Free-form RPG

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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;
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;
   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

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How far RPG has come

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

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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                LR
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

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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

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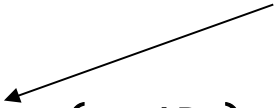
V3R2 – V4R4

```
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
 ...
```



Subprocedures

Long names. "Send overdue notice" = SendOverdueNotice

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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

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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

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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

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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
Freport    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 O if File
     Designation is blank, otherwise to I.
RNF2005E The Sequence entry is not blank, A, or D; defaults to blank.
... more error messages
```


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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**

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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

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

vs

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


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More information

PTFs

- PTF SI51094 (or latest supersede) for RPG compiler support
- DB2 Group PTF SF99701 level 26 for SQL precompiler support https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/IBM%20i%20Technology%20Updates/page/DB2%20for%20i%20TR7%20ti

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/iseries/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

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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 convesion of H, F, D and P specs

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Let's look at the details

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

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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;
```


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Some general features

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

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


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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 ();
```


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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);
```


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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
```


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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

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File statements

DCL-F (Declare file) statement

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

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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)

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


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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

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


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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

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

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

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File statements – the usage

Some usage values imply other values

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

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

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

Can specify implied values explicitly too

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


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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

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File statements – Keyed files

For externally-described files, KEYED keyword

```
dcl-f orders disk keyed;
```

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

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


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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;
```


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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_orrders int(10);
```

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


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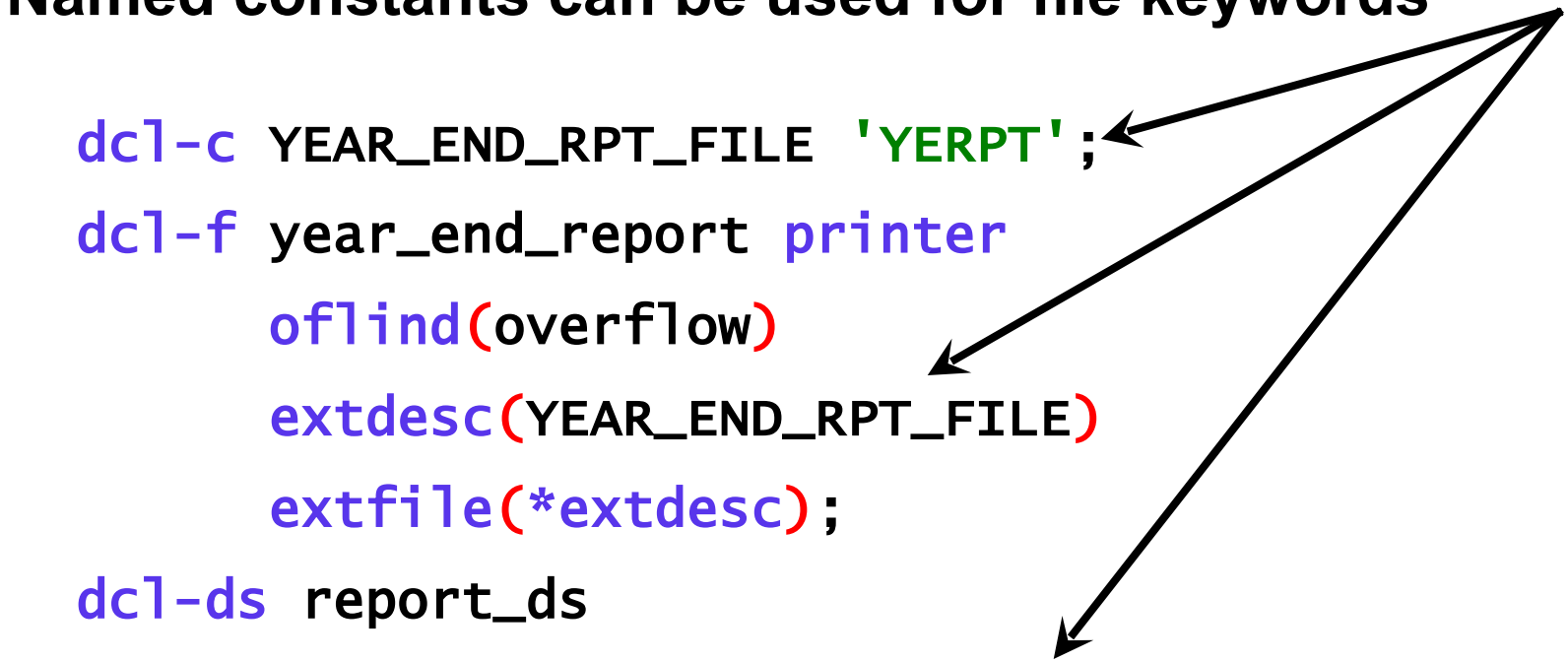
File statements

Named constants can be used for file keywords



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


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Standalone fields

The first keyword must be a data-type keyword or the LIKE keyword

