements for Qt

- 1. Java SE Development Kit (JDK) v6 or later
- 2. Apache Ant v1.8 or later
- 3. Android NDK
- 4. Android SDK
- 5. Qt 5.3





Construction develop environment

• Let's construct a development environment on Windows x64.

We can develop on this environment Windows 8 tablets Apps Android tablets Apps





JDK 7

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ORACLE	Sign In/Register Help Country Communities I am a V I want to V Search Products Solutions Downloads Store Support Training Partner	Q rs About OTN
racle Technology Network >	Java > Java SE > Downloads	
Java SE	Overview Downloads Documentation Community Technologies Training	Java SDKs and Tools
Java EE		🝷 <u>Java SE</u>
Java ME	Java SE Development Kit 7 Downloads	🛓 Java EE and Glassfish
Java SE Support	Thank you for downloading this release of the Java TM Platform, Standard Edition Development Kit	🛓 <u>Java ME</u>
Java SE Advanced & Suite	(JDK TM). The JDK is a development environment for building applications, applets, and	👤 Java Card
Java Embedded	components using the Java programming language.	🛓 NetBeans IDE
Java DB	The JDK includes tools useful for developing and testing programs written in the Java	🛓 Java Mission Control
Web Tier	programming language and running on the Java platform.	Java Resources
Java Card	Looking for JavaFX SDK?	👤 Java APIs
Java TV		Technical Articles
New to Java	 Java Developer Newsletter (tick the checkbox under Subscription Center > Oracle Technology 	Demos and Videos
Community	News)	Eorums
Java Magazine	 Java Developer Day hands-on workshops (free) and other events 	👤 Java Magazine
	Java Magazine	₹ Java.net
	JDK MD5 Checksum	Developer Training
	Looking for JDK on ARM?	➡ Tutorials
	JDK 7 for ARM downloads have moved to the JDK 7 for ARM download page.	<u>■ Java.com</u>
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JDK 7

Java SE Development Kit 7u60 You must accept the Oracle Binary hank you for accepting the Oracle Bi do) Code License Ag software. nary Code Licens wnload this softw	reement for Java SE to download this se Agreement for Java SE; you may nov vare.
You must accept the Oracle Binary hank you for accepting the Oracle Bi do	Code License Ag software. nary Code Licens wnload this softv	reement for Java SE to download this se Agreement for Java SE; you may now vare.
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Apache Ant

Apache > Ant.apache



• Apache Ant

- Welcome
- License
- News
- Security Reports
- Documentation
 - Manual
 - Related Projects
 - External Tools and Tasks
 - Resources
 - Frequently Asked Questions
 - Wiki
 - Having Problems?

Download

- Binary Distributions
- Source Distributions
- Ant Manual
- Contributing
 - Mailing Lists
 - Git Repositories
 - Subversion Repositories
 - Nightly+Continuous Builds
 - Bug Database
 - Security
- Sponsorship
 Thanks
 - -



Migration to Git

May 23d, 2014 - Apache Ant's family of projects migrates to gi wip-us.apache.org/repos/asf

The Apache Ant family of projects migrates to git hosted by the Apache Softwa infrastructure on https://git-wip-us.apache.org/repos/asf.

The source code of Apache Ant, Ivy, Ivyde, the Antlibs and EasyAnt Are all mig keeping our web site in Subversion, as well as the sandbox.

Apache Ant™

Apache Ant is a Java library and command-line tool whose mission is to drive profiles as targets and extension points dependent upon each other. The main know build of Java applications. Ant supplies a number of built-in tasks allowing to cor run Java applications. Ant can also be used effectively to build non Java applica C++ applications. More generally, Ant can be used to pilot any type of process terms of targets and tasks.



Mirror

You are currently using **http://ftp.jaist.ac.jp/pub/apache/**. If you encounter a problem with this mirror, please select another mirror. If all mirrors are failing, there are *backup* mirrors (at the end of the mirrors list) that should be available.

Other mirrors:	http://ftp.jaist.ac.jp/pub/apache/	_	Change	
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Current Release of Ant

Currently, Apache Ant 1.9.4 is the best available version, see the release notes.

Note

Ant 1.9.4 was released on 05-May-2014 and may not be available on all mirrors for a few days.

Tar files may require gnu tar to extract

Tar files in the distribution contain long file names, and may require gnu tar to do the extraction.

