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EECS 361: SINGLE CYCLE PROCESSOR, GROUP 2

Introduction

In this project, we were asked to design, implement, and test a single-cycle processor that is capable of handling the below subset of the MIPS instruction set:

- Arithmetic: add, addi, addu, sub, subu
- Logical: and, or, sll
- Data Transfer: lw, sw
- Conditional Branch: beq, bne, slt, sltu

Design

We successfully implemented this project through a structural design approach, first implementing the required lower level components (such as the various types of multiplexers), and then combining them to form the higher-level components (such as the register file and control logic). Finally, we wired up these higher-level components together in a fashion similar to the diagram in *Figure 1* to produce the highest-level single-cycle processor component named *mips_single_cycle*.

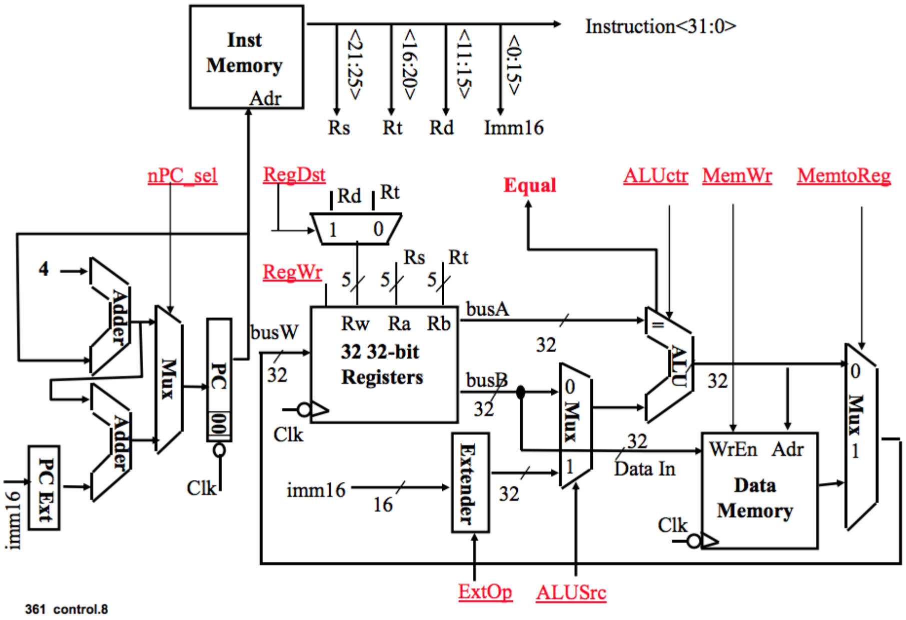


Figure 1: *Single Cycler Processor Design (Slide 8, Lecture 8)*

We justify these design decisions through the benefits that this approach provides, which are mainly:

1. A modular approach allows us to not only test and debug individual components, but also allows us to reuse components and work as a team building multiple components at the same time.
2. An ALU from previous projects was reused in this project, in large part because of its applicability to many operations in the requested subset of the MIPS Instruction Set.
3. Control logic is wired manually using a control logic component and built from very basic gates as a custom logic component for this very specific set of instructions. This is to ensure speed and output according to specification on the project handout design document.

Control Signals

The results of our project include all VHDL files implemented and used in making the processor, as well as the waveforms of the test benches running the three test *.dat files. A mapping from VHD file to component can be found below:

Component	File Name
Control Logic	control_unit.vhd
PC Instruction Logic	pc_logic.vhd
ALU Control Logic	alu_control.vhd
ALU	alu.vhd
32 32-bit registers	registerfile32.vhd
Extender	extender.vhd
Data Memory	sram.vhd (library file)

Furthermore, we have outlined the control signals in a table below:

ALU Operations

Operation	Code	func	Control Signal
Load/Store	00	X	000
Branch	01	X	001
Add	10	100000	000
Subtract	10	100010	001
And	10	100100	010
Or	10	100101	011
SLT	10	101010	101
SLTU	10	101011	110
SLL	10	000000	100
AddU	10	100001	000
SubU	10	100011	000
AddI	11	X	000

Control Unit Operations

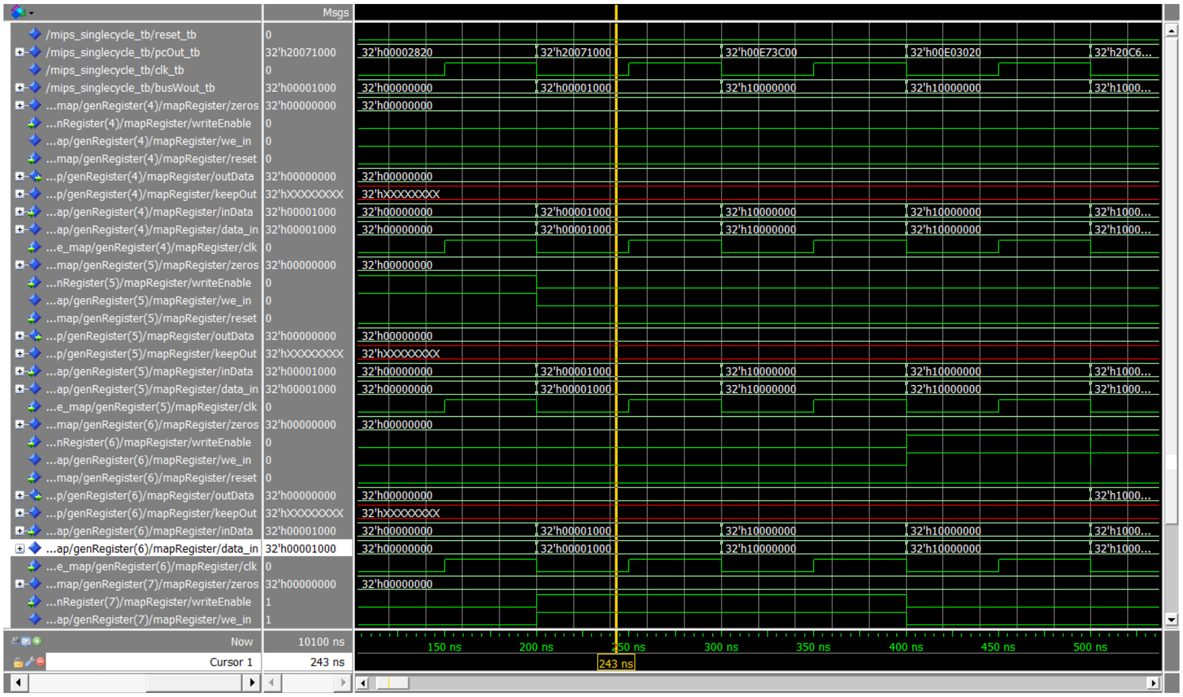
Operation	Opcode	ALU Op	RegDst	RegWr	ALU Src	PC Src	MemRead	MemWr	MemReg	ExtOp
R Type	000000	10	1	1	0	0	0	0	0	1
BEQ	000100	01	X	0	0	1	0	0	X	1
BNE	000101	01	X	0	0	1	0	0	X	1
AddI	001000	11	0	1	1	0	0	0	0	1
lw	100011	00	0	1	1	0	1	0	1	1
sw	101011	00	X	0	1	0	0	1	X	1

As indicated above, the various operations that our processor must perform will require the use of one or more control signals listed above. For example, an R-Type instruction will have an opcode of 000000, and as a result will flag various controls on and off to components located around the processor. Note that for all components, the *ExtOp* signal will always be set.

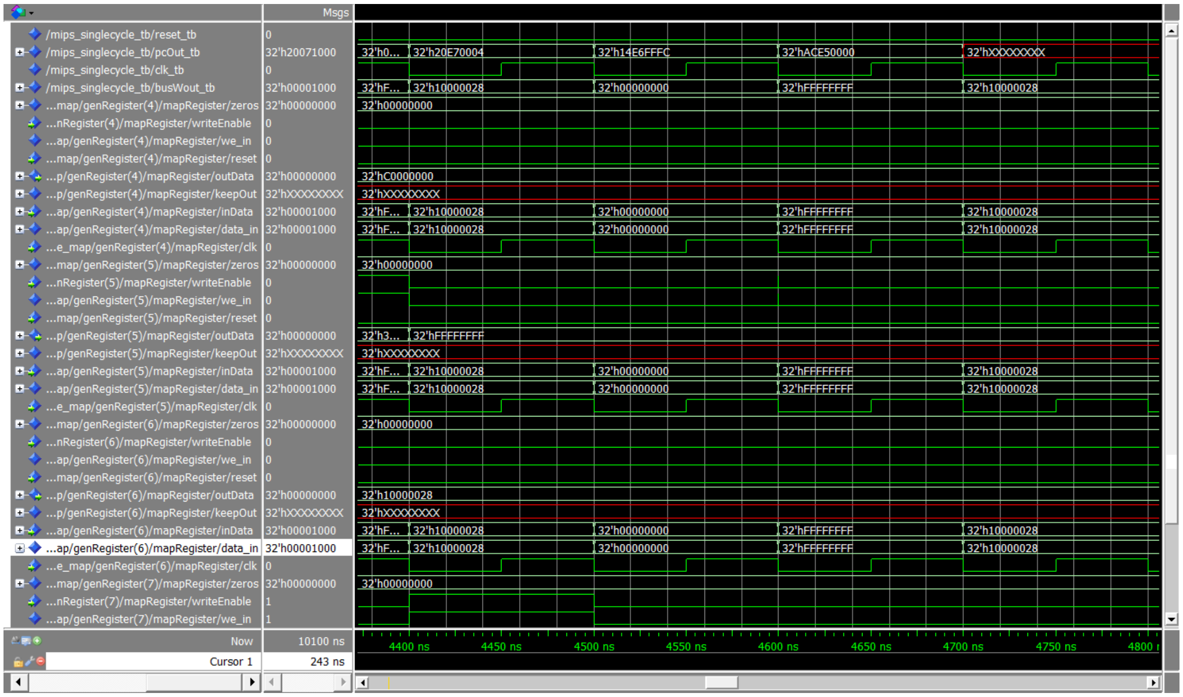
Waveforms

We attach the significant waveforms for the three test *.dat files in this section. These are the waveforms that show results, either by writing to memory the correct 32 bit hex value at the correct address, or by outputting that correct result to the output port of the processor. Both types of correct output can be seen in the waveforms below.

unsigned_sum.dat, showing first and last segments of waveform trace.

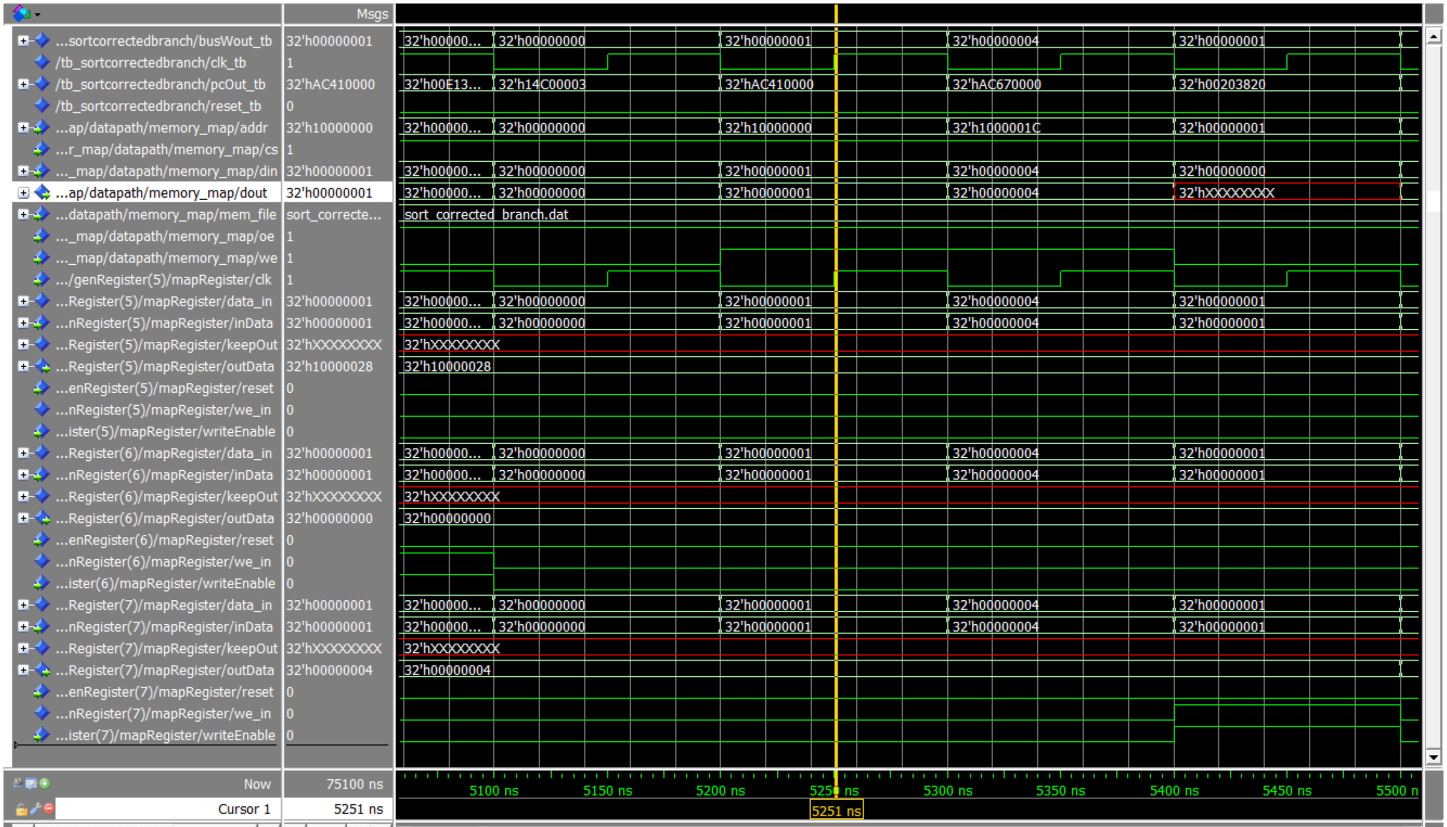


	Msgs
/mips_singlecycle_tb/reset_tb	0
/mips_singlecycle_tb/pcOut_tb	32'h20071000
/mips_singlecycle_tb/clk_tb	0
/mips_singlecycle_tb/busWout_tb	32'h00001000
...map/genRegister(4)/mapRegister/zeros	32'h00000000
...nRegister(4)/mapRegister/writeEnable	0
...ap/genRegister(4)/mapRegister/we_in	0
...map/genRegister(4)/mapRegister/reset	0
...p/genRegister(4)/mapRegister/outData	32'h00000000
...p/genRegister(4)/mapRegister/keepOut	32'hXXXXXXXX
...ap/genRegister(4)/mapRegister/inData	32'h00001000
...ap/genRegister(4)/mapRegister/data_in	32'h00001000
...e_map/genRegister(4)/mapRegister/clk	0
...map/genRegister(5)/mapRegister/zeros	32'h00000000
...nRegister(5)/mapRegister/writeEnable	0
...ap/genRegister(5)/mapRegister/we_in	0
...map/genRegister(5)/mapRegister/reset	0
...p/genRegister(5)/mapRegister/outData	32'h00000000
...p/genRegister(5)/mapRegister/keepOut	32'hXXXXXXXX
...ap/genRegister(5)/mapRegister/inData	32'h00001000
...ap/genRegister(5)/mapRegister/data_in	32'h00001000
...e_map/genRegister(5)/mapRegister/clk	0
...map/genRegister(6)/mapRegister/zeros	32'h00000000
...nRegister(6)/mapRegister/writeEnable	0
...ap/genRegister(6)/mapRegister/we_in	0
...map/genRegister(6)/mapRegister/reset	0
...p/genRegister(6)/mapRegister/outData	32'h00000000
...p/genRegister(6)/mapRegister/keepOut	32'hXXXXXXXX
...ap/genRegister(6)/mapRegister/inData	32'h00001000
...ap/genRegister(6)/mapRegister/data_in	32'h00001000
...e_map/genRegister(6)/mapRegister/clk	0
...map/genRegister(7)/mapRegister/zeros	32'h00000000
...nRegister(7)/mapRegister/writeEnable	1
...ap/genRegister(7)/mapRegister/we_in	1
Now	10100 ns
Cursor 1	243 ns

