



RPG is free at last!

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TR7? (How to get this support)

How does TR7 relate to this enhancement?

- **The RPG free-form support was announced with TR7 on November 15, 2013**

How do I get the new free-form support?

- **You need RPG compiler PTF SI51094 (or its latest supersede) to compile RPGLE source**
- **You also need DB2 group PTF SF99701 level 26 to compile SQLRPGLE source**
- **You don't need TR7**

Do I need the PTFs on the system where I run the program?

- **No, you only need the PTFs for compiling**

What about RDI?

- **Fixpack 9.0.1 has support for free-form**

Another big step forward for RPG – a totally free-form program

```
ctl-opt bnddir('ACCRCV');

dcl-f custfile usage(*update);
dcl-ds custDs likerec(custRec);
dcl-f report printer;

read custfile custDs;
do not %eof;
  if dueDate > %date(); // overdue?
    sendOverdueNotice();
    write reportFmt;
    exec sql insert :name, :duedate into
      mylib/myfile;
  endif;
  read custfile custDs;
enddo;
*inlr = '1';

dcl-proc sendOverdueNotice;
  sendInvoice (custDs : %date());
end-proc;
```

RPG programmers will find this new syntax easy to learn

Non-RPG programmers will find this new syntax much easier to learn than fixed form

How far RPG has come

**Let's take a look at the
last 25 years of RPG
syntax**

RPG III (OPM RPG) System-38 – V2R3

```

FCUSTFILEIF  E          DISK
FREPORT  O  E          PRINTER
ICUSTDS      E DSCUSTFILE
/COPY GETCURDAT
/COPY INVOICE
C              READ CUSTFILE
C          *INLR  DOWNE*ON
C          DUEDAT IFGT CURDAT
C              EXSR SNOVDU ←
C              WRITEREPORTFM
C/EXEC SQL INSERT :NAME, :DUEDATE INTO
C+           MYLIB/MYFILE
C/END-EXEC
C              ENDIF
C              READ CUSTFILE
C              ENDDO
C*
C          SNOVDU BEGSR
C              CALL 'SNDINVCE'
C              PARM          CUSTDS
C              PARM ISOVDU   OVERDU 10
C              ENDSR

```

Limit of 6 character names. "Send overdue notice" = SNOVDU

All code is upper case

LR

V3R1

```

H bnddir('ACCRCV') dftactgrp(*no)
Fcustfile  uf  e          disk
Freport    o  e          printer
D custDs   e ds          extname(custfile)
D today    s            d  datfmt(*iso)
/copy invoices
C          time          today
C          read          custfile
C          dow           not %eof
C          if            dueDate > today
C          exsr          sendOvrNtc
C          read          custfile
C          write         reportFmt
C/exec sql insert :name, :duedate into
C+          mylib/myfile
C/end-exec
C          endif
C          enddo
C          eval          *inlr = '1'

C          sndOvrNtc     begsr
C          call          'SNDINVCE'
C          parm          custDs
C          parm          IS_OVERDUE  overdue  10
C          endsr

```

Mixed case

Up to 10 characters for names. "Send overdue notice" = SendOvrNtc

Date/time support

V3R2 – V4R4

```

H bnddir('ACCRCV') dftactgrp(*no)
Fcustfile  uf  e          disk
Freport    o  e          printer
D custDs   e ds          extname(custfile)
D today    s            d  datfmt(*iso)
D sendOverdueNotice...
D          pr
C          time          today
C          read         custfile
C          dow         not %eof
C          if          dueDate > today
C          callp       sendOverdueNotice (custDs)
C          write       reportFmt
C/exec sql insert :name, :duedate into
C+          mylib/myfile
C/end-exec
C          endif
C          read         custfile
C          enddo
C          eval        *inlr = '1'

P sendOverdueNotice...
P          b
...

```

today



Subprocedures

Long names. "Send overdue notice" = SendOverdueNotice

V5R1 – V5R2

```

H bnddir('ACCRCV') dftactgrp(*no)
Fcustfile  uf  e          disk
Freport    o  e          printer
D custDs          ds          extname(custfile)

D sendOverdueNotice...
D          pr

/free
  read custfile custDs;
  dow not %eof;
    if dueDate > %date(); // overdue?
      sendOverdueNotice ();
      write reportFmt;
  /end-free
C/exec sql insert :name, :duedate into
C+          mylib/myfile
C/end-exec
/free
  endif;
  read custfile custDs;
  enddo;
  *inlr = '1';
/end-free
...

```

Free form calculations

Indentation!

Many new built-in
functions

V5R3 – 7.1

```

H bnddir('ACCRCV') dftactgrp(*no)
Fcustfile  uf  e          disk
Freport    o  e          printer
D custDs   e ds          extname(custfile)
D sendOverdueNotice...
D          pr
/free
  read custfile custDs;
  dow not %eof;
    if dueDate > %date(); // overdue?
      sendOverdueNotice ();
      write reportFmt;
      exec sql insert :name, :duedate into
        mylib/myfile;
    endif;
  read custfile custDs;
enddo;
*inlr = '1';
/end-free

P sendOverdueNotice...
P          b
/copy invoices
...

