

系統程式 期末 Demo



資管三 110213018 陳宣閔

SIC two-pass 程式基本功能

1. pass-one 可以將合乎正確語法的原始程式 (Source Program) 輸出成中間檔；也可以同時偵測出多個錯誤，並輸出行號和錯誤訊息。
2. pass-two 讀取中間檔並組譯成目的程式 (Object Program) 。

正常- 中間檔

```
7 1000 COPY START 1000 *** direct
8 1000 FIRST STL RETADR 14 direct
9 1003 CLOOP JSUB RDREC 48 direct
10 1006 *** LDA LENGTH 00 direct
11 1009 *** COMP ZERO 28 direct
12 100c *** JEQ ENDFIL 30 direct
13 100f *** JSUB WRREC 48 direct
14 1012 *** J CLOOP 3C direct
15 1015 ENDFIL LDA EOF 00 direct
16 1018 *** STA BUFFER 0C direct
17 101b *** LDA THREE 00 direct
18 101e *** STA LENGTH 0C direct
19 1021 *** JSUB WRREC 48 direct
20 1024 *** LDL RETADR 08 direct
21 1027 *** RSUB *** 4C direct
22 102a EOF BYTE C'EOF' *** direct
23 102d THREE WORD 3 *** direct
24 1030 ZERO WORD 0 *** direct
25 1033 RETADR RESW 1 *** direct
26 1036 LENGTH RESW 1 *** direct
```

```
27 1039 BUFFER RESB 4096 *** direct
31 2039 RDREC LDX ZERO 04 direct
32 203c *** LDA ZERO 00 direct
33 203f RLOOP TD INPUT E0 direct
34 2042 *** JEQ RLOOP 30 direct
35 2045 *** RD INPUT D8 direct
36 2048 *** COMP ZERO 28 direct
37 204b *** JEQ EXIT 30 direct
38 204e *** STCH BUFFER,X 54 indexed
39 2051 *** TIX MAXLEN 2C direct
40 2054 *** JLT RLOOP 38 direct
41 2057 EXIT STX LENGTH 10 direct
42 205a *** RSUB *** 4C direct
43 205d INPUT BYTE X'F1' *** direct
44 205e MAXLEN WORD 4096 *** direct
49 2061 WRREC LDX ZERO 04 direct
50 2064 WLOOP TD OUTPUT E0 direct
51 2067 *** JEQ WLOOP 30 direct
52 206a *** LDCH BUFFER,X 50 indexed
53 206d *** WD OUTPUT DC direct
```

num

loc

label

mnemonic

operand


opcode


addressing

```
54 2070 *** TIX LENGTH 2C direct
55 2073 *** JLT WLOOP 38 direct
56 2076 TEST RSUB *** 4C direct
57 2079 OUTPUT BYTE X'05' *** direct
58 207a *** END FIRST *** direct
```

正常- object table

SIC_passTwo.py X

 SIC_passOne.py

 SIC_twoPass.py

 passTwo_output.txt X

 SIC_test.txt

passTwo_output.txt

```
1  H·COPY· · 001000·00107a
2  T·001000·1e·141033·482039·001036·281030·301015·482061·3C1003·00102A·0C1039·00102D
3  T·00101e·15·0C1036·482061·081033·4C0000·454F46·000003·000000
4  T·002039·1e·041030·001030·E0205D·30203F·D8205D·281030·302057·549039·2C205E·38203F
5  T·002057·1c·101036·4C0000·F1·001000·041030·E02079·302064·509039·DC2079·2C1036
6  T·002073·07·382064·4C0000·05
7  E·001000
```

同時多個錯誤訊息

```
SIC_test.txt
31  RDREC · LDX · ZERO ······ .. subroutine
32  LDA · ZERO
33  RLOOP · TD · INPUT
34  RLOOP · TD · INPUT
35  JEQ · RLOOP
36  RD · INPUT
37  COMP · ZERO
38  JEQ · EXIT
39  STCH · BUFFER, ·, ··, X
40  TIX · MAXLEN
41  JLT · RLOOP
42  EXIT · STX · LENGTH
43  RSUB
44  INPUT · BYTE · X'F1GGG'
45  MAXLEN · WORD · hi
46  .
```

PROBLEMS OUTPUT TERMINAL ... powershell

- PS C:\documents\系統程式> python SIC_twoPass.py
索引定址格式錯誤 in line : 39
BYTE 的 X 型態內容要為偶數長度(F1GGG) in line : 44
BYTE 的 X 型態裡只能為16進位數字 in line : 44
WORD 只能接10進位數字 in line :45
重複的symbol(RLOOP) in line : 34
- PS C:\documents\系統程式> █

以下是正確的 Case

1. RSUB 可以有 Label
2. 程式碼可以改起始位置
3. 索引定址前後可以空白
 - Ex : LDA BUFFER , X
4. BYTE型態與內容之間可以空白
5. BYTE C 型態，內容可以有空白
6. 程式名需補空白到6碼

RSUB 可以有 Label

```
Windows PowerShell
39 2051 *** TIX MAXLEN 2C direct
40 2054 *** JLT RLOOP 38 direct
41 2057 EXIT STX LENGTH 10 direct
42 205a *** RSUB *** 4C direct
43 205d INPUT BYTE X'F1' 4C direct
44 205e MAXLEN WORD 4096 *** direct
49 2061 WRREC LDX ZERO 04 direct
50 2064 WLOOP TD OUTPUT E0 direct
51 2067 *** JEQ WLOOP 30 direct
52 206a *** LDCH BUFFER,X 50 indexed
53 206d *** WD OUTPUT DC direct
54 2070 *** TIX LENGTH 2C direct
55 2073 *** JLT WLOOP 38 direct
56 2076 TEST RSUB *** 4C direct
57 2079 OUTPUT BYTE X'05' 4C direct
58 207a *** END FIRST *** direct
----
pass two :
H COPY 001000 00107a
T 001000 1e 141033 482039 001036 281030 301015 482061 3C1003 00102A 0C1039 00102D
T 00101e 15 0C1036 482061 081033 4C0000 454F46 000003 000000
T 002039 1e 041030 001030 E0205D 30203F D8205D 281030 302057 549039 2C205E 38203F
T 002057 1c 101036 4C0000 F1 001000 041030 E02079 302064 509039 DC2079 2C1036
T 002073 07 382064 4C0000 05
E 001000
PS C:\documents\系統程式>
```

```
系統程式
passTwo_output.txt
SIC_test.txt
SIC_test.txt
45 .
46 .
47 .
48
49 WRREC LDX ZERO → . . . subrouti
50 WLOOP TD OUTPUT
51 JEQ WLOOP
52 LDCH BUFFER, X
53 WD OUTPUT
54 TIX LENGTH
55 JLT WLOOP
56 TEST RSUB
57 OUTPUT BYTE X'05'
58 END FIRST
59
60 . . . end of this program
```

程式碼可以改起始位置

```
Windows PowerShell
27 4039 BUFFER RESB 4096 *** direct
31 5039 RDREC LDX ZERO 04 direct
32 503c *** LDA ZERO 00 direct
33 503f RLOOP TD INPUT E0 direct
34 5042 *** JEQ RLOOP 30 direct
35 5045 *** RD INPUT D8 direct
36 5048 *** COMP ZERO 28 direct
37 504b *** JEQ EXIT 30 direct
38 504e *** STCH BUFFER,X 54 indexed
39 5051 *** TIX MAXLEN 2C direct
40 5054 *** JLT RLOOP 38 direct
41 5057 EXIT STX LENGTH 10 direct
42 505a *** RSUB *** 4C direct
43 505d INPUT BYTE X'F1' 4C direct
44 505e MAXLEN WORD 4096 *** direct
49 5061 WRREC LDX ZERO 04 direct
50 5064 WLOOP TD OUTPUT E0 direct
51 5067 *** JEQ WLOOP 30 direct
52 506a *** LDCH BUFFER,X 50 indexed
53 506d *** WD OUTPUT DC direct
54 5070 *** TIX LENGTH 2C direct
55 5073 *** JLT WLOOP 38 direct
56 5076 TEST RSUB *** 4C direct
57 5079 OUTPUT BYTE X'05' 4C direct
58 507a *** END FIRST *** direct
----
pass two :
H COPY 004000 00107a
T 004000 1e 144033 485039 004036 284030 304015 485061 3C4003 00402A 0C4039 00402D
T 00401e 15 0C4036 485061 084033 4C0000 454F46 000003 000000
T 005039 1e 044030 004030 E0505D 30503F D8505D 284030 305057 54C039 2C505E 38503F
T 005057 1c 104036 4C0000 F1 001000 044030 E05079 305064 50C039 DC5079 2C4036
T 005073 07 385064 4C0000 05
E 004000
PS C:\documents\系統程式>
```

```
Windows PowerShell
PS C:\documents\系統程式> python SIC_twoPa
pass one :
7 4000 COPY START 4000 *** direct
8 4000 FIRST STL RETADR 14 direct
9 4003 CLOOP JSUB RDREC 48 direct
10 4006 *** LDA LENGTH 00 direct
11 4009 *** COMP ZERO 28 direct
12 400c *** JEQ ENDFIL 30 direct
13 400f *** JSUB WRREC 48 direct
14 4012 *** J CLOOP 3C direct
15 4015 ENDFIL LDA EOF 00 direct
16 4018 *** STA BUFFER 0C direct
17 401b *** LDA THREE 00 direct
```

```
SIC_test.txt
1 . comment
2 |.. indexed addressing
3 .. free format coding
4 . empty line detection
5 |.. comand line user filenames
6
7 COPY START 4000 . program star
8 FIRST STL RETADR
9 CLOOP JSUB RDREC
10 LDA LENGTH
11 COMP ZERO
12 JEQ ENDFIL
13 JSUB WRREC
14 J CLOOP
15 ENDFIL LDA EOF
16 STA BUFFER
17 LDA THREE
18 STA LENGTH
19 JSUB WRREC
20 LDL RETADR
21 | RSUB
22 EOF BYTE C'EOF'
23 THREE WORD 3
24 ZERO WORD 0
25 RETADR RESW 1
```


索引定址前後可以空白

```
Windows PowerShell

37 204b *** JEQ EXIT 30 direct
38 204e *** STCH BUFFER,X 54 indexed
39 2051 *** TIX MAXLEN 2C direct
40 2054 *** JLT RLOOP 38 direct
41 2057 EXIT STX LENGTH 10 direct
42 205a *** RSUB *** 4C direct
43 205d INPUT BYTE X'F1' 4C direct
44 205e MAXLEN WORD 4096 *** direct
49 2061 WRREC LDX ZERO 04 direct
50 2064 WLOOP TD OUTPUT E0 direct
51 2067 *** JEQ WLOOP 30 direct
52 206a *** LDCH BUFFER,X 50 indexed
53 206d *** WD OUTPUT DC direct
54 2070 *** TIX LENGTH 2C direct
55 2073 *** JLT WLOOP 38 direct
56 2076 TEST RSUB *** 4C direct
57 2079 OUTPUT BYTE X'05' 4C direct
58 207a *** END FIRST *** direct
----
pass two :
H COPY 001000 00107a
T 001000 1e 141033 482039 001036 281030 301015 482061 3C1003 00102A 0C1039 00102D
T 00101e 15 0C1036 482061 081033 4C0000 454F46 000003 000000
T 002039 1e 041030 001030 E0205D 30203F D8205D 281030 302057 549039 2C205E 38203F
T 002057 1c 101036 4C0000 F1 001000 041030 E02079 302064 509039 DC2079 2C1036
T 002073 07 382064 4C0000 05
E 001000
PS C:\documents\系統程式>
PS C:\documents\系統程式>
PS C:\documents\系統程式>
PS C:\documents\系統程式>
```

```
passTwo_output.txt SIC_test.txt
SIC_test.txt
40 JLT RLOOP
41 EXIT STX LENGTH
42 RSUB
43 INPUT BYTE X'F1'
44 MAXLEN WORD 4096
45 .
46 .
47 .
48
49 WRREC LDX ZERO → . . . subrouti
50 WLOOP TD OUTPUT
51 JEQ WLOOP
52 LDCH BUFFER . , X
53 WD OUTPUT
54 TIX LENGTH
55 JLT WLOOP
56 TEST RSUB
57 OUTPUT BYTE X'05'
58 END FIRST
59
60 . . . end of this program
```

