50,000,000

50,000,000

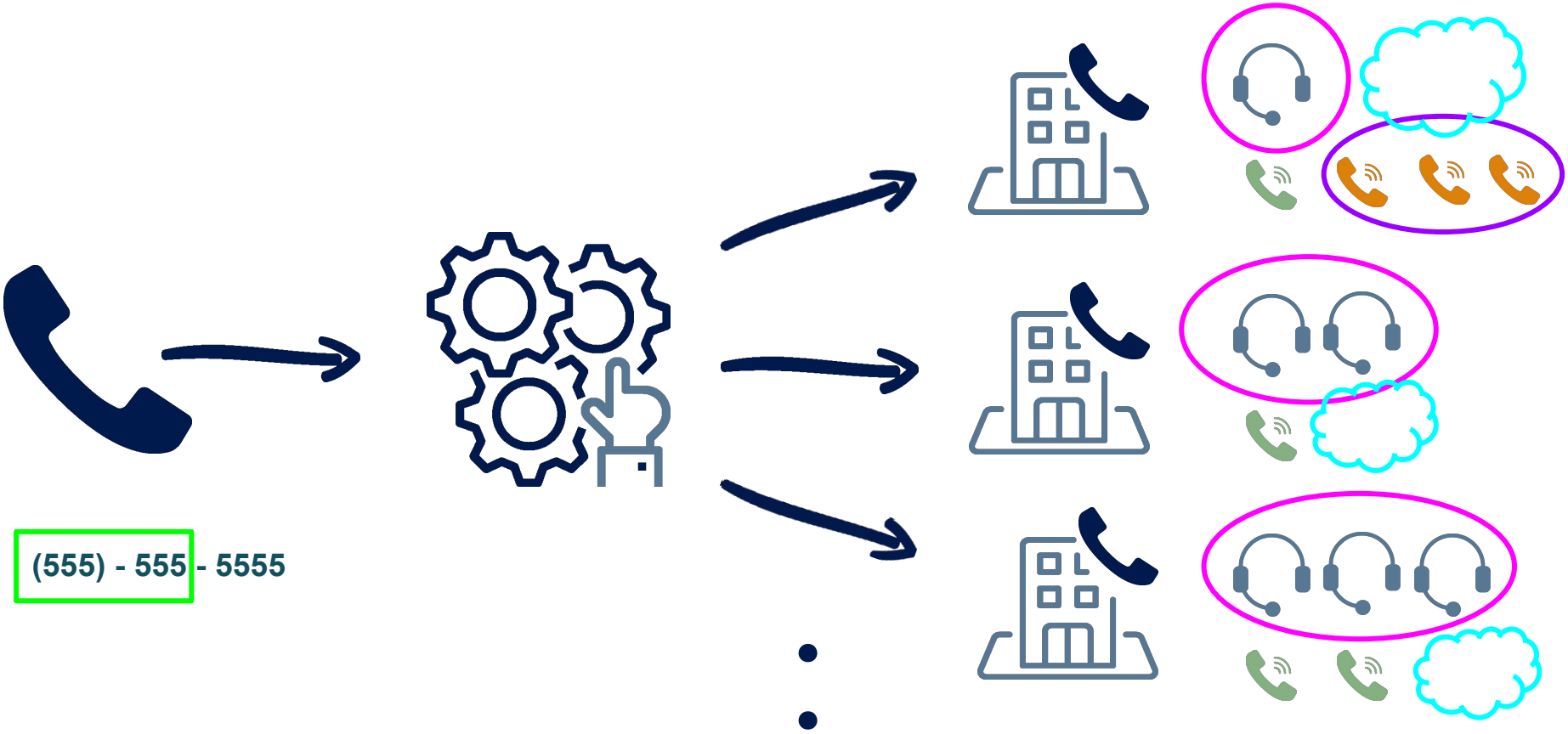
988
SUICIDE
& CRISIS
LIFELINE

2,000,000
calls

300,000
calls are abandoned

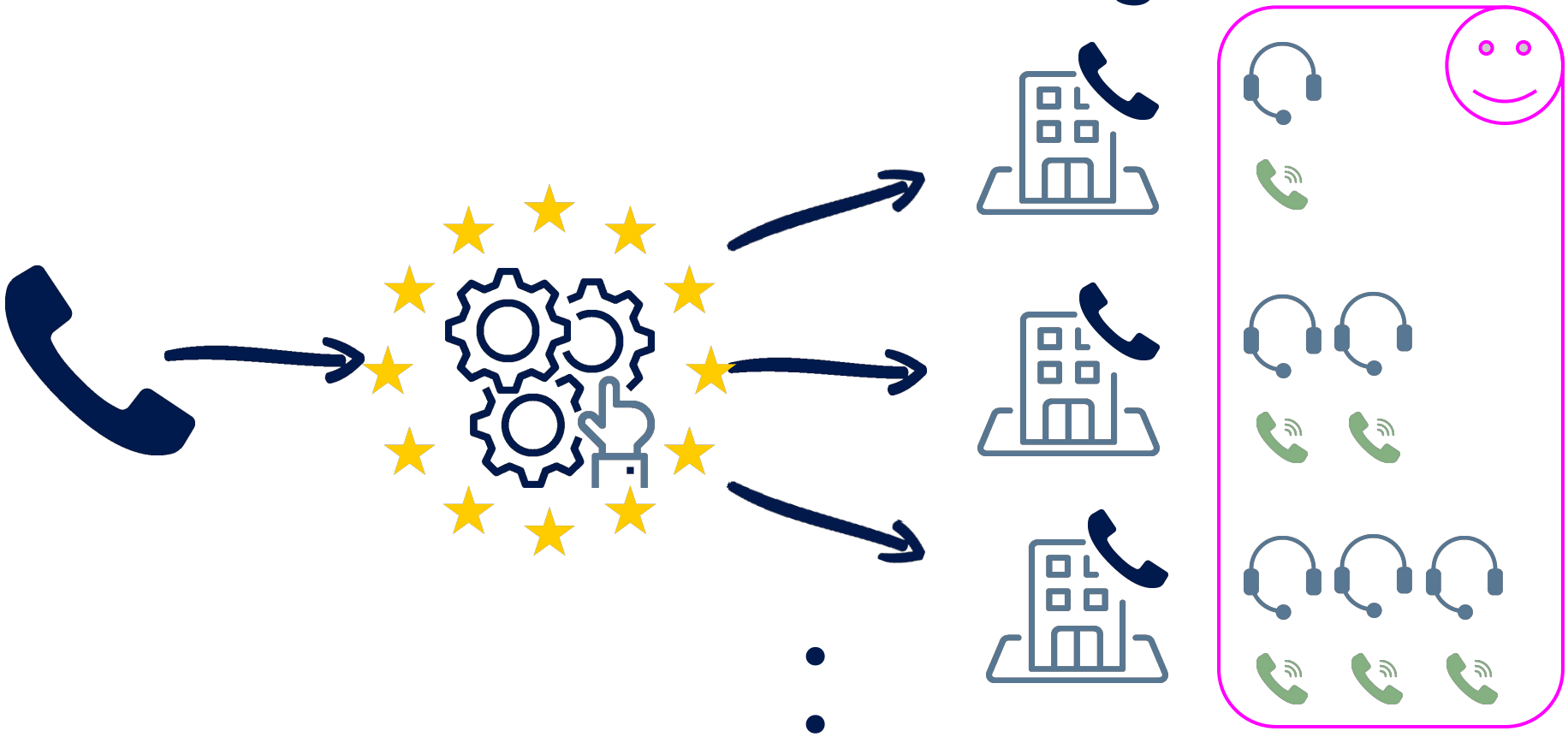
V!brant
Emotional Health

988
SUICIDE
& CRISIS
LIFELINE


(555) - 555 - 5555

