The Report of The Third Lisp Contest
and The First Prolog Contest

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benchmarking without analysis is as
useless as analysis without benchmarking
– Richard P. Gabriel and Larry M. Masinter –

Abstract

This is the report of the Third Lisp Contest and the First Prolog Contest. The benchmarks for these Contests were presented at the 28th meeting of WGSYM of IPSJ on June 15, 1984 and the timing results were gathered till August 1985. The benchmarks are distributed more than 70 sites both in Japan and in U.S.A. and Europe. However, almost all the participants are in Japan. It is not meant that almost all the implementations are developed in Japan. The number of Lisp and Prolog implementations measured in these Contests are more than fifty:

The Third Lisp Contest	37 implementations
The First Prolog Contest	20 implementations

This report covers various Lisp and Prolog implementations; from mainframes to micro computers; from general-purpose machines to dedicated Lisp and/or Prolog machines.

The limit of the length of this report allows me to present only the total execution time and the summary of the profile of each system. I had to cut the profile of each system and the detailed information such as garbage collection time, facilities and machine specifications. However, I think that the data presented here will be sufficient to analyze each system, because the ratio of garbage collection time to total execution time is very small except a few benchmarks. The timing results of Lisp benchmarks are shown in alphabetical order of the name of each Lisp system with the exception of the arrangement of the page. The order to provide the timing results is different from that of Lisp benchmarks; first, the timing results for interpreted codes are provided, and then those for compiled codes are shown. This is because the system whose data is shown for both interpreted codes and compiled codes is only DEC-10 PROLOG system.

The comparison of Lisp and Prolog implementations is very difficult. The main reason why Lisp and Prolog are used as a pricipal programming language in Artificial Intelligence research is due to an excellent programming environment which each Lisp or Prolog implementation provides. And one of the key points that Lisp/Prolog can provide such a good programming environments is to use interpreter. This is why I proposed to gather timing data for interpreted codes. In this report, we have no space to describe facilities and programming environments. Therefore, the analysis of the implementation is left to the implementors and the readers. Of course, the speed is very important factor for good programming environments.

I'll publish the complete report of these Contests. If you measure the speed of a new system or the data listed here is updated, please send the results to me by a floppy disk, a magntic tape or electric mail. My network address is as follows:

```
uucp: {titcca, ccut, kddlab, riken, tsuda}!nttmecl!ntt20!okuno
      {hplabs, ihnp4, mcvax, ukc}!kddlab!nttmecl!ntt20!okuno
junet: okuno@ntt20.ntt
```

Any comment or suggestion on this report or benchmarking is welcome. It's not the end of The Third Lisp Contest and The First Prolog Contest, but the start of the next Lisp and Prolog Contest.

References
H.G. Okuno: The proposal of the benchmarks for The Third Lisp Contest and The First Prolog Contest, Report of WGSYM, No. 28-4, IPSJ (June 1985).
R.P. Gabriel: Performance and Evaluation of Lisp Systems, MIT Press, to appear (Aug. 1985)

Lisp System Profile

FRANZ LISP
> implemented in CAMBRIDGE LISP
> measured by Kentaro Shimizu (C.C., University of Tokyo)
> HITAC M280-H under VOS03-SP21

CAMBRIDGE LISP (TOKYO VERSION)
> measured by Yuichi Murao (Computer Center, University of Tokyo, Junet: z0085@todai)
> HITAC M-280H under VOS03-SP21
> [The scalar processor of the vector processor S-810 model 20 is equivalent to M-280H. However, the benchmarks prove that the scalar processor runs faster than M-280H by 10 percents.]

DECUS LISP
> developed by Chris Meyers (Eugene Register Guard)
> measured by Mihoko Okada (University of Niigata)
> PDP 11/44 under RSX 11-M

ELIZA LISP C type / Version 1.17
> developed by Hirokazu Taki
> (Manufacturing Development Lab., Mitsubishi Electoric cop.)
> measured by the author
> HP HP9000-500 under HP-UX with 1.5M byte memory

ETA LISP version 3.00
> developed by Tsukasa Ogasawara and Toshihiro Matsui
> (Electrotechnical Laboratory, MITI) for Robotics Research
> measured by the authors
> DEC VAX-11/780 under VMS with 4M bytes physical memory

EVLIS: Single LISP with A-List Binding version 1.1
> developed by T.Saito , T.Doi , T.Nishikawa , H.Maegawa , H.Yasui
> (Dept. of Applied Physics , Faculty of Engineering , Osaka University)
> measured by the authors
> EVLIS is a dedicated Lisp machine.
> (CPU: EVAL II processor, cycle time: 100 nsec, width of internal bus: 20 bits
> real memory: 160K bytes with 40bit/word)

EVLIS: Parallel LISP with A-List Binding version 1.4
> developed by T.Nishikawa , H.Nishikaichi , H.Yasuda , T.Takahashi , T.Saito , H.Yasui
> (Dept. of Applied Physics , Faculty of Engineering , Osaka University)
> measured by the authors
> EVLIS is a dedicated Lisp machine. *(See above)*

EVLIS: Single LISP with Shallow Binding version 1.2
> developed by T.Saito , T.Doi , T.Nishikawa , H.Maegawa , H.Yasui
> (Dept. of Applied Physics , Faculty of Engineering , Osaka University)
> measured by the authors
> EVLIS is a dedicated Lisp machine. *(See above)*

FLATS LISP
> developed by Kentaro Shimizu, Masayuki Suzuki, Mitsuhisa Sato, Nobuyuki Inada
> (RIKEN, Junet: suzuki@riken, inada@riken)
> measured by the authors
> FLATS is a dedicated Lisp machine developed by Eiichi Goto, Kei Hiraki, Kentaro Shimizu, Takasi Soma, Nobuyuki Inada, Tetuo Ida, Masayuki Suzuki (RIKEN).
> (CPU: cycle time 140ns, internal bus width: 64 bit
>   Memory: virtural and cdr-coding, real memory: 8M byte)

FRANZ LISP OPUS38.79
> implemented by SHARP CORP.
> measured by Suzuki (one of the authors)
> SHARP OA-90DX under UNIX SYSTEM III with 1.8M bytes

FRANZ LISP OPUS 38.79 (LISZT 8.36)
> measured by Kentaro Shimizu (C.C., University of Tokyo)

```
            DEC VAX-11/780 under UNIX 4.2 BSD

   HLISP
            developed by Motoaki Terashima (Univ. of Electro-Communications)
            measured by the author
            MITSUBISHI MELCOM-COSMO 800/3 under UTS/VS

   INTERLISP-10
            measured by Hiroshi G. Okuno (Musashino ECL, N.T.T., Junet: okuno@ntt20.ntt)
            DEC DECSYSTEM-2060 under TOPS-20 5.1 with 2M byte

   INTERLISP-D           Fugue 1.0
            measured by Hiroshi G. Okuno (Musashino ECL, N.T.T., Junet: okuno@ntt20.ntt)
            XEROX 1100 SIP (Dolphine)

   LISP68K
            developed by Tsuyoshi YAMAMOTO, Takahiro KOBAYASHI and Yoshinao AOKI.
            (Hokkaido University, Dept. of Electical Eg.)
            measured by the authors
            68000MPU (12.5MHZ) under CP/M-68K with 1.5MB memory system

   LISPVM
            developed by T. J. Watson Research Center, I.B.M.
            measured by Shigeko Yoda (Musashino ECL, N.T.T.)
            IBM 3081K under CMS

   LISP-09         version 2.10 under OS-9 version
            developed by Teruo Serizawa (KOGAKUIN University)
            measured by the author
            FUJITSU FM-11 AD2  (cpu 6809 2MHz) under OS-9 level II with 128K bytes
            FLEX version is also available.

   LISP3.9         version 0.9
            developed by Mitsuhisa Sato (LOGICA, Inc.)
            measured by the author
            NEC PC9801F (8MHz) under MS-DOS

   LISP05          version 2.8
            developed by Masayuki Ida (Aoyama Gakuin University)
            measured by the author
            NEC N5200-05 under CP/M-86 with 384K bytes
            NEC PC9801 (5MHz)

   KONOLISP        version 01/16
            measured by Nakamura (Hitachi Software Engineering Co., Ltd.)
            SORD M68 under CP/M-68K with 1M byte memery

   KYOTO COMMON LISP (KCL)
            measured by Taiichi Yuasa and Masami Hagiya
            (Research Institute for Mathematical Sciences, Kyoto Unoversity)
            Data General MV10000 under AOS/VS with 10M bytes physical memory

   LISP/I          version 1-1
            developed by Hiromitsu Nakagawa (Matsushita Electoric Industrial Co.,Ltd.)
            measured by the author
            NCR TOWER/1632 under UNIX with 2M byte memory (MC 68000, 10MHz)

   MACLISP         version 2022
            measured by Akira Takura (Musashino ECL, N.T.T., Junet: takura@ntt-vax-5.ntt)
            DEC DECSYSTEM-2060 with 2M word physical memory under Tops-20 version 5.1

   OLISP-V         version 1.0
            developed by Ryouzou Kiyohara, Hirofumi Takeichi, Kouichi Murakami, Toshifumi Saito
   and Hiroshi Yasui (Department of Applied Physics, Faculty of Engineering, Osaka University)
            measured by the authors
            NEC ACOS 1000/40 under ACOS-6 with 64M bytes
```

REWMOL   version 3.3
        developed by Joji Karia (Yamaguchi University, Information Processing center)
        measured by the author
        NEC ACOS 850 under ACOS-6

SYMBOLICS COMMON LISP   release 6 (system 271.19 and microcode 319)
        measured by Robert Cassels (Symbolics Inc.)
        Symbolics 3600 with 1.5M word physical memory (6M Bytes)
        The scheduler is disabled during benchmarking

ZETALISP   release 5.2
        measured by Hiroshi G. Okuno (Musashino ECL, N.T.T.,Junet: okuno@ntt20.ntt)
        Symbolics 3600 with 2M word physical memory (8M Bytes)

T LISP version 2.8
        developed by Yale University
        measured by Kentaro Shimizu (Computer Center, Univ. of Tokyo)
        DEC VAX-11/780 under UNIX 4.2 BSD

TAO   version -20
        developed by Ikuo Takeuchi, Hiroshi G. Okuno and Nobuyasu Osato
        (Musashino Electrical Communication Labs., N.T.T., Junet: nue@ntt20.ntt)
        measured by the authors
        ELIS is a dedicated Lisp machine developed by Yasushi Hibino, Kazufumi Watanabe and
        Nobuyasu Osato (Yokosuka ELectrical Communication Labs., N.T.T.)
        (CPU: cycle time 180ns, internal bus width 32 bit
         Memory: real memory: 4M bytes, writable control store: 32K words, 64 bit word
        Interpreter is microcoded. Multi-user support)

TINY LISP   version 1.7
        developed by T.Ogawa (Department of Mathematics, Tsuda College., Junet: ogawa@tsuda)
        measured by the author
        FUJITSU FM-11EX under CP/M-68K with 128K bytes

TUO-LISP   version 1.0
        developed by Akira Kon (Faculty of Engineering, Tohoku University.)
        measured by the author
        Sumitomo electric industries Ltd. USTATION-E15 under UNIX SYSTEM V (Uniplus)
        with 2M byte memory

ULISP (LISP 1.9)   version #3
        developed by Tatsuo Unemi (Tokyo Institute of Technology)
        measured by Shigeru Wakabayashi (Kobe Industrial High School)
        MITSUBISHI MELCOM-COSMO 800 III

UTILISP
        developed by Takashi Chikayama (ICOT)
        measured by Yuichi Murao (Computer Center, Univ. of Tokyo, Junet: z0085@todai)
        HITAC M-280H under VOS03-SP21

VAX LISP
        developed by DEC
        measured by Maebata (Digital Equipement Corporation, Japan)
        DEC VAX-11/785 under VMS 4.1
        measured by Sugimura (Yokosuka ECL, N.T.T.) using Maebata's program
        DEC VAX 8600 under VMS 4.1
        measured by Hiroshi G. Okuno (Musashino ECL, N.T.T.) using Maebata's program
        DEC VAX-11/780 under VMS 3.7

