
[SoC Design]
Term Project: Accelerator for CNN

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Outline

- ❑ Open Vivado projects
- ❑ Running C Applications

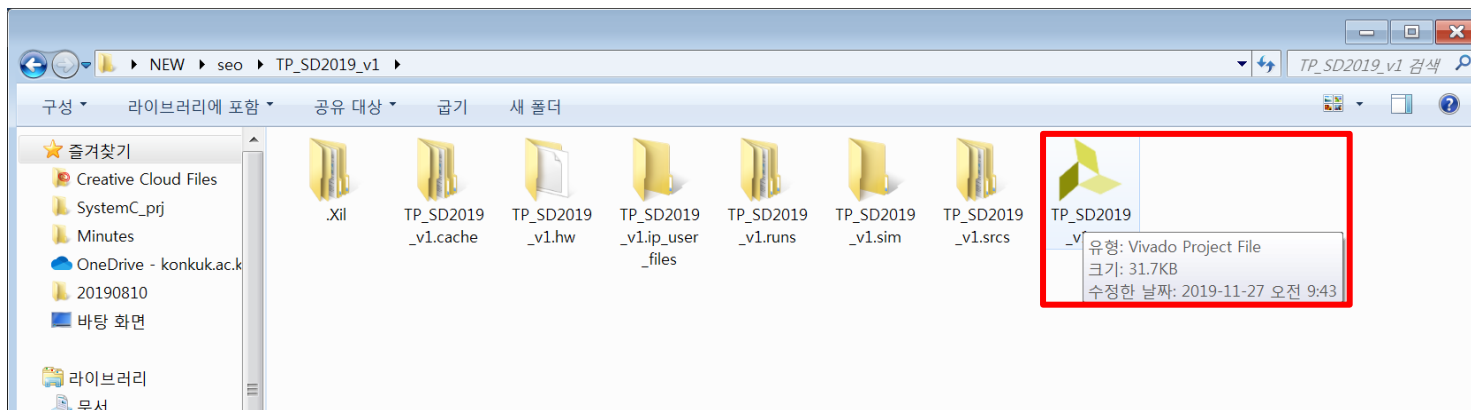
Open Vivado projects

❑ Open Vivado projects

- Unzip and open '**TP_SD2019_v1**' folder and run file '**TP_SD2019_v1.xpr**'

Download link:

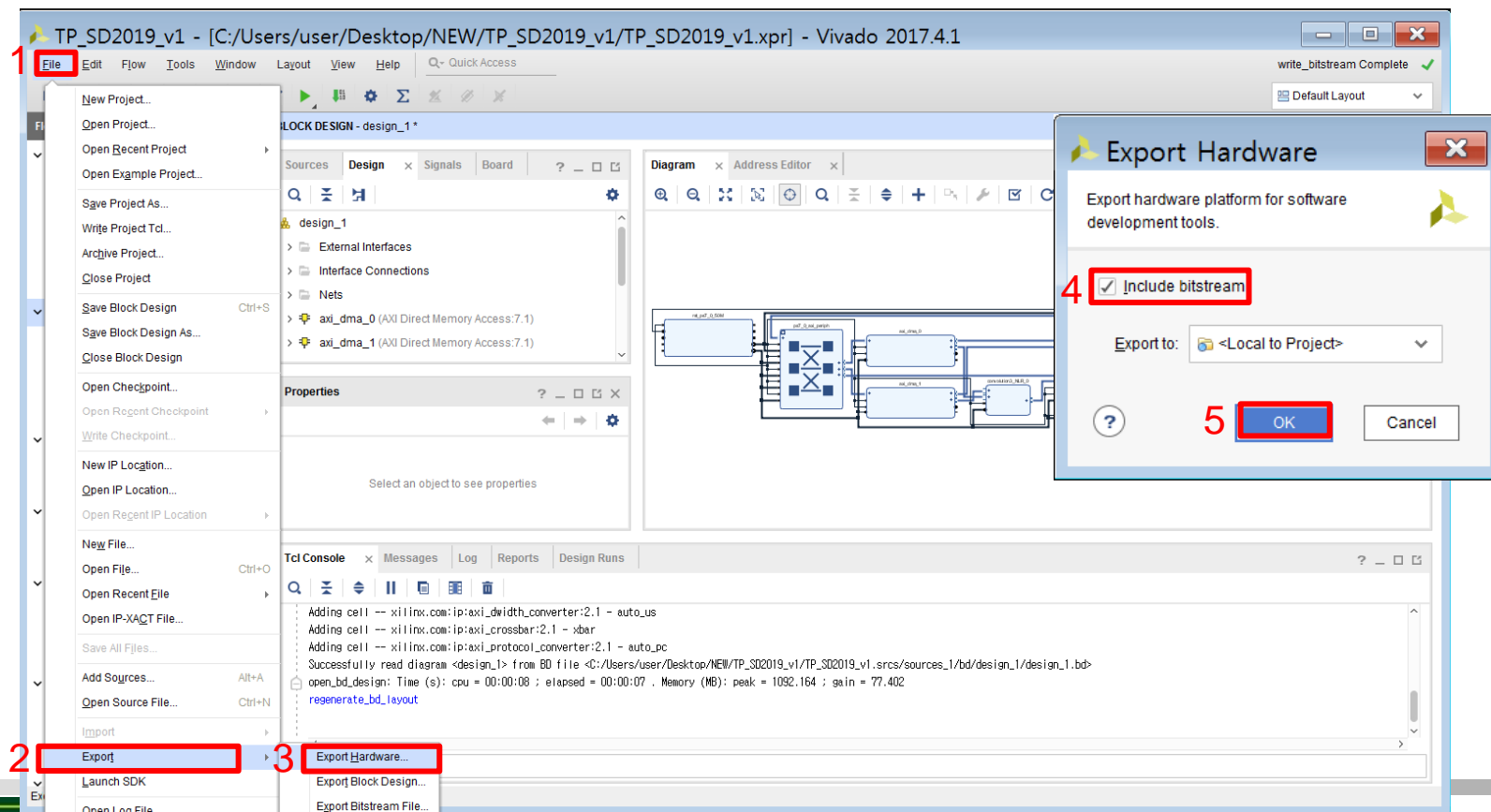
<https://drive.google.com/open?id=1zwLSdnKHZNEAO4TTdc0Yk2tIPeKX14SV>



