PHP Arrays

- Arrays in PHP are quite versatile
  - See http://php.net/manual/en/language.types.array.php
  - We can use them as we use **traditional arrays**, indexing on integer values
  - We can use them as **hashes**
    - You may know hashing from CS2150 associating a key with a value in an arbitrary index of the array
  - In either case we access the data via subscripts
    - In the first case the subscript is the integer index
    - In the second case the subscript is the key value
  - We can even mix the two if we'd like

PHP Arrays

- Creating Arrays
  - PHP Arrays can be created in a number of ways
    - Explicitly using the array() construct
    - Implicitly by indexing a variable
      - Since PHP has dynamic typing, you cannot identify a variable as an array except by assigning an actual array to it
      - If the variable is already set to a string, indexing will have undesirable results – indexes the string!
      - However, we can unset() it and then index it
        - » We can test a variable to see if it is set (isset()
          and if it is an array (is_array()) among other things
    - Size will increase dynamically as needed

More on PHP Arrays

- Accessing Arrays – can be done in many ways
  - We can use **direct access** to obtain a desired item
    - Good if we are using the array as a hash table or if we need direct access for some other reason
    - We provide the key and retrieve the value
  - For **sequential access**, the **foreach** loop was designed to work with arrays
    - Iterates through the items in two different ways

      `foreach ($arrayvar as $key => $value)`

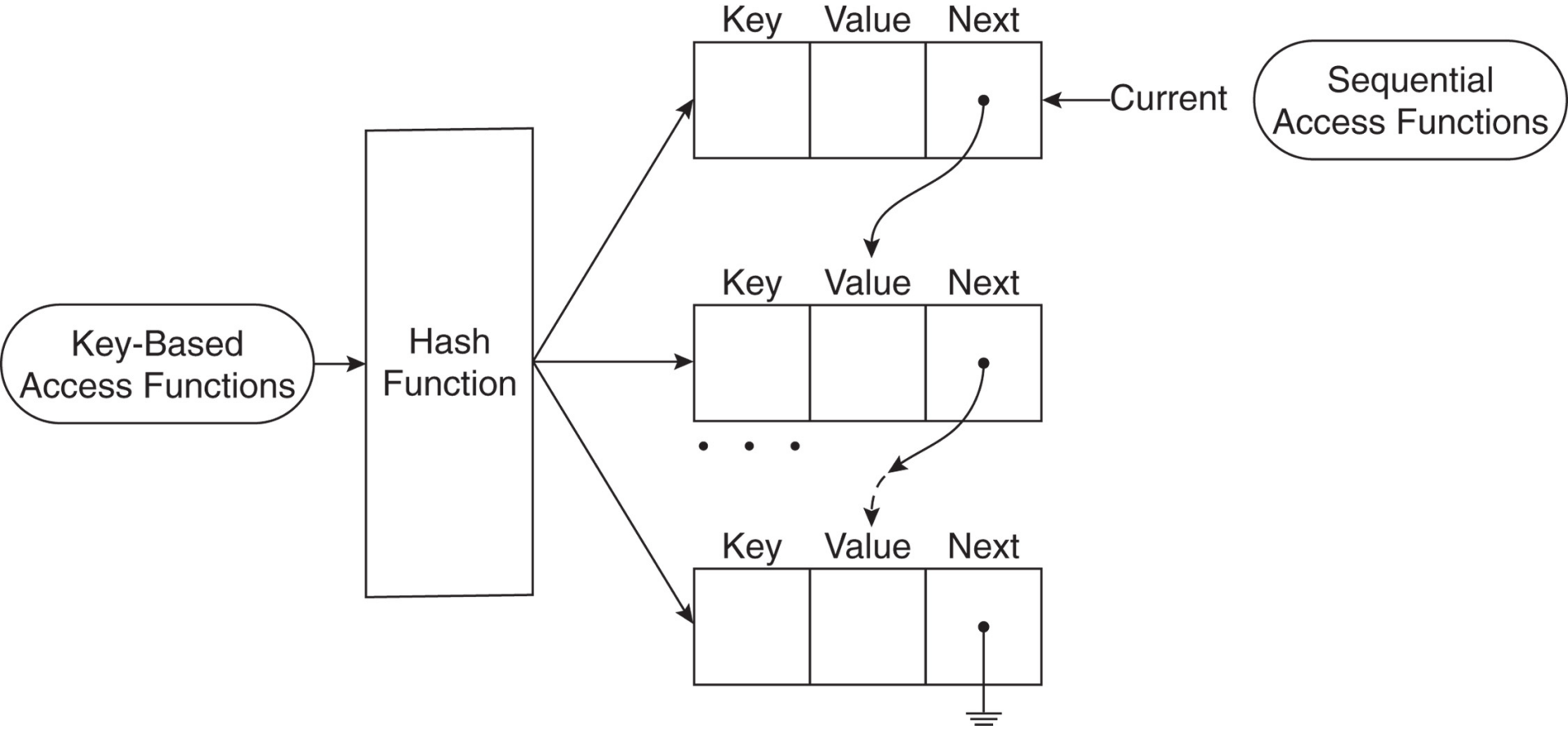
      » Gives both the key and value at each iteration

