



# rEDActor – A PDK Cross-platform Integrated Development Environment for Semiconductor Technologies

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innovations  
for high  
performance  

































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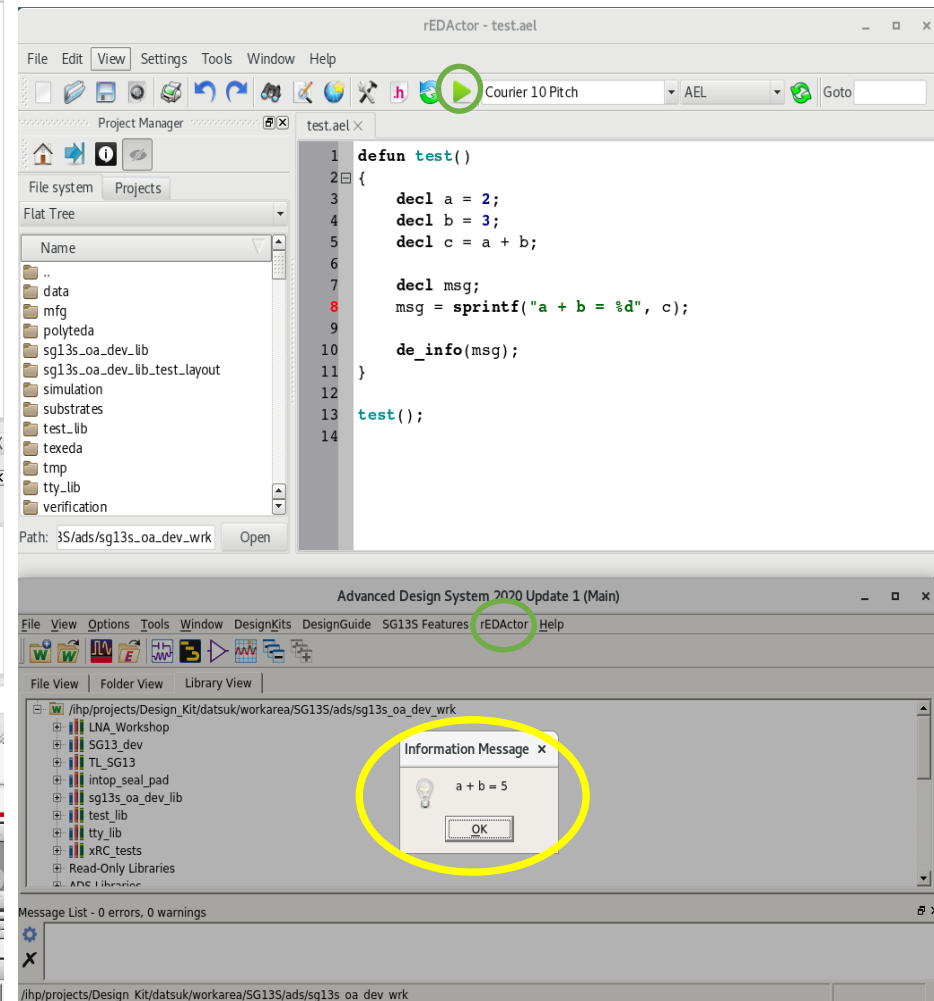
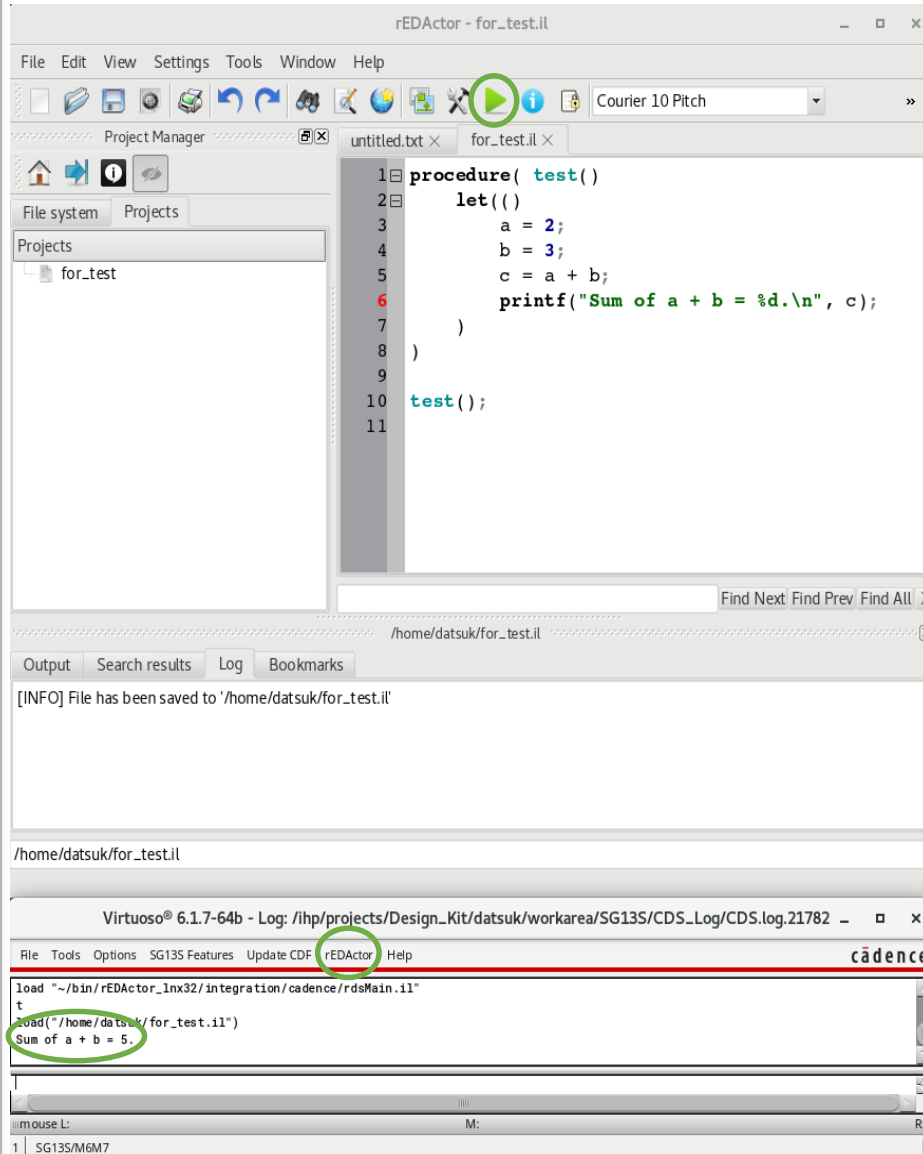
# Motivation