ZETALISP-PLUS release 1.2
        measured by Hiroshi G. Okuno (Musashino ECL, N.T.T., Junet:okuno@ntt20.ntt)
        LAMBDA with 512 K word physical memory (2M Bytes)

```
                    FRANZ LISP
                      M280-H
                 Interpreted  Compiled
  (milliseconds)      codes      codes
  =========================================
  [1-1] Tarai-4         1446       70.7
  [1-2] Tarai-5        39010     1932
  [1-3] Tarai-6          ---     76110
  [1-4] Tak-18-12-6     7984      418

  [2-1] List-Tarai-4    1928      276
  [2-2] Srev-5            56.7      1.4
  [2-3] Srev-6           228        6
  [2-4] Qsort-50          62.4      2.1
  [2-5] Nrev-30           45.8      1.7
  [2-6] Rev-30             0.048    0.035
  [2-7] Drev-30            0.0365   0.0276
  [2-8] Rev-10             0.028    0.013
  [2-9] Rev-100            0.12     0.11
  [2-10] Rev-1000          1.12     1.15
  [2-11] Rev-10000        12       11
  [2-12] Drev-10           0.01811  0.00976
  [2-13] Drev-100          0.10345  0.09474
  [2-14] Drev-1000         0.9622   0.9343
  [2-15] Drev-10000       10.89    10.03

  [3-1] String-Tarai-4  4600      2948

  [4-1] Flonum-Tarai-4  1997      1337
  [4-2] Bignum-Tarai-4  1188       230

  [5-1] Bubble-50       1579       305

  [6-1] Seq-100           63.35     31.60

  [7-1] BITA-5            55.8       0.95
  [7-2] BITA-6          192          5.16
  [7-3] BITB-5           19.64       0.28
  [7-4] BITB-6           56.44       0.80

  [8-1] Sort-50          14.6       13.9
  [8-2] Sort-10           1.24       1.18
  [8-3] Sort-100         21.6       21.7
  [8-4] Sort-1000       307        309
  [8-5] Sort-10000     4810       4816
  [8-6] Rsort-10          1.20       1.12
  [8-7] Rsort-100        20.7       20.3
  [8-8] Rsort-1000      304        299
  [8-9] Rsort-10000    4745       4753

  [9-1] TPU-1           734        132
  [9-2] TPU-2          3566        400
  [9-3] TPU-3          1253        167
  [9-4] TPU-4          1635        229
  [9-5] TPU-5           242         25
  [9-6] TPU-6          7108        704
  [9-7] TPU-7          1308        144
  [9-8] TPU-8          1283        106
  [9-9] TPU-9           865         76

  [10-1] Prl-Rev-15    2103        304
  [10-2] Prl-sort-20   8890       1740

  [11-1] Diff-3          13.6        0.854
  [11-2] Diff-5        1183         80.9

  [12-1] Boyer       140800       4744
```

(milliseconds)	CAMBRIDGE LISP (TOKYO VERSION) HITAC M-280H/VOS3-SP21				DECUS LISP PDP 11/44	ELIZA LISP HP9000-500
	Interpreted codes		Compiled codes		Interpreted codes	Interpreted codes
[1-1] Tarai-4	1014	[1000]	66.5	[20.3]	33850	862000
[1-2] Tarai-5	27591	[27140]	1809	[558]	S/O	2362000
[1-3] Tarai-6	---		66578	[20436]	S/O	---
[1-4] Tak-18-12-6	1493	[5718]	425	[107]	160700	533000
[2-1] List-Tarai-4	1920		270		53300	547000
[2-2] Srev-5	56.9		1.27		---	40000
[2-3] Srev-6	226.9		5.06		---	16000
[2-4] Qsort-50	62.3		1.96		S/O	40000
[2-5] Nrev-30	0.0505		0.00269		---	43000
[2-6] Rev-30	0.0530		0.0393		2.41	700
[2-7] Drev-30	0.0361		0.0290		3.38	1300
[2-8] Rev-10	0.0271		0.0143		1.17	300
[2-9] Rev-100	0.140		0.126		7.36	180?
[2-10] Rev-1000	1.30		1.26		S/O	170?
[2-11] Rev-10000	13.6		13.2		S/O	---
[2-12] Drev-10	0.0172		0.00981		22.3	1200
[2-13] Drev-100	0.102		0.0948		214	12000
[2-14] Drev-1000	0.957		0.956		S/O	150000
[2-15] Drev-10000	9.70		9.73		S/O	---
[3-1] String-Tarai-4	1929		490		N/A	1982000
[4-1] Flonum-Tarai-4	1144		171		N/A	89000
[4-2] Bignum-Tarai-4	1219		273.4		N/A	---
[5-1] Bubble-50	307	[269]	16.6	[3.39]	N/A	803000
[6-1] Seq-100	38.2	[37.5]	13.0	[12.0]	N/A	3000
[7-1] BITA-5	12.8		0.501		---	25000
[7-2] BITA-6	42.5		1.737		---	81000
[7-3] BITB-5	4.57		0.201		---	5000
[7-4] BITB-6	12.5		0.578		---	4000
[8-1] Sort-50	3.66	[3.22]	3.64	[3.21]	N/A	127000
[8-2] Sort-10	0.757	[0.669]	0.722	[0.639]	N/A	23000
[8-3] Sort-100	69.7	[60.6]	70.6	[60.6]	N/A	23000
[8-4] Sort-1000	6999	[6149]	7140	[6077]	N/A	23000
[8-5] Sort-10000	---		---		N/A	226000
[8-6] Rsort-10	0.716	[0.672]	0.685	[0.637]	N/A	26000
[8-7] Rsort-100	65.6	[59.9]	66.0	[60.0]	N/A	26000
[8-8] Rsort-1000	6566	[6158]	6662	[6069]	N/A	26000
[8-9] Rsort-10000					N/A	264000
[9-1] TPU-1	600		130		S/O	---
[9-2] TPU-2	2630		394		14970	---
[9-3] TPU-3	1019		164		S/O	---
[9-4] TPU-4	1319		228		S/O	---
[9-5] TPU-5	187		23.5		S/O	---
[9-6] TPU-6	5337		688		S/O	---
[9-7] TPU-7	1019		140		S/O	---
[9-8] TPU-8	981		105		S/O	---
[9-9] TPU-9	671		73.9		S/O	---
[10-1] Prl-Rev-15	1048		114		S/O	1247000
[10-2] Prl-Sort-20	1498		174		S/O	1705000
[11-1] Diff-3	12.5		0.661		299	15000
[11-2] Diff-5	1062		64.9		28470	189000
[12-1] Boyer	70790		1540		D/O	---

(milliseconds)	ETA LISP VAX 780		A-list binding single EVLIS	A-list binding parallel EVLIS	Shallow binding Single EVLIS
	Interpreted codes	Compiled codes	Interpreted codes	Interpreted codes	Interpreted codes
[1-1] Tarai-4	19190	2380	837	562	483
[1-2] Tarai-5	532600	62190	22783	13268	13145
[1-3] Tarai-6	---	2366700	---	---	---
[1-4] Tak-18-12-6	107750	13350	4443	2613	2593
[2-1] List-Tarai-4	37270	9850	1075	654	717
[2-2] Srev-5	1090	160	35.6	24.6	25.0
[2-3] Srev-6	4300	450	142	96.1	100
[2-4] Qsort-50	1250	74	38.5	40.8	26.8
[2-5] Nrev-30	950	54	30.6	33.2	21.63
[2-6] Rev-30	1.5	$\le$	0.063	0.113	0.063
[2-7] Drev-30	0.5	$\le$	0.045	0.043	0.044
[2-8] Rev-10	0.80	$\le$	0.026	0.042	0.025
[2-9] Rev-100	4	$\le$	0.19	0.36	0.20
[2-10] Rev-1000	40	$\le$	1.8	1.8	1.8
[2-11] Rev-10000	340	$\le$	18.8	35.4	18.6
[2-12] Drev-10	0.46	$\le$	0.019	0.017	0.019
[2-13] Drev-100	1.4	$\le$	0.135	0.134	0.134
[2-14] Drev-1000	14	$\le$	1.29	1.31	1.29
[2-15] Drev-10000	140	$\le$	12.9	13.1	12.8
[3-1] String-Tarai-4	41800	27000	---	---	---
[4-1] Flonum-Tarai-4	21700	4750	---	---	---
[4-2] Bignum-Tarai-4	N/A	N/A	---	---	---
[5-1] Bubble-50	4990	793	---	---	---
[6-1] Seq-100	71.5	198	40.2	41.8	36.3
[7-1] BITA-5	276	29.9	7.6	5.8	5.76
[7-2] BITA-6	892	89	25.8	18.1	19.3
[7-3] BITB-5	104	11.1	2.77	2.4	2.05
[7-4] BITB-6	275	27	7.80	5.9	5.69
[8-1] Sort-50	N/A	N/A	---	---	---
[8-2] Sort-10	N/A	N/A	---	---	---
[8-3] Sort-100	N/A	N/A	---	---	---
[8-4] Sort-1000	N/A	N/A	---	---	---
[8-5] Sort-10000	N/A	N/A	---	---	---
[8-6] Rsort-10	N/A	N/A	---	---	---
[8-7] Rsort-100	N/A	N/A	---	---	---
[8-8] Rsort-1000	N/A	N/A	---	---	---
[8-9] Rsort-10000	N/A	N/A	---	---	---
[9-1] TPU-1	14290	3590	513	546	355
[9-2] TPU-2	65510	10260	2387	2531	1422
[9-3] TPU-3	25370	4350	913	969	561
[9-4] TPU-4	32290	5900	1151	1223	740
[9-5] TPU-5	4650	600	180	193	101
[9-6] TPU-6	136400	18520	4638	4940	2869
[9-7] TPU-7	26200	3840	1008	1073	554
[9-8] TPU-8	24600	2960	958	1019	515
[9-9] TPU-9	17380	2090	651	693	354
[10-1] Prl-Rev-15	23350	2020	703	759	---
[10-2] Prl-Sort-20	32820	3060	1071	1154	---
[11-1] Diff-3	289	37	7.86	5.9	5.58
[11-2] Diff-5	23900	2870	659	437	479
[12-1] Boyer	1312000	142300	---	---	---

(milliseconds)	FLATS LISP FLATS Compiled codes	FRANTZ LISP SHARP OA-90DX Interpreted codes	FRANTZ LISP SHARP OA-90DX Compiled codes	FRANZ LISP VAX-11/780/UNIX 4.2BSD Interpreted codes	FRANZ LISP VAX-11/780/UNIX 4.2BSD Compiled codes
[1-1] Tarai-4	18.0	24100	2700	11980	4397
[1-2] Tarai-5	487.4	656500	71600	327420	120700
[1-3] Tarai-6	17914	---	---	12270000	4487000
[1-4] Tak-18-12-6	90.0	142800	13300	69250	21420
[2-1] List-Tarai-4	272	80900	12600	6480	20730
[2-2] Srev-5	1.0	1770	50	777	140
[2-3] Srev-6	4.8	6100	360	3130	580
[2-4] Qsort-50	1.2	1990	170	887	130
[2-5] Nrev-30	1.0	1560	210	687	110
[2-6] Rev-30	0.2	123	117	0.995	1.05
[2-7] Drev-30	0.0	0.3	0.54	0.433	0.30
[2-8] Rev-10	0.0	1	0.35?	0.48	0.42
[2-9] Rev-100	0.2	10	0.36?	3.0	2.5
[2-10] Rev-1000	1.2	620	210	32.3	28.2
[2-11] Rev-10000	14.0	---	---	280	288
[2-12] Drev-10	0.2	0.4?	0.284?	0.298	0.16
[2-13] Drev-100	0.2	0.2?	0.281?	1.41	1.06
[2-14] Drev-1000	2.4	0.3?	0.329?	11.9	12.0
[2-15] Drev-10000	28.0	---	---	174	125
[3-1] String-Tarai-4	3862	---	---	45290	37370
[4-1] Flonum-Tarai-4	---	46300	7.9	14380	8070
[4-2] Bignum-Tarai-4	5400	---	---	28170	21520
[5-1] Bubble-50	7.6	---	---	6700	1990
[6-1] Seq-100	4.0	800	170	470	166
[7-1] BITA-5	0.6	730	164	201	48.2
[7-2] BITA-6	3.2	1960	569	690	148
[7-3] BITB-5	0.4	140	62	71.2	11
[7-4] BITB-6	1.0	710	165	190	31.8
[8-1] Sort-50	3.4	194	93	62	61.3
[8-2] Sort-10	0.8	14	16.3	8.3	7.5
[8-3] Sort-100	9.8	63	170	130	150
[8-4] Sort-1000	144	3600	2600	1780	1870
[8-5] Sort-10000	1590	---	---	24730	24850
[8-6] Rsort-10	0.8	14	16.1	9.3	6.7
[8-7] Rsort-100	9.8	25	180	130	130
[8-8] Rsort-1000	142	7400	2600	1770	1930
[8-9] Rsort-10000	1550	---	---	24670	24300
[9-1] TPU-1	154	48400	9600	15200	7580
[9-2] TPU-2	450	134800	40800	59820	24200
[9-3] TPU-3	174	48900	13100	23330	9920
[9-4] TPU-4	268	66600	19400	30930	13300
[9-5] TPU-5	30.0	11800	2700	4020	1400
[9-6] TPU-6	796	237800	63400	115300	42270
[9-7] TPU-7	162	47800	10400	22300	7970
[9-8] TPU-8	122	40200	7800	20500	6500
[9-9] TPU-9	88.0	28900	6500	14130	4620
[10-1] Prl-Rev-15	---	---	9500	N/0	6050
[10-2] Prl-Sort-20	---	---	15100	N/0	N/0
[11-1] Diff-3	0.6	340	20	180	32
[11-2] Diff-5	39.8	28800	2400	15450	289
[12-1] Boyer	---	---	---	1040300	153200