Open Vivado projects

❑ Export Hardware

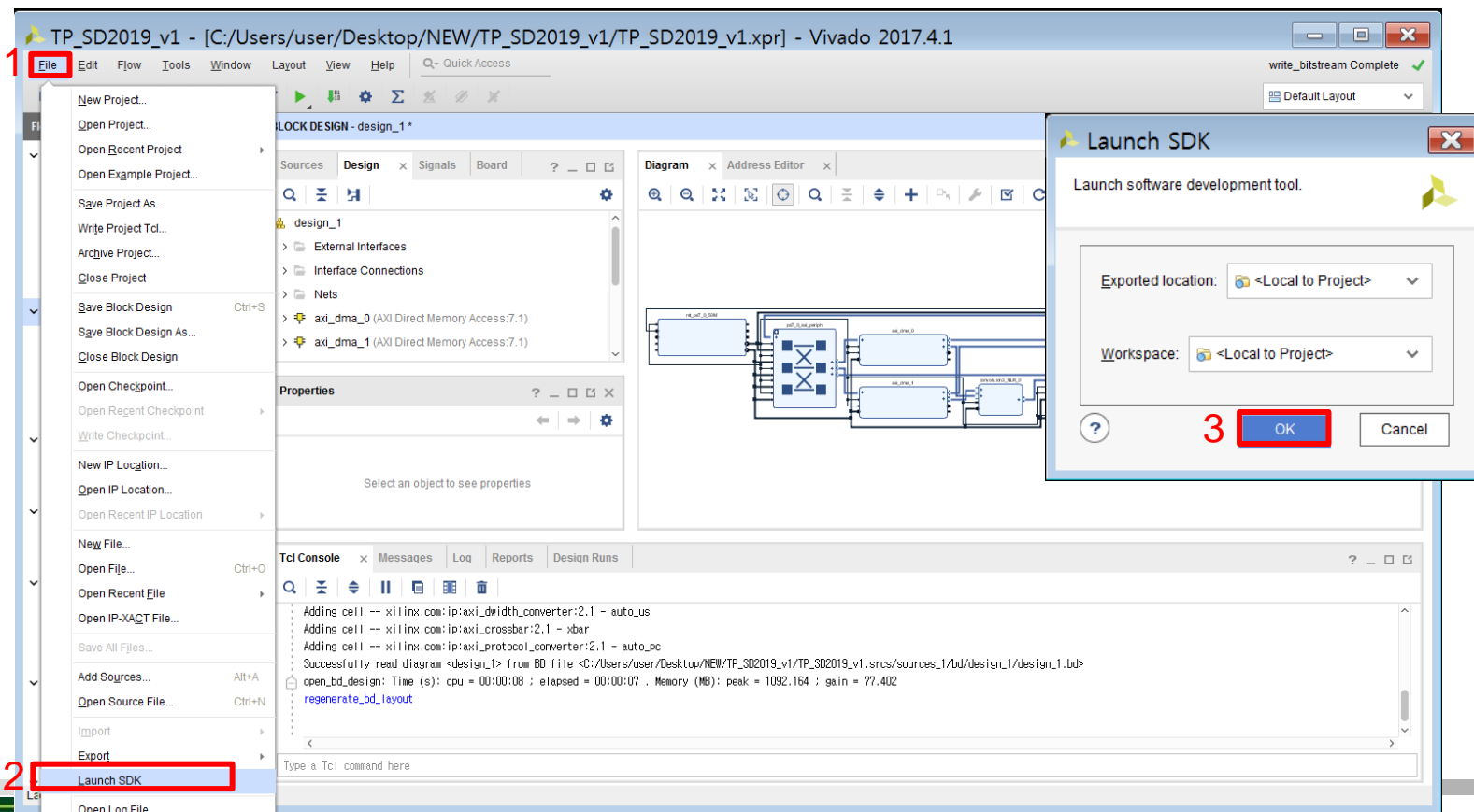
- Click '**Export > Export Hardware**' in '**File**' menu
- Check '**Include Bitstream**' and then click '**OK**'



Open Vivado projects

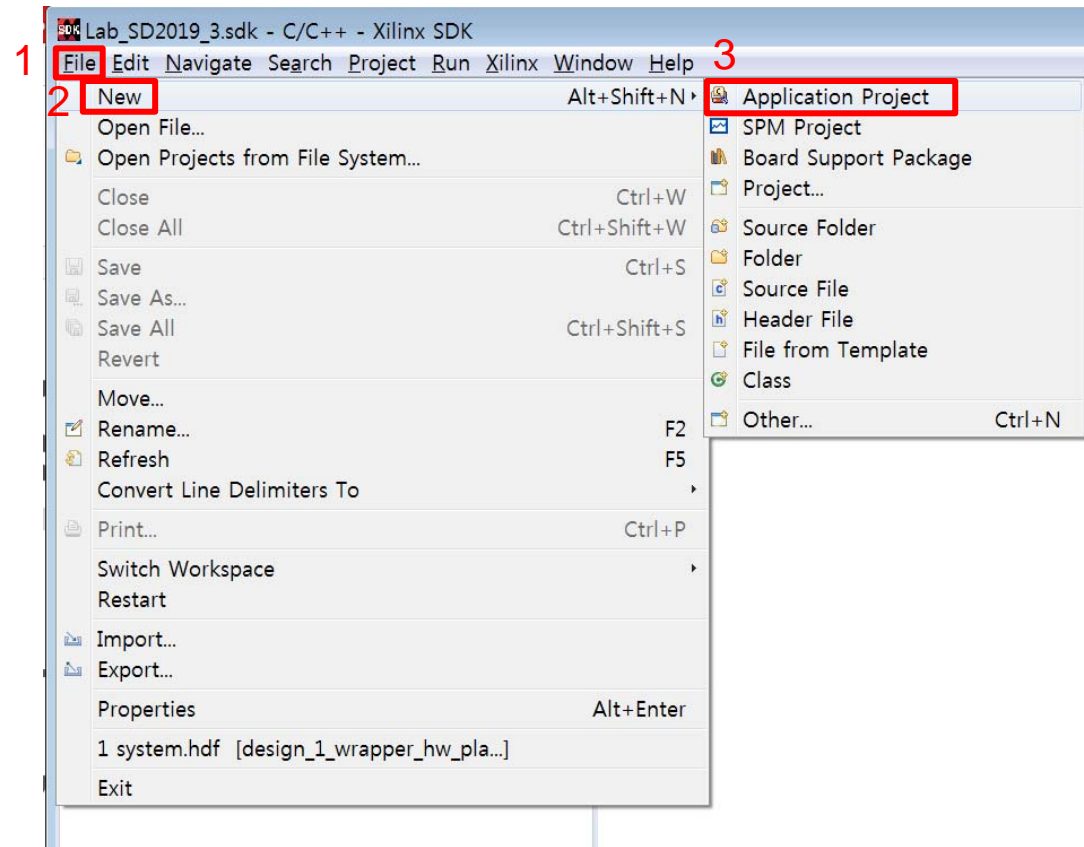
❑ Launch SDK

- Click '**Launch SDK**' in '**File**' menu
- Click '**OK**'



Running C Applications

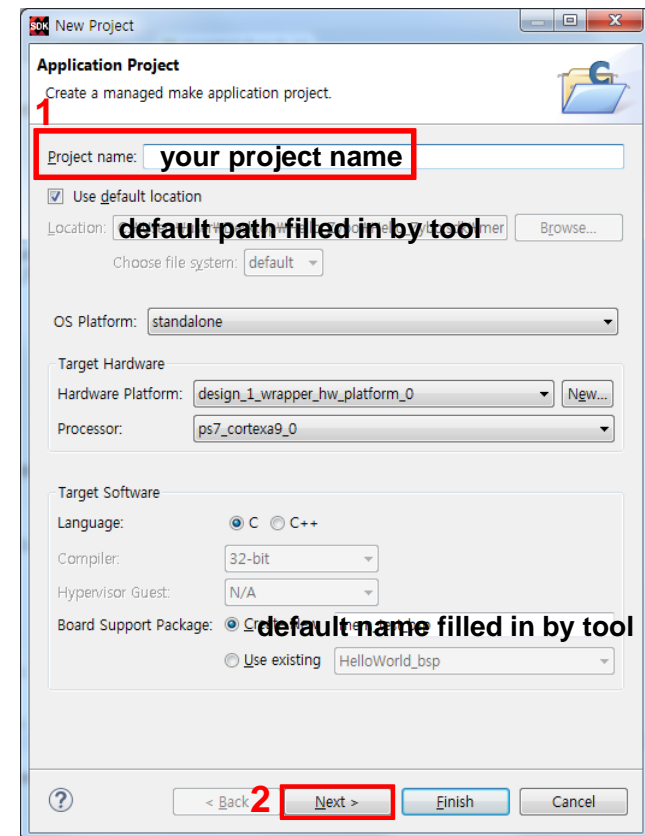
- ❑ Create a C application project
 - Click '**File**' > '**New**' > '**Application Project**'



