Inspiring Excellence

CSE360: Computer Interfacing

Project Title: Smart Home Security System

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Introduction :

Security systems are highly recommended for both homes and other locations to prevent unauthorized access as well as mitigate the risk of potential accidents. With rising concerns about safety and security, people are taking proactive measures to safeguard their homes. The need for security systems has become even more apparent in recent times, as criminals are becoming more advanced in their methods and can exploit weaknesses in traditional security measures. By installing advanced security technologies such as motion sensors, one can have a real-time view of one's property and receive instant notifications of any suspicious activity. This enables you to take immediate action and prevent any potential harm. Additionally, some security systems can detect hazardous situations such as smoke, carbon monoxide, and gas leaks and alert people to take appropriate action.

Application Area:

The project we're developing "Smart Home Security System" can be used to protect homes and other similar types of buildings. Home invasions can be avoided by it. The security of our house will be increased and enhanced. Despite the fact that there are additional home security systems, most of them are expensive and difficult to operate.Our device provides a better interface. The MQ-2 gas sensor and flame sensor will enable our system to detect gas and flame. Together with it, a PIR sensor will be used to detect motion from intruders. So, it can be used in a variety of settings besides just the home, such as offices, businesses, hospitals, and schools.

Technology and tools :

- **Arduino Uno R3:** The operation of Arduino is very simple. It mainly relies on three components: inputs, which are responsible for providing data to the controller from sensors and switches. Almost anything can be input, including on/off signals, signals with variable voltage, and communications with other controllers.

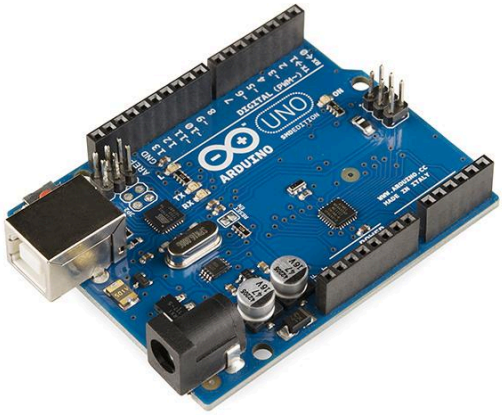


Figure 1:Arduino Uno

- **20x4 LCD Display:** A 20x4 LCD display is a simple and very common component that can be found in many devices and circuits. A 20x4 LCD defines that it can show 20 characters on each of its 4 lines. Each character is made up of a 5x7 grid of pixels. The LCD has two registers. There are (1) Command Register and (2) Data Register.

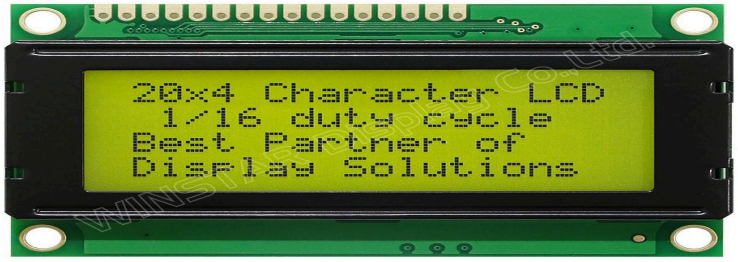


Figure 2: 20x4 LCD

- **PIR Sensor:** PIR sensor is commonly used in PIR-based motion detectors. It is frequently utilized in safety and security systems. When a living thing gets exposed to the sensor, it will detect the movement since the living thing's body emits heat energy in a form of infrared radiation.

Figure 3: PIR Sensor

- **Flame Sensor:** A flame sensor is a type of detector that is designed to detect and respond to the occurrence of a fire or flame. This sensor is capable of ensuring safety from fire hazards. The flame sensor is more effective in detecting flames compared to other heat or smoke sensors due to its detection mechanism, which enables it to respond faster and more accurately.

