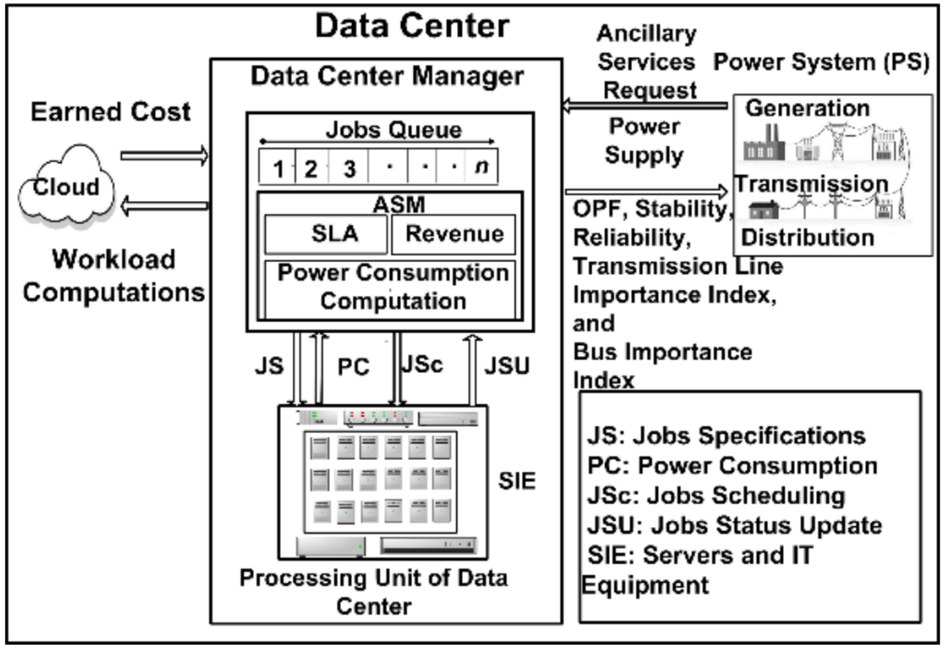
# Digital Systems and Microelectronics Emphasis Area

| Professor | Classes | Research Interests |
|---|---|---|
| Dr. Bryan A. Jones | Senior design | Literate programming, writing to learn to program, embedded systems |
| Dr. Jean Mohammadi-Aragh | Intro to ECE design I & II | First-year experiences, writing to learn to program, learning analytics, educational 3D viz |
| Dr. Yaroslav Koshka | Nanoelectronics, Intro to quantum computing,<br>Solid state electronics | Quantum computing, Nanoelectronics |
| Dr. Chaomin Luo | Computer architecture | Robotics, control systems, computational intelligence, embedded systems |
| Dr. Yu Luo | Microprocessors | Sustainable wireless networks, cyber-physical systems (CPS), internet of things (IoT), and underwater cognitive acoustic communications |
| Dr. Samee Khan | | Cloud computing, data centers |

# Recommended Courses

- ECE6273 - Microelectronics Device Design
- ECE6713 - Computer Architecture
- ECE6723 - Embedded Systems
- ECE6743 - Digital System Design
- ECE6833 - Digital Communications Networks
- ECE6990-02 - RF Circuit Design
- ECE6990-04 – Introduction to Nanoelectronics
- ECE8990-03 - Wireless Communications
- ECE8990-05 - Asynchronous Design
- Other recommended courses: Digital Controls, Digital Signal Processing, Software Engineering, Power Electronic




# Research on Cloud Computing & Data Centers

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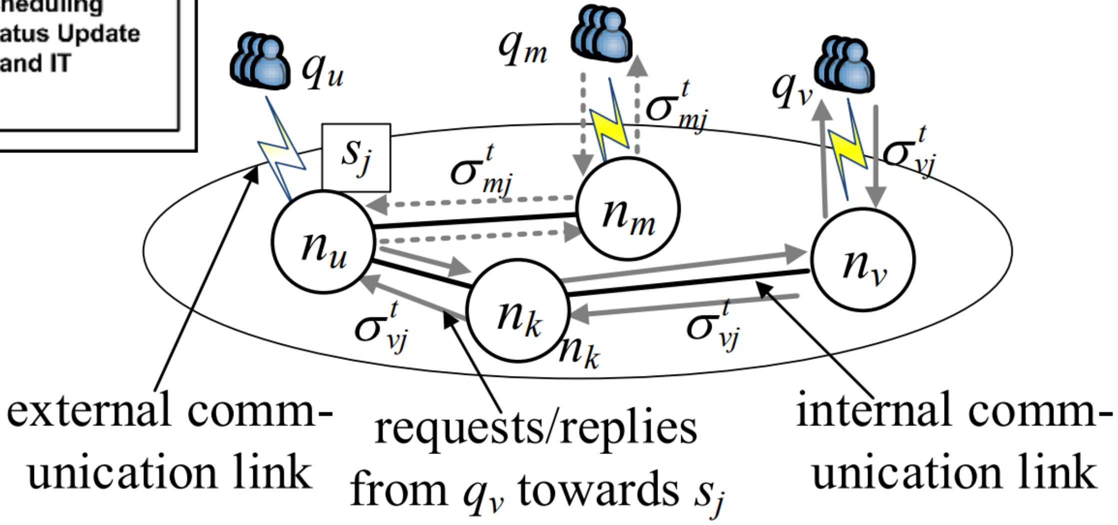

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# CodeChat: MS Word for developers

**What do you believe about your code?**

“Now faith is confidence in what we hope for and assurance about what we do not see.” – Hebrews 11:1

What you believe about your code changes the way you create it.

