Course Overview

URL: [http://www.ee.nmt.edu/~erives/classes.php](http://www.ee.nmt.edu/~erives/classes.php)

**Texts:** Freescale Databooks on the MC9S12
Recommended: *The HCS12/9S12: An Introduction to Software and Interfacing, 2nd Edition* by Han-Way Huang

Grading:
- 10%: Homework.
- 10%: Quizzes
- 60%: Three midterms exams
- 20%: Final exam

- Introduction to the MC9S12 Microcontroller

- Binary and Hexadecimal Numbers

- Assembly Language Programming

- C Language Programming

- Introduction to MC9S12 Internal Peripherals
  - The MC9S12 Timer Subsystem
  - Interrupts using the Timer Subsystem
  - The MC9S12 Pulse Width Modulator Subsystem

- The MC9S12 Expanded Mode
  - Address and Data Buses and Timing
  - Adding Memory and External Peripherals
  - Interfacing to the MC9S12

- More MC9S12 Internal Peripherals
  - The A/D Converter Subsystem
  - The Serial Peripheral Interface
  - The Serial Communications Interface

- Using the MC9S12 in a Control Application
Lab Overview

- The lab meets Monday and Wednesday afternoons. **No labs this week.**

- Lab handouts will be posted starting the following week.

- The 9S12 evaluation kits will be passed out in lab next week.

- **You need to bring a bound lab notebook to the first lab.**

- There will be a prelab for each lab. This must be done and turned in at the start of your lab section. The lab TA will verify that you have completed the prelab.

- Be prepared to answer questions about the pre-lab when you come to lab.

- If you do not complete the prelab before coming to lab, you will lose 70% (TBD) of the points for that lab.
• Introduction to Microprocessors and Microcontrollers.
  o Course Overview
  o Cruise Control Block Diagrams and Flowchart
  o Block Diagrams of Simple Microprocessor and Microcontroller
  o Harvard architecture and Princeton architecture microprocessor block diagrams
  o Memory map for a Princeton architecture microprocessor
\( \Delta T \) = time for one revolution of wheel.

**Speed** = \( \frac{C}{\Delta T} \), where \( C \) is the circumference of the wheel
MICROCONTROLLER

SIMPLE MICROPROCESSOR
<table>
<thead>
<tr>
<th>INSTRUCTION</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 06</td>
<td>(A) + (B) ⇒ A</td>
</tr>
<tr>
<td>87</td>
<td>0 ⇒ A</td>
</tr>
<tr>
<td>5A 05</td>
<td>(A) ⇒ Address 5</td>
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</table>

**HARVARD ARCHITECTURE**

**MICROPROCESSOR**

![Diagram of Harvard Architecture Microprocessor]
PRINCETON (VON NEUMAN) ARCHITECTURE

MICROPROCESSOR

MEMORY

IN
DATA

INSTRUCTION

CONTROL & ADDR

ALU

CONTROL

OUT

STATUS

CLOCK

MEMORY MAP

(Princeton Architecture)

Function of memory determined by programme

PROGRAM

DATA
Figure 2-1. Programming Model
<table>
<thead>
<tr>
<th>Binary</th>
<th>Hex</th>
<th>Decimal</th>
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</thead>
<tbody>
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<tr>
<td>1100</td>
<td>C</td>
<td>12</td>
</tr>
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<td>1101</td>
<td>D</td>
<td>13</td>
</tr>
<tr>
<td>1110</td>
<td>E</td>
<td>14</td>
</tr>
<tr>
<td>1111</td>
<td>F</td>
<td>15</td>
</tr>
</tbody>
</table>

**Convert Binary to Decimal**

$$1111011_2$$

$$1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

$$1 \times 64 + 1 \times 32 + 1 \times 16 + 1 \times 8 + 0 \times 4 + 1 \times 2 + 1 \times 1$$

$$123_{10}$$

**Convert Hex to Decimal**

$$82D6_{16}$$

$$8 \times 16^3 + 2 \times 16^2 + 13 \times 16^1 + 6 \times 16^0$$

$$8 \times 4096 + 2 \times 256 + 13 \times 16 + 6 \times 1$$

$$33494_{10}$$