University Computer Center Newsletter

University of Minnesota
Twin Cities
Minneapolis, Minnesota

November 1980
Volume 14
Number 11

Open House

November 20, 1980
3:00 - 5:00 PM
140 Experimental Engineering
Demonstrations
Displays
Tours
Sustenance

Contents

HOLIDAY HOURS

	Down	Up
Laud.	0400 11/27 (THU)	0800 11/29 (SAT)
Exp. Eng.	2400 11/26 (WED)	1600 11/30 (SUN)

Director: Peter C. Patton
Editor : Naomi Miner

Comments about the content of this newsletter, or suggestions for changes may be directed to the editor, 235a Experimental Engineering, or call 612/376-4668.

tests of standard FORTRAN functions

Perhaps you are interested in the accuracy and execution time of the functions associated with our FORTRAN compilers. This article describes what functions we have, how we test for accuracy of those functions, and how we fare on those tests.

In the early seventies, we developed a number of REAL precision functions to accompany our MNF compiler, but we used CDC-developed COMPLEX and DOUBLE PRECISION function libraries to provide a complete FORTRAN function library. The MNF REAL functions ATAN, ATAN2, COS and SIN were more accurate and faster than comparable CDC functions; in fact they were adopted by CDC.

When we decided to implement M77, a FORTRAN compiler to meet the new ANS standard FORTRAN language, we also decided to provide a complete function library and post mortem dump (PMD) processor. We were influenced by the difficulty of integrating CDC function libraries and the University of Leicester's MANTRAP post mortem dump processor into a cohesive system. In addition, we knew our inability to control future design differences in those products could cause problems. For example, over the past several years MNF, a stable compiler, would often stop working or develop obscure errors whenever we installed a new version of associated CDC products. Finally, the seven subscripts and character data additions to the new FORTRAN standard would have required a complete rewrite of MANTRAP, instead we wrote a new PMD. We think these decisions have helped make M77 a state-of-the-art FORTRAN compiler.

measurement methods

There are two methods for measuring the accuracy of compiler's functions. First, we can compare a function against a higher precision function. Second, we can use trigonometric and other identities to identify inaccuracies. The routine method for measuring accuracy involves comparing a function against a higher precision function. In other words, a REAL function is tested against the corresponding DOUBLE PRECISION function. However, since higher precision FORTRAN functions are not supplied for complex and double precision functions, we developed and tested our own. The formula we used, called relative error, is as follows:

RE = (LOWER-HIGHER)/HIGHER FUNCTION

where the RE = relative error, and where the functions are evaluated at either a specific argument or at the extension of that argument to higher precision.

In the table accompanying this article you will find figures for maximum relative error (MRel) and root mean square. Maximum relative error for a range of arguments is that relative error exceeding all other relative errors within that range. Root mean square (RMS) is another measurement to show the average error encountered for a function. The formula for root mean square is:

RMS = SQRT(SUM(RE**2)/N)

For equally-spaced arguments the maximum relative errors multiplied by 10**29 and the corresponding execution times are given in the table for M77 and FTN4.8(T) DOUBLE PRECISION functions.

An independent group interested in testing for accuracy of functions is headed by William J. Cody, Jr. at the Argonne National Laboratory. In his "Software Manual for the Elementary Functions" a number of test programs are given for determining the maximum relative error in these functions in terms of a "loss of digits" (bits on a binary machine). Cody's tests use trigonometric and other identities of the same precision as the functions in question to test for accuracy. As a result they do not require the writing of higher precision functions. We converted these programs to provide both REAL and DOUBLE PRECISION function tests. Since there are sometimes up to four different test results for a specific function, the test value with the maximum relative error is shown in the table accompanying this article.

analysis of the Cody tests

M77 does well for the REAL functions. FTN4.8 has some slight problems with RMS for the COSH, SINH, ALOG10 and TAN and with MRel for ALOG10 and TAN function. As Cody has pointed out, implementation of an accurate power function (** operation in FORTRAN) requires in the equation X**Y = EXP(Y*LOG(X)) that the operation Y*LOG(X) carry more precision than the precision of the resulting function. Only the M77 REAL ** does not show this type of accuracy loss. Double precision arithmetic on the Cyber machine is done with a series of upper and lower real precisions which inherently have twice the loss of accuracy of REAL. Thus if an MRel of approximately 2.2 is good for REAL functions then 4.4 is good for DOUBLE PRECISION functions. By this criterion the M77 double routines (except for **) are accurate and only DCOS, DLOG, DSIN, (besides **) have problems in FTN. The double versus triple precision tests also indicate that for the given argument ranges, the FTN functions DCOS and DLOG have serious accuracy problems. The DOUBLE PRECISION timing figures reflect values taken uniformly from the given argument range.

