

2020年度電子情報工学科実験III ボードコンピュータ実験 第3部 QtSPIMを用いた実験 (Windows)

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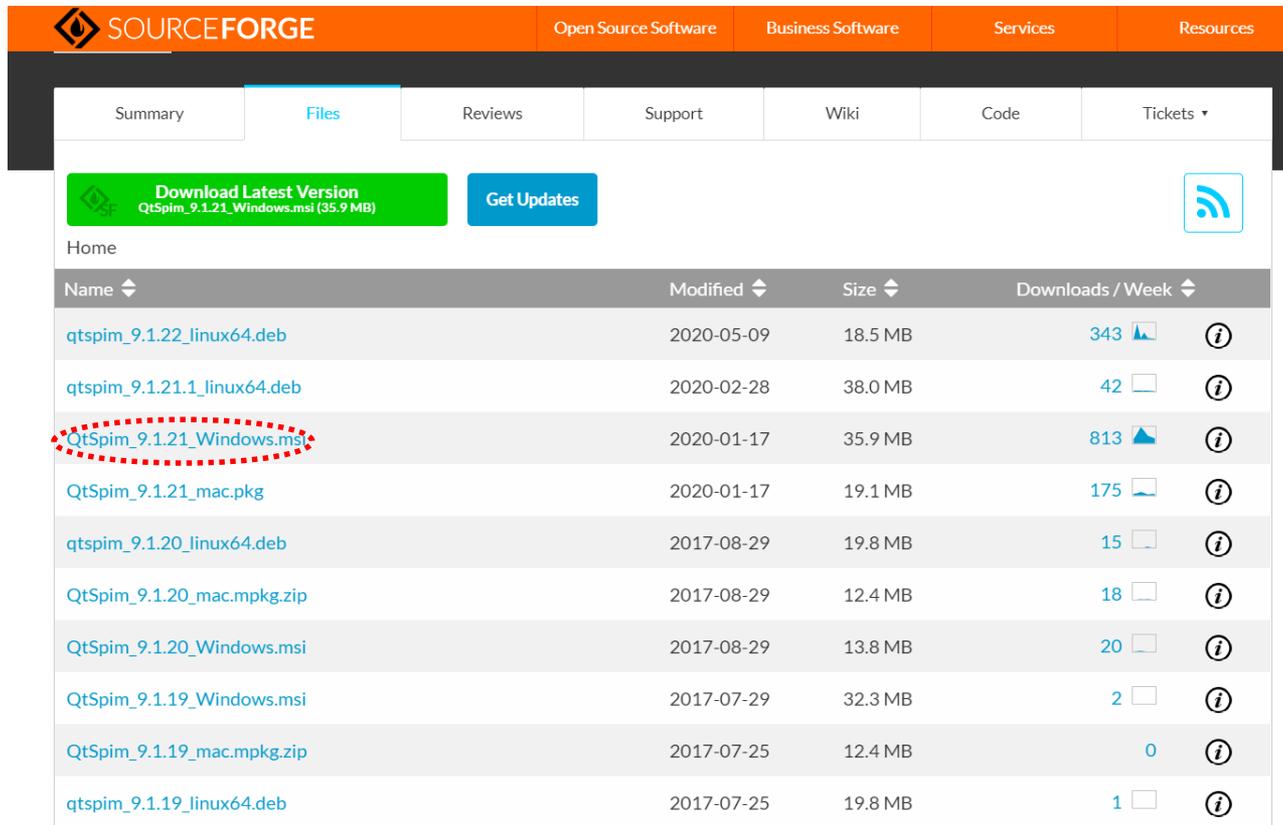
2020/6/3

QtSPIM

- Wisconsin大学Madison校のJames Larusにより開発されたMIPS32のアセンブリ言語のシミュレータ
- 本スライドではWindows10にてQtSPIM 9.1.21の環境構築を行う
(<https://sourceforge.net/projects/spimsimulator/files/>)

インストール手順

① Windowsの最新版をダウンロード



The screenshot shows the SourceForge project page for QtSpim. The navigation bar includes 'SOURCEFORGE', 'Open Source Software', 'Business Software', 'Services', and 'Resources'. Below the navigation bar, there are tabs for 'Summary', 'Files', 'Reviews', 'Support', 'Wiki', 'Code', and 'Tickets'. A green button labeled 'Download Latest Version' with the text 'QtSpim_9.1.21_Windows.msi (35.9 MB)' is prominent. A blue button labeled 'Get Updates' is also visible. A table lists various download files with columns for Name, Modified, Size, and Downloads / Week. The file 'QtSpim_9.1.21_Windows.msi' is circled in red.