(milliseconds)	HLISP MELCOM COSMO 800/3 Compiled codes		INTERLISP-10 DECSYSTEM-2060 Interpreted codes	INTERLISP-10 DECSYSTEM-2060 Compiled codes	INTERLISP-D XEROX 1100 SIP Interpreted codes	INTERLISP-D XEROX 1100 SIP Compiled codes
[1-1] Tarai-4	2014	[1448]	5090	2560	65540	990
[1-2] Tarai-5	55920	[40310]	138400	118460	1855900	26897
[1-3] Tarai-6	---	[1449000]	---	6939	67357140	988160
[1-4] Tak-18-12-6	10626	[8116]	33560	16200	366200	4821
[2-1] List-Tarai-4	7386	[5286]	14350	6430	92321	10153
[2-2] Srev-5	96	[72]	295	28.2	3980	84.3
[2-3] Srev-6	374	[276]	1190	110	16100	335
[2-4] Qsort-50	170	[120]	324	199	3751	109
[2-5] Nrev-30	156	[116]	243	23.3	2490	86.0
[2-6] Rev-30	10		0.573	<=	5.05	<=
[2-7] Drev-30	12		0.367	<=	124	<=
[2-8] Rev-10	8		0.478	<=	2.08	<=
[2-9] Rev-100	16		1.61	<=	18.9	<=
[2-10] Rev-1000	116		15.5	<=	133	<=
[2-11] Rev-10000	1052		161	<=	1549	<=
[2-12] Drev-10	8	[6]	0.162	<=	3.91	<=
[2-13] Drev-100	24	[16]	0.992	<=	36.6	<=
[2-14] Drev-1000	158	[122]	9.39	<=	402	<=
[2-15] Drev-10000	1054	[1204]	92.6	<=	3996	<=
[3-1] String-Tarai-4	24360		21190	15020	115916	64006
[4-1] Flonum-Tarai-4	2000		14340 [13650]	11490 [6140]	90662	5860
[4-2] Bignum-Tarai-4	4076		N/A	N/A	N/A	N/A
[5-1] Bubble-50	568		2970	893	21764	1821
[6-1] Seq-100	2722	[122]	887	439	3633	2168
[7-1] BITA-5	90	[84]	96.5	43.7	1032	80.7
[7-2] BITA-6	242	[206]	235	13.7	3360	293
[7-3] BITB-5	40	[31]	29.1	19.7	360	31.6
[7-4] BITB-6	74	[59]	79.5	51.9	1057	123
[8-1] Sort-50	90		25.4	25.4	194	<=
[8-2] Sort-10	20		4.07	4.07	13.9	<=
[8-3] Sort-100	806		37.2	<=	160	<=
[8-4] Sort-1000	71400		485	<=	2008	<=
[8-5] Sort-10000	---		6450	<=	23148	<=
[8-6] Rsort-10	18		4.36	<=	36.9	<=
[8-7] Rsort-100	828		141	<=	1130	<=
[8-8] Rsort-1000	75920		3390	<=	25003	<=
[8-9] Rsort-10000	S/O		57980	<=	345195	<=
[9-1] TPU-1	9956	[9634]	6950	2890	44143	9722
[9-2] TPU-2	27340	[26640]	5070	1.31 sec	195613	29389
[9-3] TPU-3	11750	[11410]	23670	4.39 sec	75724	13297
[9-4] TPU-4	16200	[15630]	9280	1.84 sec	91518	12278
[9-5] TPU-5	1660	[1574]	12110	2.50 sec	15390	2135
[9-6] TPU-6	49100	[46960]	50060	9.07 sec	421424	53780
[9-7] TPU-7	10620	[10240]	10820	1.69 sec	84329	11672
[9-8] TPU-8	6920	[6536]	99200	1.50 sec	79905	9158
[9-9] TPU-9	5928	[5740]	6760	1.03 sec	5392	462
[10-1] Prl-Rev-15	---		S/O	2680	S/O	5657
[10-2] Prl-Sort-20	---		S/O	3938	S/O	20301
[11-1] Diff-3	78	[64]	96	28.6	7943	498
[11-2] Diff-5	4706	[4356]	6840	2570	70520	5668
[12-1] Boyer	---		652200	163000	5830249	246932

| (milliseconds) | KONOLISP SORD M68 | | KYOTO COMMON LISP (KCL) MV10000 | | | LISP/I TOWER/1632 |
	Interpreted codes	Compiled codes	Interpreted codes	Compiled codes		Interpreted codes
[1-1] Tarai-4	9950	990	14650	510	[84.4]	116000
[1-2] Tarai-5	274600	27500	400810	13251	[2300]	3264000
[1-3] Tarai-6	---	---	---	---	[84732]	---
[1-4] Tak-18-12-6	55400	4980	75905	2264	[420]	642000
[2-1] List-Tarai-4	15600	3430	19362	1550		131000
[2-2] Srev-5	565	25	743	18.2	[14.8]	5570
[2-3] Srev-6	2265	95	3119	72	[61]	21590
[2-4] Qsort-50	570	34	646	24.7	[17.3]	5960
[2-5] Nrev-30	430	24	506	16.9	[13.2]	5420
[2-6] Rev-30	=>	3	0.66	<=		247
[2-7] Drev-30	28	4	0.014	<=		7
[2-8] Rev-10	=>	2	0.24	<=		87
[2-9] Rev-100	=>	5	2.1	<=		824
[2-10] Rev-1000	=>	33	21	<=		8170
[2-11] Rev-10000	=>	309	207	<=		---
[2-12] Drev-10	11	3	0.057	<=		3
[2-13] Drev-100	83	6	0.463	<=		17
[2-14] Drev-1000	812	35	5.44	<=		90
[2-15] Drev-10000	8080	320	51.7	<=		---
[3-1] String-Tarai-4	18900	3520	28021	8431		236000
[4-1] Flonum-Tarai-4	15050	N/A	16668	700	[120]	131000
[4-2] Bignum-Tarai-4	N/A	N/A	17526	1768		---
[5-1] Bubble-50	N/A	N/A	2476	298	[26.9]	69740
[6-1] Seq-100	N/A	N/A	464	120		380000
[7-1] BITA-5	162	N/A	138	11.5		3640
[7-2] BITA-6	572	N/A	464	40.0		12610
[7-3] BITB-5	46	N/A	48.9	4.2		1070
[7-4] BITB-6	122	N/A	207	12.2		2990
[8-1] Sort-50	=>	54	62.8	<=		5960
[8-2] Sort-10	=>	12	5.91	<=		1170
[8-3] Sort-100	=>	1030	90.3	<=		103000
[8-4] Sort-1000	=>	D/O	1158	<=		---
[8-5] Sort-10000	=>	D/O	14466	<=		---
[8-6] Rsort-10	=>	12	8.15	<=		1170
[8-7] Rsort-100	=>	1020	125	<=		103000
[8-8] Rsort-1000	=>	D/O	1582	<=		---
[8-9] Rsort-10000	=>	D/O	21627	<=		---
[9-1] TPU-1	8800	2490	6920	1430		370000
[9-2] TPU-2	43100	8360	32794	4121		1266000
[9-3] TPU-3	16200	3440	12338	1715		463000
[9-4] TPU-4	20500	4640	15585	2424		688000
[9-5] TPU-5	3190	492	2279	262		84000
[9-6] TPU-6	86400	16850	68722	6965		2371000
[9-7] TPU-7	18500	2880	13195	1524		504000
[9-8] TPU-8	17500	2460	13945	1071		394000
[9-9] TPU-9	12050	1650	9110	802		262000
[10-1] Prl-Rev-15	13500	N/A	---	395	[208]	---
[10-2] Prl-Sort-20	21550	N/A	---	585	[308]	---
[11-1] Diff-3	129	15	133	5.9		---
[11-2] Diff-5	10900	1215	12960	502		---
[12-1] Boyer	---	---	1199895	23231		---

(milliseconds)	Lisp 3.9 PC-9800 F2		Lisp05 PC9801 (5Mhz)		Lisp05 N5200-05 (8Mhz)	
	Interpreted codes	Compiled codes	Interpreted codes	Compiled codes	Interpreted codes	Compiled codes
[1-1] Tarai-4	29300	6300	15300	2900	12800	
[1-2] Tarai-5	798000	171000	417000	79000	309000	1900
[1-3] Tarai-6	---	---	---		---	51000
[1-4] Tak-18-12-6	165000	37000	78000		66500	
[2-1] List-Tarai-4	118000	83000	19600		16600	
[2-2] Srev-5	1700	470	645		560	
[2-3] Srev-6	7000	2000	2600		2240	
[2-4] Qsort-50	3000	300	695		600	
[2-5] Nrev-30	2800	500	530		460	
[2-6] Rev-30	30	<=	3.8		2.9	
[2-7] Drev-30	18	<=	4.7		3.5	
[2-8] Rev-10	7	<=	1.9		1.3	
[2-9] Rev-100	70	<=	10.6		7.8	
[2-10] Rev-1000	700	<=	104		73	
[2-11] Rev-10000	---	---	---		---	
[2-12] Drev-10	6?	---	2.3		1.9	
[2-13] Drev-100	6?	---	13.4		9.6	
[2-14] Drev-1000	---	---	126		89	
[2-15] Drev-10000	---	---	---		---	
[3-1] String-Tarai-4	N/A	N/A	---		---	
[4-1] Flonum-Tarai-4	N/A	N/A	---		---	
[4-2] Bignum-Tarai-4	N/A	N/A	---		---	
[5-1] Bubble-50	---		---		---	
[6-1] Seq-100	1700	1200	---		---	
[7-1] BITA-5	500	230	147		125	
[7-2] BITA-6	2500	800	500		425	
[7-3] BITB-5	200	100	53		45	
[7-4] BITB-6	400	270	146		123	
[8-1] Sort-50	N/A	N/A	280		202	
[8-2] Sort-10	N/A	N/A	6		4.4	
[8-3] Sort-100	N/A	N/A	54.5		39.0	
[8-4] Sort-1000	N/A	N/A	560		400	
[8-5] Sort-10000	N/A	N/A	---		---	
[8-6] Rsort-10	N/A	N/A	22		16.0	
[8-7] Rsort-100	N/A	N/A	2100		1500	
[8-8] Rsort-1000	N/A	N/A	220000		156000	
[8-9] Rsort-10000	N/A	N/A	---		---	
[9-1] TPU-1	51000	38000	10200		8300	
[9-2] TPU-2	206000	124000	47600		39000	
[9-3] TPU-3	82000	43000	18100		14800	
[9-4] TPU-4	115000	81000	23000		19000	
[9-5] TPU-5	9000	5000	3460		2820	
[9-6] TPU-6	404000	220000	94000		77000	
[9-7] TPU-7	80000	40000	19200		15700	
[9-8] TPU-8	57000	32000	18500		15100	
[9-9] TPU-9	30000	13000	12400		10200	
[10-1] Prl-Rev-15	---	31000	---		---	
[10-2] Prl-Sort-20	---	50000	---		---	
[11-1] Diff-3	370	110	---		---	
[11-2] Diff-5	33000	12000	---		---	
[12-1] Boyer	D/O	D/O	---		---	