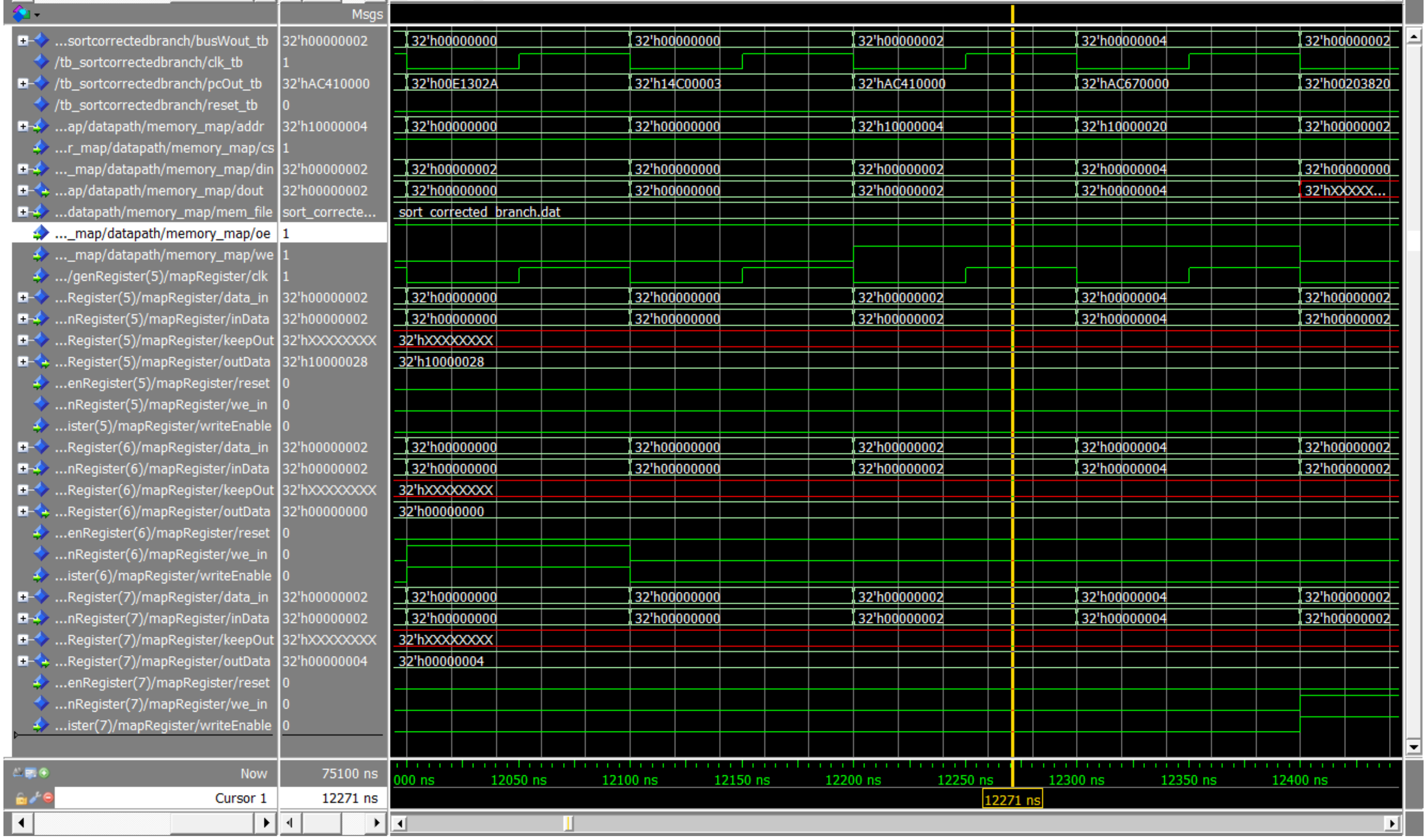


	Msgs
/mips_singlecycle_tb/reset_tb	0
/mips_singlecycle_tb/pcOut_tb	32'h20071000
/mips_singlecycle_tb/clk_tb	0
/mips_singlecycle_tb/busWout_tb	32'h00001000
...map/genRegister(4)/mapRegister/zeros	32'h00000000
...nRegister(4)/mapRegister/writeEnable	0
...ap/genRegister(4)/mapRegister/we_in	0
...map/genRegister(4)/mapRegister/reset	0
...p/genRegister(4)/mapRegister/outData	32'h00000000
...p/genRegister(4)/mapRegister/keepOut	32'hXXXXXXXX
...ap/genRegister(4)/mapRegister/inData	32'h00001000
...ap/genRegister(4)/mapRegister/data_in	32'h00001000
...e_map/genRegister(4)/mapRegister/clk	0
...map/genRegister(5)/mapRegister/zeros	32'h00000000
...nRegister(5)/mapRegister/writeEnable	0
...ap/genRegister(5)/mapRegister/we_in	0
...map/genRegister(5)/mapRegister/reset	0
...p/genRegister(5)/mapRegister/outData	32'h00000000
...p/genRegister(5)/mapRegister/keepOut	32'hXXXXXXXX
...ap/genRegister(5)/mapRegister/inData	32'h00001000
...ap/genRegister(5)/mapRegister/data_in	32'h00001000
...e_map/genRegister(5)/mapRegister/clk	0
...map/genRegister(6)/mapRegister/zeros	32'h00000000
...nRegister(6)/mapRegister/writeEnable	0
...ap/genRegister(6)/mapRegister/we_in	0
...map/genRegister(6)/mapRegister/reset	0
...p/genRegister(6)/mapRegister/outData	32'h00000000
...p/genRegister(6)/mapRegister/keepOut	32'hXXXXXXXX
...ap/genRegister(6)/mapRegister/inData	32'h00001000
...ap/genRegister(6)/mapRegister/data_in	32'h00001000
...e_map/genRegister(6)/mapRegister/clk	0
...map/genRegister(7)/mapRegister/zeros	32'h00000000
...nRegister(7)/mapRegister/writeEnable	1
...ap/genRegister(7)/mapRegister/we_in	1
Now	10100 ns
Cursor 1	243 ns

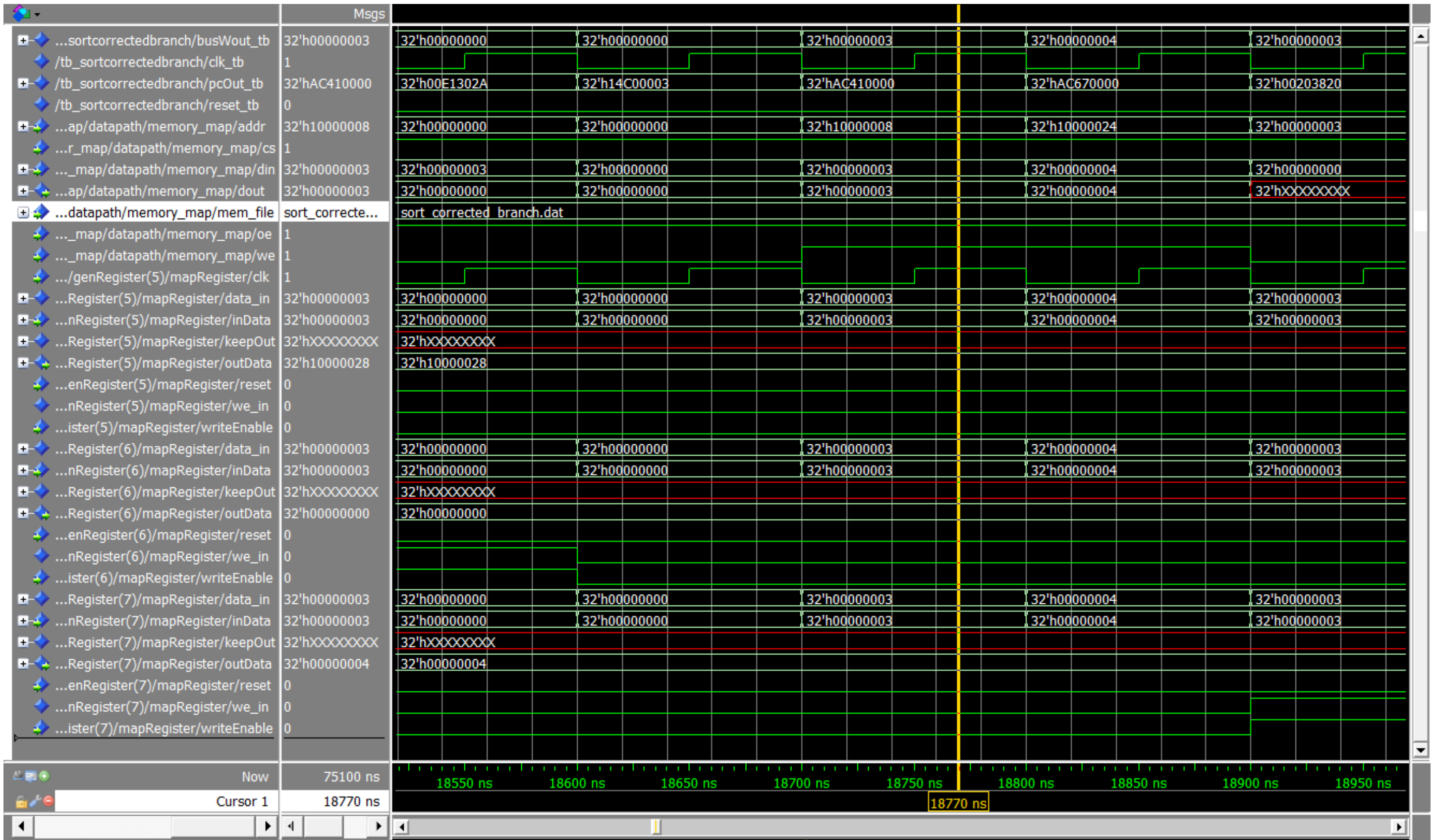
sort_corrected_branch.dat



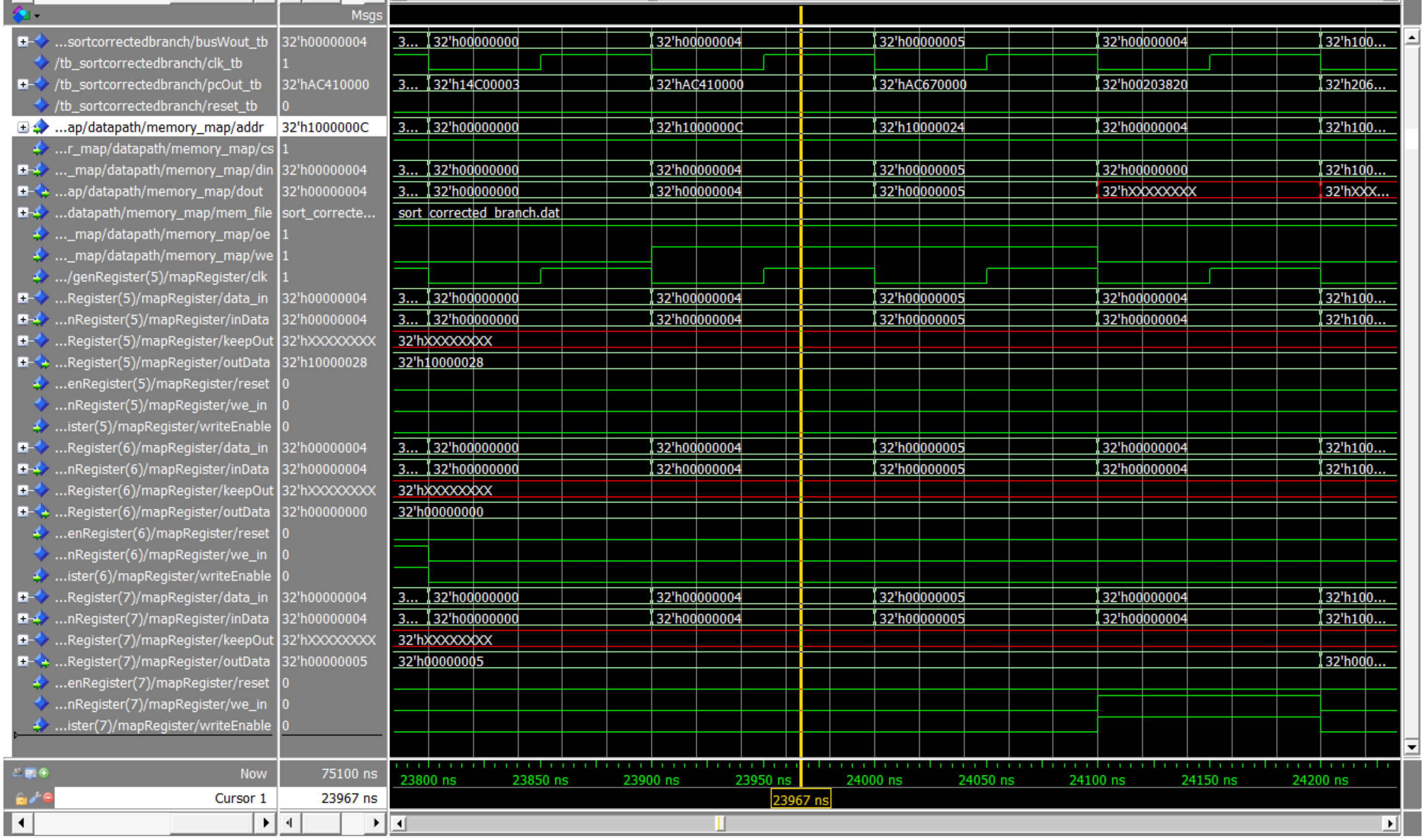
	Msgs
...sortcorrectedbranch/busWout_tb	32'h00000001
/tb_sortcorrectedbranch/clk_tb	1
/tb_sortcorrectedbranch/pcOut_tb	32'hAC410000
/tb_sortcorrectedbranch/reset_tb	0
...ap/datapath/memory_map/addr	32'h10000000
...r_map/datapath/memory_map/cs	1
..._map/datapath/memory_map/din	32'h00000001
...ap/datapath/memory_map/dout	32'h00000001
...datapath/memory_map/mem_file	sort_correcte...
..._map/datapath/memory_map/oe	1
..._map/datapath/memory_map/we	1
.../genRegister(5)/mapRegister/clk	1
...Register(5)/mapRegister/data_in	32'h00000001
...nRegister(5)/mapRegister/inData	32'h00000001
...Register(5)/mapRegister/keepOut	32'hXXXXXXXX
...Register(5)/mapRegister/outData	32'h10000028
...enRegister(5)/mapRegister/reset	0
...nRegister(5)/mapRegister/we_in	0
...ister(5)/mapRegister/writeEnable	0
...Register(6)/mapRegister/data_in	32'h00000001
...nRegister(6)/mapRegister/inData	32'h00000001
...Register(6)/mapRegister/keepOut	32'hXXXXXXXX
...Register(6)/mapRegister/outData	32'h00000000
...enRegister(6)/mapRegister/reset	0
...nRegister(6)/mapRegister/we_in	0
...ister(6)/mapRegister/writeEnable	0
...Register(7)/mapRegister/data_in	32'h00000001
...nRegister(7)/mapRegister/inData	32'h00000001
...Register(7)/mapRegister/keepOut	32'hXXXXXXXX
...Register(7)/mapRegister/outData	32'h00000004
...enRegister(7)/mapRegister/reset	0
...nRegister(7)/mapRegister/we_in	0
...ister(7)/mapRegister/writeEnable	0
Now	75100 ns
Cursor 1	5251 ns