- Experience drives belief.
- Test-driven design is better.
- A program is a document.

https://barrowmediacenter.files.wordpress.com/2015/08/mirandus-1.jpg

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File Edit Selection View Go Run Terminal Help    wscript.py - all (Workspace) - Visual Studio Code

xc16_as.py | asm.py | wscript.py | CodeChat

pic24_asm_to_c > _sources > build > waf > wscript.py > options

```
#
# ********************************************************
# |docname| - Waf build script for in-class examples
# ********************************************************
# This is invoked by ``wscript``.
#
# Imports
# =======
# These are listed in the order prescribed by `PEP 8
# <http://www.python.org/dev/peps/pep-0008/#imports>`_.
#
# Standard library
# ----------------
import os.path
from os import makedirs
from pathlib import Path
import subprocess
import zipfile

# Local application imports
# -------------------------
from waflib import Logs, Utils
from waflib.Errors import WafError
from waflib.TaskGen import after_method, feature

# Local imports
```

# wscript.py - Waf build script fo[r] in-class examples

This is invoked by `wscript`.

## Imports

These are listed in the order prescribed by PEP 8.

### Standard library

```
import os.path
from os import makedirs
from pathlib import Path
import subprocess
import zipfile
```

### Local application imports

```
from waflib import Logs, Utils
from waflib.Errors import WafError
from waflib.TaskGen import after_method, feature
```

### Local imports

```
from runestone.lp.lp_common_lib import (
```

Build complete.    Error(s): 0, warning(s): 0

lp* 18↓ 24↑ Python 3.8.3 64-bit ⊗ 4 ⚠ 0    Ln 88, Col 77 Spaces: 4 UTF-8 CRLF Python [off]

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# main

```
int main(void) {
```

**Setup**

```
    configBasic(HELLO_MSG);
    CONFIG_LED1();
    config_pb1();
```

**Line A**: Start with the LED off.

```
    LED1 = 0;
```

**Main loop**

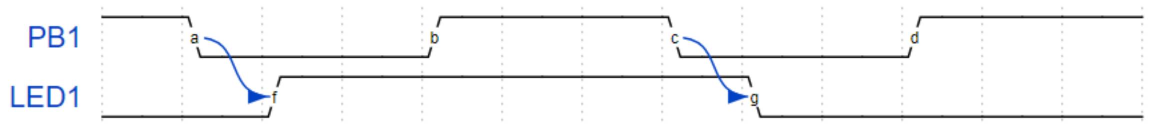


*Fig. 2.12* A copy of Fig. 2.10, to help illustrate the operation of the code below.

```
    while (1) {
        test_main();
```

This function returns after edge a.

```
        wait_for_press();
```

A few instructions later, at edge f, this line toggles the LED.

```
        LED1 = !LED1;
```

This function returns after edge b; the process starts again.

```
        wait_for_release();
    }

    return 0;
}
```

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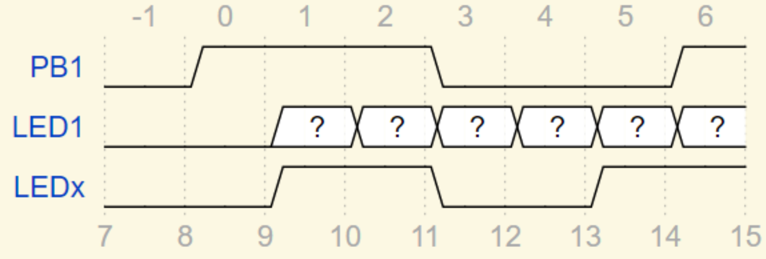
# Assessment

Q-1: What waveform would be produced by the following code snippet in `main()` ?

```
while (1) {}
    // Toggle when the pushbutton is **released**.
    if (PB_RELEASED()) {
        LED1 = !LED1;
    }
}
```

Answer with an six-character string of 1s and 0s, giving the value of LED1 at time periods 1–6. For example, and answer of `110011` produced the LEDx waveform. Hint: at time 7 and 8, the pushbutton is pressed. Therefore, the LED remains unchanged. The pushbutton is released at the time 9, which will cause the LED to toggle at time 1.




Check me Compare me

Activity: 1 -- Fill in the Blank (8Dbb6I7Ega)

