EXP NO: 25 DECIMAL TO BINARY CONVERSION

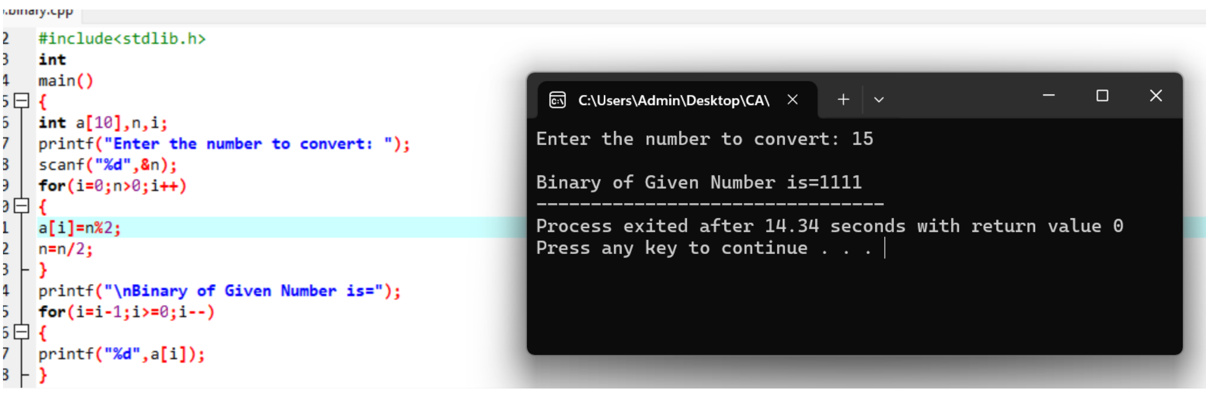
AIM: To write a C program to implement decimal to binary conversion.

ALGORITHM:

1) Check if your number is odd or even.
2) If it's even, write 0 (proceeding backwards, adding binary digits to the left of the result).
3) Otherwise, if it's odd, write 1 (in the same way).
4) Divide your number by 2 (dropping any fraction) and go back to step 1. Repeat until your original number is 0.

PROGRAM:

```
#include<stdio.h>
#include<stdlib.h>
int
main()
{
int a[10],n,i;
printf("Enter the number to convert: ");
scanf("%d",&n);
for(i=0;n>0;i++)
{
a[i]=n%2;
n=n/2;
}
printf("\nBinary of Given Number is=");
for(i=i-1;i>=0;i--)
{
printf("%d",a[i]);
}
return 0;
}
```



BINARY TO DECIMAL CONVERSION

EXP NO: 26

AIM: To write a C program to implement binary to decimal conversion.

ALGORITHM:

1) Start
2) Read the binary number from the user, say ‘n’
3) Initialize the decimal number, d=0
4) Initialize i=0
5) Repeat while n != 0:

i. Extract the last digit by: remainder = n % 10

ii. n = n/10
iii. d = d + (remainder * 2ⁱ)
iv. Increment i by 1
6) Display the decimal number, d
7) Stop

PROGRAM:

```c
#include <stdio.h>

#include <math.h>

int main() {

    int binary, decimal = 0, base = 1, remainder;

    // Input binary number from user

    printf("Enter a binary number: ");

    scanf("%d", &binary);

    int temp = binary; // Store the binary number for later use

    while (binary > 0) {

        remainder = binary % 10; // Get the last digit of the binary number

        decimal = decimal + remainder * base;

        binary = binary / 10;

        base = base * 2; // Increase the base (2^n)

    }

    // Output the result

    printf("The decimal equivalent of binary %d is: %d\n", temp, decimal);

    return 0;

}
```

Output:

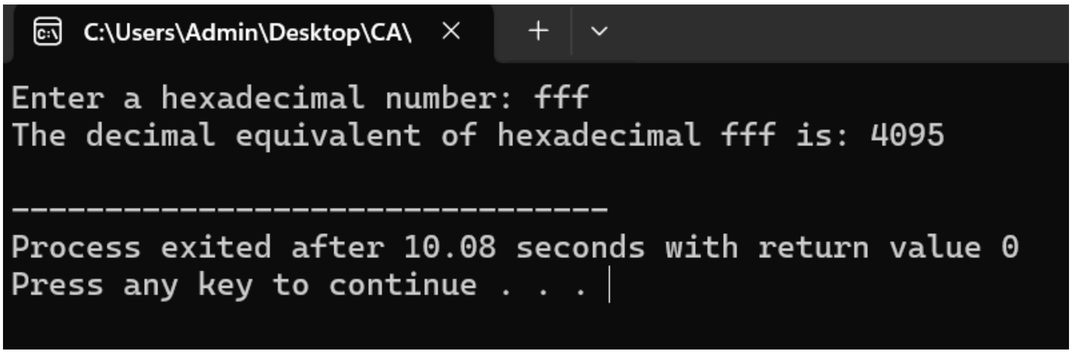
```
Enter a binary number: 1111
The decimal equivalent of binary 1111 is: 15

--------------------------------
Process exited after 6.643 seconds with return value 0
Press any key to continue . . .
```

HEXADECIMAL TO DECIMAL CONVERSION
EXP NO: 27
AIM:To write a C program to implement hexadecimal to decimal conversion.
ALGORITHM:
1) Start from the right-most digit. Its weight (or coefficient) is 1.
2) Multiply the weight of the position by its digit. Add the product to the result.
(0=0, 1=1, 2=2, … 9=9, A=10, B=11, C=12, D=13, E=14,F=15)
3) Move one digit to the left. Its weight is 16 times the previous weight.
4) Repeat 2 and 3 until you go through all hexadecimal digits.
PROGRAM:

```
#include <stdio.h>

#include <string.h>

#include <math.h>

int hexToDecimal(char hex[]) {

    int length = strlen(hex);

    int base = 1; // Base for hexadecimal (16^0)

    int decimal = 0;

    // Convert hex to decimal

    for (int i = length - 1; i >= 0; i--) {

        if (hex[i] >= '0' && hex[i] <= '9') {

            decimal += (hex[i] - 48) * base;

            base = base * 16;

        }

        else if (hex[i] >= 'A' && hex[i] <= 'F') {

            decimal += (hex[i] - 55) * base;

            base = base * 16;

        }

        else if (hex[i] >= 'a' && hex[i] <= 'f') {

            decimal += (hex[i] - 87) * base;

            base = base * 16;

        }

    }

    return decimal;

}
```

```c
int main() {
    char hex[20];
    // Input hexadecimal number from user
    printf("Enter a hexadecimal number: ");
    scanf("%s", hex);
    // Convert and display the decimal equivalent
    int decimal = hexToDecimal(hex);
    printf("The decimal equivalent of hexadecimal %s is: %d\n", hex, decimal);
    return 0;
}
```

Output:



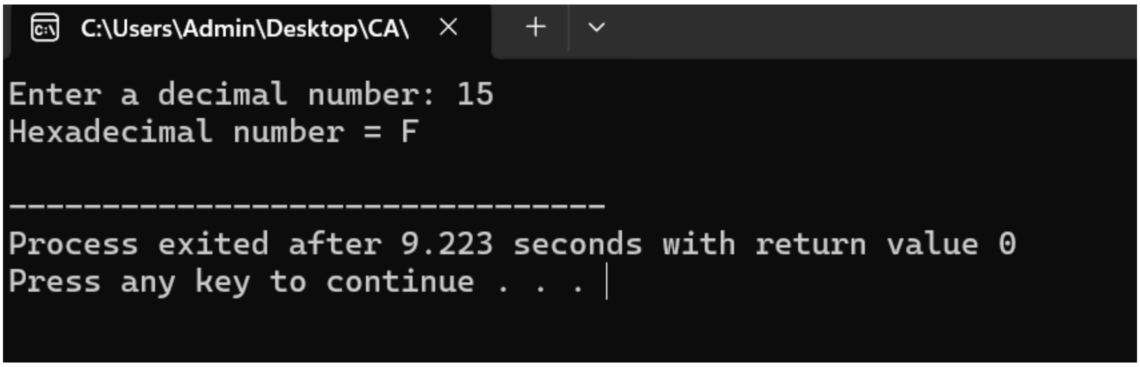
Exp No:28. Decimal to Hexadecimal

Program:

```c
#include <stdio.h>
void toHexadecimal(int decimal) {
    char hex[32]; // Array to store hexadecimal number
    int i = 0;
    // Convert decimal to hexadecimal
    while (decimal != 0) {
        int remainder = decimal % 16;
        if (remainder < 10) {
            hex[i] = remainder + 48; // Convert remainder to character (0-9)
        } else {
            hex[i] = remainder + 55; // Convert remainder to character (A-F)
        }
```

```
        decimal = decimal / 16;
        i++;
    }
    //Print hexadecimal number in reverse order
    printf("Hexadecimal number = ");
    for (int j = i - 1; j >= 0; j--)
        printf("%c", hex[j]);
    printf("\n");
}
int main() {
    int decimal;
    // Input decimal number from user
    printf("Enter a decimal number: ");
    scanf("%d", &decimal);
    // Convert and display the hexadecimal equivalent
    toHexadecimal(decimal);
    return 0;
}
```

Output:



EXP NO: 29

AIM:To write a C program to implement decimal to octal conversion.

ALGORITHM:

1) **Store the remainder when the number is divided by 8 in an array.**
2) **Divide the number by 8 now**
3) **Repeat the above two steps until the number is not equal to 0.**
4) **Print the array in reverse order now.**

PROGRAM:

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

```c
void toOctal(int decimal) {
    int octal[32]; // Array to store octal number
    int i = 0;

    // Convert decimal to octal
    while (decimal != 0) {
        octal[i] = decimal % 8;
        decimal = decimal / 8;
        i++;
    }

    // Print octal number in reverse order
    printf("Octal number = ");
    for (int j = i - 1; j >= 0; j--)
        printf("%d", octal[j]);
    printf("\n");
}

int main() {
    int decimal;

    // Input decimal number from user
    printf("Enter a decimal number: ");
    scanf("%d", &decimal);

    // Convert and display the octal equivalent
    toOctal(decimal);

    return 0;
}
```

Output:

```
Enter a decimal number: 56
Octal number = 70

--------------------------------
Process exited after 6.135 seconds with return value 0
Press any key to continue . . .
```

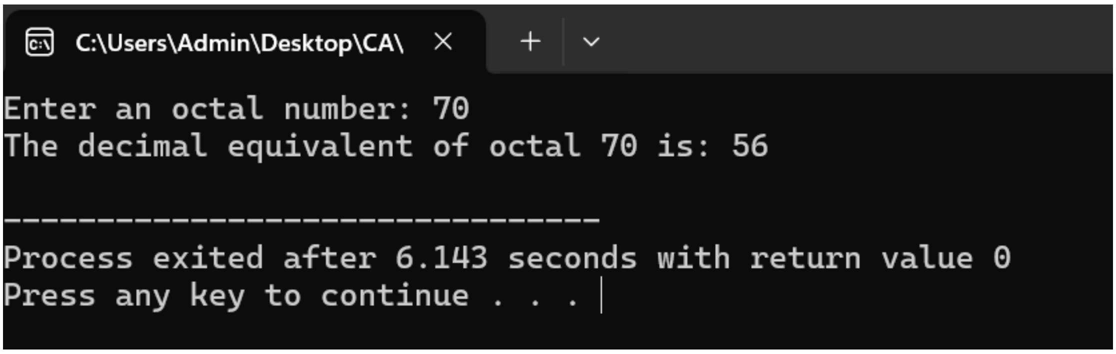
EXP NO 30 Convert Octal to Decimal

Program:

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

int octalToDecimal(int octal) {
   int decimal = 0, base = 1, remainder;

   // Convert octal to decimal
   while (octal > 0) {
      remainder = octal % 10;
      decimal += remainder * base;
      base *= 8;
      octal /= 10;
   }

   return decimal;
}

int main() {
   int octal;

