

## Arrays (Lists)

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An *array* is a sequence of scalars, indexed by position (0,1,2,...)

The whole array is denoted by `@array`

Individual array elements are denoted by `$array[index]`

`$#array` gives the *index of the last element*.

Example:

```
$a[0] = "first string";
```

```
$a[1] = "2nd string";
```

```
$a[2] = 123;
```

```
# or, equivalently,
```

```
@a = ("first string", "2nd string", 123);
```

```
print "Index of last element is $#a\n";
```

```
print "Number of elements is ", $#a+1, "\n";
```

## Arrays (Lists)

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```
@a = ("abc", 123, 'x');  
  
# scalar context ... gives list length  
$n = @a;           # $n == 3  
  
# string context ... gives space-separated elems  
$s = "@a";         # $s eq "abc 123 x"  
  
# scalar context ... gives list length  
$t = @a."";        # $t eq "3"  
  
# list context ... gives joined elems  
print @a;          # displays "abc123x"
```

In Perl, interpretation is context-dependent.

## Arrays (Lists)

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Arrays do not need to be declared, and they grow and shrink as needed.

"Missing" elements are interpolated, e.g.

```
$abc[0] = "abc"; $abc[2] = "xyz";  
# reference to $abc[1] returns ""
```

Can assign *to* a whole array; can assign *from* a whole array, e.g.

```
@numbers = (4, 12, 5, 7, 2, 9);  
($a, $b, $c, $d) = @numbers;
```

Since assignment of list elements happens in parallel ...

```
($x, $y) = ($y, $x);    # swaps values of $x, $y
```

## Arrays (Lists)

---

Array *slices*, e.g.

```
@list = (1, 3, 5, 7, 9);  
print "@list[0,2]\n";    # displays "1 5"  
print "@list[0..2]\n";   # displays "1 3 5"  
print "@list[4,2,3]\n";  # displays "9 5 7"  
print "@list[0..9]\n";   # displays "1 3 5 7 9"
```

Array values interpolated into array literals:

```
@a = (3, 5, 7);  
@b = @a;           # @b = (3,5,7);  
@c = (1, @a, 9);    # @c = (1,3,5,7,9);  
@a == (@a) == ((@a)) ...
```

## Arrays (Lists)

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Arrays can be accessed element-at-a-time using the for loop:

```
@nums = (23, 95, 33, 42, 17, 87);  
$sum = 0;  
# @nums in scalar context gives length  
for ($i = 0; $i < @nums; $i++) {  
    $sum += $nums[$i];  
}  
$sum = 0;  
foreach $num (@nums) { sum += $num; }
```

push and pop act on the "right-hand" end of an array:

	<i># Value of @a</i>
@a = (1,3,5);	<i># (1,3,5)</i>
push @a, 7;	<i># (1,3,5,7)</i>
\$x = pop @a;	<i># (1,3,5,7), \$x == 7</i>
\$y = pop @a;	<i># (1,3,5), \$y == 5</i>

## Arrays (Lists)

---

Other useful operations on arrays:

<code>@b = sort(@a)</code>	returns sorted version of @a
<code>@b = reverse(@a)</code>	returns reversed version of @a
<code>shift(@a)</code>	like <code>pop(@a)</code> , but from left-hand end
<code>unshift(@a,x)</code>	like <code>push(@a,x)</code> , but at left-hand end

## Lists as Strings

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Recall the marks example from earlier on; we used "54,67,88" to effectively hold a list of marks.

Could we turn this into a real list if e.g. we wanted to compute an average?

The *split* operation allows us to do this:

Syntax: `split(/pattern/, string)` returns a list

The *join* operation allows us to convert from list to string:

Syntax: `join(string, list)` returns a string

(Don't confuse this with the `join` filter in the shell. Perl's `join` acts more like `paste`.)

# Lists as Strings

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## Examples:

```
$marks = "99,67,85,48,77,84";

@listOfMarks = split(/,/ , $marks);
# assigns (99,67,85,48,77,84) to @listOfMarks

$sum = 0;
foreach $m (@listOfMarks) {
    $sum += $m;
}

$newMarks = join(':',@listOfMarks);
# assigns "99:67:85:48:77:84" to $newMarks
```



## Lists as Strings

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Complex splits can be achieved by using a full regular expression rather than a single delimiter character.

If part of the regexp is parenthesised, the corresponding part of each delimiter is retained in the resulting list.

