DBMS LAB

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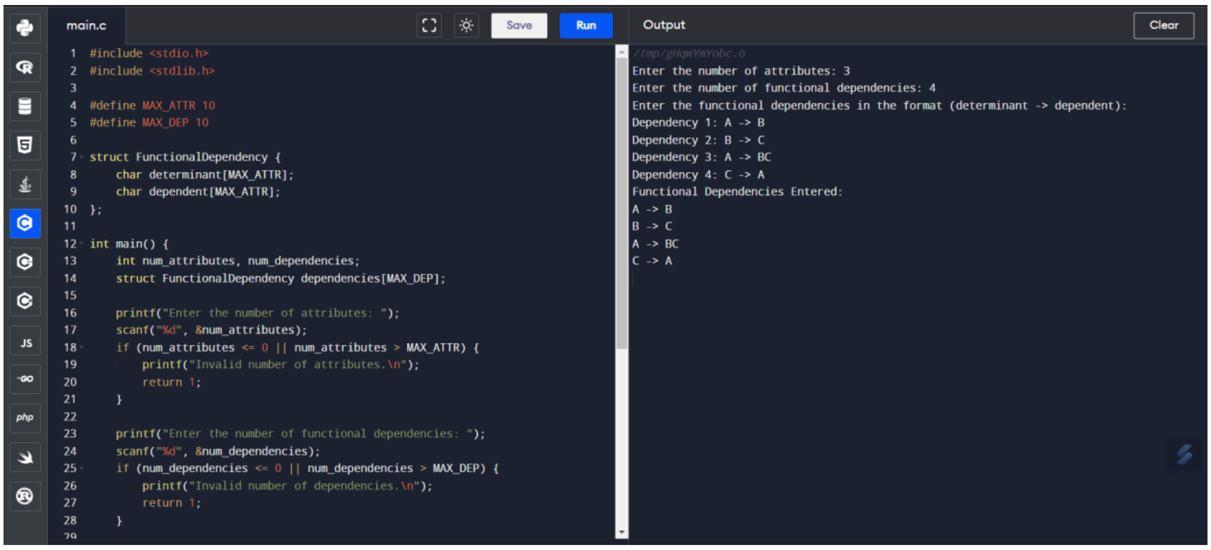
1.

```
#include <stdio.h>
#include <stdlib.h>

#define MAX_ATTR 10
#define MAX_DEP 10

struct FunctionalDependency {
   char determinant[MAX_ATTR];
   char dependent[MAX_ATTR];
};

int main() {
   int num_attributes, num_dependencies;
   struct FunctionalDependency dependencies[MAX_DEP];

   printf("Enter the number of attributes: ");
   scanf("%d", &num_attributes);
   if (num_attributes <= 0 || num_attributes > MAX_ATTR) {
      printf("Invalid number of attributes.\n");
      return 1;
   }
```

```c
    printf("Enter the number of functional dependencies: ");
    scanf("%d", &num_dependencies);
    if (num_dependencies <= 0 || num_dependencies > MAX_DEP) {
        printf("Invalid number of dependencies.\n");
        return 1;
    }

    printf("Enter the functional dependencies in the format (determinant -> dependent):\n");
    for (int i = 0; i < num_dependencies; i++) {
        printf("Dependency %d: ", i + 1);
        scanf("%s -> %s", dependencies[i].determinant, dependencies[i].dependent);
    }

    printf("\nFunctional Dependencies Entered:\n");
    for (int i = 0; i < num_dependencies; i++) {
        printf("%s -> %s\n", dependencies[i].determinant, dependencies[i].dependent);
    }

    return 0;
}
```