   // Input octal number from user
   printf("Enter an octal number: ");
   scanf("%d", &octal);
```

```
    // Convert and display the decimal equivalent
    int decimal = octalToDecimal(octal);
    printf("The decimal equivalent of octal %d is: %d\n", octal, decimal);

    return 0;
}
```

Output:



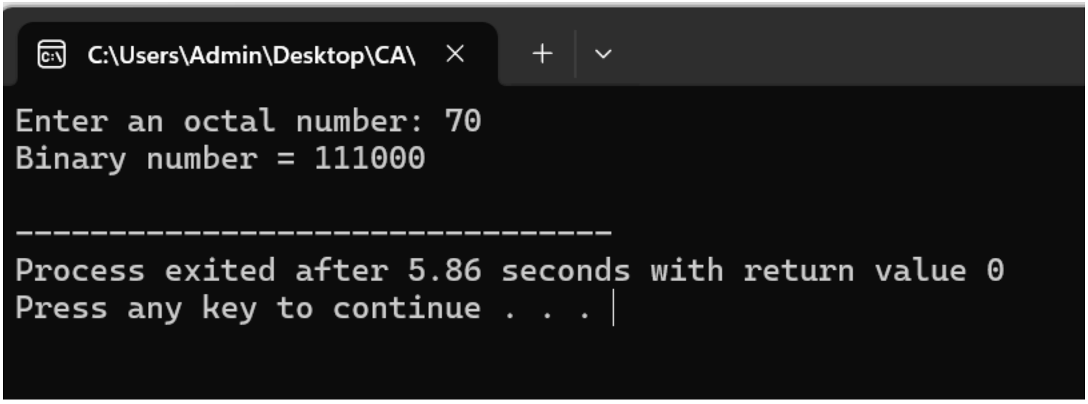
Exp. No: 31. Octal to Binary

Program:

```
#include <stdio.h>

// Function to convert octal to decimal
int octalToDecimal(int octal) {
    int decimal = 0, base = 1, remainder;

    while (octal > 0) {
        remainder = octal % 10;
        decimal += remainder * base;
        base *= 8;
        octal /= 10;
    }

    return decimal;
}

// Function to convert decimal to binary
```

```
void decimalToBinary(int decimal) {
   int binary[32], i = 0;

   while (decimal > 0) {
      binary[i] = decimal % 2;
      decimal /= 2;
      i++;
   }

   printf("Binary number = ");
   for (int j = i - 1; j >= 0; j--)
      printf("%d", binary[j]);
   printf("\n");
}

int main() {
   int octal;

   // Input octal number from user
   printf("Enter an octal number: ");
   scanf("%d", &octal);

   // Convert octal to decimal
   int decimal = octalToDecimal(octal);

   // Convert decimal to binary and print the result
   decimalToBinary(decimal);

   return 0;
}
```

Output:



CPU PERFORMANCE
EXP NO: 32
AIM:To write a C program to implement CPU performance measures.
ALGORITHM:
Step 1: start
Step 2:Declare the necessary variables: cr (clock rate), p (number of processors), p1 (a copy of the number of processors), i (loop variable), and cpu (array to store CPU times).

Step 3: Initialize the cpu array elements to 0.
Step 4: Prompt the user to enter the number of processors (p).
Step 5: Store the value of p in p1.
Step 6: Start a loop from 0 to p-1:
- **a. Prompt the user to enter the cycles per instruction (cpi) for the current processor.**
- **b. Prompt the user to enter the clock rate (cr) in GHz for the current processor.**
- **c. Calculate the CPU time (ct) using the formula: ct = 1000 * cpi / cr.**
- **d. Display the CPU time for the current processor.**
- **e. Store the CPU time in the cpu array at index i.**

Step 7: Set max as the first element of the cpu array.
Step 8:Start a loop from 0 to p1-1:
- **a. If the CPU time at index i is less than or equal to max, update max to the current CPU time.**

Step 9: Display the processor with the lowest execution time (max).
Step 10: Exit the program.
PROGRAM:

```
 #include <stdio.h>
int
main()


