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Electronics Education Today

NetWorks is an NSF-funded ATE Resource Center supporting faculty in Semiconductor, Automated Manufacturing, and Electronics education

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National Science Foundation

Funded, in part, by a grant from the National Science Foundation.
DUE-0501626

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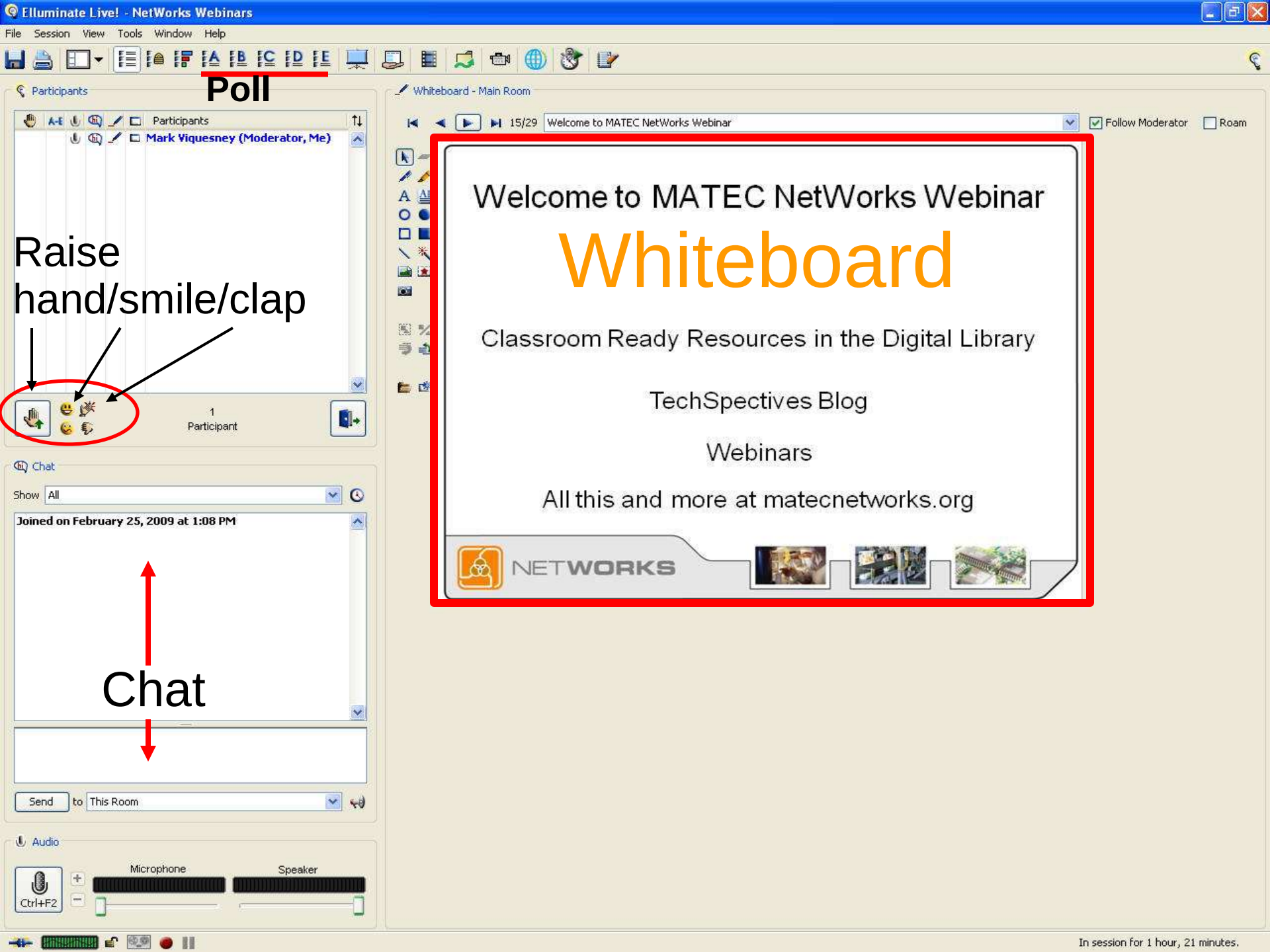
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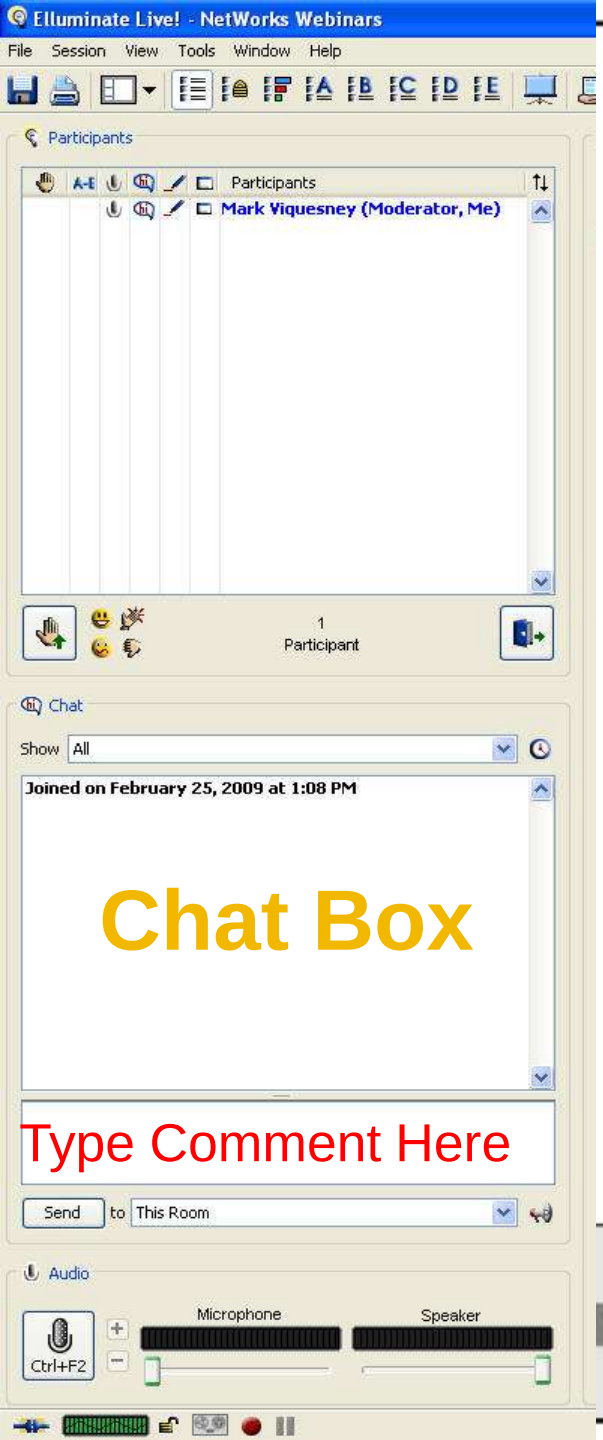
In session for 1 hour, 21 minutes.



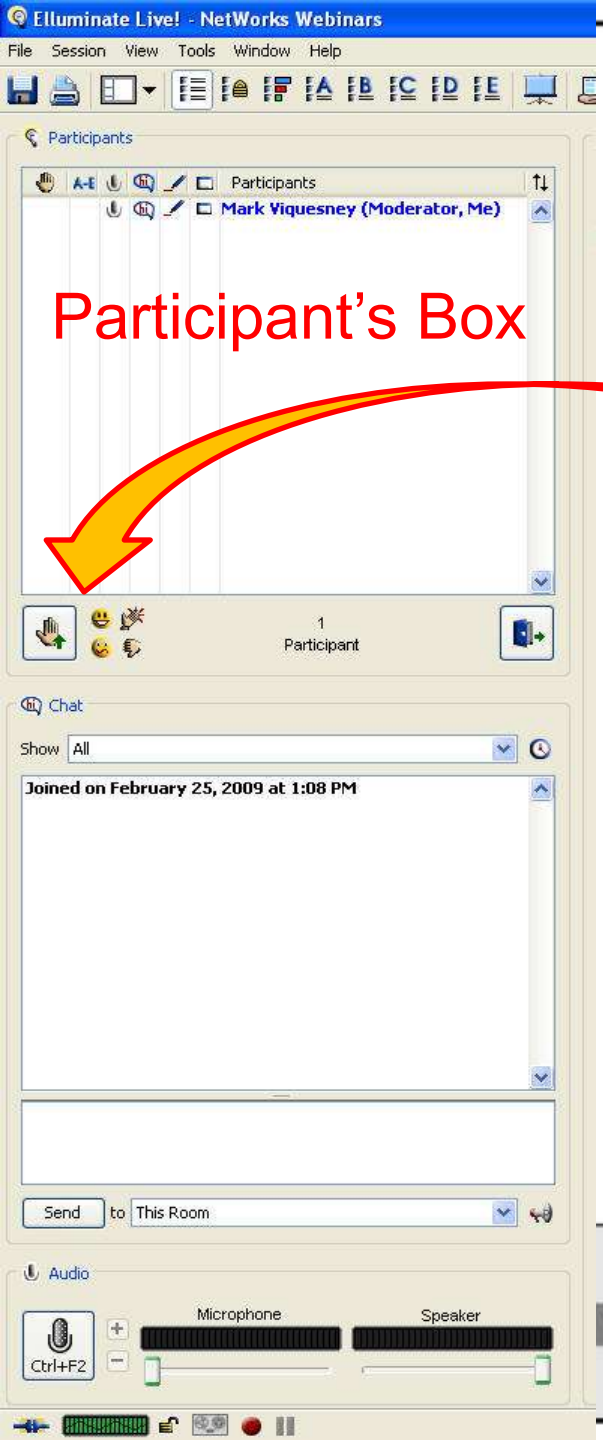
Chat Box

In the **Chat Box**,
please type the name of
your school or organization,
your location,
and how many people are
attending with you today.