BYTE 型態與內容之間可以空白

```
Windows PowerShell
31 2039 RDREC LDX ZERO 04 direct
32 203c *** LDA ZERO 00 direct
33 203f RLOOP TD INPUT E0 direct
34 2042 *** JEQ RLOOP 30 direct
35 2045 *** RD INPUT D8 direct
36 2048 *** COMP ZERO 28 direct
37 204b *** JEQ EXIT 30 direct
38 204e *** STCH BUFFER,X 54 indexed
39 2051 *** TIX MAXLEN 2C direct
40 2054 *** JLT RLOOP 38 direct
41 2057 EXIT STX LENGTH 10 direct
42 205a *** RSUB *** 4C direct
43 205d INPUT BYTE X'F1' 4C direct
44 205e A BYTE C'EOF' 4C direct
45 2061 MAXLEN WORD 4096 *** direct
50 2064 WRREC LDX ZERO 04 direct
51 2067 WLOOP TD OUTPUT E0 direct
52 206a *** JEQ WLOOP 30 direct
53 206d *** LDCH BUFFER,X 50 indexed
54 2070 *** WD OUTPUT DC direct
55 2073 *** TIX LENGTH 2C direct
56 2076 *** JLT WLOOP 38 direct
57 2079 TEST RSUB *** 4C direct
58 207c OUTPUT BYTE X'05' 4C direct
59 207d *** END FIRST *** direct
----
pass two :
H COPY 001000 00107d
T 001000 1e 141033 482039 001036 281030 301015 482064 3C1003 00102A 0C1039 00102D
T 00101e 15 0C1036 482064 081033 4C0000 454F46 000003 000000
T 002039 1e 041030 001030 E0205D 30203F D8205D 281030 302057 549039 2C2061 38203F
T 002057 1c 101036 4C0000 F1 454F46 001000 041030 E0207C 302067 509039 DC207C
T 002073 0a 2C1036 382067 4C0000 05
E 001000
PS C:\documents\系統程式>
```

```
SIC_test.txt
32 LDA ZERO
33 RLOOP TD INPUT
34 JEQ RLOOP
35 RD INPUT
36 COMP ZERO
37 JEQ EXIT
38 STCH BUFFER ,X
39 TIX MAXLEN
40 JLT RLOOP
41 EXIT STX LENGTH
42 RSUB
43 INPUT BYTE X 'F1'
44 A BYTE C 'EOF'
45 MAXLEN WORD 4096
46 .
47 .
48 .
49
50 WRREC LDX ZERO → . . . subrouti
51 WLOOP TD OUTPUT
52 JEQ WLOOP
53 LDCH BUFFER, X
54 WD OUTPUT
55 TIX LENGTH
56 JLT WLOOP
```

BYTE C 型態，內容可以有空白

```
Windows PowerShell
28 103d BUFFER RESB 4096 *** direct
32 203d RDREC LDX ZERO 04 direct
33 2040 *** LDA ZERO 00 direct
34 2043 RLOOP TD INPUT E0 direct
35 2046 *** JEQ RLOOP 30 direct
36 2049 *** RD INPUT D8 direct
37 204c *** COMP ZERO 28 direct
38 204f *** JEQ EXIT 30 direct
39 2052 *** STCH BUFFER,X 54 indexed
40 2055 *** TIX MAXLEN 2C direct
41 2058 *** JLT RLOOP 38 direct
42 205b EXIT STX LENGTH 10 direct
43 205e *** RSUB *** 4C direct
44 2061 INPUT BYTE X'F1' 4C direct
45 2062 MAXLEN WORD 4096 *** direct
50 2065 WRREC LDX ZERO 04 direct
51 2068 WLOOP TD OUTPUT E0 direct
52 206b *** JEQ WLOOP 30 direct
53 206e *** LDCH BUFFER,X 50 indexed
54 2071 *** WD OUTPUT DC direct
55 2074 *** TIX LENGTH 2C direct
56 2077 *** JLT WLOOP 38 direct
57 207a TEST RSUB *** 4C direct
58 207d OUTPUT BYTE X'05' 4C direct
59 207e *** END FIRST *** direct
----
pass two :
H COPY 001000 00107e
T 001000 1e 141037 48203D 00103A 281034 301015 482065 3C1003 00102A 0C103D 001031
T 00101e 19 0C103A 482065 081037 4C0000 454F46 454F2046 000003 000000
T 00203d 1e 041034 001034 E02061 302043 D82061 281034 30205B 54903D 2C2062 382043
T 00205b 1c 10103A 4C0000 F1 001000 041034 E0207D 302068 50903D DC207D 2C103A
T 002077 07 382068 4C0000 05
E 001000
PS C:\documents\系統程式>
```

```
系統程式
passTwo_output.txt
SIC_test.txt
SIC_test.txt
11 COMP ZERO
12 JEQ ENDFIL
13 JSUB WRREC
14 J CLOOP
15 ENDFIL LDA EOF
16 STA BUFFER
17 LDA THREE
18 STA LENGTH
19 JSUB WRREC
20 LDL RETADR
21 RSUB
22 EOF BYTE C'EOF'
23 A BYTE C'EO F'
24 THREE WORD 3
25 ZERO WORD 0
26 RETADR RESW 1
27 LENGTH RESW 1
28 BUFFER RESB 4096
29 .
30 .
31 .
32 RDREC LDX ZERO .....subroutin
33 LDA ZERO
34 RLOOP TD INPUT
35 JEQ RLOOP
```


程式名必須補空白到6碼

```
Windows PowerShell

38 204e *** STCH BUFFER,X 54 indexed
39 2051 *** TIX MAXLEN 2C direct
40 2054 *** JLT RLOOP 38 direct
41 2057 EXIT STX LENGTH 10 direct
42 205a *** RSUB *** 4C direct
43 205d INPUT BYTE X'F1' 4C direct
44 205e MAXLEN WORD 4096 *** direct
49 2061 WRREC LDX ZERO 04 direct
50 2064 WLOOP TD OUTPUT E0 direct
51 2067 *** JEQ WLOOP 30 direct
52 206a *** LDCH BUFFER,X 50 indexed
53 206d *** WD OUTPUT DC direct
54 2070 *** TIX LENGTH 2C direct
55 2073 *** JLT WLOOP 38 direct
56 2076 TEST RSUB *** 4C direct
57 2079 OUTPUT BYTE X'05' 4C direct
58 207a *** END FIRST *** direct
----
pass two :
H COPY 001000 00107a
T 001000 1e 141033 482039 001036 281030 301015 482061 3C1003 00102A 0C1039 00102D
T 00101e 15 0C1036 482061 081033 4C0000 454F46 000003 000000
T 002039 1e 041030 001030 E0205D 30203F D8205D 281030 302057 549039 2C205E 38203F
T 002057 1c 101036 4C0000 F1 001000 041030 E02079 302064 509039 DC2079 2C1036
T 002073 07 382064 4C0000 05
E 001000
PS C:\documents\系統程式>
PS C:\documents\系統程式>
PS C:\documents\系統程式>
PS C:\documents\系統程式>
PS C:\documents\系統程式>
```

```
系統程式
passTwo_output.txt
SIC_test.txt X
SIC_test.txt
1 . comment
2 . . indexed addressing
3 . . free format coding
4 . empty line detection
5 . . comand line user filenames
6
7 COPY START 1000 . program star
8 FIRST STL RETADR
9 CLOOP JSUB RDREC
10 LDA LENGTH
11 COMP ZERO
12 JEQ ENDFIL
13 JSUB WRREC
14 J CLOOP
15 ENDFIL LDA EOF
16 STA BUFFER
17 LDA THREE
18 STA LENGTH
19 JSUB WRREC
20 LDL RETADR
21 RSUB
22 EOF BYTE C'EOF'
```

以下是錯誤的 Case

1. Opcode 錯誤

2. 索引定址類型錯誤

ex. Operand,XX 逗號後面太長

Operand,,,,,x 太多逗號

Operand,C 逗號後面只能接X

3. 無法找到 Symbol

4. 重覆定義 Symbol

5. 程式開頭要是 START

以下是錯誤的 Case

6. 程式結尾要是 END

7. 程式碼格式錯誤

8. WORD, RESW, RESB 只能搭配十進位數字

9. START 只能接十六進位數字(記憶體位置)

10. Symbol 不能與 Mnemonic 撞名

11. Symbol 不能與 Operand 撞名

12. RSUB 不能有 Operand

以下是錯誤的 Case

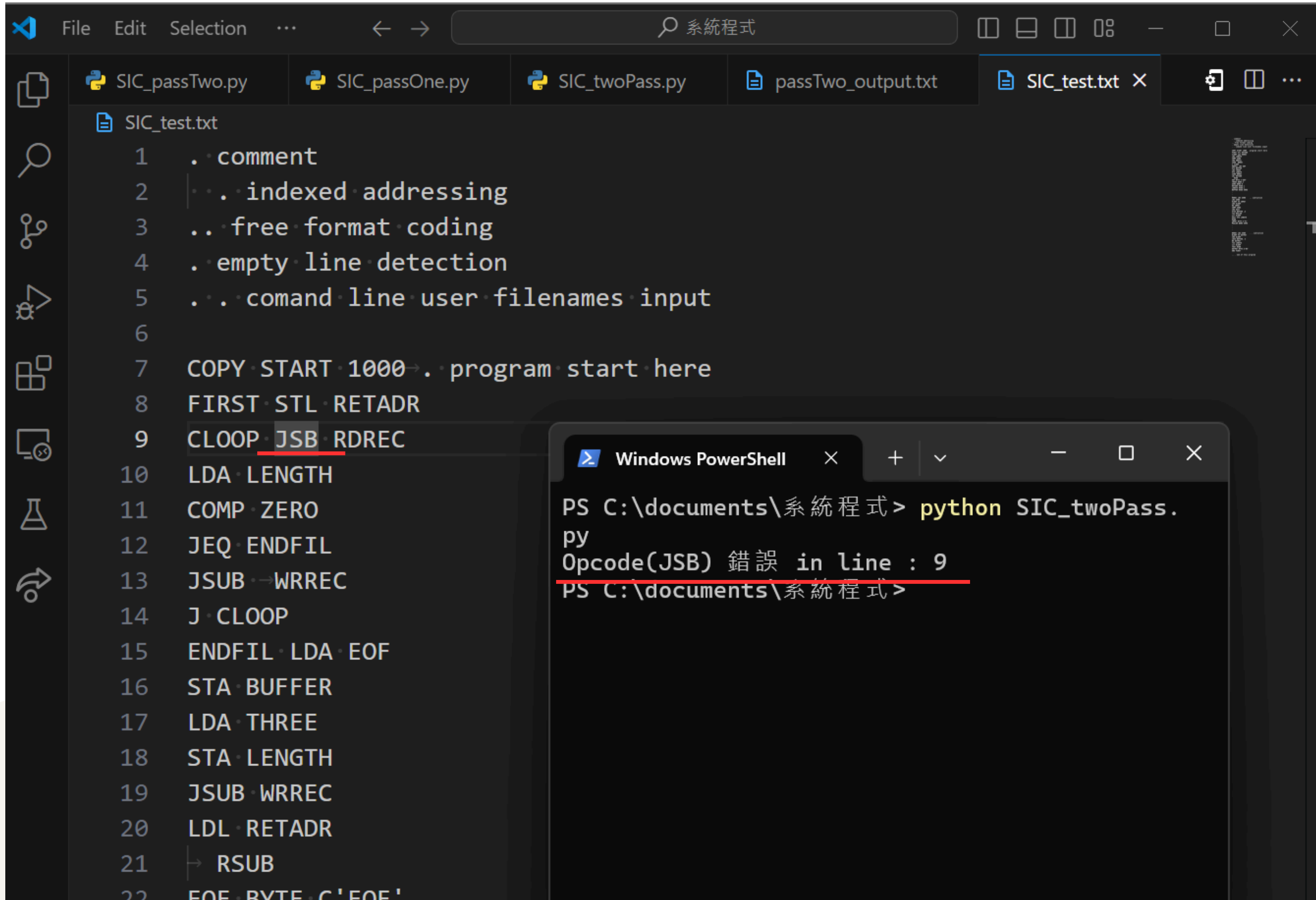
13. BYTE 格式有誤

14. BYTE型態裡面不可沒內容

15. BYTE X 內容只能是十六進位數字

16. BYTE X 內容個數只能為偶數

OPCODE 錯誤



The image shows a code editor window with several files open: SIC_passTwo.py, SIC_passOne.py, SIC_twoPass.py, passTwo_output.txt, and SIC_test.txt. The SIC_test.txt file is active, displaying assembly code. Line 9, 'CLOOP JSB RDREC', is highlighted with a red underline. A Windows PowerShell terminal window is overlaid on the code editor, showing the command 'python SIC_twoPass.py' and the resulting error message: 'Opcode(JSB) 錯誤 in line : 9'. The error message is underlined in red.

```
File Edit Selection ... ← → 系統程式
```

