1. Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	9

Give the physical address for each of the following logical addresses or write "segmentation fault" if the reference would cause a segmentation fault:

a) <0,430>

430 < 600 => 219 + 430 = 649

b) <1,10>

10 < 14 => 2300 + 10 = 2310

c) <2,500>

500 > 100 => segmentation fault

d) <3,400>

400 < 580 => 1327 + 400 = 1727

e) <4,112>

112 > 9 => segmentation fault

2. Suppose the FrameSize is 2048 and a process' page table is:

Page Number	Frame Number	Valid
[0]	4	T
[1]	2	T
[2]	-	F
[3]	3	T

Give the physical address for each of the following logical addresses or write "pagefault" if the reference would cause a page fault:

a) 56

page# = 56 DIV 2048 = 0
offset = 56 MOD 2048 = 56
physical address = 4 * 2048 + 56 = 8248

b) 5000

page# = 5000 DIV 2048 = 2
offset = 5000 MOD 2048 = 904
page fault

c) 6500

page# = 6500 DIV 2048 = 3
offset = 6500 MOD 2048 = 356
physical address = 3 * 2048 + 356 = 6500

d) 1024

page# = 1024 DIV 2048 = 0
offset = 1024 MOD 2048 = 1024
physical address = 4 * 2048 + 1024 = 9216

e) 3000

page# = 3000 DIV 2048 = 1
offset = 3000 MOD 2048 = 952
physical address = 2 * 2048 + 952 = 5048

3. Suppose that there are only 3 frames of physical memory (initially empty), and a process accesses its page in the following order: 1,2,3,4,2,1,5,6,2,1,2,3,7,6,3,2,1,2,3,6. Show which pages are in each frames as the pages are reference and give the total number of page faults using each of the following page replacement algorithms:

a) FIFO

	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
Frame 0:	**1**	1	1	**4**	4	4	4	**6**	6	6	6	**3**	3	3	3	**2**	2	2	2	**6**
Frame 1:		**2**	2	2	2	**1**	1	1	**2**	2	2	2	**7**	7	7	7	**1**	1	1	1
Frame 2:			**3**	3	3	3	**5**	5	5	**1**	1	1	1	**6**	6	6	6	6	**3**	3
	PF	PF	PF	PF		PF	PF	PF	PF	PF		PF	PF	PF		PF	PF		PF	PF

Queue: ~~1~~ ~~2~~ ~~3~~ ~~4~~ ~~1~~ ~~5~~ ~~6~~ ~~2~~ ~~1~~ ~~3~~ ~~7~~ ~~6~~ ~~2~~ 1 3 6
16 Pagefaults

Key:
Blue – New page
Black – Existing page
PF – Pagefault
[ ] – Victim

b) LRU

	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
Frame 0:	**1**	1	1	**4**	4	4	**5**	5	5	**1**	1	1	**7**	7	7	**2**	2	2	2	2
Frame 1:		**2**	2	2	2	2	2	**6**	6	6	6	**3**	3	3	3	3	3	3	3	3
Frame 2:			**3**	3	3	**1**	1	1	**2**	2	2	2	2	**6**	6	6	**1**	1	1	**6**
	PF	PF	PF	PF		PF	PF	PF	PF	PF		PF	PF	PF		PF	PF			PF

Queue: ~~1~~ ~~2~~ ~~3~~ ~~4~~ ~~2~~ ~~1~~ ~~5~~ ~~6~~ ~~2~~ ~~1~~ ~~2~~ ~~3~~ ~~7~~ ~~6~~ ~~3~~ ~~2~~ ~~1~~ 2 3 6
15 Pagefaults

Key:
Blue – New page
Black – Existing page
PF – Pagefault
[ ] – Victim

c) Optimal

	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
Frame 0:	**1**	1	1	1	1	1	1	1	1	1	1	**3**	3	3	3	3	3	3	3	**6**
Frame 1:		**2**	2	2	2	2	2	2	2	2	2	2	**7**	7	7	**2**	2	2	2	2
Frame 2:			**3**	**4**	4	4	**5**	**6**	6	6	6	6	6	6	6	6	**1**	1	1	1
	PF	PF	PF	PF			PF	PF				PF	PF			PF	PF			PF

Any of these can be chosen as the next victim

11 Pagefaults

Key:
Blue – New page
Black – Existing page
PF – Pagefault
□ – Victim

d) Second Chance

	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
Frame 0:	**1**	1	1	**4**	4	4	4	**6**	6	6	6	**3**	3	3	3	3	**1**	1	1	1
Frame 1:		**2**	2	2	2	2	**5**	5	5	**1**	1	1	1	**6**	6	6	6	6	**3**	3
Frame 2:			**3**	3	3	**1**	1	1	**2**	2	2	2	**7**	7	7	**2**	2	2	2	**6**
	PF	PF	PF	PF		PF	PF	PF	PF	PF		PF	PF	PF		PF	PF		PF	PF

Queue:	**1/1**	1/1	1/1	2/0	2/**1**	4/1	1/1	5/1	6/1	2/1	2/**1**	1/1	3/1	7/1	7/1	3/0	6/0	6/0	2/1	1/0
(head is at the top)		2/1	2/1	3/0	3/0	2/0	4/0	1/0	5/0	6/0	6/0	2/0	1/0	3/0	3/**1**	6/0	2/1	2/**1**	1/1	3/0
			3/1	4/1	4/1	1/1	5/1	6/1	2/1	1/1	1/1	3/1	7/1	6/1	6/1	2/1	1/1	1/1	3/1	6/1
Changed			1/**0**		2/**0**	4/**0**	1/**0**	5/**0**	6/**0**		2/**0**	1/**0**	3/**0**		7/**0**	3/0		6/0	2/**0**	
Queue:			2/**0**		3/0	2/0	4/0	1/0	5/0		6/0	2/0	1/0		3/**0**	6/0		2/1	1/**0**	
			3/**0**		4/1	1/1	5/1	6/1	2/1		1/1	3/1	7/1		6/**0**	2/1		1/1	3/**0**	

16 Pagefaults

Key:
Queue Entires – Page#/Refbit
Blue – New page
Black – Existing page
Green – Changes to Queue
PF – Pagefault
□ – Victim