

Image-based Table Cell Detection: a Novel Table Structure Decomposition Method with New Dataset

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Two main tasks and our contributions

- 1. How to annotate table cell efficiently or even automatically?
 - TableCell dataset:
- 2. How to improve table cell and structure decomposition?
 - Table Projection Module

Task 1: Table cell annotation

Table-wise to Cell-wise annotations

ATTACHMENT ONE: EVALUATION CRITERIA

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Scored Criteria. In the technical evaluation phase, the State will rate the technical merits of the Proposals based on the following requirements and the weight assigned to each requirement:

| Supplement Two Salesforce Projects In addition to the Mandatory Requirements Scored Criteria pertaining to Supplement Two | | | | | |
|--|--------|---------------|-----------------|-------|---------|
| Scored Criteria | Weight | Does Not Meet | Partially Meets | Meets | Exceeds |
| Offeror or subcontractor must demonstrate capabilities as a Firm in performing Salesforce Based Application Development Projects (Supplement Two, Section 2.1) | 25 | 0 | 2 | 5 | 7 |
| Offeror or subcontractor must demonstrate capabilities to Provide Qualified Personnel and Teams to performing Salesforce Based Application Development Projects (Supplement Two, Section 2.2) | 75 | 0 | 2 | 5 | 7 |
| Offeror or subcontractor development tools, accelerators, methodologies and capabilities designed to produce high-quality, on-time and cost-effective Applications based upon the Salesforce platform (Supplement Two, Section 2.3) | 75 | 0 | 2 | 5 | 7 |
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Raw image

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RFP: Salesforce Managed Service and Projects

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RFP: Salesforce Managed Service and Projects

Raw image

Table-wise annotations

TableBank^[1]

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Raw image

Table-wise annotations
TableBank^[1]

Cell-wise annotations
TableCell(Ours)

[1] M. Li, et al, "Tablebank: Table benchmark for image-based table detection and recognition"

Task 1: Table cell annotation

Label manually?

Cost-ineffective!

The screenshot shows the labelme application window with a document titled "labelme - E:/SJTU/image/raw.jpg". The document contains the following content:

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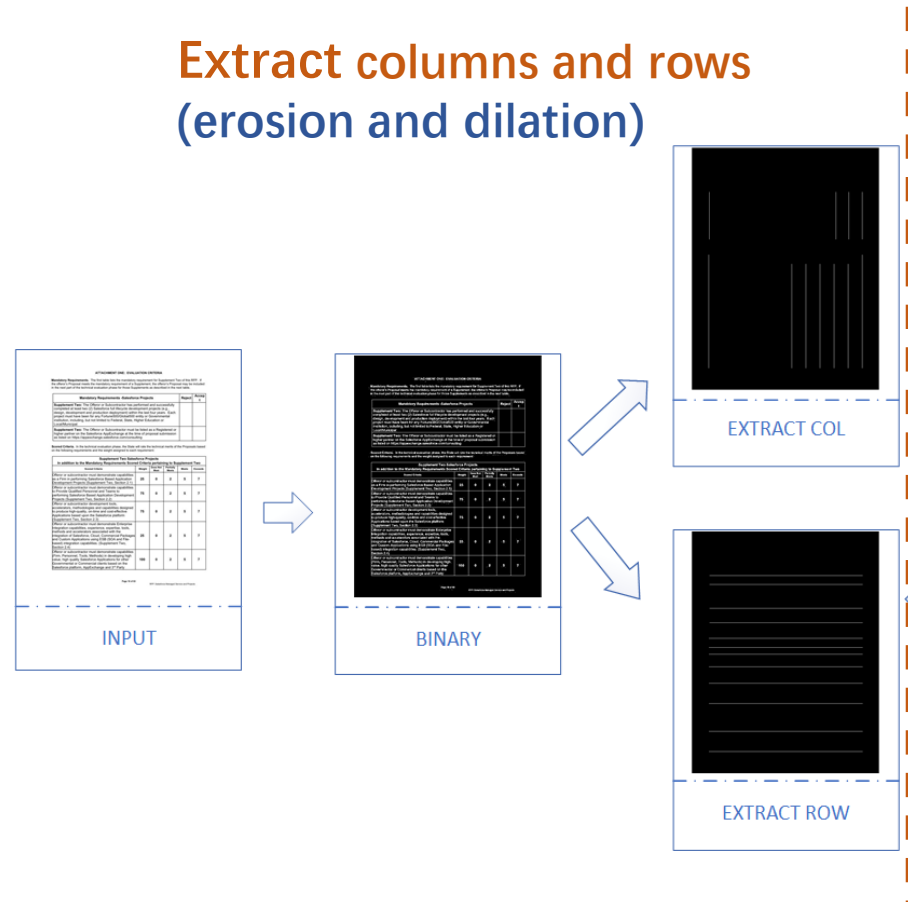
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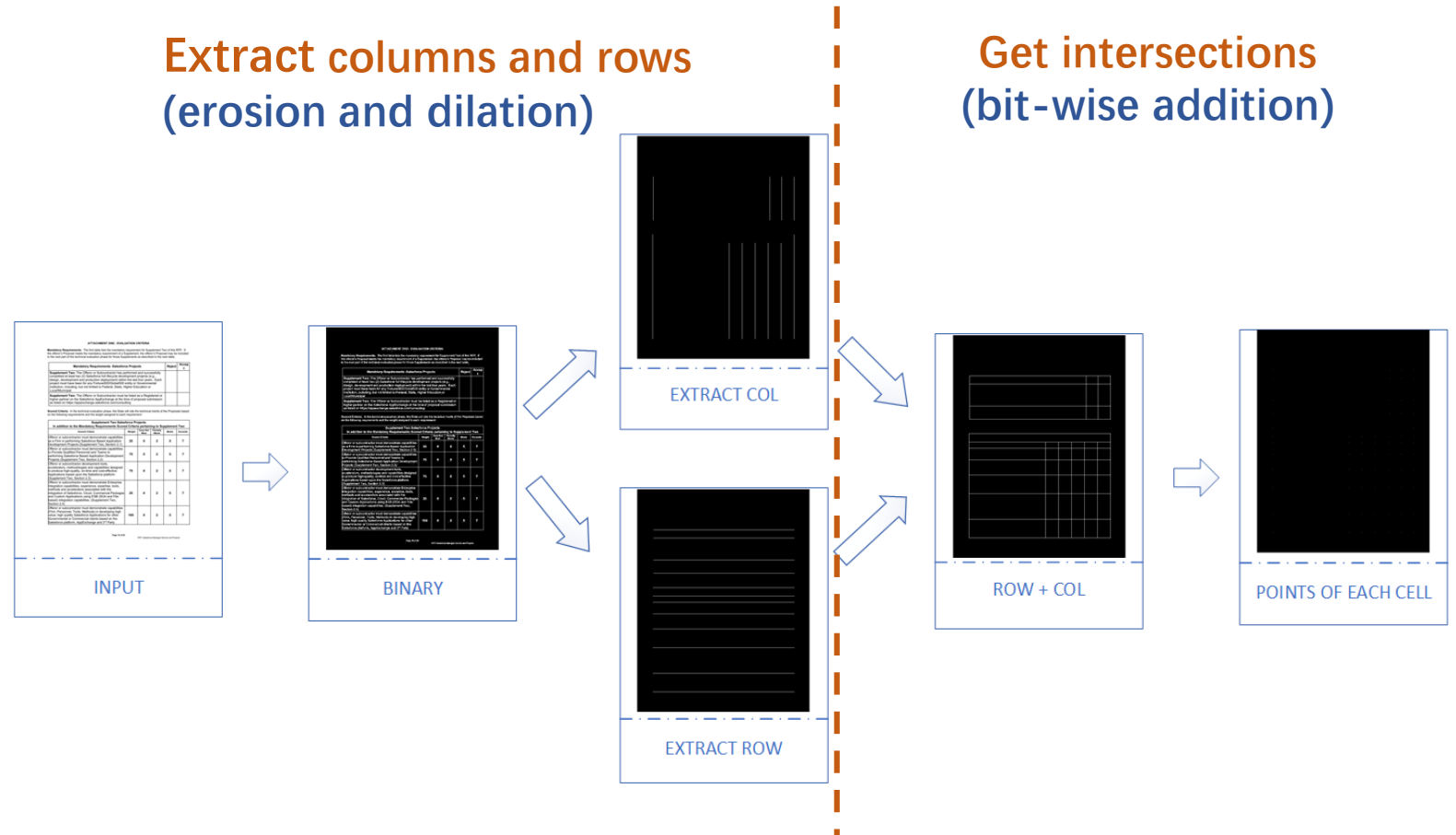
The interface also shows a left sidebar with tools like Open, Open Dir, Next Image, Prev Image, Save, Delete File, Create Polygons, Edit Polygons, Duplicate Polygons, Delete Polygons, Undo, Brightness Contrast, 119 %, Fit Width. On the right, there are panels for "Label List" (containing "cell"), "Polygon Labels" (listing "cell" with checkboxes), and "File List" (listing various image files).

