Tiling Visualizer

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Roadmap

What is loop tiling?

What is the Tiling Visualizer?

What are the limitations?

What is this tool?

T-Vis renders rectangular tilings of 2D polyhedral loops.

Tiling is a loop transformation for optimization

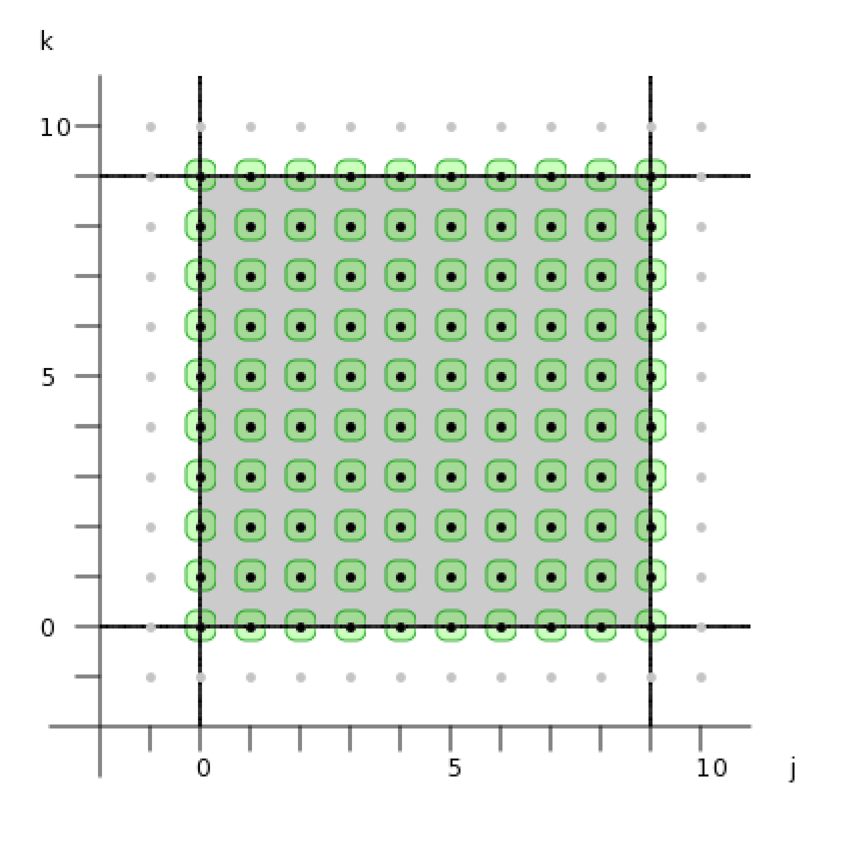
T-Vis images are useful for papers and in explaining tiling in a classroom setting.

Intro to tiling

Matrix vector multiply:

$$\begin{bmatrix} a_{00} & a_{01} & \cdots & a_{0(n-1)} \\ a_{10} & & & a_{1(n-1)} \\ \vdots & & & \vdots \\ a_{(n-1)0} & a_{(n-1)1} & \cdots & a_{(n-1)(n-1)} \end{bmatrix} \cdot \begin{bmatrix} b_0 \\ b_1 \\ \vdots \\ b_{(n-1)} \end{bmatrix} = \begin{bmatrix} c_0 \\ c_1 \\ \vdots \\ c_{(n-1)} \end{bmatrix}$$

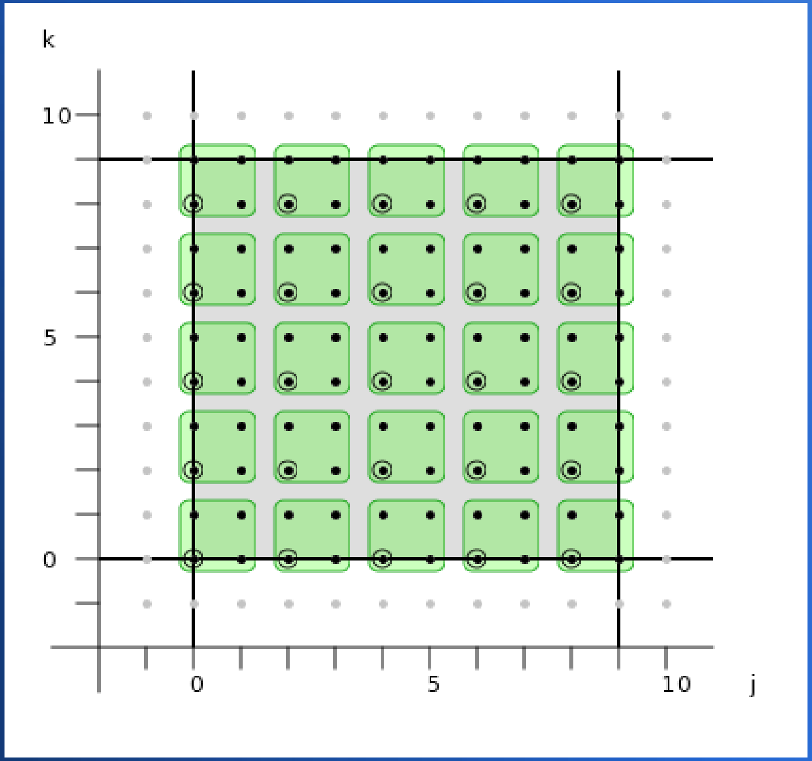
```
for (i=0; i<N; i++)
    for (k=0; k<N; k++)
        c[i] += a[i,k] * b[k];
```



