Solver setups

Name	Solver	Flags	Input
Vampire	Vampire	`-ind struct`	SMT-LIB
Vampire*	Vampire	`-ind struct -indgen on`	SMT-LIB
Vampire**	Vampire	`-ind struct -indgen on -indoct on`	SMT-LIB
Cvc4	CVC4	`--quant-ind`	SMT-LIB
Cvc4-Gen	CVC4	`--quant-ind --conjecture-gen`	SMT-LIB
Zeno	Zeno	default mode	functional program encoding
Zipperposition	Zipperposition	default mode	`.zf` (native input format)
ZipRewrite	Zipperposition	default mode	`.zf` with definitions as rewrite rules
Imandra	Imandra	default mode	functional program encoding
Acl2	ACL2	default mode	functional program encoding

Benchmarks

	Vampire	Vampire*	Vampire**	Cvc4	Cvc4-Gen	Zeno	Zipperposition	ZipRewrite	Imandra	Acl2
$\forall x.\forall y.(x+y)=(y+x)$	✓	✓	✓	✓	✓	✓	✓	✓	✓	–
$\forall x.\forall y.\forall z.(x+(y+z))=((x+y)+z)$	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
$\forall x.(x+(x+x))=((x+x)+x)$	–	✓	✓	–	✓	✓	–	✓	–	–
$\forall x.(s(x)+x)=s(x+x)$	–	✓	✓	–	✓	–	–	✓	–	–
$\forall x.\forall y.(x \leq (x+y))$	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
$\forall x.(x \leq (x+x))$	–	✓	✓	–	–	–	–	–	–	–
$\forall x.\forall y.\forall z.(x +\!\!+ (y +\!\!+ z))=((x +\!\!+ y) +\!\!+ z)$	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
$\forall x.(x +\!\!+ (x +\!\!+ x))=((x +\!\!+ x) +\!\!+ x)$	–	✓	✓	–	–	–	–	✓	–	–
$\forall x.\forall y.pref(x, x +\!\!+ y)$	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
$\forall x.pref(x, x +\!\!+ x)$	–	✓	✓	–	–	–	–	–	–	–
x + x + ... 3	–	✓	✓	–	✓	✓	–	✓	–	?
x + x + ... 4	–	90% (9)	100% (10)	–	100% (10)	20% (2)	–	100% (10)	–	?
x + x + ... 5	–	30% (15)	50% (25)	–	100% (50)	12% (6)	–	100% (50)	–	?
x + x + ... 6	–	8% (4)	18% (9)	–	100% (50)	22% (11)	–	100% (50)	–	?
x + x + ... 7	–	–	10% (5)	–	100% (50)	2% (1)	–	100% (50)	–	?
x + x + ... 8	–	–	2% (1)	–	100% (50)	4% (2)	–	100% (50)	–	?
x + x + ... 9	–	–	2% (1)	–	100% (50)	8% (4)	–	84% (42)	–	?
x + x + ... 10	–	–	–	–	100% (50)	8% (4)	–	90% (45)	–	?
x +\!\! + x +\!\! + ... 3	–	✓	✓	–	–	–	–	✓	–	?
x +\!\! + x +\!\! + ... 4	–	70% (7)	90% (9)	–	–	–	–	100% (10)	–	?

	Vampire	Vampire*	Vampire**	Cvc4	Cvc4-Gen	Zeno	ZipperPosition	ZipRewrite	Imandra	Acl2
x ++ x ++ ... 5	–	46% (23)	48% (24)	–	–	–	–	100% (50)	–	?
x ++ x ++ ... 6	–	6% (3)	26% (13)	–	–	6% (3)	–	100% (50)	–	?
x ++ x ++ ... 7	–	2% (1)	6% (3)	–	–	–	–	100% (50)	–	?
x ++ x ++ ... 8	–	–	–	–	–	–	–	90% (45)	–	?
x ++ x ++ ... 9	–	–	–	–	–	–	–	88% (44)	–	?
x ++ x ++ ... 10	–	–	–	–	–	–	–	68% (34)	–	?
$\leq (\mathbf{3},\mathbf{3})$	–	100% (2)	100% (2)	–	100% (2)	100% (2)	–	100% (2)	–	?
$\leq (\mathbf{4},\mathbf{4})$	–	–	15% (3)	–	100% (20)	20% (4)	–	100% (20)	–	?
