

Ten Years of Badge-Based/Mastery Learning for Computer Architecture

- Lessons Learned

Peter Jamieson

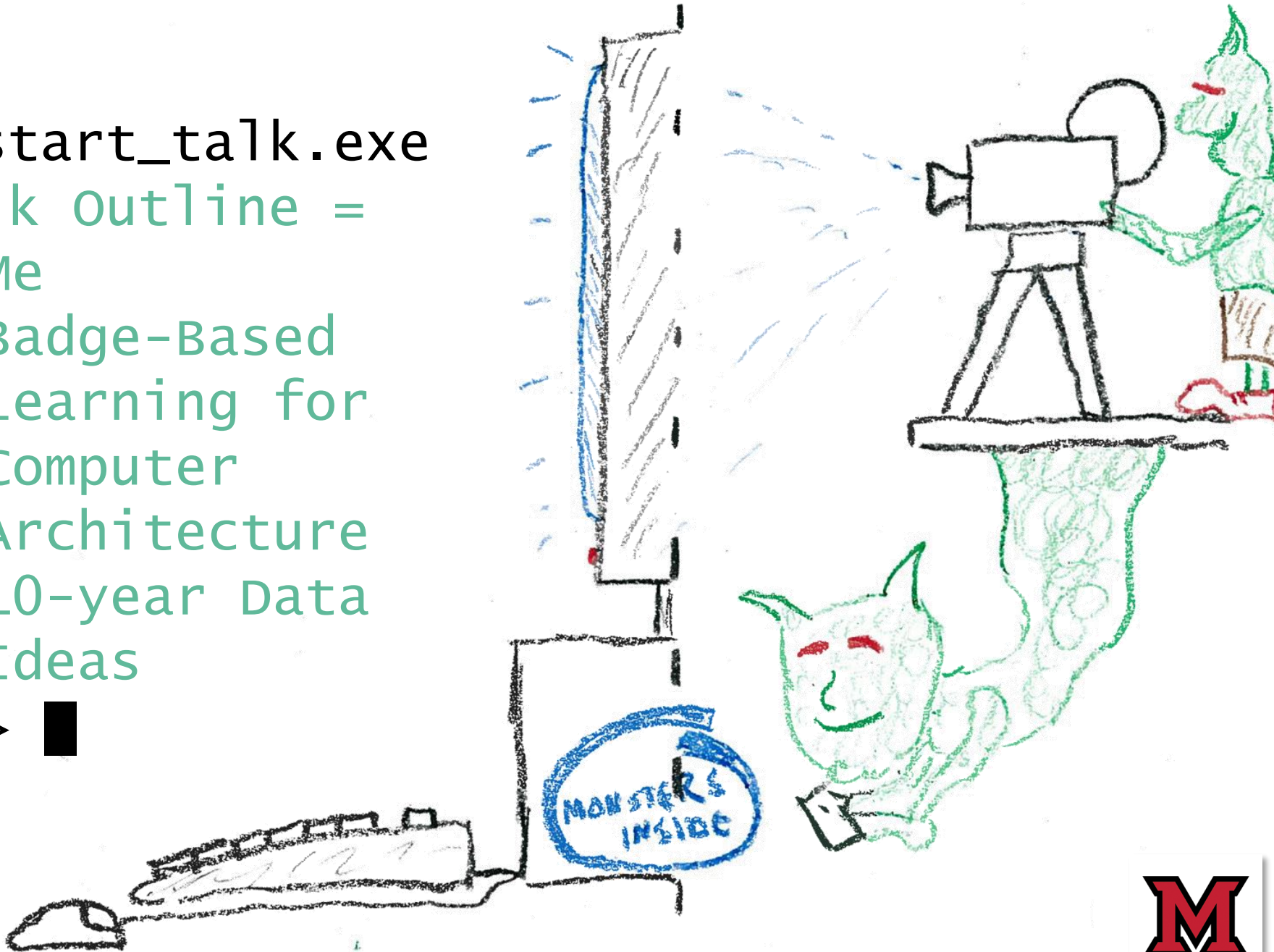
Miami University



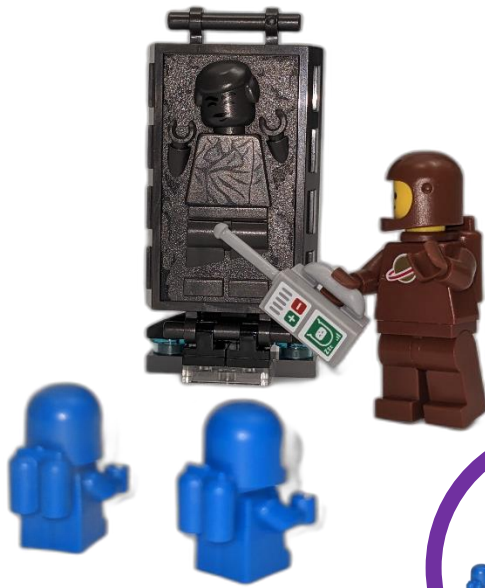
> start_talk.exe

Talk Outline =

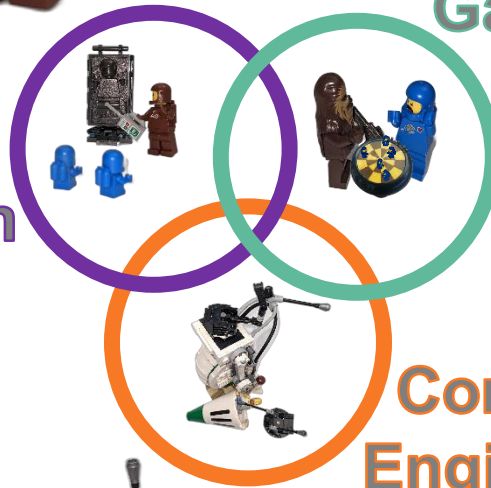
- Me
- Badge-Based Learning for Computer Architecture
- 10-year Data
- Ideas
- > ■



