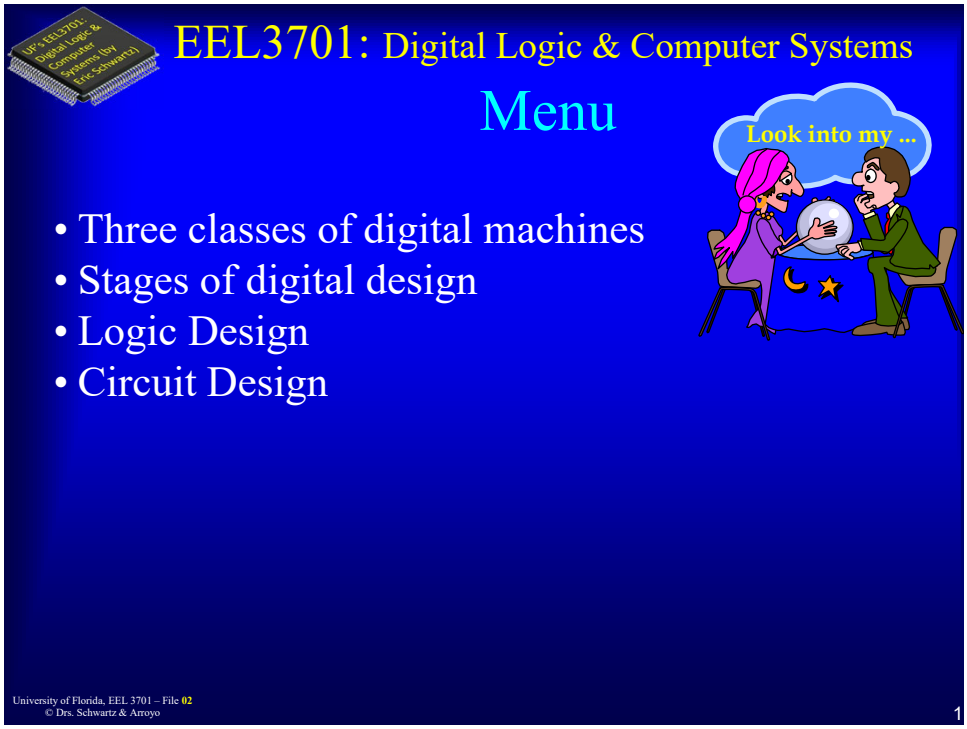
EEL3701: Digital Logic & Computer Systems
Menu
• Three classes of digital machines
• Stages of digital design
• Logic Design
• Circuit Design
Look into my ...
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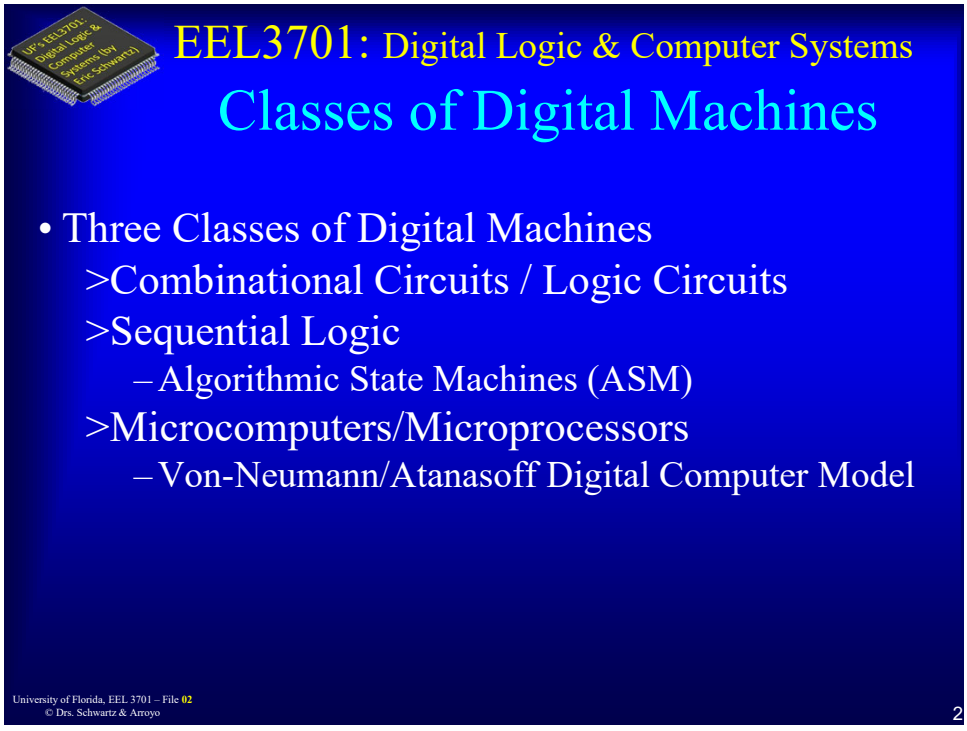
EEL3701: Digital Logic & Computer Systems
Classes of Digital Machines
• Three Classes of Digital Machines
>Combinational Circuits / Logic Circuits
>Sequential Logic
– Algorithmic State Machines (ASM)
>Microcomputers/Microprocessors
– Von-Neumann/Atanasoff Digital Computer Model