Running C Applications

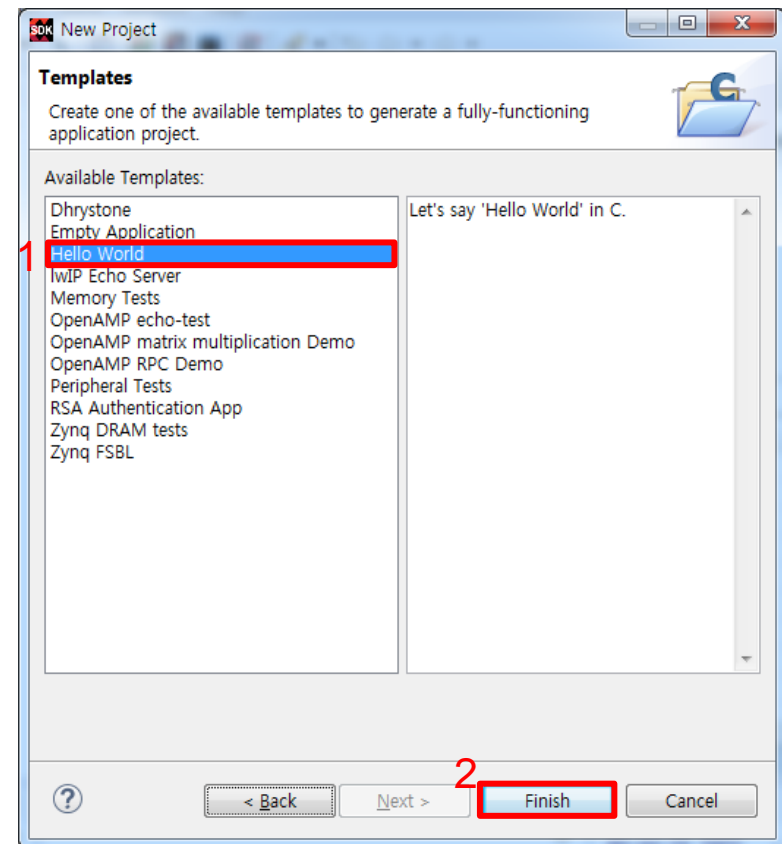
❑ Create a C application project (cont'd)

- Type the project name
- Click '**Next**'



Running C Applications

- ❑ Create a C application project (cont'd)
 - Choose ***'Hello World'*** and then click ***'Finish'***



Running C Applications

❑ Add source files

- Choose 'your project name'
- Unzip and copy src folder and paste into the 'your project name' folder
- Click '**OK > Yes To All**'