As for execution times, FTN's DACOS, DASIN and DTAN are significantly faster than M77's while M77 does significantly better than FTN for DCOS, DLOG, DLOG10 and DSIN. The ratios of execution times for the functions given in the table on the Cyber 172 to the Cyber 74 are 3.6 for M77 and 3.7 for FTN. Function evaluation and Double and Complex arithmetic are some areas in which the Cyber 74 is significantly faster than the ratio, 2.06, we use for accounting purposes.

Next month in Part II of this article, I will discuss Complex FORTRAN functions.

L. A. Liddiard, 373-5239

W.J. CODY Loss of bits Tests

	REAL				DOUBLE PRECISION			
	M77		FTN4.8		M77		FTN4.8	
	MRel	RMS	MRel	RMS	MRel	RMS	MRel	RMS
DACOS/ACOS	1.98	0	2.00	0	3.78	1.86	3.29	1.32
DASIN/ASIN	1.76	.01	1.24	.32	3.29	1.25	3.14	1.00
DATAN/ATAN	1.96	.04	2.05	.67	2.90	1.24	3.50	1.37
DCOS/COS	1.94	.07	2.29	.67	2.87	.97	17.31	11.86
DCOSH/COSH	1.95	.13	2.21	1.01	3.21	1.50	3.62	2.34
DEXP/EXP	2.02	.06			2.63	.75	2.49	.45
DLOG/ALOG	1.32	0	1.99	.39	4.26	2.16	5.11	3.13
DLOG10/ALOG10	2.27	.40	2.95	.92	3.75	1.53	4.13	1.96
DSIN/SIN	2.03	.15	2.35	.63	2.82	.86	17.74	12.26
DSINH/SINH	1.94	.14	2.21	.99	3.22	1.53	3.43	2.34
DSQRT/SQRT	.50	0	.50	0	2.56	1.07	2.50	1.22
DTAN/TAN	2.33	.39	2.74	.91	4.23	2.06	4.12	2.29
DTANH/TANH	2.00	.30	2.35	.48	3.89	1.75	4.58	1.33
POWER/**	5.30	2.67	9.92	8.54	10.63	9.14	11.08	9.49

MRel = Maximum Relative loss
RMS = Root Mean Square loss

Double vs Triple Precision Routines

Double Precision Timing in microseconds

Maximum Relative Error *10**29	ARGUMENT RANGE	M77	FTN4.7	Cyber 74 M77	Cyber 74 FTN4.8 (T)	Cyber 172 M77	Cyber 172 FTN4.7 (T)
DACOS	-1,1	-4.6,5.8	-10.2,7.1	118.2	88.6	384.9	342.5
DASIN	-1,1	-6.0,7.2	-7.9,5.6	116.5	86.1	382.8	337.3
DATAN	-2,2	-3.1,5.1	-5.8,5.2	76.7	77.0	273.6	268.1
DCOS	-PI/2,PI/2	-4.3,5.4	$-10.^{15}$,2.7	72.1	93.3	296.1	350.6
DCOSH	-1.5,1.5	-4.9,4.1	-3.7,4.0	89.4	85.1	315.5	304.5
DEXP	-600,600	-3.3,2.9	-3.5,2.6	75.9	79.6	286.4	289.5
DLOG	.14,7.39	-8.6,6.2	-22.8,28.5	90.9	129.4	342.8	481.4
DLOG10	.01,100	-6.2,3.9	-14.2,6.1	90.9	135.9	343.8	503.5
DSIN	-PI/2,PI/2	-3.3,5.8	-12.8,6.2	73.6	93.0	296.0	351.9
DSINH	-1.5,1.5	-7.4,6.9	-5.9,6.8	79.8	84.0	288.1	304.2
DSQRT	0,100	-2.2,2.3	-2.3,2.3	25.1	27.4	59.5	67.5
DTAN	-PI/2,PI/2	-10.8,6.2	-8.1,6.9	85.1	67.2	328.7	251.3
DTANH	-1.5,1.5	-12.4,7.3	-7.1,6.0	95.8	92.1	325.1	325.6

writeupdate

For November, the list of significant WRITEUP changes is long. So without further ado:

ACCRATE (ALL) - Updates to the current accounting rates for the Cyber 172. (2 pp.)