Intro to tiling

Tiled Matrix-Vector Multiply:

```
for (jT=0; jT<N; jT+=2)
  for (kT=0; kT<N; kT+=2)
    for (j=jT; j<min(jT+2,N); j++)
      for (k=kT; k<min(kT+2,N); k++)
        c[j] += a[j,k] * b[k];
```



Insets & Outsets

Inset

All tile origins within the inset are all full tiles

Calculation[1]

Shift all upper bounds in along their normal by a value related to the tile size

Outset

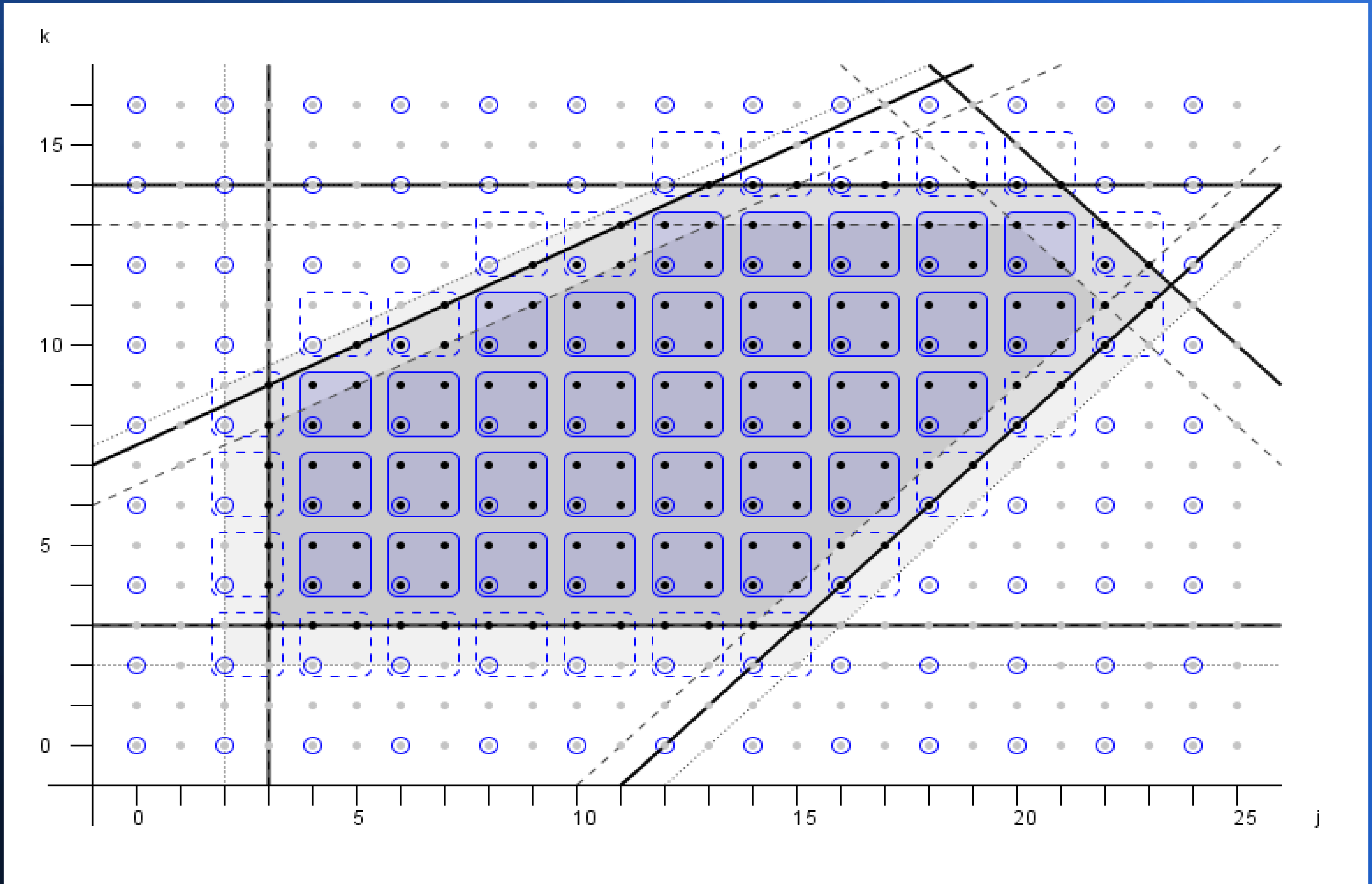
All tile origins for points in the iteration space are in the outset

