



FIRST ASSIGNMENT HPC

Team 3

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WHAT DOES THE CODE DO?

2 - KERNEL_COVARIANCE

Determine mean of
column vectors of matrix

4 - KERNEL_COVARIANCE

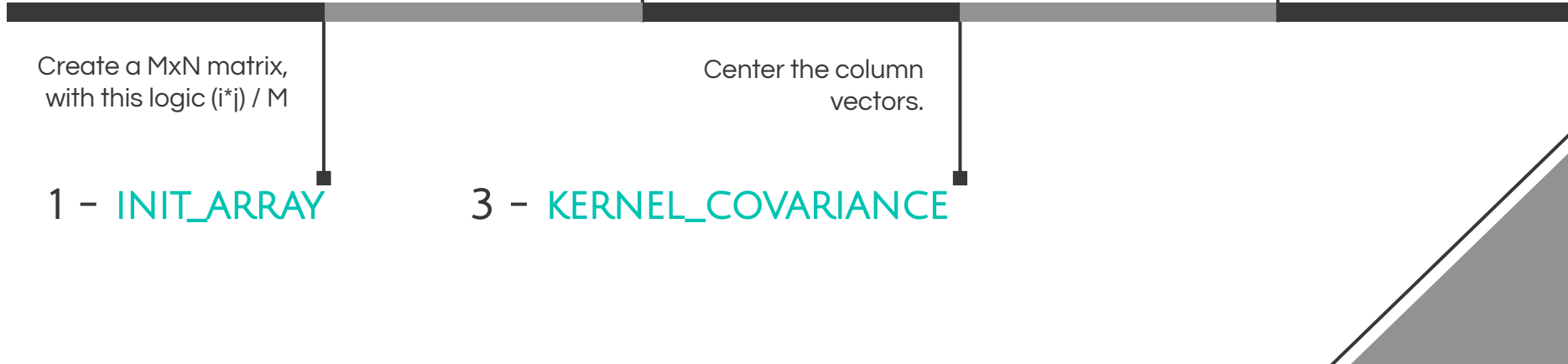
Calculate the
covariance matrix

Create a MxN matrix,
with this logic $(i*j) / M$

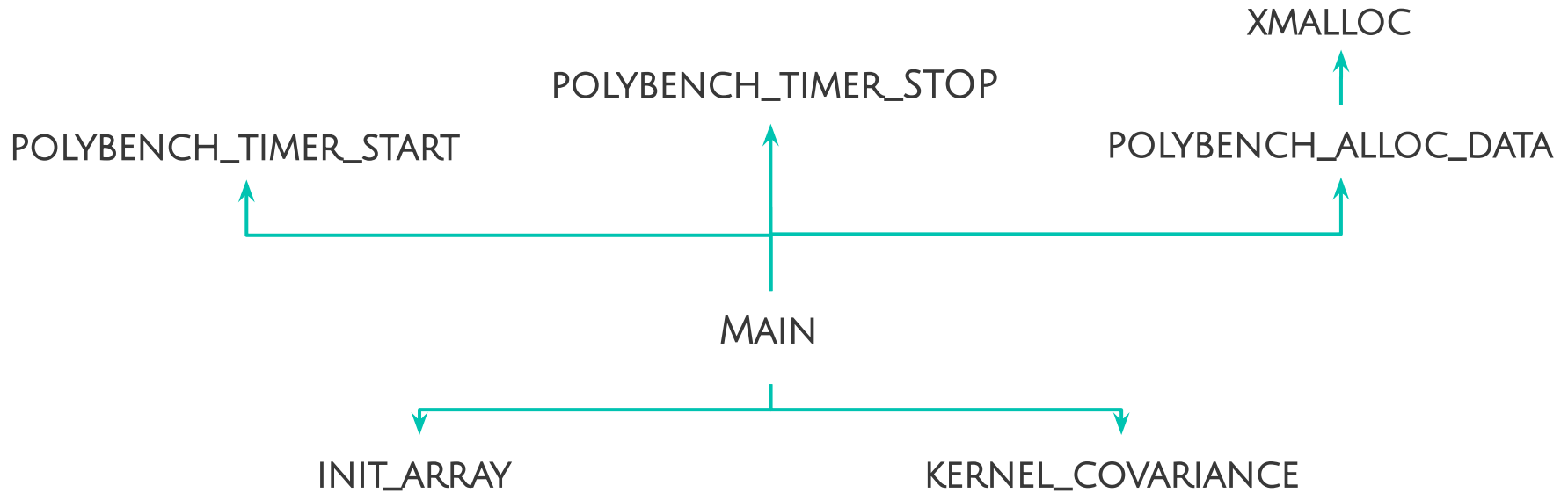
Center the column
vectors.

