Configware in the Computer Science Curriculum

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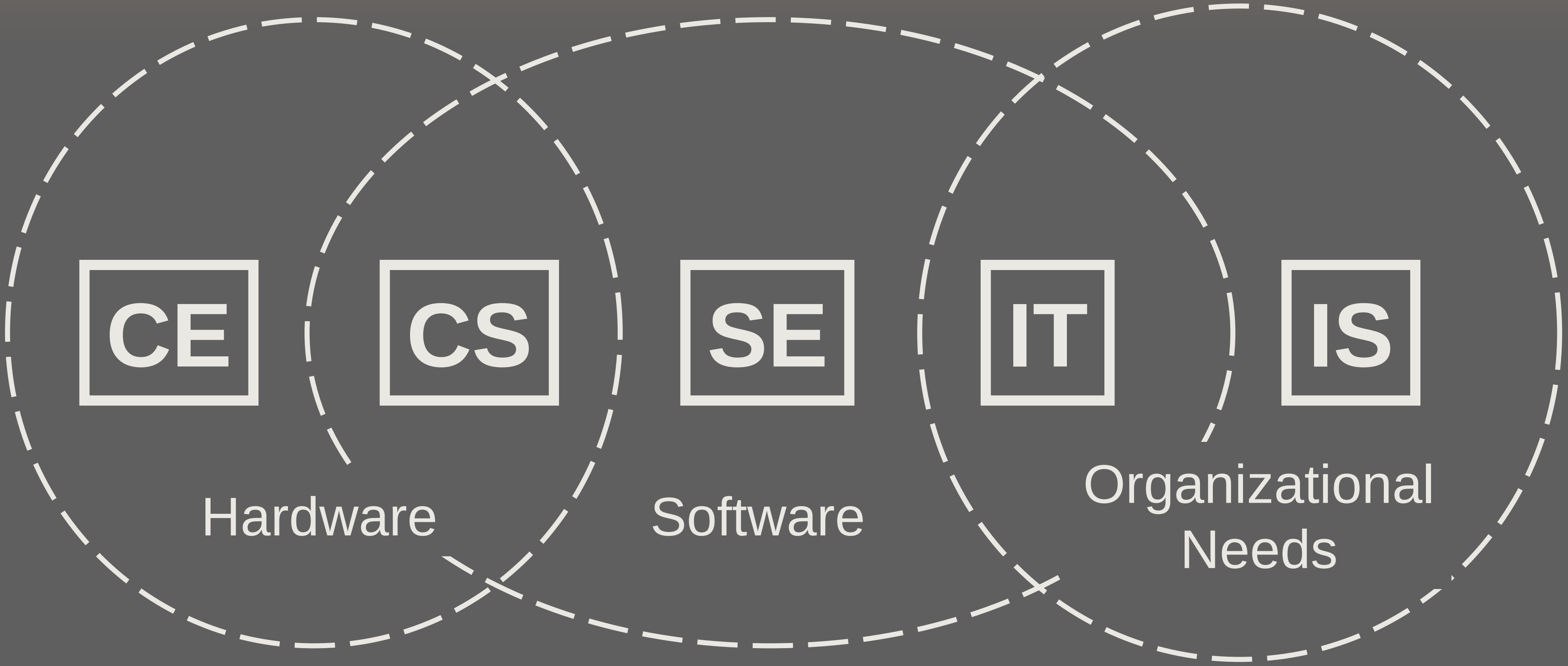
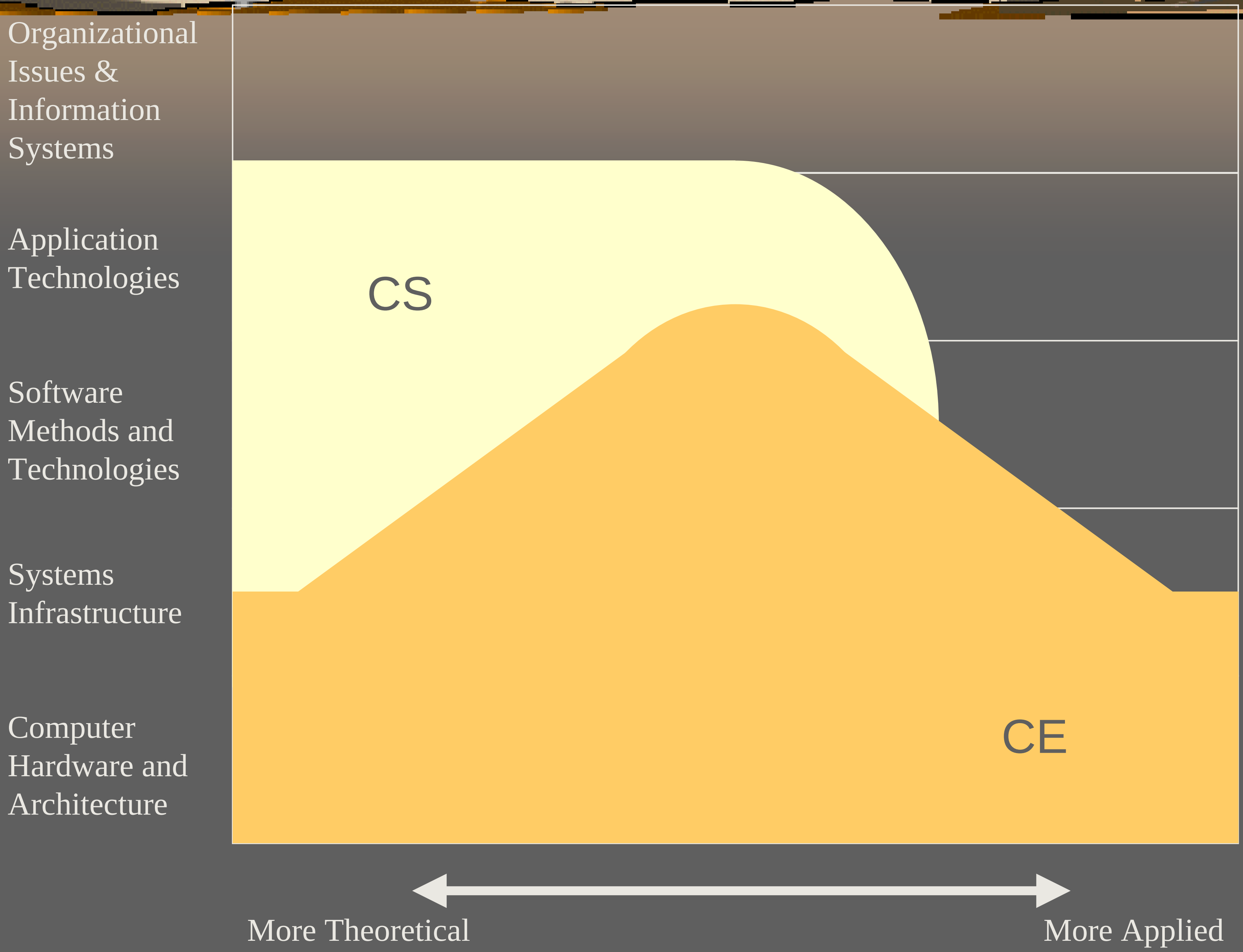
CE, CS, SE, IT, and IS