```
dcl-s salary packed(9:2) inz(0);
dcl-s annual_salary like(salary : +2);
```


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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
```


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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`

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Data-type keywords

Numeric data types

("BINDEC" is explained on the next slide)

Decimal types with default zero decimal positions	`PACKED(digits)`
	`ZONED(digits)`
	`BINDEC(digits)`

Decimal types with specific decimal positions	`PACKED(digits : decimals)`
	`ZONED(digits : decimals)`
	`BINDEC(digits : decimals)`

Integer, Unsigned	`INT(digits)  3,5,10,20` `UNS(digits)  3,5,10,20`
Float	`FLOAT(bytes) 4,8`

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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 documention 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

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Data-type keywords

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 are optional for the return type of a constructor method)

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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.

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Data structures

Data-structures end the subfield list with END-DS

- not used for LIKEDS or LIKEREC 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;
```


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Prototypes and procedure interfaces

Prototypes and procedure interfaces are similar

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

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

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

dcl-pi *n varchar(25); // no need for a
    name
    id int(10);
end-pi;
```

Bonus feature: EXTPGM parameter is optional

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*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**

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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;
```


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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)
```

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


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Subfields

Free-form OVERLAY only overlays subfields

- Use POS to overlay the data structure.
- 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:

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


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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;
```


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Can use named constants for keywords

```
dcl-c SYS_NAME_LEN 10;

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


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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 data1?

```
D name      C                'MYLIB/DTAARA1'
D data1     S          10A   DTAARA(name)
```

What about data2?

```
D data2     S          10A   DTAARA(name2)
```


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DTAARA keyword change

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

```
D name      C                   'MYLIB/DTAARA1'
```

```
D data1a    S      10A   DTAARA(name)
dcl-s data1b char(10) dtaara('NAME');
```

*LIBL/NAME

```
dcl-s data1c char(10) dtaara(name);
```

MYLIB/DTAARA1

```
D data2a    S      10A   DTAARA(*VAR:nameFld)
  dcl-s data2b char(10) dtaara(nameFld);
```

Value of nameFld

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Procedure statements

Begin a procedure

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

```
dcl-proc myProc export;
```

End a procedure

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

```
end-proc myProc;
```

or

```
end-proc;
```


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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

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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)

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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

