系統程式
期末
Demo

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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 | SIC_passOne.py | SIC_twoPass.py | passTwo_output.txt | 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

e.py | SIC_twoPass.py | passTwo_output.txt | SIC_test

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  .
```

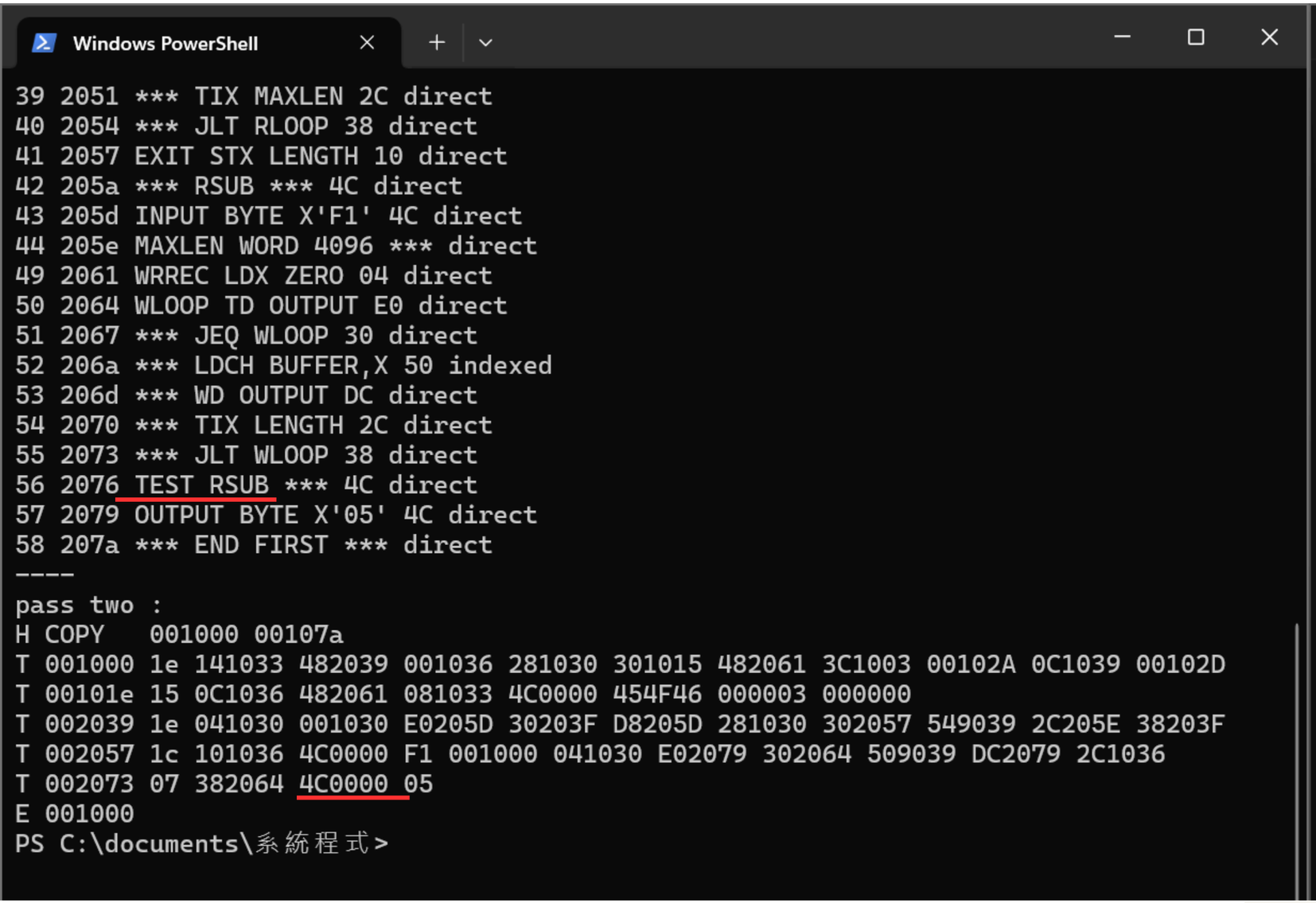
PROBLEMS OUTPUT TERMINAL ··· powershell

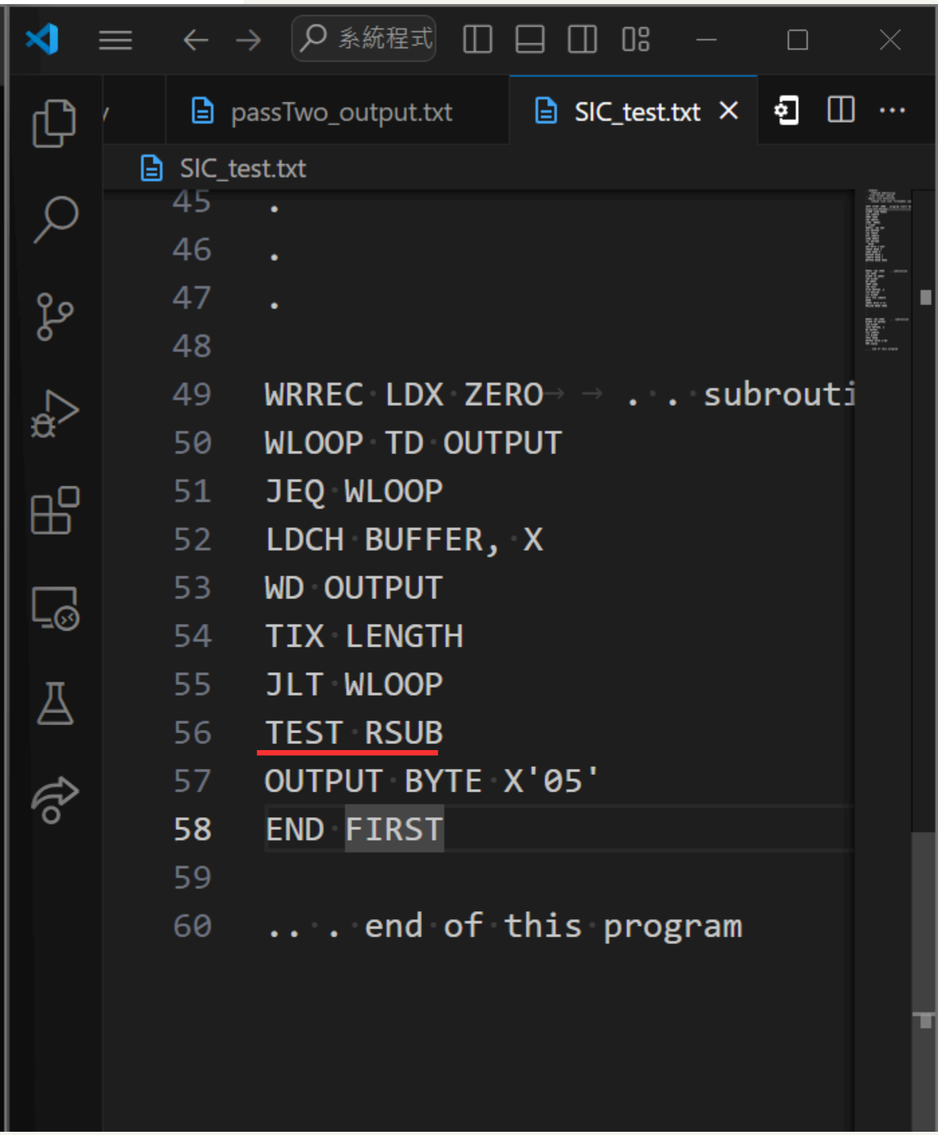
```
PS C:\documents\系統程式> python SIC_twoPass.py
索引定址格式錯誤 in line : 39
BYTE 的 X 型態內容要為偶數長度(F1GGG) in line : 44
BYTE 的 X 型態裡只能為16進位數字 in line : 44
WORD 只能接10進位數字 in line :45
重複的symbol(RLOOP) in line : 34
PS C:\documents\系統程式>
```

以下是正確的 Case

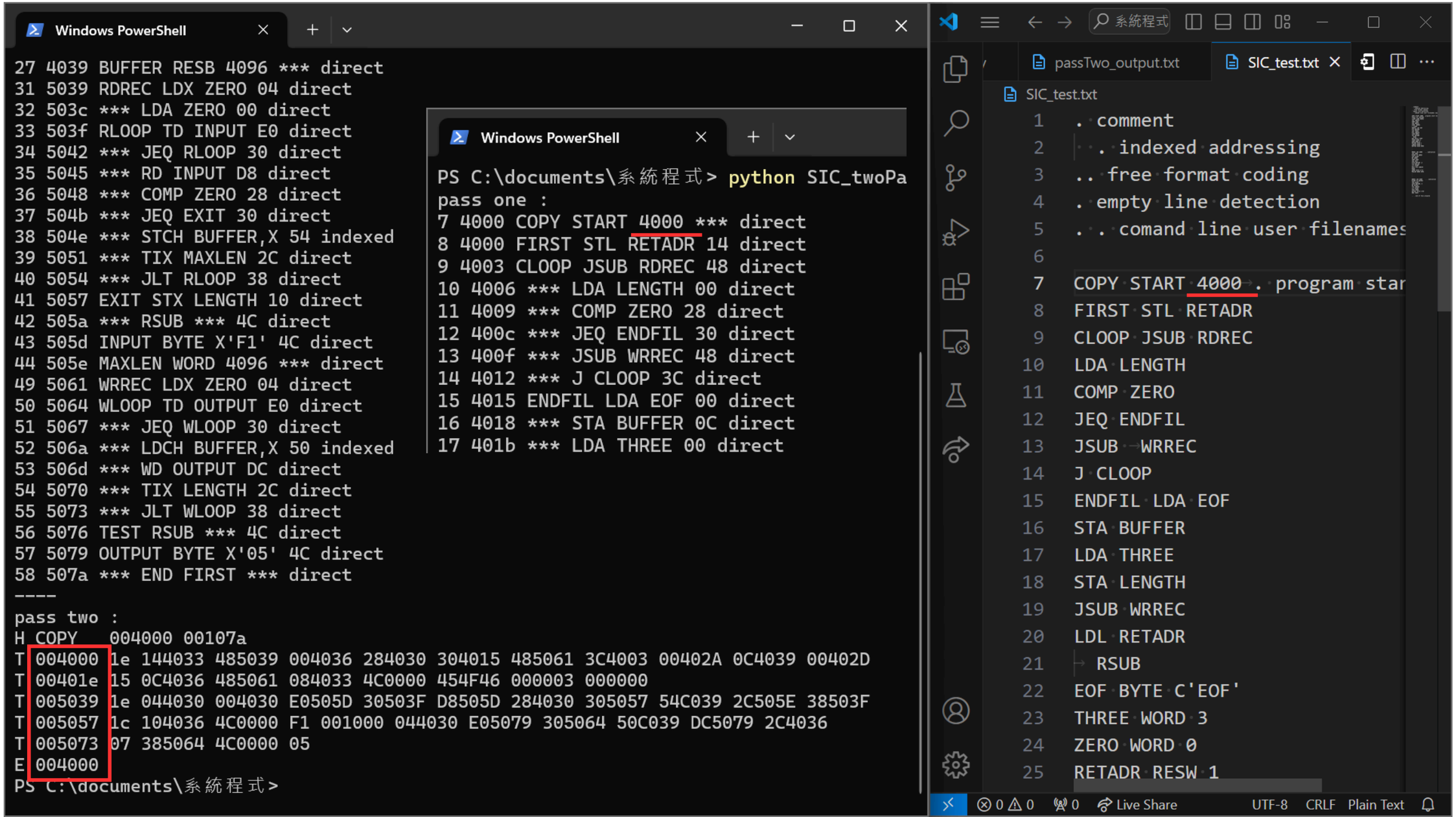
1. RSUB 可以有 Label
2. 程式碼可以改起始位置
3. 索引定址前後可以空白
   - Ex：LDA BUFFER , X
4. BYTE型態與內容之間可以空白
5. BYTE C 型態，內容可以有空白
6. 程式名需補空白到6碼

RSUB 可以有 Label





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
passTwo_output.txt
SIC_test.txt
SIC_test.txt
. comment
. indexed addressing
. free format coding
. empty line detection
. . comand line user filenames
COPY START 4000 . program star
FIRST STL RETADR
CLOOP JSUB RDREC
LDA LENGTH
COMP ZERO
JEQ ENDFIL
JSUB WRREC
J CLOOP
ENDFIL LDA EOF
STA BUFFER
LDA THREE
STA LENGTH
JSUB WRREC
LDL RETADR
RSUB
EOF BYTE C'EOF'
THREE WORD 3
ZERO WORD 0
RETADR RESW 1
Live Share
UTF-8
CRLF
Plain Text

索引定址前後可以空白

Windows PowerShell

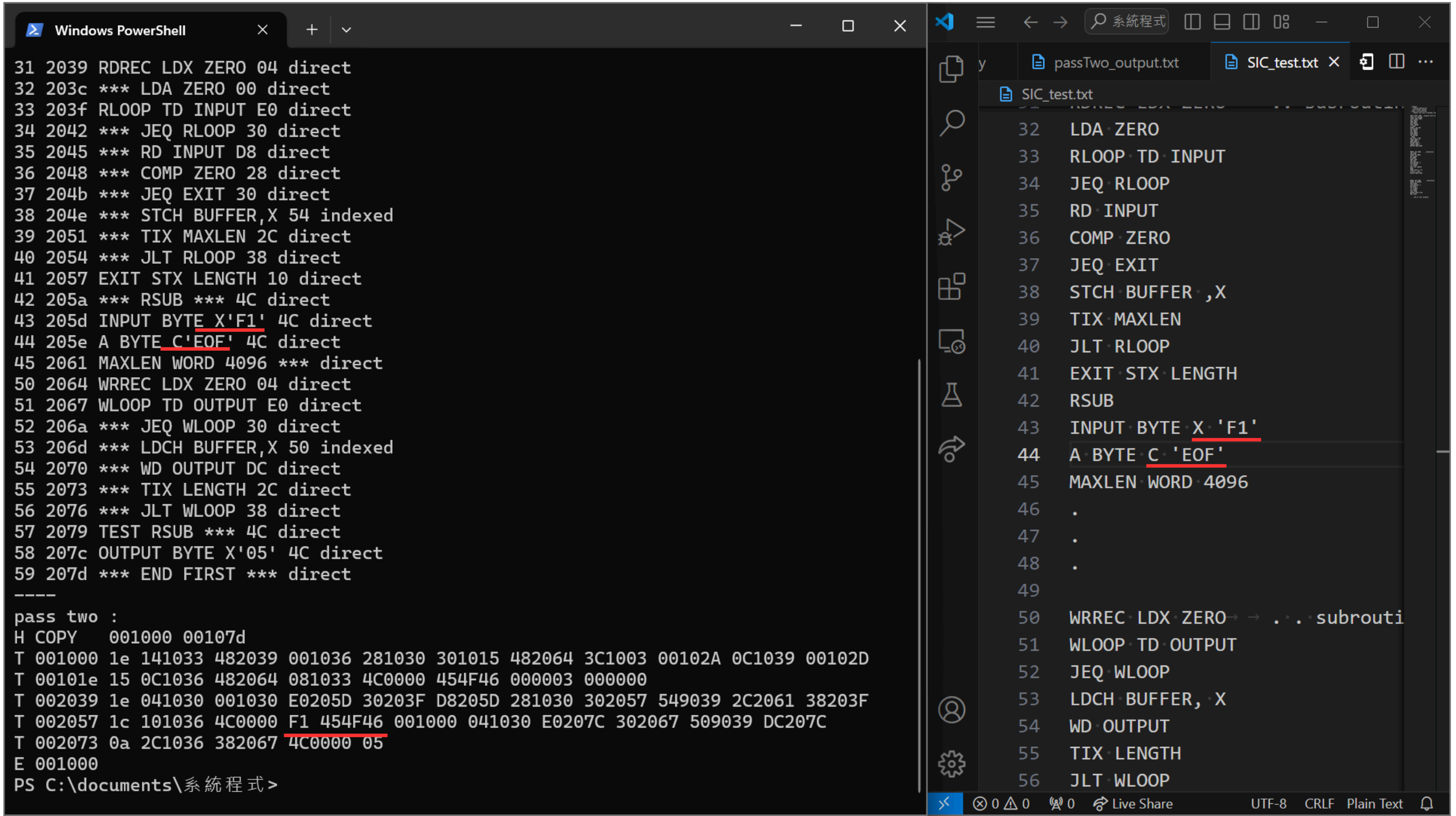
```
37 204b *** JEQ EXIT 30 direct
38 204e *** STCH BUFFER,X 54 indexed
39 2051 *** TIX MAXLEN 2C direct
40 2054 *** JLT RLOOP 38 direct
41 2057 EXIT STX LENGTH 10 direct
42 205a *** RSUB *** 4C direct
43 205d INPUT BYTE X'F1' 4C direct
44 205e MAXLEN WORD 4096 *** direct
49 2061 WRREC LDX ZERO 04 direct
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