# What we have: historical routing data

# What we want: a better routing table



# Data Science For Social Good

Summer Fellowship

Carnegie Mellon University

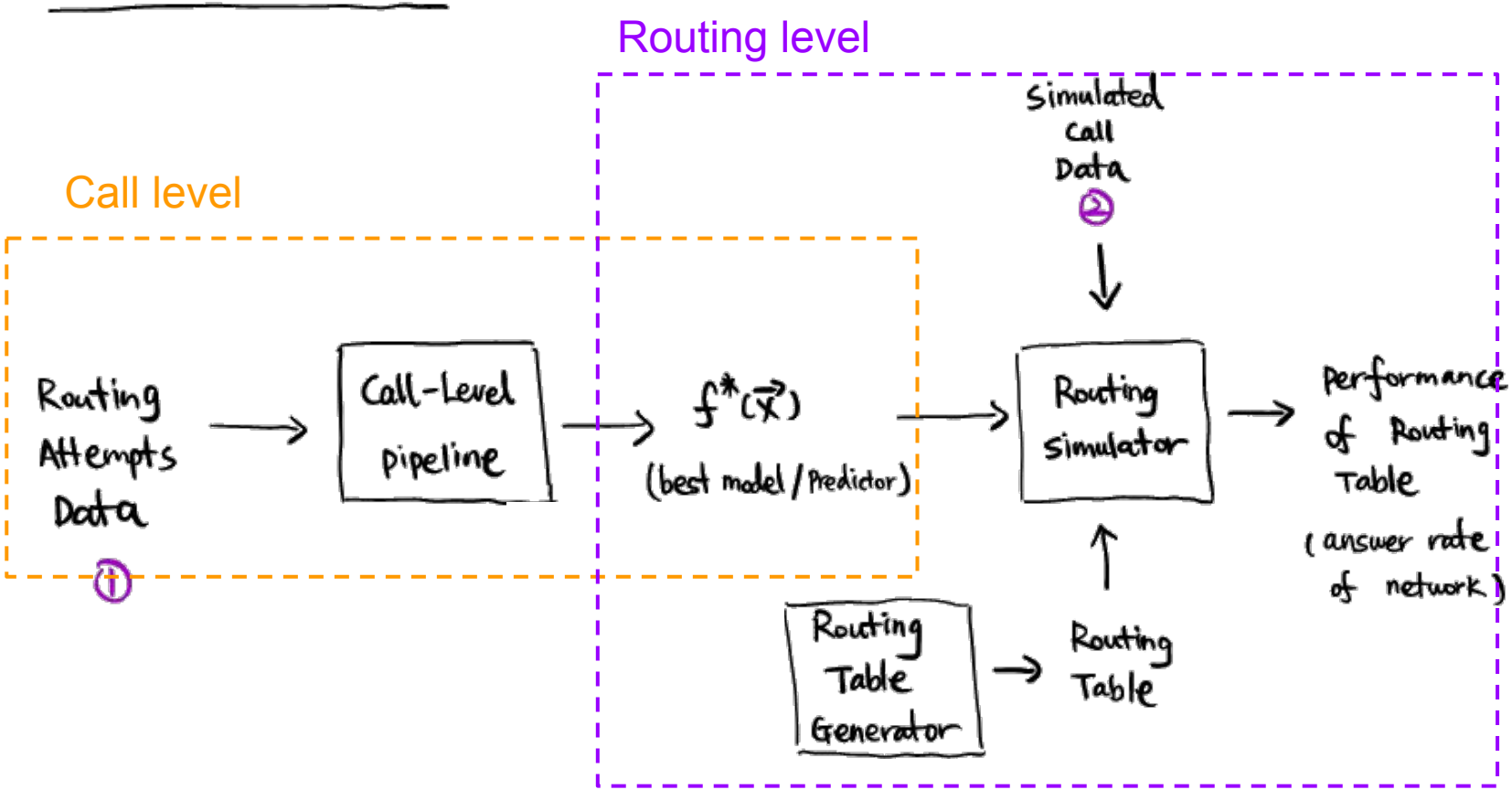
**Tejumade**
Afonja

**Paula**
Subías
Beltrán

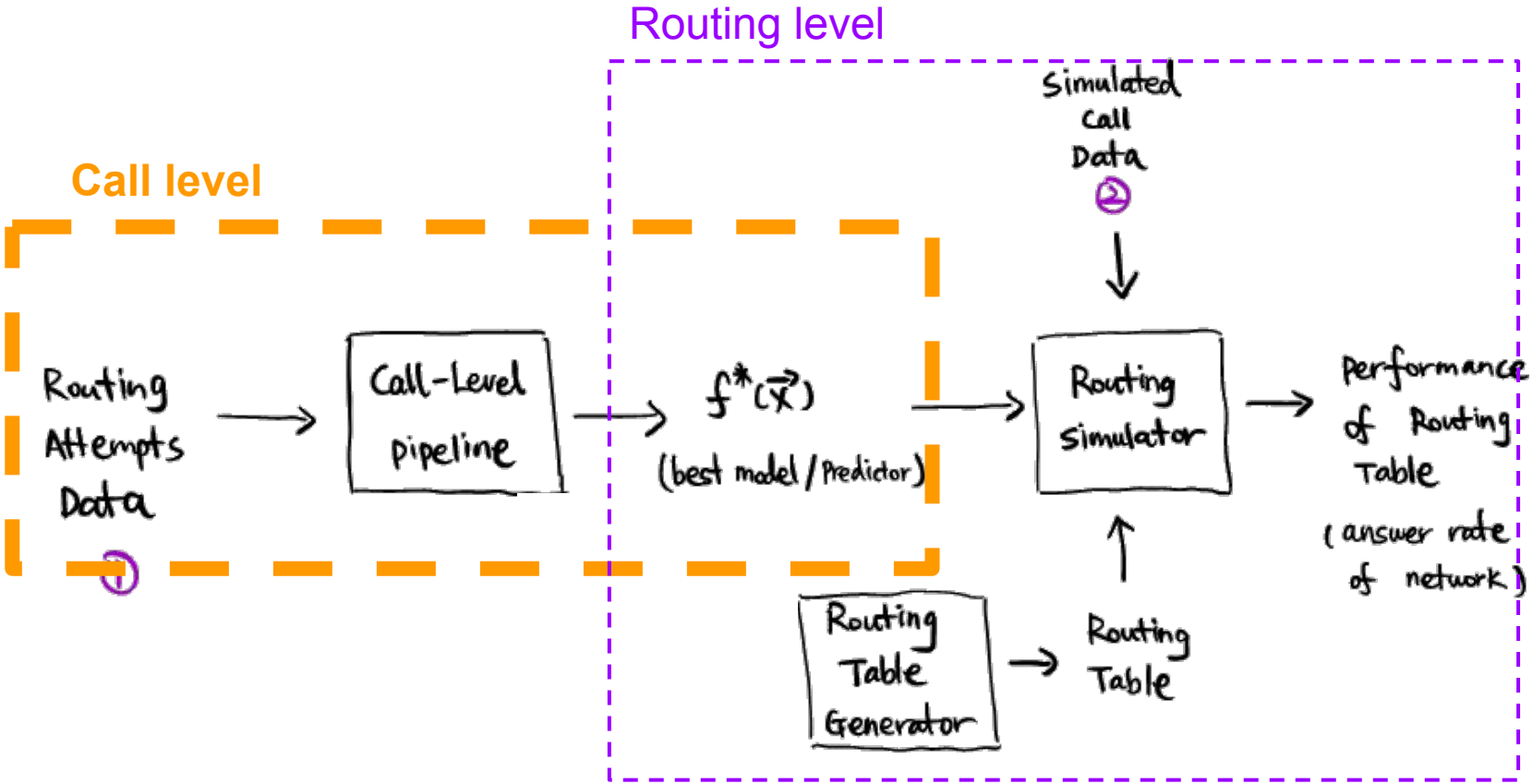
**Charles**
Cui

**Irene**
Tang

