cdn LIVE EMEA 2011

DEF File Export Considering Overlapping Structures

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Outline

- **Introduction**
- **Approach**
- **Implementation**
- **Challenges**
  - Automatic Shape Conversion
  - Design data consistency
- **Conclusion**

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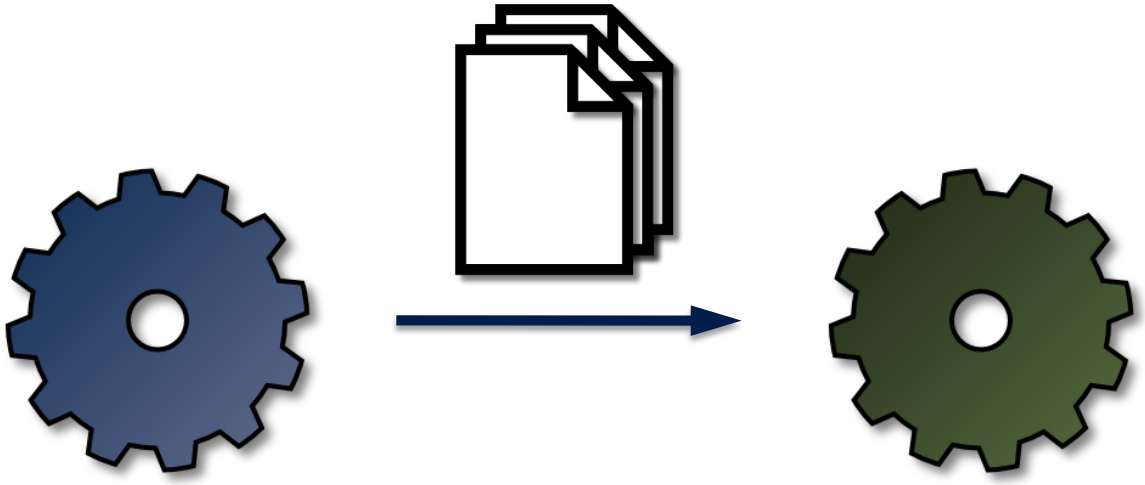
Introduction