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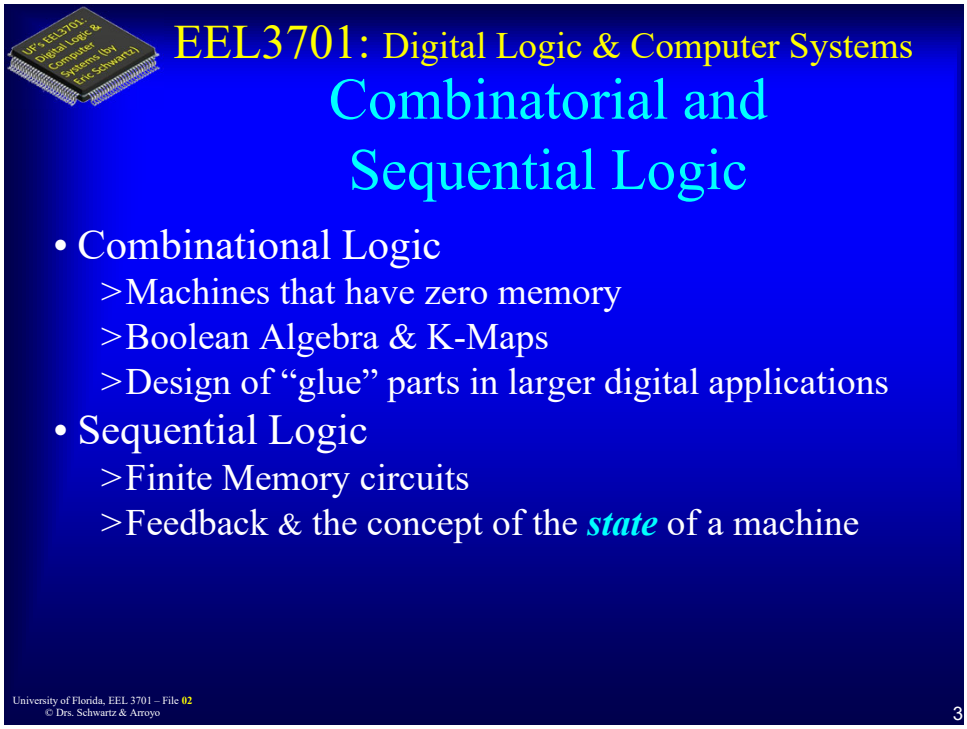
EEL3701: Digital Logic & Computer Systems
Combinatorial and Sequential Logic
• Combinational Logic
>Machines that have zero memory
>Boolean Algebra & K-Maps
>Design of "glue" parts in larger digital applications
• Sequential Logic
>Finite Memory circuits
>Feedback & the concept of the state of a machine
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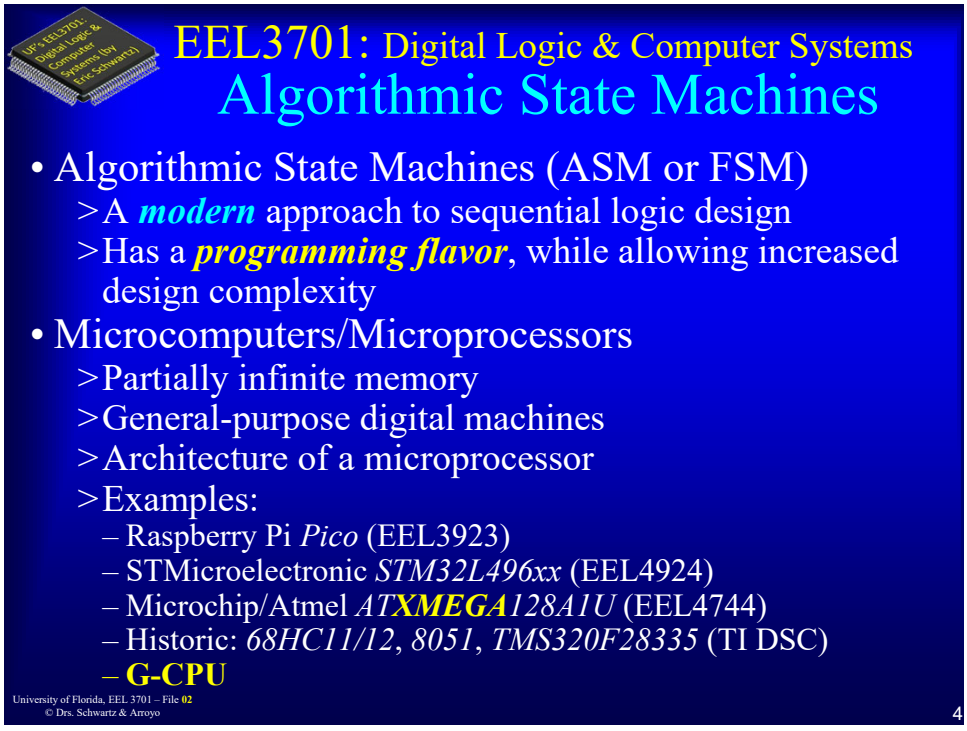
EEL3701: Digital Logic & Computer Systems
Algorithmic State Machines
• Algorithmic State Machines (ASM or FSM)
>A modern approach to sequential logic design
