REXplore: A Sketch based Interactive Explorer for Real Estates using Building Floor Plan Images

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MOTIVATION:

❖ Floor Plans are complex technical drawings.
❖ Heterogeneous in nature.
❖ Requires expert's intervention to interpret.
❖ Customers are need to understand the plan to specify/ understand.
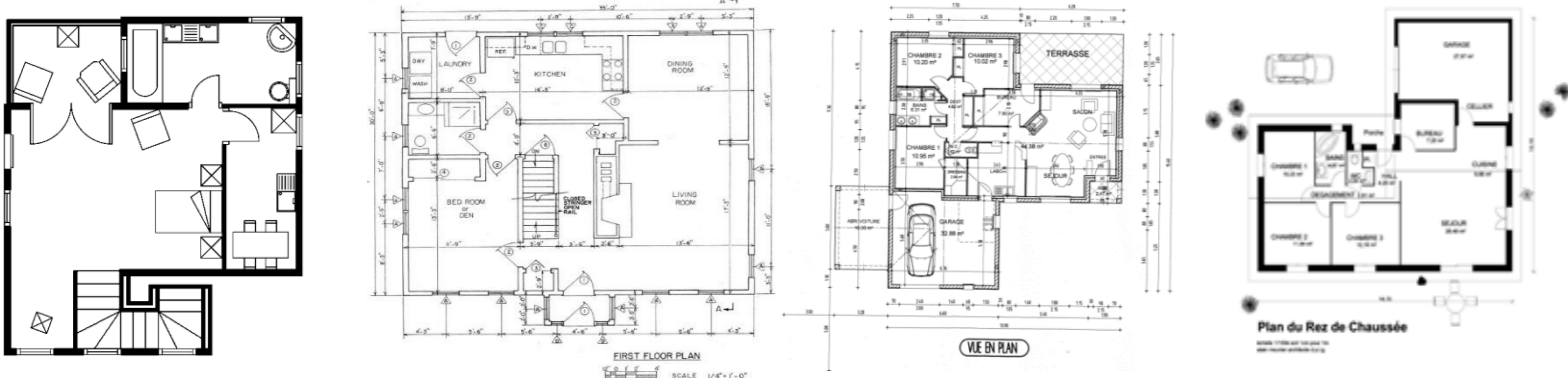
OBJECTIVE:

❖ To provide a novel method for floor plan retrieval.
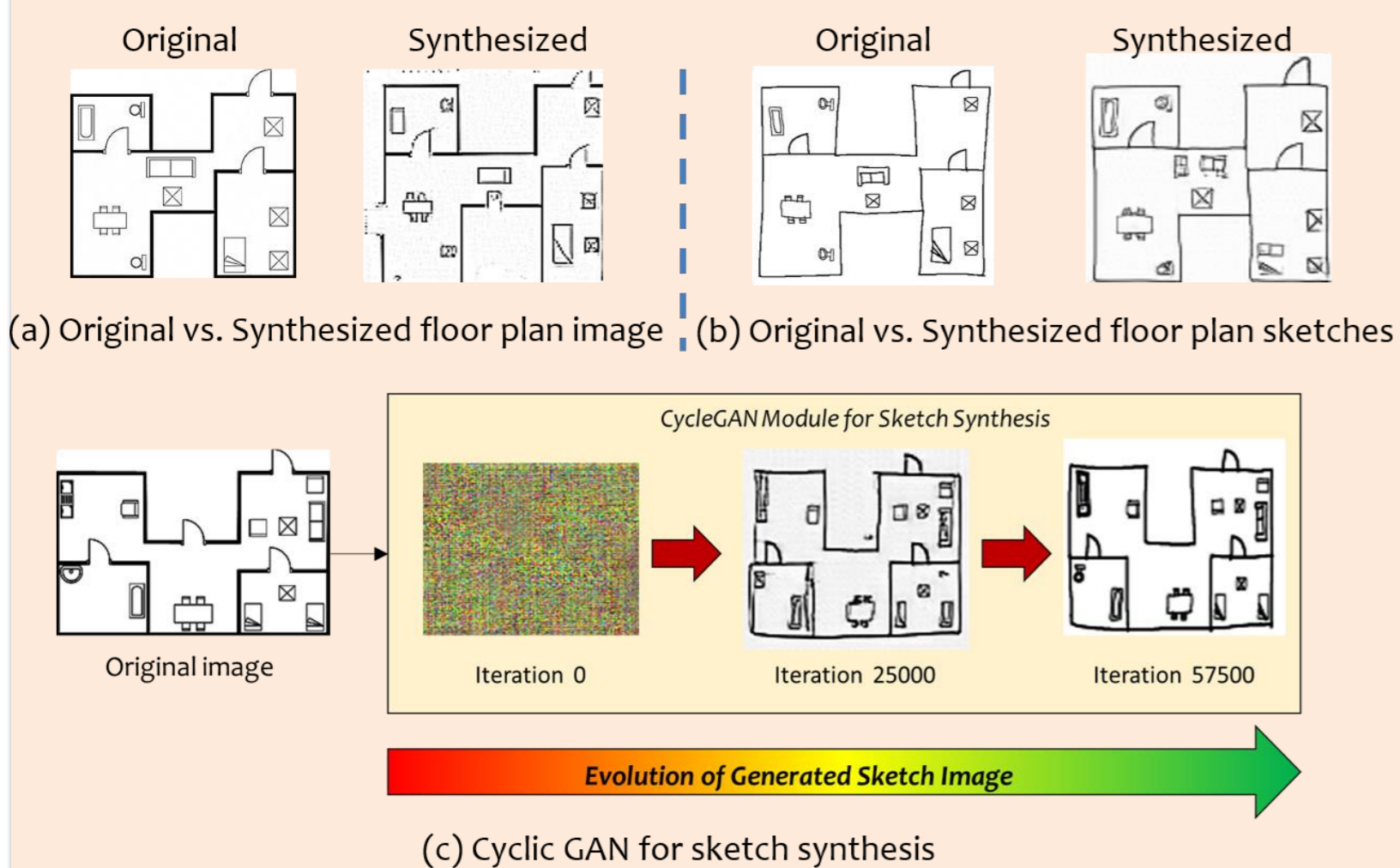❖ Bridge the gap between two domains: hand drawn and printed/ scanned documents .