Calculation[1]

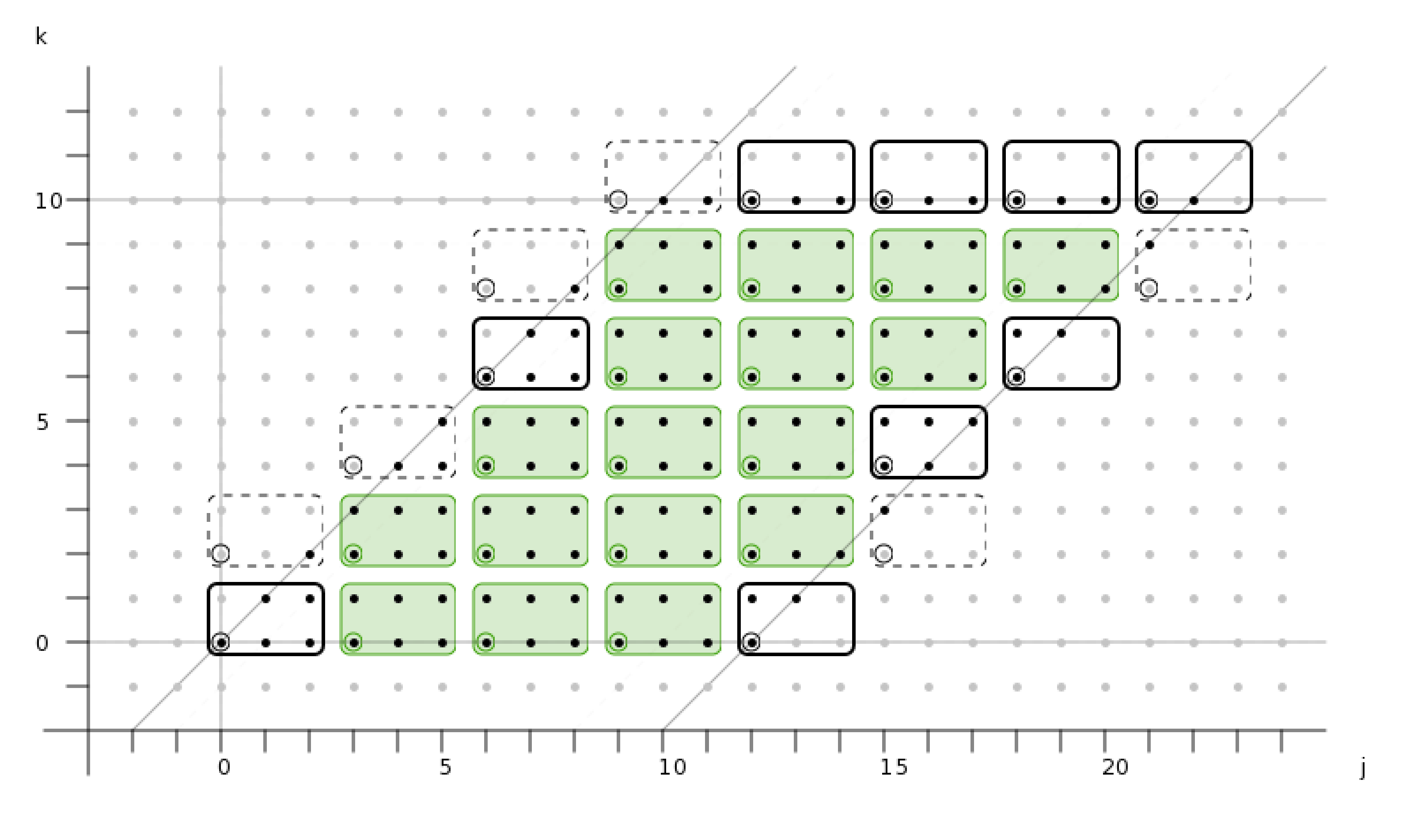
Shift all lower bounds out along their normal by a value related to the tile size

