Modern Buildable Projects with IBM i Project Explorer and Bob

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Agenda

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- Challenges with Building on IBM i
- How does local development overcome this?
- What are IBM i Projects?
- What is Bob and how to use it?
- Ins and Outs of IBM i Project Explorer

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Challenges with Building on IBM i

Building on IBM i is limiting...

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1. SRC-PF
   - 10 char names
   - Fixed record length
   - Not accessible to open ecosystem, including Git and Make
   - Source of the same type stored in QxxxSRC to avoid name conflicts (member type does not disambiguate)

2. Libraries
   - Only 2 level hierarchy to organize, with only short 10 char names

3. Source control
   - None (sequence number dates)
   - Home grown
   - Proprietary IBM i systems
     - Cost
     - Smaller market = less investment

4. Build system
   - Individual CRTXXXMOD + CRTPGM
   - CL Scripts
   - A couple of vendors have dependency-based build

Let’s look ahead to the future

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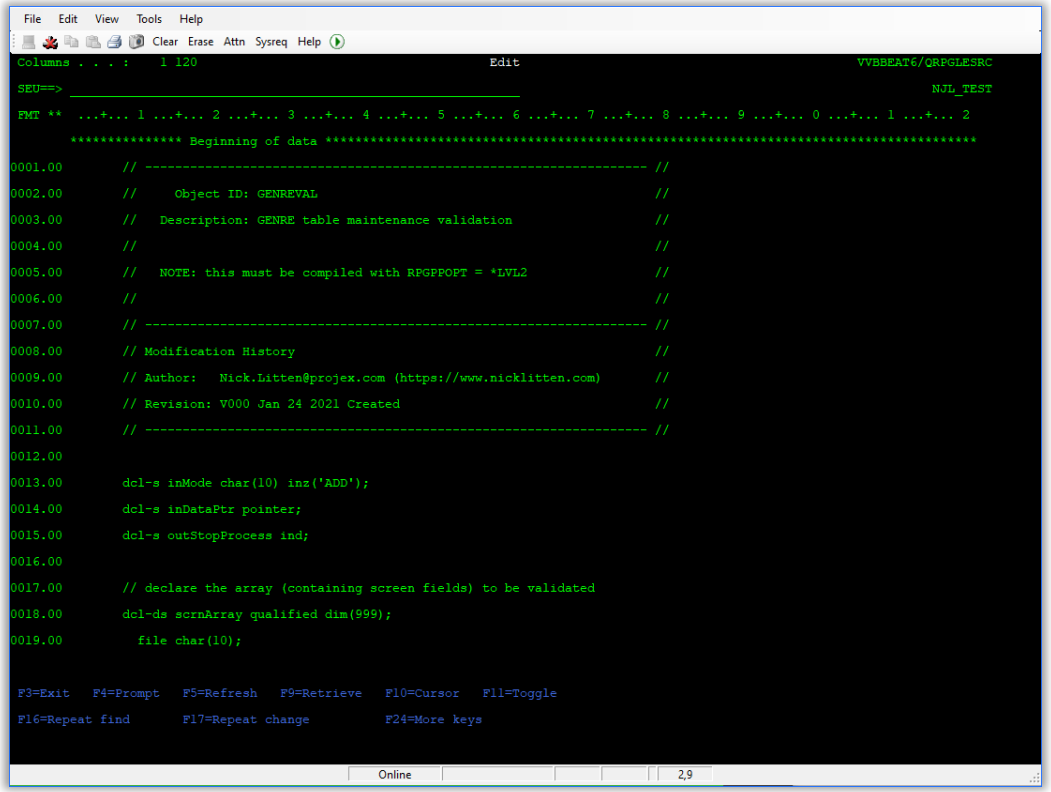
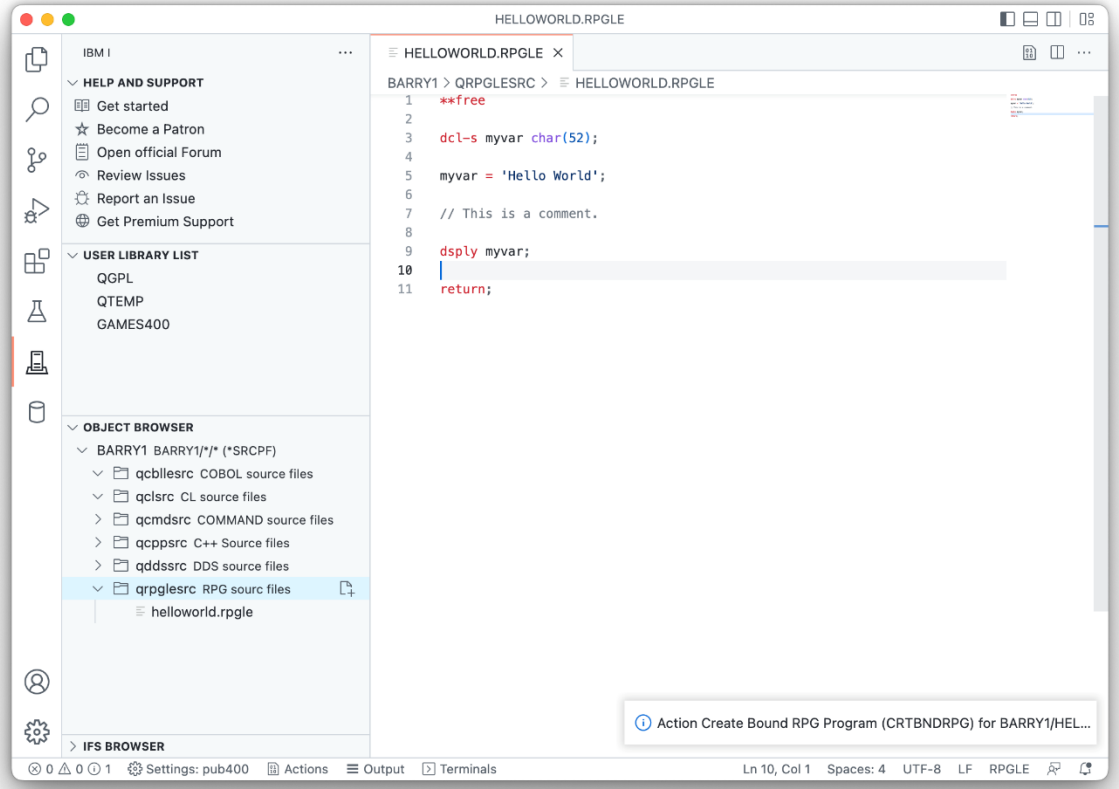
New Developers Incoming!

Need for Modernization is Urgent

New development tools/ecosystems (ie. Code for IBM i/Merlin)

Modern development practices (ie. Git)





How does local development overcome this?

Let's use a different (but similar) file system

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MYPROJECT
- QRPGLESRC
  - CUSTOMER.RPGLE
  - INVENTORY.RPGLE
  - STARTJOB.RPGLE
- QSQLSRC
  - CUSTOMERS.SQL
  - INVENTORY.SQL
- QCLLESRC
  - START.CLLE
- QCMDSRC
  - STARTJOB.CMD

QSYS.LIB Library

No more character name restrictions

Now usable with Git and Make

/my-project
- /.git
- qrpglesrc
  - customer.rpgle
  - inventory.rpgle
  - startjob.rpgle
- qsqlsrc
  - customer.table
  - inventory.table
- qcllesrc
  - start.clle
- qcmdsrc
  - startjob.cmd

IFS/Local File System

Let’s go one step further!

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/my-project
- /.git
- qrpglesrc
  - customer.rpgle
  - inventory.rpgle
  - startjob.rpgle
- qsqlsrc
  - customer.table
  - inventory.table
- qcllesrc
  - start.clle
- qcmdsrc
  - startjob.cmd

IFS/Local File System

Flexible directory structure

/my-project
- /.git
- customer-management
  - customer.rpgle
  - customer.table
- inventory-service
  - inventory.rpgle
  - inventory.table
- start-command
  - startjob.pgm.rpgle
  - start.clle
  - startjob.cmd

Logical Organization

Unlocking source control with Git

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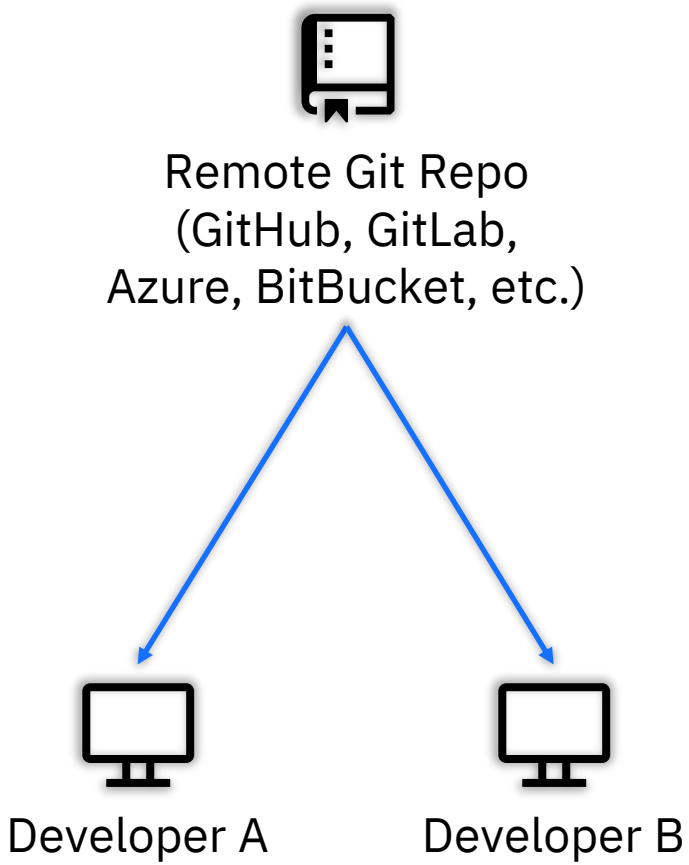
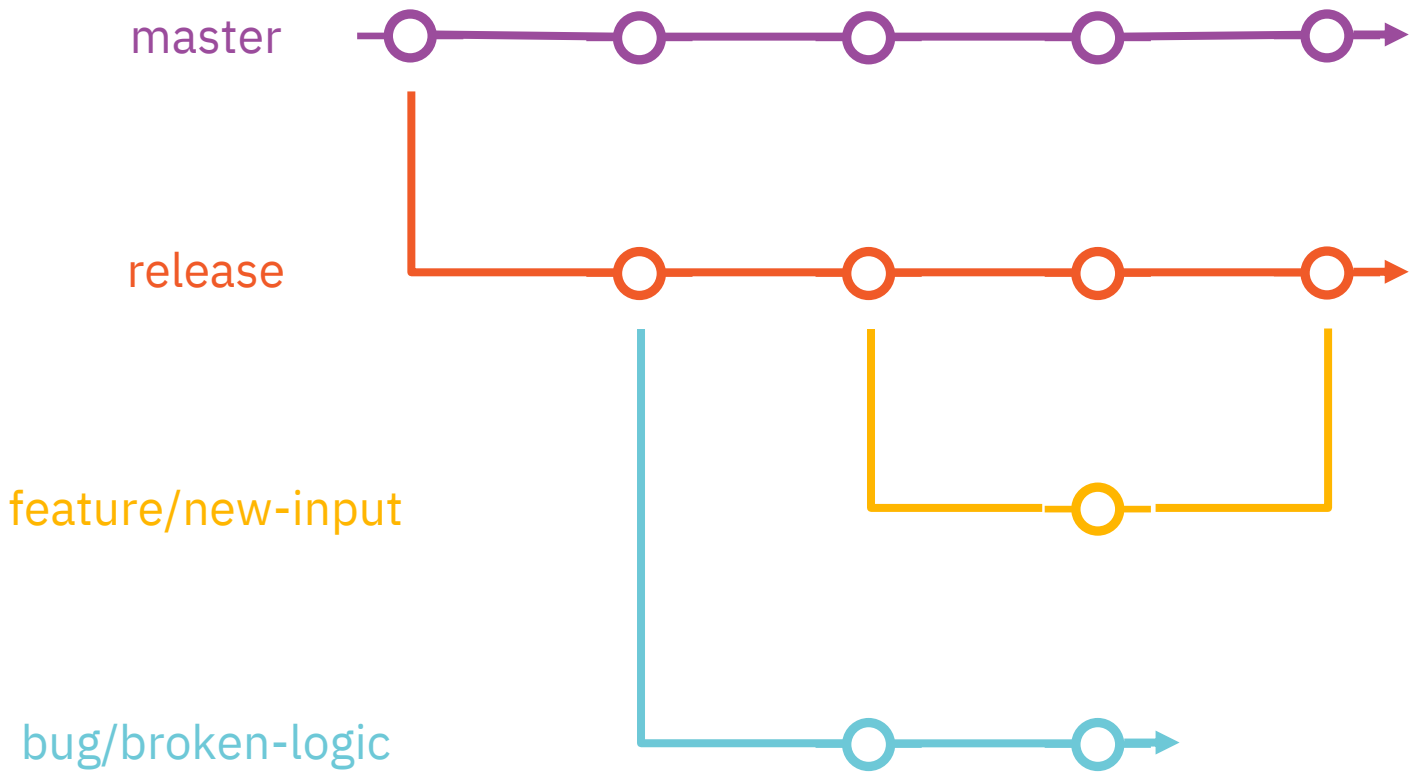
Distributed Development



Version Control and Git Workflow



Did we solve our problems?