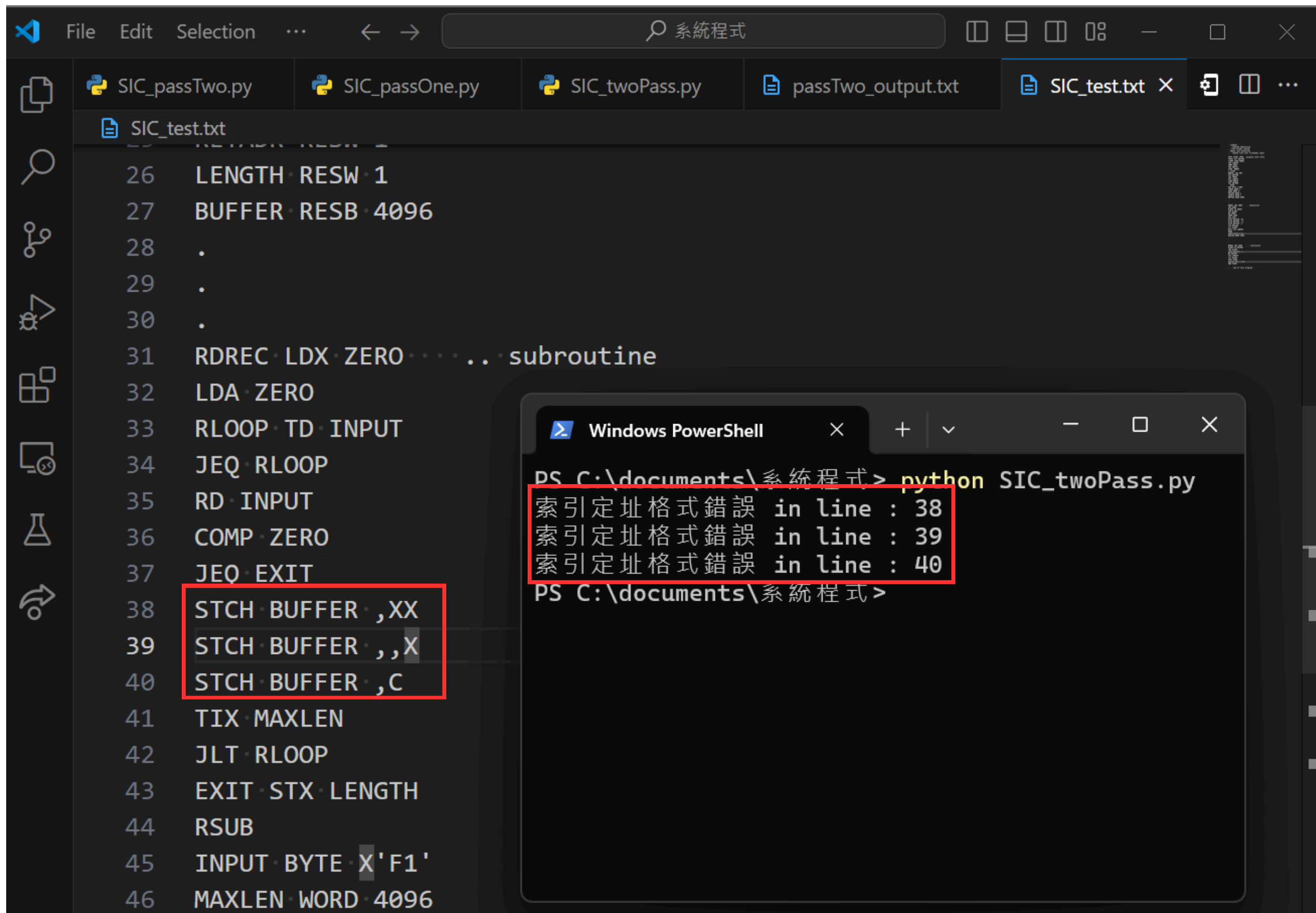
SIC_test.txt

```
1  . comment
2  | . . indexed addressing
3  .. free format coding
4  . empty line detection
5  . . comand line user filenames input
6
7  COPY START 1000 . program start here
8  FIRST STL RETADR
9  CLOOP JSB RDREC
10 LDA LENGTH
11 COMP ZERO
12 JEQ ENDFIL
13 JSUB →WRREC
14 J CLOOP
15 ENDFIL LDA EOF
16 STA BUFFER
17 LDA THREE
18 STA LENGTH
19 JSUB WRREC
20 LDL RETADR
21 → RSUB
22 EOF BYTE C'EOF'
```

Windows PowerShell

```
PS C:\documents\系統程式> python SIC_twoPass.py
Opcode(JSB) 錯誤 in line : 9
PS C:\documents\系統程式>
```

索引定址 錯誤

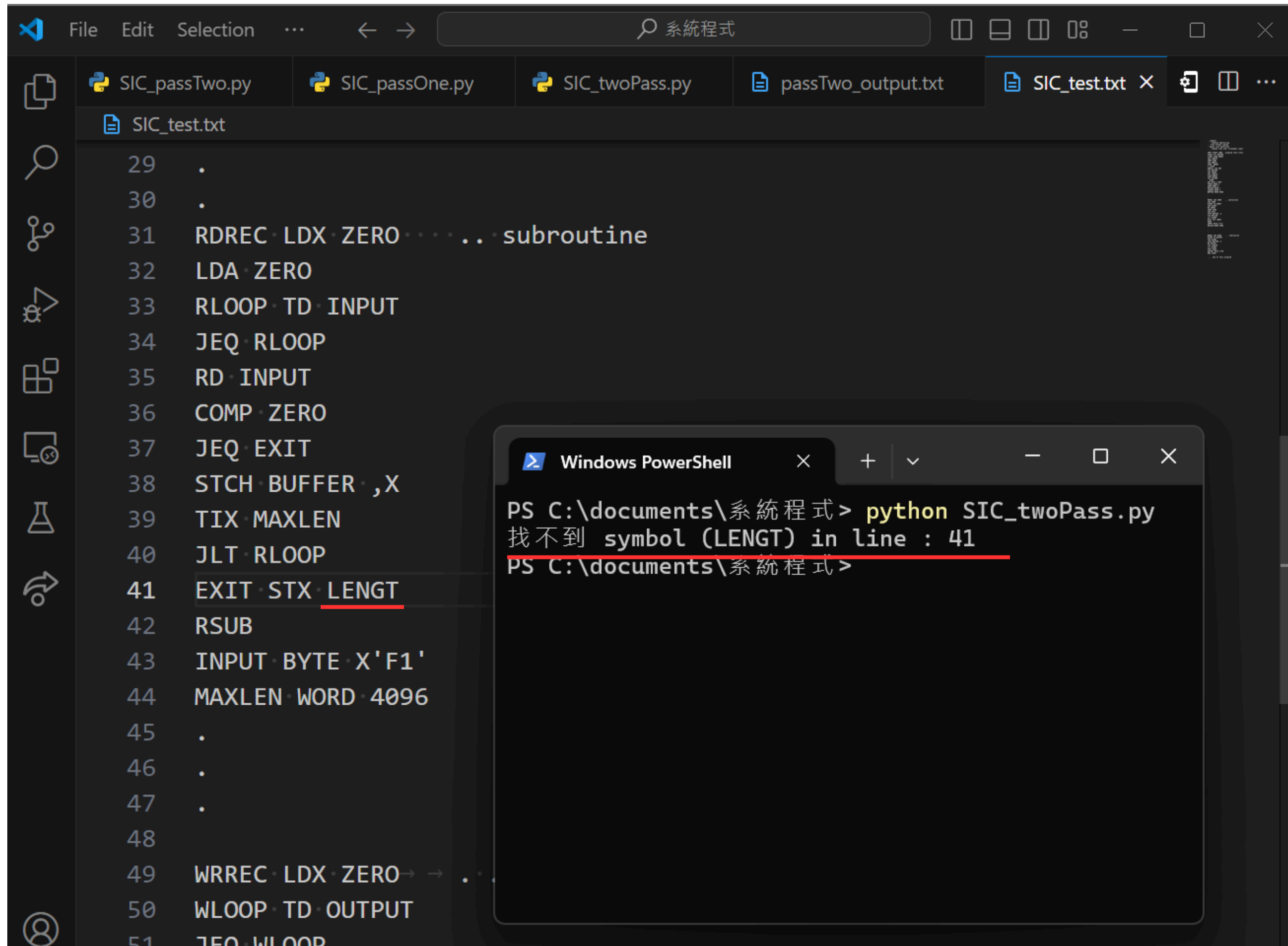


The image shows a code editor window with a dark theme. The top menu bar includes 'File', 'Edit', 'Selection', and a search bar containing '系統程式'. The tab bar shows several files: 'SIC_passTwo.py', 'SIC_passOne.py', 'SIC_twoPass.py', 'passTwo_output.txt', and 'SIC_test.txt'. The main editor area displays assembly code for 'SIC_test.txt'. Lines 26 through 46 are visible. Lines 38, 39, and 40 are highlighted with a red box. These lines contain instructions with index addressing: 'STCH BUFFER, XX', 'STCH BUFFER, ,X', and 'STCH BUFFER, C'. A Windows PowerShell window is overlaid on the editor, showing the command 'python SIC_twoPass.py' and three error messages: '索引定址格式錯誤 in line : 38', '索引定址格式錯誤 in line : 39', and '索引定址格式錯誤 in line : 40'. The PowerShell window title is 'Windows PowerShell' and the prompt is 'PS C:\documents\系統程式>'.

```
26 LENGTH RESW 1
27 BUFFER RESB 4096
28 .
29 .
30 .
31 RDREC LDX ZERO . . . . . subroutine
32 LDA ZERO
33 RLOOP TD INPUT
34 JEQ RLOOP
35 RD INPUT
36 COMP ZERO
37 JEQ EXIT
38 STCH BUFFER ,XX
39 STCH BUFFER , ,X
40 STCH BUFFER ,C
41 TIX MAXLEN
42 JLT RLOOP
43 EXIT STX LENGTH
44 RSUB
45 INPUT BYTE X'F1'
46 MAXLEN WORD 4096
```

```
PS C:\documents\系統程式> python SIC_twoPass.py
索引定址格式錯誤 in line : 38
索引定址格式錯誤 in line : 39
索引定址格式錯誤 in line : 40
PS C:\documents\系統程式>
```

無法找到 Symbol



The image shows a code editor window with several files open: SIC_passTwo.py, SIC_passOne.py, SIC_twoPass.py, passTwo_output.txt, and SIC_test.txt. The active file is SIC_test.txt, which contains assembly code. Line 41, `EXIT STX LENGT`, is highlighted with a red underline. Overlaid on the editor is a Windows PowerShell terminal window. The terminal shows the command `python SIC_twoPass.py` being executed in the directory `C:\documents\系統程式`. The output is an error message: `找不到 symbol (LENGT) in line : 41`. The terminal prompt is `PS C:\documents\系統程式>`.

```
File Edit Selection ... ← → 系統程式
```

SIC_test.txt

```
29 .
30 .
31 RDREC LDX ZERO ... .. subroutine
32 LDA ZERO
33 RLOOP TD INPUT
34 JEQ RLOOP
35 RD INPUT
36 COMP ZERO
37 JEQ EXIT
38 STCH BUFFER ,X
39 TIX MAXLEN
40 JLT RLOOP
41 EXIT STX LENGT
42 RSUB
43 INPUT BYTE X'F1'
44 MAXLEN WORD 4096
45 .
46 .
47 .
48
49 WRREC LDX ZERO → → .
50 WLOOP TD OUTPUT
51 JEQ WLOOP
```

Windows PowerShell

```
PS C:\documents\系統程式> python SIC_twoPass.py
找不到 symbol (LENGT) in line : 41
PS C:\documents\系統程式>
```


重覆定義 Symbol

The image shows a Visual Studio Code editor window with several files open: SIC_passTwo.py, SIC_passOne.py, SIC_twoPass.py, passTwo_output.txt, and SIC_test.txt. The SIC_test.txt file is active, displaying assembly-like code. Line 45, which defines MAXLEN as a word, is highlighted with a red box. A Windows PowerShell terminal window is overlaid on the editor, showing the command `python SIC_twoPass.py` and the resulting error message: `重覆的 symbol(MAXLEN) in line : 45`.

