

# Index

**\*\*** operator (exponentiation), 30

## A

**%abs**, 85–86

numeric return data type and, 13*t*

absolute values. *See* **%abs**

accumulation operators, 83

Acos, 24

ACTGRPDFN\*, 69

activation groups, 65–70, **65**

CALLER\*, 68

CEETREC API and, 69

cleaning up, using RCLACTGRP, 69

default, 66

displaying, for a job, 70

ending of, 66

named, 67

NEW\*, 67, 68

Original Program Model (OPM) programs  
and, 66

performance considerations for, 69

scoping overrides and, ACTGRPDFN\*, 69

scoping resources with OVRSCOPE and,  
68–69

**%addr**, 86–87

definition specifications using, 9

pointer return data type and, 16*t*

address, storage. *See* **%addr**

addresses, procedure, retrieve. *See* **%paddr**

**%alloc**, 4, 88

pointer return data type and, 16*t*

allocating storage. *See* **%alloc**

AND, bitwise (**%bitand**), 88–89

API interfacing, 63–65

binding and, 64

CEEHDLR API and, 64–65

CEEHDLU API and, 64

dynamic calls to, 63–65

QCMDEXC, 63

Application Program Interfaces. *See* API

interfacing

arguments, 4. *See also* parameters

arrays

elements in, retrieve (**%elem**), 111

lookups in (**%lookupxx**), 124–126

substrings in (**%subarr**), 144–145

sum of elements in (**%tfoot**), 157

Asin, 24

assignment statements, indicator data type and, 11

Atan/Atan2, 24

**B**

B (begin), subprocedures and, 34  
%BIN, 1  
bind-by-copy, 57–58, **57**, 60  
bind-by-reference in, 58–59, **59**, 60  
binding, 56–60  
    activation groups and, 66–67  
    API interfacing and, 64  
    bind-by-copy in, 57–58, **57**, 60  
    bind-by-reference in, 58–59, **59**, 60  
    binding directory for, 62–63  
    in C vs. RPG IV, 26–27  
    CEEHDLR API and, 64–65  
    CEEHDLU API and, 64  
    Create Bound Program (CRTBNDRPG) and, 56, 57, 62  
    Create Program (CRTPGM) and, 56, 57, 60  
    Create RPG Module (CRTPGMOD) and, 57  
    Create Service Program (CRTSRVPGM) and, 58  
    prototyping and, 52  
    service program signatures and, 60–62  
    Update Module (UPDPGM) and, 60  
binding directory, QC2LE, 26, 62–63  
bit inversion, 90  
%bitand, 88–89  
%bitnot, 90  
%bitor, 91–92  
bitwise AND. *See* %bitand  
bitwise NOT. *See* %bitnot  
bitwise OR. *See* %bitor  
bitwise XOR. *See* %bitxor  
%bitxor, 92–93  
blank lines in code, 78  
Bnddir(), 26  
built-in functions  
    history and development of, 1–2  
    uses for, 7–8  
bytes used. *See* %size

**C**

C functions, 19–31  
    binding in, RPG IV vs. 26–27  
    character strings differences, vs. RPG IV, 26

    data conversion using, 27  
    data types and, C vs. RPG IV, 24–25, 25*t*  
    exponentiation using, 30–31  
    parameter passing to, 25–26  
    random numbers from, 22–24  
    RPG IV and, how they work, 21–22  
    trigonometric, 24  
    uses for, 19–21  
calculations in subprocedures, 35  
CALL, 50  
CALLER\* activation group, 68  
CallP, 21, 34, 50, 54  
calls  
    to APIs, 63–65  
    CALLVL\* scoping, 68  
    dynamic, 50  
CALLVL\* scoping, 68  
capitalization and case sensitivity, 83  
CEEHDLR API, 64–65  
CEEHDLU API, 64  
CEETREC API, 69  
%char, 74, 81, 93–94  
    character return data type and, 15*t*  
character conversion to graphic. *See* %graphic  
character data types, 24  
    convert to (%char), 93–94  
    converted to unsigned integer (%uns, %unsh), 156  
    insert/remove in string (%replace), 134–135  
    remove leading/trailing (%trimxx), 154  
    translate (%xlate), 158  
character return data type, 15, 15*t*  
character strings. *See* character data types; strings  
character substring, set/retrieve (%subst), 148–149  
check field  
    left to right (%check), 94–95  
    right to left (%checkr), 96  
%check, 81, 94–95  
    numeric return data type and, 13*t*  
%checkr, 81, 96  
    numeric return data type and, 13*t*  
CL, 1  
code changes at positions 1–5, 78

