CS 444 Project 4: The SLOB SLAB

Helena A. Bales, Kathryn Maule, and Alexander Scott Wilson

November 28, 2016

Abstract

For the SLOB SLAB assignment we will be implementing code in the default yocto kernel. The purpose of this assignment is to understnad how the SLOB first-fit algorithm works, through the implementation of the afforementioned algorithm. We will also be implementing the best-fit allocation algorithm. We will be writing a program that computes the efficiency of both algorithms and compare the fragmentation suffered by each. The solution to this problem will be implemented within the default yocto kernel.

Contents

1 Program Design

1.1 Description of Problem

The SLOB SLAB assignment will require the implementation of code in the default Linux yocto kernel. The algorithms that will be implemented are the SLOB first-fit algorithm and the best-fit allocation algorithm. In addition to these two algorithms, we will be measuring the efficiency of both algorithms, and we will compare the fragmentation suffered by each. Measuring the efficiency will require the addition of a system call that will measure the actual memory usage. This program will be developed in the slob.c file in the mm directory of the Linux kernel.

There are additional hints given by the assignment description that may be useful for the design of the implementation of these algorithms. These hints include that the best-fit must be over all allocated pages, not just the current page. Additionally, we must pick a system call number that has never been used for measuring the actual memory usage. Finally we will also need to be careful with our memory tracking, and that SLOB is just a simple list of blocks. With the help of these hints we should be able to complete the tasks described above as well as the following sections of documentation.

1.2 Design of SLOB First-Fit Algorithm

The SLOB First-Fit algorithm is one of three default memory allocation algorithms available in the Linux kernel. We will be implementing the SLOB memory allocator in a default Linux yocto kernel within the slob.c file in the mm directory. SLOB uses a first-fit memory allocation algorithm. This means that the SLOB allocator simply allocates the first sufficiently-large block of memory that it can find. We will implement the algorithm by receiving a desired block size, then running through the memory until a free block of sufficient size is detected. The memory block will then be allocated.

1.3 Design of Best-Fit Allocation Algorithm

The Best-Fit allocation algorithm optomizes the allocation of memory in order to limit fragmentation, and consolodating memory. It works by searching for a free block of memory that best fits the desired size of block. This optomization must be performed over all allocated pages, not just the current page. This method of memory allocation will require that all memory be traversed until a free block of equal size to the requested block is found, or until the end of the memory has been reached. If there is not a block of the exact correct size, the block should be placed where a free block closest to the size of the desired block is located.

1.4 Design of Effeciency and Fragmentation Measurement Script

The script that measures the effeciency of the algorithms will run each algorithm for a series of different inputs. The script will allocate various sizes of memory using each method. The measurement of the efficiency will be accomplished by measuring the total time required to allocate all memory blocks using each method. The times will be output to a CSV along with the number of blocks allocated during the test.

The script which measures the fragmentation of each implementation of the algorithm will be performed on the output of the effeciency test. After the allocation of each memory block has occured,

a check will be run on the used memory for each algorithm. This will be accomplished using a system call. The fragementation suffered by the memory blocks allocated by each algorithm will be output to the same CSV as the effeciency measurements.

2 Version Control Logs

Detail	Author	Description
c47d121	balesh2	init
08ba19e	balesh2	don't remove pdf on make clean
fd62761	balesh2	get rid of extra files
d782deb	balesh2	add documentation to tex doc
78d8e5f	balesh2	update pdf

3 Work Log

3.1 November 22nd, 2016 - 11:00 am

Added Makefile, changes script, and tex document. The changes script generates a change log tex document to be included in the tex write up that formats the commit log as a table. The tex document (this document) contains all documentation on the project. The Makefile will compile this document and the table of commits into a pdf.

3.2 November 28nd, 2016 - 2:30 pm

Wrote assignment abstract and started Program Design. Added subsection for the description of the problem, which includes an overview of the project description given on the CS444 class website. Added content in sections for purpose of assignment, testing methods, and learning outcomes.

3.3 November 28nd, 2016 - 3:00 pm

Wrote content for design of efficiency and fragmentation measurement algorithms. Wrote content for design of SLOB and Best-fit memory allocation algorithms.

4 Purpose of Assignment

The purpose of this assignment is to understand how the SLOB first-fit algorithm and the best-fit allocation algorithm work through the implementation of each algorithm, the measuring of their efficiencies, and comparing the fragmentation caused by each algorithm. This will help us understand the way that the allocation of memory blocks works in Linux systems. The algorithms and algorithm analytics will be implemented in the default Linux yocto kernel, which should help us understand the portion of the implementation that is Linux-specific.

5 Testing Methods

We will be testing the implementations of these algorithms through measuring their efficiency and comparing the fragmentation caused by each of the algorithms. We will measure the efficiency by writing a test script that will run the algorithms with a variety of inputs and measure the runtime of each trial. From there we should be able to equate the runtimes with a complexity using the data. Measuring the fragmentation of each algorithms will require adding a system call which will return the memory usage. This test script should store the results in a CSV which can then be used as the input to create any desired graph.

6 Learning Outcomes

From this assignment we will learn how to implement SLOB first-fit algorithm and a best-fit allocation algorithm. We will learn how to make a system call to measure the fragmentation caused by each of the algorithms. We will learn how to measure and calculate the efficiency of the algorithms. We learned how to do all this within the Linux yocto kernel.