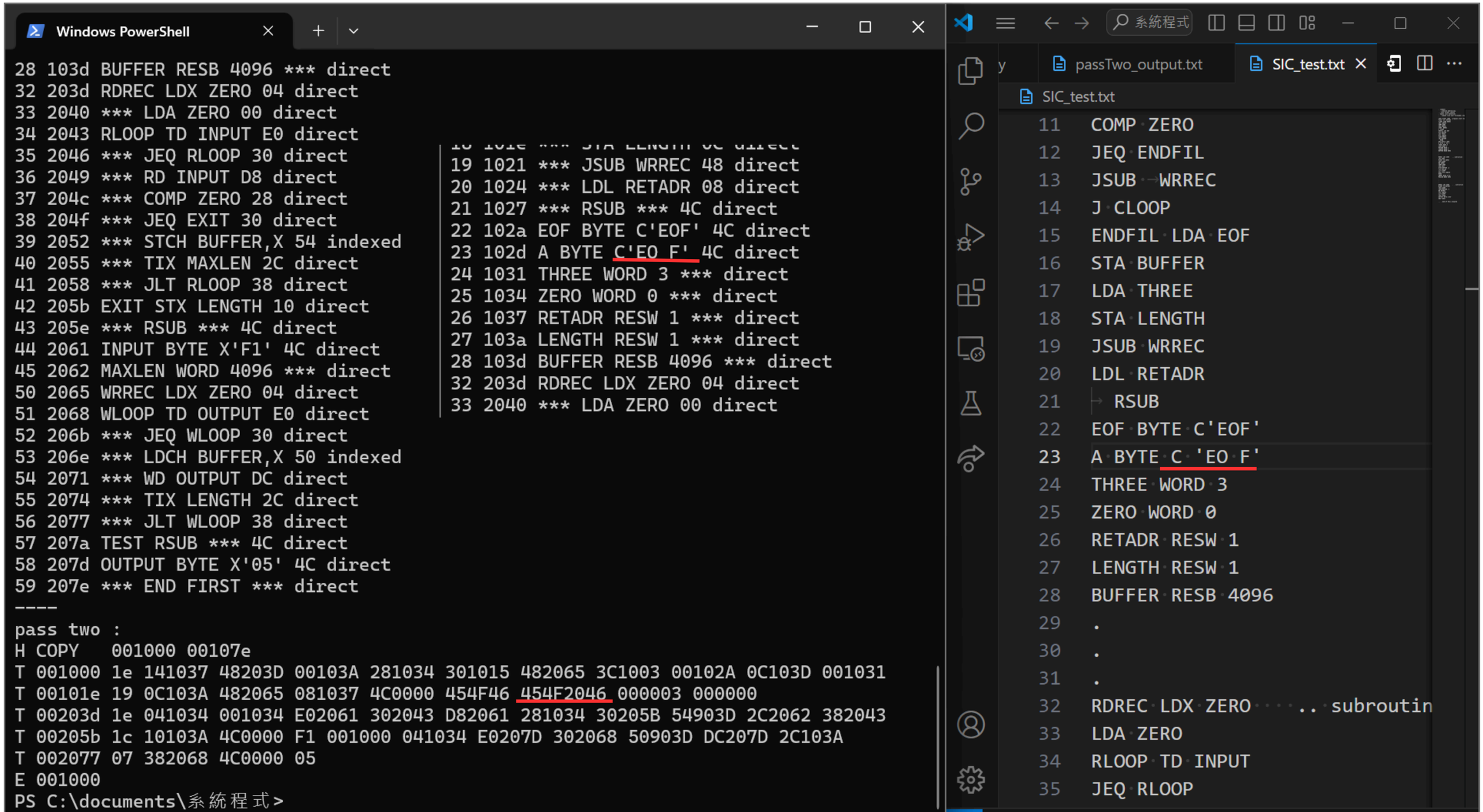
SIC_test.txt

```
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



BYTE C 型態，內容可以有空白



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>
```

