Trees
The definition of a tree
The definition of a tree

- The empty tree is a tree.
- A nonempty tree has three parts.
  - root — an element.
  - left-subtree — a tree.
  - right-subtree — a tree.
my-tree

(define my-tree
  '(4 (2 (1 () ()) (3 () ())) (6 (5 () ()) (7 () ()()))))
my-tree

(define my-tree
  '(4 (2 (1 () ()) (3 () ())) (6 (5 () ()) (7 () ()))))

-   -   -
my-tree

(define my-tree
  '(4 (2 (1 () ()) (3 () ())) (6 (5 () ()) (7 () ()))))
The definition of a binary search tree (BST)
The definition of a binary search tree (BST)

- Every element in the left subtree is less than the root.
- Every element in the right subtree is greater than the root.
- The left subtree is a BST.
- The right subtree is a BST.
Preorder traversal

Returns a list
Preorder traversal

Returns a list

If the tree is not empty
• Visit the root.
• Do a preorder traversal of the left subtree.
• Do a preorder traversal of the right subtree.
Preorder traversal

Returns a list

What is the preorder traversal?
Preorder traversal

Returns a list

(4 2 1 3 6 5 7)
(preorder-onto (a b c))
(preorder-onto '(a b c))
(preorder-onto (a b c))

(preorder-onto (a b c))
(preorder-onto (a b c) '(a b c))

(preorder-onto (a b c) '(a b c))

(6 5 7 a b c)
(preorder-onto '(a b c))
(preorder-onto ' (a b c))

(preorder-onto ' (6 5 7 a b c))
(preorder-onto '(a b c))

(2 1 3 6 5 7 a b c)

(2 1 3 6 5 7 a b c)
(preorder-onto '(a b c))

(2 1 3 6 5 7 a b c)

(preorder-onto '(6 5 7 a b c))

(2 1 3 6 5 7 a b c)
Inorder traversal

Returns a list

If the tree is not empty
• Do an inorder traversal of the left subtree.
• Visit the root.
• Do an inorder traversal of the right subtree.
The definition of an expression tree

• A number is an expression tree.
• A non-number tree has three parts.
  • A left operand — an expression tree.
  • An operator name.
  • A right operand — an expression tree.
my-expression

(define my-expression
  '(1 + (2 * (3 - 5))))