Overview:

In this TI-Nspire™ CX lesson, you will learn how to read a digital input pin on the breadboard connector of the TI-Innovator™ Hub. The digital input pin will sense the on or off state of a toggle switch used to switch the power to an LED circuit on or off. A program will be written to read the state of the digital input pin and then, based on the state of the pin, display an appropriate message.

Goals:

1. Build an LED circuit with a toggle (power) switch on a breadboard.
2. Connect a digital input pin on the TI-Innovator Hub to the circuit switch to sense if the LED is on or off.
3. Create a TI-Basic program on a TI-Nspire CX handheld device that displays an appropriate message based upon if the power switch is either on or off.

Background:

Connecting the BB 1 digital input pin to the power SPDT Slide Switch of an LED circuit sends a digital input signal to the TI-Innovator Hub.

The switch will allow the user to change between an open circuit and a closed circuit. A switch in the OFF state creates an open circuit and the LED will not turn on because electrons cannot move through the circuit. A switch in the ON state creates a closed circuit and allows electrons to flow, thus, turning on the LED.

Using TI-BASIC, the input pin can be read just like a variable. When 3.3 Volts is connected to the digital input pin, the variable value will read as a 1. When 0 Volts (ground) is connected to the pin, the value will read as 0. An “if -then” statement can be used to change the program action based upon the pin state.

A real-world application of a digital switch is a button on a game control pad that is programmed to make an animated character jump in a game when the button is pressed.

Flowcharts are often used to create or design computer programs. A flowchart illustrating a program algorithm was seen in the Unit 1 Skill Builder.

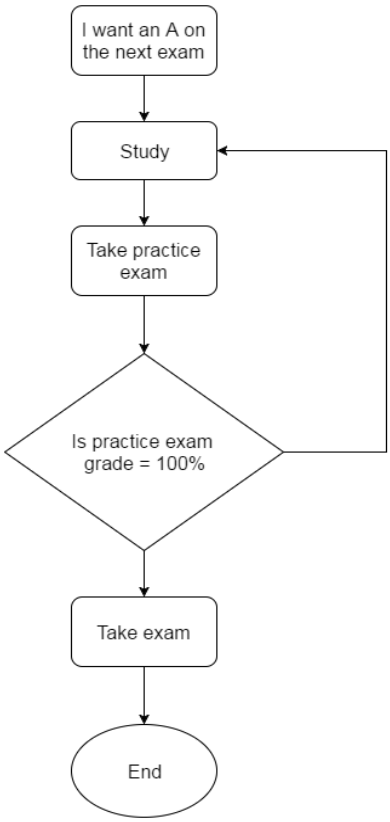
An algorithm is a series of steps that must be followed to complete a task and is used to organize the flow of a computer program. They are written in no specific computer language so anyone can understand them. Computer algorithms are often illustrated using flowcharts that contain rectangles, circles, and diamonds. Rectangles are program statements, while diamonds are “if -then” decision statements, and circles are the end of a program. Arrows are used in the flowchart to show how the program flows from start to finish.

Using these flowchart symbols, a programmer can describe a computer program in a way similar to how a football coach describes a play using Xs and Os to represent players on both sides and arrows showing individual player movements during the play.

Practice:

Task: Have students draw a flowchart to illustrate how to prepare well for a test.

Sample Answer:

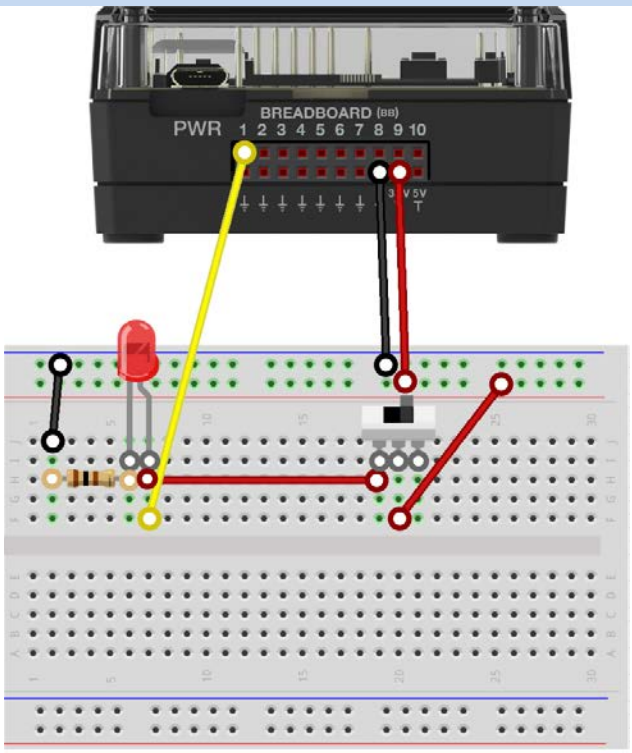


Materials and Tools:

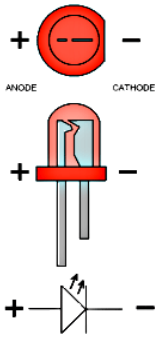
- TI-Nspire CX Technology
- TI-Innovator™ Hub with USB Cable
- Needle Nose pliers (optional)
- Wire nippers (optional)
- TI-Innovator Breadboard Pack:
  - Breadboard
  - Male to Male Jumper Cables
  - Resistor 100 Ohm (brown, black, brown)
  - SPDT Slide Switch
  - Red LED

