

Programação Paralela com OpenMP

ELC139 - Programação Paralela

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1 Introdução

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Exemplo: Pi

```
for (i=1; i<= num_steps; i++) {  
    x = (i-0.5)*step;  
    sum = sum + 4.0/(1.0+x*x);  
}
```

Exemplo: Pi

- x precisa ser privado
- sum é somado por todos

```
#pragma omp parallel for private(x) reduction(+:sum)  
for (i=1;i<= num_steps; i++){  
    x = (i-0.5)*step;  
    sum = sum + 4.0/(1.0+x*x);  
}
```

Exemplo: Histograma

```
for(int i=0; i<num_trials; i++){  
    long ival = (long) (x[i] - xlow)/bucket_width;  
    hist[ival]++;  
}
```

Exemplo: Histograma

```
#pragma omp parallel for
for(int i=0;i<num_trials;i++){

    long ival = (long) (x[i] - xlow)/bucket_width;

    #pragma omp critical
        hist[ival]++;

}
```

Exemplo: Histograma

```
#pragma omp parallel for reduction(+:hist[0:num_buckets])  
for(int i=0;i<num_trials;i++){  
  
    long ival = (long) (x[i] - xlow)/bucket_width;  
  
    hist[ival]++;  
  
}
```

Exemplo: Jacobi

● $Ax = b$

```
while((conv > TOLERANCE) && (iters<MAX_ITERS))
{
    iters++;
    xtmp  = xnew;    // don't copy arrays.
    xnew  = xold;    // just swap pointers.
    xold  = xtmp;

    for (i=0; i<Ndim; i++){
        xnew[i] = (TYPE) 0.0;
        for (j=0; j<Ndim; j++){
            if(i!=j)
                xnew[i] += A[i*Ndim + j]*xold[j];
        }
        xnew[i] = (b[i]-xnew[i])/A[i*Ndim+i];
    }
}
```

```
1  //
2  // test convergence
3  //
4  conv = 0.0;
5  for (i=0; i<Ndim; i++){
6      tmp  = xnew[i]-xold[i];
7      conv += tmp*tmp;
8  }
9  conv = sqrt((double)conv);
10 }
```

Exemplo: Jacobi OpenMP

```
while((conv > TOLERANCE*TOLERANCE) &&
↪  (iters<MAX_ITERS))
{
    {
        iters++;
        conv = 0.0;
        xtmp = xnew;    // don't copy arrays.
        xnew = xold;    // just swap pointers.
        xold = xtmp;
    }

    #pragma omp parallel for private(i,j)
    for (i=0; i<Ndim; i++){
        xnew[i] = (TYPE) 0.0;
        for (j=0; j<Ndim; j++){
            xnew[i] += A[i*Ndim + j]*xold[j] * (i != j);
        }
        xnew[i] = (b[i]-xnew[i])/A[i*Ndim+i];
    }
}
```

```
1  //
2  // test convergence
3  //
4  #pragma omp parallel for
   ↪ private(tmp)
   ↪ reduction(+:conv)
5  for (i=0; i<Ndim; i++){
6      tmp = xnew[i]-xold[i];
7      conv += tmp*tmp;
8  }
9  }
```

Exemplo: Jacobi OpenMP

```
#pragma omp parallel default(none) private(tmp) \
    shared (Ndim, conv, iters, b, A, xnew, xold,
    ↪ xtmp)
{
    while((conv > TOLERANCE*TOLERANCE) &&
    ↪ (iters<MAX_ITERS))
    {
        #pragma omp single
        {
            xtmp = xnew;    // don't copy arrays.
            xnew = xold;    // just swap pointers.
            xold = xtmp;
        }
        #pragma omp for private(i,j) nowait
        for (i=0; i<Ndim; i++){
            xnew[i] = (TYPE) 0.0;
            for (j=0; j<Ndim; j++){
                xnew[i] += A[i*Ndim + j]*xold[j] * (i != j);
            }
            xnew[i] = (b[i]-xnew[i])/A[i*Ndim+i];
        }
    }
}
```

```
1  #pragma omp single
2  {
3      iters++;
4      conv = 0.0;
5  }
6
7  // test convergence
8  #pragma omp for private(tmp)
    ↪ reduction(+:conv)
9  for (i=0; i<Ndim; i++){
10     tmp = xnew[i]-xold[i];
11     conv += tmp*tmp;
12 }
13 }
14 }
```

<https://joao-ufsm.github.io/par2023a/>