File Edit Selection ... ← → 系統程式

SIC_passTwo.py SIC_passOne.py SIC_twoPass.py passTwo_output.txt SIC_test.txt

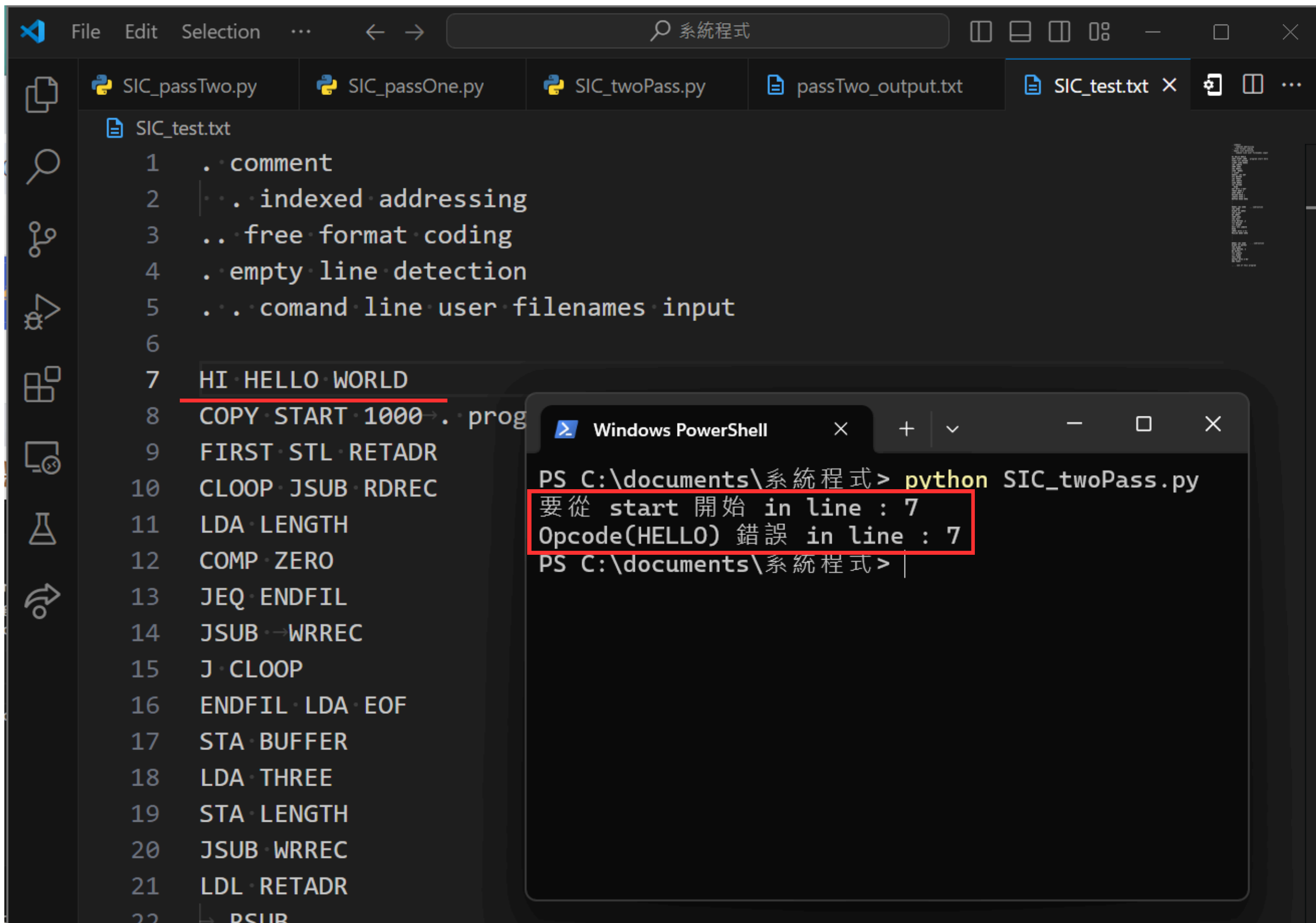
SIC_test.txt

```
32 LDA ZERO
33 RLOOP TD INPUT
34 JEQ RLOOP
35 RD INPUT
36 COMP ZERO
37 JEQ EXIT
38 STCH BUFFER, X
39 TIX MAXLEN
40 JLT RLOOP
41 EXIT STX LENGTH
42 RSUB
43 INPUT BYTE X'F1'
44 MAXLEN WORD 4096
45 MAXLEN WORD 4096
46 .
47 .
48 .
49
50 WRREC LDX ZERO → . . .
51 WLOOP TD OUTPUT
52 JEQ WLOOP
```

Windows PowerShell

```
PS C:\documents\系統程式> python SIC_twoPass.py
重覆的 symbol(MAXLEN) in line : 45
PS C:\documents\系統程式>
```

程式開頭要是START



The image shows a code editor window with several files open. The active file is `SIC_test.txt`, which contains assembly code. Line 7, `HI HELLO WORLD`, is highlighted with a red line. A Windows PowerShell terminal window is overlaid on the editor, showing the command `python SIC_twoPass.py` and its output. The output indicates an error in line 7: `要從 start 開始 in line : 7` and `Opcode(HELLO) 錯誤 in line : 7`. The error message is highlighted with a red box.

```
File Edit Selection ... < > 系統程式
```

SIC_passTwo.py SIC_passOne.py SIC_twoPass.py passTwo_output.txt SIC_test.txt

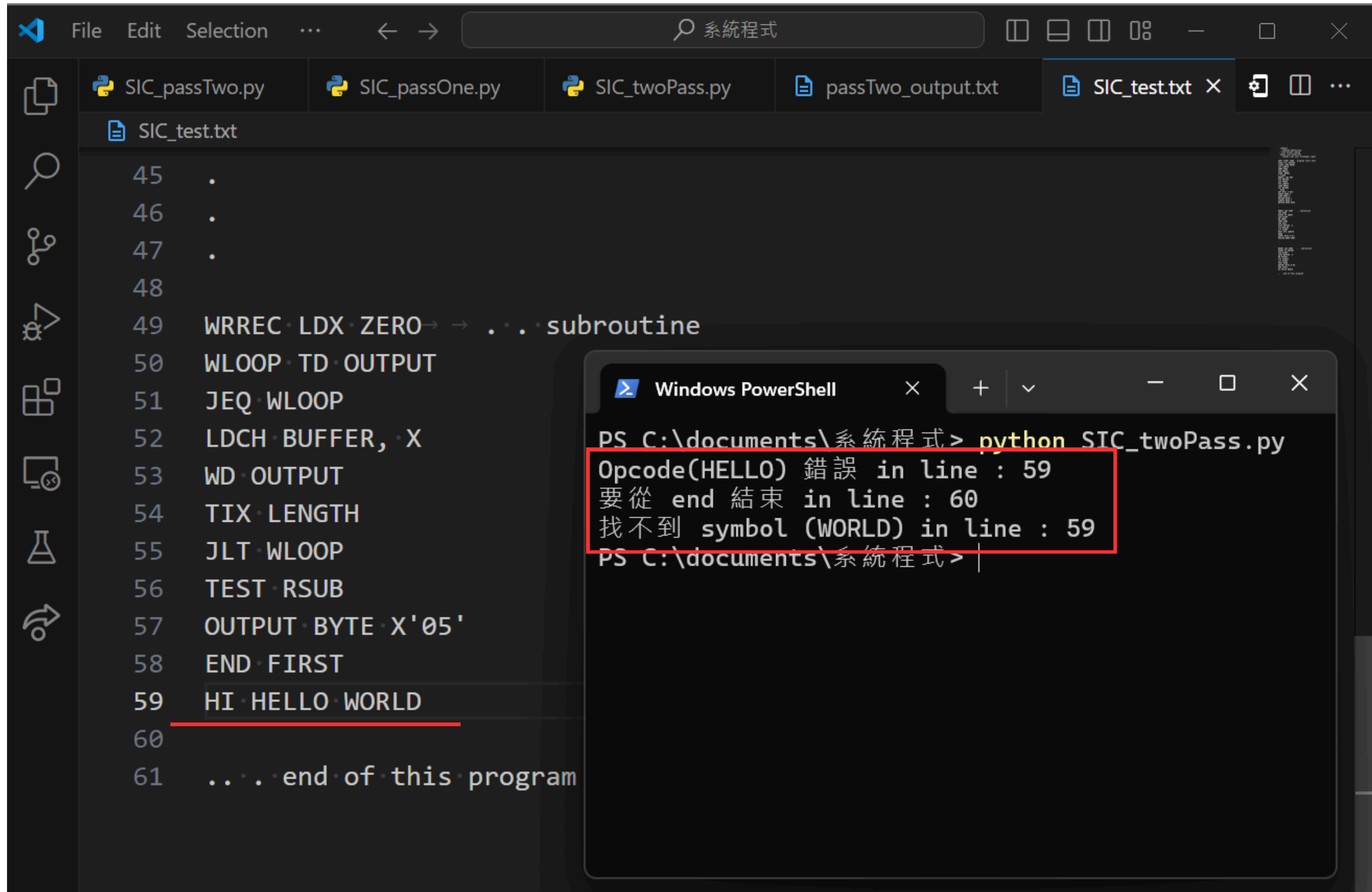
SIC_test.txt

```
1 . comment
2 . . indexed addressing
3 . . free format coding
4 . empty line detection
5 . . comand line user filenames input
6
7 HI HELLO WORLD
8 COPY START 1000 . . prog
9 FIRST STL RETADR
10 CLOOP JSUB RDREC
11 LDA LENGTH
12 COMP ZERO
13 JEQ ENDFIL
14 JSUB WRREC
15 J CLOOP
16 ENDFIL LDA EOF
17 STA BUFFER
18 LDA THREE
19 STA LENGTH
20 JSUB WRREC
21 LDL RETADR
22 JSUB
```

Windows PowerShell

```
PS C:\documents\系統程式> python SIC_twoPass.py
要從 start 開始 in line : 7
Opcode(HELLO) 錯誤 in line : 7
PS C:\documents\系統程式>
```