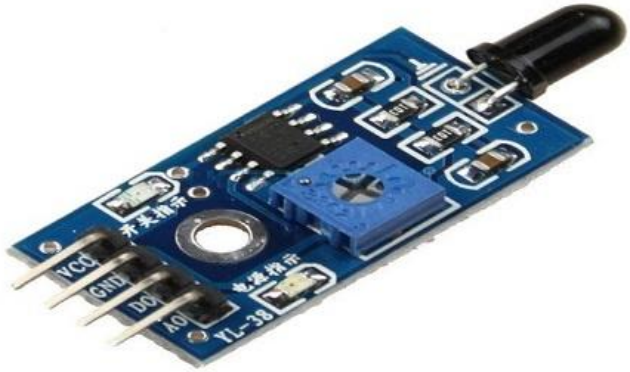


Figure 4: Flame Sensor

- **<u>MQ-2 Smoke and Gas Sensor:</u>** MQ gas sensors are a group of sensors that can identify many different types of gases, such as alcohol, smoke, methane, and hydrogen. One type of MQ gas sensor is called MQ-2, which can detect flammable gas in a range of 300 to 10,000 parts per million (ppm). Since MQ-2 is very sensitive to propane and smoke, it is frequently used in domestic gas leak alarms.

Figure 5: MQ-2 Smoke and Gas Sensor

- **<u>Jumper wire:</u>** Jumper wires are commonly used to connect two terminals in a circuit. They are available in various lengths.

Figure 6: Jumper Wire

- **Buzzer:** A buzzer is an electrical gadget that converts an audio signal into sound, and it can be designed electromechanically, piezoelectrically, or mechanically. It is commonly utilized in a range of gadgets such as timers, alarms, and railway systems, and as a means of confirming human input, such as a mouse click or keyboard stroke.

Figure 7: Buzzer

- **Large breadboard:** Using a breadboard to create temporary circuits is a common practice as it allows designers to quickly add, remove, or change components. In a

nutshell, it is a board made of plastic with interconnected sockets arranged in rows, designed for constructing electronic circuits.

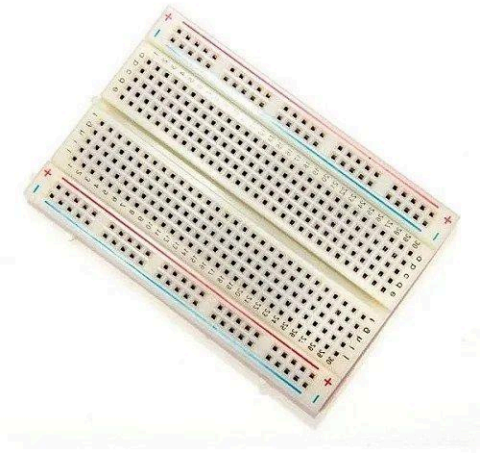


Figure 8: Large Breadboard

Programming Language :

In this project, the Arduino UNO will be programmed using the Arduino programming language. We'll be working with the Arduino IDE for this project.

Working Mechanism of Sensors :

In this project, we will be using three sensors. There are (1) PIR Motion Sensor, (2) MQ-2 Smoke and Gas Sensor, and (3) Flame Sensor. A brief overview of the mechanism of these sensors is given below:

1. **WORKING MECHANISM OF PIR MOTION SENSOR:** A passive infrared (PIR) sensor is a type of motion detector that can detect the presence of moving objects by monitoring changes in the heat energy emitted by those objects. The PIR sensor uses a Fresnel lens to enable its two slots to detect changes in the amount of infrared radiation reaching each slot. Normally, both slots detect the same amount of radiation from the environment. However, when a person or animal passes by, the first slot is temporarily blocked, resulting in a positive differential change between the two slots. When the body leaves the sensor's range, the opposite occurs, and a negative differential change is detected. This change in radiation triggers the sensor to send a signal to a connected device to activate an alarm or perform another action.