About Me



Education



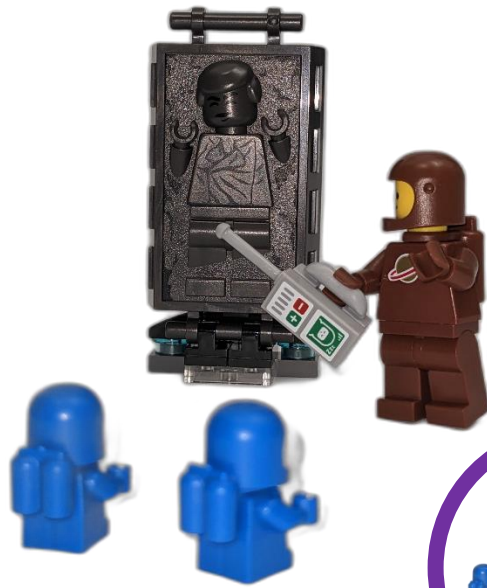
Games



Computer
Engineering



About Me



Education



Games



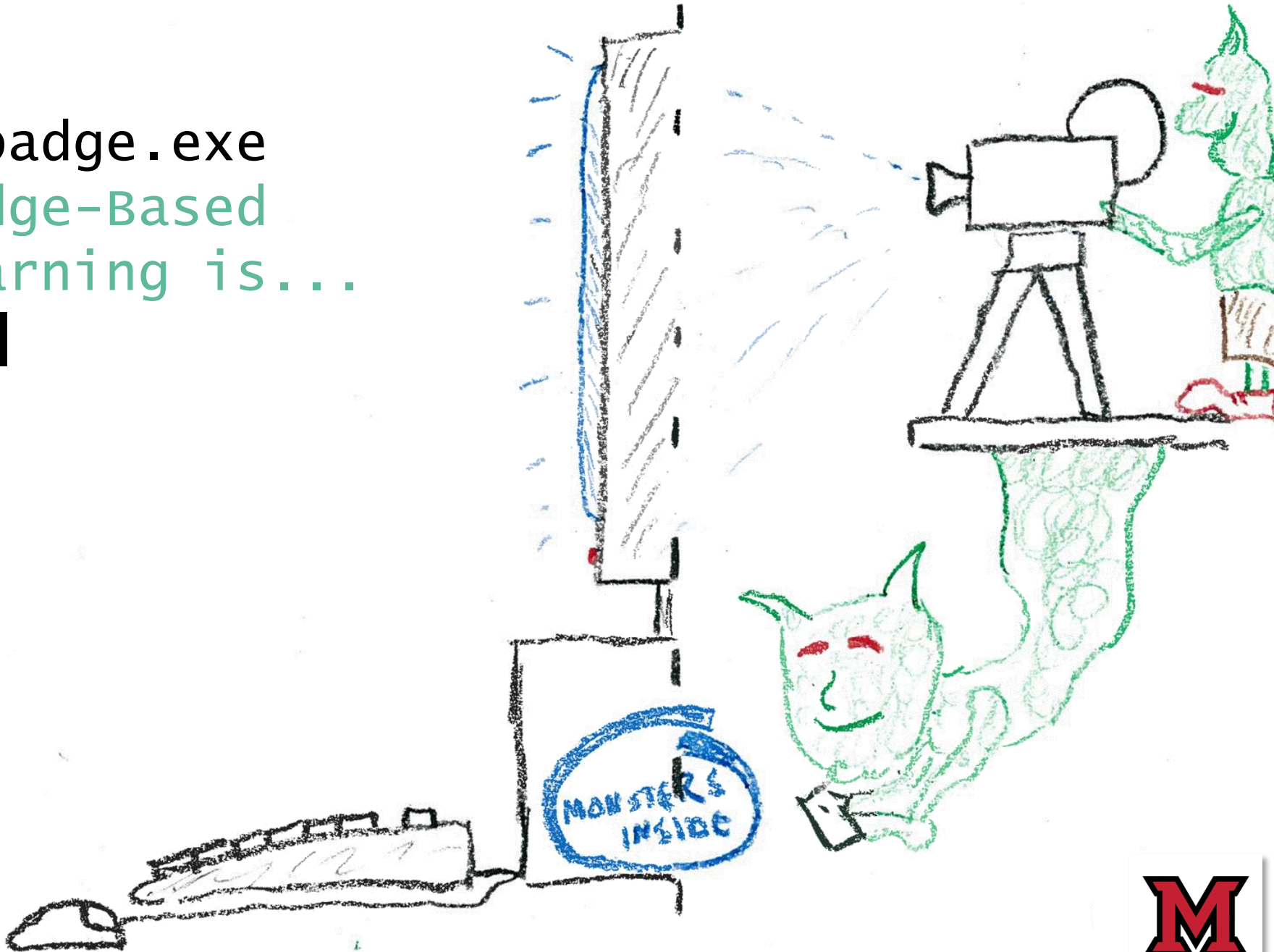
Computer Engineering



> badge.exe

Badge-Based
Learning is...