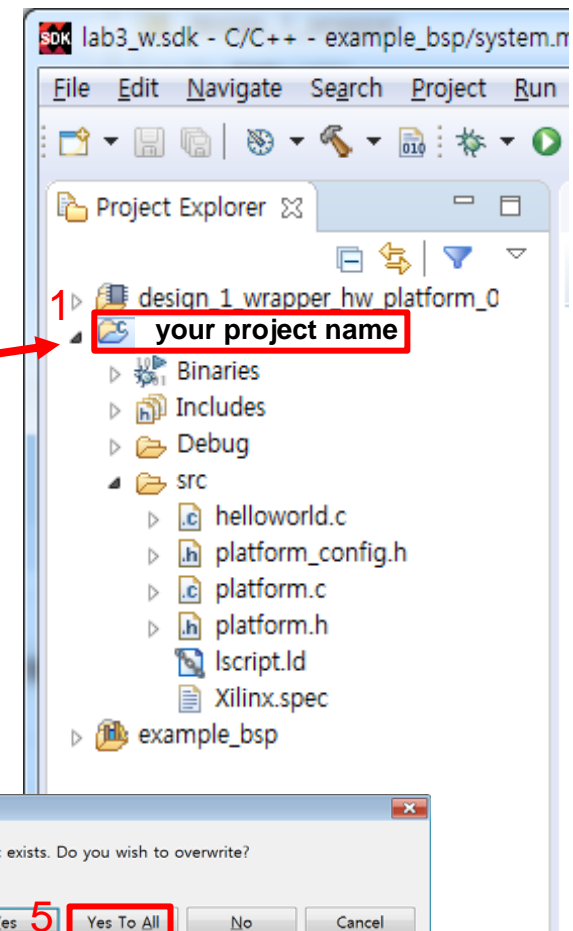


src.zip



src

2



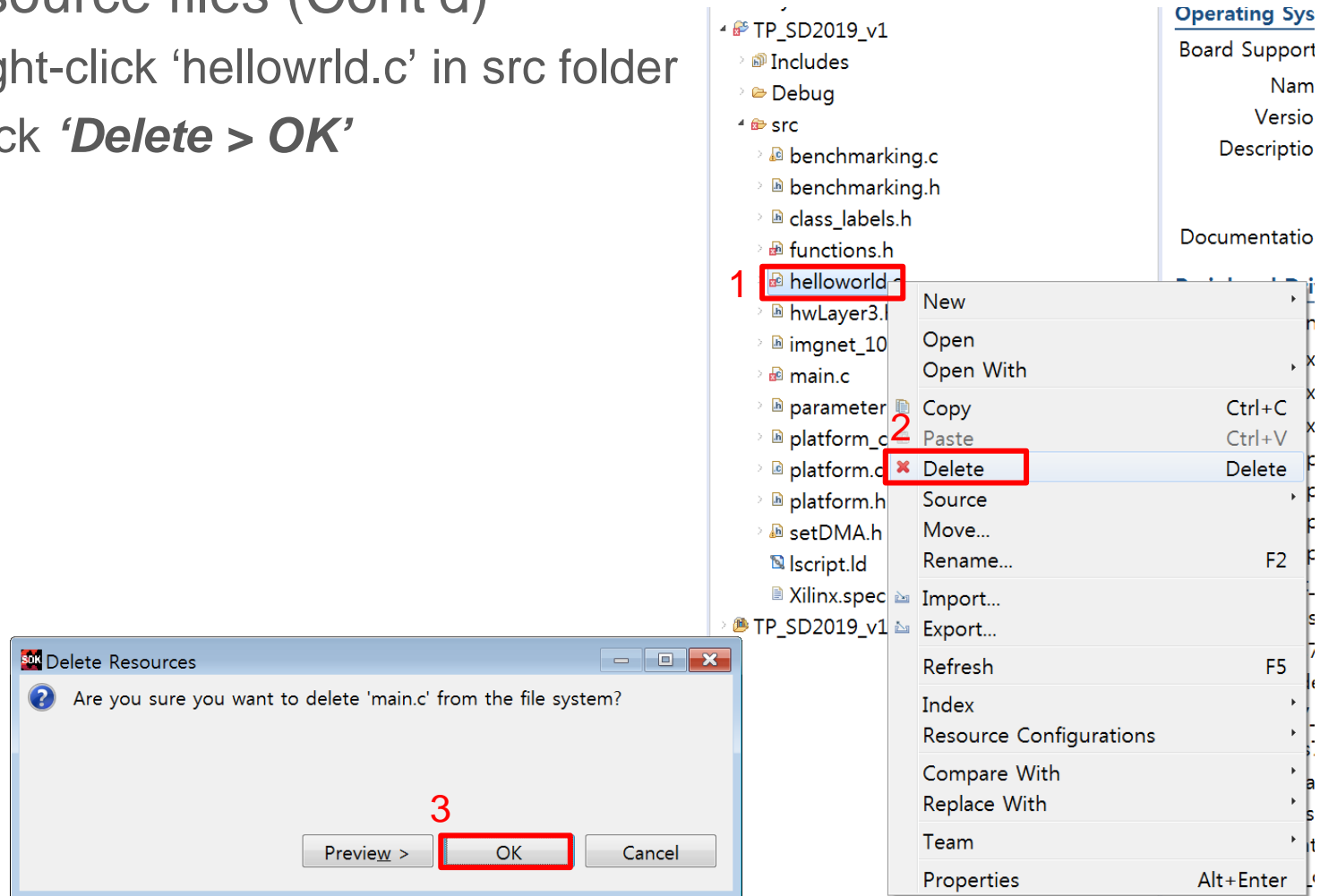
3

4

5

Running C Applications

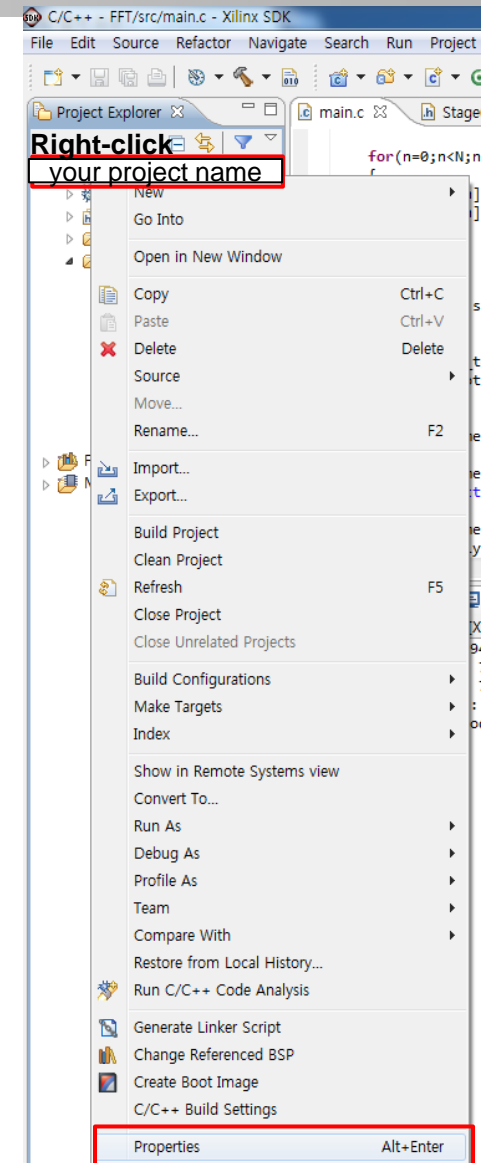
- ❑ Add source files (Cont'd)
 - Right-click 'helloworld.c' in src folder
 - Click **'Delete > OK'**



Running C Applications

❑ Adding Math Library

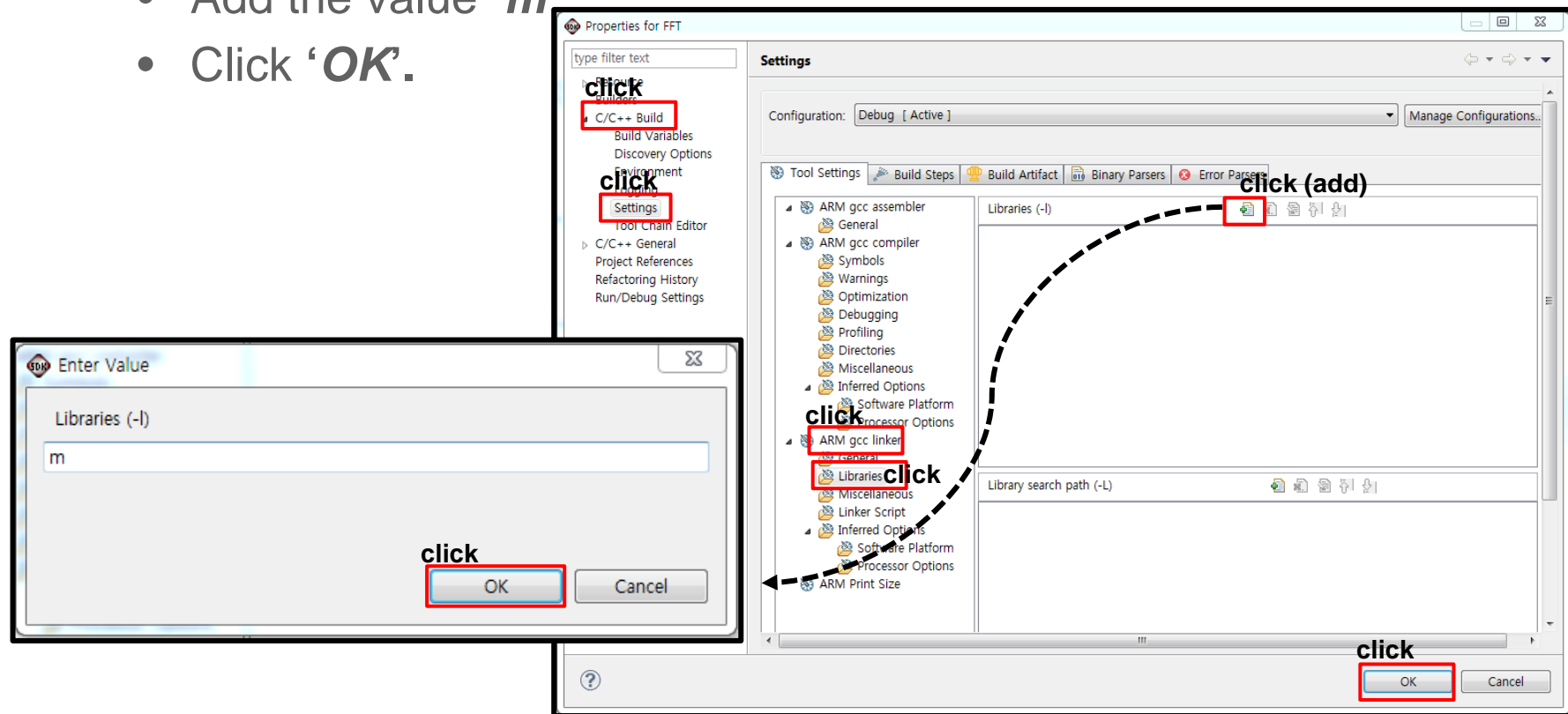
- Project must have ***'-lm library'*** to use ***'math.h'*** header file.
- Right-click ***'your project name'*** and then click ***'Properties'***