commenting code, 77–78, 83

Const keyword, procedure interface (PI),  
prototyping, and, 55

Control Language (CL), 1

control specifications. *See* H control  
specification

conversion

- C functions for, 27
- character to double-byte graphic (%graphic),  
118
- character/numeric expression to unsigned  
integer (%uns, %unsh), 156
- date to date data type (%date), 96–98
- field/expression to packed decimal (%dec,  
%dech), 98–99
- negative sign and numeric-to-character  
(%editc), 106–107, 107*t*
- numeric to character, using edit codes  
(%editc), 104–107, 105*t*, 107*t*
- numeric to character, using edit word  
(%editw), 108–110
- numeric to character, using floating-point  
notation (%editflt), 107–108
- numeric to floating point (%float), 116
- numeric/character expression to time  
(%time), 149–150, 149*t*
- numeric/character expression to timestamp  
(%timestamp), 151
- string to UCS-2 varying-length string  
(%ucs2), 155
- to character (%char), 93–94
- tokens, Strtok() and, 27, 28–30

Cos/Cosh, 24

Create Bound Program (CRTBNDRPG), 56,  
57, 62

- activation groups and, 67, 68

Create Program (CRTPGM), 56, 57, 60

- activation groups and, 67, 68

Create RPG Module (CRTPGMOD), 57

Create Service Program (CRTSRVPGM), 58,  
61, 62

- activation groups and, 67, 68

CTDATA\*\*, 79

## D

data structures

- elements in, retrieve (%elem), 111
- key (%kds), 121–122
- occurrence number of, set/retrieve (%occur),  
128–129

data types

- C vs. RPG IV, 24–25, 25*t*
- character return, 15, 15*t*
- date, time, and timestamp return, 14, 14*t*
- indicator return, 10–12
- numeric return, 12–14
- pointer return, 16, 16*t*
- unsigned integer, 81

DATCV67 module, 52–53

%date, 38, 74, 96–98

- date, time, and timestamp return data types  
and, 14, 14*t*

Date-conversion (Date6toLJ) subprocedure for,  
37–40

Date6toLJ subprocedure, 37–40

dates

- convert to date data type (%date), 96–98
- date, time, and timestamp return data types  
and, 14, 14*t*
- Date-conversion (Date6toLJ) subprocedure  
for, 37–40
- day calculation in (%days), 103–104
- difference between (%diff), 101–102
- duration BIFs for, 103–104
- duration limit values, 101*t*
- format conversions and calculations on, 82
- formats for, codes, 97*t*
- month calculation in (%months), 103–104
- prototyping and, conversion using, 52–53
- retrieve component of (%subdt), 146–147
- year calculation in (%years), 103–104

day calculation. *See* %days

%days, 103–104

- no return value in, 17*t*

%dec/%dech, 38, 74, 98–99

- numeric return data type and, 13*t*

decimal position, retrieve. *See* %decpos

`%decpos`, 100  
  definition specifications using, 9  
  numeric return data type and, 13*t*, 13  
definition specifications (D), 79  
  `%addr` in, 9  
  BIFs in, 8–10  
  `%decpos` in, 9  
  `%elem` in, 10  
  `%len` in, 8–9  
  `%paddr` in, 9–10  
  `%size` in, 8  
  subprocedures and, PI, 34  
`%diff`, 101–102  
difference between fields. *See* `%diff`  
`%div`, 102–103  
  numeric return data type and, 13*t*  
division. *See* `%div`  
duration BIFs, 103–104  
duration limit values, 101*t*  
dynamic calls, 50  
  to APIs, 63–65  
dynamic storage allocation. *See* `%realloc`