>Has a programming flavor, while allowing increased design complexity
• Microcomputers/Microprocessors
>Partially infinite memory
>General-purpose digital machines
>Architecture of a microprocessor
>Examples:
– Raspberry Pi Pico (EEL3923)
– STMicroelectronic STM32L496xx (EEL4924)
– Microchip/Atmel ATXMEGA128A1U (EEL4744)
– Historic: 68HC11/12, 8051, TMS320F28335 (TI DSC)
– G-CPU
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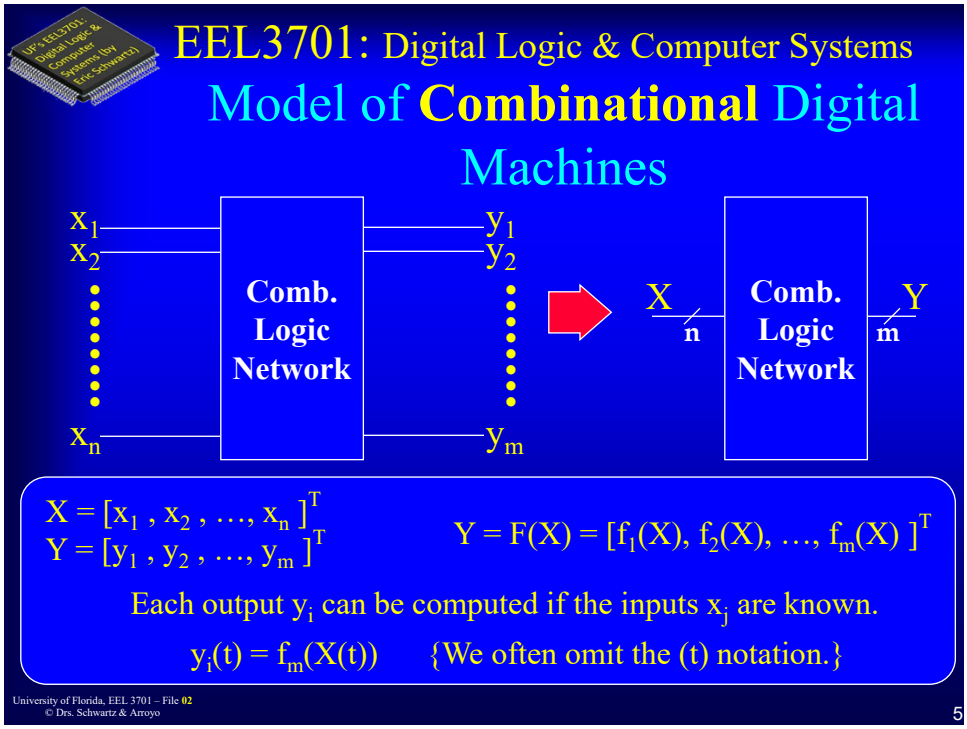
EEL3701: Digital Logic & Computer Systems
Model of Combinational Digital Machines
x1
x2
xn
Comb. Logic Network
y1
y2
ym
X
n
