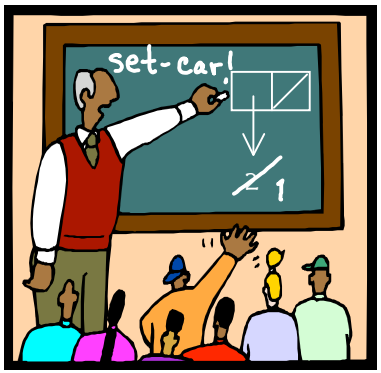
6.001 recitation 11 3/21/07

- stack, queue problems



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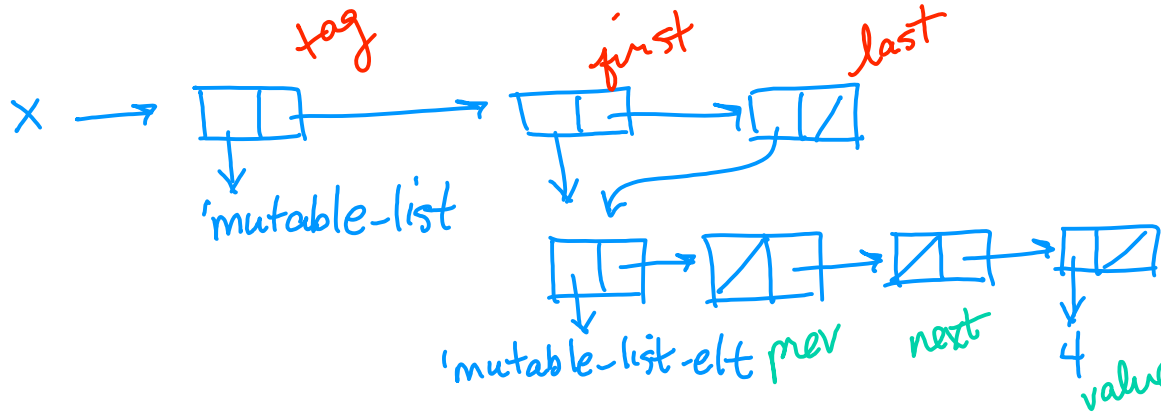
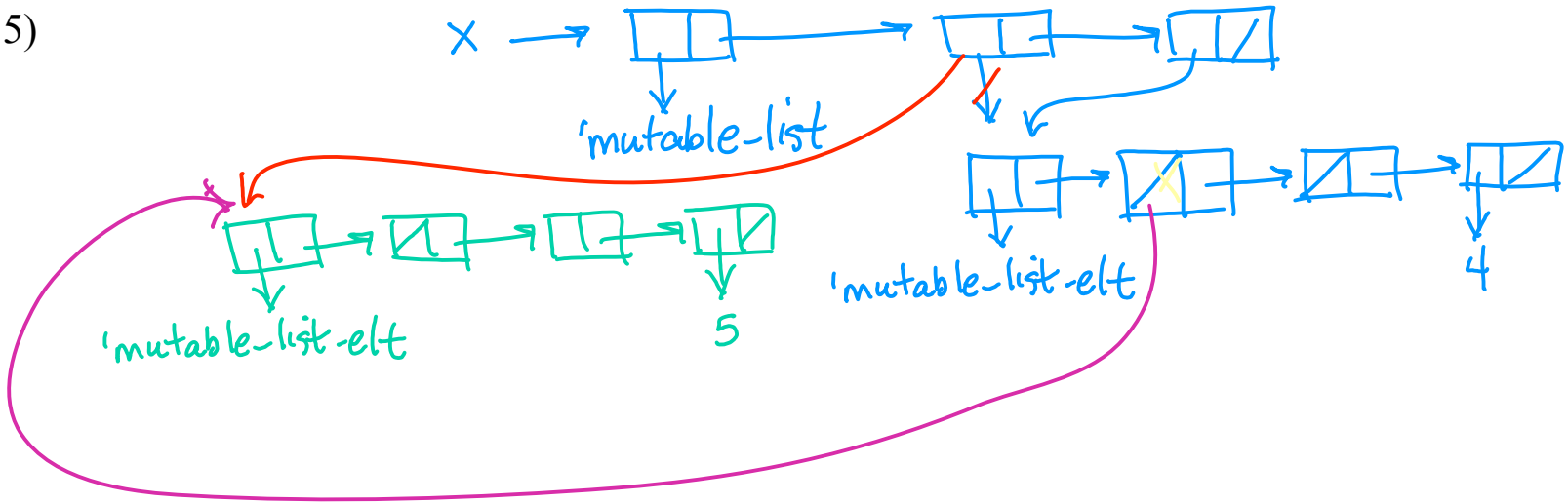
stacks and queues