RESEARCH ISSUES:

❖ To provide a novel method for text extraction from the floor plan images.
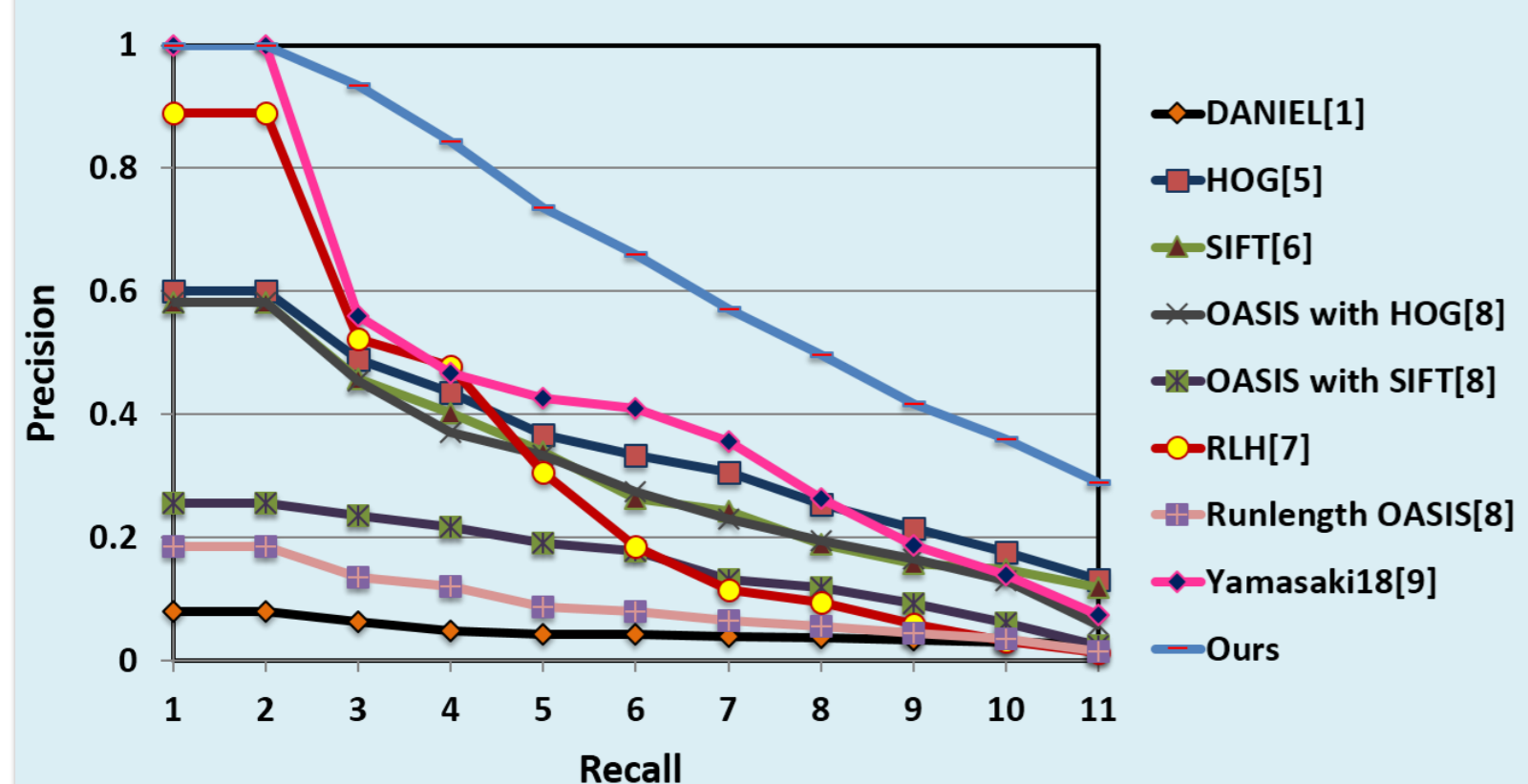❖ Provide a novel framework for generating a textual description out of a given floor plan image.