Comb. Logic Network
Y
m
X = [x1 , x2 , …, xn]T
Y = [y1 , y2 , …, ym]T
Y = F(X) = [f1(X), f2(X), …, fm(X)]T
Each output yi can be computed if the inputs xj are known.
yi(t) = fm(X(t)) {We often omit the (t) notation.}
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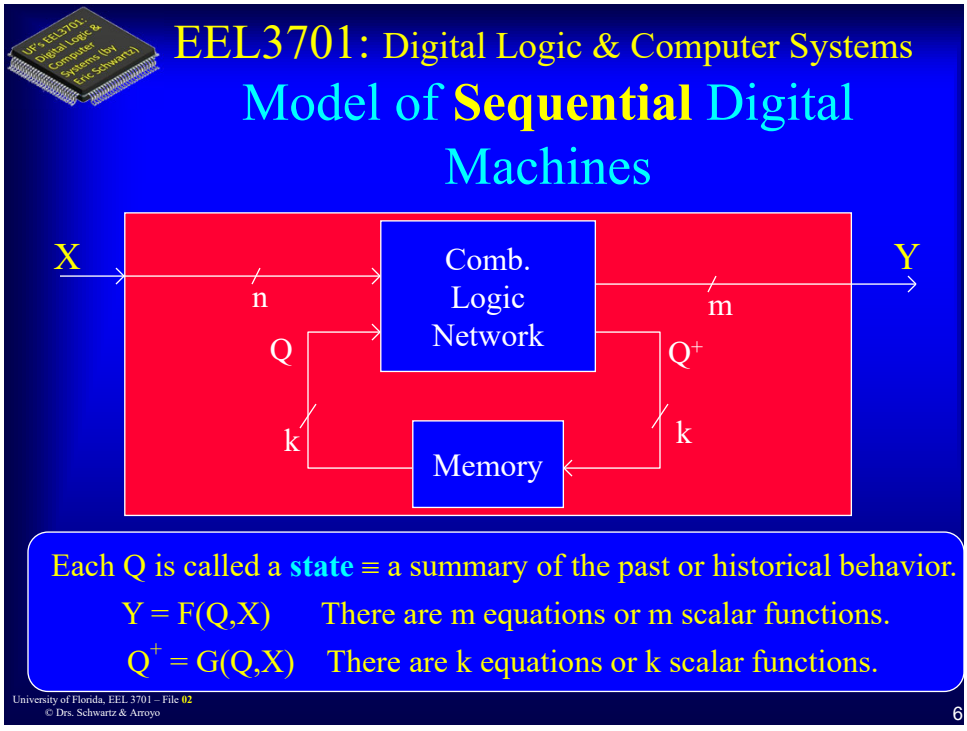
EEL3701: Digital Logic & Computer Systems
Model of Sequential Digital Machines
X
n
Comb. Logic Network
m
Y
Q
Q+
k
k
Memory
Each Q is called a state ≡ a summary of the past or historical behavior.
Y = F(Q,X) There are m equations or m scalar functions.
Q+ = G(Q,X) There are k equations or k scalar functions.