Participant's Box

Allows you to non-verbally respond to the presenter's comments.

Participant's Box



Let the presenter know if you like what they say with a smile or clap. Raise a hand if you have a question – and then type it into the chat box.

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Click A-E to take the Poll

This webinar will have a Poll. Please answer:
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E. Other (please type where in chat box)



NetWorks Webinar Presenters

Louis Frenzel
Editor
Electronic Design Magazine

Kevin Gullivar
Nida President

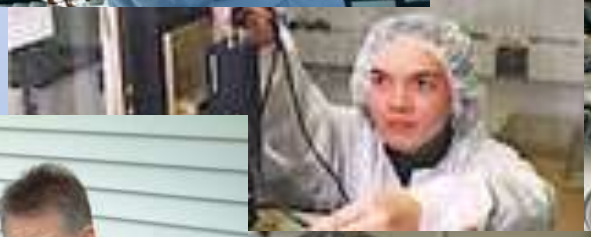
Shekhar Sharad
Group Manager
Academic Products
National Instruments

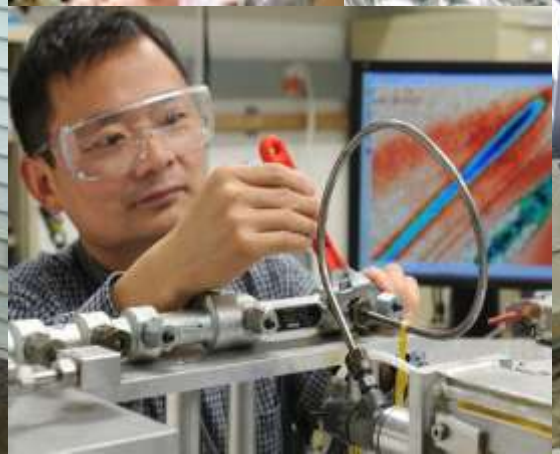
Tom McGlew
eSyst Project Manager

Mark Viquesney
Host

Why Systems Troubleshooting?






We Know Technicians

Technical Fields Supported by Nida
Aerospace Engineering Technicians
Aircraft Technicians (A&P, AME, AET)
Automotive Service Techs (electrical, electronics, systems)
Avionics Technicians (Shop & Line)
Biomedical Equipment Repair Techs
Electrical & Electronic Engineering Technicians
HVAC
Maintenance & Repair (buildings, factories, energy)
Telecommunications Equipment Repair (non-line)
Military Technicians (> 50k/year)

Nida Research Summit

- Industry
- Military
- Educators

Nida Research Summit

- Industry
  - Energy, Transportation, Manufacturing, Distribution, Aerospace
- Military
  - Air Force, Army, Navy
- Education
  - Technical Universities, Polytechnics, Secondary Education

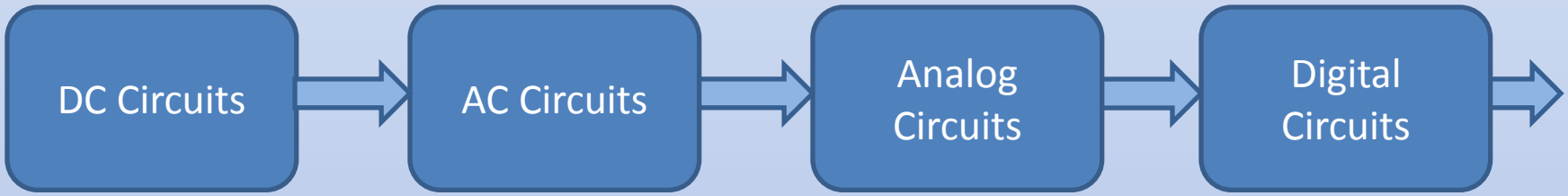
Industry Concerns

- Tech Performance Unknown When Hiring
- Troubleshooting Skills Deficient
- No Fault Found (NFF) Rates

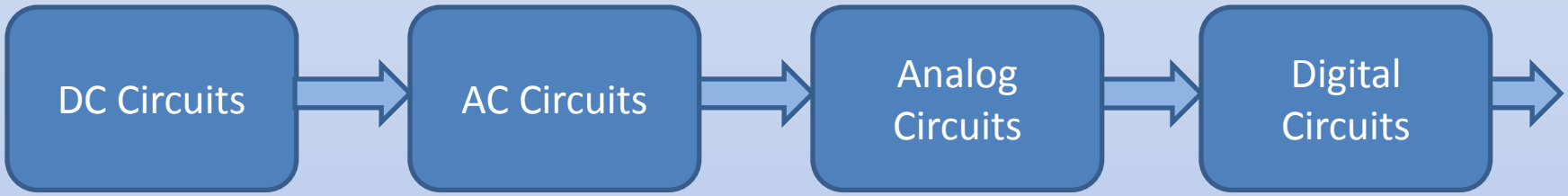
Summit Recommendations

- Troubleshoot to the LRU v. Component Level
- Understand how to use Block Diagrams
- Understand what the TE is reporting
- Develop a Systems Thinking Approach to Troubleshooting
- Performance-Based Certifications

