ASSEMBLY LANGUAGE AND MICROCOMPUTER PRACTICE

CodeSourcery G++ tool-chain

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Outline

- What is the CodeSourcery G++ tool-chain
- How to get it
- How to install
- Basic for compilation
- Basic for simulation
- Basic for debugging
- Basic for pure assembly

What is the CodeSourcery G++ tool-chain?

- The ARM tool-chain (GCC based)
- It’s free software
- CodeSourcery, in partnership with ARM, Ltd., develops improvements to the GNU Toolchain for ARM processors and provides regular, validated releases of the GNU Toolchain.

What is the CodeSourcery G++ tool-chain?

	free	$399	$2799
	Lite Edition	Personal Edition	Professional Edition
GNU C & C++ Compilers	✔	✔	✔
GNU Assembler & Linker	✔	✔	✔
C & C++ Runtime Libraries	✔	✔	✔
Additional C & C++ Runtime Libraries			✔
CS3		✔	✔
GNU Debugger	✔	✔	✔
Debug Sprites		✔	✔
Instruction Set Simulator	✔	✔	✔
GNU/Linux Application Simulator		✔	✔
Eclipse IDE		✔	✔
GNU/Linux Prelinker		✔	✔
GNU/Linux Library Optimizer		✔	✔
Sysroot Utilities		✔	✔
Access to Updates		✔	✔
Knowledge Base		✔	✔
Unlimited Support			✔

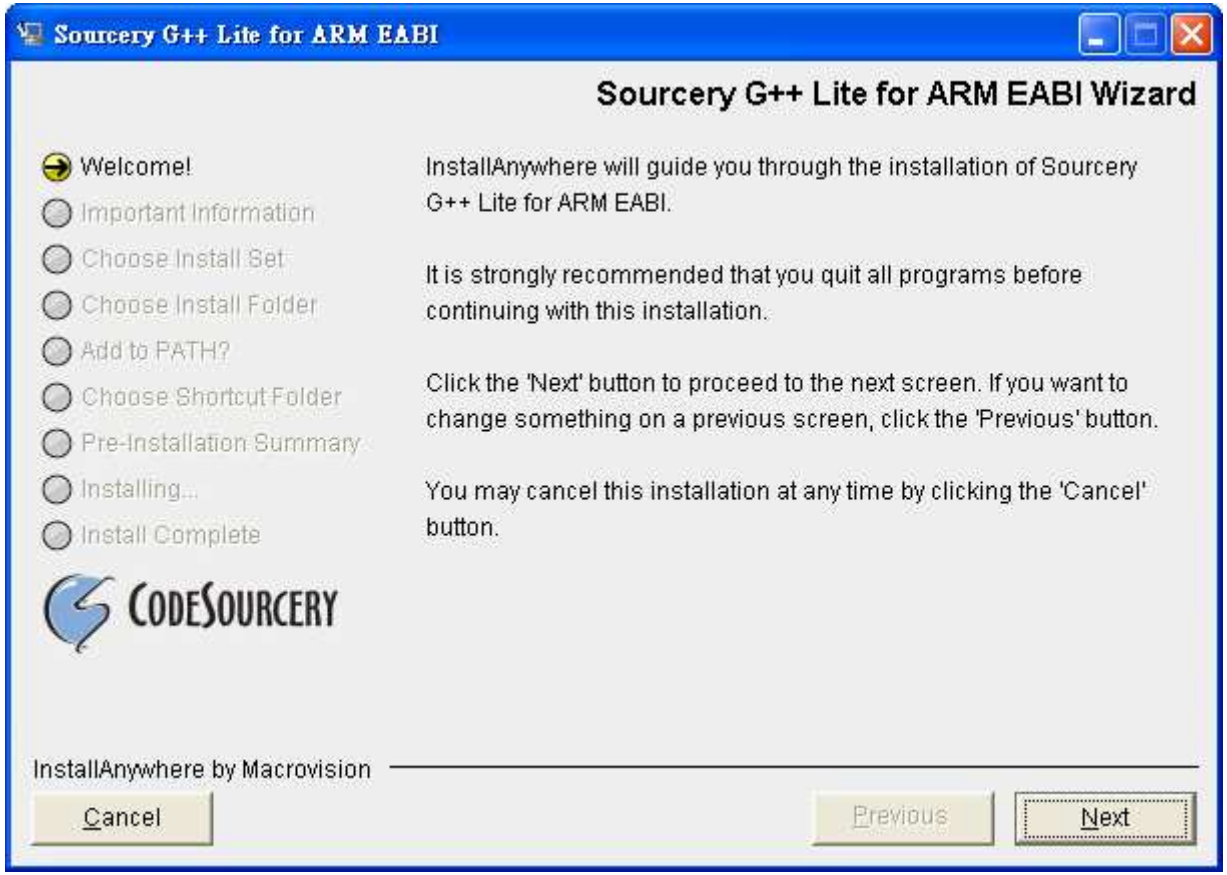
How to get it

- http://140.117.176.59/ASSEMBLY_LANGUAGE_AND_MICROCOMPUTER_PRACTICE/tools/sourceryG++/
- http://www.codesourcery.com/sgpp/lite/arm/portal/subscription3053

