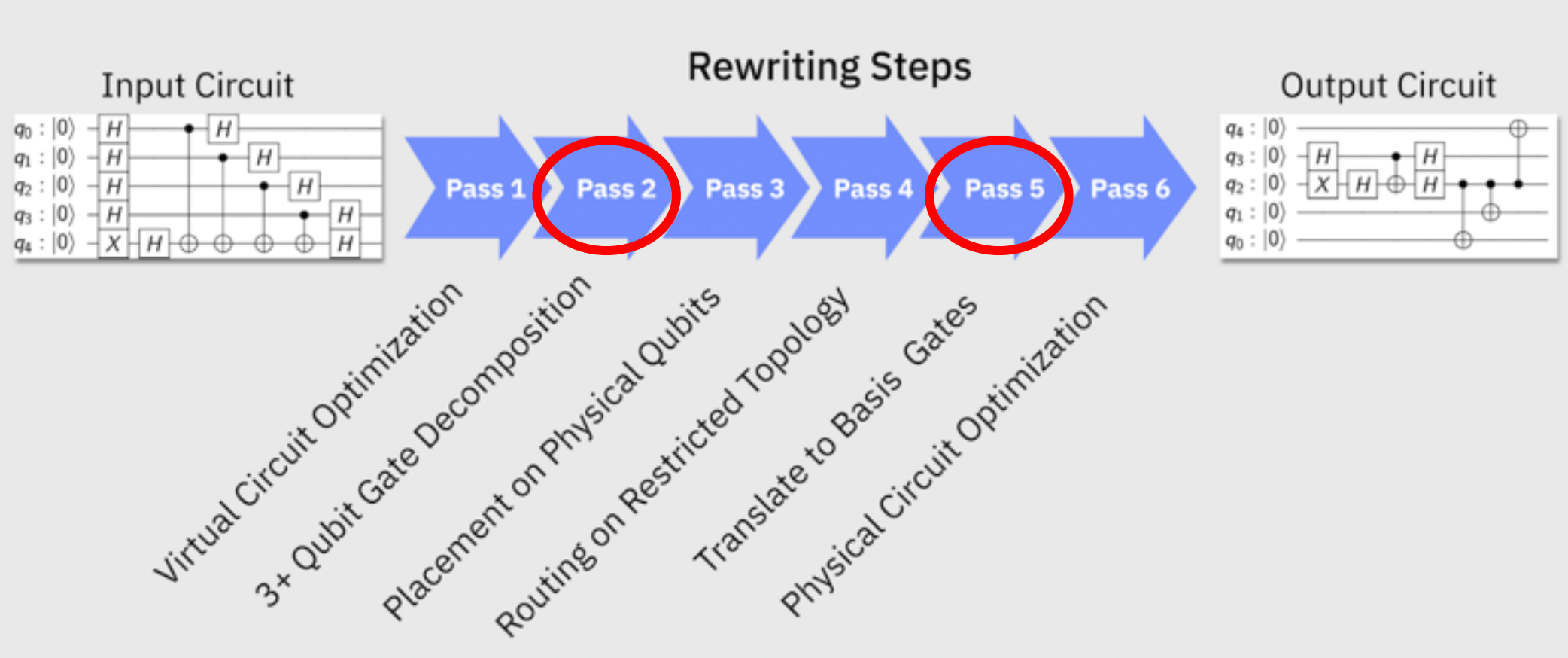
Various Applicated Adders implementation on Qiskit and their performance

Team QAS

Challenge Topic 1 :
Build your **minimal quantum circuit** making **a quantum calculator**