- .zip archive: apache-ant-1.9.4-bin.zip [PGP] [SHA1] [SHA512] [MD5]
- .tar.gz archive: apache-ant-1.9.4-bin.tar.gz [PGP] [SHA1] [SHA512] [MD5]
- .tar.bz2 archive: apache-ant-1.9.4-bin.tar.bz2 [PGP] [SHA1] [SHA512] [MD5]





Apache Ant

- Unpack the following file: apache-ant-1.9.4-bin.zip
- Copy the folder "apache-ant-1.9.4" to an appropriate location (e.g. c:\android)





Develop > Tools > Android NDK

+



Android NDK Download Android Studio \sim The NDK is a toolset that allows you to implement parts of your app using native-code languages such as C and C++. For certain types of apps, this can Workflow \sim IN THIS DOCUMENT be helpful so you can reuse existing code libraries written in these languages, Support Library \sim but most apps do not need the Android NDK. **Tools Help** Before downloading the NDK, you should understand that the NDK will not \sim benefit most apps. As a developer, you need to balance its benefits against its Revisions drawbacks. Notably, using native code on Android generally does not result in \sim a noticable performance improvement, but it always increases your app NDK complexity. In general, you should only use the NDK if it is essential to your app-never because you simply prefer to program in C/C++. ADK \sim Typical good candidates for the NDK are CPU-intensive workloads such as game engines, signal processing, physics simulation, and so on. When

examining whether or not you should develop in native code, think about your requirements and see if the Android framework APIs provide the functionality that you need.

Downloads	
Revisions	
System and Software Requirements	
Installing the NDK	
Getting Started with the NDK Using the NDK	
Contents of the NDK	
Development tools	
Documentation	
Sample apps	

Downloads

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Platform	Package	Size (P, tes)	MD5 Checksum
Windows 32-bit	android-ndk-r9d-windows-x86.zip	• 91440074	b16516b611841a075685a10c59d6d7a2
Windows 64-bit	android-ndk-r9d-windows- x86_64.zip	520997454	8cd244fc799d0e6e59d65a59a8692588
Mac OS X 32-bit	android-ndk-r9d-darwin-x86.tar.bz2	393866116	ee6544bd8093c79ea08c2e3a6ffe3573
Mac OS X 64-bit	android-ndk-r9d-darwin- x86_64.tar.bz2	400339614	c914164b1231c574dbe40debef7048be

Develop > Tools > Android NDK Download Before installing the Android NDK, you must agree to the following terms and conditions. Android Studio V Ξ Terms and Conditions Workflow V Support Library \sim This is the Android Software Development Kit License Agreement **Tools Help** 1. Introduction Revisions 1.1 The Android Software Development Kit (referred to in this License Agreement as the "SDK" and specifically including the Android system files, packaged APIs, and Google APIs add-ons) is licensed to you NDK subject to the terms of this License Agreement. This License Agreement forms a legally binding contract between you and Google in relation to your use of the SDK. ADK 1.2 "Android" means the Android software stack for devices, as made available under the Android Open Source Project, which is located at the following URL: http://source.android.com/, as updated from time to time. 1.3 "Google" means Google Inc., a Delaware corporation with principal place of business at 1600 Amphitheatre Parkway, Mountain View, CA 94043, United States. I have read and agree with the above terms and conditions Download android-ndk-r9d-windows-x86_64.zip Mac OS X 32-bit android-ndk-r9d-darwin-x86.tar.bz2 393866116 ee6544bd8093c79ea08c2e3a6ffe3573 Mac OS X 64-bit c914164b1231c574dbe40debef7048be android-ndk-r9d-darwin-400339614

Unpack the following file: android-ndk-r9d-windows-x86_64.zip
Copy the folder "android-ndk-r9d" to an appropriate location (e.g. c:\android)







With a single download, the Eclipse ADT bundle includes everything you need to begin developing apps:

Eclipse + ADT plugin

Get Android Studio Beta

Android Studio is a new IDE powered by IntelliJ that



Download Eclipse ADT with the Android SDK for Windows

- Unpack the following file: adt-bundle-windows-x86_64-20140702.zip
- Copy the following file and folder to an appropriate location (e.g. c:\android)
 - SDK Manager.exe
 - sdk folder

Then,

Execute "SDK Manager.exe"