## E

edit codes, 104–107. *See also* `%editc`  
edit words, 108–110. *See also* `%editw`  
`%editc`, 104–107, 105*t*, 107*t*  
  character return data type and, 15*t*  
`%editflt`  
  character return data type and, 15*t*  
`%editw`, 108–110  
  character return data type and, 15*t*  
`%elem`, 111  
  definition specifications using, 10  
  numeric return data type and, 13*t*  
elements in array/data structure, retrieve. *See*  
  `%elem`  
embedded SQL, 72  
end of file. *See* `%eof`  
`%eof`, 4, 112  
  filenames on, 81  
  indicator data type and, 12*t*  
equal status. *See* `%equal`  
`%equal`, 113  
  indicator data type and, 12*t*

`Setxx` operations and, 82  
error condition status. *See* `%error`  
`%error`, 114  
  indicator data type and, 12*t*  
exclusive OR. *See* `%bitxor`  
exponentiation using C functions, 30–31  
expressions  
  extract signed-integer portion from (`%int`,  
  `%inth`), 120–121  
  set/retrieve length (`%len`), 123  
EXTPGM, 52  
extract signed-integer portion. *See* `%int`, `%inth`

## F

field check  
  left to right (`%check`), 94–95  
  right to left (`%checkr`), 96  
fields  
  extract signed-integer portion from (`%int`,  
  `%inth`), 120–121  
  to update (`%fields`), 115  
`%fields`, 115  
  no return value in, 17*t*  
`%fields` option, 81  
file operations  
  end of file (`%eof`), 112  
  open file check (`%open`), 129  
file status. *See* `%status`  
filenames on `%eof` and `%found`, 81  
`%float`, 116  
  numeric return data type and, 13*t*  
floating point, 24  
  numeric conversion to (`%float`), 116  
  numeric to character, floating-point notation  
  (`%editflt`), 107–108  
format date codes, 97*t*  
`%found`, 117  
  filenames on, 81  
  indicator data type and, 12*t*  
free- vs. fixed-format, prototyping and, 50–51  
free-format RPG IV, 3, 7–18, 72, 77–84  
functions  
  defined, 1–2  
  vs. op codes, 2–3  
  writing your own, 33. *See also* subprocedures

**G**

global variables, 2  
 global visibility concepts,  
   subroutines/subprocedures, 33  
 graphic character conversion. *See* %graphic  
 %graphic, 118

**H**

H control specification, 26–27, 82  
   activation group and, 67, 68  
   binding and, example of, 26–27  
 half-adjust packed decimal (%dech), 98–99  
 %handler, 118–119  
   no return value in, 17*t*  
 hours calculation. *See* %hours  
 %hours, 103–104  
   no return value in, 17*t*

**I**

If, 4  
   indicator data type and, 11  
 ILE  
   binding and, 56–60  
   prototyping and, 49–52  
*ILE C/C++ Runtime Library Functions  
 Reference*, 21  
 indicator return data type, 10–12  
 indicators, 80  
 %int, %inth, 120–121  
   numeric return data type and, 13*t*, 13  
 integer data types, 24  
 Integrated Language Environment. *See* ILE  
 inversion, bit. *See* %bitnot

**J**

JOBLVL\* override scoping, 69

**K**

%kds, 121–122  
   no return value in, 17*t*  
 key data structure (%kds), 121–122  
 keywords and specifications, 82

**L**

left to right field check (%check), 94–95  
 %len, 74, 123  
   definition specifications using, 8–9  
   numeric return data type and, 13*t*  
 length, set/retrieve. *See* %len  
 linking, 37  
 LOOKUP, 7  
 %lookupxx, 4, 5, 124–126  
   numeric return data type and, 13*t*  
   table type (%tlookupxx), 152–153

**M**

main procedures and subprocedures  
   no shared source members in, 43–47  
   NOMAIN and, 44, 58  
   shared source members in, 40–43, **41**, **43**  
   spec keyword and, 44  
 milliseconds calculation. *See* %mseconds  
 minutes calculation. *See* %minutes  
 %minutes, 103–104  
   no return value in, 17*t*  
 modular coding, 80, 71–76  
   analyzing program needs in, 71–73  
   binding and, 56–60  
   breaking down programs for, 72  
   embedded SQL and, 72  
   free-format RPG IV in, 72, 77–84  
   gathering code for, 73  
   help and collaborative efforts in, 72–73  
   nested BIFs and, 74–76  
   peer review of code and, 73  
   recommended practices in, 82–83  
   standards for, 72, 77–84  
   structured programming techniques and, 80  
   subprocedures in, 72  
 Monitor/Endmon, 38  
 Monitor/On-error/Endmon, 82–83  
 month calculation. *See* %months  
 %months, 103–104  
   no return value in, 17*t*  
 Move/MoveA/MoveL, 7  
 %mseconds, 103–104  
   no return value in, 17*t*