Name	Modified	Size	Downloads / Week
qtspim_9.1.22_linux64.deb	2020-05-09	18.5 MB	343
qtspim_9.1.21.1_linux64.deb	2020-02-28	38.0 MB	42
QtSpim_9.1.21_Windows.msi	2020-01-17	35.9 MB	813
QtSpim_9.1.21_mac.pkg	2020-01-17	19.1 MB	175
qtspim_9.1.20_linux64.deb	2017-08-29	19.8 MB	15
QtSpim_9.1.20_mac.mpkg.zip	2017-08-29	12.4 MB	18
QtSpim_9.1.20_Windows.msi	2017-08-29	13.8 MB	20
QtSpim_9.1.19_Windows.msi	2017-07-29	32.3 MB	2
QtSpim_9.1.19_mac.mpkg.zip	2017-07-25	12.4 MB	0
qtspim_9.1.19_linux64.deb	2017-07-25	19.8 MB	1

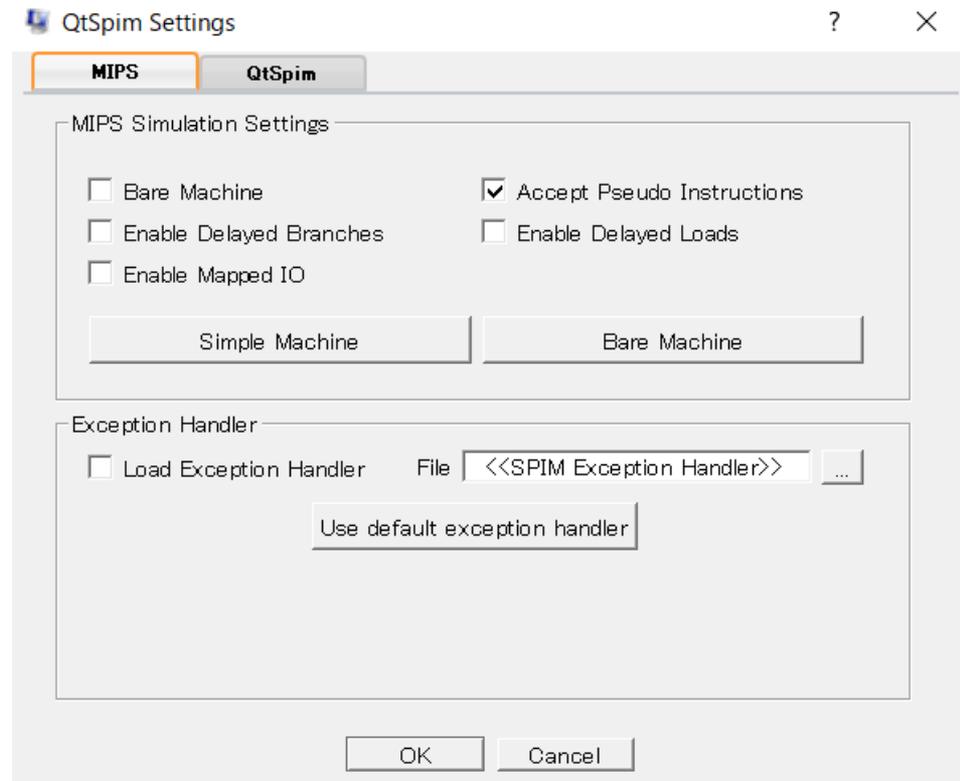
インストール手順

- ② “Next”→チェックして“Next”→インストール場所を指定して“Next”→“Install”でインストール



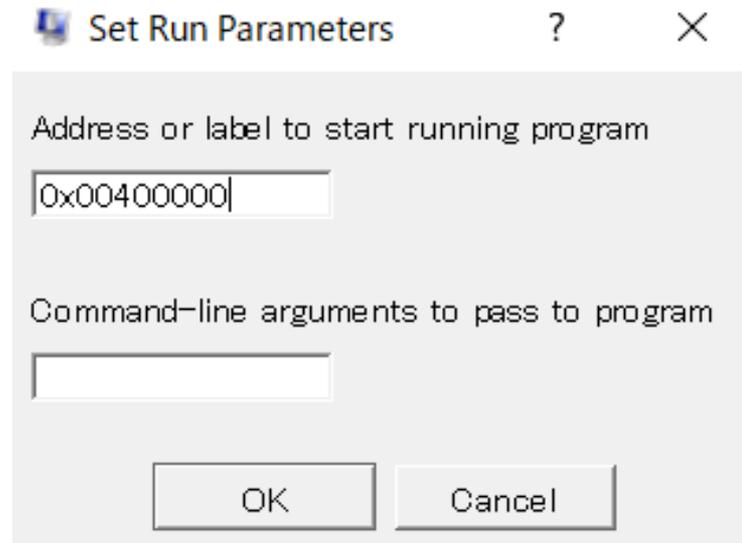
初期設定

- “Simulator” → “Settings” から下画像のように設定する(MIPSのみ)



