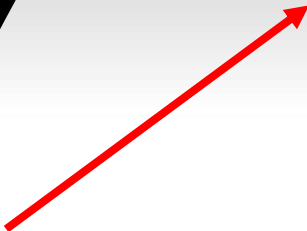# ARDUINO STEAM ACADEMY

Art without Engineering is dreaming. Engineering without Art is calculating.

- Steven K. Roberts

STEAM CLOWN™
&
Squeaky Hinge
PRODUCTIONS

STEAM CLOWN™ PRODUCTIONS

Attribution-NonCommercial-ShareAlike
3.0 Unported (CC BY-NC-SA 3.0)

SEE APPENDIX A, FOR LICENSING & ATTRIBUTION INFORMATION

by-nc-sa-3.0

https://creativecommons.org/licenses/by-nc-sa/3.0/

https://creativecommons.org/faq/#what-does-some-rights-reserved-mean

STEAM CLOWN™
& Squeaky Hinge
PRODUCTIONS

BITS & BYTES

SOME VARIABLE TYPES

- char text like A,B,C…

- byte 8-bit unsigned number, from 0 to 255

- int : 16-bit (2-byte) value. This yields a range of -32,768 to 32,767 (minimum value of -2^15 and a maximum value of (2^15) - 1)

- unsigned int 2 byte value. Instead of storing negative numbers, they only store positive values, yielding a useful range of 0 to 65,535 (2^16) - 1).

- long 32 bits (4 bytes), from -2,147,483,648 to 2,147,483,647

- unsigned long Unsigned longs won't store negative numbers, making their range from 0 to 4,294,967,295 (2^32 - 1)

- float Floating-point numbers can be as large as 3.4028235E+38 and as low as -3.4028235E+38. They are stored as 32 bits (4 bytes) of information

BITS AND BYTES?

- How does a computer count?
- What is Base 2 number system?

> You See the Number 3, The Computer Sees 0011

- Bits, Bytes, Words

41_{10} = 0010 1001
254_{10} = 1111 1110
255_{10} = 1111 1111
256_{10} = 0001 0000 0000

2 BYTES

BIT

0000 0000 0010 1001

BYTE = 4 Bits

WORD = 2 BYTES

Int (Integer) = 2 BYTES

Decimal (Base 10)	Binary (Base 2)	Hex (Base 8)
0	0000 0000	0
1	0000 0001	1
2	0000 0010	2
3	0000 0011	3
4	0000 0100	4
5	0000 0101	5
6	0000 0110	6
7	0000 0111	7
8	0000 1000	8
9	0000 1001	9
10	0000 1010	A
11	0000 1011	B
12	0000 1100	C
13	0000 1101	D
14	0000 1110	E
15	0000 1111	F
16	0001 0000	10

Rollover...

- [GitHub steamClown Arduino](#)
- First look at [steamClass_IntRollover_1](#)
- Then look at [steamClass_IntRollover_2](#)
- Then look at [steamClass_IntRollover_3](#)

- What Is This Code Doing?

```
void setup()
{
int intRollOver = 32764;
}

void loop()
{
        while(intRollOver != -32764){
            Serial.print("Intiger =  ");  // this prints text
            Serial.println(intRollOver); // this prints integer
            intRollOver++;
        }
}
```

- Now Change it to be an Unsigned Integer
  - int : 16-bit (2-byte) value. This yields a range of -32,768 to 32,767 (minimum value of -2^15 and a maximum value of (2^15) - 1)
  - unsigned int 2 byte value. Instead of storing negative numbers, they only store positive values, yielding a useful range of 0 to 65,535 (2^16) - 1).

LETS DO SOME MATH

```
{
  Serial.begin(9600);
  int a = 1;
  int b = 2;
  int c = a + b;
  Serial.print("a + b = ");
  Serial.println(c);
}
```

- Open and Download Sketch "Math"
  - steamClass_Math
- Now do some math in the Main Loop

x = a + b;   a = a + b;

x = a - b;

x = x * b;

x = a / b;

- Know that integer constants default to int, so some constant calculations may overflow (e.g. 60 * 1000 will yield a negative result)

- Know at what point your variable will "roll over" and also what happens when it does

APPENDIX

APPENDIX A: LICENSE & ATTRIBUTION

- This content is primarily the Intellectual Property of Jim Burnham, Top STEAM Clown, at STEAMClown.org

- This presentation and content is distributed under the Creative Commons License CC-by-nc-sa-3.0

- My best attempt to properly attribute, or reference any other sources or work I have used are listed in Appendix B

APPENDIX B: ATTRIBUTION FOR SOURCES USED

- http://www.arduino.cc/ ← Official Arduino Site

REFERENCE SLIDES

STEAM CLOWN™
& Squeaky Hinge
PRODUCTIONS

IS IT POSSIBLE TO GET HELP?

- Git Hub – See Steam Clown's Files
- http://www.arduino.cc/ ← Official Arduino Site
- http://www.arduinobook.com/
- Google Is Your Friend…
  - Google Arduino Getting Started
  - Google Arduino Tutorials
  - Google Arduino Sketches
- PDF books
  - Arduino Programmers Notebook
  - Arduino in a Nutshell
  - Introduction to Arduino - A piece of cake!
- YouTube
  - Arduino: Your First Arduino Sketch
  - Tutorial 01 for Arduino: Getting Acquainted with Arduino