Our methods



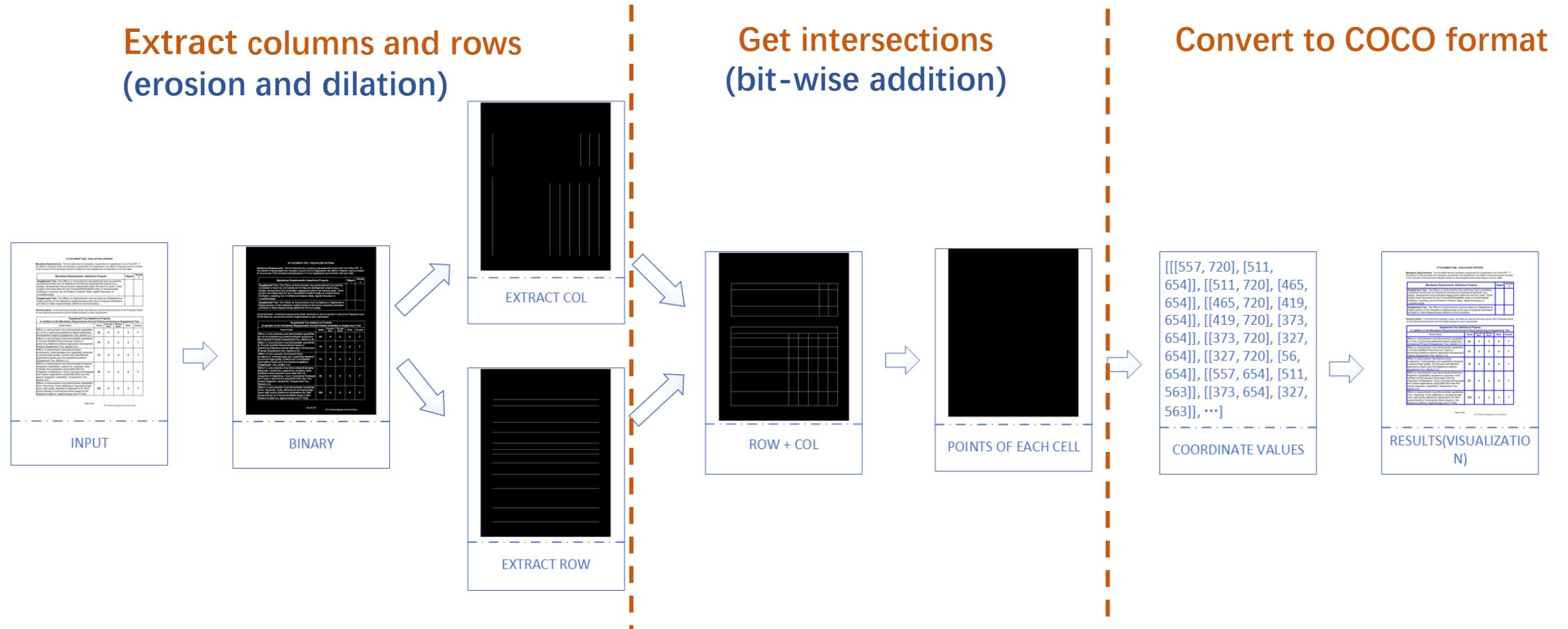
Pipeline of extracting columns and rows automatically using traditional morphological operations including erosion and dilation.

Our methods



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Task 1: Table cell annotation

How about tables with only partial lines?