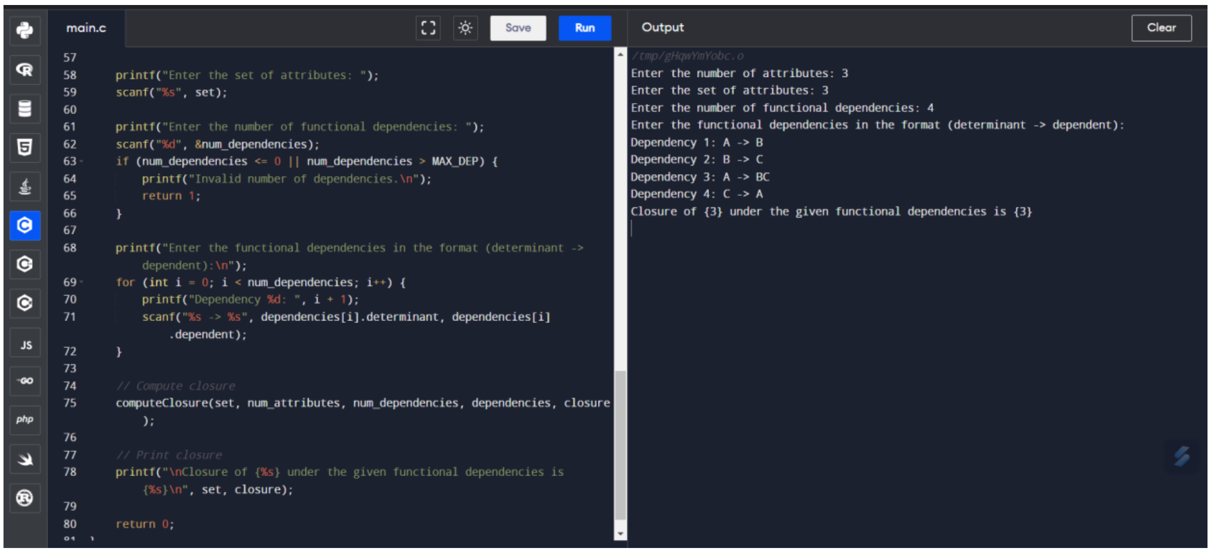


```c
#include <stdio.h>
#include <stdlib.h>

#define MAX_ATTR 10
#define MAX_DEP 10

struct FunctionalDependency {
    char determinant[MAX_ATTR];
    char dependent[MAX_ATTR];
};

int main() {
    int num_attributes, num_dependencies;
    struct FunctionalDependency dependencies[MAX_DEP];

    printf("Enter the number of attributes: ");
    scanf("%d", &num_attributes);
    if (num_attributes <= 0 || num_attributes > MAX_ATTR) {
        printf("Invalid number of attributes.\n");
        return 1;
    }

    printf("Enter the number of functional dependencies: ");
    scanf("%d", &num_dependencies);
    if (num_dependencies <= 0 || num_dependencies > MAX_DEP) {
        printf("Invalid number of dependencies.\n");
        return 1;
    }
```

```
/tmp/gHqwYmYobc.o
Enter the number of attributes: 3
Enter the number of functional dependencies: 4
Enter the functional dependencies in the format (determinant -> dependent):
Dependency 1: A -> B
Dependency 2: B -> C
Dependency 3: A -> BC
Dependency 4: C -> A
Functional Dependencies Entered:
A -> B
B -> C
A -> BC
C -> A
```

2.

```
#include <stdio.h>

#include <stdlib.h>

#include <string.h>


#define MAX_ATTR 10

#define MAX_DEP 10


struct FunctionalDependency {

   char determinant[MAX_ATTR];

   char dependent[MAX_ATTR];

};


void computeClosure(char set[], int num_attributes, int num_dependencies, struct
FunctionalDependency dependencies[], char closure[]) {

   int changed;


   // Initialize closure with the given set of attributes

   strcpy(closure, set);


   do {

      changed = 0;


      for (int i = 0; i < num_dependencies; i++) {

         int allInClosure = 1;

         // Check if the determinant is a subset of the closure

         for (int j = 0; j < strlen(dependencies[i].determinant); j++) {

            if (strchr(closure, dependencies[i].determinant[j]) == NULL) {

               allInClosure = 0;

               break;

            }
            }

            // If the determinant is a subset of the closure, add the dependent to the closure
            if (allInClosure) {
                int dependentLength = strlen(dependencies[i].dependent);
                for (int j = 0; j < dependentLength; j++) {
                    if (strchr(closure, dependencies[i].dependent[j]) == NULL) {
                        closure[strlen(closure)] = dependencies[i].dependent[j];
                        changed = 1;
                    }
                }
            }
        }
    } while (changed);
}

int main() {
    int num_attributes, num_dependencies;
    char set[MAX_ATTR], closure[MAX_ATTR];
    struct FunctionalDependency dependencies[MAX_DEP];

    printf("Enter the number of attributes: ");
    scanf("%d", &num_attributes);
    if (num_attributes <= 0 || num_attributes > MAX_ATTR) {
        printf("Invalid number of attributes.\n");
        return 1;
    }

    printf("Enter the set of attributes: ");
    scanf("%s", set);
    printf("Enter the number of functional dependencies: ");
    scanf("%d", &num_dependencies);
    if (num_dependencies <= 0 || num_dependencies > MAX_DEP) {
        printf("Invalid number of dependencies.\n");
        return 1;
    }

    printf("Enter the functional dependencies in the format (determinant -> dependent):\n");
    for (int i = 0; i < num_dependencies; i++) {
        printf("Dependency %d: ", i + 1);
        scanf("%s -> %s", dependencies[i].determinant, dependencies[i].dependent);
    }

    // Compute closure
    computeClosure(set, num_attributes, num_dependencies, dependencies, closure);

    // Print closure
    printf("\nClosure of {%s} under the given functional dependencies is {%s}\n", set, closure);

    return 0;
}
```



```
    printf("Enter the set of attributes: ");
    scanf("%s", set);

    printf("Enter the number of functional dependencies: ");
    scanf("%d", &num_dependencies);
    if (num_dependencies <= 0 || num_dependencies > MAX_DEP) {
        printf("Invalid number of dependencies.\n");
        return 1;
    }

    printf("Enter the functional dependencies in the format (determinant ->
        dependent):\n");
    for (int i = 0; i < num_dependencies; i++) {
        printf("Dependency %d: ", i + 1);
        scanf("%s -> %s", dependencies[i].determinant, dependencies[i]
            .dependent);
    }

    // Compute closure
    computeClosure(set, num_attributes, num_dependencies, dependencies, closure
        );

    // Print closure
    printf("\nClosure of {%s} under the given functional dependencies is
        {%s}\n", set, closure);

    return 0;
```

