Deep Vectorization of Technical Drawings

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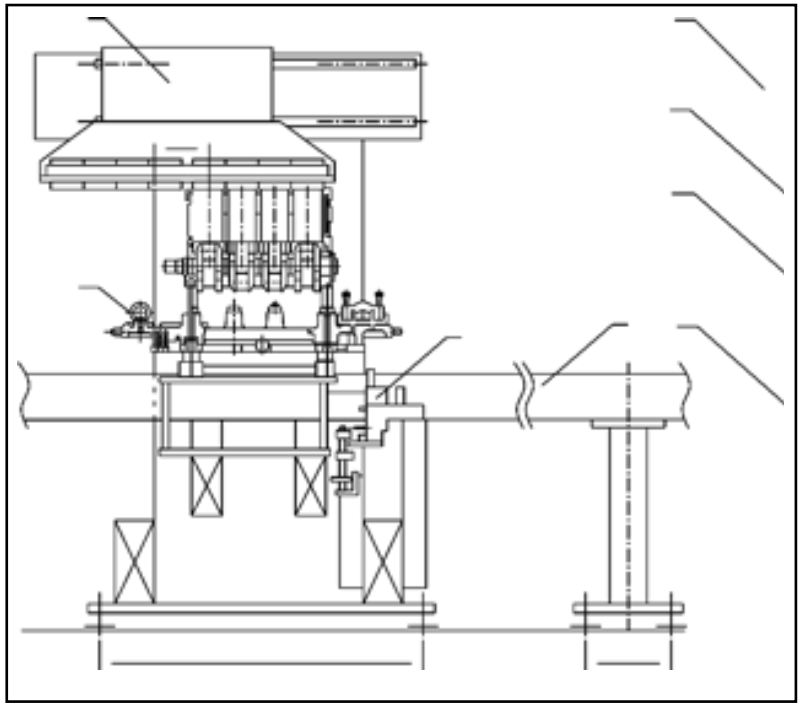
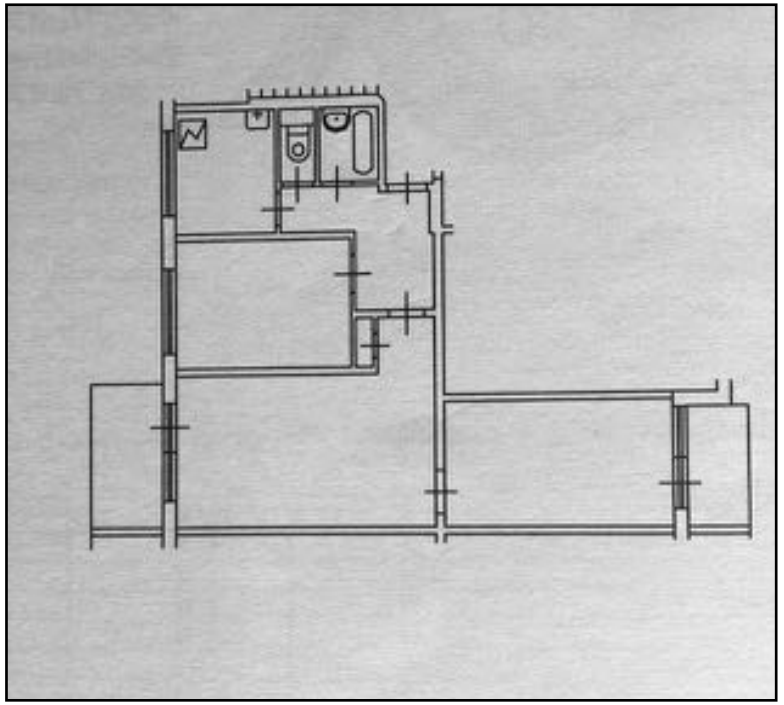
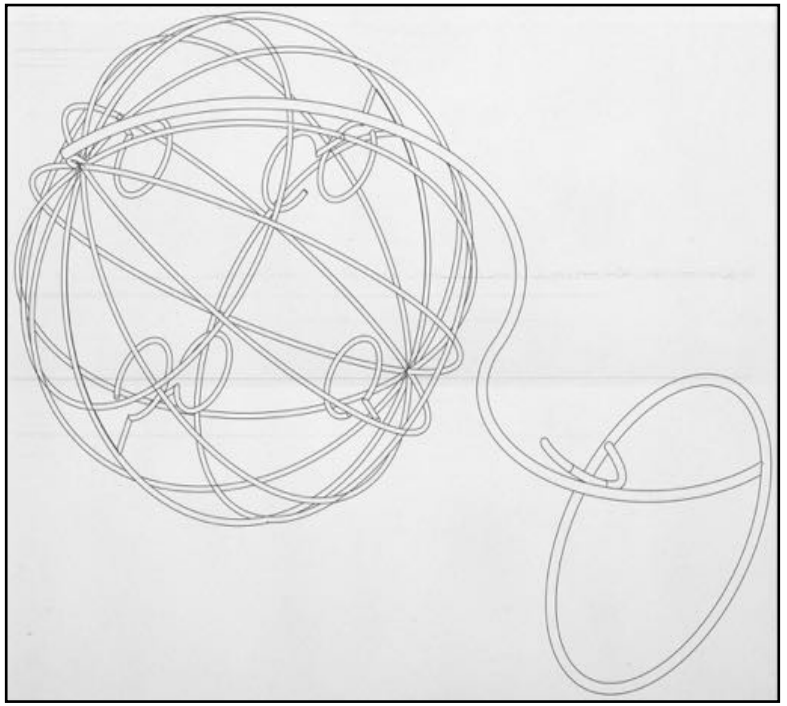
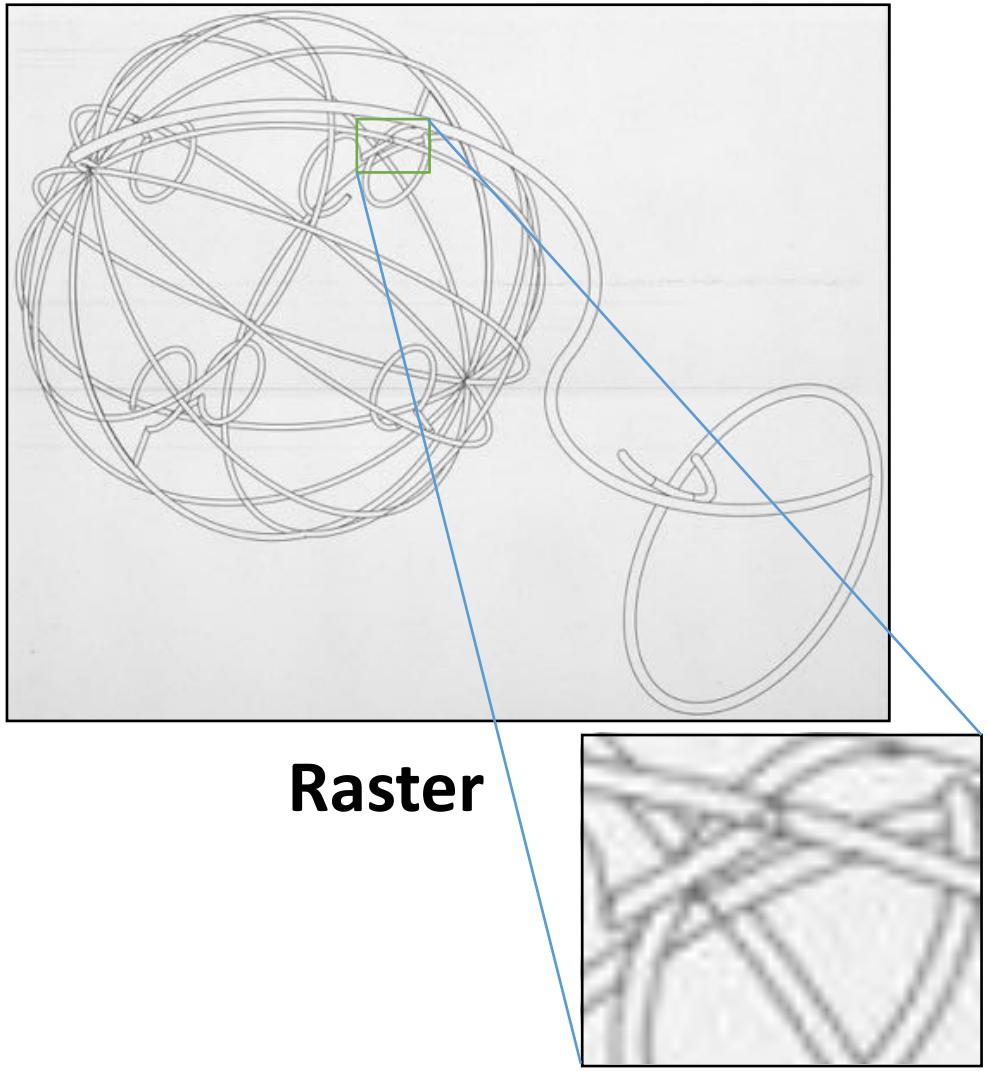
[2] New York University, USA

Intro:

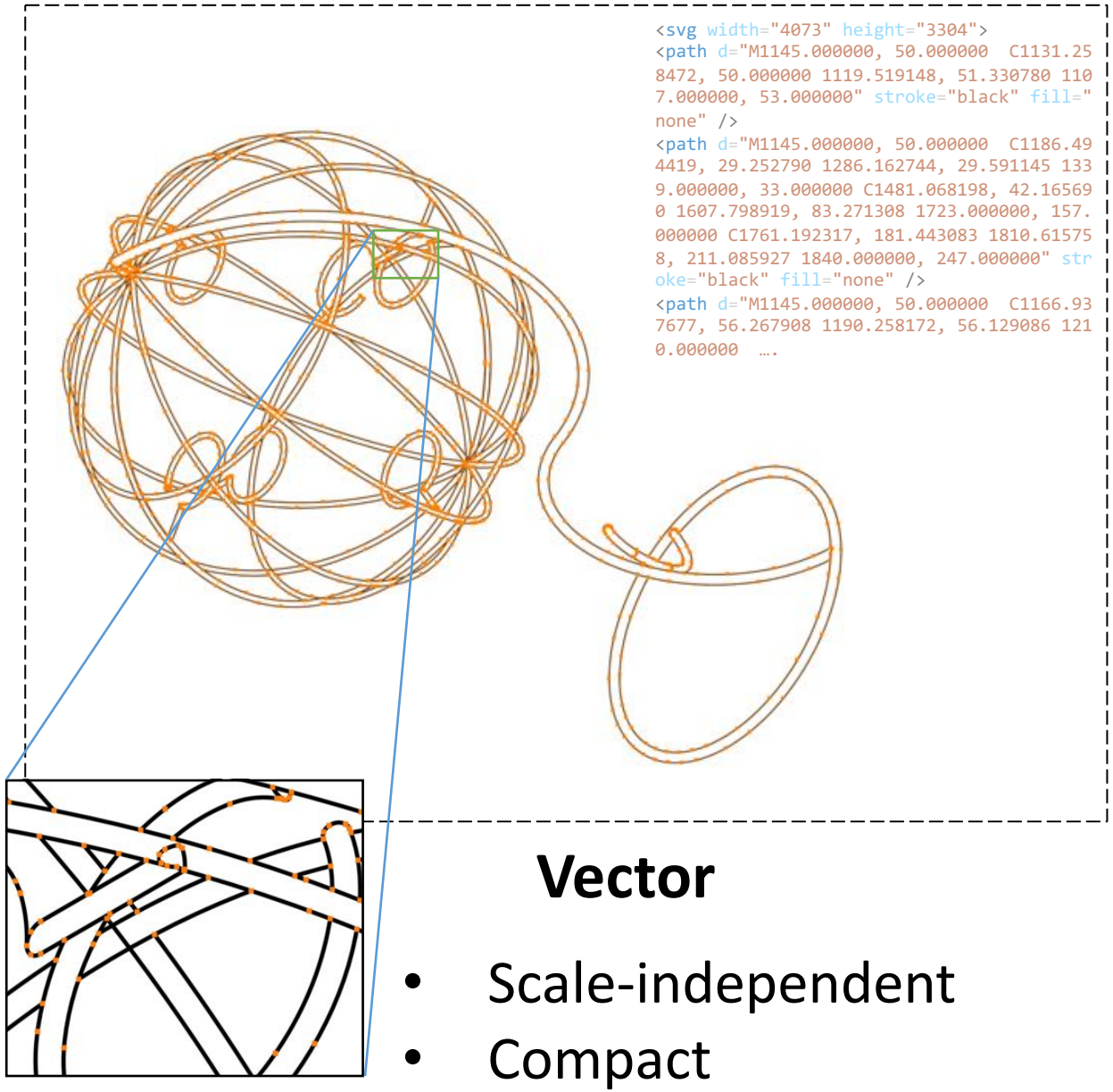








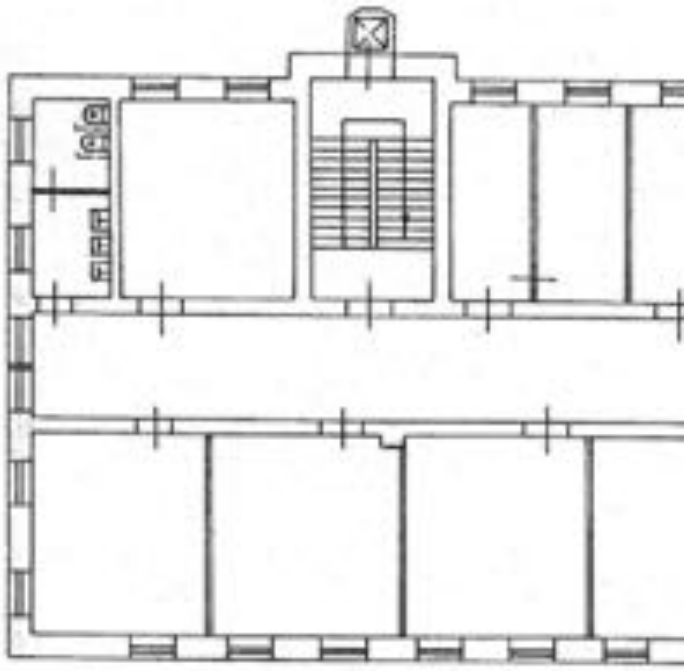
Raster



Vector

- Scale-independent
- Compact
- Easy primitive-level editing

Requirements of technical vectorization



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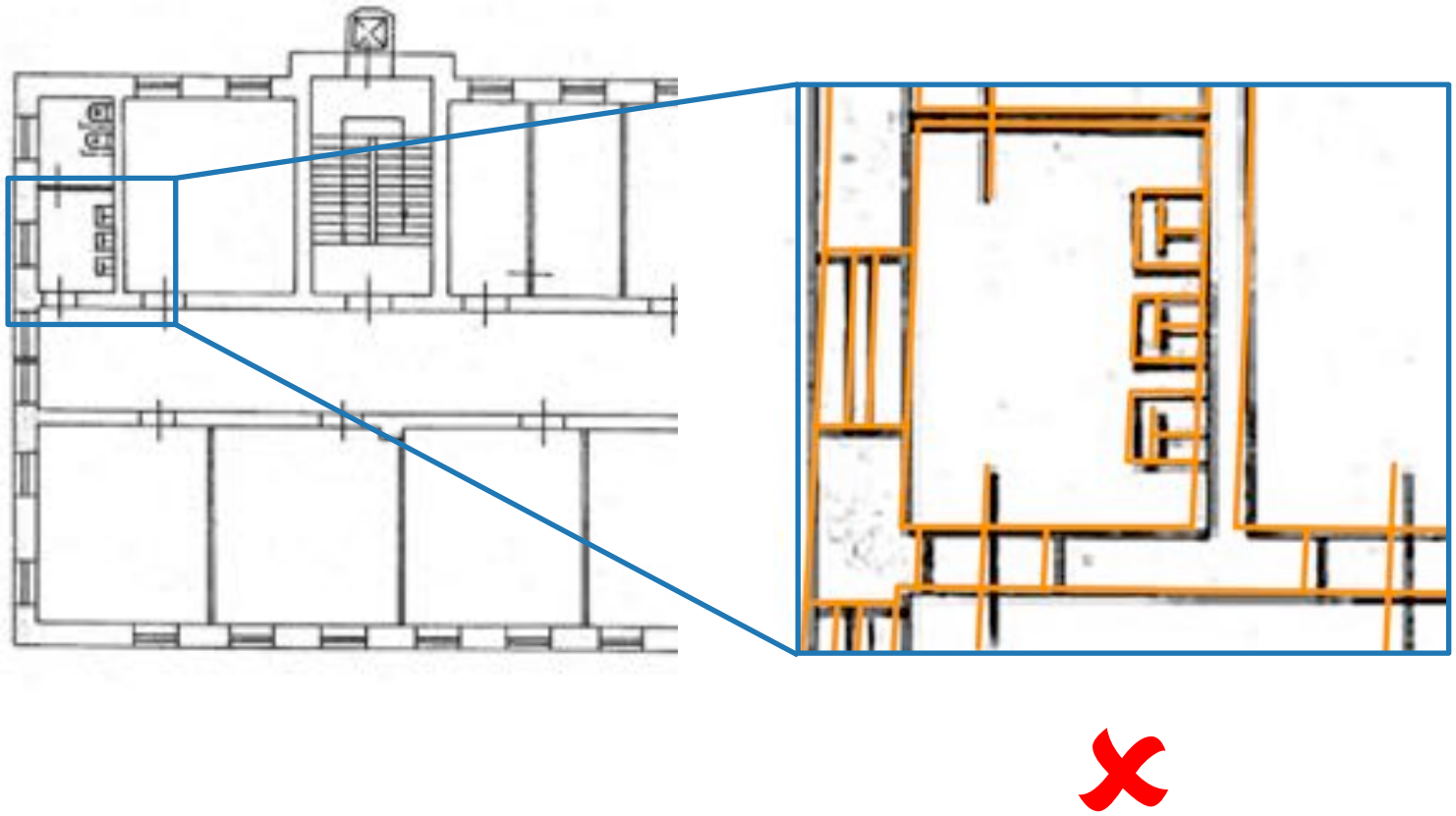
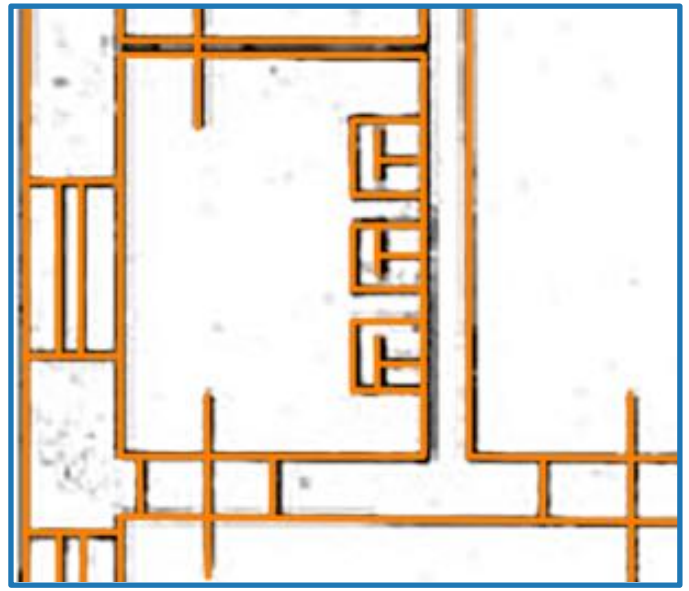
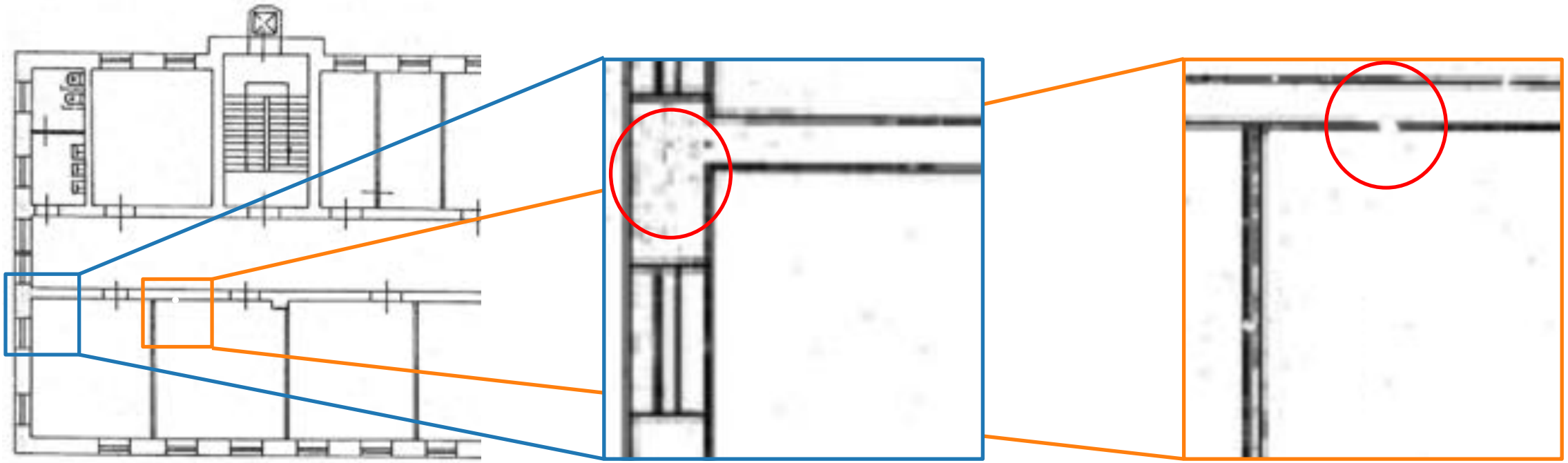