CLASSES (All machines) - The short course schedule and descriptions for Fall Quarter, 1980. (15 pp.)

CODING (MERITSS) - Coding conventions for NOS 1.4. (57 pp.)

COSTEST (74/172) - Updated to included sample costs for tape jobs and miscellaneous special services. (Variable length)

DAREP (MERITSS) - Instructions for accessing the simulation package DAREP. (1 p.)

DOCLIST (74/172) - Updated to include the most up-to-date list of documentation. (Variable length)

FICHE (74/172) - Information on our new microfiche output service. (4 pp.)

FORMS (74/172) - Updates on the use of special output forms, card interpretation, etc. (5 pp.)

LABHOUR (MERITSS) - New instructional lab hours as of October 14, 1980. (3 pp.)

LISP (All machines) - Updates for LISP 1.4. (175 pp.)

MOVE (MERITSS) - Updates for inter-machine permanent file transmission. (1 pp.)

M77 (MERITSS) - Differences between the new M77 compiler and FTN5. (20 pp.)

PASCLIB (MERITSS) - Updates to the Pascal Library PASCLIB. (Variable length)

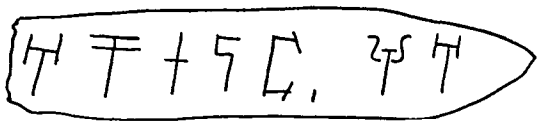
SUBMIT (74/172) - Major updating and reformatting on this document, which describes processing batch jobs from an interactive terminal. (18 pp.)

TAPEUSE (74/172) - The revised text of the soon-to-be-published third edition of the our User's Manual Supplement "Guide to Magnetic Tape Usage." (136 pp.)

J. T. Jaynes, 376-5262

corrections

Last month we made several errors concerning the amount of Central Memory on our Cybers. For the record, the 172 has 196,000 words of CM, the 720 has 98,000 words of CM, and the 74 has 131,000 words of CM. The correct hours for NOFRILL service on Saturdays are 4:00AM - 8:00AM. The Musical Apple article in September's issue was co-authored by Wendy Griffin.



Humanities News in Linear B, an ancient form of Greek. All of the existing writing is found on clay tablets, simulated above. (Graphic, V. Walsh)

humanities news text processing

As part of a short course on microcomputers, a one-day class on using the Terak's Editor will be held Monday, November 17 from 2:15 to 4:00 PM in 193 ExpEng. This class will cover use of the UCSD Pascal system for text entry and editing as well as special Terak programs for text formatting (Prose) and for communicating with our large computers (COM). A short description of the microcomputer classes was published in the September issue of this Newsletter. For more information on this or any other microcomputer class, call Mike Collins, 373-5754, or the Micro HELP-line, 37M-ICRO,

V. A. Walsh, 373-5780

humanities data bases

A number of research projects we have supported have produced machine-retrievable collections of texts. As reported in last month's newsletter, these data bases are available for interested users. In the list that follows, the principal investigator's name is given in parentheses where appropriate.

Babylonian economic tablets from Katulla (Dick Ward)
Biblical texts
  The Greek New Testament
  The Pauline Epistles
Caesar's Gallic War (Linda Ricketts)
The Iliad and the Odyssey (Steve Nimis)
Old English (J. Lawrence Mitchell)
  Orosius, Bk.II, Chapters I-VIII
  Peterborough Chronicle
Sumerian texts (Steve Sparley)
  Ana ittisu
  Hara tablets
Miscellany
  30 short texts (of approximately 1000 words) from various modern and ancient Afro-Asiatic and Indo-European languages.

If you are interested in these texts, call Vicky Walsh, 373-5780.

T. C. Rindflesch, 373-0167

short courses

Beginning FORTRAN; 3:15-5pm, 3-21 Nov (mwf), Arch 5
COBOL; 3:15-5pm, 3-26 Nov (mw), Arch 10
System 2000/RW; 3:15-5pm, 10-14 Nov (mwf), Arch 60
System 2000/PLI; 3:15-5pm, 17-21 Nov (mwf), Arch 55
Graphics; 3:15-5pm, 17-21 Nov (mtwf), MinMet 116
Graphics Workshop; 7:30-9:30pm, 20 Nov (th), Laud#
SIR; 3:15-5pm, 24 Nov-3 Dec (mw), Arch 15

#: Class held at Lauderdale conference room, Lauderdale computer site, 2520 Broadway Drive, Lauderdale, MN. For more information concerning these short courses, see (WRITEUP,CLASSES), or call Lincoln Fetcher at 376-1637.

microcosm

The microcomputer group has obtained instructional software on topics in Biology, Chemistry and Physics from CONDUIT. The programs and their documentation are available for inspection by appointment at the Micro HELP-line office.

