

- **Agenda:** recalling that COMS10015 comprises 3 high-level themes, i.e.,

Theme #1 $\Rightarrow$ “from Mathematics and Physics to digital logic”

Theme #2 $\Rightarrow$ “from digital logic to computer processors”

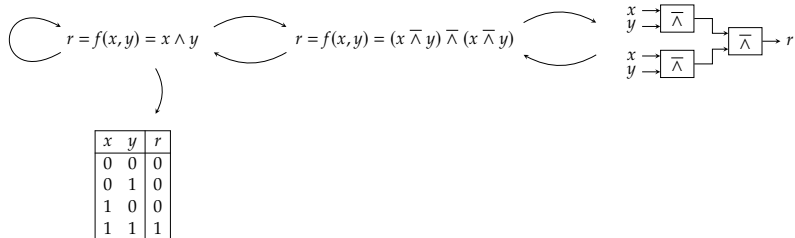
Theme #3 $\Rightarrow$ “from computer processors to software applications”

the aim is to summarise (or wrap-up), by

1. looking *backward* $\Rightarrow$ what we *have done* in TB1
2. looking *forward* $\Rightarrow$ what we *will do* in TB2

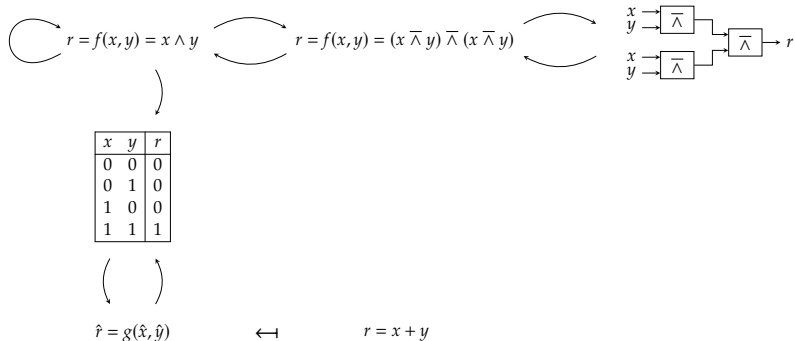
Unit summary (1)

Looking backward, low-level perspective: arc #1 = “no remaining magic between abstract and concrete computation”



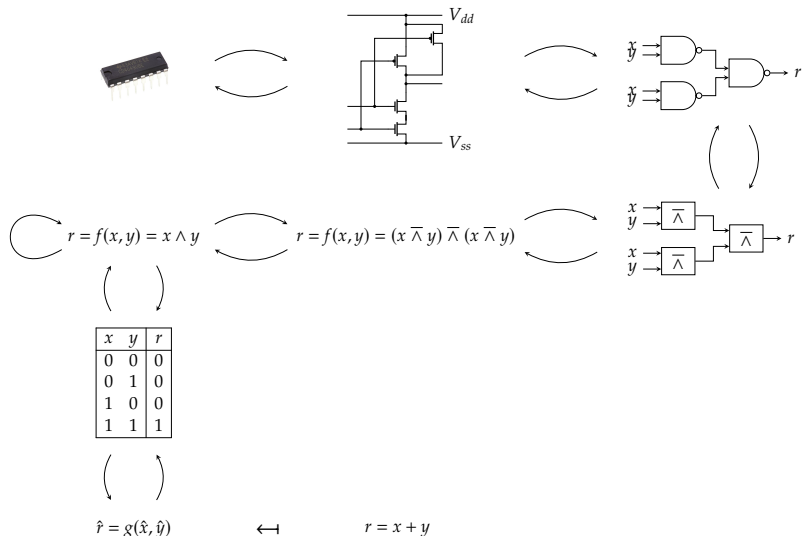
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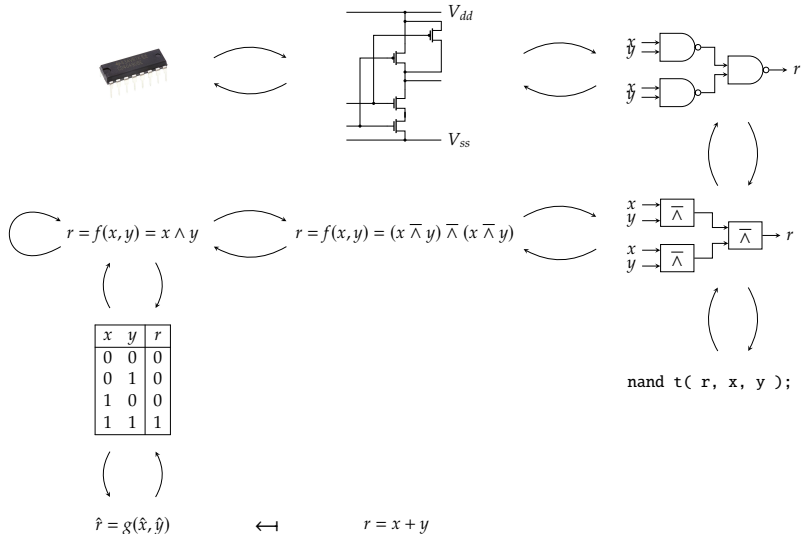
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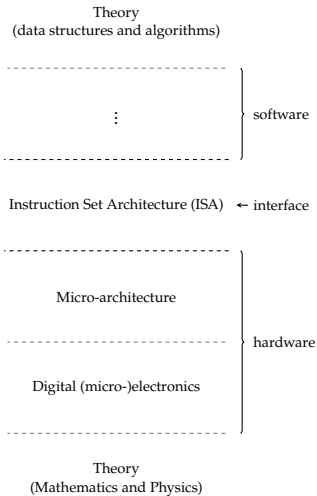
Unit summary (2)