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INPUT

COL LINES MASK

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2023 Salesforce Design Services and People

ERASE LINES RESULT

Task 1: Table cell annotation

Results

Criteria 2: Strong Leadership
The leaders of a charter school are stewards of the charter's mission and vision and carry out their duties in a professional, responsible and ethical manner. Charter school leaders use their influence and authority for the primary purpose of achieving student success.

| The criteria for judging the quality of Strong Leadership | Quality of element broadly equivalent to the following would be assessed at Level 5 | Quality of element broadly equivalent to the following would be assessed at Level 2 |
|---|---|--|
| 2.1 Effectively communicates and engages stakeholders in the mission and vision of the school | The board and school leadership clearly and effectively communicate the mission, goals, pedagogical approach and education model of the school with all relevant stakeholder groups. Stakeholders are active supporters and communicators of the mission and vision to the school community. The mission and vision of the school is clearly articulated, well-known by school stakeholders, and implemented in daily practice. | Communication regarding the mission and vision with stakeholders is sporadic and/or inconsistent. The school's mission and vision are known and understood by few of the school's stakeholders. |
| 2.2 Generates and sustains a school culture conducive to staff professional growth | The school leadership provides professional development opportunities that advance the effectiveness of teaching and learning and monitors that professional development for impact on school achievement. There is open and clear communication between students, staff, and administration, and teachers are empowered to demonstrate teacher leadership throughout the school, as well as establish goals for professional growth. | Staff development is restricted to individuals with little or no link to meeting overall schoolwide goals or to the performance of students. The types of professional development in which teachers participate are limited and/or not relevant to individual and schoolwide needs. Staff does not set goals for professional growth. |
| 2.3 Treats all individuals with fairness, dignity and respect | School leaders ensure that school policies regarding equal opportunity and unlawful harassment are effectively implemented. There is open communication among the staff and with the leadership team. School stakeholders report that they are treated with fairness, dignity, and respect and that school leadership is working effectively to create an optimal teaching and learning environment. | There are gaps in communication in the school. Policies regarding equal opportunity and unlawful harassment are nonexistent and/or ineffectively implemented. Stakeholders do not feel they have a voice in the school. |

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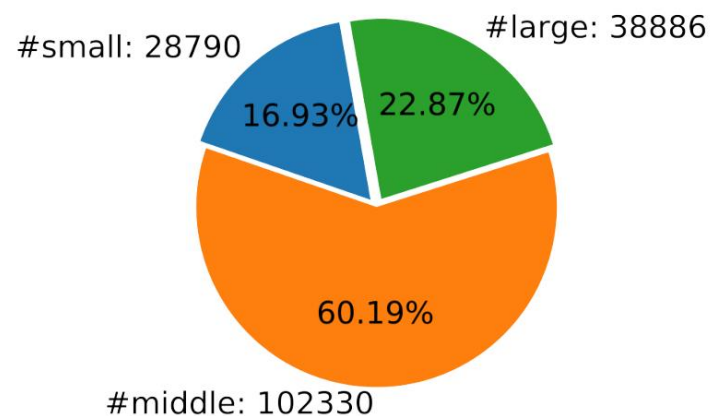


Fig. 4. The proportion and numbers of objects with different size in dataset TableCell. {small, middle, large} objects correspond to the area {< 32², 32² ~ 96², > 96²}, respectively.

Table image showing a financial statement with a red circular stamp and a red rectangular stamp.

Table image showing a financial statement with a red circular stamp and a red rectangular stamp.

| | # Total images | # Total cells | # Electronic images | # Electronic cells | # Scan images | # Scan cells |
|-------|----------------|---------------|---------------------|--------------------|---------------|--------------|
| Train | 3684 | 122354 | 3500 | 99632 | 184 | 22722 |
| Val | 1578 | 47652 | 1532 | 43935 | 46 | 3717 |
| Total | 5262 | 170006 | 5032 | 143567 | 230 | 26439 |

Difficulty in Table structure decomposition

Calendar of meetings:

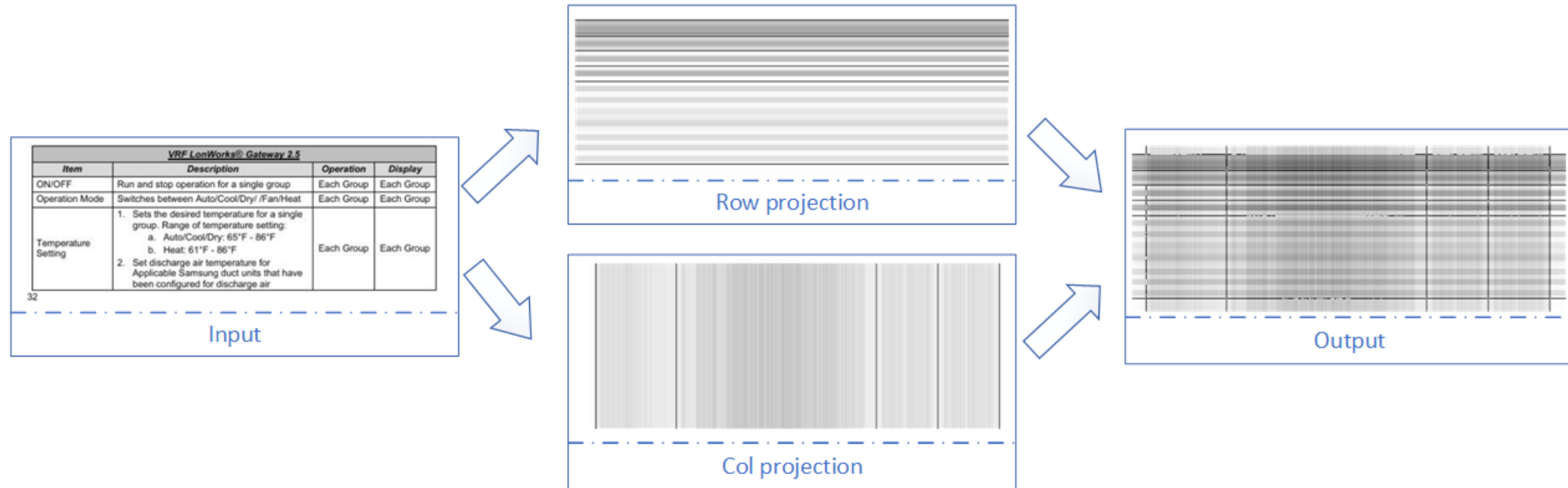
The calendar of meetings is the following:

| N° | Date | N° | Date | N | Date |
|----|----------------|----|----------------|---|----------------|
| 1 | 08 / 04 / 2014 | 5 | 12 / 02 / 2015 | 9 | 12 / 11 / 2015 |
| 2 | 04 / 06 / 2014 | 6 | 16 / 04 / 2015 | | |
| 3 | 04 / 09 / 2014 | 7 | 24 / 06 / 2015 | | |
| 4 | 20 / 11 / 204 | 8 | 23 / 09 / 2015 | | |

How to distinguish the 'blank' area?
Whether belongs to a table?
Or just blank?