Android SD	K Ma	anager 🗕 🗖	×
Packages Tools			
SDK Path: C:\android\sdk			
Packages			
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🖌 🛧 Android SDK Build-tools		20 🗟 Installed	
🛛 📌 Android SDK Build-tools		19.1 ^C Not installed	
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Done loading packages.			🕐 -:#

Android SD	K Ma	inage	er 🗕 🗖	×
Packages Tools				
SDK Path: C:\android\sdk				
Packages				
🖷 Name	API	Rev.	Status	~
4 🗖 🔁 Android 4.4.2 (API 19)				
SDK Platform	19	3	Not installed	
Samples for SDK	19	5	Not installed	
✔ 💷 ARM EABI v7a System Image	19	2	Not installed	
Intel x86 Atom System Image	19	2	Not installed	
🚽 🛱 Google APIs (x86 System Image)	19	6	Not installed	
✔ 🛱 Google APIs (ARM System Image	19	6	Not installed	
🔄 说 Glass Development Kit Preview	19	8	Not installed	
Sources for Android SDK	19	2	Not installed	
> 🔄 🔁 Android 4.3 (API 18)				~
Show: Updates/New Installed Sort by: API level Repository	Obso	olete S	Select <u>New</u> or <u>Updates</u> Deselect All	nstall ·
Done loading packages.				-EM

Androi	_ □	×						
Packages Tools								
SDK Path: C:\android\sdk								
Packages								
🖷 Name	API	Rev.	Status		~			
🔺 🦳 🖴 Extras								
Android Support Repository		6	Not installed					
🖌 🖬 Android Support Library		20	🗟 Installed					
Google Play services for Froyo		12	Not installed					
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Google Repository		9	Not installed					
🔄 🖬 Google Play APK Expansion Libr		3	Not installed					
🔄 🖬 Google Play Billing Library		5	Not installed					
Google Play Licensing Library		2	Not installed					
✔ 🖬 Google USB Driver		10	Not installed					
🔄 🖬 Google Web Driver		2	Not installed					
☐ Intel x86 Emulator Accelerator (4	□ Not installed					
Show: ✔ Updates/New ✔ Installed Obsolete Select <u>New</u> or <u>Updates</u> Install 4 packages								
Sort by: API level Repository Deselect All Delete 4 packag								

1



http://qt-project.org/



http://qt-project.org/







Select the file according to your operating system from the list below to get the latest Qt 5.3 for your computer. The binary packages include Qt 5.3.1 libraries and Qt Creator 3.1.2

License



Qt is available under GPL v3, LGPL v2 and a commercial license. Learn more about licenses here.

Develop with a Qt Enterprise Commercial License

The Qt Enterprise commercial license offers varied licensing terms and includes additional functionality, support and product updates.

Learn more and evaluate Qt Enterprise here (qt.digia.com)

- Qt Online Installer for Linux 32-bit (23 MB) (Info)
- 🕒 Qt Online Installer for Linux 64-bit (22 MB) (Info)
- Qt Online Installer for Mac (9.4 MB) (Info)
- Qt Online Installer for Windows (14 MB) (Info)
- 🕛 Qt 5.3.1 for Android (Linux 32-bit, 516 MB) (Info)
- U Qt 5.3.1 for Android (Linux 64-bit, 513 MB) (Info)
- Qt 5.3.1 for Android (Windows 32-bit, 814 MB) (Info)
- Qt 5.3.1 for Linux 32-bit (447 MB) (Info)
- Qt 5.3.1 for Linux 64-bit (444 MB) (Info)
- Qt 5.3.1 for Mac (453 MB) (Info)
- Qt 5.3.1 for iOS (Mac, 910 MB) (Info)

Execute

"qt-opensource-windows-x86-android-5.3.1.exe"





Tool -> Options

Qt,		Ор	otions			>
Filter	Android					
Environment	Android Configurations	s				
Text Editor	JDK location:	C:¥android¥	jdk1.7.0_60			Browse 🛃
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✓ Неір () С++	Android NDK location:	C:¥android¥	android-ndk-ı	-9d		Browse 🛃
\land Qt Quick	\ \	Found 6 tool	chains for this	s NDK.	•	
🚯 Build & Run		🖌 Automat	ically create k	its for Android tool cha	ains	
🔍 Debugger		▲ Qt versior	n for architect e Ot version s	ure mips is missing. select Options > Buildu	& Run > Qt	Versions
📡 Designer	Ant evecutable:	C:Yandmid¥	aracha-ant-1	9 4¥bin¥ant bat		
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Devices	Android4.4	ļ	API 19	armeabi-v7a		Remove
🚮 Code Pasting						Start