	rEDActor	Nedit	Sublime Text	SKILL IDE
Integration with EDA software (Virtuoso, ADS)				
Code auto-formatting				
Code folding				
Keyword auto-completion				
Embedded syntax checker				
Auto initialization of global variables				
Code Debugging				
SKILL to AEL code conversion				

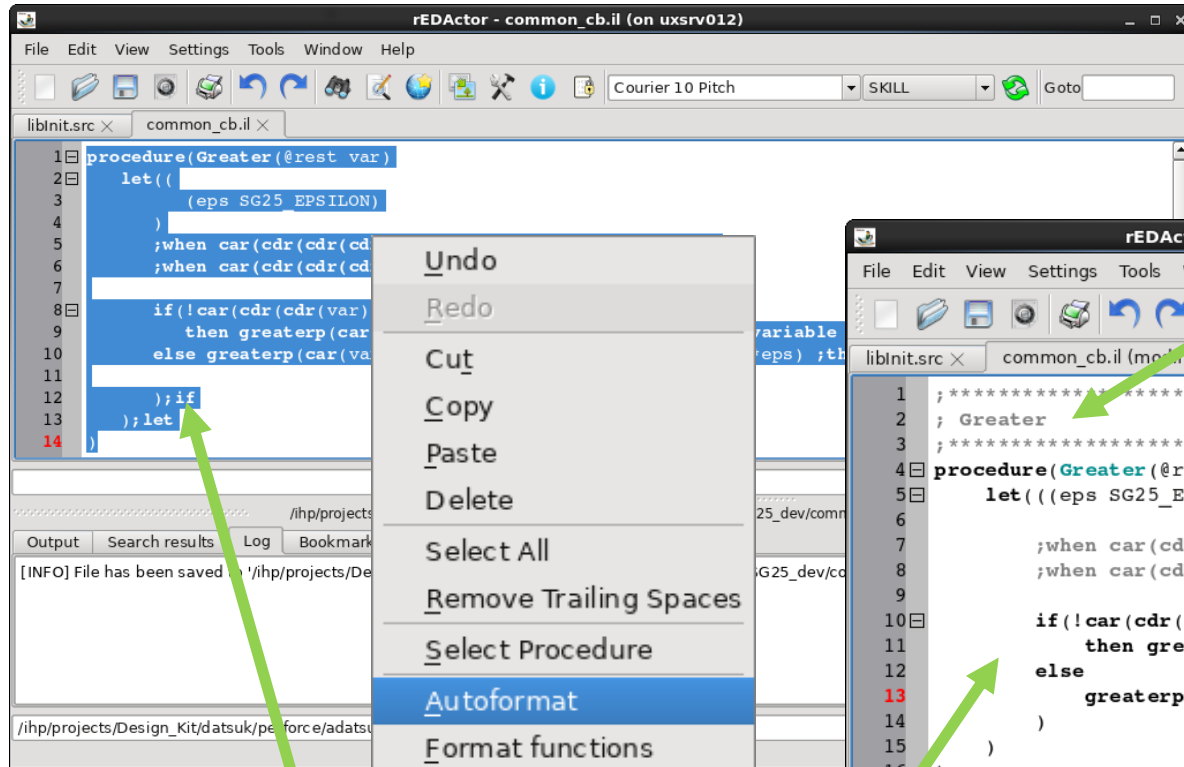
# Integration with leading edge EDA vendors