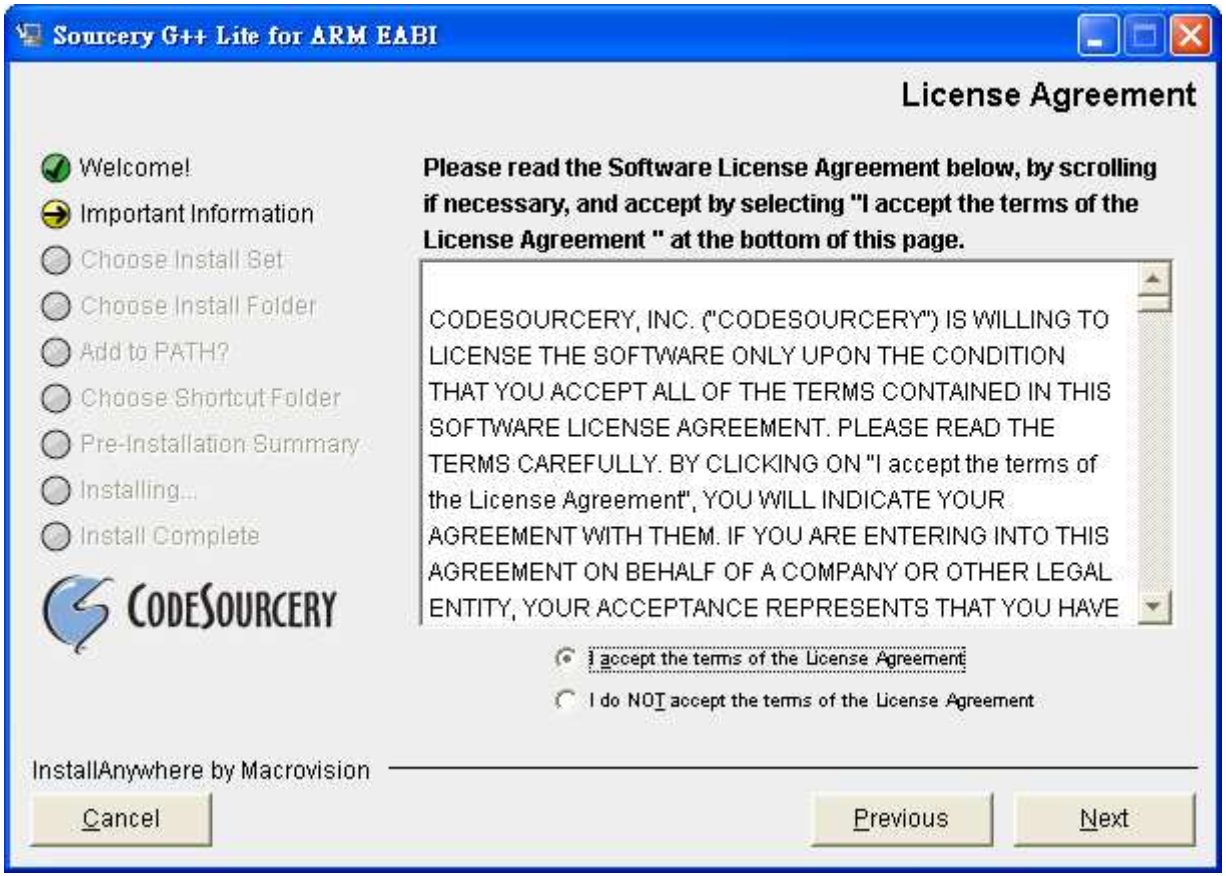
How to install

- You must be administrator.
- According to the following slides to install.

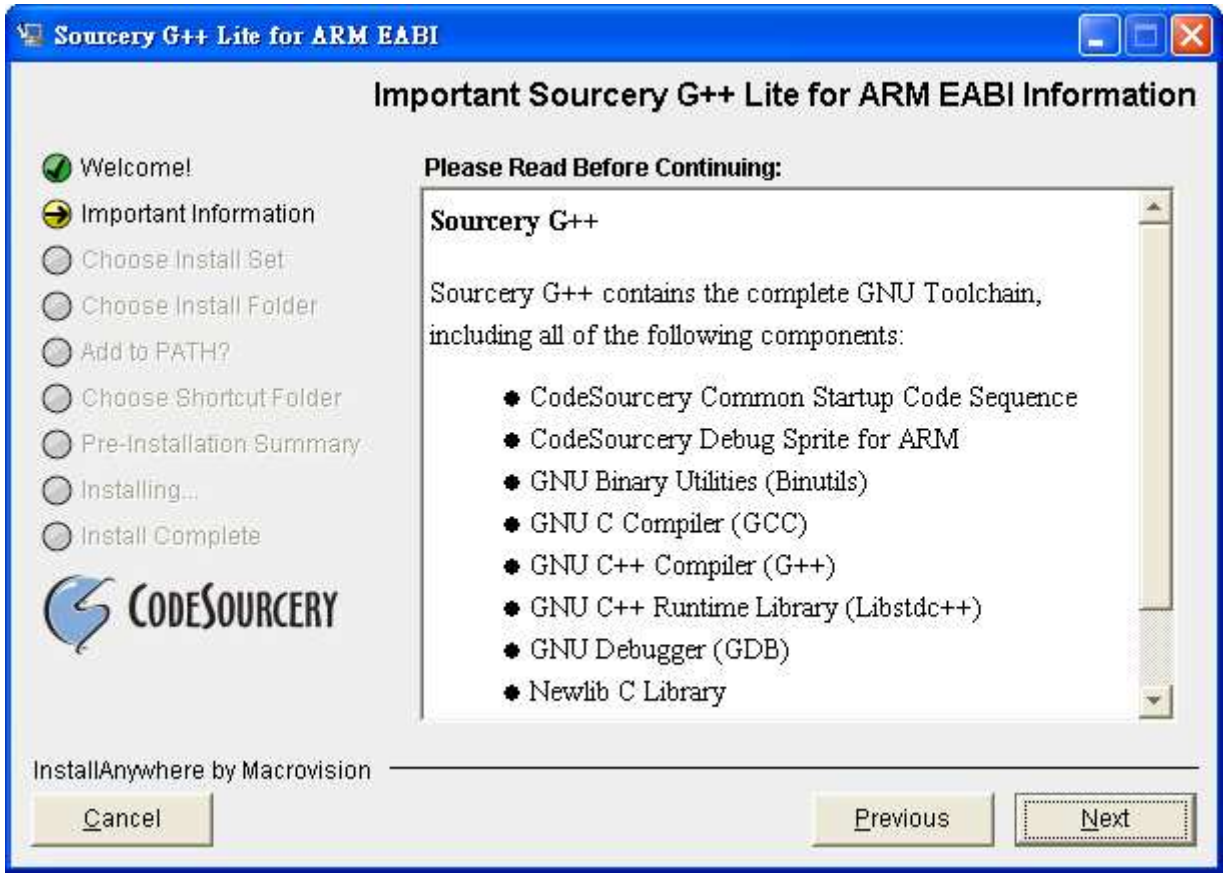
Step1


Sourcery G++ Lite for ARM EABI
Sourcery G++ Lite for ARM EABI Wizard
Welcome!
Important Information
Choose Install Set
Choose Install Folder
Add to PATH?
Choose Shortcut Folder
Pre-Installation Summary
Installing...
Install Complete
InstallAnywhere will guide you through the installation of Sourcery G++ Lite for ARM EABI.
It is strongly recommended that you quit all programs before continuing with this installation.
Click the 'Next' button to proceed to the next screen. If you want to change something on a previous screen, click the 'Previous' button.
You may cancel this installation at any time by clicking the 'Cancel' button.
CODESOURCERY
InstallAnywhere by Macrovision
Cancel
Previous
Next