Training Methodology– Status Quo

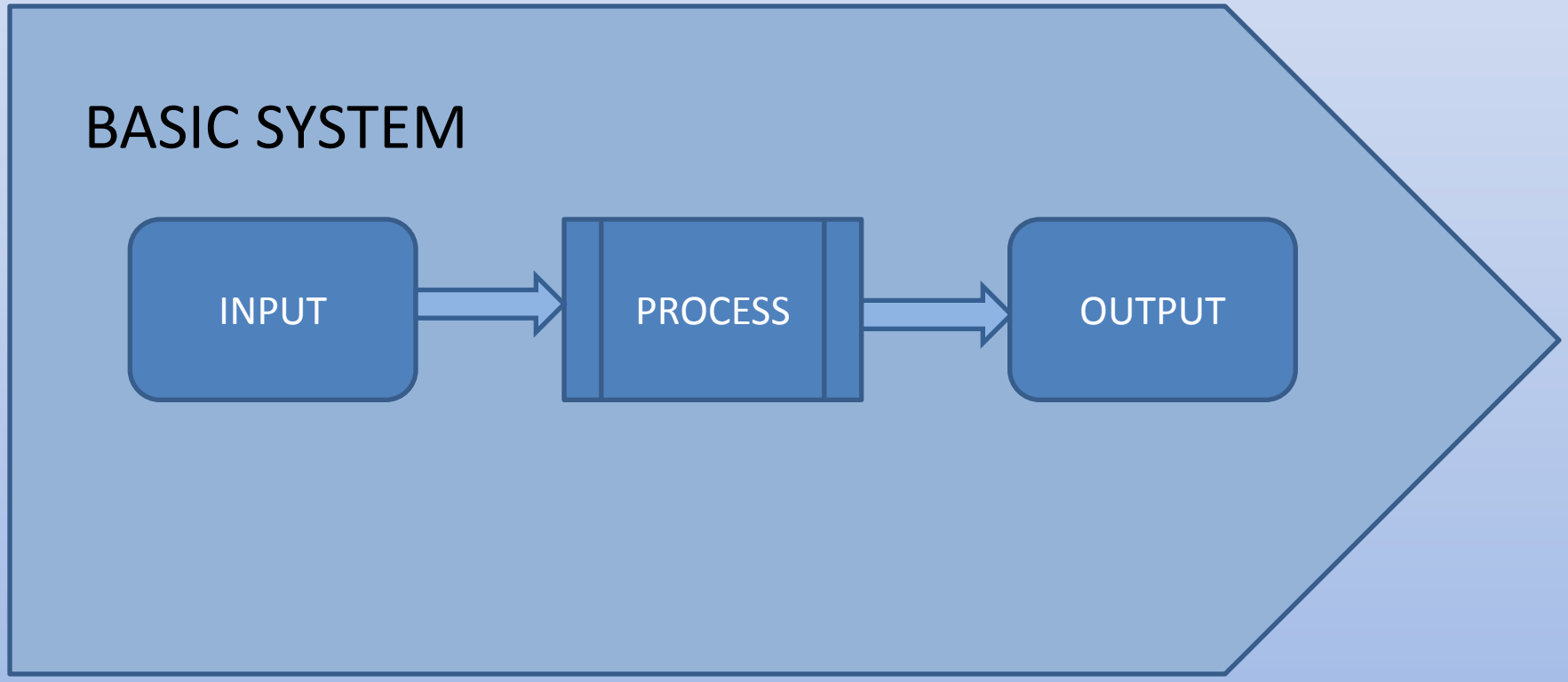


Training Methodology– Status Quo

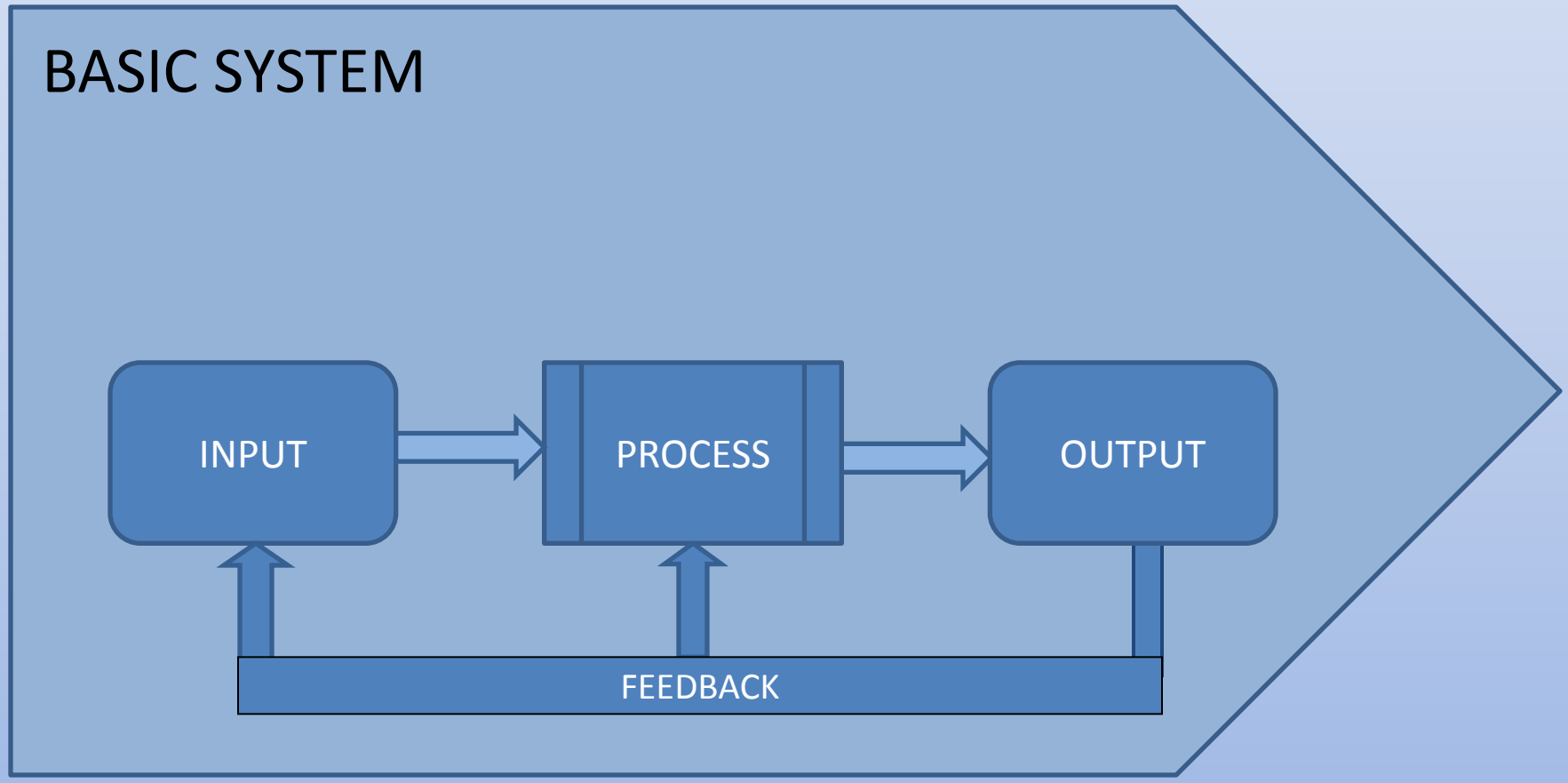


No Application to the Student's World

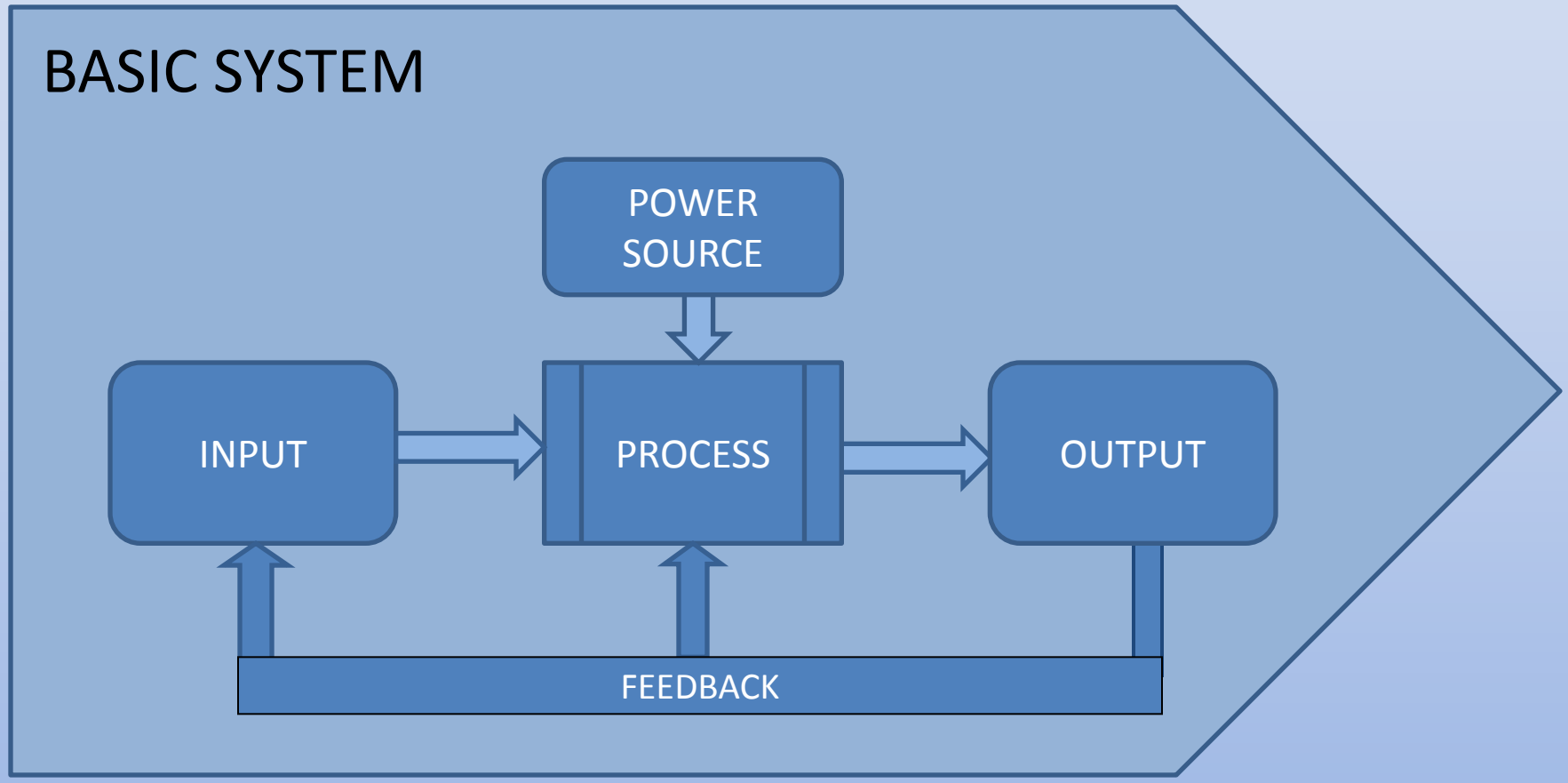
Systems Approach



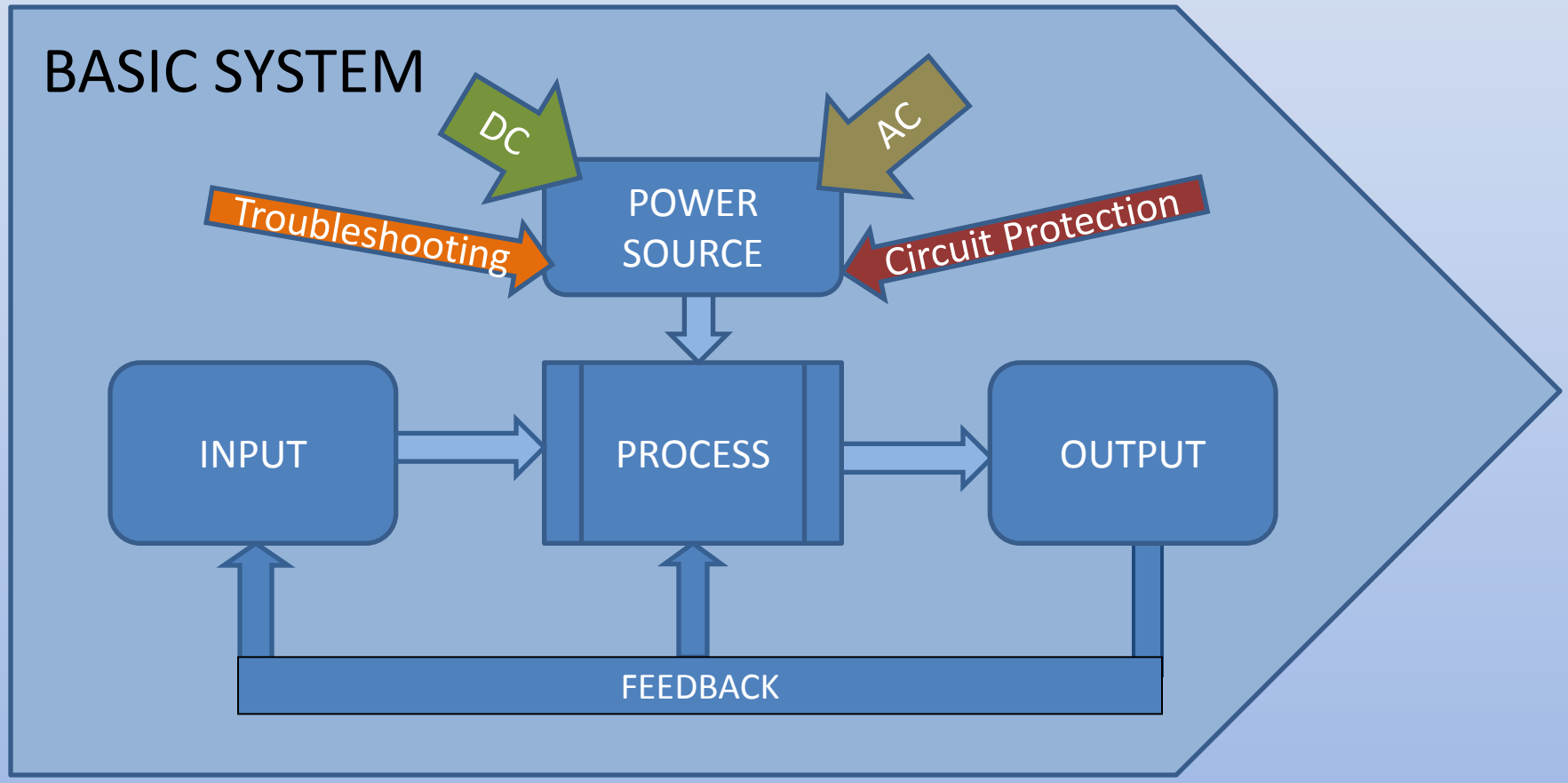
Systems Approach



Systems Approach



Systems Approach



Basic Electrical & Electronics

Ω

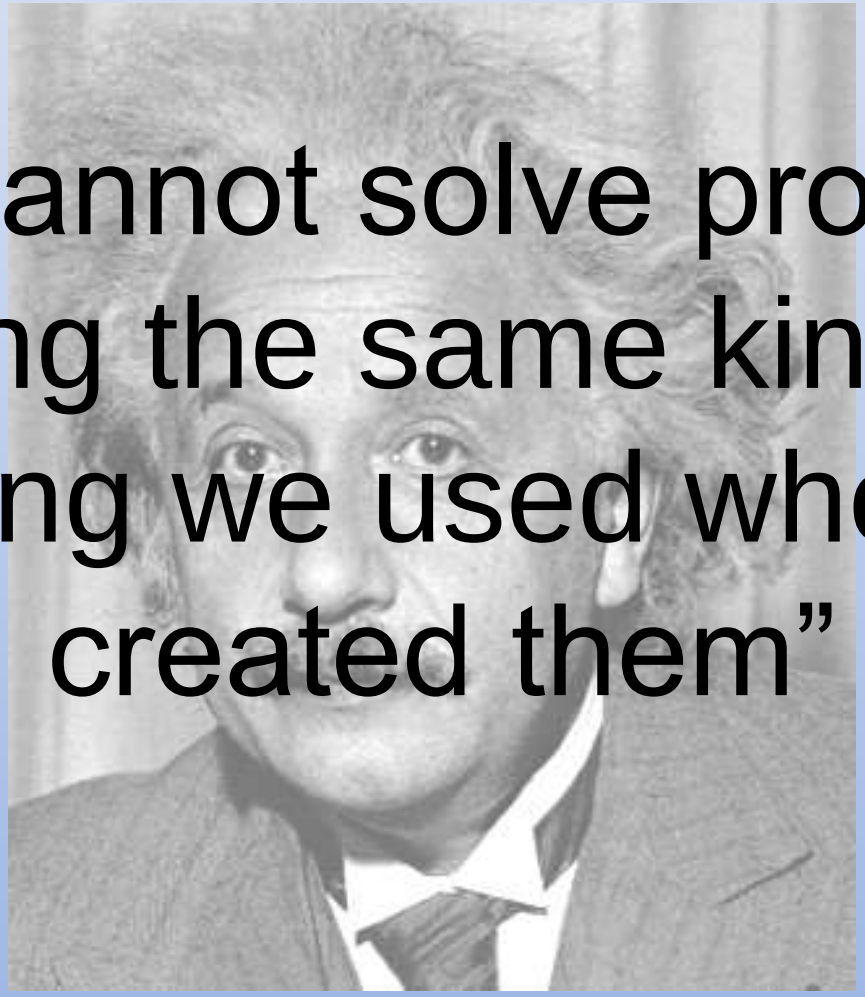
$V = IR$

Advanced Systems Training

Cross-Disciplines

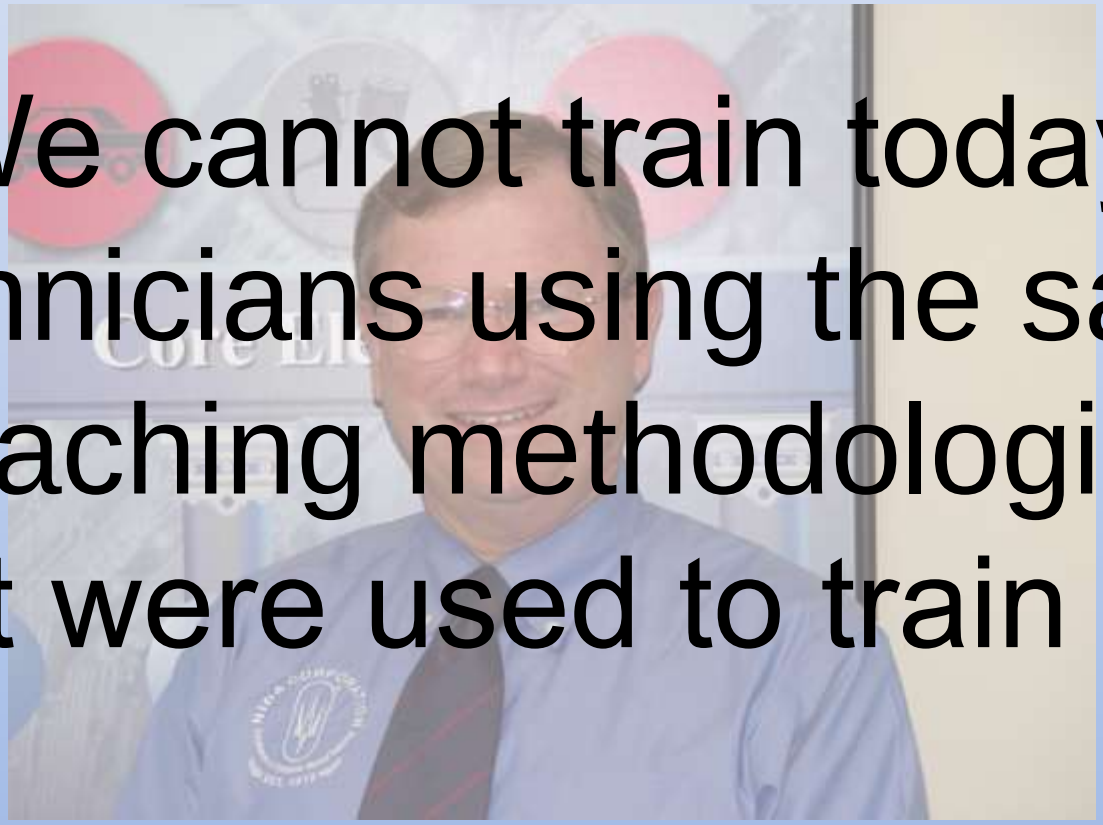
Occupation Installation/Maintenance/Repair	2018 Projection	Growth	Today's Median Salary
Aircraft Technicians (A&P)	129,300	6%	$51k
Avionics Technicians (Shop & Line)	20,800	11%	$56k
Automotive Service Tech (non-body)	600,000	5%	$35k
Biomedical Equipment Repair	53,000	27%	$42k
HVAC	395,000	28%	$40k
Maintenance & Repair (building & factory)	1,500,000	11%	$35k
Telecommunications Equipment (non-line)	203,000	-0-	$56k

Source: 2010 BLS



"We cannot solve problems using the same kind of thinking we used when we created them"

Albert Einstein



"We cannot train today's technicians using the same teaching methodologies that were used to train us."