実行手順

- ① “File” → “Reinitialize and Load File”から開きたいファイルを選択する
- ② はじめから実行する場合は“Simulator” → “Run Parameters”から下画像のように初期値を設定する



実行手順

- ③ “Run”で実行する。“Int Regs”, “Data”などのウィンドウからメモリ・レジスタの値を確認できる

The screenshot shows the QtSpim simulator interface. The 'Int Regs [16]' window on the left lists registers PC through R21 with their current values. The 'Data' window on the right shows memory segments: 'User data segment [10000000]..[10040000]' and 'User Stack [7ffff62c]..[80000000]'. The stack contains ASCII text including 'ane / Documents / 20', '20 TA / sum . s . C', ': / Users / Kenta . wi', 'ndir=C: \ WINDOWS .', 'V S l i 0 C O M N T O O L S = C', ': \ Program Files', '2074666f (x86) \ Microsoft', 'V i s u a l S t u d i o 1 1', '. 0 \ Common7 \ Tools', '\ . USERPROFILE=C:', '\ Users \ Kenta Shi', 'rane . USERNAME=Ke', 'nta Shirane . USER'. A large Japanese character '資料' (Shiryō) is overlaid on the register list. The bottom status bar contains copyright and license information.

資料

```
PC = 0
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000fff0

HI = 0
LO = 0

R0 [r0] = 0
R1 [at] = 0
R2 [v0] = 0
R3 [v1] = 0
R4 [a0] = 2
R5 [a1] = 7ffff630
R6 [a2] = 7ffff63c
R7 [a3] = 0
R8 [t0] = 0
R9 [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0

User data segment [10000000]..[10040000]
[10000000]..[1000ffff] 00000000
[10010000] 00000001 00000002 00000004 00000003
[10010010]..[1003ffff] 00000000

User Stack [7ffff62c]..[80000000]
[7ffff62c] 00000002
[7ffff630] 7ffff70f 7ffff6ec 00000000 7fffffe1
[7ffff640] 7fffffb2 7fffff81 7fffff45 7fffff14
[7ffff650] 7ffffef7 7ffffed3 7ffffea1 7ffffe94
[7ffff660] 7ffffe76 7ffffe53 7ffffe21 7ffffe03
[7ffff670] 7ffffd9e 7ffffdc7 7ffffd9e 7ffffd6d
[7ffff680] 7ffffd5f 7ffffa5d 7ffffa1f 7ffffa02
[7ffff690] 7ffff9b9 7ffff9a7 7ffff98f 7ffff974
[7ffff6a0] 7ffff956 7ffff92d 7ffff90f 7ffff8a4
[7ffff6b0] 7ffff88d 7ffff879 7ffff86a 7ffff854
[7ffff6c0] 7ffff82a 7ffff801 7ffff7e6 7ffff7bc
[7ffff6d0] 7ffff7a5 7ffff782 7ffff730 7ffff71e
[7ffff6e0] 00000000 00000000 00000000 72696853
[7ffff6f0] 2f656e61 75636f44 746e656d 30322f73
[7ffff700] c08e3032 4154b18c 6d75732f 4300732e
[7ffff710] 73552f3a 2f737265 746e654b 69770061
[7ffff720] 7269646e 5c3a433d 444e4957 0053574f
[7ffff730] 31315356 4d4f4330 4f4f544e 433d534c
[7ffff740] 72505c3a 6172676f 6946206d 2073656c
[7ffff750] 36387828 694d5c29 736f7263 2074666f
[7ffff760] 75736956 53206c61 69647574 3131206f
[7ffff770] 435c302e 6f6d6d6f 545c376e 736c6f6f
[7ffff780] 5355005c 52505245 4c49464f 3a433d45
[7ffff790] 6573555c 4b5c7372 61746e65 69685320
[7ffff7a0] 65e6e172 45535500 4d414e52 654b3d45
[7ffff7b0] 2061746e 72696853 00656e61 52455355

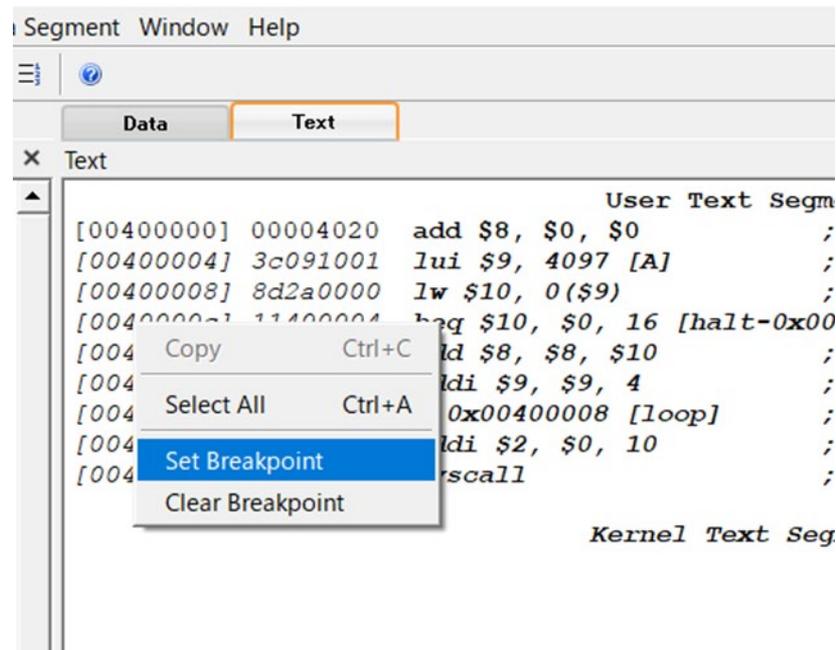
All Rights Reserved.
SPIM is distributed under a BSD license.
See the file README for a full copyright notice.
QtSPIM is linked to the Qt library, which is distributed under the GNU Lesser General Public License version 3 and version 2.1.
```

