1 Introduction

You are to write two programs:

- A mini-shell which can run processes in the foreground, background, and move them between the two.
- A program, called navigate, which will enable a cursor to be moved around the screen.

2 Minishell

The minishell should print a prompt of ‘:’ when its ready to accept a command. The possible commands are:

- **jobs**: list the background processes
- **fg i**: move process number i to the foreground.
- **Ctrl Z**: move the current process to the background and stop it.
- **bg i**: continue a stopped job.
- **prog arg1 arg2 ... argn**: execute a program in the foreground with \( n \geq 0 \) arguments. One of the programs is `navigate`.
- **prog arg1 arg2 ...argn &**: execute a program in the background with \( n \geq 0 \) arguments. One of the programs is `navigate`.

You should use the PATH variable to find program executables.

You need not support any of the shell I/O redirection, including ‘|’, ‘<’, ‘>’ and variants thereof.

3 Navigate

The navigate process prints a 20x20 grid of '.', except for a single X which is initially located at position 10x10.

Each time one of the following keys is typed, the cursor moves a single position, and should wrap around when it reaches the end:

- **U**: up
- **D**: down
- **L**: left
- **R**: right

Each time the key is pressed, the window is erased and the new value pattern is shown.

The pattern is only shown when the process is brought to the foreground.