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

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

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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;
```


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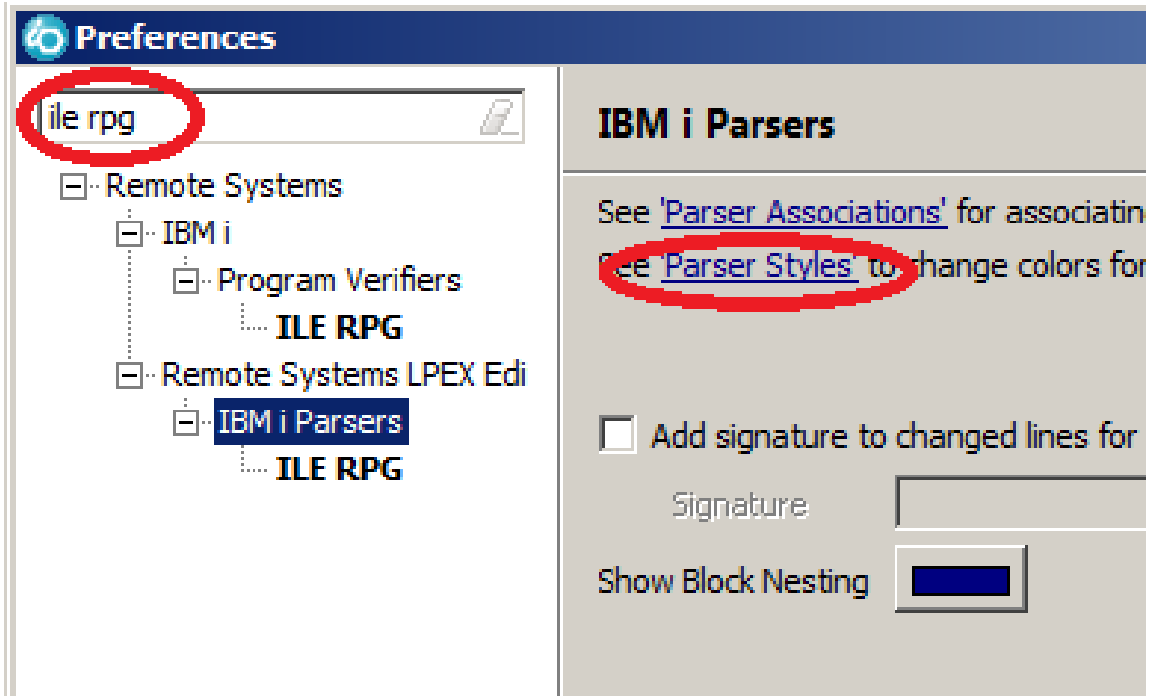
Navigate to the color preferences

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



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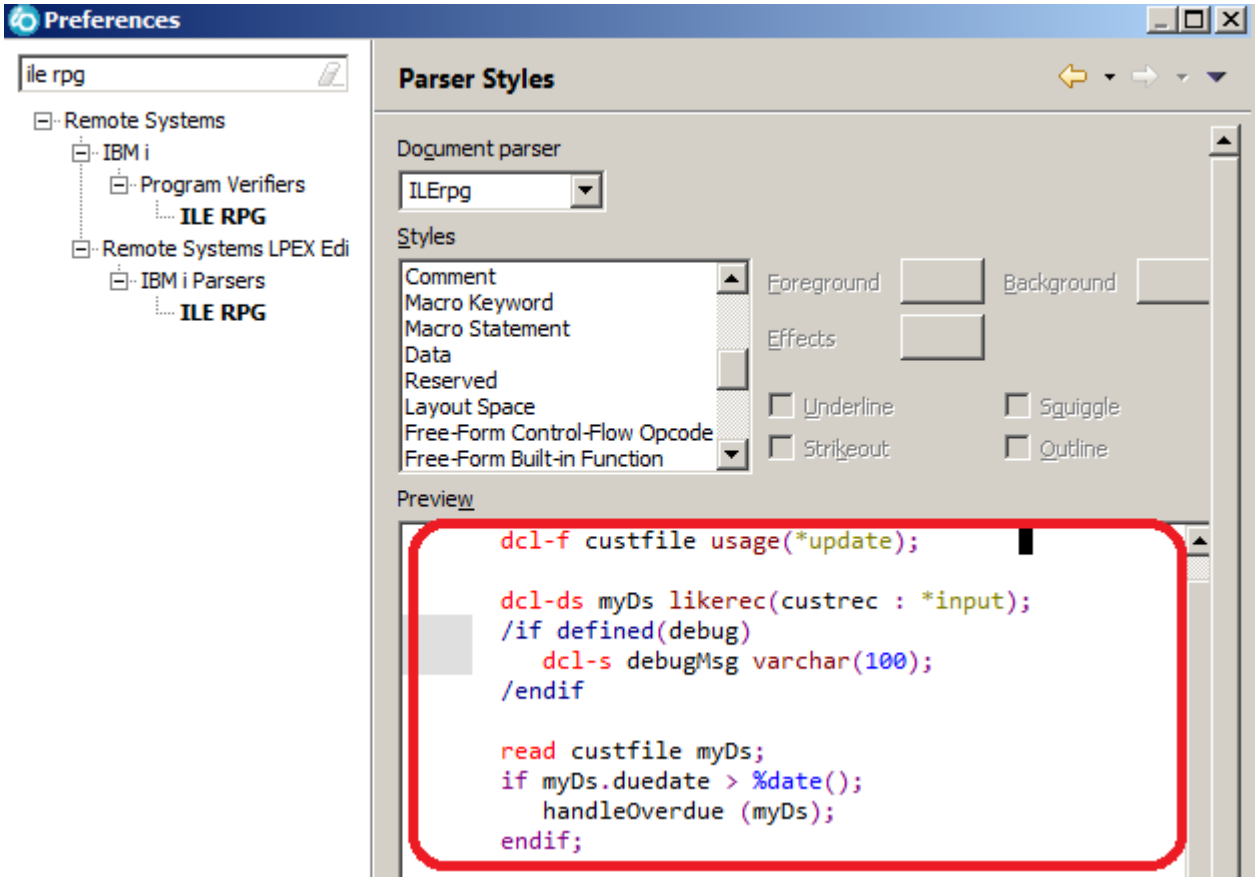
You can change the code to work with