{
  float cr;
  int p,p1,i;
 float cpu[5];
  float cpi,ct,max;
  int n=1000;
```

```
  for(i=0;i<=4;i++)

  {
     cpu[5]=0;
  }
  printf("\n Enter the number of processors:");
  scanf("%d",&p);
  p1=p;
  for(i=0;i<p;i++)
{
   printf("\n Enter the Cycles perInstrcution of processor:");

  scanf("%f",&cpi);
 printf("\n Enter the clockrate inGHz:");
  scanf("%f",&cr);

  ct=1000*cpi/cr;

  printf("The CPU time is: %f",ct);
  cpu[i]=ct;

}

max=cpu[0];

for(i=0;i<p1;i++)

{
   if(cpu[i]<=max)

   max=cpu[i];
}
printf("\nThe processor has lowest Execution time is: %f ", max);
   return 0;

}
```

output:

```
 Enter the number of processors:4

 Enter the Cycles perInstrcution of processor:2

 Enter the clockrate inGHz:4
The CPU time is: 500.000000
 Enter the Cycles perInstrcution of processor:5

 Enter the clockrate inGHz:4
The CPU time is: 1250.000000
 Enter the Cycles perInstrcution of processor:5

 Enter the clockrate inGHz:7
The CPU time is: 714.285706
 Enter the Cycles perInstrcution of processor:2

 Enter the clockrate inGHz:4
The CPU time is: 500.000000
The processor has lowest Execution time is: 500.000000
--------------------------------
```

Exp No:33. Integer Restroring Division

Program:

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

// Function to perform integer restoration division
void integerRestorationDivision(int dividend, int divisor) {
   int quotient = 0, remainder = 0;
   int bitSize = (int)log2(dividend) + 1;

   // Process each bit
   for (int i = bitSize - 1; i >= 0; i--) {
      // Bring down the next bit of the dividend
      remainder = (remainder << 1) | ((dividend >> i) & 1);

      // Perform subtraction if possible
```

```
        if (remainder >= divisor) {
            remainder -= divisor;
            quotient |= (1 << i); // Set the ith bit of the quotient to 1
        }
    }

    // Output the result
    printf("Quotient = %d\n", quotient);
    printf("Remainder = %d\n", remainder);
}

int main() {
    int dividend, divisor;

    // Input dividend and divisor from user
    printf("Enter the dividend: ");
    scanf("%d", &dividend);
    printf("Enter the divisor: ");
    scanf("%d", &divisor);

    // Check if divisor is not zero
    if (divisor == 0) {
        printf("Error: Division by zero is not allowed.\n");
        return 1;
    }

    // Perform integer restoration division
    integerRestorationDivision(dividend, divisor);

    return 0;
}
```

Output:

```
Enter the dividend: 8
Enter the divisor: 2
Quotient = 4
Remainder = 0

--------------------------------
Process exited after 7.51 seconds with return value 0
```