```

Free-form SQL

7.1 TR7 and RDI 9.0.1

```

ctl-opt bnddir('ACCRCV');

dcl-f custfile usage(*update);
dcl-ds custDs likerec(custRec);
dcl-f report printer;

read custfile custDs;
dow not %eof;
  if dueDate > %date(); // overdue?
    sendOverdueNotice ();
    write reportFmt;
    exec sql insert :name, :duedate into
      mylib/myfile;
  endif;
read custfile custDs;
enddo;
inlr = '1';

dcl-proc sendOverdueNotice;
  /copy invoices
  sendInvoice (custDs : IS_OVERDUE);
end-proc;

```

No /FREE, /END-FREE

All free-form statements

Better colorization
options in the editor

What is wrong with fixed-form code?

- Most programmers today have never seen fixed form code
- When they see RPG code like this, it looks like gibberish

```
H bnddir('ACCRCV') dftactgrp(*no)
Fcustfile  if  e                disk
Freports   o   e                printer
```

- Here's what happens when a non-RPG programmer tries to make a change

```
H bnddir('ACCRCV')
Fcustfile  if  e                disk
Freport    o   e                printer
RNF0289E Entry contains data that is not valid; only valid data is
        used.
RNF2013E The Device entry is not PRINTER, DISK, SEQ, WORKSTN or
        SPECIAL; defaults to DISK.
RNF2003E The File Type is not I, O, U, or C; defaults to 0 if File
        Designation is blank, otherwise to I.
RNF2005E The Sequence entry is not blank, A, or D; defaults to blank.
... more error messages
```

RPG is still not 100% free

There are still some areas where RPG is not yet free

- **Free-form code is still restricted to columns 8 – 80**
- **I specs and O specs must still be coded in fixed-form**
 - **I and O specs are considered deprecated by many RPG programmers in favor of externally-described files**
- **Code related to the RPG cycle must be coded in fixed-form**
 - **The cycle is considered deprecated by many RPG programmers in favor of using SQL for scenarios where the cycle formerly shone**

What does an all-free RPG mean?

- Fewer "secret codes" to remember ("E in column 19 means externally-described")
- Indented code is more maintainable
- Better token-colorization in the RDI editor, allowing programmers to have the same look-and-feel for RPG code as for other languages like Java or PHP
- New programmers will only have to learn how to use RPG, without having to struggle with how it is coded

Removal of many frustrations

- /FREE and /END-FREE in every procedure
- Two lines for many definitions in fixed-form

```
D getNextCustomer...
D                               pr
```

VS

```
dcl-pr getNextCustomer;
```

- Insufficient room in D-spec keywords for long strings

```
D HSSFCellStyle      c
D
D 'org.apache.poi.hssf.usermodel.HSSFCellStyle'
```

VS

```
dcl-c HSSFCellStyle 'org.apache.poi.hssf.usermodel.HSSFCellStyle';
```

More information

Documentation

- There is a new PDF in the 7.1 Info Center with full documentation for the new free-form syntax
 - <http://pic.dhe.ibm.com/infocenter/series/v7r1m0/topic/books/sc092508a.pdf>
- In the PDF, start at "What's New Since 7.1" in the "What's New" section

RPG Café wiki page https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/We13116a562db_467e_bcd4_882013aec57a

Conversion

- **RDI will not do any conversion from H F D P to free-form**
- **ARCAD announced a free-form conversion at the same time as TR7**
- **Linoma has a version that supports conversion of H, F, D and P specs**

The details

Let's look at the details

- **General features**
- **Control (H)**
- **File declaration (F)**
- **Data declaration (D)**
- **Procedure (P)**

Some general features

The new statements all

- Start with an "opcode"
- End with a semicolon

Just like calculation statements in RPG:

```
if duedate > today;  
    sendAngryLetter (customer);  
endif;
```

Some general features

Unlike free-form calculations, can have **/IF**, **/ELSEIF**, **/ELSE**, **/ENDIF** within a statement

```
dc1-s salary  
  /if defined(large_vals)  
    packed(13 : 3)  
  /else  
    packed(7 : 3)  
  /endif  
  ;
```

Some general features

Can mix fixed-form and free-form without /FREE and /END-FREE

Example: Defining the TAG for SQL "whenever"

```
    exec sql whenever sqlerror goto err;
    ...
    return;
C      err          tag
    ok = *off;
    reportSqlError ();
```

Control statements

CTL-OPT (Control Option) statement

- Start with CTL-OPT
- Zero or more keywords
- End with semicolon

```
ctl-opt option(*srcstmt : *nodebugio)  
dftactgrp(*no);
```

Control statements

- Can have multiple CTL-OPT statements
- The rules about not repeating keywords apply across all statements

```
ctl-opt; // no keywords
ctl-opt option(*srcstmt : *nodebugio)
           dftactgrp(*no); // two keywords
H datfmt(*iso) text('My Program')
ctl-opt alwnull(*usrctl); // free again
```

Control statements

One little enhancement for free-form H:

If there is at least one free-form control statement, you don't need DFTACTGRP(*NO) if you have one of the ACTGRP, BNDDIR, or STGMDL keywords

File statements

DCL-F (Declare file) statement

- **Start with DCL-F**
- **File name**
- **Keywords**
- **End with semicolon**

File statements

- Only full-procedural and output – no cycle, RAF or table files
- The name can be longer than 10 as long as there's an EXTFILE keyword (and an EXTDESC keyword if externally-described)

```
dc1-f year_end_report printer  
    oflind(overflow)  
    extdesc('YERPT')  
    extfile(*extdesc);
```

File statements – the device

Device keyword or LIKEFILE must be the first keyword

DISK, PRINTER, SEQ, SPECIAL, WORKSTN

- **Defaults to DISK**

Externally-described: *EXT (default)

Program-described: record-length

```
dc1-f orders; // defaults to DISK(*EXT)
dc1-f qprint printer(132);
dc1-f screen workstn; // defaults to *EXT
```

File statements – the usage

USAGE keyword

***INPUT, *OUTPUT, *UPDATE, *DELETE**

Equivalent of fixed-form File Type (I, O, U, C) and File-Addition

Default for USAGE depends on the device

```
dc1-f orders disk; // *INPUT
dc1-f report printer; // *OUTPUT
dc1-f screens workstn; // *INPUT : *OUTPUT
```

- **SEQ and SPECIAL default to USAGE(*INPUT)**

File statements – the usage

Some usage values imply other values

***UPDATE implies *INPUT**

***DELETE implies *UPDATE and *INPUT**

```
// USAGE(*INPUT : *UPDATE)  
dc1-f orders disk usage(*update);
```

```
// USAGE(*INPUT : *UPDATE : *DELETE)  
dc1-f arrears disk usage(*delete);
```

Can specify implied values explicitly too

```
dc1-f orders disk usage(*update : *input);
```

File statements – the usage

If you specify the **USAGE** keyword, the defaults are not considered

```
// output only
```

```
dc1-f f1 disk usage(*output);
```

```
// input and output
```

```
dc1-f f2 disk usage(*input : *output);
```

File statements – difference for *DELETE

In fixed form, U enables update and delete

In free form, *UPDATE does not enable delete

- ***DELETE must be coded explicitly**

File statements – Keyed files

For externally-described files, KEYED keyword

```
dc1-f orders disk keyed;
```

For program-described files, KEYED(*CHAR:len)

```
dc1-f generic disk(2000) keyed(*CHAR:100);
```

File statements – Program-described keyed files

Only character keys supported for program-described

For other types, use a data structure

```
dcl-f generic disk(2000) keyed(*CHAR:7);
```

```
dcl-ds key len(7) qualified;  
    item_num packed(12);  
end-ds;
```

```
key.item_num = 14;  
chain key generic;
```


File statements

F specs can be mixed with D specs (even in fixed form)

Group related items together

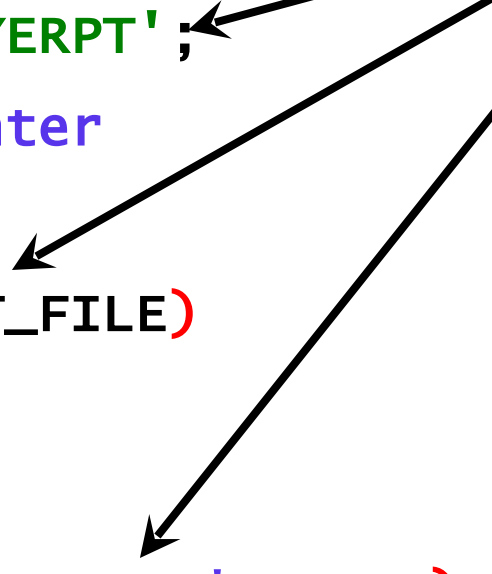
```
[ dcl-f orders
    usage (*update : *output) keyed;
  dcl-ds orders_dsi
    likerec (ordersR:*input);
  dcl-ds orders_dso
    likerec (ordersR:*output);
  dcl-s num_orders int(10);
```

```
[ dcl-f report printer;
  dcl-ds report_ds
    likerec (reportR:*output);
```

File statements

Named constants can be used for file keywords

```
dc1-c YEAR_END_RPT_FILE 'YERPT';  
dc1-f year_end_report printer  
oflind(overflow)  
extdesc(YEAR_END_RPT_FILE)  
extfile(*extdesc);  
dc1-ds report_ds  
extname(YEAR_END_RPT_FILE:*output);
```

A diagram consisting of three black arrows originates from a single point on the right side of the slide. The top arrow points to the string 'YERPT' in the first line of code. The middle arrow points to the constant YEAR_END_RPT_FILE in the second line of code. The bottom arrow points to the constant YEAR_END_RPT_FILE in the last line of code.