P. Kevin Gulliver

Nida Corporation

Systems Thinking…
The logical approach to technical training

Type them in your chat window

Doing Engineering to Understand Electronic Systems

Shekhar Sharad

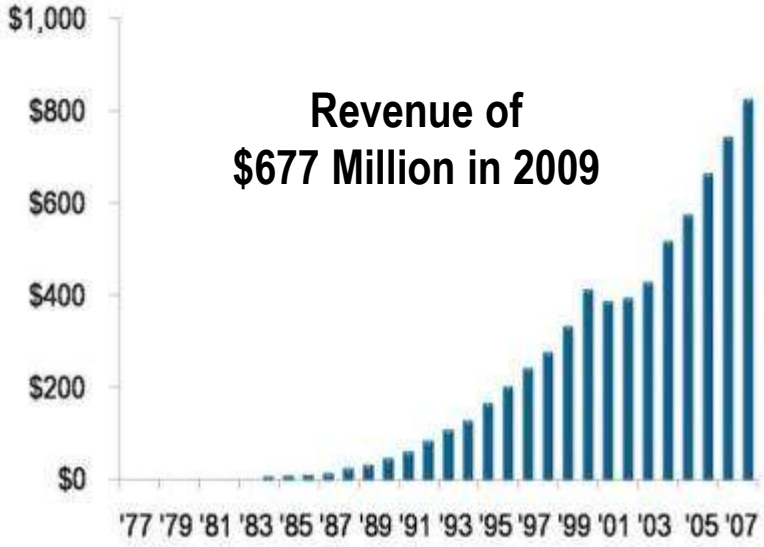
Group Manager - Academic Products

National Instruments

Corporate Background

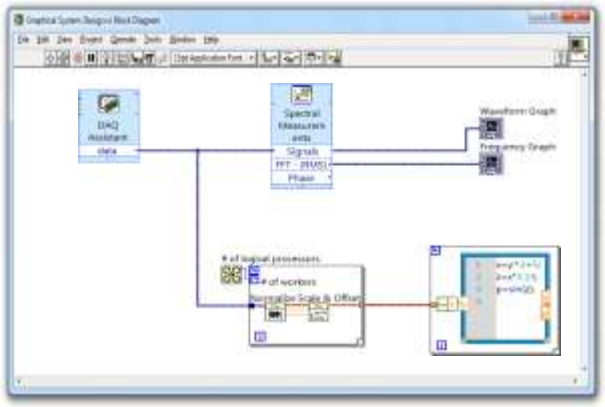
- Leaders for 30 years in Computer-Based Measurement and Automation
- Direct Operations in 40+ Countries
- 5,000+ Employees
- R&D Investment: 16% of Annual Income
- Corporate Headquarters in Austin, Texas
- 600+ Alliance Partners
- Long History of Financial Success