   Features of PIR sensor:

   - Detection Range: Upto 30 feet
   - Field of View: 110-180 Degrees
   - Response Time: Within a fraction of second
   - Power Consumption: Very low

2. **WORKING MECHANISM OF MQ-2 SMOKE and GAS SENSOR:** MQ2 gas sensors detect the presence of gases such as LPG, methane, ethanol, and carbon monoxide in the air ranging up to 10000 ppm using electricity. The ability of this gas sensor to detect gases depends on the chemiresister to conduct current. It contains a sensing element made up of a metal oxide film that conducts electricity when it comes into contact with a gas. The resistance of the sensing material changes depending on the amount of gas present. When it comes to detecting gas, sensors use variations in resistance value that generates the output voltage. The

MQ-2 sensor also contains a heating element that heats the sensing element to a high temperature, making it more sensitive to gas. When the sensor material is heated to a high temperature in the air, oxygen is adsorbed on the surface. Here, the conduction will be proportional to the number of toxic gases available in the environment. The voltage values can be used to compute the concentration of a gas. When the gas concentration is high, the voltage values are greater.

3. **WORKING MECHANISM OF FLAME SENSOR:** A flame sensor is an electrical device that detects flames or fire in an area by using infrared (IR) radiation emitted by the flames. The sensor consists of a lens that directs IR radiation onto a sensing element, which is usually a photodiode or a phototransistor. When a flame is within sight of the sensor, it sends IR radiation to a sensing element. This changes the electrical current passing through the element and triggers the sensor's output signal. The signal can activate a buzzer. There are several wavelengths of flame sensors normally in the range of 700 to 1100 nm from the source. Generally, the operating temperature of the flame sensor is -25°~85°.

Connection with ICs :

The main microcontroller board used in the project is ARDUINO UNO R3. It is connected to various peripherals using jumper wires. The detailed connections between the Arduino board and peripherals are given below:

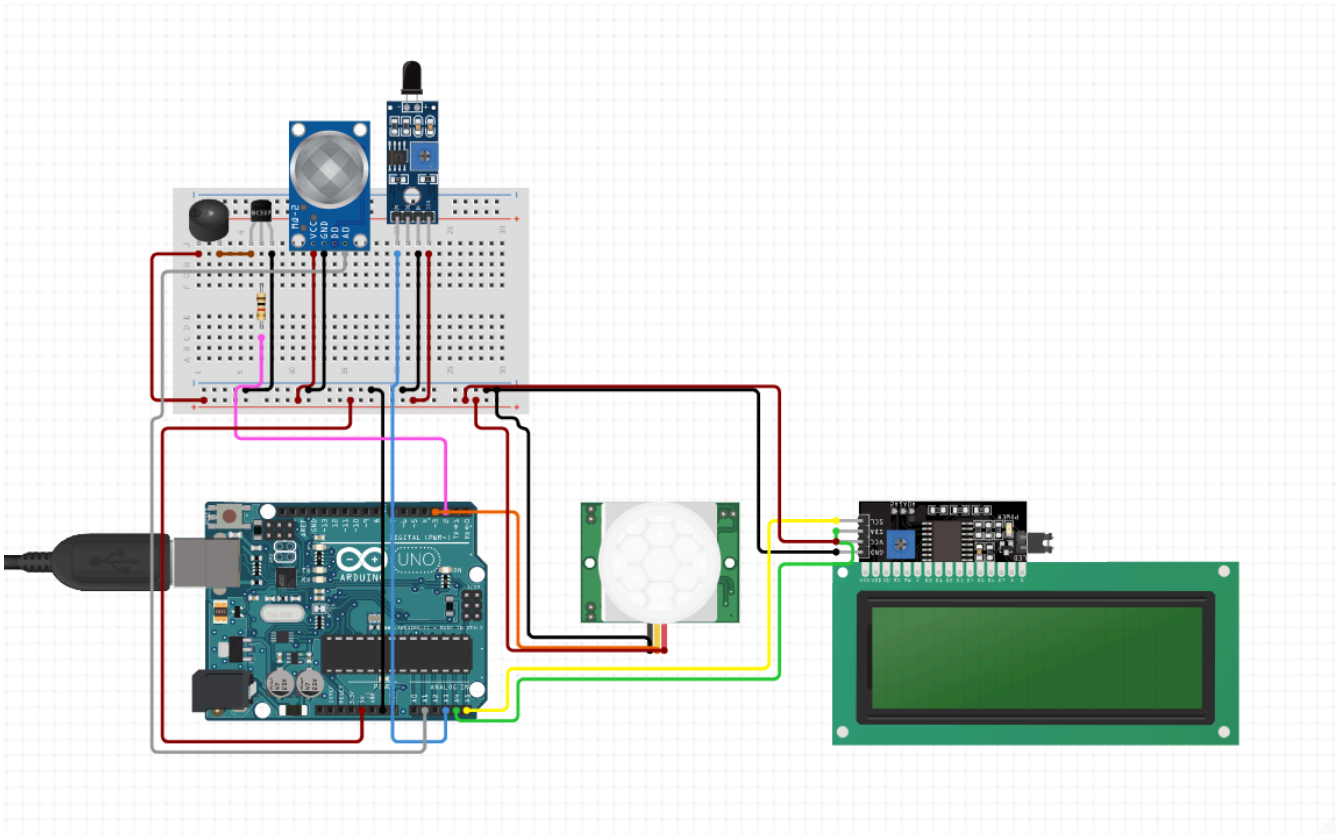
1. **PIR MOTION SENSOR:** PIR sensor has three pins: VCC, GND, and OUT. The VCC pin is connected to the 5V pin of the Arduino board. Then the GND pin is connected to the GND pin of the Arduino board. The OUT pin is connected to the digital pin(3) of the Arduino board.

