Lab 6 posted

To bounce properly use constrain()

\[
\text{constrain}(x, a, b) = \begin{cases} 
  a & x < a \\
  x & a \leq x \leq b \\
  b & x > b 
\end{cases}
\]

- Lite! Glider

- Turing Machines
Glider (rule: B3/S23)

0th Gen.

1st Gen.

Exercise: continue this for at least 3 more generations.
Turing Machines
languages we've studied.
- Light-Bot
- Processing
- Circuits

now! Turing machine lang.
what is an Algorithm?
Defy

a collection of donations that are

1.) well ordered
   always know what is next.

2.) unambiguous
   primitive ops. only

3.) Effectively Computable?
   Computable by some Turing machine.

4.) Produce a result
   answer or error msg.

5.) Halts in finite time
    on good input
A TM includes a **tape** that extends infinitely in both directions.

---

divided into cells. **Each cell** is written a single **symbol** from a finite set called the **alphabet**. The **alphabet** contains a special symbol called **blank**, denoted by 'b'. All but finitely many cells contain **blank**.
A TM also has a device called head that reads and writes symbols onto the tape.

A TM also has a finite set of internal states

\[ S = \{ 1, 2, \ldots, n \} \]

\[ \text{Ex.} \]

- \[ b \mid b \mid 0 \mid 1 \mid 0 \mid 1 \mid b \mid b \mid b \mid b \mid \ldots \]
A TM performs exactly one basic operation consisting of three actions:

1.) write a symbol in a cell (overwriting current symbol)

2.) go into a new state (could be current state)

3.) move head one cell left or right

which symbol to write, which new state to assume, and which direction to move depend on current state & symbol.
Thus each instruction is a conditional or of the following form:

If (in state i) and (reading symbol k)
write symbol k
go into state s
move in direction D

We specify such an instruction by a 5-tuple

\[(i, j, k, s, D)\]
Ex. $(2, 0, 1, 5, R)$

Says 1

if in state 2 reading 0

write 1

go to state 5

move right

\[ \begin{array}{cccccccc}
  & & & & & & & \\
  & & b & b & 0 & 1 & 0 & b \\
\end{array} \]

\[ \begin{array}{cccccccc}
  & & & & & & & \\
  & & b & b & 1 & 1 & 0 & b \\
\end{array} \]
A configuration is a combination of tape, head location, and state.