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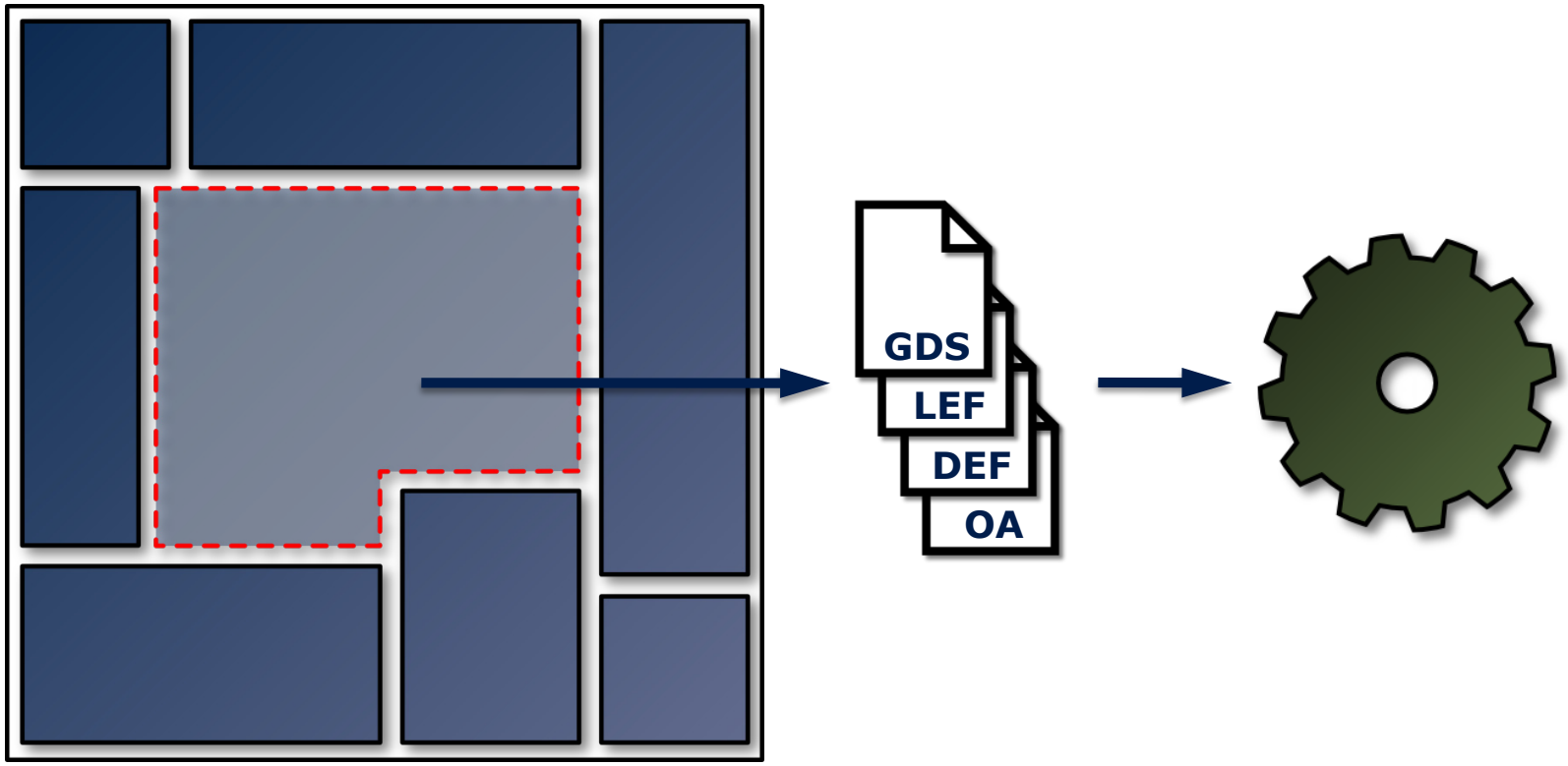