Data definition statements

- Start with DCL-x
- Item name – can be *N if not named
- Keywords
- End with semicolon

```
dcl-s name like(other_name);
```

Standalone fields

The first keyword must be a data-type keyword.

```
dc1-s salary packed(9:2) inz(0);
```

If you are using the LIKE keyword, it doesn't have to be first.

```
dc1-s annual_salary inz(0)  
      like(salary : +2);
```

Data-type keywords

Some data-type keywords match the Data-Type entry exactly

CHAR, INT, POINTER ...

Some merge the Data-Type entry with another keyword

VARCHAR = A + VARYING

DATE = D + DATFMT

OBJECT = O + CLASS

Data-type keywords

String data types

Fixed length	CHAR(characters) GRAPH(characters) UCS2(characters)
Varying length	VARCHAR(characters) VARGRAPH(characters) VARUCS2(characters)
Varying length with specific prefix-size	VARCHAR(characters : 4) VARGRAPH(characters : 4) VARUCS2(characters : 4)
Indicator	IND

Data-type keywords

Numeric data types

("BINDEC" is explained on the next slide)

<p>Decimal types with default zero decimal positions</p>	<p>PACKED(digits) ZONED(digits) BINDEC(digits)</p>
<p>Decimal types with specific decimal positions</p>	<p>PACKED(digits : decimals) ZONED(digits : decimals) BINDEC(digits : decimals)</p>
<p>Integer, Unsigned</p>	<p>INT(digits) 3,5,10,20 UNS(digits) 3,5,10,20</p>
<p>Float</p>	<p>FLOAT(bytes) 4,8</p>

BINDEC keyword – reduce confusion over RPG's "binary" type

RPG's "binary" type is a decimal type stored in binary form, not a "true binary".

D binfld **S** **9B 3**

- Values between -999999.999 and 999999.999

RPG programmers see "binary" in API documentation and think they should code B in their RPG programs

Non-RPG programmers see "binary" as the RPG data type, and think it means true binary

- When they want an 4 byte binary, they code 4B which is a 2-byte binary with 4 digits

Other data types

Date, time, timestamp	DATE TIME TIMESTAMP
Date, time with format	DATE(*YMD-) TIME(*HMS-)
Pointer	POINTER
Procedure pointer	POINTER(*PROC)
Object	OBJECT(*JAVA:class) (parameters not needed for a constructor prototype)

Tip for remembering the data-type keywords

If there is a related built-in function, the data-type keyword has the same name:

%CHAR	- CHAR and VARCHAR
%GRAPH	- GRAPH and VARGRAPH
%UCS2	- UCS2 and VARUCS2
%DATE	- DATE
%TIME	- TIME
%TIMESTAMP	- TIMESTAMP
%INT	- INT
%UNS	- UNS
%FLOAT	- FLOAT

Exception: %DEC. The decimal data types are PACKED, ZONED, BINDEC.

Data structures

Data-structures end the subfield list with END-DS

- not used for LIKEDS or LIKEREK data structures

END-DS is optionally followed by the DS name

```
dcl-ds info;  
    name varchar(25);  
    price packed(4 : 2);  
end-ds info;
```

If no subfields, code END-DS on the DCL-DS line

```
dcl-ds prt_ds len(132) end-ds;
```

Data structures

END-DS is not used if LIKERECD or LIKEDS is used

(because you can't code additional subfields)

```
dc1-ds info likeds(info_t);  
dc1-ds custInDs likerec(custrec : *input);
```

END-DS is needed for an externally-described DS

```
dc1-ds custDs extname('CUSTFILE') end-ds;
```

Prototypes and procedure interfaces

Prototypes and procedure interfaces are similar

```
dcl-pr qcmdexc extpgm;  
  cmd char(3000);  
  cmd_len packed(15 : 5);  
end-pr;
```

Bonus feature:
EXTPGM parameter
is optional

```
dcl-pr init end-pr; // no parameters
```

```
dcl-pr init;  
end-pr; // can be a separate  
statement
```

```
dcl-pi *n varchar(25); // name not needed  
  id int(10);  
end-pi;
```

*DCLCASE for external procedure names

A common bug:

- EXTPROC is needed for the mixed-case name
- The programmer uses copy-paste and forgets one change

Bug!

```
D Qc3EncryptData...
D           pr      extproc('Qc3EncryptData')
D Qc3DecryptData...
D           pr      extproc('Qc3EncryptData')
```

Use *DCLCASE to avoid retyping the name:

```
dcl-pr Qc3EncryptData extproc(*dclcase);
dcl-pr Qc3DecryptData extproc(*dclcase);
```

- Less error prone when coding
- Easier for code reviewers to see that it's correct

Subfields

Subfields officially start with the DCL-SUBF opcode

The opcode is optional unless the name is the same as a free-form opcode

```
dcl-ds info;  
    name char(25);  
    dcl-subf select int(10);  
end-ds info;
```

DCL-SUBF must be used because "select" is an opcode supported in free-form

Same as the rule for EVAL and CALLP

```
name = 'sally';  
eval select = 5;
```

Subfields

The POS keyword replaces

- From-and-to positions
- OVERLAY(dsname)

```

D info      DS
D sub1      25    34A
D sub2      D    OVERLAY(info:100)
D sub3      5P 2  OVERLAY(info)