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



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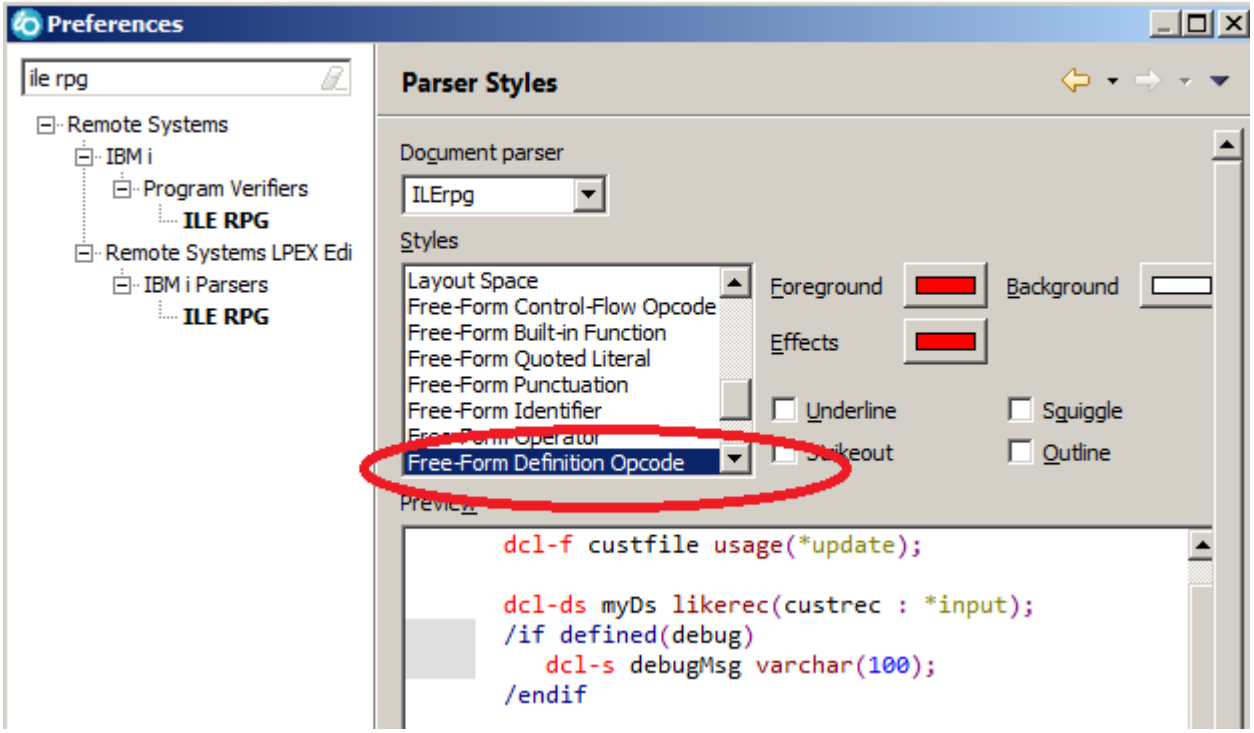
Choose which style you want to change

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



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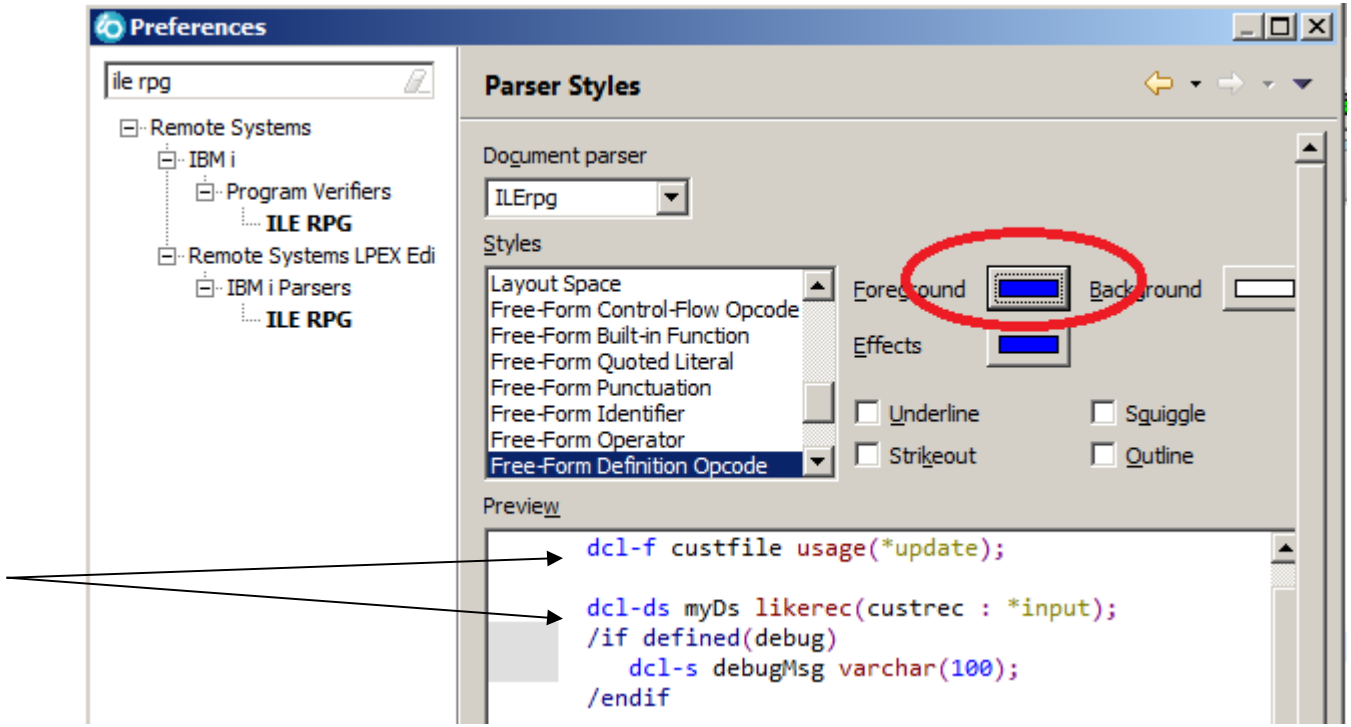
Customize your colors

- Choose the color you want
- It will automatically in the code section



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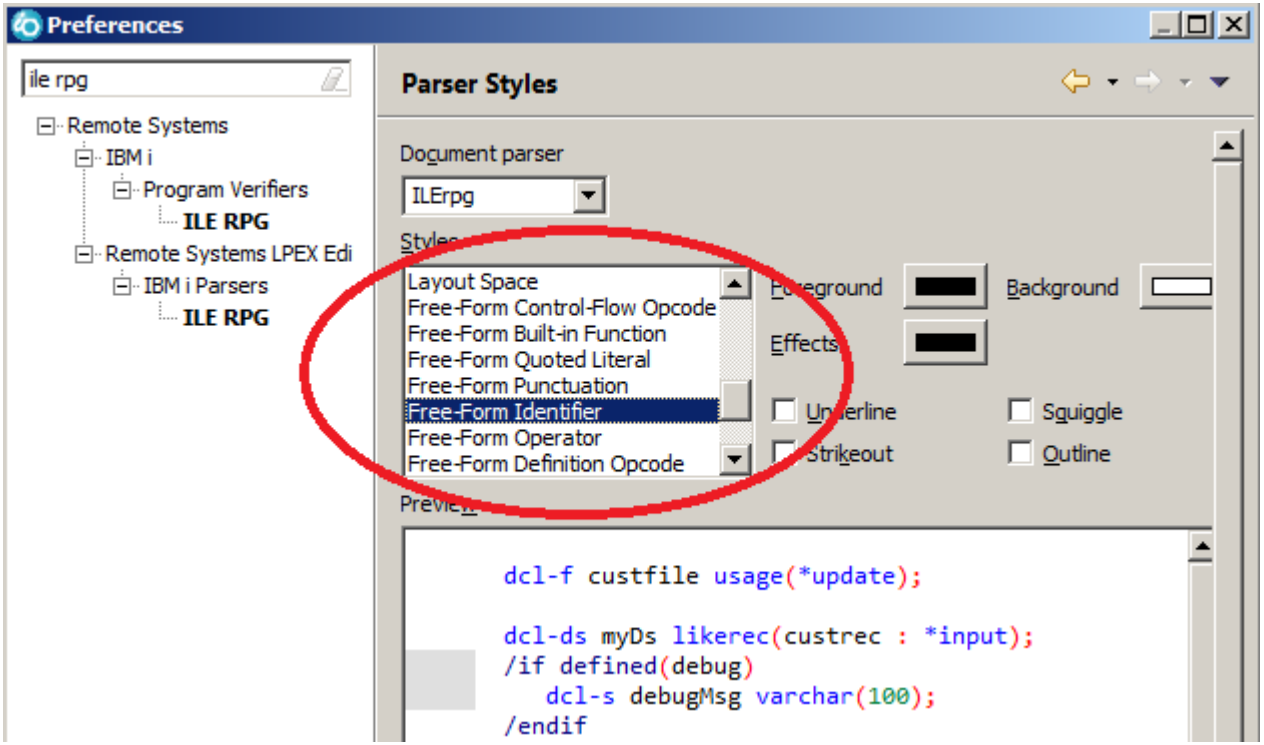
Another way to choose the style

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



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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;
```


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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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Revised September 26, 2006

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Revised December 2, 2010

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