**N**

naming conventions, 79–80  
activation group, 67  
prototyping and, 51–52  
special characters used in naming and, 84  
negative sign and numeric-to-character  
conversion (`%editc`), 106–107, 107*t*  
nested BIFs, 74–76, 82  
NEW\* activation group, 67, 68  
NOMAIN, 44, 58  
NoPass\* keyword, 55  
NOT, bitwise. *See* `%bitnot`  
null indication. *See* `%nullind`  
null-terminated data types, 24  
set/retrieve (`%str`), 142–143  
`%nullind`  
indicator data type and, 12*t*  
numeric data type  
to character conversion, using edit codes  
(`%editc`), 104–107, 105*t*, 107*t*  
to character conversion, using edit word  
(`%editw`), 108–110  
to character conversion, using floating-point  
notation (`%editflt`), 107–108  
to floating point conversion (`%float`), 116  
numeric return data type, 12–14

**O**

`%occur`, 128–129  
numeric return data type and, 13*t*  
occurrence number of data structure,  
set/retrieve. *See* `%occur`  
Omit\* keyword, 55  
open file check. *See* `%open`  
`%open`, 129  
indicator data type and, 12*t*  
operation codes/op codes vs. functions, 2–3  
operation extender (e), 81, 82–83  
Options(\*NoPass) keyword, procedure interface  
(PI), prototyping, and, 55  
Options(\*Omit) keyword, procedure interface  
(PI), prototyping, and, 55  
Options(\*RightAdj) keyword, procedure  
interface (PI), prototyping, and, 56

Options(\*String) keyword, 26  
procedure interface (PI), prototyping, and, 56  
Options(\*Trim) keyword, procedure interface  
(PI), prototyping, and, 56  
Options(\*Varsize) keyword, procedure interface  
(PI), prototyping, and, 56  
OR, bitwise. *See* `%bitor`  
Original Program Model (OPM) programs and  
activation groups, 66  
overrides, 68–69

**P**

P specification, subprocedures and, 34  
packed decimal data types, 25  
convert field/expression to (`%dec`, `%dech`),  
98–99  
`%paddr`, 130  
definition specifications using, 9–10  
pointer return data type and, 16*t*  
parameter passing  
by reference, 25–26, 51  
by value, 26  
prototyping and, 51–52  
to C functions, 25–26  
parameters, 2, 4–6  
count of (`%parms`), 131  
number of, limit to, 5–6  
prototyping and, 50, 52  
subprocedures and, 34  
PARAM, 50, 51  
`%parms`, 131  
numeric return data type and, 13*t*  
parse request handler, XML. *See* `%handler`  
passing by reference, 25–26, 51  
passing by value, 26  
peer review of code, 73  
PLIST, 51  
pointer return data type, 16, 16*t*  
powers. *See* exponentiation  
procedure address, retrieve. *See* `%paddr`  
procedure interface (PI)  
prototyping and, 51–56  
subprocedure definition specs and, 34  
procedures, 2  
built-in functions in, by return value, 10–16

Program Development Manager (PDM), 56  
 program status. *See* %status  
 prologues to code, 78  
 prototyping, 49–52  
   activation groups and, 66–67  
   binding and, 52  
   CALLP and, 50  
   Const keyword in, 55  
   date conversion example of, 52–53  
   dynamic call and, 50  
   dynamic calls to APIs and, 63–65  
   free- vs. fixed-format in, 50–51  
   keywords for, 54–56  
   naming conventions and, 51–52  
   Options(\*NoPass) keyword in, 55  
   Options(\*Omit) keyword in, 55  
   Options(\*RightAdj) keyword in, 56  
   Options(\*String) keyword in, 56  
   Options(\*Trim) keyword in, 56  
   Options(\*Varsize) keyword in, 56  
   parameter passing and, 51–52  
   parameters and, 50, 52  
   passing variables in, 50  
   procedure interface (PI) and, 51–56  
   string replacement example of, 53–54  
   Value keyword in, 54–55