You will find below a list of the software accompanied by a brief description:

COEXIST Population dynamics, a simulator of population in competition.

COMPETE Plant competition, a simulator for studying interactions between flowering plants.

ECOLOGICAL MODELLING Techniques for modelling ecological systems and processes on the computer.

ENZKIN Program for simulating enzyme-catalyzed results.

EVOLUT Instructional program for testing hypothesis that inherited variations showing a small positive survival value are sufficient for micro-evolution.

LINKOVER Instructional program for planning and executing genetic mapping experiments.

HABER Simulation of Haber process, difficult to perform in conventional laboratory setting.

RKINET Simulator to extend students' laboratory experience with reaction kinetics.

INTERP Wave superposition and diffraction patterns.

NEWTON Calculation of the intial velocity for a circular orbit of a projectile launched horizontally.

SCATTER Three models simulating particle scattering.

M. P. Timmerman, 37M-ICRO

remodeling

A group of secure bins was installed at the I/O station in 131 Experimental Engineering as part of the remodelling project recently completed. You may rent these bins if you need more secure handling of input and output materials than that provided by our standard procedures. You may get detailed information regarding rates, policies and procedures for this service from Sue Brennan, 376-3068. (See accompanying photo story.)

suggestion box

You should put up a sign at site 4F that lengthy card reads, as well as prints, should not be done there. I waited through a 600-card read tonight.

CB:18Sep

We are sorry for the inconvenience you suffered. We have tried signs at other locations and found that they are ineffectual. Short of imposing system-enforced limits (where everyone suffers) there appears to be no way to deter inconsiderate users.

R. Franta

The UCC driver picked up some tapes today at 1:45PM. I thought the driver wasn't supposed to pick up until 2:00?

MM:5Aug

The posted time of 2:00PM at the West Bank I/O Station was on an old sign. We have since acquired a supplemental vehicle and modified our delivery schedule. We have subsequently updated the schedules posted at West Bank and on the St. Paul campus.

J. Larson

Buy smaller 7 and 9 track labels as well as smaller TT (customer owned tape) label. The current size will not fit on small reels.

LC:27Aug

We will consider this suggestion the next time we order tape labels. Our current supply of labels will last several months.

J. Larson

Sue Brennan and Jerry Larson, secure bins are at left. (photo, R. Hotchkiss)

statistics

***PRODUCTION USAGE SUMMARIES: Cyber 74+172

	September, 1980	September, 1979
System resource units (SRU)	1,265,874 (1,668,538)	828,872 (1,115,813)
Batch jobs and MIRJE sessions	95,773 (107,132)	78,260 (88,522)
Total central processor (CP hours)	148/193 (186/290)	121/117 (134/207)
DELAY queue CP hours	33/ 19 (48/ 27)	37/ 23 (38/ 35)
NO FRILLS queue CP hours	10/ 23 (11/ 24)	--/ -- (--/ --)
Mass storage transfers (KPR)	428,182 (524,468)	297,577 (437,797)
Magnetic tape transfers (KPR)	10,932 (15,412)	9,219 (12,540)
Pages printed, charged from UCC	755,747 (906,672)	624,497 (732,469)
Cards punched	275,145 (344,214)	295,256 (308,096)
Microfilm frames produced	21,745 (472,447)	31,629 (370,588)
MIRJE terminal hours	17,623 (20,146)	11,993 (13,995)
Number of terminal sessions	39,747	27,990 (estimated)
Statos plotting production (feet)	9,123	6,528
Tapes mounted	12,297	11,027
Average file storage (char)	3,126.3 million	2,302.7 million
Mean time between failures	56.6/254.5 hours	27.2/37.7 hours
Available during scheduled hours	98.3/99.7 percent	98.1/ 97.6 percent

(totals in parentheses include staff development, accounting, and maintenance runs)