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Badge Name: Advanced - HW Parallel 1



Badge Description

The goal of this badge is for the learner to demonstrate how to build a parallel architecture with 4 or more processors that share a common memory.

Badge Prerequisite Knowledge

- An understanding of assembly languages (completion of the badge [Core - Assembly](#) or equivalent)
- An understanding of computer architecture (completion of the badge [Core - Architecture](#) or equivalent)
- An understanding of basic architecture optimizations (completion of the badge [Core - Optimization](#) or equivalent)
- One of completion of the badges [Intermediate - HW Implementation](#)

Badge Objectives

Demonstrate **application**, **analysis**, and **evaluation** of how to make a parallel system with 4 cores including a system to allow each of the processors to lock and unlock access for main memory.

Badge Knowledge

application, **analysis**, and **evaluation** of the following:

- Instantiating 4 cores
- Building an advanced main memory with locking capabilities and multi access

Badge Deliverables

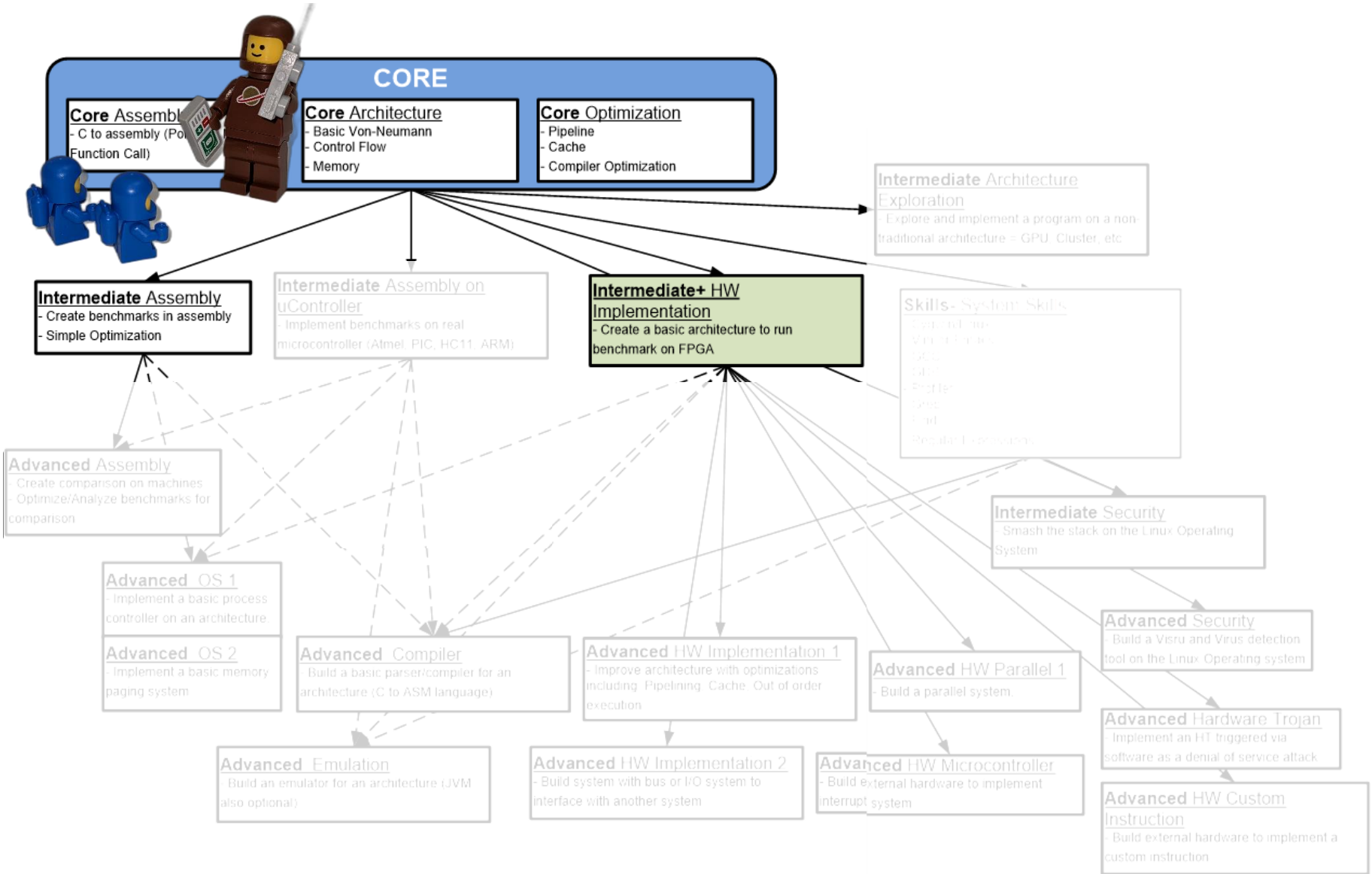
1. An architecture that runs a program demonstrating how the system is parallel and can be synchronized with the locking mechanism.

