CMPE240
Fall 2023

1/

Aug 21 (Monday).
Organizational meeting.

1. github.

https://github.com/hualili/CMPE240-Adv-Microprocessors/tree/master/2018F

2.

Course and Contact Information

Instructor(s): Harry Li
Office Location: Engineering Building, Room 267A
Telephone: (650) 400-1116
Email: hua.li@sjsu.edu
Office Hours: M.W. 3:00-4:00 pm ← In Person.
Class Days/Time: Mondays, Wednesdays, 1:30-2:45 pm
Classroom: Engineering Building, Room 331
Prerequisites: CmpE 180D for non CMPE or non EE undergradua
documentation of having satisfied the class prerequisite requireme
dropped from the class.

3. Emphasis on the Advanced Nature of the Microprocessor Systems. → Embedded Nature, ARM CPU. → GPU: graphics Processing Unit

Architecture of a computing system including system bus, memory subsystems and peripherals. Uni-directional and bidirectional bus architectures. SRAM and FLASH memories and their interfaces with the system bus. Design of Graphics Processing Engines, interrupt controller, transmitter receiver, timers, display adapter, and other system peripherals and bus interfaces.

→ Engine for Deeplearning, AI etc.

4. Hands-on.

Datasheets. → Spec. → Hardware Prototype Board With Color LCD Display ← 2D Graphics Engine

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3D Graphics Engine

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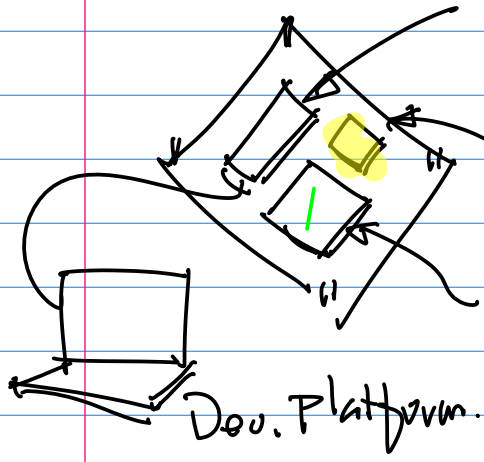
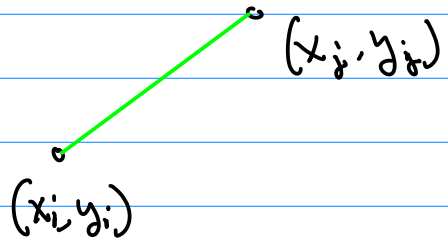
Benchmarking (with Ref. to NVDA Jetson NANO)



Live Drawing Sample Code.

(x_i, y_i) Starting pt.

(x_j, y_j) Ending pt.



Action Item (Homework, No Submission)

About 22,800,000 results (0.59 seconds)

NXP Semiconductors
https://www.nxp.com

NXP Semiconductors: Automotive, IoT & Industrial Solutions

NXP is a global semiconductor company creating solutions that enable secure connections for a smarter world.

Results from nxp.com

Note: Homework/Projects are ~~to be~~ posted on CANVAS, with Written Requirements. Those are the material to be Submitted.

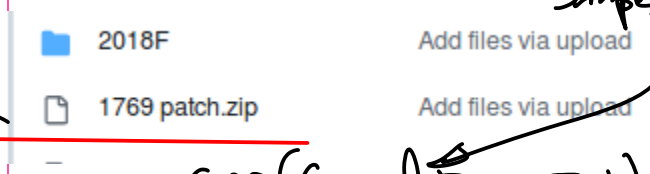
5. PPTs, Lecture Notes (White Board Notes), Datasheet(s), are posted on the github.

Textbook

- NXP LPC17xx datasheets;
- LPC1768/1769 CPU Module schematics;
- Dave Jaggar, ARM Architectural Reference Manual, Prentice Hall, ISBN 0-13-736299-4;

- Reference: ARM11 data sheets and on-line web materials on line https://github.com/hualili/ , or at the SJSU CANVAS provided copyright permitted;
- (Optional) Nvidia Jetson NANO datasheet and user menu (online from Nvidia developer website);
- (Optional) RISC-V tutorial (the link to be given in the lecture) and FPGA verilog implementation guide (the link to be given in the lecture).