Step2

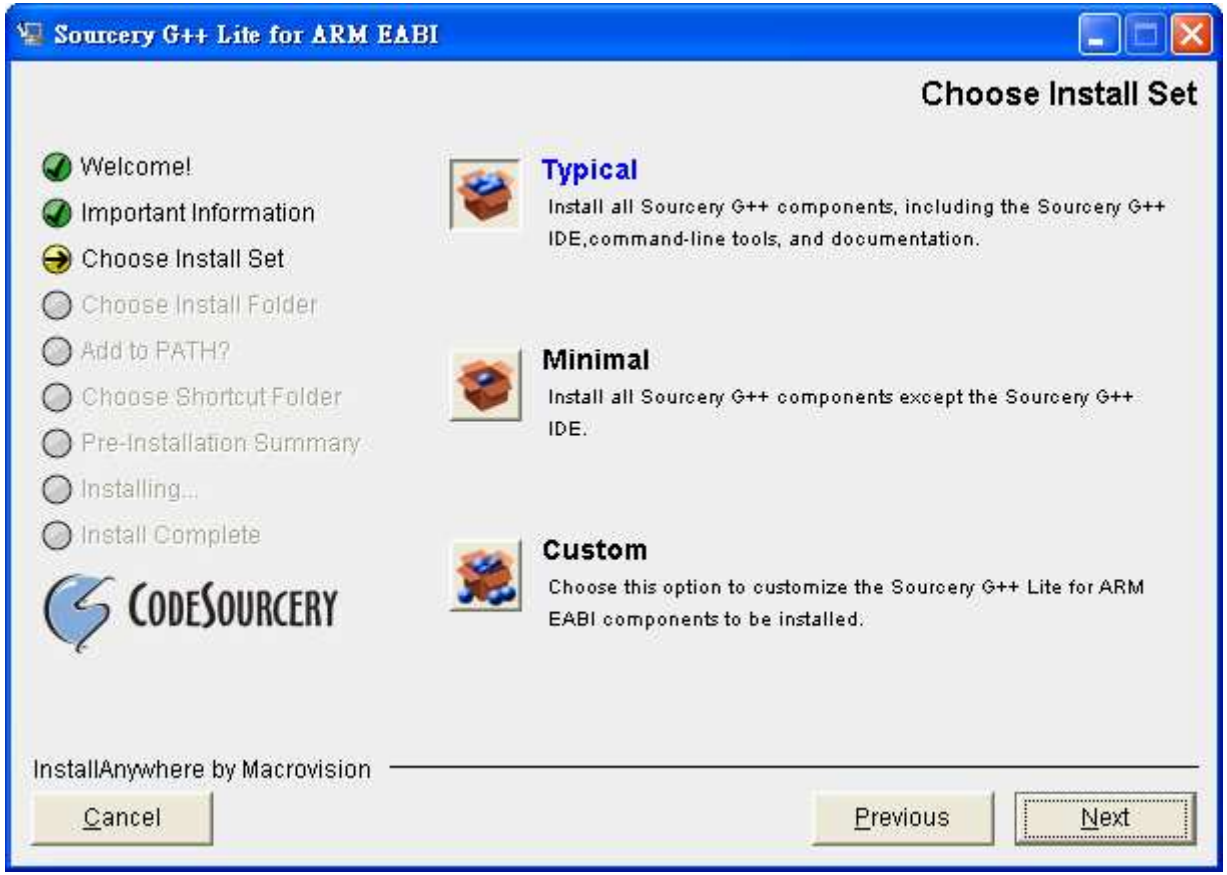

Sourcery G++ Lite for ARM EABI
License Agreement
Welcome!
Important Information
Choose Install Set
Choose Install Folder
Add to PATH?
Choose Shortcut Folder
Pre-Installation Summary
Installing...
Install Complete
CODESOURCERY
Please read the Software License Agreement below, by scrolling if necessary, and accept by selecting "I accept the terms of the License Agreement " at the bottom of this page.
CODESOURCERY, INC. ("CODESOURCERY") IS WILLING TO LICENSE THE SOFTWARE ONLY UPON THE CONDITION THAT YOU ACCEPT ALL OF THE TERMS CONTAINED IN THIS SOFTWARE LICENSE AGREEMENT. PLEASE READ THE TERMS CAREFULLY. BY CLICKING ON "I accept the terms of the License Agreement", YOU WILL INDICATE YOUR AGREEMENT WITH THEM. IF YOU ARE ENTERING INTO THIS AGREEMENT ON BEHALF OF A COMPANY OR OTHER LEGAL ENTITY, YOUR ACCEPTANCE REPRESENTS THAT YOU HAVE
I accept the terms of the License Agreement
I do NOT accept the terms of the License Agreement
InstallAnywhere by Macrovision
Cancel
Previous
Next