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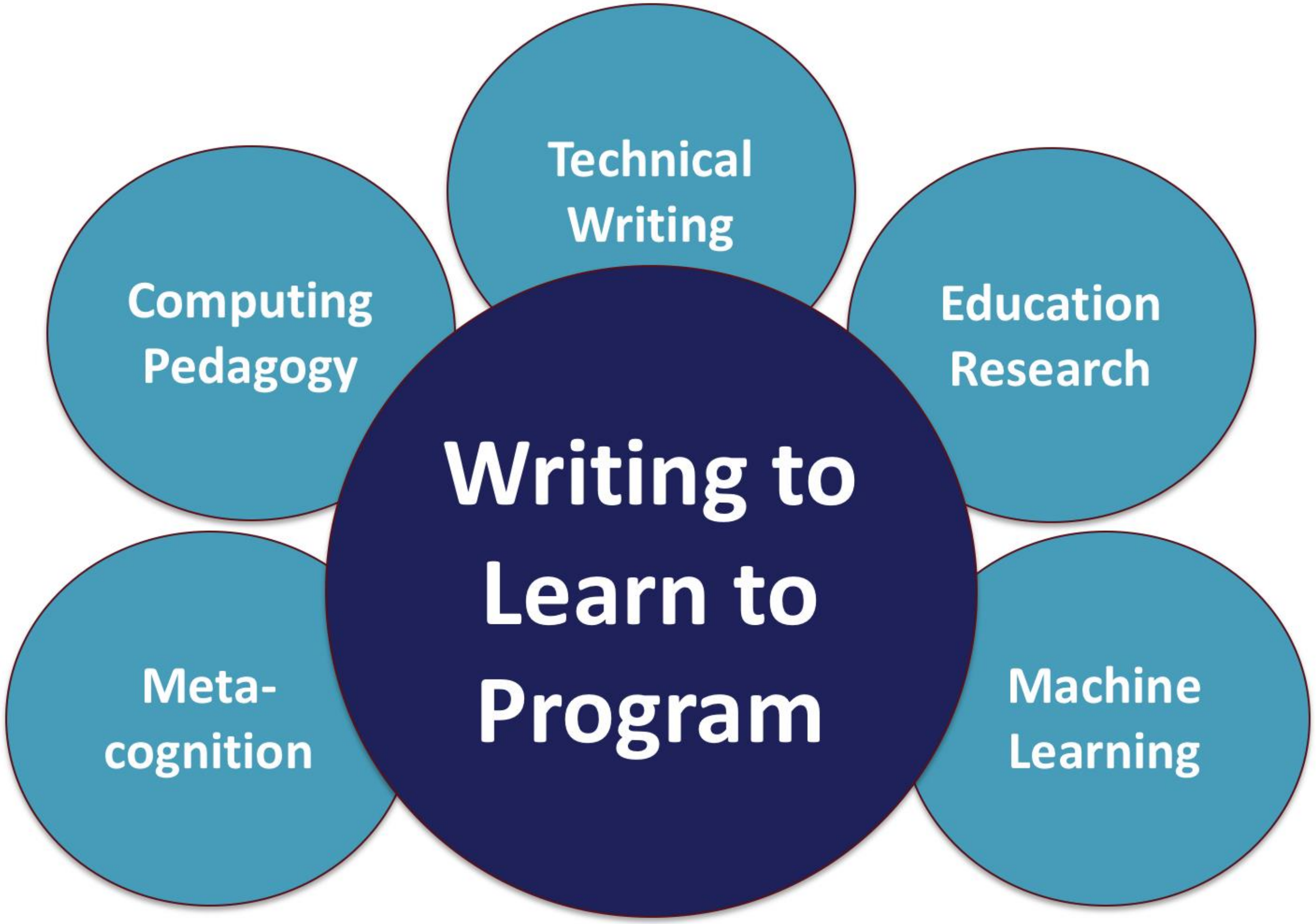
# Example #1: Writing to Learn to Program




**Writing makes thinking visible.**

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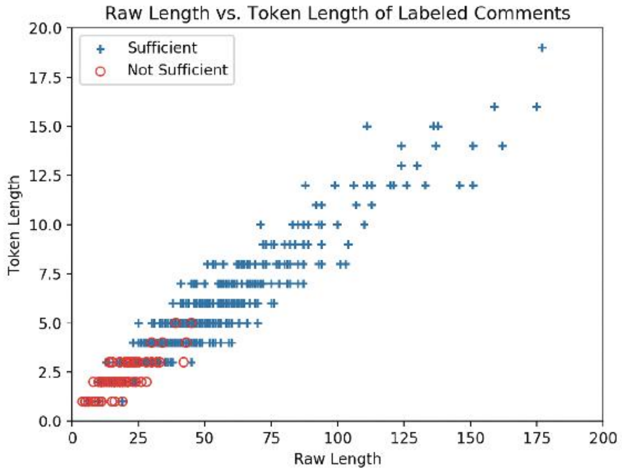
# Example #1: Writing to Learn to Program

