Programming Languages Table

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What Is A Language Level?

As language levels go up, fewer statements to code one Function Point are required. For example, COBOL is a level 3 and requires about 105 statements per Function Point.

The numeric levels of various languages provide a convenient shortcut for converting size from one language to another. For example, if an application requires 1000 non-commentary COBOL statements (level 3), then it would take only 500 statements in a level 6 language (such as NATURAL) and only 250 statements in a level 12 language (such as OBJECTIVE C). As you can see, the average number of statements required is proportional to the levels of the various languages.

Do Language Levels Affect Productivity?

The correlation between the level of a language and development productivity is not linear. For most large software projects, coding amounts to only about 30 percent of the effort.

Assume a program is written in a language that is twice the level of a similar program, for instance level 6 versus level 3. In this example, the coding effort might be reduced by 50 percent. But the total project might be improved by only 15 percent, since coding only comprised 30 percent of the original effort. Double the level of the language again to a level 12. That will only give an additional 7.5 percent net savings. Once again, coding is halved. But coding is not a major factor for very high level languages.

More accurate economic productivity rates can be gained by examining the average monthly Function Point production rates associated with various language levels. Table 1 looks at how language levels affect productivity.

Table 1. Language Level Relationship to Productivity

LANGUAGE LEVEL	PRODUCTIVITY AVERAGE PER STAFF MONTH
1 - 3	5 to 10 Function Points
4 - 8	10 to 20 Function Points
9 - 15	16 to 23 Function Points
16 - 23	15 to 30 Function Points
24 - 55	30 to 50 Function Points
Above 55	40 to 100 Function Points

What Is The Basis For Language Levels?

The languages and levels in Table 2 were gathered in four ways.

- Counting Function Points and Source Code
- Counting Source Code
- Inspecting Source Code
- Researching Languages

Counting Function Points And Source Code

Actual counts of Function Points and source code statements were performed. Samples of counting Function Points and source code statements were done on Ada, several BASIC dialects, COBOL, PASCAL, and PL/I.

Counting Source Code

Source code statements were counted, then compared to the size of the same program in languages of known levels. Assembly, APL, C, OBJECTIVE C, FORTH, FORTRAN, LISP, PILOT, and PROLOG are languages that produce the same source code count as COBOL. So code sizes were compared to the known quantity of COBOL source code.

Inspecting Source Code

Source code inspection for common applications was done. Then the volume of code for the application in a measured language was hypothesized. ACTOR, CLARION, and TRUE BASIC are examples of languages that were inspected and their levels hypothesized by subjective means.

Researching Languages

Research was done by reading descriptions and genealogies of languages and making an educated guess as to their levels. KL, CLOS, TWAICE, and FASBOL are examples of languages that were assigned tentative levels merely from descriptions of the language, rather than from actual counts.

For spreadsheets the ordinary concepts of a language do not apply. In this case, formulas, labels, and constants were considered to be statements.

List Of Programming Languages

As of 1996, there were more than 500 languages and major dialects of languages available to software practitioners. Table 2 lists the most common of them in what is considered version 7 of the SPR Programming Languages Table.

Table 2. Programming Languages and Levels

LANGUAGE	LEVEL	AVERAGE SOURCE STATEMENTS PER FUNCTION POINT
1032/AF	20.00	16

1st Generation default	1.00	320
2nd Generation default	3.00	107
3rd Generation default	4.00	80
4th Generation default	16.00	20
5th Generation default	70.00	5
AAS Macro	3.50	91
ABAP/4	20.00	16
ACCEL	17.00	19
Access	8.50	38
ACTOR	15.00	21
Acumen	11.50	28
Ada 83	4.50	71
Ada 95	6.50	49
ADR/DL	8.00	40
ADR/IDEAL/PDL	16.00	20
ADS/Batch	16.00	20
ADS/Online	16.00	20
AI shell default	6.50	49
AI SHELLS	6.50	49
ALGOL 68	3.00	107
ALGOL W	3.00	107
AMBUSH	10.00	32
AML	6.50	49
AMPPL II	5.00	64
ANSI BASIC	5.00	64
ANSI COBOL 74	3.00	107
ANSI COBOL 85	3.50	91
ANSI SQL	25.00	13
ANSWER/DB	25.00	13
APL 360/370	10.00	32
APL default	10.00	32
APL*PLUS	10.00	32
APPLESOFT BASIC	2.50	128
Application Builder	16.00	20
Application Manager	9.00	36
APS	19.00	17
APT	4.50	71
APTools	16.00	20