1 - INIT_ARRAY

3 - KERNEL_COVARIANCE

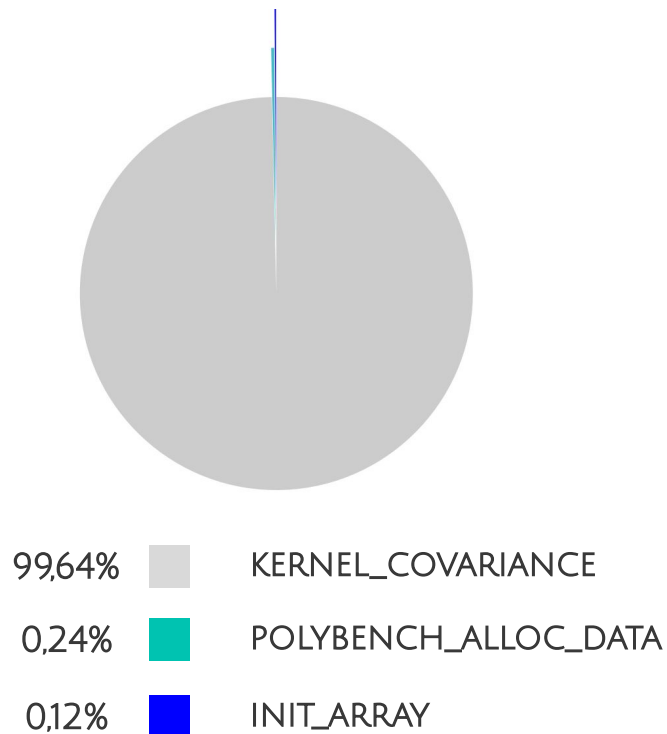
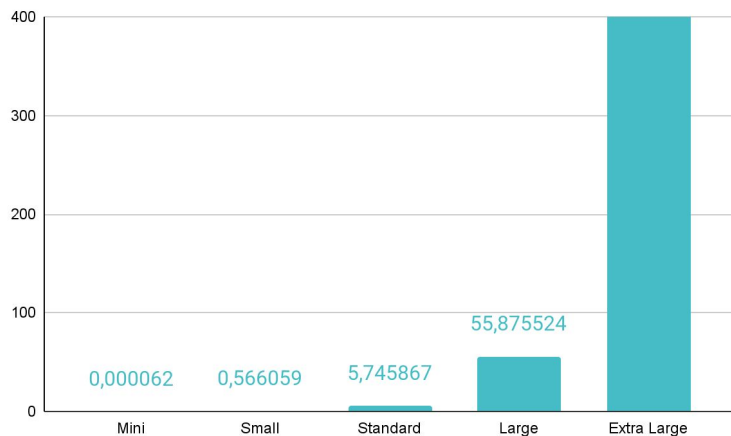


CALL GRAPH



PROFILING ORIGINAL CODE

EXECUTION TIME:





PARALLELISATION APPROACHES

Parallelise a nested loop over i and j with **OpenMP collapse(2)** directive, distributing work across all threads to initialize the matrix.

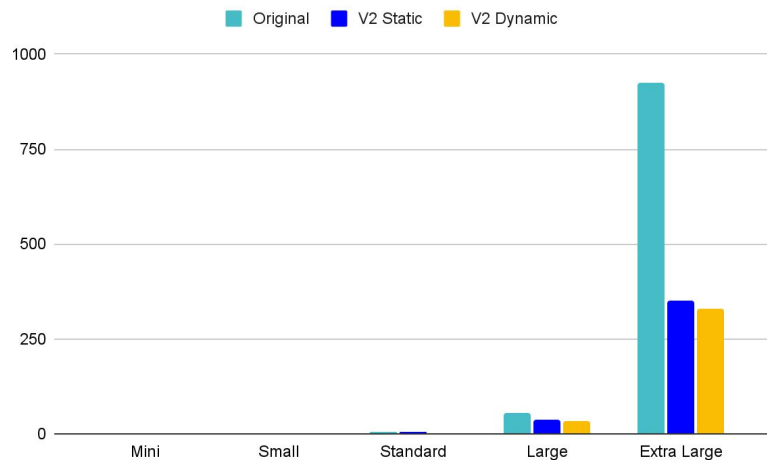
Applies **dynamic scheduling** with a calculated chunk size to balance load in a nested parallel loop.

```
#pragma omp parallel for collapse(2)
  for (i = 0; i < _PB_M; i++)
    for (j = 0; j < _PB_N; j++)
      data[i][j] = ((DATA_TYPE) i*j) / M;
```

```
int chunk_size = _PB_M / (4 * omp_get_max_threads());
```

```
#pragma omp parallel for schedule(dynamic, chunk_size) \
private(i,j2)
  for (j1 = 0; j1 < _PB_M; j1++)
    for (j2 = j1; j2 < _PB_M; j2++)
    {
      DATA_TYPE temp_sum = 0.0;
      for (i = 0; i < _PB_N; i++)
        temp_sum += data[i][j1] * data[i][j2];
      symmat[j1][j2] = temp_sum;
      symmat[j2][j1] = temp_sum;
    }
```

RESULT



	ORIGINAL	V2 STATIC	SPEEDUP	V2 DYNAMIC	SPEEDUP
Mini	0,000062	0,000047	1,31	0,000042	1,48
Small	0,566059	0,394118	1,43	0,352103	1,60
Standard	5,745867	3,751174	1,53	3,189519	1,80
Large	55,875524	38,767421	1,44	33,610301	1,66
Extra Large	924,894858	351,956128	2,62	330,647356	2,8

$$Amdahl's Law = \frac{1}{(1 - p) + (\frac{p}{n})} = \frac{1}{(1 - 0.9976) + (0.9976/4)} = 3.97141$$

THANKS

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