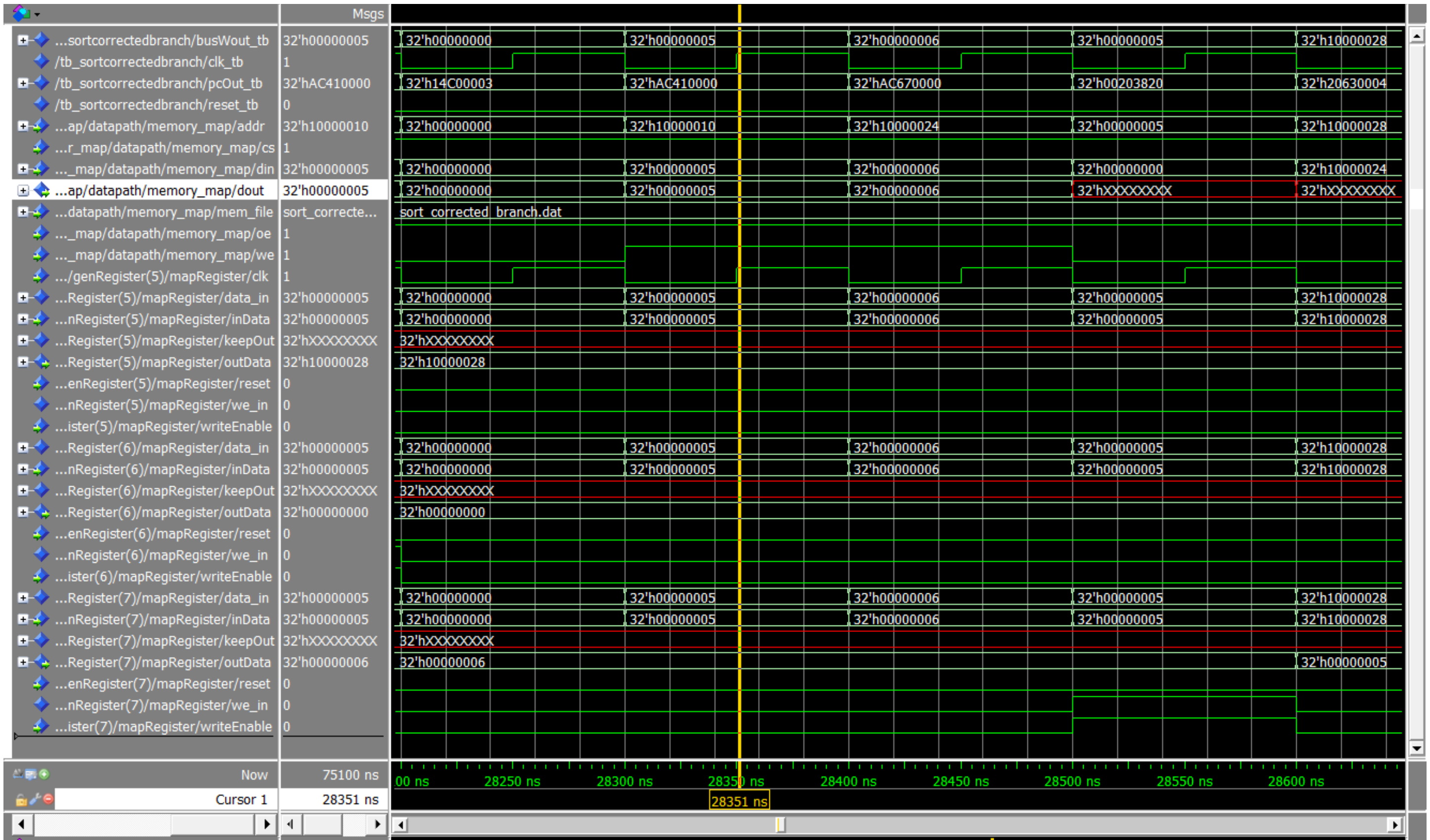
	Msgs
...sortcorrectedbranch/busWout_tb	32'h00000002
/tb_sortcorrectedbranch/clk_tb	1
/tb_sortcorrectedbranch/pcOut_tb	32'hAC410000
/tb_sortcorrectedbranch/reset_tb	0
...ap/datapath/memory_map/addr	32'h10000004
...r_map/datapath/memory_map/cs	1
..._map/datapath/memory_map/din	32'h00000002
...ap/datapath/memory_map/dout	32'h00000002
...datapath/memory_map/mem_file	sort_correcte...
..._map/datapath/memory_map/oe	1
..._map/datapath/memory_map/we	1
.../genRegister(5)/mapRegister/clk	1
...Register(5)/mapRegister/data_in	32'h00000002
...nRegister(5)/mapRegister/inData	32'h00000002
...Register(5)/mapRegister/keepOut	32'hXXXXXXXX
...Register(5)/mapRegister/outData	32'h10000028
...enRegister(5)/mapRegister/reset	0
...nRegister(5)/mapRegister/we_in	0
...ister(5)/mapRegister/writeEnable	0
...Register(6)/mapRegister/data_in	32'h00000002
...nRegister(6)/mapRegister/inData	32'h00000002
...Register(6)/mapRegister/keepOut	32'hXXXXXXXX
...Register(6)/mapRegister/outData	32'h00000000
...enRegister(6)/mapRegister/reset	0
...nRegister(6)/mapRegister/we_in	0
...ister(6)/mapRegister/writeEnable	0
...Register(7)/mapRegister/data_in	32'h00000002
...nRegister(7)/mapRegister/inData	32'h00000002
...Register(7)/mapRegister/keepOut	32'hXXXXXXXX
...Register(7)/mapRegister/outData	32'h00000004
...enRegister(7)/mapRegister/reset	0
...nRegister(7)/mapRegister/we_in	0
...ister(7)/mapRegister/writeEnable	0
Now	75100 ns
Cursor 1	12271 ns



```
Msgs
...sortcorrectedbranch/busWout_tb     32'h00000003
/tb_sortcorrectedbranch/clk_tb        1
/tb_sortcorrectedbranch/pcOut_tb      32'hAC410000
/tb_sortcorrectedbranch/reset_tb      0
...ap/datapath/memory_map/addr        32'h10000008
...r_map/datapath/memory_map/cs       1
..._map/datapath/memory_map/din       32'h00000003
...ap/datapath/memory_map/dout        32'h00000003
...datapath/memory_map/mem_file       sort_correcte...
..._map/datapath/memory_map/oe        1
..._map/datapath/memory_map/we        1
.../genRegister(5)/mapRegister/clk    1
...Register(5)/mapRegister/data_in    32'h00000003
...nRegister(5)/mapRegister/inData    32'h00000003
...Register(5)/mapRegister/keepOut    32'hXXXXXXXX
...Register(5)/mapRegister/outData    32'h10000028
...enRegister(5)/mapRegister/reset    0
...nRegister(5)/mapRegister/we_in     0
...ister(5)/mapRegister/writeEnable   0
...Register(6)/mapRegister/data_in    32'h00000003
...nRegister(6)/mapRegister/inData    32'h00000003
...Register(6)/mapRegister/keepOut    32'hXXXXXXXX
...Register(6)/mapRegister/outData    32'h00000000
...enRegister(6)/mapRegister/reset    0
...nRegister(6)/mapRegister/we_in     0
...ister(6)/mapRegister/writeEnable   0
...Register(7)/mapRegister/data_in    32'h00000003
...nRegister(7)/mapRegister/inData    32'h00000003
...Register(7)/mapRegister/keepOut    32'hXXXXXXXX
...Register(7)/mapRegister/outData    32'h00000004
...enRegister(7)/mapRegister/reset    0
...nRegister(7)/mapRegister/we_in     0
...ister(7)/mapRegister/writeEnable   0
Now                                   75100 ns
Cursor 1                              18770 ns
```

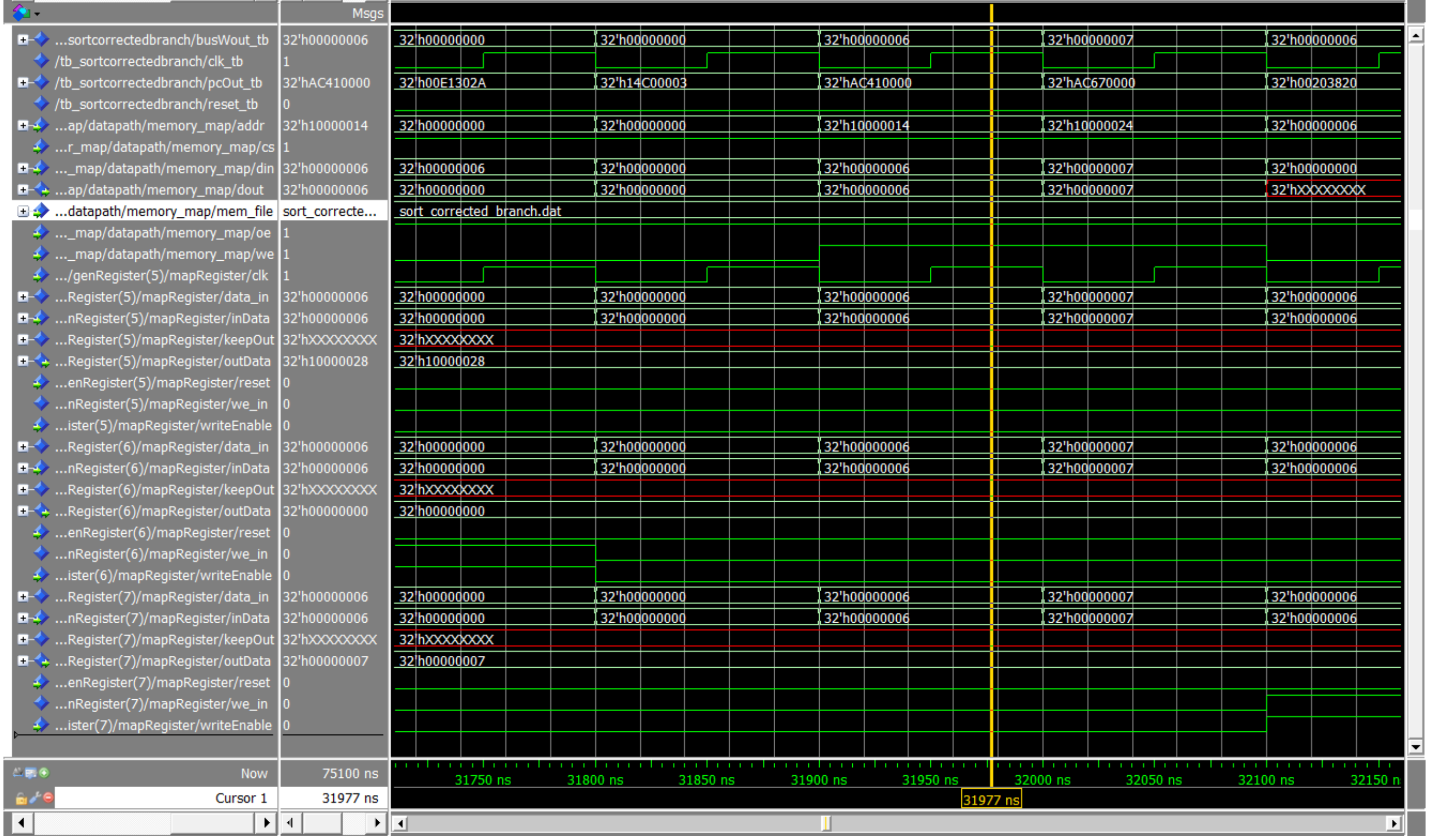


```
Msgs
...sortcorrectedbranch/busWout_tb     32'h00000004
/tb_sortcorrectedbranch/clk_tb        1
/tb_sortcorrectedbranch/pcOut_tb      32'hAC410000
/tb_sortcorrectedbranch/reset_tb      0
...ap/datapath/memory_map/addr        32'h1000000C
...r_map/datapath/memory_map/cs       1
..._map/datapath/memory_map/din       32'h00000004
...ap/datapath/memory_map/dout        32'h00000004
...datapath/memory_map/mem_file       sort_correcte...
..._map/datapath/memory_map/oe        1
..._map/datapath/memory_map/we        1
.../genRegister(5)/mapRegister/clk    1
...Register(5)/mapRegister/data_in    32'h00000004
...nRegister(5)/mapRegister/inData    32'h00000004
...Register(5)/mapRegister/keepOut    32'hXXXXXXXX
...Register(5)/mapRegister/outData    32'h10000028
...enRegister(5)/mapRegister/reset    0
...nRegister(5)/mapRegister/we_in     0
...ister(5)/mapRegister/writeEnable   0
...Register(6)/mapRegister/data_in    32'h00000004
...nRegister(6)/mapRegister/inData    32'h00000004
...Register(6)/mapRegister/keepOut    32'hXXXXXXXX
...Register(6)/mapRegister/outData    32'h00000000
...enRegister(6)/mapRegister/reset    0
...nRegister(6)/mapRegister/we_in     0
...ister(6)/mapRegister/writeEnable   0
...Register(7)/mapRegister/data_in    32'h00000004
...nRegister(7)/mapRegister/inData    32'h00000004
...Register(7)/mapRegister/keepOut    32'hXXXXXXXX
...Register(7)/mapRegister/outData    32'h00000005
...enRegister(7)/mapRegister/reset    0
...nRegister(7)/mapRegister/we_in     0
...ister(7)/mapRegister/writeEnable   0
Now                                   75100 ns
Cursor 1                              23967 ns
```