## Code execution from rEDActor environment



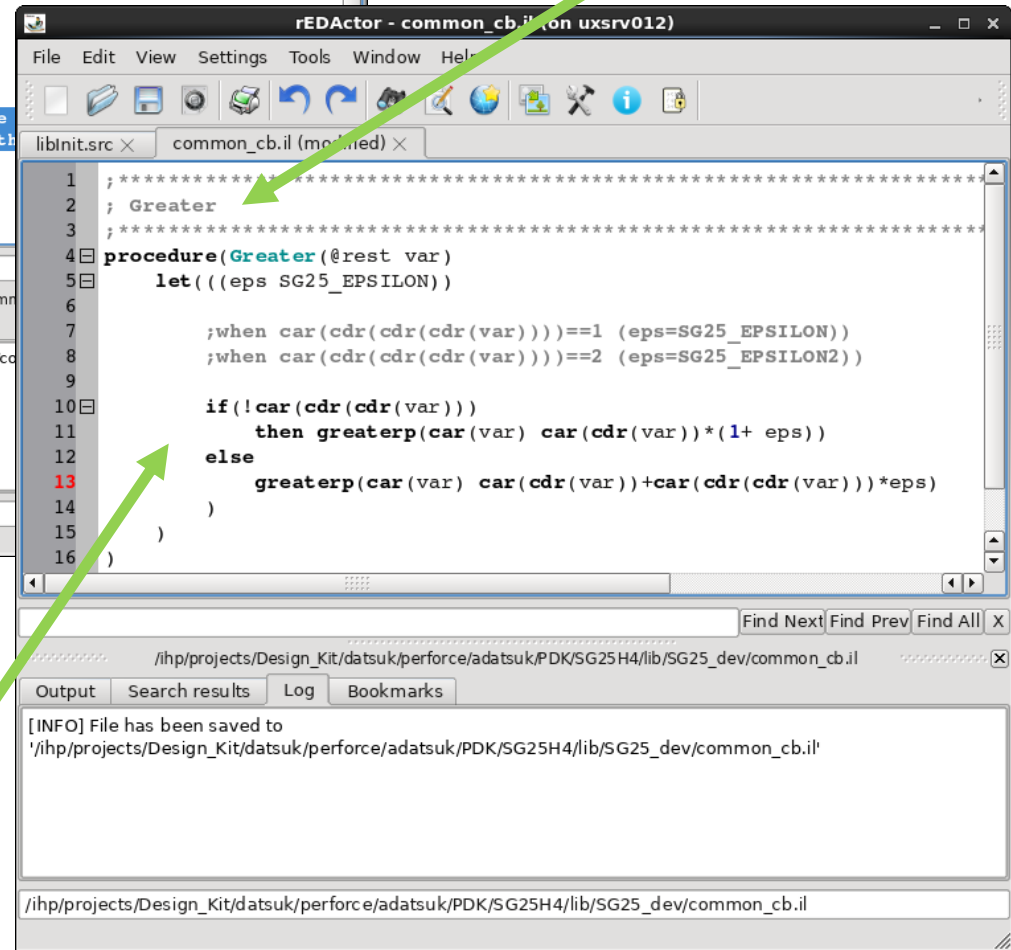
# Code autoformatting



Removes unrequired  
comments (on demand)

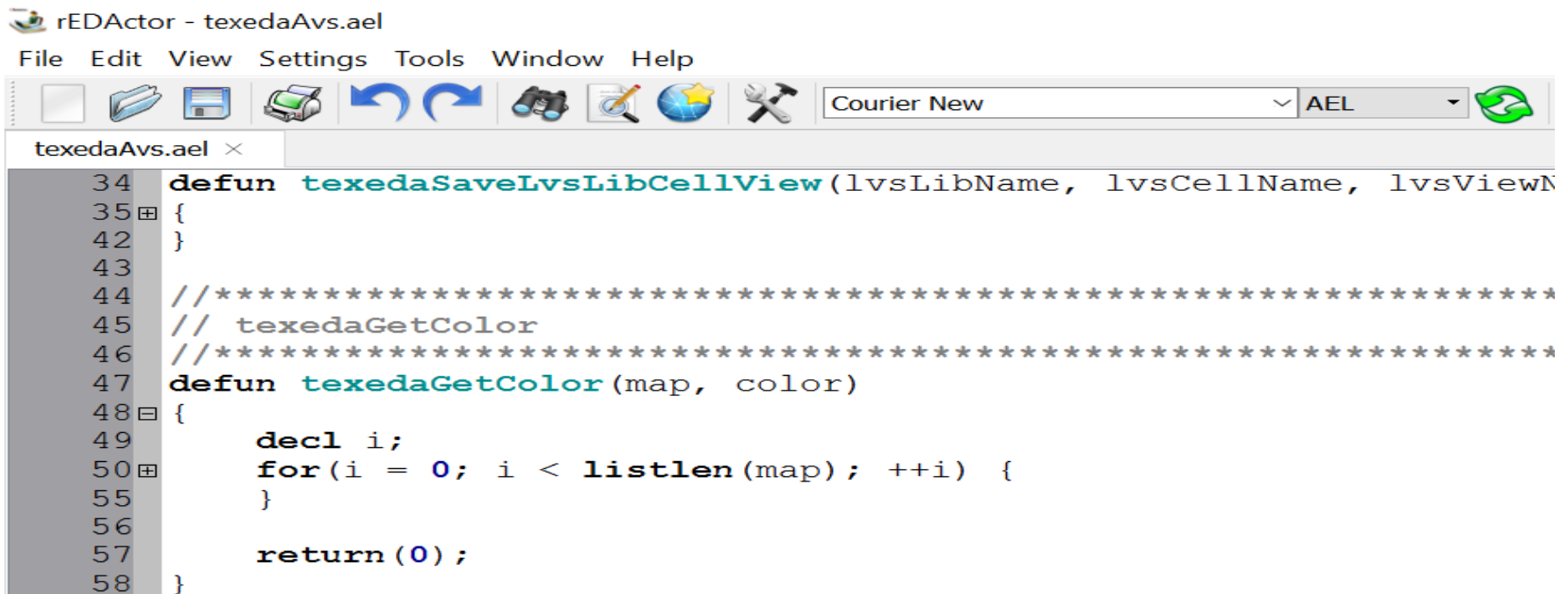
Reformats the code in  
accordance to user settings