What we try



Pass 5 : Ripple Carry Adder, QFT

Pass 2 : ccx decomposed

Adders we built

- **Full Adder**
- **Ripple Carry Adder**

4 versions

1. Original
2. Changing ccx gate
3. Transpiler of (1)
4. Transplier of (2)

- **Quantum Fourier Transfrom Adder (QFT Adder)**

2 versions

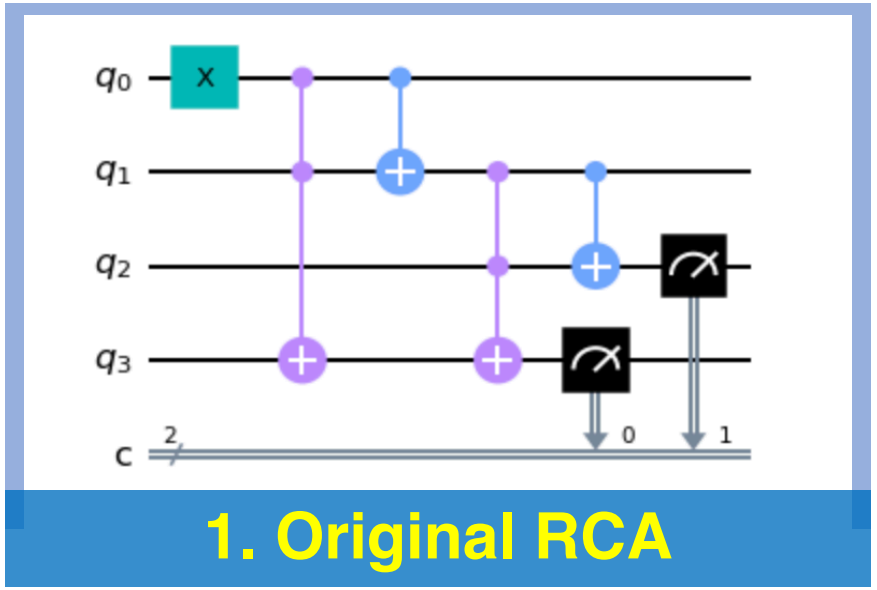
1. Original
2. Transpiler of (1)