Badge Assessment

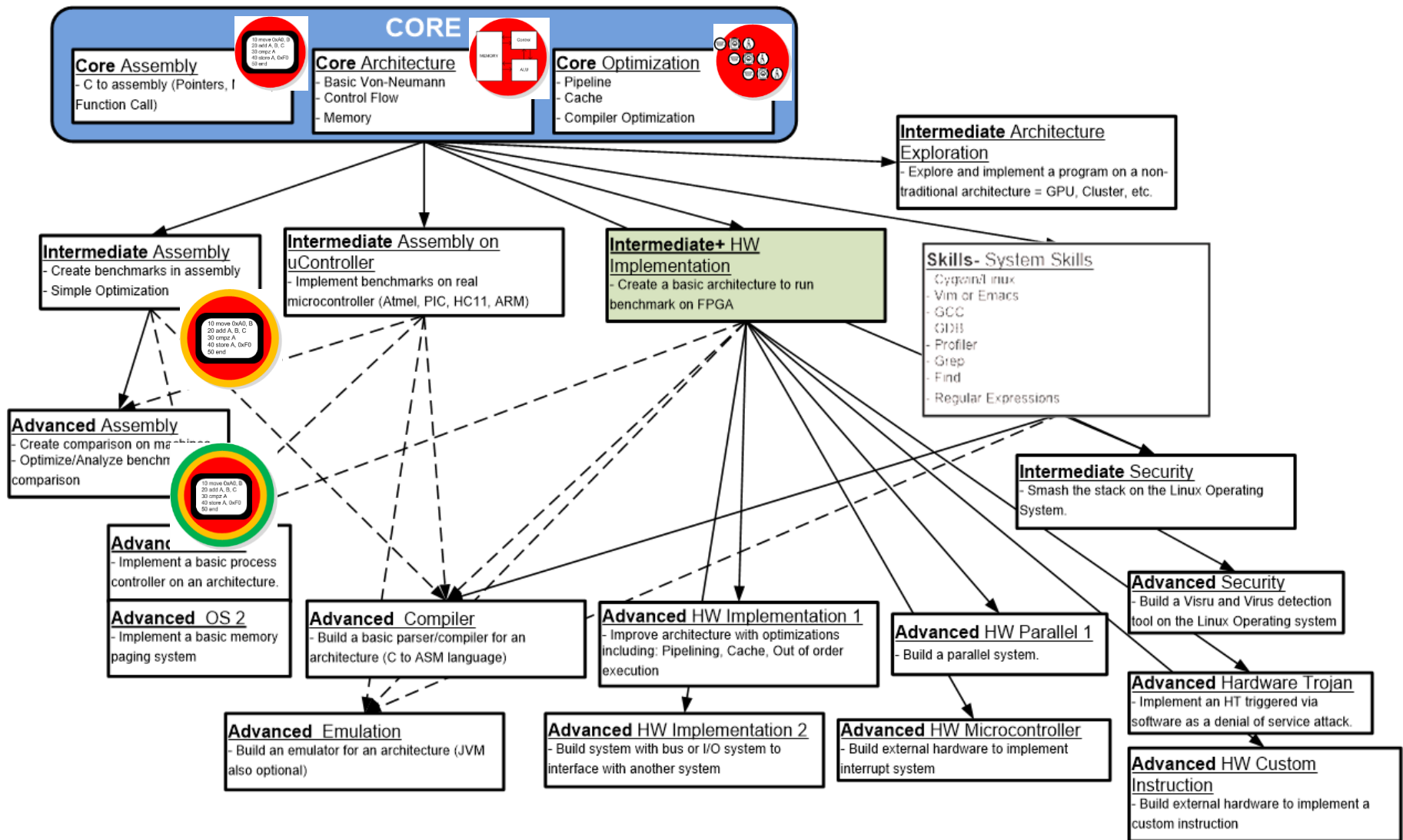
Assessment will be based on a review on the satisfactory completion of the deliverables above and a brief discussion.