Adds footer



## Code folding

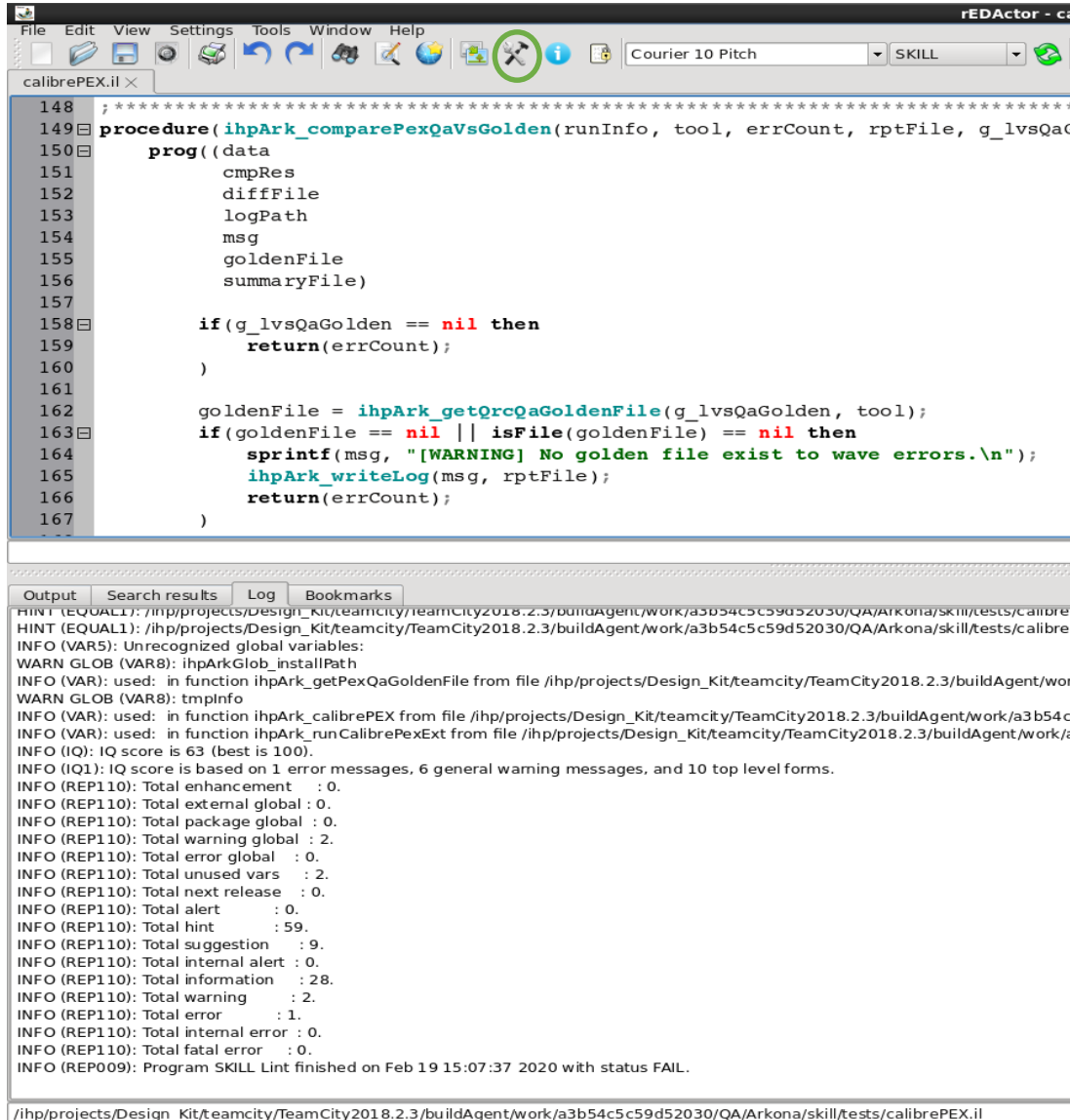
- IDE rEDActor allows the user to selectively hide and display (fold) sections of a currently edited file.
- This simplifies managing large amounts of text while viewing only those subsections of the text that are specifically relevant at any given time.



```

rEDActor - texedaAvs.ael
File Edit View Settings Tools Window Help
texedaAvs.ael x
34 defun texedaSaveLvsLibCellView(lvsLibName, lvsCellName, lvsViewN
35 {
42 }
43
44 //*****
45 // texedaGetColor
46 //*****
47 defun texedaGetColor(map, color)
48 {
49     decl i;
50     for(i = 0; i < listlen(map); ++i) {
55     }
56
57     return (0);
58 }
  
```

# Embedded syntax checkers



```

148 ; *****
149 procedure (ihpArk_comparePexQaVsGolden(runInfo, tool, errCount, rptFile, g_lvsQaGolden, g_lvsQaGoldenFile, g_lvsQaGoldenSummaryFile))
150     prog((data
151         cmpRes
152         diffFile
153         logPath
154         msg
155         goldenFile
156         summaryFile)
157
158     if(g_lvsQaGolden == nil then
159         return(errCount);
160     )
161
162     goldenFile = ihpArk_getQrcQaGoldenFile(g_lvsQaGolden, tool);
163     if(goldenFile == nil || isFile(goldenFile) == nil then
164         sprintf(msg, "[WARNING] No golden file exist to wave errors.\n");
165         ihpArk_writeLog(msg, rptFile);
166         return(errCount);
167     )
168 )

```

Output Search results Log Bookmarks

HINT (EQUAL1): /ihp/projects/Design\_Kit/teamcity/TeamCity2018.2.3/buildAgent/work/a3b54c5c59d52030/QA/Arkona/skill/tests/calibrePEX.il

HINT (EQUAL1): /ihp/projects/Design\_Kit/teamcity/TeamCity2018.2.3/buildAgent/work/a3b54c5c59d52030/QA/Arkona/skill/tests/calibrePEX.il

INFO (VAR5): Unrecognized global variables: ihpArkGlob\_installPath

WARN GLOB (VAR8): ihpArkGlob\_installPath

INFO (VAR): used: in function ihpArk\_getPexQaGoldenFile from file /ihp/projects/Design\_Kit/teamcity/TeamCity2018.2.3/buildAgent/work/a3b54c5c59d52030/QA/Arkona/skill/tests/calibrePEX.il

WARN GLOB (VAR8): tmplinfo

INFO (VAR): used: in function ihpArk\_calibrePEX from file /ihp/projects/Design\_Kit/teamcity/TeamCity2018.2.3/buildAgent/work/a3b54c5c59d52030/QA/Arkona/skill/tests/calibrePEX.il

INFO (VAR): used: in function ihpArk\_runCalibrePexExt from file /ihp/projects/Design\_Kit/teamcity/TeamCity2018.2.3/buildAgent/work/a3b54c5c59d52030/QA/Arkona/skill/tests/calibrePEX.il

INFO (IQ): IQ score is 63 (best is 100).

INFO (IQ1): IQ score is based on 1 error messages, 6 general warning messages, and 10 top level forms.

INFO (REP110): Total enhancement : 0.

INFO (REP110): Total external global : 0.

INFO (REP110): Total package global : 0.

INFO (REP110): Total warning global : 2.

INFO (REP110): Total error global : 0.

INFO (REP110): Total unused vars : 2.

INFO (REP110): Total next release : 0.

INFO (REP110): Total alert : 0.

INFO (REP110): Total hint : 59.

INFO (REP110): Total suggestion : 9.

INFO (REP110): Total internal alert : 0.

INFO (REP110): Total information : 28.

INFO (REP110): Total warning : 2.

INFO (REP110): Total error : 1.