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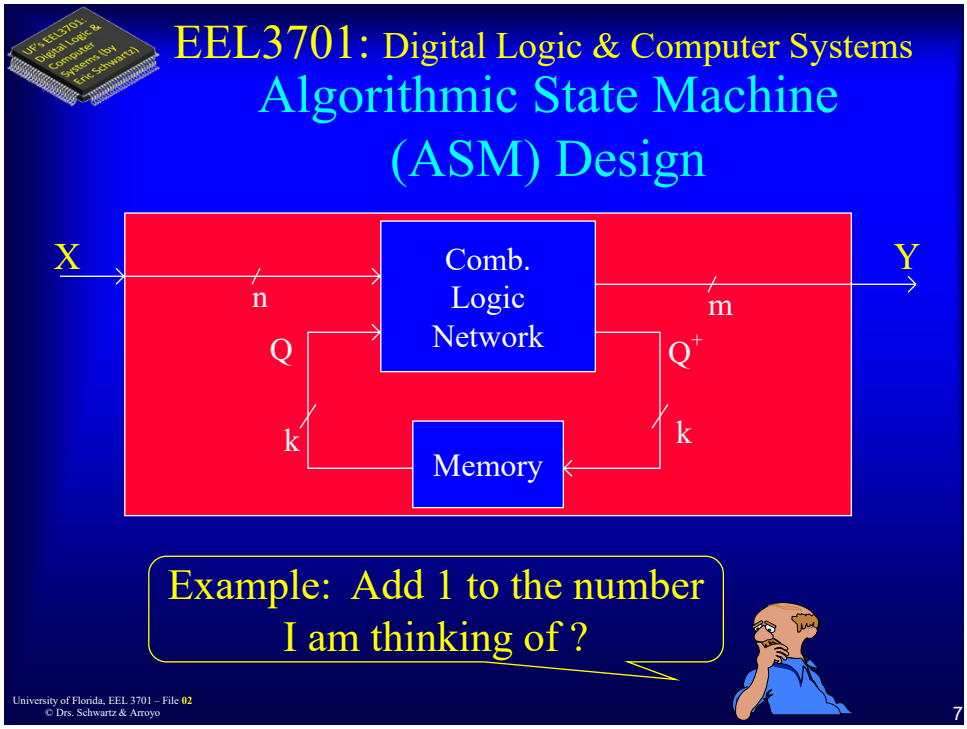
EEL3701: Digital Logic & Computer Systems
Algorithmic State Machine
(ASM) Design
X
n
Comb.
Logic
Network
m
Y
Q
Q+
k
k
Memory
Example: Add 1 to the number
I am thinking of ?
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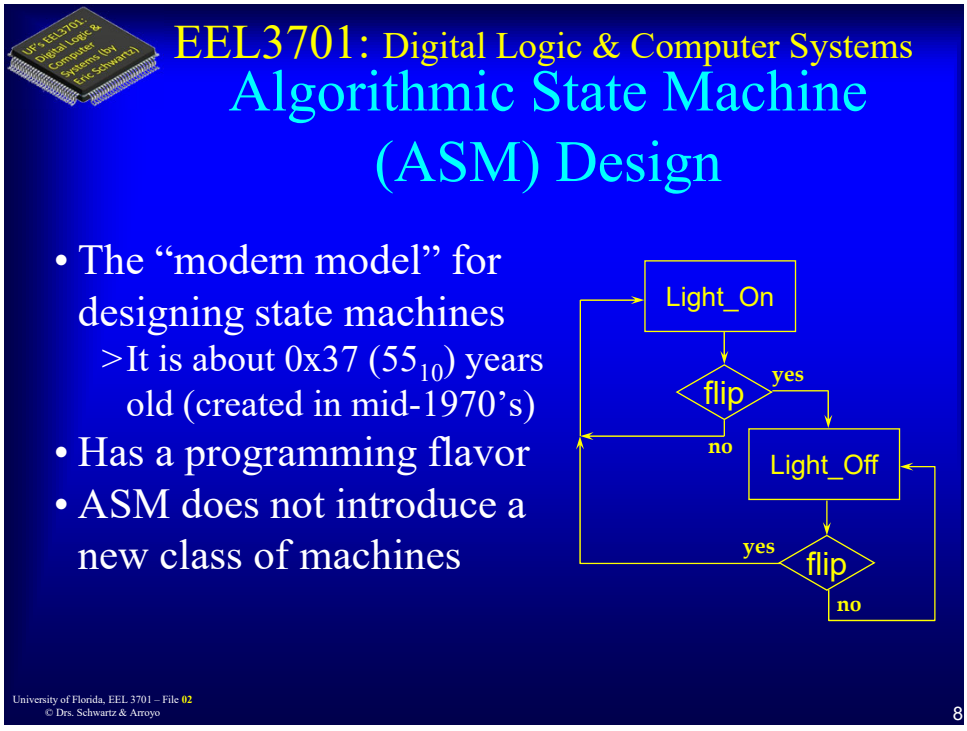
EEL3701: Digital Logic & Computer Systems
Algorithmic State Machine
(ASM) Design
• The "modern model" for designing state machines
>It is about 0x37 (55_{10}) years old (created in mid-1970's)
• Has a programming flavor
