

## **Challenge\_0010**

### **Improving RV32IMCK for Real Edge AI**

Challenge 0010 builds directly on Challenge 0009. Two top-performing designs are provided — **Solution1.zip** (best miner) and **Solution2.zip** (second-best). Your task is to study these designs, combine insights from both, and create an improved RV32IMCK implementation that achieves a higher score under the new scoring system while maintaining 100% functional correctness.

### **Results from Challenge 0009 (Old Scoring Model)**

Challenge 0009 used the scoring formula:

- Functionality: **50% weight**
- Area: **25% weight**
- Performance: **25% weight**

Under this old scoring model, the top design from Challenge 0009 achieved:

- Functionality: 100%
- Area Score: 61.81
- Performance Score: 93.06
- Final Score : 88.72

This was a clear improvement over the baseline design shipped with Challenge\_0009, which had a **final score of < 82** under the same formula.

However, when our chip design team performed a deeper analysis and ran power estimates on the winning core, we discovered a critical issue:

The top design consumes **~202 mW**, which is far too high for a realistic edge-AI processor.

For an edge-AI core, this level of power consumption is not acceptable, even if area and performance are strong. To reflect this reality, we decided to introduce power as

a first-class metric and re-evaluate the design under a new scoring model. This is the motivation behind **Challenge\_0010**.

## Re-evaluation Using Challenge 0010 Scoring Model

Challenge 0010 introduces a new balanced scoring formula:

- **1/3 Area**
- **1/3 Performance**
- **1/3 Power**
- Functionality: **0% weight**, but must be **100%** to qualify

When we applied the **new Challenge 0010 scoring formula** to the winning Challenge 0009 design, we obtained:

- Area Score: 61.81
- Performance Score: 93.06
- Power Score: 49.50
- **Final Score (new model): 67.94**

This 67.94 is **not sufficient** under the new rules. The updated requirement now states:

To be eligible for emissions, Final Score must be  $\geq 75.00$  and Functionality must still be 100%.

## Your Task in Challenge 0010

With the new scoring model, miners must meaningfully improve the previous design. The top design's high power consumption (~202 mW) dragged its power score down to 49.5, reducing the final score to 67.94. This makes **power optimization the highest-priority target**, followed by area and performance tuning.

To qualify, your submission must:

- Use the two top Challenge 0009 designs as your starting point
- Achieve **Final Score  $\geq 75.00$**
- Maintain **100% functionality**

- Reduce power significantly below the previous ~202 mW
- Make area and/or performance improvements if needed to get the final score above 75.0

## Goal of the Challenge

Your mission is to bring the RV32IMCK core closer to a realistic edge-AI processor. Edge devices require low power, ideally near **50 mW**, and no higher than **100 mW**. Achieving this will require creative low-power design: clock gating, lowering switching activity, tightening control logic, simplifying pipelines, optimizing register file and memory access, and more.

By lowering power while improving area and performance where possible, miners can push the new design above the 75-point threshold and produce a more efficient, deployable core.