[1] There is a better explanation of this in M.Strout's LCPC'07 paper

Example



Example



A Little Motivation

Before T-Vis

- Tiling diagrams drawn by hand
- Time consuming to adjust
- Not very uniform in style

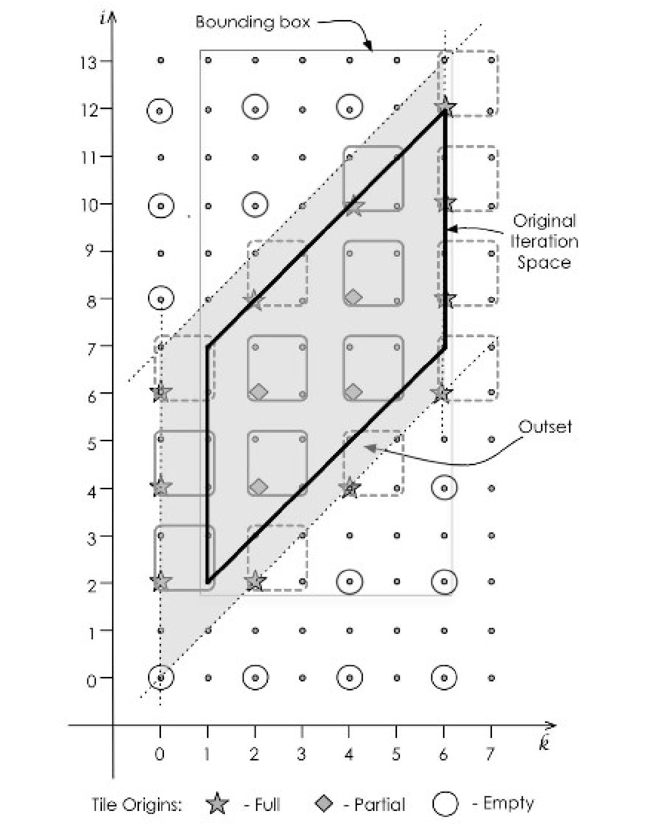


Figure 5. A 2 × 2 rectangular tiling of the 2D stencil iteration space with $N_i = N_j = 6$. The outset and bounding box are also shown. Compare the number of empty tile origins contained in each of them.

Diagram borrowed from M.Strout's LCPC'07 paper

Features

Input

- Simple text file
- CLooG-style matrix & additional markup for tiling
- [Example]

Output

- svg, pdf, png, jpeg or tiff of the tiling

Open Source – NewBSD License

Live Demo

There is a terminal version and a GUI!

Limitations

2d iteration space

rectangular tiles

no legend yet

requires Java 1.6.0_7 or later

End

Where can I find it?