• ASM does not introduce a new class of machines
Light_On
flip
yes
no
Light_Off
yes
flip
no
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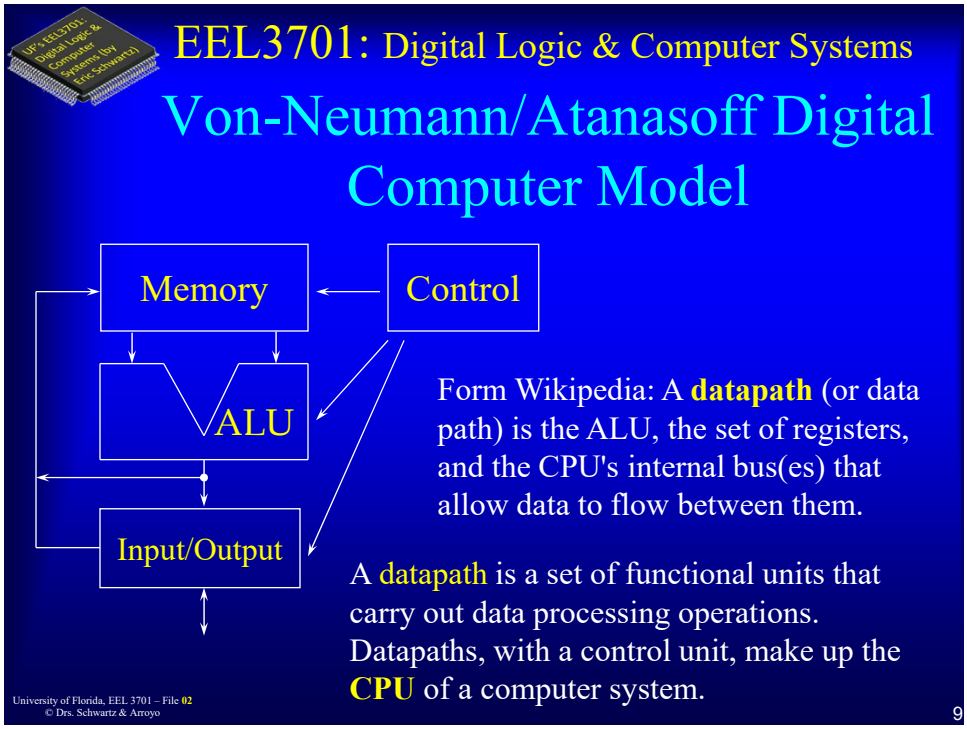
EEL3701: Digital Logic & Computer Systems
Von-Neumann/Atanasoff Digital Computer Model
Memory
Control
ALU
Input/Output
Form Wikipedia: A datapath (or data path) is the ALU, the set of registers, and the CPU's internal bus(es) that allow data to flow between them.
A datapath is a set of functional units that carry out data processing operations. Datapaths, with a control unit, make up the CPU of a computer system.