INFO (REP110): Total internal error : 0.

INFO (REP110): Total fatal error : 0.

INFO (REP009): Program SKILL Lint finished on Feb 19 15:07:37 2020 with status FAIL.

/ihp/projects/Design\_Kit/teamcity/TeamCity2018.2.3/buildAgent/work/a3b54c5c59d52030/QA/Arkona/skill/tests/calibrePEX.il

rEDAActor supports syntax checkers for:

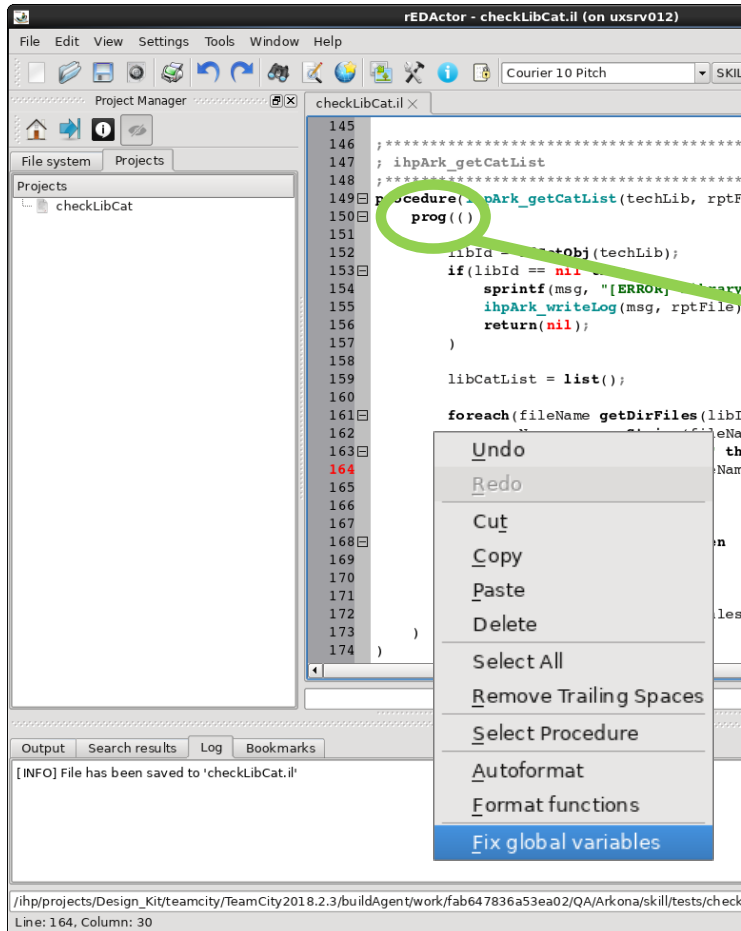
- SKILL (Cadence)
- AEL (Keysight)
- SVRF (Mentor)
- LAYTOOLS (TexEDA)
- XML .

On clicking on the line number when the error was found rEDAActor automatically navigates to this line.



# Auto initialization of global variables

IDE finds the global variables and brings them under procedure scopes.

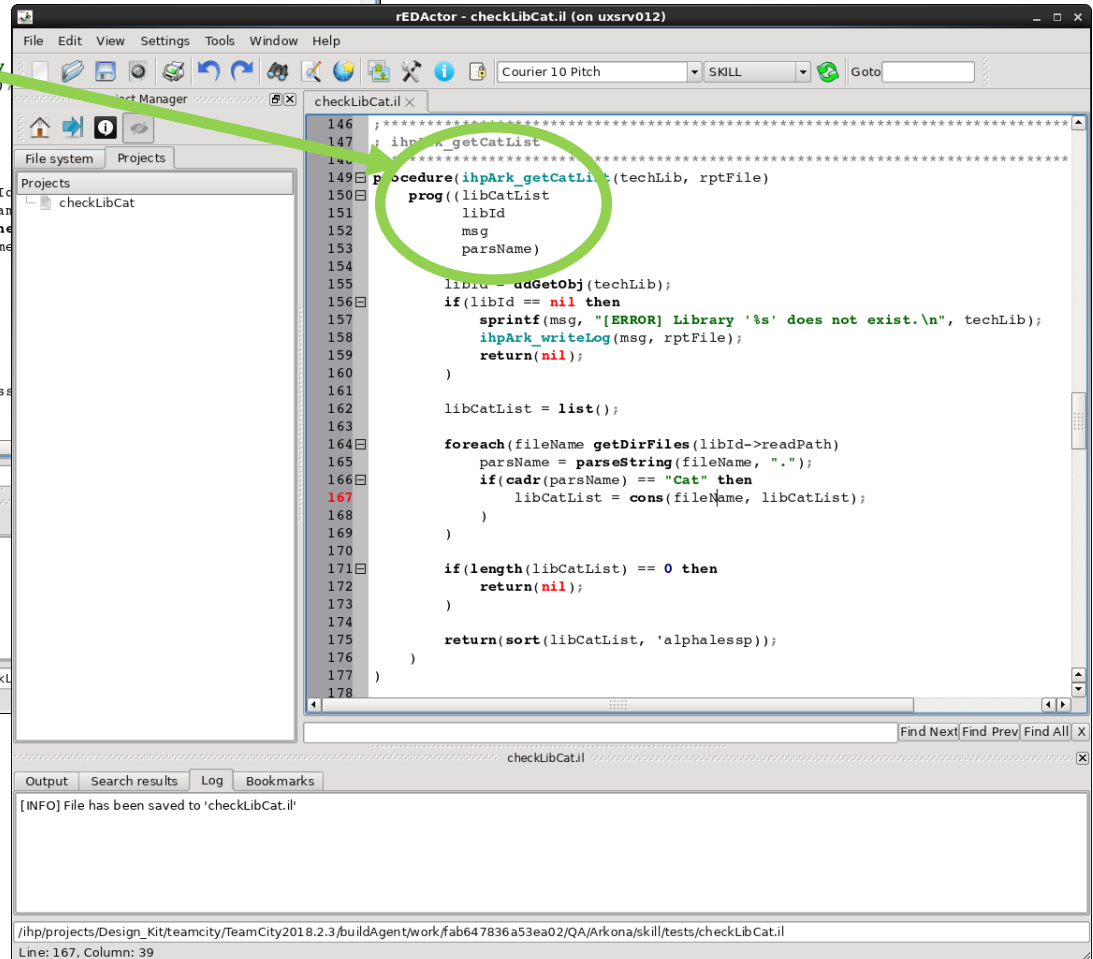


```

145 *****
146 ; ihpArk_getCatList
147 ; ihpArk_getCatList
148 *****
149 procedure(ihpArk_getCatList(techLib, rptFile)
150     prog()
151
152     libId = addGetObj(techLib);
153     if(libId == nil)
154         sprintf(msg, "[ERROR] Library '%s' does not exist.\n", techLib);
155         ihpArk_writeLog(msg, rptFile);
156         return(nil);
157     )
158
159     libCatList = list();
160
161     foreach(fileName getDirFiles(libId->readPath)
162         parsName = parseString(fileName, ".");
163         if(cadr(parsName) == "Cat" then
164             libCatList = cons(fileName, libCatList);
165         )
166     )
167
168     if(length(libCatList) == 0 then
169         return(nil);
170     )
171
172     return(sort(libCatList, 'alphalessp));
173 )
174
  
