Integrating Engineering Concepts in Math Circle Activities.

MAA Session on What Makes a Successful Math Circle: Organization and Problems II

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Context

Engineering Concepts

- Engineering methods and tools are deeply rooted in math
- Basic engineering concepts are easy to grasp and relate to.
- Big engineering program at TAMU (more than 400 faculty)
  - many parents associated with the College of Engineering
- Great tool to demonstrate the applications of math

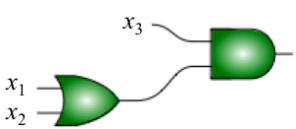
Sample activities in TAMU math circle:

- Boolean algebra, Circuit analysis and synthesis
- Sequential circuits, Finite State Machines
- Graph algorithms and data structures
- Communication and information theory
- Error correcting codes
- Distributed algorithms

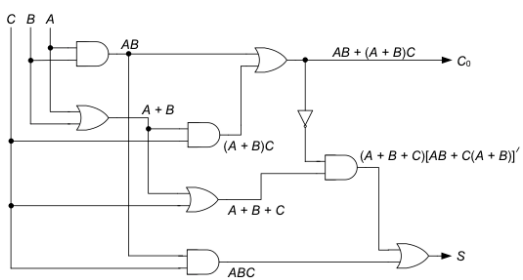
Example Activity

Combinational Logic Design

- Introduce different logic gates
- Understand boolean algebra (axioms and theorems)
- Understand different representations of boolean functions
- Truth table, Karnaugh maps, circuits
  - Understand basic techniques for functions simplifications
- Use web-based tools to verify design (e.g., http://logic.ly)



x_1	x_2	x_3	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1



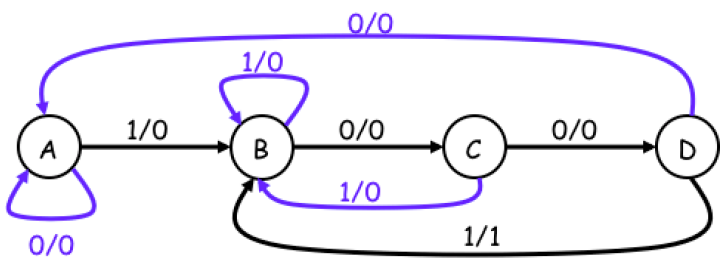
Example Activity (cont.)

Finite State Machines (FSM)

- Design of sequential logic
- Design sequential circuit for real life problems

E.g., sequence recognizer

- Detect the bit pattern "1001"
- Input: 11100110100100110. . .
- Output: 00000100000100100. . .



Challenges and Future plans

Need to develop new lesson plans.

- Few engineering activity plans are available in the literature
- Need to max complex engineering concepts accessible
- Web-based tools require computer access
- Challenge to develop inexpensive manipulatives
- Recruiting and training engineering faculty
- Transition from lecture-based to activity-based format