Note: 1° Initial Sample Projects, ~A Dozen Sample Projects.

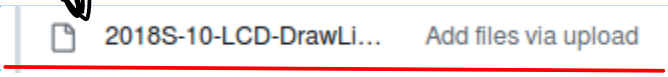


GPP (General Purpos Port)

Target CPU
NXP LPC11C24
LPC1769

The Code was for LPC17ba, But Newer Samples for GPP, Graphics Display for LPC11C24 were developed and posted on the github.

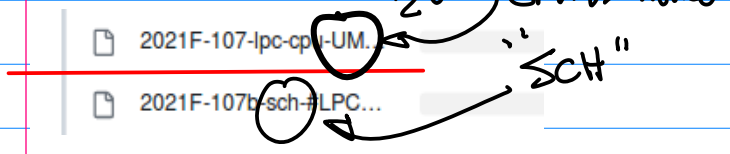
Next Level of the Sample Code



The Lower After Sample code for 2D & 3D Engine Design.

PPT Material in pdf.
will be used in the Class.

Datasheet. Note: 1° CPU Datasheet is in CMPE244 folder



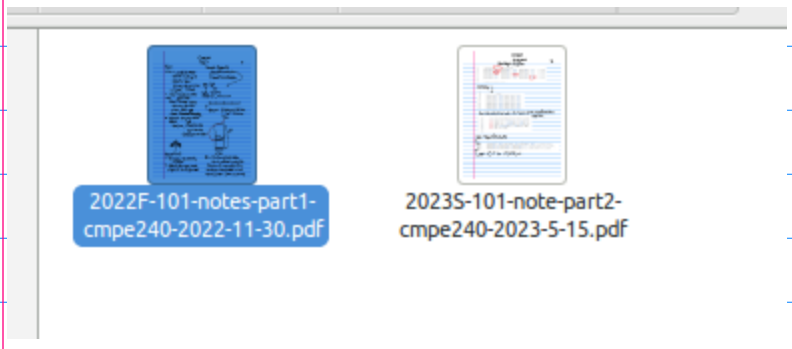
Grading Information

Quiz, Homework, Projects	30%
Midterm Examination	30%
Final Examination	40%

August 23rd (Wed)

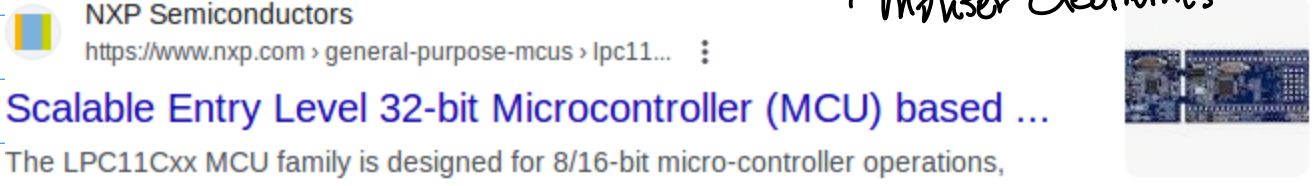
Announcement:
1° Lab Space BM268
2° CANVAS to be up by this week.

Introduction.



Example: Architecture of LPC1769 (LPC11C24)

