alpaka Parallel Programming – Online Tutorial

Lecture 20: Thread Parallelism in alpaka

Lesson 23: Computing π – Part I

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TECHNISCHE UNIVERSITÄT DRESDEN
CBG Max Planck Institute of Molecular Cell Biology and Genetics
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Computing π

- Focus of the next four lessons
- Good example for Thread parallelism
- Introduces parameter passing and memory management
- Initial algorithm: Find points in a circle

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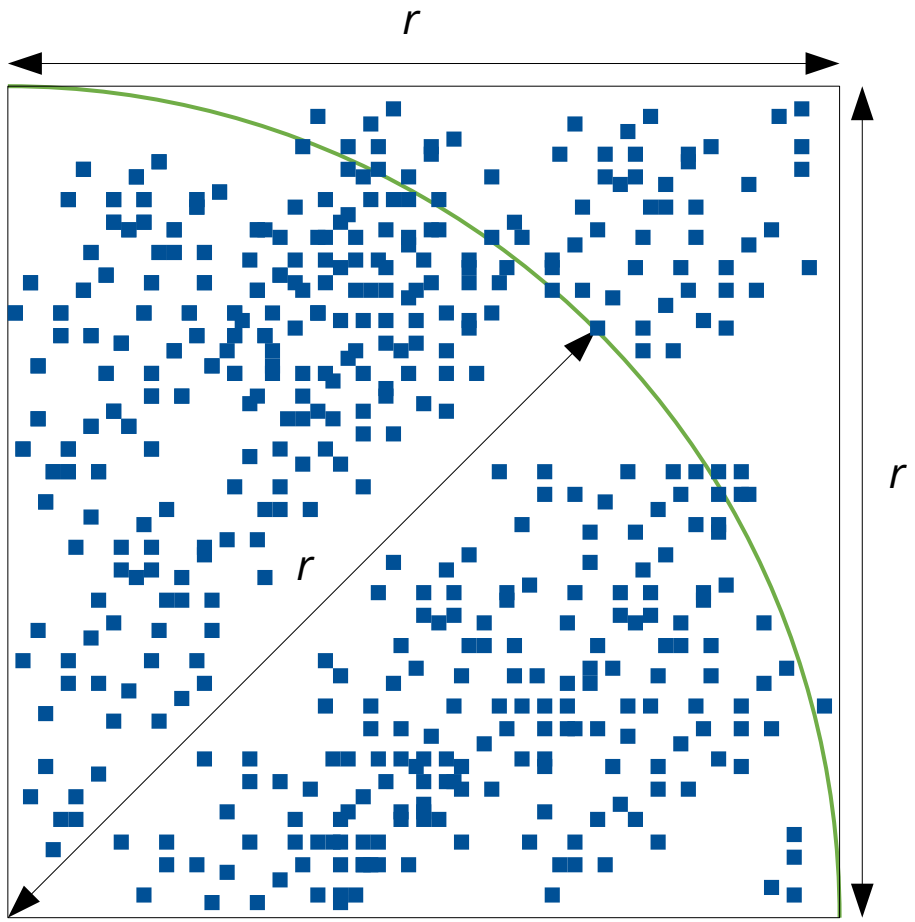
Points in a circle

- Task: Given a circle quarter with the radius *r* and a set of *n* randomly scattered points, find all points inside the circle quarter
- Approach:
  - Create a Grid with *n* Threads
  - Each Thread evaluates a single point



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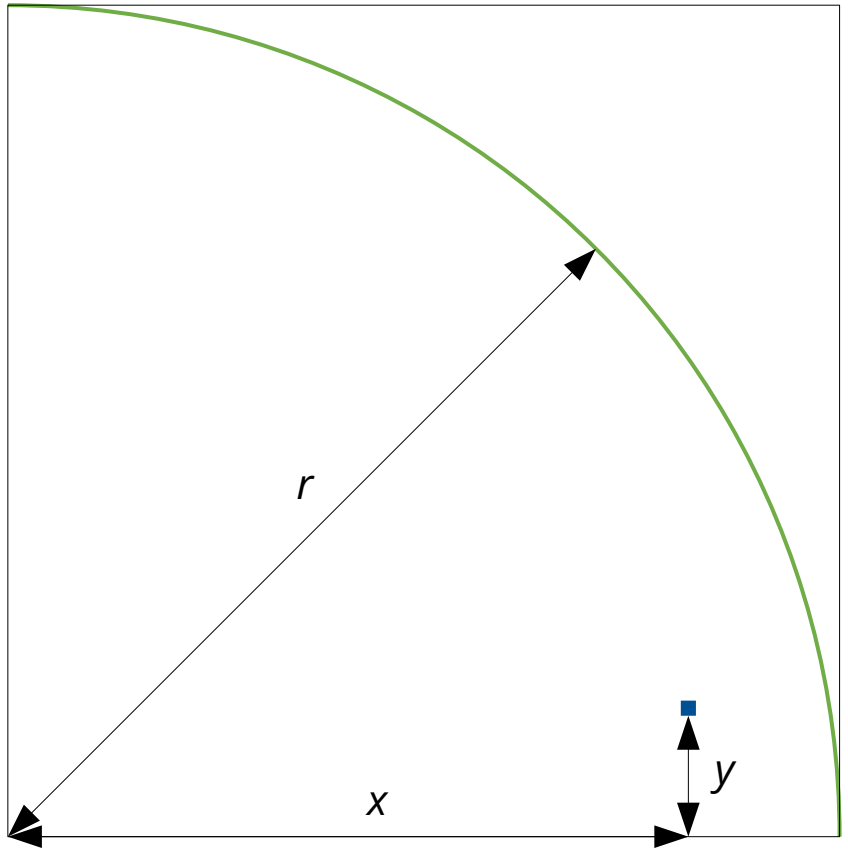
Algorithm

- Using Pythagoras' theorem, the distance d from a point to the origin can be calculated:

  $$d = \sqrt{x^2 + y^2}$$

- If $d \leq r$, return `true`, otherwise `false`



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Kernel requirements

- For the computation we need:
  - The point coordinates:

```
struct Points {
    float * x;
    float * y;
    bool * inside;
};
```

  - The radius: `float r;`
- How do we pass these to the kernel?

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Passing parameters

- alpaka kernels accept three different parameter types:
  - The accelerator: `Acc const & acc` (required)
  - Pointers to memory buffers of any data type: `float * bufferA`, `MyDataType * bufferB`
  - Scalar values of trivially copyable types: `float scalar`, `struct Composed { int a; float b; };`
- Signature of the `PixelFinderKernel`'s `operator()`:

```
template <typename Acc>
ALPAKA_FN_ACC void operator()(Acc const & acc, // required
                              Points points,   // this struct contains memory buffers
                              float r          // this is a scalar
) const
```

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