Running C Applications

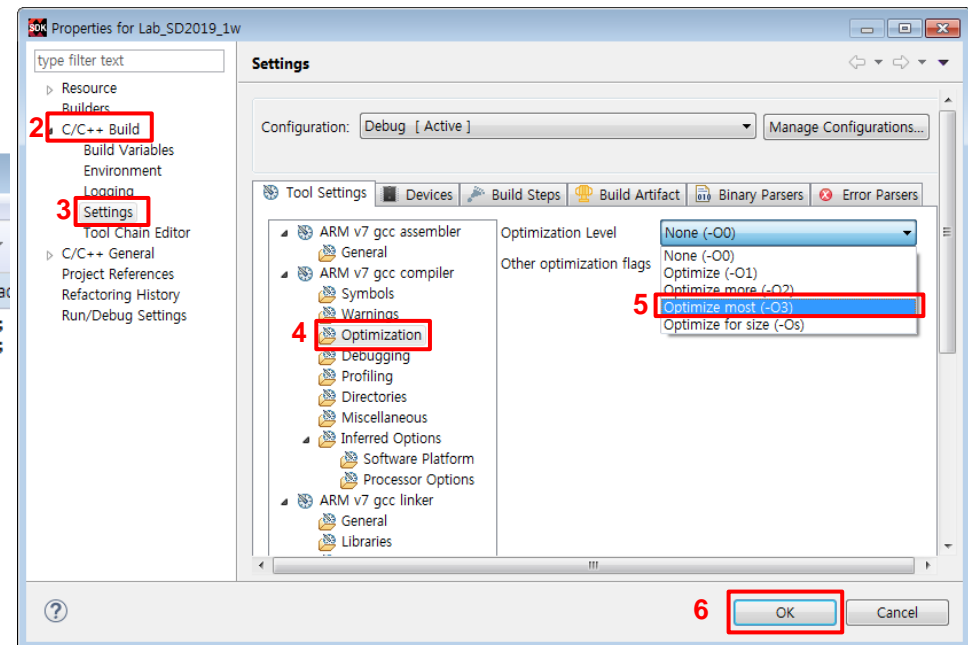
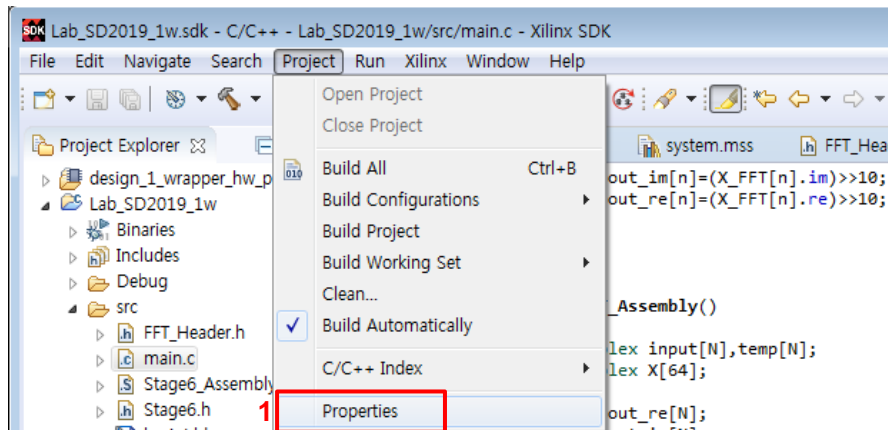
❑ Adding Math Library (Cont'd)

- Click '**C/C++ Build > Settings > ARM gcc linker > libraries > add**'
- Add the value '**m**'
- Click '**OK**'.



Running C Applications

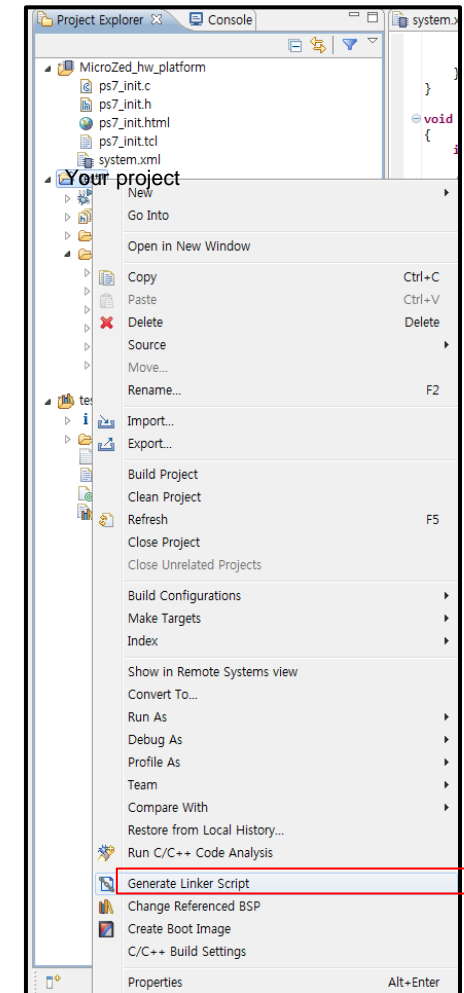
- ❑ Set the compiler optimization level
 - Select '**Project**' menu and click '**Properties**'
 - Select '**Settings**' tap and click '**ARM v7 gcc compiler > Optimization**'
 - Select '**Optimization most (-O3)**' in the dropdown menu of '**Optimization Level**'
 - Click '**OK**'



Running C Applications

❑ Setting Stack & Heap Size

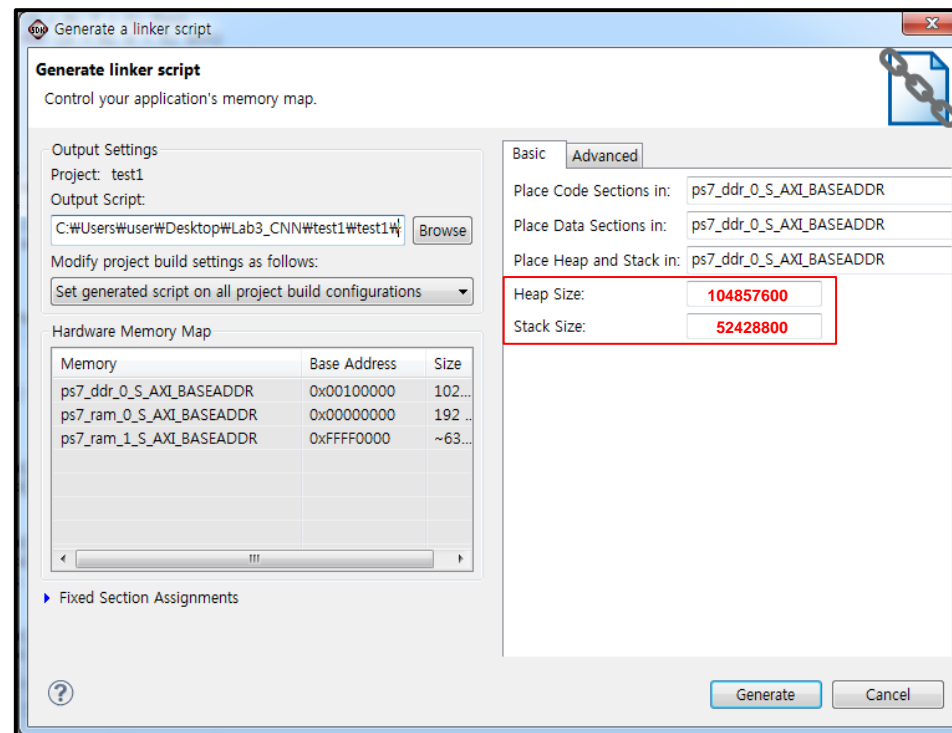
- Select the application project in the **Project Explorer** or **C/C++ Projects** view
- Right-click '**your project name**' and then click '**Generate Linker Script**' or click '**Xilinx Tools > Generate Linker script**'



