CS 3810 Assignment 10

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Question 1:

Let processor is byte-addressable

a) Virtual Memory $= 2^{32} = 4\,GB$

b) Physical memory $= 2^{36} = 64\,GB$

c) Number of Virtual pages $= 2^{32}/2^{12} = 2^{20}$

d) Number of physical pages $= 2^{36}/2^{12} = 2^{24}$

Question 2:

Request	Cache Hit/Miss	Request on the bus	who responds	State in Cache 1	... in Cache 2	... in cache 3
$P_1:RdX$	miss	Rd X	Memory	S	INV	INV
$P_1:WrX$	Perms miss	Upgrade· X	No response. other caches invalidate	M	INV	INV
$P_3:RdX$	Read miss	RdX	memory	INV	m	INV
$P_2:RdX$	Read miss	RdX	P_1 respondes	INV	S	INV
$P_3:WrX$	write miss	WrX	P_2 responds	INV	INV	m

Question 3:

Request	Cache Hit/Miss	Request on the bus	who responds	State in cache1	State in cache2	State in cache3
P_1/RdX						

Question 3:

Request	Cache Hit/Miss	Messages	Dir State	State in C_1	..in C_2	..in C_3
$P_1: Rd\ X$	Miss	Read Request to Directory Directory responds.	$X: S: 1$	S	INV	INV
$P_1: Wr\ X$	Perms Miss	Upgrade to request to directory. Grants permission to P_1	$X: M: 1$	m	INV	INV
$P_2: Rd\ X$	Read miss	Read request to directory Directory forward request to P_1. P_1 sends data to directory. memory write back. Directory sends data to P_2.	$X: S: 2$	INV	S	INV
$P_3: Wr\ X$	Write Miss	write request to directory. Directory sends invailid to P_2. P_2 sends ACK to Directory Directory grants perms to P_3	$X: M: 3$	INV	INV	m
$P_3: Rd\ X$	Read Miss	Read request to directory Directory forward request to P_2. P_2 sends data to directory. memory write back. Directory send data to P_3	$X: S: 3$	INV	INV	S

Question 4:

Since those footprints were left behind, the attacker was able to essentially walk through the cache and figure out the elements.

As a result, the processors can defend the meltdown attacker by squashing the illegal instructions in the reorder buffer and clear the foot prints. often.