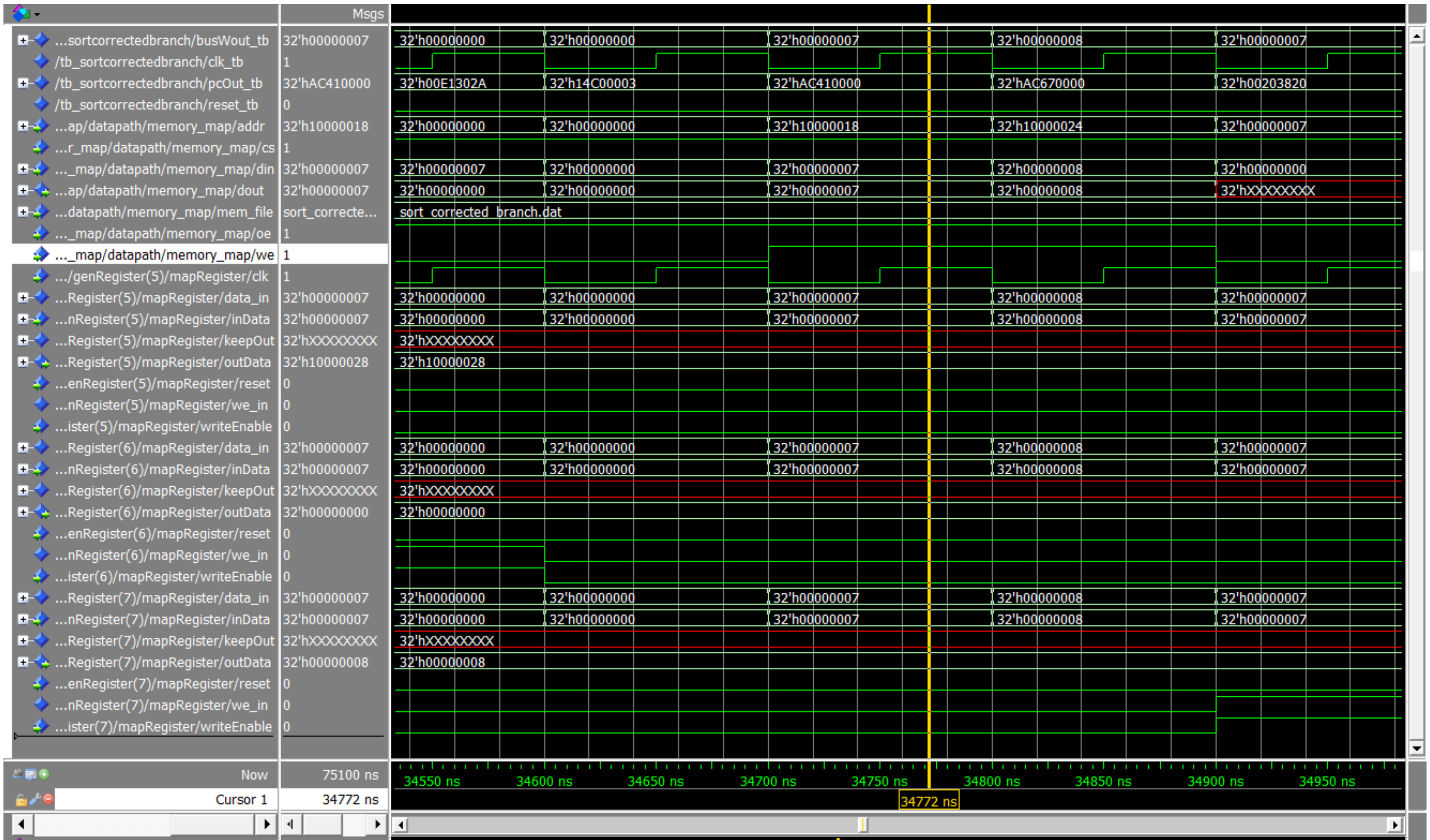
```
Msgs
...sortcorrectedbranch/busWout_tb        32'h00000005   32'h00000000  32'h00000005  32'h00000006  32'h00000005  32'h10000028
/tb_sortcorrectedbranch/clk_tb           1
/tb_sortcorrectedbranch/pcOut_tb         32'hAC410000   32'h14C00003  32'hAC410000  32'hAC670000  32'h00203820  32'h20630004
/tb_sortcorrectedbranch/reset_tb         0
...ap/datapath/memory_map/addr           32'h10000010   32'h00000000  32'h10000010  32'h10000024  32'h00000005  32'h10000028
...r_map/datapath/memory_map/cs          1
..._map/datapath/memory_map/din          32'h00000005   32'h00000000  32'h00000005  32'h00000006  32'h00000000  32'h10000024
...ap/datapath/memory_map/dout           32'h00000005   32'h00000000  32'h00000005  32'h00000006  32'hXXXXXXXX  32'hXXXXXXXX
...datapath/memory_map/mem_file          sort_correcte...  sort_corrected_branch.dat
..._map/datapath/memory_map/oe           1
..._map/datapath/memory_map/we           1
.../genRegister(5)/mapRegister/clk       1
...Register(5)/mapRegister/data_in       32'h00000005   32'h00000000  32'h00000005  32'h00000006  32'h00000005  32'h10000028
...nRegister(5)/mapRegister/inData       32'h00000005   32'h00000000  32'h00000005  32'h00000006  32'h00000005  32'h10000028
...Register(5)/mapRegister/keepOut       32'hXXXXXXXX   32'hXXXXXXXX
...Register(5)/mapRegister/outData       32'h10000028   32'h10000028
...enRegister(5)/mapRegister/reset       0
...nRegister(5)/mapRegister/we_in        0
...ister(5)/mapRegister/writeEnable      0
...Register(6)/mapRegister/data_in       32'h00000005   32'h00000000  32'h00000005  32'h00000006  32'h00000005  32'h10000028
...nRegister(6)/mapRegister/inData       32'h00000005   32'h00000000  32'h00000005  32'h00000006  32'h00000005  32'h10000028
...Register(6)/mapRegister/keepOut       32'hXXXXXXXX   32'hXXXXXXXX
...Register(6)/mapRegister/outData       32'h00000000   32'h00000000
...enRegister(6)/mapRegister/reset       0
...nRegister(6)/mapRegister/we_in        0
...ister(6)/mapRegister/writeEnable      0
...Register(7)/mapRegister/data_in       32'h00000005   32'h00000000  32'h00000005  32'h00000006  32'h00000005  32'h10000028
...nRegister(7)/mapRegister/inData       32'h00000005   32'h00000000  32'h00000005  32'h00000006  32'h00000005  32'h10000028
...Register(7)/mapRegister/keepOut       32'hXXXXXXXX   32'hXXXXXXXX
...Register(7)/mapRegister/outData       32'h00000006   32'h00000006                                            32'h00000005
...enRegister(7)/mapRegister/reset       0
...nRegister(7)/mapRegister/we_in        0
...ister(7)/mapRegister/writeEnable      0

Now        75100 ns    00 ns   28250 ns   28300 ns   28350 ns   28400 ns   28450 ns   28500 ns   28550 ns   28600 ns
Cursor 1   28351 ns    28351 ns
```



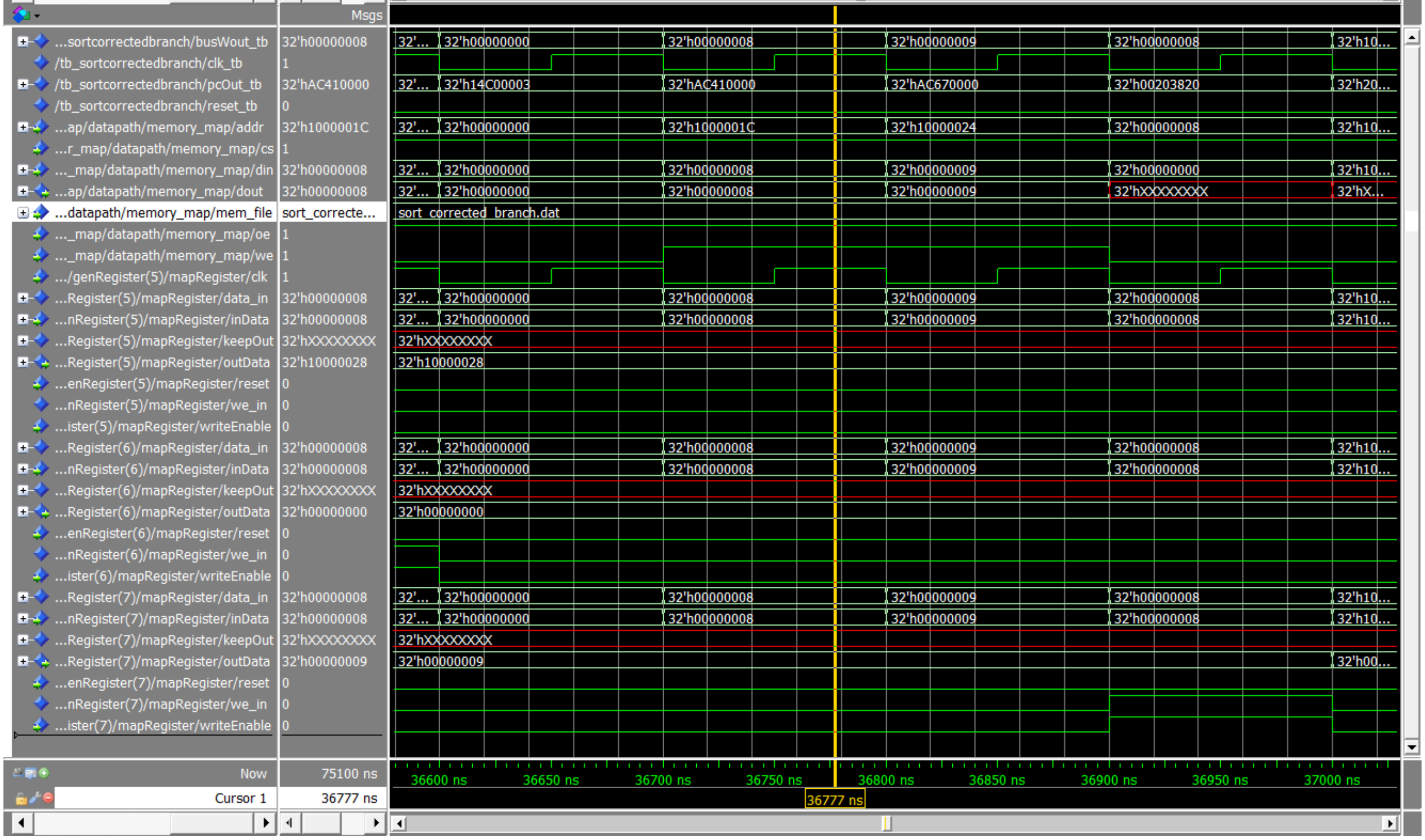
```
Msgs
...sortcorrectedbranch/busWout_tb        32'h00000006   32'h00000000  32'h00000000  32'h00000006  32'h00000007  32'h00000006
/tb_sortcorrectedbranch/clk_tb           1
/tb_sortcorrectedbranch/pcOut_tb         32'hAC410000   32'h00E1302A  32'h14C00003  32'hAC410000  32'hAC670000  32'h00203820
/tb_sortcorrectedbranch/reset_tb         0
...ap/datapath/memory_map/addr           32'h10000014   32'h00000000  32'h00000000  32'h10000014  32'h10000024  32'h00000006
...r_map/datapath/memory_map/cs          1
..._map/datapath/memory_map/din          32'h00000006   32'h00000006  32'h00000000  32'h00000006  32'h00000007  32'h00000000
...ap/datapath/memory_map/dout           32'h00000006   32'h00000000  32'h00000000  32'h00000006  32'h00000007  32'hXXXXXXXX
...datapath/memory_map/mem_file          sort_correcte...  sort_corrected_branch.dat
..._map/datapath/memory_map/oe           1
..._map/datapath/memory_map/we           1
.../genRegister(5)/mapRegister/clk       1
...Register(5)/mapRegister/data_in       32'h00000006   32'h00000000  32'h00000000  32'h00000006  32'h00000007  32'h00000006
...nRegister(5)/mapRegister/inData       32'h00000006   32'h00000000  32'h00000000  32'h00000006  32'h00000007  32'h00000006
...Register(5)/mapRegister/keepOut       32'hXXXXXXXX   32'hXXXXXXXX
...Register(5)/mapRegister/outData       32'h10000028   32'h10000028
...enRegister(5)/mapRegister/reset       0
...nRegister(5)/mapRegister/we_in        0
...ister(5)/mapRegister/writeEnable      0
...Register(6)/mapRegister/data_in       32'h00000006   32'h00000000  32'h00000000  32'h00000006  32'h00000007  32'h00000006
...nRegister(6)/mapRegister/inData       32'h00000006   32'h00000000  32'h00000000  32'h00000006  32'h00000007  32'h00000006
...Register(6)/mapRegister/keepOut       32'hXXXXXXXX   32'hXXXXXXXX
...Register(6)/mapRegister/outData       32'h00000000   32'h00000000
...enRegister(6)/mapRegister/reset       0
...nRegister(6)/mapRegister/we_in        0
...ister(6)/mapRegister/writeEnable      0
...Register(7)/mapRegister/data_in       32'h00000006   32'h00000000  32'h00000000  32'h00000006  32'h00000007  32'h00000006
...nRegister(7)/mapRegister/inData       32'h00000006   32'h00000000  32'h00000000  32'h00000006  32'h00000007  32'h00000006
...Register(7)/mapRegister/keepOut       32'hXXXXXXXX   32'hXXXXXXXX
...Register(7)/mapRegister/outData       32'h00000007   32'h00000007
...enRegister(7)/mapRegister/reset       0
...nRegister(7)/mapRegister/we_in        0
...ister(7)/mapRegister/writeEnable      0

Now        75100 ns    31750 ns   31800 ns   31850 ns   31900 ns   31950 ns   32000 ns   32050 ns   32100 ns   32150 n
Cursor 1   31977 ns    31977 ns
```



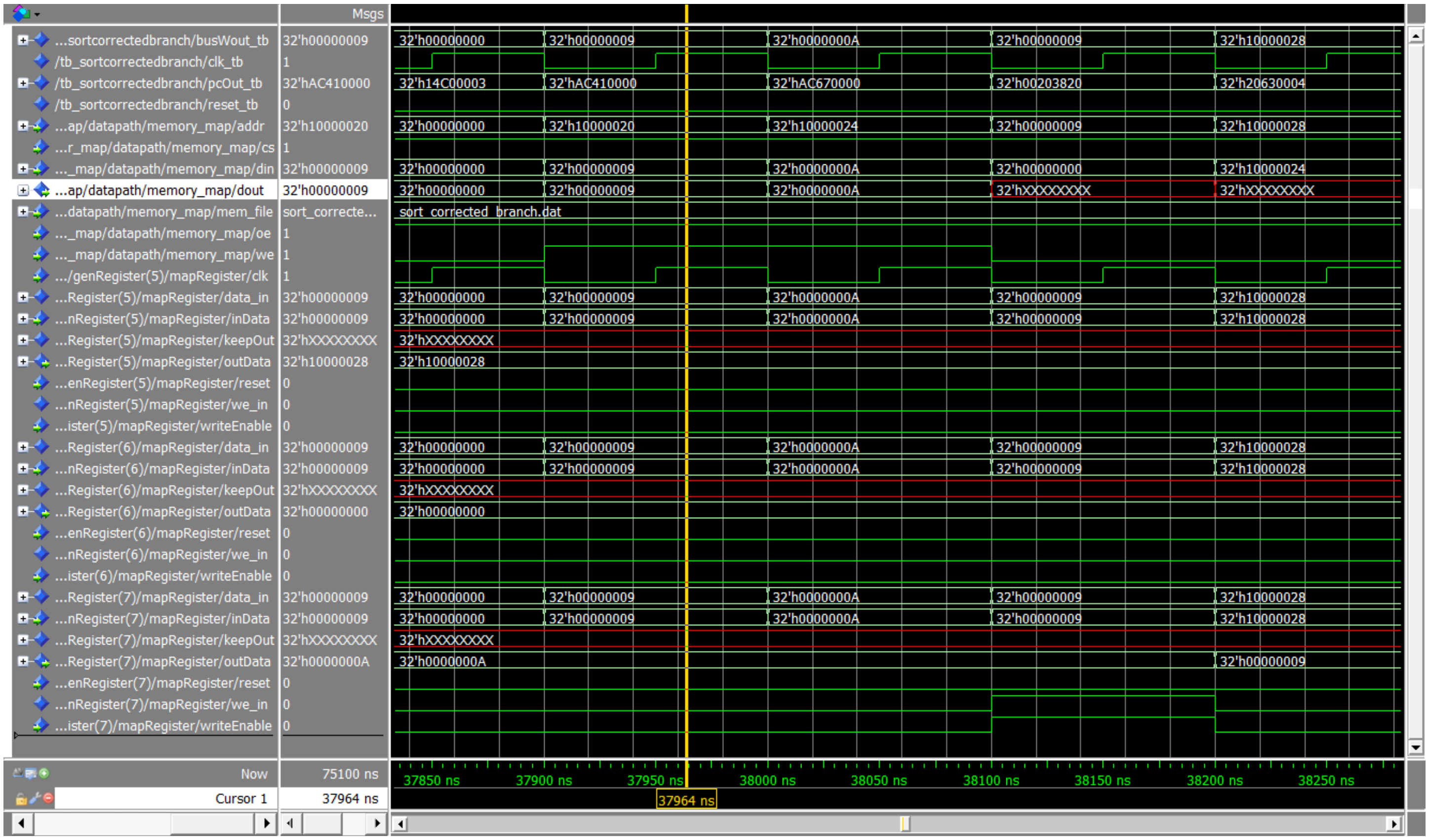
```
                                                  Msgs
...sortcorrectedbranch/busWout_tb        32'h00000007
/tb_sortcorrectedbranch/clk_tb           1
/tb_sortcorrectedbranch/pcOut_tb         32'hAC410000
/tb_sortcorrectedbranch/reset_tb         0
...ap/datapath/memory_map/addr           32'h10000018
...r_map/datapath/memory_map/cs          1
..._map/datapath/memory_map/din          32'h00000007
...ap/datapath/memory_map/dout           32'h00000007
...datapath/memory_map/mem_file          sort_correcte...
..._map/datapath/memory_map/oe           1
..._map/datapath/memory_map/we           1
.../genRegister(5)/mapRegister/clk       1
...Register(5)/mapRegister/data_in       32'h00000007
...nRegister(5)/mapRegister/inData       32'h00000007
...Register(5)/mapRegister/keepOut       32'hXXXXXXXX
...Register(5)/mapRegister/outData       32'h10000028
...enRegister(5)/mapRegister/reset       0
...nRegister(5)/mapRegister/we_in        0
...ister(5)/mapRegister/writeEnable      0
...Register(6)/mapRegister/data_in       32'h00000007
...nRegister(6)/mapRegister/inData       32'h00000007
...Register(6)/mapRegister/keepOut       32'hXXXXXXXX
...Register(6)/mapRegister/outData       32'h00000000
...enRegister(6)/mapRegister/reset       0
...nRegister(6)/mapRegister/we_in        0
...ister(6)/mapRegister/writeEnable      0
...Register(7)/mapRegister/data_in       32'h00000007
...nRegister(7)/mapRegister/inData       32'h00000007
...Register(7)/mapRegister/keepOut       32'hXXXXXXXX
...Register(7)/mapRegister/outData       32'h00000008
...enRegister(7)/mapRegister/reset       0
...nRegister(7)/mapRegister/we_in        0
...ister(7)/mapRegister/writeEnable      0

Now                                      75100 ns
Cursor 1                                 34772 ns
```