(milliseconds)	TAO ELIS Interpreted codes	TINY LISP FM-11EX Interpreted codes	TUO-LISP Ustation-E15 Interpreted codes	ULISP (LISP 1.9) MELCOM COSMO 800 III Interpreted codes	Compiled codes
[1-1] Tarai-4	628	44140	4782	11896	6399
[1-2] Tarai-5	17100	1201000	132900	356980	188330
[1-3] Tarai-6	628100	---	4898400	---	---
[1-4] Tak-18-12-6	3180	246700	27560	90690	50994
[2-1] List-Tarai-4	960	86600	9740	9798	2000
[2-2] Srev-5	28	2416	248	340	40
[2-3] Srev-6	140	9660	1000	1400	200
[2-4] Qsort-50	500	2608	282	380	60
[2-5] Nrev-30	24	1946	208	0?	0?
[2-6] Rev-30	0.0168	2.6	0.8	20	2
[2-7] Drev-30	0.0082	2.2	0.2	---	---
[2-8] Rev-10	0.0072	1.94	0.28	8	0
[2-9] Rev-100	0.0660	15.8	2.4	80	0
[2-10] Rev-1000	0.716	202	22	600	0
[2-11] Rev-10000	6.96	---	260	---	---
[2-12] Drev-10	0.0034	1.02	0.10	---	---
[2-13] Drev-100	0.0238	6.0	0.6	---	---
[2-14] Drev-1000	0.227	55.2	6	---	---
[2-15] Drev-10000	2.29	---	60	---	---
[3-1] String-Tarai-4	1780	---	34760	20158	12598
[4-1] Flonum-Tarai-4	1280	---	N/A	13998	8398
[4-2] Bignum-Tarai-4	980	---	N/A	14194	8596
[5-1] Bubble-50	530	---	N/A	4500	---
[6-1] Seq-100	97.8	1880	420	378	198
[7-1] BITA-5	12.2	542	72	100	60
[7-2] BITA-6	48.6	2006	238	419	199
[7-3] BITB-5	5.22	196	26	40	19
[7-4] BITB-6	14.2	542	66	119	59
[8-1] Sort-50	5.3	---	N/A	52	50
[8-2] Sort-10	0.316	---	N/A	8	10
[8-3] Sort-100	2.16	---	N/A	980	960
[8-4] Sort-1000	23.1	---	N/A	96200	96576
[8-5] Sort-10000	240	---	N/A	---	---
[8-6] Rsort-10	0.696	---	N/A	10	10
[8-7] Rsort-100	9.84	---	N/A	959	940
[8-8] Rsort-1000	134	---	N/A	95196	94998
[8-9] Rsort-10000	1684	---	N/A	---	---
[9-1] TPU-1	546	28940	3580	---	---
[9-2] TPU-2	2220	127600	17220	---	---
[9-3] TPU-3	878	47100	5980	---	---
[9-4] TPU-4	1160	63340	9640	---	---
[9-5] TPU-5	156	7440	1080	---	---
[9-6] TPU-6	4480	262600	32560	---	---
[9-7] TPU-7	856	47920	7920	---	---
[9-8] TPU-8	805	43360	5720	---	---
[9-9] TPU-9	550	29350	3920	---	---
[10-1] Prl-Rev-15	7700	29800	6080	---	---
[10-2] Prl-Sort-20	9680	45540	8920	---	---
[11-1] Diff-3	8.9	506	64	---	---
[11-2] Diff-5	882	45520	5440	---	---
[12-1] Boyer	47880	---	338220	---	---

(milliseconds)	LISP68K 68K (12.5MHz) Interpreted codes	Compiled codes	LISPVM 3081K Interpreted codes	Compiled codes	LISP-09 FM-11 Interpreted codes	
[1-1] Tarai-4	5141	636	5075	137	16342	
[1-2] Tarai-5	139941	17312	144000	3680	445220	
[1-3] Tarai-6	---	---	5562000	135100	---	
[1-4] Tak-18-12-6	29789	3583	17080	870	85920	
[2-1] List-Tarai-4	9670	1934	7925	937	16420	
[2-2] Srev-5	293	24.2	233	0.50	696	[568]
[2-3] Srev-6	1171	97	941	19.9	2620	[2120]
[2-4] Qsort-50	313	29.0	156	8.46	716	[252]
[2-5] Nrev-30	240	24.8	170	5.09	546	[526]
[2-6] Rev-30	0.32	0.30	0.19	<=	1.8	
[2-7] Drev-30	0.05?	0.00?	0.05	<=	1.8	
[2-8] Rev-10	0.14	0.12	0.14	<=	0.6	
[2-9] Rev-100	0.96	0.92	0.4	<=	6.0	
[2-10] Rev-1000	9.37	9.37	4.81	<=	80	
[2-11] Rev-10000	0.06?	0.02?	59.7	<=	---	
[2-12] Drev-10	0.05?	0.00?	0.32	<=	1.6?	
[2-13] Drev-100	0.04?	0.02?	0.357	<=	1.5?	
[2-14] Drev-1000	0.10?	0.08?	0.642	<=	1.56?	
[2-15] Drev-10000	0.70?	0.67?	3.66	<=	-----	
[3-1] String-Tarai-4	8011	2099	8578	838	33100	[16680]
[4-1] Flonum-Tarai-4	6721	2163	2488	178	N/A	
[4-2] Bignum-Tarai-4	6998	2489	2668	293	N/A	
[5-1] Bubble-50	1612	271	1540	3.45	N/A	
[6-1] Seq-100	206	94	91	19	N/A	
[7-1] BITA-5	65.1	11.9	168	2.2	148	
[7-2] BITA-6	218	41.5	620	6.3	538	
[7-3] BITB-5	23.2	6.0	736	0.5	62	
[7-4] BITB-6	63.9	18.5	176	1.5	162	
[8-1] Sort-50	14.3	14.16	12.8	<=	406	(SORT is
[8-2] Sort-10	2.20	2.04	1.09	<=	49.8	defined
[8-3] Sort-100	169	168	21.6	<=	676	by
[8-4] Sort-1000	16520	16514	353	<=	9240	merge
[8-5] Sort-10000			4968	<=	---	sort)
[8-6] Rsort-10	2.34	2.20	1.12	<=	50.2	
[8-7] Rsort-100	181	181	22.0	<=	636	
[8-8] Rsort-1000	17753	17742	552	<=	9280	
[8-9] Rsort-10000			5188	<=	---	
[9-1] TPU-1	3298	920	2039	921	10280	
[9-2] TPU-2	14226	2773	9757	3435	45020	
[9-3] TPU-3	5548	1187	3716	1819	15840	
[9-4] TPU-4	7206	1623	4906	1814	21580	
[9-5] TPU-5	1030	181	709	294	2640	
[9-6] TPU-6	29168	5329	20520	8023	100840	
[9-7] TPU-7	5657	1029	3916	1847	16380	
[9-8] TPU-8	5391	818	3946	1714	13980	
[9-9] TPU-9	3699	587	2697	1029	9540	
[10-1] Prl-Rev-15	4667	601	---	---	10520	
[10-2] Prl-Sort-20	6677	859	---	---	15260	
[11-1] Diff-3	66.8	7.7	3.50	0.340	138	
[11-2] Diff-5	5886	681	3323	327	13300	
[12-1] Boyer	366347	35556	285637	5730	D/O	

(milliseconds)	MACLISP DECSYSTEM-2060 Interpreted codes	Compiled codes		OLISP-V ACOS 1000/40 Interpreted codes	REWMOL ACOS 850 Interpreted codes
[1-1] Tarai-4	4640	640	[588]	405	3090
[1-2] Tarai-5	126300	18720	[4390]	11125	85340
[1-3] Tarai-6	5241000	648000	[157000]	---	---
[1-4] Tak-18-12-6	26830	3589	[1270]	2284	17230
[2-1] List-Tarai-4	9551	2069		835.	13670
[2-2] Srev-5	236	7.8		22.6	141
[2-3] Srev-6	951	32		90.4	630
[2-4] Qsort-50	283	13.7		24.7	209
[2-5] Nrev-30	208	6.7		18.2	135
[2-6] Rev-30	0.370	0.337		.018	0.306
[2-7] Drev-30	=>	0.154		.011	0.217
[2-8] Rev-10	0.16	0.115		.0096	0.154
[2-9] Rev-100	1.2	1.04		.046	0.779
[2-10] Rev-1000	10	10.2		.421	9.12
[2-11] Rev-10000	=>	108		6.0	139
[2-12] Drev-10	=>	0.072		.0066	0.128
[2-13] Drev-100	=>	0.473		.030	0.540
[2-14] Drev-1000	=>	4.48		.266	5.15
[2-15] Drev-10000	=>	54.3		3.53	101
[3-1] String-Tarai-4	N/A	N/A		---	10600
[4-1] Flonum-Tarai-4	6432	1123		458	3380
[4-2] Bignum-Tarai-4	6121	1809		537	N/A
[5-1] Bubble-50	1529	18		99.2	954
[6-1] Seq-100	141	---		27	75.4
[7-1] BITA-5	62.9	3.7		4.75	47.8
[7-2] BITA-6	204	13.3		15.9	163
[7-3] BITB-5	22.4	2.0		1.71	17.2
[7-4] BITB-6	59.9	5.4		4.66	43.0
[8-1] Sort-50	7.91	7.22		---	N/A
[8-2] Sort-10	1.21	0.89		---	N/A
[8-3] Sort-100	12.6	11.9		---	N/A
[8-4] Sort-1000	156	154		---	N/A
[8-5] Sort-10000	=>	2330		---	N/A
[8-6] Rsort-10	0.98	0.70		---	N/A
[8-7] Rsort-100	11.7	10.3		---	N/A
[8-8] Rsort-1000	154	151		---	N/A
[8-9] Rsort-10000	=>	1949		---	N/A
[9-1] TPU-1	3852	932		273	5984
[9-2] TPU-2	15530	2955		1108	16660
[9-3] TPU-3	6101	1223		434	6633
[9-4] TPU-4	7768	1518		575	9289
[9-5] TPU-5	1302	112		78	1124
[9-6] TPU-6	31484	4891		2233	30830
[9-7] TPU-7	6061	1088		425	6025
[9-8] TPU-8	5463	715		402	5070
[9-9] TPU-9	3601	549		275	3899
[10-1] Prl-Rev-15	5948	686		256	3062
[10-2] Prl-Sort-20	8195	1324		380	4291
[11-1] Diff-3	63.9	4.0		4.92	32.7
[11-2] Diff-5	5379	335		42.8	3478
[12-1] Boyer	344700	23130		28757	189400