We'll implement stacks and queues using the ADT, mutable-list, described in the accompanying handout. Here's an example.

```
(let*  ((e  (make-element  4))
        (x  (make-mutable-list e  e)))
x)
```




```
(add-to-front!  x  5)
```



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Using the procedures for a new data type called mutable-list, provided in the accompanying handout, write the following procedures.

1. Define set-last! which modifies the first or last pointers of a mutable-list to point at the new elements. set-first! is defined for you. (Recall that the car of a mutable-list is a tag, so the first list element is actually the cadr.)

```
(define (set-first! m-l e)
;;  type:  mutable-list, <element|null>→ unspecified
  (if (mutable-list? m-l)
      (set-car! (cdr m-l) e)
      (error  "not a mutable list")))

(define (set-last! m-l  e)
;;  type:  mutable-list, <element|null>→ unspecified
```

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2. Define set-prev! and set-next! that change the prev or next field of a mutable-element.

```
(define (set-prev! element prev)
;;  type:  element,  <element|null>→ unspecified
```

```
(define (set-next! element next)
;;  type:  mutable-list, <element|null>→ unspecified
```

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3. Complete the definition for add-to-front! which takes any value and adds a new element to the front of the list containing that value. Then define add-to-back! which does the same for the back of the list.

```
(define (add-to-front! lst item)
;;  type:  mutable-list A → unspecified
  (let ((e  (make-element  item)))
     (cond  ((not  (mutable-list?  lst))
                (error "not a mutable list"))
            ((empty-mutable-list?  lst)
                (set-first! lst  e)
                (set-last!
```

```
(define (set-next! element next)
 ;;  type:  mutable-list, <element|null>→ unspecified
```

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4. Complete the definition for add-to-front! which takes any value and adds a new element containing that value to the front of the list.

```
(define (add-to-front! lst item)
;;  type:  mutable-list A → unspecified
  (let ((e  (make-element  item)))
    (cond  ((not  (mutable-list?  lst))
              (error "not a mutable list"))
          ((empty-mutable-list?  lst)
              (set-first! lst  e)
              (set-last!  lst  e))
          (else
```

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5. Write add-to-back! which takes any value and adds a new element containing that value to the back of the list.

```
(define (add-to-back! lst item)
;;  type:  mutable-list A → unspecified
```

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6. Complete the definition for remove-from-back! which removes the last element and returns it.

```
(define (remove-from-back! lst)
;;  type:  mutable-list → A
  (let ((e  (make-element  item)))
     (cond  ((not  (mutable-list?  lst))
                (error "not a mutable list"))
            ((empty-mutable-list?  lst)
                (error "list is empty"))
            ((single-entry?  lst)
```

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7. Write remove-from-front! which removes the first element and returns it.

```
(define (remove-from-front! lst)
;;  type:  mutable-list → A
```

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8. Write push! and pop! to use the mutable list as a stack.

9. Write enqueue! and dequeue! to use the mutable list as a queue.

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10. Using either a stack or a queue (or both!) define a procedure rpn-calc that takes a simple arithmetic expression in postfix notatino and evaluates it. You may assume a procedure list->mutable-list which takes a Scheme list and returns the corresponding doubly-linked list.

e.g. (rpn-calc '(1 2 +) → 3
(rpn-calc '(5 1 2 + - 10 + 6 / 3 *)) → 6

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11. Can you define rpn-calc without using any mutating procedure?