- Computing Curricula 2005: The Overview Report
  - Joint project of ACM, IEEE-CS, AIS
- Five Computing Disciplines Today:
  - Computer Engineering
  - Computer Science
  - Software Engineering
  - Information Technology
  - Information Systems

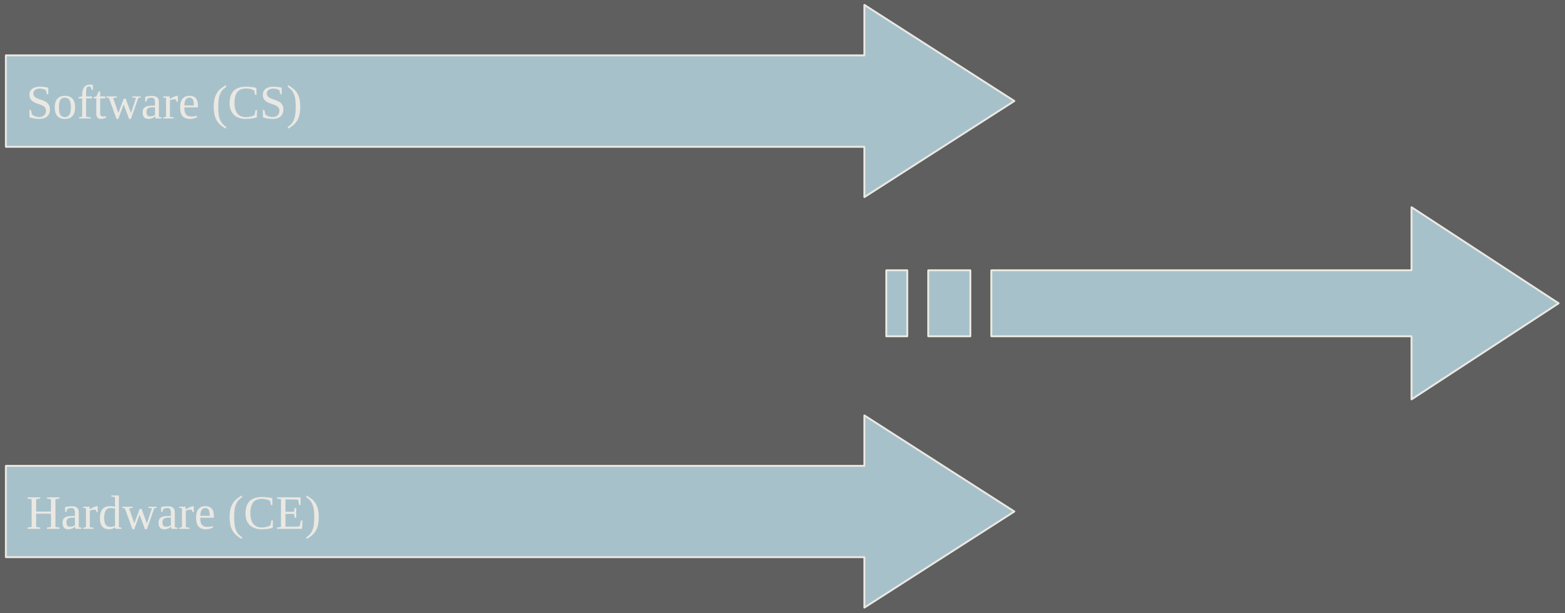


From CC2005 Final Report
Figure 2.1


Organizational Issues & Information Systems
Application Technologies
Software Methods and Technologies
Systems Infrastructure
Computer Hardware and Architecture
CS
CE
More Theoretical
More Applied