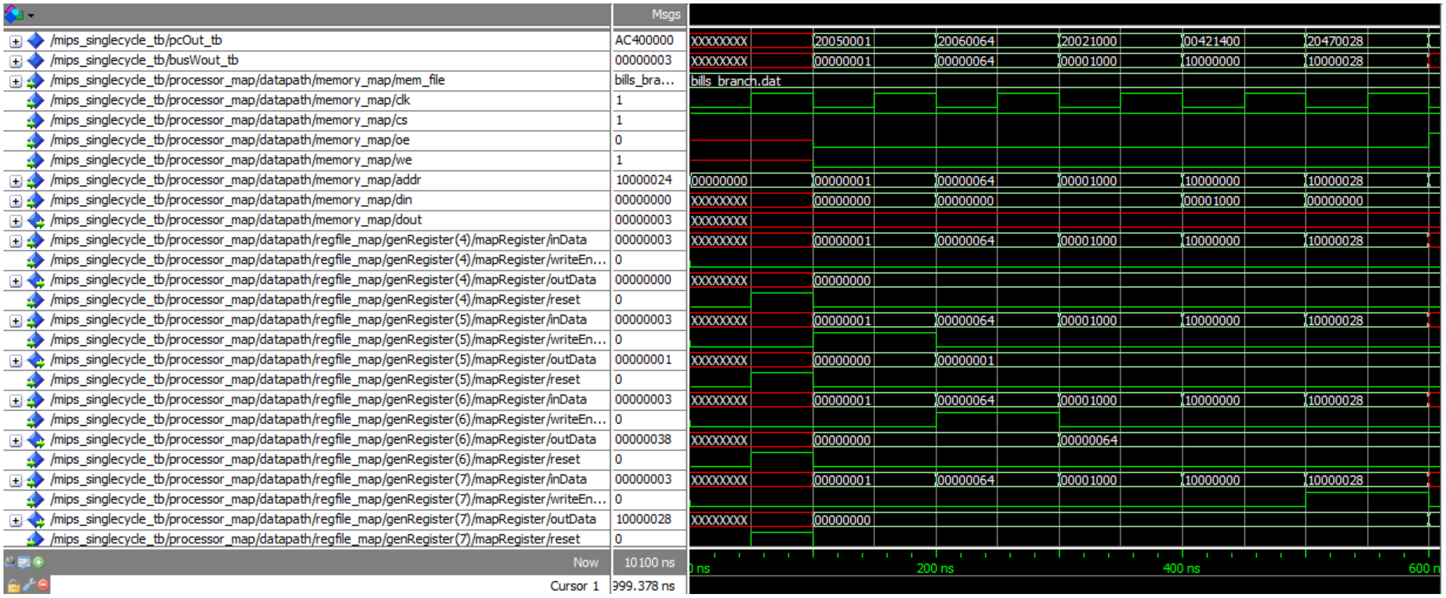
```
                                                  Msgs
...sortcorrectedbranch/busWout_tb        32'h00000008
/tb_sortcorrectedbranch/clk_tb           1
/tb_sortcorrectedbranch/pcOut_tb         32'hAC410000
/tb_sortcorrectedbranch/reset_tb         0
...ap/datapath/memory_map/addr           32'h1000001C
...r_map/datapath/memory_map/cs          1
..._map/datapath/memory_map/din          32'h00000008
...ap/datapath/memory_map/dout           32'h00000008
...datapath/memory_map/mem_file          sort_correcte...
..._map/datapath/memory_map/oe           1
..._map/datapath/memory_map/we           1
.../genRegister(5)/mapRegister/clk       1
...Register(5)/mapRegister/data_in       32'h00000008
...nRegister(5)/mapRegister/inData       32'h00000008
...Register(5)/mapRegister/keepOut       32'hXXXXXXXX
...Register(5)/mapRegister/outData       32'h10000028
...enRegister(5)/mapRegister/reset       0
...nRegister(5)/mapRegister/we_in        0
...ister(5)/mapRegister/writeEnable      0
...Register(6)/mapRegister/data_in       32'h00000008
...nRegister(6)/mapRegister/inData       32'h00000008
...Register(6)/mapRegister/keepOut       32'hXXXXXXXX
...Register(6)/mapRegister/outData       32'h00000000
...enRegister(6)/mapRegister/reset       0
...nRegister(6)/mapRegister/we_in        0
...ister(6)/mapRegister/writeEnable      0
...Register(7)/mapRegister/data_in       32'h00000008
...nRegister(7)/mapRegister/inData       32'h00000008
...Register(7)/mapRegister/keepOut       32'hXXXXXXXX
...Register(7)/mapRegister/outData       32'h00000009
...enRegister(7)/mapRegister/reset       0
...nRegister(7)/mapRegister/we_in        0
...ister(7)/mapRegister/writeEnable      0

Now                                      75100 ns
Cursor 1                                 36777 ns
```

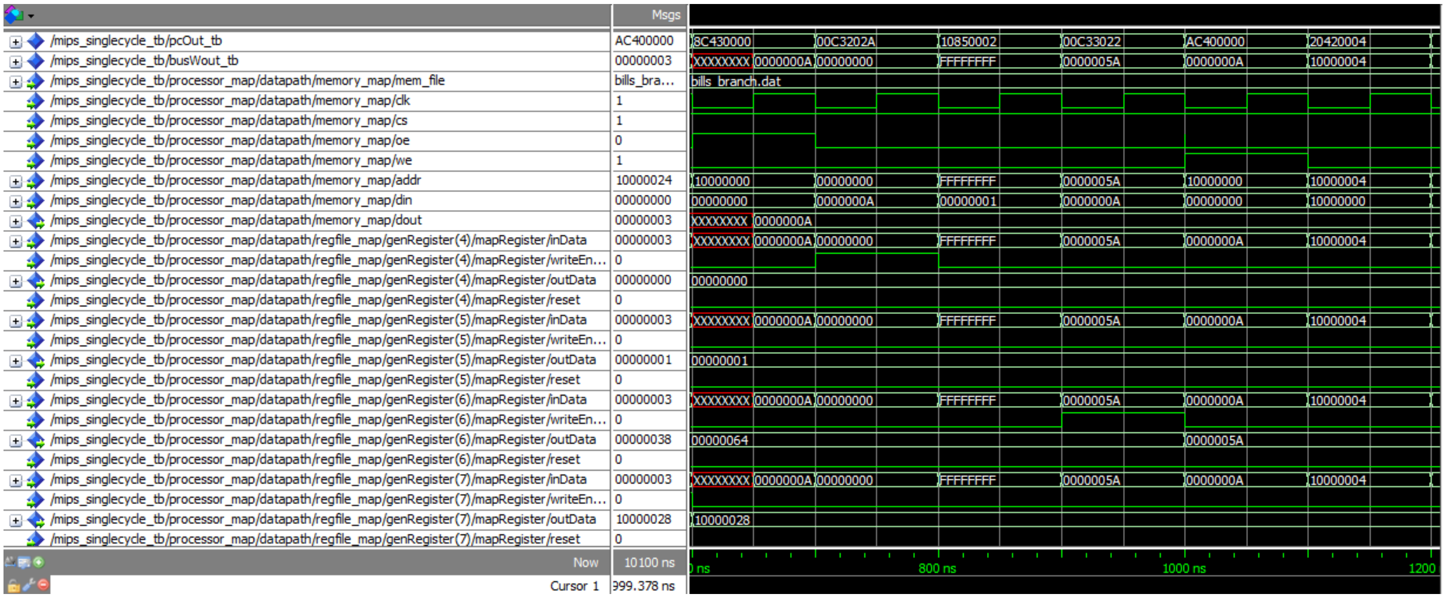


	Msgs	
...sortcorrectedbranch/busWout_tb	32'h00000009	32'h00000000 32'h00000009 32'h0000000A 32'h00000009 32'h10000028
/tb_sortcorrectedbranch/clk_tb	1	
/tb_sortcorrectedbranch/pcOut_tb	32'hAC410000	32'h14C00003 32'hAC410000 32'hAC670000 32'h00203820 32'h20630004
/tb_sortcorrectedbranch/reset_tb	0	
...ap/datapath/memory_map/addr	32'h10000020	32'h00000000 32'h10000020 32'h10000024 32'h00000009 32'h10000028
...r_map/datapath/memory_map/cs	1	
..._map/datapath/memory_map/din	32'h00000009	32'h00000000 32'h00000009 32'h0000000A 32'h00000000 32'h10000024
...ap/datapath/memory_map/dout	32'h00000009	32'h00000000 32'h00000009 32'h0000000A 32'hXXXXXXXX 32'hXXXXXXXX
...datapath/memory_map/mem_file	sort_correcte...	sort_corrected_branch.dat
..._map/datapath/memory_map/oe	1	
..._map/datapath/memory_map/we	1	
.../genRegister(5)/mapRegister/clk	1	
...Register(5)/mapRegister/data_in	32'h00000009	32'h00000000 32'h00000009 32'h0000000A 32'h00000009 32'h10000028
...nRegister(5)/mapRegister/inData	32'h00000009	32'h00000000 32'h00000009 32'h0000000A 32'h00000009 32'h10000028
...Register(5)/mapRegister/keepOut	32'hXXXXXXXX	32'hXXXXXXXX
...Register(5)/mapRegister/outData	32'h10000028	32'h10000028
...enRegister(5)/mapRegister/reset	0	
...nRegister(5)/mapRegister/we_in	0	
...ister(5)/mapRegister/writeEnable	0	
...Register(6)/mapRegister/data_in	32'h00000009	32'h00000000 32'h00000009 32'h0000000A 32'h00000009 32'h10000028
...nRegister(6)/mapRegister/inData	32'h00000009	32'h00000000 32'h00000009 32'h0000000A 32'h00000009 32'h10000028
...Register(6)/mapRegister/keepOut	32'hXXXXXXXX	32'hXXXXXXXX
...Register(6)/mapRegister/outData	32'h00000000	32'h00000000
...enRegister(6)/mapRegister/reset	0	
...nRegister(6)/mapRegister/we_in	0	
...ister(6)/mapRegister/writeEnable	0	
...Register(7)/mapRegister/data_in	32'h00000009	32'h00000000 32'h00000009 32'h0000000A 32'h00000009 32'h10000028
...nRegister(7)/mapRegister/inData	32'h00000009	32'h00000000 32'h00000009 32'h0000000A 32'h00000009 32'h10000028
...Register(7)/mapRegister/keepOut	32'hXXXXXXXX	32'hXXXXXXXX
...Register(7)/mapRegister/outData	32'h0000000A	32'h0000000A 32'h00000009
...enRegister(7)/mapRegister/reset	0	
...nRegister(7)/mapRegister/we_in	0	
...ister(7)/mapRegister/writeEnable	0	
Now	75100 ns	
Cursor 1	37964 ns	37964 ns

bills_branch.dat

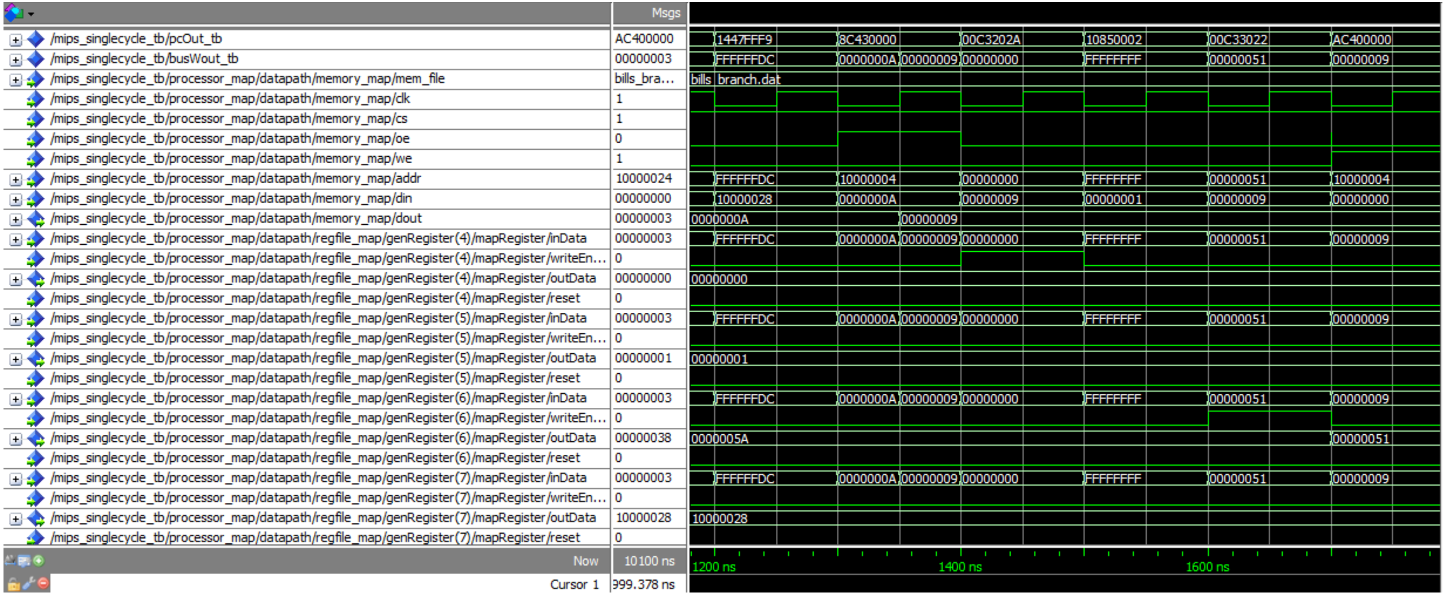


	Msgs	
/mips_singlecycle_tb/pcOut_tb	AC400000	XXXXXXXX 20050001 20060064 20021000 00421400 20470028
/mips_singlecycle_tb/busWout_tb	00000003	XXXXXXXX 00000001 00000064 00001000 10000000 10000028
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file	bills_bra...	bills_branch.dat
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk	1	
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs	1	
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe	0	
/mips_singlecycle_tb/processor_map/datapath/memory_map/we	1	
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr	10000024	00000000 00000001 00000064 00001000 10000000 10000028
/mips_singlecycle_tb/processor_map/datapath/memory_map/din	00000000	XXXXXXXX 00000000 00000000 00001000 00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout	00000003	XXXXXXXX
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData	00000003	XXXXXXXX 00000001 00000064 00001000 10000000 10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...	0	
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData	00000000	XXXXXXXX 00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset	0	
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData	00000003	XXXXXXXX 00000001 00000064 00001000 10000000 10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...	0	
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData	00000001	XXXXXXXX 00000000 00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset	0	
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData	00000003	XXXXXXXX 00000001 00000064 00001000 10000000 10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...	0	
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData	00000038	XXXXXXXX 00000000 00000064
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset	0	
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData	00000003	XXXXXXXX 00000001 00000064 00001000 10000000 10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...	0	
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData	10000028	XXXXXXXX 00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset	0	
Now	10100 ns	
Cursor 1	999.378 ns	