- Exact representation
- No noise in output
- Minimal number of primitives

Requirements of technical vectorization



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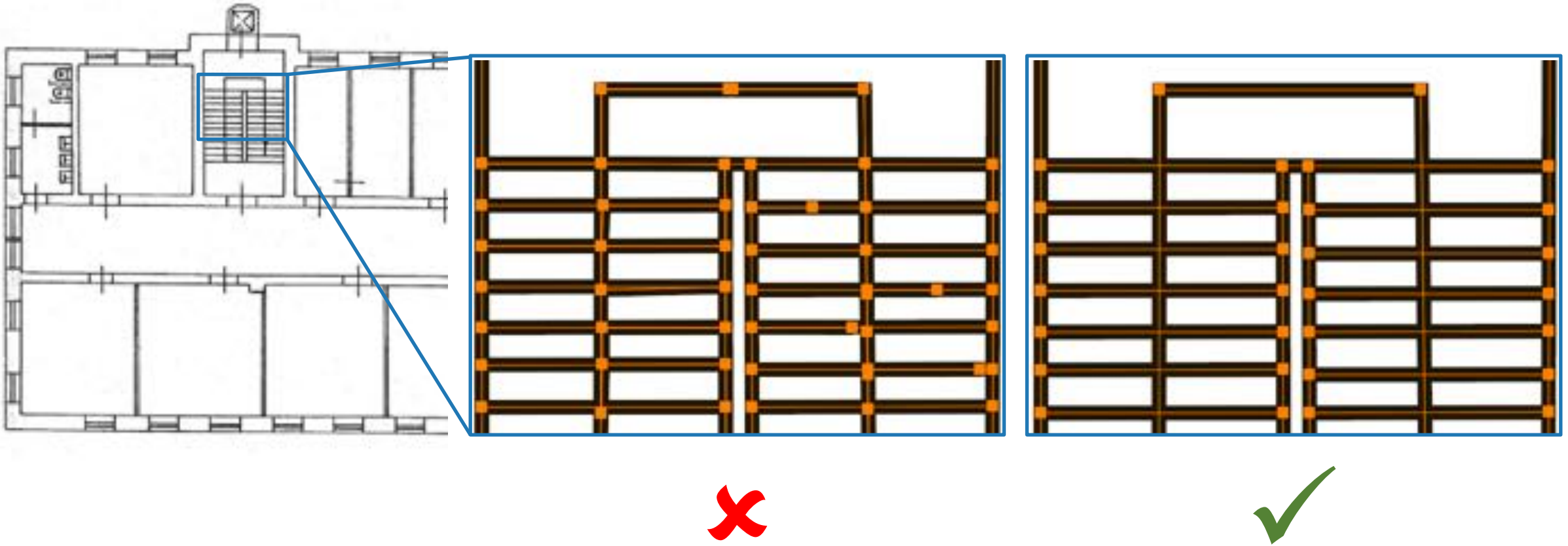

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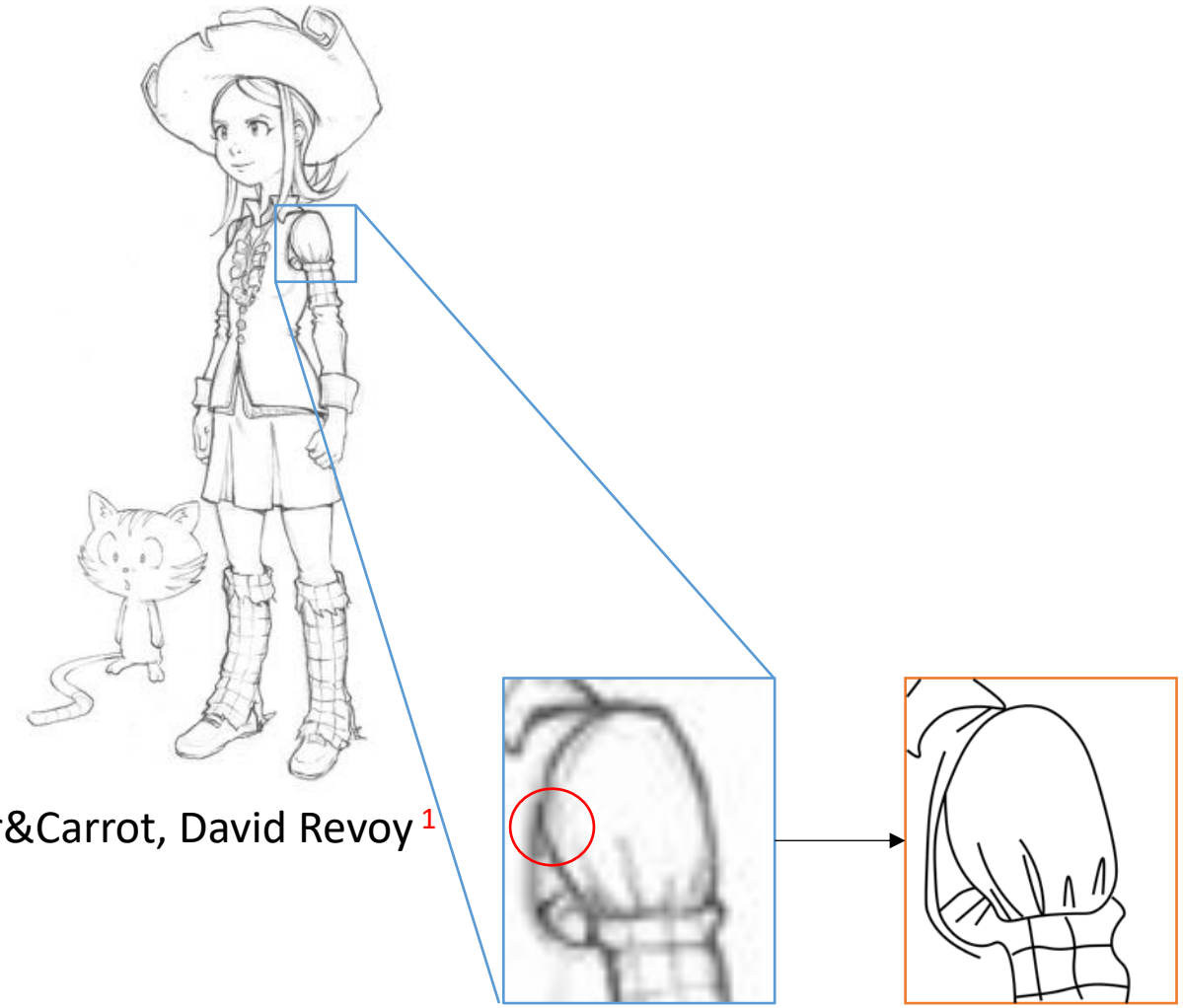
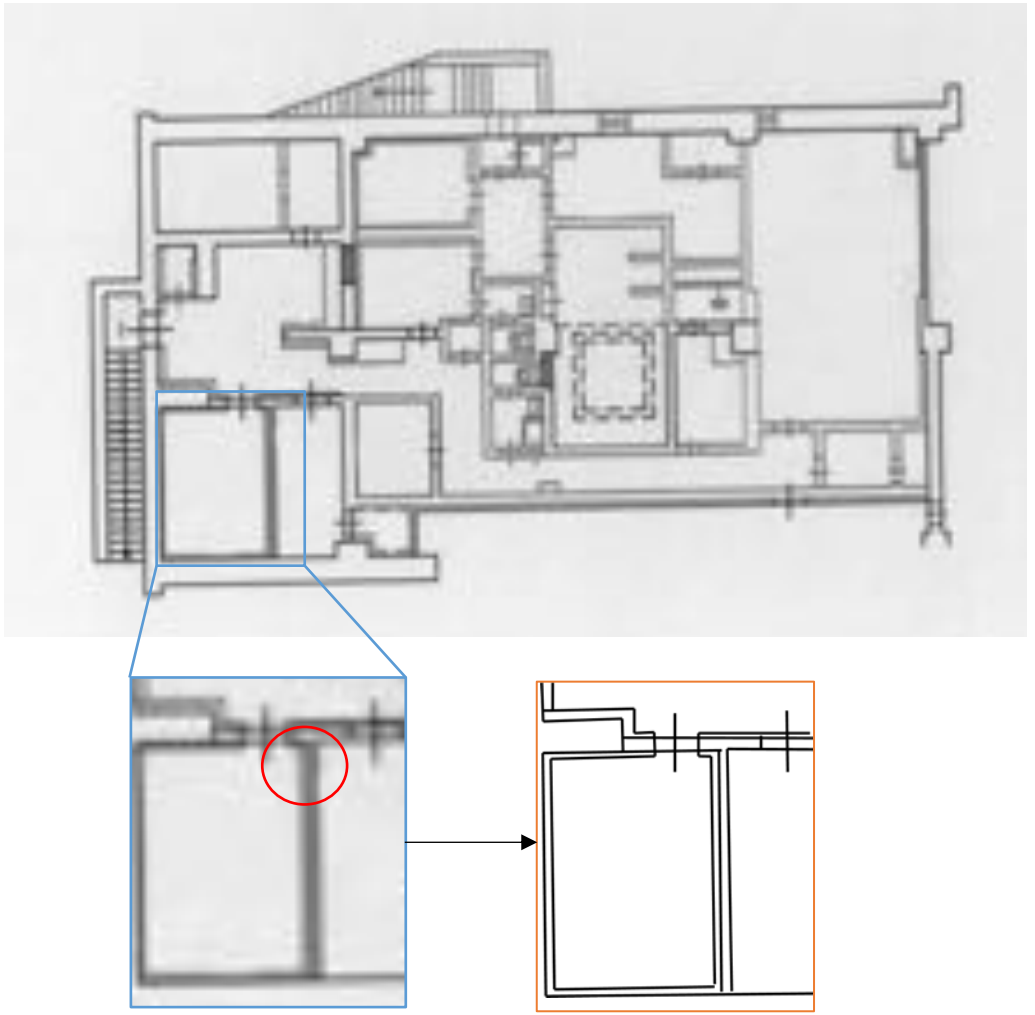
Intro3:

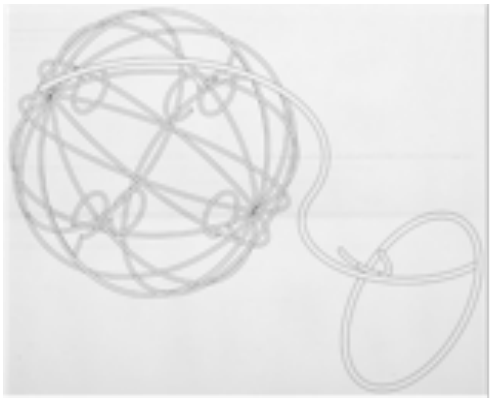


Pepper&Carrot, David Revoy [1]

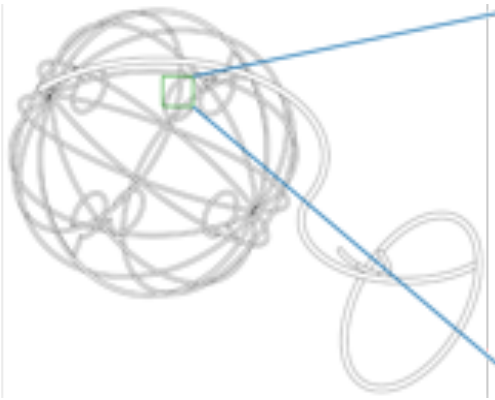


[1] www.peppercarrot.com

Overview



Input raster image



Noise removal, contrast adjustment, hole inpainting

Estimation of primitives

Refinement of primitives

Merging of patches

Requirements of technical vectorization

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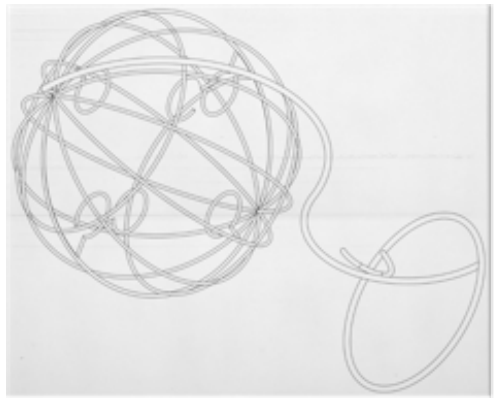

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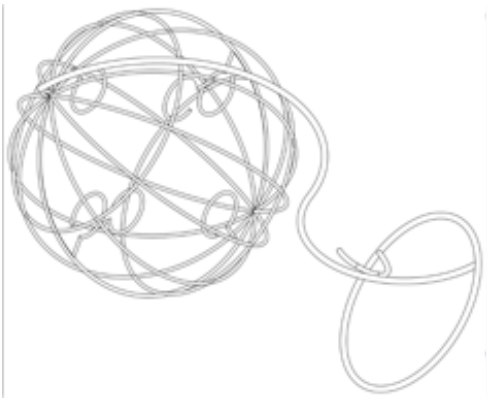

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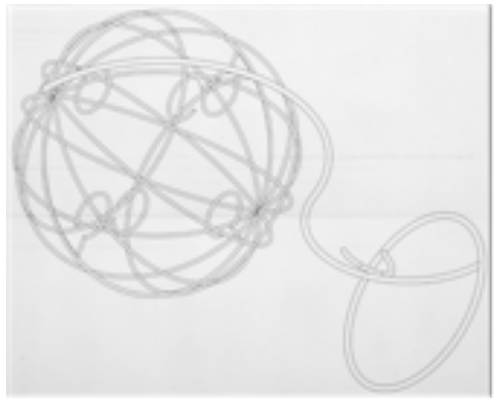

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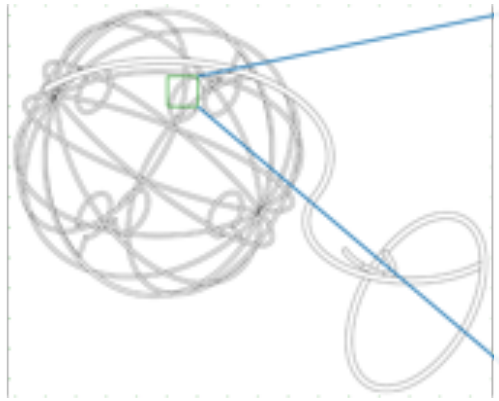

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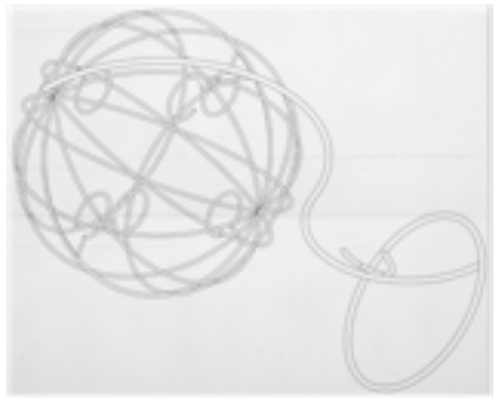
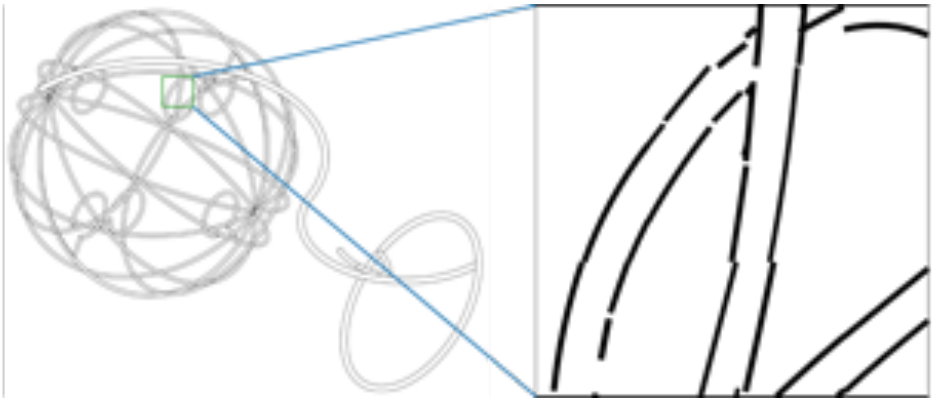


Input raster image



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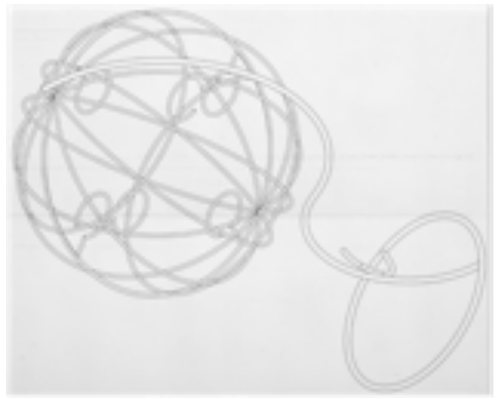
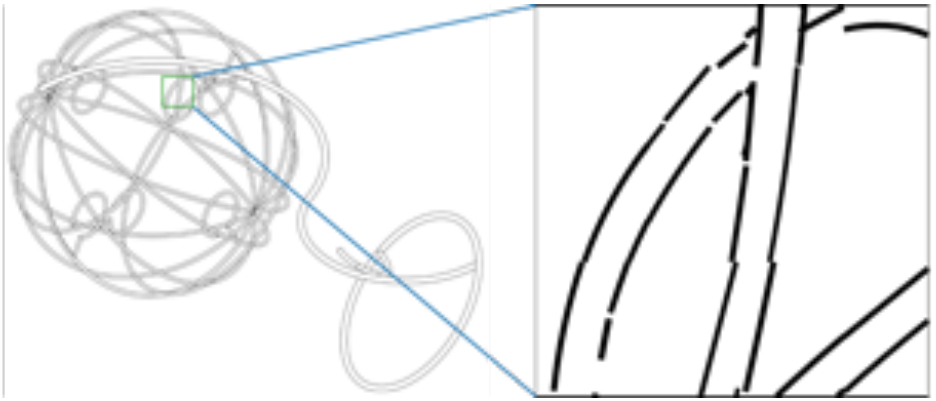