Step3

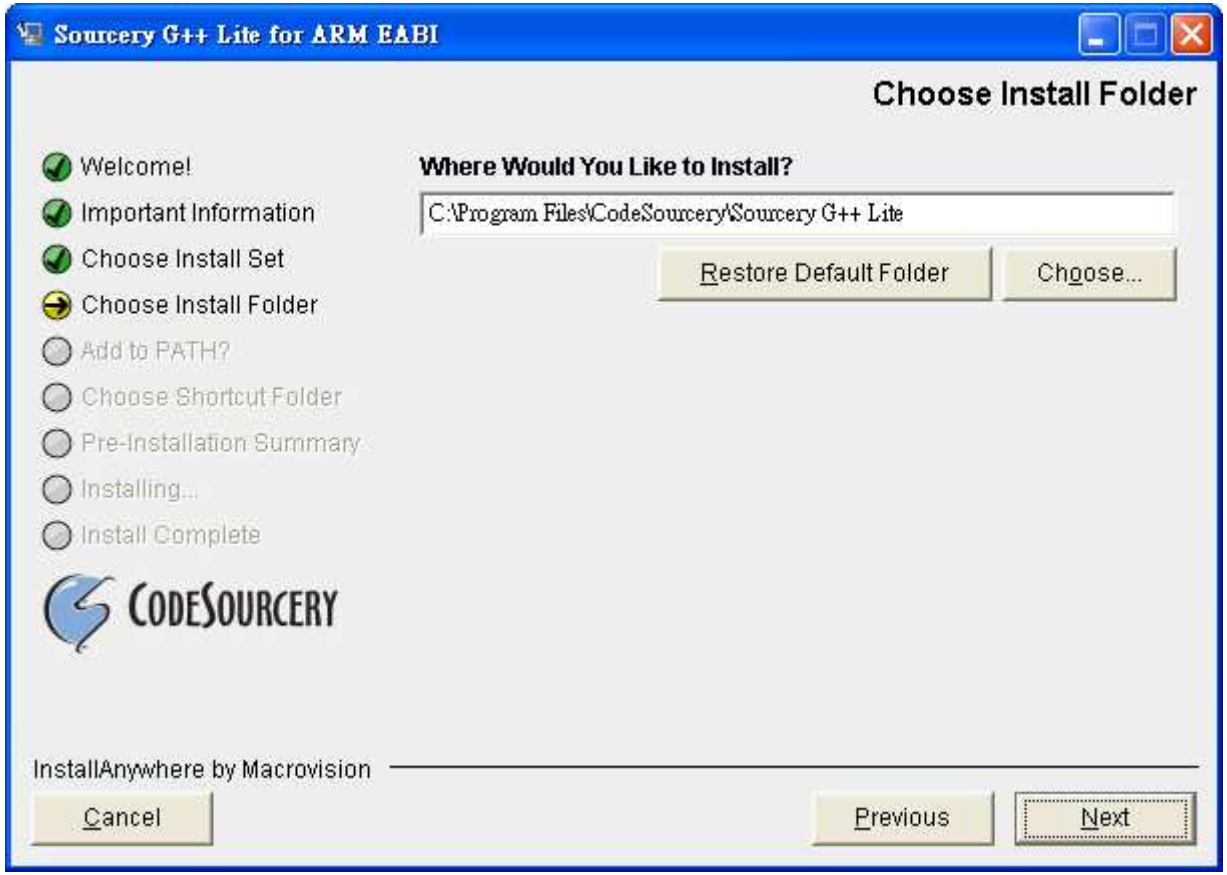

Sourcery G++ Lite for ARM EABI
Important Sourcery G++ Lite for ARM EABI Information
Welcome!
Important Information
Choose Install Set
Choose Install Folder
Add to PATH?
Choose Shortcut Folder
Pre-Installation Summary
Installing...
Install Complete
CODESOURCERY
Please Read Before Continuing:
Sourcery G++
Sourcery G++ contains the complete GNU Toolchain, including all of the following components:
CodeSourcery Common Startup Code Sequence
CodeSourcery Debug Sprite for ARM
GNU Binary Utilities (Binutils)
GNU C Compiler (GCC)
GNU C++ Compiler (G++)
GNU C++ Runtime Library (Libstdc++)
GNU Debugger (GDB)
Newlib C Library
InstallAnywhere by Macrovision
Cancel
Previous
Next