Can be purchased from digi-key.com or Mouser electronics



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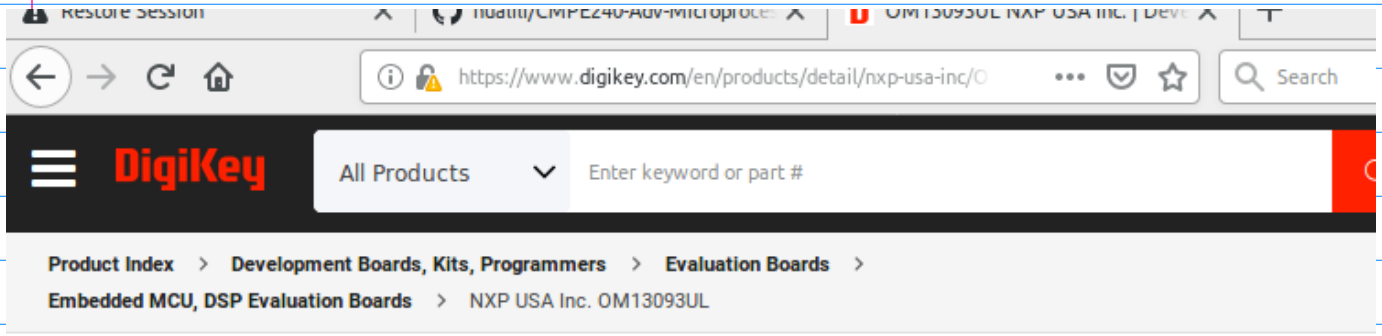


Image shown is a representation only. Exact specifications should be obtained from the product data sheet.

OM13093UL

Digi-Key Part Number	568-14402-ND
Manufacturer	NXP USA Inc.
Manufacturer Product Number	OM13093UL
Description	LPCXPRESSO LPC11C24 EVAL BRD
Manufacturer Standard Lead Time	16 Weeks
Detailed Description	LPC11C24 LPCXpresso™ LPC11C00 ARM® Cortex®-M Evaluation Board
Customer Reference	Customer Reference

Note: Please start the Purchasing Process.

Note: CPU Datasheet.