Cancel

Apply

Connecting your Physical Android Device to Windows



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	+	Add account		
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	⋓	Accessibility		
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	{}	Developer options		
	\bigcirc	Abouttablat		



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1	Security		•
	ENCRYPTION		
	Encrypt tablet Require a numeric PIN or password to decrypt your tablet each time you po on	wer it	
	SIM CARD LOCK		
	Set up SIM card lock		
	PASSWORDS		
	Make passwords visible	~	
	DEVICE ADMINISTRATION		
	Device administrators View or deactivate device administrators		
	Unknown sources Allow installation of apps from sources other than the Play Store		
	Verify apps Disallow or warn before installation of apps that may cause harm		
	CREDENTIAL STORAGE		
	Storage type Hardware-backed		
	Trusted credentials Display trusted CA certificates		
	Install from storage Install certificates from storage		
	Clear credentials Remove all certificates		





Connect to Windows

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A surface?	Nexus 7 Properties
Audio inputs and outputs	Descriptions Details French
Batteries	General Driver Details Events
Bluetooth	Nexus 7
Image: Computer	
Disk drives	Driver Provider: Unknown
Display adapters	Driver Date: Not available
Firmware	Driver Version: Not available
Human Interface Devices	Digital Signer: Not digitally signed
IDE ATA/ATAPI controllers	
Imaging devices	Driver Details To view details about the driver files.
Keyboards	
Mice and other pointing devices	Update Driver To update the driver software for this device.
Monitors	If the device fails after updating the driver roll
Network adapters	Roll Back Driver back to the previously installed driver.
A D Other devices	
🕅 Nexus 7	Disable Disables the selected device.
Portable Devices	
Print queues	Uninstall To uninstall the driver (Advanced).
Printers	
	OK Cancel

Connect to Windows

Update Driver Software - Nexus 7 \leftarrow

How do you want to search for driver software?

Search automatically for updated driver software Windows will search your computer and the Internet for the latest driver sof for your device, unless you've disabled this feature in your device installation settings.

Browse my o Locate and instal



Browse For Folder

 \mathbf{X}

Select the folder that contains drivers for your hardware.



Connecting Nexus7







How to develop Qt App





How to develop Qt App

- Creating a GUI by QML
 QML is CSS/JavaScript like language.
- 2. Creating C++ plugins for QML
 - Calling external program
 - Setting environment variables
 - File I/O
- 3. Importing C++ plugins in QML

Let's make a Qt App calling CAS engine.





Creating a GUI by QML

 Create a project folder in c:\android e.g. projects

2. Execute Qt Creator





Qt						Qt (Creator				×		
File Eo	dit Build	Debug	Analyze	Tools	Window	Help							
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New Qt Quick Application

🔿 Location	Introduction and Project Location	
Component Set Kits Summary	This wizard generates a Qt Quick Application project. Name: MobileCAS	
	Create in: C:¥android¥projects Brow	vse
	Next	Cancel
la		

Input Name: MobileCAS Create in: c:\android\projects



Qt Quick component set: Qt Quick Controls 1.1

New Qt Quick Application

Kit Selection

Component Set

🗼 Kits

(←)

QL

Summary

Location

Qt Creator can use the following kits for project MobileCAS:

Android for armeabi (GCC 4.8, Qt 5.3.1)	Details •
☐ 🧔 Android for armeabi−v7a (GCC 4.8, Qt 5.3.1)	Details 🔻
🗌 🧔 Android for x86 (GCC 4.8, Qt 5.3.1)	Details 🔻
Desktop Qt 5.3 MinGW 32bit	Details ▼



New Qt Quick Application

یا 🕤

Location Component Set Kits I Summary	Project Management	
	Add as a subproject to project: <a>None>	~
	Add to version control:	✓ Configure
	Files to be added in C:\android\projects\MobileCAS:	
	deployment.pri main.cpp main.qml MobileCAS.pro qml.qrc	
		<u>F</u> inish Cancel

 \mathbf{X}

main.gml - MobileCAS - Qt Creator





File

Hello Asir

Rectangle {

Mobile CAS

id: outputArea
anchors.left: parent.left
width: parent.width * 0.7
height: parent.height
border.color: "DarkGray"
border.width: 1
TextArea {
 id: output
 width: parent.width
 height: parent.height
 font.pointSize: 18
 text: qsTr("Hello Asir")