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
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

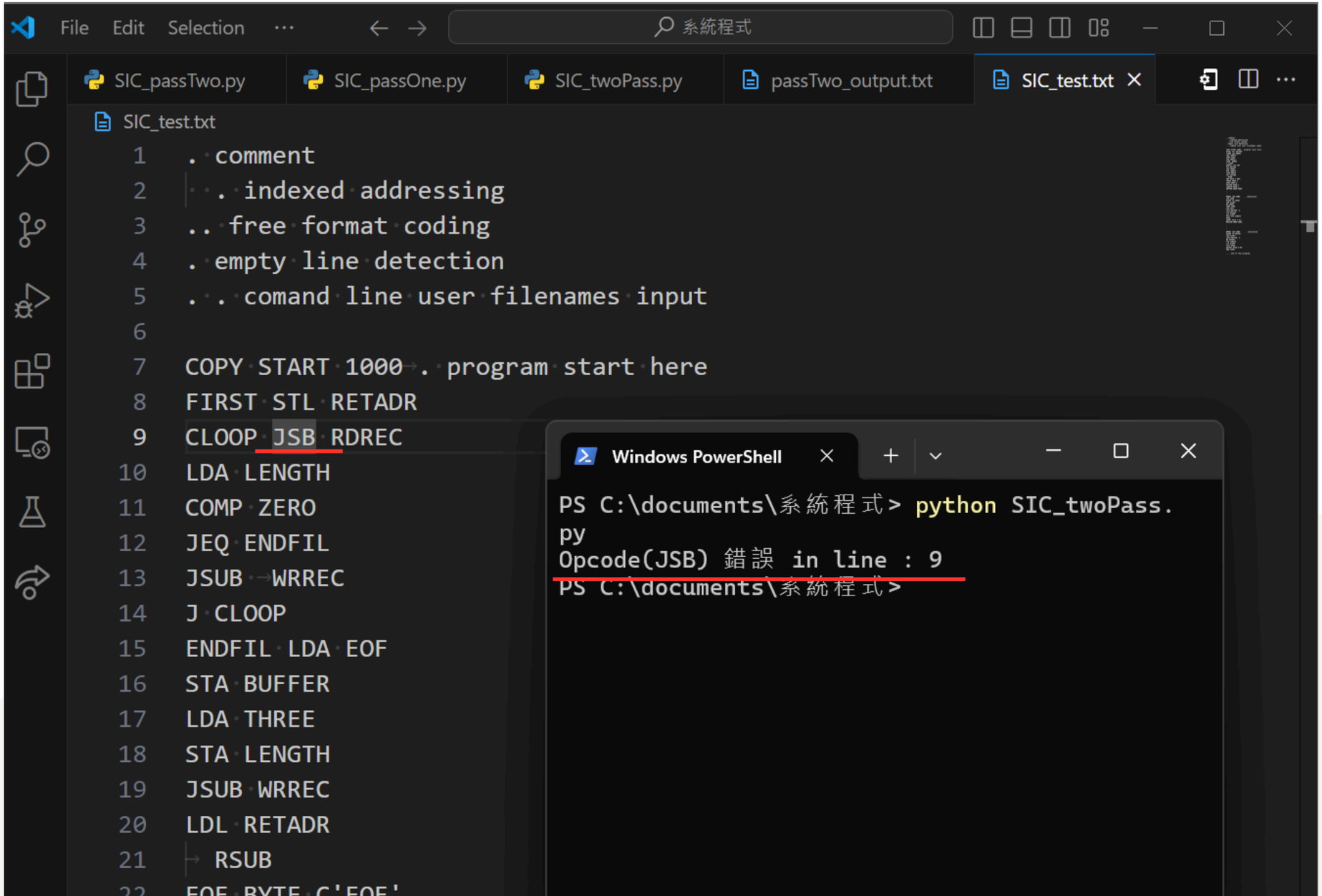
11. Symbol 不能與 Operand 撞名

12. RSUB 不能有 Operand

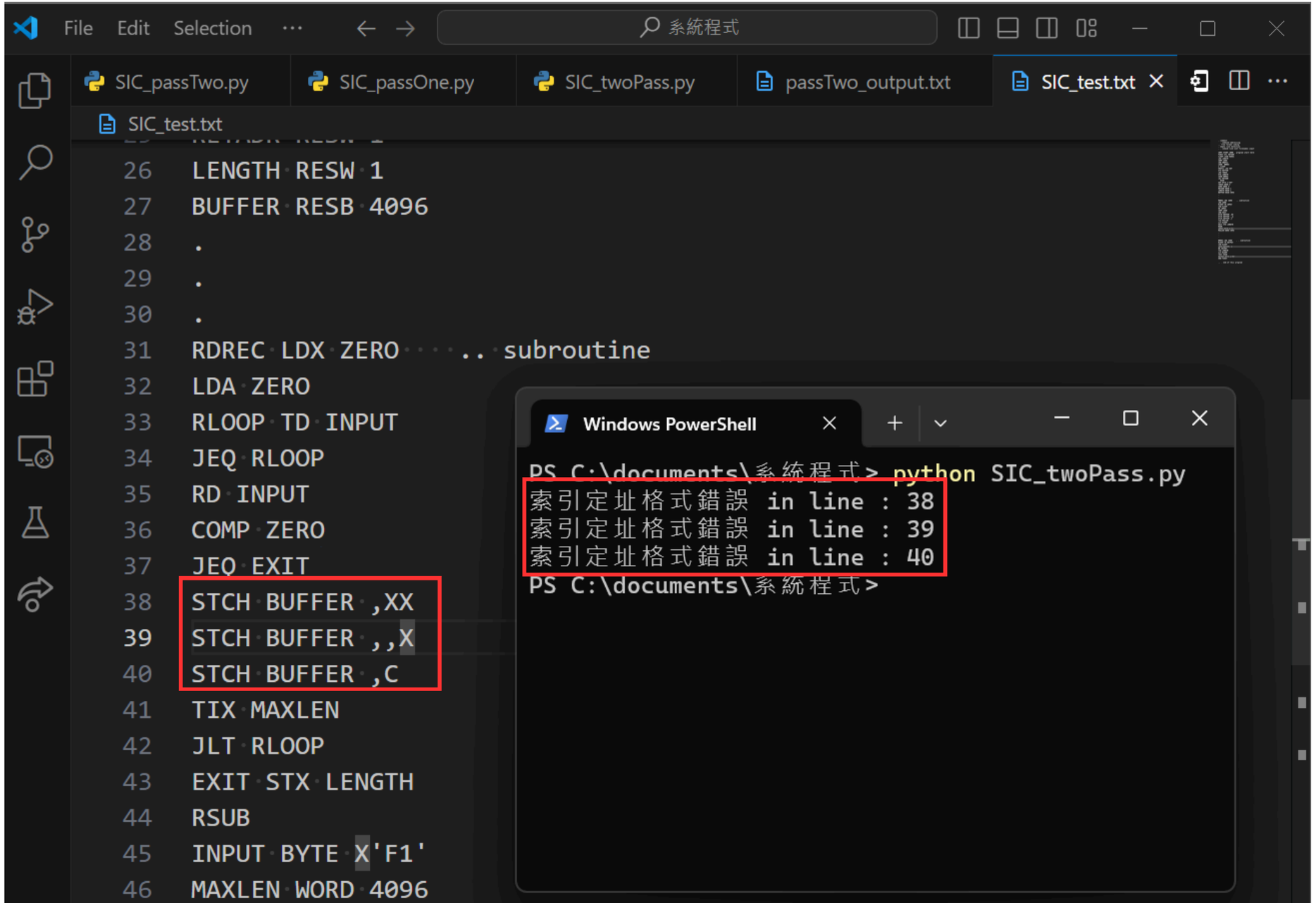
以下是錯誤的 Case

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

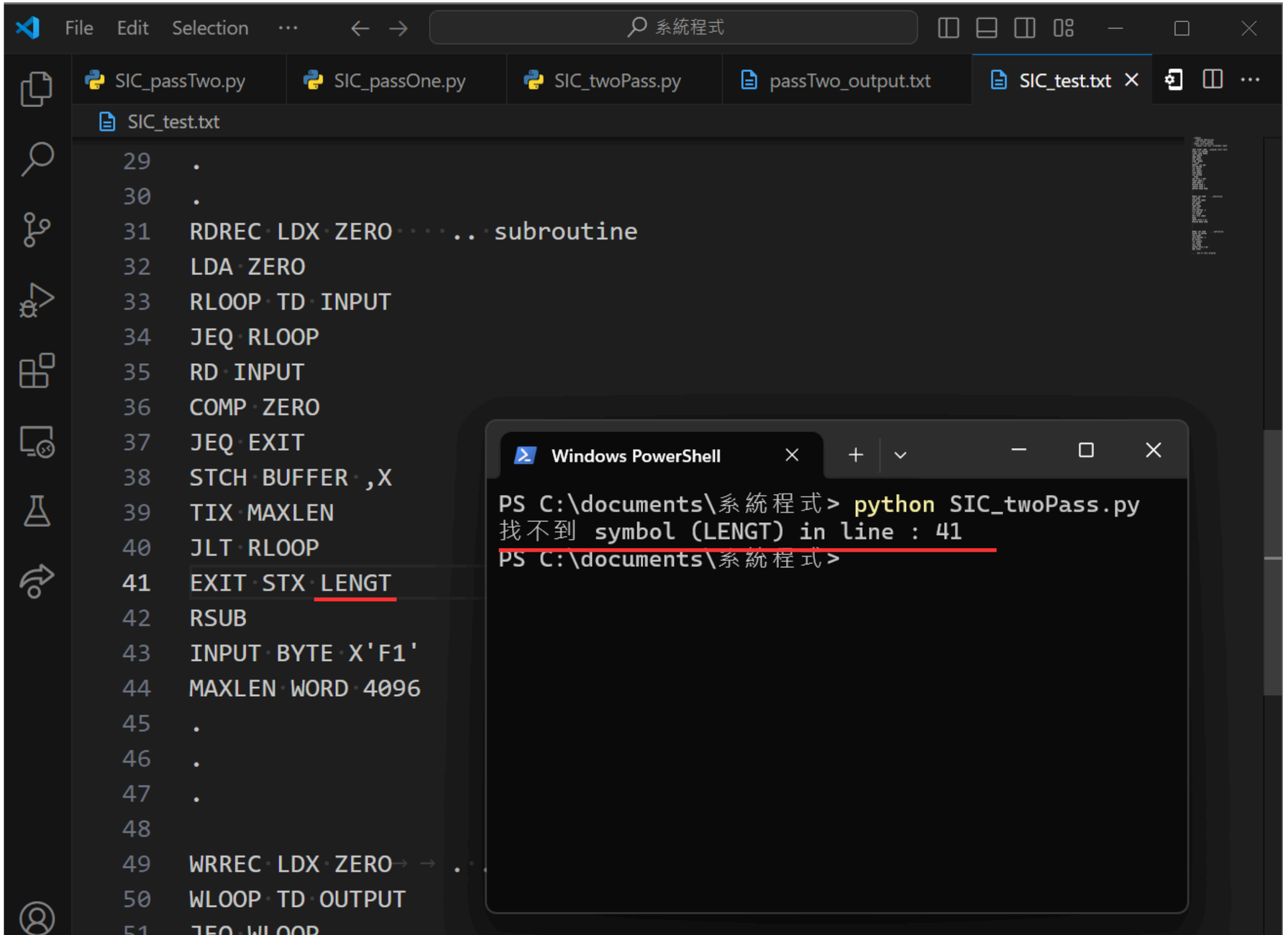
OPCODE 錯誤


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 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
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>