2011

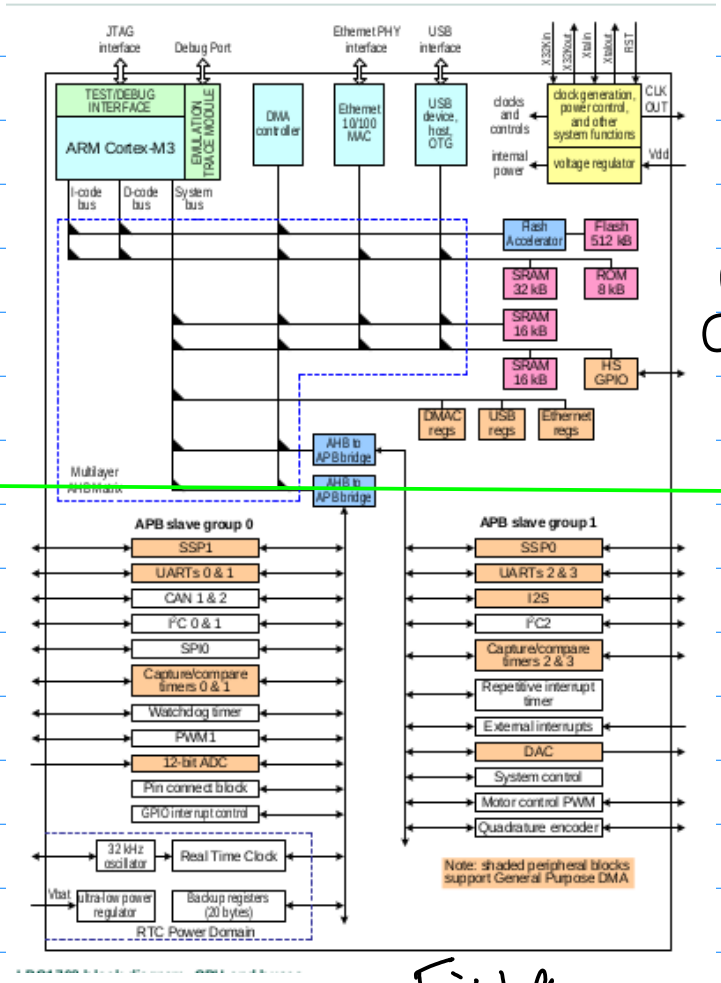


Fig 1.a

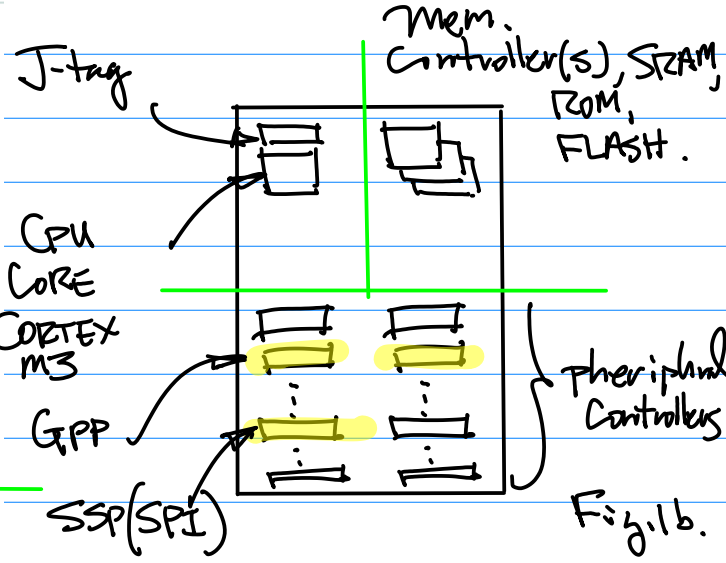


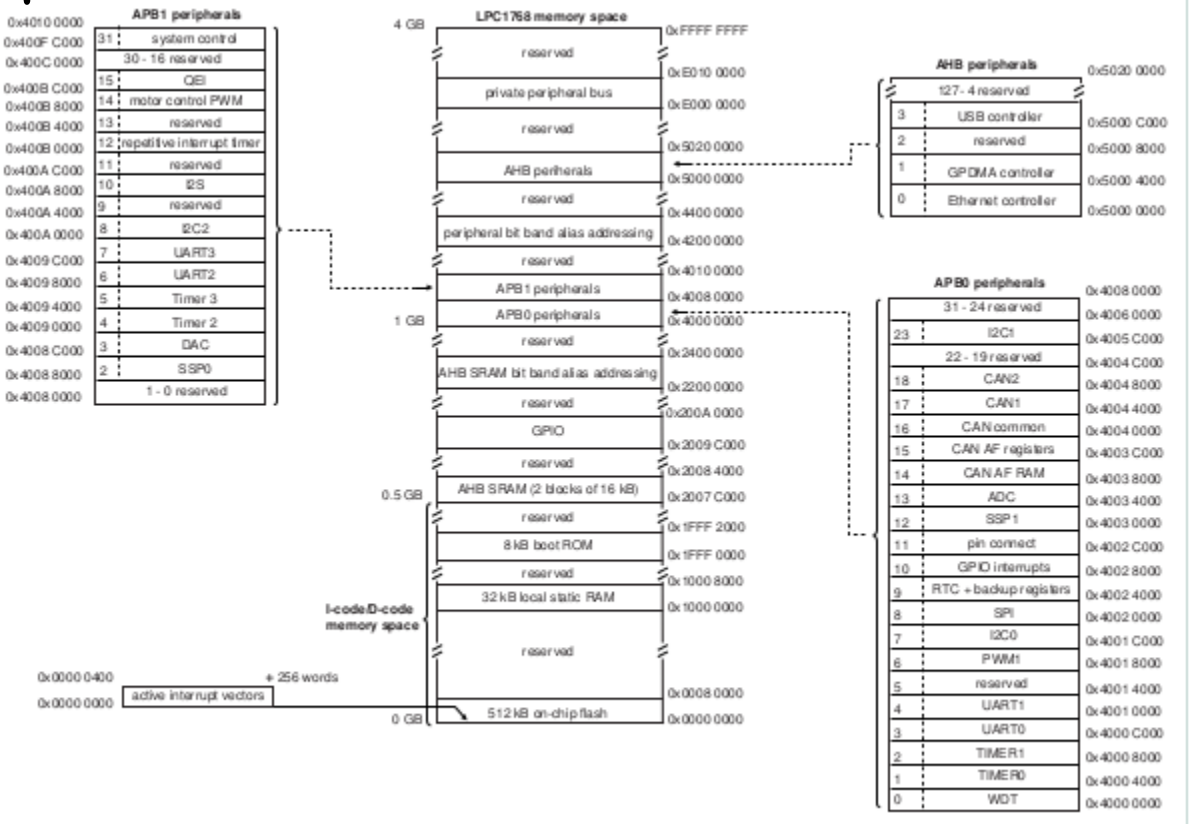
Fig 1.b.