Text Normalization → Bag of Words → Automated Classification

Multinomial Naive Bayes

Random Forest




# Machine Learning to Classify Source Code Comments in Real-time

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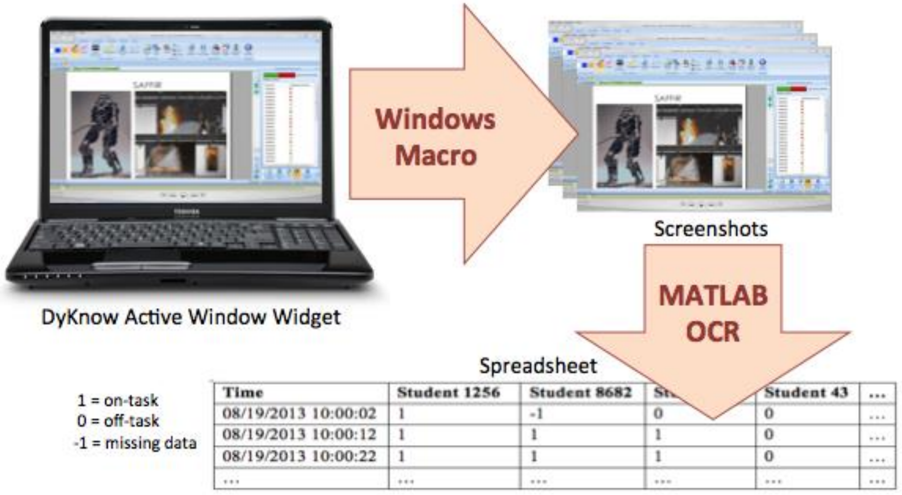
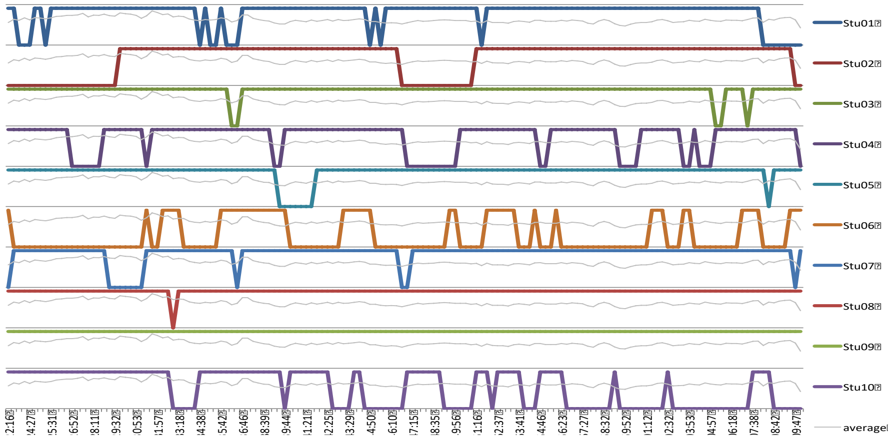
# Example #2: Impact of Classroom Computers on Learning




| Time | Student 1256 | Student 8682 | St | Student 43 | ... |
|---|---|---|---|---|---|
| 08/19/2013 10:00:02 | 1 | -1 | 0 | 0 | ... |
| 08/19/2013 10:00:12 | 1 | 1 | 1 | 0 | ... |
| 08/19/2013 10:00:22 | 1 | 1 | 1 | 0 | ... |
| ... | ... | ... | ... | ... | ... |

## Attention in a 50-min 270-Seat Lecture



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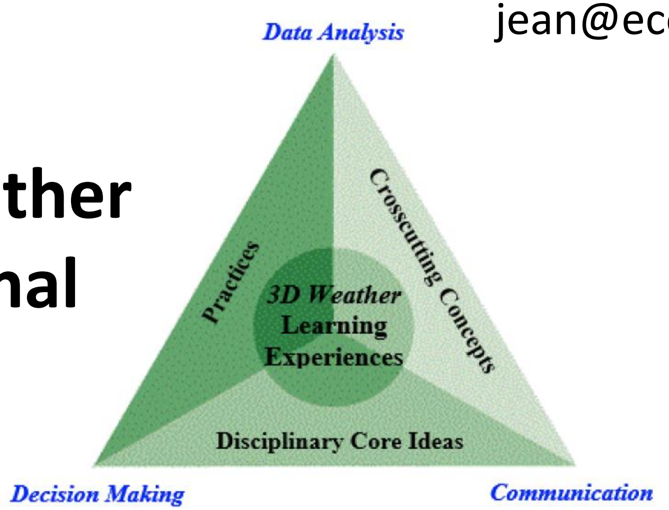
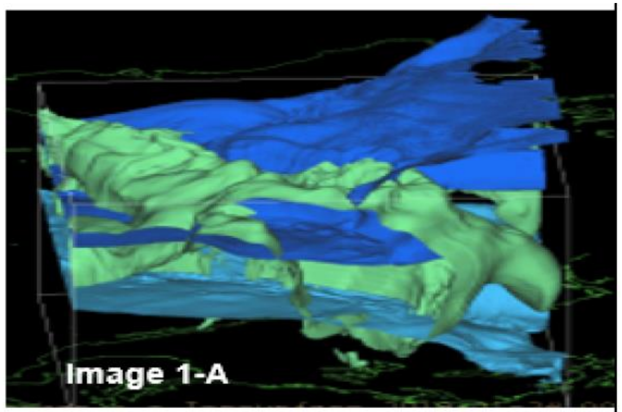
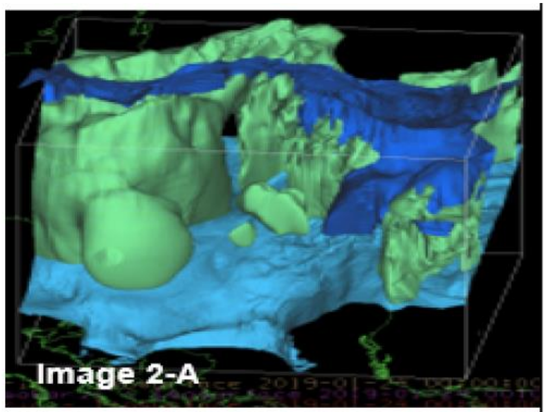
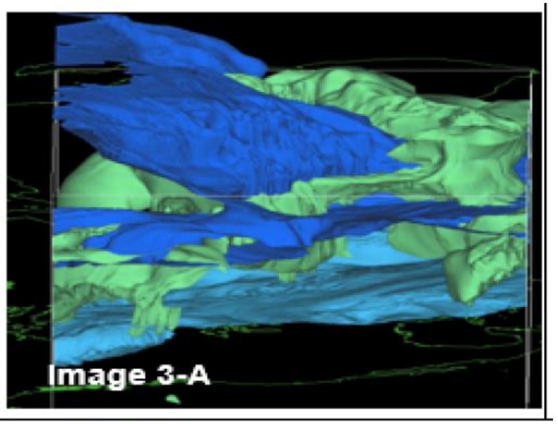
# Example #3: Using 3D Weather Data to Teach Computational Thinking to 7th Graders



