

# Software Specification (2IW05)

## Z and Alloy Notations: A Quick Reference

### Logic and Set Theory

Z	Alloy	Intuitive meaning
$p \wedge q$	p and q, p && q	conjunction
$p \vee q$	p or q, p    q	disjunction
$p \Rightarrow q$	p implies q, p => q	implication
$\neg p$	not p, ! p	negation
$\forall a : A \mid p_0 \bullet p_1$	all a:A   p0 implies p1	universal quantification
$\exists a : A \mid p_0 \bullet p_1$	some a:A   p0 and p1	existential quantification
$\emptyset$	none	the empty set
$\#A$	# A	cardinality
$a \in A$	a : one A (see the note below)	membership*
$a \subseteq A$	a in A	subset or equal
$(a \subseteq A) \wedge (\#a \geq 1)$	a : some A	non-empty subset or equal
$a \subseteq A \wedge \#a \leq 1$	a : lone A	option
$=$	=	equality
$[Name]$	sig Name {}	given set
$\mathbb{P} A$		power set
$A \cap B$	A & B	intersection
$A \cup B$	A + B	union
$A \setminus B$	A - B	difference

### Relations and Functions

Z	Alloy	Intuitive meaning
$A \times B$	A -> B	Cartesian product
$R \cdot R$	R.R	composition
$\text{dom } R$	R.univ	domain
$\text{ran } R$	univ.R	range
$A \triangleleft R$	A <: R	domain restriction
$R \triangleright B$	R >: B	range restriction
$A \mapsto B$	A -> lone B	partial function
$f \oplus \{a \mapsto b\}$	R ++ (a->b)	function (relation) overriding

### Sequences

Z	Alloy	Intuitive meaning
$\text{seq } A$	seq A	sequence
$s \frown t$	s.append[t]	concatenation
$\text{head } s$	s.first	head
$\text{tail } s$	s.rest	tail
$\text{ran } s$	s.elems	elements

\* There is no notion of membership in Alloy; a : one A, or alternatively a : A, specifies that a is a singleton *subset* of A.

## Schemas

<i>State</i>
$a : A$
$p(a)$

```
sig State { a : A }  
fact { all s : S | p(s.a) }
```

<i>Op</i>
$\Delta State$
$i? : I$
$o! : O$
$p(a, a', i?, o!)$

```
pred Op(s,s' : State, i?: I, o!: O)  
  { p(s.a,s'.a, i?: I, o!: O) }
```