

## Budget Justification

**PI and co-PI** Most of the funding sought will be divided equally among the collaborators, all but two of whom are subcontracted, as discussed in the next subsection.

The PI and co-PI will be seeking hardware support to purchase and update workstations for two implementation projects associated with the proposal, which will run for the full five years for which funding is being sought. One of the projects is the implementation of a relational rewriting system and compiler discussed in the proposal, a prototype of which has been developed by Lipton, Dougherty and students. We also hope to reimplement the rewriting engine on top of a more efficient platform, such as the Maude rewriting system at Stanford. Lipton will also be collaborating with Hermenegildo on the assertion and testing platform discussed in the proposal. We expect an undergraduate, a graduate student (both supported with department funds) and a postdoctoral associate (funded by this grant) to participate in the work at different phases, and we will require four workstations, some peripherals and hardware upgrades. No single item is likely to exceed \$5000 in cost.

Travel support is requested to fund visits between collaborators, and attendance at pertinent conferences. Since the work proposed here calls for some collaboration and fusion of areas not traditionally linked in conferences or prior research (Declarative programming, specification and software engineering) the PI's and collaborators will be attending conferences and workshops in both areas. Also there will be an unusually heavy reliance on collaborative work between different teams involved in the different ends (theoretical and implementation) of the endeavor, requiring extended visits. In particular, Lipton and Dougherty will be collaborating with Hermenegildo's group in Madrid and carrying out research with Levi's group at the University of Pisa.

For this reason we have requested combined (PI + co-PI) annual travel allowances of \$2000 domestic and \$4500 international, as well as setting aside workshop and participant travel support as discussed in the next section.

**Subcontracting** Nine of the eleven collaborators in this research project will be funded by subcontracts to Wesleyan, the other two being the PI and co-PI. With the exception of an overhead-free participant support item of approximately \$ 10,000 per year, set aside at Wesleyan to pay for biannual meetings of the collaborators and workshops, the total award is to be divided evenly amongst all collaborators (\$ 222,500 apiece).

Budget breakdowns for all subcontracts are included in this budget justification. Since some collaborators will be more involved in implementation and others working in the more theoretical aspects of the work described herein, some have requested hardware support (e.g. Lipton, Dougherty), and others graduate student support (Levi, Miller, Palamidessi, de Moor, Hermenegildo, O'Donnell, Nadathur, Buneman) and postdoc support (Levi, Lipton, O'Donnell). Most have requested salary support.

All have requested travel support to attend and send graduate students to the leading relevant conferences: ILPS, PLILP,ALP, ELP in logic programming, LICS, POPL, ICDT (Logic, Programming Languages, Database Theory) RTA (Rewriting), TAPSOFT and other leading Software Engineering conferences.

**University of Chicago**

Collaborating Researchers: Gopalan Nadathur and Michael O'Donnell

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Cumulative
A. Senior Personnel (2 sum mos)						
A1. O'Donnell	25,693	26,464	27,257	28,075	28,917	136,406
A2. Nadathur	16,194	16,680	17,180	17,695	18,226	85,975
A7 Total	41,887	43,144	44,437	45,770	47,143	222,381
B. Other Personnel						
B3. Graduate Student	7,500	7,500	6,750	6,000	5,000	32,750
TOTAL SALARIES (A+B)	49,387	50,644	51,187	51,770	52,143	255,131
C. Fringe Benefits						
	0	0	0	0	0	0
TOTAL SALARIES + FRINGE BEN.	49,387	50,644	51,187	51,770	52,143	255,131
E. Travel						
Domestic	2,850	2,850	2,850	2,850	2,850	14,250
Foreign	2,850	2,850	2,850	2,850	2,850	14,250
G6. Other (Tuition at. 62.5% of B.3)	4,688	4,688	4,219	3,750	3,125	20,470
Total Other Direct Cost	4,688	4,688	4,219	3,750	3,125	20,470
H. Total Direct Costs	59,775	61,032	61,106	61,220	60,968	304,101
I. Indirect Cost (51% excluding G.6)	28,094	28,735	29,012	29,310	29,500	144,651
J. Total Direct and Indirect Costs	87,869	89,767	90,118	90,530	90,468	448,752
L. Amount of Request	87,869	89,767	90,118	90,530	90,468	448,752