# Overall Flow

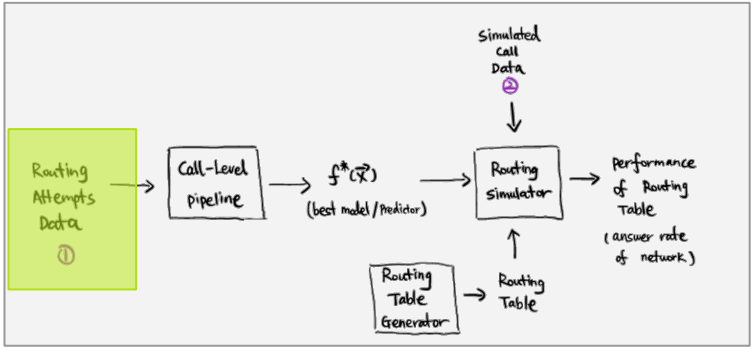


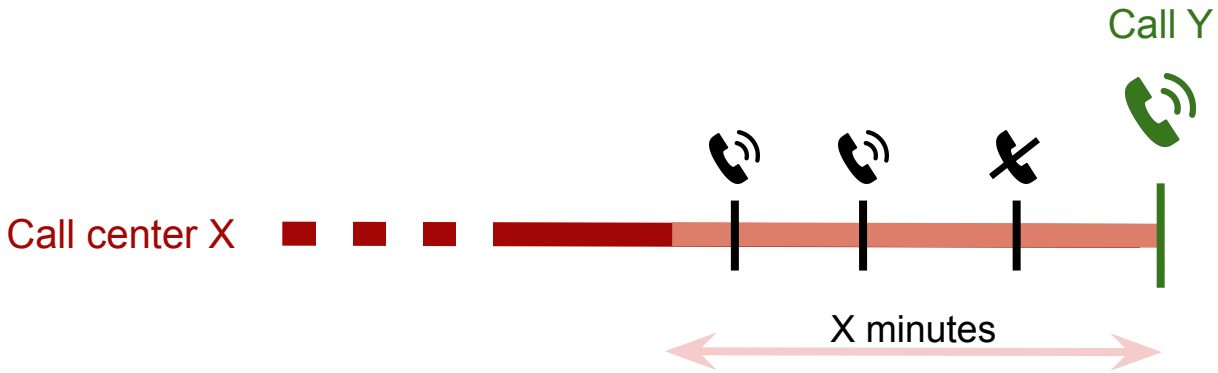
# Overall Flow

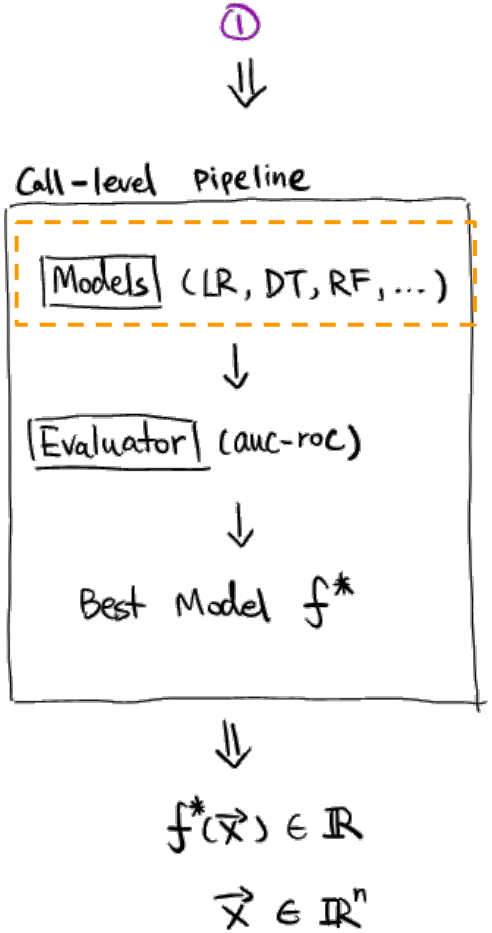


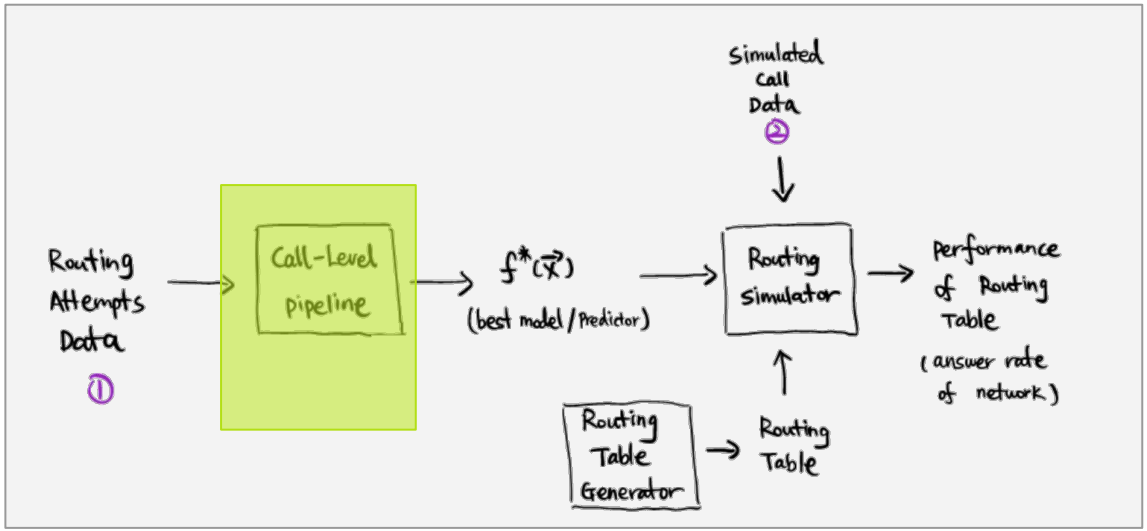
## Features

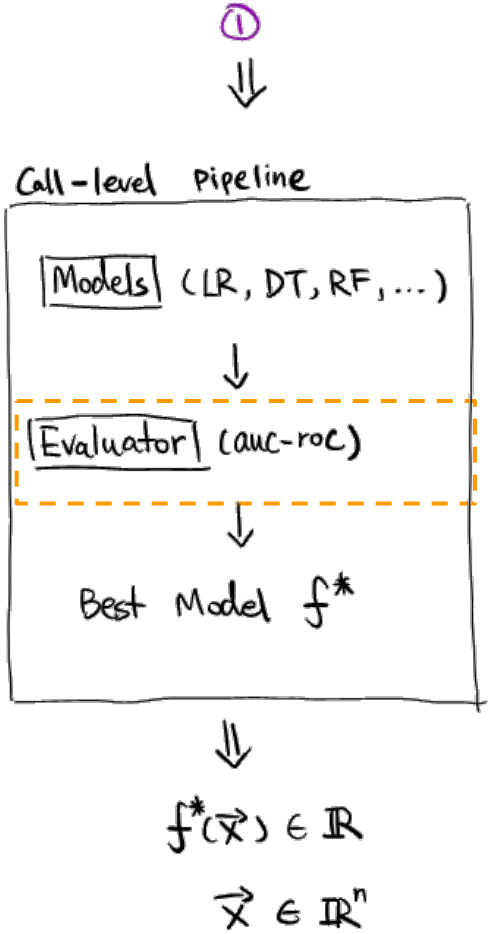
- number of past calls at center
- number of past calls flowed out center