Input raster image



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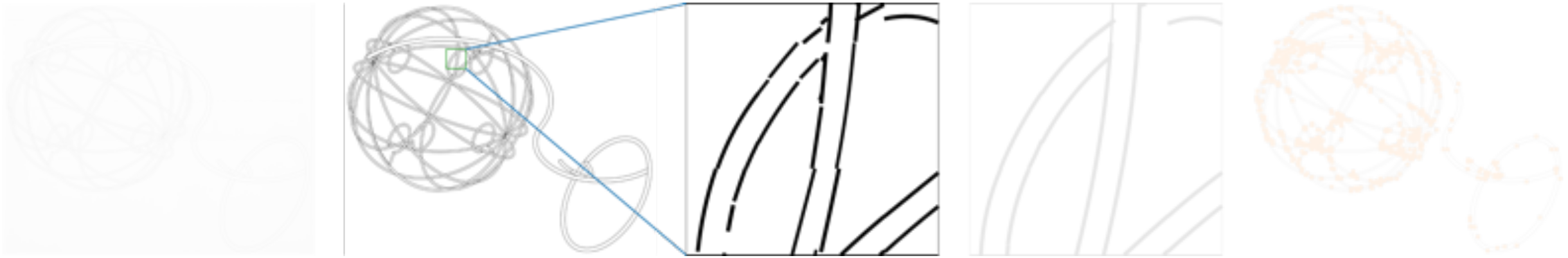

Input raster image

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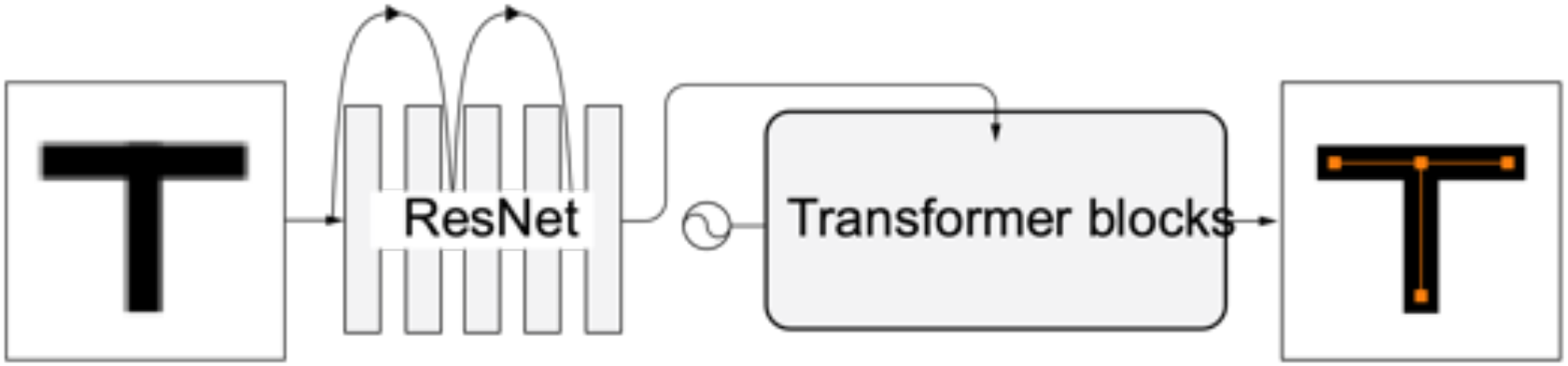
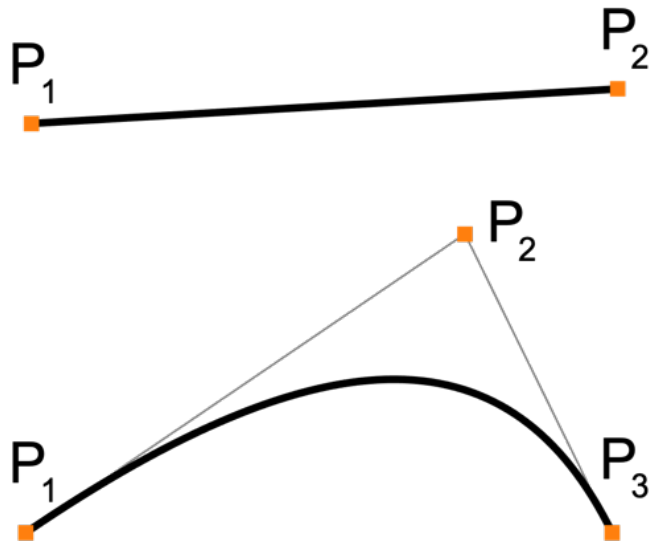
Estimation of primitives

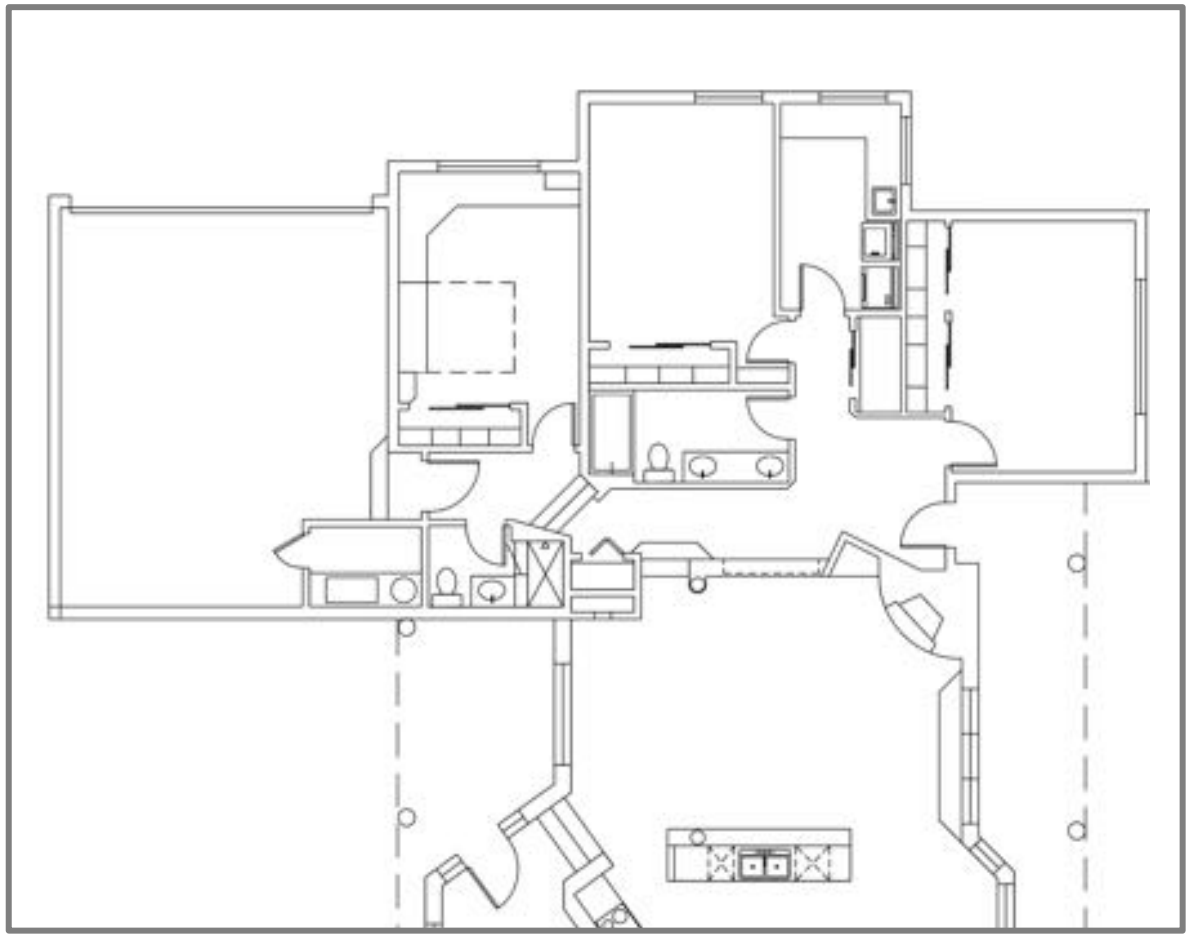



```
Primitive {
    control_point_1_x;
    control_point_1_y;
    ...
    control_point_k_y;
    width;
    confidence;
}
```