Result

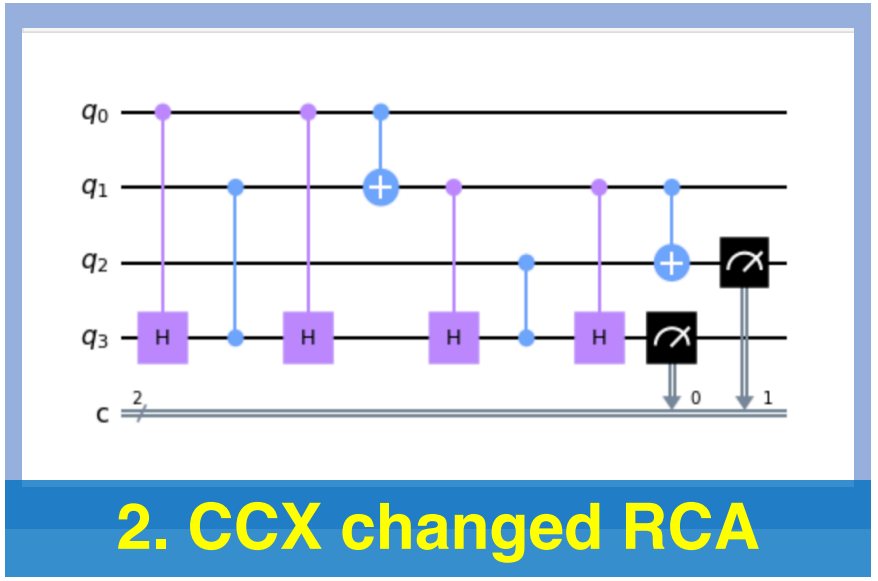
1. Full

TRANSPILE

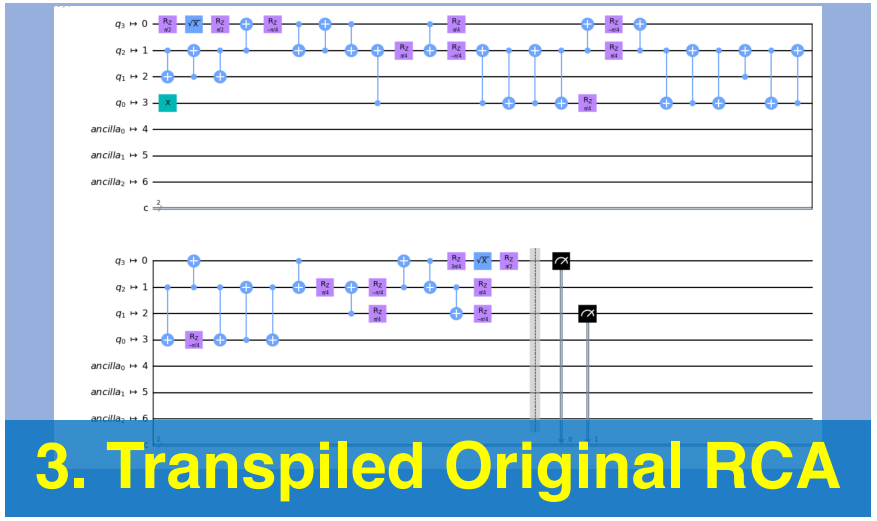
CCX



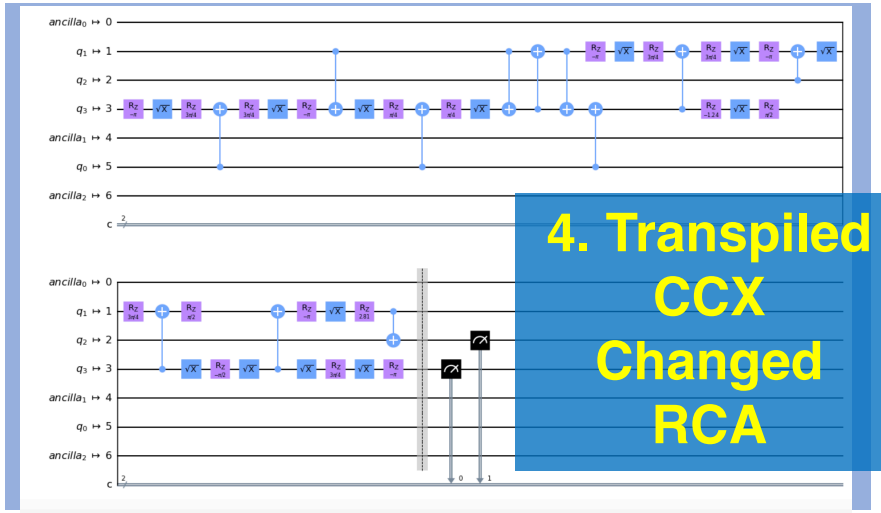
1. Original RCA



2. CCX changed RCA



3. Transpiled Original RCA



4. Transpiled CCX Changed RCA

Full adder Trial 1

```
Total count for output 10 are: {'00': 470, '01': 542, '10': 2418, '11': 570}

Total count for output 10 are: {'00': 544, '01': 732, '10': 950, '11': 1774}

Total count for output 00 are: {'00': 3015, '01': 252, '10': 528, '11': 205}

Total count for 00 and 11 are: {'00': 2987, '01': 379, '10': 426, '11': 208}
```

Trial 2

```
Total count for output 10 are: {'00': 441, '01': 405, '10': 2705, '11': 449}

Total count for output 10 are: {'00': 493, '01': 620, '10': 855, '11': 2032}

Total count for output 00 are: {'00': 2620, '01': 548, '10': 659, '11': 173}

Total count for 00 and 11 are: {'00': 3173, '01': 277, '10': 439, '11': 111}
```

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Trial 3

```
Total count for output 10 are: {'00': 553, '01': 407, '10': 2555, '11': 485}

Total count for output 10 are: {'00': 476, '01': 358, '10': 2624, '11': 542}

Total count for output 00 are: {'00': 3186, '01': 302, '10': 304, '11': 208}

Total count for 00 and 11 are: {'00': 3258, '01': 249, '10': 371, '11': 122}
```