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1. ~~SRC-PF~~
   - ~~10 char names~~
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   - ~~Not accessible to open ecosystem, including Git and Make~~
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4. Build system
   - Individual CRTXXXMOD + CRTPGM
   - CL Scripts
   - A couple of vendors have dependency-based build

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What are IBM i Projects?

Projects that self-describe how to build themselves!?

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- my-project
  - .evfevent
    - file.evfevent
    - source.evfevent
  - .logs
    - joblog.json
    - file.splf
    - source.splf
  - includes
    - constants.rpgleinc
  - QRPGLESRC
    - .ibmi.json
    - Rules.mk
    - source.rpgle
  - QDDSSRC
    - Rules.mk
    - file.pf
  - .env
  - .gitignore
  - .ibmi.json
  - iproj.json
  - Rules.mk

Project Information

Configure library list

Configure build/compile environment

iproj.json

```
{
    "version": "0.0.1",
    "description": "SAMPLE PROJECT",
    "repository": "https://github.com/edmundreinhardt/bob-recursive-example.git",
    "license": "Apache 2.0",
    "objlib": "&CURLIB",
    "curlib": "&CURLIB",
    "includePath": [
        "includes",
        "QPROTOSRC"
    ],
    "preUsrlibl": [
        "&lib1"
    ],
    "postUsrlibl": [
        "&lib2"
    ],
    "setIBMiEnvCmd": [],
    "compileCommand": "makei c -f {filename}",
    "buildCommand": "makei build"
}
```

Standardized metadata format with variables (&...)

Set build/compile command

iproj.json in project root

Flexible subdirectories and build customization

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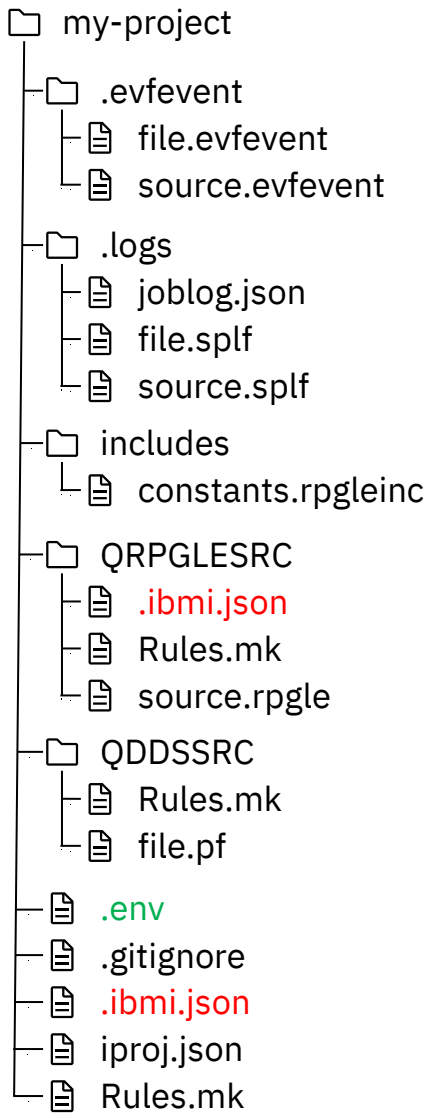
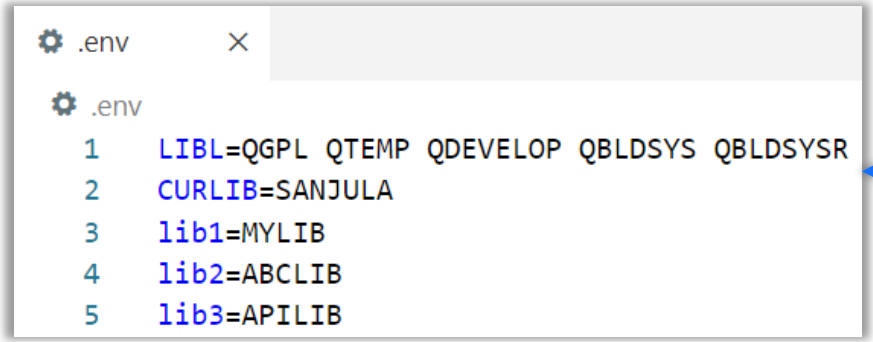


EBCDIC encoding for compiler

Target object library for directory

.ibmi.json in project root or subdirectories



Custom variable values so that each developer can customize build

.env in project root

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What is Bob and how to use it?

What is Bob?

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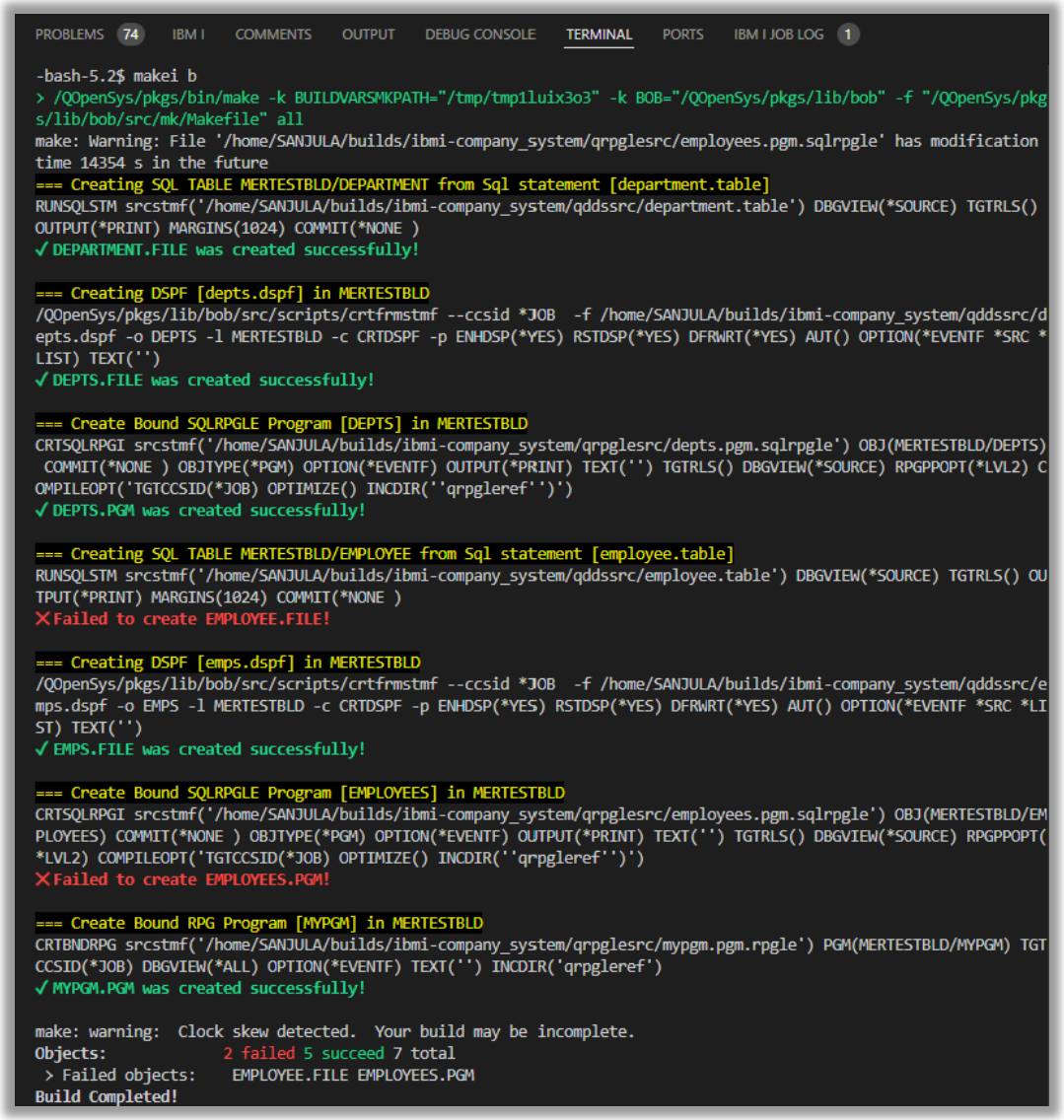
Free and open-source build system to build QSYS objects on IBM i

- 🚀 Speed: Compile objects that need recompiling (new or changed source code)
- 🛠️ Reliability: If an item changes, then it and everything it depending on it will be rebuilt
- 💎 Industry standard: Object dependencies are specified using standard makefile syntax
- 🔧 Flexibility: Override compile parameters, write custom recipes (If you can code it, you can build it!)
- 🌟 Ease of use: Build with a single command or a single button in an IDE (IBM i Project Explorer in VS Code)



Defining targets with Rules.mk

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- my-project
  - .evfevent
    - file.evfevent
    - source.evfevent
  - .logs
    - joblog.json
    - file.splf
    - source.splf
  - includes
    - constants.rpgleinc
  - QRPGLESRC
    - .ibmi.json
    - Rules.mk
    - source.rpgle
  - QDDSSRC
    - Rules.mk
    - file.pf
  - .env
  - .gitignore
  - .ibmi.json
  - iproj.json
  - Rules.mk

Rules.mk

```
1   SUBDIRS = qrpglesrc qddssrc
```

Declare subdirectories to be built

Rules.mk in project root

Rules.mk

```
1   FVAT.SRVPGM: fvat.bnd VAT300.MODULE
2   FVAT.SRVPGM: private TEXT = Functions VAT
3
4   VAT300.MODULE: vat300.rpgle QPROTOSRC/vat.rpgleinc VATDEF.FILE
5   VAT300.MODULE: private TEXT := bound into FVAT.SRVPGM
6   VAT300.MODULE: private DBGVIEW ::= *SOURCE
7
8   VATDEF.FILE: vatdef.pf SAMREF.FILE
```

Makefile with list of objects to be built and from which source files

Rules.mk in subdirectories

Variables in Rules.mk

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Declare variables to override compile settings for multiple targets

Rules.mk U

SAMPLE > Rules.mk

```
1   PRO200.MODULE: private TGTRLS := *PRV
2   PRO200.MODULE: PRO200.RPGLE
3
4   VAT.MODULE: private TGTRLS := *PRV
5   VAT.MODULE: VAT.RPGLE
```


Rules.mk U

SAMPLE > Rules.mk

```
1   PROJECT_TGTRLS := *PRV
2
3   PRO200.MODULE: private TGTRLS := $(PROJECT_TGTRLS)
4   PRO200.MODULE: PRO200.RPGLE
5
6   VAT.MODULE: private TGTRLS := $(PROJECT_TGTRLS)
7   VAT.MODULE: VAT.RPGLE
```

Wildcarding in Rules.mk

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Use wildcarding when you have files that create objects of the same type

Rules.mk

```
1   FILE_TGTRLS = V7R3M0
2   MOD_TGTRLS = V7R3M0
3
4   TEST1.FILE: private TGTRLS := $(FILE_TGTRLS)
5   TEST1.FILE: TEST1.TABLE DEP1.FILE DEP2.FILE
6
7   TEST2.FILE: private TGTRLS := $(FILE_TGTRLS)
8   TEST2.FILE: TEST2.TABLE DEP1.FILE DEP2.FILE
9
10  TEST1.MODULE: private TGTRLS := $(MOD_TGTRLS)
11  TEST1.MODULE: TEST1.RPGLE
```


Rules.mk

```
1   FILE_TGTRLS = V7R3M0
2   MOD_TGTRLS = V7R3M0
3
4   %.FILE: private TGTRLS := $(FILE_TGTRLS)
5   %.MODULE: private TGTRLS := $(MOD_TGTRLS)
6
7   %.FILE: %.TABLE DEP1.FILE DEP2.FILE
8   %.MODULE: %.RPGLE
```

Overriding Wildcards in Rules.mk

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Explicitly defined compile options take precedence over wildcarding

Rules.mk

```
1   FILE_TGTRLS = V7R3M0
2   MOD_TGTRLS = V7R3M0
3
4   %.FILE: private TGTRLS := $(FILE_TGTRLS)
5   %.MODULE: private TGTRLS := $(MOD_TGTRLS)
6
7   %.FILE: %.TABLE DEP1 DEP2
8   %.MODULE: %.RPGLE
9
10  EMP.MODULE: private TGTRLS := V7R4M0
11  EMP.MODULE: EMP.RPGLE A.TABLE
```

Supported Object Types

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These IBM i source types can be compiled directly from the IFS ...