```

```

dc1-ds info;
  sub1 char(10) pos(25);
  sub2 date pos(100);
  sub3 packed(5 : 2) pos(1);
end-ds info;

```


Subfields

Free-form OVERLAY only overlays subfields

- No free-form equivalent for OVERLAY(ds:*NEXT)
- OVERLAY(ds:*NEXT) means "after all previous subfields" which is the same as not having the OVERLAY keyword at all
- SUB3 starts at position 101, after all previous subfields.

```

D info      DS
D sub1      1  100A
D sub2      11 20A
D sub3      5A  OVERLAY(info:*next)

```

Equivalent:

```

dc1-ds info;
sub1 char(100) pos(1); // 1-100
sub2 char(10) pos(11); // 11-20
sub3 char(5); // 101-105

```

Parameters

Parameters officially start with DCL-PARM

DCL-PARM is optional. Same rule as for subfields

```
dcl-pr proc;  
    name char(25) const;  
    dcl-parm clear ind value;  
end-pr;
```

Can use named constants for keywords

```
dc1-c SYS_NAME_LEN 10;
```

```
dc1-ds sys_obj qualified;  
      obj char(SYS_NAME_LEN);  
      lib char(SYS_NAME_LEN);  
end-ds;
```

Can use named constants for keywords

In fixed form, some keywords allow literals to be specified without quotes: DTAARA, EXTNAME, EXTFLD

What data area is used for fld1?

D fld1 **S** **10A** DTAARA(dta1)

What about fld2?

D dta2 **C** 'MYLIB/DTAARA2'
D fld2 **S** **10A** DTAARA(dta2)

DTAARA keyword change

In free-form, an unquoted name is always a variable or named constant

D dta1 C 'MYLIB/DTAARA1'

D fld1a S 10A DTAARA(dta1)
 dc1-s fld1b char(10) dtaara('DTA1');

*LIBL/DTA1

dc1-s fld1c char(10) dtaara(dta1);

MYLIB/DTAARA1

D fld2a S 10A DTAARA(*VAR:nameFld)
 dc1-s fld2b char(10) dtaara(nameFld);

Value of
nameFld

Procedure statements

Begin a procedure

- DCL-PROC
- Procedure name
- Keywords
- End with semicolon

```
dc1-proc myProc export;
```

End a procedure

- END-PROC
- Optional procedure name
- End with semicolon

```
end-proc myProc;
```

or

```
end-proc;
```

Procedure example

```
dcl-proc getCurUser export;  
  dcl-pi *n char(10) end-pi;  
  
  dcl-s curUser char(10) inz(*user);  
  
  return curUser;  
end-proc;
```

- The PI uses the place-holder *N for the name
- END-PI is specified as a keyword at the end of the DCL-PI statement

Gotchas

- **Update does not imply delete**
- **END-DS, END-PR, END-PI needed at the end of a subfield or parameter list (even when there are no subfields or parameters)**
- **Keywords like DTAARA and EXTNAME that assume unquoted names are named constants or variables**

(These have already been discussed)

Another gotcha

If you are in the habit of using ellipsis at the end of D and P spec names

P customerName...

P S 50A

That will not work for free-form declarations

```
dc1-s customerName...
      char(50);
```

The name is customerNamechar, and "(50)" is found where the compiler expects to find the data type.

```
dc1-s customerName
      char(50);
```

Colorization in RDI

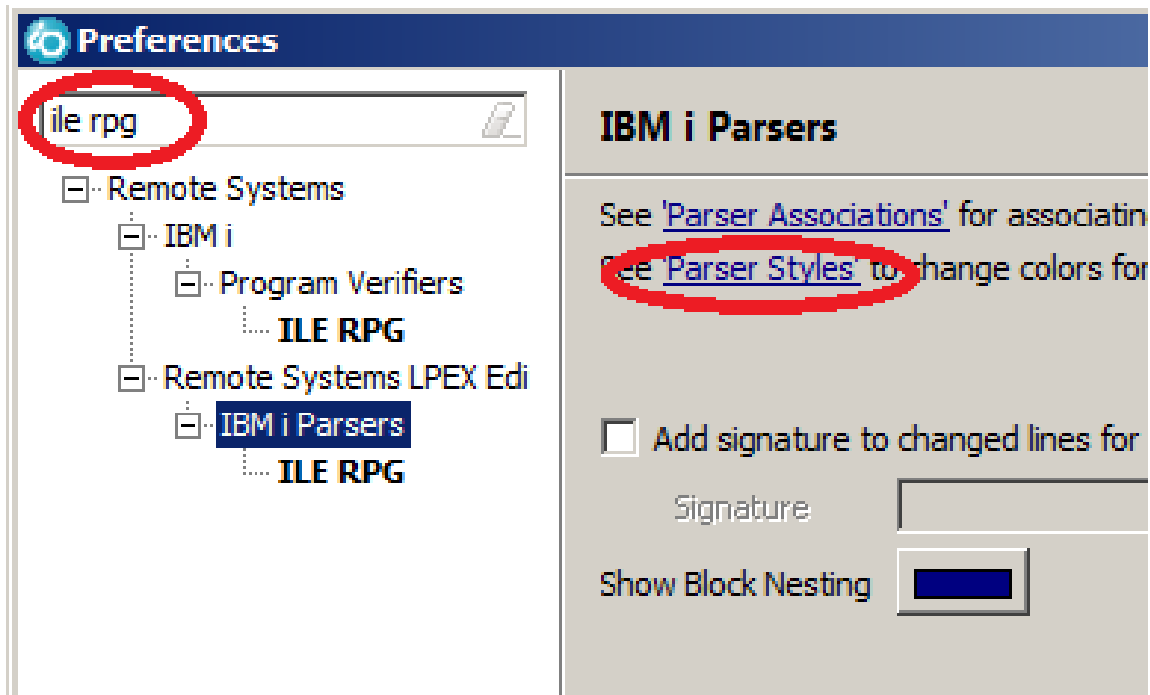
Much more control for colorizing your code

