

ITP 30002-{01, 02} Operating System, Spring 2021

Midterm Exam

10 problems

7 PM—9 PM (2 hours), 23 April 2021

Overview

Problem 1 16 points

Problem 2 12 points

Problem 3 9 points

Problem 4 8 points

Problem 5 10 points

Problem 6 8 points

Problem 7 9 points

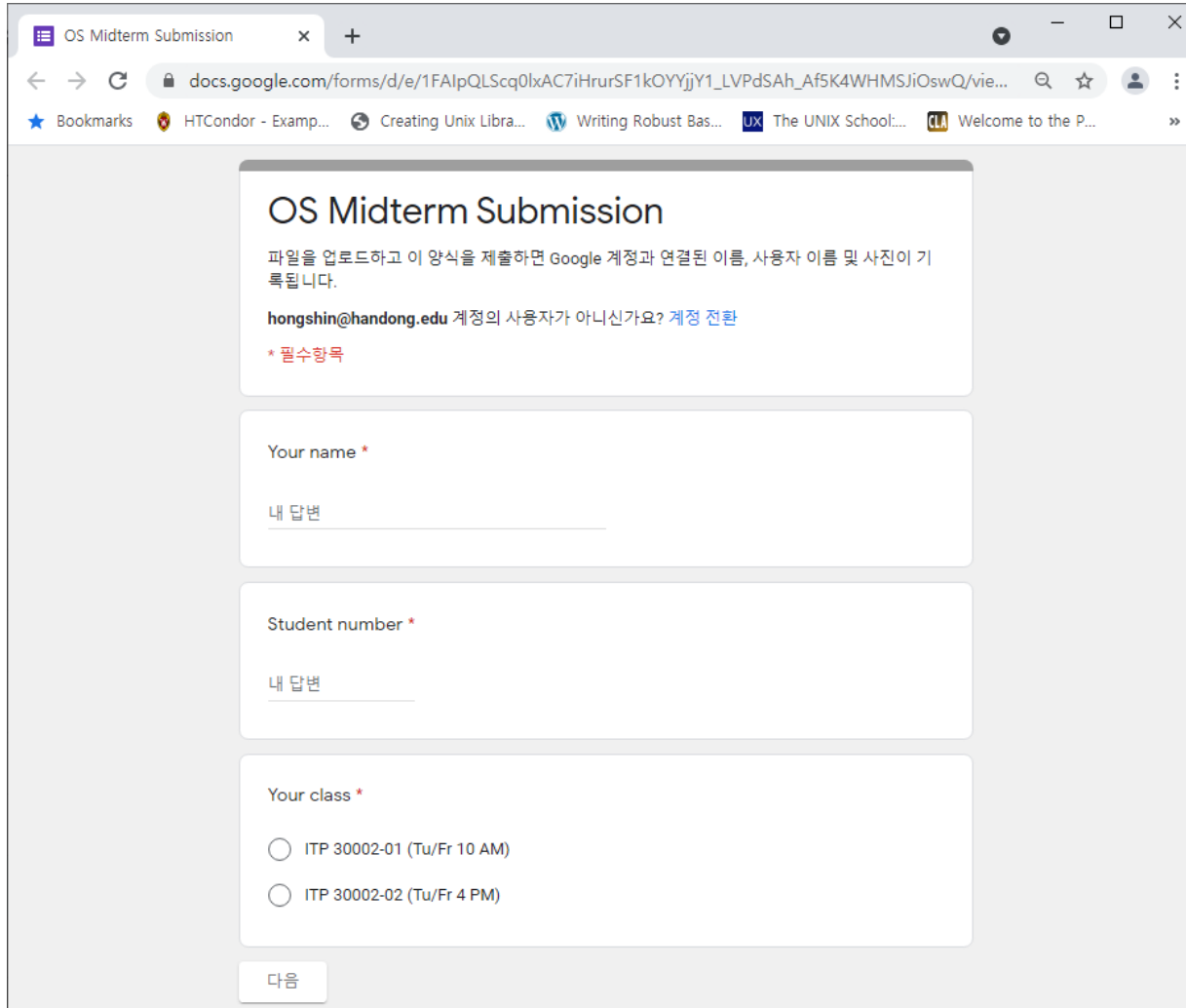
Problem 8 8 points

Problem 9 10 points

Problem 10 10 points

Answer Submission Site

- <https://forms.gle/RL8FYjyPW5NuVcM6A>



The screenshot shows a web browser window with the address bar displaying the Google Forms URL: `docs.google.com/forms/d/e/1FAIpQLScq0lxAC7iHrurSF1kOYYjY1_LVPdSAh_Af5K4WHMSJiOswQ/vie...`. The browser's bookmark bar includes links for 'HTCondor - Examp...', 'Creating Unix Libra...', 'Writing Robust Bas...', 'The UNIX School...', and 'Welcome to the P...'. The form itself is titled 'OS Midterm Submission' and contains the following text: '파일을 업로드하고 이 양식을 제출하면 Google 계정과 연결된 이름, 사용자 이름 및 사진이 기록됩니다.' (Uploading a file and submitting this form will record your Google account name, user name, and photo). Below this, it asks if the user is not a user of the `hongshin@handong.edu` account, with a link to '계정 전환' (Switch account). A red asterisk indicates a required field. The form has three text input fields: 'Your name *', 'Student number *', and 'Your class *'. The 'Your class *' field has two radio button options: 'ITP 30002-01 (Tu/Fr 10 AM)' and 'ITP 30002-02 (Tu/Fr 4 PM)'. At the bottom of the form is a button labeled '다음' (Next).