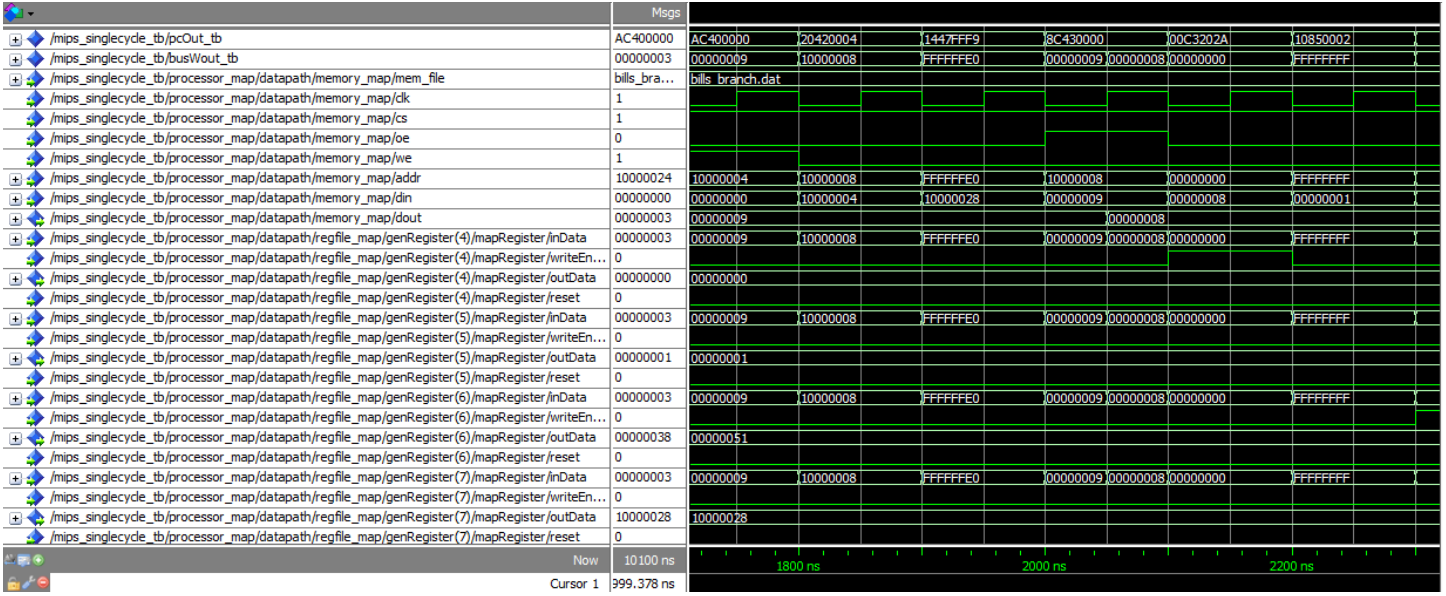
```
                                                                              Msgs
/mips_singlecycle_tb/pcOut_tb                                                 AC400000
/mips_singlecycle_tb/busWout_tb                                               00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file               bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                    1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                     1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                     0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                     1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                   10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                    00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                   00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData   00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset     0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData   00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset     0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData   00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset     0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData   10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset     0
                                                                         Now  10100 ns
                                                                    Cursor 1  999.378 ns
```

8C430000 00C3202A 10850002 00C33022 AC400000 20420004
XXXXXXXX 0000000A 00000000 FFFFFFFF 0000005A 0000000A 10000004
bills_branch.dat
10000000 00000000 FFFFFFFF 0000005A 10000000 10000004
00000000 0000000A 00000001 0000000A 00000000 10000000
XXXXXXXX 0000000A
XXXXXXXX 0000000A 00000000 FFFFFFFF 0000005A 0000000A 10000004
00000000
XXXXXXXX 0000000A 00000000 FFFFFFFF 0000005A 0000000A 10000004
00000001
XXXXXXXX 0000000A 00000000 FFFFFFFF 0000005A 0000000A 10000004
00000064 0000005A
XXXXXXXX 0000000A 00000000 FFFFFFFF 0000005A 0000000A 10000004
10000028
0 ns
800 ns
1000 ns
1200



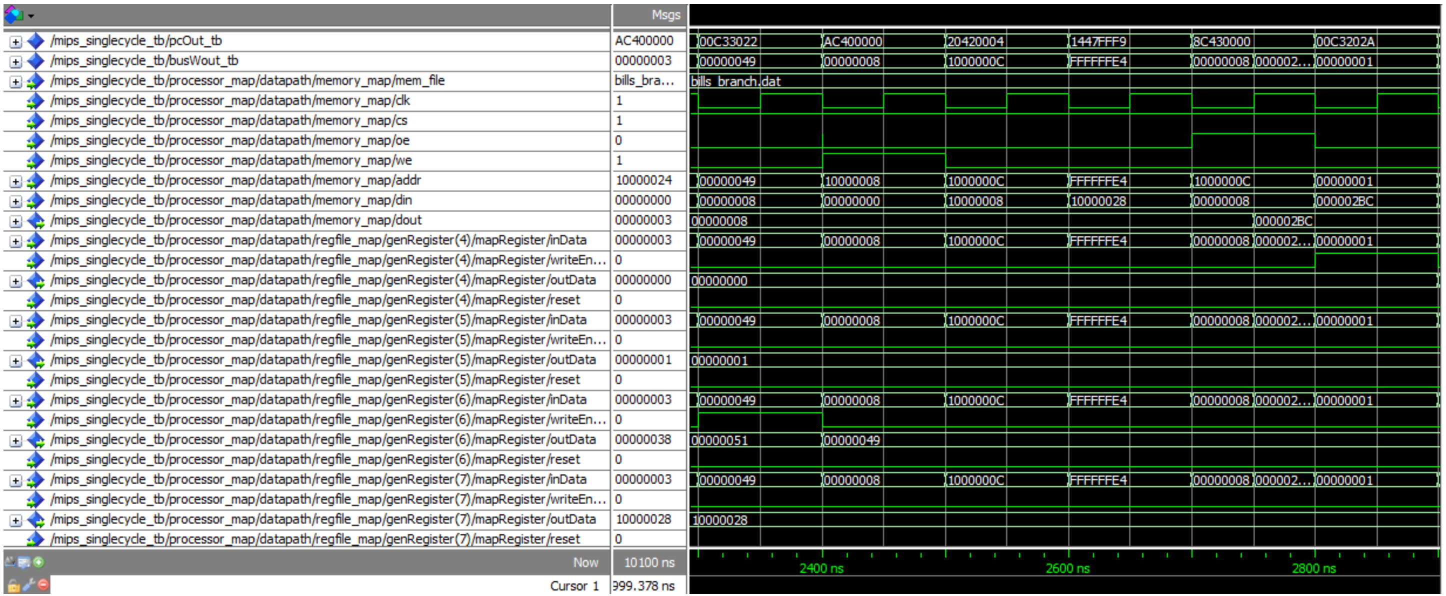
```
                                                                              Msgs
/mips_singlecycle_tb/pcOut_tb                                                 AC400000
/mips_singlecycle_tb/busWout_tb                                               00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file               bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                    1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                     1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                     0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                     1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                   10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                    00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                   00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData   00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset     0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData   00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset     0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData   00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset     0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData   10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset     0
                                                                         Now  10100 ns
                                                                    Cursor 1  999.378 ns
```

1447FFF9 8C430000 00C3202A 10850002 00C33022 AC400000
FFFFFFDC 0000000A 00000009 00000000 FFFFFFFF 00000051 00000009
bills_branch.dat
FFFFFFDC 10000004 00000000 FFFFFFFF 00000051 10000004
10000028 0000000A 00000009 00000001 00000009 00000000
0000000A 00000009
FFFFFFDC 0000000A 00000009 00000000 FFFFFFFF 00000051 00000009
00000000
FFFFFFDC 0000000A 00000009 00000000 FFFFFFFF 00000051 00000009
00000001
FFFFFFDC 0000000A 00000009 00000000 FFFFFFFF 00000051 00000009
0000005A 00000051
FFFFFFDC 0000000A 00000009 00000000 FFFFFFFF 00000051 00000009
10000028
1200 ns
1400 ns
1600 ns



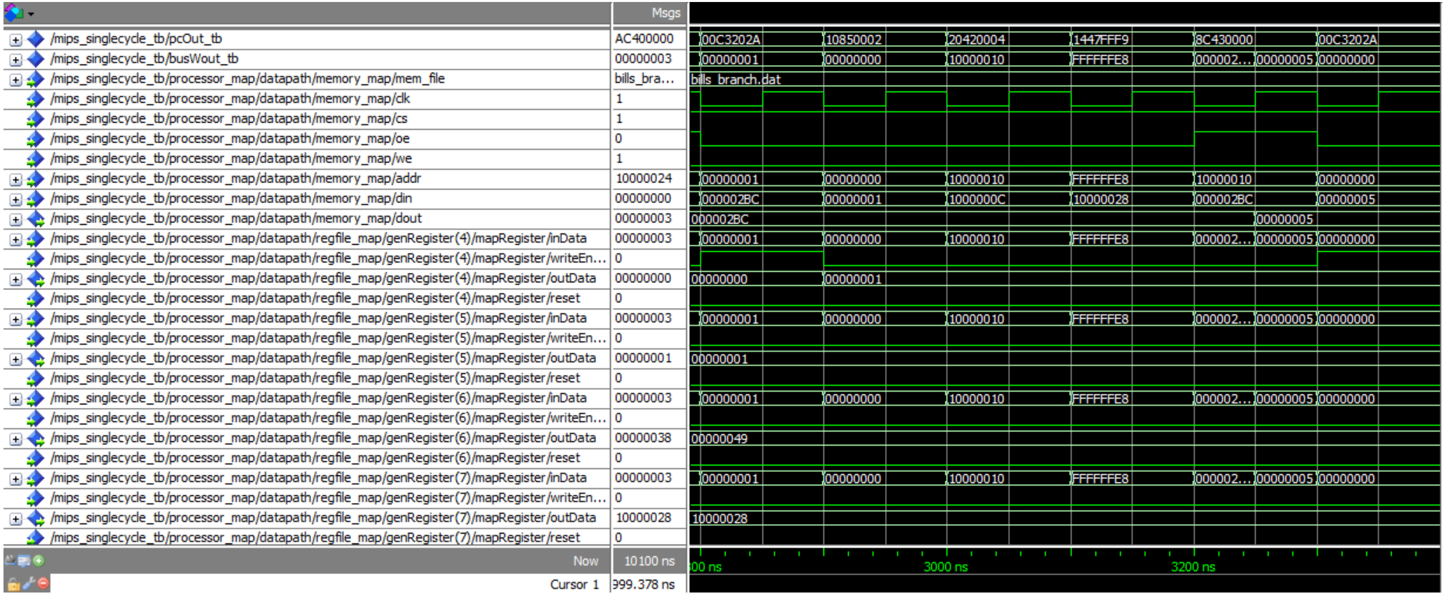
```
                                                                              Msgs
/mips_singlecycle_tb/pcOut_tb                                                 AC400000
/mips_singlecycle_tb/busWout_tb                                               00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file               bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                    1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                     1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                     0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                     1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                   10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                    00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                   00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData   00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset     0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData   00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset     0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData   00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset     0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData    00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData   10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset     0
                                                                         Now  10100 ns
                                                                    Cursor 1  999.378 ns
```

AC400000 20420004 1447FFF9 8C430000 00C3202A 10850002
00000009 10000008 FFFFFFE0 00000009 00000008 00000000 FFFFFFFF
bills_branch.dat
10000004 10000008 FFFFFFE0 10000008 00000000 FFFFFFFF
00000000 10000004 10000028 00000009 00000008 00000001
00000009 00000008
00000009 10000008 FFFFFFE0 00000009 00000008 00000000 FFFFFFFF
00000000
00000009 10000008 FFFFFFE0 00000009 00000008 00000000 FFFFFFFF
00000001
00000009 10000008 FFFFFFE0 00000009 00000008 00000000 FFFFFFFF
00000051
00000009 10000008 FFFFFFE0 00000009 00000008 00000000 FFFFFFFF
10000028
1800 ns
2000 ns
2200 ns



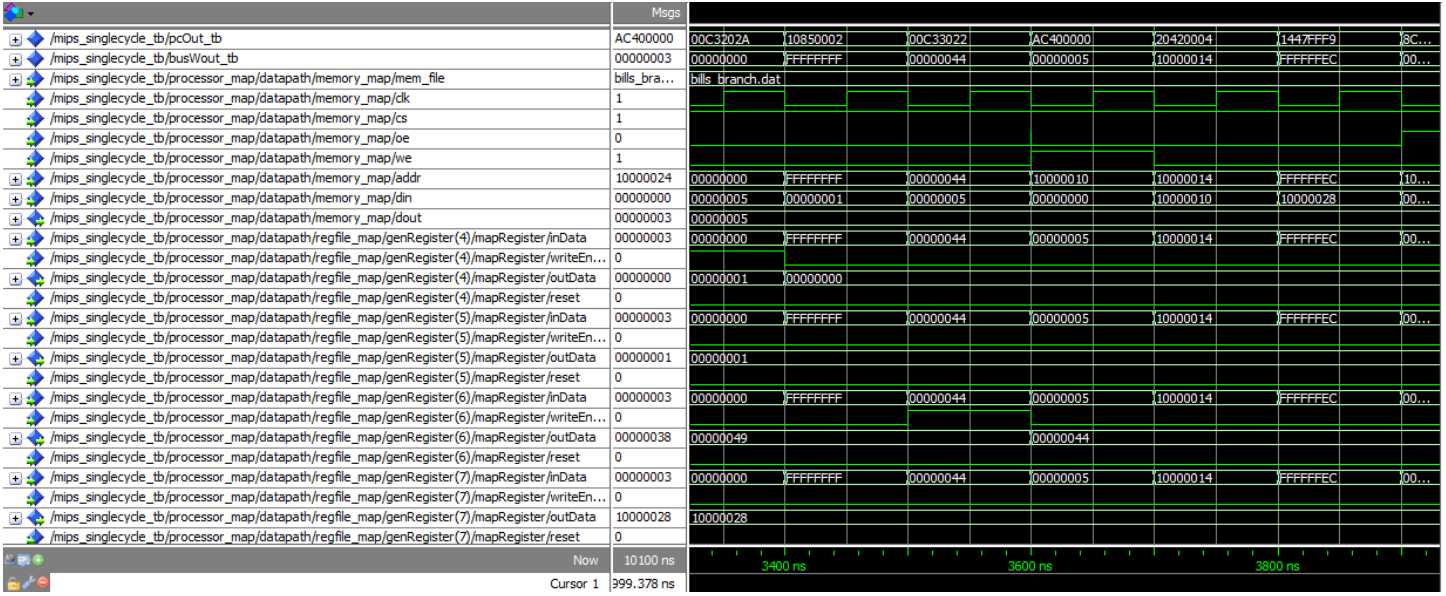
```
                                                                                   Msgs
/mips_singlecycle_tb/pcOut_tb                                                      AC400000
/mips_singlecycle_tb/busWout_tb                                                    00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file                    bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                         1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                          1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                          0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                          1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                        10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                         00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                        00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData    00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData    00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData    00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData    10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset      0
                                                                            Now    10100 ns
                                                                       Cursor 1    999.378 ns
```

00C33022 AC400000 20420004 1447FFF9 8C430000 00C3202A
00000049 00000008 1000000C FFFFFFE4 00000008 000002... 00000001
bills_branch.dat
00000049 10000008 1000000C FFFFFFE4 1000000C 00000001
00000008 00000000 10000008 10000028 00000008 000002BC
00000008 000002BC
00000049 00000008 1000000C FFFFFFE4 00000008 000002... 00000001
00000000
00000049 00000008 1000000C FFFFFFE4 00000008 000002... 00000001
00000001
00000049 00000008 1000000C FFFFFFE4 00000008 000002... 00000001
00000051 00000049
00000049 00000008 1000000C FFFFFFE4 00000008 000002... 00000001
10000028
2400 ns
2600 ns
2800 ns