- number of past calls abandoned at center
- …

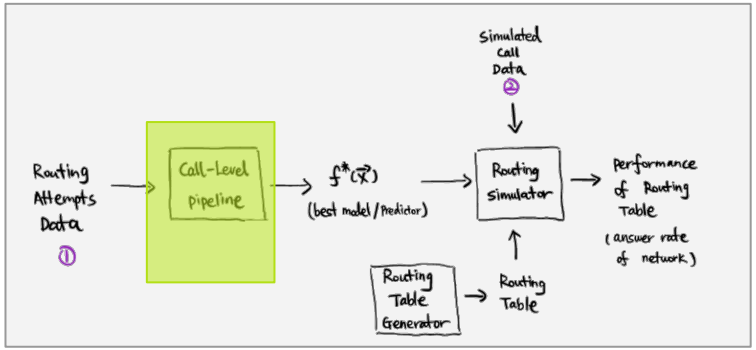



①
Call-level Pipeline
Models (LR, DT, RF, ...)
Evaluator (auc-roc)
Best Model $f^*$
$f^*(\vec{x}) \in \mathbb{R}$
$\vec{x} \in \mathbb{R}^n$


Simulated Call Data ②
Routing Attempts Data ①
Call-Level pipeline
$f^*(\vec{x})$
(best model / Predictor)
Routing Simulator
Performance of Routing Table
(answer rate of network)
Routing Table Generator
Routing Table


①
Call-level Pipeline
Models (LR, DT, RF, ...)
Evaluator (auc-roc)
Best Model $f^*$
$f^*(\vec{x}) \in \mathbb{R}$
$\vec{x} \in \mathbb{R}^n$