**Technical University of Madrid**

Collaborating Researcher: Manuel Hermenegildo

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Cumulative
A. Senior Personnel (2 sum mos)						
A1: M. Hermenegildo	14,045	14,340	14,641	14,948	15,262	73,235
B. Other Personnel						
B3: Graduate Student	6,343	6,476	6,612	6,751	6,893	33,076
TOTAL salaries (A+B)	20,387	20,816	21,253	21,699	22,155	106,312
C: fringe benefits 0						
TOTAL salaries + fringe ben.	20,388	20,816	21,253	21,699	22,155	106,311
E. Travel						
E1.Domestic	2,850	2,850	2,850	2,850	2,850	14,250
E2.Foreign	2,850	2,850	2,850	2,850	2,850	14,250
G. other direct costs						
TOTAL other direct costs	0	0	0	0	0	0
H. TOTAL direct costs (A - G)	26,088	26,516	26,953	27,399	27,855	134,812
I. Indirect Costs (F&A)	17,974	18,351	18,736	19,130	19,532	93,723
J.TOTAL direct and indirect (H+I)	44,062	44,867	45,690	46,529	47,387	228,534
K. residual funds	0	0	0	0	0	0
L. AMOUNT OF REQUEST	44,062	44,867	45,690	46,529	47,387	228,534

**University of Pisa**

Collaborating Researcher: Giorgio Levi

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Cumulative
<b>A. Senior Personnel (2 sum mos)</b>						
Levi	19,381	19,381	19,381	19,381	19,381	96,905
<b>B. Other Personnel</b>						
Postdoctoral Associate	15,000	15,000	15,000	15,000	15,000	75,000
TOTAL salaries (A+B)	34,381	34,381	34,381	34,381	34,381	171,905
<b>C: fringe benefits</b>						
TOTAL salaries + fringe ben.	34,381	34,381	34,381	34,381	34,381	171,905
<b>E. Travel</b>						
Europe	3,000	3,000	3,000	3,000	3,000	15,000
USA	5,000	5,000	5,000	5,000	5,000	25,000
<b>G. other direct costs</b>						
TOTAL other direct costs	0	0	0	0	0	0
<b>H. Total Direct Costs</b>						
Indirect Costs (5% of H)	2,119	2,119	2,119	2,119	2,119	10,595
<b>J. Total Direct and Indirect Costs</b>						
L. Amount of Request	44,500	44,500	44,500	44,500	44,500	222,500

**Oxford University**

Collaborating Researcher: Oege de Moor

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Cumulative
<b>A. Senior Personnel</b>						
	0	0	0	0	0	0
<b>B. Other Personnel</b>						
B3. Graduate Student 1	10973.50	10973.5	10973.5	10973.5	10973.5	54,867.5
B4. Graduate Student 2	10973.50	10973.5	10973.5	10973.5	10973.5	54,867.5
TOTAL SALARIES (B.3 + B.4)	21947	21947	21947	21947	21947	109,735
<b>E. Travel</b>						
(Graduate students B3,B4 in Europe/US)	850	850	850	850	850	4250
<b>G6. Other</b>						
(College + University Fees, for B3 and B4)	14,314	14,314	14,314	14,314	14,314	71,570
Research Fees (for B3,B4)	5,440	5,440	5,440	5,440	5,440	27,200
Total Direct Other	19754	19754	19754	19754	19754	98,770
<b>H. Total Direct</b>						
	42,551	42,551	42,551	42,551	42,551	212,755
<b>I. Indirect cost</b>						
	0	0	0	0	0	0
<b>J. Total Direct + Indirect</b>						
	42,551	42,551	42,551	42,551	42,551	212,755
<b>L. Amount of Request</b>						
	42,551	42,551	42,551	42,551	42,551	212,755