Looking backward, low-level perspective: arc #2 = “progressively more involved versions of addition”

theory	↷	representation	}	unsigned and signed integer
theory	↷	computation		“school-book” addition algorithm
	⋮			
combinatorial logic	↷	fixed function computation, not stateful	}	full-adder cell, ripple-carry adder
sequential logic	↷	fixed function computation, stateful		counter
FSM	↷	fixed function computation, stateful		
RM	↷	not fixed function computation, stateful	}	counter machine
	⋮			
micro-processor	↷	not fixed function computation, stateful	}	add instruction

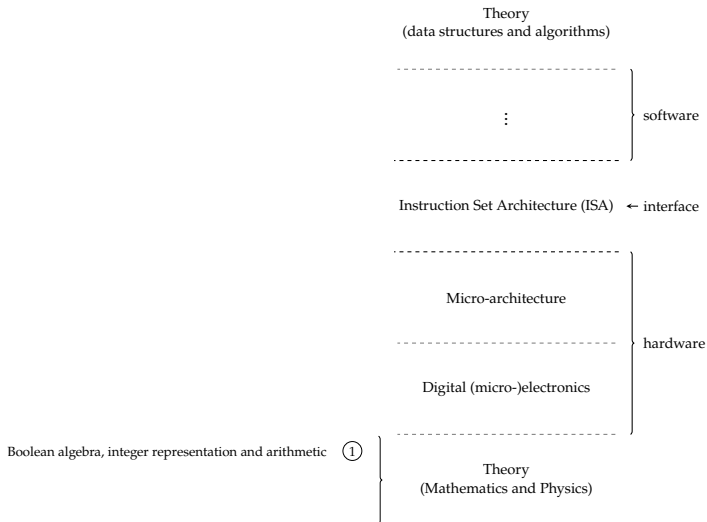
Unit summary (3)

Looking backward, high-level perspective



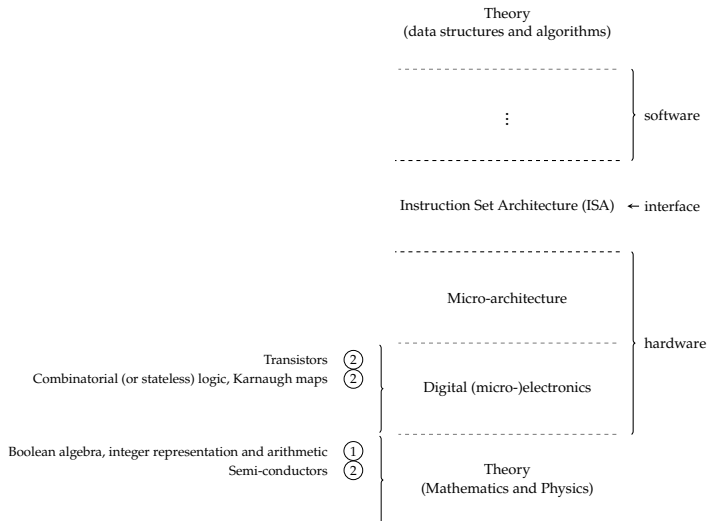
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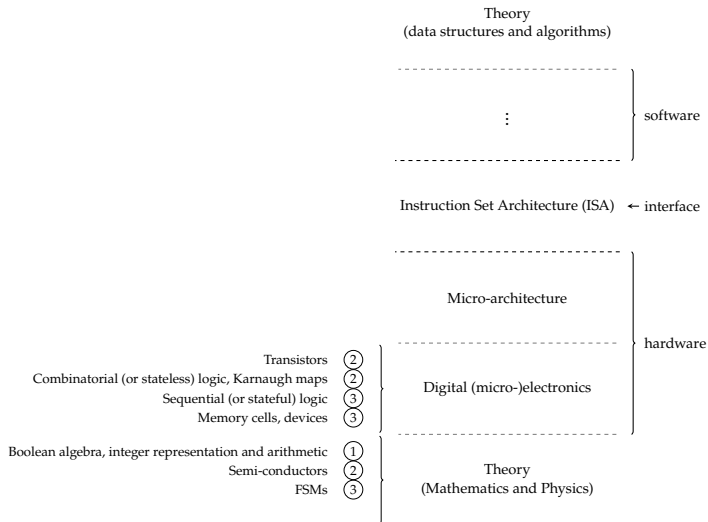
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Looking backward, high-level perspective