程式結尾要是END

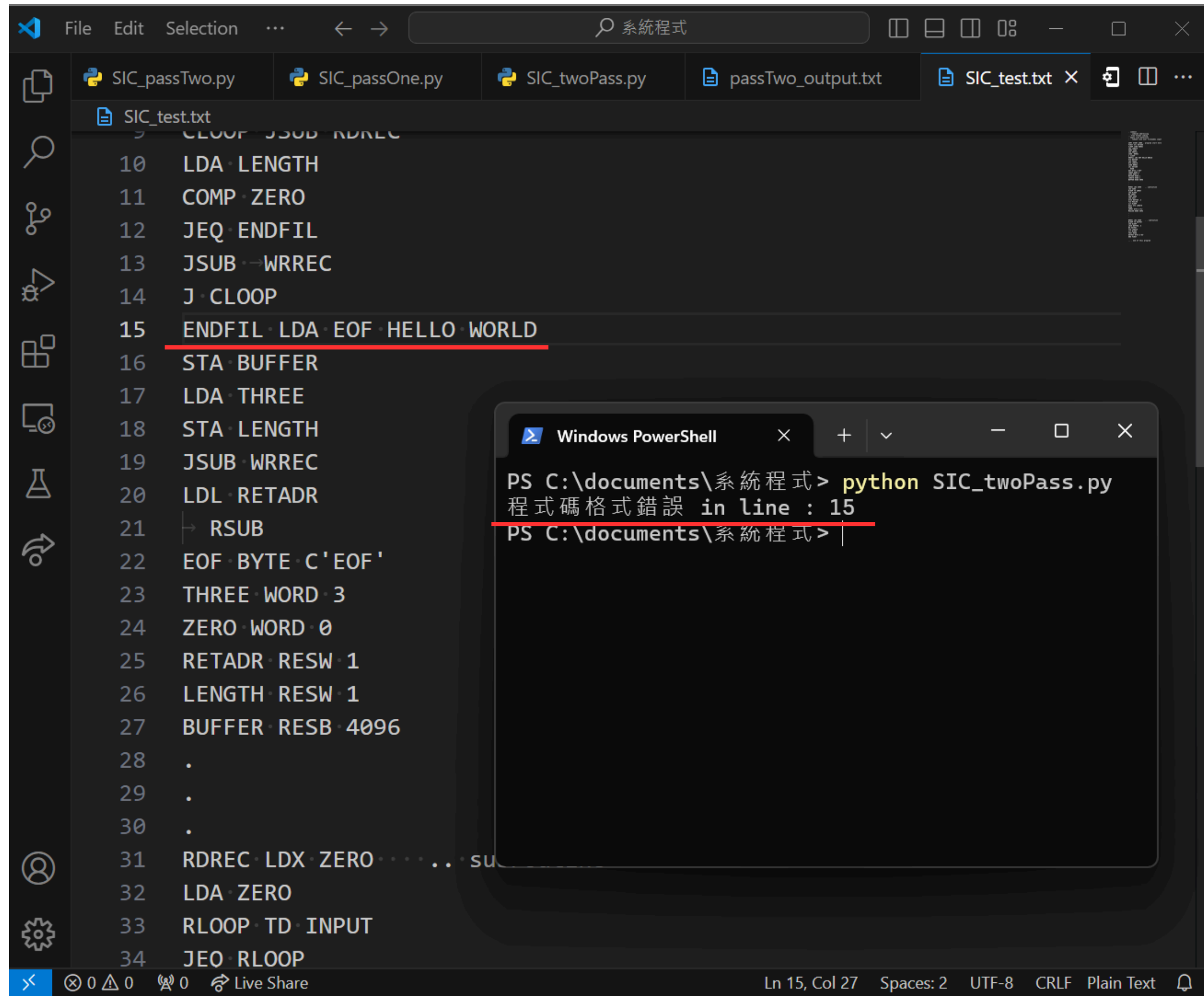


The image shows a code editor with a dark theme. The editor has a menu bar with 'File', 'Edit', 'Selection', and a search bar containing '系統程式'. The tab bar shows several files: 'SIC_passTwo.py', 'SIC_passOne.py', 'SIC_twoPass.py', 'passTwo_output.txt', and 'SIC_test.txt'. The 'SIC_test.txt' file is active, displaying assembly-like code. The code includes labels 45 through 61. Line 59, 'HI · HELLO · WORLD', is underlined in red. A Windows PowerShell terminal window is overlaid on the editor, showing the command 'python SIC_twoPass.py' and a multi-line error message. The error message, which is also highlighted with a red box, states: 'Opcode(HELLO) 錯誤 in line : 59', '要從 end 結束 in line : 60', and '找不到 symbol (WORLD) in line : 59'. The terminal prompt is 'PS C:\documents\系統程式> |'.

```
45  .
46  .
47  .
48
49  WRREC · LDX · ZERO → → . . . subroutine
50  WLOOP · TD · OUTPUT
51  JEQ · WLOOP
52  LDCH · BUFFER, · X
53  WD · OUTPUT
54  TIX · LENGTH
55  JLT · WLOOP
56  TEST · RSUB
57  OUTPUT · BYTE · X'05'
58  END · FIRST
59  HI · HELLO · WORLD
60
61  . . . . end of this program
```

```
PS C:\documents\系統程式> python SIC_twoPass.py
Opcode(HELLO) 錯誤 in line : 59
要從 end 結束 in line : 60
找不到 symbol (WORLD) in line : 59
PS C:\documents\系統程式> |
```

程式碼格式錯誤



Visual Studio Code interface showing a file named `SIC_test.txt` with the following assembly code:

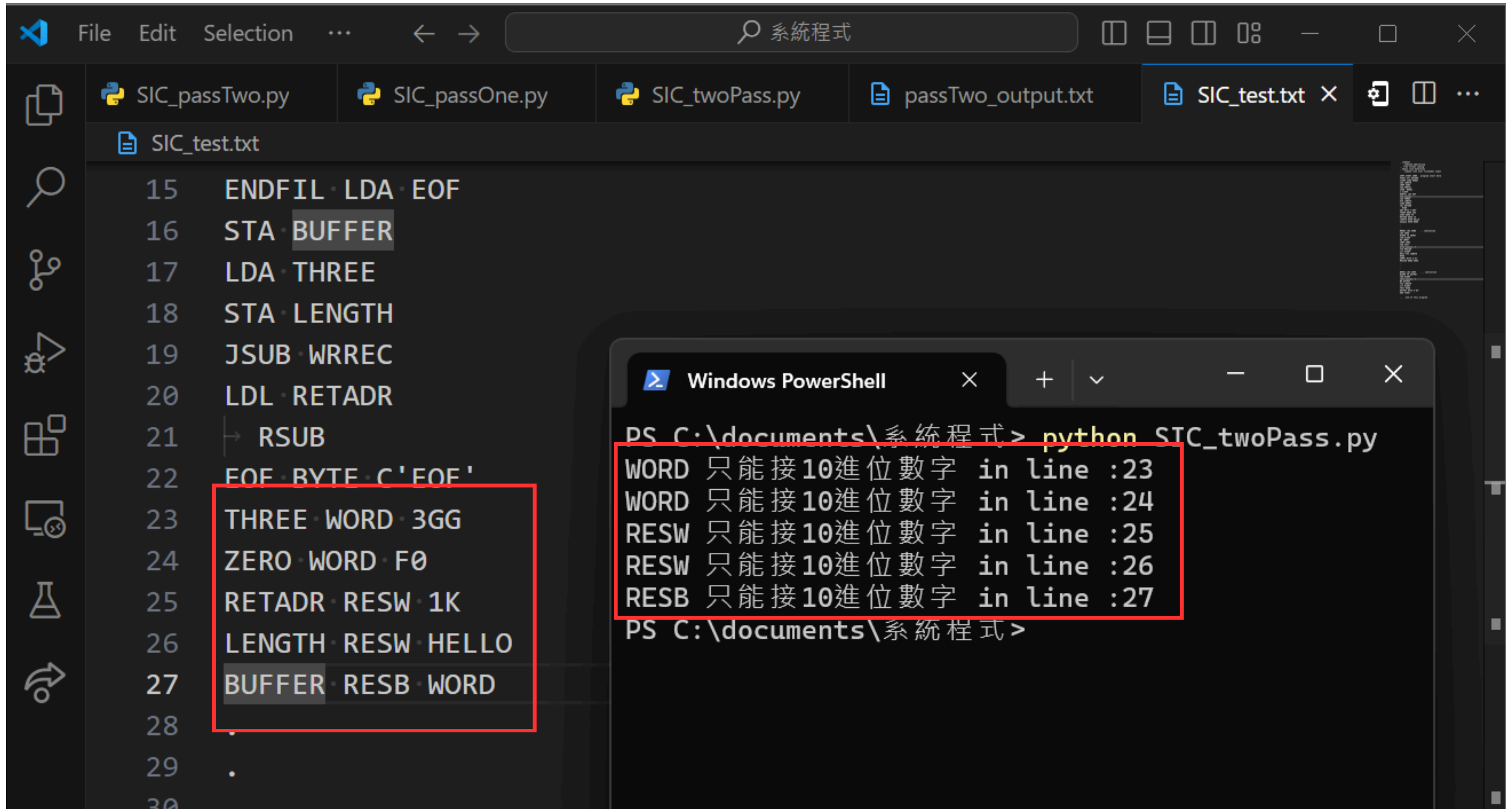
```
9  CLOOP JSUB RDREC
10 LDA LENGTH
11 COMP ZERO
12 JEQ ENDFIL
13 JSUB →WRREC
14 J CLOOP
15 ENDFIL · LDA · EOF · HELLO · WORLD
16 STA BUFFER
17 LDA THREE
18 STA LENGTH
19 JSUB WRREC
20 LDL RETADR
21 → RSUB
22 EOF · BYTE · C'EOF'
23 THREE · WORD · 3
24 ZERO · WORD · 0
25 RETADR · RESW · 1
26 LENGTH · RESW · 1
27 BUFFER · RESB · 4096
28 .
29 .
30 .
31 RDREC · LDX · ZERO · . . . . su
32 LDA ZERO
33 RLOOP · TD · INPUT
34 JEO RLOOP
```

The error message in the Windows PowerShell window is:

```
PS C:\documents\系統程式> python SIC_twoPass.py
python: 程式碼格式錯誤 in line : 15
PS C:\documents\系統程式>
```

The error indicates a syntax error in the assembly code, specifically on line 15, where the tokens are separated by spaces instead of being concatenated.

WORD, RESW, RESB 只能接十進位數字



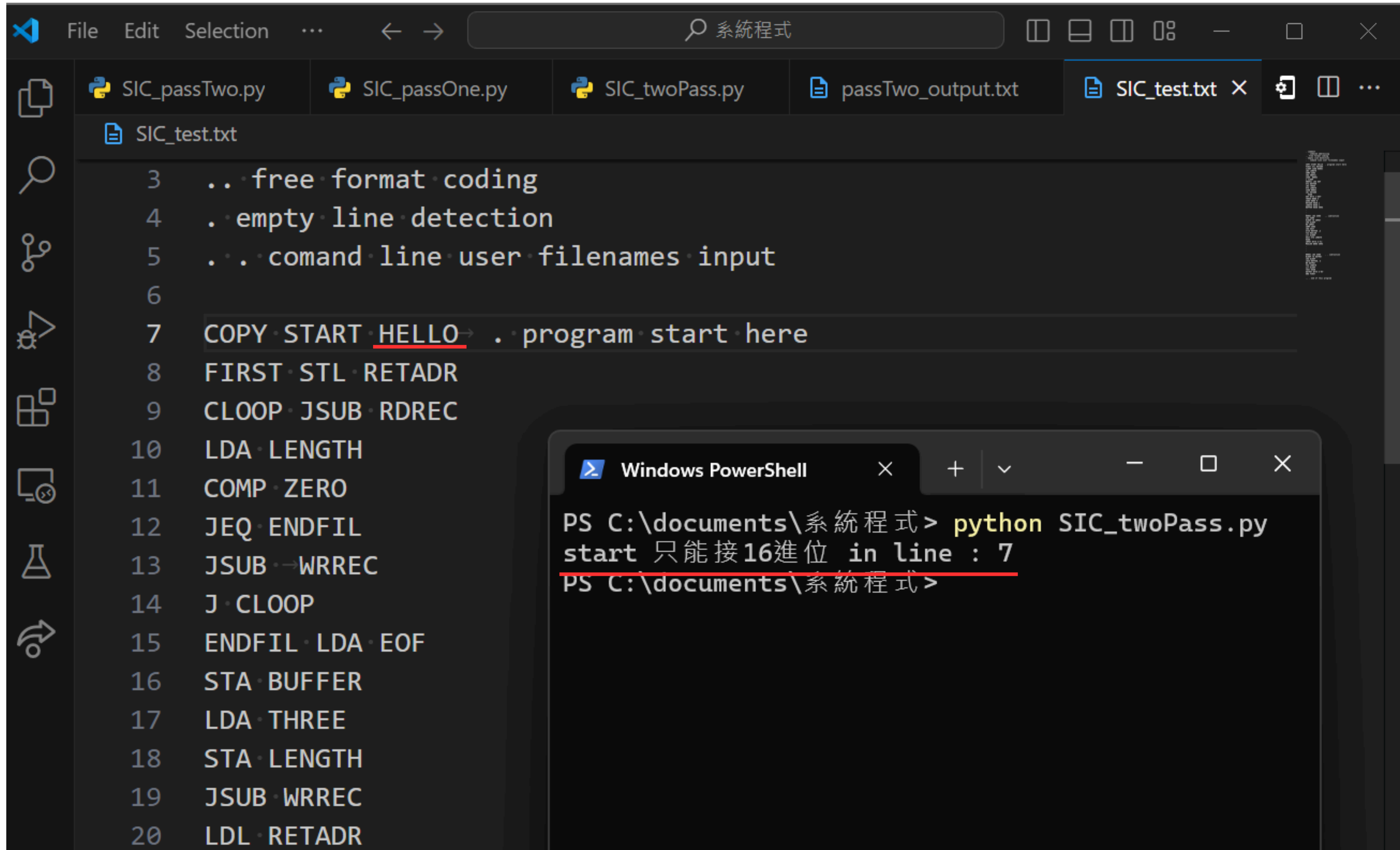
The image shows a code editor window with a file named `SIC_test.txt` open. The code is assembly language for the SIC processor. Lines 23 through 27 are highlighted with a red box:

```
15 ENDFIL · LDA · EOF
16 STA · BUFFER
17 LDA · THREE
18 STA · LENGTH
19 JSUB · WRREC
20 LDL · RETADR
21 → RSUB
22 EOF · BYTE · C'EOF'
23 THREE · WORD · 3GG
24 ZERO · WORD · F0
25 RETADR · RESW · 1K
26 LENGTH · RESW · HELLO
27 BUFFER · RESB · WORD
28 .
29 .
30 .
```

