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:
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.

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

Give specifications for:

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

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

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

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

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

\[\forall m. \ H m \Rightarrow \exists v. \exists m'. \ (t, m) \downarrow (v, m') \land\]

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?