      `foreach ($arrayvar as $value)`

      » Gives just the next value at each iteration

PHP Arrays

- How can these both be done efficiently?
  - PHP arrays are not implemented in the traditional way
    - Ex: In Java or C++ the array is a contiguous collection of memory locations
  - PHP arrays more resemble a linked list But wouldn't this not allow direct access?
  - The locations are also hashed
    - The "key" in PHP arrays is actually a hash value
  - So sequential access follows the linked list
  - Direct access accesses via the hash value



(Figure 9.3 in Sebesta text)

More on PHP Arrays

- Be careful – iteration via foreach is in the **order the data has been generated**, not by index order
  - i.e. it follows the linked list
    - Thus, even arrays with identical keys and values can have different orderings
  - Items accessed in the arrays using foreach are copies of the data, not references to the data
    - So changing the loop control variable in the foreach loop in PHP does NOT change the data in the original array
    - To do this we must change the value using indexing
  - A regular for loop can also be used, but due to the non-sequential requirement for keys, this does not often give the best results

More on PHP Arrays

- The data in the array is not contiguous, so incrementing a counter for the next access will not work correctly unless the array index values are used in the "traditional" way

```
for (int $i = 0; $i < count($A); $i++):
        echo "$A[$i] <br/>";
endfor;
```

  - We know that there are count($A) items in $A
    - What we do NOT know, is under which indices they are being stored
      - There is no requirement that they have to start at 0 or even be integers at all
    - See ex7.php

More on PHP Arrays

- In addition to foreach, we there are other array iterators that we can use
  - Ex: Using **next** to access the array elements
    - The next() function gives us the **next value** in the array with each call; end of list returns false
      - It **moves** to the next item, **then returns** it, so we must get the first item with a separate call (ex: use current())

```
$curr = current($a1);
while ($curr):
      echo "\$curr is $curr <br/>\n";
      $curr = next($a1);
endwhile;
```

More on PHP Arrays

- Ex: Using each to iterate:
  - The each() function returns a pair with each call
    - A key field for the current key
    - A value field for the current value
    - It returns the next (key,value) pair, then moves, so the first item is no longer a special case

```
while ($curr = each($a1)):
    $k = $curr["key"];
    $v = $curr["value"];
    echo "key is $k and value is $v <BR />\n";
endwhile;
```

    - This function may be preferable to next() if it is possible that FALSE or an empty string or 0 could be in the array
      - The loop on the previous slide will stop for any of those values