```

[INFO] File has been saved to 'checkLibCat.il'

/ihp/projects/Design\_Kit/teamcity/TeamCity2018.2.3/buildAgent/work/fab647836a53ea02/QA/Arkona/skill/tests/checkLibCat.il  
Line: 164, Column: 30



```

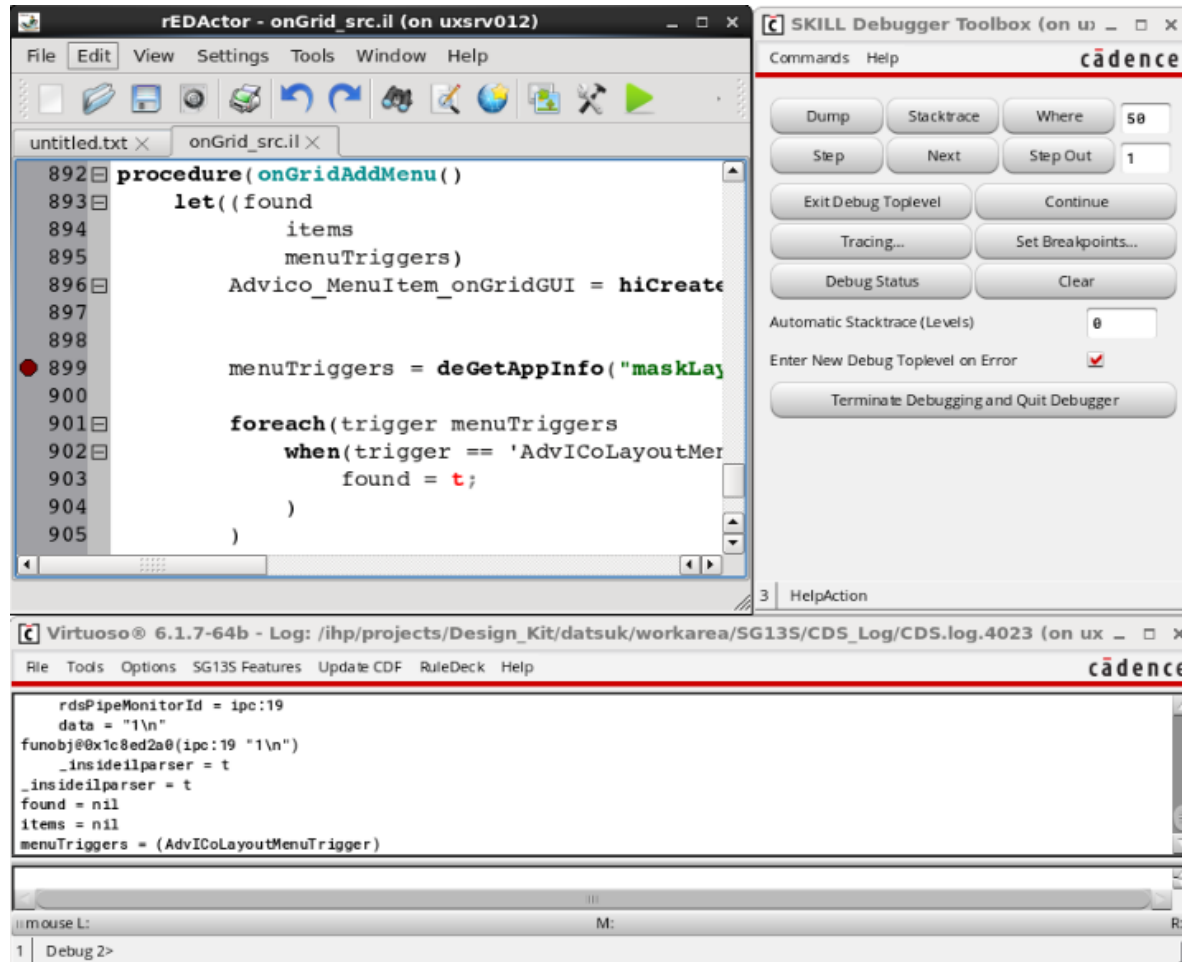
146 ; ihpArk_getCatList
147 ; ihpArk_getCatList
148 *****
149 procedure(ihpArk_getCatList(techLib, rptFile)
150     prog(libCatList
151         libId
152         msg
153         parsName)
154
155     libId = addGetObj(techLib);
156     if(libId == nil) then
157         sprintf(msg, "[ERROR] Library '%s' does not exist.\n", techLib);
158         ihpArk_writeLog(msg, rptFile);
159         return(nil);
160     )
161
162     libCatList = list();
163
164     foreach(fileName getDirFiles(libId->readPath)
165         parsName = parseString(fileName, ".");
166         if(cadr(parsName) == "Cat" then
167             libCatList = cons(fileName, libCatList);
168         )
169     )
170
171     if(length(libCatList) == 0 then
172         return(nil);
173     )
174
175     return(sort(libCatList, 'alphalessp));
176 )
177
178
  
```

[INFO] File has been saved to 'checkLibCat.il'

/ihp/projects/Design\_Kit/teamcity/TeamCity2018.2.3/buildAgent/work/fab647836a53ea02/QA/Arkona/skill/tests/checkLibCat.il  
Line: 167, Column: 39

Global variables decrease flexibility of the program and lead to errors.

