HPC Assignment 1
Durbin optimization

https://github.com/ll-castor/hpc-lab-assignment-1

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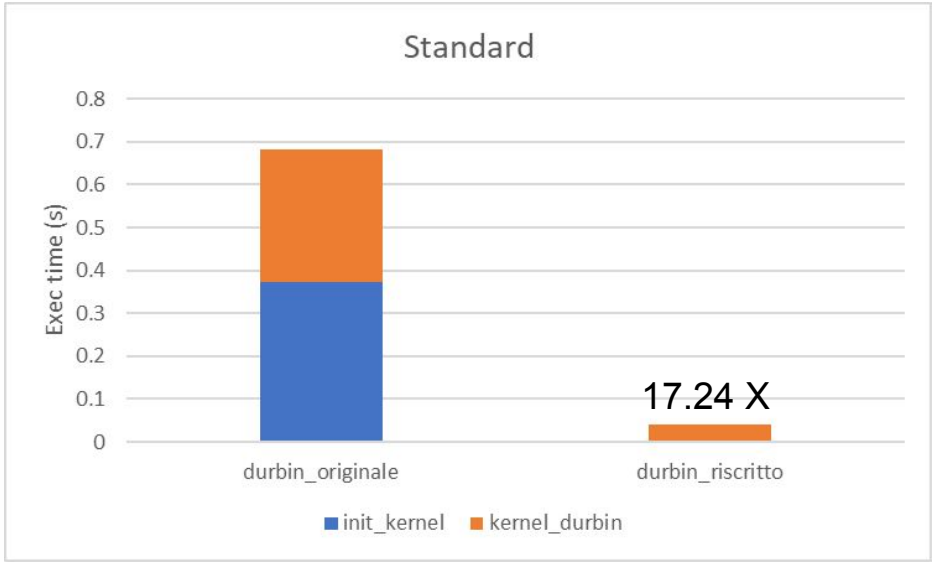
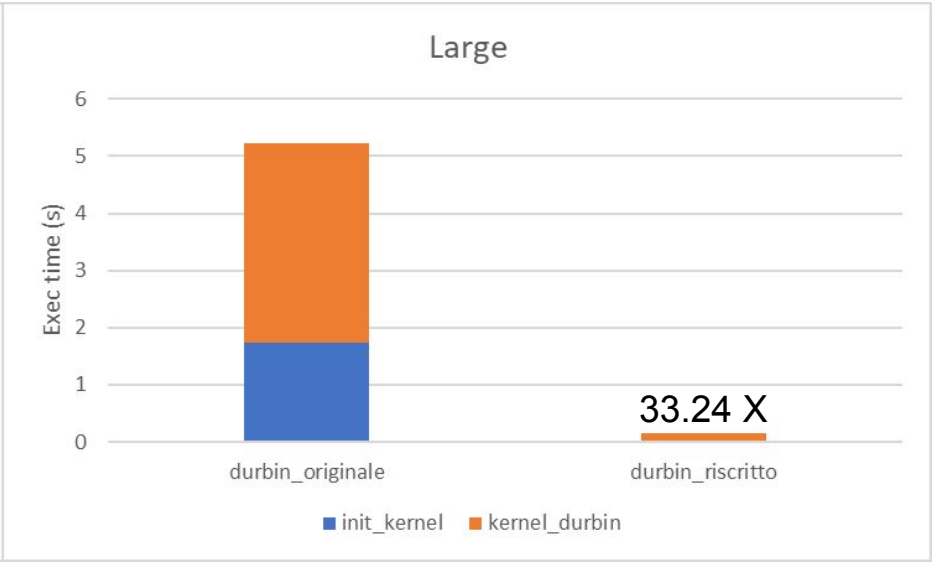
Original code vs rewritten code

```
#pragma scop
  y[0][0] = r[0];
  beta[0] = 1;
  alpha[0] = r[0];

  for (k = 1; k < _PB_N; k++)
  {
    beta[k] = beta[k - 1] - alpha[k - 1] * alpha[k - 1] * beta[k - 1];
    sum[0][k] = r[k];
    for (i = 0; i <= k - 1; i++)
      sum[i + 1][k] = sum[i][k] + r[k - i - 1] * y[i][k - 1];
    alpha[k] = -sum[k][k] * beta[k];
    for (i = 0; i <= k - 1; i++)
      y[i][k] = y[i][k - 1] + alpha[k] * y[k - i - 1][k - 1];
    y[k][k] = alpha[k];

  }
  for (i = 0; i < _PB_N; i++){
    out[i] = y[i][_PB_N - 1];

  }
}
```

```
{
  int i, k;
  DATA_TYPE sum, beta, alpha;
  DATA_TYPE y[2][N];
#pragma scop
  y[0][0] = r[0];
  beta = 1;
  alpha = r[0];


  for (k = 1; k < _PB_N; k++)
  {
    beta = beta - alpha * alpha * beta;
    sum = r[k];

    for (i = 0; i <= k - 1; i++)
      sum += r[k - i - 1] * y[(k - 1) % 2][i];
    alpha = -sum * beta;

    for (i = 0; i <= k - 1; i++)
      y[k % 2][i] = y[(k - 1) % 2][i] + alpha * y[(k - 1) % 2][k - i - 1];
    y[k % 2][k] = alpha;
  }

  for (i = 0; i < _PB_N; i++)
    out[i] = y[(_PB_N - 1) % 2][i];

}
```