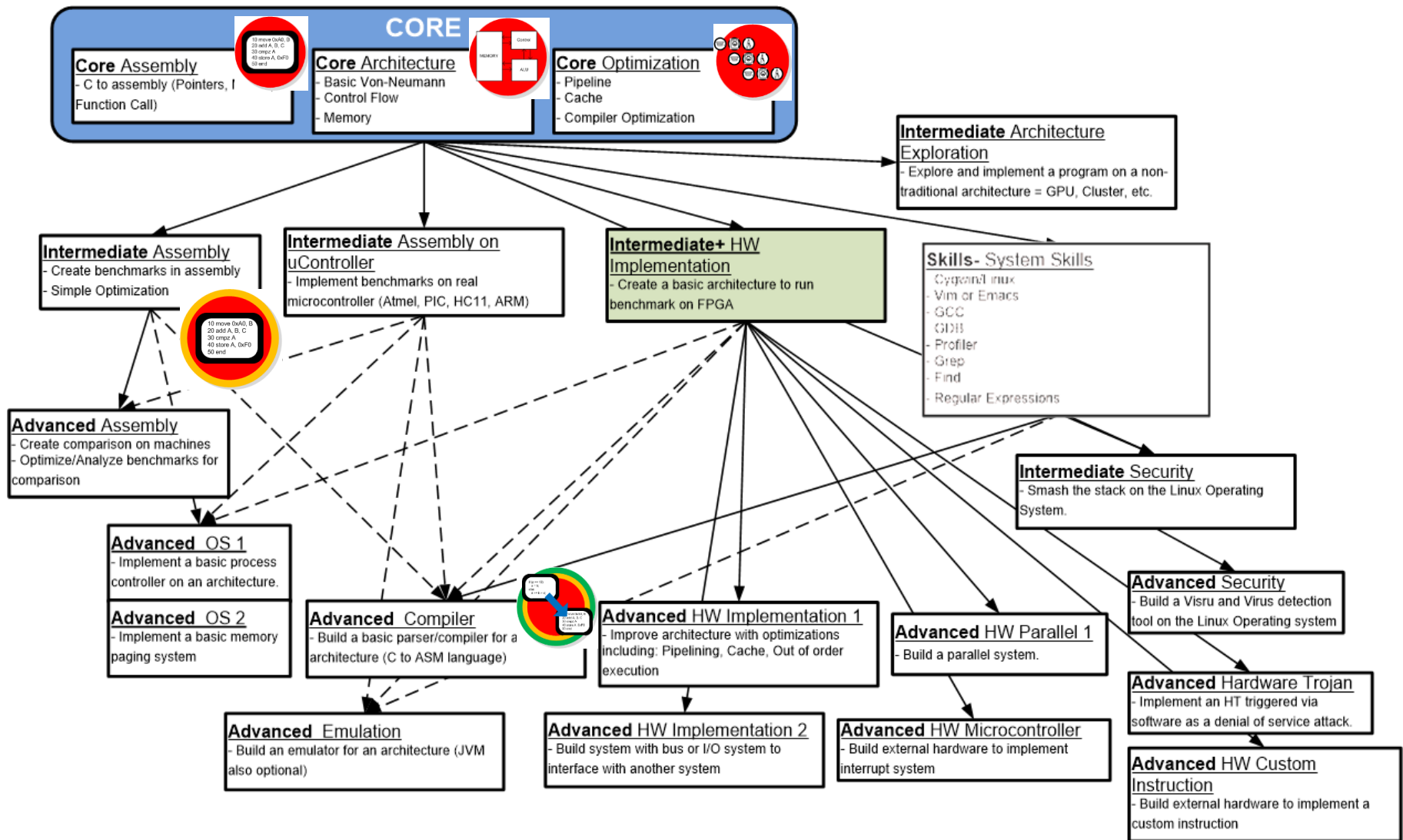
Badge Suggestions and Resources

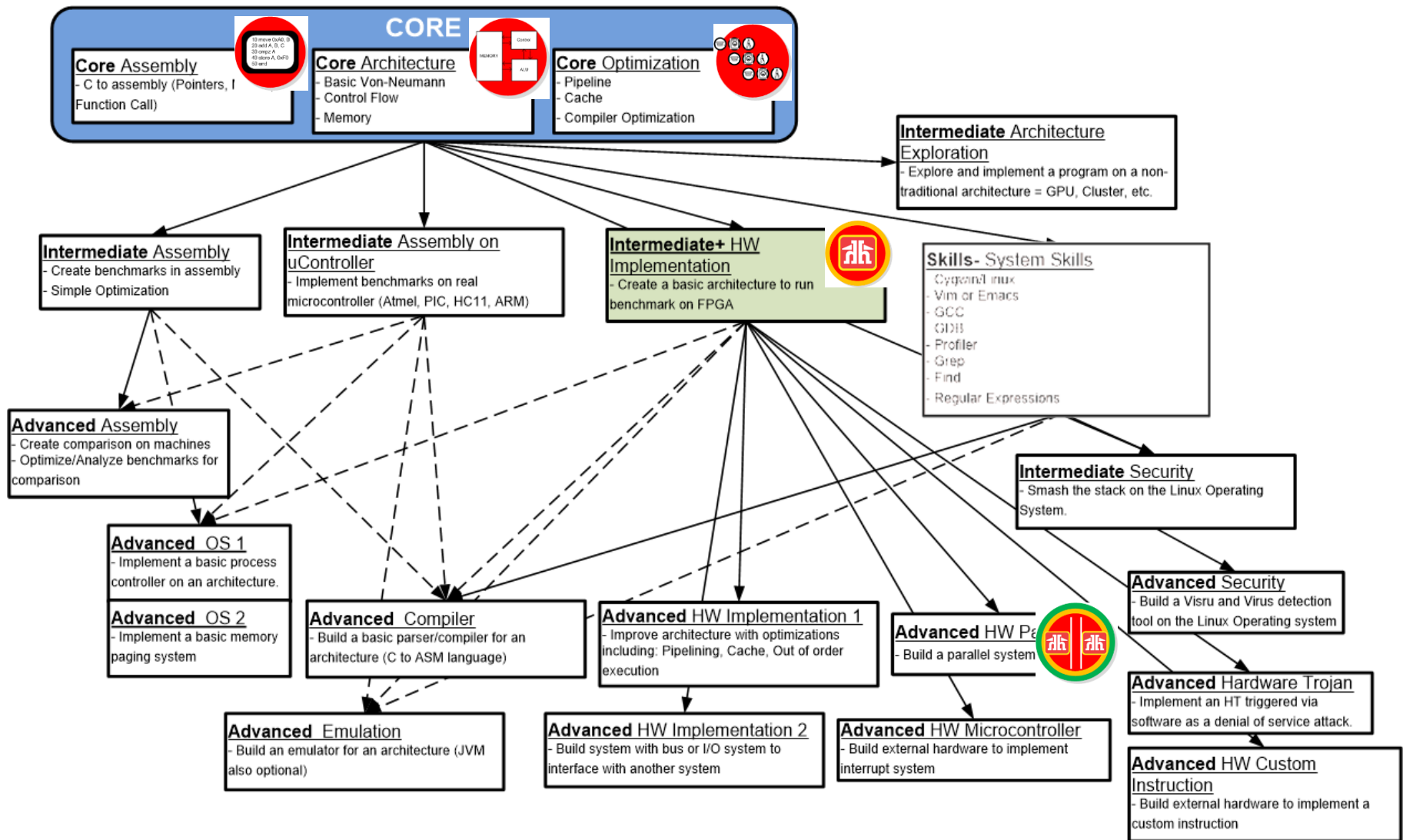


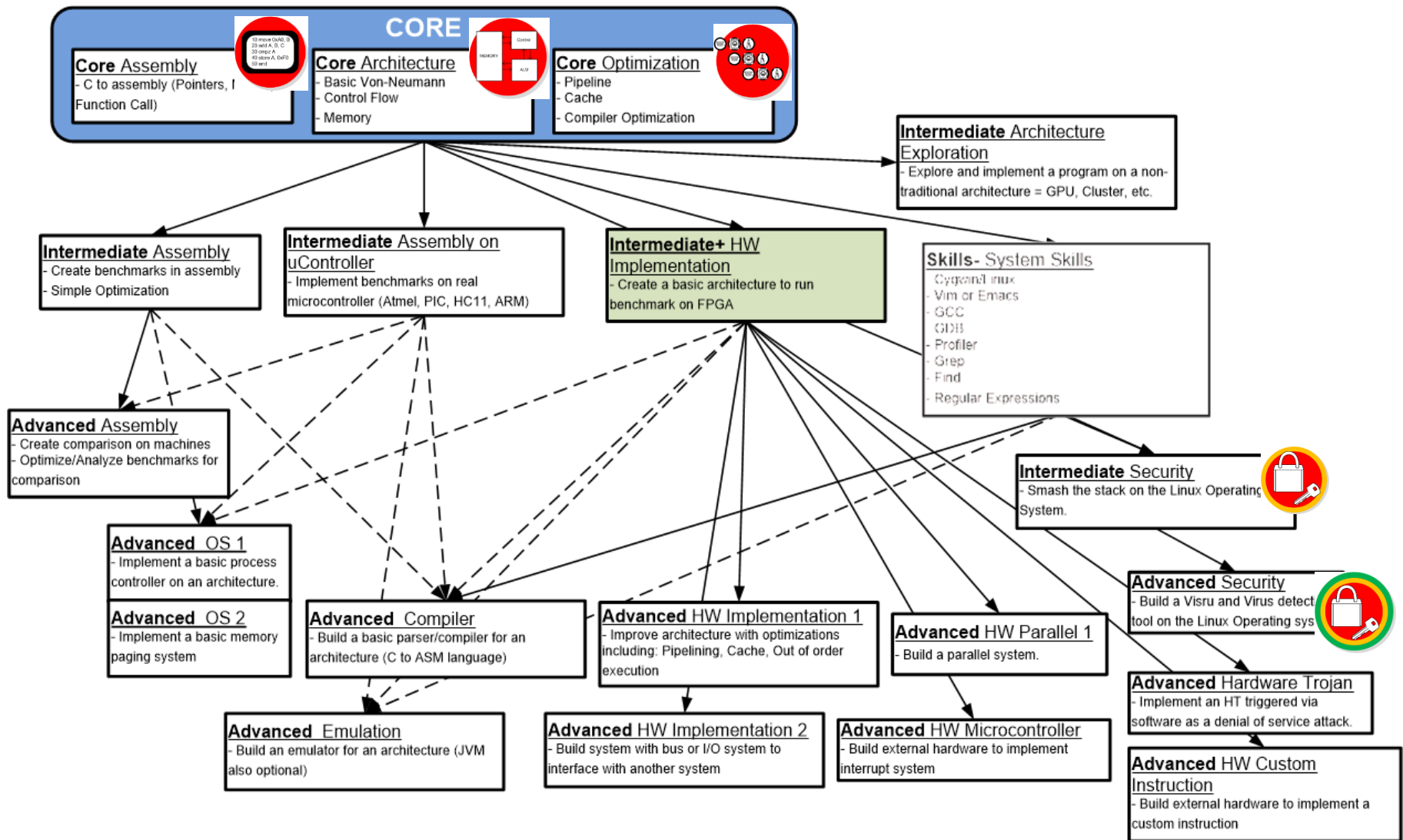


