COMP30250 Parallel and Cluster Computing

Assignment 1 – Kimberley Manning – 12251405

All the loops follow the pattern:

```
for (i=0; i<N; i++) {
    a[f(i)] = b[i] * c[i];
    d[i] = a[g(i)] + e;
```

where

```
f(i) = a1*i + a0
g(i) = b1*i + b0
```

My personal values were:

- N = 200
- k1 = 0
- k2 = 1
- k3 = 1
- k4 = 1
- k5 = 2
- k6 = 2

Loop 1.

```
f(i) = (N+1)*i+k1 = 201i + 0
g(i) = (N+1)*i+k2*N = 201i + 200

a1 = 201, a0 = 0
b1 = 201, b0 = 200
```

GCD test. No dependence if there is no solution to

```
201i – 201j = 200, 0 <= i < N, 0 <= j < N
```

If a solution exists, gcd(201,201) = 201 divides 200 → false, therefore no dependence

Loop 2.

```
f(i) = i + k3*N = 1i + 200
g(i) = i + (k3+1)*N = 1i + 400

a1 = 1, a0 = 200
b1 = 1, b0 = 400
```

GCD test. No dependence if there is no solution to

```
i - j = 200, 0 <= i < N, 0 <= j < N
```

If a solution exists, gcd(1,1) = 1 divides 200 → true, cannot draw conclusion

Incomplete Banerjee. No dependence if functions do not intersect.

```
i – j:  upper bound if i is maximised and j is minimised, vice versa for lower
U = 199 – 0 = 199
```

```
L = 0 – 199 = -199
```
L < 200 → no conclusion
U < 200 → functions do not intersect, therefore no dependence

Loop 3.

```
f(i) = N*i + k4 = 200i + 1
g(i) = (N+1)*i + k5 = 201i + 2

a1 = 200, a0 = 1
b1 = 201, b0 = 2
```

GCD test. No dependence if there is no solution to

```
200i - 201j = 1, 0 <= i < N, 0 <= j < N
```

If a solution exists, gcd(201,201) = 201 divides 1 → false, therefore no dependence

Loop 4.

```
f(i) = (N+1)*i = 201i + 0
g(i) = i + (k6+1)*N = 1i + 600

a1 = 201, a0 = 0
b1 = 1, b0 = 600
```

GCD test. No dependence if there is no solution to

```
201i - 1j = 600, 0 <= i < N, 0 <= j < N
```

If a solution exists, gcd(201,1) = 1 divides 600 → true, cannot draw conclusion

Incomplete Banerjee. No dependence if functions do not intersect.

201i – j: upper bound if i is maximised and j is minimised, vice versa for lower
U = 201*199 – 0 = 39999
L = 201*0 – 199 = -199
L < 600 → no conclusion
U > 600 → no conclusion

Complete Banerjee.

Test for antidependence:

```
0 <= j < i < N
U = 201*199 – 0 = 39999
L = 201*1 – 0 = 201
```

L < 600 → no conclusion
U > 600 → no conclusion → anti-dependence may or may not exist

Test for true dependence:

```
0 <= i <= j < N
U = 201*199 - 1*199 = 39800
L = 200*0 – 1*199 = -199
```

L < 600 → no conclusion
U > 600 → no conclusion → true dependence may or may not exist