Tutorial 3

- Side effects
- Reading input
- Global variables & mutation
- Loops

```java
while (!understand(loop_knowledge)) {
    ++loop_knowledge;
}
```
Side effects

(there are 3 types of side effects in functions for now)

- print output
- read input
- mutate a global variable
// MANY SIDE EFFECTS

int y = 2;

int main(void) {
    int x = read_int();
    printf("%d", printf("%d", y));
    if ((x = y - 1)) {
        printf("%d", x = x + 2);
    }
    if (x) {
        y *= y;
        printf("%d", y);
    }
    printf("\n");
}
Side Effects: printing vs. returning

```c
int pure_functional(int n) {
    return n * n;
}

// effects: displays a message
void just_a_side_effect(int n) {
    printf("n squared is %d\n", n * n);
    return; // (optional)
}

// effects: displays a message
int has_both_side_effect_and_return_value(int n) {
    printf("n squared is %d\n", n * n);
    return n * n;
}
```
Read Input: Exercise

Modify the code below to print out the average of the input. For example, if the input is 1, 2, 3, 2, then the program should print out 2.

```c
int main(void) {
    int n = 0;
    while (1) {
        n = read_int();
        if (n == READ_INT_FAIL) {
            break;
        }
    }
}
```
Global variables & mutation

- Global variables are defined *outside* of functions (at the “top level”).

- A function that mutates a global variable **does** have a side effect.

- Even if a function does not have a side effect, its behaviour may depend on other mutable global variables.
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:

```java
setup statement(s)
while (expression) {
    body statement(s)
    update statement(s)
}
```

• **for** loops are a “condensed” version of a **while** loop.
for vs. while

Recall the for syntax.

```
for (setup; expression; update) { body statement(s) }
```

This while example

```
i = 100;  // setup
while (i >= 0) {  // expression
    printf("%d\n", i);
    --i;  // update
}
```

is equivalent to

```
for (i = 100; i >= 0; --i) {
    printf("%d\n", i);
}
```
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"