Exercise:

1. specify: `let r = ref 5 and s = ref 3 and t = r`.

2. specify the state after subsequently executing: `incr r`.

3. specify the state after subsequently executing: `incr t`.

In-place list reversal.

Before the loop:

After the loop:

Loop invariant:

Mlength with a while loop.

Before the loop:

After the loop:
Exercises for MPRI Separation Logic course 1

Loop invariant:

Exercise: generalize MList to define $p \rightsquigarrow \text{MlistSeg } q \ L$, where $L$ denotes the list of items in the list segment from $p$ (inclusive) to $q$ (exclusive).

\[ p \rightsquigarrow \text{MlistSeg } q \ L \equiv \]

Enter:

Exit:

Step:

Exercise: define the representation predicate $p \rightsquigarrow \text{Queue } L$. 
Exercise: define \( p \leadsto \text{Mtree}\, T \).

Exercise: define \( p \leadsto \text{MtreeDepth}\, n\, T \) by generalizing \( p \leadsto \text{Mtree}\, T \).

Exercise: give an alternative definition of \( "p \leadsto \text{MtreeDepth}\, n\, T" \), this time by reusing the definition of \( p \leadsto \text{Mtree}\, T \) without modification.

Exercise: define a predicate \( p \leadsto \text{MtreeComplete}\, T \) for describing a mutable complete binary tree, of some unspecified depth.

Exercise: define a predicate \( p \leadsto \text{MsearchTree}\, E \) for describing a mutable binary search tree storing the set of elements \( E \).
**Exercise:** specify the primitive operations on references.

\[
\text{(ref } v \text{)} \\
\text{(!} r \text{)} \\
\text{(} r := v \text{)}
\]

Give specifications for:

\[
\text{(Array.get } i \text{ p)}
\]

\[
\text{(Array.set } i \text{ p } v)
\]

\[
\text{(Array.length } p)
\]

\[
\text{(Array.create } n \text{ v)}
\]

Interpretation of triples (1/3).
How is a triple \( \{H\} t \{Q\} \) interpreted?

\[
\forall m. \ H m \ \Rightarrow \ \exists v. \exists m'. \ \langle t, m \rangle \downarrow \langle v, m' \rangle \land
\]

Interpretation of triples (2/3).
In Separation Logic, a triple describes only a part \( m_1 \) of the heap.
The rest of the heap, call it $m_2$, is assumed to remain unchanged.

How is a triple $\{H\} t \{Q\}$ interpreted?

What is the *natural* specification of function `myref`?

What is missing from our current interpretation of triple?