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EEL3701: Digital Logic & Computer Systems
Stages in the Design of Digital Systems
• System Design or System Specifications:
>Break the overall system into subsystems
>Specify the characteristics of each subsystem
• Design first subsystem
>Simulate first subsystem
>Build first subsystem
>Test/verify first subsystem
• Do the above for second subsystem
• Combine first two subsystems
>Simulate them together; test/verify them together
• Etc.
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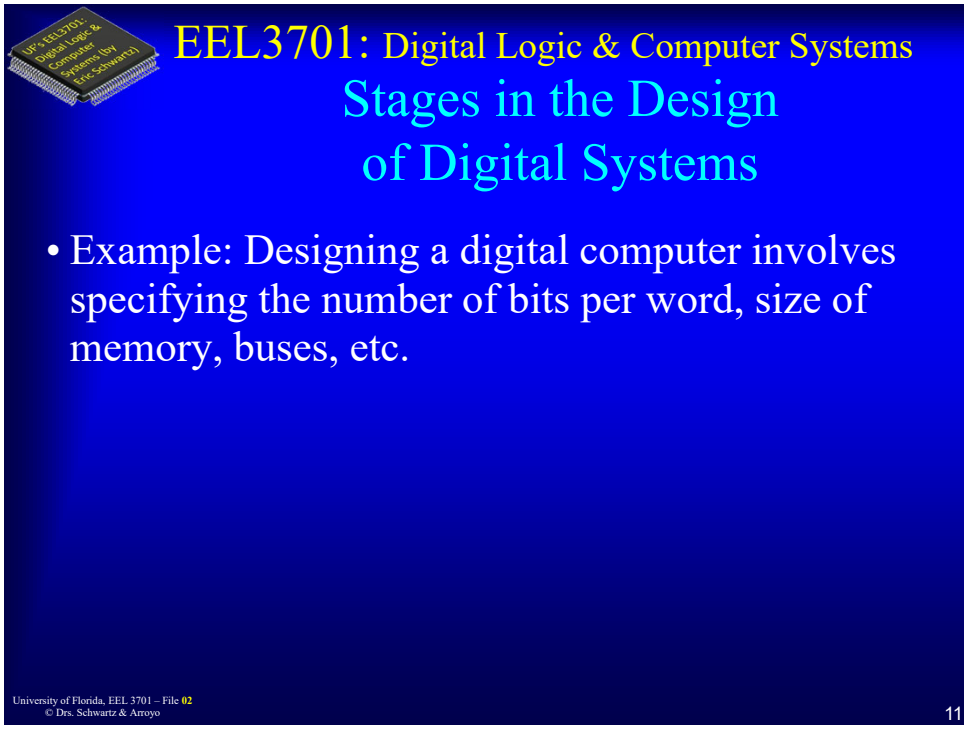
EEL3701: Digital Logic & Computer Systems
Stages in the Design of Digital Systems
• Example: Designing a digital computer involves specifying the number of bits per word, size of memory, buses, etc.
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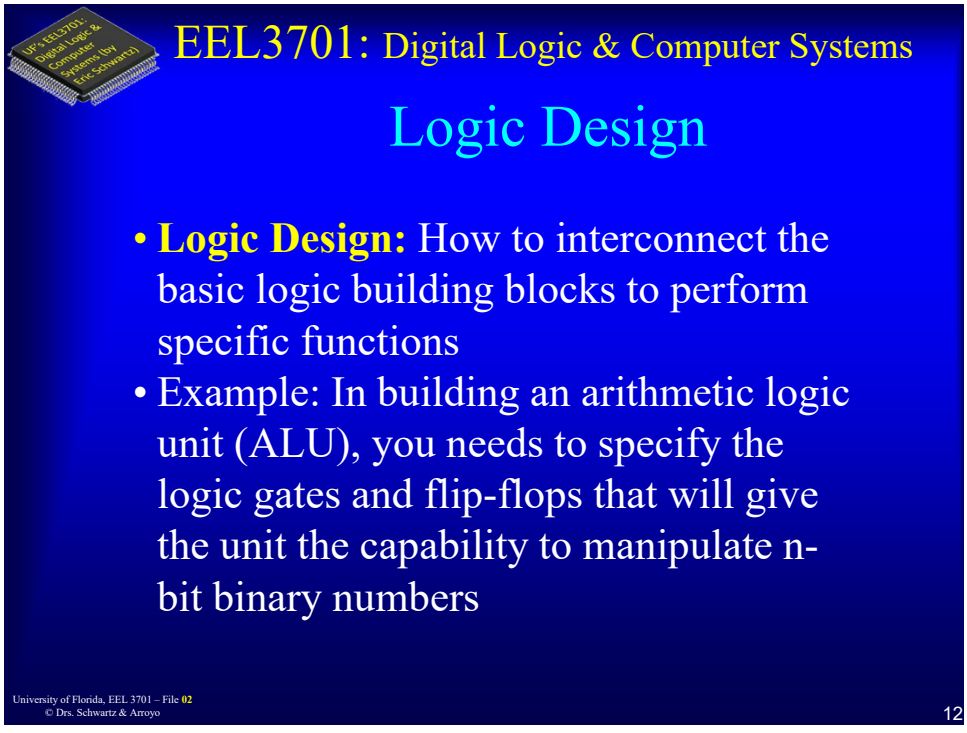