(milliseconds)	SYMBOLICS COMMON LISP SYMBOLICS-3600		ZETALISP SYMBOLICS-3600		T LISP VERSION 2.8 VAX-11/780/UNIX 4.2BSD	
	without IFU Compiled codes	with IFU	Interpreted codes	Compiled codes	Interpreted codes	Compiled codes
[1-1] Tarai-4	114	85	22650	119	27350	5491
[1-2] Tarai-5	3110	2328	608300	3238	766700	145500
[1-3] Tarai-6	114258	85481	22366000	119200	---	---
[1-4] Tak-18-12-6	602	431	117780	625	144600	24470
[2-1] List-Tarai-4	2808	2099	30580	3850	62620	11600
[2-2] Srev-5	21	10	1067	25.3	1590	45
[2-3] Srev-6	52	41	4345	55.0	6320	220
[2-4] Qsort-50	18.2	11.5	1115	33.3	1942	56.7
[2-5] Nrev-30	14.7	13.1	899	18.3	1350	36.7
[2-6] Rev-30	0.82	0.68	1.03	<=	2.77	1.97
[2-7] Drev-30	0.30	0.19	0.45	<=	1.03	0.82
[2-8] Rev-10	0.23	0.18	0.483	<=	1.1	0.7
[2-9] Rev-100	2.6	1.8	2.83	<=	5.2	6.3
[2-10] Rev-1000	21	18	33.3	<=	79.2	90.8
[2-11] Rev-10000	213	172	367	<=	55.0	3.3
[2-12] Drev-10	0.11	0.07	0.150	<=	0.689	0.191
[2-13] Drev-100	0.96	0.59	1.17	<=	2.64	2.00
[2-14] Drev-1000	9.4	5.8	9.84	<=	21.5	21.0
[2-15] Drev-10000	94	58	98.0	<=	215	2.2?
[3-1] String-Tarai-4	10162	6921	51470	25167	57720	1150
[4-1] Flonum-Tarai-4	235	198	22730	245	29680	5640
[4-2] Bignum-Tarai-4	2325	1689	27817	5600	71220	45150
[5-1] Bubble-50	32 [21]	25 [14]	5803	36	13490	1810
[6-1] Seq-100	89	68	473	105	909	372
[7-1] BITA-5	10.3	7.6	227	34.4	825	73.2
[7-2] BITA-6	35	25	772	118	1784	244
[7-3] BITB-5	2.9	2.2	73.3	7.5	250	19
[7-4] BITB-6	8.6	6.6	210	26.0	460	33
[8-1] Sort-50	14.7	11.4	18.3	<=	80.2	77.3
[8-2] Sort-10	0.86	0.60	1.33	<=	18.8	16
[8-3] Sort-100	23	17	23.8	<=	847	813
[8-4] Sort-1000	328	246	343	<=	75420	74870
[8-5] Sort-10000	4573	3451	4800	<=	7553000	7248000
[8-6] Rsort-10	3.7	2.7	4.50	<=	22.8	17.7
[8-7] Rsort-100	25	19	26.5	<=	1080	975
[8-8] Rsort-1000	352	268	377	<=	95050	96220
[8-9] Rsort-10000	4765	3621	5116	<=	8968000	8958000
[9-1] TPU-1	1256	916	10630	2388	36080	---
[9-2] TPU-2	3445	2449	45450	6635	28100	---
[9-3] TPU-3	1401	998	17830	2773	72270	---
[9-4] TPU-4	2042	1458	23200	3985	96780	---
[9-5] TPU-5	223	161	3433	458	17330	---
[9-6] TPU-6	5695	4086	98920	11710	664500	---
[9-7] TPU-7	1285	917	18370	2793	224300	---
[9-8] TPU-8	890	635	18220	1903	139200	---
[9-9] TPU-9	687	487	12220	1432	78430	---
[10-1] Prl-Rev-15	---	---	29880	8567	35570	3820
[10-2] Prl-Sort-20	---	---	43700	14250	69270	6300
[11-1] Diff-3	2.8	2.1	233	5.37	508	162
[11-2] Diff-5	222	168	18790	313	46100	15100
[12-1] Boyer	13601	10826	1289000	22150	2287000	77780

(milliseconds)	UTILISP HITAC M-280H/VOS3-SP21				ZETALISP-PLUS LAMBDA	
	Interpreted codes		Compiled codes		Interpreted codes	Compiled codes
[1-1] Tarai-4	272		15.2		76500	682
[1-2] Tarai-5	7444		423		2055000	18850
[1-3] Tarai-6	---		15641		---	694500
[1-4] Tak-18-12-6	1493		78		403400	3350
[2-1] List-Tarai-4	498		125		97760	8183
[2-2] Srev-5	14.1		1.48		3417	68.2
[2-3] Srev-6	57.0		5.78		13860	223
[2-4] Qsort-50	15.2		1.92		3713	48.7
[2-5] Nrev-30	11.3		1.03		2870	44.0
[2-6] Rev-30	0.0283		0.0346		1.83	<=
[2-7] Drev-30	0.0100		0.00925		1.58	<=
[2-8] Rev-10	0.0094		0.0120		1.28	<=
[2-9] Rev-100	0.090		0.115		6.50	<=
[2-10] Rev-1000	0.88		1.16		55.0	<=
[2-11] Rev-10000	10.1		11.8		683	<=
[2-12] Drev-10	0.0028		0.00351		0.95	<=
[2-13] Drev-100	0.0333		0.0305		4.50	<=
[2-14] Drev-1000	0.333		0.305		36.1	<=
[2-15] Drev-10000	3.57		3.20		316	<=
[3-1] String-Tarai-4	661		350		115900	25250
[4-1] Flonum-Tarai-4	295		70.0		79950	1133
[4-2] Bignum-Tarai-4	---		---		76670	1093
[5-1] Bubble-50	74.7	[69.0]	18.8	[4.30]	17750	185
[6-1] Seq-100	13.35		6.87		1833	325
[7-1] BITA-5	3.21		0.501		677	40.8
[7-2] BITA-6	10.66		1.737		2202	129
[7-3] BITB-5	1.13		0.201		223	8.33
[7-4] BITB-6	3.06		0.578		635	25
[8-1] Sort-50	2.04	[1.45]	1.69	[1.44]	81.7	<=
[8-2] Sort-10	0.198	[0.174]	0.190	[0.168]	43.3	<=
[8-3] Sort-100	2.9	[2.5]	2.9	[2.4]	108	<=
[8-4] Sort-1000	37	[29]	37	[31]	1866	<=
[8-5] Sort-10000	496	[419]	496	[417]	25200	<=
[8-6] Rsort-10	0.165	[0.146]	0.159	[0.143]	19.3	<=
[8-7] Rsort-100	2.6	[2.2]	2.5	[2.0]	115	<=
[8-8] Rsort-1000	37	[31]	35	[30]	1691	<=
[8-9] Rsort-10000	459	[386]	456	[387]	23570	<=
[9-1] TPU-1	154		40.7		29380	3717
[9-2] TPU-2	697		144		130000	9033
[9-3] TPU-3	273		57.6		50390	3916
[9-4] TPU-4	342		78.0		65350	5483
[9-5] TPU-5	51		8.9		9433	650
[9-6] TPU-6	1432		271		273800	17270
[9-7] TPU-7	279		51.5		50450	3600
[9-8] TPU-8	268		45.0		49780	2516
[9-9] TPU-9	185		30.7		33730	1916
[10-1] Prl-Rev-15	235		28		97300	20433
[10-2] Prl-Sort-20	336		41		142100	30900
[11-1] Diff-3	3.2		0.469		850	10.5
[11-2] Diff-5	270		41.5		60850	710
[12-1] Boyer	17610		1649		4176000	121000

(milliseconds)	VAX LISP VAX 8600 Interpreted codes	VAX LISP VAX 8600 Compiled codes	VAX LISP VAX-11/785 Interpreted codes	VAX LISP VAX-11/785 Compiled codes	VAX LISP VAX-11/780 Compiled codes
[1-1] Tarai-4	30260	254	57090	612	817
[1-2] Tarai-5	830100	7150	1595130	16650	2226
[1-3] Tarai-6	30290000	257400	---	---	81630
[1-4] Tak-18-12-6	163700	1280	304500	3050	4060
[2-1] List-Tarai-4	---	2850	96181	5361	9970
[2-2] Srev-5	---	15.0	3246	33.0	52.0
[2-3] Srev-6	---	60.0	12910	140	230
[2-4] Qsort-50	---	22.0	2989	43.0	68
[2-5] Nrev-30	---	17.0	2317	33.0	55
[2-6] Rev-30	=>	0.70	1.70	0.998	2.40
[2-7] Drev-30	0.73	<=	0.70	0.108	0.50
[2-8] Rev-10	=>	0.20	1.0	0.404	1.10
[2-9] Rev-100	=>	2.0	3.94	2.00	14.5
[2-10] Rev-1000	=>	40.0	30.0	39.9	---
[2-11] Rev-10000	---	---	---	---	---
[2-12] Drev-10	0.40	<=	=>	0.29	0.30
[2-13] Drev-100	1.24	<=	=>	2.30	1.13
[2-14] Drev-1000	10.9	<=	=>	27.0	---
[2-15] Drev-10000	---	---	---	---	---
[3-1] String-Tarai-4	60.0	30.0	89.6	20.0	60.0
[4-1] Flonum-Tarai-4	31050	1090	59420	2380	3880
[4-2] Bignum-Tarai-4	30610	1290	59030	2920	4440
[5-1] Bubble-50	19430	207	35144	410	658
[6-1] Seq-100	1650	100	14100	210	320
[7-1] BITA-5	341	10.0	626	19.0	31.0
[7-2] BITA-6	1149	30.0	2095	71.0	108
[7-3] BITB-5	133	3.00	225	7.00	11.0
[7-4] BITB-6	355	8.00	617	18.0	26.0
[8-1] Sort-50	3.01	2.95	66.1	59.4	90.3
[8-2] Sort-10	4.60	4.10	9.10	7.0	12.0
[8-3] Sort-100	52.0	53.0	110.9	101	165
[8-4] Sort-1000	630	630	1360	1241	---
[8-5] Sort-10000	---	---	---	---	---
[8-6] Rsort-10	4.60	3.60	8.8	6.6	11.6
[8-7] Rsort-100	50.0	48.0	106	94.0	160
[8-8] Rsort-1000	610	630	1380	1270	---
[8-9] Rsort-10000	---	---	---	---	---
[9-1] TPU-1	13870	1210	24820	2410	4150
[9-2] TPU-2	64320	3580	115810	7041	12190
[9-3] TPU-3	25100	1510	44410	2960	5000
[9-4] TPU-4	32490	2070	56750	4120	7030
[9-5] TPU-5	5000	230	8770	450	820
[9-6] TPU-6	141200	6260	246000	12410	21470
[9-7] TPU-7	26340	1330	46739	2611	4460
[9-8] TPU-8	26480	980	47120	1910	3320
[9-9] TPU-9	17950	730	31600	1410	2460
[10-1] Prl-Rev-15	---	---	---	1280	---
[10-2] Prl-Sort-20	---	---	---	1930	---
[11-1] Diff-3	3370	70.0	614.0	14.0	20.0
[11-2] Diff-5	29000	56.0	53630	122	1920
[12-1] Boyer	---	---	---	43670	12560

INTERPRETER

	ALFS/I	DOS/ES LISP1.6	FLISP	HLISP	HLISP on IBM
BITA-5	2,150	220	815	22	73
BITA-6	7,200	700	2,620+	71	241
BITB-5	600	60	297	14	22
BITB-6	1,650	160	830	40	55
TARAI-4	140,000-	11,040	73,200	1,443	4,514
TARAI-5	---	300,380	1,974,300+	39,068	125,564
TARAI-6	---	---	---	---	---
TPU-1	87,000-	42,940	41,800	4,790	16,366
TPU-2	390,000-	121,140	200,200	13,411	44,715
TPU-3	157,000-	51,620	76,800	5,684	18,928
TPU-4	194,000-	---	97,700	8,025	26,942
TPU-5	28,000	8,120	14,820	866	3,132
TPU-6	820,000-	211,200	391,700	22,849	16,741
TPU-7	150,000-	46,720	81,700	5,078	11,931
TPU-8	142,000-	32,820	77,000	3,459	8,788
TPU-9	133,000-	24,620	52,400	2,663	

	OLISP	PETL	Standard LISP	TLICS	TOSBAC-5600 LISP1.9
BITA-5	46	510	25,800	159	76
BITA-6	155	1,700+	86,000	550	249
BITB-5	13	---	8,000	54	23
BITB-6	34	---	20,500	159	59
TARAI-4	3,727	32,900+	---	6,097	5,124
TARAI-5	100,734	896,000+	---	165,007	138,819
TARAI-6	---	---	---	---	---
TPU-1	2,262	24,000	---	21,008	4,403+
TPU-2	10,262	101,000	---	60,235	21,148++
TPU-3	3,932	38,000	---	25,199	7,447+
TPU-4	5,042	49,000	---	35,324	10,958+
TPU-5	759	7,000	---	4,104	1,461+
TPU-6	20,241	194,000	---	108,024	66,502++
TPU-7	4,179	40,000	---	29,787	8,350+
TPU-8	3,987	38,000	---	16,519	5,459+
TPU-9	2,716	25,000	---	12,212	4,133+