Here is some code with the default colors

```
000101
000102     dcl-f custfile usage(*update);
000103
000104     dcl-ds myDs likerec(custrec : *input);
000105     /if defined(debug)
000106         dcl-s debugMsg varchar(100);
000107     /endif
000108
000109     read custfile myDs;
000110     if myDs.duedate > %date();
000111         handleOverdue (myDs);
000112     endif;
```

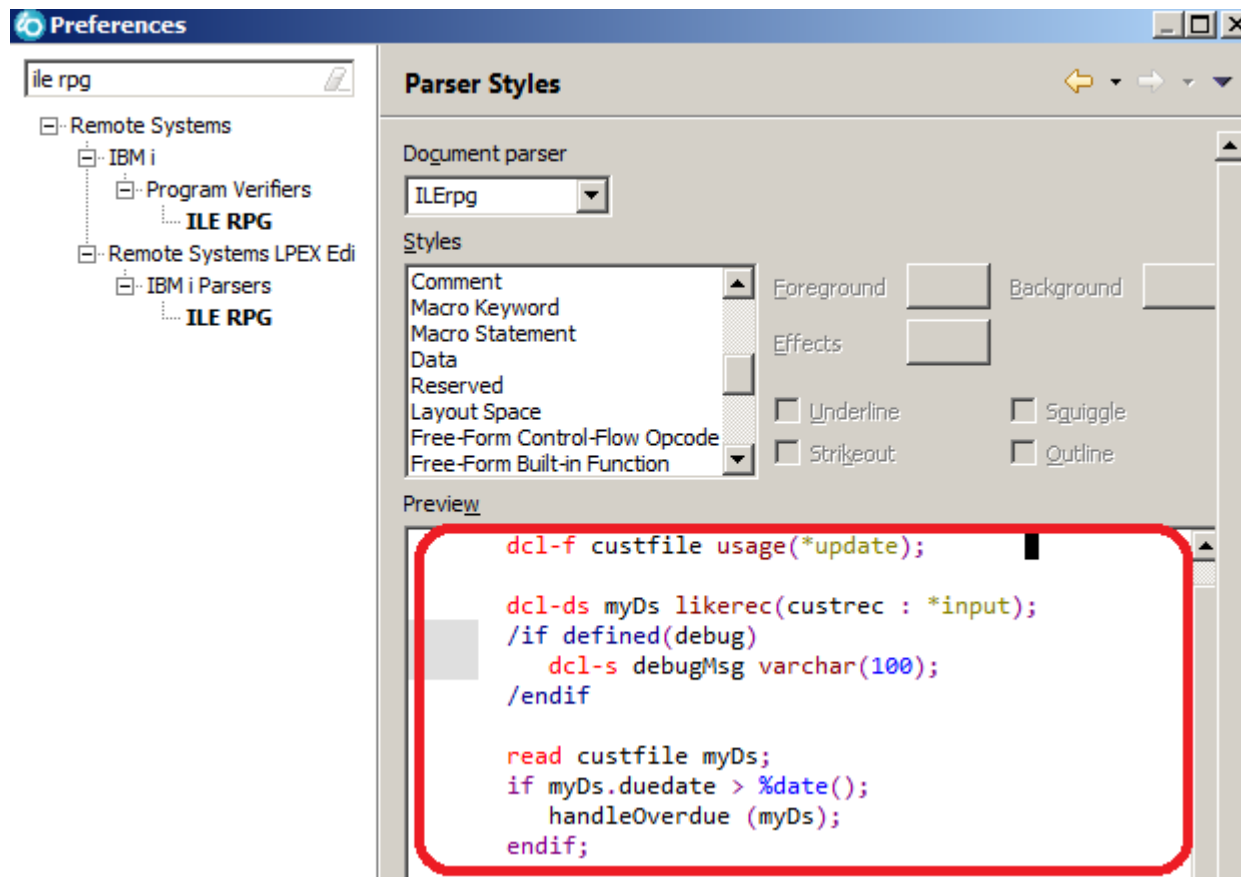
Navigate to the color preferences

- **Window > Preferences**
- **Search for ILE RPG**
- **Click on Parser Styles**



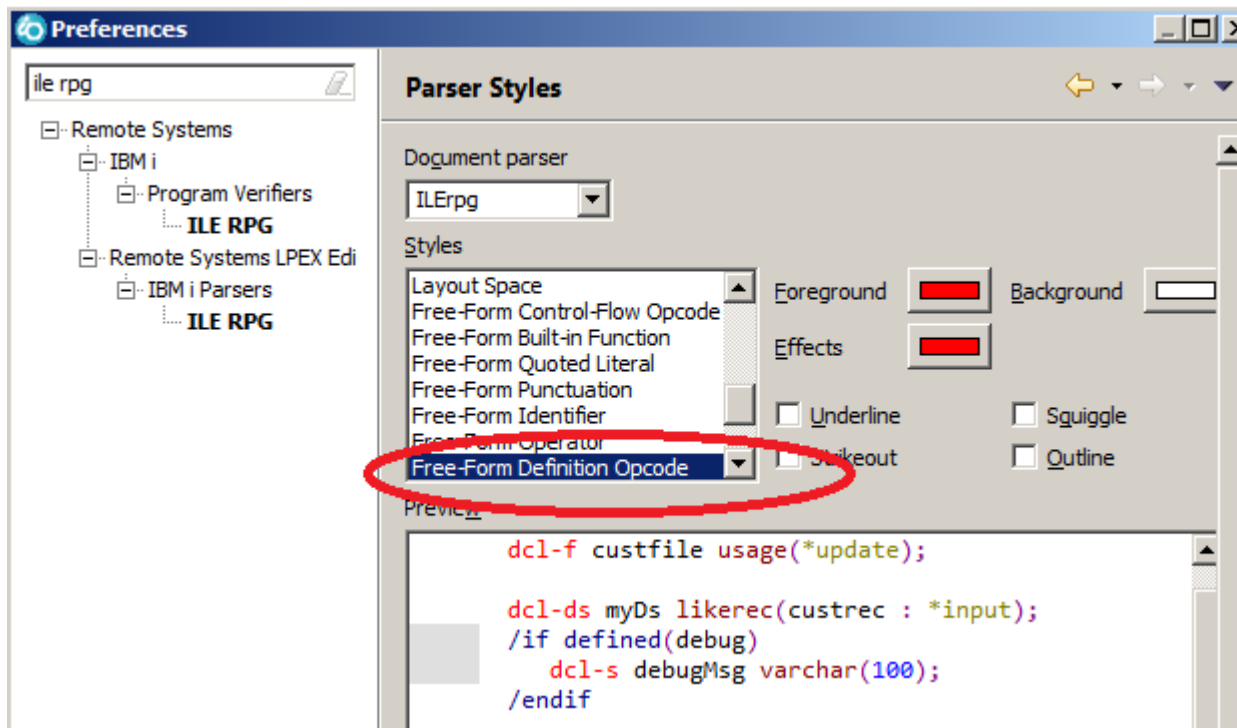
You can change the code to work with