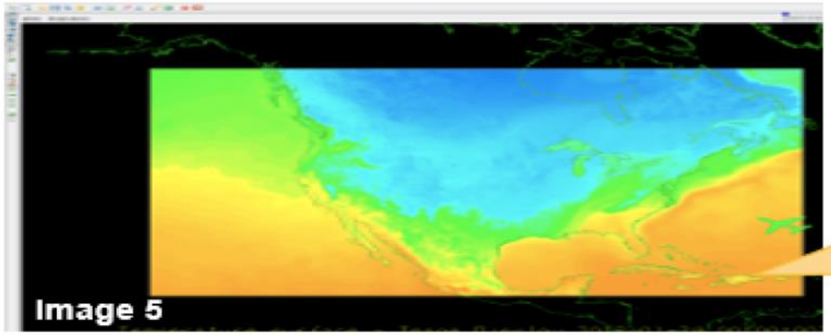
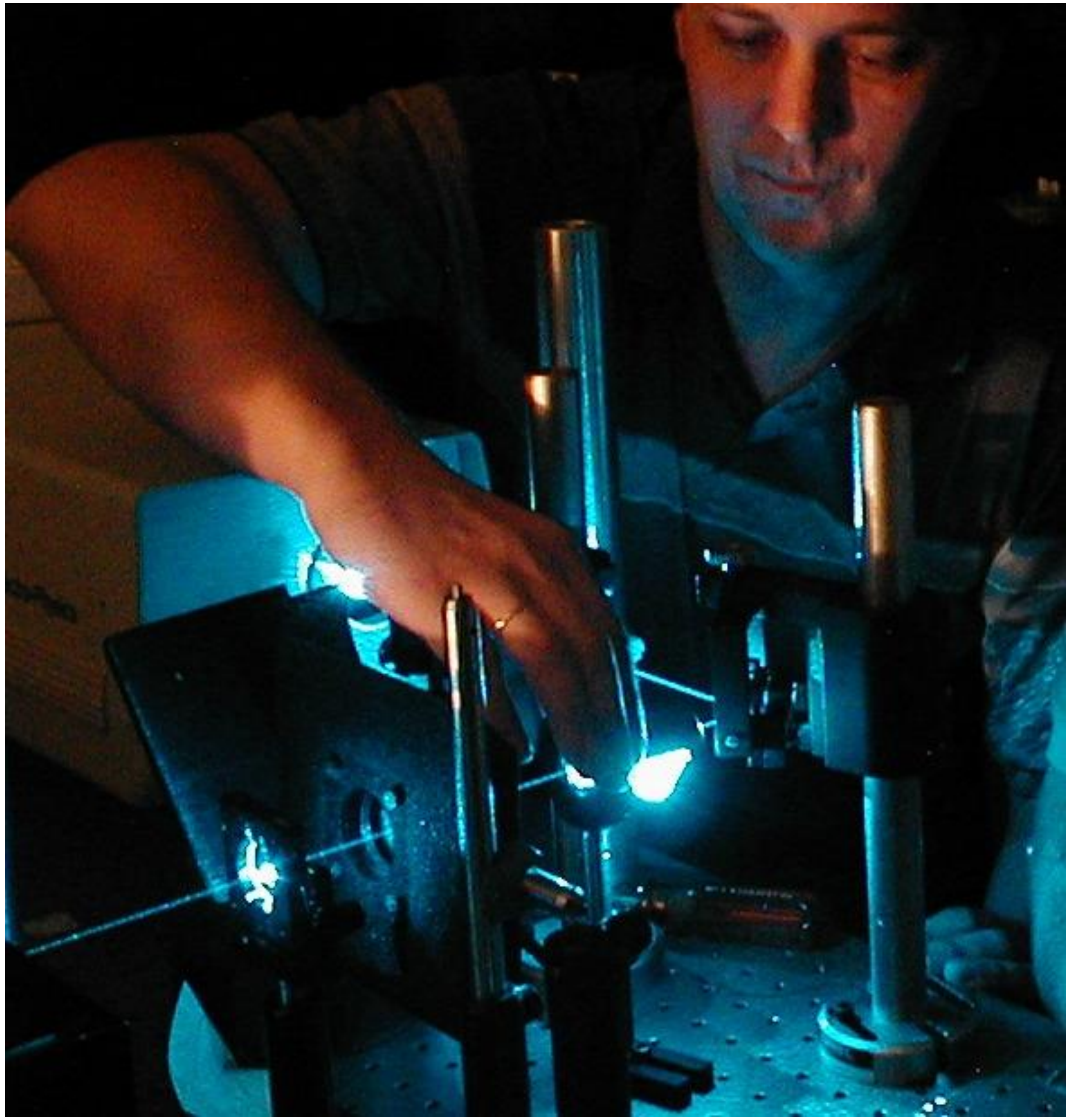




Image 5 shows a 2D Image of temperature at the surface typical of television representation of weather. While communicating cold, it provides no information about the structure of the atmosphere causing the event.