$\leq (\mathbf{5},\mathbf{5})$	–	–	4% (2)	–	100% (50)	12% (6)	–	100% (50)	–	?
$\leq (\mathbf{1},\mathbf{2})$	–	✓	✓	–	–	–	–	–	–	?
$\leq (\mathbf{2},\mathbf{3})$	–	50% (1)	50% (1)	–	–	100% (2)	–	–	–	?
$\leq (\mathbf{3},\mathbf{4})$	–	–	30% (3)	–	–	40% (4)	–	–	–	?
$\leq (\mathbf{4},\mathbf{5})$	–	–	8% (4)	–	–	16% (8)	–	–	–	?
$\leq (\mathbf{5},\mathbf{6})$	–	–	6% (3)	–	–	10% (5)	–	–	–	?
$\leq (\mathbf{1},\mathbf{3})$	–	100% (2)	100% (2)	–	–	100% (2)	–	100% (2)	–	?
$\leq (\mathbf{2},\mathbf{4})$	–	–	40% (2)	–	–	40% (2)	–	100% (5)	–	?
$\leq (\mathbf{3},\mathbf{5})$	–	–	14% (4)	–	–	28% (8)	–	100% (28)	–	?
$\leq (\mathbf{4},\mathbf{6})$	–	–	10% (5)	–	–	18% (9)	–	100% (50)	–	?
$\leq (\mathbf{5},\mathbf{7})$	–	–	4% (2)	–	–	18% (9)	–	100% (50)	–	?
$\leq (\mathbf{1},\mathbf{4})$	–	100% (5)	100% (5)	–	–	80% (4)	–	100% (5)	–	?
$\leq (\mathbf{2},\mathbf{5})$	–	–	35% (5)	–	–	42% (6)	–	100% (14)	–	?
$\leq (\mathbf{3},\mathbf{6})$	–	–	18% (9)	–	–	38% (19)	–	100% (50)	–	?
$\leq (\mathbf{4},\mathbf{7})$	–	–	6% (3)	–	–	16% (8)	–	100% (50)	–	?
$\leq (\mathbf{5},\mathbf{8})$	–	–	–	–	–	6% (3)	–	100% (50)	–	?
$\leq (\mathbf{1},\mathbf{5})$	–	100% (14)	100% (14)	–	–	85% (12)	–	100% (14)	–	?
$\leq (\mathbf{2},\mathbf{6})$	–	–	33% (14)	–	–	26% (11)	–	100% (42)	–	?
$\leq (\mathbf{3},\mathbf{7})$	–	–	14% (7)	–	–	32% (16)	–	100% (50)	–	?
$\leq (\mathbf{4},\mathbf{8})$	–	–	4% (2)	–	–	18% (9)	–	100% (50)	–	?
$\leq (\mathbf{5},\mathbf{9})$	–	–	–	–	–	14% (7)	–	100% (50)	–	?
$\mathbf{pref}(\mathbf{3},\mathbf{3})$	–	100% (2)	50% (1)	–	–	–	–	100% (2)	–	?
$\mathbf{pref}(\mathbf{4},\mathbf{4})$	–	–	25% (5)	–	–	–	–	100% (20)	–	?
$\mathbf{pref}(\mathbf{5},\mathbf{5})$	–	–	2% (1)	–	–	4% (2)	–	100% (50)	–	?
$\mathbf{pref}(\mathbf{1},\mathbf{2})$	–	✓	✓	–	–	–	–	–	–	?
$\mathbf{pref}(\mathbf{2},\mathbf{3})$	–	–	50% (1)	–	–	50% (1)	–	–	–	?
$\mathbf{pref}(\mathbf{3},\mathbf{4})$	–	–	20% (2)	–	–	20% (2)	–	–	–	?
$\mathbf{pref}(\mathbf{4},\mathbf{5})$	–	–	8% (4)	–	–	8% (4)	–	–	–	?
$\mathbf{pref}(\mathbf{5},\mathbf{6})$	–	–	–	–	–	–	–	–	–	?
$\mathbf{pref}(\mathbf{1},\mathbf{3})$	–	100% (2)	100% (2)	–	–	50% (1)	–	100% (2)	–	?
$\mathbf{pref}(\mathbf{2},\mathbf{4})$	–	20% (1)	40% (2)	–	–	20% (1)	–	100% (5)	–	?