Trial 4

```
Total count for output 10 are: {'00': 390, '01': 461, '10': 2263, '11': 886}

Total count for output 10 are: {'00': 372, '01': 391, '10': 2717, '11': 520}

Total count for output 00 are: {'00': 3089, '01': 228, '10': 511, '11': 172}

Total count for 00 and 11 are: {'00': 3206, '01': 323, '10': 308, '11': 163}
```

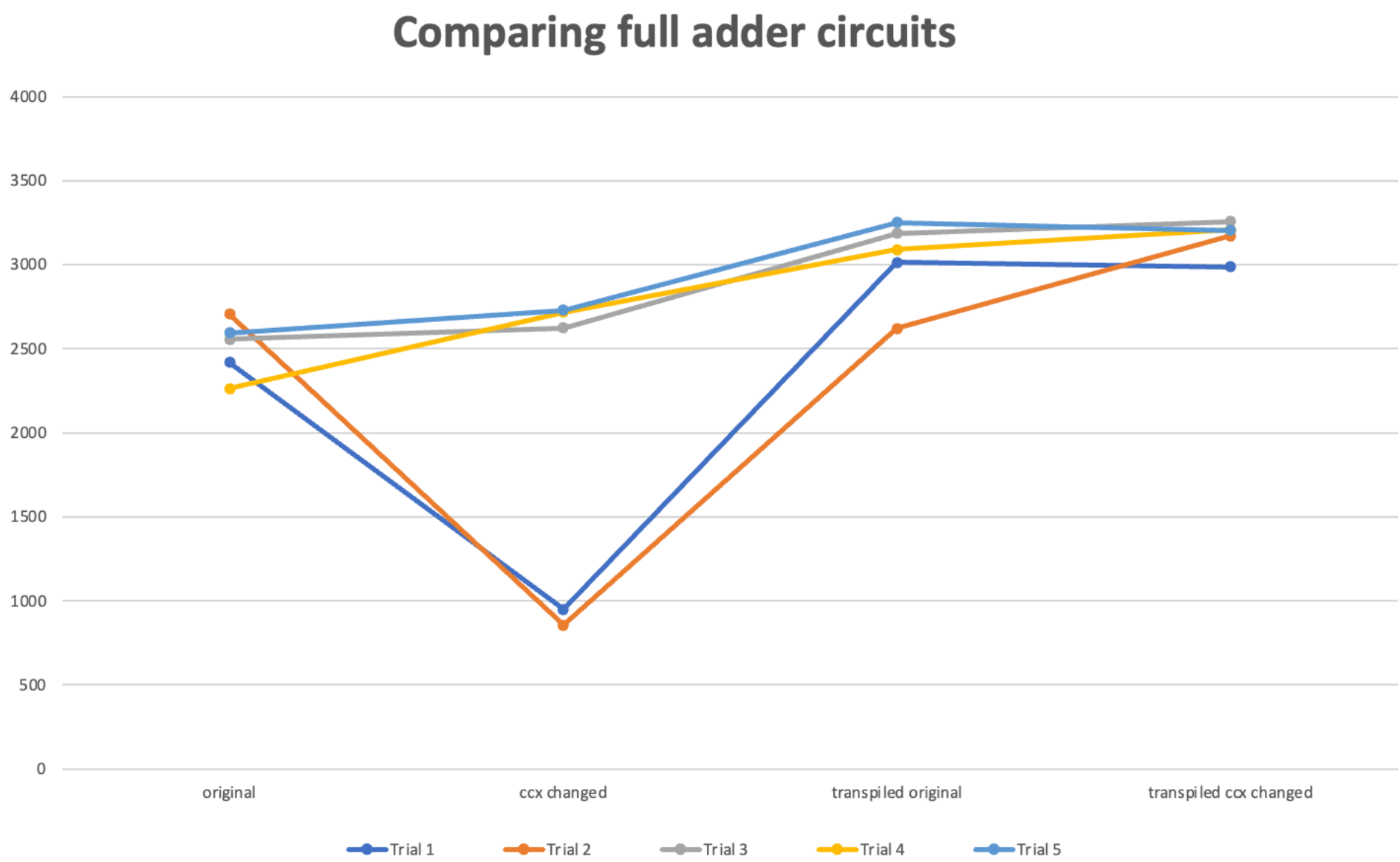
Trial 5

```
Total count for output 10 are: {'00': 335, '01': 401, '10': 2595, '11': 669}

Total count for output 10 are: {'00': 430, '01': 429, '10': 2730, '11': 411}

Total count for output 00 are: {'00': 3251, '01': 175, '10': 433, '11': 141}

Total count for 00 and 11 are: {'00': 3205, '01': 271, '10': 302, '11': 222}
```