Dr. Yaroslav Koshka

# Optical characterization lab

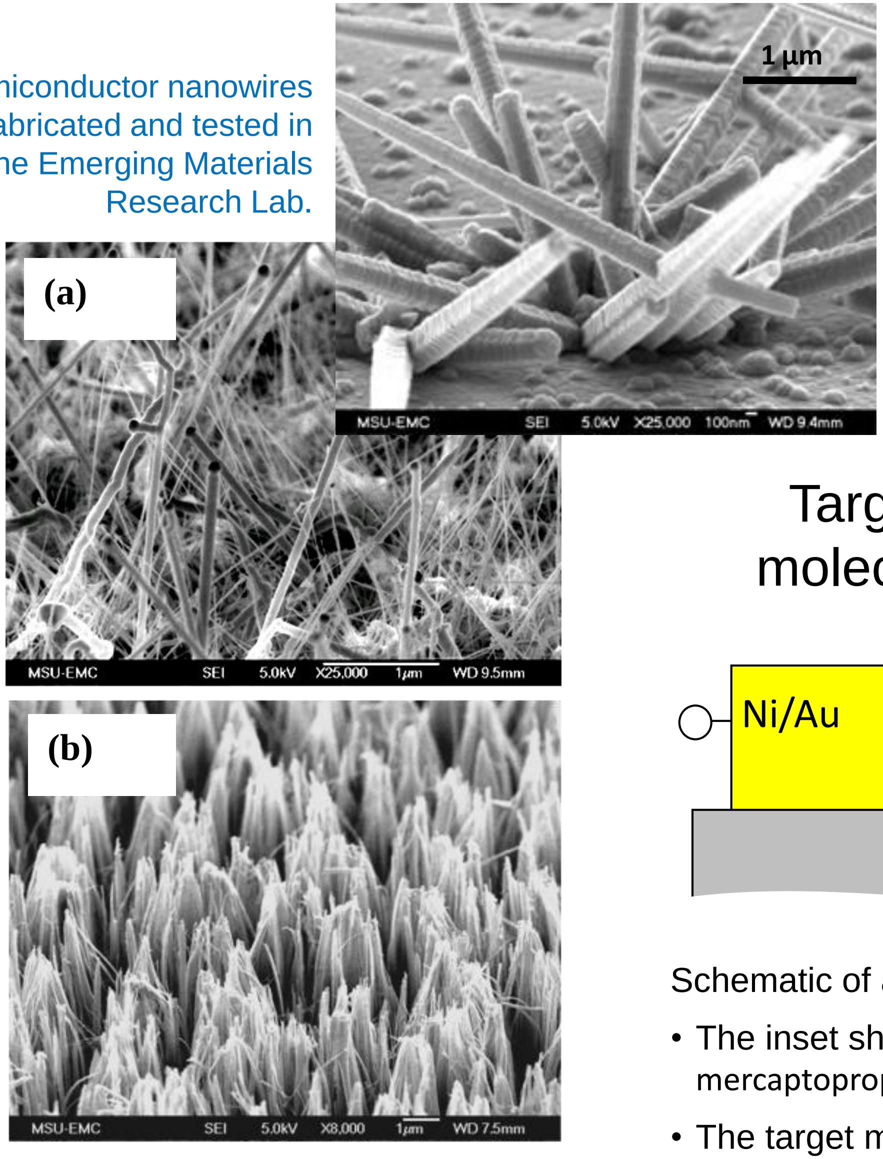


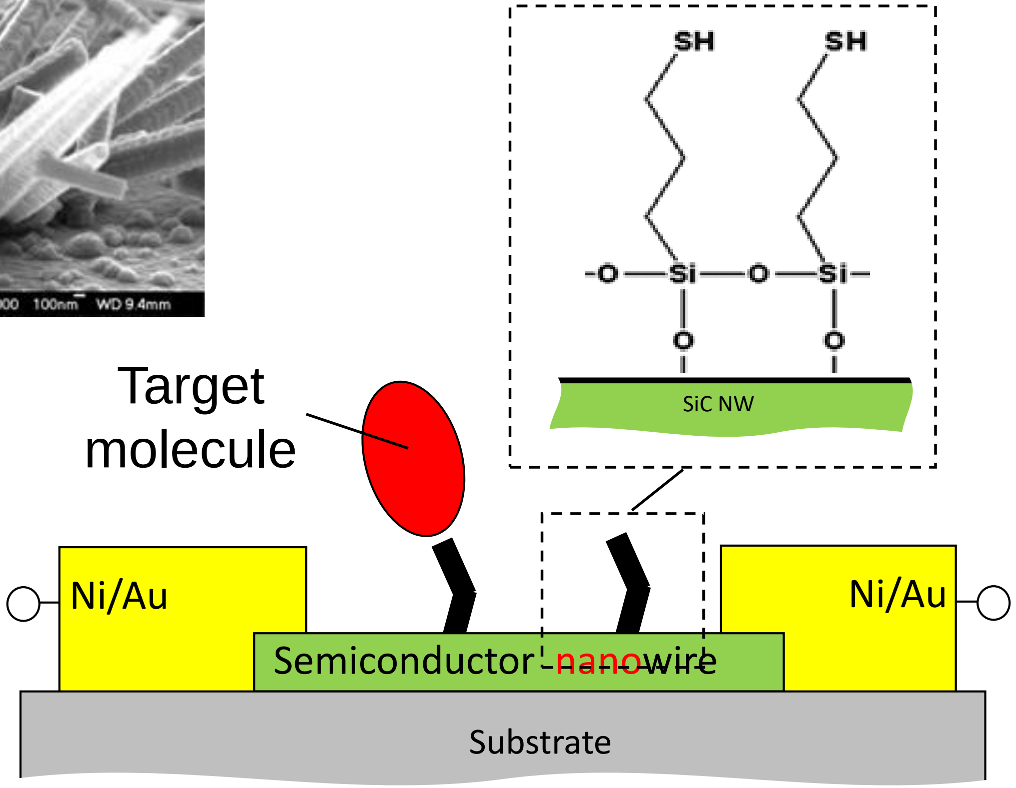
Dr. Yaroslav Koshka

# Nanoelectronics

## multidisciplinary research targeting emerging biomedical applications

Semiconductor nanowires fabricated and tested in the Emerging Materials Research Lab.