Object Type	File Extension
*CMD	.CMD
*MODULE	.RPGLE, .CLLE, .C, .SQLC, .CPP, .SQLCPP, .SQLRPGLE, .CBLLE, .SQLCBLLE
*PGM	.PGM.RPGLE, .PGM.SQLRPGLE, .PGM.C, .PGM.CBLLE, .PGM.SQLCBLLE
*SRVPGM	.BND

These older IBM i source types can be compiled as well (CRTFRMSTMF copies the source to QTEMP/QSOURCE before compiling)

Object Type	File Extension
*FILE	.DSPF, .LF, .PF, .PRTF
*MENU	.MENUSRC
*MODULE	.CLLE
*PGM	.RPG, .PGM.CLLE
*PNLGRP	.PNLGRPSRC
*WSCST	.WSCSTSRC
*QMQRY	.SQL

CL pseudo-source

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The CL command to create these object types are stored in a file with the given extension ...

Object Type	File Extension	CL Command
*MSGF	.MSGF	CRTMSGF + ADDMSGD
*BNDDIR	.BNDDIR	CRTBNDDIR
*PGM	.ILEPGM	CRTPGM
*SRVPGM	.ILESRVPGM	CRTSRVPGM
*DTAARA	.DTAARA	CRTDTAARA
*DTAQ	.DTAQ	CRTDTAQ
*TRG	.SYSTRG	ADDPFTRG

SQL pseudo-source

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The SQL command to create these object types are stored in a file with the given extension and are created via RUNSQLSTM ...

SQL Type	QSYS Object	File Extension	SQL COMMAND
TABLE	*FILE	.TABLE	CREATE OR REPLACE TABLE
VIEW	*FILE	.VIEW	CREATE OR REPLACE VIEW
INDEX	*FILE	.INDEX	CREATE INDEX
PROCEDURE	*PGM	.SQLPRC	CREATE OR REPLACE PROCEDURE
FUNCTION	*SRVPGM	.SQLUDF	CREATE OR REPLACE FUNCTION
FUNCTION	*SRVPGM	.SQLUDT	CREATE DISTINCT TYPE
TRIGGER	*PGM	.SQLTRG	CREATE OR REPLACE TRIGGER
ALIAS	*FILE	.SQLALIAS	CREATE OR REPLACE ALIAS
SEQUENCE	*DTAARA	.SQLSEQ	CREATE OR REPLACE SEQUENCE

Build and Compile Process

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Initialization and Migration

Command	Description
makei init	Create iproj.json
makei cvtsrcpf	Convert QSYS members to Unicode IFS stream files

Building

Command	Description
makei build	Build the entire project
makei b –t <object>	Build target object
makei b –d <directory>	Build all objects in the specified directory (based on Rules.mk)

Compiling

Command	Description
makei compile -f <stream file>	Compile target object of specified stream file
makei compile –files file1: file2: …	Compile target objects of all specified stream files

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Ins and Outs of IBM i Project Explorer

Overview

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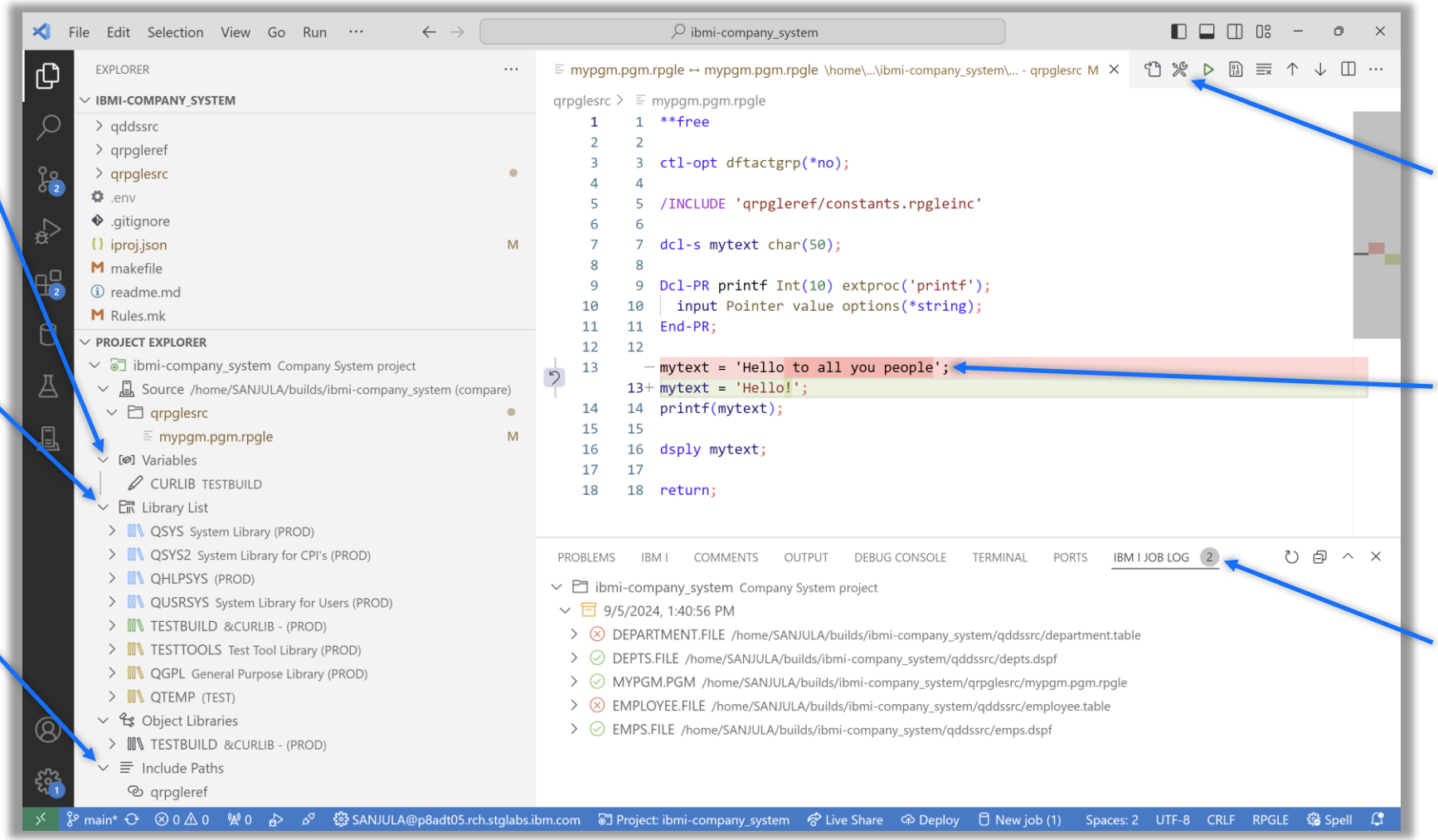
The ultimate tool for local development on IBM i!

Set variables

Manage library list

Modify include paths



Build and Compile

Local source vs. IFS source

View job logs

Installation

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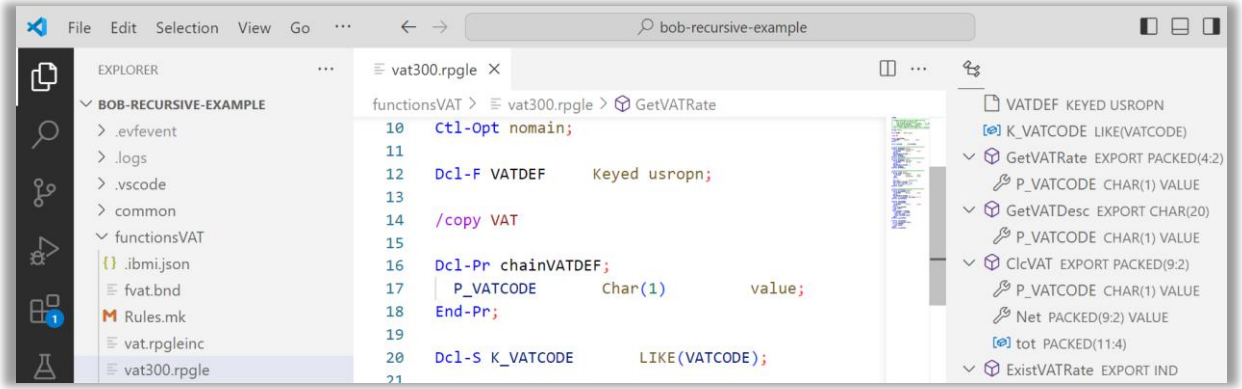
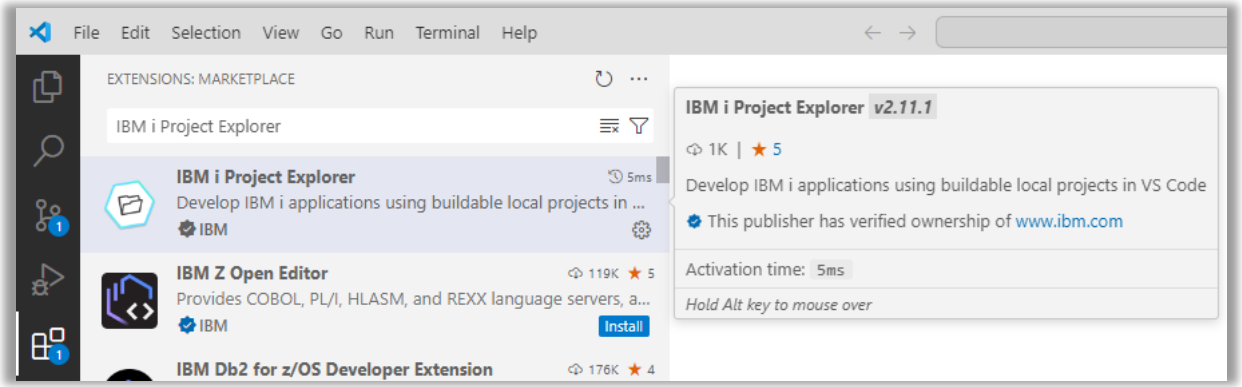
1 *Download*
Visual Studio Code



2 *Download VS Code extensions*
IBM i Project Explorer,
Source Orbit and *Code for IBM i*
or just the IBM i Development Pack