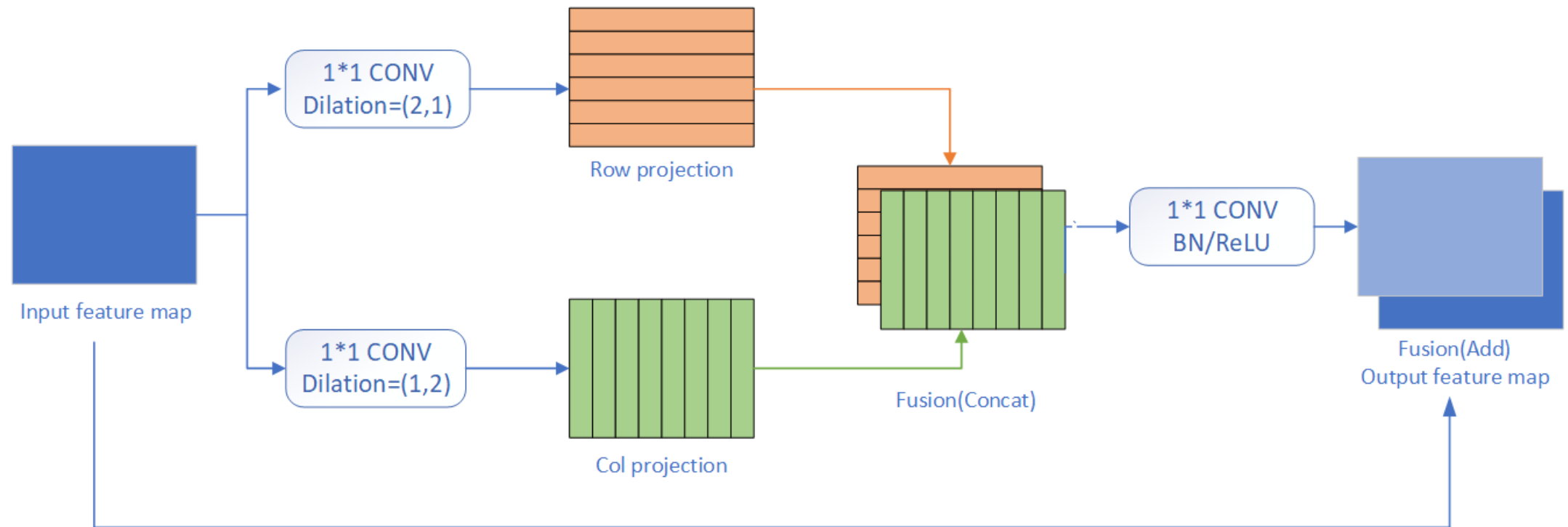
Column and row projection



Given the input feature map I , row projection averages each row and simply replaces each value with the calculated mean value, i.e.