	LIPQ	LISP1.5 on MELCOM	LISP1.7	LISP38	NIT LISP-U
BITA-5	300	787	766	1,100	660-
BITA-6	1,010	2,662	2,588	3,862	2,310-
BITB-5	104	252	255	399	240-
BITB-6	282	720	689	1,178	720-
TARAI-4	16,000	51,322-	42,361	61,785	35,310-
TARAI-5	437,000	1,427,994-	1,289,053	1,722,329	968,870-
TARAI-6	---	---	47,361,192	---	---
TPU-1	12,000+	34,465-	153,853	217,279	156,300-
TPU-2	55,200+	162,490-	429,539	602,520	605,500-
TPU-3	21,200++	62,595-	182,557	258,721	194,200-
TPU-4	27,400++	79,776-	256,457	358,449	283,300-
TPU-5	4,000++	10,969	28,184	39,175	28,700-
TPU-6	118,000++	320,847-	732,888	1,032,463	190,100-
TPU-7	21,800++	63,823-	163,831	230,928	121,400-
TPU-8	21,000++	60,118-	113,461	159,794	88,000-
TPU-9	14,200++	40,594-	85,520	119,635	

	VS-DLISP1.5	UTLISP4.1
BITA-5	2,000	110
BITA-6	8,000	368
BITB-5	---	36
BITB-6	1,000	99
TARAI-4	133,000+	7,793-
TARAI-5	3,920,000	213,058-
TARAI-6	---	---
TPU-1	84,000	24,641
TPU-2	410,000-	70,709
TPU-3	151,000	29,430
TPU-4	196,000	41,524
TPU-5	28,000	4,375
TPU-6	841,000-	123,200
TPU-7	157,000	26,835
TPU-8	157,000	18,676
TPU-9	104,000	13,784

COMPILER

	DOS/ES LISP1.6	HLISP	HLISP compiler	LIPQ	OLISP
BITA-5	40	9	3	63	15
BITA-6	180	30++	10	219+	50
BITB-5	20	3	2	25+	3
BITB-6	60	10++	3	75+	9
TARAI-4	2,980	330	310	255	670
TARAI-5	80,926	8,905	8,449	6,900	18,934
TARAI-6	---	322,347	311,242	255,000	---
TPU-1	6,020	1,029	1,813	2,200+	658
TPU-2	17,320	2,871+	5,340	6,100+	2,064
TPU-3	7,040	1,227++	2,260	2,600+	850
TPU-4	---	1,707	3,129	3,700+	1,161
TPU-5	1,060	181	332	400	132
TPU-6	28,820	4,893+	9,564	10,500+	3,617
TPU-7	6,240	1,053	1,921	2,300+	776
TPU-8	4,160	724++	1,461	1,600+	596
TPU-9	3,160	545	1,044	1,100+	424

	Standard LISP	TLICS	TOSBAC-5600 LISP1.9	UTLISP4.1
BITA-5	---	78	22	24
BITA-6	---	278	71	78
BITB-5	---	30	6	8
BITB-6	---	80	14	25
TARAI-4	375,600	2,934	1,604	2,500
TARAI-5	---	79,618	43,609	74,388
TARAI-6	---	1,603,910		
TPU-1	---	10,719	1,591	---
TPU-2	---	29,439	6,764+	---
TPU-3	---	12,716	2,798+	---
TPU-4	---	17,648	3,250+	---
TPU-5	---	1,886	555	---
TPU-6	---	51,043	27,049++	---
TPU-7	---	10,923	3,189+	---
TPU-8	---	7,631	1,163+	---
TPU-9	---	5,784	964+	---

Prolog System Profile

K-PROLOG   version 2.5
> developed by Masaharu Onish, Nobukuni Kino (CYNIK Inc.) and measured by the authors
> TOSHIBA UX-300 under UNIX SystemIII
> SUMITOMO E.I. USTATION-E10 under UNIX SystemIII
> SUMITOMO E.I. USTATION-E15 under UNIX System V
> Hewlett-Packard HP9000-500 under UNIX SystemIII
> Hewlett-Packard HP9000-200 under UNIX SystemIII
> Sun micro systems SUN2 under UNIX 4.2BSD
> SORD M685 under UNOS
> NEC PC9801 under UNIX SystemIII
> OMRON SUPER MATE under UNIX System V

PROLOG/I   version 1-1
> developed by Hiromitsu NAKAGAWA (Matsushita Electoric Industrial Co.,Ltd.)
> measured by the author
> NCR TOWER/1632 under UNIX with 2M byte physical memory (MC68000, 10MHz)

DEC-10 PROLOG   version 3.3
> developed by University of Edinburgh
> measured by Hiroshi G. Okuno (Musashino ECL, N.T.T., Junet: okuno@ntt20.ntt)
> DEC DECSYSTEM-2060 under TOPS-20 5.1 with 2M word physical memory

C-PROLOG
> developed by University of Edinburgh and enhanced by DEC JAPAN
> measured by Maebata (Digital Equipement Corporation, Japan)
> DEC VAX-11/785 under VMS V4.1

PROLOG-KABA   version 1.06
> developed by T. Hagino, T. Sakuragawa and E. Shibayama
> (Kyoto Artificial Brain Associates)
> NEC PC9801F under CP/M86 with 384K bytes (8MHz)

PROLOG/PEK
> developed by N.Tamura, K.Wada, Y.Kaneda, S.Maekawa, H.Matsuda, H.Kobayashi, M.Ayabe
> and M.Miyamoto (Kobe University) and measured by the authors
> PEK (Prolog Engine of Kobe university) is a dedicated Prolog machine.
> developed by K.Wada and N.Tamura (Kobe University)
> (CPU: Am2900 series, cycle time: 120 - 400 nsec, internal bus width: 34 bits)

TAO   version -20
> developed by Ikuo Takeuchi, Hiroshi G. Okuno and Nobuyas Osato
> (Musashino Electrical Communication Labs., N.T.T.) and measured by the authors
> ELIS is a dedicated Lisp machine. *(see TAO in Lisp System Profile)*
> Prolog is embedded in Lisp and interpreter is microcoded.

PROLOG-09   version 2.0
> developed by Teruo Serizawa (KOGAKUIN University) and measured by the author
> FUJITSU FM-11 AD2 (cpu 6809 2MHz) under OS-9 level II with 128K bytes
> FLEX version is also available.

H-PROLOG   version 2.0
> developed by Nakamura lab. (Tokyo Denki University) and measured by the authors
> UT-98 under Unix system V

SYMBOLICS PROLOG   version 1.0
> developed by Robert Cassels (Symbolics Inc.) and measured by the authors
> SYMBOLICS-3600 with/without Instruction Fetch Unit (IFU)
> Extra control store (microcode space) is needed.
> No interpreter is needed -- compiled clauses may be spyed.

KL0 and ESP
> developed by ICOT and measured by the authors
> PSI (Personal Sequential Inference machine) is a dedicated Prolog machine.
> (CPU: cycle time: 200ns, internal bus width: 40 bits Memory: vertual memory)

	K-PROLOG UX-300	K-PROLOG/USTATION- E10	E15	K-PROLOG/YHP9000- 500/real-addr	500/virtual	200
[1-1] Atom-1	0.40	0.44	0.24	0.21	0.44	0.20
[1-2] Atom-5	0.90	0.76	0.36	0.48	0.96	0.42
[2-1] Var-1	0.30	0.44	0.22	0.25	0.42	0.20
[2-2] Var-5	0.80	0.90	0.48	0.53	1.02	0.50
[3-1] Con-1	0.60	0.44	0.26	0.27	0.58	0.27
[3-2] Con-5	1.40	1.26	0.62	0.83	1.8	0.68
[4-1] Str-1	0.60	0.54	0.30	0.25	0.56	0.27
[4-2] Str-5	1.60	1.44	0.66	0.85	1.86	0.75
[5-1] Str-Var-1	0.30	0.44	0.24	0.22	0.44	0.20
[5-2] Str-Var-5	1.60	1.54	0.94	0.90	1.92	0.90
[6-1] Var-Str-1	0.40	0.42	0.22	0.20	0.44	0.23
[6-2] Var-Str-5	1.70	1.56	0.92	0.88	1.90	0.88
[7-1] Det-Call	0.90	0.94	0.46	0.43	0.88	0.50
[7-2] Ndet-Call	1.30	1.40	0.66	0.68	1.36	0.77
[7-3] Shallow-Back	5.10	5.04	2.38	2.52	5.04	2.87
[7-4] Deep-Back	14.7	15.1	7.08	7.38	15.0	8.47
[8-1] Key-First	0.50	0.58	0.30	0.30	0.66	0.33
[8-2] First	0.50	0.60	0.34	0.32	0.62	0.35
[8-3] Key-Last	70.0	67.8	32.4	37.3	72.4	39.2
[8-4] Last	90.0	79.5	37.7	44.3	90.8	46.2
[8-5] Key-Middle	35.0	34.4	16.3	17.9	36.7	19.8
[8-6] Middle	40.0	40.3	18.9	22.4	45.8	23.5
[9-1] Rev-30	800	690	390	375	796	438
[10-1] Sort-50	1000	892	508	492	986	550
[11-1] Cons-1000	300	172	100	110	234	107
[11-2] Trav-1000	C's S/O	30800	14860	missing	25100	missing
[12-1] Srev-4	250	237	128	126	263	142
[12-2] Srev-5	1000	952	516	523	1072	563
[12-3] Srev-6	---[4350]	3480	2040	2117	4180	2267
[13-1] Lisp-Tarai-3	S/O	184000	87980	106533	220980	106050
[13-2] Lisp-Fib-10	17900	16920	8100	9717	20020	9817
[13-3] Lisp-Rev-30	8100	7700	3680	4467	9220	4433
[14-1] 8-Queen-1	6750	6080	3220	3283	6480	3583
[14-2] 8-Queen-all	109350	98580	51920	53300	104900	57600
[15-1] Diff-1	225	213	107	120	234	124
[15-2] Diff-2	3950	3720	1900	2083	4080	2200
[16-1] DB-1	D/O	11.7	5.6	6.13	12.5	6.7
[16-2] DB-2	D/O	212	107	113	235	125
[16-3] DB-3	D/O	7420	3500	3750	7740	4167
[16-4] DB-4	D/O	7760	3680	3967	8120	4417
[16-5] DB-5	D/O	9360	4620	4783	9860	5417
[16-6] DB-6	D/O	84580	42100	43466	92180	48833
[16-7] DB-7	D/O	51260	24220	26950	54680	29383
[16-8] DB-8	D/O	76100	36080	missing	81020	43617
[16-9] DB-9	D/O	1648	800	918	2128	960
[16-10] DB-10	D/O	838	394	437	884	478
[17-1] Fib-Fact	2100	2030	1090	1100	2384	1217

| | Interpreted codes | | | | (milliseconds) |
	K-PROLOG SUN2	K-PROLOG M685	K-PROLOG PC9801	K-PROLOG SUPER MATE	PROLOG/I TOWER/1632
[1-1] Atom-1	.26	.24	.44	.20	403
[1-2] Atom-5	.48	.34	.93	.35	579
[2-1] Var-1	.28	.22	.47	.21	444
[2-2] Var-5	.60	.46	.97	.47	632
[3-1] Con-1	.33	.22	.57	.23	518
[3-2] Con-5	.78	.64	1.50	.63	1175
[4-1] Str-1	.33	.26	.60	.27	579
[4-2] Str-5	.92	.70	1.57	.73	1256
[5-1] Str-Var-1	.27	.22	.43	.22	512
[5-2] Str-Var-5	.98	.82	1.70	.77	982
[6-1] Var-Str-1	.27	.22	.44	.22	525
[6-2] Var-Str-5	1.00	.80	1.70	.78	1004
[7-1] Det-Call	.59	.46	.97	.45	895
[7-2] Ndet-Call	.58	.74	1.43	.67	1450
[7-3] Shallow-Back	3.07	2.60	5.50	2.57	8000
[7-4] Deep-Back	9.13	7.96	15.57	7.41	38000
[8-1] Key-First	.35	.34	.60	.28	69300
[8-2] First	.37	.30	.75	.28	63300
[8-3] Key-Last	42.0	37.1	77.0	34.0	80400
[8-4] Last	49.9	42.2	92.3	42.6	76500
[8-5] Key-Middle	21.5	18.7	39.6	17.6	73300
[8-6] Middle	25.20	21.8	47.3	20.5	68100
[9-1] Rev-30	433	380	817	350	59500
[10-1] Sort-50	575	490	1017	462	---
[11-1] Cons-1000	117	110	250	87	---
[11-2] Trav-1000	17383	14067	C's S/O	14067	---
[12-1] Srev-4	158	120	263	118	---
[12-2] Srev-5	592	520	1051	470	---
[12-3] Srev-6	2366	2160	---[4483]	2100	---
[13-1] Lisp-Tarai-3	116400	94200	S/O	94417	---
[13-2] Lisp-Fib-10	10683	8800	19150	8717	---
[13-3] Lisp-Rev-30	4850	3940	8600	3950	---
[14-1] 8-Queen-1	3783	3320	6684	3100	---
[14-2] 8-Queen-all	61133	53780	108270	50633	---
[15-1] Diff-1	135	114	250	111	---
[15-2] Diff-2	316	1980	4201	1950	---
[16-1] DB-1	7.27	6.24	D/O	5.83	---
[16-2] DB-2	130	110	D/O	105	---
[16-3] DB-3	4600	3860	D/O	3750	---
[16-4] DB-4	4833	4020	D/O	3933	---
[16-5] DB-5	5767	4860	D/O	4700	---
[16-6] DB-6	52367	43480	D/O	42516	---
[16-7] DB-7	32133	26400	D/O	26383	---
[16-8] DB-8	47667	39180	D/O	39483	---
[16-9] DB-9	1033	880	D/O	1000	---
[16-10] DB-10	525	436	D/O	482	---
[17-1] Fib-Fact	1275	1050	2200	1042	---