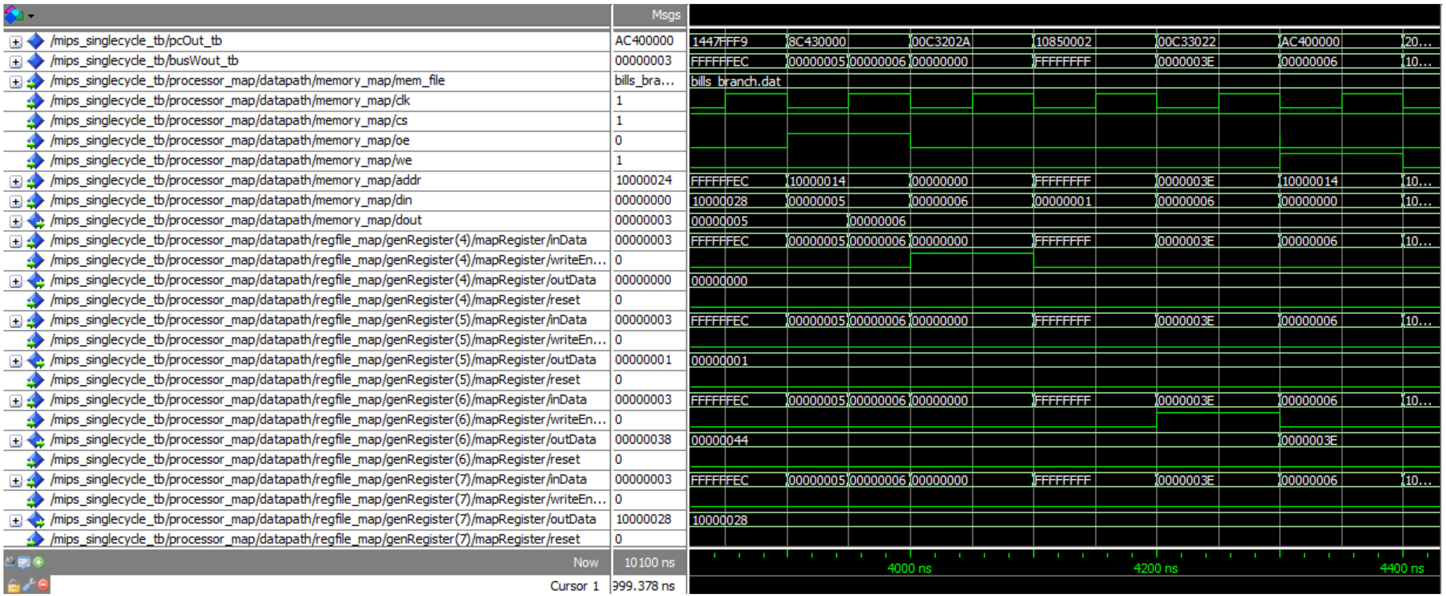
```
                                                                                   Msgs
/mips_singlecycle_tb/pcOut_tb                                                      AC400000
/mips_singlecycle_tb/busWout_tb                                                    00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file                    bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                         1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                          1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                          0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                          1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                        10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                         00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                        00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData    00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData    00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData    00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData    10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset      0
                                                                            Now    10100 ns
                                                                       Cursor 1    999.378 ns
```

00C3202A 10850002 20420004 1447FFF9 8C430000 00C3202A
00000001 00000000 10000010 FFFFFFE8 000002... 00000005 00000000
bills_branch.dat
00000001 00000000 10000010 FFFFFFE8 10000010 00000000
000002BC 00000001 1000000C 10000028 000002BC 00000005
000002BC 00000005
00000001 00000000 10000010 FFFFFFE8 000002... 00000005 00000000
00000000 00000001
00000001 00000000 10000010 FFFFFFE8 000002... 00000005 00000000
00000001
00000001 00000000 10000010 FFFFFFE8 000002... 00000005 00000000
00000049
00000001 00000000 10000010 FFFFFFE8 000002... 00000005 00000000
10000028
00 ns
3000 ns
3200 ns

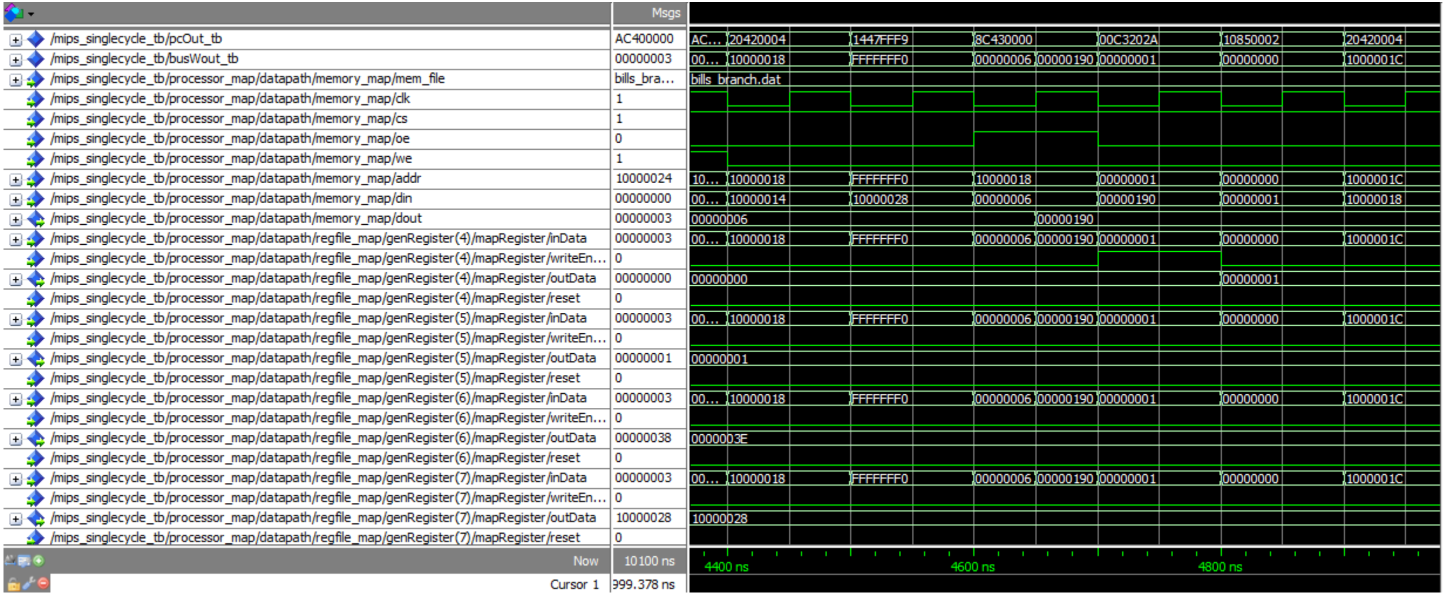


```
                                                                                   Msgs
/mips_singlecycle_tb/pcOut_tb                                                      AC400000
/mips_singlecycle_tb/busWout_tb                                                    00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file                    bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                         1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                          1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                          0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                          1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                        10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                         00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                        00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData    00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData    00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData    00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn... 0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData    10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset      0
                                                                            Now    10100 ns
                                                                       Cursor 1    999.378 ns
```

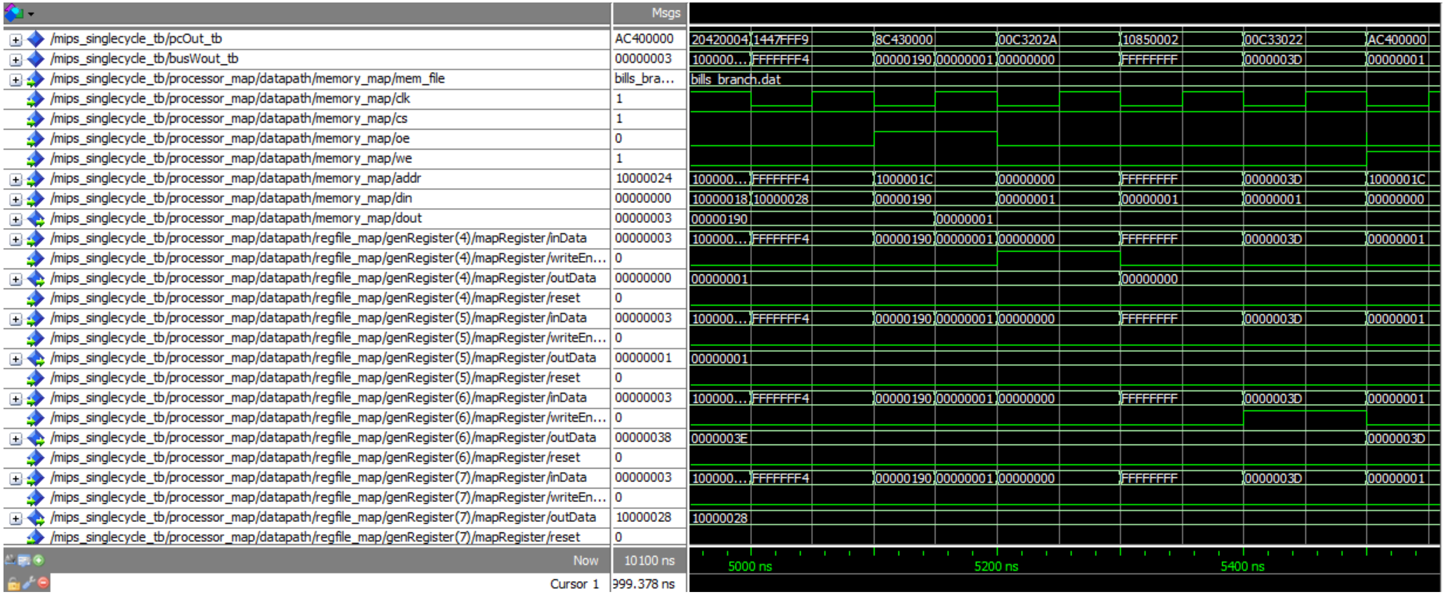
00C3202A 10850002 00C33022 AC400000 20420004 1447FFF9 8C...
00000000 FFFFFFFF 00000044 00000005 10000014 FFFFFFEC 00...
bills_branch.dat
00000000 FFFFFFFF 00000044 10000010 10000014 FFFFFFEC 10...
00000005 00000001 00000005 00000000 10000010 10000028 00...
00000005
00000000 FFFFFFFF 00000044 00000005 10000014 FFFFFFEC 00...
00000001 00000000
00000000 FFFFFFFF 00000044 00000005 10000014 FFFFFFEC 00...
00000001
00000000 FFFFFFFF 00000044 00000005 10000014 FFFFFFEC 00...
00000049 00000044
00000000 FFFFFFFF 00000044 00000005 10000014 FFFFFFEC 00...
10000028
3400 ns
3600 ns
3800 ns


Msgs
1447FFF9 8C430000 00C3202A 10850002 00C33022 AC400000 20...
FFFFFFEC 00000005 00000006 00000000 FFFFFFFF 0000003E 00000006 10...
bills_branch.dat
FFFFFFEC 10000014 00000000 FFFFFFFF 0000003E 10000014 10...
10000028 00000005 00000006 00000001 00000006 00000000 10...
00000005 00000006
FFFFFFEC 00000005 00000006 00000000 FFFFFFFF 0000003E 00000006 10...
00000000
FFFFFFEC 00000005 00000006 00000000 FFFFFFFF 0000003E 00000006 10...
00000001
FFFFFFEC 00000005 00000006 00000000 FFFFFFFF 0000003E 00000006 10...
00000044 0000003E
FFFFFFEC 00000005 00000006 00000000 FFFFFFFF 0000003E 00000006 10...
10000028
4000 ns
4200 ns
4400 ns

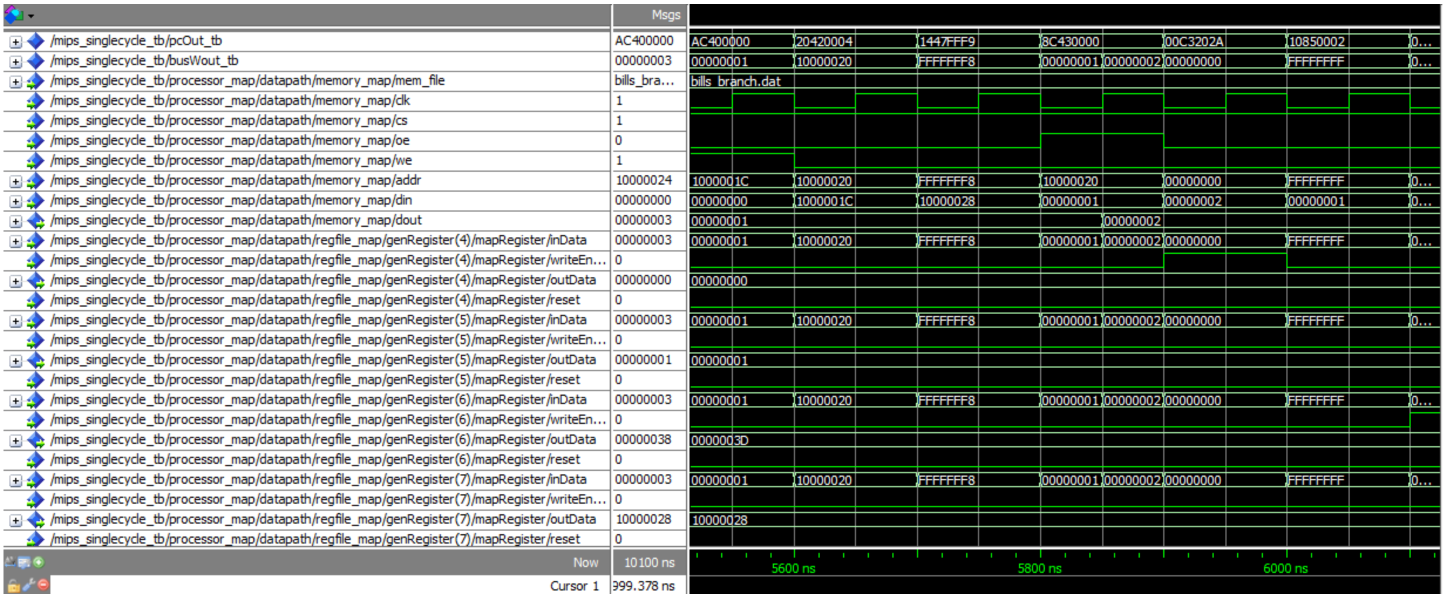
```
/mips_singlecycle_tb/pcOut_tb                                                                       AC400000
/mips_singlecycle_tb/busWout_tb                                                                     00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file                                     bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                                          1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                                           1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                                           0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                                           1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                                         10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                                          00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                                         00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData          00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset            0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData          00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset            0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData          00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset            0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData          10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset            0
                                                                                     Now            10100 ns
                                                                                     Cursor 1       999.378 ns
```


Msgs
AC... 20420004 1447FFF9 8C430000 00C3202A 10850002 20420004
00... 10000018 FFFFFFF0 00000006 00000190 00000001 00000000 1000001C
bills_branch.dat
10... 10000018 FFFFFFF0 10000018 00000001 00000000 1000001C
00... 10000014 10000028 00000006 00000190 00000001 10000018
00000006 00000190
00... 10000018 FFFFFFF0 00000006 00000190 00000001 00000000 1000001C
00000000 00000001
00... 10000018 FFFFFFF0 00000006 00000190 00000001 00000000 1000001C
00000001
00... 10000018 FFFFFFF0 00000006 00000190 00000001 00000000 1000001C
0000003E
00... 10000018 FFFFFFF0 00000006 00000190 00000001 00000000 1000001C
10000028
4400 ns
4600 ns
4800 ns

```
/mips_singlecycle_tb/pcOut_tb                                                                       AC400000
/mips_singlecycle_tb/busWout_tb                                                                     00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file                                     bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                                          1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                                           1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                                           0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                                           1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                                         10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                                          00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                                         00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData          00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset            0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData          00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset            0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData          00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset            0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData          10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset            0
                                                                                     Now            10100 ns
                                                                                     Cursor 1       999.378 ns
```