Ariel	3.00	107
ARITY	6.50	49
Arity PROLOG	5.00	64
ART	6.50	49
ART-IM	7.00	46
ART Enterprise	7.00	46
Artemis	8.00	40
AS/SET	17.00	19
ASI/INQUIRY	25.00	13
ASK Windows	7.00	46
Assembly (Basic)	1.00	320
Assembly (Macro)	1.50	213
Associative default	5.00	64
Autocoder	1.00	320
awk	15.00	21
Aztec C	2.50	128
BALM	3.00	107
BASE SAS	6.00	53
BASIC	3.00	107
BASIC A	2.50	128
Basic assembly	1.00	320
Berkeley PASCAL	3.50	91
BETTER BASIC	3.50	91
BLISS	3.00	107
BMSGEN	9.00	36
BOEINGCALC	50.00	6
BTEQ	25.00	13
C	2.50	128
C Set 2	3.50	91
C++	6.00	53
C86Plus	2.50	128
CA-dBFast	8.00	40
CA-EARL	11.50	28
CAST	6.50	49
CBASIC	3.50	91
CDADL	16.00	20
CELLSIM	7.00	46
Centerline C++	6.00	53

CHILL	3.00	107
CICS	7.00	46
CLARION	5.50	58
CLASCAL	4.00	80
CLI	10.00	32
CLIPPER	17.00	19
CLIPPER DB	8.00	40
CLOS	15.00	21
CLOUT	8.00	40
CMS2	3.00	107
CMSGEN	17.00	19
COBOL	3.00	107
COBOL II	3.00	107
Cobol/400	3.50	91
COBRA	16.00	20
CodeCenter	9.00	36
Cofac	9.00	36
COGEN	9.00	36
COGNOS	9.00	36
COGO	4.50	71
COMAL	4.00	80
COMIT II	5.00	64
Common LISP	5.00	64
Concurrent PASCAL	4.00	80
CONNIVER	5.00	64
CORAL 66	3.00	107
CORVET	17.00	19
CorVision	22.00	15
CPL	2.00	160
Crystal Reports	16.00	20
CSL	6.50	49
CSP	6.00	53
CSSL	7.00	46
CULPRIT	25.00	13
CxPERT	6.50	49
CYGNET	17.00	19
Data base default	8.00	40
Dataflex	8.00	40

dBase III	8.00	40
dBase IV	9.00	36
DCL	1.50	213
DEC-RALLY	8.00	40
Decision support default	9.00	36
DELPHI	11.00	29
DL/1	8.00	40
DNA-4	17.00	19
DOS Batch Files	2.50	128
DSP Assembly	2.00	160
DTABL	7.00	46
DTIPT	7.00	46
DYANA	4.50	71
DYNAMO-III	7.00	46
EASEL	11.00	29
EASY	6.50	49
EASYTRIEVE +	25.00	13
Eclipse	6.50	49
ED-Scheme 3.4	6.00	53
EDA/SQL	27.00	12
EIFFEL	15.00	21
ENFORM	7.00	46
English-based default	6.00	53
Ensemble	11.00	29
EPOS	16.00	20
Erlang	8.00	40
ESF	8.00	40
ESPADVISOR	6.50	49
ESPL/I	4.50	71
EUCLID	3.00	107
EXCEL 1-2	51.00	6
EXCEL 3-4	55.00	6
EXCEL 5	57.00	6
EXPRESS	9.00	36
EXSYS	6.50	49
Extended Common LISP	5.75	56
EZNOMAD	9.00	36
Facets	16.00	20

FAME	9.00	36
FileMaker Pro	9.00	36
FLAVORS	11.00	29
FLEX	7.00	46
FlexGen	11.00	29
FOCUS	8.00	40
FOIL	6.00	53
Forte	18.00	18
FORTH	5.00	64
FORTRAN 66	2.50	128
FORTRAN 77	3.00	107
FORTRAN 90	4.00	80
FORTRAN 95	4.50	71
FORTRAN	3.00	107
FORTRAN II	2.50	128
Foundation	11.00	29
FOXPRO 1	8.00	40
FOXPRO 2.5	9.50	34
FRAMEWORK	50.00	6
G2	6.50	49
GAMMA	20.00	16
Genascript	12.00	27
GENER/OL	25.00	13
GENEXUS	21.00	15
GENIFER	17.00	19
GeODE 2.0	20.00	16
GFA Basic	9.50	34
GML	7.00	46
Golden Common LISP	5.00	64
GPSS	7.00	46
GUEST	11.50	28
Guru	6.50	49
GW BASIC	3.25	98
Haskell	8.50	38
High C	2.50	128
HLEVEL	5.50	58
HP BASIC	2.50	128
HTML 2.0	20.00	16