```
# returns (ab,c,d,e)  
split(/[#@]+/, 'ab##@#c#d@@e');  
# returns (ab,##@#,c,#,d,@,e)  
split(/([#@]+)/, 'ab##@#c#d@@e');  
# returns (ab,#,c,#,d,@,e)  
split(/([#@])+/, 'ab##@#c#d@@e');
```

And as a specially useful case, the empty regexp is treated as if it matched between every character, splitting the string into a list of single characters:

```
# returns (h, e, l, l, o)  
split(/,/, 'hello');
```

## Associative Arrays (Hashes)

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As well as arrays indexed by numbers, Perl supports arrays indexed by strings: *hashes*.

Conceptually, as hash is a set (not list) of (*key*, *value*) pairs.

We can deal with an entire hash at a time via *%hashName*, e.g.

#	Key	Value
%days = (	"Sun"	=> "Sunday",
	"Mon"	=> "Monday",
	"Tue"	=> "Tuesday",
	"Wed"	=> "Wednesday",
	"Thu"	=> "Thursday",
	"Fri"	=> "Friday",
	"Sat"	=> "Saturday" );

# Associative Arrays (Hashes)

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Individual components of a hash are accessed via

`$hashName{keyString}`

Examples:

```
$days{"Sun"}    # returns "Sunday"
$days{"Fri"}    # returns "Friday"
$days{"dog"}    # is undefined (interpreted as "")
$days{0}        # is undefined (interpreted as "")

# inserts a new (key,value)
$days{"dog"} = "Dog Day Afternoon";

# replaces value for key "Sun"
$days{"Sun"} = "Soonday";
```

## Associative Arrays (Hashes)

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Consider the following two assignments:

```
@f = ("John", "blue", "Anne", "red", "Tim", "pink");  
%g = ("John" => "blue", "Anne" => "red",  
      "Tim" => "pink");
```

The first produces an array of strings that can be accessed via position, such as `$f[0]`

The second produces a lookup table of names and colours, e.g. `$g{"Tim"}`.

In fact the symbols `=>` and comma have identical meaning in a list, so either right-hand side could have been used. However, always use the arrow form exclusively for hashes.

## Associative Arrays (Hashes)

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Consider iterating over each of these data structures:

```
foreach $x (@f) {  
    print "$x\n";  
}
```

```
John  
blue  
Anne  
red  
Tim  
pink
```

```
foreach $x (keys %g) {  
    print "$x => $g{$x}\n";  
}
```

```
Anne => red  
Tim => pink  
John => blue
```

The data comes out of the hash in a fixed but arbitrary order (due to the hash function).

# Associative Arrays (Hashes)

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There are several ways to examine the (*key*, *value*) pairs in a hash:

```
foreach $key (keys %myHash) {  
    print "($key, $myHash{$key})\n";  
}
```

or, if you just want the values without the keys

```
foreach $val (values %myHash) {  
    print "(?, $val)\n";  
}
```

or, if you want them both together

```
while (($key,$val) = each %myHash) {  
    print "($key, $val)\n";  
}
```

Note that each method produces the keys/values in the same order. It's illegal to change the hash within these loops.

# Associative Arrays (Hashes)

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Example (collecting marks for each student):

- a data file of (*name*, *mark*) pairs, space-separated, one per line
- out should be (*name*, *marksList*), with comma-separated marks

```
while (<>) {  
    chomp;      # remove newline  
    ($name, $mark) = split;  # separate data fields  
    $marks{$name} .= ",$mark"; # accumulate marks  
}  
foreach $name (keys %marks) {  
    $marks{$name} =~ s/,//;  # remove comma prefix  
    print "$name $marks{$name}\n";  
}
```

## Associative Arrays (Hashes)

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The `delete` function removes an entry (or entries) from an associative array.

To remove a single pair:

```
delete $days{"Mon"};  # "I don't like Mondays"
```

To remove multiple pairs:

```
delete @days{ ("Sat", "Sun") };  # No weekend!
```

To clean out the entire hash:

```
foreach $d (keys %days) {  
  delete $days{$d};  
}
```

```
# or, more simply  
%days = ();
```