Running C Applications

❑ Setting Stack & Heap Size (Cont'd)

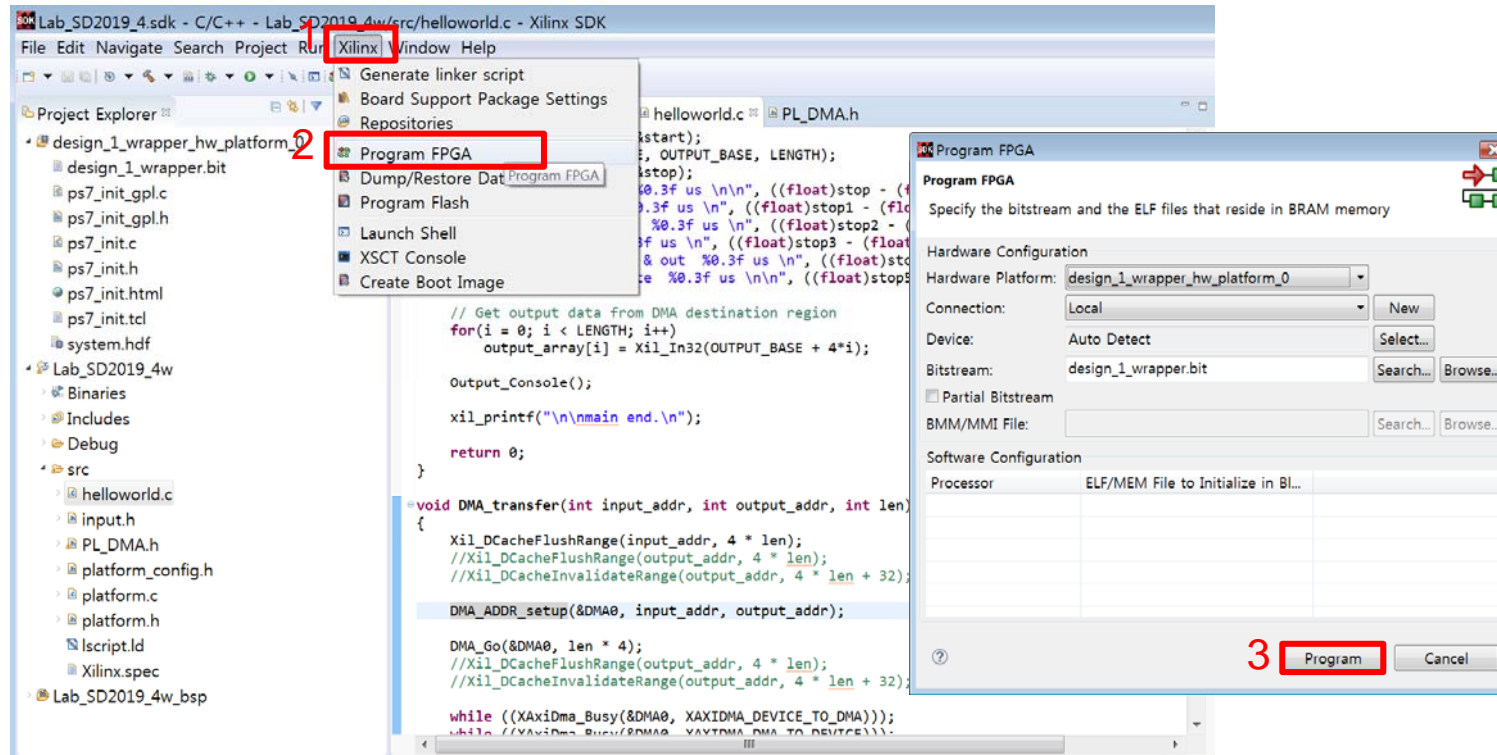
- Set both the heap and stack sizes in the **Basic** tab to **104857600** (100 MB) and **52428800** (50 MB) respectively, as shown below



Running C Applications

❑ Program FPGA

- Choose the '**Xilinx**' menu and then click '**Program FPGA**'
- Click '**Program**'



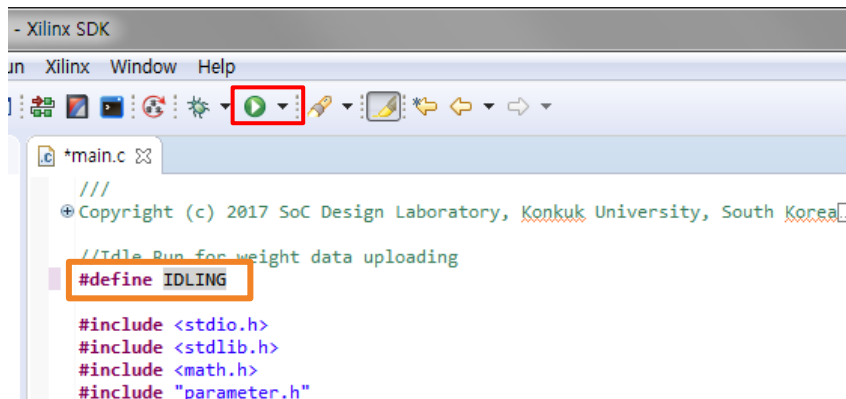
Running C Applications

❑ Check the source code: **main.c**

- Make sure that '**#define IDLING**' is written at the top of the source code

❑ Run the application

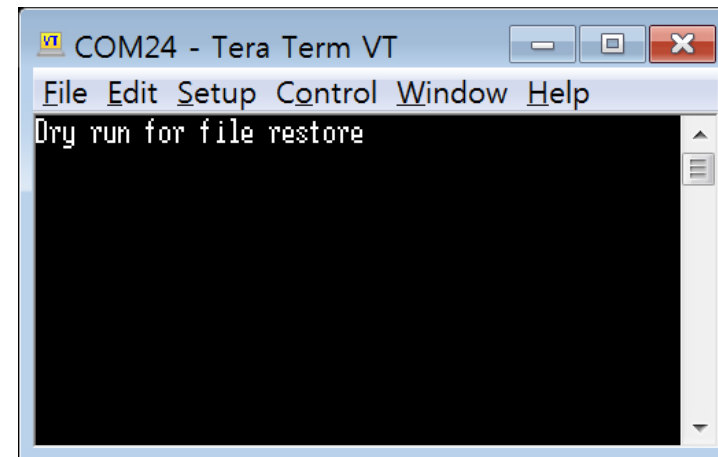
- This application is simply for uploading the convolution weights into the DDR



```
///
Copyright (c) 2017 SoC Design Laboratory, Konkuk University, South Korea

//Idle Run for weight data uploading
#define IDLING

#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#include "parameter.h"
```