Step4

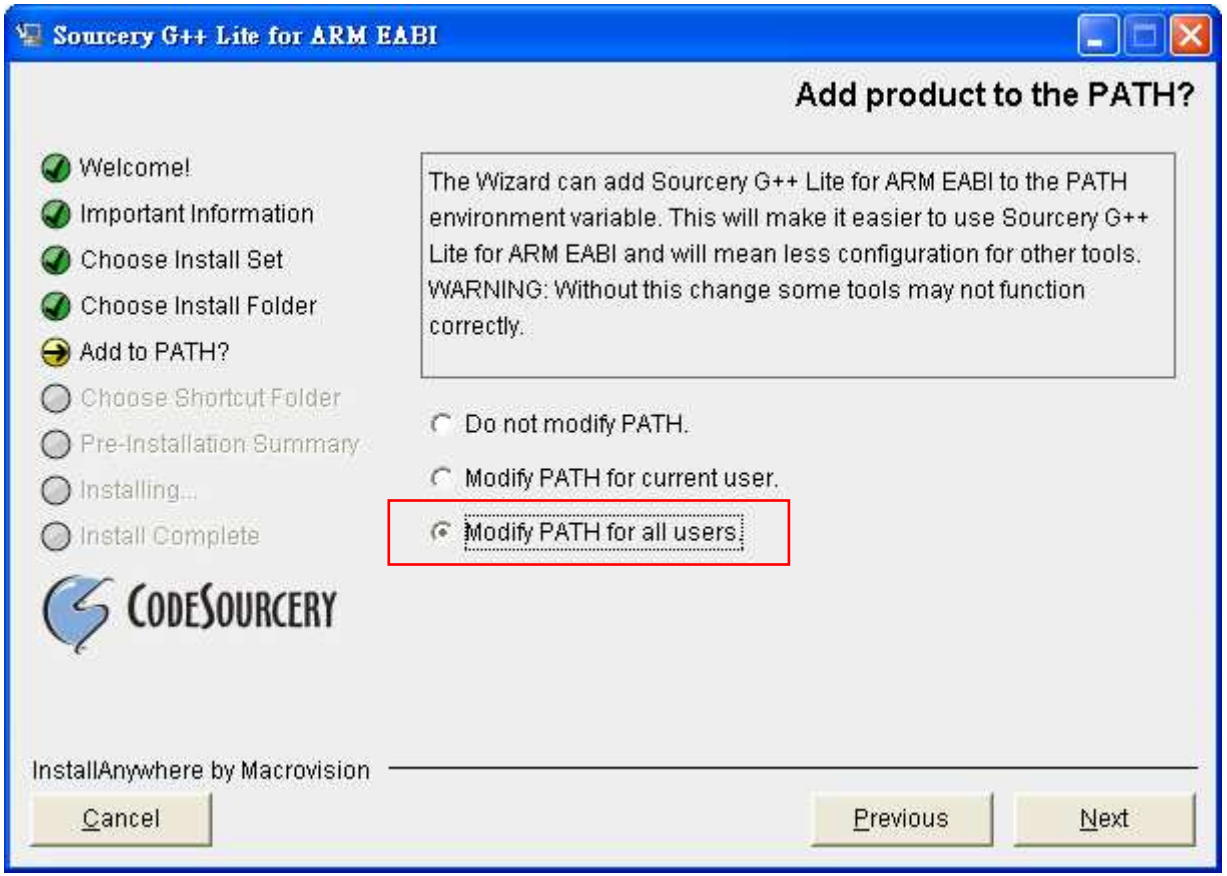
- Choose Typical option



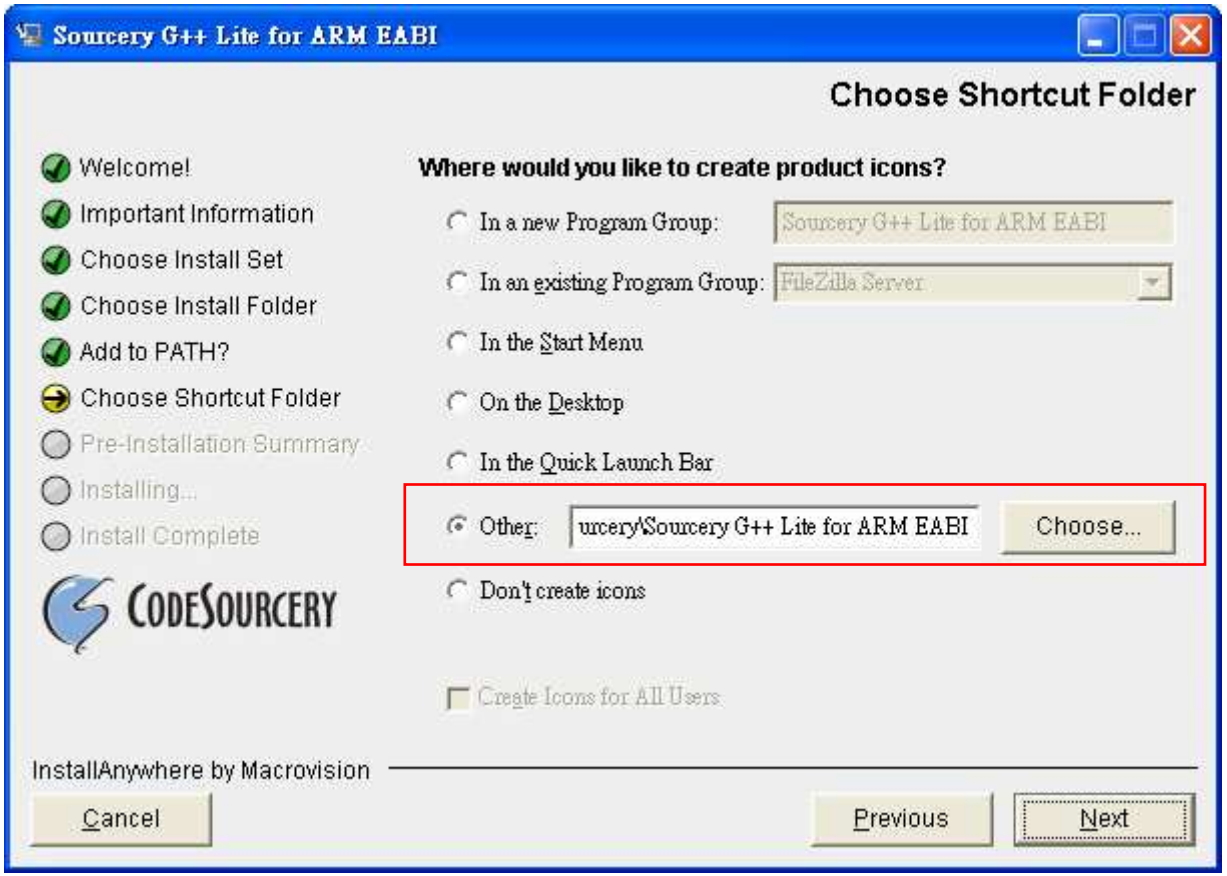
Step5


Sourcery G++ Lite for ARM EABI
Choose Install Folder
Welcome!
Important Information
Choose Install Set
Choose Install Folder
Add to PATH?
Choose Shortcut Folder
Pre-Installation Summary
Installing...
Install Complete
CODESOURCERY
Where Would You Like to Install?
C:\Program Files\CodeSourcery\Sourcery G++ Lite
Restore Default Folder
Choose...
InstallAnywhere by Macrovision
Cancel
Previous
Next