Schematic of a SiC nanowire field-effect transistor used as a biosensor.

- The inset shows the surface of the nanowire functionalized with mercaptopropyl trimethoxysilane (MPTMS) as an example.
- The target molecule detected by the device could be a cancer cell.

# Bio-inspired Autonomous Robots, Embedded Systems and Intelligent Control

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Associate Editor of International Journal of Robotics and Automation
Associate Editor of International Journal of Swarm Intelligence Research
Associate Editor of IEEE Transactions on Cognitive and Developmental Systems
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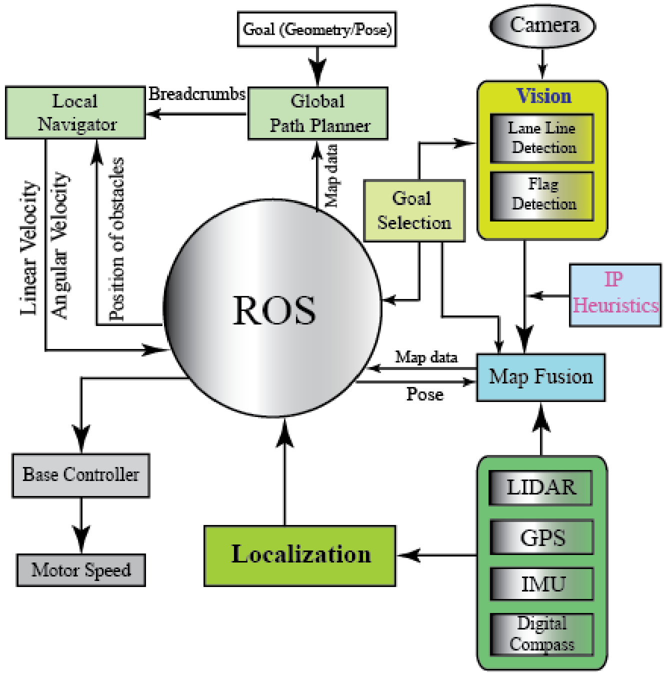
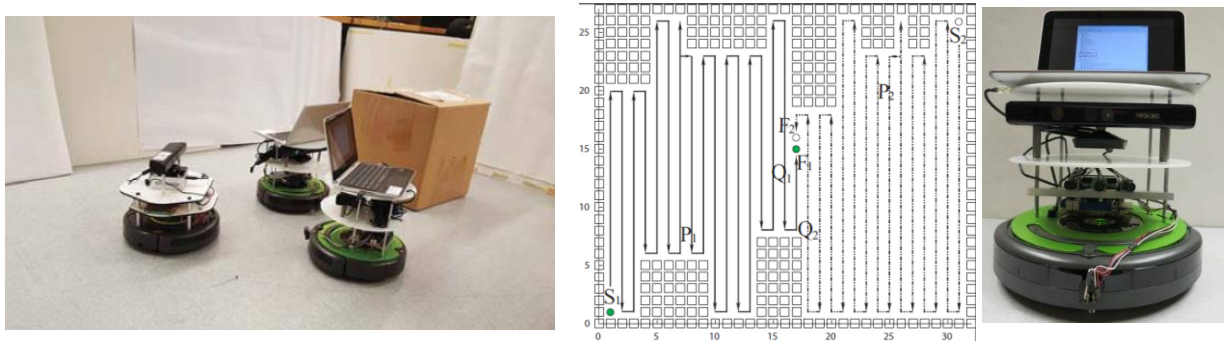
# Autonomous Robots

- **Autonomous Robot Systems**
  - Motion planning, navigation, motion control
  - Localization; sensor data fusion; robot vision
  - Hardware and software for mobile robots
  - Collaborative robots (Multi-robot)
- **Machine Learning (Computational Intelligence) for Robotics Systems**
  - Biologically inspired neural networks
  - Evolutionary Computation (genetic algorithms)
  - Immune System Algorithms
  - PSO, Ant colony optimization (ACO)
  - Q-learning, Deep reinforcement learning
  - Deep learning, clustering, reasoning…
  - Optimization (convex programming for engineering)