Problem 1 (16 point)

Write in your own words a declaration that you will uphold the honor code in taking this exam. This problem is exceptional that you can write an answer in Korean.

c.f. the Handong CSEE Standard on Examination

1. Examination is an educational act necessary for evaluation of the students' achievement and for encouraging the students to absorb the material in the process of preparation.
2. Student should do their best to prepare for exams in order to improve her/his own knowledge and skill and should fully engage in the test during examination hour.
3. Accessing or providing unauthorized information, including other students' answer sheets, is regarded as cheating. The use of electronic devices, including cell phones and computers, without permission is strictly prohibited.
4. Entering or leaving the classroom during the examination before the finish time without permission is regarded as cheating.

Problem 2 (12 points)

Suppose that there is a 16-bit architecture with 512 byte pages.

How much memory would be taken by a per-process page table?

And, how much memory would be taken by an inverted page table?

Explain your answers in detail.

Problem 3 (9 points)

What kinds of instructions a computer architecture needs to provide as privileged instructions to an operating system for supporting multi-processing and paging?

Try to find them as many as you can, and support your answers.

Problem 4 (8 points)

Discuss how the size of a page matters to the performance of a computer system.

Process 5 (10 points)

An important goal of an operating system is protection between applications. Explain what this goal is for, and also explain in detail how the operating system achieves this goal (within the scope that we have covered in the classes so far).

Problem 6 (8 points)

As an ordinary user of a computer system, give a way to estimate the number of the TLB entries in the computer architecture (not by checking the system attributes or the hardware specification).

You can assume that the size of a page is known.

Explain the limitations of your answer if there exist.

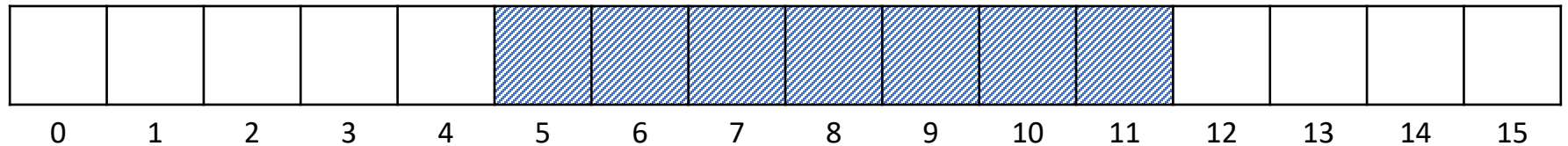
Problem 7 (9 points)

Suppose that there is a system using a multi-level feedback queue as the process scheduler.

Discuss the relation between the number of the priority levels in the process and the overall performance

Problem 8 (8 points)

Suppose that there is a 16-byte physical memory where a 7-byte segment is allocated (shaded in blue) as follows:



Give a scenario of segment allocation requests where the Worst-fit algorithm performs better than the Best-fit algorithm

Problem 9 (10 points)

There is a system running a Linux Completely Fair Scheduler with schedule latency 60 ms and minimum granularity 15 ms, and the timer interrupt happens every 15 ms.

Suppose that the following workload was given to the system, and the system first scheduled Task A:

Task Name	Arrival Time	Duration	Weight
A	0 ms	70	1
B	0 ms	90	2
C	60 ms	30	2
D	120 ms	50	1

Give a execution scenario for the first 150 ms. You should support your answer.

Problem 10 (10 points)

main.c

```
01 #include <stdio.h>
02 #include <unistd.h>
03 #include <sys/wait.h>
04 int main () {
05     if (fork() == 0) {
06         putchar('A') ;
07         if (fork() == 0) {
08             putchar('B') ;
09             return 0 ;
10         }
11         execl("./foo", "foo", (char *)0x0) ;
12         wait(0x0) ;
13         putchar('D') ;
14         return 0 ;
15     }
16     putchar('E') ;
17     wait(0x0) ;
18     putchar('F') ;
19 }
```

foo.c

```
01 #include <stdio.h>
02 int main () {
03     putchar('C') ;
04 }
```

commands

```
$ gcc -o foo foo.c
$ gcc -o main main.c
$ ./main
```

For given programs and commands, find all possible printings to the standard output by executing `main`, while assuming that the compiler does not reorder any statements and `putchar` immediately prints a given character to the standard output. You should support your answer.