$\mathbf{pref}(\mathbf{3},\mathbf{5})$	–	–	14% (4)	–	–	14% (4)	–	100% (28)	–	?

	Vampire	Vampire*	Vampire**	Cvc4	Cvc4-Gen	Zeno	ZipperPosition	ZipRewrite	Imandra	Acl2
$\mathbf{pref(4,6)}$	–	–	6% (3)	–	–	8% (4)	–	100% (50)	–	?
$\mathbf{pref(5,7)}$	–	–	2% (1)	–	–	2% (1)	–	100% (50)	–	?
$\mathbf{pref(1,4)}$	–	100% (5)	100% (5)	–	–	40% (2)	–	100% (5)	–	?
$\mathbf{pref(2,5)}$	–	–	35% (5)	–	–	21% (3)	–	100% (14)	–	?
$\mathbf{pref(3,6)}$	–	–	14% (7)	–	–	12% (6)	–	100% (50)	–	?
$\mathbf{pref(4,7)}$	–	–	4% (2)	–	–	4% (2)	–	100% (50)	–	?
$\mathbf{pref(5,8)}$	–	–	–	–	–	4% (2)	–	100% (50)	–	?
$\mathbf{pref(1,5)}$	–	100% (14)	100% (14)	–	–	42% (6)	–	100% (14)	–	?
$\mathbf{pref(2,6)}$	–	–	33% (14)	–	–	21% (9)	–	100% (42)	–	?
$\mathbf{pref(3,7)}$	–	–	16% (8)	–	–	16% (8)	–	100% (50)	–	?
$\mathbf{pref(4,8)}$	–	–	10% (5)	–	–	12% (6)	–	100% (50)	–	?
$\mathbf{pref(5,9)}$	–	–	–	–	–	–	–	100% (50)	–	?
$\mathbf{x + s(y) + s(0 + x)...3}$	94% (32)	100% (34)	100% (34)	94% (32)	100% (34)	85% (29)	94% (32)	100% (34)	85% (29)	?
$\mathbf{x + s(y) + s(0 + x)...6}$	60% (30)	76% (38)	68% (34)	68% (34)	74% (37)	52% (26)	62% (31)	96% (48)	74% (37)	?
$\mathbf{x + s(y) + s(0 + x)...9}$	36% (18)	24% (12)	20% (10)	36% (18)	42% (21)	24% (12)	34% (17)	54% (27)	50% (25)	?
$\mathbf{x + s(y) + s(0 + x)...12}$	4% (2)	2% (1)	2% (1)	10% (5)	12% (6)	10% (5)	8% (4)	16% (8)	24% (12)	?
$\mathbf{x + s(y) + s(0 + x)...15}$	–	–	–	–	–	–	–	–	2% (1)	?
$\mathbf{x + s(y) + s(0 + x)...18}$	–	–	–	–	–	–	–	2% (1)	2% (1)	?
$\mathbf{x + s(y) + s(0 + x)...21}$	–	–	–	–	–	–	–	–	–	?
$\mathbf{x + s(y) + s(0 + x)...24}$	–	–	–	–	–	–	–	–	–	?
$\mathbf{x + s(y) + s(0 + x)...27}$	–	–	–	–	–	–	–	–	–	?
$\mathbf{x + s(y) + s(0 + x)...30}$	–	–	–	–	–	–	–	–	–	?
$\mathbf{x_0 + x_1... + x_2 + ...3}$	6% (2)	70% (21)	63% (19)	6% (2)	16% (5)	40% (12)	10% (3)	100% (30)	33% (10)	?
$\mathbf{x_0 + x_1... + x_3 + ...3}$	57% (29)	57% (29)	60% (30)	68% (34)	68% (34)	66% (33)	78% (39)	100% (50)	100% (50)	?
$\mathbf{x_0 + x_1... + x_2 + ...4}$	–	20% (10)	32% (16)	–	8% (4)	28% (14)	10% (5)	74% (37)	6% (3)	?
$\mathbf{x_0 + x_1... + x_3 + ...4}$	4% (2)	20% (10)	18% (9)	4% (2)	4% (2)	20% (10)	20% (10)	57% (29)	14% (7)	?