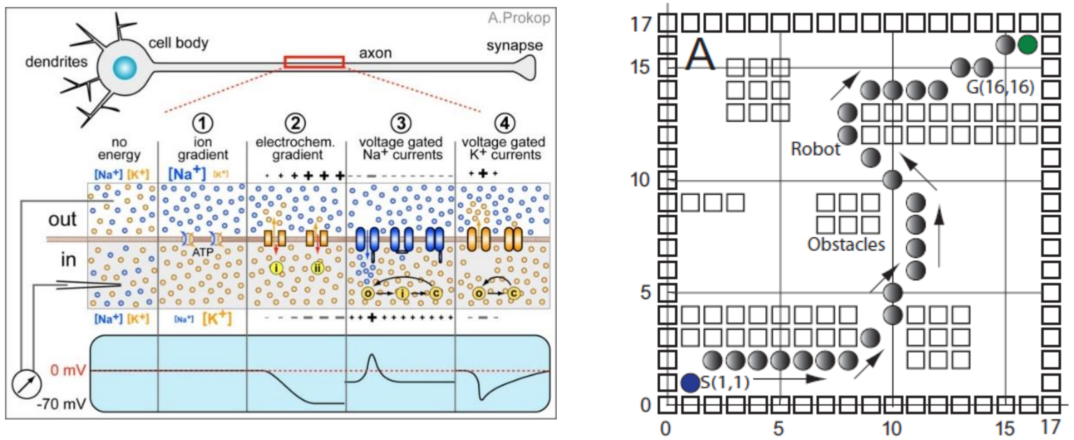
Dr. Chaomin Luo



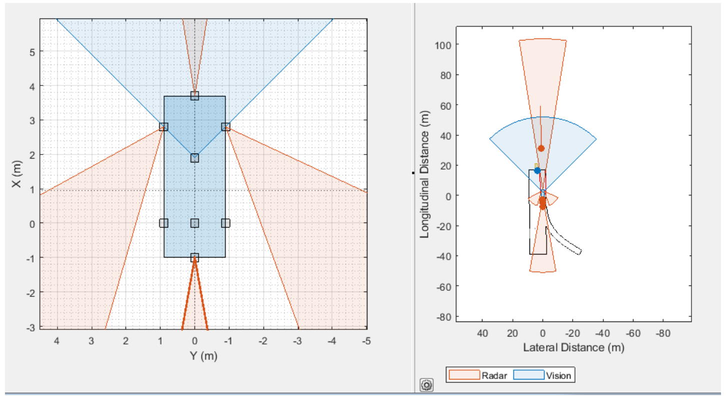

Robot sensor configuration of ROS systems



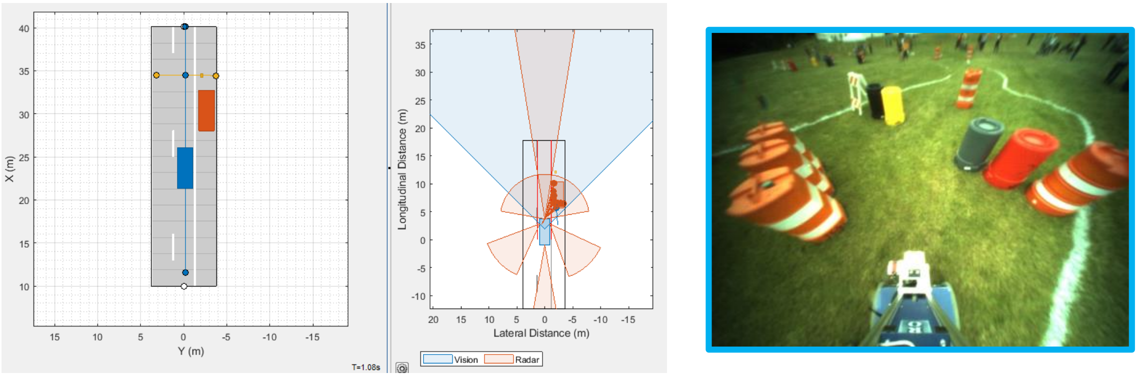
Multi-robot for environment exploration




Bio-inspired neural network model for navigation

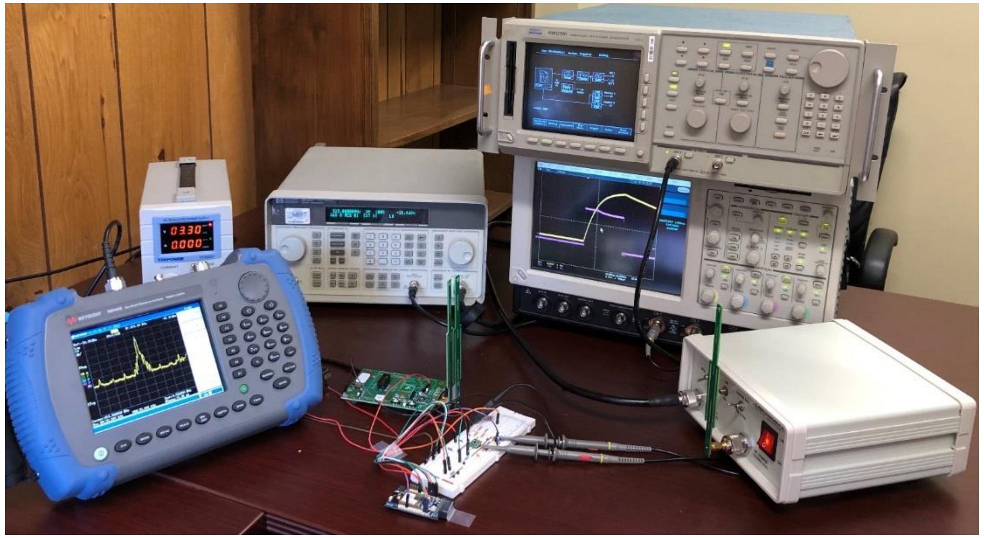



Sensor Data Fusion




Connected and Autonomous Vehicle Systems (CAVs)

## Energy Harvesting Wireless Communication Networks



- Harvest radio energy from environment
- Semi-perpetual operations & wireless communications
- Event detection, environmental monitoring, and data collection

## IoT for Underwater Exploration

- Detect coexistence of marine animals
- Share underwater acoustic channel with marine animals
- Environment-friendly communications