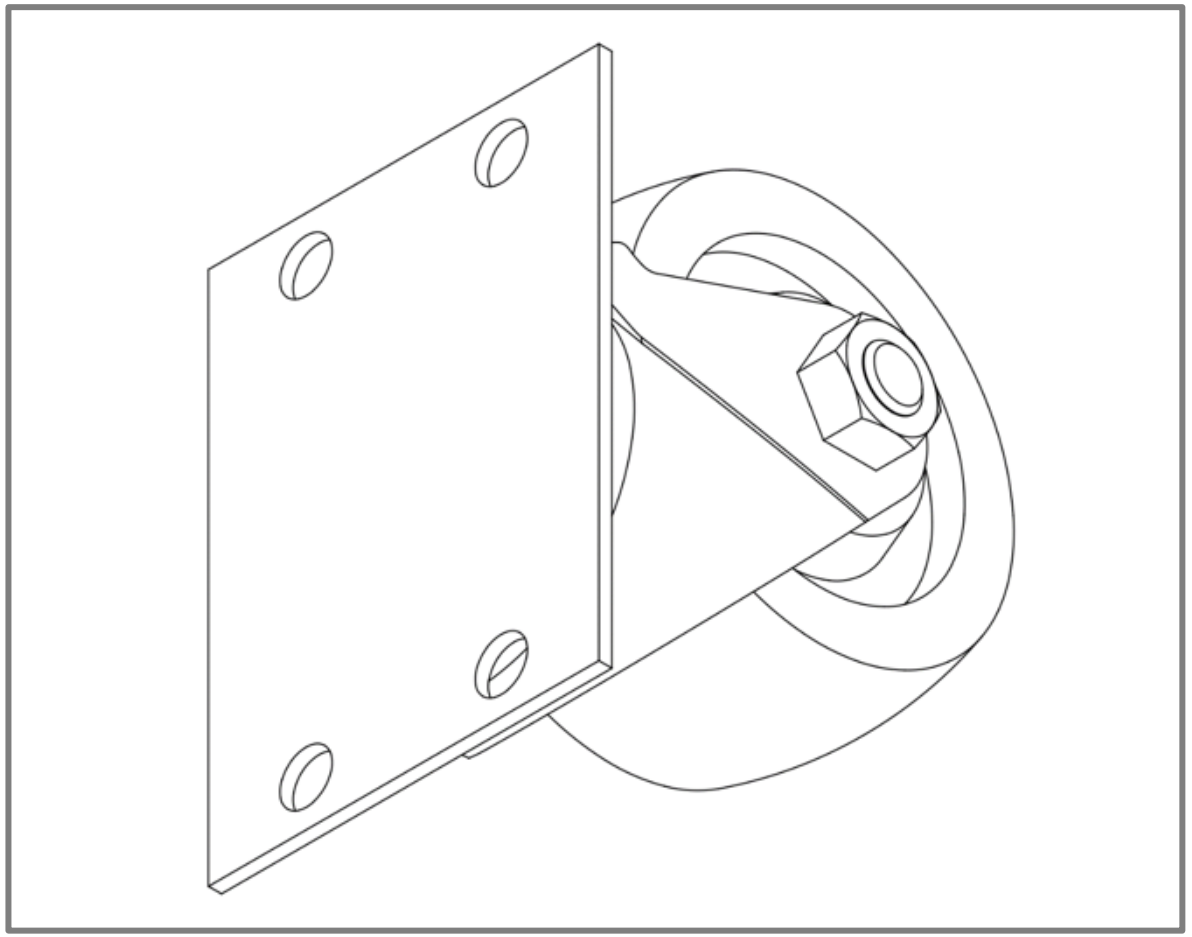
- Operation on patches for increased efficiency and robustness
- Learning for automatic optimal representation
- Attention to leverage sparsity of line drawings



Datasets:

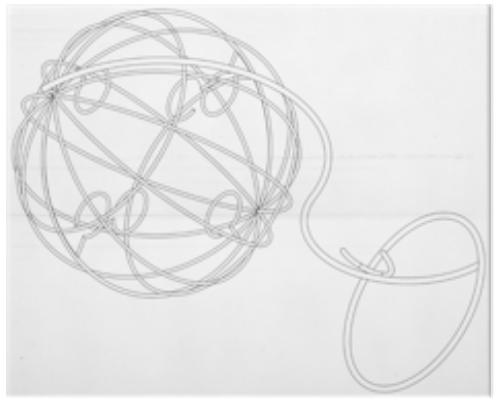


1.5k real-world floorplans [1]



10k mechanical drawings

[1] http://precisionfloorplan.com



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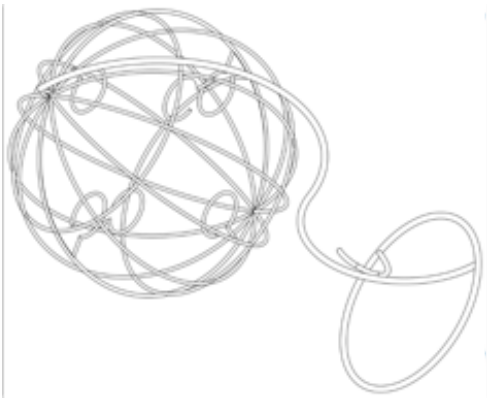

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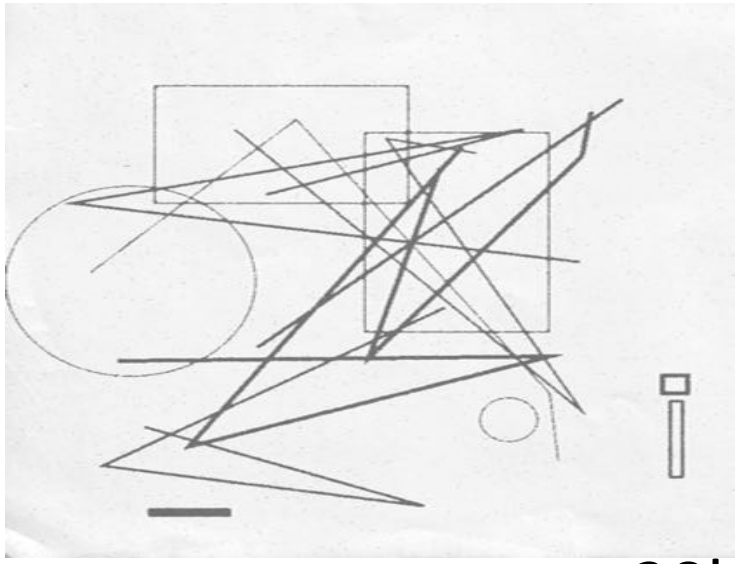
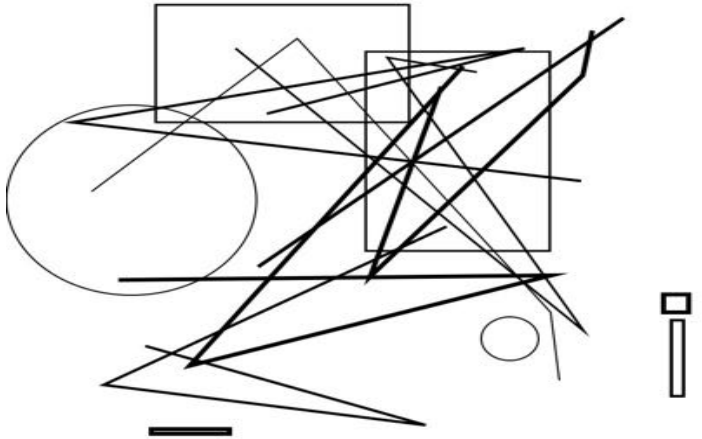
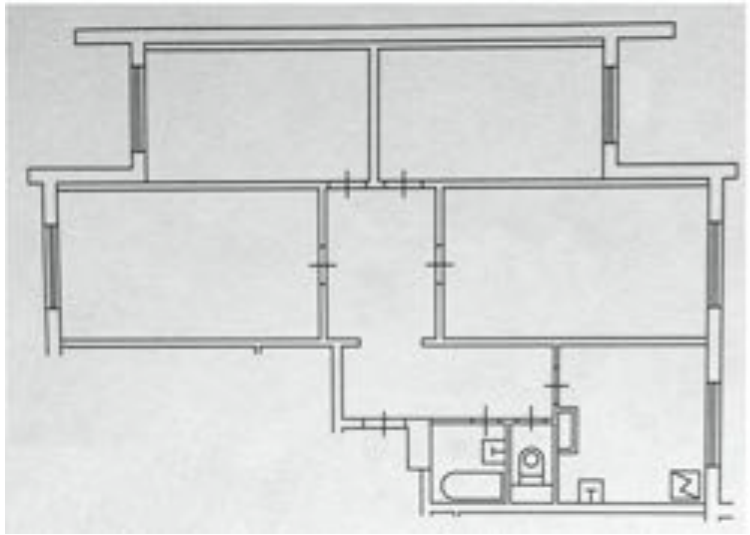
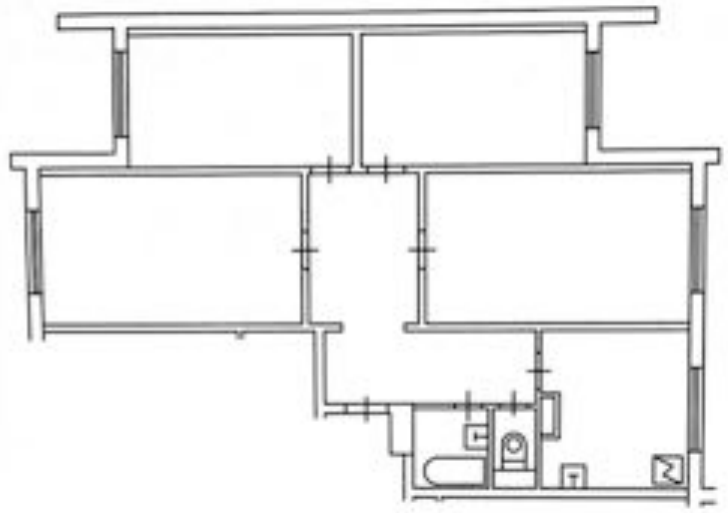
Cleaning:



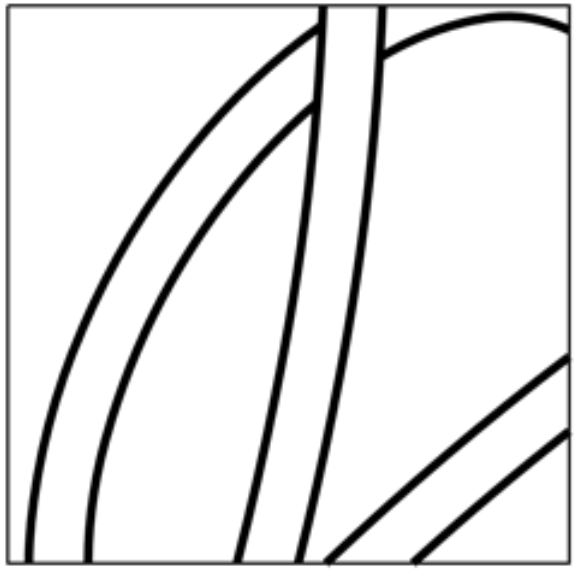


20k synthetic images





66 real-world floorplans



Input raster

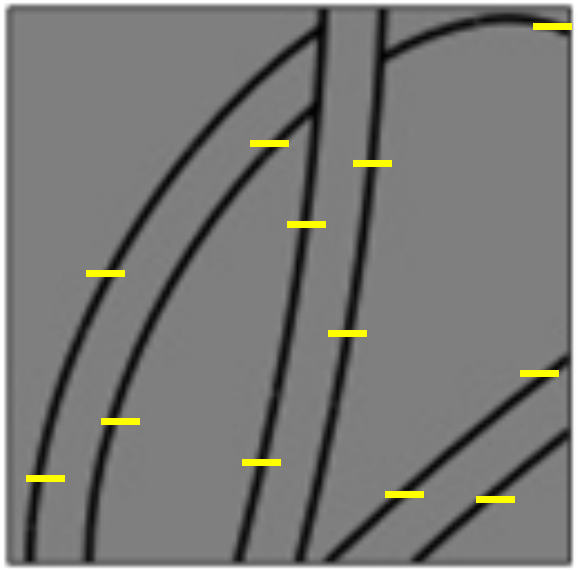
Model output

Input raster

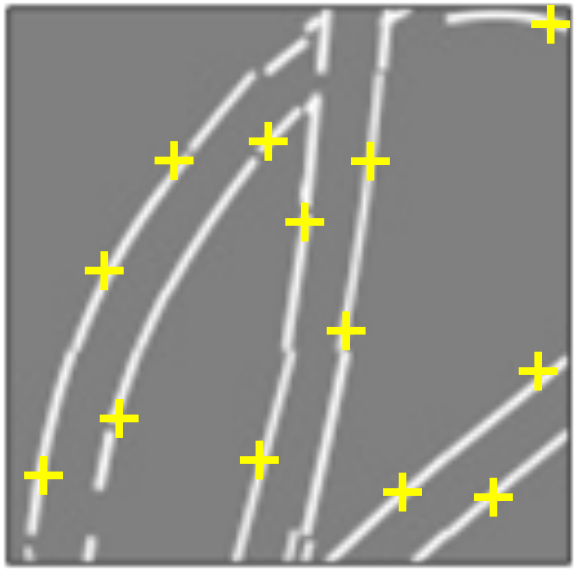
Model output

…

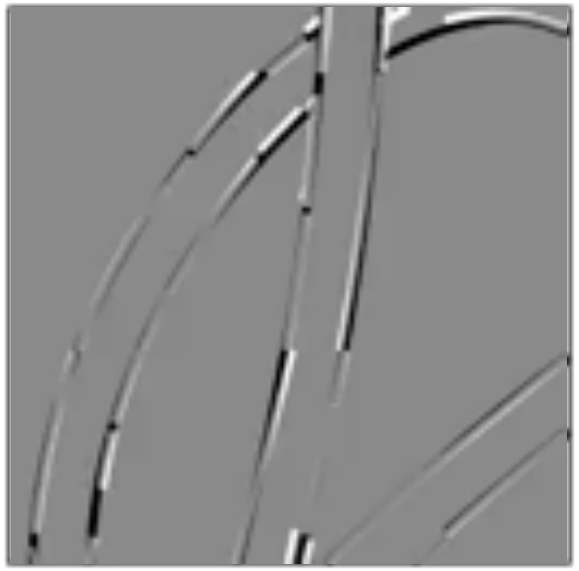
Refined



Input raster



Model output

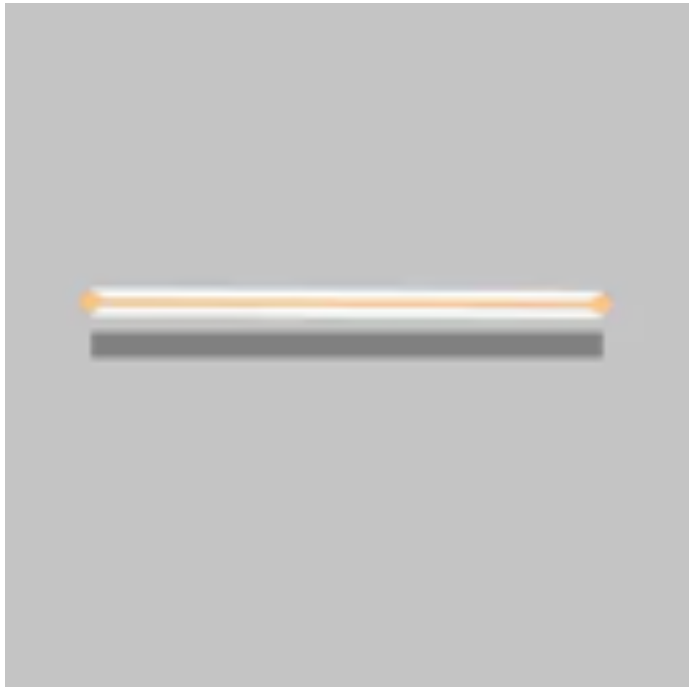


…

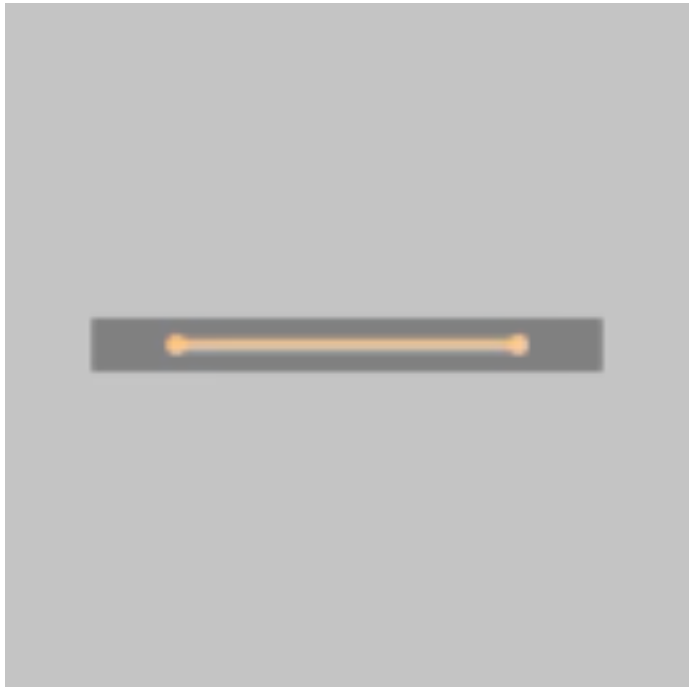
Refined

Refinement of primitives

$$E\,(\text{estimated primitives}, \text{input raster}) \longrightarrow \min$$



Refinement of position



Refinement of size

Correction of overlaps

NN
54%/ 11px
0.9px/ 109

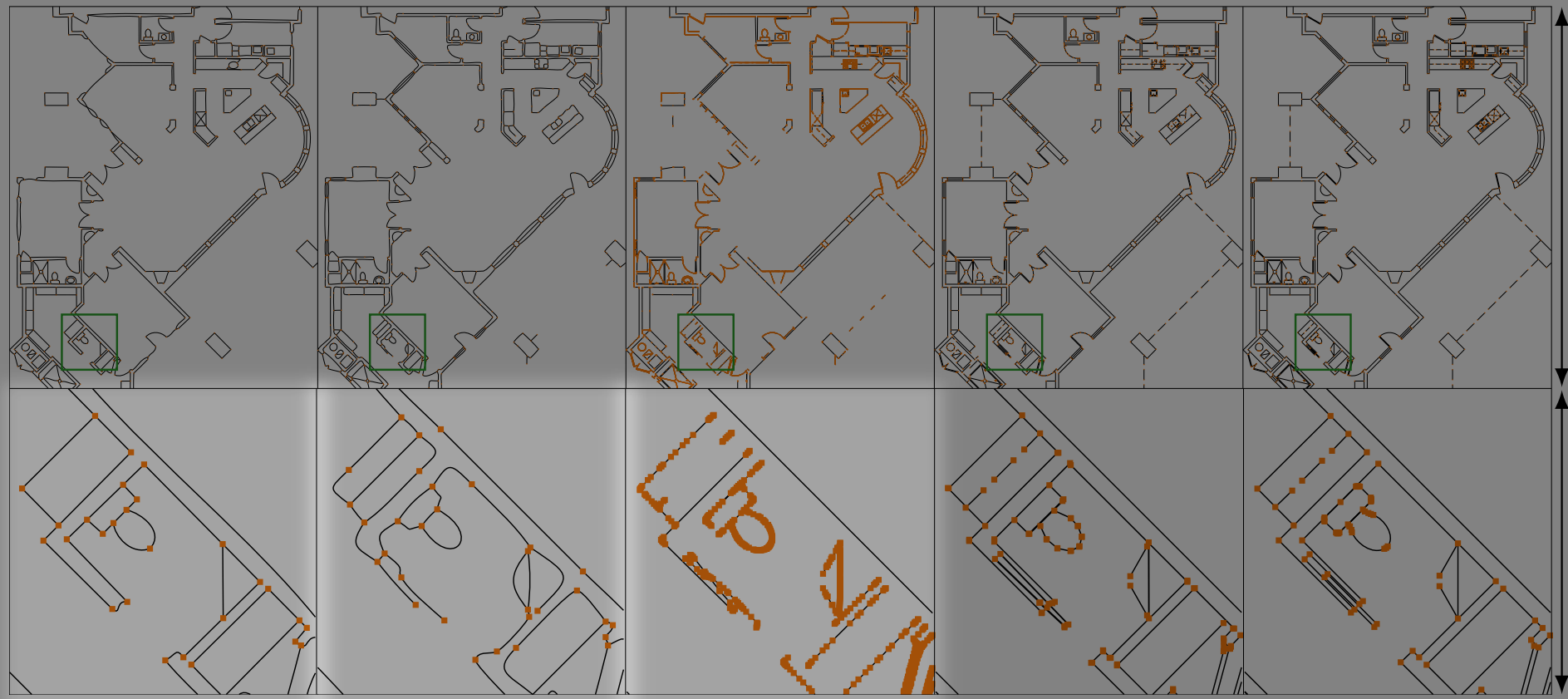
NN + Refinement
93%/ **5px**
0.2px/ 69

Full
67%/ **5px**
0.5px/ **25**

Ground truth,
#P 57

IoU / max error d_H
avg error d_M / num of primitives #P

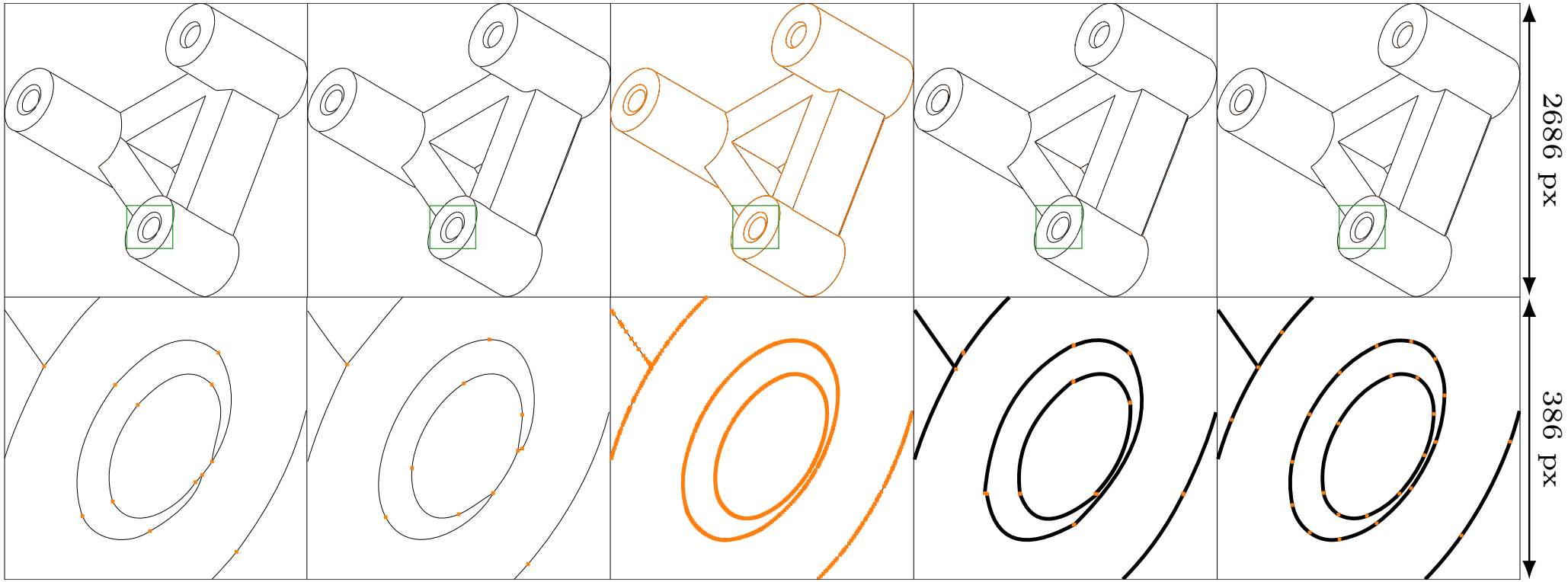
Comparisons



Favreau et al. 16	Donati et al. 19	Bessmeltsev and Solomon. 19	Our method	Ground truth
29% / 415px	21% / 215px	64% / 140px	**89%** / **28px**	
4.2px / 615	1.9px / 1192	0.9px / 35k	**0.2px** / 1286	#P 1634

	IoU,%	d_H, px	d_M, px	#P
Favreau et al. 16	31	381	2.8	696
Donati et al. 19	22	214	2.1	1214
