**Quick Start**

*How to write a one-line “hello, world” program*

1. Create the file hello.chpl:

writeln(“hello, world”);

2. Compile and run it:

> chpl hello.chpl

> ./a.out

hello, world

>

**Comments**

// single-line comment

/\* multi-line

comment \*/

**Primitive Types**

|  |  |  |  |
| --- | --- | --- | --- |
| Type | Default size | Other sizes | Default init |
| bool | impl. dep. | 8, 16, 32, 64 | false |
| int | 32 | 8, 16, 64 | 0 |
| uint | 32 | 8, 16, 64 | 0 |
| real | 64 | 32, 128 | 0.0 |
| imag | 64 | 32, 128 | 0.0i |
| complex | 128 | 64, 256 | 0.0+0.0i |
| string | variable |  | “” |

**Variables, Constants and Configuration**

**var** x: **real** = 3.14; *variable of type real set to 3.14*

**var** isSet: **bool**; *variable of type bool set to false*

**var** z = -2.0i; *variable of type imag set to -2.0i*

**const** epsilon: **real** = 0.01; *runtime constant*

**param** debug: **bool** = **false**; *compile-time constant*

**config** **const** n: **int** = 100; *> ./a.out --n=4*

**config** **param** d: **int** = 4; *> chpl -sd=3 x.chpl*

**Modules**

**module** M1 { code; } *module definition*

**module** M2 {

**use** M1; *module use*

**def** main() { body(); } *main definition*

}

**Expression Precedence and Associativity\***

|  |  |
| --- | --- |
| Operators | Uses |
| . () [] | member access, call and index |
| new *(right)* | constructor call |
| : | cast |
| \*\* *(right)* | exponentiation |
| reduce scan dmapped | reduction, scan, apply domain map |
| ! ~ *(right)* | logical and bitwise negation |
| \* / % | multiplication, division, modulus |
| *unary* + - *(right)* | positive identity, negation |
| + - | addition, subtraction |
| << >> | shift left, shift right |
| <= >= < > | ordered comparison |
| == != | equality comparison |
| & | bitwise/logical and |
| ^ | bitwise/logical xor |
| | | bitwise/logical or |
| && | short-circuiting logical and |
| || | short-circuiting logical or |
| .. | range construction |
| in | loop expression |
| by # | range/domain stride and count |
| if forall [ for sync single | conditional expression, parallel iterator expression, serial iterator expression, synchronization type |
| , | comma separated expression |

\*Left-associative except where indicated

**Casts and coercions**

**var** i: **int** = 2.0:**int**; *cast real to int*

**var** x: **real** = 2; *coerce int to real*

**Conditional and Loop Expressions**

**var** half = **if** i%2 **then** i/2+1 **else** i/2;

writeln(**for** i **in** 1..n **do** i\*\*2);

**Assignment and Swap**

**Simple Assignment:** =

**Compound Assignments:** += -= \*= /= %= \*\*=

&= |= ^= &&= ||= <<= >>=

**Swap:**  <=>

**Statements**

**if** cond **then** stmt1(); **else** stmt2();

**if** cond { stmt1(); } **else** { stmt2(); }

**select** expr {

**when** equiv1 **do** stmt1();

**when** equiv2 { stmt2(); }

**otherwise** stmt3();

}

**type** **select** actual {

**when** type1 **do** stmt1();

**when** type2 { stmt2(); }

**otherwise** stmt3();

}

**while** condition { … }

**while** condition **do** …;

**do** { … } **while** condition;

**for** index **in** aggregate { … }

**for** index **in** aggregate **do** …;

**label** outer **for** …

**break**; *or* **break** outer;

**continue**; *or* **continue** outer;

**Functions**

**def** bar(r: **real**, i: **imag**): **complex** {

**var** c: **complex** = r + i;

**return** c;

}

**def** foo(i) **return** i\*\*2 + i + 1;

**Formal Argument Intents**

|  |  |
| --- | --- |
| Intent | Semantics |
| in | copied in |
| out | copied out |
| inout | copied in and out |
| *blank* | formal arguments are constant except arrays, domains, syncs are passed by reference |

**Named Formal Arguments**

**def** foo(arg1: **int**, arg2: **real**) { … }

foo(arg2=3.14, arg1=2);

**Default Values for Formal Arguments**

**def** foo(arg1: **int**, arg2: **real** = 3.14);

foo(2);