Simulated Call Data
②
Routing Attempts Data
①
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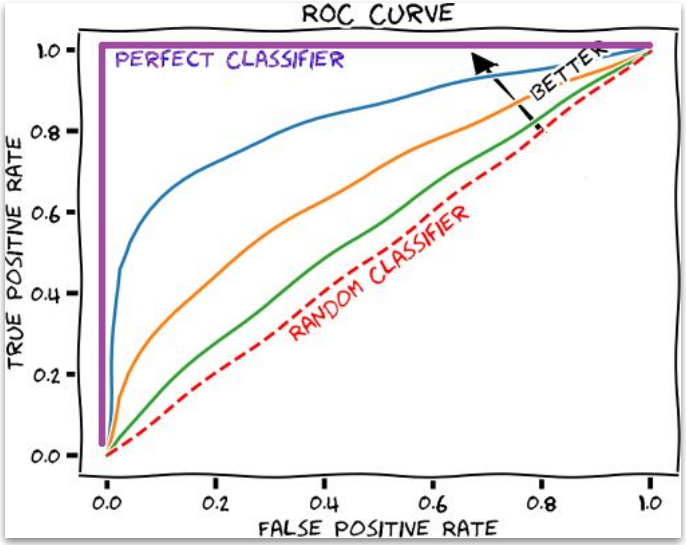
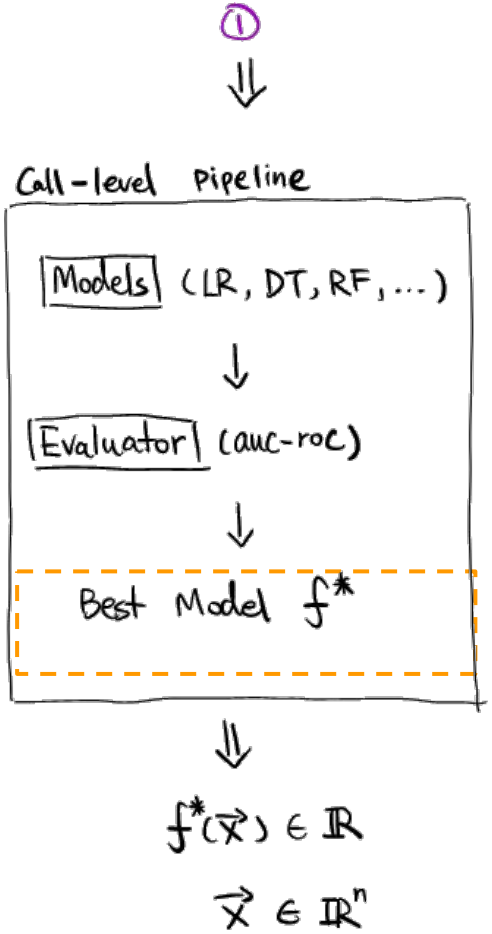