その他機能

- Reinitialize Simulator
 - シミュレータを初期化
- Stop
 - プログラムの実行を停止する
- Single Step
 - 1命令ずつ実行、デバッグなどで用いる
- Registers, Data Segment
 - メモリ・レジスタの値の表記を変更できる、初期はHex(16進数表記)
- “Window” → “Restores to default”からウィンドウの並び方を初期位置に戻せる

その他機能

- breakpoint
 - 実行した命令を停止する点を設定できる
 - “text”領域で右クリック



(実行例)例4-1を実行

- 実行前画面

The screenshot shows the QtSpim simulator interface. The 'Int Regs [16]' window is open, displaying the following register values:

PC	=	0
EPC	=	0
Cause	=	0
BadVAddr	=	0
Status	=	3000ff10
HI	=	0
LO	=	0
R0 [r0]	=	0
R1 [at]	=	0
R2 [v0]	=	0
R3 [v1]	=	0
R4 [a0]	=	2
R5 [a1]	=	7ffff630
R6 [a2]	=	7ffff63c
R7 [a3]	=	0
R8 [t0]	=	0
R9 [t1]	=	0
R10 [t2]	=	0
R11 [t3]	=	0
R12 [t4]	=	0
R13 [t5]	=	0
R14 [t6]	=	0
R15 [t7]	=	0
R16 [s0]	=	0
R17 [s1]	=	0
R18 [s2]	=	0
R19 [s3]	=	0
R20 [s4]	=	0
R21 [s5]	=	0

The 'Data' window shows the 'User data segment' and 'User Stack'. A red box highlights the memory address [10010010] with the text '配列Aがセットされている' (Array A is set). The 'User Stack' window shows the following memory addresses and values:

[7ffff62c]	00000002			
[7ffff630]	7ffff70f	7ffff6ec	00000000	7fffffe1
[7ffff640]	7fffffb2	7fffff81	7fffff45	7fffff14 E
[7ffff650]	7ffffef7	7ffffed3	7ffffea1	7ffffe94
[7ffff660]	7ffffe76	7ffffe53	7ffffe21	7ffffe03	v . . . S . . . ! . . .
[7ffff670]	7ffffdde	7ffffdc7	7ffffd9e	7ffffd6d m
[7ffff680]	7ffffd5f	7ffffa5d	7ffffa1f	7ffffa02]
[7ffff690]	7ffff9b9	7ffff9a7	7ffff98f	7ffff974 t
[7ffff6a0]	7ffff956	7ffff92d	7ffff90f	7ffff8a4	V . . . - . . .
[7ffff6b0]	7ffff88d	7ffff879	7ffff86a	7ffff854 y . . . j . . . T . . .
[7ffff6c0]	7ffff82a	7ffff801	7ffff7e6	7ffff7bc	*
[7ffff6d0]	7ffff7a5	7ffff782	7ffff730	7ffff71e 0
[7ffff6e0]	00000000	00000000	00000000	72696853 S h i r
[7ffff6f0]	2f656e61	75636f44	746e656d	30322f73	a n e / D o c u m e n t s / 2 0
[7ffff700]	c08e3032	4154b18c	6d75732f	4300732e	2 0 T A / s u m . s . C
[7ffff710]	73552f3a	2f737265	746e654b	69770061	: / U s e r s / K e n t a . w i
[7ffff720]	7269646e	5c3a433d	444e4957	0053574f	n d i r = C : \ W I N D O W S .
[7ffff730]	31315356	4d4f4330	4f4f544e	433d534c	V S 1 1 0 C O M N T O O L S = C
[7ffff740]	72505c3a	6172676f	6946206d	2073656c	: \ P r o g r a m F i l e s
[7ffff750]	36387828	694d5c29	736f7263	2074666f	(x 8 6) \ M i c r o s o f t
[7ffff760]	75736956	53206c61	69647574	3131206f	V i s u a l S t u d i o 1 1
[7ffff770]	435c302e	6f6d6d6f	545c376e	736c6f6f	. 0 \ C o m m o n 7 \ T o o l s
[7ffff780]	5355005c	52505245	4c49464f	3a433d45	\ . U S E R P R O F I L E = C :
[7ffff790]	6573555c	4b5c7372	61746e65	69685320	\ U s e r s \ K e n t a S h i
[7ffff7a0]	656e6172	45535500	4d414e52	654b3d45	r a n e . U S E R N A M E = K e
[7ffff7b0]	2061746e	72696853	00656e61	52455355	n t a S h i r a n e . U S E R

(実行例)例4-1を実行

- 実行後画面

The screenshot shows the QtSpim debugger interface. On the left, the 'Int Regs [16]' window displays the state of the CPU registers. On the right, the 'Data' window shows the 'User Stack' memory area.

停止時のPCの値 (PC value at stop time): A red box highlights the PC register value, which is 400020. A red arrow points from this box to the PC register entry in the 'Int Regs' window.

資料 (Data): A large red arrow points from the '資料' text to the 'Int Regs' window, specifically to the R9 register.

配列Aの総和がt0に出力されている (Sum of array A is output to t0): A red box highlights the value 10010010 in the R9 register. A red arrow points from this box to the R9 register entry in the 'Int Regs' window.

The 'Int Regs [16]' window shows the following register values:

```
PC = 400020
EPC = 0
Cause = 0
BadVAddr = 0
Status = 3000ff10
HI = 0
LO = 0
R0 [r0] = 0
R1 [at] = 0
R2 [v0] = a
R3 [v1] = 0
R4 [a0] = 2
R5 [a1] = 7ffff630
R6 [a2] = 7ffff63c
R7 [a3] = 0
R8 [t0] = a
R9 [t1] = 10010010
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
```

The 'User Stack [7ffff62c]..[80000000]' window shows the following memory contents:

```
[7ffff62c] 00000002
[7ffff630] 7ffff70f 7ffff6ec 00000000 7fffffe1
[7ffff640] 7fffffb2 7fffff81 7fffff45 7fffff14
[7ffff650] 7ffffef7 7ffffed3 7ffffeal 7ffffe94
[7ffff6a0] 7ffff956 7ffff92d 7ffff90f 7ffff8a4
[7ffff6b0] 7ffff88d 7ffff879 7ffff86a 7ffff854
[7ffff6c0] 7ffff82a 7ffff801 7ffff7e6 7ffff7bc
[7ffff6d0] 7ffff7a5 7ffff782 7ffff730 7ffff71e
[7ffff6e0] 00000000 00000000 00000000 72696853
[7ffff6f0] 2f656e61 75636f44 746e656d 30322f73
[7ffff700] c08e3032 4154b18c 6d75732f 4300732e
[7ffff710] 73552f3a 2f737265 746e654b 69770061
[7ffff720] 7269646e 5c3a433d 444e4957 0053574f
[7ffff730] 31315356 4d4f4330 4f4f544e 433d534c
[7ffff740] 72505c3a 6172676f 6946206d 2073656c
[7ffff750] 36387828 694d5c29 736f7263 2074666f
[7ffff760] 75736956 53206c61 69647574 3131206f
[7ffff770] 435c302e 6f6d6d6f 545c376e 736c6f6f
[7ffff780] 5355005c 52505245 4c49464f 3a433d45
[7ffff790] 6573555c 4b5c7372 61746e65 69685320
[7ffff7a0] 656e6172 45535500 4d414e52 654b3d45
[7ffff7b0] 2061746e 72696853 00656e61 52455355
```