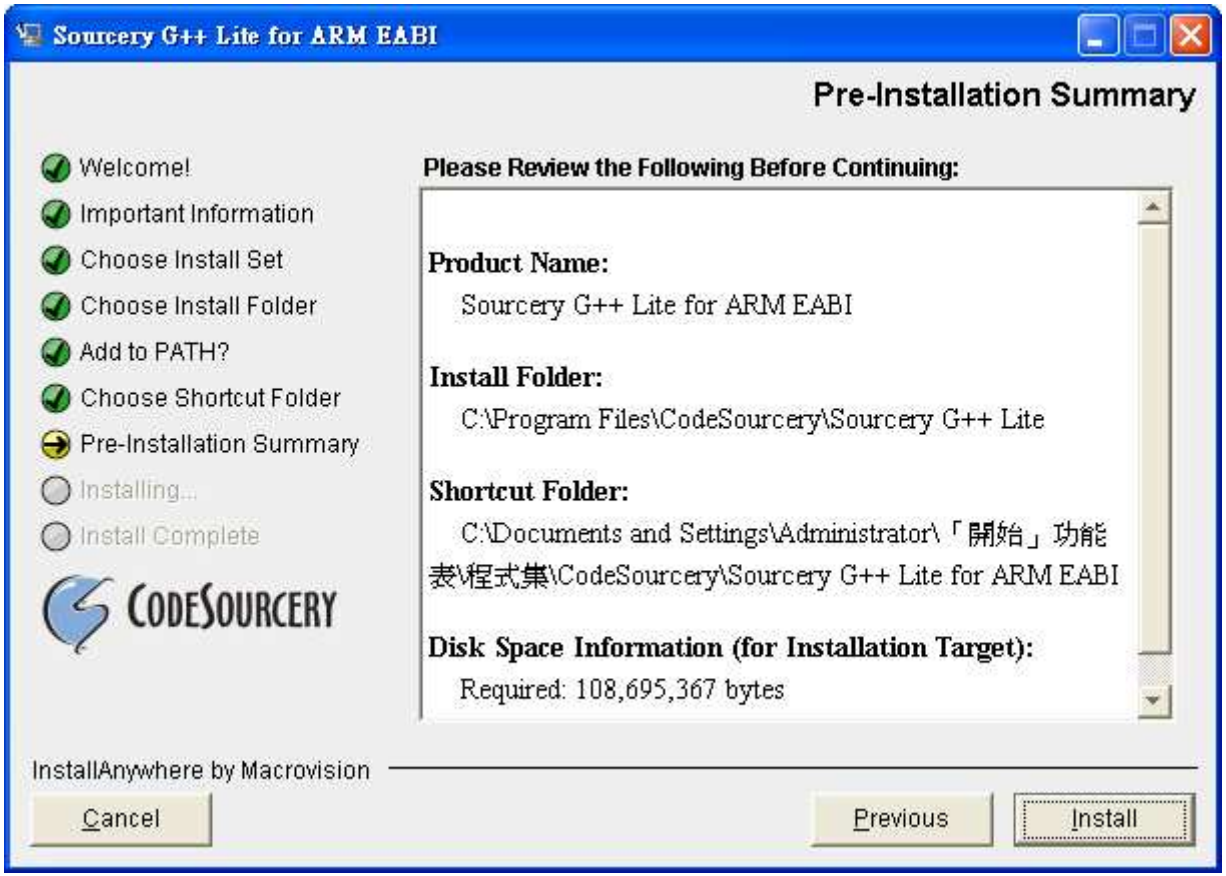
Step6


Sourcery G++ Lite for ARM EABI
Add product to the PATH?
Welcome!
Important Information
Choose Install Set
Choose Install Folder
Add to PATH?
Choose Shortcut Folder
Pre-Installation Summary
Installing...
Install Complete
CODESOURCERY
The Wizard can add Sourcery G++ Lite for ARM EABI to the PATH environment variable. This will make it easier to use Sourcery G++ Lite for ARM EABI and will mean less configuration for other tools. WARNING: Without this change some tools may not function correctly.
Do not modify PATH.
Modify PATH for current user.
Modify PATH for all users.
InstallAnywhere by Macrovision
Cancel
Previous
Next

