Loops: for loops & while loops

- Using a loop to solve a problem is called iteration.

- while is similar to if statements but while repeatedly
  "loops back" and executes the statement until the
  expression is false.

- General format of a while loop:
  
  setup statement(s)
  while (expression) {
    body statement(s)
    update statement(s)
  }

- for loops are a "condensed" version of a while loop.

Loop: Exercise

Define the following C function: (use iteration)

// draw_circle(size) draws a circle inside of a square
// with dimensions (size * 2 + 1)
// requires: size >= 1
// effects: produces output

- There is a simple example of the output in "simple.expect"
Integer Overflow: Introduction

- Any variable in C takes up a certain amount of memory (bits).
- This limits the range of values that can be represented.
- Any time you try to go past this limit it is called an “overflow”

Integer Overflow

- A variable of type `int` allocates 32 bits of memory.
- Able to represent negative and positive numbers, so roughly half of this range is negative and roughly half is positive.

As an **INT** it is impossible to represent outside of the range of:

<table>
<thead>
<tr>
<th>INT_MIN</th>
<th>$-2^{31}$</th>
<th>$-2147483648$</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT_MAX</td>
<td>$2^{31} - 1$</td>
<td>$2147483647$</td>
</tr>
</tbody>
</table>

which is why we have **other** data-types

Demo: Overflow

Overflow illustrated - Seashell Demo
<table>
<thead>
<tr>
<th>Variable Type</th>
<th>Description</th>
<th>Printf</th>
</tr>
</thead>
<tbody>
<tr>
<td>int</td>
<td>Integer (numbers)</td>
<td>%d</td>
</tr>
<tr>
<td>char</td>
<td>Characters</td>
<td>%c</td>
</tr>
<tr>
<td>float</td>
<td>Floating Point decimal numbers</td>
<td>%f</td>
</tr>
<tr>
<td>double</td>
<td>Double precision floating value</td>
<td>%f</td>
</tr>
</tbody>
</table>

Characters

Characters are integers that are typically used to hold single pieces of text data. They are 8-bit (max value of 127).

```c
char nine = '9';
char not_nine = 9; // Be careful! This is a tab!
char a = 'a';
char also_a = 97; // Equivalent, but bad practice.
char space = ' ';
char newline = '\n'; // Some characters use escape codes.
```

Character: Exercise

Define the following C function: (use iteration)

```
swapcase(c) changes c from upper to lower case
// (or vice-versa) and leaves non-letter
// values of c unchanged
// requires: size >= 1
// effects: produces output
```