Huron	20.00	16
IBM ADF I	16.00	20
IBM ADF II	18.00	18
IBM Advanced BASIC	3.25	98
IBM CICS/VS	8.00	40
IBM Compiled BASIC	3.50	91
IBM VS COBOL	3.00	107
IBM VS COBOL II	3.50	91
ICES	4.50	71
ICON	4.00	80
IDMS	8.00	40
IEF	23.00	14
IEW	23.00	14
IFPS/PLUS	10.00	32
IMPRS	8.00	40
INFORMIX	8.00	40
INGRES	8.00	40
INQUIRE	25.00	13
INSIGHT2	6.50	49
INSTALL/1	20.00	16
INTELLECT	6.00	53
INTERLISP	5.50	58
Interpreted BASIC	3.00	107
Interpreted C	2.50	128
IQLISP	5.50	58
IQRP	25.00	13
JANUS	4.50	71
JAVA	6.00	53
JCL	1.45	221
JOSS	3.00	107
JOVIAL	3.00	107
KAPPA	8.00	40
KBMS	6.50	49
KCL	5.00	64
KEE	6.50	49
Keyplus	8.00	40
KL	5.00	64
KLO	5.00	64

KRL	5.50	58
KSH	15.00	21
Ladder Logic	9.00	36
LAMBIT/L	5.00	64
Lattice C	2.50	128
Liana	2.50	128
LILITH	4.50	71
LINC II	23.00	14
LISP	5.00	64
LOGLISP	5.50	58
LOOPS	15.00	21
LOTUS 123 DOS	50.00	6
LOTUS Macros	3.00	107
LUCID 3D	51.00	6
LYRIC	6.00	53
M	20.00	16
macFORTH	5.00	64
MACH1	8.00	40
Machine language	0.50	640
Macro assembly	1.50	213
MAESTRO	20.00	16
MAGEC	20.00	16
MAGIK	15.00	21
MAKE	15.00	21
MANTIS	8.00	40
MAPPER	6.00	53
MARK IV	8.00	40
MARK V	9.00	36
MATHCAD	60.00	5
MDL	9.00	36
MENTOR	6.00	53
MESA	3.00	107
Microfocus COBOL	4.00	80
microFORTH	5.00	64
Microsoft C	2.50	128
MicroStep	16.00	20
Miranda	8.00	40
Model 204	8.50	38

MOSAIC	50.00	6
MS C ++ V. 7	6.00	53
MS Compiled BASIC	3.50	91
MSL	5.00	64
muLISP	5.00	64
MUMPS	17.00	19
NASTRAN	4.50	71
NATURAL 1	6.00	53
NATURAL 2	7.00	46
NATURAL Construct	13.00	25
Natural language	0.10	3200
NETRON/CAP	17.00	19
NEXPERT	6.50	49
NIAL	6.50	49
NOMAD2	8.00	40
Non-procedural default	9.00	36
Notes VIP	9.00	36
Nroff	6.00	53
Object-Oriented default	11.00	29
OBJECT Assembler	5.00	64
Object LISP	11.00	29
Object LOGO	11.00	29
Object PASCAL	11.00	29
Object Star	20.00	16
Objective-C	12.00	27
ObjectVIEW	13.00	25
OGL	4.00	80
OMNIS 7	8.00	40
OODL	11.00	29
OPS	7.00	46
OPS5	5.50	58
ORACLE	8.00	40
Oracle Developer/2000	14.00	23
Oscar	3.00	107
PACBASE	22.00	15
PACE	8.00	40
PARADOX/PAL	9.00	36
PASCAL	3.50	91

PDL Millenium	15.00	21
PDP-11 ADE	6.00	53
PERL	15.00	21
Persistance Object Builder	15.00	21
PILOT	6.00	53
PL/I	4.00	80
PL/M	4.50	71
PL/S	3.50	91
PLANIT	6.00	53
PLANNER	5.00	64
PLANPERFECT 1	45.00	7
PLATO	6.00	53
polyFORTH	5.00	64
POP	5.50	58
POPLOG	5.50	58
Power BASIC	6.50	49
PowerBuilder	20.00	16
POWERHOUSE	23.00	14
PPL (Plus)	8.00	40
Pro-C	12.00	27
PRO-IV	5.50	58
Problem-oriented default	4.50	71
Procedural default	3.00	107
Professional PASCAL	3.50	91
Program Generator default	20.00	16
PROGRESS V4	9.00	36
PROLOG	5.00	64
PROSE	3.00	107
PROTEUS	3.00	107
QBasic	5.50	58
QBE	25.00	13
QMF	22.00	15
QNIAL	6.50	49
QUATTRO	51.00	6
QUATTRO PRO	51.00	6
Query default	25.00	13
QUICK BASIC 1	5.00	64
QUICK BASIC 2	5.25	61