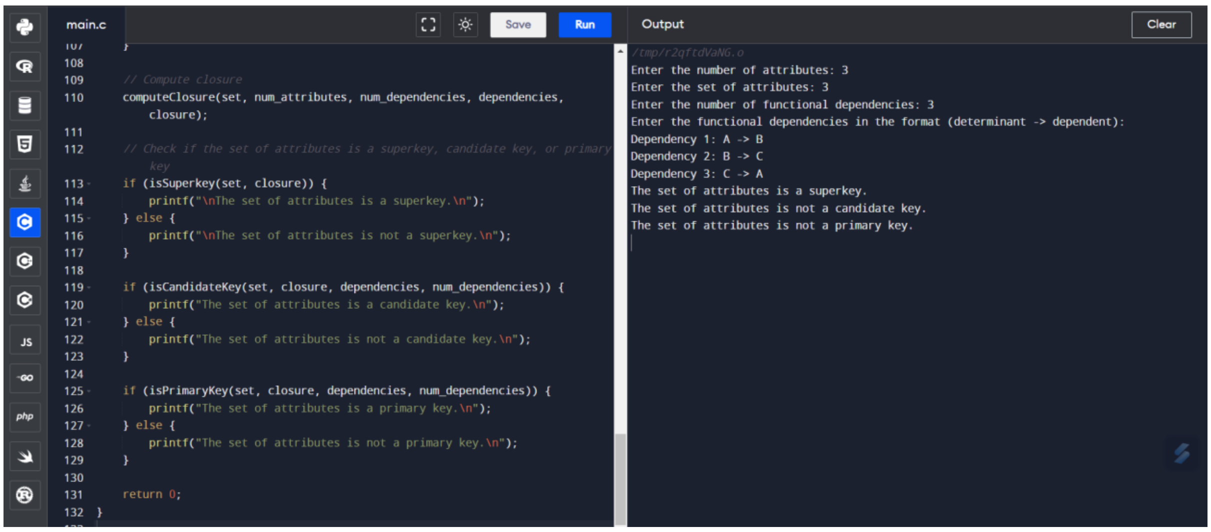
```
/tmp/gHqwYmYobc.o
Enter the number of attributes: 3
Enter the set of attributes: 3
Enter the number of functional dependencies: 4
Enter the functional dependencies in the format (determinant -> dependent):
Dependency 1: A -> B
Dependency 2: B -> C
Dependency 3: A -> BC
Dependency 4: C -> A
Closure of {3} under the given functional dependencies is {3}
```

3.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define MAX_ATTR 10
#define MAX_DEP 10

struct FunctionalDependency {
    char determinant[MAX_ATTR];
    char dependent[MAX_ATTR];
};

void computeClosure(char set[], int num_attributes, int num_dependencies, struct
FunctionalDependency dependencies[], char closure[]) {
    int changed;