## Q

QC2LE binding directory, 26, 62–63  
 QCMDEXC API, 63

## R

Rand, 20, 22–24  
 random number generation, C functions and, 22–24  
 %realloc, 131–132  
   pointer return data type and, 16*t*  
 Reclaim Activation Group (RCLACTGRP), 69  
 recommended coding practices, 82–83  
 records  
   check for existence of character field,  
     Typecheck subprocedure for, 35–37  
   found status of (%found), 117

%rem, 132–133  
   numeric return data type and, 14*t*  
 remainders. *See* %rem  
 remove leading/trailing characters. *See* %trimxx  
 %replace, 74, 75, 81, 134–135  
   character return data type and, 15*t*  
 Return, 35  
 return values, 2, 3–4, 10  
   built-in functions and, in procedures, 10–16  
   character return data type and, 15, 15*t*  
   date, time, and timestamp return data types  
     and, 14, 14*t*  
   indicator return data type, 10–12  
   none, BIFs with, 17, 17*t*  
   numeric return data type and, 12–14  
   pointer return data type and, 16, 16*t*  
 right to left field check. *See* %checkr  
 RightAdj\* keyword, 56  
 RPG IV, 1, 2  
   binding and, 26, 56–60  
   C language and functions in, 19–21  
   data types and, vs. C, 24–25, 25*t*  
   exponentiation in, 30–31  
   prototyping and, 49–52  
   strings in, vs. C, 26

## S

scan for characters in string. *See* %scan  
 %scan, 136–137  
   numeric return data type and, 14*t*  
 SCANREPL module, 53–54  
 scoping resources with OVRSCOPE, 68–69  
 seconds calculation. *See* %seconds  
 %seconds, 103–104  
   no return value in, 17*t*  
 Select/When, indicator data type and, 11  
 service programs  
   create (CRTSRVPGM), 58, 61, 62  
   signature for, 60–62, 60  
   update (UPDSRVPGM), 60  
 Setxx, %equal and, 82  
 %shtdn, 137  
   indicator data type and, 12*t*  
 shutdown. *See* %shtdn  
 signatures, service programs, 60–62

- signed-integers, extract portion from
  - field/expression (%int, %inth), 120–121
- Sin/Sinh, 20, 21, 24
- %size, 138–140, 138*t*
  - definition specifications using, 8
  - numeric return data type and, 14*t*
- source members in subprocedures, 40–43, **41**, **43**
- source members outside of subprocedures, 43–47
- spec keyword, 44
- special characters used in naming, 84
- SQL, 72
- %sqrt, 141
  - numeric return data type and, 14*t*
- square roots, 30. *See also* %sqrt
- Srand, 20, 22–24
- %SST, 1
- standards for programming, 72, 77–84
  - accumulation operators and, 83
  - blank lines in, 78
  - capitalization and case sensitivity in, 83
  - character string manipulation in, 81
  - code changes at positions 1–5, 78
  - comments and, 83
  - comments in, 77–78
  - date and time operations, 82
  - definition specifications (D) in, 79
  - filenames on %eof and %found in, 81
  - H control specifications and, 82
  - indicators in, 80
  - keywords and specifications, 82
  - modular programming techniques and, 80
  - Monitor/On-error/Endmon in, 82–83
  - naming conventions and, 79–80
  - nested BIFs and, 82
  - operation extender (e) and, 81, 82–83
  - prologues to code in, 78
  - recommended practices in, 82–83
  - Setxx operations and, 82
  - special characters used in naming and, 84
  - structured programming techniques and, 80
  - unsigned integer data types and, 81
  - %update operations and fields option, 81
- static-bound modules vs. subprocedures, 34
- %status, 142
- storage
  - activation groups and, 65–70, **65**
  - address in (%addr), 86–87
  - allocation (%alloc), 88
  - dynamic, allocation of (%realloc), 131–132
- storage address. *See* %addr
- %str, 24, 142–143
  - character return data type and, 15*t*
- string token (Strtok), 20
- String\* keyword, 56
- strings, 24
  - C vs. RPG IV, 26
  - character substring, set/retrieve (%subst), 148–149
  - convert string to UCS-2 varying-length string (%ucs2), 155
  - data conversion in, using C functions, 27
  - found status of (%found), 117
  - insert/remove characters in (%replace), 134–135
  - manipulation in, 81
  - null-terminated character, set/retrieve (%str), 142–143
  - prototyping and, replacement using, 53–54
  - remove leading/trailing characters (%trimxx), 154
  - scan for characters (%scan), 136–137
  - substrings in array (%subarr), 144–145
  - tokens in, Strtok(), 27, 28–30
- Strtok(), 20, 27, 28–30
- structured programming techniques, 80
- %subarr, 144–145
- %subdt, 146–147
- subprocedures, 2, 33–47
  - activation groups and, 66–67
  - anatomy of, 34–35
  - B (begin) for, 34
  - calculations in, 35
  - code sources for, 73
  - data items in, local nature of, 34–35
  - Date-conversion example (Date6toLJ) of, 37–40
  - global visibility concepts and, 33
  - NOMAIN and, 44, 58
  - P specification for, 34
  - parameters in, 34