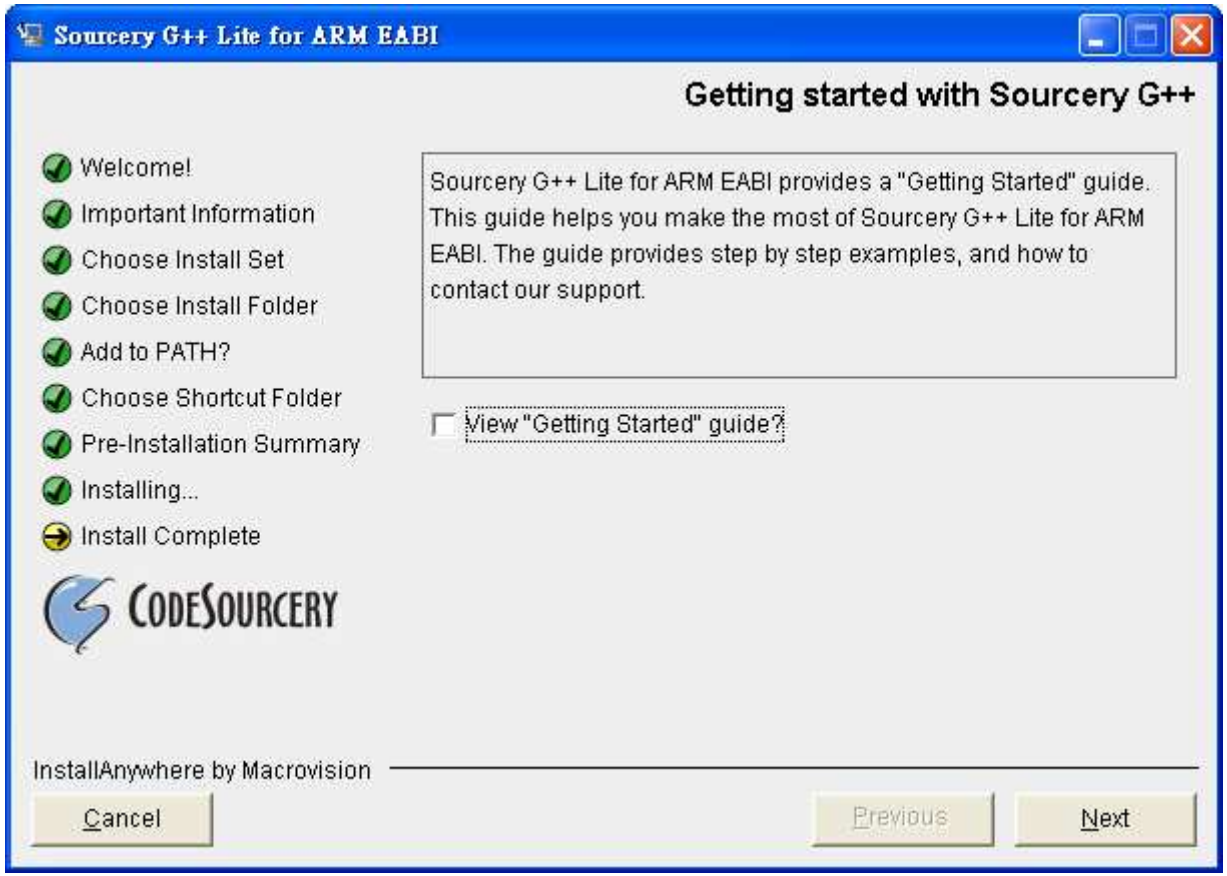
Step7


Sourcery G++ Lite for ARM EABI
Choose Shortcut Folder
Welcome!
Important Information
Choose Install Set
Choose Install Folder
Add to PATH?
Choose Shortcut Folder
Pre-Installation Summary
Installing...
Install Complete
CODESOURCERY
Where would you like to create product icons?
In a new Program Group:
Sourcery G++ Lite for ARM EABI
In an existing Program Group:
FileZilla Server
In the Start Menu
On the Desktop
In the Quick Launch Bar
Other:
urcery\Sourcery G++ Lite for ARM EABI
Choose...
Don't create icons
Create Icons for All Users
InstallAnywhere by Macrovision
Cancel
Previous
Next

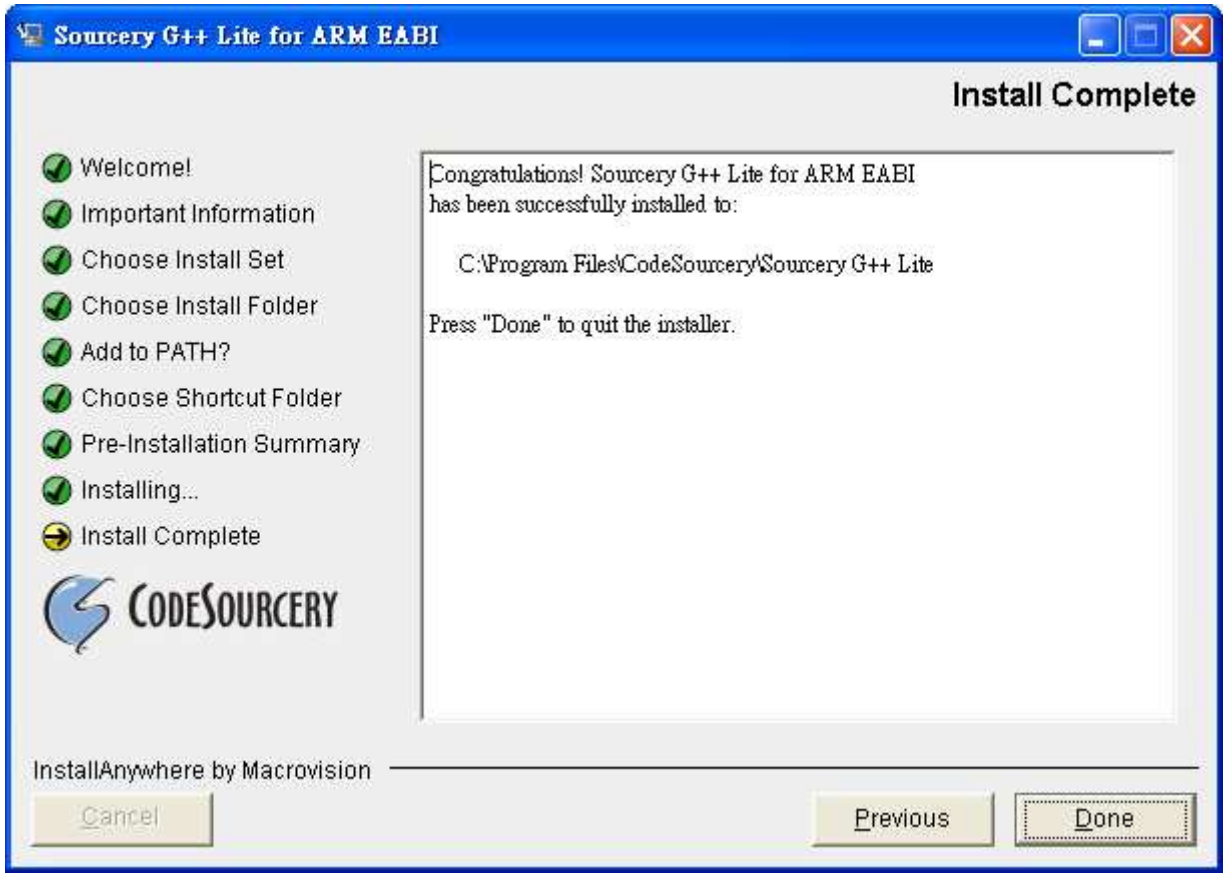
Step8


Sourcery G++ Lite for ARM EABI
Pre-Installation Summary
Welcome!
Important Information
Choose Install Set
Choose Install Folder
Add to PATH?
Choose Shortcut Folder
Pre-Installation Summary
Installing...
Install Complete
CODESOURCERY
Please Review the Following Before Continuing:
Product Name:
Sourcery G++ Lite for ARM EABI
Install Folder:
C:\Program Files\CodeSourcery\Sourcery G++ Lite
Shortcut Folder:
C:\Documents and Settings\Administrator\「開始」功能表\程式集\CodeSourcery\Sourcery G++ Lite for ARM EABI
Disk Space Information (for Installation Target):
Required: 108,695,367 bytes
InstallAnywhere by Macrovision
Cancel
Previous
Install

Step9


Sourcery G++ Lite for ARM EABI
Getting started with Sourcery G++
Welcome!
Important Information
Choose Install Set
Choose Install Folder
Add to PATH?
Choose Shortcut Folder
Pre-Installation Summary
Installing...
Install Complete
CODESOURCERY
Sourcery G++ Lite for ARM EABI provides a "Getting Started" guide. This guide helps you make the most of Sourcery G++ Lite for ARM EABI. The guide provides step by step examples, and how to contact our support.
View "Getting Started" guide?
InstallAnywhere by Macrovision
Cancel
Previous
Next