Below the code editor, a Windows PowerShell terminal window is open, showing the command `python SIC_twoPass.py` being executed. The output shows four errors, each indicating that a directive (`WORD`, `RESW`, or `RESB`) can only accept decimal numbers:

```
PS C:\documents\系統程式> python SIC_twoPass.py
WORD 只能接10進位數字 in line :23
WORD 只能接10進位數字 in line :24
RESW 只能接10進位數字 in line :25
RESW 只能接10進位數字 in line :26
RESB 只能接10進位數字 in line :27
PS C:\documents\系統程式>
```


START 只能接十六進位數字



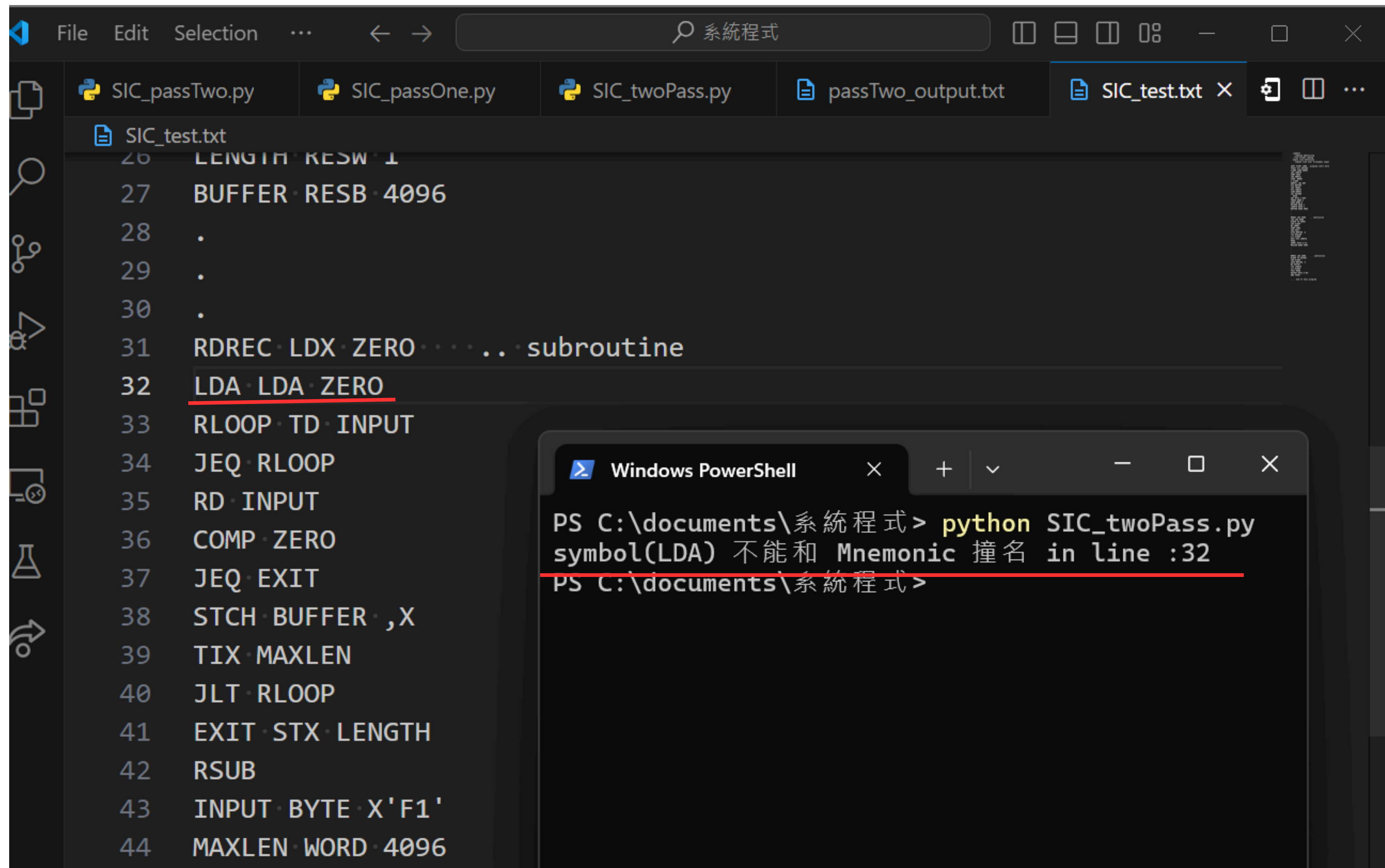
The image shows a code editor window with several files open: SIC_passTwo.py, SIC_passOne.py, SIC_twoPass.py, passTwo_output.txt, and SIC_test.txt. The active file is SIC_test.txt, which contains the following assembly code:

```
3  .. free format coding
4  . empty line detection
5  ... comand line user filenames input
6
7  COPY START HELLO . program start here
8  FIRST STL RETADR
9  CLOOP JSUB RDREC
10 LDA LENGTH
11 COMP ZERO
12 JEQ ENDFIL
13 JSUB WRREC
14 J CLOOP
15 ENDFIL LDA EOF
16 STA BUFFER
17 LDA THREE
18 STA LENGTH
19 JSUB WRREC
20 LDL RETADR
```

Below the code editor, a Windows PowerShell terminal window is open, showing the execution of the SIC_twoPass.py script. The terminal output indicates an error on line 7:

```
PS C:\documents\系統程式> python SIC_twoPass.py
start 只能接16進位 in line : 7
PS C:\documents\系統程式>
```

Symbol 不能和 Mnemonic 撞名



The image shows a code editor window with several files open: SIC_passTwo.py, SIC_passOne.py, SIC_twoPass.py, passTwo_output.txt, and SIC_test.txt. The active file is SIC_test.txt, which contains assembly code. Line 32, `LDA LDA ZERO`, is underlined in red. A Windows PowerShell terminal window is overlaid on the code editor, showing the command `python SIC_twoPass.py` and an error message: `symbol(LDA) 不能和 Mnemonic 撞名 in line :32`. The terminal window title is "Windows PowerShell".

```
File Edit Selection ... < > 系統程式
```

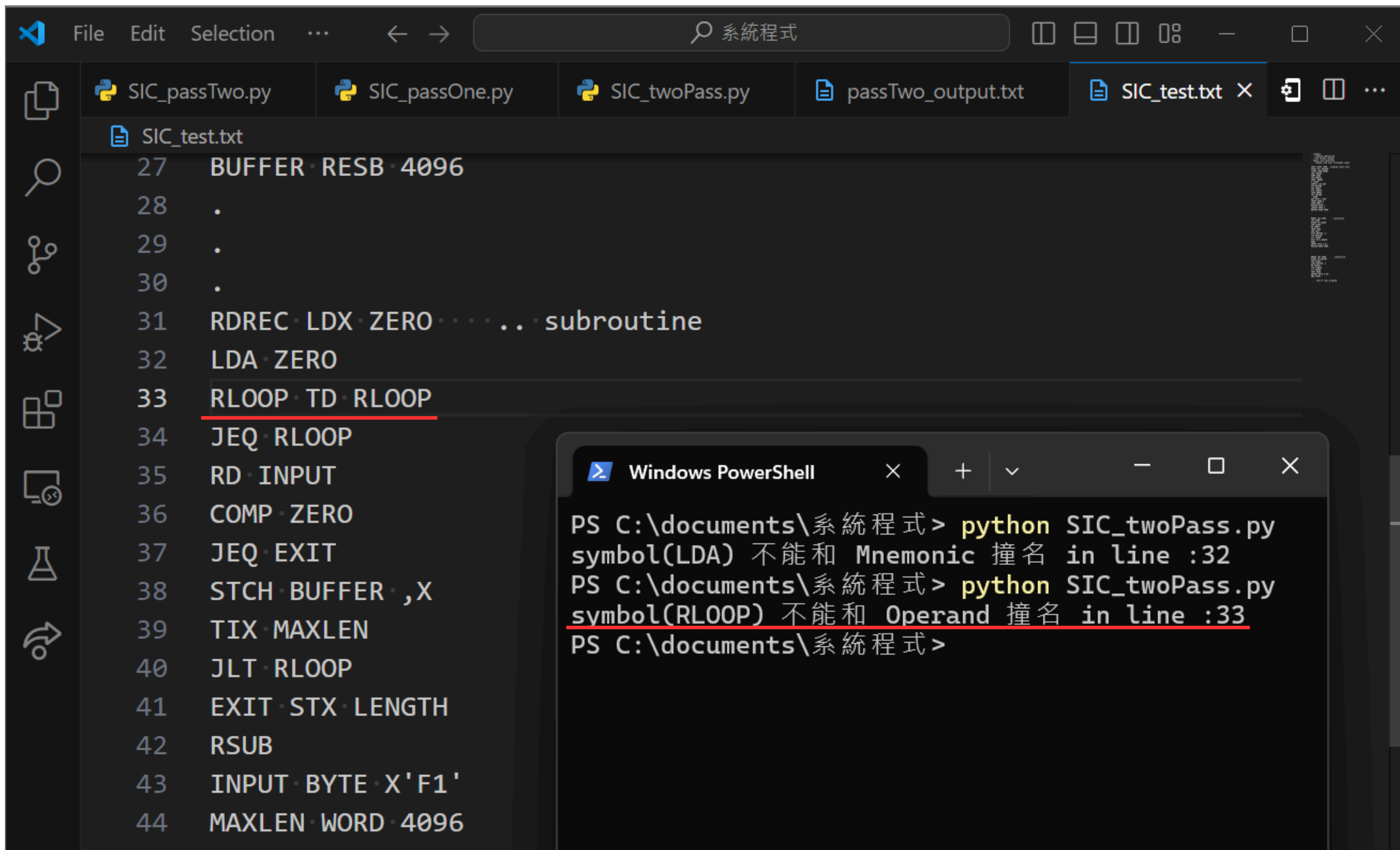
SIC_test.txt

```
26 LENGTH RESW 1
27 BUFFER RESB 4096
28 .
29 .
30 .
31 RDREC LDX ZERO ... .. subroutine
32 LDA LDA ZERO
33 RLOOP TD INPUT
34 JEQ RLOOP
35 RD INPUT
36 COMP ZERO
37 JEQ EXIT
38 STCH BUFFER ,X
39 TIX MAXLEN
40 JLT RLOOP
41 EXIT STX LENGTH
42 RSUB
43 INPUT BYTE X'F1'
44 MAXLEN WORD 4096
```

Windows PowerShell

```
PS C:\documents\系統程式> python SIC_twoPass.py
symbol(LDA) 不能和 Mnemonic 撞名 in line :32
PS C:\documents\系統程式>
```