3 *Run*
yum install bob
on IBM i

Create a New Project

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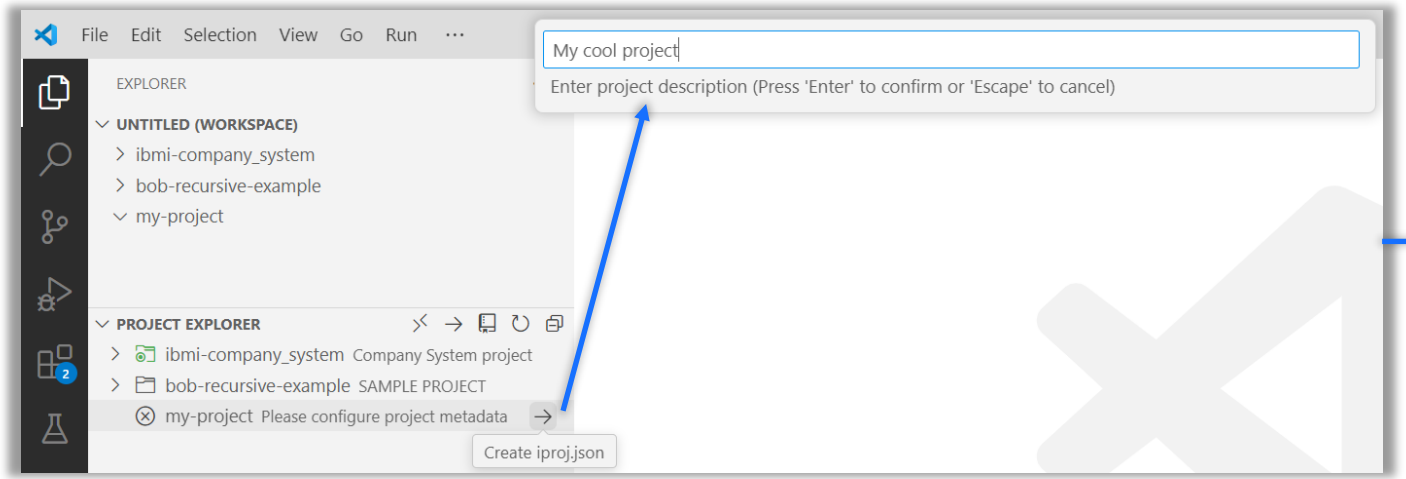
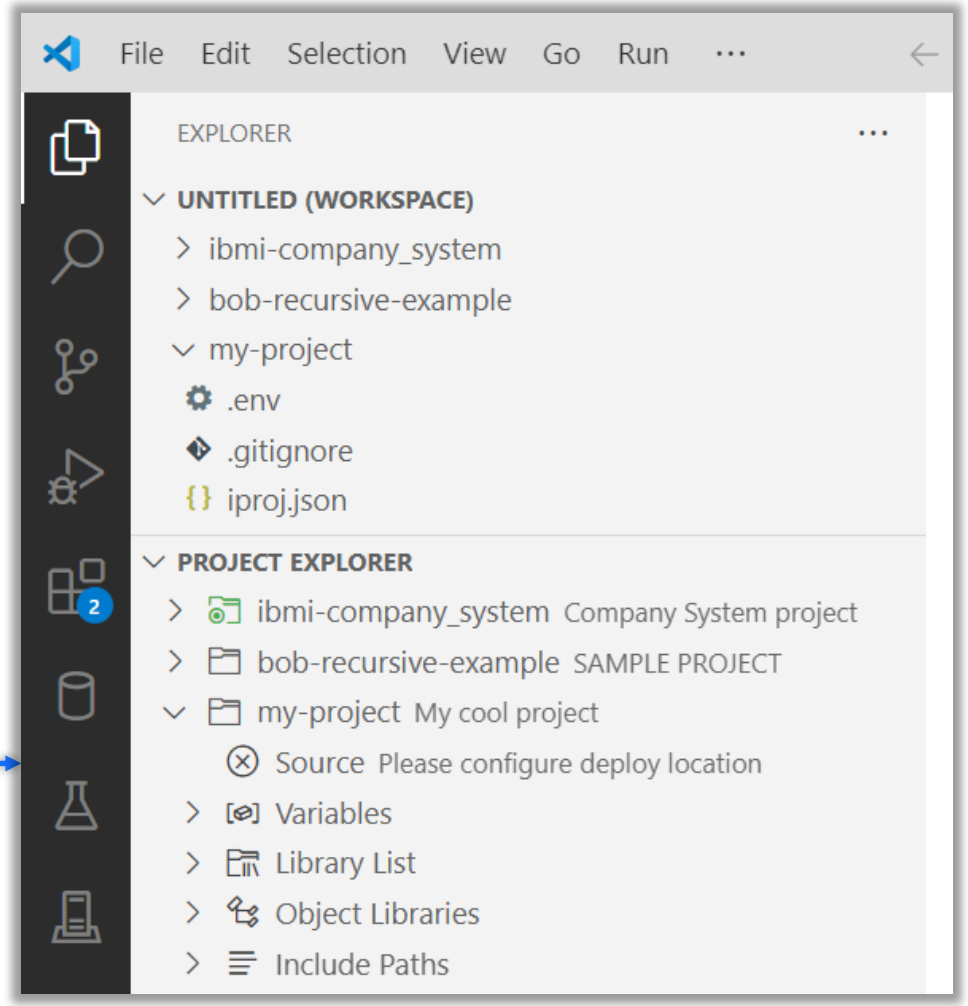
- Create and open a folder for your project
- Create an iproj.json
- Set the project description





Connect to an IBM i

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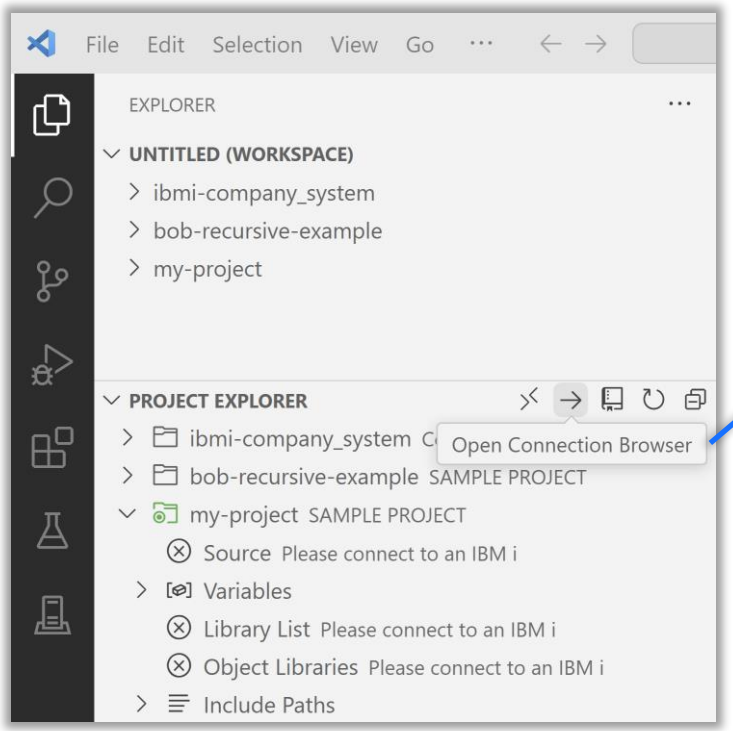
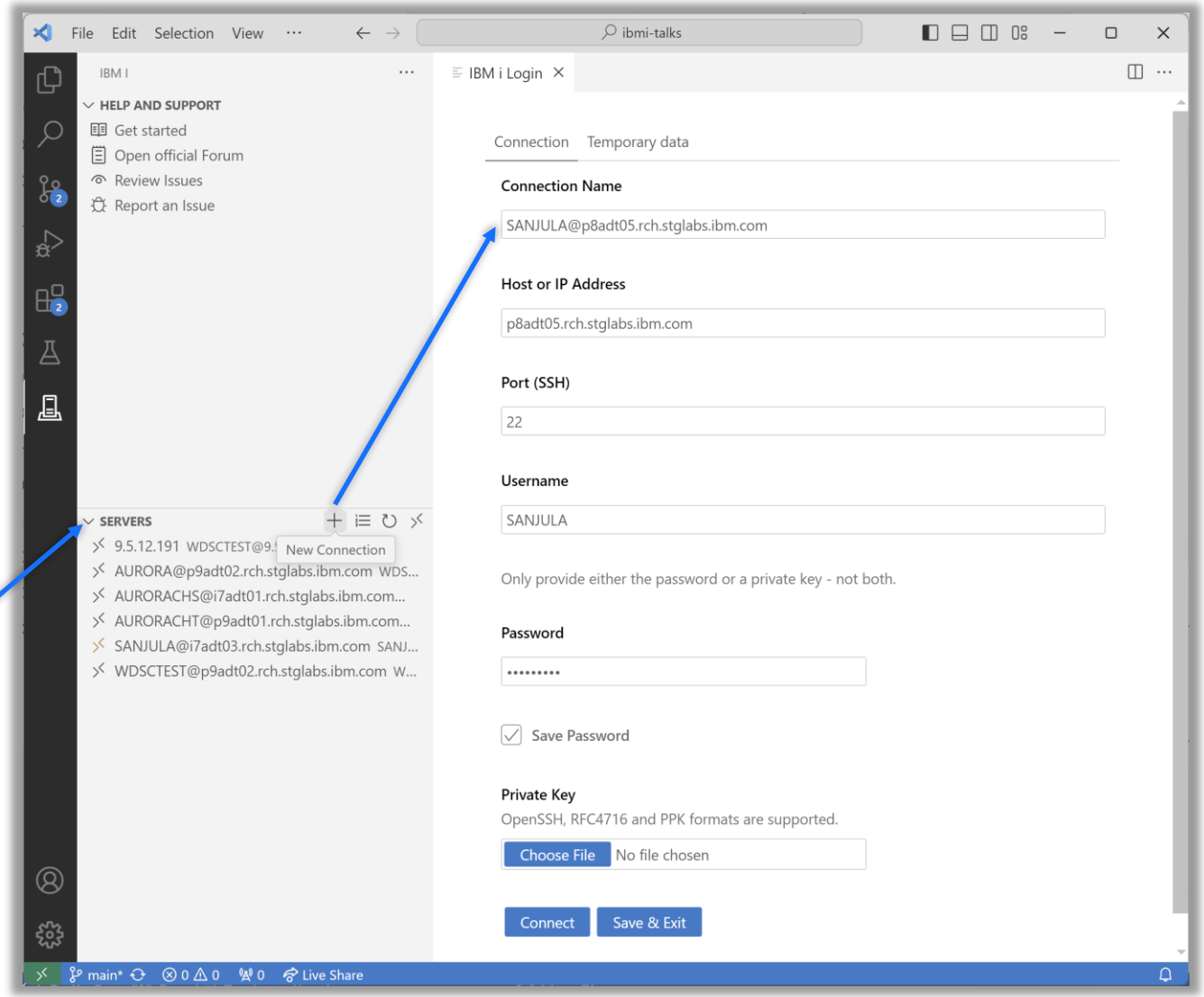
- Open the *Connection Browser* from Project Explorer
- Create new IBM i connection from the *Server* view