Qt

main.qml - MobileCAS - Qt Creator

File Edit Build Debug Analyze Tools Window Help Rectangle ⊗ B+ X Projects 4 🔶 🧉 main.gml ▼ 17. MobileCAS 47 48 Rectangle { 4 MobileCAS.pro Welcome 49 id: executeBtn Image: իրի 50 width: parent.width Description Sources Edit 51 height: 40 A Besources 52 color: "LightBlue" 🔺 📓 gml.grc Design 53 border.color: "DarkGray" 54 border.width: 1 🖬 main.gml 55 4 Text { Debug 56 id: caption 2 57 anchors.centerIn: parent Projects 58 font.pointSize: 16 59 text: gsTr("Execute") Analyze 60 ? MouseArea { roject: MobileCAS Help anchors.fill: parent Deploy: **Deploy locally** Run: MobileCAS onClicked: { Build console.debug("Click:" + Mo.... # \$ Kit Android for armeabi (GCC 4.8, Q†<mark>5</mark>.3.1) Debug Desktop Qt 5.3 MinGW 32bit Release \geq ≻ ¢

х
Qt

main.qml - MobileCAS - Qt Creator

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	Projects 🔻 🖓 🖯 🛪	🔶 🔶 🧉 main.qml		×
Ot	4 🛅 MobileCAS	47	}	~
Welcome	🖻 MobileCAS.pro	48 🔺	Rectangle {	
.=-	Image: Second	49	id: executeBtn	
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Luit		51	height: 40	
		52	color: "LightBlue"	
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		54	border.width: 1	
Debug	main.qml	55 4	Text {	
		56	id: caption	
Projects		57	anchors.centerIn: parent	
17 00		58	font.pointSize: 16	
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нетр		62	anchors.fill: parent	
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	P. Type to locate (1 Issues 2 Search	··· 3 Applicat··· 4 Compile··· 5 QML /J··· 🖨	^
	Type to locate (



Execute an external program

- MobileCAS executes an external CAS engine.
 - QML has no function to access external programs.
 - We make a C++ plugin to execute external programs.





File -> New File or Project

Q ₽	New Project	×
Choose a template: Projects Applications Libraries Other Project Non-Qt Project Import Project Files and Classes	 C++ Library Qt Quick 1 Extension Plugin Qt Quick 2 Extension Plugin Qt Creator Plugin 	 Desktop Templates Creates a C++ plugin to load extensions dynamically into applications using the QQmlEngine class. Requires Qt 5.0 or newer. Supported Platforms: Desktop Android
		Choose Cancel

Qt Quick 2 Extension Plugin

Location	Introduction and Project Location
Kits Details Summary	Name: Cmdlaunch
	Create in: C:¥android¥projects Use as default project location
	Next Cancel

Input Name: cmdlaunch Create in: c:\android\projects



Fukuoka University of Education



Qt Quick 2 Extension Plugin

Kit Selection

Qt Creator can use the following kits for project **cmdlaunch**:

Details

Location

QL

🗼 Kits

Summary

Android for armeabi (GCC 4.8, Qt 5.3.1)	Details 🔻
🗌 🧔 Android for armeabi-v7a (GCC 4.8, Qt 5.3.1)	Details 🕶
🗌 🧔 Android for x86 (GCC 4.8, Qt 5.3.1)	Details 🕶
Desktop Qt 5.3 MinGW 32bit	Details 🔻





