一、 分析以下循环中的依赖关系，并给出相应的迭代依赖图：

```
for i = 2 to 10 do   //循环 1
   for j = 2 to 10
     A[i,j] = ( A[i-1,j-1] + A[i+1,j+1] )* 0.5;
   endfor
endfor
```

```
for i = 2 to 20 do   // 循环 2
   A[2*i+2] = A[2*i-2] + B[i];
endfor
```

```
for i = 2 to 20 do   // 循环 3
   if A[i] > 0 then
      B[i] = C[i-1] + 1
   else
      C[i] = B[i] – 1
   endif
endfor
```

二、 针对以下两个循环：

```
for i = 1 to M do   //循环 1  M，N，C 均是常量
   for j = 1 to N
     A[i+1,j+1] =  A[i,j] + C;
   endfor
endfor
```

(1) 给出迭代依赖示意图。

(2) 简述能否逆转外层的 i 循环？能否交换内外循环次序？

```
for i = 1 to 100 do // 循环 2  N 是常量
   X[i] = Y[i] + 10; // 语句 S1
   for j = 1 to 100 do
      B[j] = A[j, N]; // 语句 S2
      for k = 1 to 100 do
         A[j+1, k] = B[j] + C[j, k]; // 语句 S3
      endfor // loop-k
      Y[i+j] = A[j+1, N]; // 语句 S4
   endfor // loop-j
endfor // loop-i
```

(1) 给出此循环的语句依赖图。

(2) 尝试向量化/并行化此循环。

三、 针对以下循环/程序：

```
for i = 1 to 100 do    //循环 1
   for j = 1 to 50 do
     A[3*i+2,2*j-1] =  A[5*j,i+3] + 2;
   endfor
endfor
```

（1） 给出满足依赖方向向量(1,1)的迭代依赖对集合的描述。
（2） 找出与迭代（i=11, j=11）相依赖的迭代（m,n）并指出是哪种依赖？
（3） 能否向量化最内层的 j 循环？如不行，简述理由。

```
S1: x = y * 2
    for i = 1 to 100 do
S2:   C[i] = B[i] + x
S3:   A[i] = C[i-1] + z
S4:   C[i+1] = A[i] * B[i]
      for j = 1 to 50 do
S5:      D[i,j] = D[i,j-1] + x
      endfor
    endfor
S6: z = y + 4
```

给出上述程序的语句依赖图。

四、 分析以下循环中的依赖关系，并给出相应的迭代依赖图：

```
for i = 2 to 10 do    //循环 1
   for j = i to 10
     A[i,j] =  ( A[i,j-1] + A[i-1,j] )* 0.5;
   endfor
endfor
```

```
for i = 1 to 16 do    // 循环 2
   A[i+3] = A[i] + B[i];
endfor
```

```
for k = 1 to 16 step 5 do    // 循环 3 , k 的循环步长为 5
   for i = k to min(16,i+4) do //设 min 为求最小值函数
     A[i+3] = A[i] + B[i]
   endfor
endfor
```

五、 分析以下 3 个循环中存在的依赖关系；分别通过循环交换、分布和逆转
等多种方法来尝试向量化和/或并行化变换：

```
for i = 1 to 100 do    //循环 1
    A[i] =  A[i] + B[i-1];
    B[i] =  C[i-1] * 2 ;
    C[i] =  1 / B[i] ;
    D[i] =  C[i] * C[i] ;
endfor
```

```
for i = 1 to 999 do    // 循环 2
    A[i] = B[i] + C[i];
    D[i] = ( A[i] + A[ 999-i+1 ] ) / 2 ;
endfor
```

```
for i = 1 to 100 do    // 循环 3
    for j = 1 to 100 do
        A[3*i+2*j, 2*j] = C[i,j] * 2      ;
        D[i,j]              = A[i-j+6, i+j] ;
    endfor
endfor
```