- In the code section, I like to paste in a bit of my own code at the top



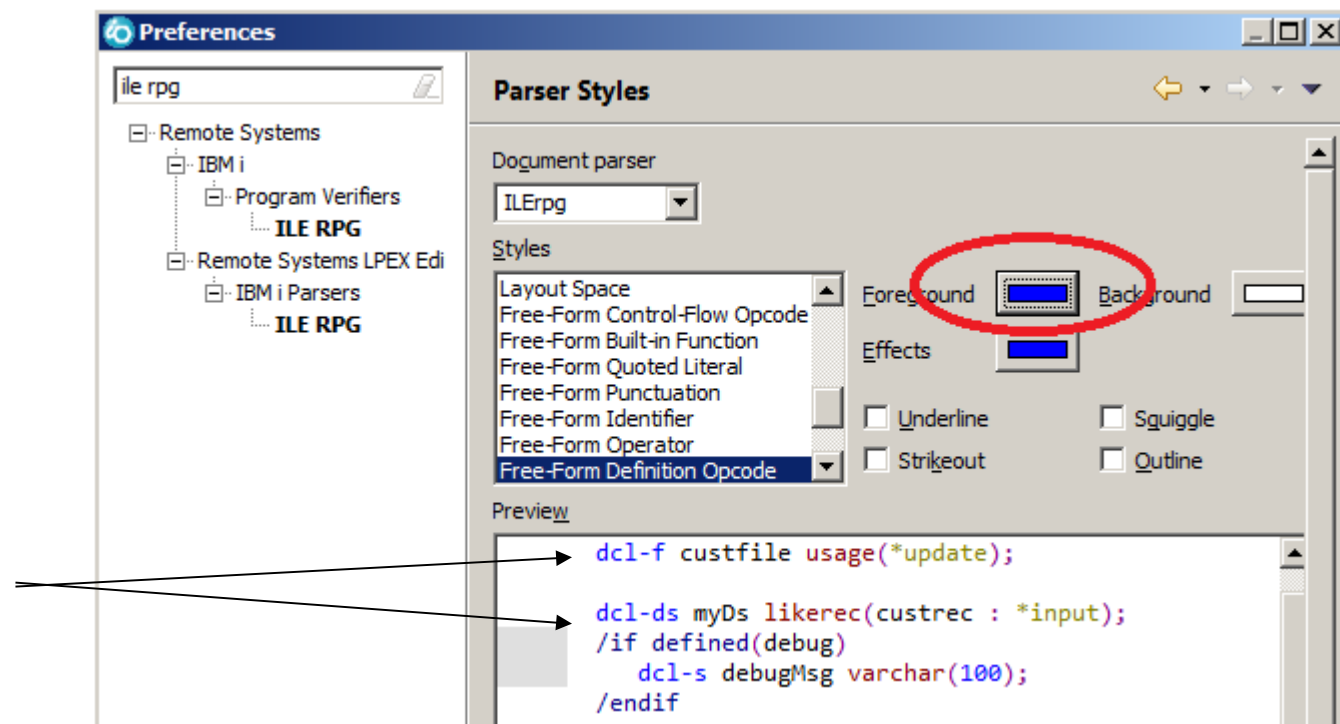
Choose which style you want to change

- Then click on the code you want to change the color for
- The top section will automatically position to the relevant style



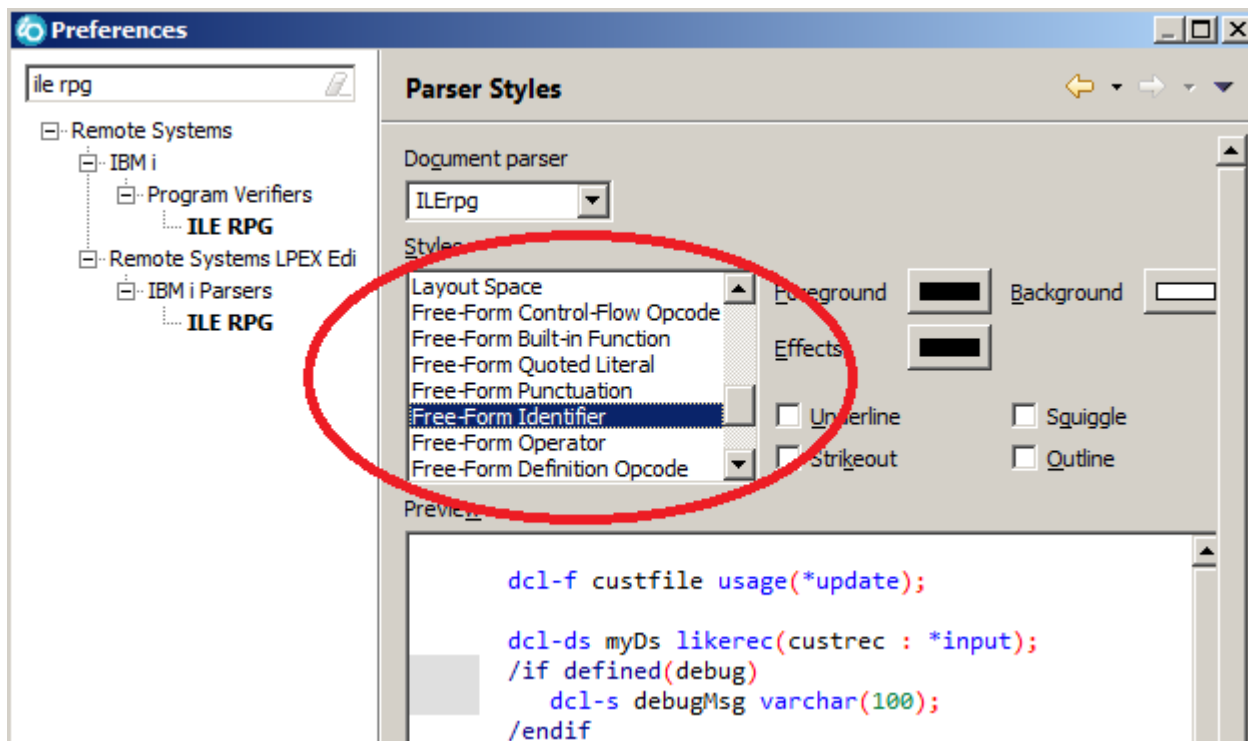
Customize your colors

- Choose the color you want
- It will automatically be colored in the code section so you can see the effect it has



Another way to choose the style

- For most free-form code, the styles are listed together
- You can select them one-by-one, adjusting the colors



Here's how I like it

- The non-free-form styles I had to change were Operation and Numeric

```
000101
000102     dcl-f custfile usage(*update);
000103
000104     dcl-ds myDs likerec(custrec : *input);
000105     /if defined(debug)
000106         dcl-s debugMsg varchar(100);
000107     /endif
000108
000109     read custfile myDs;
000110     if myDs.duedate > %date();
000111         handleOverdue (myDs);
000112     endif;
```


Summary

We had two goals when designing the new free-form syntax

- **Easy for non-RPG programmers to learn**
- **Easy for existing RPG programmers to learn**

We hope we have accomplished those goals!



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