Exp No: 34. Booth Algorithm

Program:

```
#include <stdio.h>

#include <stdlib.h>


#define BITS 8  // Number of bits in the binary representation


// Function to perform Booth's Algorithm

void boothAlgorithm(int M, int Q) {

   int A = 0;       // Accumulator

   int Q_1 = 0;     // Q-1

   int temp;


   // Create binary representations of M and Q

   int M_bin[BITS] = {0}, Q_bin[BITS] = {0};

   int result[2 * BITS] = {0};


   // Convert M and Q to binary

   for (int i = BITS - 1; i >= 0; i--) {

      M_bin[i] = M % 2;

      M /= 2;

      Q_bin[i] = Q % 2;

      Q /= 2;

   }


   printf("Initial values:\n");
```

```
printf("A = ");
for (int i = 0; i < BITS; i++) printf("%d", (A >> (BITS - 1 - i)) & 1);
printf("\nQ = ");
for (int i = 0; i < BITS; i++) printf("%d", Q_bin[i]);
printf("\nQ-1 = %d\n", Q_1);

// Perform Booth's Algorithm
for (int i = 0; i < BITS; i++) {
    // Check Q[0] and Q-1
    if (Q_bin[BITS - 1] == 0 && Q_1 == 1) {
        // A = A + M
        temp = A + M;
        if (temp >= (1 << BITS)) temp -= (1 << BITS); // Handle overflow
        A = temp;
    } else if (Q_bin[BITS - 1] == 1 && Q_1 == 0) {
        // A = A - M
        temp = A - M;
        if (temp < 0) temp += (1 << BITS); // Handle underflow
        A = temp;
    }

    // Arithmetic right shift A, Q, and Q-1
    Q_1 = Q_bin[BITS - 1];
    for (int j = BITS - 1; j > 0; j--) {
        Q_bin[j] = Q_bin[j - 1];
    }
    Q_bin[0] = (A & 1); // Update Q[0] from A
    A >>= 1;           // Arithmetic shift of A
}

// Display final result
printf("Final result:\n");
```

```
    printf("A = ");
    for (int i = 0; i < BITS; i++) printf("%d", (A >> (BITS - 1 - i)) & 1);
    printf("\nQ = ");
    for (int i = 0; i < BITS; i++) printf("%d", Q_bin[i]);
    printf("\nQ-1 = %d\n", Q_1);
}

int main() {
    int M, Q
    // Input multiplicand and multiplier from user
    printf("Enter the multiplicand (M): ");
    scanf("%d", &M);
    printf("Enter the multiplier (Q): ");
    scanf("%d", &Q);
    // Perform Booth's Algorithm
    boothAlgorithm(M, Q);
    return 0;
}
```

Output:

```
Enter the multiplicand (M): 16
Enter the multiplier (Q): -2
Initial values:
A = 00000000
Q = 000000-10
Q-1 = 0
Final result:
A = 00000000
Q = 00000000
Q-1 = 0

--------------------------------
Process exited after 14.72 seconds with return value 0
Press any key to continue . . .
```

Exp.No.35. Single Precision Representation

Program:

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

```c
// Function to display the binary representation of a float
void displayBinary(float num) {
    // Create a union to store the float and access its bits as an integer
    union {
        float f;
        unsigned int i;
    } u;

    u.f = num;

    // Print the sign bit
    printf("Sign: %d\n", (u.i >> 31) & 1);

    // Print the exponent bits
    printf("Exponent: ");
    for (int i = 30; i >= 23; i--) {
        printf("%d", (u.i >> i) & 1);
    }
    printf("\n");

    // Print the mantissa bits
    printf("Mantissa: ");
    for (int i = 22; i >= 0; i--) {
        printf("%d", (u.i >> i) & 1);
    }
    printf("\n");
}

int main() {
    float num;
```

```
    // Input the number from the user
    printf("Enter a floating-point number: ");
    scanf("%f", &num);

    // Display the binary representation
    displayBinary(num);

    return 0;
}
```

Output:

```
Enter a floating-point number: 122.7
Sign: 0
Exponent: 10000101
Mantissa: 11101010110011001100110

--------------------------------
Process exited after 7.829 seconds with return value 0
Press any key to continue . . .
```

Exp No. 36. Four stage Pipeline

Program:

```
#include <stdio.h>

// Function prototypes for each pipeline stage
void fetch(int instruction);
void decode(int instruction);
void execute(int instruction);
void write_back(int instruction);

// Simulate the instruction pipeline
void pipeline(int instructions[], int n) {
    for (int cycle = 0; cycle < n + 3; cycle++) {
        printf("Cycle %d:\n", cycle + 1);

        if (cycle < n) {
```

```c
            fetch(instructions[cycle]);
        }
        if (cycle > 0 && cycle < n + 1) {
            decode(instructions[cycle - 1]);
        }
        if (cycle > 1 && cycle < n + 2) {
            execute(instructions[cycle - 2]);
        }
        if (cycle > 2) {
            write_back(instructions[cycle - 3]);
        }

        printf("\n");
    }
}

void fetch(int instruction) {
    printf("  Fetching instruction %d\n", instruction);
}

void decode(int instruction) {
    printf("  Decoding instruction %d\n", instruction);
}

void execute(int instruction) {
    printf("  Executing instruction %d\n", instruction);
}

void write_back(int instruction) {
    printf("  Writing back result of instruction %d\n", instruction);
}
```

```
int main() {
    int instructions[] = {1, 2, 3, 4};
    int n = sizeof(instructions) / sizeof(instructions[0]);

    // Run the pipeline with 4 instructions
    pipeline(instructions, n);

    return 0;
}
```