GPP/GPIO : General Purpose Port
or General Purpose I/O

S.P.I. (Serial Peripheral Interface)

Note: One of the GPPs supports Ex INT. (External Interrupt).

Memory Map.



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Note: For the memory map Discussion:

1° RISC: Reduced Instruction Set Computer.
- ARM.
- MIPS
  - Golden Rules:
    - Uniformity,
    - Regularity,
    - Orthogonality)

2° 32Bit RISC Processor → 32bit Architecture
- 32bit Addr. Bus.
- 32bit Data Bus.
- 32bit R.F. (Register File)
  - GPRs (General-Purpose Registers) 32bits.
  - SPRs (Special Purpose Registers)
    - 3 Cats.

↓

32bit memory map.

$2^{32} = 2^{10} \cdot 2^{10} \cdot 2^{10} \cdot 2^{2}$

1K (1024)

~

1M (1K x 1K)

~

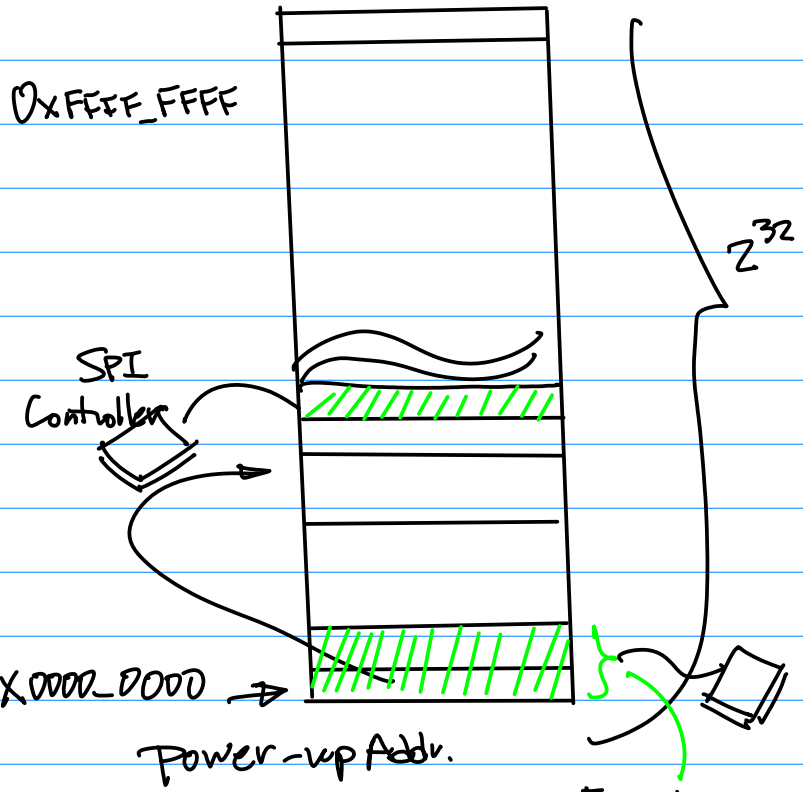
1G

4G? Byte!

3° Byte Addressable Machine.

A smallest memory cell with an Unique Address is a Single Byte.

4°



August 28 (Monday).

Note: 1° CANVAS is up.

2° CPU module & LCD module

ST7735 Controller

SPI – Interface

https://www.amazon.com/Display-Module-ST7735-128x160-STM32/dp/B07BFV69DZ

cs › Computers & Accessories › Tablet Replacement Parts › LCD Displays

Note: 8-pins or 10 pins module are OK for the Implementation

Roll over image to zoom in

1.8 inch SPI TFT LCD Display Module for ST7735 128x160 51/AVR/STM32/ARM 8/16 bit

Visit the Walfront Store

4.0 ★★★★☆ 42 ratings

Note: ST7725 or ST7735.