FORTUNE 100 BEST COMPANIES TO WORK FOR 11 YEARS



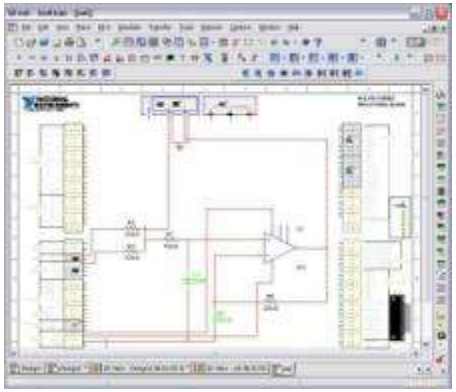
Revenue of $677 Million in 2009

Delivering Industry Grade Products for Academia



LabVIEW

Used by over 25000 Industries worldwide



NI Multisim

Leading SPICE Simulation Software

NI ELVIS

12 Instruments, DAQ

NI myDAQ

Student Owned DAQ & Instrumentation

The #1 Issue Graduating Engineers Face

The #1 Issue Graduating Engineers Face

CD+RW

Navigation

Cellular Phone

PC/Internet/ Email

Automotive Telematics

Display Technologies

Games

DVD+RW

Satellite Car Alarm / Radio

Remote Diagnostics

MP3 / AM / FM / HD Stereo

The #1 Issue Graduating Engineers Face

CD+RW

Navigation

Cellular Phone

PC/Internet/ Email

Smart Phones

Display Technologies

Games

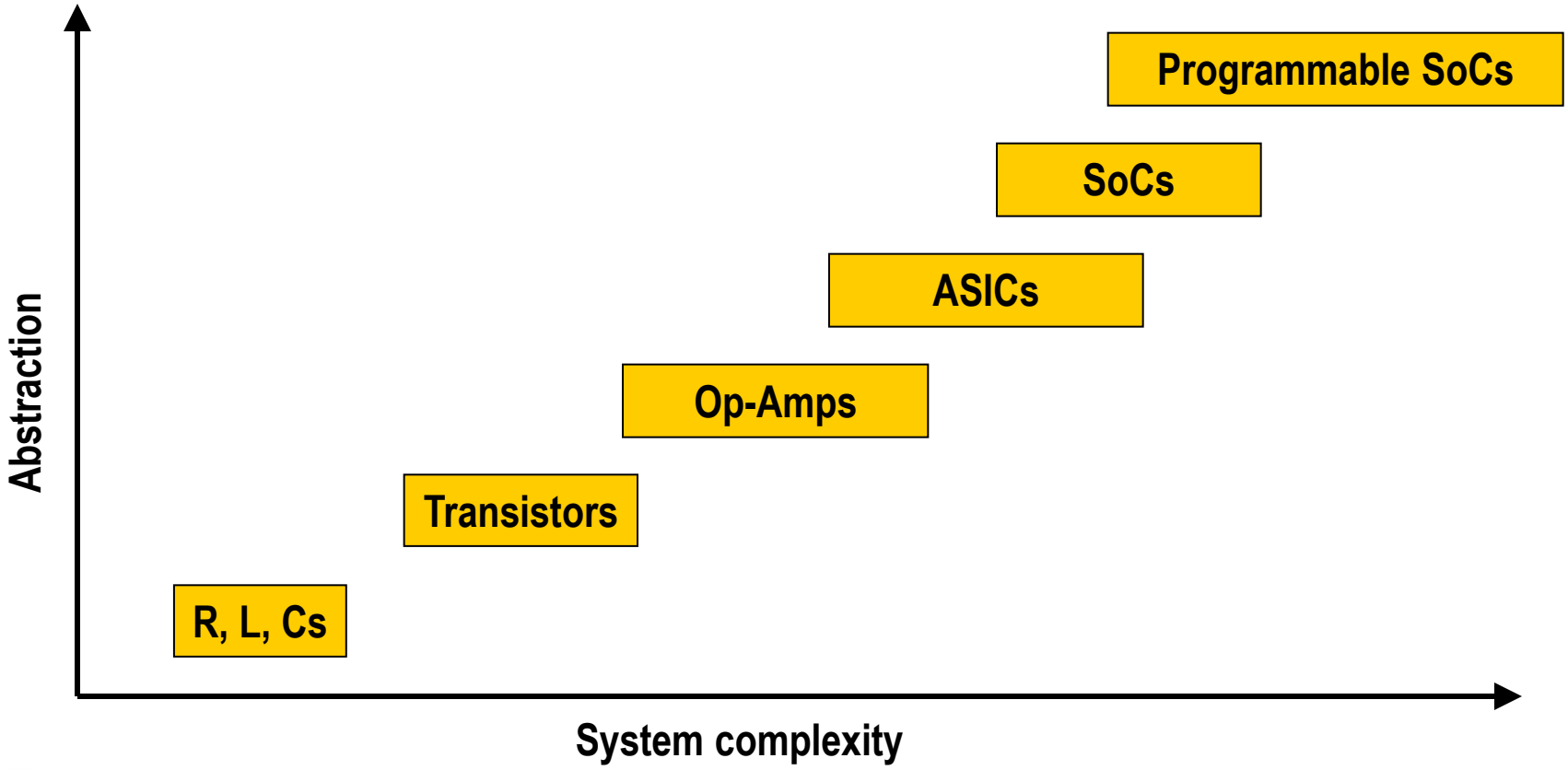
DVD+RW

Satellite Car Alarm / Radio

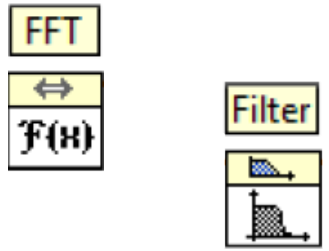
Remote Diagnostics

MP3 / AM / FM / HD Stereo

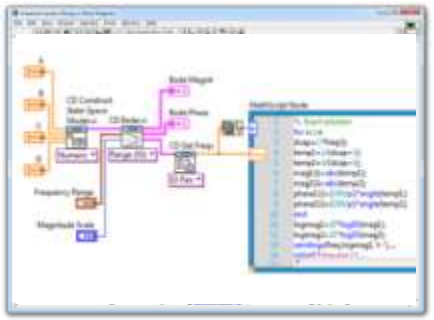
Industry Trend : Higher Level of Abstraction



Elements of an Engineering System

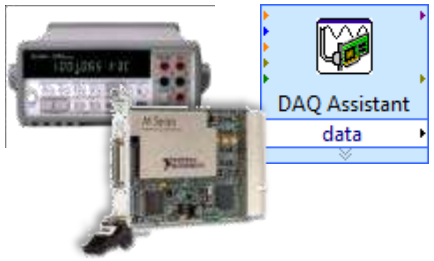


Analysis Libraries

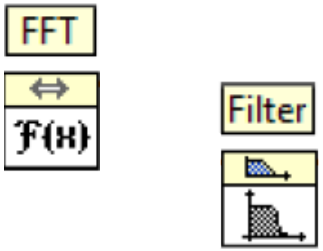


Programming Approaches

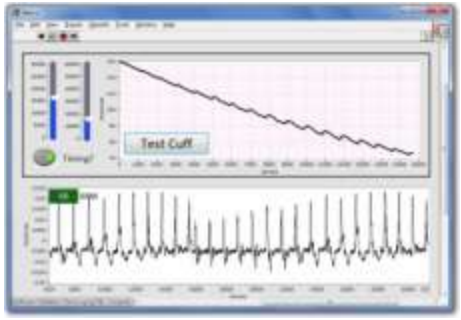
Elements of an Engineering System



Hardware APIs

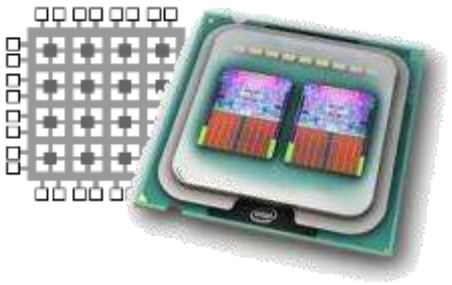


Analysis Libraries

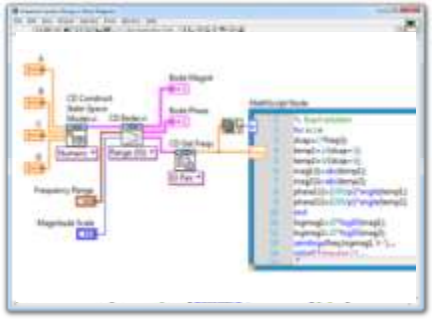


Custom User Interfaces

Deployment Targets



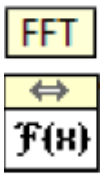
Technology Abstractions



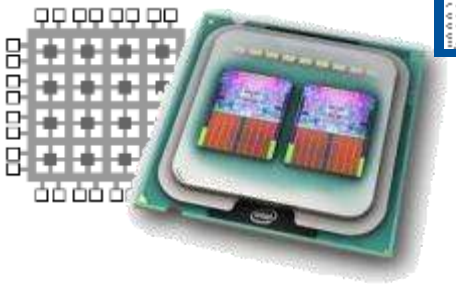
Programming Approaches

Elements of an Engineering System

Hardware APIs



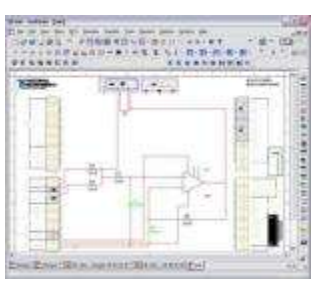
Analysis Libra

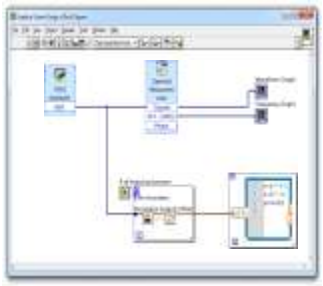


Technology Abstractions

Programming Approaches

Teaching Systems to New Students





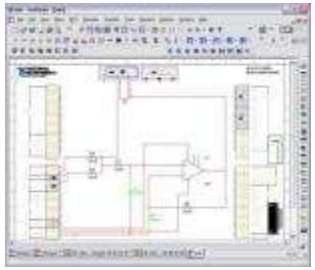
SPICE Simulation
and
Graphical Programming Software

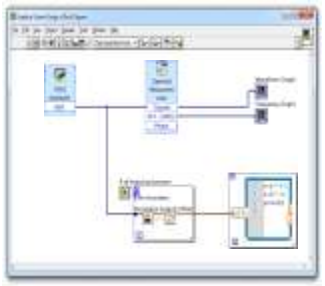
?

System to Explore
& Learn from

Instrumentation
&
Data Acquisition

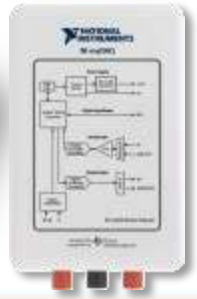
Teaching Systems to New Students





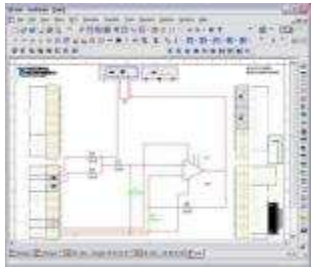
SPICE Simulation
and
Graphical Programming Software

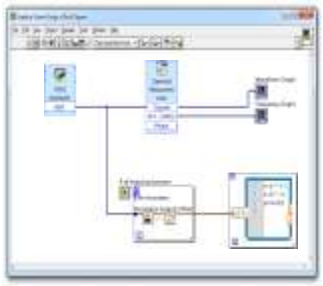
System to Explore
& Learn from



Instrumentation
&
Data Acquisition

Teaching Systems to New Students





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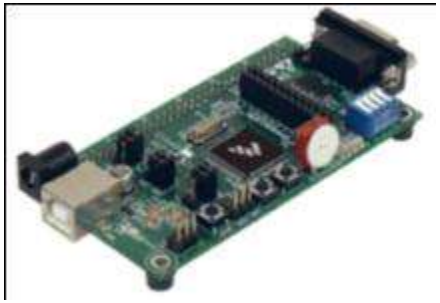

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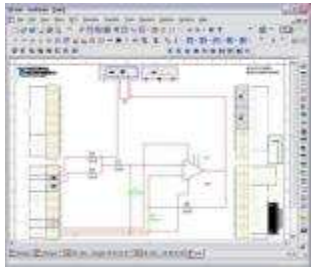

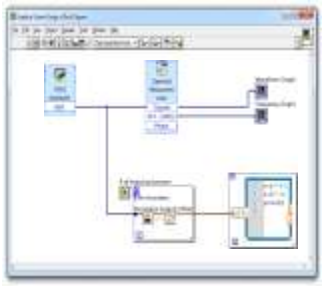

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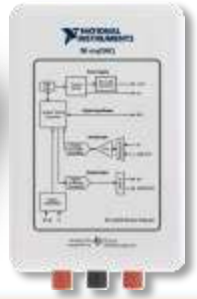