Migrate Source from QSYS

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CVTSRCPF from BOB

QSYS members in source physical files

↓

Properly encoded, terminated, and named source files in an IFS directory

↓

Download to local project

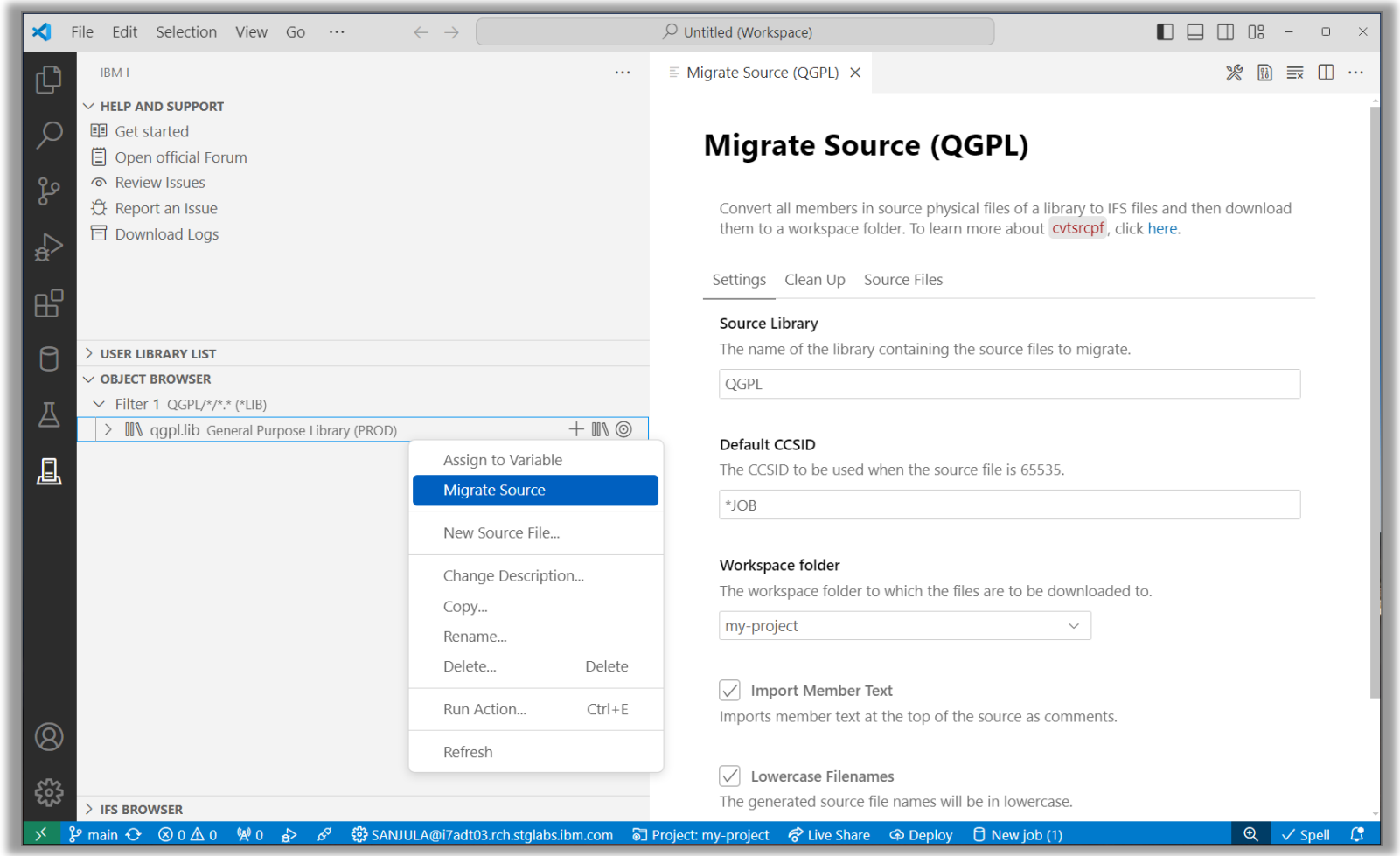
↓

Source Orbit

Rename extensions

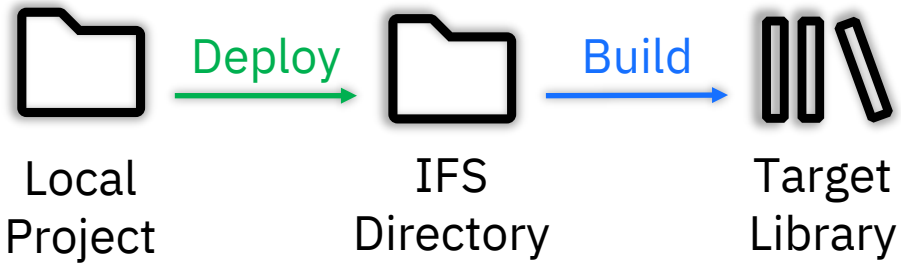
↓

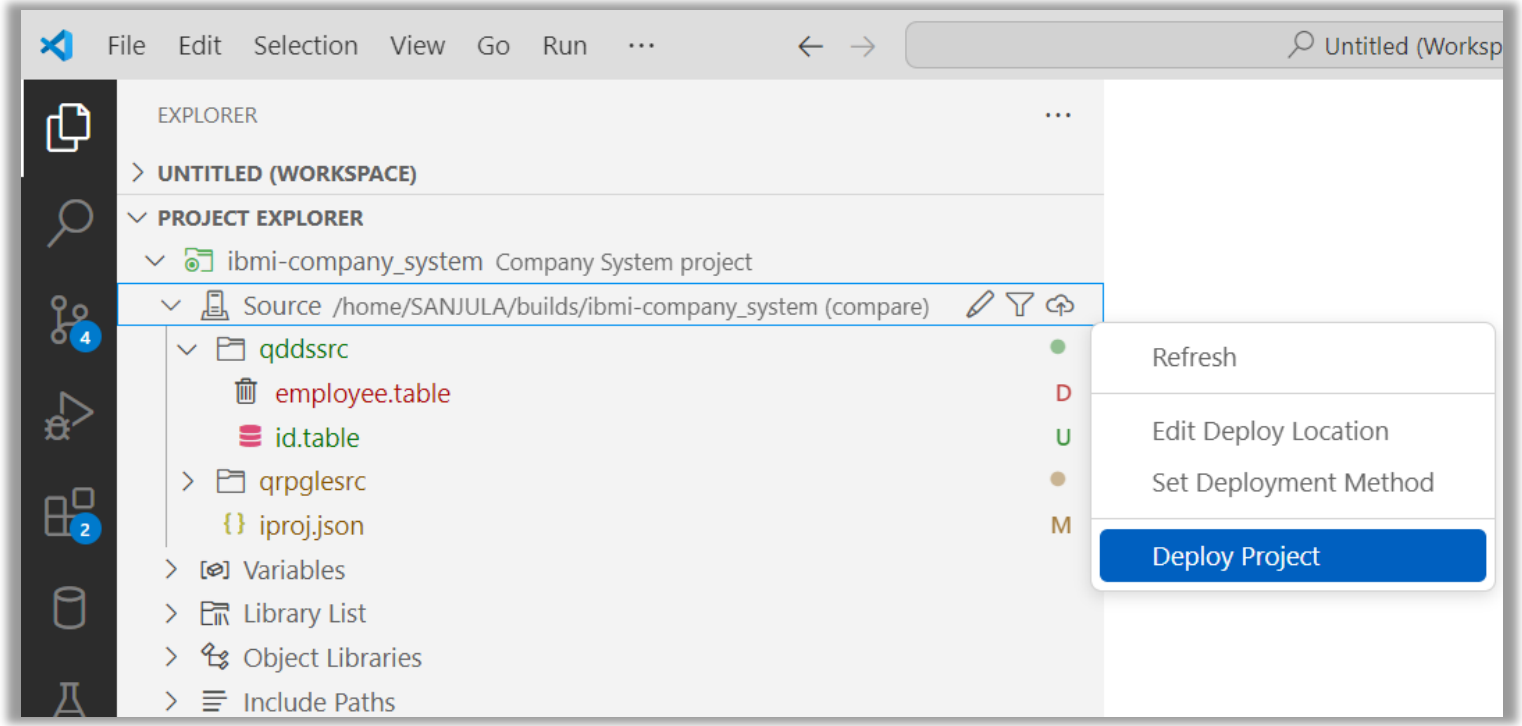
Convert includes/copy directives to Unix style paths



Deployment

- Set deploy location
  - Where source gets uploaded to
  - Typically set one
  - Each developer gets a unique location
  - Each repository gets a unique location
- Set deployment method
  - Compare (typically the safest)
  - Changes (typically the fastest)
  - Working Changes
  - Staged Changes
  - All
- Deploy project
  - Moves files to deploy location based on deployment method





Visualize Local vs. Remote Source Files

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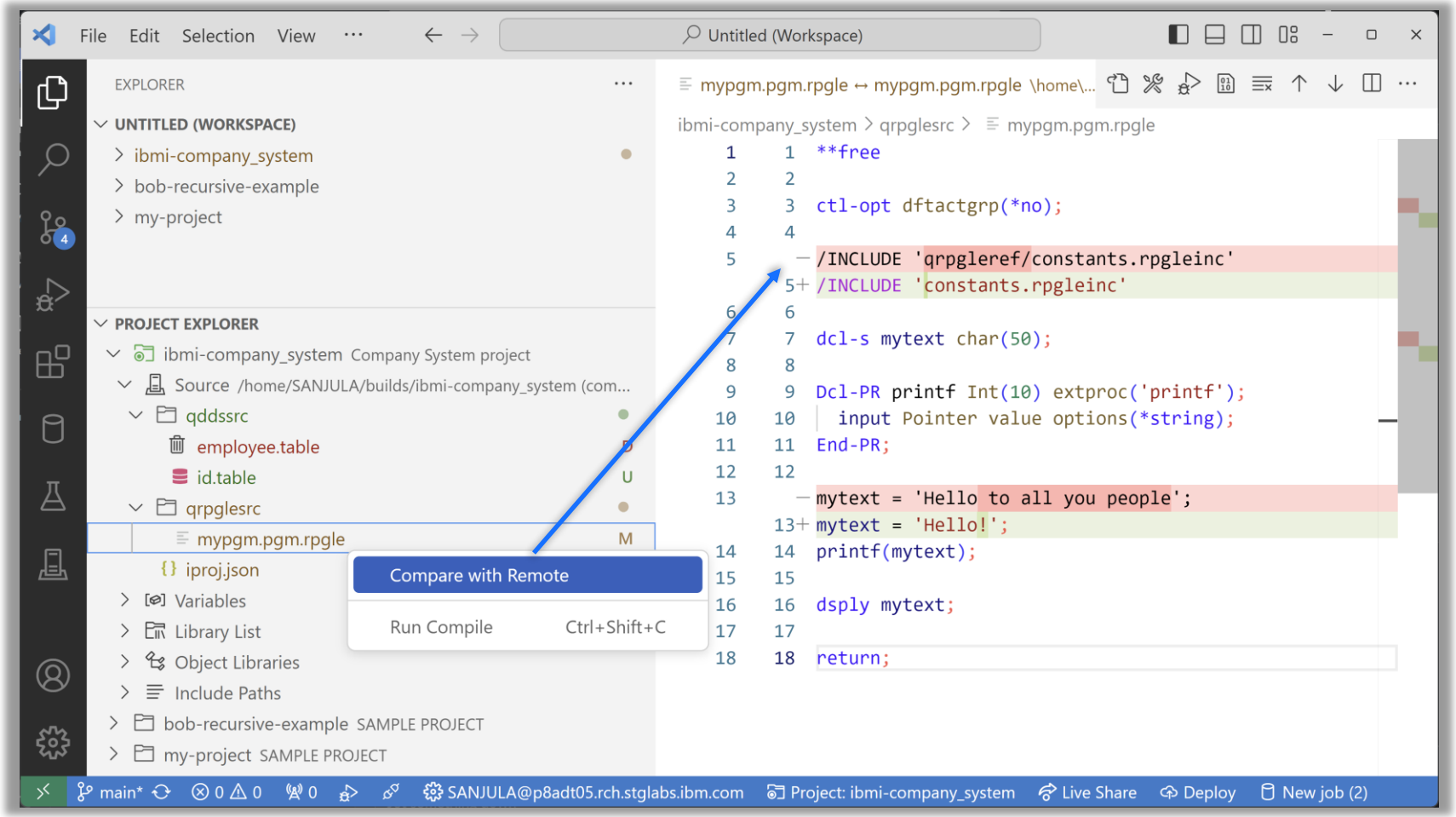
- Visualize, compare, and deploy your local source files to the deploy location in the IFS
- Track file changes (added, modified, deleted, etc.)
- Compare local file content with remote IFS



Work with Variables

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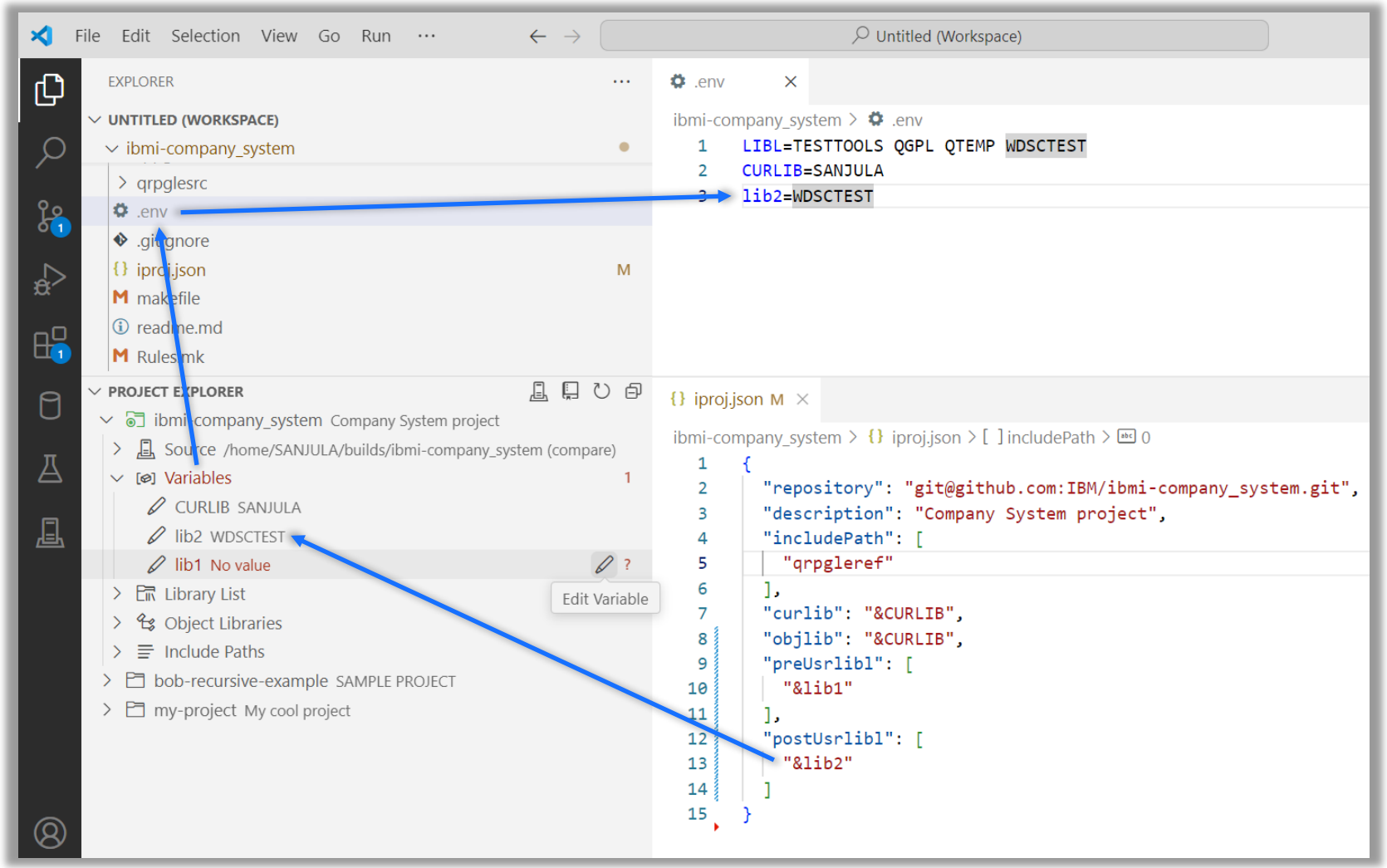
- Reusable project definition that can be used by multiple developers or in automated builds
- View and set variables (for libraries, include paths, or build/compile commands)
- Browse for libraries and assign values to variables
- Configure hardcoded values as variables

Do not push .env file to Git!