**Records**

**record** Point { *record definition*

**var** x, y: **real**; *declaring fields*

}

**var** p: Point; *record instance*

writeln(sqrt(p.x\*\*2+p.y\*\*2)); *field accesses*

p = **new** Point(1.0, 1.0); *assignment*

**Classes**

**class** Circle { *class definition*

**var** p: Point; *declaring fields*

**var** r: **real**;

}

**var** c = **new** Circle(r=2.0); *class construction*

**def** Circle.area() *method definition*

**return** 3.14159\*r\*\*2;

writeln(c.area()); *method call*

**class** Oval: Circle { *inheritance*

**var** r2: **real**;

}

**def** Oval.area() *method override*

**return** 3.14159\*r\*r2;

**delete** c; *free memory*

c = **new** Oval(r=1.0,r2=2.0); *polymorphism*

writeln(c.area()); *dynamic dispatch*

**Unions**

**union** U { *union definition*

**var** i: **int**; *alternatives*

**var** r: **real**;

}

**Tuples**

**var** pair: (**string**, **real**); *heterogeneous tuple*

**var** coord: 2\***int**; *homogeneous tuple*

pair = (“one”, 2.0); *tuple assignment*

(s, r) = pair; *destructuring*

coord(2) = 1; *tuple indexing*

**Enumerated Types**

**enum** day {sun,mon,tue,wed,thu,fri,sat};

**var** today: day = day.fri;

**Ranges**

**var** every: **range** = 1..n; *range definition*

**var** everyOther = every **by** 2; *strided range*

**var** R = 0..#count; *counted range*

**var** FiveBy2 = 0.. by 2 # 5; *0, 2, 4, 6, 8*

**Domains and Arrays**

**var** D: **domain**(1) = [1..n]; *domain*

**var** A: [D] **real**; *array*

**var** Set: **domain**(**int**); *associative domain*

Set += 3; *add index to domain*

**var** SD: **sparse** **subdomain**(D); *sparse domain*

**Domain Maps**

**var** B= **new dmap**(

**new** Block([1..n]))**;** *block distribution*

**var** D: **domain**(1) **dmapped** B; *distributed domain*

**var** A: [D] **real**; *distributed array*

**var** D2: **domain**(1) **dmapped**

Block([1..n]); *domain map sugar*

**Data Parallelism**

**forall** i **in** D **do** A(i) = 1.0; *domain iteration*

[i **in** D] A(i) = 1.0; *“*

**forall** a **in** A **do** a = 1.0; *array iteration*

[a **in** A] a = 1.0; *“*

A = 1.0; *array assignment*

**Reductions and Scans**

**Pre-defined:** + \* & | ^ && || min max

minloc maxloc

**var** sum = + **reduce** A; *1 2 3 => 6*

**var** pre = + **scan** A; *1 2 3 => 1 3 6*

**var** ml = minloc **reduce** (A, A.**domain**);

**Iterators**

**def** squares(n: **int**) { *serial iterator*

**for** i **in** 1..n **do**

**yield** i\*\*2; *yield statement*

}

**for** s **in** squares(n) **do** …; *iterate over iterator*

**Task Parallelism**

**begin** task();

**cobegin** { task1(); task2(); }

**coforall** i **in** aggregate **do** task(i);

**sync** { **begin** task1(); **begin** task2(); }

**serial** condition **do** stmt();

**Synchronization Examples**

**1)** **var** lock$: **sync** **bool**;

lock$ = **true**; lock$ = **true**; *fill lock*

critical1(); critical2();

lock$; lock$; *empty lock*

**2)** **var** data$: **sync** **int**;

data$ = produce1(); consume(data$);

data$ = produce2(); consume(data$);

**3)** **var** go$: **single** **real**;

go$=set(); use1(go$); use2(go$);

**Locality**

***Built-in Constants:***

**config** **const** numLocales: **int**; *set via -nl*

**const** LocaleSpace = [0..numLocales-1];

**const** Locales: [LocaleSpace] **locale**;

**var** c: Circle;

**on** Locales(i) { *migrate task to new locale*

writeln(**here**.id);

c = **new** Circle(); *allocate class on locale*

}

writeln(c.**locale**); *query locale of class instance*

on c do { … } *data-driven task migration*

**More Information**

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