Final Project Report

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CPE 315

1. To determine what to do at a branch at compile time, I will look at the combined data from the 3 versions of the shang program.

	Forward Branches	Backward Branches
Taken Count	25662	118328
Not Taken Count	16891	13223
Taken %	60.30597	89.94839
Not Taken %	39.69403	10.05161

For forward branches, 60% of the branches were taken, which means that for forward branches it is, on average, better to assume that the branch is taken. For backward branches, the difference is much more distinct, with almost 90% of backward branches taken. This means that, overall, it is better to assume that a branch is taken both forwards and backwards.

2. In our simulations of shang O0-O3, the 32 and 64-byte block sizes outperformed the other cache block sizes hit-rates by at least ~5%, except for in shang O0, where smaller block sizes were favored. However, the difference was less than 5% in this case, and the program was unoptimized. In shang O0, the 32-byte block size outperformed the 64-byte block size by an additional 5%, making the 32-byte block size the ideal line size overall.

3. Compiling with O2 optimization significantly reduces the number of instructions that are required for a program to execute. Between shang O0 and O2, the number of dynamic instructions executed decreased by a factor of 5. It also seems that higher optimization levels favor more complex instructions that do multiple things at once, such as ldm in shang O2 over ldr in shang O0.

Extra Credit

In order to compute the number of cycles necessary for each instruction, I used sections 16.2-16.18 of the ARM Technical Reference Manual to create an additional stat function that had the following signature:
registerInst(instruction type, destination register, source reg 1, source reg 2, optional source reg 3)

This function was called for every instruction and can keep track of data dependencies between instructions by using an array of register "delay" values to calculate the required number of stall cycles necessary to clear these data dependencies. This results in a reasonable total count of cycles for the execution of the program.