# Code debugging



If required a developer can set up break points and perform SKILL code debugging.

The debugger allows to output information for:

- Global and local variables
- Functions stack calls



# SKILL to AEL code conversion

SKILL



AEL

```
when( metallization=="M4" || metallization=="M4M5"
      bmlayer="Metal3")

; check minvalues
when(w < wmin-epsilon
      w=wmin;
      hiGetAttention()
      printf("Width < %L\n" wmin)
)
when(l < lmin-epsilon
      l=lmin;
      hiGetAttention()
      printf("Height < %L\n" lmin)
)

; how many vias?
xanz=fix((w-cont_over-cont_over+cont_dist)/(cont_size+cont_dist)+epsilon)
; width for vias
wl=xanz*(cont_size+cont_dist)-cont_dist+cont_over+cont_over
; offset to first via
xoffset=(w-wl)/2
xoffset=GridFix(xoffset)

yanz=fix((l-cont_over-cont_over+cont_dist)/(cont_size+cont_dist)+epsilon)
ll=yanz*(cont_size+cont_dist)-cont_dist+cont_over+cont_over
yoffset=(l-ll)/2
yoffset=GridFix(yoffset)

ycont_cnt=cont_over+yoffset
; draw vias
while(ycont_cnt+cont_size+cont_over <= l+epsilon
      xcont_cnt=cont_over+xoffset
      while(xcont_cnt+cont_size+cont_over <= w+epsilon
            dbCreateRect(pcCellView vialayer list(
                          list(xcont_cnt ycont_cnt)
                          list(xcont_cnt+cont_size ycont_cnt+cont_size))
            )
            xcont_cnt=xcont_cnt+cont_size+cont_dist
            )
            ycont_cnt=ycont_cnt+cont_size+cont_dist
            )
)
```

```
if(metallization == "M4" || metallization == "M4M5") {
    bmlayer = "Metal3";
}
if(w < wmin-epsilon) {
    w = wmin;
    hiGetAttention();
    de_info(sprintf("Width < %L\n", wmin));
}
if(l < lmin-epsilon) {
    l = lmin;
    hiGetAttention();
    de_info(sprintf("Height < %L\n", lmin));
}
xanz = fix((w-cont_over-cont_over+cont_dist)/(cont_size+cont_dist)+epsilon);
wl = xanz*(cont_size+cont_dist)-cont_dist+cont_over+cont_over;

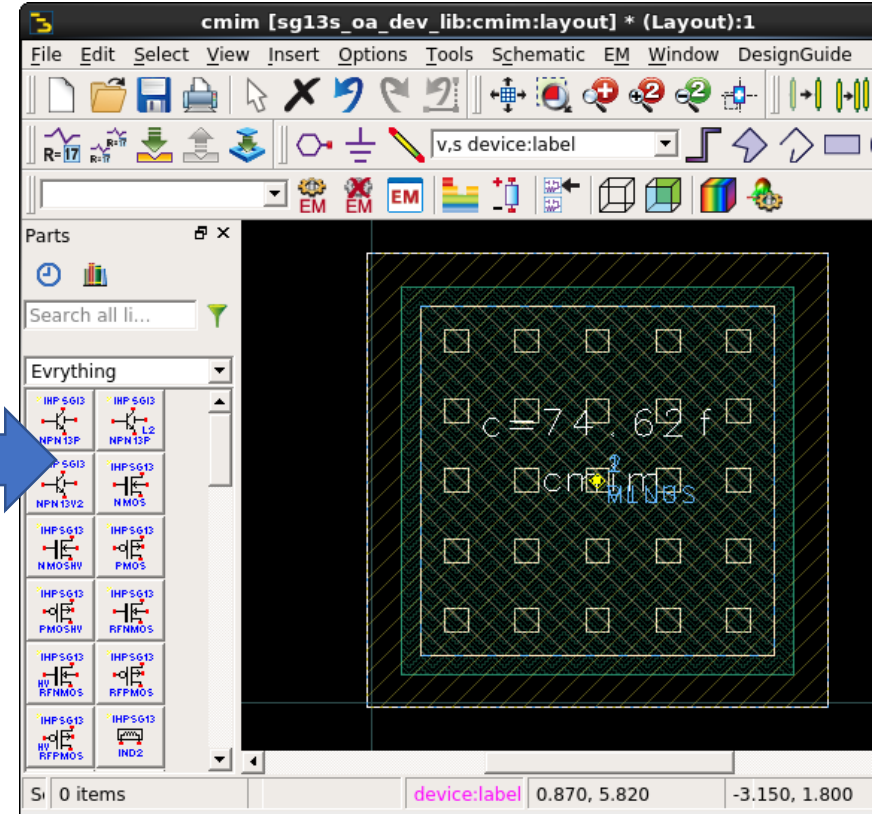
xoffset = (w-wl)/2;
xoffset = GridFix(xoffset);

yanz = fix((l-cont_over-cont_over+cont_dist)/(cont_size+cont_dist)+epsilon);
ll = yanz*(cont_size+cont_dist)-cont_dist+cont_over+cont_over;
yoffset = (l-ll)/2;
yoffset = GridFix(yoffset);

ycont_cnt = cont_over+yoffset;

while(ycont_cnt+cont_size+cont_over <= l+epsilon) {
    xcont_cnt = cont_over+xoffset;
    while(xcont_cnt+cont_size+cont_over <= w+epsilon) {
        dbCreateRect(pcCellView, vialayer,
                      list(xcont_cnt, ycont_cnt,
                           xcont_cnt+cont_size, ycont_cnt+cont_size));
        xcont_cnt = xcont_cnt+cont_size+cont_dist;
    }
    ycont_cnt = ycont_cnt+cont_size+cont_dist;
}
```