| | Interpreted codes | | | (milliseconds) |
| | DEC-10 PROLOG | C-PROLOG | PROLOG-KABA | Prolog |
	DECSYSTEM-2060	VAX 785	PC9801F	PEK
[1-1] Atom-1	0.563 [0.507]	0.048	0.331	0.0080
[1-2] Atom-5	0.586 [0.523]	0.054	0.818	0.0116
[2-1] Var-1	0.503 [0.585]	0.059	0.285	0.0092
[2-2] Var-5	0.674 [0.613]	0.089	0.834	0.0168
[3-1] Con-1	0.570 [0.545]	0.054	0.411	0.0118
[3-2] Con-5	0.652 [0.602]	0.121	1.199	0.0284
[4-1] Str-1	0.544 [0.519]	0.063	0.467	0.0128
[4-2] Str-5	0.681 [0.636]	0.149	1.338	0.0350
[5-1] Str-Var-1	0.561 [0.588]	0.039	0.362	0.0086
[5-2] Str-Var-5	0.691 [0.676]	0.175	1.150	0.0302
[6-1] Var-Str-1	0.547 [0.498]	0.056	0.290	0.0088
[6-2] Var-Str-5	0.676 [0.726]	0.149	1.137	0.0308
[7-1] Det-Call	0.811 [0.977]	0.106	0.669	0.0174
[7-2] Ndet-Call	1.40 [1.36]	0.164	1.10	0.0270
[7-3] Shallow-Back	3.86 [4.04]	0.637	5.02	0
[7-4] Deep-Back	11.4 [12.3]	1.67	12.8	0.288
[8-1] Key-First	0.506 [0.482]	0.09	0.574	0.0106
[8-2] First	0.489 [0.527]	0.078	0.586	0.0104
[8-3] Key-Last	12.5 [12.5]	3.51	54.6	0.841
[8-4] Last	16.3 [15.8]	6.60	83.4	1.04
[8-5] Key-Middle	6.85 [6.46]	1.85	27.8	0.429
[8-6] Middle	8.43 [8.23]	3.38	42.5	0.530
[9-1] Rev-30	285.6 [263]	47.9	420	7.39
[10-1] Sort-50	322.6 [330]	93.3	608	10.7
[11-1] Cons-1000	4.66 [4.59]	16.2	72.9	---
[11-2] Trav-1000	5603 [5644]	2684	1616	---
[12-1] Srev-4	101.6 [102]	17.5	165	3.13
[12-2] Srev-5	443 [432]	70.0	654	12.5
[12-3] Srev-6	3349 [2141]	297	2746	
[13-1] Lisp-Tarai3	52971 [53823]	17668	152603	---
[13-2] Lisp-Fib-10	4728 [4810]	1571	12480	---
[13-3] Lisp-Rev-30	2438 [2329]	707	5906	---
[14-1] 8-Queen-1	2160 [2194]	799	4323	90.7
[14-2] 8-Queen-all	35127 [34942]	12657	69423	---
[15-1] Diff-1	71.1 [70.3]	19.3	161	---
[15-2] Diff-2	1545 [1514]	398	2862	---
[16-1] DB-1	2.40 [2.51]	0.653	9.47	---
[16-2] DB-2	19.6 [21.0]	16.7	138	---
[16-3] DB-3	137 [144]	500	6101	---
[16-4] DB-4	1472 [1151]	532	6385	---
[16-5] DB-5	1250 [1315]	830	7009	---
[16-6] DB-6	11454 [12089]	6488	66693	---
[16-7] DB-7	8691 [9295]	3381	42643	---
[16-8] DB-8	12839 [13585]	5016	62668	---
[16-9] DB-9	229 [245]	111	1113	---
[16-10] DB-10	147 [153]	53	672	---
[17-1] Fib-Fact	767 [769]	164	1351	---

CORRIGENDA and APPENDIX

Page 1   UUCP network address should read
{titcca, ccut, kddlab, flats, tsuda, suvax1, kurims, ouicsu}!nttlab!ntt20!okuno
{hplabs, ihnp4, mcvax, ukc}!kddlab!nttlab!ntt20!okuno

Page 2   Line Bottom: 'Kentaro Shimizu' should read 'Hirokazu Murao'

Page 5   **Legend** add the followings:
          <=   see left column
          =>   see right column

Page 6   **CAMBRIDGE LISP** *Compiled codes*
        [7-1]   correction to: 0.722
        [7-2]   correction to: 2.47
        [7-3]   correction to: 0.289
        [7-4]   correction to: 0.846

Page 12 **TAO**
        [2-4]   correction to: 50.0

Page 17 **VAX LISP on VAX-11/780**
        [12-1] correction to: 125600

Page 22 **DEC-10 PROLOG**
        [16-3] correction to: 1367   [1437]

        C-PROLOG   *All data are wrong and new data are shown in Appendix.*

Page 23 **Legend**   measure =>   measurer

       TAO
        [16-6] correction to: 3960

Page 24 **DEC-10 PROLOG**
        [16-3] correction to: 25.8   [28.6]

UPDATED DATA

Cambridge LISP (Version 4 Level 1/0.91L)
    Original version was developed by Prof. J.P. Fitch and Dr. A.C. Norman.
    Ver 4 Lev1/0.91L was enhanced by Yasumasa Kanada (Computer Centre,
    University of Tokyo) and measured by him through batch processing.
    Timing fluctuates for about 10% or more depending on the environment.
    Flating point number is represented in IEEE format.
    HITAC M-280H under VOS3-ES1.

REWMOL Version 3.6
    developed and measured by Joji Kariya (Yamaguchi University)

LISP68K
    developed and measured by Tsuyoshi Yamamoto et al.
    DCL U-Station E-15 under Uniplus V

QUINTUS PROLOG Release 1.0 (VAX/VMS)
    developed by Quintus Computer Systems, Inc.
    measured by Toshiya Toba (Nihon DEC, Junet: toba@digiko.dec-j)
    DEC VAX-11/785 under VMS V4.1

C-PROLOG   Version 1.5b
    developed by EdCAAD and enhanced by Nihon DEC
    measured by Toshiya Toba (Nihon DEC, Junet: toba@digiko.dec-j)
    DEC VAX-11/785 under VMS V4.1
    DEC VAX 8600 under VMS V4.1

(milliseconds)	CAMBRIDGE LISP (TOKYO VERSION) HITAC M-280H/VOS3-ES1 Interpreted codes		Compiled codes		REWMOL ACOS 850 Interpreted codes
[1-1] Tarai-4	1024	[1015]	14.42	[14.62]	2746
[1-2] Tarai-5	31063	[30716]	401	[406]	75114
[1-3] Tarai-6	---		14770	[14787]	---
[1-4] Tak-18-12-6	3324	[6528]	69.5	[68.3]	15238
[2-1] List-Tarai-4	1576		103.5		11980
[2-2] Srev-5	59.5		1.16		139
[2-3] Srev-6	237		4.58		558
[2-4] Qsort-50	65.3		1.00		195
[2-5] Nrev-30	54.0		0.878		120
[2-6] Rev-30	0.0567		0.0367		0.250
[2-7] Drev-30	0.0666		0.0101		0.161
[2-8] Rev-10	0.0303		0.0135		0.135
[2-9] Rev-100	0.142		0.121		0.695
[2-10] Rev-1000	1.19		1.18		7.82
[2-11] Rev-10000	10.7		10.8		116
[2-12] Drev-10	0.0399		0.00371		0.095
[2-13] Drev-100	0.125		0.0334		0.411
[2-14] Drev-1000	0.986		0.331		4.02
[2-15] Drev-10000	9.12		3.31		78.7
[3-1] String-Tarai-4	1825		304		10546
[4-1] Flonum-Tarai-4	1473		349		3019
[4-2] Bignum-Tarai-4	1234		257		N/A
[5-1] Bubble-50	319	[278]	3.18	[2.6]	934
[6-1] Seq-100	41.1	[40.3]	9.18	[9.17]	83.5
[7-1] BITA-5	14.8		0.497		40.8
[7-2] BITA-6	49.2		1.70		136
[7-3] BITB-5	5.36	[5.34]	0.223	[0.18]	14.5
[7-4] BITB-6	14.7	[14.6]	0.642	[0.494]	38.2
[8-1] Sort-50	1.84	[1.42]	1.74	[1.32]	8.99
[8-2] Sort-10	0.209	[0.184]	0.155	[0.128]	0.682
[8-3] Sort-100	2.63	[2.06]	2.48	[1.85]	6.61
[8-4] Sort-1000	34.6	[26.2]	33.7	[25.1]	91.6
[8-5] Sort-10000	229	[174]	223	[165]	1307
[8-6] Rsort-10	0.229	[0.202]	0.169	[0.147]	2.79
[8-7] Rsort-100	2.62	[2.22]	2.48	[2.07]	52.6
[8-8] Rsort-1000	31.0	[26.4]	30.2	[25.0]	841
[8-9] Rsort-10000	221	[186]	215	[177]	15023
[9-1] TPU-1	620		53.1		5498
[9-2] TPU-2	2853		154		15355
[9-3] TPU-3	1090		63.8		6209
[9-4] TPU-4	1422		88.7		8505
[9-5] TPU-5	207		10.2		1019
[9-6] TPU-6	5859		266		28139
[9-7] TPU-7	1098		59.5		5591
[9-8] TPU-8	1097		43.0		4757
[9-9] TPU-9	738		31.7		3415
[10-1] Prl-Rev-15	1121		24		2620
[10-2] Prl-Sort-20	1597		36		3898
[11-1] Diff-3	12.8		0.262		36.0
[11-2] Diff-5	.620		20.7		3170
[12-1] Boyer	82061		1366		172350

LISP68K
U-Stataion E-15

(milliseconds)	Interpreter codes	Compiled codes
[1-1] Tarai-4	4328	400
[1-2] Tarai-5	117934	10650
[1-3] Tarai-6	4320417	378484
[1-4] Tak-18-12-6	25000	2067
[2-1] List-Tarai-4	8466	1300
[2-2] Srev-5	272	15.0
[2-3] Srev-6	1083	66
[2-4] Qsort-50	293	16.8
[2-5] Nrev-30	217	15.0
[2-6] Rev-30	.67	.67
[2-7] Drev-30	.16	.33
[2-8] Rev-10	.34	.33
[2-9] Rev-100	1.84	1.83
[2-10] Rev-1000	17.5	17.3
[2-11] Rev-10000	186	187
[2-12] Drev-10	.34	.17
[2-13] Drev-100	.82	.84
[2-14] Drev-1000	6.00	5.83
[2-15] Drev-10000	62.7	62.5
[3-1] String-Tarai-4	6884	1516
[4-1] Flonum-Tarai-4	5800	1617
[4-2] Bignum-Tarai-4	5884	1867
[5-1] Bubble-50	1427	173
[6-1] Seq-100	184	50
[7-1] BITA-5	58.3	6.7
[7-2] BITA-6	200	21.8
[7-3] BITB-5	23.4	3.4
[7-4] BITB-6	60.0	6.7
[8-1] Sort-50	11.0	10.8
[8-2] Sort-10	2.01	1.83
[8-3] Sort-100	118.3	118
[8-4] Sort-1000	11483	11433
[8-5] Sort-10000	---	---
[8-6] Rsort-10	1.99	2.00
[8-7] Rsort-100	128	127
[8-8] Rsort-1000	12316	12317
[8-9] Rsort-10000	---	---
[9-1] TPU-1	2983	700
[9-2] TPU-2	13050	2033
[9-3] TPU-3	5067	883
[9-4] TPU-4	6533	1200
[9-5] TPU-5	950	150
[9-6] TPU-6	26684	3766
[9-7] TPU-7	5150	816
[9-8] TPU-8	4967	600
[9-9] TPU-9	3400	450
[10-1] Prl-Rev-15	4216	284
[10-2] Prl-Sort-20	6067	417
[11-1] Diff-3	61.8	5.16
[11-2] Diff-5	5377	457
[12-1] Boyer	336667	18034