Instrumentation
&
Data Acquisition

Interfacing the Real World

Sensors

Temperature

Strain

Acceleration

Sound

Actuators

DC Motor Control*

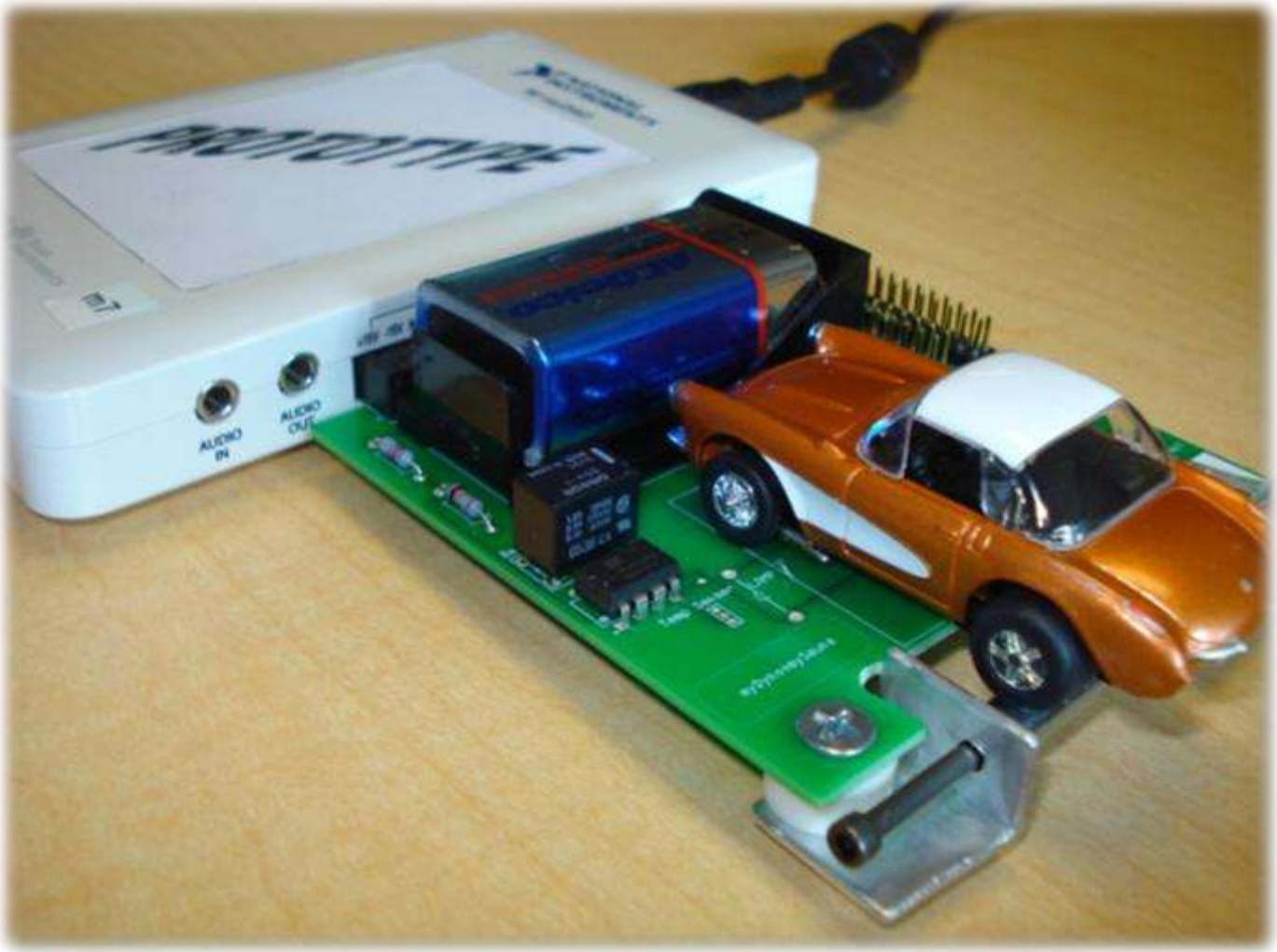
Micro Relays*

LEDs

And more…

*Driving high current requires an external DC power source and transistor circuit.

Creating “Space-effective” Small Systems



Endless Possibilities…

Breadboarding Circuits

Signal Processing & Analysis

Custom PCBs
& Signal Conditioning

Low Cost Small Systems

Our End Goal

Students need to be able to Do Engineering to understand systems anytime, anywhere

Type them in your chat window

Industry Trends Affecting Instruction and Curriculum

Louis E. Frenzel Jr.
Technology Editor
Electronic Design Magazine
Penton Media Inc.

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Is your curriculum right for today?

- Are you competently teaching yesterday's technology?
- Are you including the latest products and technologies in your courses today?
- Are you giving employers what they REALLY want in a graduate today?
- Are your graduates properly prepared for their jobs or future jobs?
- Your answers will influence the success of your program.

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Technological Trends That Affect What You Teach & How

- Focus on electronics.
- Implications for all technologies.
- Emphasis on technician level AAS degree programs.
- Direct industry input.

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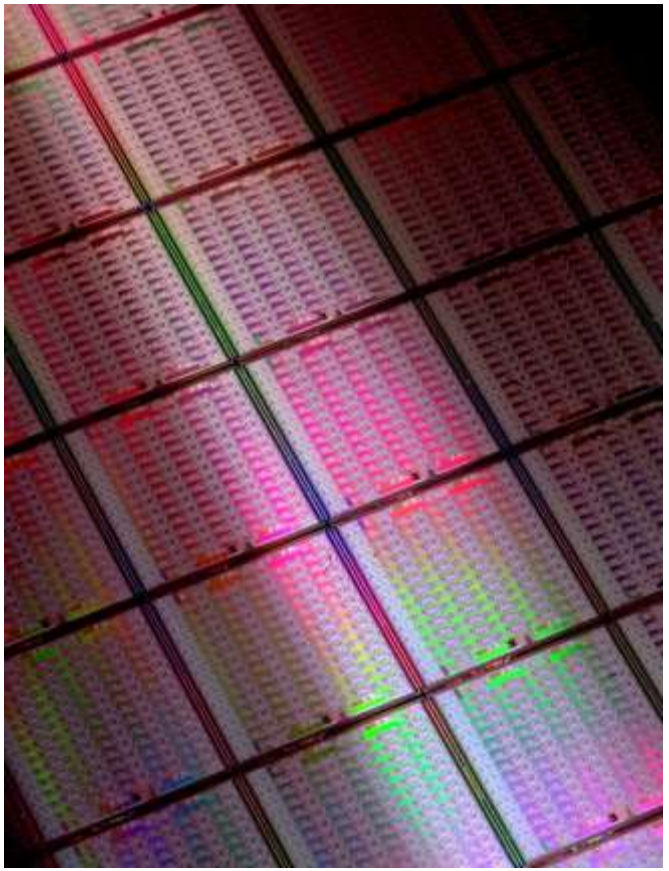
The Major Electronic Trends

- Larger integrated circuits, the SoC.
- Greater product/system complexity.
- Standards driven.
- The digital generation.
- Micro-based everything.
- Software dominance.
- Growth in consumer electronics.



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The Major Electronic Trends (continued)

- The impact of the “green” energy movement. Smart Grid.
- Massive growth in communications. (Everything is networked. Wireless everywhere.)
- Less manufacturing.
- The replace vs. repair era. (An economic thing.)
- Fewer technicians, different tech jobs.
- Greater emphasis on the big picture and the system.

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Other Trends

- Students are not prepared for college.
- Students are super-savvy when it comes to tech products.
- Many prospects not interested in technology.
- Recent election results are expected to be positive for business and technology.

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What industry expects from an AAS graduate.

- Strong grounding in fundamentals and basics.
  - Just what are the essential basics?
  - What fundamentals are essential?
- Knowledge of modern circuits and technology.
  - Integrated circuits.
  - Standards.

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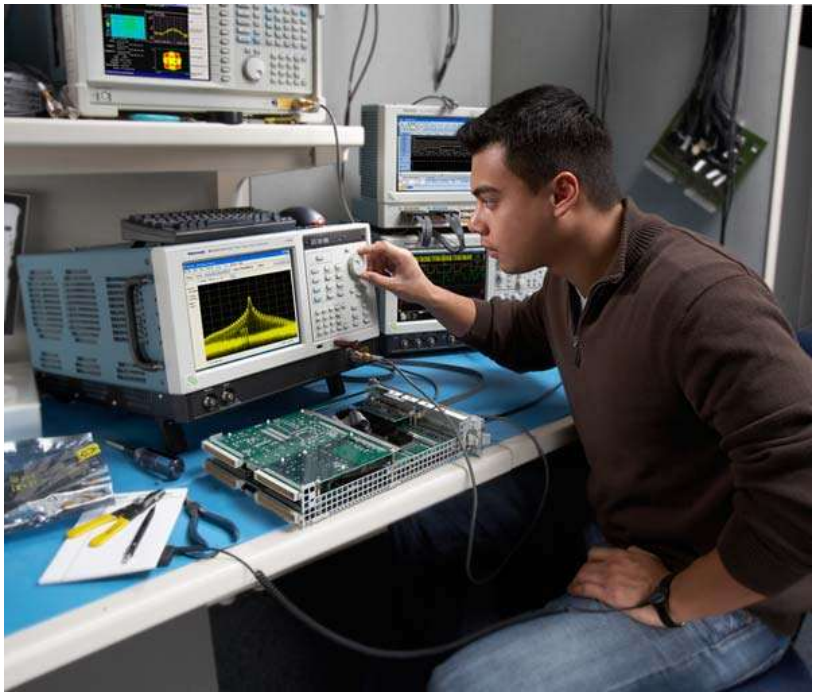
What industry expects from an AAS graduate. (continued)

- A big picture view. Systems level thinking. Less component emphasis.
- Good PC and software skills.
- Knowledge of modern test equipment and measuring methods.
- Strong troubleshooting and problem solving skills.
- Communications skills. (Writing, speaking, etc.)