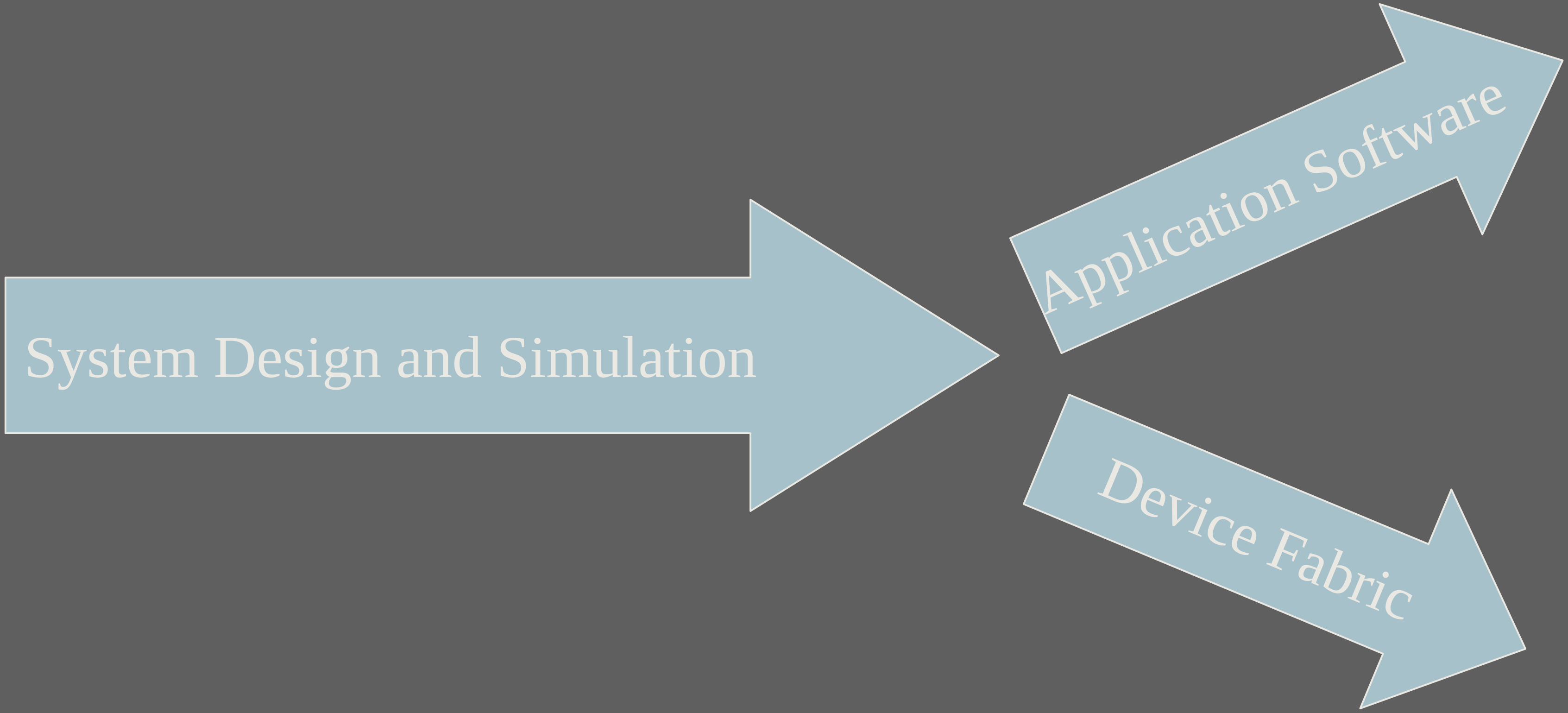
From CC2005 Final Report Figures 2.3 and 2.4

Traditional Co-Design


Software (CS)

Hardware (CE)

Software-Driven Design



System Design and Simulation

Application Software

Device Fabric

Goal: Introduce CS Students to Software-Driven System Design

- Build on existing software skills
- Develop capabilities working with:
  - Clocking
  - Real parallelism
  - Data types
  - I/O control

Laboratory Vehicle Choices

- Schematic capture and simulation
- FPGA-based prototyping boards
  - Large range of capabilities and costs
- FPGA vendor toolchains
  - Tradeoffs between power and complexity
- System Implementation Languages
  - Availability evolving

Computer Science at Queens College

- CS240 Assembly language and logic design
  - CircuitMaker (Software simulation only.)
- CS343 Computer Architecture
  - Altera UP[23] boards
  - Quartus BDF/Verilog
- CS345Hardware Laboratory
  - Celoxica RC200E boards
  - DK Integrated Development Environment

Hardware Laboratory

- RC200E Features
  - LEDs, Buttons, Seven-Segment Displays, Touchscreen, RAM, Audio, Video, Ethernet, …
  - Cost of a laptop
- DK Software Environment
  - Handel-C (CSP, Occam heritage)
  - Platform Abstraction Layer, with Simulation
  - Waveform Analyzer
  - Generates EDIF for vendor toolchain processing

DK Layers

- Platform Abstraction Layer
  - Library of Generic Devices (LED, Video …)
- Platform Support Layer
  - Provides interface to PAL for specific boards
- Pin I/O

Handel-C

- Macros
  - GCC *cpp*
  - macro proc
  - macro expr
- Statement-level clocking
- *par* blocks
  - *Loop unrolling*
  - *Runtime parallelism*
- CSP for thread synchronization (? !)
- Weird syntax for I/O

Student Assignments

- Moving average pipeline
- Sequence:
  - Keyboard to Seven-Segment Displays
  - Draw seven-segment displays on screen
  - Build framebuffer
- Servomotor controller
- UART

Student Projects

- What works?
  - Implement textbook CPU
  - Touchscreen video games
  - Voice/Video over Ethernet
- What doesn’t work?
  - Algorithms tied to dynamic data streams (Ogg Vorbis)

Conclusions

- CS Students *can* do hardware design.
- Not all are interested in it.
- Those who are find it highly stimulating and rewarding.
- Still learning how to do it.