2. **MQ-2 SMOKE and GAS SENSOR:** The MQ-2 sensor has four pins: VCC, GND, AOUT, and DOUT. The VCC and GND pin is connected to the 5V pin and GND of the Arduino board. The AOUT pin is connected to the analog pin(A1) of the Arduino board.

3. **FLAME SENSOR:** The FLAME sensor has three pins: VCC, GND, A0, and D0. VCC is connected to 5V, GND is connected to GND, A0 is connected to the analog pin(A3) of the Arduino board.

4. **I2C Serial LCD 20X4 DISPLAY :** Firstly we need to connect the I2C module with the 20X4 LCD display. Then we need to connect I2C module with the Arduino are as follows:
    - SDA pin of I2C module to A4 pin of Arduino board.
    - SCL pin of I2C module to A5 pin of Arduino board.
    - VCC pin of I2C module to 5V pin of Arduino board.
    - GND pin of I2C module to GND pin of board.

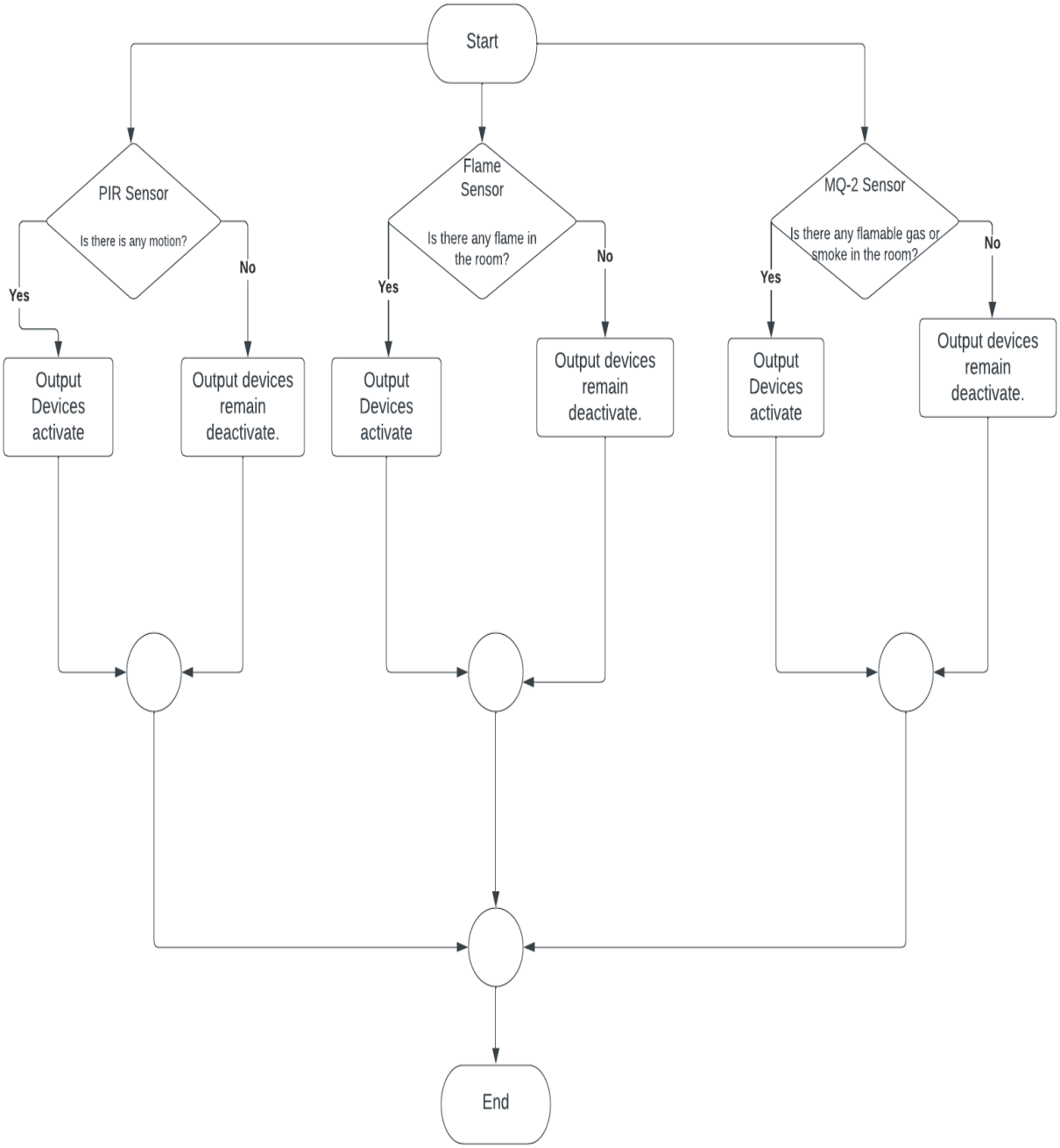
5. **BUZZER:** Buzzer has two pins. We need to connect the positive pin of the buzzer to any digital pin (2) and the negative pin is connected to the GND pin of the Arduino board.



Data flow from sensors through ICs to I/O devices :

For the PIR Sensor, Whenever it senses any motion in front of it, It will have a value of 650 and give this signal from the OUT pin to the A1 pin of ARDUINO UNO. Then ARDUINO UNO sends the data to the output devices; LCD and Buzzer. LCD will show that the PIR sensor is active, so someone is in the room. Also, Buzzer will make a sound to alert the owner. The MQ-2 gas sensor senses flammable gas and smoke in the air. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane, and Carbon Monoxide concentrations ranging from 200 to 10000 ppm. So, if there is any flammable gas or dense smoke in the air, the MQ-2 sensor activates and sends the signal to ARDUINO UNO by A0 pin. As a result, LCD will show that the gas sensor is activated, also Buzzer will be activated to alert the owner. Now the flame sensor is dependent on infrared light. The IR photodiode will identify IR light from any heated body. This number is then

compared to a threshold amount. When the radiation exceeds the threshold value, the sensor will be activated and send the signal to ARDUINO UNO by pin 10. Then ARDUINO UNO will activate the LCD and buzzer. LCD will show that the flame sensor is activated and the buzzer will make a sound to alert the owner. The buzzer will be activated longer if more than 1 sensor activates at a time.



Estimated cost analysis :

The components we will be using are 1 Arduino Uno R3, 1 I2C Serial 20x4 LCD Display, 1 Active Buzzer 5V, 1 PIR Sensor, 1 Flame Sensor, 1 MQ-2 Gas Sensor, Jumper wire 40 pcs, 1 large breadboard.