Build the Hardware:

Assemble the circuit in the diagram on the right, following these steps:

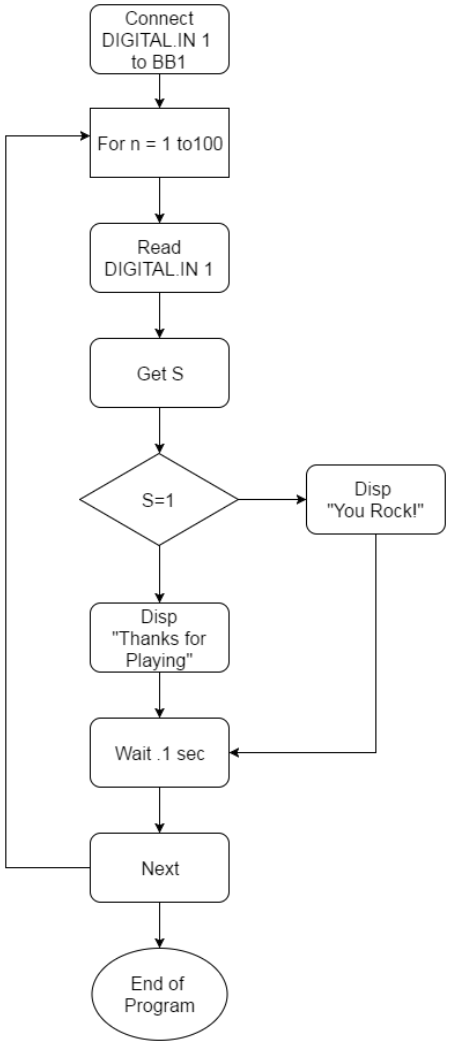


1. Place an SPDT Slide Switch and a Red LED on the breadboard in the locations noted in the figure to the right.
2. Connect a red Male to Male Jumper Cable from the 3.3V on the TI-Innovator Hub to the red 3.3V bus on the breadboard.
3. Connect a black Male to Male Jumper Cable from any ground on the TI-Innovator Hub to the blue ground bus on the breadboard.
4. Connect a red Male to Male Jumper Cable from the center leg of the SPDT Slide Switch to the red 3.3V bus on the breadboard.
5. Use a red Male to Male Jumper Cable to connect an outer leg of the switch to the anode (+) of the Red LED.
6. Connect a 100 Ohm Resistor to the cathode(-) leg of the Red LED.
7. Use a black Male to Male Jumper Cable to connect the opposite end of the 100 Ohm Resistor to the blue ground bus on the breadboard.
8. Use a yellow Male to Male Jumper Cable to connect the anode (+) leg of the Red LED to BB1 on the TI-Innovator Hub. This point will be held at 3.3V when the SPDT Slide Switch is turned on and will be held at 0V when turned off.
   - The digital input on BB1 can detect this on or off state.
9. Plug the “B” end of the “unit to unit” USB cable into the TI-Innovator Hub and the “A” end into the handheld device.



Write the Software for the TI-Nspire CX:

Task: Write a TI-BASIC program on the handheld that will read a red LED connected to a switch and pin 1 on the breadboard connector of the TI-Innovator Hub. If the switch is off, 0, display “Thanks for playing!” If the switch is on, 1, display “You rock!”



Code for the TI-Nspire CX:

```
Define sb2()=
Prgm
Send "BEGIN"
DelVar iostr.str0
GetStr iostr.str0
Disp iostr.str0
Send "CONNECT DIGITAL.IN 1 TO BB 1"
For n,1,200
Send "READ DIGITAL.IN 1"
Get a
If a=1 Then
Disp "YOU ROCK"
EndIf
Disp "THANKS FOR PLAYING"
EndFor
EndPrgm
```

Extra for Experts:

Background: Boolean algebra is the branch of mathematics dealing with logic. Variables are either TRUE or FALSE. Boolean operations are words like "**and**", "**or**" and "**not**". In digital electronics and computer science, TRUE and ON are represented with a 1, while FALSE and OFF are represented with a 0. Since computer circuits use transistors that are ON and OFF, that is digital, and software uses 1s and 0s, that is binary, Boolean algebra is useful to make logical decisions, such as the moves of a game piece in computer game.

Task: Add an additional SPDT Slide Switch to BB2 as a second digital input. Write a program that reads and displays the states of both switches and then based on those states, displays all the Boolean operations in TI BASIC, (**and**, **or**, **xor**) that are true and the **not** of each input.

Hint: the Boolean operations are under TEST then LOGIC.

Truth Table for Digital Inputs BB1 and BB2				
BB 1	BB 2	BB1 **and** BB2	BB1 **or** BB2	BB1 **xor** BB2
ON (1)	ON (1)	TRUE	TRUE	FALSE
ON (1)	OFF (0)	FALSE	TRUE	TRUE
OFF (0)	ON (1)	FALSE	TRUE	TRUE
OFF (0)	OFF (0)	FALSE	FALSE	FALSE

Truth Table for Digital Input BB1	
BB1	Not(BB1)
ON (1)	0
OFF(0)	1