



Theory Assignment Report

Only for course Teacher						
		Needs Improvement	Developing	Sufficient	Above Average	Total Mark
Allocate mark & Percentage		25%	50%	75%	100%	5
Clarity	1					.5
Content Quality	2					1.5
Spelling & Grammar	1					.5
Organization and Formatting	1					.5
Total obtained mark						3
Comments						

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Section: A

Course Code: SE 312

Course Name: Software Quality Assurance & Testing

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The task

```
#include <stdio.h>
#include <string.h>
int main() {
    const char correctUsername[] = "Admin";
    const char correctPassword[] = "abc123";
    char username[50];
    char password[50];
    int loginAttempt = 0;
    int loggedIn = 0;

    while (loginAttempt < 3 && !loggedIn) {
        printf("Enter User name: ");
        scanf("%49s", username);
        printf("Enter password: ");
        scanf("%49s", password);

        if (strcmp(username, correctUsername) == 0 && strcmp(password, correctPassword) == 0) {
            printf("Login successful!\n");
            loggedIn = 1;
        } else {
            printf("Incorrect User name or password. Please try again.\n");
            loginAttempt++;
        }
    }
    if (!loggedIn) {
        printf("You have been locked out due to too many failed login attempts.\n");
    }
    for (int i = 0; i < loginAttempt; i++) {
        printf("Login attempt %d failed.\n", i + 1);
    }

    return 0;
}
```

1. **Calculate** Cyclomatic complexity of the program.
2. Apply different types of mutation testing to the code above

Solution 1

Identifying the nodes:

```
#include <stdio.h>
#include <string.h>
int main() {
1   const char correctUsername[] = "Admin";
   const char correctPassword[] = "abc123";
   char username[50];
   char password[50];
   int loginAttempt = 0;
   int loggedIn = 0;

2   while (loginAttempt < 3 && !loggedIn) {
3       printf("Enter User name: ");
       scanf("%49s", username);
       printf("Enter password: ");
       scanf("%49s", password);

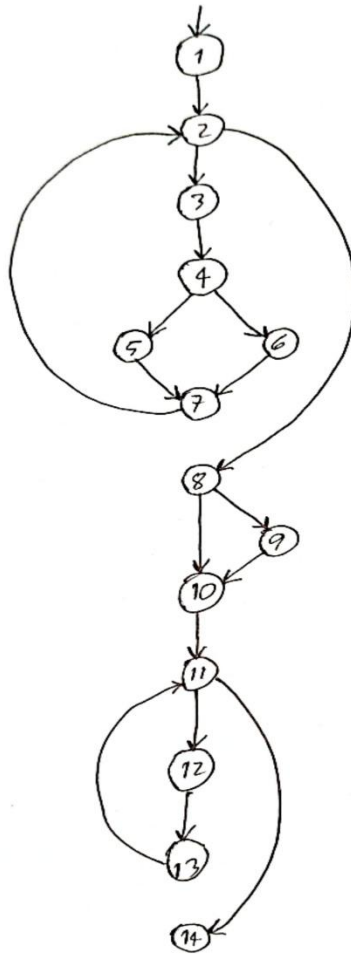
4       if (strcmp(username, correctUsername) == 0 && strcmp(password, correctPassword) == 0) {
5           printf("Login successful!\n");
           loggedIn = 1;
           } else {
6           printf("Incorrect User name or password. Please try again.\n");
           loginAttempt++;
           }

7       }
8       if (!loggedIn) {
9           printf("You have been locked out due to too many failed login attempts.\n");
           }

10, 11, 12  for (int i = 0; i < loginAttempt; i++) {
13           printf("Login attempt %d failed.\n", i + 1);
           }

14  return 0;
}
```

Control Flow Graph (CFG) and Cyclomatic Complexity:



$$\begin{aligned}\text{Cyclomatic Complexity} &= E - N + 2P \\ &= 17 - 14 + 2 \times 1 \\ &= 5\end{aligned}$$

$$\left. \begin{array}{l} E = 17 \\ N = 14 \\ P = 1 \end{array} \right\}$$

Solution 2

Applying different types of Mutation Testing techniques:

① Value Mutation :- Changing the variable / parameter values:-

```
ex:- loginAttempt = 0; } Previous code  
      loggedIn = 0; }  
      loginAttempt = 1; } Changed code  
      loggedIn = 1; }
```

② Decision Mutation :- Changing the conditions in conditional statements:-

```
ex:- while (loginAttempt < 3 && !loggedIn) } Previous code  
      if (!loggedIn)  
      for (i=0; i < loginAttempt; i++)  
      while (loginAttempt > 3 && loggedIn) } Changed code  
      if (loggedIn)  
      for (i=0; i < loginAttempt; i++)
```

③ Statement Mutation :- Deleting a statement or replacing by some other statements:-

```
ex:- if (!loggedIn) {  
      printf("You have been locked out due to too many  
      failed attempt.\n"); } Previous code  
  
      if (!loggedIn) {  
      loggedIn++; } Changed code  
      }
```