Manage the Library List

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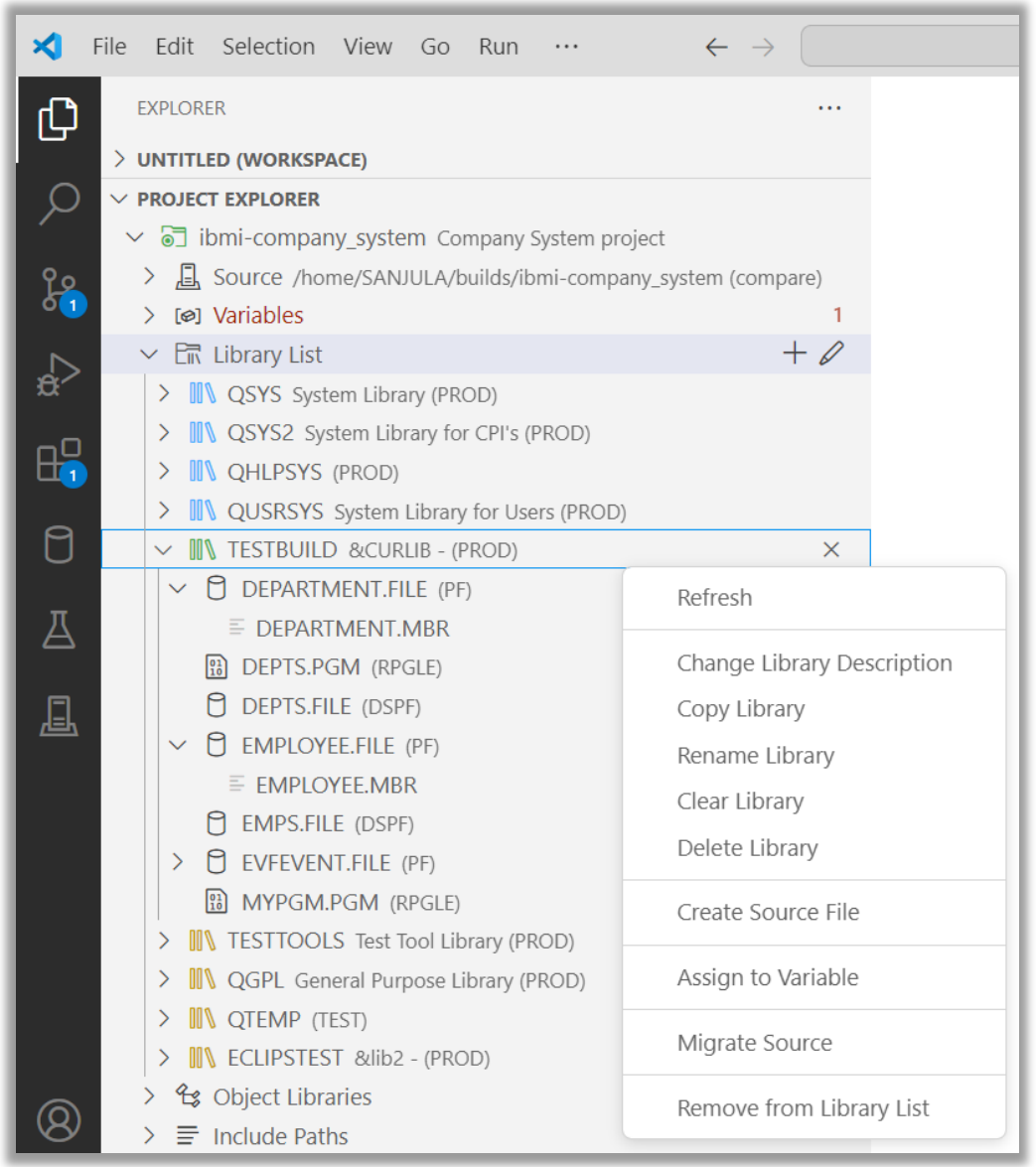
- Project's library list is a composition of your user profile's library list (from JOBD) + set of project specific libraries
- Add to beginning/end of library list (*preUsrlibl* and *postUsrlibl*) and set current library (*curlib* in iproj.json)
- Reorder library list
- Browse objects and members
- Manage libraries, objects, and members



Browse Object Libraries

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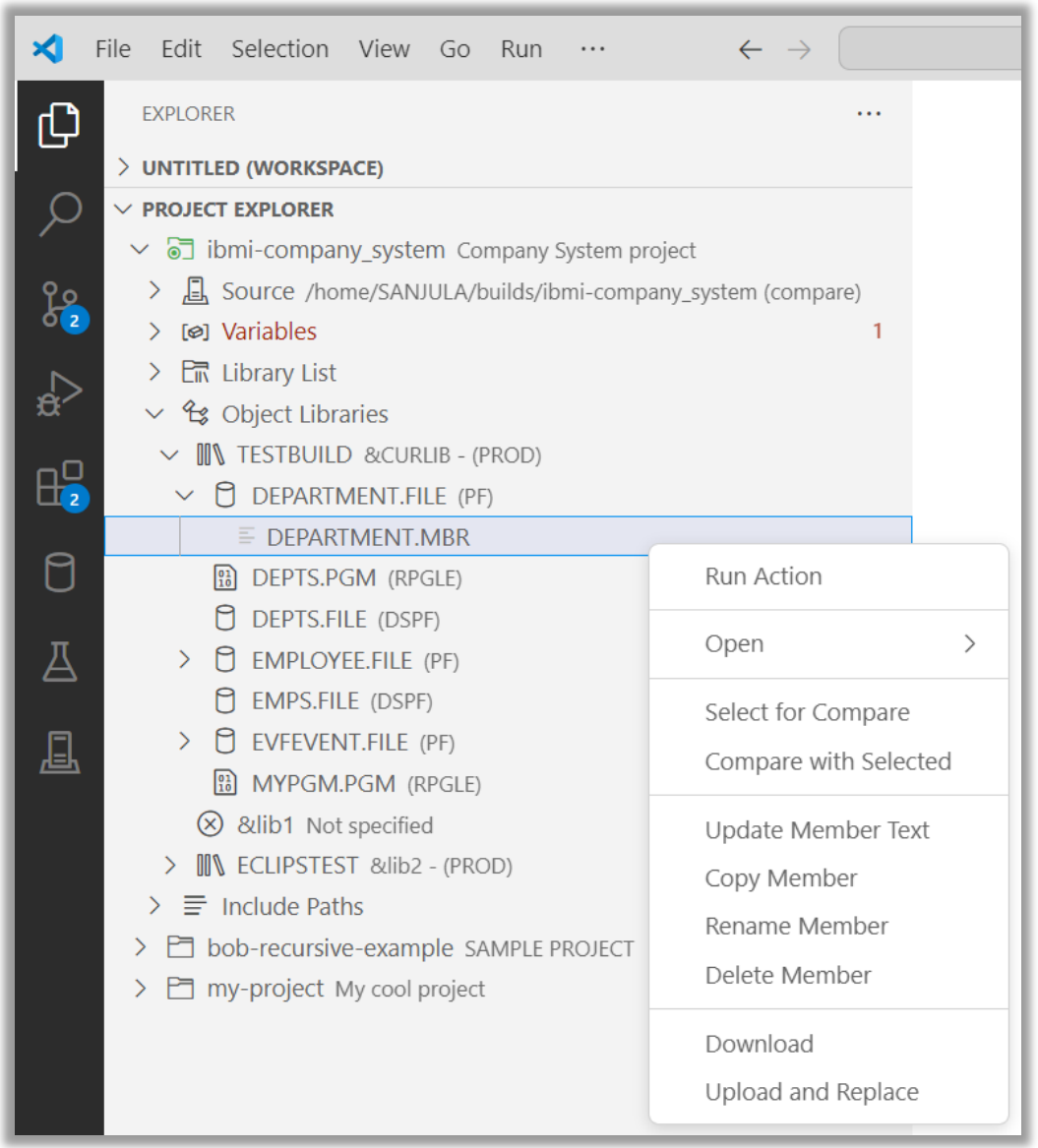
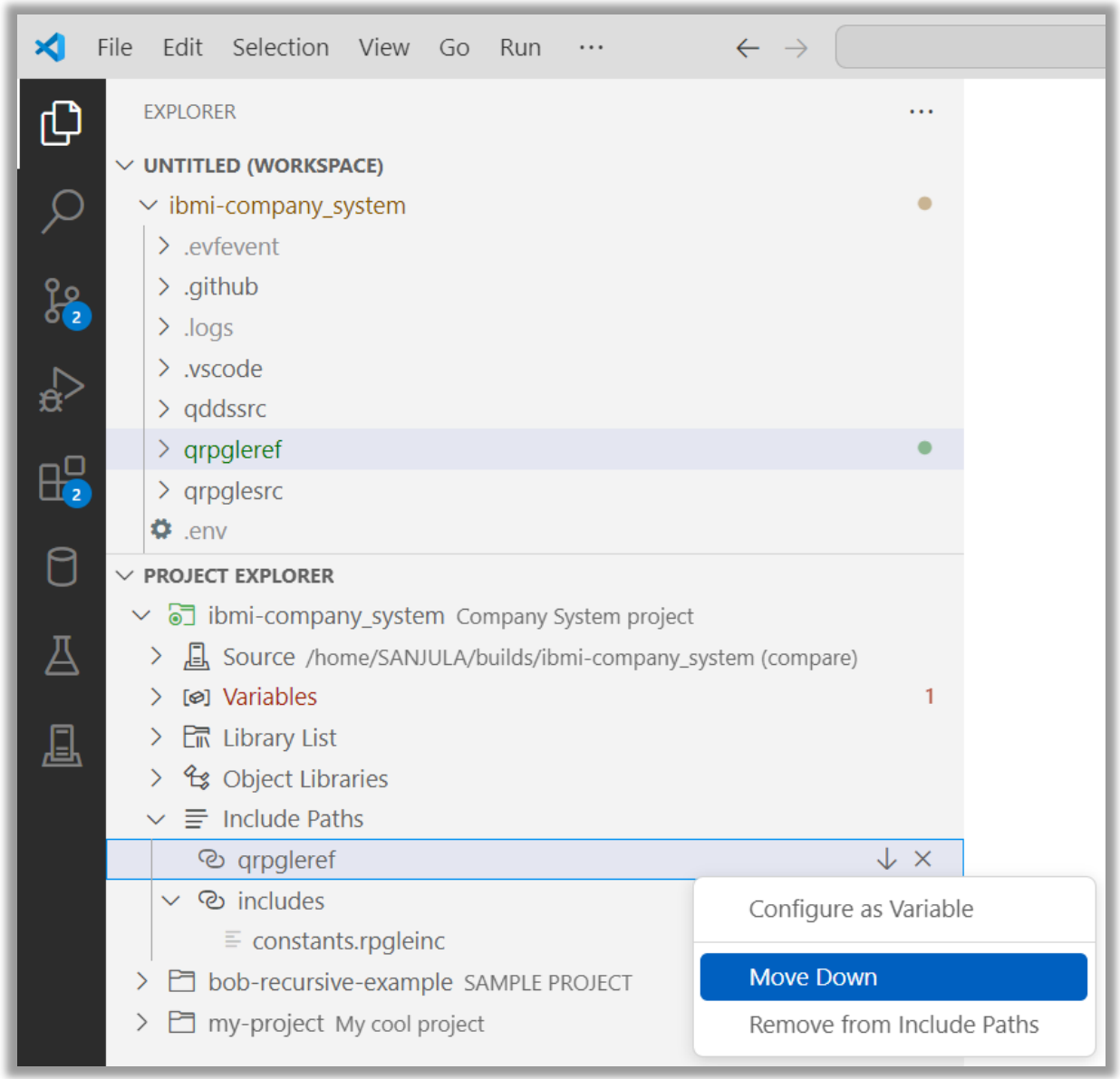
- The place for developers to easily see, debug, and manipulate the results of your build
- Another place to manage libraries in iproj.json (*curlib*, *objlib*, *preUsrlibl*, *postUsrlibl*)
- Manage libraries, objects, and members



Manage Include Paths

- Self-contained projects should know where to find includes within the project
- Add, remove, and reorder include paths
- Visualize if includes resolve locally or to remote IFS