Output:

```
Cycle 1:
  Fetching instruction 1

Cycle 2:
  Fetching instruction 2
  Decoding instruction 1

Cycle 3:
  Fetching instruction 3
  Decoding instruction 2
  Executing instruction 1

Cycle 4:
  Fetching instruction 4
  Decoding instruction 3
  Executing instruction 2
  Writing back result of instruction 1

Cycle 5:
  Decoding instruction 4
  Executing instruction 3
  Writing back result of instruction 2

Cycle 6:
  Executing instruction 4
  Writing back result of instruction 3

Cycle 7:
  Writing back result of instruction 4
```

Exp. No:37. Two Stage Pipeline

Program:

```
#include <stdio.h>

// Function prototypes for the two stages
void fetch(int instruction);
void execute(int instruction);

// Simulate the two-stage instruction pipeline
void pipeline(int instructions[], int n) {
    for (int cycle = 0; cycle < n + 1; cycle++) {
        printf("Cycle %d:\n", cycle + 1);

        if (cycle < n) {
            fetch(instructions[cycle]);
        }
        if (cycle > 0 && cycle < n + 1) {
            execute(instructions[cycle - 1]);
        }

        printf("\n");
    }
}

// Fetch stage: Simulate fetching an instruction from memory
void fetch(int instruction) {
    printf("  Fetching instruction %d\n", instruction);
}

// Execute stage: Simulate executing the fetched instruction
void execute(int instruction) {
    printf("  Executing instruction %d\n", instruction);
```

```c
}

int main() {
    int instructions[] = {1, 2, 3, 4};  // Simulate 4 instructions
    int n = sizeof(instructions) / sizeof(instructions[0]);

    // Run the two-stage pipeline with 4 instructions
    pipeline(instructions, n);

    return 0;
}
```

Output:

```
Cycle 1:
  Fetching instruction 1

Cycle 2:
  Fetching instruction 2
  Executing instruction 1

Cycle 3:
  Fetching instruction 3
  Executing instruction 2

Cycle 4:
  Fetching instruction 4
  Executing instruction 3

Cycle 5:
  Executing instruction 4


--------------------------------
```

Exo.No:38. Three stage AND operation

Program:

```c
#include <stdio.h>

// Function prototypes for each stage
void fetch(int instruction);
void decode(int instruction);
```

```
void execute(int operand1, int operand2);

// Simulate the three-stage instruction pipeline
void pipeline(int instructions[][2], int n) {
   for (int cycle = 0; cycle < n + 2; cycle++) {
      printf("Cycle %d:\n", cycle + 1);

      if (cycle < n) {
         fetch(cycle);
      }
      if (cycle > 0 && cycle < n + 1) {
         decode(cycle - 1);
      }
      if (cycle > 1 && cycle < n + 2) {
         execute(instructions[cycle - 2][0], instructions[cycle - 2][1]);
      }

      printf("\n");
   }
}

// Fetch stage: Simulate fetching an instruction (in this case, the instruction is just the
index)
void fetch(int instruction) {
   printf("  Fetching instruction %d (AND operation)\n", instruction + 1);
}

// Decode stage: Simulate decoding the instruction (identify it as AND)
void decode(int instruction) {
   printf("  Decoding instruction %d (performing AND operation)\n", instruction + 1);
}
```

```
// Execute stage: Perform the AND operation on two operands
void execute(int operand1, int operand2) {
    int result = operand1 & operand2;
    printf("  Executing AND operation: %d & %d = %d\n", operand1, operand2,
result);
}


int main() {
    // Array of operand pairs to be used in AND operation
    int instructions[][2] = {
        {5, 3},   // 5 (101) & 3 (011) = 1 (001)
        {12, 9},  // 12 (1100) & 9 (1001) = 8 (1000)
        {15, 7}   // 15 (1111) & 7 (0111) = 7 (0111)
    };

    int n = sizeof(instructions) / sizeof(instructions[0]);

    // Run the three-stage pipeline with AND operations
    pipeline(instructions, n);

    return 0;
}
```