Step10


Sourcery G++ Lite for ARM EABI
Install Complete
Welcome!
Important Information
Choose Install Set
Choose Install Folder
Add to PATH?
Choose Shortcut Folder
Pre-Installation Summary
Installing...
Install Complete
CODESOURCERY
Congratulations! Sourcery G++ Lite for ARM EABI
has been successfully installed to:
C:\Program Files\CodeSourcery\Sourcery G++ Lite
Press "Done" to quit the installer.
InstallAnywhere by Macrovision
Cancel
Previous
Done

Step11

- reboot

Outline

- What is the CodeSourcery G++ tool-chain
- How to get it
- How to install
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- Basic for simulation
- Basic for debugging
- Basic for pure assembly

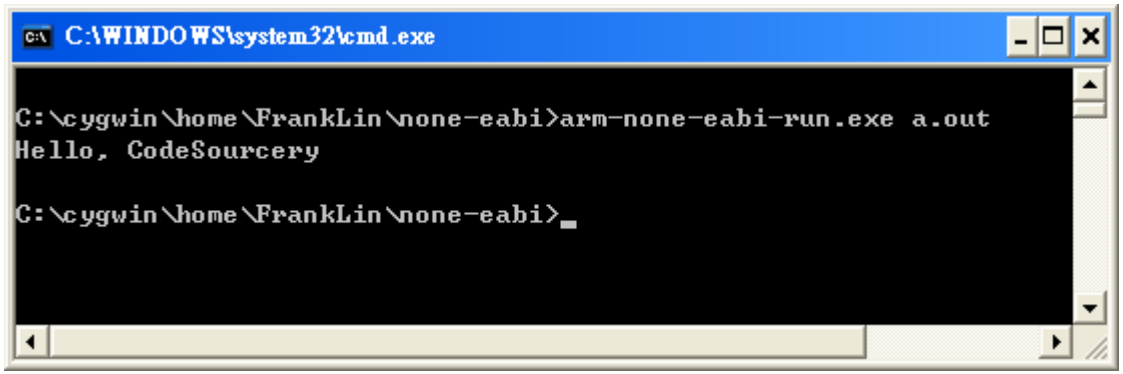
Basic for compilation

- arm-none-eabi-gcc.exe test.c -T generic-hosted.ld

```
1 #include <stdio.h>
2
3 int main()
4 {
5     printf("Hello, CodeSourcery\n");
6     return 0;
7 }
8
```

Basic for simulation

- arm-none-eabi-run.exe a.out



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Basic for debugging

- arm-none-eabi-gdb.exe a.out

C:\WINDOWS\system32\cmd.exe - arm-none-eabi-gdb.exe a.out

```
C:\cygwin\home\FrankLin\none-eabi>arm-none-eabi-gdb.exe a.out
GNU gdb (Sourcery G++ Lite 2008q3-66) 6.8.50.20080821-cvs
Copyright (C) 2008 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.  Type "show copying"
and "show warranty" for details.
This GDB was configured as "--host=i686-mingw32 --target=arm-none-eabi".
For bug reporting instructions, please see:
<https://support.codesourcery.com/GNUToolchain/>...
(no debugging symbols found)
(gdb) _
```

Debug with GDB

- In GDB, type
  - target sim
  - load
  - run

Debug with GDB

C:\WINDOWS\system32\cmd.exe - arm-none-eabi-gdb.exe a.out

```
C:\cygwin\home\FrankLin\none-eabi>arm-none-eabi-gdb.exe a.out
GNU gdb (Sourcery G++ Lite 2008q3-66) 6.8.50.20080821-cvs
Copyright (C) 2008 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.  Type "show copying"
and "show warranty" for details.
This GDB was configured as "--host=i686-mingw32 --target=arm-none-eabi".
For bug reporting instructions, please see:
<https://support.codesourcery.com/GNUToolchain/>...
(no debugging symbols found)
(gdb) target sim
Connected to the simulator.
(gdb) load
Loading section .text, size 0x331c vma 0x0
Loading section .eh_frame, size 0x4 vma 0x331c
Loading section .ARM.exidx, size 0x8 vma 0x3320
Loading section .rodata, size 0x78 vma 0x3328
Loading section .data, size 0x828 vma 0x33a0
Start address 0x40
Transfer rate: 122432 bits in <1 sec.
(gdb) run
Starting program: c:\cygwin\home\franklin\none-eabi\a.out
Hello, CodeSourcery

Program exited normally.
(gdb) _
```

Some useful GDB command

- b
  - b main
- run
- info registers
- p
  - p $pc
  - p/x $pc

•Please refer to the CodeSourcery's documents for details

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Introduction to GAS for arm

- GAS is Gnu ASsembler
- The following slides would introduce how to write a pure assembly code in CodeSourcery G++.

The assembly template

- Please refer to gcc-asm-template.S
- You can use this file as the skeleton of your homework.

assemble and run

- assemble
  - arm-none-eabi-gcc.exe -T generic-hosted.ld gcc-asm-template.S
- run
  - arm-none-eabi-run.exe a.out

Some useful assembler directives

- .align
- .global
- string
- number
- comment
  - @this is a comment
- label
  - LABEL0:

.align

- Pad the location counter (in the current subsection) to a particular storage boundary
- It is aligned power of 2
- For example, aligned 4 byte
  - .align 2

.global

- Make the symbol visible to ld
- At least we must have a global symbol called “main” because we use the “generic-hosted.ld” for our linker script.

How to define a string

- .ascii
  - It assembles each string (with no automatic trailing zero byte) into consecutive addresses.
  - for example: .ascii “Hello world\n\0”
- .asciz
  - .asciz is just like .ascii, but each string is followed by a zero byte.
  - for example: .asciz “Hello world\n”

How to define a number

- .byte
- .short
- .word
- Multiple number is separated by comma
  - for example: .byte 0x31, 0x32, 0x33, 0x34
- If you don’t use .align, assembler would compact each number.

Reference

- http://www.codesourcery.com/sgpp
- The as manual of CodeSourcery G++