Symbol 不能和 Operand 撞名



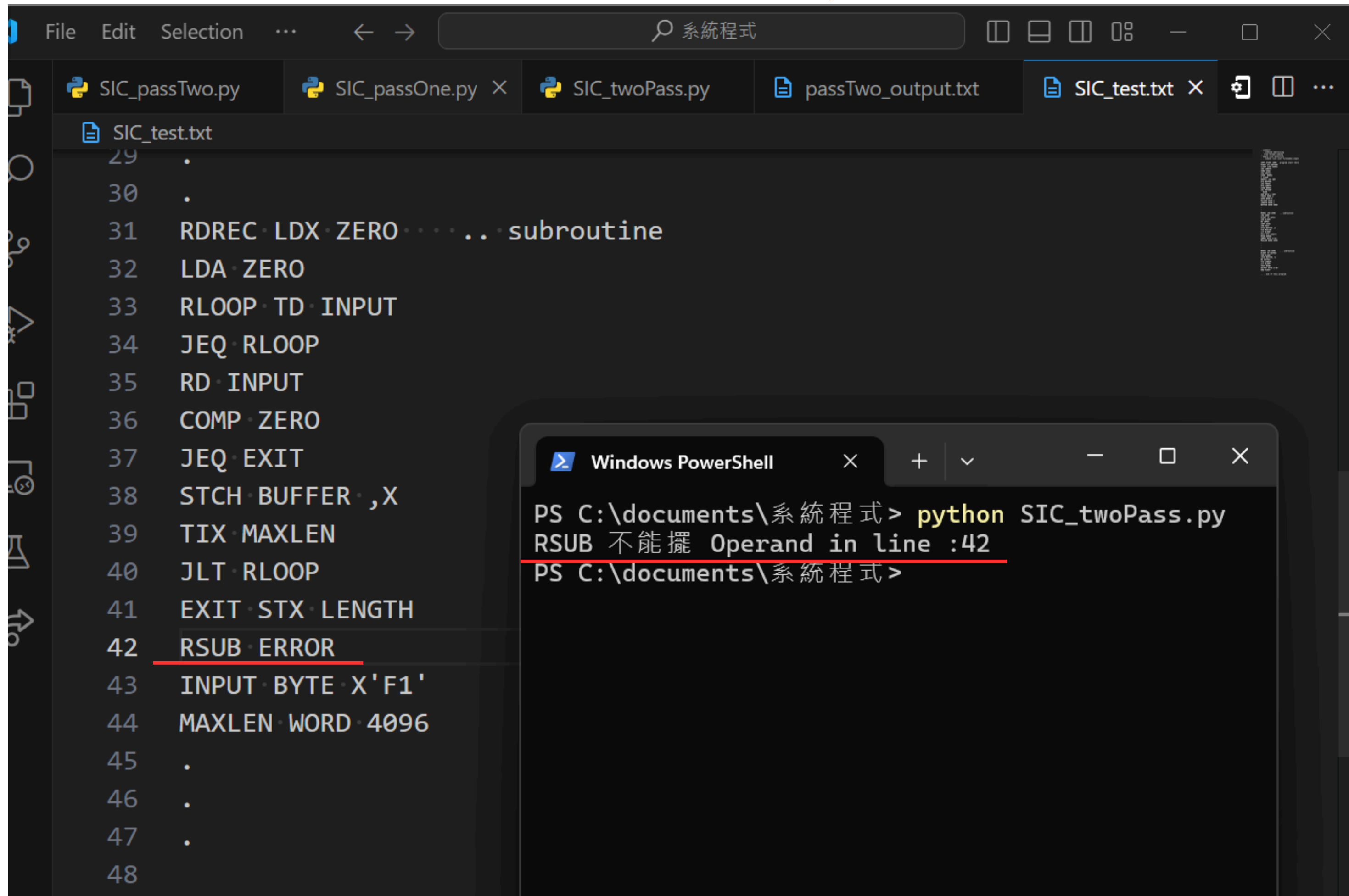
The image shows a code editor window with several files open: SIC_passTwo.py, SIC_passOne.py, SIC_twoPass.py, passTwo_output.txt, and SIC_test.txt. The active file is SIC_test.txt, which contains assembly code. Line 33, `RLOOP TD RLOOP`, is highlighted with a red underline. A Windows PowerShell window is overlaid on the bottom right, showing the execution of `python SIC_twoPass.py` and two error messages:

```
PS C:\documents\系統程式> python SIC_twoPass.py
symbol(LDA) 不能和 Mnemonic 撞名 in line :32
PS C:\documents\系統程式> python SIC_twoPass.py
symbol(RLOOP) 不能和 Operand 撞名 in line :33
PS C:\documents\系統程式>
```

The assembly code in SIC_test.txt is as follows:

```
27 BUFFER RESB 4096
28 .
29 .
30 .
31 RDREC LDX ZERO ... .. subroutine
32 LDA ZERO
33 RLOOP TD RLOOP
34 JEQ RLOOP
35 RD INPUT
36 COMP ZERO
37 JEQ EXIT
38 STCH BUFFER ,X
39 TIX MAXLEN
40 JLT RLOOP
41 EXIT STX LENGTH
42 RSUB
43 INPUT BYTE X'F1'
44 MAXLEN WORD 4096
```

RSUB 不能擺 Operand



The image shows a code editor window with several tabs. The active tab is `SIC_test.txt`, which contains assembly code. Line 42, `RSUB ERROR`, is highlighted with a red line. Overlaid on the bottom right is a Windows PowerShell terminal window. It shows the command `python SIC_twoPass.py` being executed, which results in the error message `RSUB 不能擺 Operand in line :42`. The terminal window title is `Windows PowerShell`.

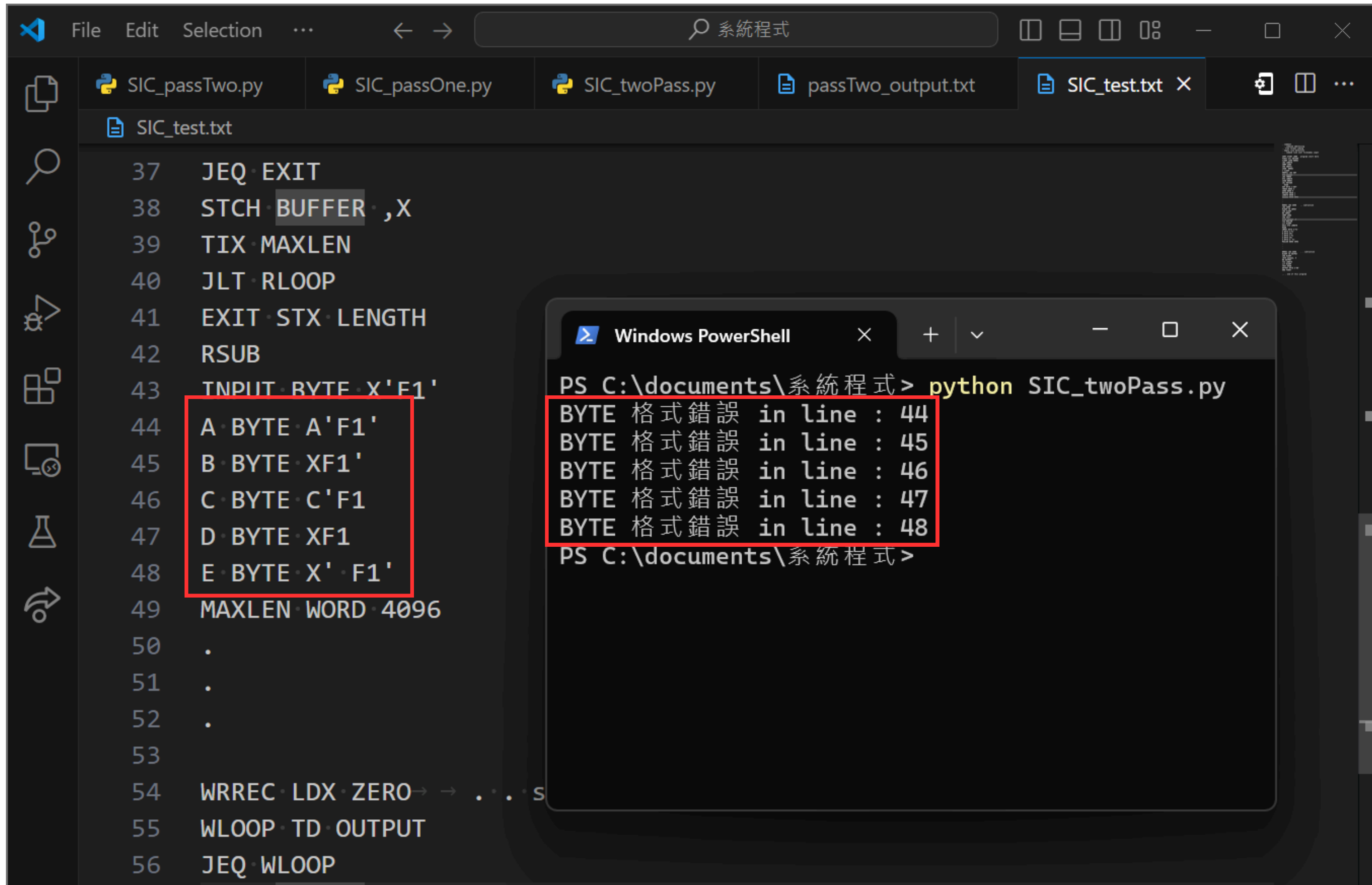
```
File Edit Selection ... < > 系統程式
```

```
SIC_passTwo.py SIC_passOne.py SIC_twoPass.py passTwo_output.txt SIC_test.txt
```

```
SIC_test.txt
29 .
30 .
31 RDREC LDX ZERO ... .. subroutine
32 LDA ZERO
33 RLOOP TD INPUT
34 JEQ RLOOP
35 RD INPUT
36 COMP ZERO
37 JEQ EXIT
38 STCH BUFFER ,X
39 TIX MAXLEN
40 JLT RLOOP
41 EXIT STX LENGTH
42 RSUB ERROR
43 INPUT BYTE X'F1'
44 MAXLEN WORD 4096
45 .
46 .
47 .
48
```

```
Windows PowerShell
PS C:\documents\系統程式> python SIC_twoPass.py
RSUB 不能擺 Operand in line :42
PS C:\documents\系統程式>
```

BYTE 格式錯誤



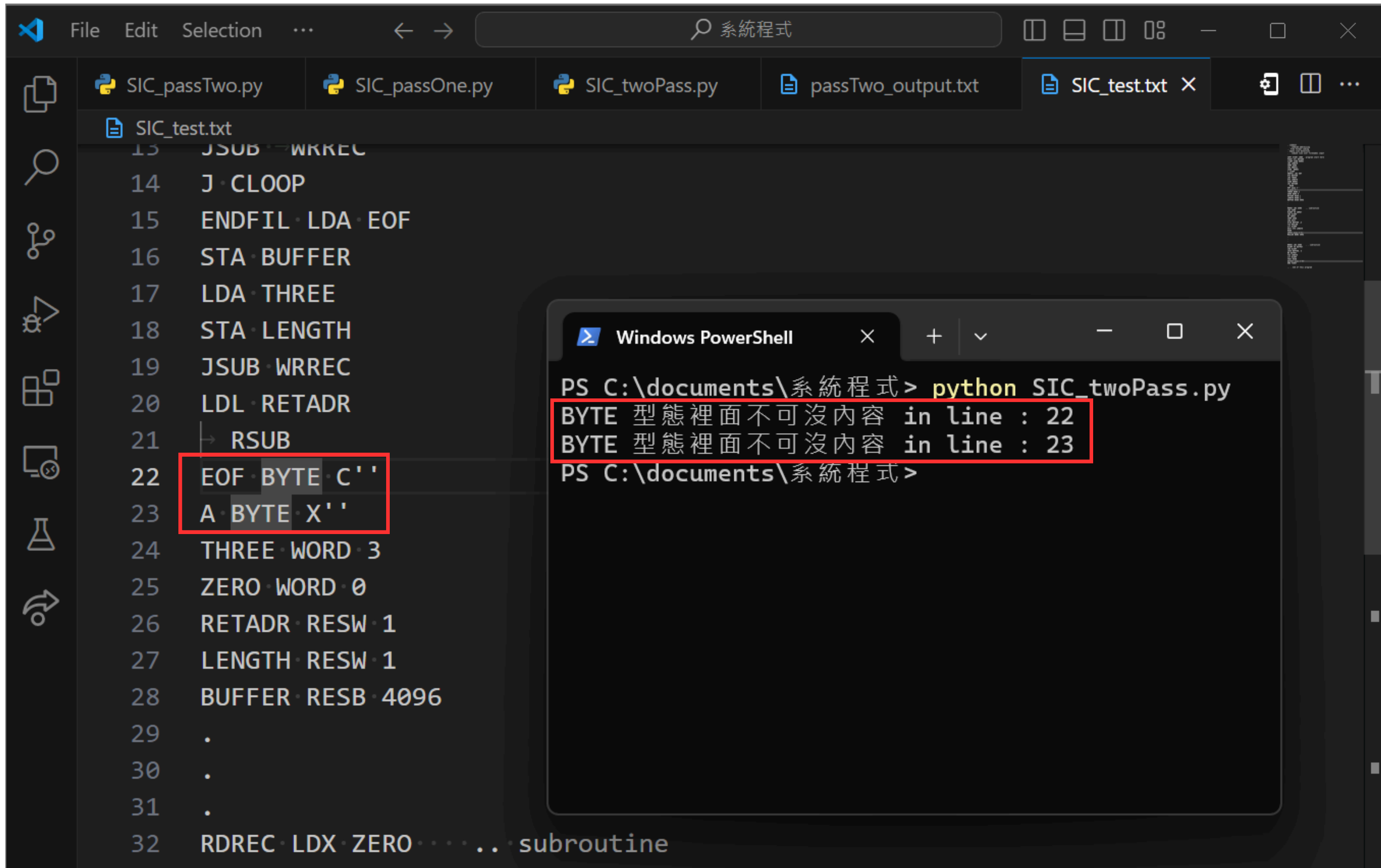
The image shows a Visual Studio Code editor with a file named `SIC_test.txt` open. The file contains assembly-like code. Lines 44 through 48 are highlighted with a red box, indicating the source of the errors. These lines are:

```
44 A · BYTE · A'F1'
45 B · BYTE · XF1'
46 C · BYTE · C'F1
47 D · BYTE · XF1
48 E · BYTE · X' · F1'
```