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How to bring your program in line with the trends.

- When was your program first developed and implemented?
- Is your enrollment growing or shrinking?
- Assess your curriculum against the trends.
- Evaluate each course with reference to the trends.
- Get input from local employers.
- Foster faculty support.
- Change ASAP.

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Assess your curriculum.

- Is it generic?
- Are specialties or “majors” offered?
- Is it engineering oriented or for techs?
- Are all the “right” technologies or skills being taught?
- When was the last time changes were made?
- What new specializations are you offering?
- Is there resistance to change?

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Evaluate each course.

- Given that it is difficult/near impossible to delete/add courses, all you can do it revise the courses.
- Look at each course to see that the correct fundamentals are present.
- Add new technology where appropriate.
- Create and add new courses if needed.

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Examine all content for relevance.

- Using the course syllabus, outline and objectives, evaluate each topic to decide whether to retain, omit or modify (+/-) coverage.
- Will graduates use the knowledge?
- Does an employer desire that knowledge?
- Determine level of coverage. See table.

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The Frenzel Formula for Depth of Knowledge

Level	Explanation
No knowledge	Ignorant of topic.
Awareness	Has heard of topic. Buzz words, jargon.
Limited familiarity	Vocabulary, basic understanding.
Detailed knowledge.	Knows theory, background.
Functional knowledge	Can apply the knowledge.
Expert	Can teach or write texts.
Guru	Can research, innovate, originate.

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Other methods of bringing a course into the 21st century.

- Add more applications that show practical uses to garner interest.
- Introduce more troubleshooting and test/measurement content.
- Introduce more advanced subjects earlier.
- Add coverage of relevant systems to each course.

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Adopt the Systems Approach

- Researched and developed at Maricopa Advanced Technology Education Center (MATEC) in Phoenix.
- NSF 3-year grant.
- Industry input and college tested.
- Materials available. www.esyst.org
- Works with existing curriculum.

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Systems approach modifies each existing course.

- A gradual and simplified update with minimal effect on curriculum.
- General pattern:
  - Removes unnecessary material.
  - Reduces coverage in some areas.
- Adds updated topics and new technologies.
- Infuses systems examples.
- Adds troubleshooting.

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Electronic course examples.

- DC Circuits
  - Removes advanced circuit analysis like mesh/nodal analysis, Norton, etc.
  - Adds systems examples (solar).
- AC Circuits
  - Eliminates advanced circuit analysis.
  - Uses more higher frequency examples.
  - Adds systems examples (AC distribution, cabling, etc.)

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Electronic course examples (continued)

- Solid State Circuits
  - Increased emphasis on MOSFETs.
  - Less BJT coverage.
  - Less circuits analysis and design.
  - Increased coverage of SMPS.
  - Increased coverage of ICs.
  - System examples.
  - Troubleshooting.

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Electronic course examples (continued)

- Digital
  - Less coverage of TTL and design.
  - Emphasis on FPGAs.
  - Introduction to microcontrollers.
  - I/O interfaces.
  - Troubleshooting.
- Microcontrollers
  - Introduction to 16/32-bit processors.
  - Multi-cores
  - Introduction to DSP.
  - Strong emphasis on interfacing.

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Recommended course additions.

- Communications
  - Wireless principles.
  - Wireless practices including transmission lines and antennas.
  - Cellular technologies.
  - Networking (Ethernet)
  - Introduction to the Internet (TCP/IP)

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Recommended course additions.

- Data Acquisition & Measurement
  - AD/DA principles.
  - Applications examples of DAQ.
  - Virtual instrumentation and LabVIEW.

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In summary…..

- Technicians do not analyze and design.
- Technicians troubleshoot, repair, install, maintain, operate, test and measure.
- Just because it is in the textbook doesn’t mean you have to teach it. Verify relevance.
- Every year you do not update puts you even further behind.
- By the time your students graduate there will be even further technological change and even new jobs.
- Revision and updating must be perpetual.

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What I worry about.

- Lack of change in the colleges.
- Knowledge of the faculty. Where is the continuing education?
- The textbook issues.
- Laboratory obsolescence and costs.
- The cost of education.

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Some things to do.

- Initiate an in-depth review of your programs.
- Get more industry input.
- Support continuing education for faculty.
  - Magazines
  - Conferences
  - Seminars
- Consider online programs.
- Add a new major or specialization.
- Consider a capstone course.

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References

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- MATEC www.matec.org
  - Esyst www.esyst.org
  - WRE www.work-readyelectronics.org

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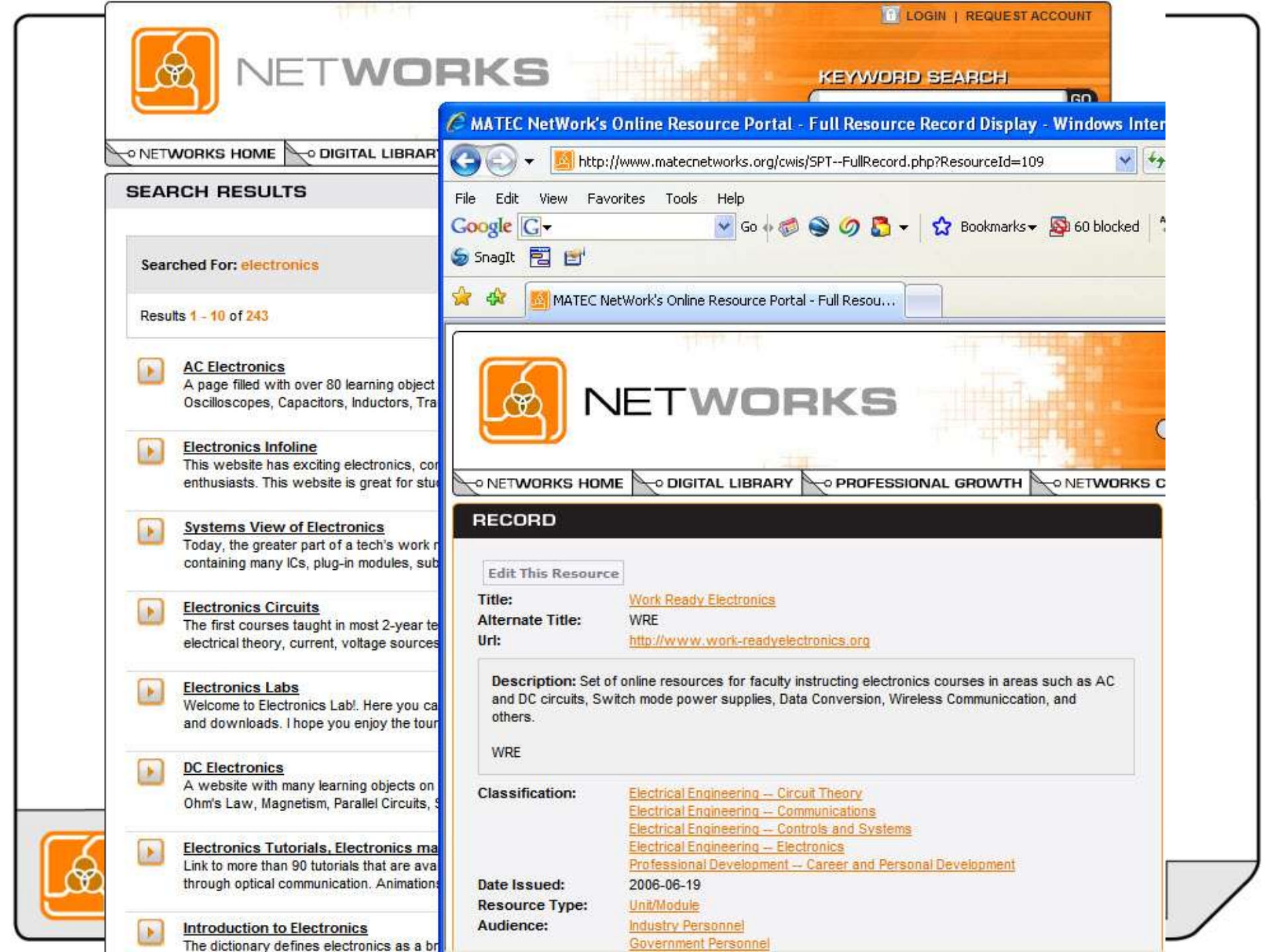
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