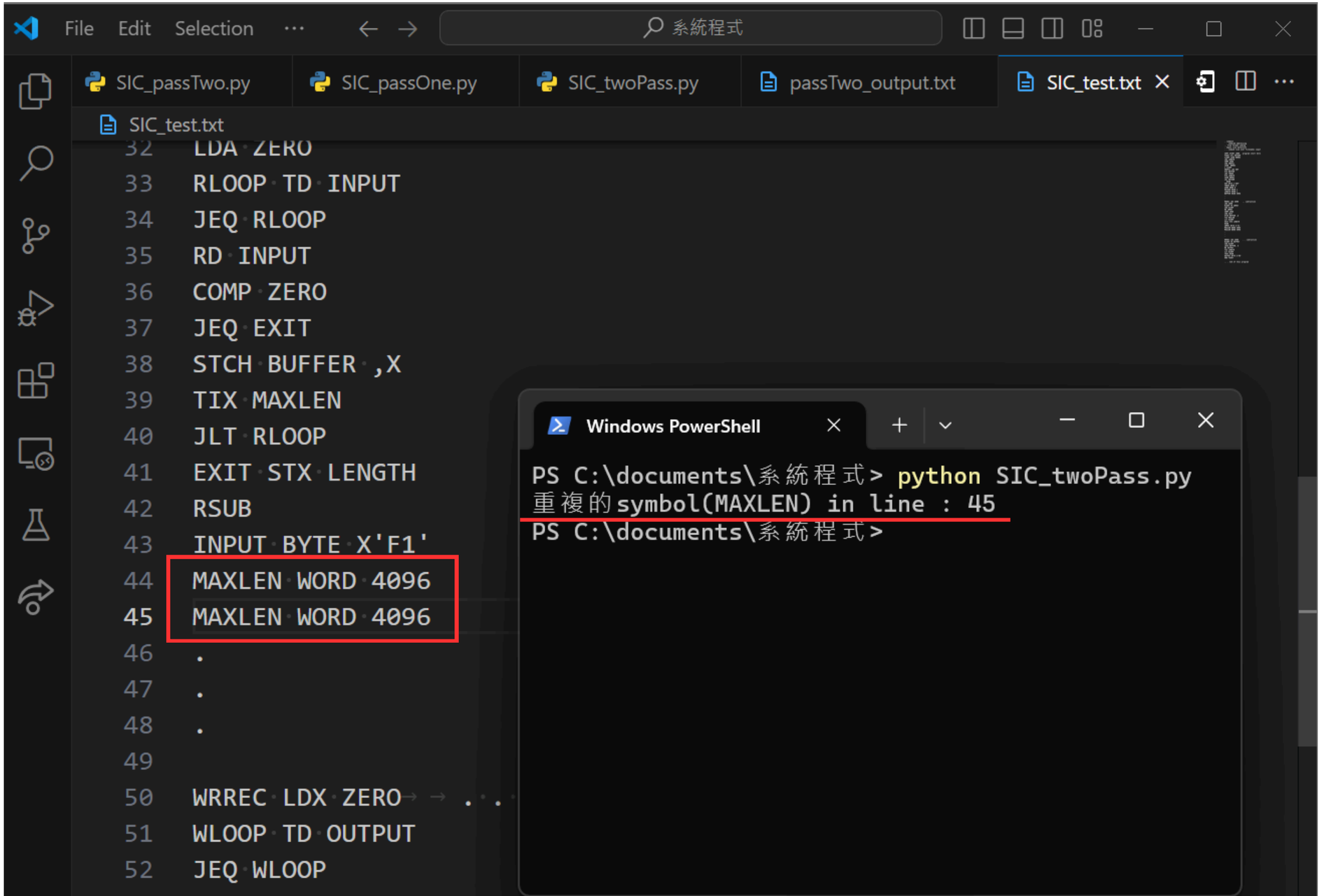
索引定址 錯誤


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
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
Windows PowerShell
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>

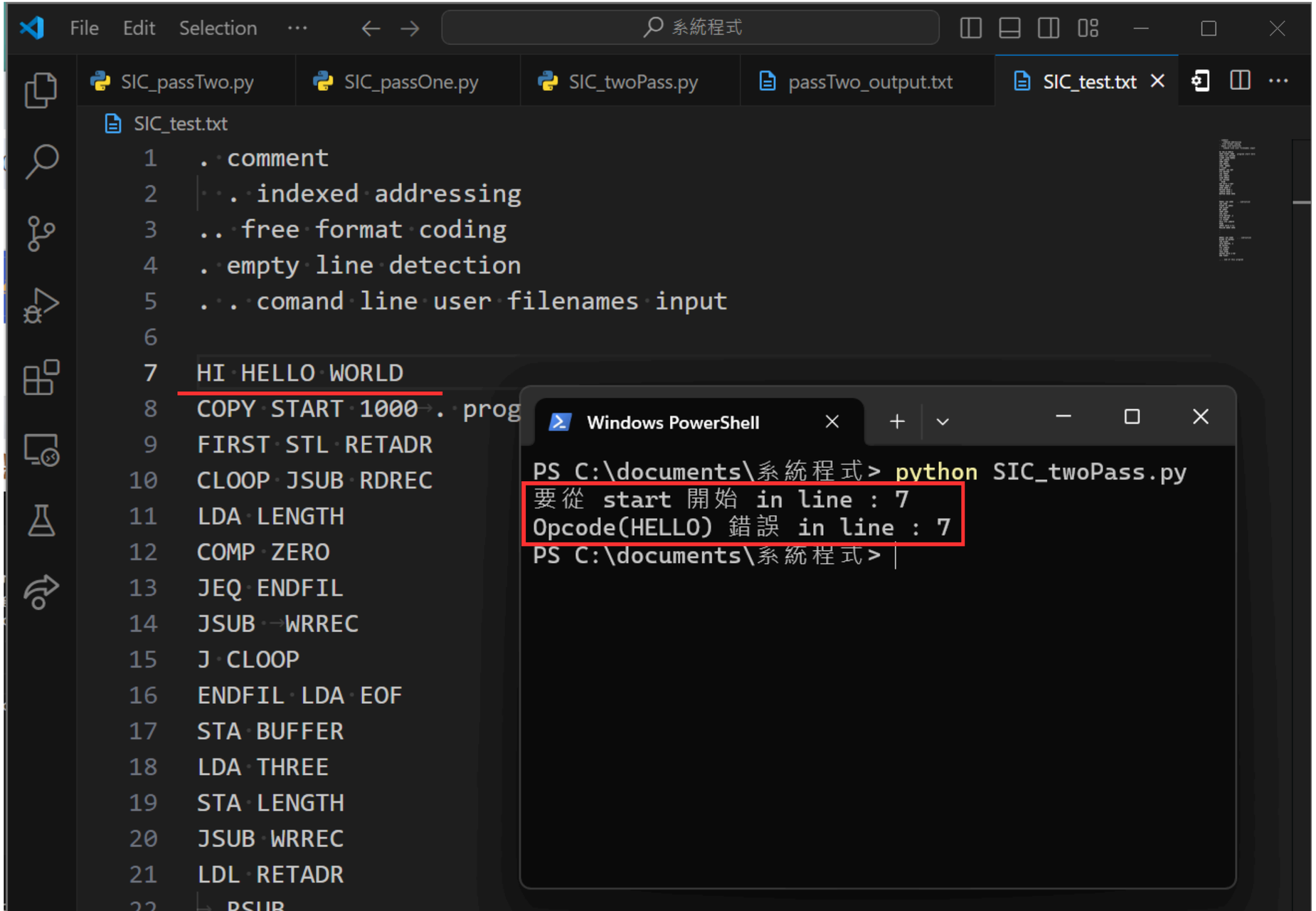
無法找到 Symbol


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 LENGT
42 RSUB
43 INPUT BYTE X'F1'
44 MAXLEN WORD 4096
45 .
46 .
47 .
48
49 WRREC LDX ZERO
50 WLOOP TD OUTPUT
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>