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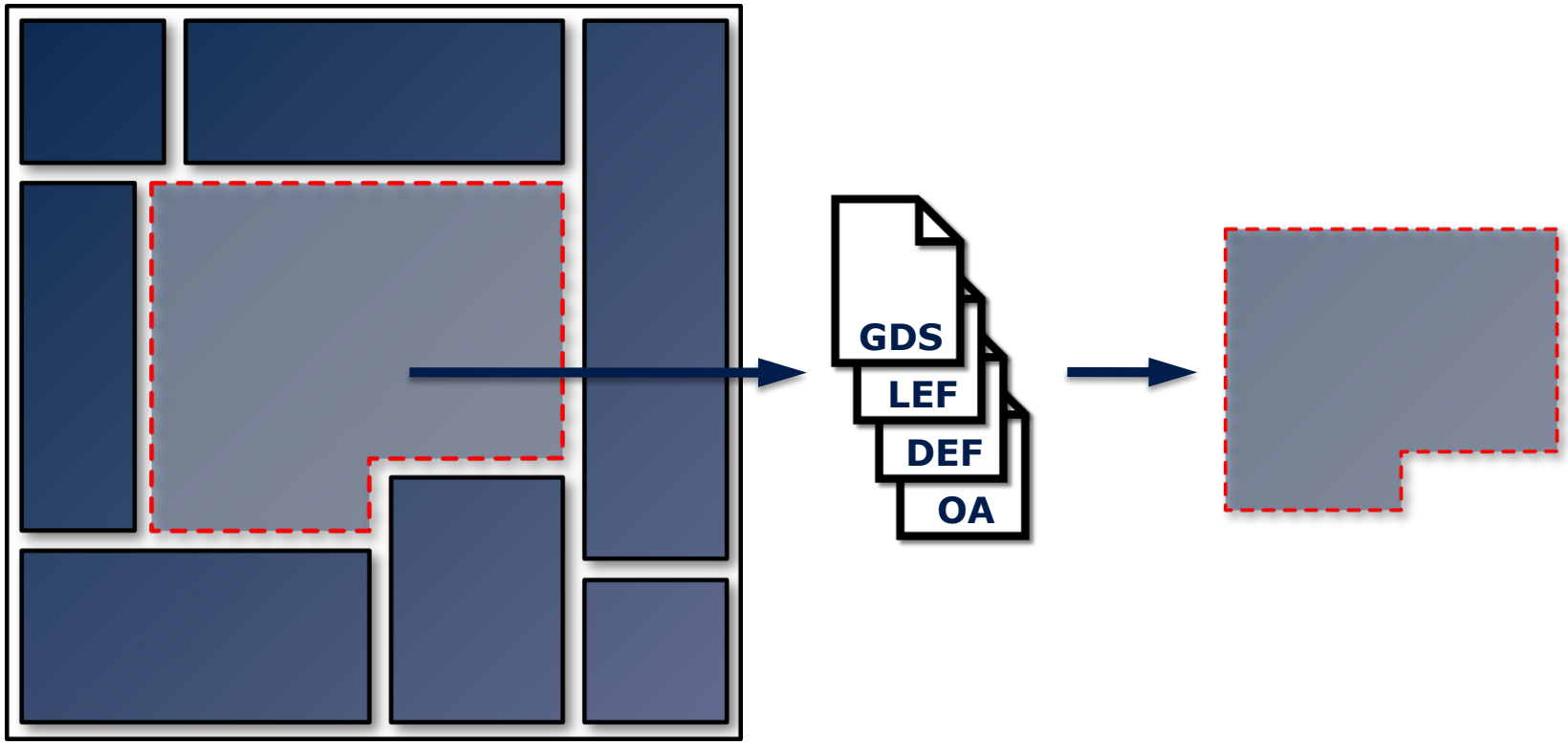