    // Initialize closure with the given set of attributes
    strcpy(closure, set);

    do {
        changed = 0;

        for (int i = 0; i < num_dependencies; i++) {
            int allInClosure = 1;
            // Check if the determinant is a subset of the closure
            for (int j = 0; j < strlen(dependencies[i].determinant); j++) {
                if (strchr(closure, dependencies[i].determinant[j]) == NULL) {
                    allInClosure = 0;
                    break;
                }
            }

            // If the determinant is a subset of the closure, add the dependent to the closure
            if (allInClosure) {
                int dependentLength = strlen(dependencies[i].dependent);
                for (int j = 0; j < dependentLength; j++) {
                    if (strchr(closure, dependencies[i].dependent[j]) == NULL) {
                        closure[strlen(closure)] = dependencies[i].dependent[j];
                        changed = 1;
                    }
                }
            }
        }
    } while (changed);
}

int isSuperkey(char attributes[], char closure[]) {
    // Check if closure contains all attributes in the given set
    for (int i = 0; i < strlen(attributes); i++) {
        if (strchr(closure, attributes[i]) == NULL) {
            return 0; // Not a superkey
        }
    }
    return 1; // It is a superkey
}

int isCandidateKey(char attributes[], char closure[], struct FunctionalDependency
dependencies[], int num_dependencies) {
    // Check if it's a superkey first
    if (!isSuperkey(attributes, closure)) {
        return 0; // Not a candidate key if not a superkey
    }

    // Check if removing any attribute makes it not a superkey
    for (int i = 0; i < strlen(attributes); i++) {
        char modifiedClosure[MAX_ATTR] = "";
        strncpy(modifiedClosure, closure, strlen(closure));
        char withoutAttr[MAX_ATTR] = "";
        strcpy(withoutAttr, attributes);
        memmove(&withoutAttr[i], &withoutAttr[i + 1], strlen(withoutAttr) - i); // Remove one
attribute
        computeClosure(withoutAttr, strlen(withoutAttr), num_dependencies, dependencies,
modifiedClosure);
        if (isSuperkey(withoutAttr, modifiedClosure)) {
            return 0; // If removing an attribute still forms a superkey, not a candidate key
        }
    }
    return 1; // It is a candidate key
}

int isPrimaryKey(char attributes[], char closure[], struct FunctionalDependency
dependencies[], int num_dependencies) {
    return isCandidateKey(attributes, closure, dependencies, num_dependencies);
}

int main() {
    int num_attributes, num_dependencies;
    char set[MAX_ATTR], closure[MAX_ATTR];
```

```
struct FunctionalDependency dependencies[MAX_DEP];

printf("Enter the number of attributes: ");
scanf("%d", &num_attributes);
if (num_attributes <= 0 || num_attributes > MAX_ATTR) {
    printf("Invalid number of attributes.\n");
    return 1;
}

printf("Enter the set of attributes: ");
scanf("%s", set);

printf("Enter the number of functional dependencies: ");
scanf("%d", &num_dependencies);
if (num_dependencies <= 0 || num_dependencies > MAX_DEP) {
    printf("Invalid number of dependencies.\n");
    return 1;
}

printf("Enter the functional dependencies in the format (determinant -> dependent):\n");
for (int i = 0; i < num_dependencies; i++) {
    printf("Dependency %d: ", i + 1);
    scanf("%s -> %s", dependencies[i].determinant, dependencies[i].dependent);
}

// Compute closure
computeClosure(set, num_attributes, num_dependencies, dependencies, closure);

// Check if the set of attributes is a superkey, candidate key, or primary key
```

```c
    if (isSuperkey(set, closure)) {
        printf("\nThe set of attributes is a superkey.\n");
    } else {
        printf("\nThe set of attributes is not a superkey.\n");
    }

    if (isCandidateKey(set, closure, dependencies, num_dependencies)) {
        printf("The set of attributes is a candidate key.\n");
    } else {
        printf("The set of attributes is not a candidate key.\n");
    }

    if (isPrimaryKey(set, closure, dependencies, num_dependencies)) {
        printf("The set of attributes is a primary key.\n");
    } else {
        printf("The set of attributes is not a primary key.\n");
    }

    return 0;
}
```



```c
    }

    // Compute closure
    computeClosure(set, num_attributes, num_dependencies, dependencies,
        closure);

