

15-410, Spring 2024, Homework Assignment 1.
Due Tuesday, February 27, 20:59:59 p.m.

Please observe the non-standard submission time, **which is not midnight**. As we intend to make solutions available on the web site promptly thereafter for exam-study purposes, please turn your solutions in on time.

Homework must be submitted in either PostScript or PDF format (not: Microsoft Word, Word Perfect, Apple Works, LaTeX, XyWrite, WordStar, etc.). Submit your answers by placing them in the appropriate hand-in directory, e.g., `/afs/cs.cmu.edu/academic/class/15410-s24-users/$USER/hw1/$USER.ps` or `/afs/cs.cmu.edu/academic/class/15410-s24-users/$USER/hw1/$USER.pdf`. A plain text file (.text or .txt) is also acceptable, though it must conform to Unix expectations, meaning lines of no more than 120 characters separated by newline characters (note that this is *not* the Windows convention or the MacOS convention). Please avoid creative filenames such as `hw1/my_15-410_homework.PdF`.

1 Tape drives (10 pts.)

Consider a system with three processes and three tape drives. The maximal needs of each process are declared below:

Resource Declarations

Process A	Process B	Process C
2 tape drives	2 tape drives	2 tape drives

1.1 3 pts

Is the following state safe? Why or why not?

Who	Max	Has	Room
A	2	1	1
B	2	1	1
C	2	0	2
System	3	1	-

1.2 3 pts

Explain why the following state is not safe.

Who	Max	Has	Room
A	2	1	1
B	2	1	1
C	2	1	1
System	3	0	-

1.3 4 pts

Show a safe state in which three tape drives are allocated.

2 Transfer trouble (10 pts.)

Consider the following code for transferring money from one bank account to another.

```
int transfer(account from, account to, int amount)
{
    int available;

    /* check */
    available = from->value;
    if (available < amount)
        return (-1);

    /* commit */
    available -= amount;
    from->value = available;
    to->value += amount;
    return (0);
}
```

In a mathematical sense, it should be ok to “transfer” money from an account to itself, e.g., `transfer(A, A, 500)`.

Using the tabular format presented in class, show how concurrent invocations of the “mathematically safe” operation `transfer(A, A, 500)` can *increase* the amount of money in account A. For fun, see if you can get `transfer(A, A, 500)` to *double* the amount of money in the account.

You may use more or fewer lines or columns than are provided in this sample table.

Execution Trace

time	Thread A	Thread B	Thread C
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			