<u>CSCE 612: VLSI System Design</u>

Instructor: Dr. Jason D. Bakos
Schedule Code: 218396
Tuesday, Thursday 12:30 – 1:45
Swearingen 2A15
Prereq's: digital logic design, programming in a high-level language

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- *Are you curious about how computer chips **work**?*
- *...how they are **manufactured**?*
- *...how they are **designed**?*

In 1958, Jack Kilby at Texas Instruments built the first integrated circuit flip-flop with two transistors. Today, the Pentium 4 microprocessor contains 55 million transistors while a 512-Mbit dynamic access memory chip contains over 500 million transistors. This number has increased 53% per year for the past 45 years. No other technology in history has sustained such a high growth rate for so long. In 2003, the semiconductor industry manufactured more than one quintillion (10^{18}) transistors, which is more than 100 million for every human being on the planet. In this year, the industry produced $200 billion in sales.

This course will begin by presenting students will the fundamentals in integrated circuit technology, including how this technology **works**, how such circuits are **manufactured**, and how their behaviors are **modeled** in the face of changing physical phenomena resulting from chip feature sizes shrinking to only a handful of atoms wide.

Next, the course will change pace in order to address the most important issue today in integrated circuit design:

*How is it possible to manage the complexity of designing, verifying, and characterizing **any** system that contains **tens of millions**, **hundreds of millions**, and soon **BILLIONS** of tightly-coupled, inter-operating devices?*

This seemingly intractable problem is attacked with **ELECTRONIC DESIGN AUTOMATION**, where sophisticated computer-aided design tools are used to hierarchically design a system from the **top-down**: from high-level logic behavior (captured with high-level description languages), down to a set of masks that are used to grow nano-scale devices on a **1 cm^2** slice of silicon.

The tools we will use in class are the **very same**, **powerful**, **state-of-the-art** industrial design tools that are used by the largest semiconductor companies in the world. By the end of the term, student designs will be sent to **AMI Semiconductor** (NASDAQ: AMIS) for **fabrication** and **packaging**.

<u>Course Overview:</u>

Part 1: Fundamentals of VLSI design
Part 2: Students design their custom cell library, the basic digital logic building blocks for their designs
Part 3: Students will couple their cell library to design automation tools to produce a complete **system-on-a-chip** using the most current, cutting-edge design methodologies in the design automation industry.