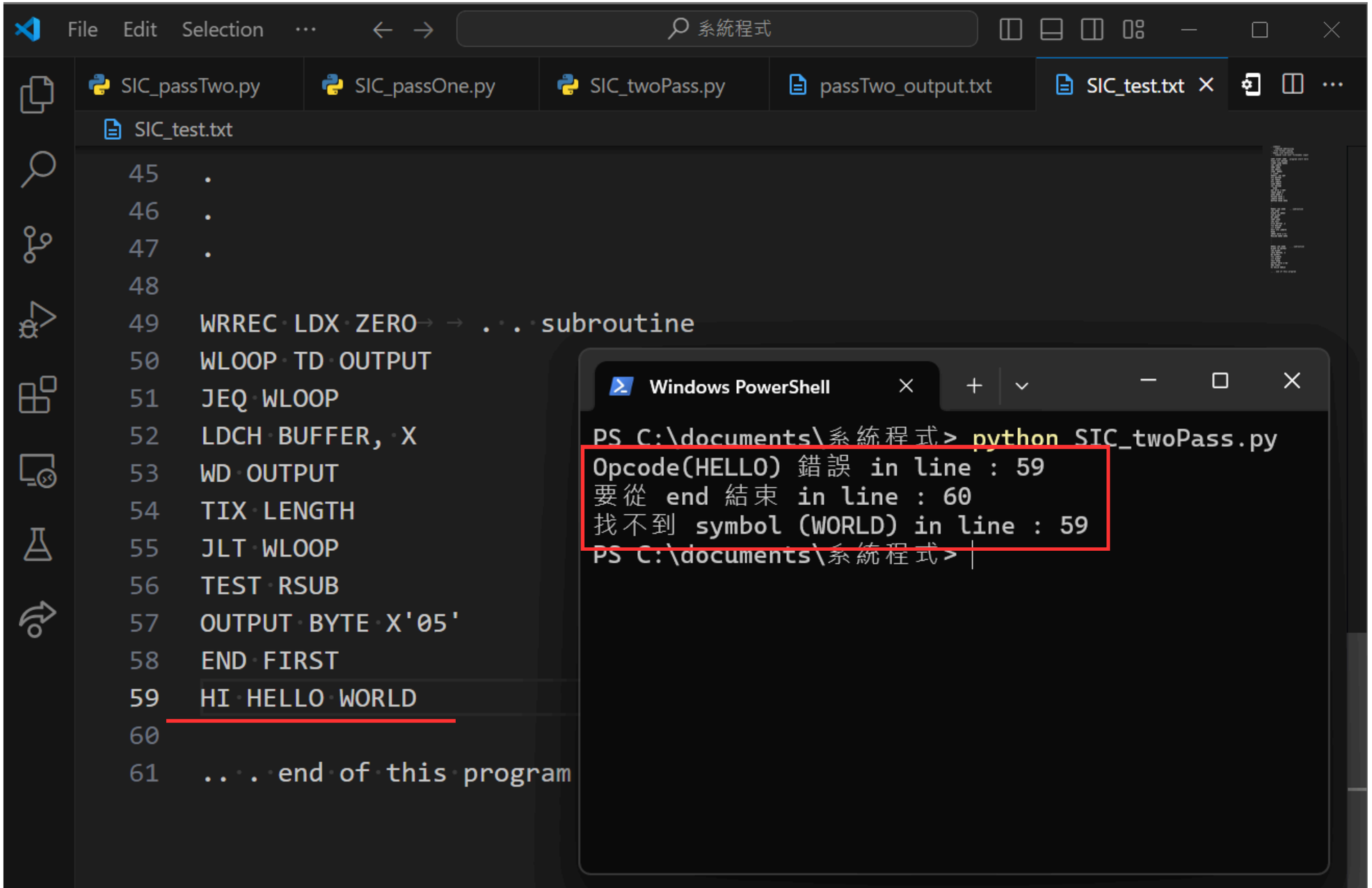
重覆定義 Symbol


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
LDA ZERO
RLOOP TD INPUT
JEQ RLOOP
RD INPUT
COMP ZERO
JEQ EXIT
STCH BUFFER ,X
TIX MAXLEN
JLT RLOOP
EXIT STX LENGTH
RSUB
INPUT BYTE X'F1'
MAXLEN WORD 4096
MAXLEN WORD 4096
.
.
.
WRREC LDX ZERO
WLOOP TD OUTPUT
JEQ WLOOP
Windows PowerShell
PS C:\documents\系統程式> python SIC_twoPass.py
重複的symbol(MAXLEN) in line : 45
PS C:\documents\系統程式>