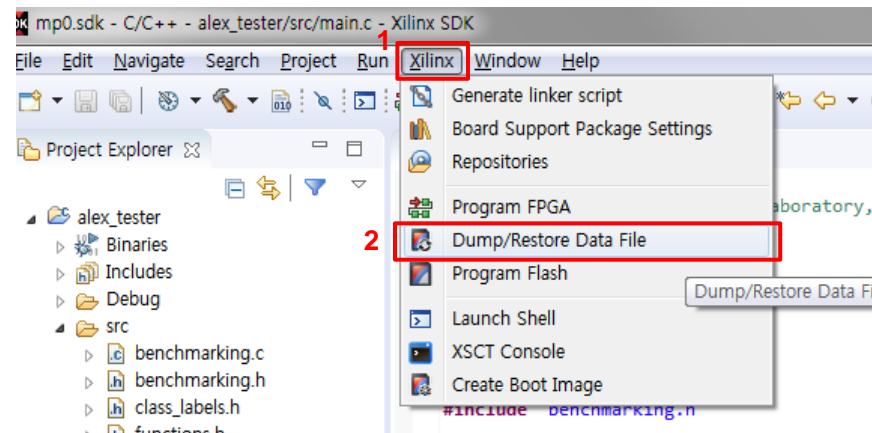


```
COM24 - Tera Term VT
File Edit Setup Control Window Help
Dry run for file restore
```

Running C Applications

❑ Restore Memory

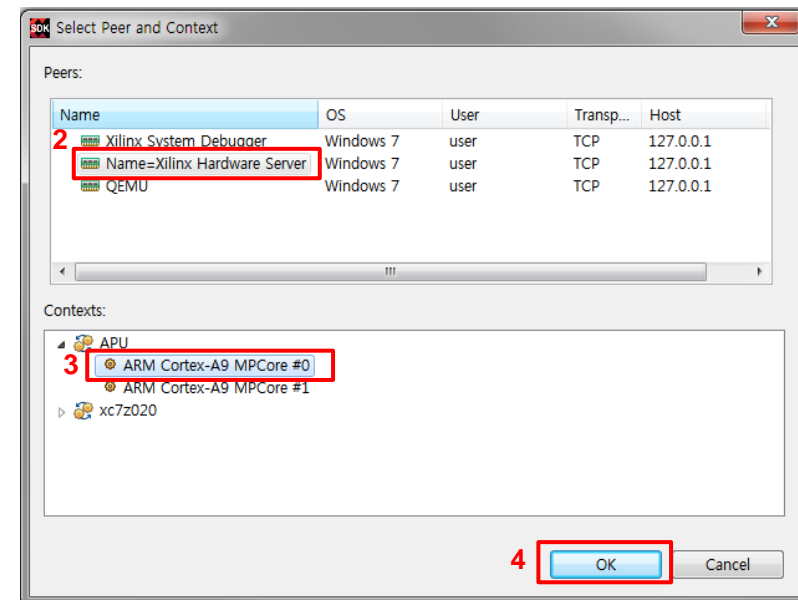
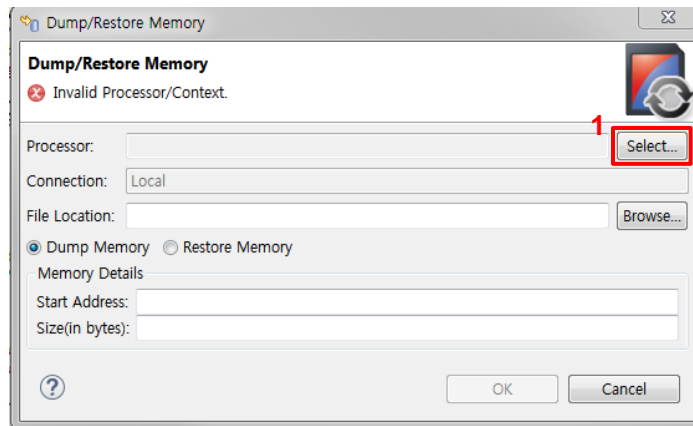
- Click '***Xilinx > Dump/Restore Data File***'



Running C Applications

❑ Restore Memory (Cont'd)

- Click '**Select**'
- Select '**Name=Xilinx Hardware Server**'
- Select '**ARM Cortex-A9 MPCore #0**'
- Click '**OK**'



Running C Applications

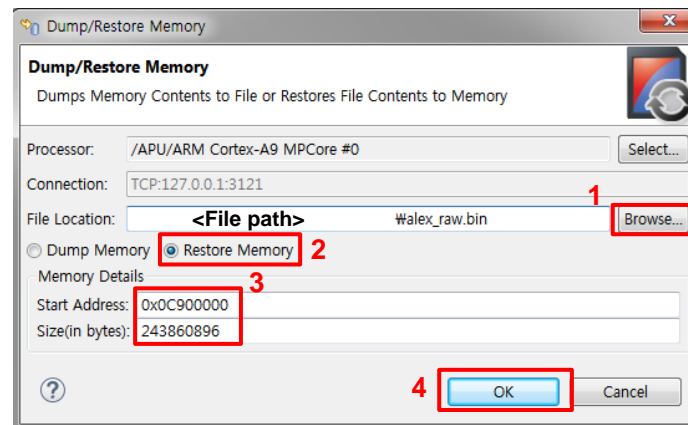
❑ Restore Memory (Cont'd)

- Click '**Browse**' and select file **alex_raw.bin**

Download link:

https://drive.google.com/open?id=122wv9t3FVrXlQYgc9bk7eK_L5-Q8ansA

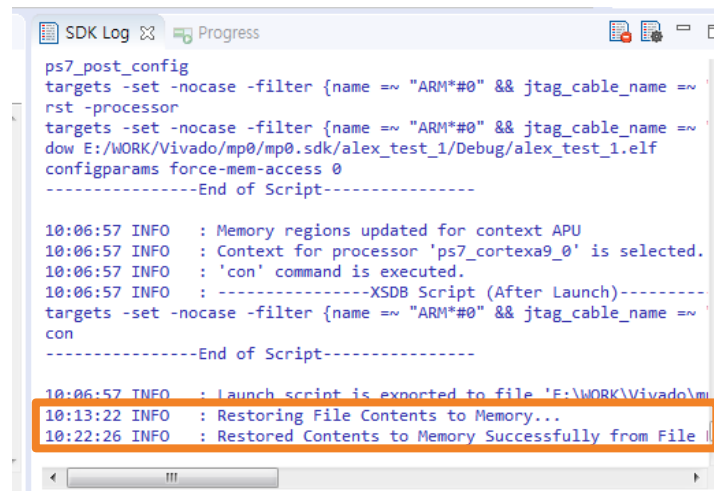
- Select '**Restore Memory**'
- Type **0x0C900000** on 'Start Address' and **243860896** on 'Size(in bytes)'



Running C Applications

❑ Restore Memory (Cont'd)

- Check the SDK log window (which may take about 9 minutes) to see the message ***'Restored Contents to Memory Successfully from File ~'***