$\mathbf{x_0 + x_1... + x_4 + ...4}$	8% (4)	6% (3)	14% (7)	22% (11)	26% (13)	44% (22)	24% (12)	34% (17)	34% (17)	?
$\mathbf{x_0 + x_1... + x_2 + ...5}$	–	4% (2)	10% (5)	–	4% (2)	6% (3)	2% (1)	24% (12)	–	?
$\mathbf{x_0 + x_1... + x_3 + ...5}$	–	2% (1)	–	–	6% (3)	12% (6)	6% (3)	26% (13)	2% (1)	?
$\mathbf{x_0 + x_1... + x_4 + ...5}$	–	2% (1)	4% (2)	–	2% (1)	6% (3)	2% (1)	20% (10)	16% (8)	?
$\mathbf{x_0 + x_1... + x_5 + ...5}$	–	–	2% (1)	–	2% (1)	20% (10)	10% (5)	14% (7)	10% (5)	?
$\mathbf{x_0 + x_1... + x_2 + ...6}$	–	–	2% (1)	–	4% (2)	4% (2)	2% (1)	4% (2)	2% (1)	?
$\mathbf{x_0 + x_1... + x_3 + ...6}$	–	–	4% (2)	–	2% (1)	10% (5)	8% (4)	10% (5)	2% (1)	?
$\mathbf{x_0 + x_1... + x_4 + ...6}$	–	–	–	–	–	4% (2)	2% (1)	4% (2)	2% (1)	?
$\mathbf{x_0 + x_1... + x_5 + ...6}$	–	–	–	–	–	2% (1)	–	6% (3)	2% (1)	?
$\mathbf{x_0 + x_1... + x_2 + ...7}$	–	–	2% (1)	–	–	2% (1)	–	4% (2)	–	?
$\mathbf{x_0 + x_1... + x_3 + ...7}$	–	–	–	–	2% (1)	4% (2)	–	–	–	?
$\mathbf{x_0 + x_1... + x_4 + ...7}$	–	–	–	–	–	4% (2)	–	–	–	?
$\mathbf{x_0 + x_1... + x_5 + ...7}$	–	–	–	–	–	–	–	–	–	?
$\forall x.\forall y.(x \times y) = (y \times x)$	–	–	–	–	–	–	–	–	–	?

	Vampire	Vampire*	Vampire**	Cvc4	Cvc4-Gen	Zeno	ZipperPosition	ZipRewrite	Imandra	Acl2
$\forall x.\forall y.\forall z.(x \times (y \times z)) = ((x \times y) \times z)$	–	–	–	–	–	–	–	–	–	?
$\forall x.\forall y.\forall z.(x \times (y + z)) = ((x \times y) + (x \times z))$	–	–	–	–	–	✓	–	–	–	?
$\forall x.\forall y.\forall z.((x + y) \times z) = ((x \times z) + (y \times z))$	–	–	–	–	–	✓	–	–	–	?
$\forall x.\forall y.\forall z.((x + y) \times z) = ((z \times x) + (y \times z))$	–	–	–	–	–	–	–	–	–	?
$\forall x.\forall y.(id(x) + y) = (y + x)$	✓	✓	✓	–	✓	✓	✓	✓	–	?
$\forall x.equal(x, x, x)$	✓	✓	✓	✓	✓	–	✓	✓	–	?
$\forall x.\forall y.\forall z.(equal(x, y, z) \leftrightarrow (x = y \wedge y = z))$	–	–	–	✓	✓	–	✓	✓	–	?
$\forall x.equal(x + (x + x), (x + x) + x, (x + x) + x)$	–	✓	✓	–	✓	–	–	✓	–	?
$\forall x.equal(x + ((x + x) + x), x + (x + (x + x)), (x + x) + (x + x))$	–	–	–	–	✓	–	–	✓	–	?
$\forall x.rev(rev(x)) = x$	–	–	–	–	–	–	–	–	–	?
$\forall x.(x +\!\!+ (rev(x) +\!\!+ x)) = ((x +\!\!+ rev(x)) +\!\!+ x)$	–	✓	✓	–	–	–	–	✓	–	?
$\forall x.rev(x +\!\!+ (x +\!\!+ x)) = rev((x +\!\!+ x) +\!\!+ x)$	–	✓	✓	–	–	–	–	✓	–	?
$\forall x.revAcc(x) = rev(x)$	–	–	–	–	–	–	–	–	–	?