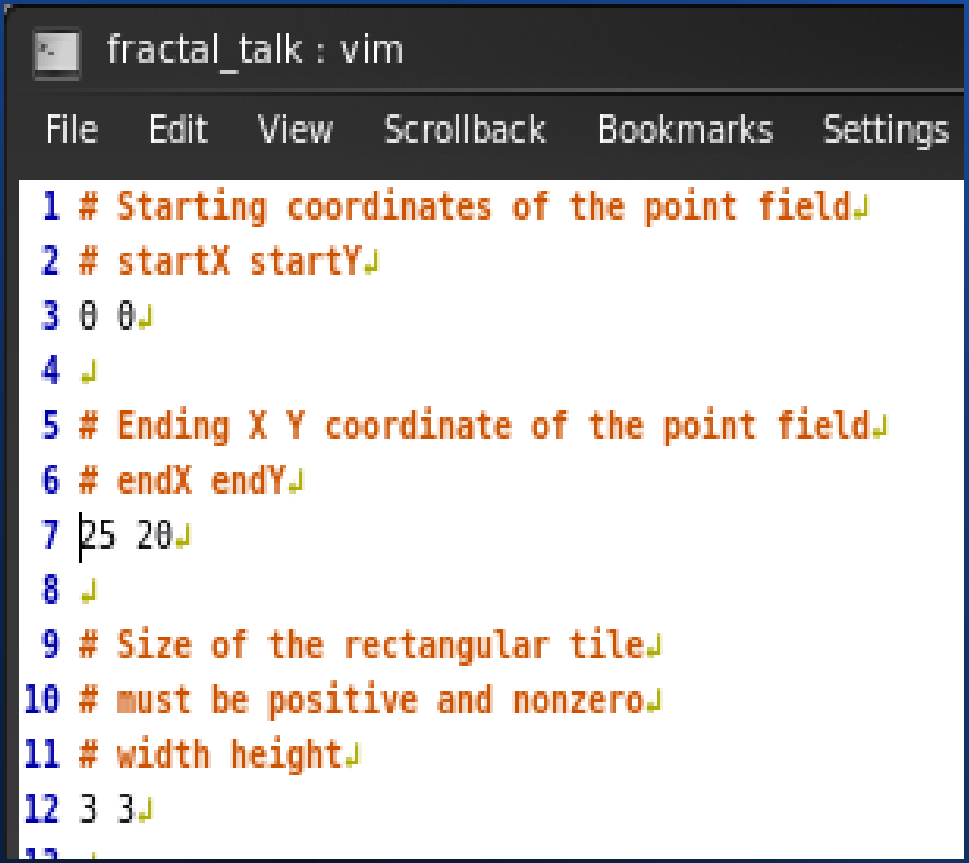
www.cs.colostate.edu/~roelofs/

Questions?

Sources:

Parameterized Tiled Loops for Free, Strout – PLDI'07

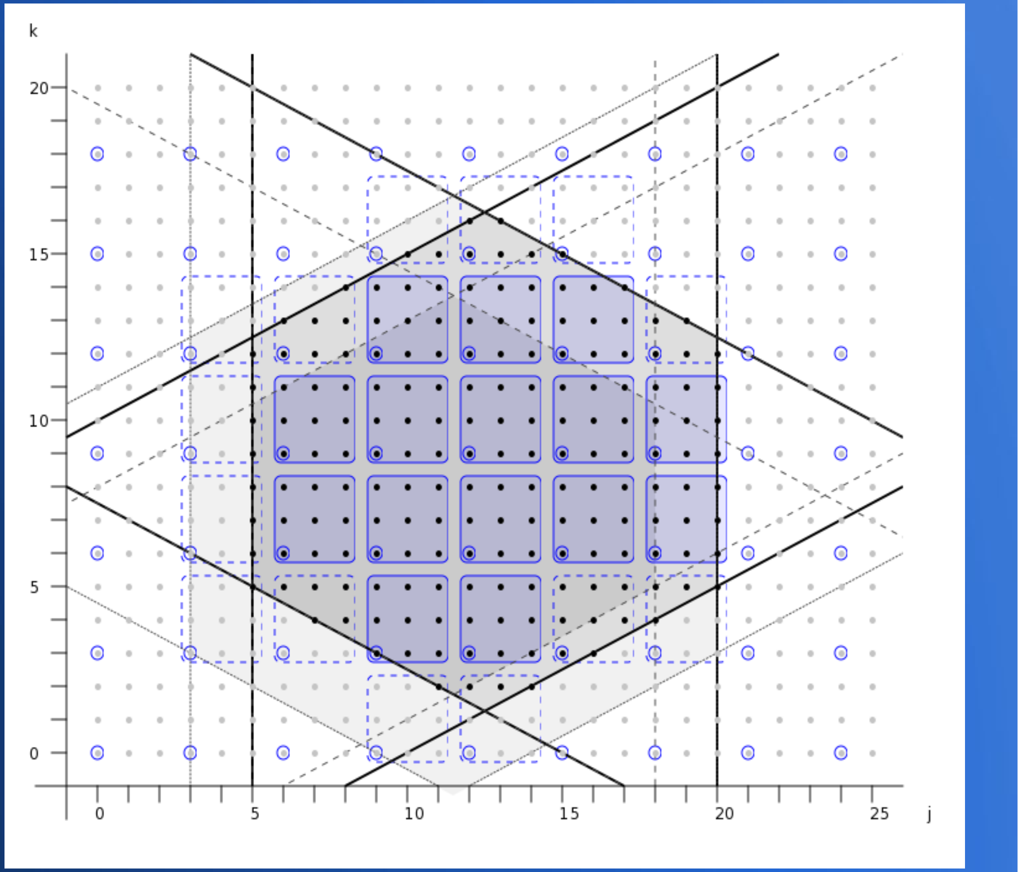
Example



```
# Starting coordinates of the point field
# startX startY
0 0

# Ending X Y coordinate of the point field
# endX endY
25 20

# Size of the rectangular tile
# must be positive and nonzero
# width height
3 3
```



Rendering

- T-Vis uses Apache's Batik for rendering
  - http://xmlgraphics.apache.org/batik/
- Batik renders operations done on a Java Graphics2D object to SVG
- SVG document is then converted to the requested output format