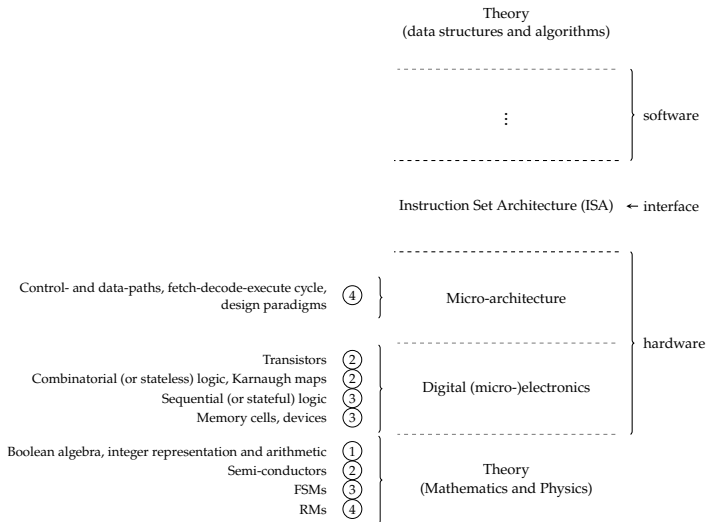
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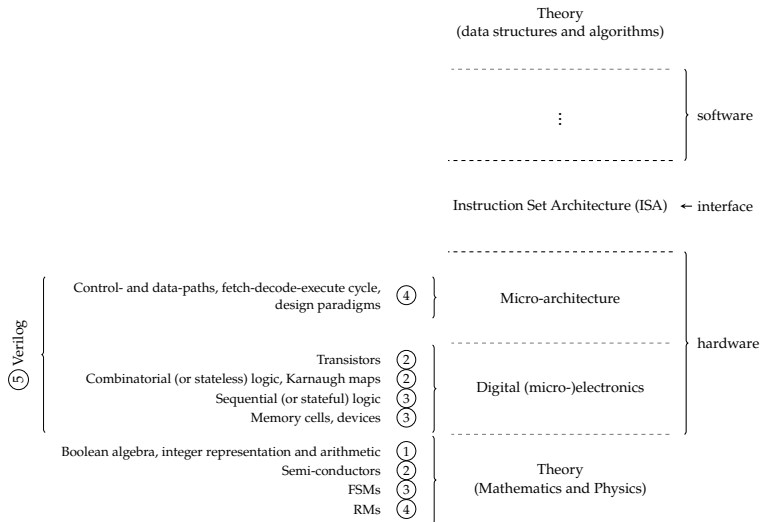
Unit summary (3)

Looking backward, high-level perspective



Unit summary (3)

Looking backward, high-level perspective



Unit summary (4)

Looking forward

► ... yet to come, in TB2:

1. Instruction Set Architecture (ISAs):

- instruction set design: instruction classes; addressing modes; instruction encoding and decoding
- real-world examples: ARMv7-A

2. micro-architecture (revisited):

- pipelined instruction execution
- von Neumann bottleneck, memory hierarchy; cache memories

3. (system) software:

- development tools: assembly language; assembly and linkage processes; debuggers; compilers
- support for structured programming (e.g., function calls)
- support for operating systems: interrupts; protection; virtual memory

4. ...

► Take away points: *hopefully*, TB1 has delivered

1. some *understanding*,
 - Boolean algebra; integer representation and arithmetic
 - physical design of logic components (e.g., logic gates from transistors)
 - use of combinatorial logic components (e.g., Karnaugh maps)
 - use of sequential logic components (e.g., state machines)
 - processor paradigms: counter, accumulator, stack, and register machines; von Neumann vs. Harvard architecture; RISC vs. CISC
 - ...
2. some *skills*,
 - Verilog-based modelling and simulation of digital logic
 - ...
3. some *experience*,
 - hierarchical design (via abstraction, and “understand-design-implement” ethos)
 - debugging strategies
 - ...

which will be further extended and enhanced by TB2.

References