**COMP304 Project 1**

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**1.1 Built-in Commands**

* **cd:** Allows changing directories. Error handling is implemented for invalid directory paths.
* **exit:** Terminates the shell session.

**1.2 Process Management**

* Used fork() and execv() to create and execute child processes.
* Implemented **background process handling** with the & operator. For background processes, the shell immediately returns to the prompt while the process executes.

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**2.1 Input and Output Redirection**

* Supported redirection symbols:
  + >: Redirects output to a file (overwrites if it exists).
  + >>: Appends output to a file.
  + <: Reads input from a file.
* Validated file existence and ensured proper error handling for redirection operations.

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**2.2 Piping**

* Implemented piping to pass the output of one command as the input of another. Supported chaining of multiple commands using pipes (|).
* Managed pipe creation and process communication using file descriptors.

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**3.1 Auto-completion**

* Implemented **tab-completion** for command and file names:
  + If multiple matches are found, all possible options are displayed.
  + Fully typed commands followed by a Tab list files in the current directory.

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**3.2 Hex Dump (kuhex)**

* Developed the kuhex command to generate a hex dump of a file.
* Supported grouping of 1, 2, 4, 8, or 16 bytes per column using the -g option.
* Ensured that each line displays exactly 16 bytes, followed by their ASCII representation.

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**4 Process Tree Visualization (psvis)**

* The psvis command retrieves and visualizes the process tree starting from a specified PID.
* Implemented using a **loadable kernel module** to extract process details and the /proc file system for inter-process communication.
* Generated a graphical representation of the process tree at the user level using external tools like graphviz.

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