CS 212: Midterm Exam Review Worksheet 1

For the exercises on this worksheet, assume we have a machine with:

- 32-bit virtual memory addresses
- 256 byte page size
- 32-bit page table entries
- TLB with 64 entries, none are pre-loadeed

Question 1: How many bits are in the offset and virtual page number portions of addresses on this machine?

Question 2: How many levels would be required in a multi-level page table for this machine?

Question 3: For the binary virtual address below, break it up into the sections that represent the offset, the page directory indexes, and the page table index.

```
11010001011101001011001011010010
```

Question 4: Assume that a process on this machine is currently using 8 pages, and below is the current virtual page to physical page frame mapping for the process:

```
0xf94a4c -> 0x12c83f
0xf94a4d -> 0xf72123
0xf94a4e -> 0x03a8fe
0xf94a4f -> 0x3cd654
0xf94a50 -> 0x4219be
0xf94a51 -> 0x9fc773
0xf94a52 -> 0x89a62a
0xf94a53 -> 0x327dd6
```

What is the physical address of the process's virtual address `0xf94a509c`?

Question 5: Let's say a process accesses the following virtual addresses in this order, and the TLB has no entries loaded beforehand. For each access, state whether the access results in a TLB hit or a TLB miss.

`0xf94a4c03`

`0xf94a4cff`

`0xf94a52a4`

`0xf94a5300`

`0xf94a52a5`

Question 6: Which principle makes the TLB so effective, spacial locality or temporal locality?