PI and definition specifications for, 34  
 source members in, 40–43, **41**, **43**  
 source members outside of, 43–47  
 spec keyword and, 44  
 standards for programming, 72  
 static-bound modules vs., 34  
 subroutines vs., 33–34  
 Typecheck example of, 35–37

subroutines  
 defined, 2  
 global visibility concepts and, 33  
 subprocedures vs., 33–34, 33

%subst, 7, 74, 148–149  
 character return data type and, 15*t*

substrings in array. *See* %subarr

sum of elements in array. *See* %xfoot

system shutdown. *See* %shtdn

## T

table lookups. *See* %tlookupxx, 152–153

Tan/Tanh, 24

%this, pointer return data type and, 16*t*

time  
 convert numeric/character expression to (%time), 149–150, 149*t*  
 date, time, and timestamp return data types and, 14, 14*t*  
 difference between (%diff), 101–102  
 duration BIFs for, 103–104  
 duration limit values, 101*t*, 101  
 format codes for, 149–150, 149*t*  
 format conversions and calculations on, 82  
 hours calculation in (%hours), 103–104  
 milliseconds calculation in (%mseconds), 103–104  
 minutes calculation (%minutes) in, 103–104  
 retrieve component of (%subdt), 146–147  
 seconds calculation in (%seconds), 103–104

%time, 149–150, 149*t*  
 date, time, and timestamp return data types and, 14, 14*t*

%timestamp, 76, 151  
 date, time, and timestamp return data types and, 14, 14*t*

timestamps  
 convert numeric/character expression to (%timestamp), 151  
 date, time, and timestamp return data types and, 14, 14*t*  
 difference between (%diff), 101–102  
 duration BIFs for, 103–104  
 duration limit values, 101*t*

%tlookupxx, 152–153  
 indicator data type and, 12*t*, 12

tokens, Strtok(), 27, 28–30

totals. *See* %xfoot

translate characters. *See* %xlate)

trigonometric C functions, 24

Trim\* keyword, 56

%trimxx, 75, 154  
 character return data type and, 15*t*

Typecheck subprocedure example, 35–37

## U

UCS-2 varying-length string (%ucs2), 155

%uns, %unsh, 156  
 numeric return data type and, 14*t*, 14

unsigned integer data types, 81. *See also* %uns, %unsh

update fields, specifying. *See* %fields

Update Module (UPDPGM), 60

%update operations and fields, 81

Update Service Program (UPDSRVPGM), 60

## V

validity checking, 5

Value keyword, procedure interface (PI), prototyping, and, 54–55

variables  
 bytes used by (%size), 138–140, 138*t*  
 global, 2

Varsize\* keyword, 56

## X

%xfoot, 157  
 numeric return data type and, 14*t*

%xlate, 74, 81, 158  
    character return data type and, 15*t*  
XML, 10  
    document identification (%xml), 159  
    parse request handler (%handler), 118–119  
%xml, 159  
    no return value in, 17*t*  
XOR, bitwise. *See* %bitxor

## **Y**

year calculation. *See* %years  
%years, 103–104  
    no return value in, 17*t*

## **Z**

zoned decimal data types, 25