More on PHP Arrays

- Both of these iteration functions operate similar to the **Iterator interface** in Java
  - Iterate through the data in the collection without requiring us to know how that data is actually organized
  - However, **unlike in Java**, if the array is changed during the iteration process, the current iteration is NOT invalidated
    - Since new items are always added at the "end" of the array (from an iterator's point of view) adding a new item during an iteration does not cause any data validity problems
    - However, we need to be careful if doing this – can lead to an infinite iteration

Sorting PHP Arrays

- There are various predefined sort functions in PHP
  - sort (rsort for reverse)
    - Sorts arrays of numbers numerically
    - Sorts arrays of strings alphabetically
    - If mixed, the strings count as 0 compared to numbers
    - Reindexes array so that keys start at 0 and increment from there
  - asort
    - Same as sort but retains the original key values (arsort for reverse)

Sorting PHP Arrays

- PHP uses Quicksort to sort arrays
  - This means that PHP sorting is NOT STABLE
  - What does it mean for a sort to be STABLE?
    - Given equal keys K_1 and K_2, their relative order before and after the sort will be the same
  - Due to data movement during partition, Quicksort is not stable
    - Implications?
    - If we want stability, we will have to do it ourselves
      - See Web for some solutions
  - See ex8.php

Two-dimensional Arrays

- Array values can be any legal PHP type
  - This includes the array type, and allows for arbitrary dimensional arrays
  - We may think of them as "arrays of arrays"
  - It seems odd but once you know the array syntax it follows quite naturally

```
$a[0] = array(1,2,3,4);
$a[1] = array(5,6,7,8);
$a[2] = array(9,10,11,12);
```

Two-dimensional Arrays

- In fact Java 2-D arrays are implemented in a similar way
  - Although in Java they must be homogeneous
  - We can also use "normal" indexing for 2-D PHP arrays
    - Keep in mind that the key values are still arbitrary, so we need to be careful
    - The standard nested i, j loops that work in Java and C++ may not be appropriate here
      - They will only work if we use the arrays in the "normal" way consistently
    - More general access can be done via iterators or recursive functions – we will see this soon
    - See ex9.php

Functions and Parameters

- General syntax:

```
function name ( params )
{
    // statements
    // optional return statement
}
```

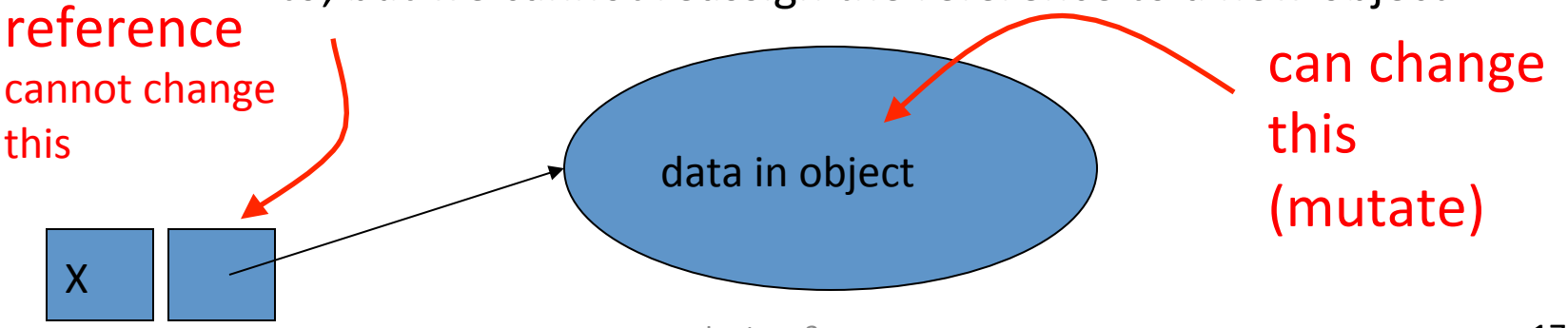
  - Parameters are optional
  - Note that there is no return type in the header
    - If no return statement is used, the function will return NULL
    - If return is done, type could be anything
  - Cannot overload function names
    - Dynamic typing does not allow for disambiguation

