Code Optimization

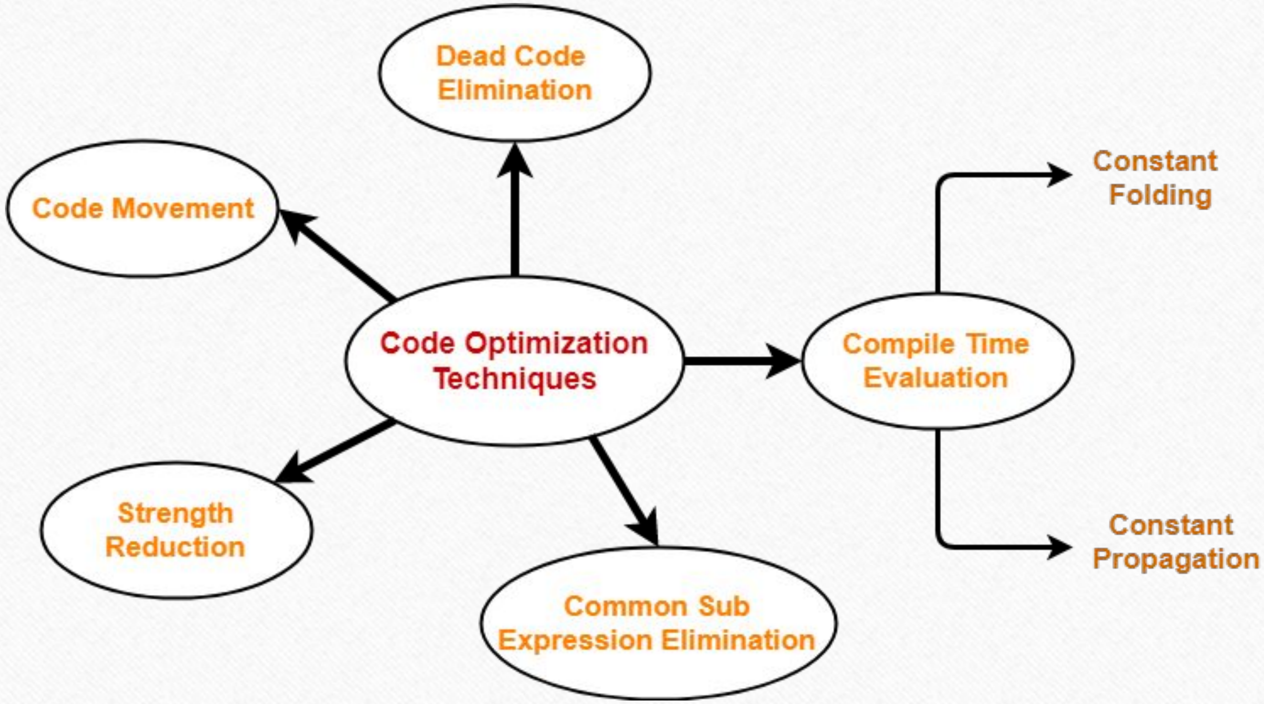
Code Optimization

- Eliminating the unwanted code lines
- Rearranging the statements of the code

Advantages

- Optimized code has faster execution speed.
- Optimized code utilizes the memory efficiently.
- Optimized code gives better performance.

Techniques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Compile Time Evaluation

1. **Constant Folding**

- As the name suggests, it involves folding the constants.
- The expressions that contain the operands having constant values at compile time are evaluated.
- Those expressions are then replaced with their respective results

Compile Time Evaluation (Cont.)

Constant Folding example:

Circumference of Circle = (22/7) x Diameter

- Here,
- This technique evaluates the expression 22/7 at compile time.
- The expression then is replaced with its result 3.14
- This saves the time at run time

Compile Time Evaluation (Cont.)

2. **Constant Propagation**

- If some variable has been assigned some constant value, then it replaces that variable with its constant value in the further program during compilation.
- The condition is that the value of variable must not get alter in between.

Compile Time Evaluation (Cont.)

Constant Propagation Example

pi = 3.14

radius = 10

Area of circle = pi x radius x radius

- This technique substitutes the value of variables ‘pi’ and ‘radius’ at compile time.
- It then evaluates the expression 3.14 x 10 x 10.
- The expression is then replaced with its result 314.
- This saves the time at run time.

Common Sub-Expression Elimination

The expression that has been already computed before and appears again in the code for computation is called as Common Sub-Expression.

Common Sub-Expression Elimination (Cont.)

In this technique,

- As the name suggests, it involves eliminating the common sub expressions.
- The redundant expressions are eliminated to avoid their re-computation.
- The already computed result is used in the further program when required.

Common Sub-Expression Elimination (Cont.)

- Example

Before Optimization	After Optimization
S1 = 4 x i	S1 = 4 x i
S2 = a[S1]	S2 = a[S1]
S3 = 4 x j	S3 = 4 x j
S4 = 4 x i	S4 = S1
S5 = n	S5 = n
S6 = b[S4] + S5	S6 = b[S4] + S5

Common Sub-Expression Elimination (Cont.)

- Remember, if some expression is used more than once, you can save that expression in a temporary variable and then use it.

Before Optimization	After Optimization
A=B+C+D	X=B+C
E=F+G	A=X+D
H=B+C+I	E=F+G
	H=X+I

Code Movement

In this technique,

- As the name suggests, it involves movement of the code.
- The code present inside the loop is moved out if it does not matter whether it is present inside or outside.
- Such a code unnecessarily gets execute again and again with each iteration of the loop.
- This leads to the wastage of time at run time.

Code Movement (Cont.)

- Example

Before Optimization	After Optimization

for (int j = 0 ; j < n ; j ++)
{
x = y + z ;
a[j] = 6 x j;
}
	x = y + z ;
	for (int j = 0 ; j < n ; j ++)
	{
	a[j] = 6 x j;
	}

Dead Code Elimination

In this technique,

- As the name suggests, it involves eliminating the dead code.
- The statements of the code which either never executes or are unreachable or their output is never used are eliminated.

Dead Code Elimination (Cont.)

- Example

Before Optimization	After Optimization

i = 0 ;
if (i == 1)
{
a = x + 5 ;
}
	i = 0 ;

Strength Reduction

In this technique,

- As the name suggests, it involves reducing the strength of expressions.
- This technique replaces the expensive and costly operators with the simple and cheaper ones.

Strength Reduction (Cont.)

- **Example**

Before Optimization	After Optimization
B = A x 2	**B=A+A**

Here,

- The expression “A x 2” is replaced with the expression “A + A”.
- This is because the cost of multiplication operator is higher than that of addition operator.

Problem 1

Before Optimization	After Optimization

i = 1;
y = x + 5;
if (i == 0)
{
a = x + 5 ;
}
	i = 1;
	y = x + 5;
	
	Explanation: Because the integer "I" will never be 0, so that loop will never be executed. This is an example of dead code elimination

Problem 2

Before Optimization	After Optimization

i = 1;
y = x + 5;
if (i == 1)
{
a = x + 5 ;
}
	i = 1;
	y = x + 5;
	if (i == 1)
	{
	a = y;
	}
	
	Explanation: since the subexpression x+5 is used more than once, we replaced x+5 with y in the code.