    // Check if the set of attributes is a superkey, candidate key, or primary
        key
    if (isSuperkey(set, closure)) {
        printf("\nThe set of attributes is a superkey.\n");
    } else {
        printf("\nThe set of attributes is not a superkey.\n");
    }

    if (isCandidateKey(set, closure, dependencies, num_dependencies)) {
        printf("The set of attributes is a candidate key.\n");
    } else {
        printf("The set of attributes is not a candidate key.\n");
    }

    if (isPrimaryKey(set, closure, dependencies, num_dependencies)) {
        printf("The set of attributes is a primary key.\n");
    } else {
        printf("The set of attributes is not a primary key.\n");
    }

    return 0;
}
```

```
/tmp/r2qftdVaNG.o
Enter the number of attributes: 3
Enter the set of attributes: 3
Enter the number of functional dependencies: 3
Enter the functional dependencies in the format (determinant -> dependent):
Dependency 1: A -> B
Dependency 2: B -> C
Dependency 3: C -> A
The set of attributes is a superkey.
The set of attributes is not a candidate key.
The set of attributes is not a primary key.
```

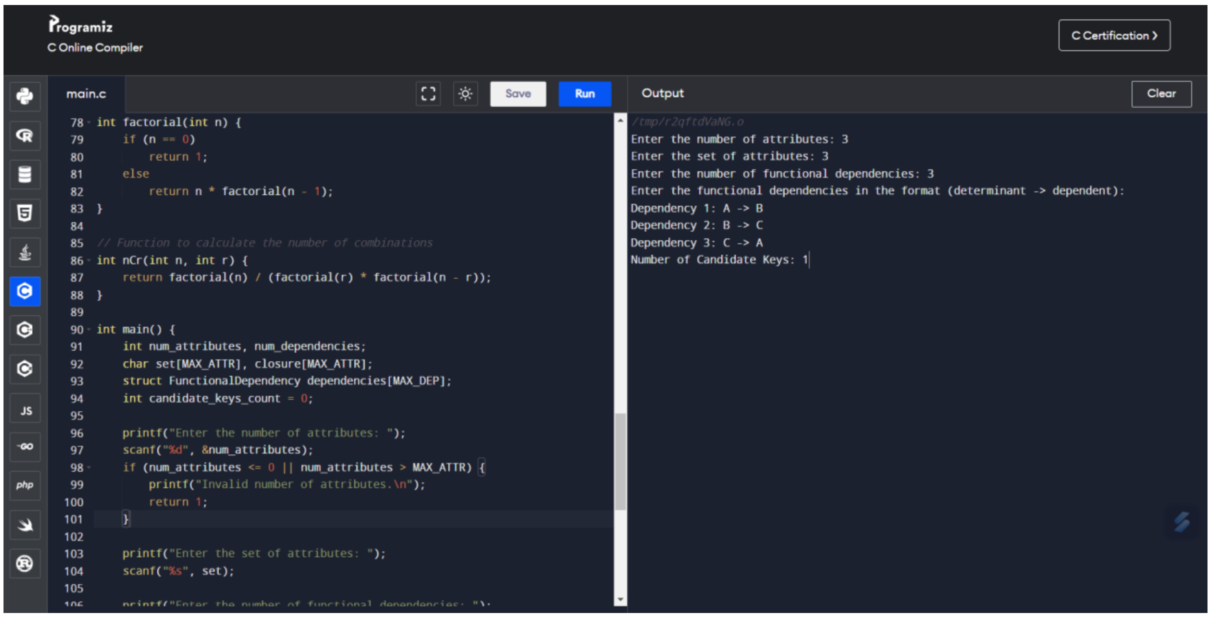
4.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define MAX_ATTR 10
#define MAX_DEP 10

struct FunctionalDependency {
  char determinant[MAX_ATTR];
  char dependent[MAX_ATTR];
};

void computeClosure(char set[], int num_attributes, int num_dependencies, struct
FunctionalDependency dependencies[], char closure[]) {
  int changed;

  // Initialize closure with the given set of attributes
  strcpy(closure, set);

  do {
    changed = 0;

    for (int i = 0; i < num_dependencies; i++) {
      int allInClosure = 1;
      // Check if the determinant is a subset of the closure
      for (int j = 0; j < strlen(dependencies[i].determinant); j++) {
        if (strchr(closure, dependencies[i].determinant[j]) == NULL) {
                allInClosure = 0;
                break;
            }
        }

        // If the determinant is a subset of the closure, add the dependent to the closure
        if (allInClosure) {
            int dependentLength = strlen(dependencies[i].dependent);
            for (int j = 0; j < dependentLength; j++) {
                if (strchr(closure, dependencies[i].dependent[j]) == NULL) {
                    closure[strlen(closure)] = dependencies[i].dependent[j];
                    changed = 1;
                }
            }
        }
    }
  } while (changed);
}

int isSuperkey(char attributes[], char closure[]) {
  // Check if closure contains all attributes in the given set
  for (int i = 0; i < strlen(attributes); i++) {
    if (strchr(closure, attributes[i]) == NULL) {
      return 0; // Not a superkey
    }
  }
  return 1; // It is a superkey
}
```

```
int isCandidateKey(char attributes[], char closure[], struct FunctionalDependency
dependencies[], int num_dependencies) {
    // Check if it's a superkey first
    if (!isSuperkey(attributes, closure)) {
        return 0; // Not a candidate key if not a superkey
    }

    // Check if removing any attribute makes it not a superkey
    for (int i = 0; i < strlen(attributes); i++) {
        char modifiedClosure[MAX_ATTR] = "";