Input Object class-name: Launcher URI: org.inftyproject.launcher



 \mathbf{X}

launch.h

1					li	auncher.h - cmdlaunch - Qt Creator	-		×	
ile <u>E</u>	dit <u>B</u> uild <u>D</u>	ebug <u>A</u> na	lyze	<u>T</u> ools	<u>W</u> in	dow <u>H</u> elp				
	Projects	• 7, 0	B+ ×	(🔶 🖬	i launcher.h* 🔹 🔹 🖍 m process: QProcess *	•	# »	8+	×
oje otro n oh e bug b je otr n oh e bug	 Cmdlau Cmdlau Cmdlau Head Cu Ia Sour Ia Sour Ia Mobile Mobile	unch launch.pro ders mdlaunch_p auncher.h rces mdlaunch p auncher.cpp er files cCAS bileCAS.pro oyment rces hents + pro plugin.cpp plugin.h	olug olug ⊌+ ×	1 1 1 1 1 1 1 1 1 1 1 2	1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0	<pre>#ifndef LAUNCHER_H #define LAUNCHER_H #include <qobject> #include <qprocess> class Launcher : public QObject { Q_OBJECT public: explicit Launcher(QObject *parent = 0); Q_INVOKABLE QString launch(const QString & private: QProcess *m_process; }; #endif // LAUNCHER_H</qprocess></qobject></pre>	Sprog	gran	a);	
	launcher.h* main.qml			<					>	~
~	D P- Typ	e to locate ((11	sues	2 Search R… 3 Applicati… 4 Compile … 5 QML/JS… 6 General … ᅌ			^	

This code is available from

http://askubuntu.com/questions/288494/run-system-commands-from-qml-app

launcher.cpp

×

launcher.cpp - cmdlaunch - Qt Creator



Build Windows plugin



Build Android plugin



Build Android plugin The following error occurs:



Delete the following lines in the "cmdlaunch.pro"

🛕 🖓

Issues



Install plugin

- Windows
- Сору
 - +c:\android\project\cmdlaunch\qmldir
 - c:\android\project\build-cmdlaunch-Desktop_Qt_5_3_MinGW_32bit-Debug\ debug\cmdlaunch.dll

to

c:\Qt\Qt5.3.1\5.3\mingw482_32\qml\org\ inftyproject\launcher\





Importing C++ plugins in QML

	Projects 🔻 🖓 🔁 🖽 🗙	🔶 🔶 i	🖌 main.qml		🝷 Launche	r
0t	🔺 🛃 Sources 📃 🔨	1	import	QtQuick 2.2		
Velcome	📄 cmdlaunch_plug	2	import	QtQuick.Cont:	cols 1.1	<u> </u>
li il	launcher.cpp	3	import	org.inftypro	ject.lau	uncher 1.0
Edit	Other files	4				
\sim	🔺 🖻 MobileCAS	5 4	Applica	ationWindow {		
	MobileCAS.pro	6	vis	sible: true		
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		12		Iu: Tauncher	-	
Analyze	a main.qml	1/	1			Launcher
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Help		16 4	mer	Menii {	- L	element
cm… ch	Upen Documents 👻 🖽 🗙	17		title: (us <i>Tr(</i> "Fi	le")
	cmdlaunch.pro	18 4		MenuIten	1211 (14 n {	
Debug	cmdlaunch_plugin.cpp	19		text	: asTr	("Exit")
	cmdlaunch_plugin.h	20		onTi	riggered	d: Ot.quit();
	launcher.cpp	21		}		2 (, ,
	launcher.h	22		}		
	main.qml	23	}	-		

Importing C++ plugins in QML







MobileCAS: Build -> Run

Input "notepad" in the textfield Click "Execute" button Notepad will appear



Install plugin

- Android
- Сору
 - +c:\android\project\cmdlaunch\qmldir
 - c:\android\project\build-cmdlaunch-Android_for_armeabi_GCC_4_8_Qt_5_3_1-Debug\libcmdlaunch.so

to

c:\Qt\Qt5.3.1\5.3\android_armv5\qml\org\ inftyproject\launcher\







Set PATH, File I/O plugin

These C++ plugins are available from: http://www.inftyproject.org/ISSAC2014/

- For Windows
 - Extract windows_plugins.zip, and copy "org" to c:\Qt\Qt5.3.1\5.3\mingw482_32\qml\
- For Android
 - Extract android_plugins.zip, and copy "org" to c:\Qt\Qt5.3.1\5.3\android_armv5\qml\





Copy CAS engine for Windows

Download asirwin.zip from: http://www.inftyproject.org/ISSAC2014/

Extract it, and copy all files including asir.exe to c:\android\project\build-MobileCAS-Desktop_Qt_5_3_MinGW_32bit-Debug\