Performance boost

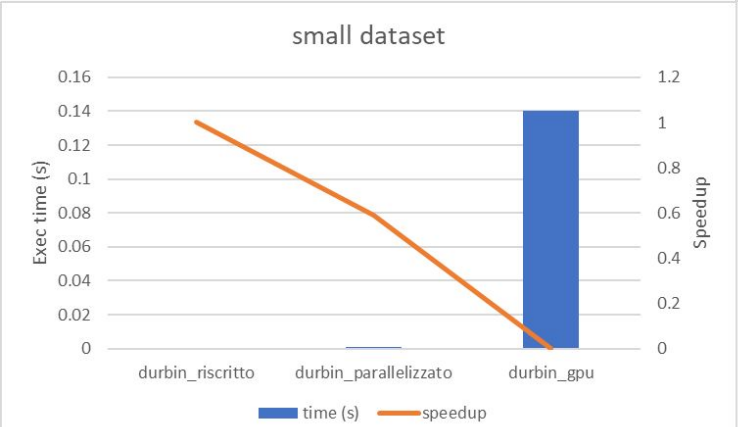


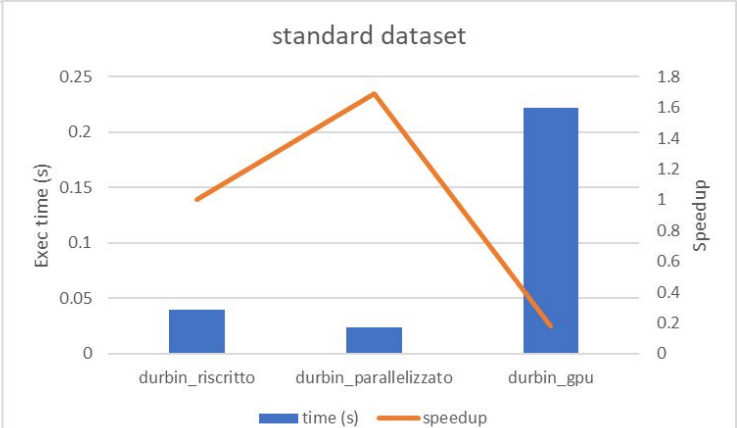


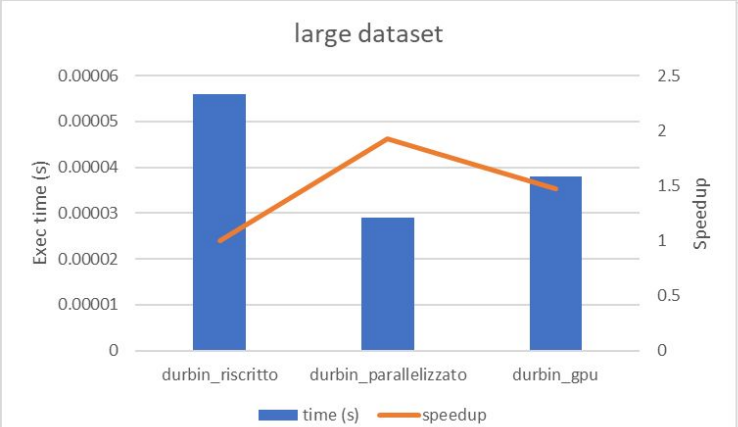
Parallel code

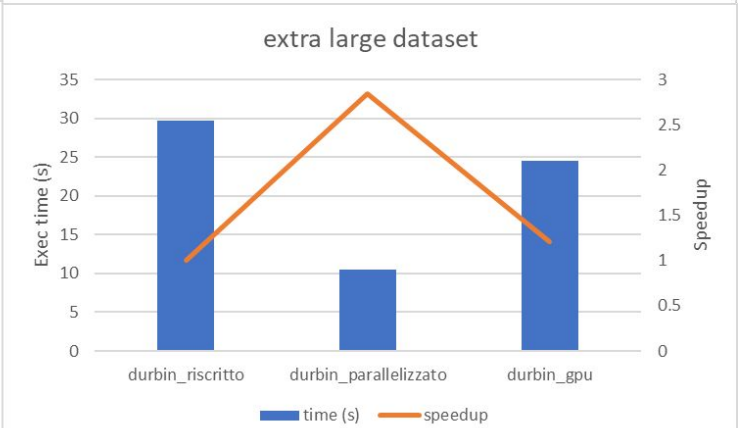
```
y[0][0] = r[0];
beta = 1;
alpha = r[0];

#pragma omp parallel default(none) firstprivate(i, k, alpha, beta, r, n, out) shared(sum, y) num_threads(NTHREADS)
{
  for (k = 1; k < _PB_N; k++)
  {
    beta = beta - alpha * alpha * beta;
    sum = r[k];
    #pragma omp for reduction(+:sum)
    for (i = 0; i <= k - 1; i++)
      sum += r[k - i - 1] * y[(k - 1) % 2][i];
    alpha = -sum * beta;
    #pragma omp for
    for (i = 0; i <= k - 1; i++)
      y[k % 2][i] = y[(k - 1) % 2][i] + alpha * y[(k - 1) % 2][k - i - 1];
    y[k % 2][k] = alpha;
  }
  #pragma omp for
  for (i = 0; i < _PB_N; i++)
    out[i] = y[(_PB_N - 1) % 2][i];
}
```

Kernel Durbin









Optional assignment