        strncpy(modifiedClosure, closure, strlen(closure));
        char withoutAttr[MAX_ATTR] = "";
        strcpy(withoutAttr, attributes);
        memmove(&withoutAttr[i], &withoutAttr[i + 1], strlen(withoutAttr) - i); // Remove one
attribute
        computeClosure(withoutAttr, strlen(withoutAttr), num_dependencies, dependencies,
modifiedClosure);
        if (isSuperkey(withoutAttr, modifiedClosure)) {
            return 0; // If removing an attribute still forms a superkey, not a candidate key
        }
    }
    return 1; // It is a candidate key
}

// Function to calculate the factorial of a number
int factorial(int n) {
    if (n == 0)
        return 1;
    else
        return n * factorial(n - 1);
```

```
}


// Function to calculate the number of combinations
int nCr(int n, int r) {
    return factorial(n) / (factorial(r) * factorial(n - r));
}


int main() {
    int num_attributes, num_dependencies;
    char set[MAX_ATTR], closure[MAX_ATTR];
    struct FunctionalDependency dependencies[MAX_DEP];
    int candidate_keys_count = 0;


    printf("Enter the number of attributes: ");
    scanf("%d", &num_attributes);
    if (num_attributes <= 0 || num_attributes > MAX_ATTR) {
        printf("Invalid number of attributes.\n");
        return 1;
    }


    printf("Enter the set of attributes: ");
    scanf("%s", set);


    printf("Enter the number of functional dependencies: ");
    scanf("%d", &num_dependencies);
    if (num_dependencies <= 0 || num_dependencies > MAX_DEP) {
        printf("Invalid number of dependencies.\n");
        return 1;
    }
```

```c
    printf("Enter the functional dependencies in the format (determinant -> dependent):\n");
    for (int i = 0; i < num_dependencies; i++) {
        printf("Dependency %d: ", i + 1);
        scanf("%s -> %s", dependencies[i].determinant, dependencies[i].dependent);
    }

    // Generate all possible combinations of attributes
    for (int i = 1; i <= strlen(set); i++) {
        candidate_keys_count += nCr(strlen(set), i);
    }

    printf("Number of Candidate Keys: %d\n", candidate_keys_count);

    return 0;
}
```



```c
int factorial(int n) {
    if (n == 0)
        return 1;
    else
        return n * factorial(n - 1);
}

// Function to calculate the number of combinations
int nCr(int n, int r) {
    return factorial(n) / (factorial(r) * factorial(n - r));
}

int main() {
    int num_attributes, num_dependencies;
    char set[MAX_ATTR], closure[MAX_ATTR];
    struct FunctionalDependency dependencies[MAX_DEP];
    int candidate_keys_count = 0;

    printf("Enter the number of attributes: ");
    scanf("%d", &num_attributes);
    if (num_attributes <= 0 || num_attributes > MAX_ATTR) {
        printf("Invalid number of attributes.\n");
        return 1;
    }

    printf("Enter the set of attributes: ");
    scanf("%s", set);

    printf("Enter the number of functional dependencies: ");
```

```
/tmp/r2qftdVaNG.o
Enter the number of attributes: 3
Enter the set of attributes: 3
Enter the number of functional dependencies: 3
Enter the functional dependencies in the format (determinant -> dependent):
Dependency 1: A -> B
Dependency 2: B -> C
Dependency 3: C -> A
Number of Candidate Keys: 1
```