Build and Compile

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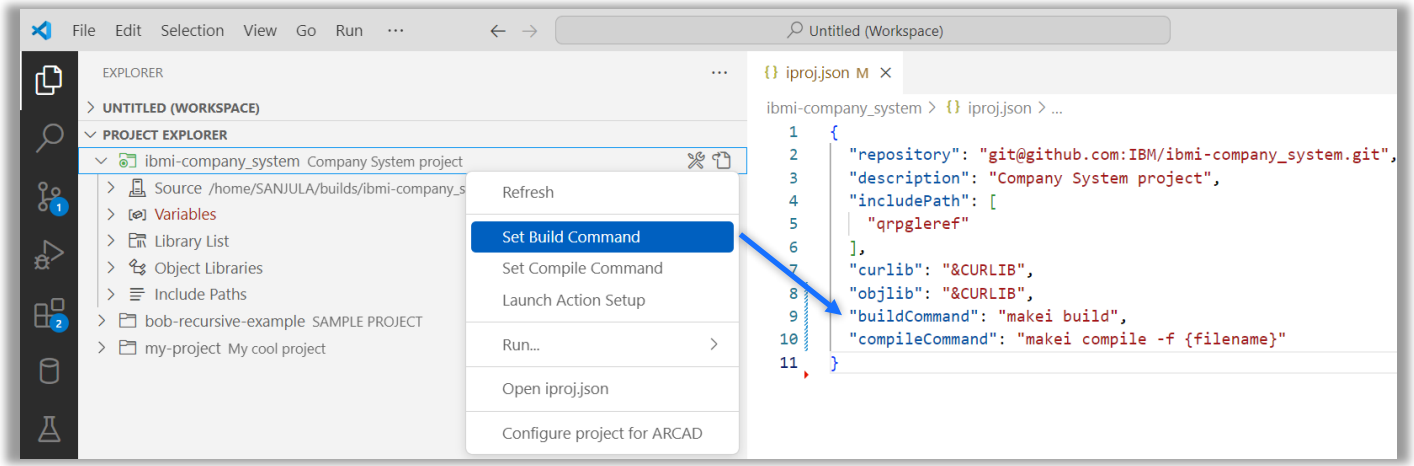
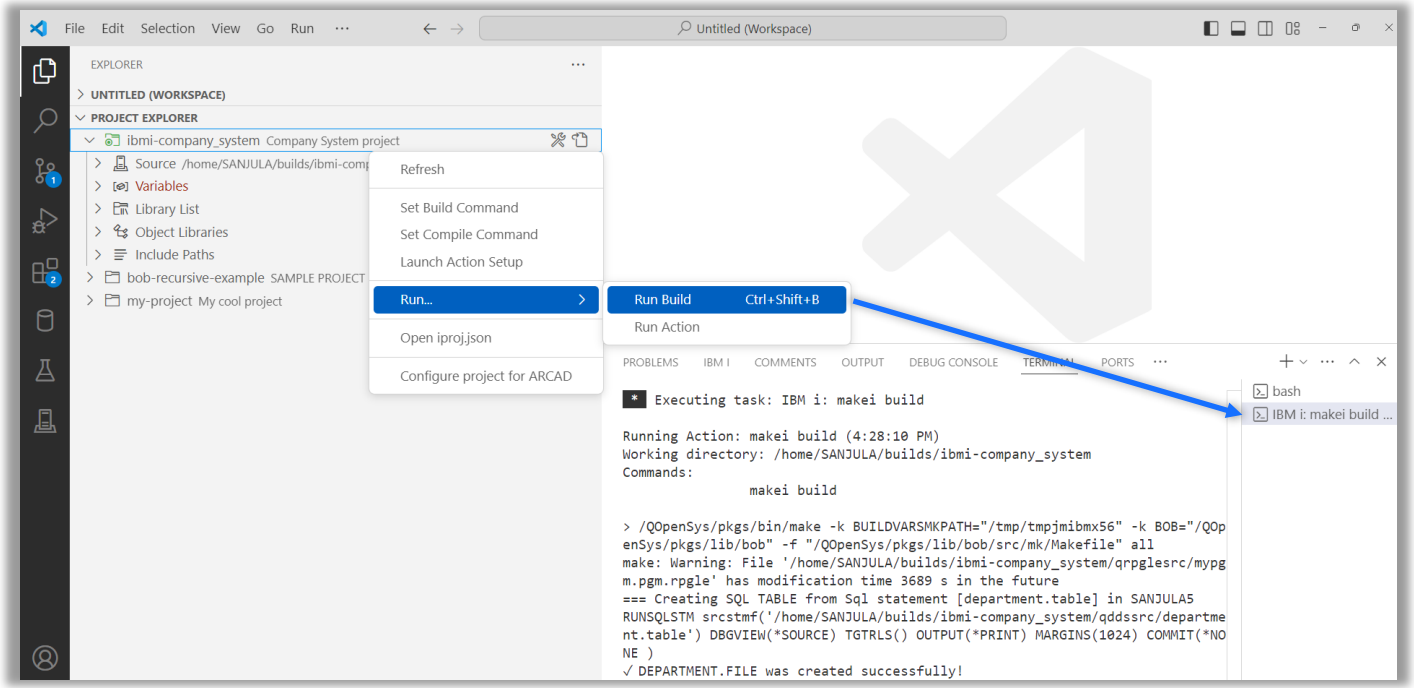
1. Deploy
↓
2. Run build or compile command (any build framework)
↓
3. Download logs and evfevent files



- Building
  - Set build command
  - Run Build (*Ctrl+Shift+b* or *Cmd+Shift+b*)

- Compiling
  - Set compile command
  - Run compile (*Ctrl+Shift+c* or *Cmd+Shift+c*)
    - On active editor
    - On file or directory in File Explorer
    - On file or directory in Source



Run Actions

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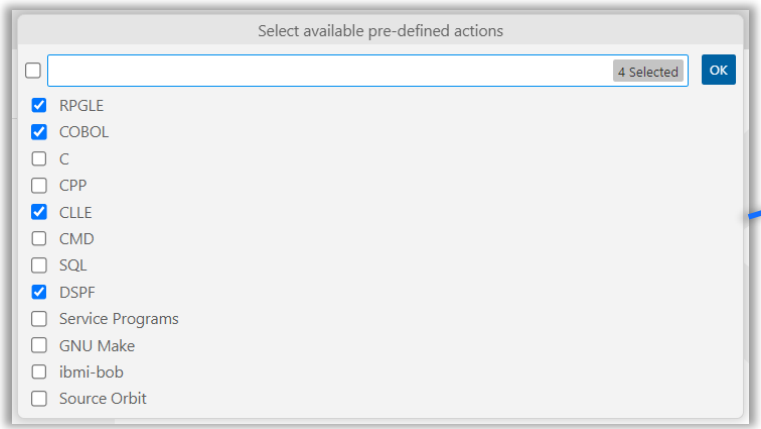
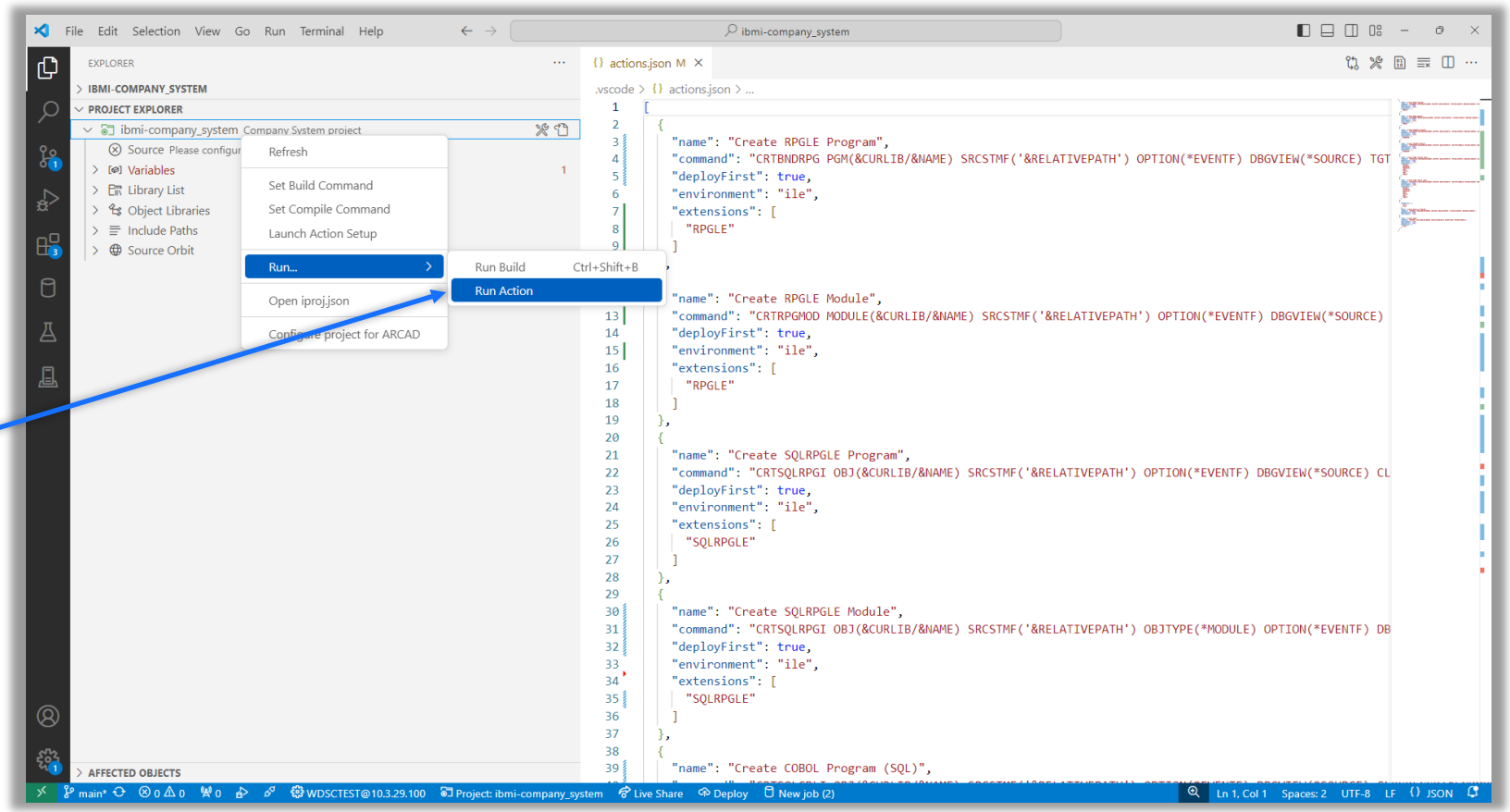
IBM i Project Explorer also supports running Code for IBM i's custom workspace actions





View Diagnostics

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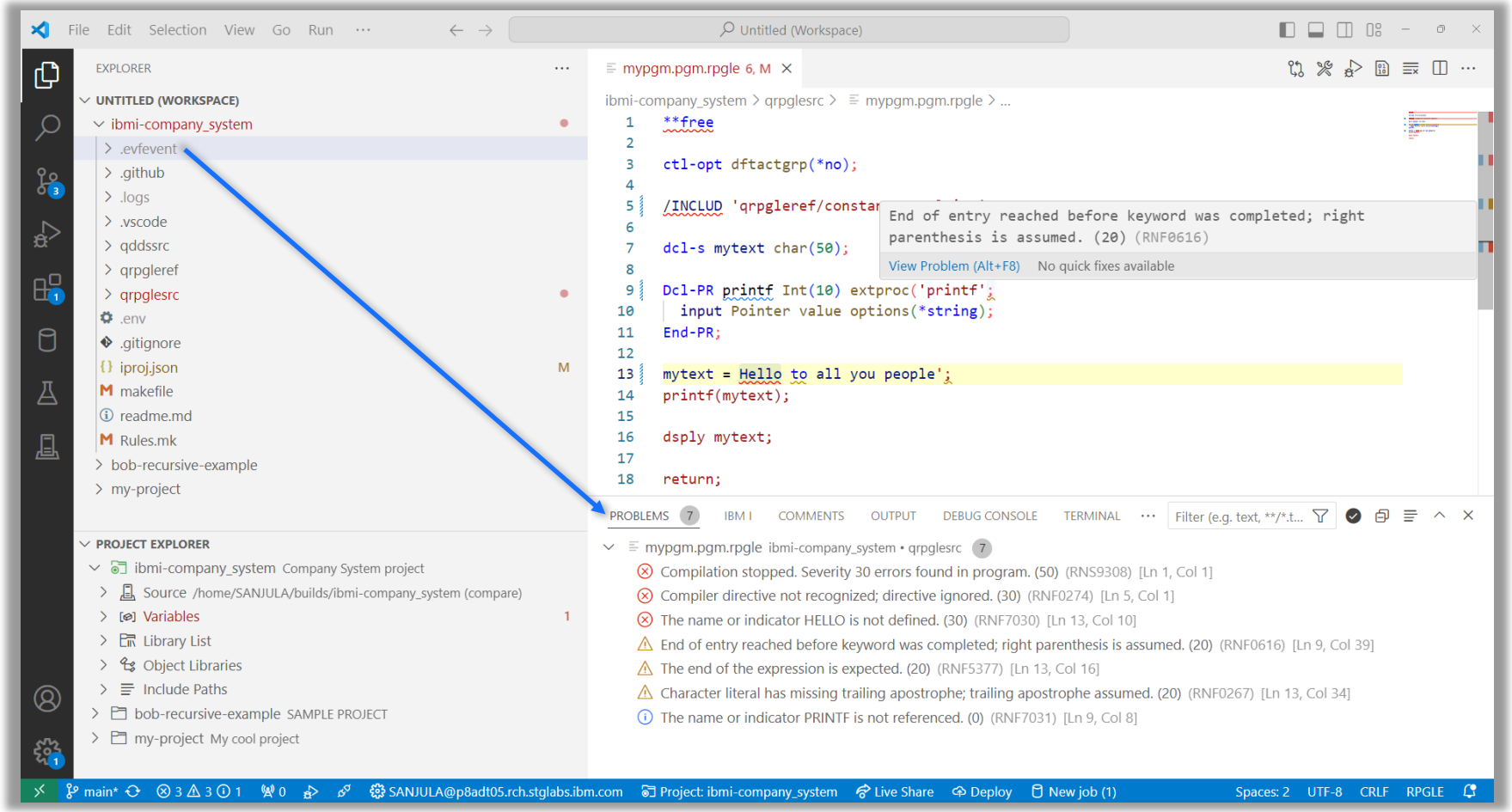
- Visualize build or compile diagnostics in the Problems view
- Evfevent file diagnostics are dumped in a .evfevent directory after a build or compile
- Diagnostics are also rendered inline in the source file