# AEL



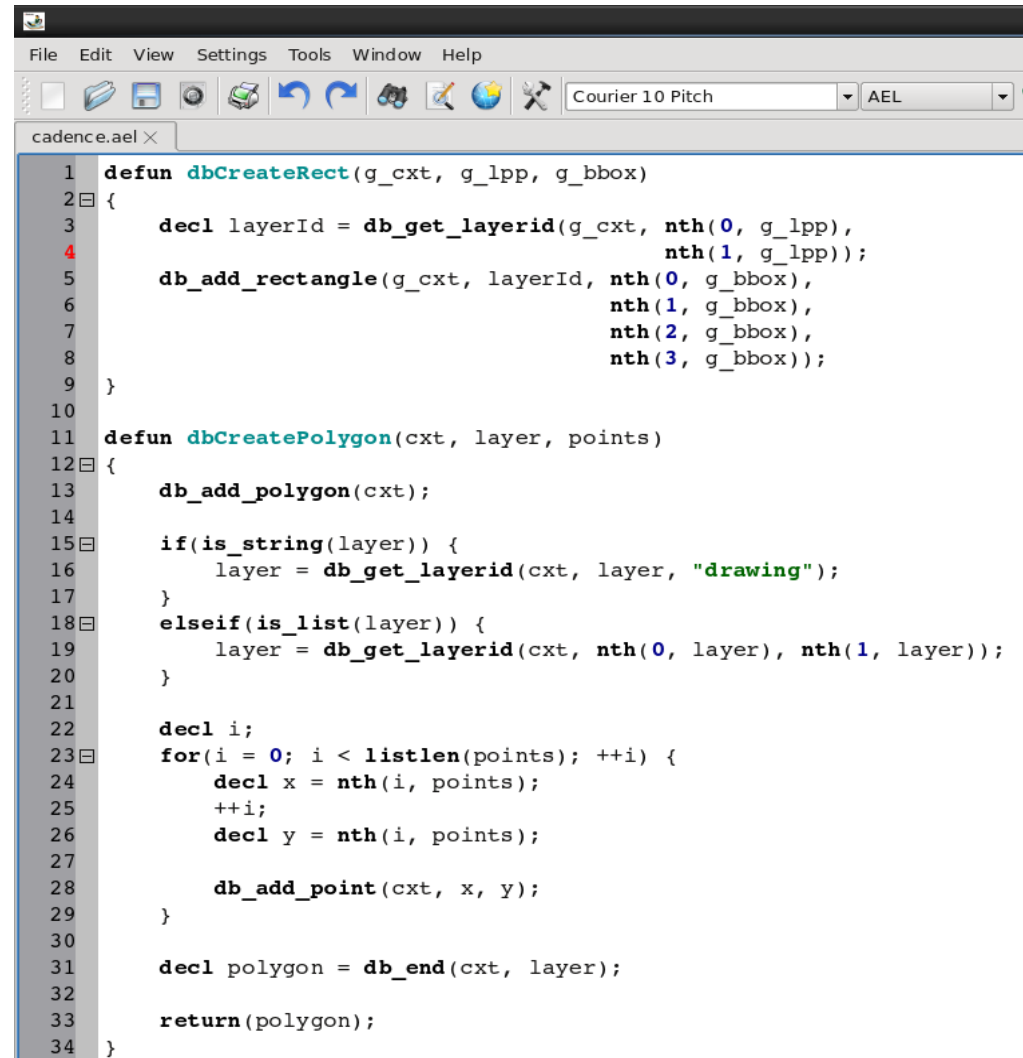
The converted AEL code for CMIM Pcell has been loaded into Keysight ADS environment without any additional modifications.

## SKILL to AEL code conversion

The conversion works based on plug-ins.

For this the basic SKILL procedures (for ex. dbCreateRect, dbCreatePolygon, etc.), have been developed using Keysight AEL language.

User can extend the plug-in file on demand.



```

1 defun dbCreateRect(g_cxt, g_lpp, g_bbox)
2 {
3     decl layerId = db_get_layerid(g_cxt, nth(0, g_lpp),
4                                     nth(1, g_lpp));
5     db_add_rectangle(g_cxt, layerId, nth(0, g_bbox),
6                                     nth(1, g_bbox),
7                                     nth(2, g_bbox),
8                                     nth(3, g_bbox));
9 }
10
11 defun dbCreatePolygon(cxt, layer, points)
12 {
13     db_add_polygon(cxt);
14
15     if(is_string(layer)) {
16         layer = db_get_layerid(cxt, layer, "drawing");
17     }
18     elseif(is_list(layer)) {
19         layer = db_get_layerid(cxt, nth(0, layer), nth(1, layer));
20     }
21
22     decl i;
23     for(i = 0; i < listlen(points); ++i) {
24         decl x = nth(i, points);
25         ++i;
26         decl y = nth(i, points);
27
28         db_add_point(cxt, x, y);
29     }
30
31     decl polygon = db_end(cxt, layer);
32
33     return(polygon);
34 }
  
```

## Current Users



The following companies are using IDE rEDActor:



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for high  
performance  
microelectronics



AMPLEON

mikron

TEXEDA  
DESIGN GMBH



## Conclusions and results

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1. rEDActor has been incorporated into the leading-edge software tools increasing efficiency of PDK development.
2. The IDE provides a functionality to perform code autoformatting, folding, debugging etc.
3. The editor allows to convert SKILL code to AEL thus increasing productivity of Cadence interoperable PDKs.
4. The IDE rEDActor has been successfully applied for development of PDKs for 0.13  $\mu\text{m}$  and 0.25  $\mu\text{m}$  SiGe BiCMOS technologies resulting in highly reliable and robust PDK releases.





# Thank you for attention!

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