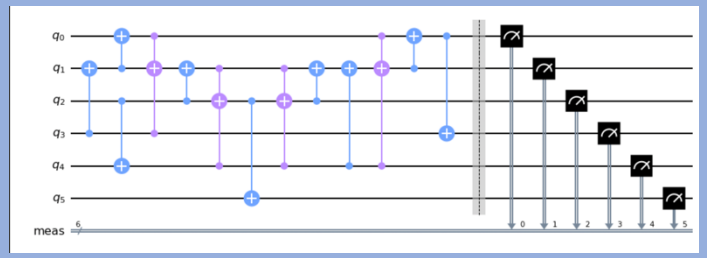

Comparing full adder circuits
4000
3500
3000
2500
2000
1500
1000
500
0
original
ccx changed
transpiled original
transpiled ccx changed
Trial 1
Trial 2
Trial 3
Trial 4
Trial 5

Result

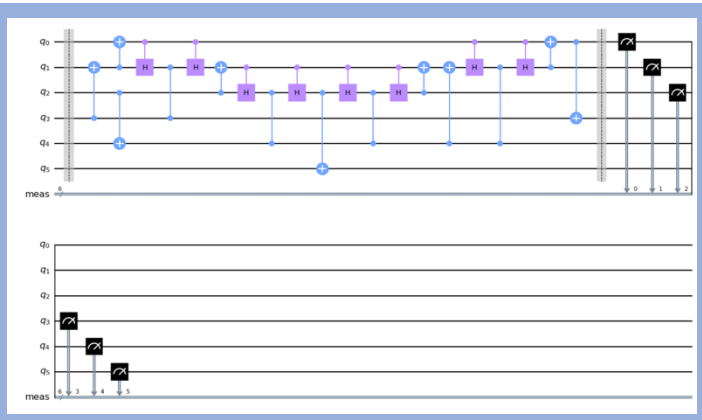
2. Ripple-Carry

TRANSPILE

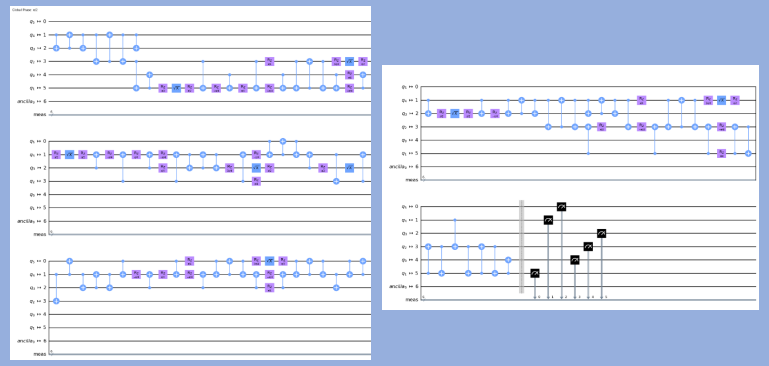