***DOWNTIME SUMMARY: October, 1980 (Column 1, Cyber 74 : Column 2, Cyber 172)

	0800-1800 M-F		other		total	
Total possible scheduled uptime hours	230.0	230.0	314.0	314.0	544.0	544.0
Total downtime hours (see Schedule A)	.6	.2	1.8	1.9	2.4	2.1
Total uptime hours	229.4	229.8	312.2	312.1	541.6	541.9
Uptime (percent)	99.7	99.9	99.4	99.4	99.6	99.6
Average downtime per occurrence (min)	12.6	14.0	26.8	112.0	20.7	63.0
Mean time between failures (hours)	76.7	115.0	78.5	157.0	77.7	272.0
Subsystem failures						
SUPIO	5	-	0	-	5	-
TELEX	0	0	0	0	0	0
EXPORT	1	-	2	-	3	-

Schedule A: downtime hours

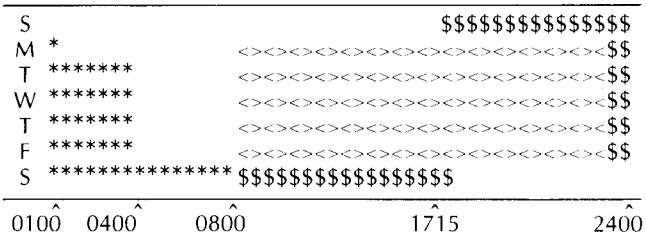
	Number		Total hours		Average minutes	
(1) Preventive maintenance over-runs	0	0	0.0	0.0	0.0	0.0
(2) Software related problems	2	0	0.4	0.0	12.5	0.0
(3) Hardware related problems	4	2	1.8	2.1	26.3	63.0
(4) Indeterminate problems	0	0	0.0	0.0	0.0	0.0
(5) External Problems	1	0	0.3	0.0	15.0	0.0

***PRODUCTION USAGE SUMMARIES: Cyber 720 (MERITSS)

	September, 1980	September, 1979
Number of jobs run	82,877	86,419
Central processor hours	121.9	148.7
MERITSS terminal hours	12,720	9,857
Number of terminal sessions	27,068	22,633
Maximum number of simultaneous users	83	95
Average file storage (char)	450.0 million	364.9 million
Mean time between failures	117.0 hours	32.0 hours
Available during scheduled hours	99.9 percent	99.7 percent

OPERATIONS

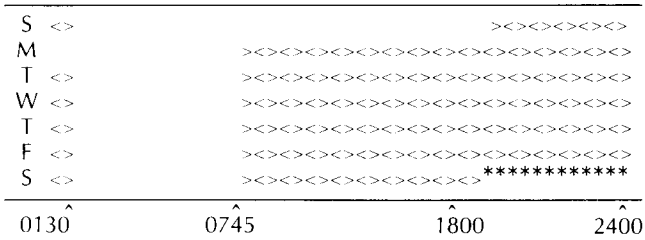
CYBER 74+172 OPERATING HOURS



<><><><> Lauderdale, ExpEng, NORMAL rate
$$$$$$$ Lauderdale, ExpEng, DELAY rate
******** Lauderdale only, DELAY rate

See WRITEUP(HOURS) for schedule of batch job pickup/delivery service.

CYBER 720 OPERATING HOURS



****** up, not attended
<><><> up, attended

See WRITEUP(LABHOUR) for a schedule of open hours in the student computer laboratories.

TWIN CITIES CAMPUS PUBLIC REMOTE JOB ENTRY SITES

SITE	ID	SUPERVISOR	PHONE
		East Bank	
ElectE 38	4V	V. Zahhos	373-5346
EltH N640	4W	D. Anderson	373-5827
ExpEng 130	3L	I/O Coordinator	373-4596
ExpEng 130	4B	I/O Coordinator	373-4596
ExpEng 130	4N	I/O Coordinator	373-4596
FrontH	4E	D. Schumacher	373-2740
KoltH S191	4Z		
MinMet 321	41	R. Larson	376-2668
Physics 69	44	L. Whitney	376-7627
TerrH W106	4I	B. Hackett	373-6621
D388 Mayo	24	L. Croatt	373-7714
Zoology 314	4J	E. Cushing	373-2232
		West Bank	
SocSci 167	4X	D. Lund	373-3608
SocSci 1009	4K	M. Mongiat	373-0168
		St. Paul	
BioSci 257A	47	M. Simmons	373-1961
ClaOff 125G	48	C. Bingham	373-0988
McN H	42	G. Wahlert	373-0939
NorH 24	4G	J. Colten	373-0990
NorH 24	40	J. Colten	373-0990
		Lauderdale	
User's Room	49	Secretary	373-4912
User's Room	3F	Secretary	373-4912

Keypunches provided at each site.