ROC CURVE
PERFECT CLASSIFIER
BETTER
RANDOM CLASSIFIER
TRUE POSITIVE RATE
FALSE POSITIVE RATE
0.0
0.2
0.4
0.6
0.8
1.0


Call-level Pipeline
Models (LR, DT, RF, ...)
Evaluator (auc-roc)
Best Model $f^*$
$f^*(\vec{x}) \in \mathbb{R}$
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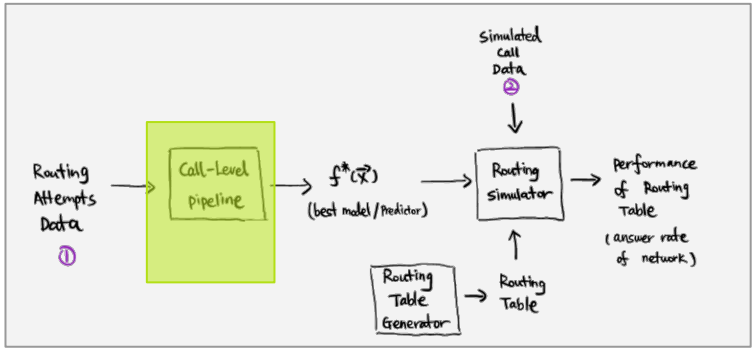
Routing Attempts Data
Call-Level Pipeline
$f^*(\vec{x})$
(best model / predictor)
Simulated Call Data
Routing Simulator
Performance of Routing Table
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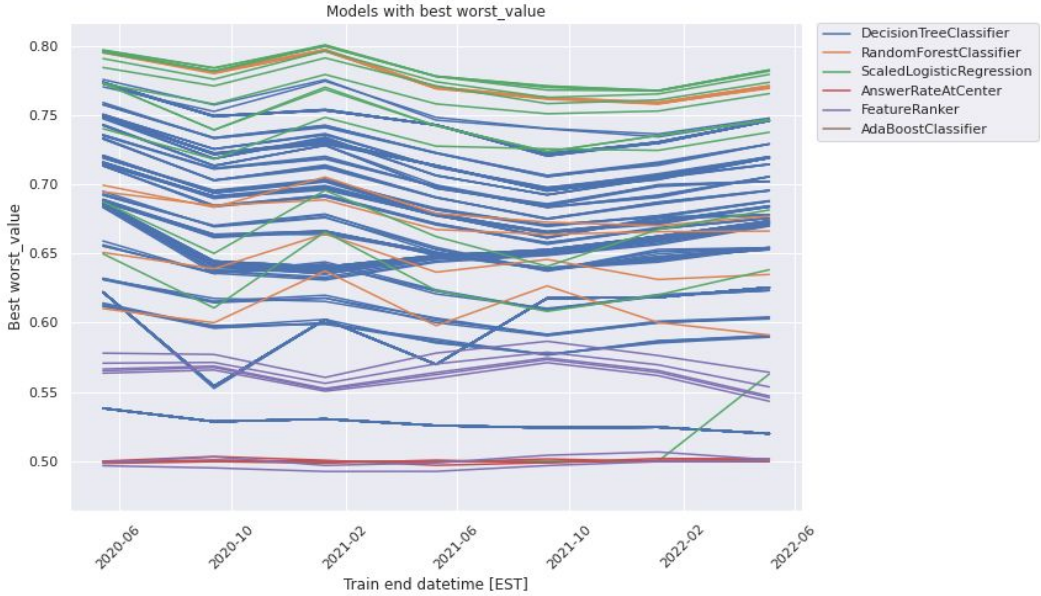
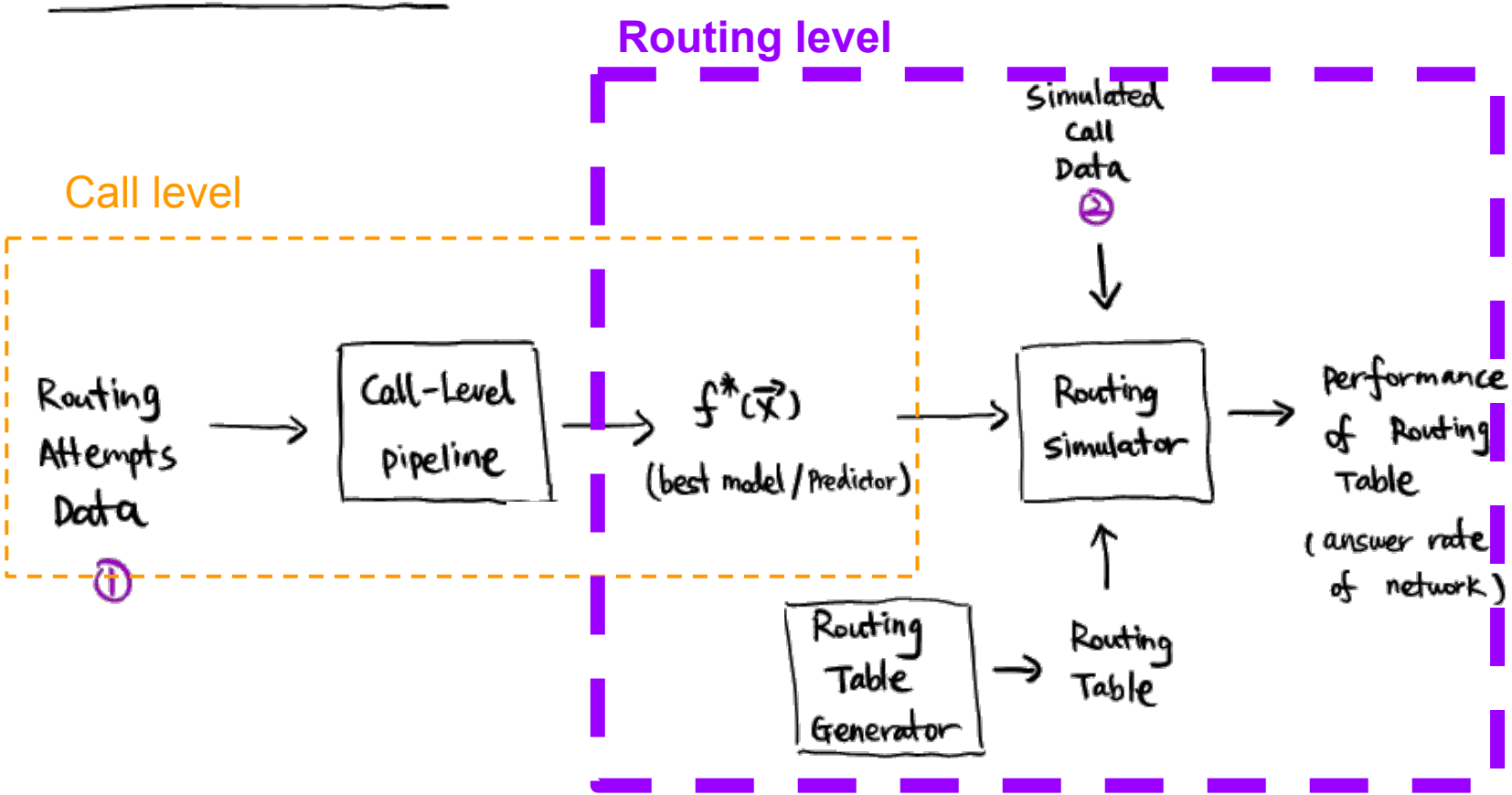
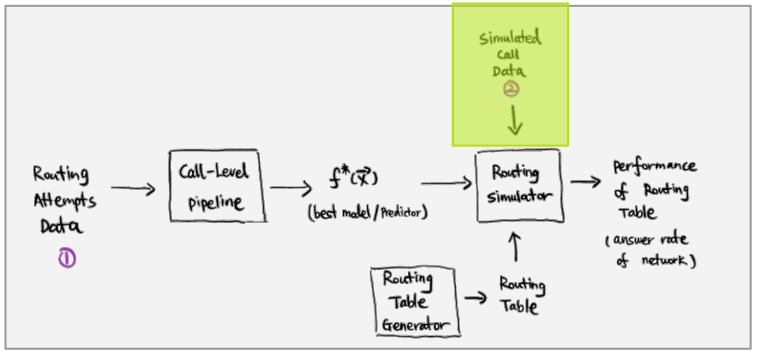
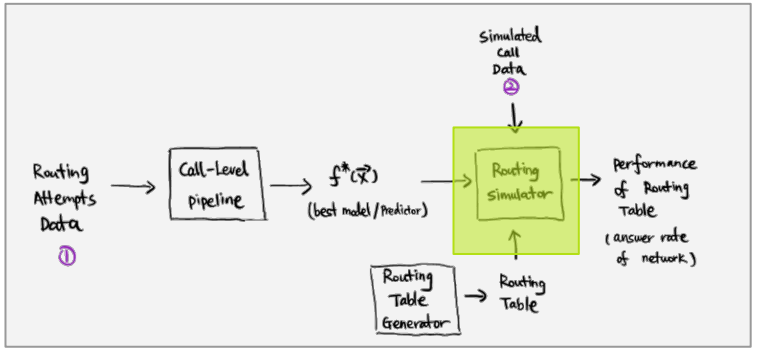