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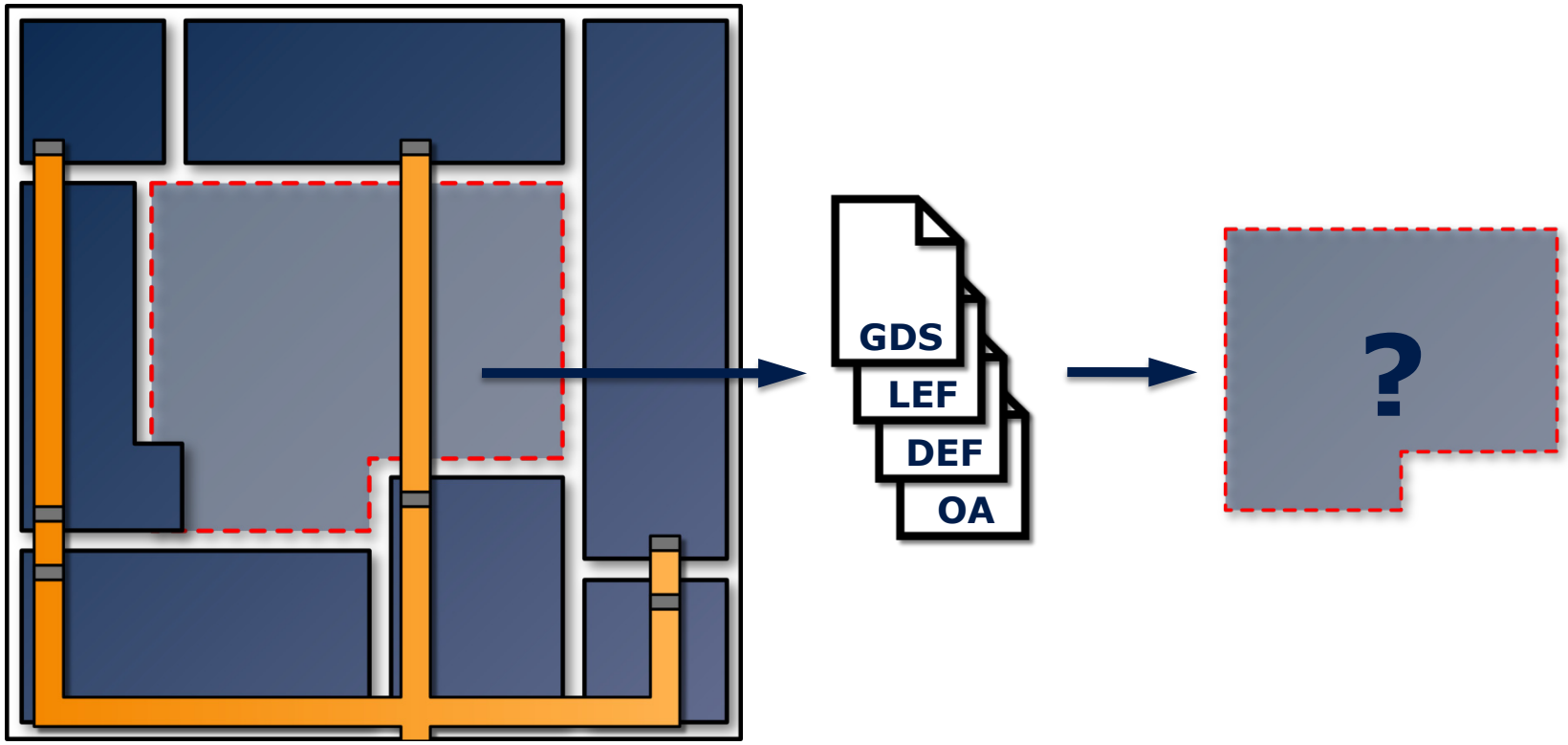

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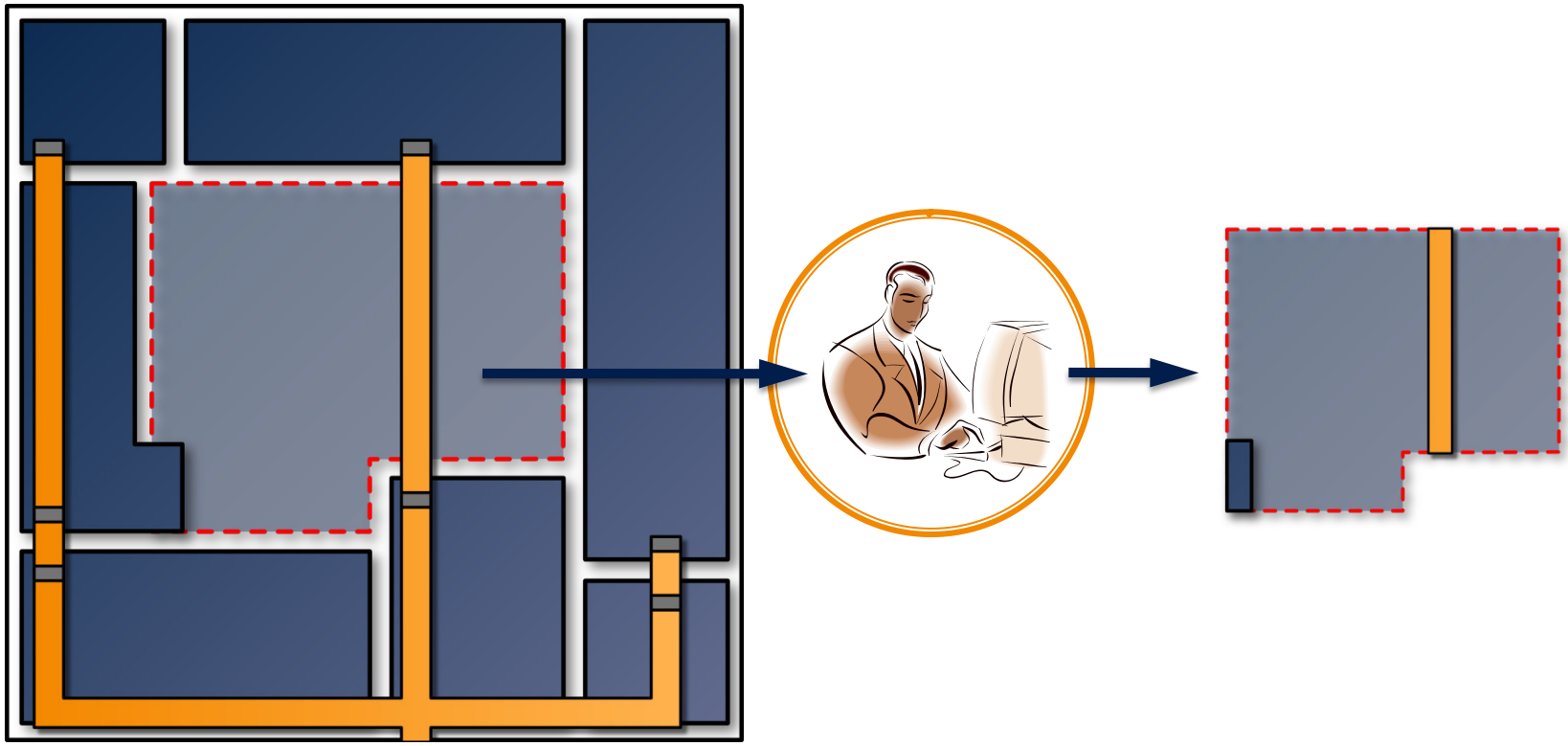