University of Pennsylvania

Collaborating Researchers: Peter Buneman and Peter Freyd

Peter Buneman

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Cumulative
A. Senior Personnel						
A.1 Peter Buneman	12,422	12,086	11,716	11,400	10,942	58,586
TIME in SUMR mos.	1.21	1.13	1.06	0.98	0.96	5.0
B. Other Personnel						
B1. Graduate Student	7,291	7,500	7,708	7,916	8,125	38,540
TOTAL SALARIES (A.1+B.1)	19,733	19,586	19,424	19,316	19,067	97,126
C. Fringe Benefits	3,832	3,722	3,609	3,511	3,370	18,044
TOTAL SALARIES + FRINGE BEN.	23,565	23,308	23,033	22,827	22,437	115,170
E. Travel						
Domestic						
Foreign						
G6. Other (Tuition for B.1)	7,031	7,440	7,878	8,205	8,825	39,379
Total Other Direct Cost	7031	7,440	7,878	8,205	8,825	39,379
H. Total Direct	30,596	30,748	30,911	31,032	31,262	154,549
I. Indirect cost (59%)	13,903	13,752	13,589	13,468	13,238	67,951
J. Total Direct + Indirect	44,500	44,500	44,500	44,500	44,500	222,500
L. Amount of Request	44,500	44,500	44,500	44,500	44,500	222,500

Peter Freyd

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Cumulative
A. Senior Personnel (2 sum mos)						
A. Peter Freyd 2 SUMR mos	20,422	20,422	20,422	20,422	20,422	102,110
TOTAL salaries	20,422	20,422	20,422	20,422	20,422	102,110
C. Emp. Benefits 31.0%	6,331	6,331	6,331	6,331	6,331	31,655
TOTAL SALARIES + FRINGE BEN.	26,753	26,753	26,753	26,753	26,753	133,765
E. Dom. Travel	900	900	900	900	900	4,500
G. OTHER: Supplies	247	247	247	247	247	1,235
H. Total Direct	27,900	27,900	27,900	27,900	27,900	139,500
Indirect Costs 59.5%	16,600	16,600	16,600	16,600	16,600	83,000
J. Total Costs	44,500	44,500	44,500	44,500	44,500	222,500
L. AMOUNT OF REQUEST	44,500	44,500	44,500	44,500	44,500	222,500

**Pennsylvania State University**

Collaborating Researchers: Dale Miller and Catuscia Palamidessi

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Cumulative
A. Senior Personnel (1 sum mo. ea.)						
A1. Miller	16,024	16,585	17,165	17,766	18,388	85,928
A2. Palamidessi	8,667	8,970	9,284	9,609	9,946	46,476
A7 Total	24,691	25,555	26,449	27,375	28,334	132,404
B. Other Personnel						
B3. Graduate Student	16,516	17,095	17,692	18,311	18,953	88,567
TOTAL SALARIES (A+B)	41,207	42,650	44,141	45,686	47,287	220,971
C. Fringe Benefits	8,771	9,077	9,395	9,723	10,064	47,030
TOTAL SALARIES + FRINGE BEN.	49,978	51,727	53,536	55,409	57,351	268,001
E. Travel						
Domestic	2,000	2,000	2,000	2,000	2,000	10,000
Foreign	3,000	3,000	3,000	3,000	3,000	15,000
G6. Other						
(Tuition)	6,730	6,964	7,207	7,461	7,722	36,084
(Supplies, Material, etc)	2,000	2,000	2,000	2,000	2,000	10,000
Total Other Direct Cost	8,730	8,964	9,207	9,461	9,722	46,084
H. Total Direct Costs	63,708	65,691	67,743	69,970	72,073	339,085
I. Indirect Cost (37.13%)	21,156	21,806	22,479	23,173	23,894	112,508
J. Total Direct and Indirect Costs	84,864	87,497	90,222	93,043	95,967	451,593
L. Amount of Request						
(Voluntary cash contrib)	849	875	902	930	960	4,516