CCX



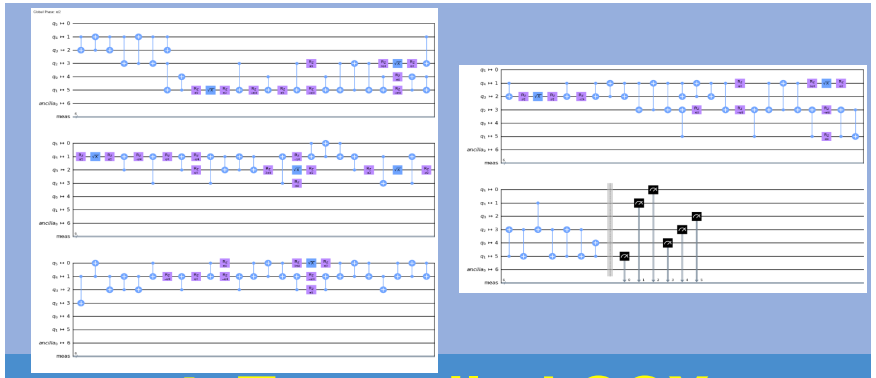
1. Original RCA



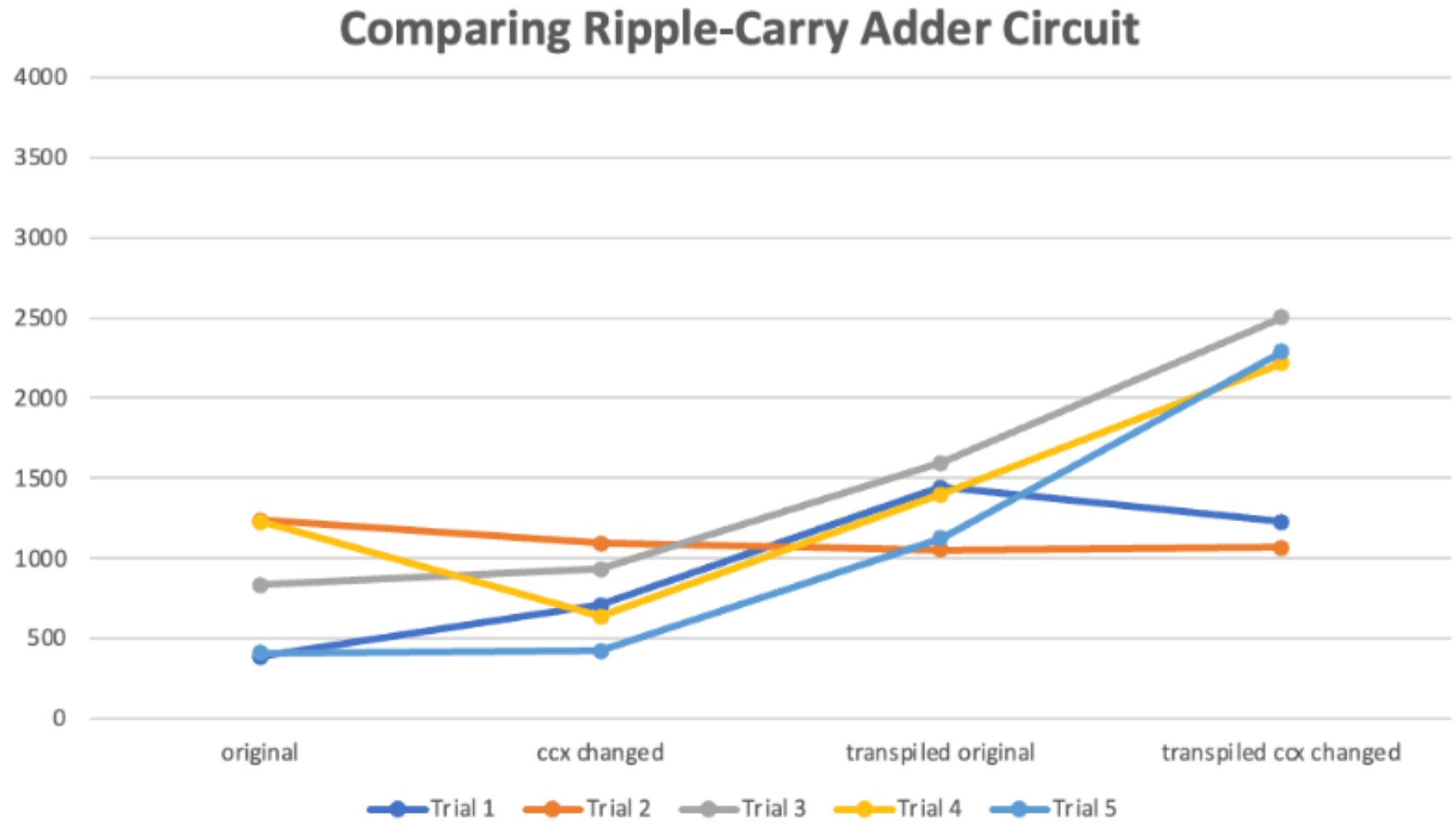
2. CCX changed RCA



3. Transpiled Original RCA

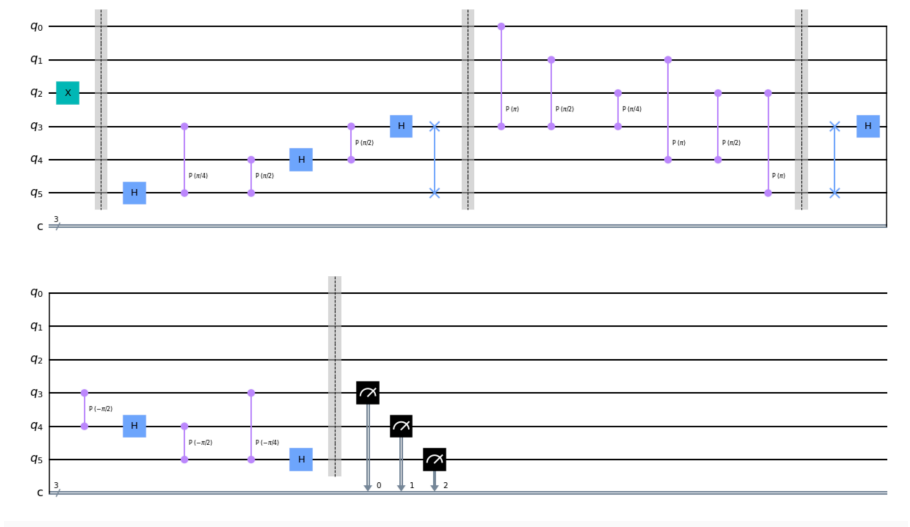


4. Transpiled CCX Changed RCA


Comparing Ripple-Carry Adder Circuit
4000
3500
3000
2500
2000
1500
1000
500
0
original
ccx changed