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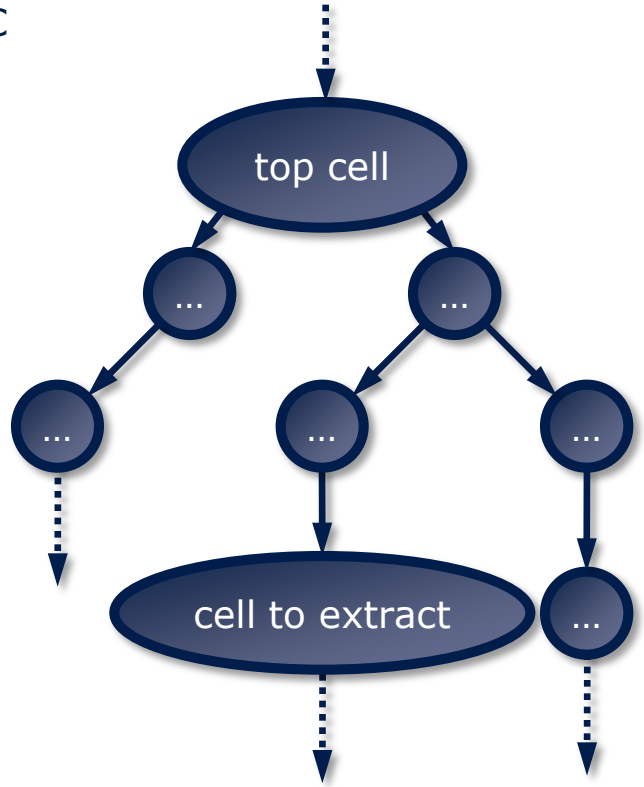
Approach

- Creation of a SKILL script for Cadence CIC
- Input:
  1. Cell to extract,
     e.g. the digital core
  2. Arbitrary higher-level cell,
     e.g. the top cell
- Output:
  - DEF file of the cell including all overlapping shapes



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Approach

- Start traversing the design hierarchy at the top cell
- For the current cell:
  - Calculate and store intersection of all shapes with the boundary
  - Add all child instances to the queue
- Finally, write all shapes to the DEF file

