

pre-conditions conditions must be true...
 - before enter fn

post-conditions - after " "

loop invariants - at the top and bottom of a loop body

```

int foo(...) {
  assert( pre-conditions );
  for ( .. ) {
    assert( loop invariant );
  }
  assert( loop invariant );
  assert( post-conditions );
  return result;
}
  
```

Uses

- assert(...):
- thinking about expectations
- communicating expectations via comments in some organizations (not req'd here)

Pre-conditions, post-conditions, and loop invariants

A *pre-condition* to a function is a condition that must be true before *entering* the function—no matter what.

A *post-condition* to a function is a condition that must be true before *leaving* the function—no matter what.

A *loop invariant* is a condition that must be true at the beginning and end of the body of a loop.

Pre-conditions may include expectations about the arguments (except for type, which the compiler guarantees).

Post-conditions and loop invariants should depend only on whether the function is implemented correctly.

Exercise: Consider the code below. *No assert for external inputs*

```

struct Node {          // SINGLY-linked list
    int value;
    struct Node* next;
};

// Insert a new node with the given value before an existing node.
// If the list is empty, create a new node, which becomes the head.
void insert_after(struct Node* existing, int value, struct Node** a_head) {
    // ... pre - ...
}
// post - ...

// Create a list with the numbers from start to stop. Return the head.
struct Node* create_count_list(int start, int stop) {
    struct Node* head = NULL; // start as empty list
    struct Node* tail = NULL;
    for(int value = start; value <= stop; value++) {
        loop inv → insert_after(tail, value, &head);
        tail = tail -> next;
    }
    return head;
}

```

(eg. args passed by main())
after
int main() { struct Node head = NULL; insert_after(head, 5, &head); }*

1) **Pre-conditions.** Write ≥ 2 pre-conditions *in English and/or code* for `insert_after(...)`.

a) _____

b) _____

2) **Post-conditions.** Write ≥ 2 pre-conditions *in English and/or code* for `insert_after(...)`.

a) **a-head != NULL*

b) _____

3) **Loop invariants.** Write ≥ 2 loop invariants *in English and/or code* for the loop in `create_count_list(...)`.

a) _____

b) _____