Benchmarks	Interpreted codes			Compiled codes	
	C-PROLOG VAX11/785	QUINTUS PROLOG VAX11/785	QUINTUS PROLOG VAX 8600	QUINTUS PROLOG VAX11/785	QUINTUS PROLOG VAX 8600
[1-1] Atom-1	0.07	1.21	0.73	0.04	0.02 *(msec)*
[1-2] Atom-5	0.2	1.35	0.81	0.05	0.05
[2-1] Var-1	0.15	1.24	0.77	0.04	0.01
[2-2] Var-5	0.29	1.45	0.83	0.1	0.07
[3-1] Con-1	0.17	1.36	0.75	0.05	0.03
[3-2] Con-5	0.57	1.67	0.95	0.18	0.09
[4-1] Str-1	0.22	1.28	0.75	0.06	0.02
[4-2] Str-5	0.59	1.74	0.93	0.21	0.11
[5-1] Str-Var-1	0.15	1.17	0.86	0.07	0.04
[5-2] Str-Var-5	0.51	1.51	0.89	0.19	0.09
[6-1] Var-Str-1	0.18	1.16	0.73	0.04	0.01
[6-2] Var-Str-5	0.54	1.57	0.90	0.26	0.14
[7-1] Det-Call	0.33	2.07	1.16	0.04	0.02
[7-2] Ndet-Call	0.51	2.24	1.29	0.09	0.02
[7-3] Shallow-Back	2.02	3.73	2.04	0.21	0.09
[7-4] Deep-Back	5.3	18.0	8.96	0.79	0.31
[8-1] Key-First	0.3	1.21	0.67	0.06	0.02
[8-2] First	0.27	1.14	0.68	0.08	0.04
[8-3] Key-Last	11.7	26.9	13.4	0.06	0.04
[8-4] Last	21.1	30.1	15.2	6.49	3.26
[8-5] Key-Middle	5.84	13.9	6.92	0.06	0.03
[8-6] Middle	10.7	16.0	7.79	3.28	1.68
[9-1] Rev-30	192	596	294	19	8
[10-1] Sort-50	288	979	508	33	17
[11-1] Cons-1000	56.9	211	108	16.3	9.2
[11-2] Trav-1000	10330	2080	1040	110	50
[12-1] Srev-4	57.8	263	138	13.2	7
[12-2] Srev-5	234	1074	565	53.6	30
[12-3] Srev-6	1020	7550	3640	460	230
[13-1] Lisp-Tarai-3	54240	137700	73850	7580	3670
[13-2] Lisp-Fib-10	4760	12690	6690	730	360
[13-3] Lisp-Rev-30	2490	6030	3160	320	160
[14-1] 8-Queen-1	2620	7920	4270	230	100
[14-2] 8-Queen-all	42670	128870	67430	3680	1670
[15-1] Diff-1	67.1	213	112	9.8	5.4
[15-2] Diff-2	1370	4930	2560	170	90
[16-1] DB-1	2.05	5.51	2.62	0.07	0.03
[16-2] DB-2	53	51.7	25.5	28.1	13.2
[16-3] DB-3	1570	3070	1480	150	80
[16-4] DB-4	1650	3260	1520	190	90
[16-5] DB-5	2510	3110	1480	810	400
[16-6] DB-6	20690	27370	12930	5960	2870
[16-7] DB-7	10720	19360	9190	1580	780
[16-8] DB-8	15680	28840	13810	2070	1000
[16-9] DB-9	360	582	281	74	36
[16-10] DB-10	157	331	159	7	3
[17-1] Fib-Fact	528	1710	918	115	52

	Interpreted codes	(milliseconds)	
	TAO / ELIS	PROLOG-09 / FM-11	H-PROLOG / UT-98
[1-1] Atom-1	0.022	5.34	3
[1-2] Atom-5	0.056	6.30	2.8
[2-1] Var-1	0.036	5.76	3.4
[2-2] Var-5	0.088	6.76	4.8
[3-1] Con-1	0.042	5.80	2.4
[3-2] Con-5	0.142	8.60	2.2
[4-1] Str-1	0.050	6.24	3.2
[4-2] Str-5	0.170	9.20	7
[5-1] Str-Var-1	0.054	5.74	3.6
[5-2] Str-Var-5	0.180	8.60	7.6
[6-1] Var-Str-1	0.050	5.76	3
[6-2] Var-Str-5	0.132	8.60	6
[7-1] Det-Call	0.068	13.0	6
[7-2] Ndet-Call	0.100	23.3	7.6
[7-3] Shallow-Back	0.354	115	24.6
[7-4] Deep-Back	1.02	263	60
[8-1] Key-First	0.046	7.44	1.8
[8-2] First	0.046	7.48	0.8
[8-3] Key-Last	3.24	614	93.8
[8-4] Last	6.24	765	174
[8-5] Key-Middle	1.66	310	48.2
[8-6] Middle	3.16	386	17
[9-1] Rev-30	43.4	D/O [2422]	2640
[10-1] Sort-50	54.6	D/O [4578]	3280
[11-1] Cons-1000	10.3	706	4
[11-2] Trav-1000	1020	D/O	5620
[12-1] Srev-4	14 [26]	1846	S/O
[12-2] Srev-5	58 [112]	D/O	S/O
[12-3] Srev-6	S/O [480]	D/O	S/O
[13-1] Lisp-Tarai-3	37200	D/O	---
[13-2] Lisp-Fib-10	3020	D/O	---
[13-3] Lisp-Rev-30	1420	D/O	---
[14-1] 8-Queen-1	365	46000	26760
[14-2] 8-Queen-all	5940	754640	492860
[15-1] Diff-1	20.9	1812	660
[15-2] Diff-2	296	D/O	13440
			(by Associative Indexing)
[16-1] DB-1	0. 572	D/O	16.6 / 4
[16-2] DB-2	6.38	D/O	261 / 74.8
[16-3] DB-3	64	D/O	19410 / 33.2
[16-4] DB-4	462	D/O	20920 / 2080
[16-5] DB-5	27.8	D/O	22820 / 10580
[16-6] DB-6	396	D/O	220280 / 38
[16-7] DB-7	3100	D/O	148640 / 21460
[16-8] DB-8	4480	D/O	218680 / 37.2
[16-9] DB-9	66.4	D/O	3860 / 640
[16-10] DB-10	46	D/O	1984 / 1280
[17-1] Fib-Fact	159	D/O	720

Benchmarks

[1] ~ [8] Primitive operations
(unification and backtracking)
[9] Reverse of a list of 30
elements which requires
496 Logical Inferences
[10] Quicksort of 50 elements
which requires 609 Logical
Inferences
[11] Consing and Travese of
1000 elements
[12] Naive reverse
which is the same program
as [2-2] and [2-3] for Lisp
Contest
[13] Lisp simulator
[14] 8 Queen
[15] Differentiation
[16] Database queries
[17] Bidirectional Computation

caluculate fact(fib^{-1}(13))

Legend

[...]	cut is inserted
N/A	Not Available
S/O	Stack Overflow
D/O	Data Area Exhausted
---	retired
missing	Data is lost by measure

	Compiled codes			(milliseconds)	
	DEC-10 PROLOG	**PROLOG**/SYMBOLICS 3600		**KLO**	**ESP**
	DECSYSTEM-2060	without IFU	with IFU	PSI	PSI
[1-1] Atom-1	0.0091 [0.0074]	0.0076	0.0067	0.0089	
[1-2] Atom-5	0.0231 [0.0231]	0.0165	0.0137	---	
[2-1] Var-1	0.0086 [0.0068]	0.0059	0.0046	---	
[2-2] Var-5	0.0366 [0.0347]	0.0222	0.0193	0.0079	
[3-1] Con-1	0.0110 [0.0109]	0.0171	0.0146	---	
[3-2] Con-5	0.0450 [0.0386]	0.0615	0.0537	0.0142	
[4-1] Str-1	0.0129 [0.0054]	0.0192	0.0168	---	
[4-2] Str-5	0.0852 [0.0800]	0.0675	0.0591	---	
[5-1] Str-Var-1	0.0223 [0.0232]	0.0172	0.0146	---	
[5-2] Str-Var-5	0.0873 [0.0874]	0.0688	0.0596	---	
[6-1] Var-Str-1	0.0118 [0.0101]	0.0109	0.0098	---	
[6-2] Var-Str-5	0.0998 [0.101]	0.0176	0.0142	---	
[7-1] Det-Call	0.0166 [0.0166]	0.0089	0.0077	0.0056/call&ret	
[7-2] Ndet-Call	0.0338 [0.0339]	0.0188	0.0180	0.0097/call&ret	
[7-3] Shallow-Back	0.124 [0.127]	0.0801	0.0784	0.0065/baktrack	
[7-4] Deep-Back	0.351 [0.347]	0.235	0.223	0.0273/baktrack	
[8-1] Key-First	0.0184 [0.0166]	0.0225	0.0198	---	
[8-2] First	0.0298 [0.0287]	0.0603	0.0689	---	
[8-3] Key-Last	0.0236 [0.0170]	0.0227	0.0198	---	
[8-4] Last	2.62 [2.64]	0.0484	0.0258	---	
[8-5] Key-Middle	0.0163 [0.0176]	0.0226	0.0198	---	
[8-6] Middle	1.23 [1.19]	0.0306	0.0268	---	
[9-1] Rev-30	17.5 [13.8]	11.6	9.4	13.6	
[10-1] Sort-50	21.0 [17.1]	14.5	12.3	15.2	
[11-1] Cons-1000	0.0163 [0.0163]	6.0	5.9	51.7	
[11-2] Trav-1000	69.6 [62.9]	57.8	53.8	---	
[12-1] Srev-4	6.96 [5.85]	6.6 [4.4]	5.8 [3.9]	---	
[12-2] Srev-5	38.4 [23.1]	29.1 [18.0]	25.8 [15.5]	---	
[12-3] Srev-6	202 [95.0]	118 [71.9]	107 [61.8]	99.4	
[13-1] Lisp-Tarai3	6757 [4959]	3014	2644	4024	
[13-2] Lisp-Fib-10	500 [426]	262	228	369	
[13-3] Lisp-Rev-30	266 [203]	158	140	173	
[14-1] 8-Queen-1	128 [101]	81.4	65.3	96	
[14-2] 8-Queen-all	2019 [1624]	1318	1059	1570	
[15-1] Diff-1	3.90 [3.88]	3.9	3.5	---	
[15-2] Diff-2	74.8 [72.4]	59.1	52.3	---	
[16-1] DB-1	0.0121 [0.0149]	---	---		65
[16-2] DB-2	7.25 [7.44]	---	---		245
[16-3] DB-3	2.58 [2.86]	13.3	12.0		55
[16-4] DB-4	109 [112]	---	---		60
[16-5] DB-5	186 [192]	---	---		74
[16-6] DB-6	1797 [1792]	---	---		734
[16-7] DB-7	64.3 [652]	31.4	28.2		466
[16-8] DB-8	826 [825]	---	---		596
[16-9] DB-9	27.1 [27.6]	---	---		51
[16-10] DB-10	2.90 [2.89]	0.75	0.703		29
[17-1] Fib-Fact	70.0 [72.8]	38.5	34.1	---	