Quick C	2.50	128
Quickbuild	11.50	28
QUIZ	22.00	15
RALLY	8.00	40
RAMIS II	8.00	40
RapidGen	11.50	28
RATFOR	3.50	91
RDB	8.00	40
REALIA	7.00	46
Realizer 1.0	8.00	40
Realizer 2.0	9.00	36
RELATE/3000	8.00	40
Reuse default	60.00	5
REXX (MVS)	4.00	80
REXX (OS/2)	7.00	46
RM BASIC	3.50	91
RM COBOL	3.00	107
RM FORTRAN	3.00	107
RPG I	4.00	80
RPG II	5.50	58
RPG III	5.75	56
RT-Expert 1.4	5.50	58
S-PLUS	10.00	32
SAIL	3.00	107
SAPIENS	20.00	16
SAS	10.00	32
SAVVY	25.00	13
SBASIC	3.50	91
SCEPTRE	4.50	71
SCHEME	6.00	53
Screen painter default	57.00	6
SEQUAL	27.00	12
SHELL	15.00	21
SIMPLAN	9.00	36
SIMSCRIPT	7.00	46
SIMULA	7.00	46
SIMULA 67	7.00	46
Simulation default	7.00	46

SMALLTALK 80	15.00	21
SMALLTALK/V	15.00	21
SNAP	4.00	80
SNOBOL2-4	2.50	128
SoftScreen	23.00	14
SOLO	5.50	58
SPEAKEASY	9.00	36
Spinnaker PPL	9.00	36
Spreadsheet default	50.00	6
SPS	1.00	320
SPSS	10.00	32
SQL	25.00	13
SQL-Windows	27.00	12
Statistical default	10.00	32
STRATEGEM	9.00	36
STRESS	4.50	71
Strongly typed default	3.50	91
STYLE	7.00	46
SUPERBASE 1.3	9.00	36
SURPASS	50.00	6
SYBASE	8.00	40
Symantec C++	11.00	29
SYMBOLANG	5.00	64
Synchroworks	18.00	18
SYNON/2E	17.00	19
System-W	9.00	36
Tandem Access Language	3.50	91
TCL	5.00	64
TELON	20.00	16
TESSARACT	8.00	40
THE TWIN	50.00	6
THEMIS	25.00	13
TI-IEF	23.00	14
Topspeed C ++	11.00	29
TRANSFORM	22.00	15
TRANSLISP PLUS	5.75	56
TREET	5.00	64
TREETRAN	5.00	64

TRUE BASIC	5.00	64
Turbo C	2.50	128
TURBO C++	6.00	53
TURBO EXPERT	6.50	49
Turbo PASCAL >5	6.50	49
Turbo PASCAL 1-4	4.00	80
Turbo PASCAL 4-5	4.50	71
Turbo PROLOG	4.00	80
TURING	4.00	80
TUTOR	6.00	53
TWAICE	6.50	49
UCSD PASCAL	3.50	91
UFO/IMS	9.00	36
UHELP	10.00	32
UNIFACE	20.00	16
UNIX Shell Scripts	15.00	21
VAX ACMS	5.50	58
VAX ADE	8.00	40
VECTRAN	3.00	107
VHDL	17.00	19
Visible C	6.50	49
Visible COBOL	8.00	40
Visicalc 1	35.00	9
Visual 4.0	11.00	29
Visual Basic 1	7.00	46
Visual Basic 2	7.50	43
Visual Basic 3	8.00	40
Visual Basic 4	9.00	36
Visual Basic 5	11.00	29
Visual Basic DOS	8.00	40
Visual C++	9.50	34
Visual COBOL	16.00	20
Visual Objects	20.00	16
VisualAge	15.00	21
VisualGen	18.00	18
VS-REXX	10.00	32
VULCAN	5.00	64
VZ Programmer	9.00	36

WATCOM C	2.50	128
WATCOM C/386	2.50	128
Waterloo C	2.50	128
Waterloo PASCAL	3.50	91
WATFIV	3.75	85
WATFOR	3.50	91
WHIP	3.50	91
Wizard	11.50	28
XLISP	5.00	64
YACC	6.00	53
YACC++	6.00	53
ZBASIC	3.50	91
ZIM	17.00	19
ZLISP	5.00	64

On-Going Research Of Languages

The relationship between source code statements and Function Points has only been subject to research for a few years, so the margin of error in Table 2 can be quite high. Even so, the method is useful enough so publication of a preliminary table may be helpful in filling in the gaps and correcting the errors.

A complete and reliable industry-wide study of languages and their levels is of necessity a large multi-year project. A reasonable sampling of applications and languages would require data from about 5000 projects, assuming 10 projects in each language or dialect.

The organizing principle used in this research is basically sound and the construction of a periodic table of languages is potentially as useful to software engineering as the periodic table of the elements has been to chemical engineering and to physics.

SPR is conducting an on-going study of languages and their levels. For additional information, or to participate in this study, contact SPR Customer Support at 781-273-0140 or use e-mail: support@spr.com.

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