Secondary Goals

- No modification of design data
- Short runtime (seconds to a few minutes at most)

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Implementation – Preparations

- Get the path between the cells

```
path = geFindPathToCellViewInst(topcell cell)
```

- Get the transformation lists

```
cell2top = geGetInstTransform(path)
top2cell = icDbInvertTransform(cell cell2top)
```

- Copy the boundary to the top cell

```
dbCopyFig(boundary topcell cell2top)
```

- Load routing layers from tech file

```
techGetViaLayers(techfile)
techGetPrRoutingLayers(techfile)
```


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Implementation – Main Loop (1)

- Start at the top cell

```
queue = list(list(topcell list(0:0 "R0" 1.0))
```

- Remove first element from queue
- Process all shapes
  - For each layer: Copy shapes to the top cell

```
copy = dbCopyFig(shape topcell transformation)
```

  - Calculate and store the intersection with the boundary

```
shapes = dbLayerAnd(topcell … boundary copies)
```


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Implementation – Main Loop (2)

- Process all instances (ignoring mosaics)
  - Transform bounding box to top cell coordinates

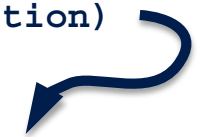
    ```
    dbTransformBBox(instance~>bBox transformation)
    ```

  - Calculate transformation list of all children

    ```
    dbConcatTransform(instance~>transform transformation)
    ```

  - If bounding box intersects:

    ```
    queue = cons(list(instance~>master newTransformation) queue)
    ```



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Implementation – Main Loop (3)

- Process all mosaics
  - Copy mosaic to top cell

    ```
    copy = dbCopyFig(mosaic topcell transformation)
    ```

  - Flatten the copy

    ```
    dbFlattenInst(copy 1)
    ```

  - Add intersecting instances to the queue

    ```
    queue = cons(list(instance~>master instance~>transform) queue)
    ```

- Restart main loop: Process next instance in queue

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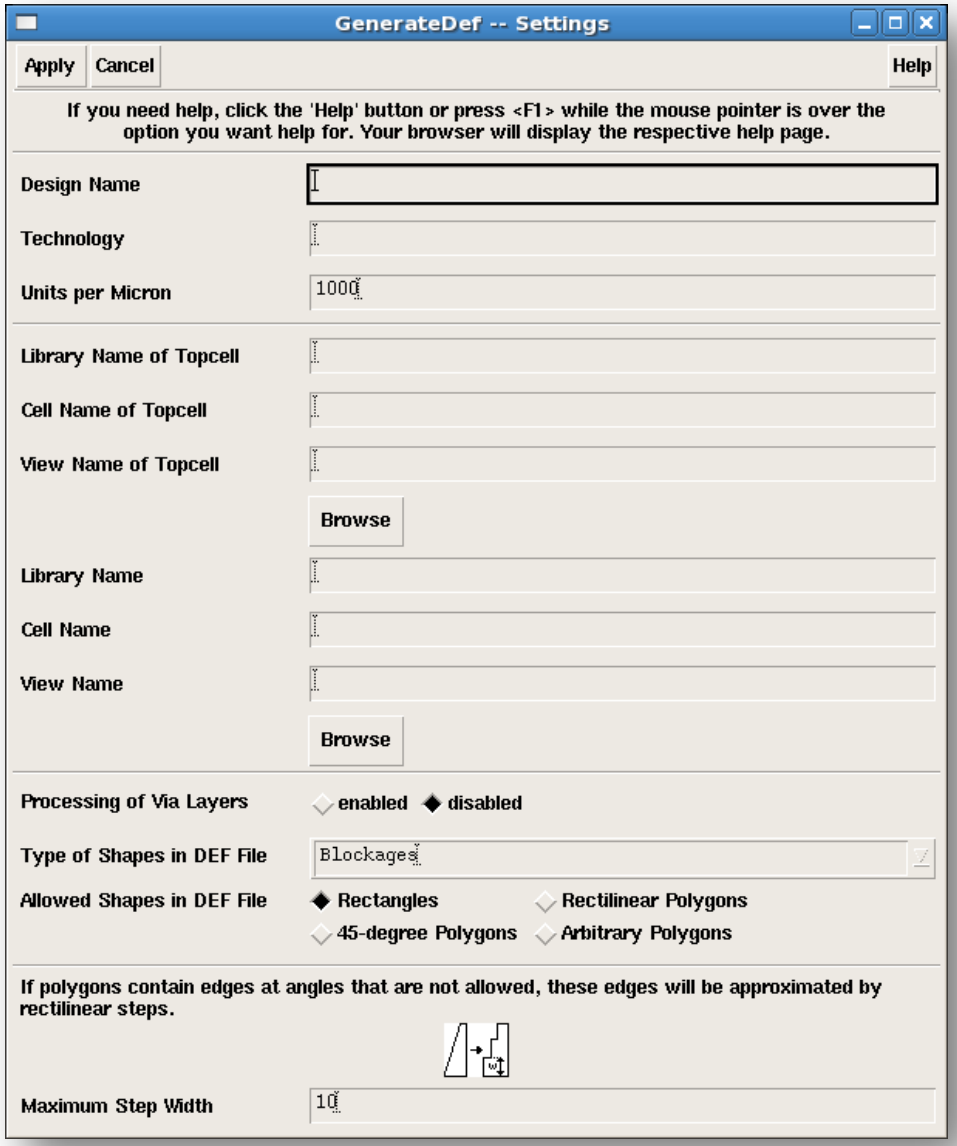
Graphical User Interface