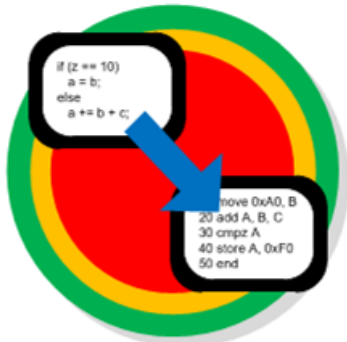
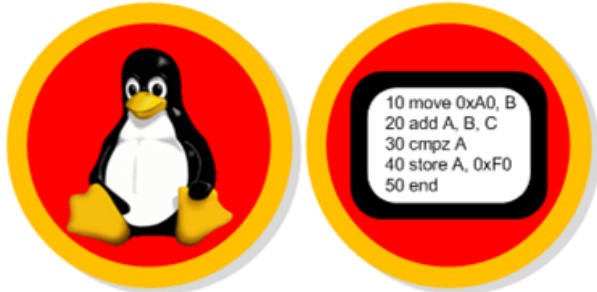
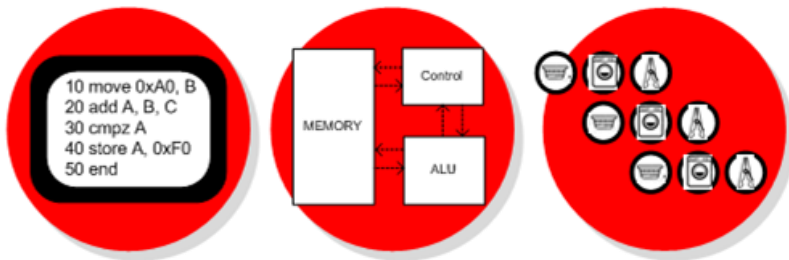












Letter Grade	Core Badges	Intermediate Badges	Advanced Badges