KNOWN RESULTS:

❖ **Markus et al. (ICFHR 2010):** Hand crafted features, symbol spotting, sketched symbols
❖ **Ahmed et al. (PRL 2014):** Sketch based interface, graph based matching, automatic analysis
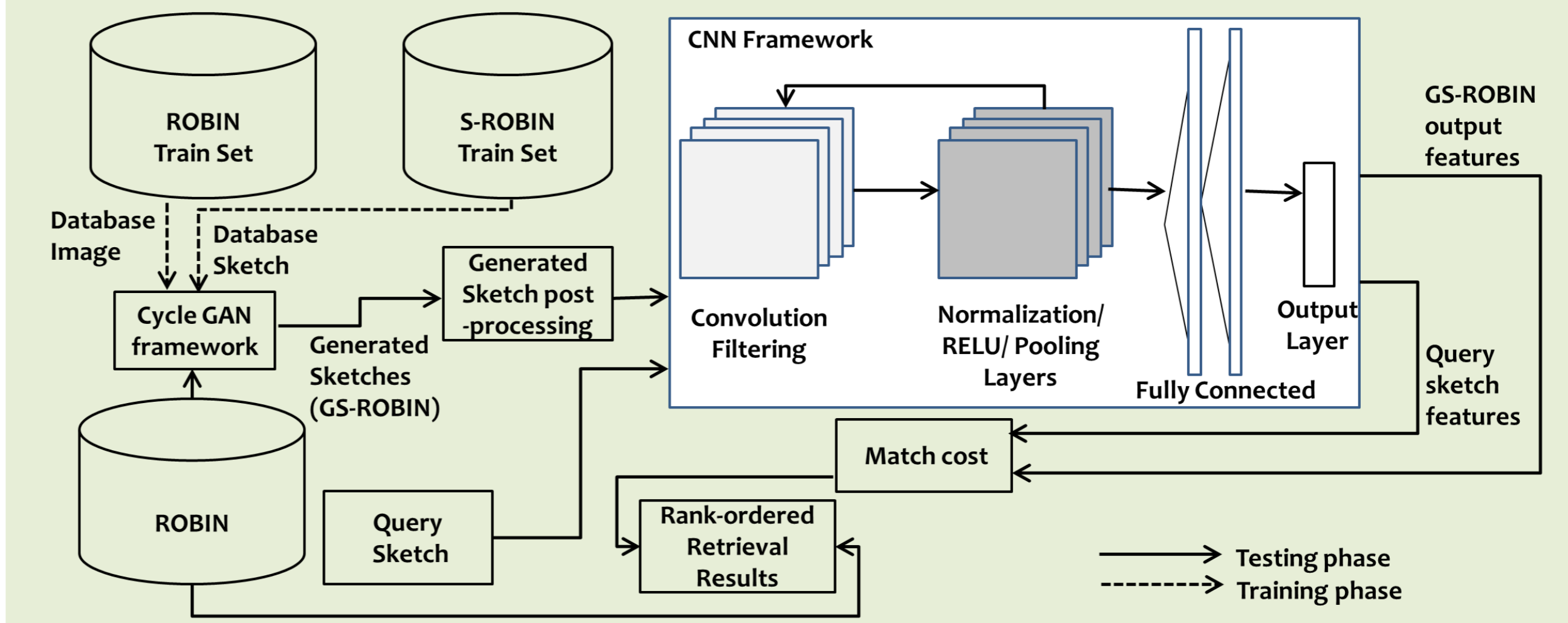❖ **Sharma et al. (ICDAR 2017):** CNN, Floor plan images, First deep learning framework.
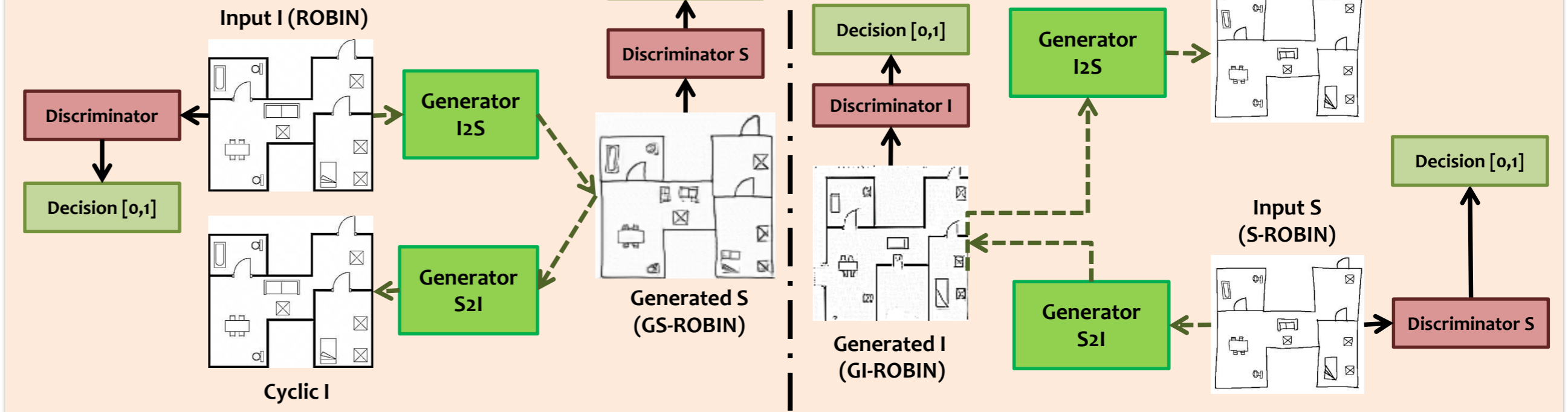
SAMPLE GENERATION:

Original   Synthesized   Original   Synthesized

(a) Original vs. Synthesized floor plan image   (b) Original vs. Synthesized floor plan sketches

CycleGAN Module for Sketch Synthesis

Original image   Iteration 0   Iteration 25000   Iteration 57500

Evolution of Generated Sketch Image

(c) Cyclic GAN for sketch synthesis

PERFORMANCE COMPARISON:

- DANIEL[1]
- HOG[5]
- SIFT[6]
- OASIS with HOG[8]
- OASIS with SIFT[8]
- RLH[7]
- Runlength OASIS[8]
- Yamasaki18[9]
- Ours

(axes: Precision vs Recall)

FRAMEWORK:

ROBIN Train Set   S-ROBIN Train Set

CNN Framework

Database Image   Database Sketch

Cycle GAN framework → Generated Sketches (GS-ROBIN) → Generated Sketch post-processing

Convolution Filtering   Normalization/ RELU/ Pooling Layers   Fully Connected   Output Layer

GS-ROBIN output features

Query sketch features

ROBIN   Query Sketch   Match cost   Rank-ordered Retrieval Results

→ Testing phase
⇢ Training phase

NETWORK DIAGRAM

Input I (ROBIN)   Discriminator   Decision [0,1]   Generator I2S   Decision [0,1]   Discriminator S   Generator I2S   Cyclic S

Generated S (GS-ROBIN)   Generator S2I   Cyclic I

Decision [0,1]   Discriminator I   Generated I (GI-ROBIN)   Generator S2I   Input S (S-ROBIN)   Discriminator S   Decision [0,1]

FORMULATION:

- **Adversarial loss** for mapping floor plan sketch to image:

$$S2I_A(G, D_I, S, I) = E_{f_I \to p(f_I)}[\log D_I(f_I)] + E_{f_s \to p(fs)}[\log(1 - D_I(F(f_s)))]$$