TWIN CITIES INSTRUCTIONAL COMPUTER LABORATORIES

SITE	SUPERVISOR	PHONE	EQUIPMENT
	East Bank		
CentH	R. Rickgarn	3-2289	TTY33(2)
ComH	C. Youngdale	3-2453	TTY43(1)
DiehlH 535	N. Sauro	6-7005	CRT(2)
EltH 121, 125	D. Anderson	3-5827	TTY33(6) CDC713(1) Hazeltine(3) Teleray(1)
FrontH	D. Schumacher	3-2740	TTY33(1)
HS-A 1-752	L. Ellis	3-0331	TTY33(4) TTY43(2) Teleray(1)
LindH 25	M. Schneider	3-0137	CDC713(6) Decwriter(5) Tektronix4013(1) Teleray(1) TTY43(11)
MechE 308	D. Riley	3-0340	TTY33(4) Teleray(3) Decwriter(5)
SanfH	M. Kilbury	3-3434	TTY33(1)
TerrH	B. Hackett	3-3567	TTY33(1)
VincentH 4	W. Stenberg	3-2586	TTY33(2) CDC713(2) Decwriter(7) Teleray(2)
WaLib 204	R. Estelle	3-2538	TTY43(10) CRT(2)
	West Bank		
BlegH 140	D. Lund	3-3608	TTY43(13) Teleray(1)
MdbH	R. Baker	3-9818	TTY33(1)
SocSci 167	D. Lund	3-3608	TTY33(5) Teleray(3) Decwriter(2)
	St. Paul		
ClaOff 125	C. Bingham	3-0988	TTY33(6) Hazeltine(2) Decwriter(4)

phone numbers

Accounting 373-4548, 373-2521
Computer-Aided Instruction 376-2975
Computer Hours (recorded message) 373-4927
Computer Store 373-4877
Consulting
  HELP-line 376-5592
    9 AM—5 PM, Monday—Friday
  Business Data Products 376-1761
    10-11 AM and 1-3 PM, Monday—Friday
  COBOL Language 376-1761
    11 AM—12M, Monday, Wednesday, Friday
  Statistics Packages 376-5062
    1-2 PM, Monday—Friday
  Data Bases 376-1761
    10-11 AM and 1-2 PM, Monday—Friday
  Microcomputers 376-4276
    10-12 AM and 2-4 PM, Monday—Friday
  Humanities 373-5780
    10:30-11:30 AM, Monday, Wednesday, Friday
    2-3 PM, Tuesday, Thursday
Contract Programming 376-1764
Data Base Applications 373-7878
Educational Services 376-3963
EDUNET Interface 373-7745
Equipment Purchase or Lease 376-8153
Experimental Engineering I/O 373-4596
Field Engineering 376-7584
Graphics Software 376-1636
HELP-line 376-5592
    9 AM—5 PM, Monday—Friday
HOURS-line (recorded message) 373-4927
Image Processing Center 373-7878
Information, Experimental Engineering 373-4360
Information, Lauderdale 373-4912
Information Systems 373-7878
Instructional Labs 373-5754
Job Status, ExpEng (recorded message) 373-4994
Lauderdale Operations 373-4920
Lauderdale Services 373-7538
Lauderdale Users Room 373-4921
MECC Interface 373-4573
Microcomputers 376-4276
Microfilm Operator 373-4995
Newsletter Subscription 376-4668
Permanent File Restoration 376-5605
Professional Services Division (PSD) 376-1764
Project Assistance 376-1764
Program Librarian 376-1636
Programming Languages 376-7290
Reference Room 373-7744
Remote Batch (RJE) Services 373-5754
Short Courses 376-1637
Shuttle Bus Service 376-3068
System Status (recorded message) 373-4927
Tape Librarian and EBR Operator 373-4995
Technical Writing 373-2522
User Numbers
  Instructional Batch 373-2521
  Instructional Timesharing 373-7745
  Research Batch 373-2521
  Research Timesharing 373-2521
User Services 373-4599

University Computer Center Newsletter

User Services
227 Experimental Engineering
University of Minnesota
208 Union Street SE
Minneapolis, Minnesota 55455