View Job Logs

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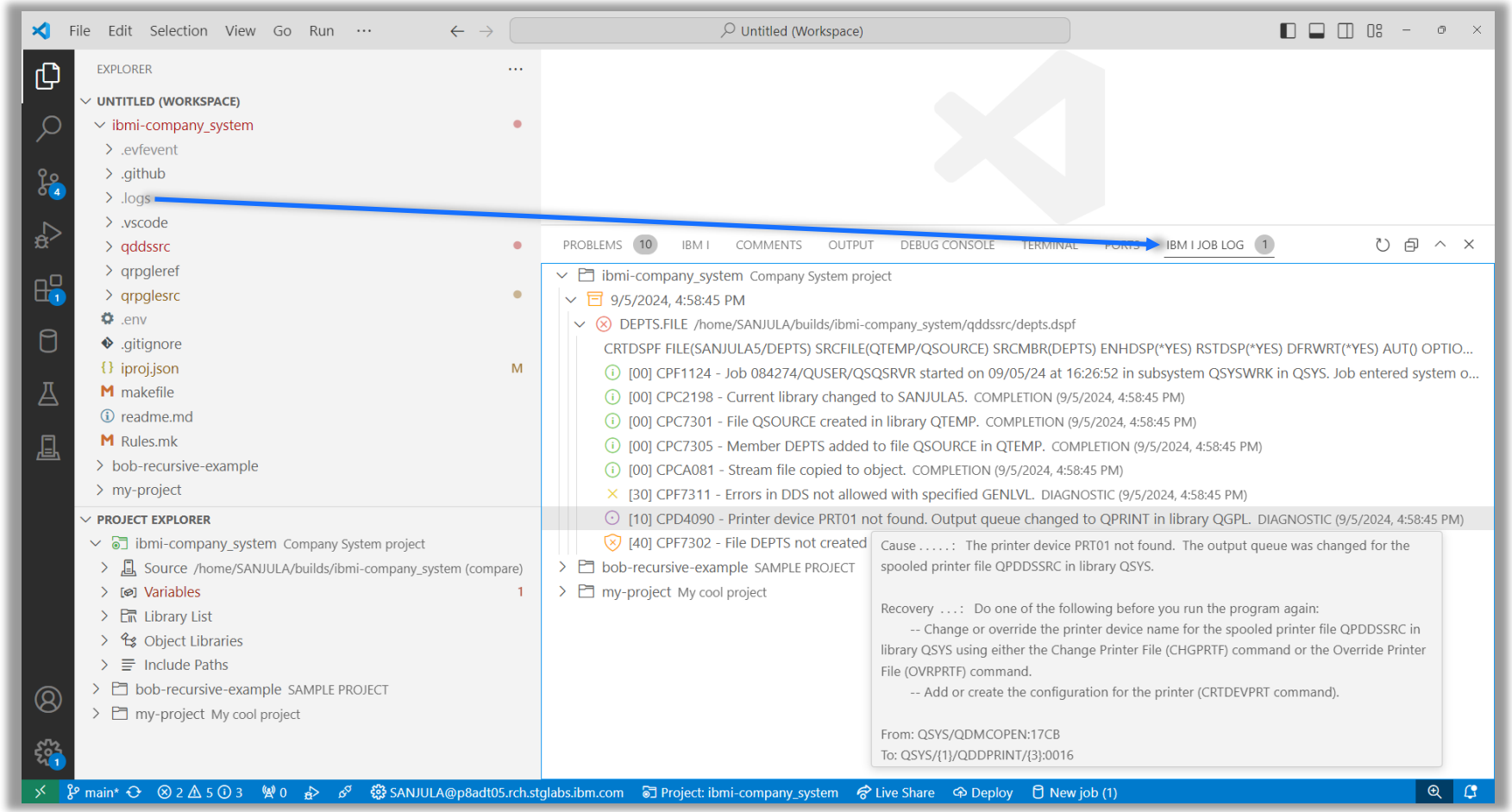
- Visualize and manage anything that could be seen in an IBM i job log including second level help
- Job log and spool files are dumped in .logs directory after a build or compile
- Track up to 10 of the previous logs in memory
- Organized by the ILE objects being built
- Filter by failed objects or severity



Integration

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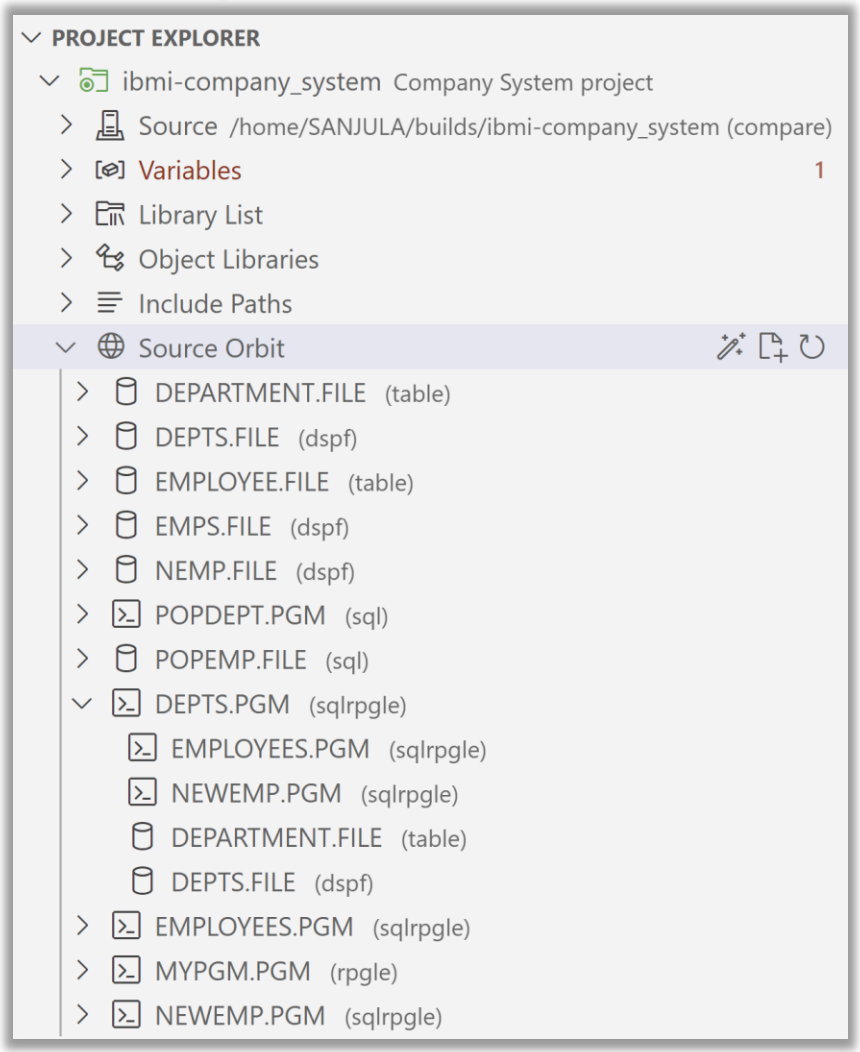
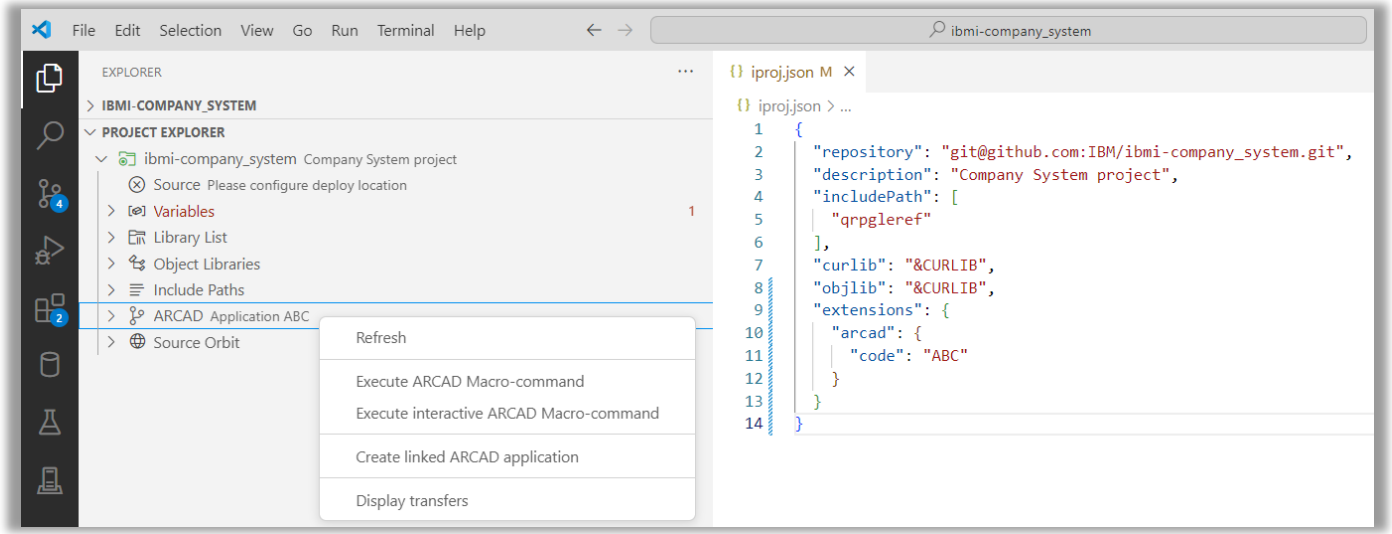
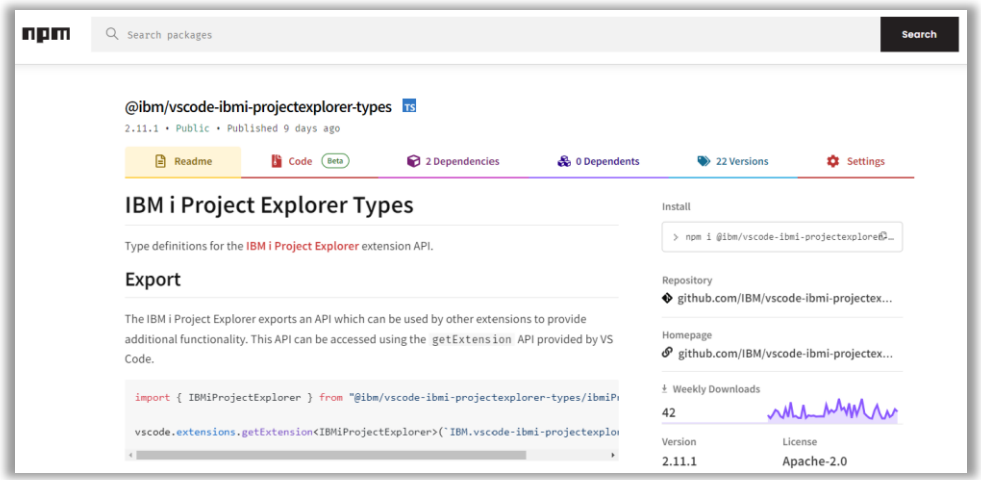
Source Orbit



ARCAD-Elias



What can you integrate with IBM i Project Explorer's API?



Any Questions?

Important Links

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IBM i Project Explorer

- VS Code Marketplace https://marketplace.visualstudio.com/items?itemName=IBM.vscode-ibmi-projectexplorer
- Documentation https://ibm.github.io/vscode-ibmi-projectexplorer/#/
- GitHub Repository https://github.com/IBM/vscode-ibmi-projectexplorer
- API https://www.npmjs.com/package/@ibm/vscode-ibmi-projectexplorer-types

Bob

- Documentation https://ibm.github.io/ibmi-bob/#/
- GitHub Repository https://github.com/IBM/ibmi-bob

Code for IBM i

- VS Code Marketplace https://marketplace.visualstudio.com/items?itemName=HalcyonTechLtd.code-for-ibmi
- Documentation https://codefori.github.io/docs/#/
- GitHub Repository https://github.com/codefori/vscode-ibmi
- API https://www.npmjs.com/package/@halcyontech/vscode-ibmi-types

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