Homework 3

20125071 – Bùi Lê Gia Cát

Problem 1

a/

The register %rdx is increased by 8 every step in the inner loop. In C, the size of the data type *long* is 8 bytes. As a result, at each step of the inner loop, the register percent %rdx is increased by 8 to move to the next element of A. Therefore, %rdx holds the pointer to element A[i][j].

b/

In Assembly, there are instructions "movq (%rdx), %rcx" and "movq %rcx,(%rax)". These instructions swap the address of the register %rdx and %rax. The register %rdx holds the address of A[i][j], so the register %rax must hold the address of A[j][i].

c/

In Assembly, in line 7, there is an instruction "addq $120, %rax". This instruction means changing the address of A[j][i] hold by the register %rax to the address of A[j+1][i]. So, the total size of M elements data types is 120. Hence M = 120/8 = 15.

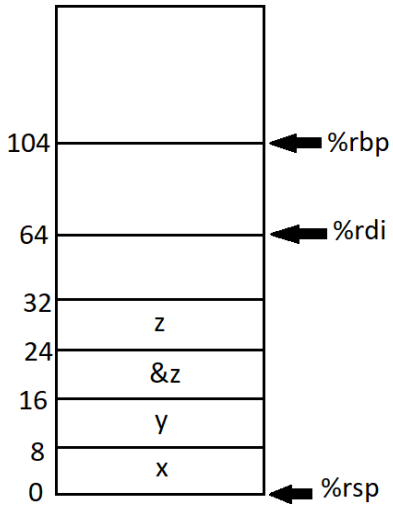
Problem 2

The instructions "addq $1,%rdx" and "cmpq %rdi,%rdx" are found on Assembly lines 13 and 15. In C, these instructions are equivalent to "i++" and "i < NR(n)". As a result, the register %rdi keeps the result of NR(n). There are instructions "leaq (%rdi,%rdi,2), %rax" and "movq %rax, %rdi" on lines 3 and 4. Hence, NR(n) = 3x%rdi = 3n.

The register %rcx, which stores the address of element A[i][j], increases %r8 bytes to move to A[i+1][j], hence the register %r8 stores the size of NC(n) elements. The value in the register %r8 is shifted left by 3 or multiplied by 8 in Assembly line 7. Therefore, the value saved in the register %r8 in line 2 is the definition of NC(n) = %rdi*4+1 = 4n+1

Problem 3

a/



b/

In C, *eval* passes the function *process* with a StrA s, while in Assembly, there is an instruction "leaq 64(%rsp),%rdi". In Assembly, the register %rdi is use to pass the first parameter. Then, we know that %rsp+64 is the pointer to the begin of the first paprameter of function *process*. Therefore, *eval* passes %rsp+64 to function *process*.

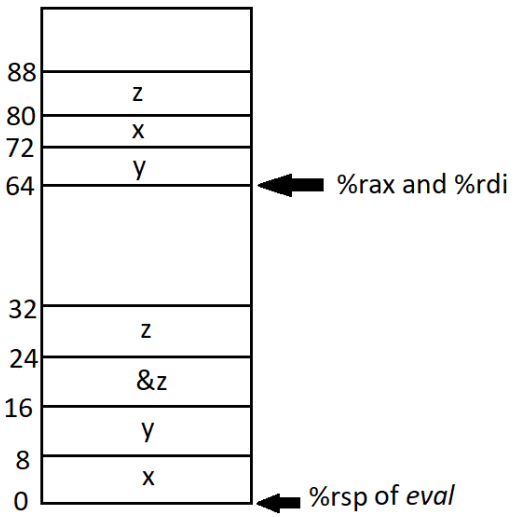
c/

Since *eval* passes %rsp+64 to function *process*, the Assembly code adds the register %rsp with an offset to access the elements in structure argument s.

d/

Since *eval* passes %rsp+64 to the register %rdi, the function *process* calculate %rdi + offset to access and set value of the elements of structure r in *eval*.

e/



f/

In Assembly, the caller allocates stack space and passes the address to the callee, which then stores data in the space and returns the address to the caller.

Problem 4

Cache	m	C	B	E	S	t	s	b
1.	32	1024	4	4	64	24	6	2
2.	32	1024	4	256	1	30	0	2
3.	32	1024	8	1	128	22	7	3
4.	32	1024	8	128	1	29	0	3
5.	32	1024	32	1	32	22	5	5
6.	32	1024	32	4	8	24	3	5

Problem 5

Cache	m	C	B	E	S	t	s	b
1.	32	**2048**	8	1	**256**	21	8	3
2.	32	2048	**4**	**4**	128	23	7	2
3.	32	1024	2	8	64	**25**	**6**	1
4.	32	1024	**32**	2	16	23	4	**5**

Problem 6

a/

CT	CT	CT	CT	CT	CT	CT	CT	CI	CI	CO	CO
11	10	9	8	7	6	5	4	3	2	1	0

b/

Operation	Address	Hit?	Read value (or unknow)
Read	0x834	Miss	Unknown
Write	0x836	Hit	
Read	0xFFD	Hit	0xC0

Problem 7

The size of (C) of this cache in bytes is 128

CT	CT	CT	CT	CT	CT	CT	CT	CI	CI	CI	CO	CO
12	11	10	9	8	7	6	5	4	3	2	1	0

Problem 8

Address format:

0	0	1	1	1	0	0	0	1	1	0	1	0
12	11	10	9	8	7	6	5	4	3	2	1	0

Memory reference:

Parameter	Value
Blockoffset (CO)	0x2
Index (CI)	0x6
Cache tag (CT)	0x38
Cache hit? (Y/N)	Y
Cache byte return	0xEB

Problem 9

a/

Address format:

1	0	1	1	0	1	1	1	0	1	0	0	0
12	11	10	9	8	7	6	5	4	3	2	1	0

Memory reference:

Parameter	Value
Blockoffset (CO)	0x0
Index (CI)	0x2
Cache tag (CT)	0xB7
Cache hit? (Y/N)	N
Cache byte return	—

b/

- 0x1140, 0x1141, 0x1142, 0x1143
- 0x16C8, 0x16C9, 0x16CA, 0x16CB
- 0x180C, 0x180D, 0x180E, 0x180F
- 0x1150, 0x1151, 0x1152, 0x1153
- 0x1798, 0x1799, 0x179A, 0x179B

Problem 10

dst array				
	Col. 0	**Col. 1**	**Col. 2**	**Col. 3**
Row 0	m	m	m	m
Row 1	m	m	m	m
Row 2	m	m	m	m
Row 3	m	m	m	m

src array				
	Col. 0	**Col. 1**	**Col. 2**	**Col. 3**
Row 0 b	m	h	h	h
Row 1	m	h	h	h
Row 2	m	h	h	h
Row 3	m	h	h	h