

Programming assignment 1

Getting started

All your submissions should be implemented in Go unless the problem specifies something different. You can download Go at <https://go.dev/dl/>. You can also use various package managers to install it, e.g., [HomeBrew](#) on macOS.

Problem 1

Implement a deque using a linked list that multiple goroutines can safely use. Your locking strategy should be as fine-grained as possible (but you must use mutex locking). Describe the strategy in the report and argue for why it is minimal.

Problem 2

You know that the string a74277500228f7b4cfa8694098443fc5 is an md5 hash of a password. You also know that the password is six characters; the only characters allowed are a-z0-9. Your task is to create a parallel password cracker in Go.

You can use `crypto/md5` to create an md5-hash of a string. You have cracked the password when you find a string that generates the same md5-hash as the one above.

Your solution should use goroutines and channels. Describe your design in the report as well as benchmarks of how well it scales with an increasing number of goroutines.

Problem 3 (required for C+)

A mutex lock or a binary semaphore can be used to allow a single thread or goroutine to access a critical region. A counting semaphore can allow up to N threads or goroutines to access a critical region. Implement a counting semaphore using mutex locks. N should be a parameter. Describe your design in the report and provide a simple example showing it works.

Problem 4 (required for C+)

- Implement a binary heap that multiple goroutines can safely use. It is ok to use coarse-grained locking, i.e., lock the heap in each method that accesses it.
- Modify the heap in problem 1 to use a reader/writer lock (`RWMutex`). The methods should be modified to use the correct type of lock/unlock operations.

Submission guidelines

Submit your solutions as a single zip file via Moodle no later than 17:00 on Dec 10 (Wed), 2025.