*Dafny Cheatsheet*

## Imperative and OO

| **Keyword(s)** | **What it does** | **Snippet** |
| --- | --- | --- |
| **var** | declares variables | **var** nish: int;  **var** m := 5; /\* inferred type \*/  **var** i: int, j: nat;  **var** x, y, z: bool := 1, 2, true; |
| **:=** | assignment | z **:=** false;  x, y **:=** x+y, x-y; /\* parallel assignment \*/ |
| **if..else** | conditional statement | **if** z { x := x + 1; } /\* braces are \*/  **else** { y := y - 1; } /\* mandatory \*/ |
| **if..then ..else** | conditional expression | m := **if** x < y **then** x **else** y; |
| **while forall** | loops | **while** x > y { x := x - y; } **forall** i | 0 <= i < m { Foo(i); } |
| **method returns** | subroutines | /\* Without a return value \*/  **method** Hello() { print “Hello Dafny”; }  /\* With a return value \*/  **method** Norm2(x: real, y: real)  **returns** (z: real) /\* return values \*/  { /\* must be named \*/  z := x \* x + y \* y;  }  /\* Multiple return values \*/  **method** Prod(x: int) **returns** (dbl: int, trpl: int)  { dbl, trpl := x \* 2, x \* 3; } |
| **class** | object classes | **class** Point /\* classes contain \*/  { /\* variables and methods \*/  var x: real, y: real  method Dist2(that: Point) returns (z: real)  requires that != null  { z := Norm2(x - that.x, y - that.y); }  } |
| **array** | typed arrays | var a := new bool[2];  a[0], a[1] := true, false;  method Find(a: **array**<int>, v: int)  returns (index: int) |

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## Specification

| **Keyword(s)** | **What it does** | **Snippet** |
| --- | --- | --- |
| **requires** | precondition | method Rot90(p: Point) returns (q: Point)  requires p != null  { q := new Point; q.x, q.y := -p.y, p.x; } |
| **ensures** | postcondition | method max(a: nat, b: nat) returns (m: nat)  ensures m >= a /\* can have as many \*/  ensures m >= b /\* as you like \*/  { if a > b { m := a; } else { m := b; } } |
| **assert assume** | inline propositions | assume x > 1;  assert 2 \* x + x / x > 3; |
| **! && || ==> <== <==>** | logical connectives | assume (z || !z) && x > y;  assert j < a.Length ==> a[j]\*a[j] >= 0;  assert !(a && b) <==> !a || !b; |
| **forall exists** | logical quantifiers | assume forall n: nat :: n >= 0; assert forall k :: k + 1 > k; /\* inferred k:int \*/ |
| **function**  **predicate** | pure definitions | function min(a: nat, b: nat): nat  { /\* body must be an expression \*/  if a < b then a else b  }  predicate win(a: array<int>, j: int)  requires a != null  { /\* just like function(...): bool \*/  0 <= j < a.Length  } |
| **modifies** | framing (for methods) | method Reverse(a: array<int>) /\* not allowed to \*/  modifies a /\* assign to elements of “a” otherwise \*/ |
| **reads** | framing (for functions) | predicate Sorted(a: array<int>) /\* not allowed to \*/  reads a /\* refer to “a[\_]” otherwise \*/ |
| **invariant** | loop invariants | i := 0;  while i < a.Length  invariant 0 <= i <= a.Length  invariant forall k :: 0 <= k < i ==> a[k] == 0  { a[i], i := 0, i + 1; }  assert forall k :: 0 <= k < a.Length ==> a[k] == 0; |
| **set seq**  **multiset** | standard data types | var s: set<int> := {4, 2};  assert 2 in s && 3 !in s;  var q: seq<int> := [1, 4, 9, 16, 25];  assert q[2] + q[3] == q[4];  assert forall k :: k in s ==> k\*k in q[1..];  var t: multiset<bool> := multiset{true, true};  assert t - multiset{true} != multiset{};  /\* more at: \*/  /\* <http://rise4fun.com/Dafny/tutorial/Collections> \*/ |