Qt

main.qml - MobileCAS - Qt Creator

. 🗆 🗙

<u>File Edit Build Debug Analyze Tools Window Help</u> ▼ 7. 8 B+ X - EnvSet Projects è 🖬 main.gml ▼ » ⊟+ import org.inftyproject.launcher 1.0 fileio_plugin.h Qt Δ import org.inftyproject.fileio 1.0 Sources Welcome 5 import org.inftyproject.envset 1.0 fileio.cpp իրի 6 fileio_plugin.cpp ApplicationWindow { Edit Other files visible: true X 9 width: 1000 MobileCAS Design 10height: 700 MobileCAS.pro Add 11 title: gsTr("Mobile CAS") deployment 12 Debug elements D La Sources Launcher { 13 \square id: launcher 14 Resources Projects 15 4 📓 gml.grc FileIO { 16 Analyze 17 id: inFile 🗟 main.gml 18 source: "input.txt" ? 19 onError: console.log(msg) Help 20 < ≻ 21 Open Documents FileIO { ▼ 日+ \sim 22 id: outFile Mo… AS envset plugin.cpp 23 source: "result.txt" envset plugin.h 24 onError: console.log(msg) Debug fileio.cpp 25 fileio.h EnvSet { 26 27 id: pathEnv fileio.pro 28 main.gml ~ ~ У Issues 2 Searc··· 3 Applic··· 4 Compi··· 5 QML/··· 6 Gener·· 🗧 P- Type to locate (

main.qml for Windows

```
Text {
    id: caption
    anchors.centerIn: parent
    font.pointSize: 16
    text: gsTr("Execute")
QtObject {
    id: inputNo
    property int i:0
    function next() {
        i++;
        return i:
                             Create input file
    ł
MouseArea {
                                              Execute Asir
    anchors.fill: parent
    onClicked: {
        console.debug("Click:" + caption.text)
        outFile.write("")
        inFile.write("R=" + input.text + "output(\"result.txt\")$R;quit;")
        output.append("[" + inputNo.next() +
                                                 .
                                                   + input.text)
        launcher.launch("asir -f input.txt")
        output.append(outFile.read())
                                           Get result
```



Copy CAS engine to Android

- 1. Install <u>Terminal IDE</u> to your Android device through Google Play.
- 2. Click 'Install System' in the menu of Terminal IDE.
- Download and install Risa/Asir on Terminal IDE: \$ wget http://133.81.157.19/~fujimoto/android/ asiroid.tar.gz \$ tar zxvf asiroid.tar.gz \$ chmod –R 755 local





Copy CAS engine to Android

- 4. Execute the following on Terminal IDE:
- \$ install_gcc
- \$ chmod -R 755 android-gcc-4.4.0
- \$ mkdir bin
- \$ cd bin
- \$ In -s ../android-gcc-4.4.0/bin/arm-eabi-cpp cpp
- \$ In -s ../local/lib/asir/asir asir

\$ cd ..

- \$ chmod –R 755 bin
- 5. Run asir to check this installation

\$ fep asir





main.qml for Android



}

main.qml for Android

```
MouseArea {
    anchors.fill: parent
    onClicked: {
        console.debug("Click:" + caption.text)
        outFile.write("")
        inFile.write("R=" + input.text + "output(\"/sdcard/tmp/result.txt\")$R;quit;")
        output.append("[" + inputNo.next() + "] " + input.text)
        launcher.launch("asir -f /sdcard/tmp/input.txt")
        output.append(outFile.read())
    }
```

Screenshot on Android

23 🖬 🖾 🐵 😂	🕺 📚 🖬 🛢 2:26
MobileCAS	:
Hello Asir	CAS: Risa/Asir
[1] diff(log(x),x);	fctr(x^3-1);
(1)/(x)	Execute
[2] fctr(x^3-1);	
[[1,1],[x-1,1],[x^2+x+1,1]]	
	in a second s
当人 Fukuoka University of	
ラ Education	

Computing Process of Mobile CAS



Further development

- Communication with CAS engine
 - ✤ OpenXM
 - A communication protocol on TCP/IP sockets
 - Client Server Model
- Inputting math expressions
 - Handwriting interface of InftyEditor
 - Importing Infty handwriting recognition algorithm written by C++
- Math font for Qt
 - Infty Math fonts





AsirPad for Windows

2	AsirPad2 2014	
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		Next
		N/A
		Factorial
		IntQuotient
		Execute
	All Delete Undo	OK Quit

AsirPad for Android



Conclusion

• We explained an implementation method of a computer algebra system for tablets.

- Building a CAS engine
 - Arm rootfs + QEMU + chroot
- Creation of GUI
 - Qt Quick
 - ♦ C++ plugin
- This method is available for developing cross-platform computer algebra Apps.