Discriminator function

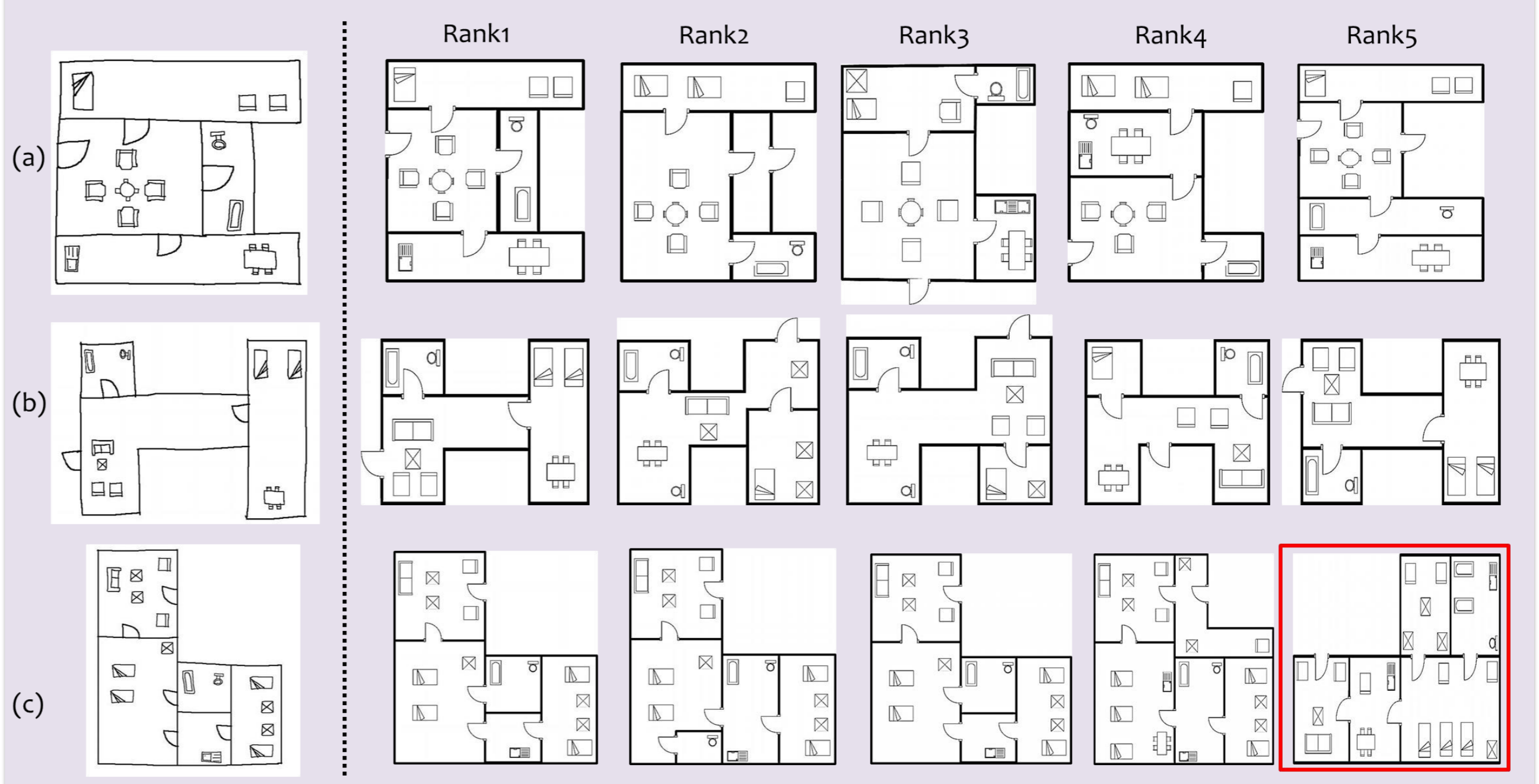- **Adversarial loss for mapping floor plan image to sketch:**

$$I2S_A(F, D_s, I, S) = E_{f_s \to p(f_s)}[\log D_S(f_S)] + E_{f_I \to p(f_I)}[\log(1 - D_S(F(f_I)))]$$

- **Objective function:**

$$X(G, F, D_I, D_S) = I2S_A(F, D_s, I, S) + S2I_A(G, D_I, S, I) + \alpha CCL(G, F)$$

Cycle Consistency Loss

RETRIEVAL RESULTS:

Rank1   Rank2   Rank3   Rank4   Rank5

(a)

(b)

(c)

CONCLUSIONS:

❖ A deep learning framework using GAN model for sketch based retrieval of building floor plan images.
❖ Achieve an average precision value of 0.63 upon experimenting real world floor plan images.
❖ Future work: Partial/abstract floor plan specifications.