Higher-ranking cell →

Cell to extract →



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Challenges

- Problem: Multiple versions of the DEF standard exist
- EDA tools support different versions with varying properties
- Main difference: Supported shape types
  - Rectangles
  - Rectilinear polygons
  - Octilinear polygons
  - (Arbitrary polygons)
- Conversion of unsupported shape types is necessary

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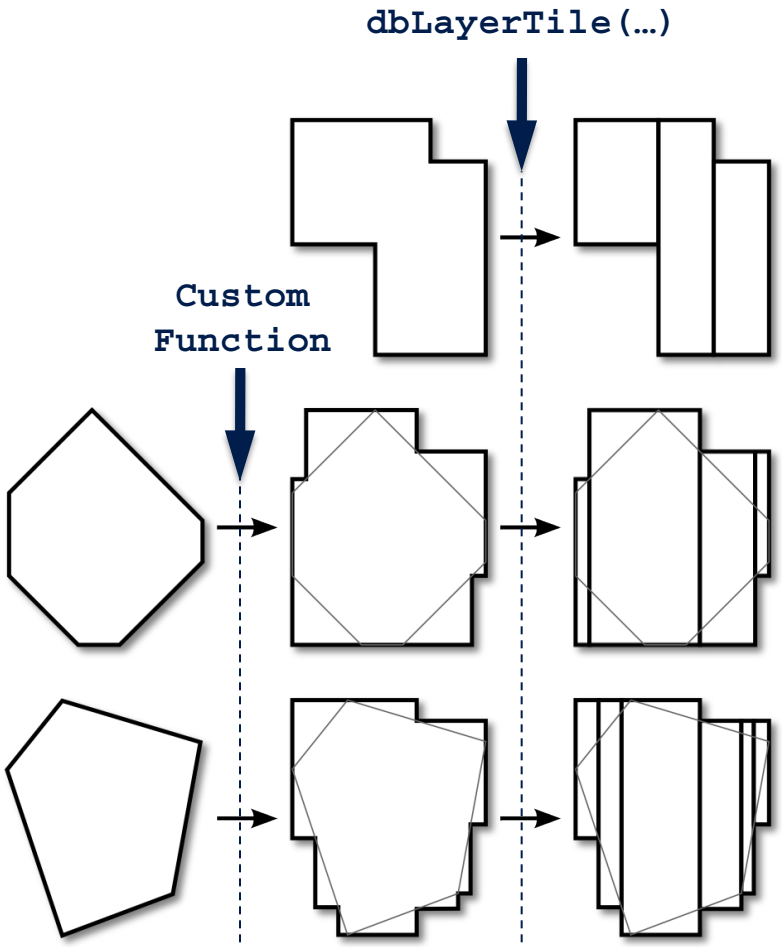
Shape Conversion