Below the code, a Windows PowerShell terminal window is open, showing the command `python SIC_twoPass.py` and the resulting error messages, which are also highlighted with a red box:

```
PS C:\documents\系統程式> python SIC_twoPass.py
BYTE 格式錯誤 in line : 44
BYTE 格式錯誤 in line : 45
BYTE 格式錯誤 in line : 46
BYTE 格式錯誤 in line : 47
BYTE 格式錯誤 in line : 48
PS C:\documents\系統程式>
```


BYTE 型態裡面不可沒內容



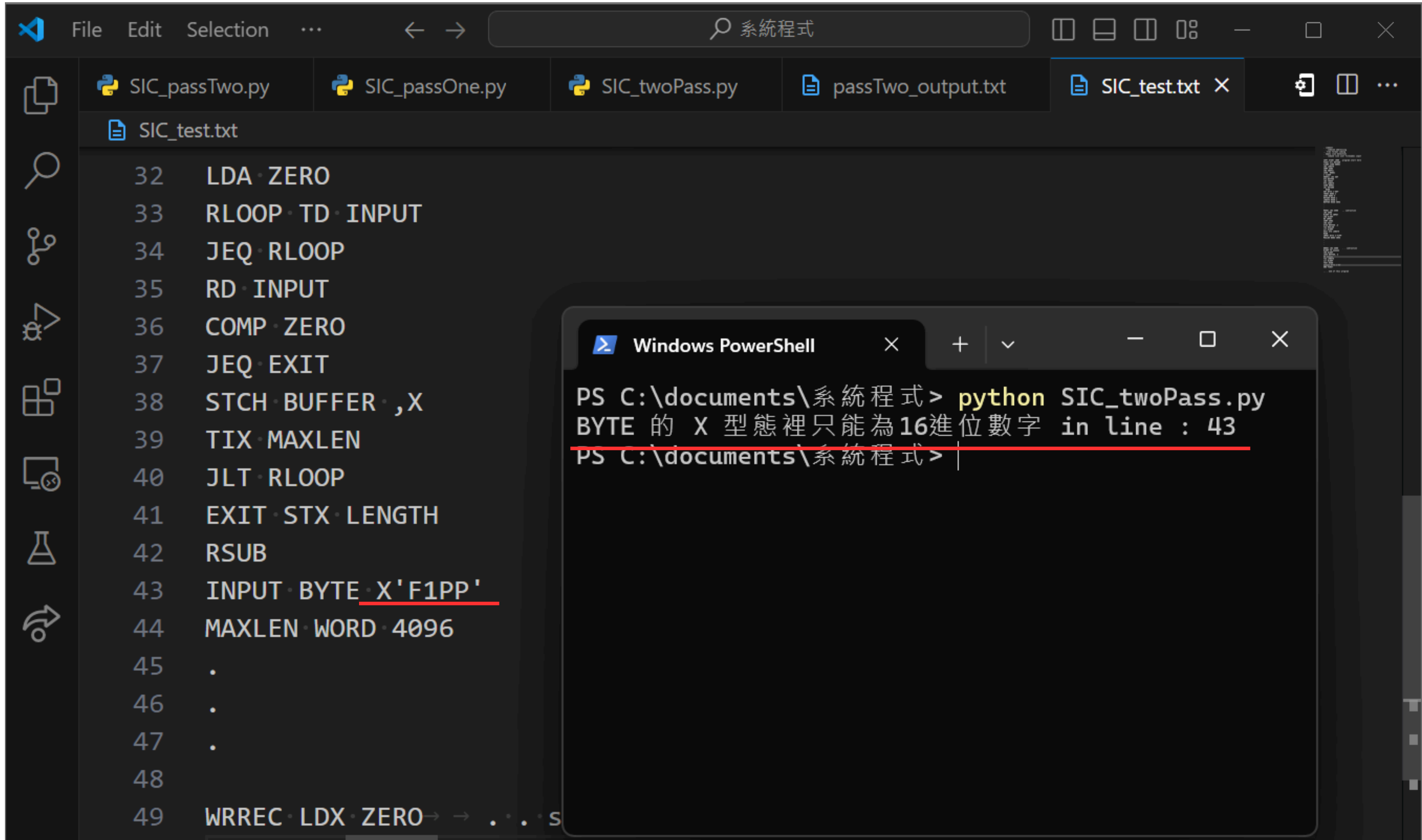
The image shows a screenshot of a code editor (Visual Studio Code) with a dark theme. The editor has several tabs open: SIC_passTwo.py, SIC_passOne.py, SIC_twoPass.py, passTwo_output.txt, and SIC_test.txt. The active tab is SIC_test.txt, which contains assembly code. Lines 22 and 23 are highlighted with a red box:

```
22 EOF BYTE C''  
23 A BYTE X''
```

Below the code editor, a Windows PowerShell terminal window is open. It shows the command `python SIC_twoPass.py` being executed, and the output is displayed in two lines, which are also highlighted with a red box:

```
PS C:\documents\系統程式> python SIC_twoPass.py  
BYTE 型態裡面不可沒內容 in line : 22  
BYTE 型態裡面不可沒內容 in line : 23  
PS C:\documents\系統程式>
```

BYTE X 內容只能是十六進位



The image shows a Visual Studio Code editor window with several files open. The active file is `SIC_test.txt`, which contains assembly code. Line 43, `INPUT · BYTE · X'F1PP'`, is highlighted with a red underline. A Windows PowerShell terminal window is overlaid on the editor, showing the command `python SIC_twoPass.py` and an error message: `BYTE 的 X 型態裡只能為16進位數字 in line : 43`. The terminal window also shows the command prompt `PS C:\documents\系統程式>`.

Visual Studio Code interface showing the file explorer on the left with icons for Explorer, Search, Source Control, Run and Debug, Extensions, Testing, and Docker. The top toolbar includes icons for File, Edit, Selection, and a search bar labeled "系統程式".

Open files in the editor:

- `SIC_passTwo.py`
- `SIC_passOne.py`
- `SIC_twoPass.py`
- `passTwo_output.txt`
- `SIC_test.txt` (Active)

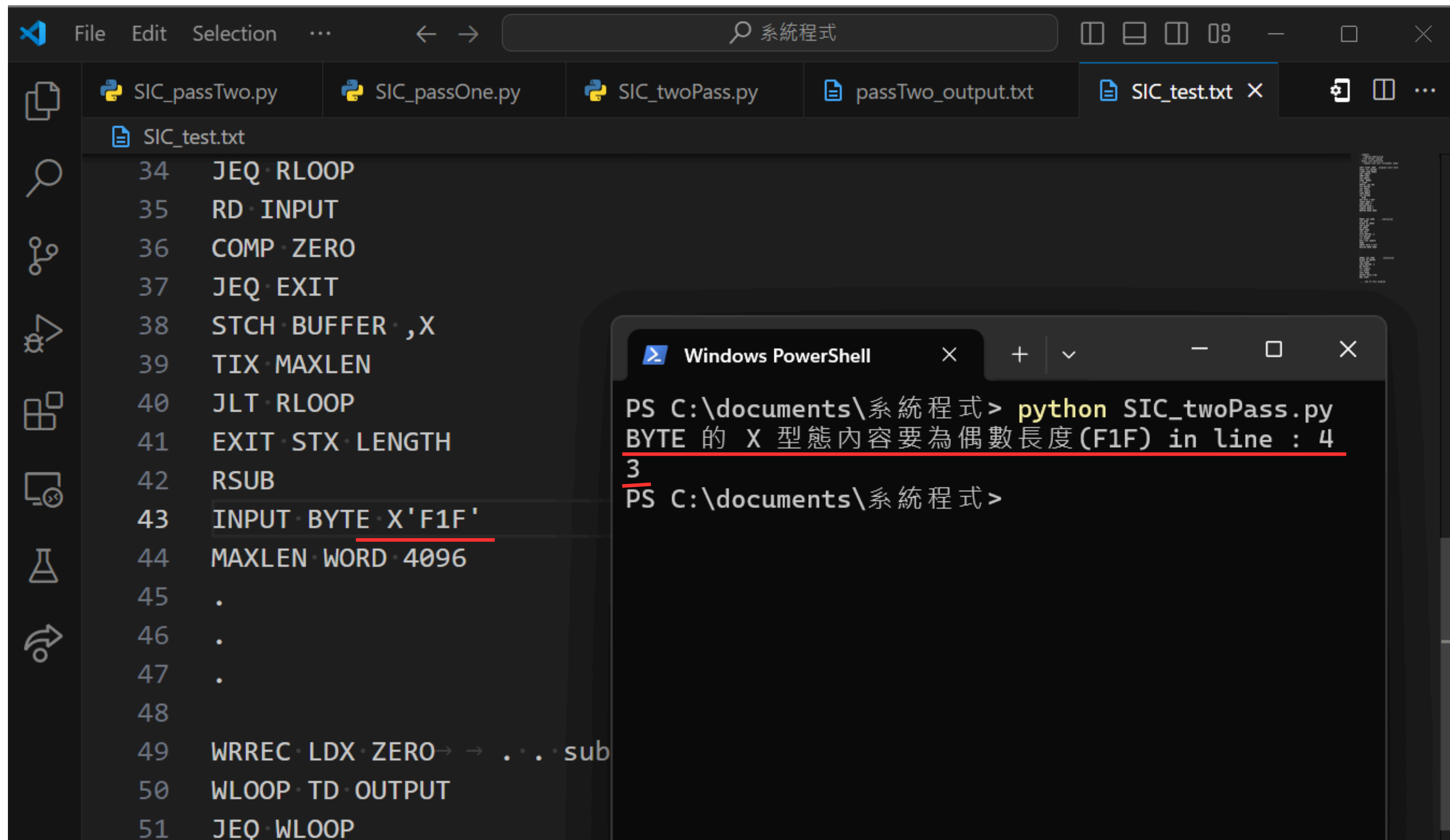
Code in `SIC_test.txt`:

```
32 LDA · ZERO
33 RLOOP · TD · INPUT
34 JEQ · RLOOP
35 RD · INPUT
36 COMP · ZERO
37 JEQ · EXIT
38 STCH · BUFFER · ,X
39 TIX · MAXLEN
40 JLT · RLOOP
41 EXIT · STX · LENGTH
42 RSUB
43 INPUT · BYTE · X'F1PP'
44 MAXLEN · WORD · 4096
45 .
46 .
47 .
48
49 WRREC · LDX · ZERO → → . . . S
```

Windows PowerShell terminal output:

```
PS C:\documents\系統程式> python SIC_twoPass.py
BYTE 的 X 型態裡只能為16進位數字 in line : 43
PS C:\documents\系統程式>
```

BYTE X 內容個數只能為偶數



The image shows a code editor window with several files open: SIC_passTwo.py, SIC_passOne.py, SIC_twoPass.py, passTwo_output.txt, and SIC_test.txt. The SIC_test.txt file is active, displaying assembly-like code. Line 43, `INPUT · BYTE · X 'F1F'`, is highlighted with a red underline. A Windows PowerShell terminal window is overlaid on the code editor, showing the command `python SIC_twoPass.py` and an error message: `BYTE 的 X 型態內容要為偶數長度(F1F) in line : 43`. The error message is underlined in red. The PowerShell prompt is `PS C:\documents\系統程式>`.

```
File Edit Selection ... ← → 系統程式
```

SIC_test.txt

```
34 JEQ · RLOOP
35 RD · INPUT
36 COMP · ZERO
37 JEQ · EXIT
38 STCH · BUFFER · ,X
39 TIX · MAXLEN
40 JLT · RLOOP
41 EXIT · STX · LENGTH
42 RSUB
43 INPUT · BYTE · X 'F1F'
44 MAXLEN · WORD · 4096
45 .
46 .
47 .
48
49 WRREC · LDX · ZERO → → . . . sub
50 WLOOP · TD · OUTPUT
51 JEQ · WLOOP
```

Windows PowerShell

```
PS C:\documents\系統程式> python SIC_twoPass.py
BYTE 的 X 型態內容要為偶數長度(F1F) in line : 43
PS C:\documents\系統程式>
```