The screenshot shows the 'SDK Log' window with the following text:

```
ps7_post_config
targets -set -nocase -filter {name =~ "ARM*#0" && jtag_cable_name =~
rst -processor
targets -set -nocase -filter {name =~ "ARM*#0" && jtag_cable_name =~
dow E:/WORK/Vivado/mp0/mp0.sdk/alex_test_1/Debug/alex_test_1.elf
configparams force-mem-access 0
-----End of Script-----

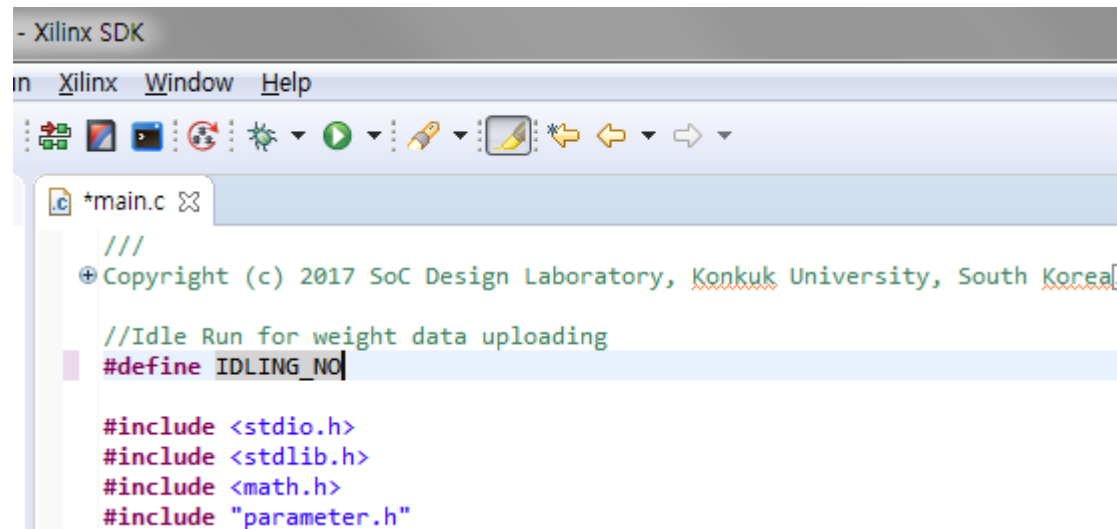
10:06:57 INFO : Memory regions updated for context APU
10:06:57 INFO : Context for processor 'ps7_cortexa9_0' is selected.
10:06:57 INFO : 'con' command is executed.
10:06:57 INFO : -----XSDb Script (After Launch)-----
targets -set -nocase -filter {name =~ "ARM*#0" && jtag_cable_name =~
con
-----End of Script-----

10:06:57 INFO : Launch script is exported to file 'E:/WORK/Vivado\m
10:13:22 INFO : Restoring File Contents to Memory...
10:22:26 INFO : Restored Contents to Memory Successfully from File
```

The last three lines of the log are highlighted with an orange box.

Running C Applications

- ❑ Modify the source code: *main.c*
 - Change ‘**#define IDLING**’ to ‘**#define IDLING_NO**’ (or anything different from ‘**IDLING**’)
- ❑ Run the application again
 - This application is for actually running the CNN algorithm



```
- Xilinx SDK
Xilinx Window Help

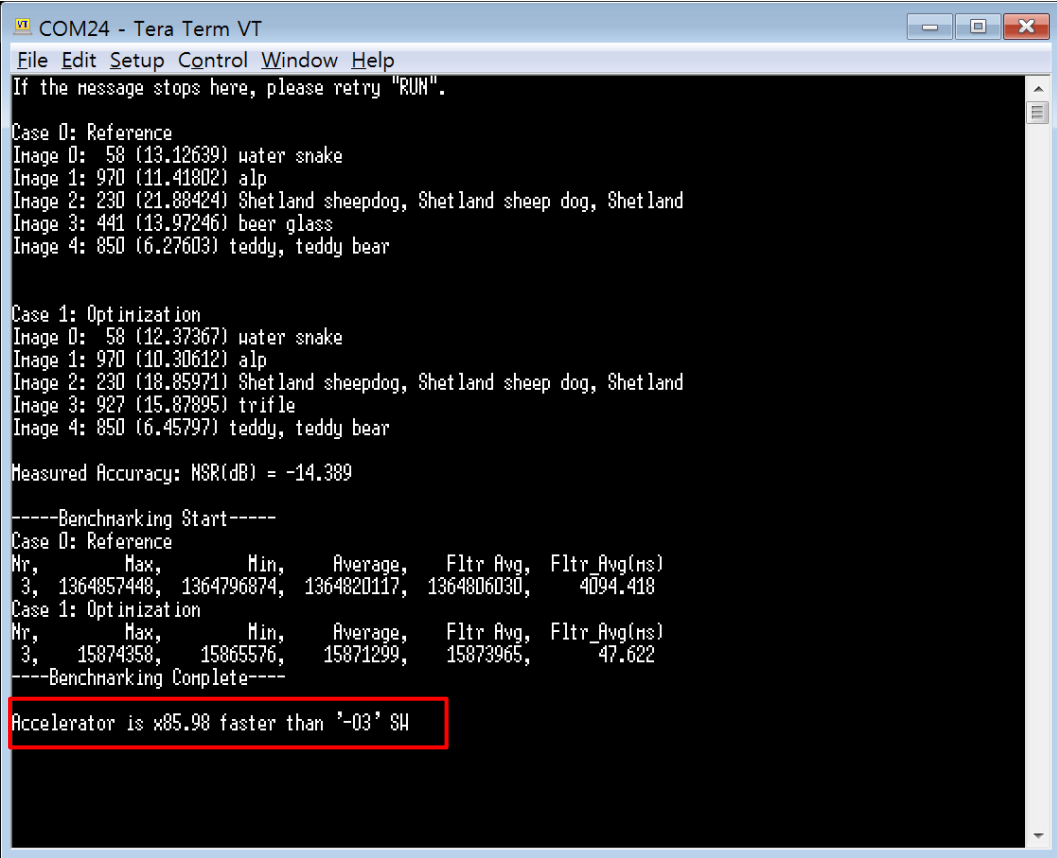
*main.c
///
+ Copyright (c) 2017 SoC Design Laboratory, Konkuk University, South Korea.

//Idle Run for weight data uploading
#define IDLING_NO

#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#include "parameter.h"
```

Running C Applications

- ❑ Run the application again (Cont'd)
 - Check the output of the application on '*Tera Term*'



```
COM24 - Tera Term VT
File Edit Setup Control Window Help
If the message stops here, please retry "RUN".

Case 0: Reference
Image 0: 58 (13.12639) water snake
Image 1: 970 (11.41802) alp
Image 2: 230 (21.88424) Shetland sheepdog, Shetland sheep dog, Shetland
Image 3: 441 (13.97246) beer glass
Image 4: 850 (6.27603) teddy, teddy bear

Case 1: Optimization
Image 0: 58 (12.37367) water snake
Image 1: 970 (10.30612) alp
Image 2: 230 (18.85971) Shetland sheepdog, Shetland sheep dog, Shetland
Image 3: 927 (15.87895) trifle
Image 4: 850 (6.45797) teddy, teddy bear

Measured Accuracy: NSR(dB) = -14.389

-----Benchmarking Start-----
Case 0: Reference
Nr,      Max,      Min,      Average,  Fltr Avg,  Fltr Avg(ns)
3, 1364857448, 1364796874, 1364820117, 1364806030, 4094.418
Case 1: Optimization
Nr,      Max,      Min,      Average,  Fltr Avg,  Fltr Avg(ns)
3, 15874358, 15865576, 15871299, 15873965, 47.622
-----Benchmarking Complete-----

Accelerator is x85.98 faster than '-03' SW
```