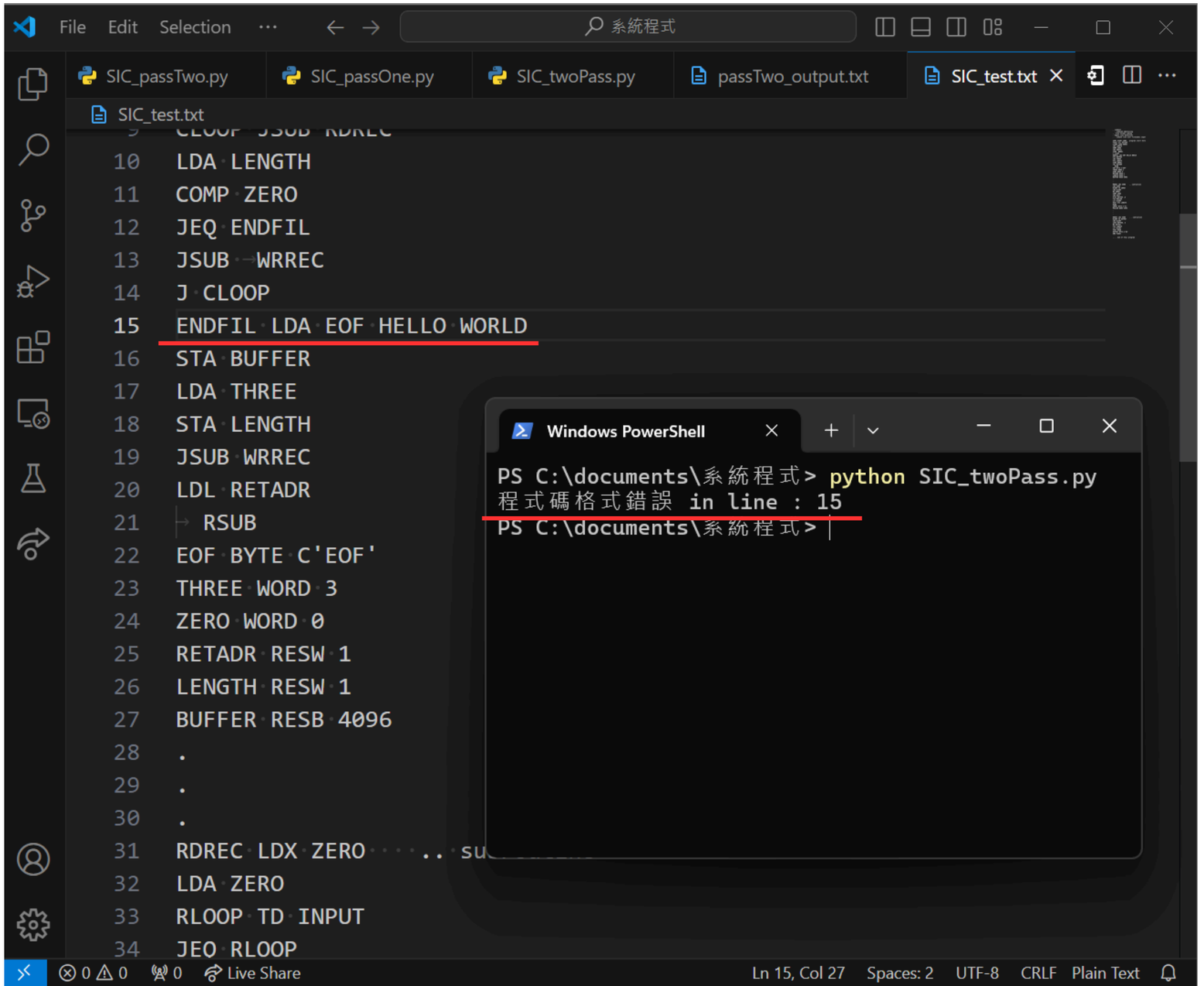
程式開頭要是START



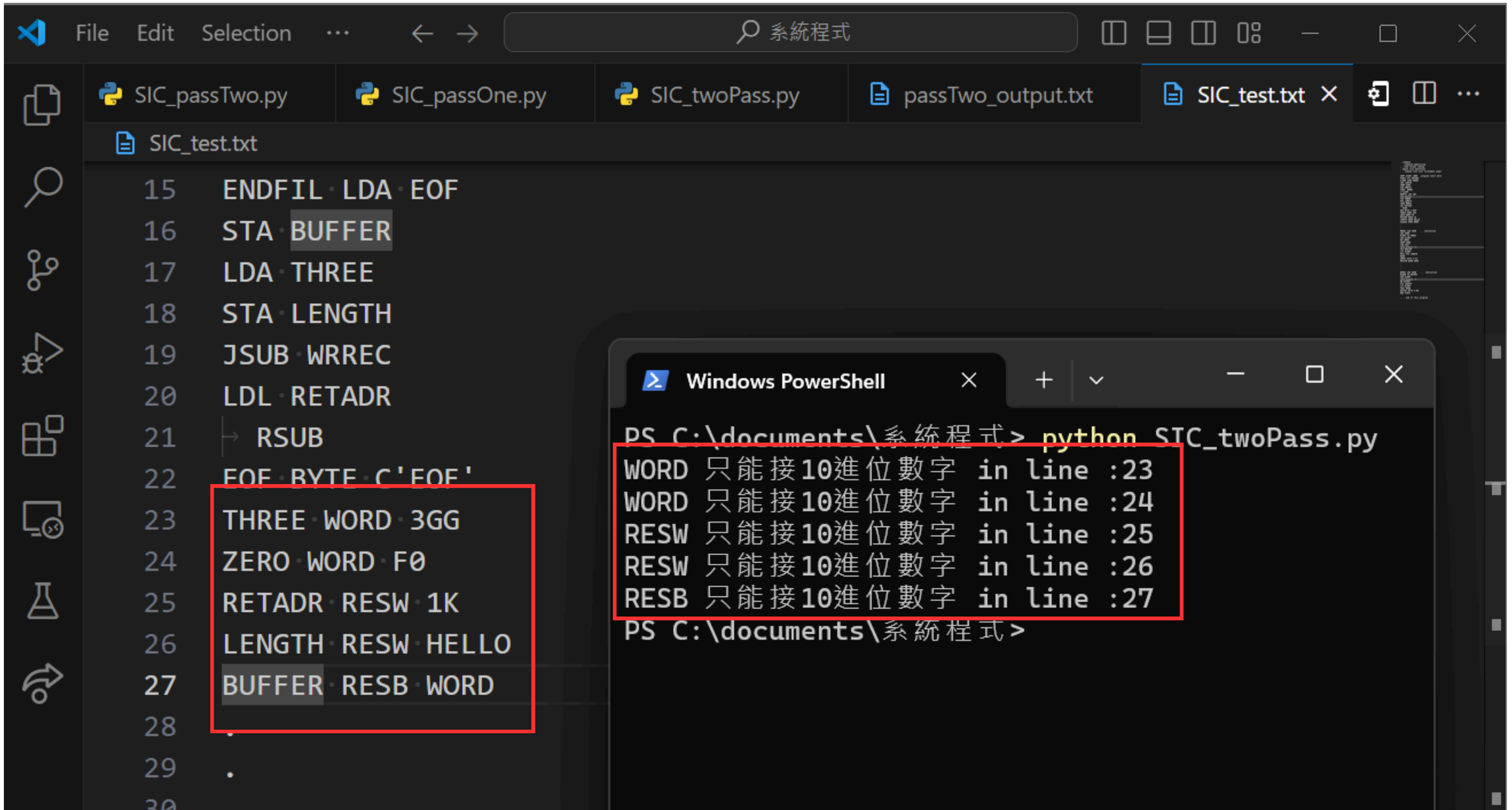
程式結尾要是END


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
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
Windows PowerShell
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>

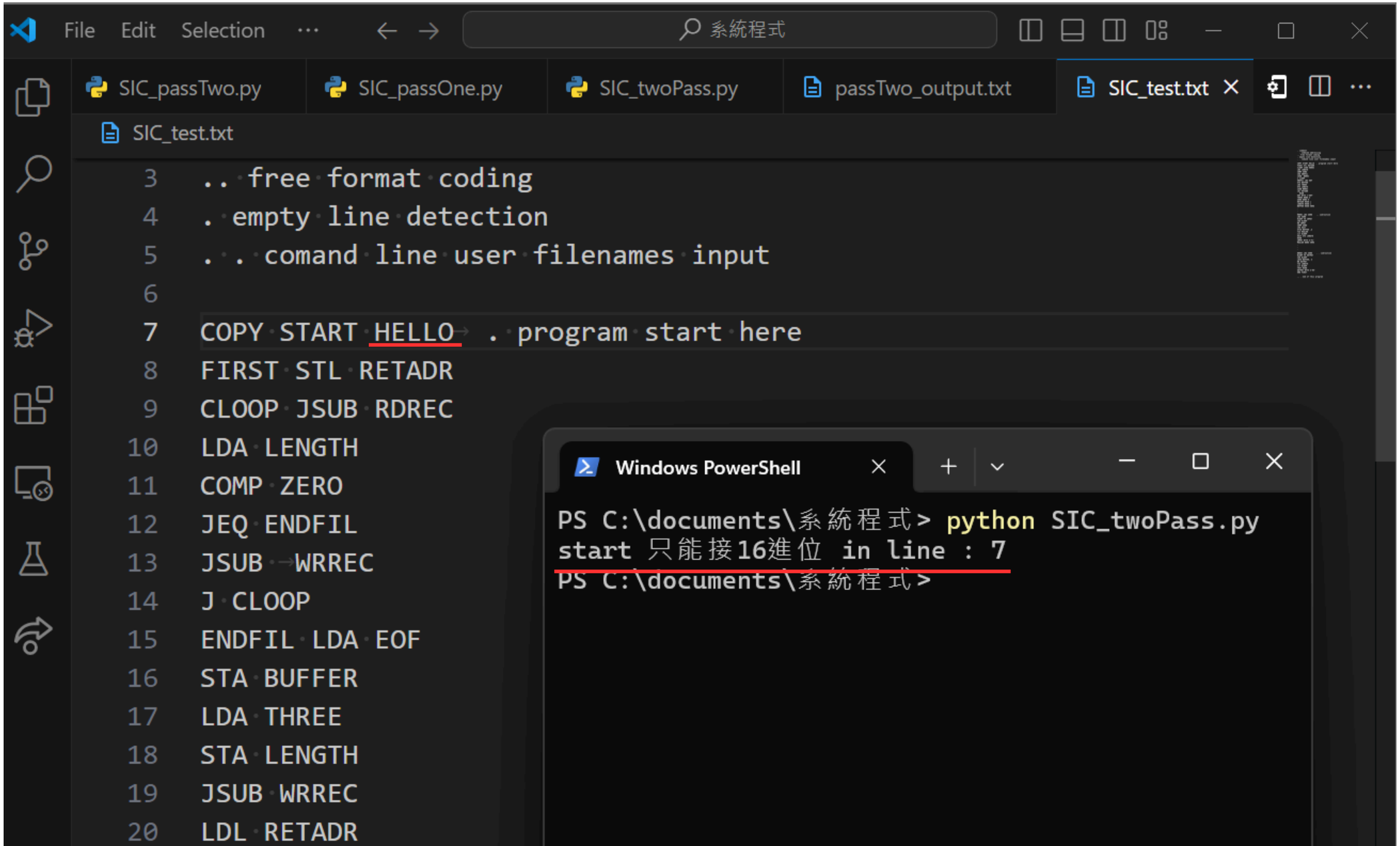
程式碼格式錯誤


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
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
32 LDA ZERO
33 RLOOP TD INPUT
34 JEQ RLOOP
Windows PowerShell
PS C:\documents\系統程式> python SIC_twoPass.py
程式碼格式錯誤 in line : 15
PS C:\documents\系統程式>
Live Share
Ln 15, Col 27
Spaces: 2
UTF-8
CRLF
Plain Text