Bessmeltsev and Solomon. 19	60	204	1.5	38k
Our method	**88**	**25**	**0.2**	1331

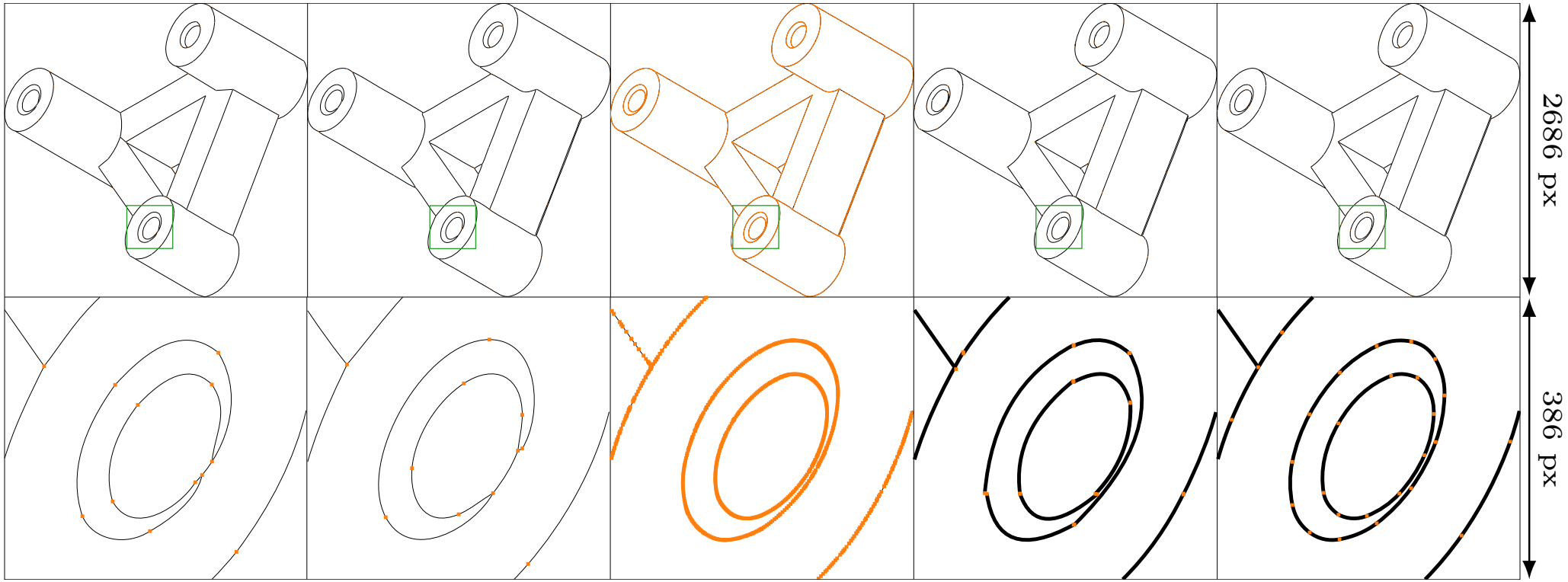
IoU / max error d_H
avg error d_M / num of primitives #P



Favreau et al. 16	Donati et al. 19	Bessmeltsev and Solomon. 19	Our method	Ground truth
67%/ 32px 1.1px/ 79	67%/ 7px 1.0px/ 108	95%/ 4px 0.2px/ 9.5k	86%/ 5px 0.4px/ 139	#P 139

	IoU,%	d_H, px	d_M, px	#P
Favreau et al. 16	65	38	1.7	63
Donati et al. 19	60	**9**	1	109
Our method	**77**	19	**0.6**	97

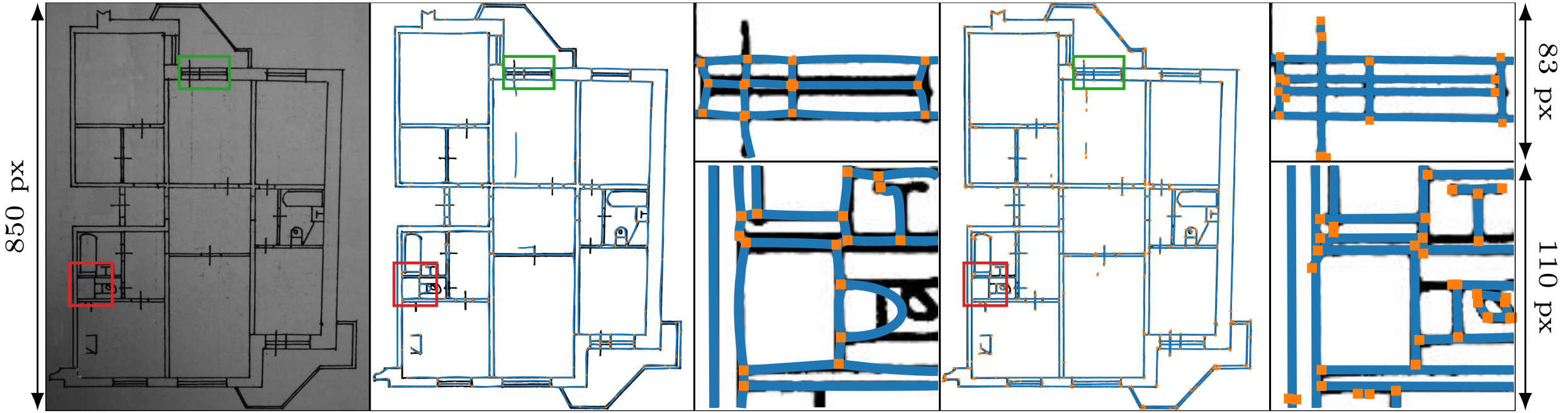
IoU / max error d_H
avg error d_M / num of primitives #P



Favreau et al. 16	Donati et al. 19	Bessmeltsev and Solomon. 19	Our method	Ground truth
67%/ 32px 1.1px/ 79	67%/ 7px 1.0px/ 108	95%/ 4px 0.2px/ 9.5k	86%/ 5px 0.4px/ 139	#P 139

	IoU,%	d_H, px	d_M, px	#P
Favreau et al. 16	65	38	1.7	63
Donati et al. 19	60	**9**	1	109
Bessmeltsev and Solomon. 19	89	17	0.7	7818
Our method	77	19	0.6	97
w/o final merging	**91**	19	**0.3**	240

IoU / max error d_H
avg error d_M / num of primitives #P



Input image Donati et al. 19, 52% / 349 Our method, **78%** / 368

	IoU,%	#P
Donati et al. 19	47	329
Our method	**82**	452