$$\hat{I}_{ij} = \frac{1}{W} \sum_{j=1}^W I_{ij}$$

TPM: Table Projection Module



Task 2: Table structure decomposition

TPM

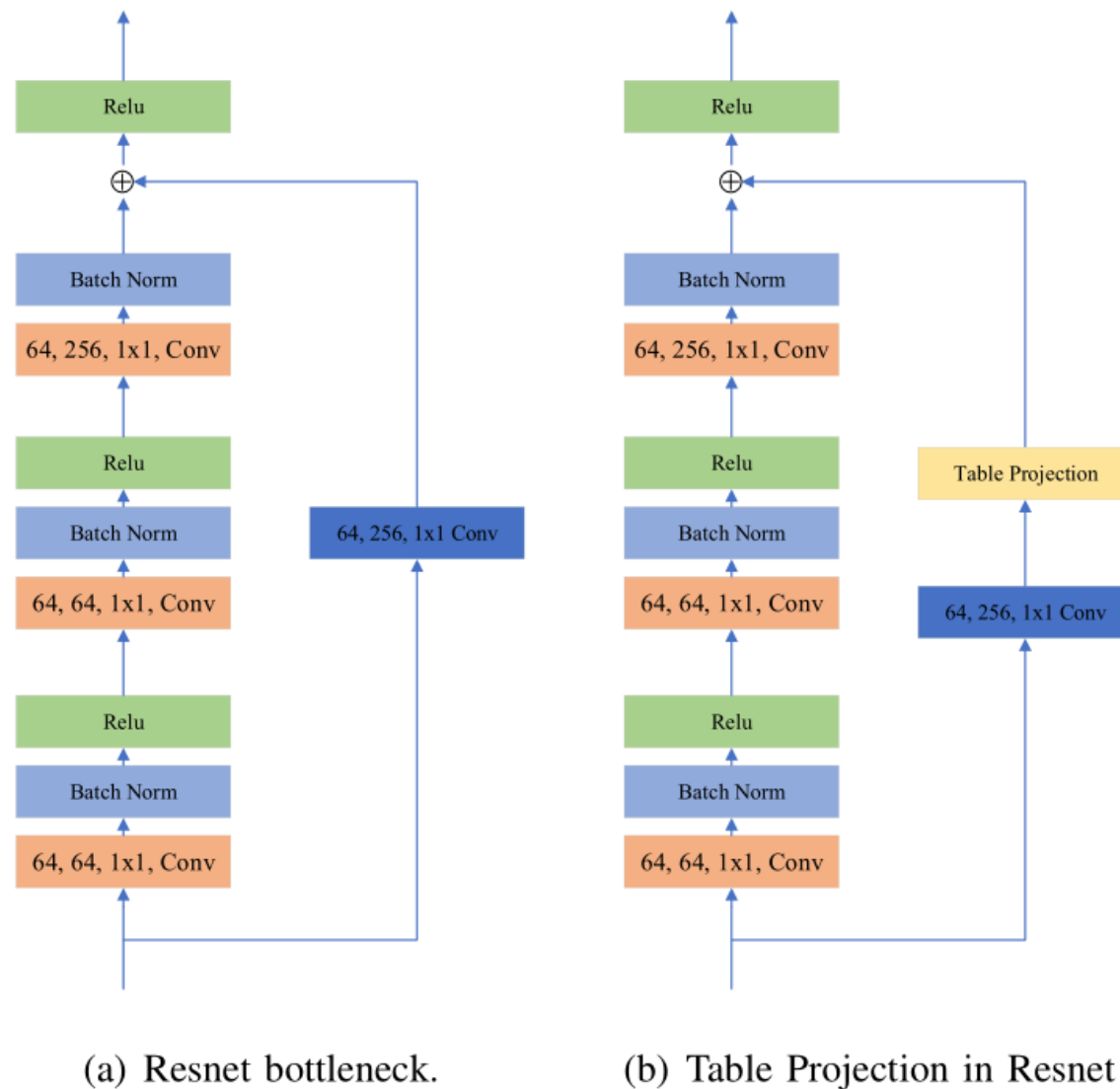


Fig. 7. We use TPM as an explicit row and column feature extraction module in the downsample shortcut path of ResNet backbone. The format of Conv block is $\{input, output, kernel_size\}$.

Results

TABLE III

EVALUATION RESULTS ON TABLECELL DATASET WITH RESNET-50 AS THE BACKBONE NETWORKS. AP MEANS MAP AVERAGED OVER: $\{0.5 : 0.05 : 0.95\}$ IOU THRESHOLD, $AP_{\{50, 75\}}$ MEANS MAP AT $\{0.50, 0.75\}$ IOU THRESHOLD AND $AP_{\{s, m, l\}}$ REPRESENTS FOR $\{small, medium, large\}$ OBJECTS OF AREA $\{< 32^2, 32^2 \sim 96^2, \geq 96^2\}$.

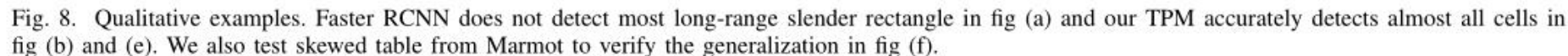
| Components | | | | | | Average Precision | | | | | |
|------------|-----|------------|------|------------|----------|-------------------|-------|-------|-------|-------|-------|
| | TPM | 0.25 ratio | OHEM | Focal Loss | Soft-NMS | AP | AP_50 | AP_75 | AP_s | AP_m | AP_l |
| Baseline | | | | | | 0.807 | 0.895 | 0.874 | 0.685 | 0.848 | 0.777 |
| | ✓ | | | | | 0.818 | 0.895 | 0.874 | 0.712 | 0.858 | 0.783 |
| Our models | ✓ | ✓ | | | | 0.833 | 0.915 | 0.894 | 0.685 | 0.884 | 0.789 |
| | ✓ | ✓ | ✓ | ✓ | | 0.844 | 0.918 | 0.907 | 0.719 | 0.889 | 0.797 |
| | ✓ | ✓ | ✓ | ✓ | ✓ | 0.848 | 0.918 | 0.907 | 0.721 | 0.894 | 0.801 |

TABLE V

RESULTS ON ONE-STAGE FCOS AND TWO-STAGE MASKRCNN VERIFY OUR PLUG-AND-RUN MODULE TPM CAN BRING CONSISTENT IMPROVEMENTS.

| | TPM | Average Precision | | | | | |
|-----------|-----|-------------------|---------|---------|-------|-------|-------|
| | | AP | AP_0.50 | AP_0.75 | AP_s | AP_m | AP_l |
| FCOS | ✓ | 0.776 | 0.893 | 0.85 | 0.69 | 0.816 | 0.726 |
| | | 0.783 | 0.893 | 0.852 | 0.708 | 0.821 | 0.73 |
| Mask RCNN | ✓ | 0.828 | 0.878 | 0.867 | 0.758 | 0.852 | 0.805 |
| | | 0.838 | 0.906 | 0.886 | 0.76 | 0.873 | 0.788 |

Results



Want to know more?

- Email: weidafeng@sjtu.edu.cn
- Source Code and dataset: <http://github.com/weidafeng/TableCell>