Price list:

Arduino Uno – 1100TK

20x4 LCD – 499TK

Active Buzzer 5V – 19TK

PIR Sensor – 80TK

Flame Sensor – 49TK

MQ-2 Gas Sensor – 149TK

Jumper wire 40 pcs – 100TK

Large breadboard –145TK

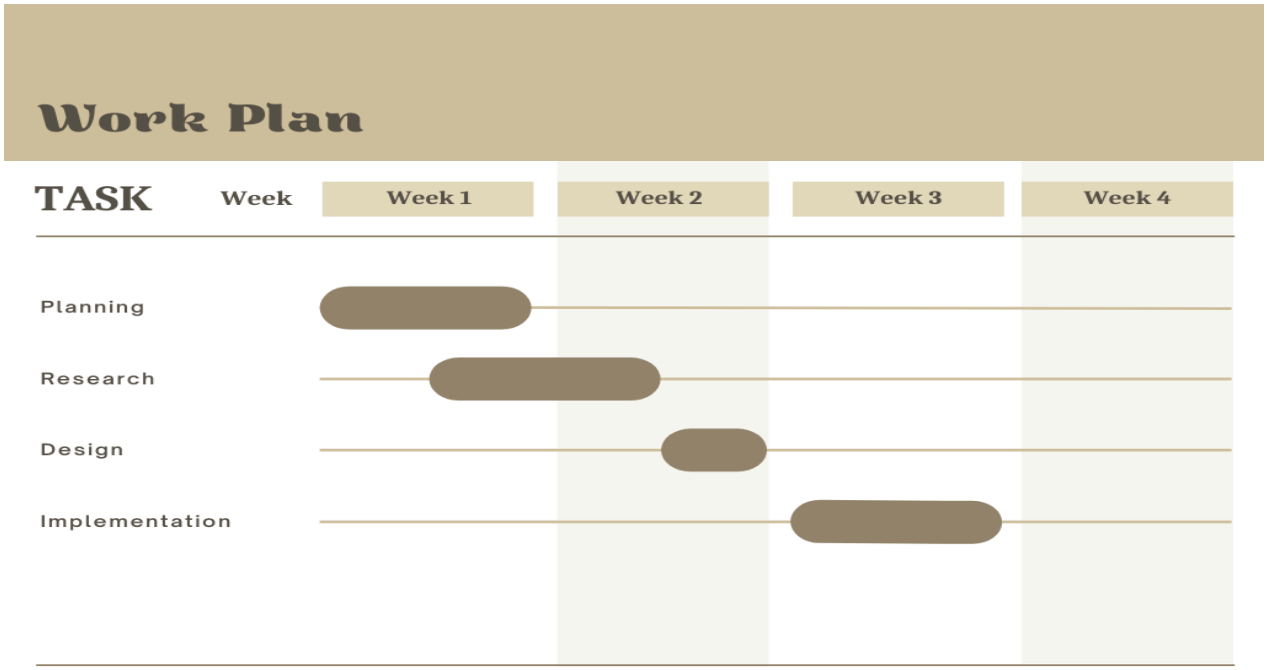
I2C Module - 100Tk

Total Amount –2296 TK

Responsibilities of each member :

Responsibilities	Name	ID
Connection with ICs, Programming Language, Application Area, Estimated Cost Analysis, Conclusion	Aunon Halder	20301133
Working Mechanism of Sensors, Introduction, Technology and Tools Data flow from sensors through ICs to I/O devices, Workplan.	Rifa Tasfiya	20301126

WorkPlan :



Conclusion :

The Smart House Security System with Arduino is a project that demonstrates how technology can be utilized to improve security measures in homes. Mainly this system deters crime and notifies the user about the gas or fire problem. The main uses of home security systems are for safety purposes in homes, companies, and educational facilities. Moreover, we can also increase the number of sensors to make it better. Another option is to use a mobile device or the internet to send data to a remote location. We can also add a wind sensor or a fire sensor to the system in the future. Voice alarm modules may also alert us to an intruder or a gas leak if we use them. Overall, the Smart Home Security System using Arduino is a great example of how technology can be used to create innovative and effective solutions to real-world problems.

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