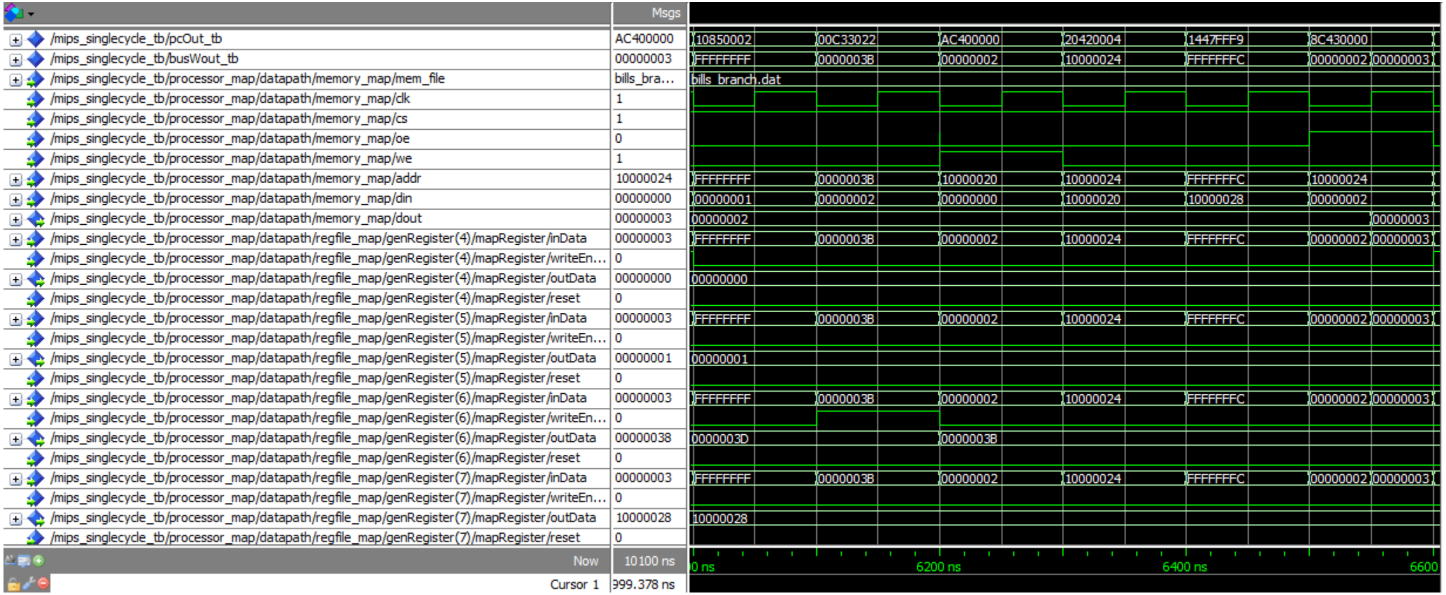

Msgs
20420004 1447FFF9 8C430000 00C3202A 10850002 00C33022 AC400000
100000... FFFFFFF4 00000190 00000001 00000000 FFFFFFFF 0000003D 00000001
bills_branch.dat
100000... FFFFFFF4 1000001C 00000000 FFFFFFFF 0000003D 1000001C
10000018 10000028 00000190 00000001 00000001 00000001 00000000
00000190 00000001
100000... FFFFFFF4 00000190 00000001 00000000 FFFFFFFF 0000003D 00000001
00000001 00000000
100000... FFFFFFF4 00000190 00000001 00000000 FFFFFFFF 0000003D 00000001
00000001
100000... FFFFFFF4 00000190 00000001 00000000 FFFFFFFF 0000003D 00000001
0000003E 0000003D
100000... FFFFFFF4 00000190 00000001 00000000 FFFFFFFF 0000003D 00000001
10000028
5000 ns
5200 ns
5400 ns

```
/mips_singlecycle_tb/pcOut_tb                                                                       AC400000
/mips_singlecycle_tb/busWout_tb                                                                     00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file                                     bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                                          1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                                           1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                                           0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                                           1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                                         10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                                          00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                                         00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData          00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset            0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData          00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset            0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData          00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset            0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData           00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...       0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData          10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset            0
                                                                                     Now            10100 ns
                                                                                     Cursor 1       999.378 ns
```



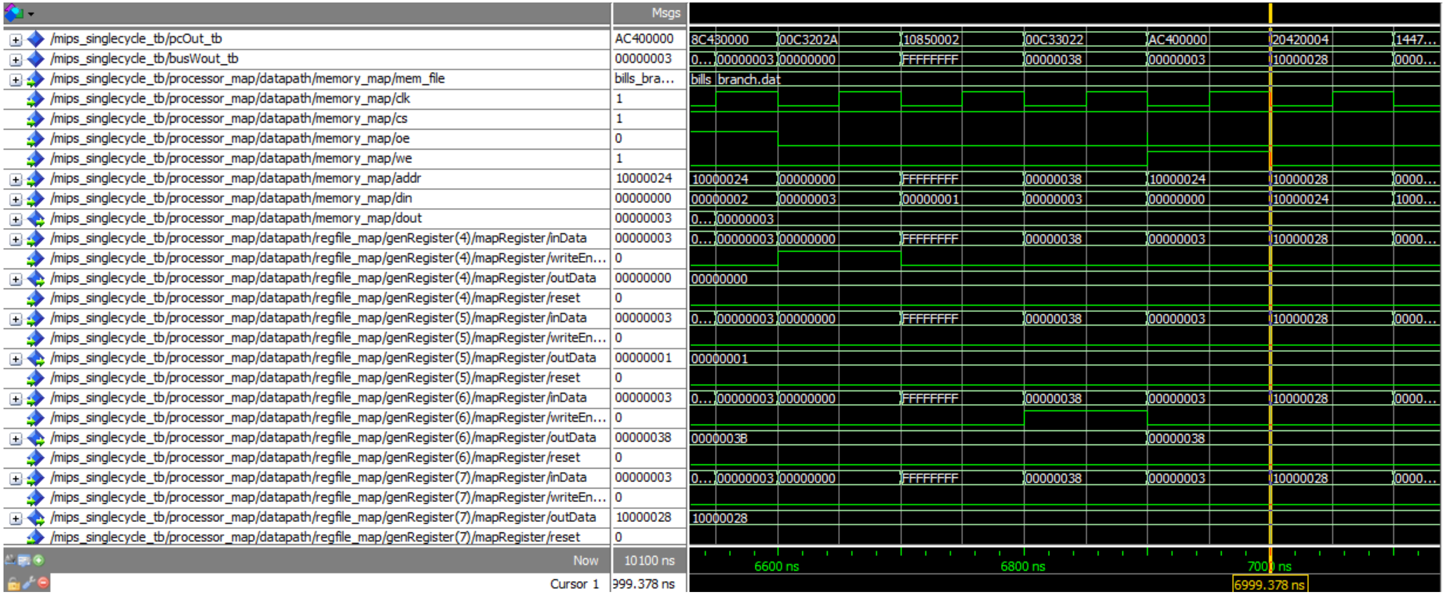
```
                                                                                  Msgs
/mips_singlecycle_tb/pcOut_tb                                                     AC400000
/mips_singlecycle_tb/busWout_tb                                                   00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file                   bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                        1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                         1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                         0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                         1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                       10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                        00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                       00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData    00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData    00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData    00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData    10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset      0
                                                                          Now     10100 ns
                                                                     Cursor 1     999.378 ns
```

AC400000 20420004 1447FFF9 8C430000 00C3202A 10850002 0...
00000001 10000020 FFFFFFF8 00000001 00000002 00000000 FFFFFFFF 0...
bills_branch.dat
1000001C 10000020 FFFFFFF8 10000020 00000000 FFFFFFFF 0...
00000000 1000001C 10000028 00000001 00000002 00000001 0...
00000001 00000002
00000001 10000020 FFFFFFF8 00000001 00000002 00000000 FFFFFFFF 0...
00000000
00000001 10000020 FFFFFFF8 00000001 00000002 00000000 FFFFFFFF 0...
00000001
00000001 10000020 FFFFFFF8 00000001 00000002 00000000 FFFFFFFF 0...
0000003D
00000001 10000020 FFFFFFF8 00000001 00000002 00000000 FFFFFFFF 0...
10000028
5600 ns
5800 ns
6000 ns



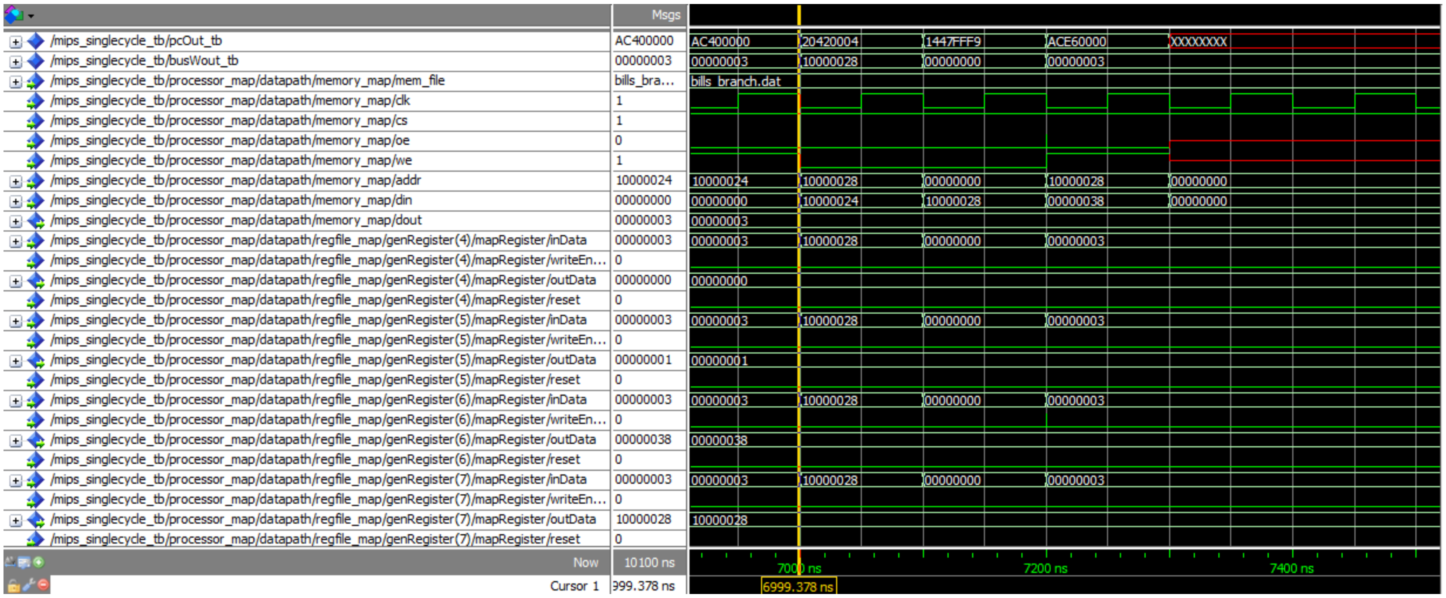
```
                                                                                  Msgs
/mips_singlecycle_tb/pcOut_tb                                                     AC400000
/mips_singlecycle_tb/busWout_tb                                                   00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file                   bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                        1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                         1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                         0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                         1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                       10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                        00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                       00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData    00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData    00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData    00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData    10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset      0
                                                                          Now     10100 ns
                                                                     Cursor 1     999.378 ns
```

10850002 00C33022 AC400000 20420004 1447FFF9 8C430000
FFFFFFFF 0000003B 00000002 10000024 FFFFFFFC 00000002 00000003
bills_branch.dat
FFFFFFFF 0000003B 10000020 10000024 FFFFFFFC 10000024
00000001 00000002 00000000 10000020 10000028 00000002
00000002 00000003
FFFFFFFF 0000003B 00000002 10000024 FFFFFFFC 00000002 00000003
00000000
FFFFFFFF 0000003B 00000002 10000024 FFFFFFFC 00000002 00000003
00000001
FFFFFFFF 0000003B 00000002 10000024 FFFFFFFC 00000002 00000003
0000003D 0000003B
FFFFFFFF 0000003B 00000002 10000024 FFFFFFFC 00000002 00000003
10000028
0 ns
6200 ns
6400 ns
6600



```
                                                                                  Msgs
/mips_singlecycle_tb/pcOut_tb                                                     AC400000
/mips_singlecycle_tb/busWout_tb                                                   00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file                   bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk                        1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs                         1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe                         0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we                         1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr                       10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din                        00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout                       00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData    00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData    00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData    00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset      0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData     00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...  0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData    10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset      0
                                                                          Now     10100 ns
                                                                     Cursor 1     999.378 ns
```

8C430000 00C3202A 10850002 00C33022 AC400000 20420004 1447...
0... 00000003 00000000 FFFFFFFF 00000038 00000003 10000028 0000...
bills_branch.dat
10000024 00000000 FFFFFFFF 00000038 10000024 10000028 0000...
00000002 00000003 00000001 00000003 00000000 10000024 1000...
0... 00000003
0... 00000003 00000000 FFFFFFFF 00000038 00000003 10000028 0000...
00000000
0... 00000003 00000000 FFFFFFFF 00000038 00000003 10000028 0000...
00000001
0... 00000003 00000000 FFFFFFFF 00000038 00000003 10000028 0000...
0000003B 00000038
0... 00000003 00000000 FFFFFFFF 00000038 00000003 10000028 0000...
10000028
6600 ns
6800 ns
7000 ns
6999.378 ns



	Msgs
/mips_singlecycle_tb/pcOut_tb	AC400000
/mips_singlecycle_tb/busWout_tb	00000003
/mips_singlecycle_tb/processor_map/datapath/memory_map/mem_file	bills_bra...
/mips_singlecycle_tb/processor_map/datapath/memory_map/clk	1
/mips_singlecycle_tb/processor_map/datapath/memory_map/cs	1
/mips_singlecycle_tb/processor_map/datapath/memory_map/oe	0
/mips_singlecycle_tb/processor_map/datapath/memory_map/we	1
/mips_singlecycle_tb/processor_map/datapath/memory_map/addr	10000024
/mips_singlecycle_tb/processor_map/datapath/memory_map/din	00000000
/mips_singlecycle_tb/processor_map/datapath/memory_map/dout	00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/inData	00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/writeEn...	0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/outData	00000000
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(4)/mapRegister/reset	0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/inData	00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/writeEn...	0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/outData	00000001
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(5)/mapRegister/reset	0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/inData	00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/writeEn...	0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/outData	00000038
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(6)/mapRegister/reset	0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/inData	00000003
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/writeEn...	0
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/outData	10000028
/mips_singlecycle_tb/processor_map/datapath/regfile_map/genRegister(7)/mapRegister/reset	0
Now	10100 ns
Cursor 1	999.378 ns

Conclusion

To conclude, we have successfully created a single-cycle processor that performed all of the operations requested in the specification. As is evident in the above waveforms as well as by running the test bench, our processor is capable of reading a MIPS instruction set and producing valid output.

Challenges

1. Much early discussion revolved around how we should efficiently split up the work amongst our team. We found that the best collaborative method was using a private GitHub repository and assigning standalone components to each team member (e.g. one member took the registers, and the other took the control logic). After establishing these collaborative guidelines, progress was made at a much quicker pace.
2. The control logic had to be designed from the bottom up using basic gates, and it was a challenge to create a combinational structure that supported very many signals. We surmounted this by creating a truth table, forming Boolean expressions, and implementing them in logic gates (as was taught in *EECS 303*).
3. Reading from files and storing registers was something none of our teammates had encountered before, and was thus a challenge in implementing in our processor. We solved this by viewing the existing *sram.vhd* component, as well as looking at its test bench, *sram_demo.vhd*. From there, we were able to adapt the component to suit our needs.