$10.99

With **Amazon Business**, you would have **saved $85.08** in the last year. Create a free account and **save up to 5%** today.

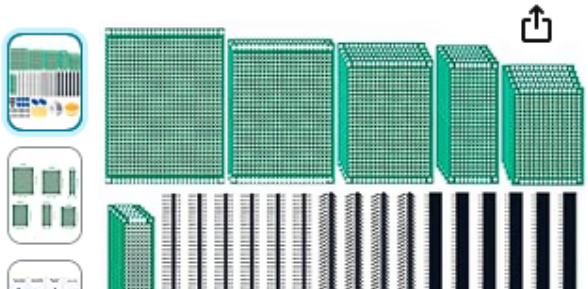
Brand	Walfront
Personal computer design type	All in One
Operating	Linux

3° Bill of Material (BoM) for this Class:

1°. CPU module
2°. LCD module
3°. Wire Wrapping Board.

4"x3" Through-Holes with metal plating (Just to cover the holes, Not the Entire Board)

Or your Choice



Miuzei PCB Board Prototype Kit for Electronic Projects, Circuit Solder Double-Side Board with 40 Pin 2.54 mm Male to Female Headers Connector, 2P&3P Screw

Example: Memory Map.

Divid the mem. Map into 8 Equal Banks.

			$a_{31}a_{30}a_{29}$ Starting Addr.
BANK 0	First	000	0000;0000;...;0000 → 0x0
BANK 1	2nd	001	0010; ... → 0x2000_0000
BANK 2	3rd	010	0100; .. → 0x4000_0000
⋮		⋮	
BANK 7	8th	111	

$a_{31}a_{30}\cdots$ $a_{29}a_0$ ← LSB

MSB — 32 bits Addr. Bus

Note: Important, to be used in the Design Process.

Note: "Little Endian" Convention

Choose $a_{31}a_{30}a_{29}$ to Identify the memory Bank.

$a_{31}a_{30}a_{29}$ 0;0000;...;0000 — Lowest Addr.

$a_{31}a_{30}a_{29}$ 1;1111;...;1111 — Highest Addr.

$2^{32}/2^3 = 2^{29} = 2^9 \cdot 2^{20}$

512 | meg.

Example: Identify One of the SPI Peripheral Controllers By mem. map.

Memory Bank with a Starting Addr. 0x4000_0000 → 3rd BANK (BANK0, BANK1, BANK2)

Find A SPI Block

9	RTC + backup registers	0x4002 4000
8	SPI	0x4002 0000
7	I2C0	0x4001 C000

SPI Peripheral Controller is Located at 0x4002_0000

Question: How Big is the memory Block for SPI Controller?

$$\begin{array}{r} 0x4002\_4000 \\ - \quad 0x4002\_0000 \\ \hline 0x4000 \end{array}$$

Prefix 3 Letters + Root 3 Letters

LSB

MSB

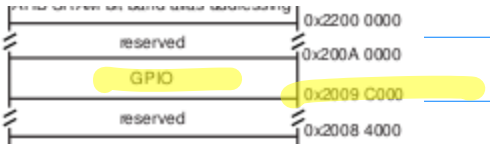
0100 : 0000 : 0000 : 0000

$2^x = 1 \cdot 2^{14} = 1 \cdot 2^4 \cdot 2^{10}$

16 . K

Note: This Block of memory is employed for A set of SPR's (Special Purpose Registers) to perform SPI function.

Example: GPP (General Purpose Port)



GPP (Peripheral Controller)

↓

mem. map Location & its Block size

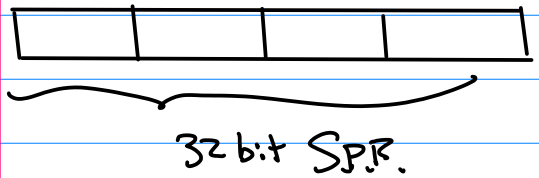
↓

SPRs (Special Purpose Registers)

Responsible for Init & Config.

↓

Control Register.



32 bit SPR.

Naming Convention "3+3" for All if Possible