EEL3701: Digital Logic & Computer Systems
Logic Design
• Logic Design: How to interconnect the basic logic building blocks to perform specific functions
• Example: In building an arithmetic logic unit (ALU), you needs to specify the logic gates and flip-flops that will give the unit the capability to manipulate n-bit binary numbers
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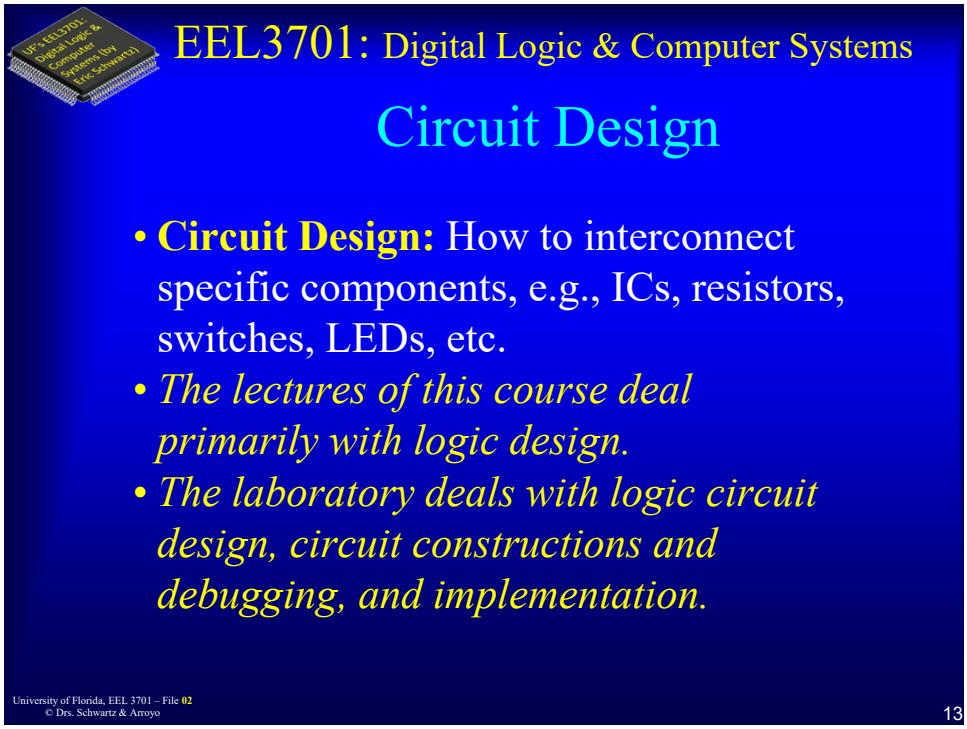
EEL3701: Digital Logic & Computer Systems
Circuit Design
• Circuit Design: How to interconnect specific components, e.g., ICs, resistors, switches, LEDs, etc.
• The lectures of this course deal primarily with logic design.
• The laboratory deals with logic circuit design, circuit constructions and debugging, and implementation.
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EEL3701: Digital Logic & Computer Systems
The End!
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