Functions and Parameters

- By default, parameters are passed **by value**
  - Formal parameter is a **copy** of the actual parameter
  - Changes to formal parameter do not affect the actual parameter
- If we add an ampersand before the formal parameter, we change it to pass **by reference**
  - Like in C++, but not an option in Java
  - Formal parameter is **another name** for the actual parameter
  - Changes to the formal parameter also change the actual parameter

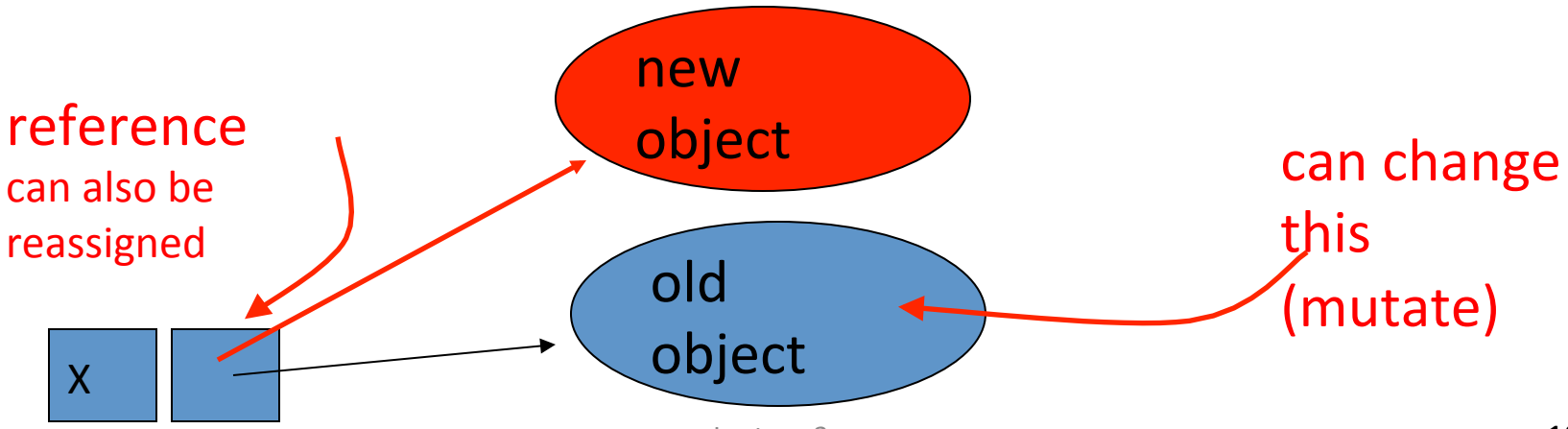
Value vs. Reference Parameters

- Let's discuss this a bit
  - Java has only **value parameters**
    - This means we cannot alter the data **stored in the actual parameter** within the function
    - However, in many cases the data passed into the function is **itself a reference**
      - This allows us to change the object that the reference refers to, but we cannot reassign the reference to a new object



Value vs. Reference Parameters

- **Reference parameters** allow the data in the object to be changed
  - Assuming the parameter is a reference to an object
- They also allow the reference to be reassigned so that the actual parameter can reference a different object



Value vs. Reference Parameters

- Implications:
  - In Java we can alter objects, including the contents of arrays, via parameters
    - However, the argument itself (either a primitive value or a reference) cannot change
    - If we want to reassign a variable within a method what can we do?
      - » Use instance variables
      - » Pass them in via an array (i.e. hack)
  - In PHP we CAN reassign a reference with a function if we want
    - Be careful if you choose to do this
      - » Avoid inadvertent changes to arguments

Functions and Parameters

- Variables within functions by default are local to the function
  - Like method variables in Java or automatic variables in C++
  - We can use the **global** declaration to state that a variable used in a function is a global rather than a local variable
- See ex10.php