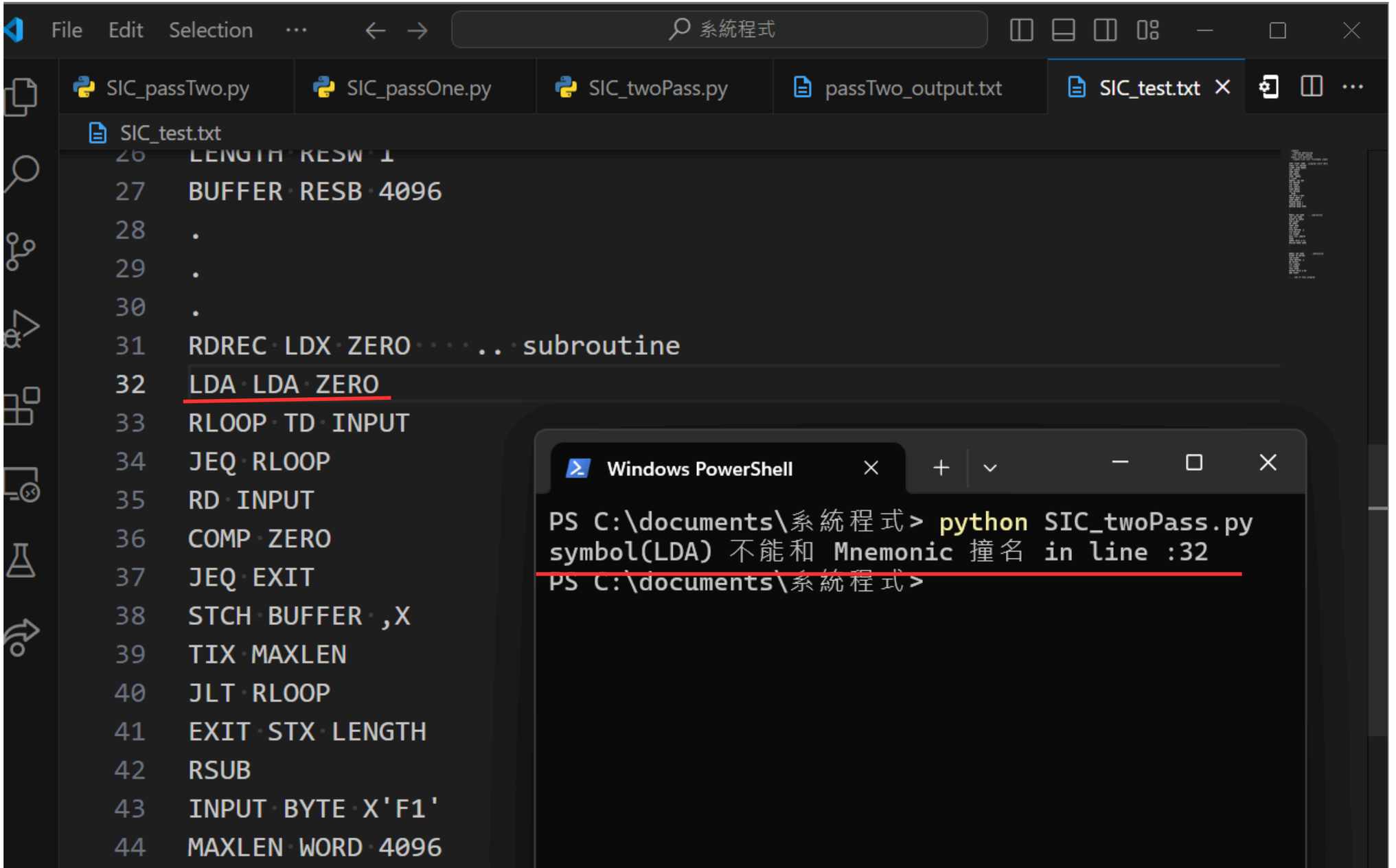
WORD,RESW,RESB 只能接十進位數字



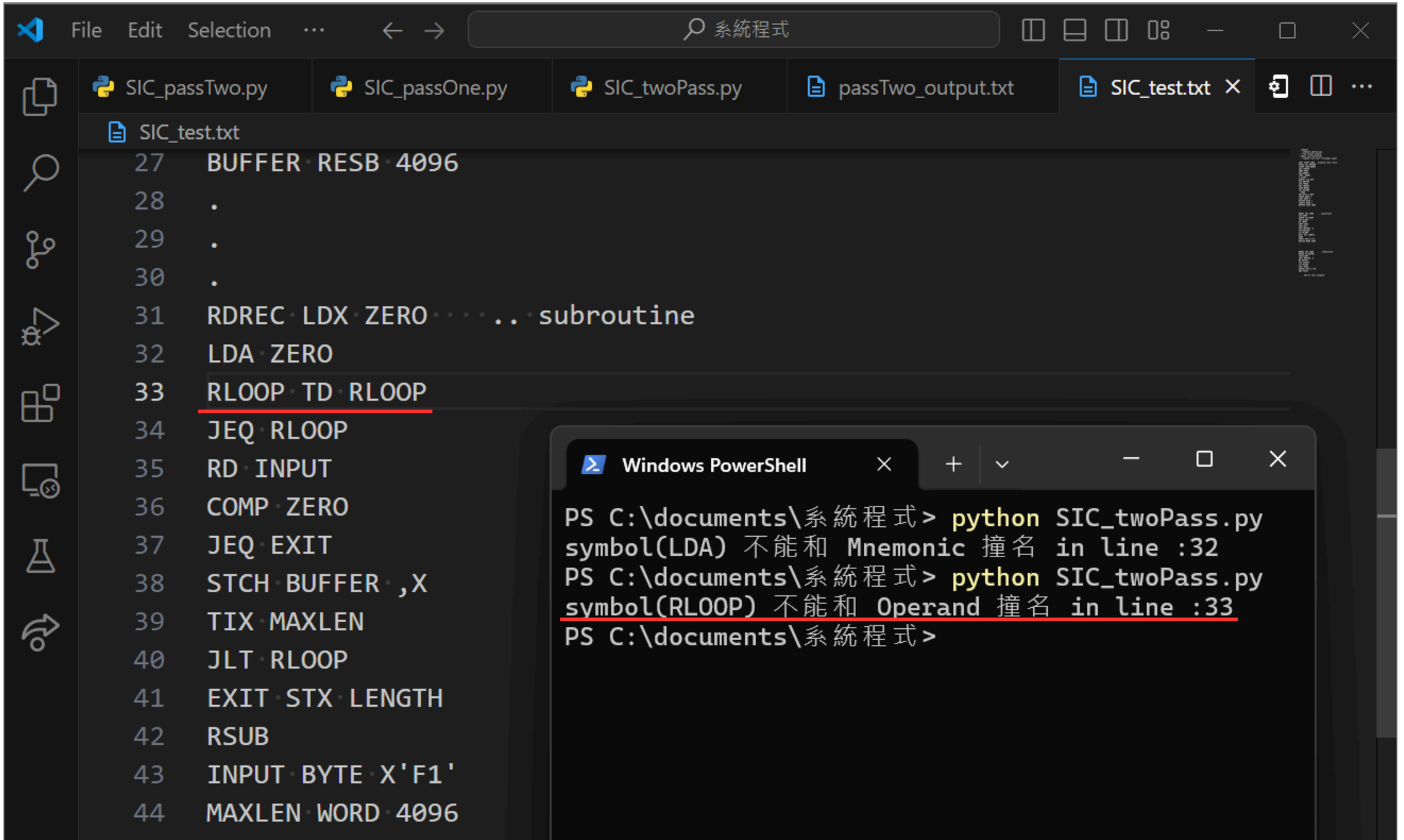
START 只能接十六進位數字



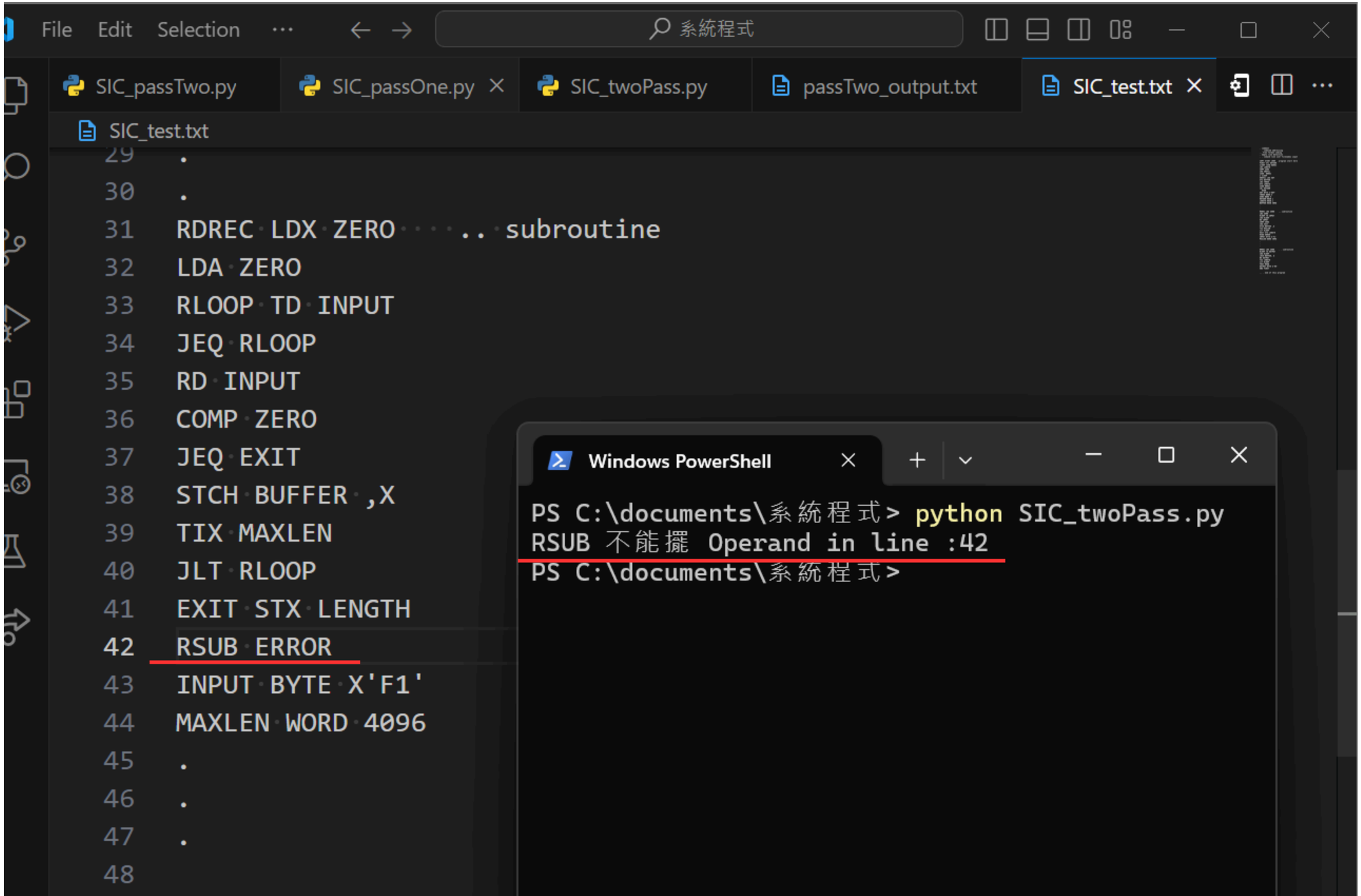
Symbol 不能和 Mnemonic 撞名



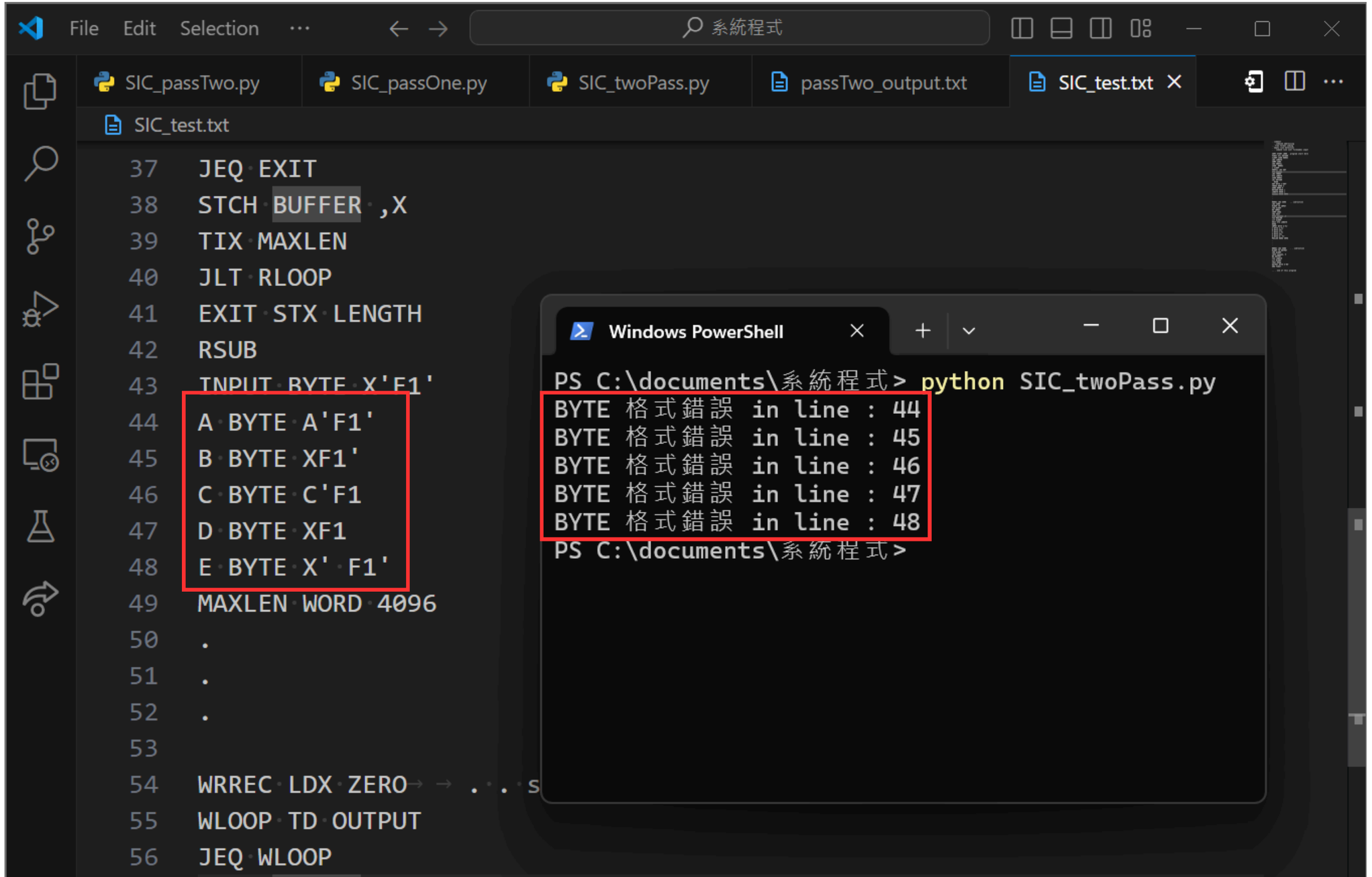
Symbol 不能和 Operand 撞名



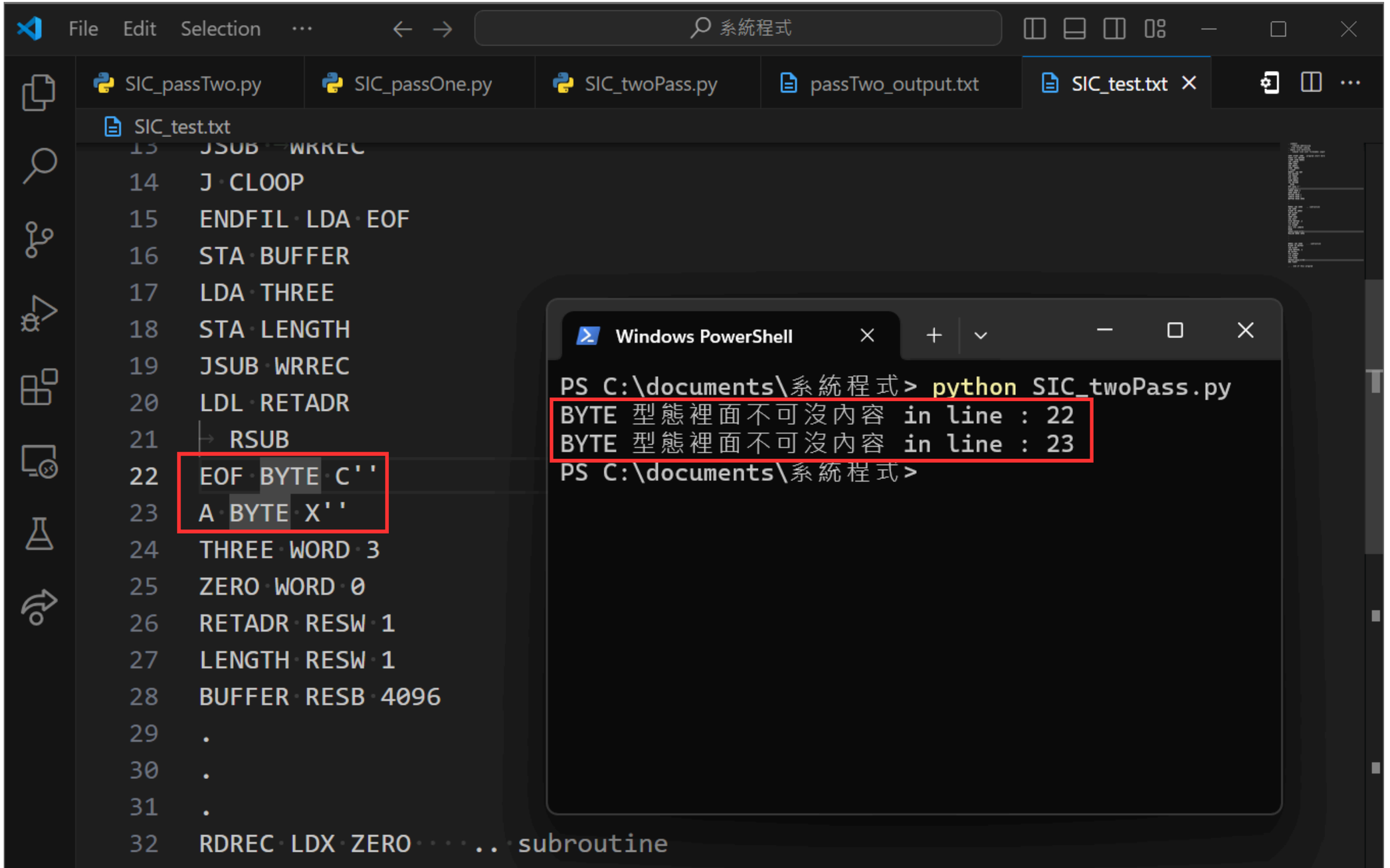
RSUB 不能擺 Operand



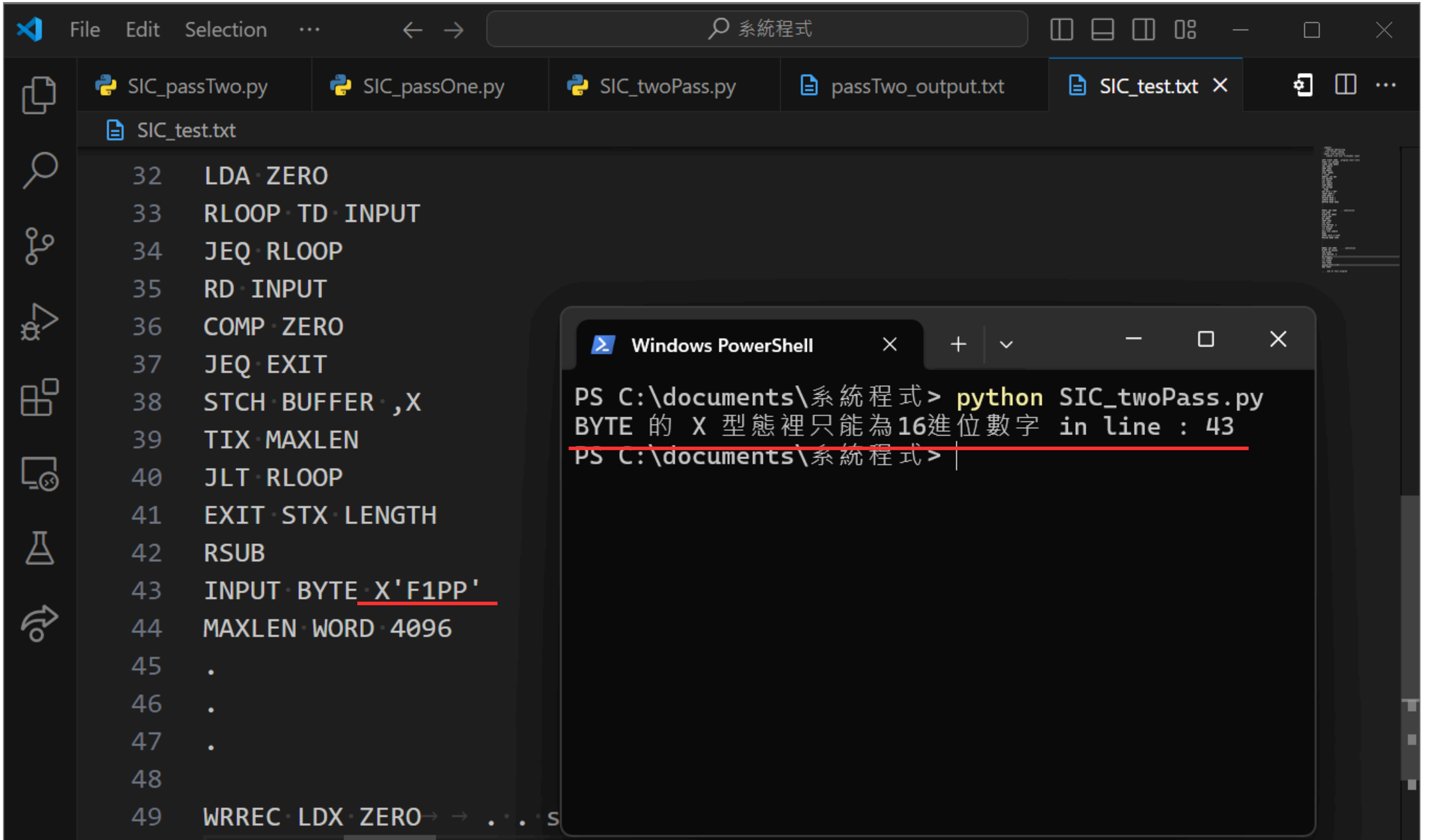
BYTE 格式錯誤


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
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 A'F1'
45 B BYTE XF1'
46 C BYTE C'F1
47 D BYTE XF1
48 E BYTE X' F1'
49 MAXLEN WORD 4096
50 .
51 .
52 .
53
54 WRREC LDX ZERO
55 WLOOP TD OUTPUT
56 JEQ WLOOP
Windows PowerShell
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



BYTE X 內容只能是十六進位



BYTE X 內容個數只能為偶數