

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
 Department of Electrical Engineering and Computer Science
 6.001—Structure and Interpretation of Computer Programs
 Fall 2007

Recitation 20 — 11/16/2007
Amb Evaluator

AMB Eval

The AMB evaluator adds one new special form called **amb** which takes a set of possible values and returns one of them. For example,

`(amb 1 2 3)` could take on the value 1, 2, or 3.

amb called with no values represents **a failure**: there are no possible values, so the evaluator needs to **backtrack** and try another value.

In addition to the new special form, a new procedure named **require** is often useful:

```
(define (require p)
  (if (not p) (amb)))
```

One way to read that definition is to check the condition **p**, and if it is true, then proceed, otherwise backtrack to try some other set of values before proceeding.

Example:

```
(let ((a (amb 1 2 3 4)))
  (require (even? a))
  (require (> a 3))
  a)
```

How about this version?

```
(let ((a (an-element-of (list 1 2 3 4))))
  (require (even? a))
  (require (odd? a))
  a)
```

Implementing AMB as an evaluator

In the normal version of the analyzer evaluator, **analyze** takes in an expression, and returns a procedure that takes in an environment as argument and carries out that operation.

In **amb-eval** the procedures returned are different and all look like this:

8 Queens

Suppose you have a $n \times n$ chessboard. How can you place n queens on the board such that all the positions are safe (no other queen can capture one of the others in a single move).

For $n = 2$, there are no solutions, though for $n = 8$ there are several, one of which is:

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Write a procedure `queens` which uses `amb` to produce solutions to this puzzle.

To begin with, notice that any solution will have exactly one queen in each row and column of the solution. As such let's represent a solution as a list of n elements: each element represents the row that that column's queen is in. For example `(queens 4) \implies (2 4 1 3)` is one possible solution.

The following helper procedures may be useful:

```
(define (an-element-of items)
  (require (not (null? items))))
  (amb (car items) (an-element-of (cdr items))))

(define (distinct? items)
  (cond ((null? items) #t)
        ((null? (cdr items)) #t)
        ((member (car items) (cdr items)) #f)
        (else (distinct? (cdr items)))))

(define (enumerate-interval l u)
  (if (> l u) '()
      (cons l (enumerate-interval (+ l 1) u))))

(define (except n lst)
  (filter (lambda (x) (not (eq? x n))) lst))
```