Rules

- You may work together, but you are expected to turn in your own independent writeup of the answers.
- HW is due on sakai by the beginning of class.
- Better to hand an answer in late than not at all.
- Email questions to TAs/professor or ask in class.
1. How Many Pops?

A. When the flag is clicked, how many times will the pop sound happen before everything stops?

B. What value will num have at the end?
An “xor” gate takes two bits as input, A and B. It produces one bit of output, which is equal to True if an odd number of bits (exactly one of A and B, in this case) are True. It can be constructed out of 2 nots, 1 or, and 2 ands.

If we generalize to a “Parity-\(k\)” gate, there are \(k\) input bits and still one output bit, which is True if an odd number of inputs are True. It can be constructed out of \(k-1\) separate “xor” gates.

How many nots, ands, and ors does it take to make a “Parity-16” gate?
3. A Machine Says What?

What will \( E \) be after each of these short machine-language programs are executed? Give a logical expression like \( E = \ldots \).

(A) \[
\begin{align*}
\text{acc} &= B \\
E &= \text{acc} \\
\text{acc} &= \text{not} \ A \\
E &= \text{acc and} \ E
\end{align*}
\]

(B) \[
\begin{align*}
\text{acc} &= B \\
E &= \text{acc} \\
\text{acc} &= \text{not} \ A \\
E &= \text{acc and} \ E \\
\text{acc} &= \text{not} \ C \\
\text{acc} &= \text{acc or} \ A \\
E &= \text{acc and} \ E
\end{align*}
\]
4. Evaluation Trees

For each of the following evaluation trees, write down the corresponding Boolean formula that is being evaluated and a small $ML^3$ program. Below is an example. Remember only use statements from the slide in lecture 10 for part 2.

Example Problem

```
A
and
not
B
```

Example Answer

```
Part 1
A and not B
acc = not B
acc = acc and A

Part 2
```
4. Evaluation Trees

(A) or
   not
   B
   A

(B) and
   A
   not
   B

(C) and
   or
   A
   not
   B
   A
   C
   B

(D) not
   and
   A
   B
5. Sing a Song

Write a scratch program that prints the lyrics to a song of your choosing. Use a subroutine (broadcast) at least twice.

Reminder: There are links on our website to scratch programs that do something very similar, for example the Magical Mystery Tour. You can download these programs from the Scratch page, open it in the Scratch program and modify it.
6. Happy Halloween!

Download scratch. Write a program that could act as a Halloween card for someone of your choosing (friend, teammate, family member, pet, celebrity). Have fun and be creative!

Your program should include some:

- animation
- sound
- keyboard interaction

To turn in your program, you can upload it to sakai as an attachment or upload it to the scratch site and send us the URL.