Models with best worst_value
Best worst_value
0.80
0.75
0.70
0.65
0.60
0.55
0.50
2020-06
2020-10
2021-02
2021-06
2021-10
2022-02
2022-06
Train end datetime [EST]
DecisionTreeClassifier
RandomForestClassifier
ScaledLogisticRegression
AnswerRateAtCenter
FeatureRanker
AdaBoostClassifier

# Overall Flow



| call_key | caller_npanxx | initiated_datetime_est |
|---|---|---|
| e3225-20220502083313992-426 | 607,582 | 2022-05-02 08:33:13.000 |
| e3225-20220502121556977-316 | 864,279 | 2022-05-02 12:15:56.000 |
| e3225-20220502130758752-550 | 813,972 | 2022-05-02 13:07:58.000 |
| e3225-20220502131509392-582 | 518,434 | 2022-05-02 13:15:09.000 |
| e3225-20220502153336417-160 | 929,252 | 2022-05-02 15:33:36.000 |
| e3225-20220502170350972-520 | 434,939 | 2022-05-02 17:03:50.000 |
| e3225-20220502174802577-704 | 910,594 | 2022-05-02 17:48:02.000 |
| e3225-20220502194921528-026 | 201,870 | 2022-05-02 19:49:21.000 |
| e3225-20220502200641343-068 | 330,309 | 2022-05-02 20:06:41.000 |
| e3225-20220502224047123-298 | 479,629 | 2022-05-02 22:40:47.000 |
| e3225-20220503073615623-508 | 813,215 | 2022-05-03 07:36:15.000 |
| e3225-20220503074952522-524 | 312,690 | 2022-05-03 07:49:52.000 |
| e3225-20220503085613228-686 | 916,835 | 2022-05-03 08:56:13.000 |
| e3225-20220503115611864-282 | 646,626 | 2022-05-03 11:56:11.000 |
| e3225-20220503130724863-562 | 319,217 | 2022-05-03 13:07:24.000 |






## Routing Simulator

② ⇒

$f^*$ ⇒

Routing table ⇒

for next call i in ②:

- → Get the center $S_j$ it gets routed to using routing table
- → Compute the features for (call i, $S_j$)
- → Compute the probability $P_{ij}$ that i gets picked up by $S_j$ using $f^*$ and features
- → Flip a $P_{ij}$-biased coin
  - → If heads: call i gets answered by $S_j$
  - → If tails: call i is NOT picked up by $S_j$
    - → Add 3 min to call i and insert back to ②

# Results

An improved routing table that has a **1%** higher predicted overall answer rate than the 988's current routing table.

estimated
+20,000
callers helped

**Charles** Cui

**Irene** Tang

**Tejumade** Afonja

**Paula** Subías Beltrán

# Thank you!