Output:

```
Cycle 1:
  Fetching instruction 1 (AND operation)

Cycle 2:
  Fetching instruction 2 (AND operation)
  Decoding instruction 1 (performing AND operation)

Cycle 3:
  Fetching instruction 3 (AND operation)
  Decoding instruction 2 (performing AND operation)
  Executing AND operation: 5 & 3 = 1

Cycle 4:
  Decoding instruction 3 (performing AND operation)
  Executing AND operation: 12 & 9 = 8

Cycle 5:
  Executing AND operation: 15 & 7 = 7
```

Exp No:39. Four stage AND operation

Program:

```
#include <stdio.h>

// Function prototypes for each stage
void fetch(int instruction);
void decode(int instruction);
void execute(int operand1, int operand2);
void write_back(int result);

// Simulate the four-stage instruction pipeline
void pipeline(int instructions[][2], int n) {
  int results[n];  // Store the results of the AND operations
  for (int cycle = 0; cycle < n + 3; cycle++) {
    printf("Cycle %d:\n", cycle + 1);

    if (cycle < n) {
```

```
            fetch(cycle);
        }
        if (cycle > 0 && cycle < n + 1) {
            decode(cycle - 1);
        }
        if (cycle > 1 && cycle < n + 2) {
            execute(instructions[cycle - 2][0], instructions[cycle - 2][1]);
        }
        if (cycle > 2 && cycle < n + 3) {
            int result = instructions[cycle - 3][0] & instructions[cycle - 3][1];
            results[cycle - 3] = result;
            write_back(result);
        }

        printf("\n");
    }

    // Print final results
    printf("Final results:\n");
    for (int i = 0; i < n; i++) {
        printf("Result of AND operation %d: %d\n", i + 1, results[i]);
    }
}

// Fetch stage: Simulate fetching an instruction
void fetch(int instruction) {
    printf("  Fetching instruction %d (AND operation)\n", instruction + 1);
}

// Decode stage: Simulate decoding the instruction
void decode(int instruction) {
    printf("  Decoding instruction %d (performing AND operation)\n", instruction + 1);
```

```c
}

// Execute stage: Perform the AND operation on two operands
void execute(int operand1, int operand2) {
   printf("  Executing AND operation: %d & %d\n", operand1, operand2);
}

// Write Back stage: Store the result of the AND operation
void write_back(int result) {
   printf("  Writing back result: %d\n", result);
}

int main() {
   // Array of operand pairs for AND operation
   int instructions[][2] = {
      {5, 3},   // 5 (101) & 3 (011) = 1 (001)
      {12, 9},  // 12 (1100) & 9 (1001) = 8 (1000)
      {15, 7}   // 15 (1111) & 7 (0111) = 7 (0111)
   };

   int n = sizeof(instructions) / sizeof(instructions[0]);

   // Run the four-stage pipeline with AND operations
   pipeline(instructions, n);

   return 0;
}
```

Output:

```
Cycle 1:
  Fetching instruction 1 (AND operation)

Cycle 2:
  Fetching instruction 2 (AND operation)
  Decoding instruction 1 (performing AND operation)

Cycle 3:
  Fetching instruction 3 (AND operation)
  Decoding instruction 2 (performing AND operation)
  Executing AND operation: 5 & 3

Cycle 4:
  Decoding instruction 3 (performing AND operation)
  Executing AND operation: 12 & 9
  Writing back result: 1

Cycle 5:
  Executing AND operation: 15 & 7
  Writing back result: 8

Cycle 6:
  Writing back result: 7

Final results:
Result of AND operation 1: 1
Result of AND operation 2: 8
Result of AND operation 3: 7
```