transpiled original
transpiled cox changed
Trial 1
Trial 2
Trial 3
Trial 4
Trial 5

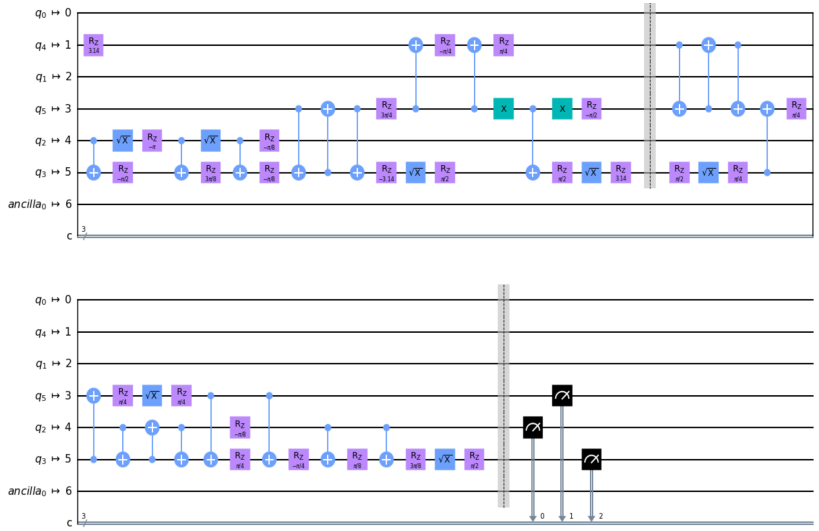
Result

3. Quantum Fourier Transform Adder



1. Original QFT Adder

transpile



2. Transpiled QFT Adder

What we have learned

- **Utilizing Qiskit**

- **Transpiler**

-How to use

-Transpiler vs Unroller