- Allowed shape types are configurable
- Automatic conversion of forbidden shape types
- Conversion to rectilinear polygons:
  - Iterating over all edges
  - If angle not allowed: Approximation with rectilinear steps
  - Maximum step width configurable



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Design data consistency

- Goal: No modification of design data
- Top cell view opened in scratch mode:

```
cV = dbOpenCellViewByType(libName cellName viewName nil "s")
```

- Problem: Every window displaying this cell view records changes
- 1st Solution: Unroll all changes
- 2nd Solution:

```
dbClose(cV)
if(member(cV dbGetOpenCellViews()) then
    ; refreshing the cell view discards all edits
    dbRefreshCellView(cV)
) ; if
```


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Conclusion

- Resulting DEF file contains *all* overlapping shapes
- All shapes are completely located within the bounds of the cell
- Automatic approximation of unsupported shapes
- No modification of design data
- Short runtime

- Shorter average design time (about 3 man days per design)
- Increase of design quality by avoiding potential DRC and LVS errors

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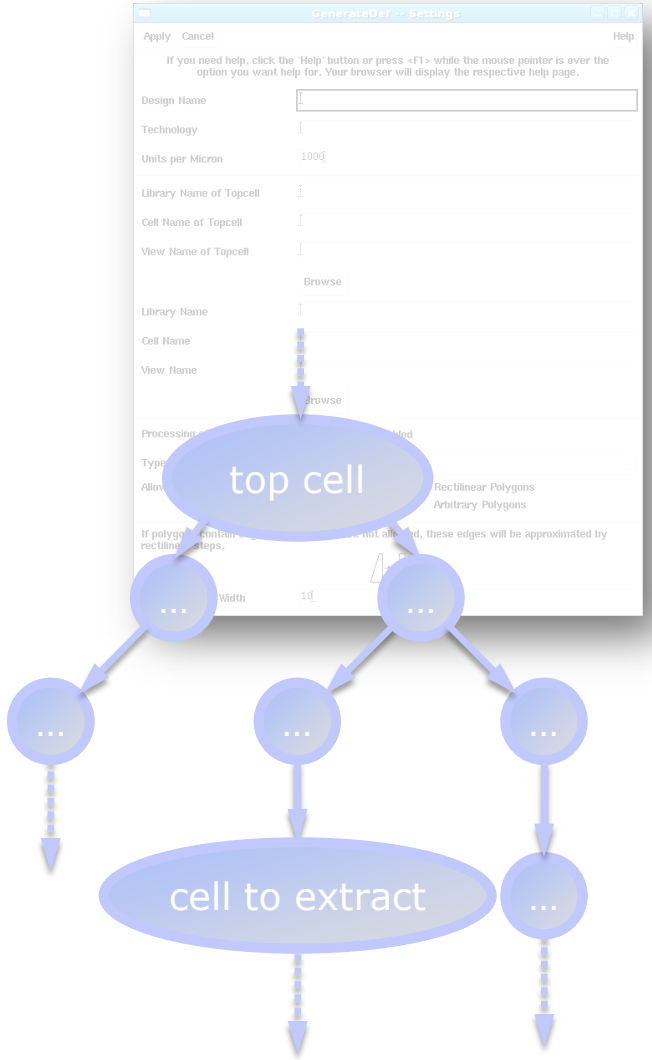
Thank You!



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