F	0	-	-
D-	0-3	-	-
D	3	-	-
C	3	-	-
B	3	1	-
B+	3	2	-
A-	3	3	-
A	3	1	1
A+	3	1	1

*

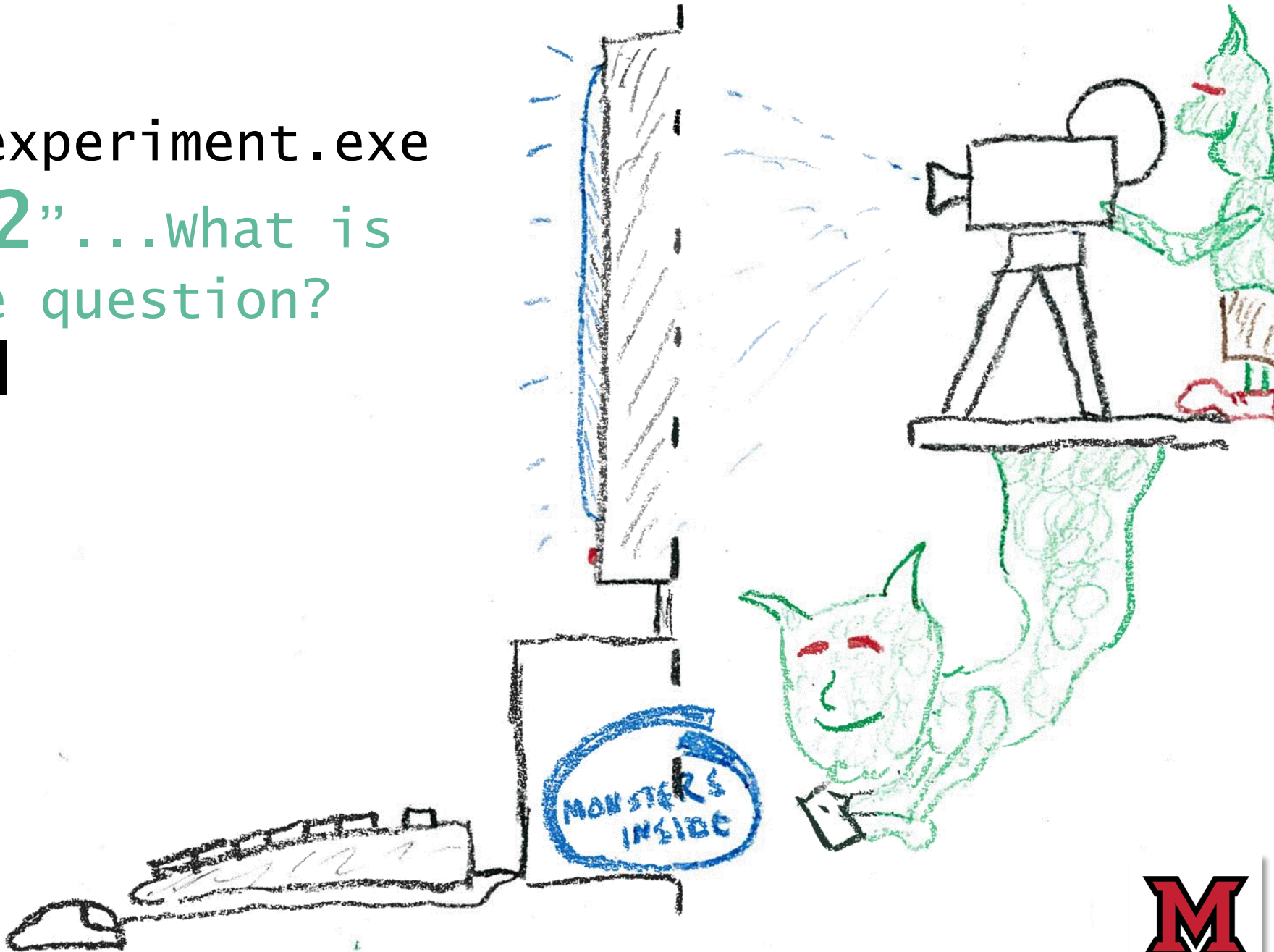
*



> experiment.exe

“42”...what is
the question?

> ■



Grades over 10 years

Letter	# Total Students
A	44
B	70
C	49
D	23
F	4
Total	190



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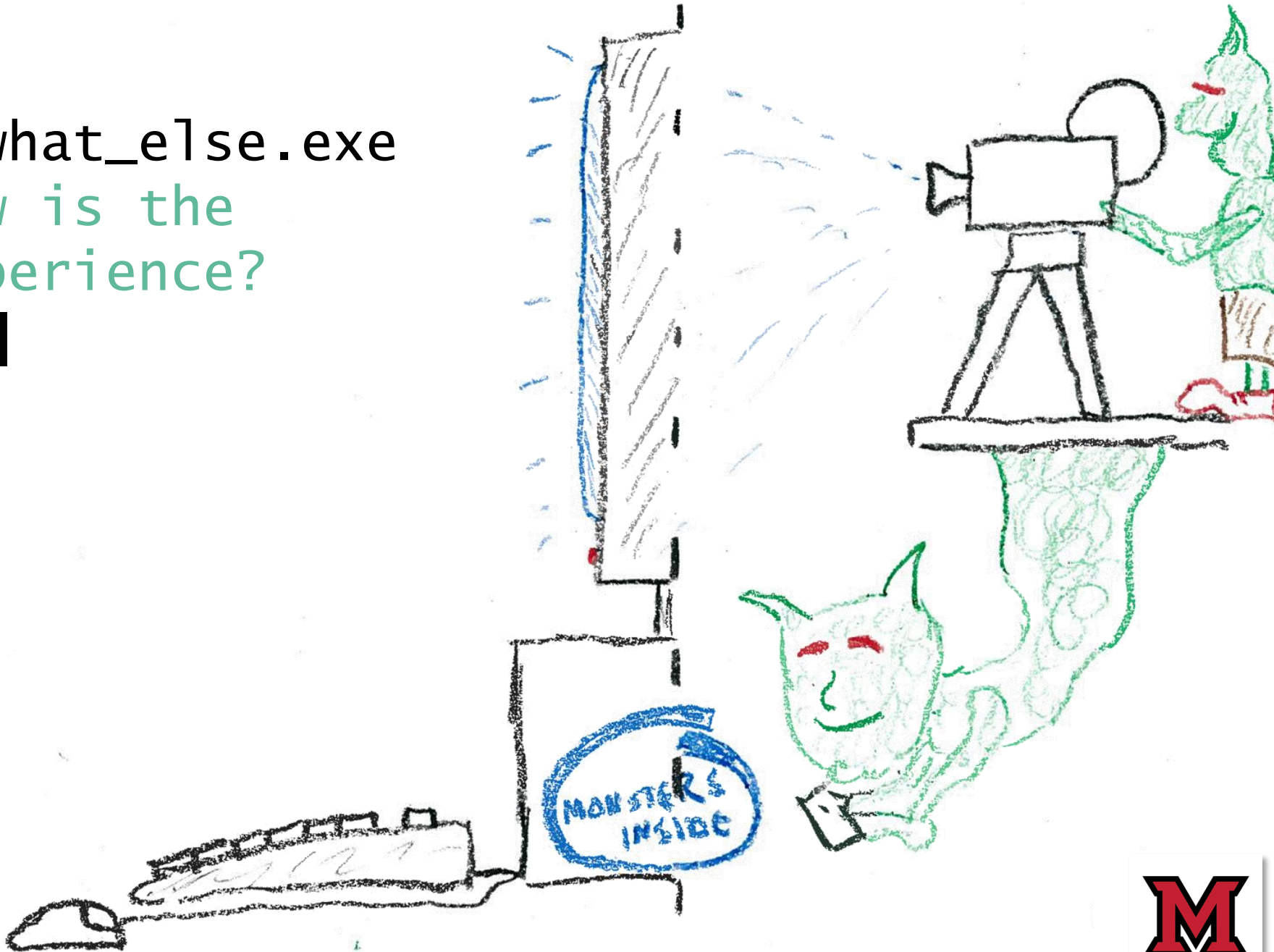
Badges	#
Core – Assembly	182
Core - Architecture	165
Core – Optimization	151
Intermediate - System Skills (until 2016)	42
Intermediate - Assembly	45
Intermediate+ - HW	20
Intermediate – Security	27
Advanced - Assembly	9
Advanced - OS 1	11
Advanced - Compiler	7
Advanced - Emulation	1
Advanced - HW Implementation 1	2
Advanced - HW Implementation 2	1
Advanced - HW Parallel	6
Advanced - Security (Virus)	6



> what_else.exe

How is the
experience?

> ■



Year	Change
2013	Created initial course with new modality
2015	Transitioned the course to “Canvas” course management
2015	Made lectures to help students achieve “C” with core badges
2017	Removed the “Intermediate - System Skills” badge
2017	Shifted to implementing RISC-V systems over MIPS
2019	Shifted to Online for Covid-19 (pass/fail)
2020	Created inverted teaching modules for Core badges (pass/fail)
2020	Provided an assignment that assessed Core badges
2022	Added a microcontroller advanced badge
2024	Added Hardware Trojan badge



Attendance



Students like?



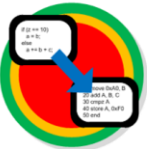
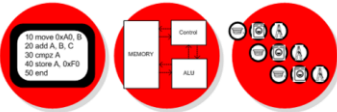
Is it teaching?



Does it Scale?



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